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ROYAL AUSTRALIAN AIR FORCE

DEFENCE INSTRUCTION (AIR FORCE)

AAP 7213.003-1

FLIGHT MANUAL

MIRAGE IIIO AND IIID

THIS MANUAL, TOGETHER WITH DI(AF) AAP 7213.003-1-1
SUPERSEDES AAP 7213.001-1-1 AND AAP 7213.002-1-1

Date : 01JUN78

Sponsor : DAP-AF

(J.A. ROWLAND)
Air Marshal
Chief of the Air Staff

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Amendment List		Topic Affected	*Amendment Effect	Amended By	Date
No	Dated				
1	MAR 79	LIST EFF PAGES PGE 1-19 TO 1-20 RAAF SUP NO 3.	INSERT NEW PAGES.	L WOFF	26 JUN 79.
2	JUL 79	SUP STAT SHEET RAAF SUPP 4	INSERT NEW PAGES	WOFF	6 NOV 79.
3	AUG 80	SUP 5 VARIOUS	NEW PAGES		29 SEP 80
4	AUG 80		RAAF SUPP 5		23 OCT 80
5	10 OCT 80	RAAF SUP 6 & 7			12 NOV 80
6	APR 81	RAAF SUPP 8	SUPP 8		25 MAR 81
7	01 MAR 81	RAAF SUPPS	REMOVE 2&7 INSERT 9, 10 & 11		19 MAY 81
8	05 MAR 81	AS PER	LIST OF E/PAGES		07 DEC 81
9	18 AUG 81		INSERT NEW PAGES	G E Hendy	18 MAR 82
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25	SEP 84	VARIOUS	DESTROY RAAF SUPP 40, 41, 46, 48-50		9 MAR 84

*Note. Insert brief details of page(s) amended, inserted or cancelled.

AMENDMENT CERTIFICATE (Continued)

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26	23 JAN 85	VARIOUS	RAAF SUPP 51, 52, 53, 54		19 MAR 85
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28	SEP 85	VARIOUS.	RAAF SUPPS 58, 59, 60, 61		20 OCT 85
29	DEC 85	VARIOUS.	RAAF SUPPS. 62 TO 67		10 APR 86
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31	25 FEB 86	VARIOUS	REPLACE		4 AUG 86
32	11 FEB 87	SS SHEET FO-5-1E 5-1-12	REPLACE.		11 FEB 87
33	11 FEB 87	3-14.	REPLACE.		11 FEB 87.
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FLIGHT MANUAL
AND SUPPLEMENT STATUS SHEET

Instructions

This sheet accompanies each issue of Supplements to the Flight Manual.

Insert each attached Supplement in accordance with its instructions. The information in each Supplement supersedes that in the published text to which reference is made.

This sheet is to be inserted immediately after the list of effective pages, replacing the sheet accompanying the previous Supplement issue.

Commanders are responsible for bringing the content of the attached Supplements to the attention of affected personnel.

General

Supplements to Flight Manuals are issued as a means of incorporating information of a temporary nature, as an interim method of directing attention to changes to the aircraft operating procedures or limitations pending issue of a formal amendment and as a means of incorporating information where it is not practicable to amend the published text. Periodically, information contained in Supplements will be consolidated and issued as an amendment to the publication.

The reverse of this sheet lists all current Supplements applicable to this manual. Also listed is the Amendment List status of each associated publication, current at the date of issue of this sheet.

Flight Manual and Supplement Status

This page lists the current status of the Flight Manual, associated Checklist and Supplements applicable to Mirage IIIO and IIID operations. Supplements are issued in numerical sequence - if you are missing one listed, a copy may be obtained through your unit TPO/Library.

Current Flight Manuals	Date	Last AL	Last RS
AAP 7213.003-1	1JUN78	35	78
AAP 7213.003-1-1	1JUN78		
AAP 7213.003-34	1JUN78		

Current Aircrew Checklists	Date	Last AL
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AAP 7213.003-34CL	1JUN78	

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45	OCT 83	Matra R550 Weapon Clearances	Page 5-9
51	JAN 85	Matra Magic R550	Page 1-87
57	SEP 85	Engine EGT (T4) Limits	Page 5-1
74	JUN 86	Matra R530/R550 Terminology	Page 1-1
75	SEP 86	IIID Rear Cockpit Canopy Breaker	Page 3-14
76	NOV 86	Release of MK 82 and LGB's from RPK-10	Page 5-12
77	NOV 86	Release of MK 82 and LGB's from RPK-10	Page FO5 -1E
78	JAN 87	External Canopy Jettison Cable	Page 1-69

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Nil

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70	FEB86	Manual Bail Out Procedures	Page 3-23
71	FEB86	Prohibited Manoeuvres	Page 5-5
72	FEB86	374 Gallon Tanks - Prohibited Manoeuvres	Page 5-7
73	FEB86	Flight Characteristics with 374 Gallon External Tanks	Page 6-16

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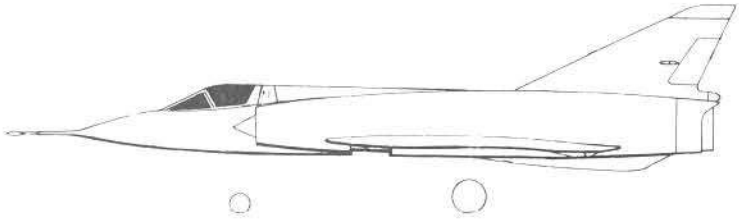
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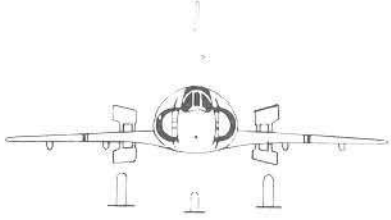
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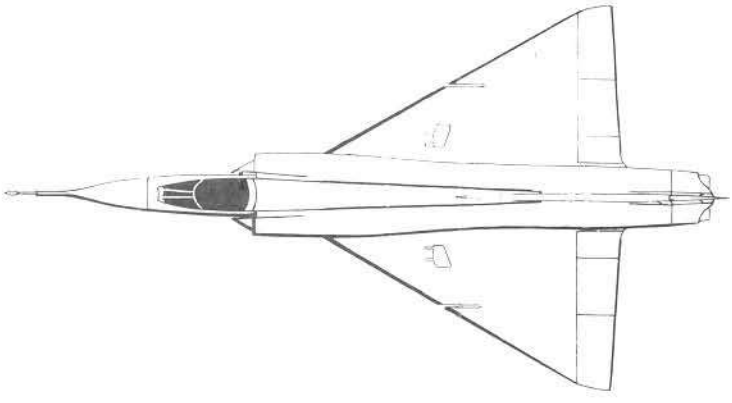
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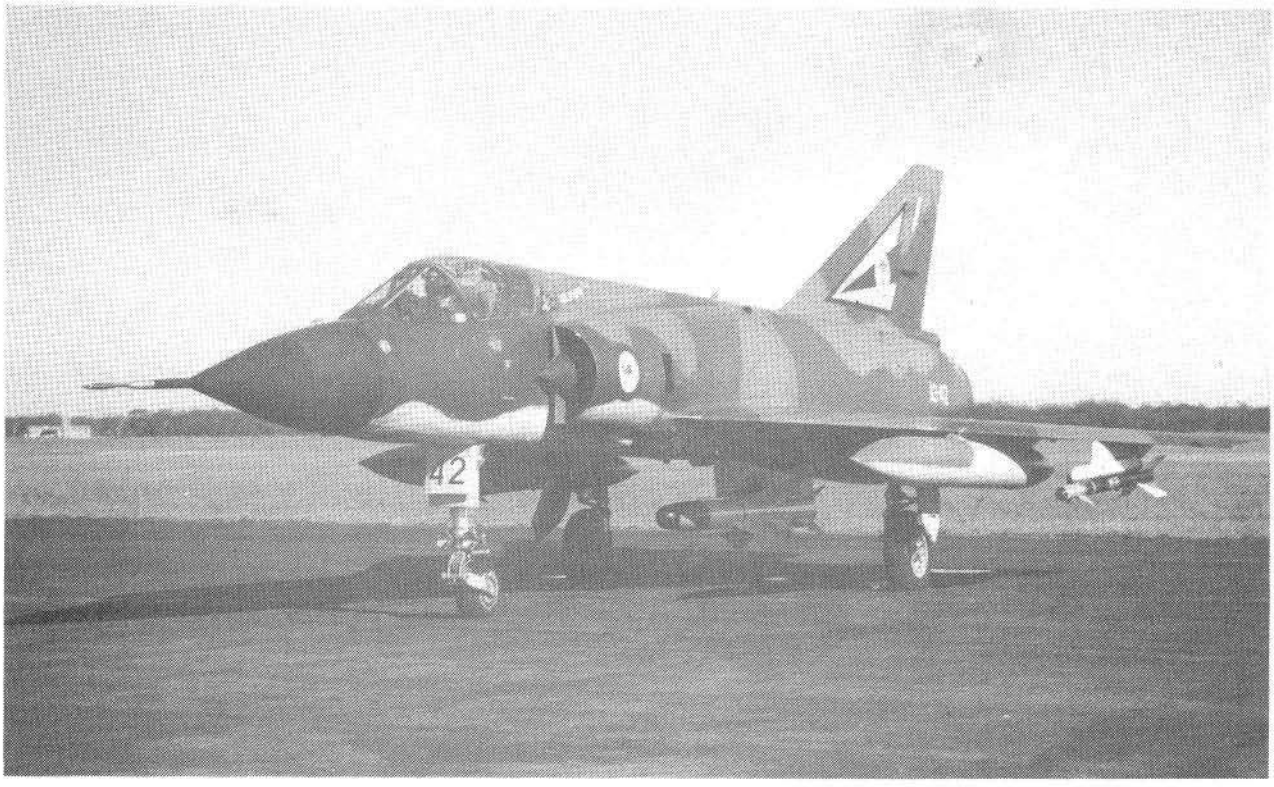
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Mirage IIIO Aircraft

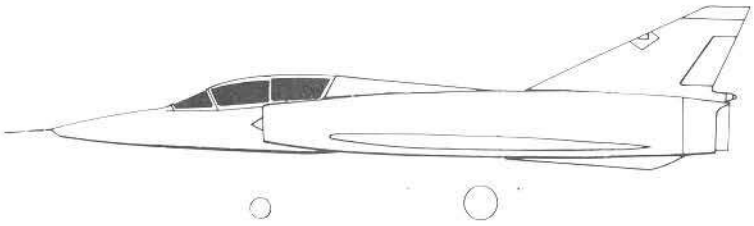




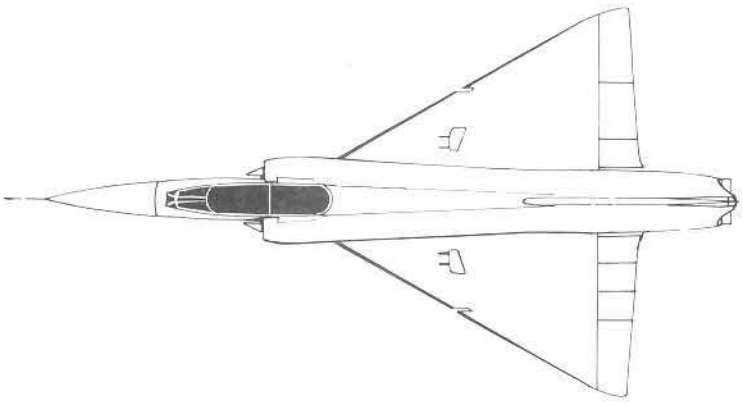




Mirage IIID Aircraft









FOREWORD

AUTHORITY

Users are to regard this Flight Manual as an authoritative publication. It is compiled from data obtained from operating, technical, manufacturing, and safety sources and represents the best level of information available.

SCOPE

This manual contains the information required for safe and efficient operation of the Mirage IIIO and IIID aircraft. These instructions provide a general knowledge of the aircraft, its characteristics and normal and emergency operating procedures. The pilot's flying experience is recognised and reference to basic flight principles is avoided.

OPERATING INSTRUCTIONS

Instructions in this manual are for a pilot inexperienced in the operation of the aircraft. The manual provides the best possible operating instructions; however, on occasions these instructions may prove to be a poor substitute for sound judgement. Multiple emergencies, adverse weather, terrain and other considerations may require modification of the procedures.

PERMISSIBLE OPERATIONS

The Flight Manual takes a positive approach and normally states only what the pilot may do. Unusual operations or configurations are prohibited unless specifically covered herein. Clearance must be obtained before any questionable operation not specifically permitted in this manual is attempted.

USE OF THE MANUAL

To use the Flight Manual correctly it is essential to understand the division of the Manual into its sections and the subsequent division of the sections. Each section has a table of contents, and best use will be obtained from the Manual by becoming familiar with the table of contents for each section. The alphabetical index enables easy reference to a particular topic or item by page number.

The Flight Manual covers operation of the Mirage aircraft and the systems and equipment forming part of the aircraft. The weapons delivery manual (DI(AF) AAP7213.003-34) covers external stores and their suspension systems, and procedures and other information required to deliver weapons from the aircraft. Aircraft performance data is contained in DI(AF) AAP7213.003-1-1.

PRESENTATION OF MODEL DIFFERENCES

Much of the information is common to both Mirage IIIO and IIID models. Throughout the manual the following principles have been observed to illustrate the different information for each model :

- The information is common to both aircraft models unless otherwise indicated.
- Where the information for the two aircraft models differs, the IIIO information is always presented first. The IIID information will be prefixed by the symbol [D] and will immediately follow the IIIO information.
- Where a IIID system or sub-system is substantially different to the IIIO system the text is contained under a heading beginning with the symbol [D] or a self-explanatory heading, eg IIID Communications Equipment.
- Where figures are substantially different they appear under a self-explanatory title, eg IIID Instrument Panel.
- Checklist procedures are arranged in the order that they are performed in the IIIO aircraft. Specific normal or emergency checklist procedures for the IIID aircraft are at the end of the appropriate block of IIIO text prefixed by the symbol [D] or an appropriate heading.
- Unless indicated, equipment in the IIIO cockpit is also fitted in the IIID front cockpit and is not significantly different in appearance, operation or location.

MAJOR DIFFERENCES BETWEEN MODELS

The Mirage IIIO is a single seat, all-weather interceptor and tactical strike aircraft. The Mirage IIID is a two-seat trainer version of the Mirage IIIE/IIIO. The IIID's operational capability is limited by lack of the following systems/components, fitted to the IIIO :

a. Cyrano IIB radar.
b. Matra R530 missile.
c. Changeable nose cones.
d. Doppler radar navigation equipment.
e. Roll stabilisation.

CHECKLIST

The Flight Manual contains amplified checklists. The abbreviated Pilot's Checklist is issued as a separate document (DI(AF) AAP7213.003-1CL).

Checklist items with alpha/numeric identification in the Flight Manual are repeated identically in the Pilot's Checklist.

COCKPIT MARKINGS

The use of block capitals in the text when identifying equipment, controls, switches, and positions, indicates the markings which actually appear in the cockpit.

AIRSPEEDS

All airspeeds quoted in this manual are indicated airspeeds unless otherwise stated.

WARNINGS, CAUTIONS, AND NOTES

The following definitions apply to 'Warning', 'Cautions', and 'Notes' found throughout the manual.

WARNING

Operating procedures, techniques etc., which will result in personal injury or loss of life if not carefully followed.

CAUTION

Operating procedures, techniques, etc., which will result in damage to equipment if not carefully followed.

Note

Operating procedures, techniques, etc., which it is considered essential to emphasize.

AMENDMENT ACTION

To assist in maintaining this publication at a high standard, users are to bring to the notice of higher authority, without delay, any errors, omissions or suggestions for improvement. This should be done through the Unit Flight Manuals Officer. Attention is drawn to DI(AF) OPS 5/2.

Urgent flight safety information is disseminated to users by message as interim amendments (IAL). IAL may authorise pen amendment of the manual and are superseded by a formal amendment list.

RAAF Supplements (RS) are issued as required and may authorise pen amendment of abbreviated checklists. RS are periodically superseded by white page replacements.

The current amendment list (AL) status of each white page in the manual is defined in the List of Effective Pages (LOEP). The currency of applicable RAAF Supplements is defined in the Flight Manual and Supplement Status Sheet (FMSSS). Ensure the integrity of your manual by periodically checking its content against the LOEP and FMSSS.

GLOSSARY

A/B	Afterburner
ACFT	Aircraft
AC	Alternating Current
A.C.	Autocommand
ADC	Air Data Computer
AEC	Automatic Exposure Control
AFC	Automatic Frequency Control
AFU	Artificial Feel Unit
AGL	Above Ground Level
A/H	Artificial Horizon
AMSL	Above Mean Sea Level
ASAP	As Soon As Possible
ASI	Air Speed Indicator
AUW	All Up Weight
AUX	Auxiliary
BOMB	Bezu Output Multiplier Box
C	Celsius
CAB P	Cabin Pressure
CAB T	Cabin Temperature
CAS	Calibrated Air Speed
CB	Circuit Breaker
CG	Centre of Gravity
cm	Centimetre
CPS	Cycles Per Second
CSD	Constant Speed Drive
DA	Drift Angle
daN	Decanewton
DC	Direct Current
DG	Directional Gyro
DH	Decision Height
DR	Dead Reckoning
DT	Drop Tank
ECM	Electronic Counter Measures
EGT (T4)	Exhaust Gas Temperature
EmB	Emergency Brake
EMG	Emergency
EPM	Estimated Point Marker
EQ T	Equipment Temperature
ERP	Earth Rate Precession
ET	External Tanks
ETA	Estimate Time of Arrival
EU	Electronic Unit
form	Formation
FRL	Fuselage Reference Line
FUS	Fuselage
'g'	Load factor
gal	Gallon
gal (Imp)	Gallon (Imperial)
gal/min	Gallon Per Minute
GB	Gun Bay
GBT	Gun Bay Tank
GCA	Ground Controlled Approach
GCI	Ground Controlled Intercept/Interception
GM	Gyro Stabilized Magnetic Heading
GP	Gun Pack
G/R/M	Guns, Rockets, Missiles
G/S	Gunsight
HA	High Altitude
hm	Hectometres
HP	High Pressure
HT	High Tension
HYD	Hydraulic
Hz	Hertz (cycles per sec)
IAS	Indicated Air Speed
ICAO	International Civil Aviation Organisation
IFF	Identification Friend or Foe
IMC	Image Motion Compensation
IMC	Instrument Meteorological Conditions
IMN	Indicated Mach Number
INM	Indicated Nautical Miles
I/P	Identification of Position
IR	Infra-Red
ISA	International Standard Atmosphere
IWT	Internal Wing Tank
KCAS	Knots Calibrated Air Speed
kHz	Kilohertz
KIAS	Knots Indicated Air Speed
km	Kilometres
kn	Knots
kPa	Kilopascal
KTAS	Knots True Air Speed

kV.A	Kilo Volt Ampere
kW	Kilowatt
L	Left
LA	Low Altitude
LE tanks	Leading Edge tanks
LP	Low Pressure
M	Indicated Mach Number (when quantified)
m	Metre
MAC	Mean Aerodynamic Chord
MAP	Missed Approach Point
max	Maximum
MDA	Minimum Descent Altitude
MFCU	Main Fuel Control Unit
MHz	Megahertz
min	Minimum
min	Minute
mm	Millimetres
MN	Mach Number (true)
MP	Medium Pressure
MSEA	Minimum Safe Ejection Altitude
MSL	Mean Sea Level
nav	navigation
N	Normal
N/EMG	Normal/Emergency
NM	Nautical Mile
N/N	Normal/Normal
NO TR	No Transfer
OAT	Outside Air Temperature
PEC	Personal Equipment Connector
PHI	Position Homing Indicator
PPI	Plan Position Indicator
PRNC	Photo Reconnaissance Nose Cone
PRF	Pulse Repetition Frequency
psi	Pounds per Square Inch
PTO	Power Take Off
PTT	Press to talk
QDA	Quick Disconnect Assembly
QFE	Airfield Barometric Pressure
QNH	Airfield Barometric Pressure Adjusted to Sea Level
QRB	Quick Release Box
RBT	Rocket Bay Tank
R	Right
rad	Radian
RF	Radio Frequency
RPM	Revolutions per minute
RTB	Return to Base
RX	Receiver
S/B	Speed Brakes
sec	Second (Time)
SIF	Selective Identification Feature
SS	Special Stores
SSU	Station Storage Unit
S.W.	Sidewinder
TAS	True Air Speed
TACAN	Tactical air navigation
TB	Telebrief
TGP	Twin Gyro Platform
TX/RX	Transmitter-Receiver
TX	Transmitter
U/C	Undercarriage
U/C B	Undercarriage Brakes
UHF	Ultra High Frequency
UV	Ultra Violet
V	Volts
V.A	Volt Amperes
VAC	Volts Alternating Current
Vc	Closing Speed
VDC	Volts Direct Current
Vg	Groundspeed
VMC	Visual Meteorological Conditions
VOL	Volume
VSI	Vertical Speed Indicator
W	Watts
W/V	Wind Velocity

SECTION 1
DESCRIPTION AND OPERATION

SECTION 1

DESCRIPTION AND OPERATION

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RAAF SUPPLEMENT NO 74

MIRAGE IIIO AND IIID

MATRA R530/R550 TERMINOLOGY

Instructions

This supplement is to be inserted facing page 1-1.

Action

Wherever the unqualified term 'Matra' is used in this publication, it is to be assumed that it means the MATRA R530K missile.

SECTION 1

DESCRIPTION AND OPERATION

AIRCRAFT

The Mirage IIIO is a single seat Mach 2 all-weather interceptor and tactical strike aircraft. The Mirage IIID is a two-seater Mach 2 trainer and tactical strike aircraft. The general arrangement diagram for both aircraft is shown at Figure 1-1. Both aircraft were manufactured under licence by the Government Aircraft Factories in Australia and are capable of performing a number of roles. Various configurations are available to suit these roles. The IIID operational capability is limited by lack of the following equipment, fitted to the IIIO :

a. Cyrano IIB radar,
b. Matra R530 missile,
c. Doppler navigation radar, and
d. Roll stabilization.

General Arrangement

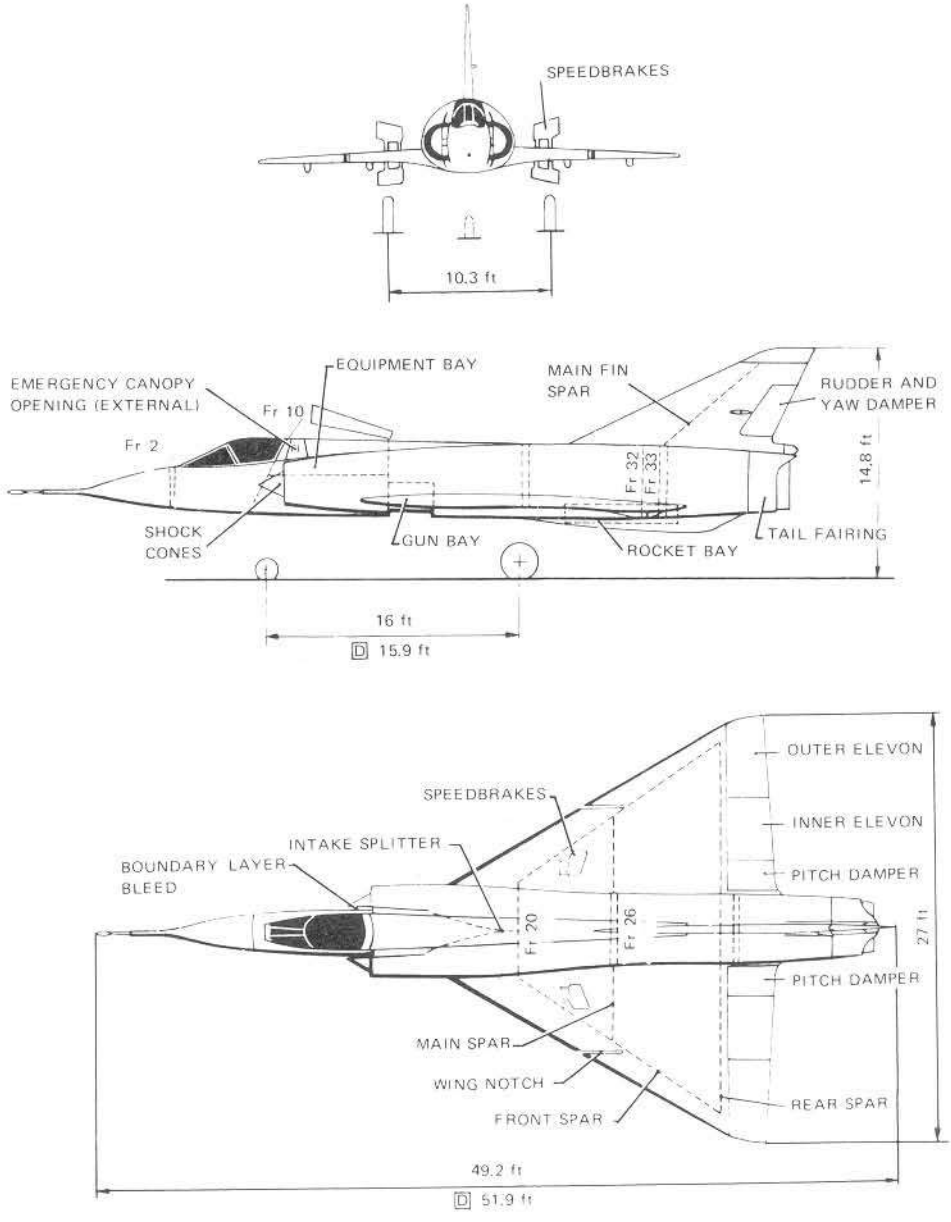


Figure 1-1

INTERNAL CONFIGURATIONS

The aircraft internal configurations (refer to Fig 1-2) can consist of :

a. a nose cone containing a Cyrano radar, replaceable by a photo reconnaissance nose cone or a dummy nose cone.

b. a gun pack containing two 30mm cannon, replaceable by a 72 gal fuel tank or, in modified aircraft, a photo reconnaissance pack, and

c. a 120 gal fuel tank permanently installed in the rocket bay.

[D] The nose cone is a permanent fixture.

Internal Configurations

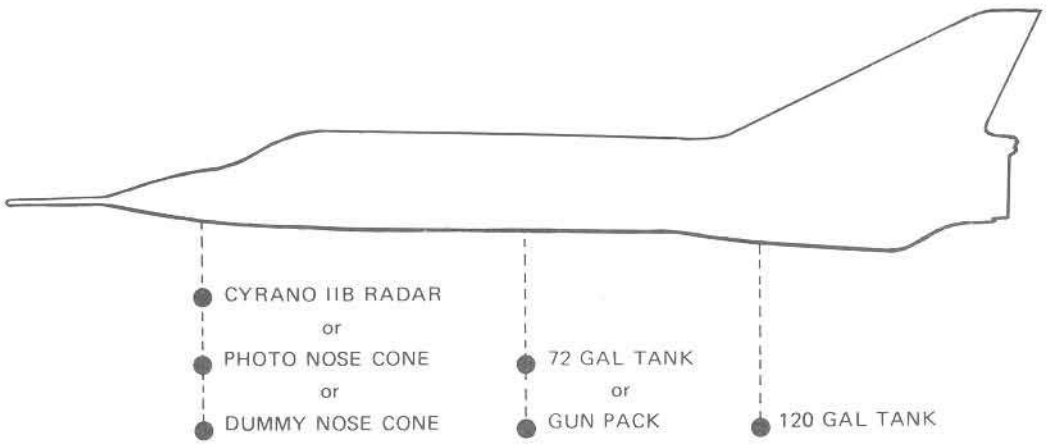


Figure 1-2

EXTERNAL CONFIGURATIONS

Weapons and tanks may be carried externally on the outboard, inboard and centreline stations (refer to Fig 1-3).

Outboard Stations

The outboard stations may be clean or fitted with :

a. a Sidewinder missile with rails and pylons on each station, or

b. a MK26 Mod 0 target rocket on the left station and a Sidewinder on the right station, or

c. a MK 26 Mod 0 target rocket on each station.

Inboard Stations

The inboard stations may be clean or fitted with :

a. a finned 110 gal tank (jettisonable), or

b. a non-finned 110 gal tank (not jettisonable), or

c. a 286 gal tank (pylon not jettisonable), or

d. a 374 gal tank (pylon not jettisonable), or

e. an RPK10 tank/bomb carrier (not jettisonable) capable of carrying up to four MK82 bombs, or

f. a Lundy AN/ALE-32 chaff dispenser on the left station and a 110 gal tank on the right station.

Centreline Station

The centreline station may be clean or fitted with :

a. a PM-3 bomb beam capable of carrying one SUU-20A/A bomb dispenser, one or two MK 82 bombs or one AN/ALQ-72 ECM pod (PM-3, SUU-20A/A and AN/ALQ-72 not jettisonable), one SUU-11B/A gun pod with Luneberg lens, or one HIPATS-1 target system, or

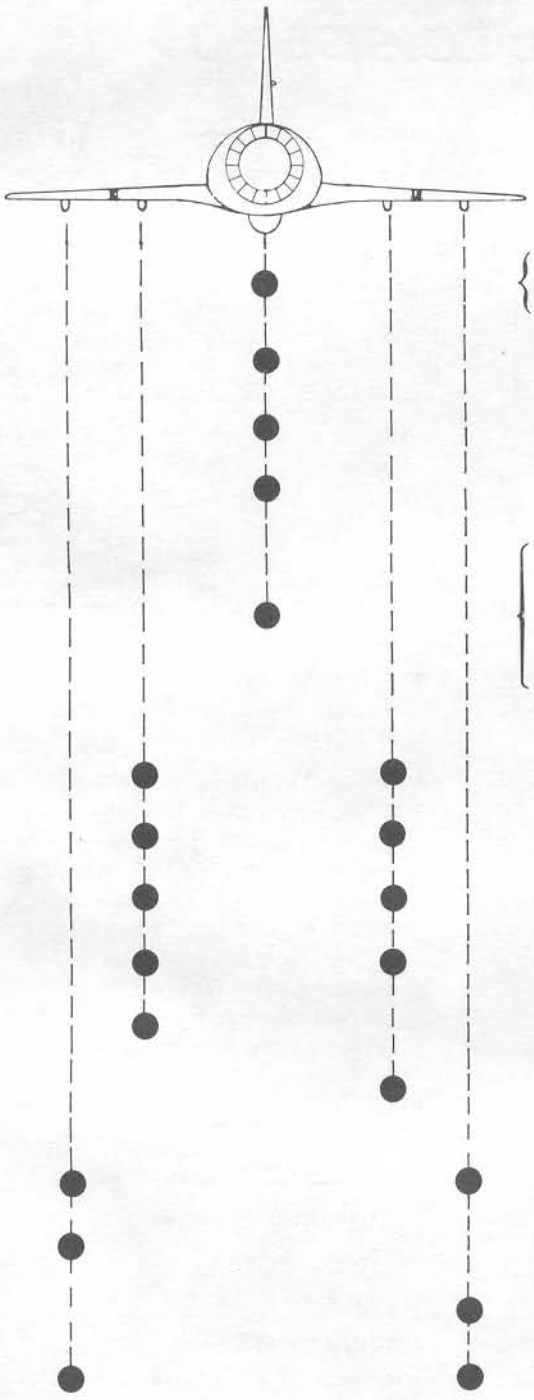
b. a 286 gal tank and pylon (pylon not jettisonable), or

c. a Matra R530 missile and pylon, or

d. a pannier, constructed from a 286 gal tank, capable of carrying a 1000 lb load, mounted on the normal tank pylon (pylon not jettisonable).

[D] The PM-3 bomb beam and the 242 gal tank may be fitted to this station. The 286 gal tank, the Matra missile and the pannier cannot be fitted.

External Configurations



286 GAL TANK
[D] 242 GAL TANK
or
MATRA R530
or
PANNIER
or
PM-3
+
SUU-20A/A or
ONE OR TWO MK82 or
AN/ALQ-72 or
SUU-11B/A GUNPOD
(LUNEBERG LENS [O] FRONT STATION
[D] REAR STATION) or
HIPATS-1 TARGET SYSTEM

110 GAL TANK
or
286 GAL TANK
or
374 GAL TANK
or
RPK10 WITH ≤ FOUR MK 82
or
AN/ALE-32
WITH
110 GAL TANK

SIDEWINDER
or
TDU-11/B TARGET ROCKET
WITH
SIDEWINDER
or
TDU-11/B TARGET ROCKET

Note
One S.W. or one target rocket may be carried. The store may be carried on either the right or left station.

Figure 1-3

CONFIGURATION CODE

Because of the numerous tank and weapons configurations of the dual role Mirage IIIO and IIID aircraft, a configuration code has been devised to simplify the designation of any particular configuration. The configuration is expressed as a five group alpha numeric code, each group being separated by an oblique stroke, eg N/B/S6L4R/G120/RG. Reference to the code shows :

a. the first group N means nil stores on the outboard wing stations,

b. the second group B means a 286 gal tank on each inboard wing station,

c. the third group S6L4R means a SUU-20A/A with six low-drag BDU-33C/B bombs and four rockets on the centreline station,

d. the fourth group G120 means a gunpack with 120 rounds is mounted in the gun bay, and

e. the fifth group RG means radar for the air-to-ground role is required.

Group	Code	Meaning
1st - Wing Outboard	N	Nil
	SC	Sidewinder, captive head
	SD	Sidewinder, dummy
	SL	Sidewinder, live
	T	Target rocket
2nd - Wing Inboard	N	Nil
	A	110 gal (non-jettisonable)
	AJ	110 gal (jettisonable)
	B	286 gal tank
	C	374 gal tank
	R	RPK10
	R4H	RPK10 with 4 MK82 High Drag
	R4L	RPK10 with 4 MK82 Low Drag
	CD	Chaff Dispenser
3rd - Centreline	N	Nil
	MD	Matra, dummy
	ML	Matra, live
	B	286 gal tank
	D	242 gal tank (IIID)
	Pa	Pannier
	PM	PM-3
	PM2H	PM-3 with 2 MK82 High Drag
	PM2L	PM-3 with 2 MK82 Low Drag
	S	SUU-20A/A
3rd - Centreline (Cont'd)	S6H	SUU-20A/A with 6 BDU-33C/B High Drag
	S6L	SUU-20A/A with 6 BDU-33C/B Low Drag
	S4R	SUU-20A/A with 4 Rockets
	E	ECM pod
	L	SUU-11B/A with Luneberg lens
	T	HIPATS-1 Target
4th - Gunbay	N	No special requirement
	T	Fuel tank
	G	Gunpack - empty
	G120	Gunpack - 120 rds
	O	Oil (Smoke modification)
	P	Photo pack - F95
5th - Nose	N	Radar not required
	RA	Radar - Air-to-air
	RG	Radar - Air-to-ground
	P	Photo - KA56B1
	D	Dummy

Note

- A number shown within each group denotes the number of stores on that station, eg 2H means two MK 82 high-drag bombs.
- A configuration can occur when the store on the left station is different from the store on the right station, eg a Sidewinder with a captive head (SC) on the left outboard station and a dummy Sidewinder (SD) on the right outboard station. The group for this configuration is SCD. Similarly, with a chaff dispenser (CD) on the left inboard station and a 110 gal non-jettisonable tank (A) on the right inboard station the group would read CDA.

AIRCRAFT DIMENSIONS

The aircraft dimensions are :

a. Length - 15 m (49.2 ft),

[D] Length - 15.8 m (51.9 ft),

b. Span - 8.2 m (27 ft), and

c. Height - 4.5 m (14.8 ft).

AIRCRAFT WEIGHT

Aircraft weights without fuel are :

a. Mirage IIIO - 6949 kg (15 320 lb), and

b. Mirage IIID - 6949 kg (15 320 lb).

Note

Basic weights for individual aircraft are listed in AAP 7213.003-5 Mirage Loading and Balance Summary.

ENGINE

The aircraft is powered by a SNECMA Atar 9C5 turbojet manufactured under licence in Australia by the Commonwealth Aircraft Corporation. The engine is provided with a full range afterburner (A/B) system.

Static Thrust

The static thrusts available are :

a. Dry engine - 4217 ± 33 daN (9480 ± 165 lb),

b. Maximum A/B - 5911, + 169, − 122 daN (13 288, + 375, − 275 lb), and

c. Overspeed - 6308 daN (14 180 lb).

Overspeed

The engine is equipped with an overspeed system that acts as a thrust recovery device for operation in high ambient temperatures during take-off. The system increases RPM by approximately 3% which results in a thrust increase of approximately 7%. It can be manually selected for take-off and operates for one minute if the impact temperature is at or above 27 °C and more than 85% A/B is being used. The system also operates automatically at or above 27 °C and the engine RPM is equal to or greater than 8100.

ROCKET MOTOR

A kerosene/nitric acid rocket motor of about 1334 daN (3000 lb) thrust can be fitted to the aircraft but it is not fitted to RAAF aircraft. The rocket motor bay is permanently occupied by a 120 gal fuel tank.

PERFORMANCE

The aircraft's performance limits are :

a. Maximum IAS - 750 kn (or the illumination of the MACH light),

b. Maximum IMN - M2.0 (or the illumination of the MACH light), and

c. Operational ceiling with one Matra - 54 000 ft.

[D] The operational ceiling (clean) is 72 000 ft at 200 KIAS.

EQUIPMENT

The aircraft equipment includes :

a. pitch and yaw dampers,

b. autocommand (attitude hold and automatic trim),

c. altitude lock,

d. roll stabilization (heading hold),

e. UHF transmitters and receivers,

f. IFF,

g. Martin Baker OM6 ejection seat, and

h. a brake chute,

[D] Roll stabilization is not fitted.

NAVIGATION SYSTEM

The navigation system includes :

a. TACAN

b. a navigation computer (PHI),

c. a gyro reference system,

d. an air data computer,

e. Cyrano IIB (ground mapping) radar, and

f. a Doppler system.

[D] Radar and Doppler are not fitted.

WEAPONS SYSTEM

The weapons system includes :

a. a CSF 97K gunsight, and

b. Cyrano IIB (fire control) radar or a reconnaissance nose cone, and

c. air-to-air weapons:

(1) Matra R530,

(2) Matra R550, and

(3) Defa 30 mm cannon, and

d. air-to-ground weapons:

(1) Defa 30 mm cannon,

(2) MK82 bombs, and

(3) Karinga

[D] The weapons system consists of a CSF 97 gunsight capable of manual ranging information only (no radar). Matra R530 cannot be carried. For all types of attack a visual sighting is necessary.

AIRFRAME

FUSELAGE

The fuselage is of conventional stressed skin construction and complies with the area rule formula.

NOSE CONE

The nose cone (refer to Fig 1-2) is secured to frame 1 by means of four attachment fittings. A pitot probe

on a boom is attached to the front of the nose.

The nose cone can be :

a. a Cyrano IIB radar, or

b. a photographic nose cone containing the Fairchild KA56 B1 photographic reconnaissance camera system, or

c. a dummy cone made of metal and ballasted to the correct weight. The dummy nose cone is fitted with electrical resistances which load the alternator and prevent over-frequency.

[D] The IIID nose cone is a permanent fixture. It contains the IFF, TACAN and components of the air conditioning system. The TACAN is accessible through a panel on the left side of the nose cone.

COCKPIT

The cockpit is pressurized, airconditioned and heat insulated. It has a windshield made of flat glass and two plexiglass side panels.

[D] A plexiglass shield just behind the front ejection seat separates the two cockpits and provides protection for the rear seat pilot if the front seat pilot ejects first.

FORWARD FUSELAGE

The forward fuselage consists of the nosewheel well, the equipment bay, the air intakes and the shock-cones commonly known as MICE.

Nosewheel Well

The nosewheel well contains a large number of pressurization/air conditioning and flight control components. The Doppler transmitter/receiver is housed in the rear of the nosewheel well, the Doppler antenna being housed in a bay beneath the cockpit.

[D] The battery is located at the rear of the nose wheel well. A canopy de-clutching handle, painted red, is located to the rear of the central bulkhead. When the handle is pulled, the driving mechanism is disconnected from the canopy and the canopy may be raised manually.

Equipment Bay

The equipment bay is located just behind the cockpit and is reached through a large door on the top of the fuselage. This bay is partially heat protected and receives pressurization air from the cockpit.

Air from the equipment conditioning system is directly supplied to the electronic unit, TACAN and the gyro output multiplier.

The bay houses :

a. an armament box,

b. the IFF transponder,

c. the twin gyro platform and its output multiplier,

d. the debitmeter amplifier,

e. the DC main box,

f. the battery,

g. the air data computer and its output multiplier,

h. the TACAN receiver/transmitter,

i. the PHI navigation computer,

j. the primary UHF set,

k. the autocommand amplifier,

l. the servo-control amplifier,

m. the computing voltage supply box,

n. the radar altimeter transmitter/receiver,

o. two oxygen cylinders,

p. the negative 'g' accumulator, and

q. the Matra harmonization box.

[D] The equipment bay is located just behind the rear cockpit. It is neither pressurized nor airconditioned. The bay is reached through a Dzus fastened door on top of the fuselage. This bay contains components of the air data and armament systems and the servo-controls. Major components include an armament box, the autocommand box and servo-control amplifier. The oxygen cylinders and negative 'g' accumulator are located in front of the equipment bay and have the same access door.

Air Intakes and Ducts

The aircraft has side air intakes with inner ducts which channel boundary layer air for cooling the engine, and the equipment and cockpit air conditioning heat exchangers. An auxiliary intake door, located in the side of each intake, provides extra air to the engine during ground running and slow speed flight. The panels containing the intake doors are removable, allowing access to the engine compressor face and intake area.

[D] Boundary layer bleed air is used only for engine cooling. A separate intake for the cockpit air conditioning heat exchanger is located in the nose cone.

Shock Cones

The air intakes are fitted with variable position shock-cones (MICE). The mice start moving forward at M1.25 and move in accordance with the Mach number so that the air intakes operate at their best efficiency at all times.

CENTRE FUSELAGE

The centre fuselage consists of the fuselage fuel tanks, the main wheel wells, the gun bay and the aircraft gearbox compartment.

Fuselage Fuel Tanks

There are two fuel tanks within the centre fuselage section located either side of the intake air duct. Each tank is divided into two cells.

Main Wheel Wells

The main wheel wells give access to certain compo-

nents of the hydraulic and fuel systems. A panel in the right well allows access to the engine oiling points and the starting speed detector. A panel in the left well allows access to the starter control box.

Gun Bay

The gun bay is located in front of the main wheel wells.

Aircraft Gearbox Compartment

The aircraft gearbox compartment is located slightly aft of the main wheel wells.

REAR FUSELAGE

The rear fuselage consists of the engine compartment, rocket bay, two rear side bays and the tail cone section.

Engine Compartment

This compartment houses the Atar engine.

Rocket Bay

The rocket bay houses a 120 gal fuel tank.

Two Rear Side Bays

The two rear side bays are heat insulated and air conditioned. The left bay houses the secondary UHF set. The right bay is empty, but is capable of housing a tail warning radar receiver.

[D] The two rear side bays are heat insulated but not air conditioned. The left bay houses the primary UHF set and the right bay houses the secondary UHF set.

Tail Cone Section

The tail cone section which is the rearmost component of the fuselage, can be easily removed to permit engine removal or to gain access to the nozzle flap assembly. It contains the brake chute housing located above the engine at the base of the fin. The brake chute mechanism is located in the upper rear fuselage.

Brake Chute

A nylon brake chute of cruciform shape is housed in a container mounted in a housing at the base of the fin.

WING

The wing is a delta planform of multi-spar structural box construction. The wing is attached to the fuselage by the main spar at frame 26 and by the rear spar.

The space between the main and rear spars contains the wing fuel tank of 120 gal capacity per wing. The inboard section of the leading edge of some aircraft is a fuel tank of 27.5 gal capacity per wing.

The main characteristics of the wing are as follows :

a. total area: 34.79 m² (374.5 ft²);

b. leading edge sweep back: 60° 34' 45";

c. t/c ratio: 4.5 to 3.5% ;

d. anhedral: 1°; and

e. wing loading (clean): 2.56 kPa (53.6 lb/ft²).

Each wing contains :

a. outboard and inboard elevons which are deflected the same amount by separate hydraulic jacks,

b. inboard control surfaces (pitch dampers) which assist the elevons in pitch and dampen out the higher frequency pitch oscillations, and

c. the speed brakes consisting of an upper and lower surface in each mainplane.

The leading edge of the wing has a conical camber and can be considered as lying on the surface of a cone which has its apex at the wing root. This type of aerofoil improves the aerodynamic behaviour at high angles of attack and in particular improves the low speed handling characteristics of the aircraft. The low speed characteristics are also improved by leading edge notches which are located at 53% span.

FIN

The fin is of the multi-spar type and supports a hydraulically powered rudder. The rudder, as well as working as a conventional control surface, acts as a damper and dampens out yawing oscillations.

The main UHF antenna is installed at the top of the fin and the two stand-by UHF antennae are installed one on the leading edge, and the other on the trailing edge of the fin.

The flux valve detector is located in the fin and provision has been made for the accommodation of a tail warning radar antenna.

GROUND CONNECTION RECEPTACLES

There are five connectors located under the fuselage. They are :

a. The radar and cockpit pre-conditioning connection located between the nose wheel well and the doppler antenna, with an electrically operated automatic door.

b. The telebrief connector located on the lower fuselage near the left trailing edge, with a spring loaded door.

c. The DC and AC ground connectors located aft of the left wheel well, with a manually operated door.

d. The equipment ventilation connector located in the nose wheel well.

e. The transfer gyro connector located on the left side aft of the wing with a manually operated door.

Note

If either the pre-conditioning or the AC/DC ground connector doors are not closed, the GRD CONN warning light illuminates.

[D] There are three connectors located under the fuselage. They are the :

a. nose cone pre-conditioning connector, which is not normally used, located inside the lower access door in the nose cone,

b. AC and DC ground connector, and

c. ground communications connector located with the AC/DC ground connection.

Note

[D] If the AC/DC ground connector door is not closed, the GRD CONN warning light in the front cockpit illuminates.

ENGINE

The engine weight (dry) is about 1365 kg (3090 lb). Special features incorporated in the Atar 9C5 are :

a. A hydro-mechanical regulating system which adjusts the engine for optimum operating conditions. A single engine control, the throttle, is provided to set engine RPM or A/B thrust.

b. An overspeed device which permits a 3% increase in the maximum RPM, thereby providing additional thrust which increases with higher IMN. It may be selected manually or may operate automatically at or above 30 000 ft. In both cases the impact temperature must be + 27°C ± 2°C before overspeed operates.

c. An approach control system which, when selected, maintains a constant 190 KIAS during an approach.

d. An emergency oil pump and electric throttle which allows recovery of the aircraft after an oil failure, fuel regulation system failure or a mechanical failure of throttle linkages.

e. A fuel dipper, which restricts fuel delivery when the guns or the Matra missile are fired, prevents compressor stalls or engine flame outs.

DESCRIPTION

The basic engine components (refer to Fig 1-4) are the :

a. starter motor,

b. inlet assembly,

c. compressor,

d. centre section,

e. combustion chamber,

f. turbine assembly,

g. junction section,

h. afterburner chamber,

i. the exhaust nozzle, and

j. drives and gearing.

STARTER MOTOR

The starter motor unit is the Noelle 002-01. It is a small self-contained turbojet which uses aircraft fuel and operates off the battery bus.

INLET ASSEMBLY

The inlet assembly contains guide vanes which ensure that air from the intake passes to the first stage of the compressor at the desired angle. The starter motor, reduction gearbox and the No 1 engine bearing are mounted within the inlet assembly by means of a six spoke support.

COMPRESSOR

The compressor is a nine-stage axial flow type with a compression ratio of 5:1. The first three rows and last two rows of compressor blades are steel and the other four rows are a light alloy material.

CENTRE SECTION

The centre section is located between the compressor and the combustion chamber. It contains :

a. the compressor outlet guide vanes,

b. the burner ring with its 20 attached burners, and

c. two ignition chambers for starting and relighting.

COMBUSTION CHAMBER

The combustion chamber is an annular type. An afterburner ignition injector is mounted on the outer casing.

TURBINE ASSEMBLY

The turbine assembly consists of two rows of nozzle guide vanes and two rows of turbine blades. The first row of vanes are hollow and air cooled, the second row of vanes are solid. The turbine blades, high pressure and low pressure, are attached to the main engine shaft.

JUNCTION SECTION

The junction section consists of two main assemblies; the upstream manifold assembly and the downstream burner rings. The gas flow from the turbine outlet passes through the junction section to the afterburner chamber. EGT (T4) is measured in the junction section.

AFTERBURNER CHAMBER

The A/B chamber is contained in the nozzle support which is mounted between the junction section and the nozzle multiflap assembly. The A/B chamber contains five corrugated liners.

EXHAUST NOZZLE

The exhaust nozzle is a fully variable multiflap assembly. It consists of 36 inner (hot) flaps and 18 outer (cold) flaps. Nine activating jacks vary the effective diameter of the tail pipe by operating the flaps to maintain optimum engine operation.

Engine Components

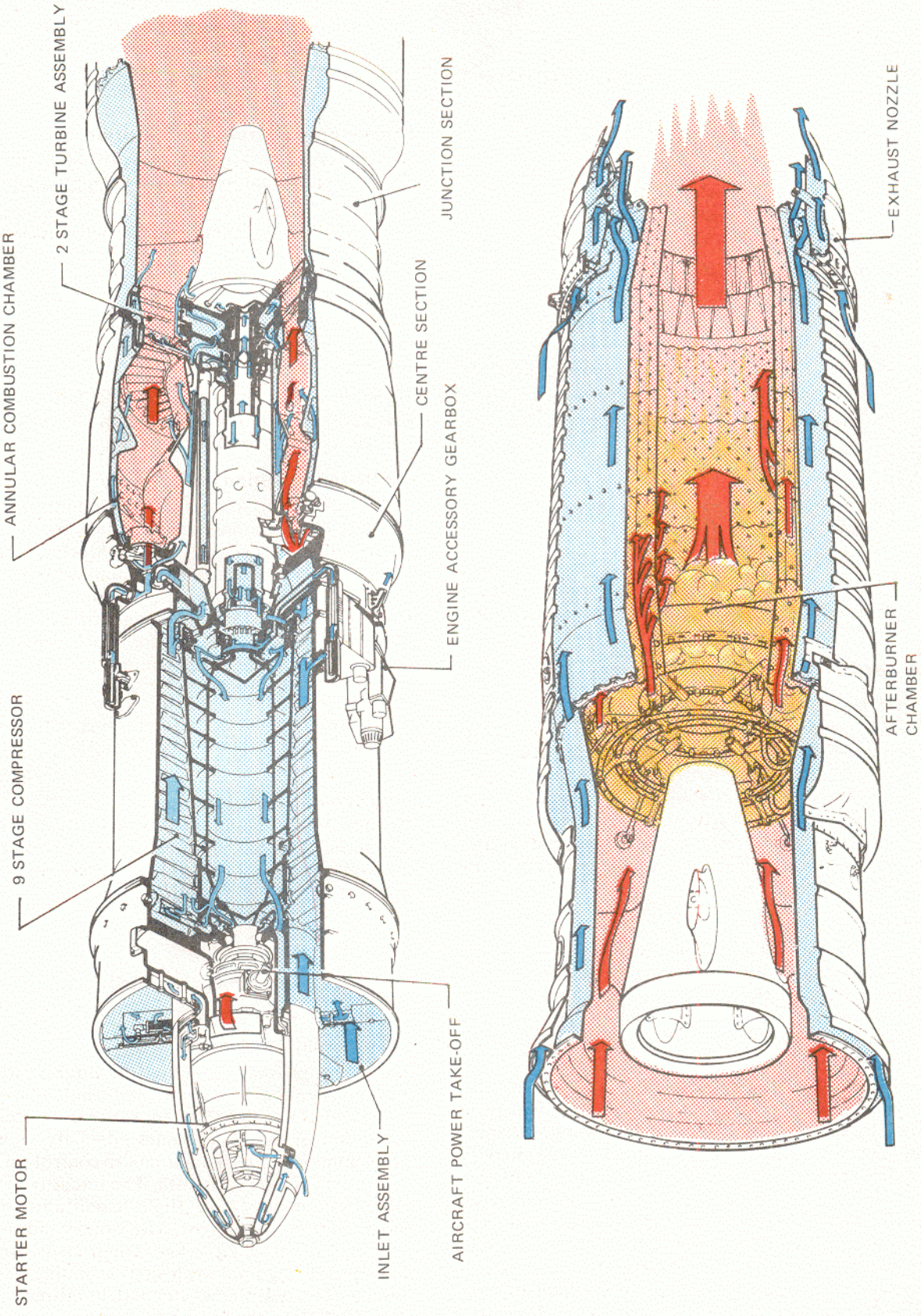


Figure 1-4

DRIVES AND GEARING

The kinematic gear train which drives the various accessories is driven from the front of the compressor shaft. A reduction gearbox is attached to the compressor shaft by a coupling shaft. The reduction gearbox drives the aircraft power take off (PTO) and the angle drive (refer to Fig 1-5).

Aircraft PTO

The aircraft PTO drives the aircraft gearbox through a telescopic drive shaft. The aircraft gearbox, which is located in the centre fuselage, drives the HYD 2 pump, the generator and the alternator.

Angle Drive and Engine Accessory Gearbox

The angle drive directly drives the HYD 1 pump, fuel dip speed detector, the 2000 RPM speed detector for engine starting, and the engine accessory gearbox drive shaft. The engine accessory gearbox drives :

a. the high pressure (HP) fuel pump,

b. the tachogenerator,

c. five oil pumps (two scavenge and one low pressure internal; one high pressure and one 'lost oil' external),

d. the stops corrector flyweights, and

e. the governor flyweights and the medium pressure oil pump inside the main fuel control unit.

AIR INTAKE DUCTS

Purpose of Air Intake Ducts

Engine performance directly depends upon the pressure of the air supplied to the engine. The purpose of the air intake is to decelerate free stream flow to the correct inlet velocity and to convert the kinetic energy to pressure energy with the minimum of losses. Air intake efficiency is measured by the pressure recovery, ie the ratio of inlet pressure to stagnation pressure.

Shock-cone Function

The Mirage air intake ducts include variable position shock-cones (MICE) to improve air intake efficiency in supersonic flight conditions (refer to Fig 1-6). With a pitot intake the pressure recovery across the normal shock wave is unity for speeds up to M1.4. The flow downstream of an oblique shock wave is supersonic for all Mach numbers, and the pressure recovery is unity up to M2.5. The flow downstream of a normal wave is always subsonic. For supersonic flight, a double shock wave system is required for best intake efficiency, with the oblique wave just on the intake lip and the normal wave at the throat of the intake duct. Penetration into the air duct of the oblique shock wave, or of the wave from the intersection of both shock waves, can provoke irregularities in the air intake operation which are evidenced as noises, vibrations, and buzz. These irregularities may cause compressor stall or even engine flame-out.

As the slope of the first shock wave decreases with the increase in Mach No, it is necessary to move the shock-cone forward. This operation is automatically achieved by slaving the shock-cone position to the Mach number, according to a predetermined law. The shock-cones start moving forward at M1.25 ±0.05 and are fully out at M2.6.

Shock-cone Control and Operation

The shock-cones are mechanically interconnected. They are activated by an electric motor supplied by the main DC bus.

When the MICE plunger on the left panel is in its normal position (in), command signals originating from the air data computer are fed to the electric motor through an amplifier supplied by the AC bus bar. The shock-cones are then slaved to the Mach number and automatically follow the law controlling their position.

If the shock-cone automatic control fails, the MICE plunger pops out. The shock-cones can then be controlled by using the MICE switch.

Shock-cone Position Indicator

Shock-cone position is shown by an indicator (refer to Fig 1-6) on the instrument panel. As the shock-cone position is only governed by Mach number, the indicator is graduated in Mach number. This allows the pilot to check the shock-cones for correct operation by comparing readings of the aircraft Machmeter with those of the shock-cone MACH meter. They should agree within ± 0.1 MN.

Note

During supersonic accelerations, check the shock-cone position regularly.

Aerodynamic Vibration

At high Mach number (above M1.6), aerodynamic vibration, evidenced as intake buzz, can occur in the air intake ducts. Factors which cause intake buzz are :

a. high incidence,

b. drop in engine RPM,

c. shock-cones too far retracted,

d. high ambient temperature, and

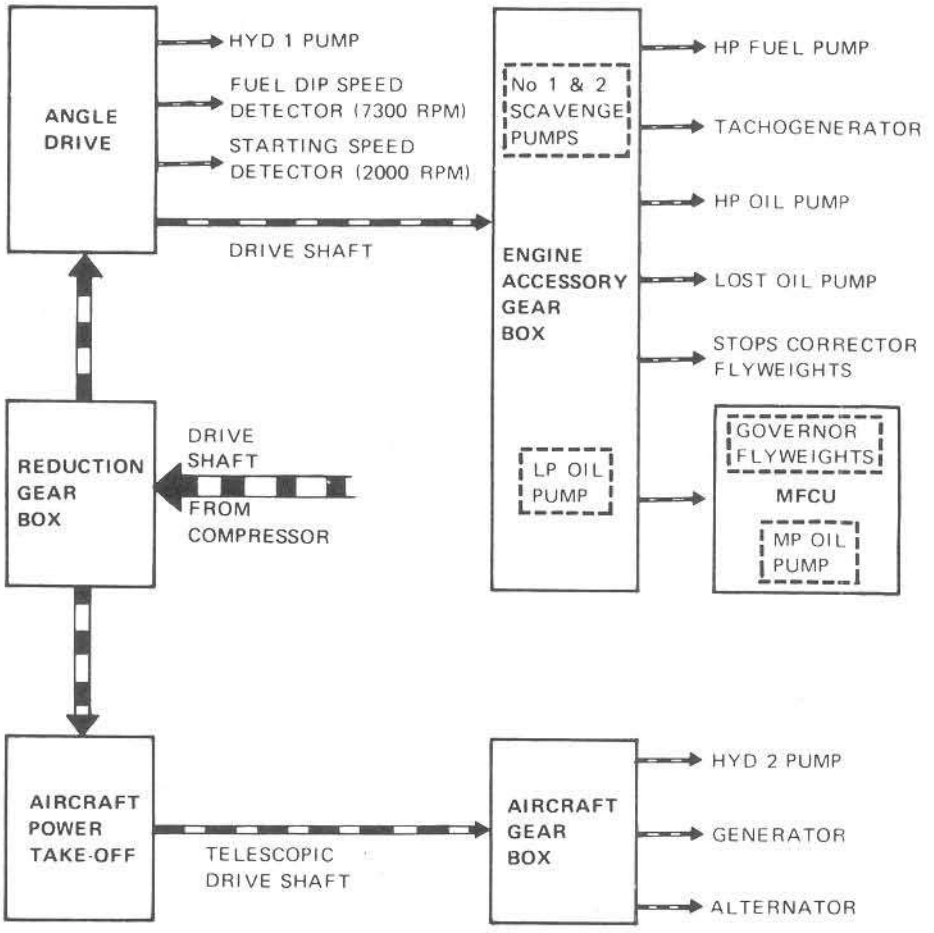
e. excessive sideslip.

The effect of intake buzz on the aircraft structure and the engine can be severe and can lead to engine flame-out. The most frequent cause is an accidental retraction of the shock-cones when flying at high Mach numbers after an automatic control failure or an air data computer failure. The intensity of the intake buzz depends on flight conditions and the shock-cone position error. The worst conditions are experienced at M2.0. The compressor suddenly stalls producing loud explosions sounding similar to gunfire. The A/B flames-out and, at altitudes higher than 50 000 ft, an engine flame-out can also occur.

At a constant high Mach number :

a. Reduction of A/B or cancelling A/B causes no

Drives and Gearing



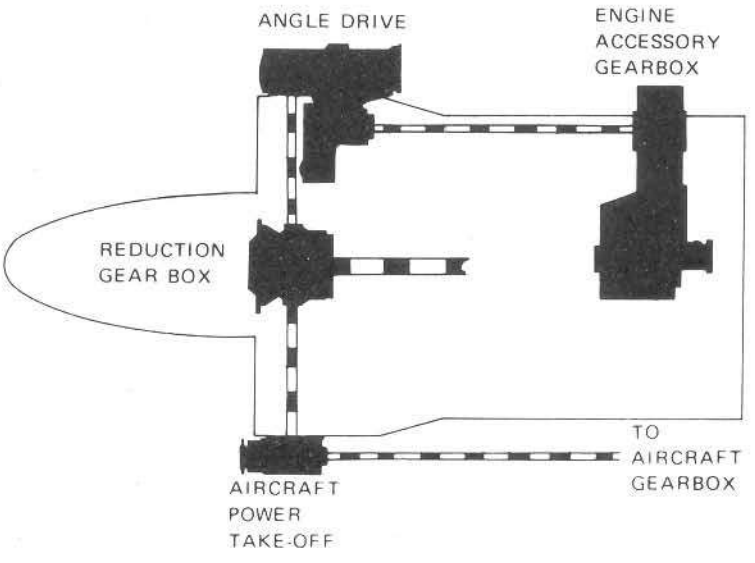
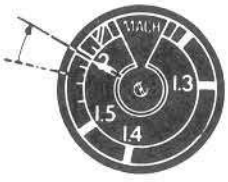


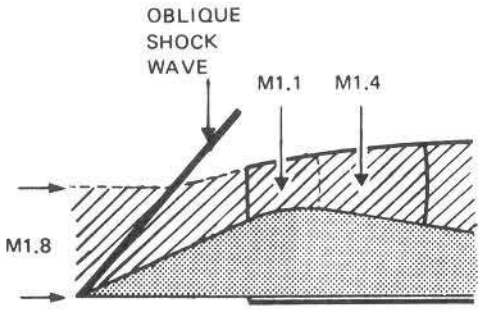
Figure 1-5

Shock-cone Influence with Stabilized RPM and Constant Mach No

SHOCK-CONE TOO FAR OUT



M2.0



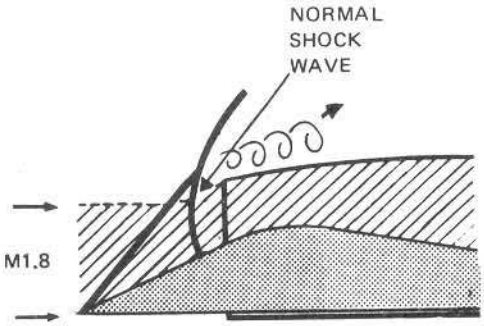
SHOCK-CONE

NOT DANGEROUS BUT SUDDEN DECREASE OF PERFORMANCE OF THE AIR INTAKE

NORMAL POSITION

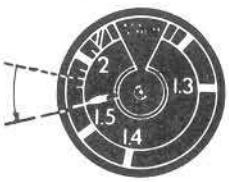


M1.8

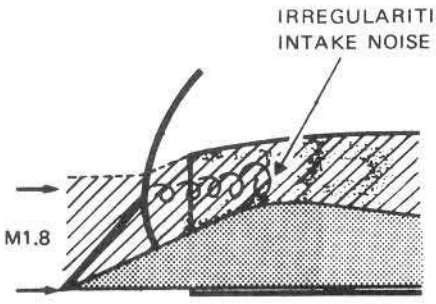


BEST PERFORMANCE

SHOCK-CONE TOO FAR IN



M1.6



DANGEROUS
STRONG VIBRATIONS
AND RISK OF FLAME OUT

Figure 1-6

variation in the engine airflow so air intake operation is not disturbed. When the Mach number decreases, the shock-cones should retract, otherwise intake performance is degraded. This state is not dangerous.

b. A large throttle reduction in the dry sector, reduces engine demand causing a sudden build up of pressure forward of the compressor. This can cause the intake doors to blow out.

AIR FLOW THROUGH THE ENGINE

The airflow through the engine can be divided into the following :

a. air flow from the intake to the combustion chamber,

b. gas flow from the combustion chamber to the efflux,

c. air used for heating, and

d. air used for cooling.

AIR FLOW

Air is passed to the compressor via the intake duct and the inlet guide vanes which direct the air at the correct angle to the compressor. Air is guided across the compressor by eight rows of stator blades.

GAS FLOW

Of the air delivered by the compressor, 25% is used for burning (primary air) and the remaining 75% (secondary air) is used to :

a. cool the combustion chamber walls,

b. cool the gases leaving the combustion chamber,

c. cool the No 2 and 3 engine bearings, and

d. effect anti-icing of the starter fairing, inlet guide vanes and air inlet casing spokes.

Gas temperature in the combustion chamber reaches 1500-1800°C. The turbine could not accept a gas flow at this temperature, so secondary air is mixed with primary air, at the rear of the combustion chamber, to reduce the gas flow temperature to an acceptable level. The gas flow passes through the turbine, through the junction section and into the A/B section where unburnt air may be used for A/B combustion.

ENGINE AIR USED FOR HEATING

Ninth stage air from the compressor is used to prevent icing of the inlet guide vanes, the starter fairing and the air inlet casing spokes.

ENGINE AIR USED FOR COOLING

Secondary air, mixed with primary air, is used for cooling the turbine blades. Secondary air is also used to cool the front and rear faces of the 1st stage turbine disc and the front face of the 2nd stage turbine disc. Seventh stage compressor air is used to cool No 2 and 3 bearings and the rear face of the 2nd stage turbine disc.

ENGINE FUEL CONTROL SYSTEM

The operation of the engine fuel control system is shown diagramatically at Fig FO 1-12.

LOW PRESSURE FUEL

Fuel is pumped to the engine by a boost pump located in each main fuselage tank. The pumps are turned on by selecting the two switches, marked L.P. PUMPS, on the left console to the ON (outboard) position. The fuel from the boost pumps joins a common line with fuel from the negative 'g' accumulator, and is fed to the main low pressure cock. The cock is operated by a switch, situated just forward of the L.P. pump switches. The switch is marked MAIN L.P. and guarded in the ON position. From the main low pressure cock, the fuel passes through the debitmeter and then to either the dry engine HP fuel pump or the A/B turbo pump. If the absolute pressure of the fuel entering the dry engine section is less than 69 kPa (10 psi), the FUEL warning light on the main failure panel illuminates.

HIGH PRESSURE PUMP AND MAIN FUEL CONTROL UNIT

Low pressure fuel enters the HP pump, passes through a filter and leaves the pump at a maximum pressure of 10 000 kPa (1450 psi). The fuel then passes to the MFCU which contains the following major components :

a. pressure regulation valve,

b. density corrector,

c. fuel metering valve containing the dozer,

d. collapsible coupling,

e. HP cock,

f. six-bar starting solenoid, and

g. 80-bar starting by-pass solenoid.

After leaving the MFCU via the HP cock, the fuel passes through the pressurization and dump valve to the burners.

PRESSURE REGULATION VALVE

The pressure regulation valve monitors fuel pressure both upstream and downstream of the dozer. It maintains a constant pressure drop of 345 kPa (50 psi) across the dozer and provides a fuel flow proportional to the dozer position.

DENSITY CORRECTOR

The density corrector is a variable spring-loaded orifice which can be manually altered to modify the pressure drop across the dozer. This device compensates for changes in fuel density.

FUEL METERING VALVE, DOZER AND COLLAPSIBLE COUPLING

The fuel metering valve contains a piston called the dozer which meters the amount of fuel being supplied to the engine. The operation of the collapsible coupling allows the temperature control unit to open

the nozzle flaps during slam accelerations or on A/B ignition.

HP COCK

The HP cock in the MFCU is opened when the throttle is moved from the stop position to the idle position. This allows fuel to flow to the engine via the pressurization and dump valve.

STARTING SOLENOID, SIX-BAR

The six-bar starting solenoid valve opens during the starting sequence, and allows fuel to flow to the two starting injectors before the high pressure cock is opened.

STARTING BY-PASS SOLENOID, 80-BAR

After the high pressure cock is opened, the by-pass solenoid allows a percentage of fuel to by-pass the main injectors and return to the inlet side of the HP pump. This prevents overfuelling during start, and is cut out at 2000 RPM as a function of starter speed detector operation.

Note

When this solenoid valve closes at approximately 2000 RPM the engine may resonate as the burners receive extra fuel.

PRESSURIZING AND DUMP VALVE

This valve divides the fuel flow to the pilot and main fuel manifolds. This enables fuel to be maintained at the burners at all altitudes and RPM settings. At low RPM (less than 4500 RPM) or high altitude (greater than 65 000 ft), only the pilot flow is operating. At high RPM, both the pilot flow and the main flow are operating. On engine shut down, this valve also dumps the fuel remaining in the pilot and main fuel lines.

ENGINE STARTING SYSTEM

The starter for the Mirage is a Noelle 002-01. The starter has a power output of 60 kW (80HP) and operates for a duration of 20-22 seconds. The components of the starting system (refer to Fig FO 1-13) are as follows:

a. the gas turbine,

b. the electric starting motor,

c. the starter fuel pump and 3-way solenoid valve,

d. the starter control box, located in the left wheel well, containing the 7.5 and 14 sec relays and control relays A, B and C,

e. a 2000 RPM start speed detector located in the right wheel well,

f. an ignition (Labavia) box, and

g. a starting fuel regulator located in the right side of the fuselage consisting of fuel and air pressure bellows and electrical contacts.

SYSTEM OPERATION

The starting cycle is illustrated at Fig FO 1-14. Correct control conditions for the starting cycle are established with the throttle at stop, the MAIN L.P. switch ON, the L.P. PUMPS switches ON, the ignition/ventilation switch to IGN and the STARTER CB in. When the START button on the left console is pressed, electrical power is supplied via relay A to the starter fuel pump, the 3-way solenoid valve and the 14 second safety relay.

The fuel pump should build up pressure in two seconds. When the fuel pressure reaches 148 kPa (21.6 psi), a pressure switch in the starter fuel regulator operates and the following occurs:

a. power is supplied through relay B to the:

   (1) starter ignition coil, and

   (2) electric starter motor (heard in the earphones),

b. power is supplied to the 7.5 second safety relay, and

c. power is removed from the 14 second safety relay.

On a cold start, the fuel pump operation may be faintly heard in the earphones. The fuel pump noise is not heard on a hot start because the noise of the electric starting motor which is much louder is also heard in the earphones when the START button is pressed. If pressure does not build up, the 14 second safety relay opens after 14 seconds and the starting cycle stops.

The air pressure in the starter combustion chamber (starter P2) reaches 34.5 kPa (5 psi) within 7.5 seconds and the starter gas turbine is now self-sustaining. The starter P2 operates a diaphragm in the starter fuel regulator which increases fuel pressure to the starter combustion chamber and activates a pressure switch which:

a. energizes Relay C which supplies power through the ignition relay to the:

   (1) six-bar starting solenoid valve to allow fuel into the main engine ignition pre-chambers,

   (2) Labavia box which supplies power to the main engine glow plugs in the ignition pre-chambers, and

   (3) red IGN light, and

b. supplies power to the 80-bar solenoid valve through relay C,

c. resupplies power to the 14 second safety relay,

d. removes power from relay B which deactivates the starter ignition coil and the electric starting motor, and

e. removes power from the 7.5 second safety relay.

Note

If starter P2 does not reach 34.5 kPa (5 psi) in 7.5 seconds, the 7.5 second safety relay stops the starting cycle.

After 6-8 seconds or 200-400 RPM the fuel is alight in the main engine ignition pre-chambers and a hot streak is projected across four of the burners.

At 600-800 RPM, the throttle is opened to the idle position and fuel for engine combustion flows to the burners via the HP cock in the MFCU. EGT (T4) rises at about 1200 RPM. At 2000 RPM :

a. the 2000 RPM speed start detector opens the starting circuit and the cycle shuts down, and

b. the 80-bar solenoid valve closes and idle fuel flow is delivered to the burners. This may cause the engine to resonate. From 2000 RPM, the engine accelerates to idle under its own power.

Note

If engine ignition does not take place, the 14 second safety relay stops the starting cycle after a total elapsed time of 20-22 seconds.

VENTILATION

A dry ventilation may be necessary after a false start to remove excess fuel from the engine. The procedure is the same as for a normal start, except for the following :

a. the ignition/ventilation switch is placed in the VENTIL position; this cuts both the fuel supply to the starting injectors and power supply to the glow plugs.

b. The throttle lever remains at stop.

c. The starter motor operates and engine speed builds up to 1200-1500 RPM then drops back to zero.

CAUTION

- Only three consecutive engine start attempts, or starts, are allowed after which 30 minutes must elapse to allow the starter motor to cool.
- A start attempt is to be considered as any impulse causing operation of the starter control box, ie fuel pump or electric motor operation. At this stage, fuel is injected to the starter motor combustion chamber and further attempts may result in a starter motor fire.
- If RPM exceeds 250, a further start attempt is to be delayed until the RPM falls below 250. If the RPM does not exceed 250, a further start may be attempted immediately.
- If the electric starting motor is still operating (buzz in the earphones) after about 10 seconds, the START CB is to be pulled. If the electric starting motor still continues to run, the starter control box in the left wheel well must be disconnected as soon as possible.

Note

- The electric starting motor is powered directly from the battery bus whether external power is connected or not. When external DC power is connected, the starter control box is powered through the main DC bus. Hence, if external power is suspect, it should be disconnected and a battery start carried out.
- If the start sequence stops on releasing the START button, the hold-in relay is unserviceable. An engine start may be accomplished by holding the START button down for the duration of the start cycle, ie for about 22 seconds.

RELIGHT SYSTEM

The RELIGHT switch is located on the throttle quadrant and is safety-wired in the off (rear) position. With the RELIGHT switch on :

a. electrical power is supplied to the Labavia box which energises the main engine glow plugs (igniters),

b. the six-bar starting solenoid is activated to allow fuel into the ignition pre-chambers, and

c. the red IGN light illuminates indicating that the ignition circuits have been energised.

CAUTION

As soon as the engine relights, select the RELIGHT switch off to avoid burning out the glow plugs. The glow plugs must be switched off after 30 seconds to allow the carbon electrodes to cool.

MAIN FUEL CONTROL UNIT OPERATION

Fuel is metered to the engine by the dozer. To control this flow under changing flight conditions and engine acceleration and deceleration, three devices are used. These devices are part of the MFCU (refer to Fig FO 1-15) and are the governor unit, temperature control unit and acceleration control unit.

GOVERNOR UNIT

The governor unit maintains a constant RPM value for a given throttle setting. Once a throttle position is set, rotating flyweights detect any change in RPM and adjust the position of the fuel dozer through the dozer servo to maintain the desired RPM. Governor control of the dozer's position may be modified directly by the acceleration control unit through the double stop bridge or indirectly by the temperature control unit.

TEMPERATURE CONTROL UNIT

The temperature control unit controls the position

of the nozzle flaps to maintain a constant T4 for a given throttle setting as altitude and airspeed vary. It also controls nozzle flap opening during slam accelerations and A/B ignition. The unit consists of the temperature control bellows, temperature control servo and the nozzle jack control valve. The bellows, which is acted upon by P1 and modified P2 air from the P2 pressure reducer, controls the temperature control servo. The temperature control servo positions the nozzle jack control valve. Nozzle jack control valve movement results from a combination of dozer displacement acting through the three in one lever and the expansion or contraction of the temperature control bellows. The dozer acts directly on the temperature control unit but the temperature control unit cannot act directly on the dozer. The temperature control unit affects the dozer position indirectly through variations in nozzle area, engine speed and governor response. During a climb, the temperature control bellows contract, the nozzle flaps open and P4 decreases. Engine speed tends to increase and governor response moves the dozer to reduce fuel flow and hence T4 remains constant.

ACCELERATION CONTROL UNIT

The acceleration control unit prevents over or underfuelling during engine acceleration or deceleration at all altitudes, thus preventing engine flame out due to rich or lean extinction. The unit consists of the double stop bellows, the double stop servo and the double stop bridge. Modified P2 air from the stops corrector expands or contracts the bellows. During acceleration, the dozer moves to provide more fuel until the double stop bridge contacts the maximum stop. As P2 air increases, the bellows contracts and the bridge rotates about the maximum stop allowing further dozer movement. During deceleration, the bridge contacts the minimum stop and the reverse occurs.

NOZZLE FLAP OPERATION IN DRY ENGINE

The nozzle flaps are ultimately controlled by the temperature control unit. However, on a slam acceleration or on A/B ignition the temperature control operation is modified by the acceleration control unit through the collapsible coupling.

Acceleration

Below about 7300 RPM the nozzle flaps are kept open regardless of external conditions.

At about 7300 RPM on a normal acceleration, modified P2 air from the P2 pressure reducer is supplied to the inside of the temperature control bellows. The bellows progressively expand thus closing the nozzle flaps.

Rapid Acceleration

During rapid acceleration, the dozer is displaced until the double stop bridge contacts the maximum stop. The dozer servo continues to move and the collapsible coupling collapses. The three in one lever follows the movement of the dozer servo and the nozzle flaps are opened by the temperature control unit. At about 8100 RPM, modified P2 air from the stops corrector contracts the double stop bellows, the double stop bridge rotates about the maximum stop allowing further dozer movement. The collapsible coupling progressively recovers under its spring action thus closing the nozzle flaps.

Deceleration

During either fast or slow deceleration, modified P2 air is mechanically dumped by the P2 pressure reducer as the throttle is closed. The nozzle flaps progressively open, reaching the fully open position at about 7000 RPM.

NOZZLE FLAP OPERATION IN A/B

When the A/B is lit, P4 increases causing a RPM drop. The governor senses the RPM drop and the dozer is displaced until the double stop bridge contacts the maximum stop. The dozer servo continues to move, compressing the collapsible coupling. The resultant movement of the three in one lever moves the temperature control unit thus opening the nozzle flaps. The increased nozzle area causes P4 to reduce; RPM increases and the governor displaces the dozer servo and the dozer moves to prevent overspeed. The dozer servo displacement allows the collapsible coupling to expand to its full extent and the double stop bridge then moves off the maximum stop. The temperature control unit adjusts the nozzles, restoring P4 to its original value and engine speed stabilizes. The nozzles now operate about a mean position close to the fully open position. A sudden change from mini burner to max burner also results in rapid opening of the nozzle flaps.

EMERGENCY FUEL REGULATION

The Atar 9C5 engine is provided with an emergency system of throttle control (refer to Fig FO 1-15) which enables the pilot to control the engine RPM with an electrically operated EMERGENCY THROTTLE in cases of:

a. oil failure,

b. mechanical linkage failure, and

c. main fuel control unit failure.

As well as enabling the pilot to regain control of RPM, the system incorporates a 3.4 litre (6 pint) emergency oil tank and a pump which, when selected, supplies about 20 minutes of oil to the No 1 engine bearing in the event of an oil failure.

[D] The EMERGENCY THROTTLE and the EMG OIL PUMP switches are fitted in the front cockpit only.

Operation

Emergency regulation of the engine is achieved by turning on the emergency oil pump switch (marked

EMG OIL PUMP) located on the left console in front of the throttle, and setting the engine RPM by operating the EMERGENCY THROTTLE.

The EMERGENCY THROTTLE, located on the left cockpit wall above the normal throttle, is a three position switch spring-loaded to neutral.

When the pilot selects the EMG OIL PUMP switch ON:

a. the emergency oil pump supplies oil to the No 1 bearing, providing about 20 minutes of lubrication if the OIL failure light is illuminated,

b. power is supplied to the EMERGENCY THROTTLE, and

c. the air pressure to the temperature control bellows is dumped by the discharge solenoid valve. The temperature control unit then initiates opening of the nozzle flaps to the fully open position.

The EMERGENCY THROTTLE controls an actuator on the main fuel control unit which moves the dozer and thus controls fuel flow to the engine. A spring returns the dozer to the idle position. The EMERGENCY THROTTLE operates in the same sense as a normal throttle; pushing the switch forwards increases RPM and pulling it rearwards decreases RPM. When the switch is released, it maintains the neutral position and the metering dozer holds its position.

Note

The emergency throttle electric actuator takes about six seconds to travel from idle to full dry.

When the EMG OIL PUMP switch is ON, the nozzle flaps are fully open. Therefore, EGT(T4) remains low (less than 550°C) and RPM can be increased to 9000 depending on speed and altitude. RPM is to be constantly monitored during maneouvres because the governor and the temperature and acceleration control units are by-passed.

If the MFCU electric actuator is left in an intermediate position and the EMG OIL PUMP switch is OFF, the RPM is controlled by the throttle only above a minimum engine speed, depending on the position of the electric actuator. Therefore, the electric actuator must be returned to idle before turning off the EMG OIL PUMP switch. If the electric actuator is not in the idle position when the engine is started, the fuel flow will be too great, extensive overheating will occur and the idle RPM will exceed 3000.

CAUTION

Before starting, check that the EMG OIL PUMP switch is safety-wired down. Do not attempt to start the engine if the safety-wire is broken.

Within the range of normal operating speeds, engine handling with emergency control presents no major difficulties. The accuracy of dozer control varies with:

a. the duration of EMERGENCY THROTTLE actuation;

b. the engine speed at the moment of actuation (less accuracy when RPM is lower);

c. the type of failure (inaccuracy is higher for oil system failure; about 350 RPM at engine speed 8400 RPM); and

d. ambient conditions.

In certain cases, with the EMERGENCY THROTTLE selected and the acceleration control unit inoperative, the resultant incorrect minimum stop position may allow the dozer to be incorrectly displaced. The incorrect dozer position may result in flow rates lower than that for normal idling leading to lean flame-out. Overfuelling may occur during a continuous engine acceleration, when the initial engine speed is less than 7000 RPM. Overfuelling may lead to a flame-out due to rich extinction especially as altitude increases above 4000 ft. Therefore avoid using engine speeds lower than 7000 RPM and:

a. above 4000 ft, actuate the EMERGENCY THROTTLE briefly and wait for RPM to stabilize before actuating again; and

b. below 4000 ft, continuous actuation of the EMERGENCY THROTTLE is permissible if engine speed is greater than 7000 RPM.

Note

In the case of an oil failure, operation of the emergency system will not extinguish the OIL warning light.

Training Exercises

During specially authorized training flights, the EMG OIL PUMP switch can be turned on and operation of the EMERGENCY THROTTLE can be practised. The failure can be simulated as follows:

a. enter the operating envelope and set the throttle to idle;

b. select the EMG OIL PUMP switch ON;

c. control the RPM with the EMERGENCY THROTTLE switch;

d. when the exercise is finished set the engine RPM to idle with the EMERGENCY THROTTLE. Hold the EMERGENCY THROTTLE in the CLOSE position for ten seconds to ensure that the actuator is in the closed position; and

e. select the EMG OIL PUMP switch OFF and check for normal operation of the throttle.

CAUTION

It is important that the metering dozer is returned to the idle position. If, when checking the normal operation of the throttle, the idle RPM is higher than normal, select the EMG OIL PUMP switch on and hold the EMERGENCY THROTTLE switch in the CLOSE position for a further ten seconds.

ENGINE OVERSPEED CONTROL

Note

With overspeed in operation, both engine life and stall margins are reduced. For peacetime operations, manual selection of overspeed is restricted to take-off only.

Operation Below 30 000 Feet

Below 30 000 ft overspeed may be selected by pressing the plunger (marked OVERSPEED) located on the right side of the instrument panel. Overspeed will not engage until the throttle is advanced through the 85% A/B position and the temperature at the impact probe is 27 + 2°C or higher. When overspeed engages, the overspeed light located above the OVERSPEED plunger illuminates and the plunger pops out. The RPM increases to 8710 + 50 and the EGT(T4) may increase to 760°C. Overspeed lasts for one minute.

Operation Above 30 000 Feet

At or above 30 000 ft, whenever the impact probe temperature reaches 27°C and the RPM is above 8100, the overspeed is engaged. If the impact temperature is 27°C or above and the RPM is less than 8100, the overspeed is not engaged but the overspeed light illuminates. This light remains illuminated until the impact temperature is below 27°C.

Component Operation

The system (refer to Fig FO 1-12 and 1-15) is operated by high pressure oil. On command from the air data computer, when the predetermined impact temperature, throttle position and altitude conditions are met, the overspeed solenoid valve opens allowing high pressure oil to act on the overspeed piston. The piston repositions the speed selector shaft increasing the spring tension opposing the governor flyweights. The maximum regulated engine speed is increased and more thrust is obtained.

APPROACH CONTROL

The approach control system (refer to Fig FO 1-15) modifies engine thrust, at a fixed RPM setting, to maintain a constant approach speed of 190 KIAS. The system reduces pilot workload during final approach when the aircraft is operating in the area of speed instability where excessive power changes may be required. Basic instrument approaches are not changed. Approach control is operated by lifting the approach control lever marked APPR CONT on the side of the throttle quadrant.

[D] The APPR CONT lever is fitted in the front cockpit only.

The working components are the :

a. approach control regulator,

b. approach control solenoid valve, and

c. temperature control unit in the MFCU.

Approach Control Regulator

A bellows within the approach control regulator takes pitot pressure from the probe on the right side of the nose and static pressure from a source near the nozzle flaps and operates in the same way as an ASI. This bellows regulates the amount of P2 air which is allowed to act on the temperature control unit.

Approach Control Solenoid Valve

Without approach control selected, normal controlling P2 air is allowed to act on the temperature control unit, through the P2 reducer. When the approach control solenoid valve operates, it allows only P2 air modified by the approach control regulator to act on the temperature control unit.

Temperature Control Unit

P2 air, modified by the pitot input to the approach control regulator is supplied to the temperature control bellows. If IAS decreases below that demanded by the approach control regulator, less P2 air is supplied to the bellows and the nozzle flaps close. Thrust and T4 are increased and the aircraft accelerates to the correct speed.

Operation

Approach control may be used during instrument approaches. The system is operated as follows :

a. stabilize the aircraft in the appropriate instrument approach configuration with the speed between 200 and 240 KIAS;

b. at one NM prior to descent, set 7500 RPM and lift the APPR CONT lever up;

c. monitor the IAS and note that it stabilizes at a mean value of 190 + 2 knots; operation of the approach control system is indicated by an increase in T4;

d. to maintain approach speed, make smooth adjustments to the throttle within the range 7400-7600 RPM when compensating for aircraft weight or altitude variations;

e. at break-off, manually disengage the APPR CONT lever and revert to normal operation of the throttle;

f. if a full stop landing is planned, complete the approach and touch down with approach control engaged; use small throttle movements;

Aircraft Ground Running Danger Areas

1. Engine intake Danger Area 25 feet
2. Engine exhaust Danger Area at idle 100 feet.
3. Engine exhaust Danger Area without afterburner 200 feet
4. Engine exhaust Danger Area with afterburner 400 feet

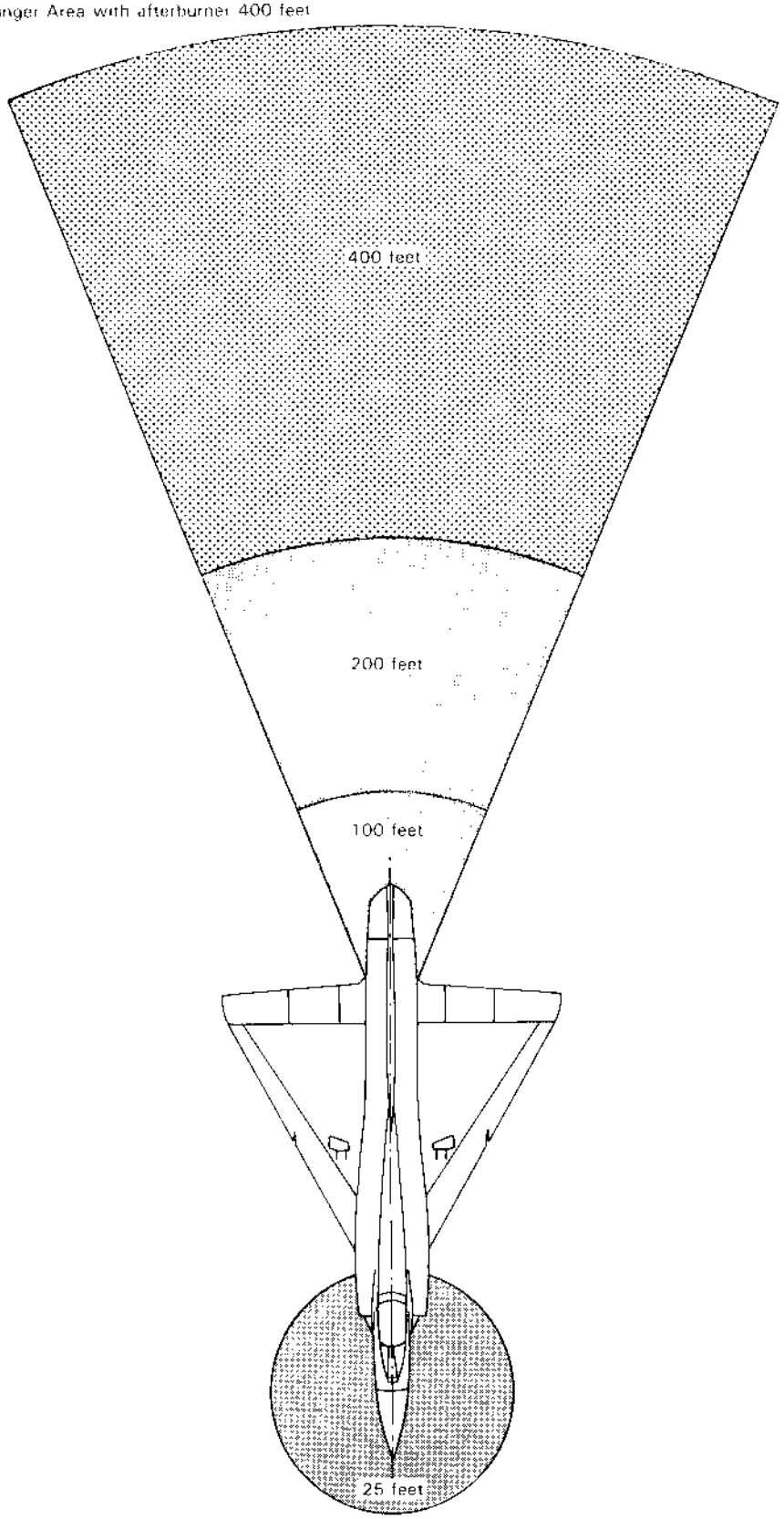


Figure 1-6A

RAAF SUPPLEMENT NO 67

MIRAGE

FUEL DIP FOR MATRA R550

Instructions

This supplement is to be inserted facing Page 1-19.

Information

The existing fuel dip system for the MATRA R530 is utilized for the MATRA R550 missile.

Action

Read the following for Mirage R550 operations:

During launch of the MATRA R550 missile, the fuel dip will operate for a period of three seconds.

Date: DEC85

g. if the full stop landing is converted to an overshoot/touch and go, manually disengage the approach control before advancing the throttle.

WARNING

- A faulty APPR CONT lever may not fully disengage automatically as the throttle is advanced. This causes a thrust loss during take-off/overshoot as the approach control operating speed is reached.
- Failure to disengage the APPR CONT lever before advancing the throttle may result in an engine surge as the engine accelerates with the nozzle flaps closed.
- Operation of the approach control at low IAS may result in an engine surge. If the approach control system does not operate, as indicated by T4 rise and speed stabilization, before 180 KIAS is reached, it is to be manually disengaged and normal throttle control resumed.

Note

- When RPM is reduced to achieve the desired threshold speed, the approach control system continues to close the nozzle flaps in an attempt to maintain 190 KIAS. Dependent upon throttle handling, the nozzle flap closing may result in less aircraft deceleration than expected during flare and landing.
- In tropical areas, the approach control is calibrated and flight tested at 7600 RPM.

FUEL DIPPER

The fuel dipper prevents compressor surge and possible flame out when either the guns or the Matra missiles are fired. The surge is caused by ingestion of burnt gases. The fuel dipper consists of two systems (refer to Fig FO 1-12):

a. A fuel by-pass between the MFCU and the dry engine burner rings. Fuel flow along this by-pass is regulated by a solenoid valve.

b. An electrical circuit controlling the solenoid valve including a timer.

Operation

When the trigger is depressed, a delay unit holds the fuel dipper solenoid valve open for 0.8 ± 0.2 seconds after the trigger is first depressed or, if the trigger is depressed for longer than this period, until the trigger is released. A speed detector limits any decrease in RPM to a minimum of 7300 RPM. During launch of a Matra R550 missile, the fuel dip operates for a period of 3 seconds.

Fuel Dipper Malfunction

If the fuel dipper continues to operate after the trigger is released, the engine exhibits the following symptoms:

a. ***Max A/B Selected.*** Below 7000 ft with max A/B selected, RPM is governed RPM and EGT(T4) is about 80 °C below normal EGT(T4) for the RPM achieved. Above 7000 ft, RPM and EGT(T4) reduce until the speed detector operates at 7300 RPM. This causes RPM to oscillate between 7300 and 7600.

b. ***Max Dry Selected.*** EGT(T4) is about 200 °C below normal EGT(T4) for the RPM achieved. Max dry RPM is maintained up to about 20 000 ft depending on aircraft speed. Above 20 000 ft, RPM drops steadily until the 7300 RPM cut-out is reached when RPM oscillates between about 7300 and 7600 RPM. This occurs at about 38 000 to 46 000 ft.

AFTERBURNER

The major components of the afterburner (A/B) system (refer to Fig FO 1-12) are the :

a. Teddington valve,

b. A/B turbo pump,

c. A/B fuel control unit,

d. A/B fuel pressurizing and dump valve,

e. A/B ignition solenoid valve and pressure switch,

f. A/B ignition injector, and

g. ionization probe and circuitry.

The indicators and controls located in the cockpit are the :

a. A/B injection warning light,

b. A/B ON warning light,

c. A/B emergency button,

d. throttle, and

e. A/B cock.

A/B FUEL SYSTEM MECHANICAL COMPONENTS

A/B Cock

The A/B cock is an electro-cock which controls the fuel supply to the A/B system (refer to Fig FO 1-12). The A/B cock switch is normally in the ON position but should be selected OFF after an A/B failure, in the event of an A/B fire or where the normal means of deselection has failed.

Teddington Valve

When the throttle is selected to mini burner, a microswitch is activated and this opens the Teddington valve, which allows P2 air to drive the turbo pump.

A/B Turbo Pump

The centrifugal type A/B turbo pump is located in the engine bay and is driven by P2 air. The pump, which is downstream of the A/B cock, pumps fuel to the A/B fuel control unit.

A/B Fuel Control Unit

The A/B fuel control unit meters fuel flow to the A/B manifolds and burner rings. This flow depends on the throttle position and is corrected for altitude and Mach Number.

A/B Pressurizing and Dump Valve

This valve receives metered fuel from the A/B fuel control unit and distributes it to the A/B manifolds and burner rings, thus achieving even burning.

A/B FUEL SYSTEM ELECTRICAL COMPONENTS

A/B Ignition Solenoid Valve

When A/B is selected, the A/B ignition solenoid valve opens. This directs fuel, tapped from the turbo pump outlet, to the A/B injector. A pressure switch is activated and the red A/B INJ light illuminates. The fuel from the injector ignites and a hot streak passes through the turbine, igniting the fuel entering the A/B chamber from the fuel manifolds.

Ionization Probe

A/B light up is detected by the ionization probe which acts as a flame detector. The electrical current contained in one electrode cannot flow to earth unless a flame occurs; the flame is ionized and therefore electro-conductive. This transmits a signal to the A/B amplifier which causes :

a. the A/B ignition solenoid valve to close,

b. the red A/B INJ light to extinguish, and

c. the amber A/B ON light to illuminate.

A/B ignition immediately causes a pressure rise in the jet pipe; this is a back pressure on the turbine which causes a slight decrease in RPM. The MFCU senses the RPM drop and opens the nozzle flaps to restore engine speed. The RPM swing does not normally exceed ± 250 RPM, but near the edge of the flight envelope larger swings may occur.

CAUTION

If the red A/B INJ warning light does not extinguish after 10 seconds, cancel the A/B as there is a risk of damage to the turbine.

A/B IGNITION

At 35 000 ft or above, the A/B should not be ignited or operated below 250 KIAS. If the A/B is engaged and the IAS is less than 250 kn, the IAS must be increased to above 250 kn before disengaging the A/B. Below 35 000 ft, the A/B should not be ignited or operated below 150 KIAS.

If the A/B is operated outside its flight envelope it may flame-out. When a flame-out occurs, the amber A/B ON light extinguishes and the red A/B INJ light illuminates. In all cases of A/B flame-out, the throttle is to be selected to the dry sector.

WARNING

- Before moving the throttle from the mini A/B position towards max A/B, pause until the RPM stabilizes.
- If the throttle is advanced towards max A/B before the engine speed stabilizes, a compressor stall is possible.

EMERGENCY IGNITION

AC power is requried for normal A/B ignition because the ionization probe uses AC power. The A/B can be lit when there is no AC power by setting the throttle to mini burner and pressing the emergency injection (A/B EMERG) button (refer to Fig FO 1-12). The red A/B INJ warning light illuminates but the pilot must ensure that A/B ignition is felt. He then releases the A/B EMERG button. The amber A/B ON light does not illuminate.

ENGINE CONTROL

NORMAL CONTROL

Normal control is achieved by operating the throttle lever which is located on the left console. The throttle can be moved in two sectors (refer to Fig 1-7). These are the dry sector and the A/B sector.

DRY SECTOR

Idle Stop

With the throttle in the rearmost position, the HP cock is closed and fuel is cut off from the engine. When the engine is started, the throttle is advanced slightly so that it passes the idle stop position and then moved back until it rests on the stop. With the throttle on this position the engine is at idle. To shut the engine down, the idle stop must be released by moving the small red lever on the throttle quadrant to the rear and then moving the throttle fully to the rear. The engine normally takes about 25 to 30 seconds to run down. The run-down must be timed and noted in the Form EE500.

[D] The rear cockpit has no idle stop lever on the throttle quadrant.

Throttle Positions

The following sequence occurs as the throttle is advanced from idle :

a. at about 7300 RPM on a slow acceleration the nozzle flaps begin to close,

b. at 8000 RPM :

(1) a microswitch operates, cutting out operation of the undercarriage flasher, and

(2) a microswitch operates and available braking pressure to the wheels is increased (second braking pressure), and

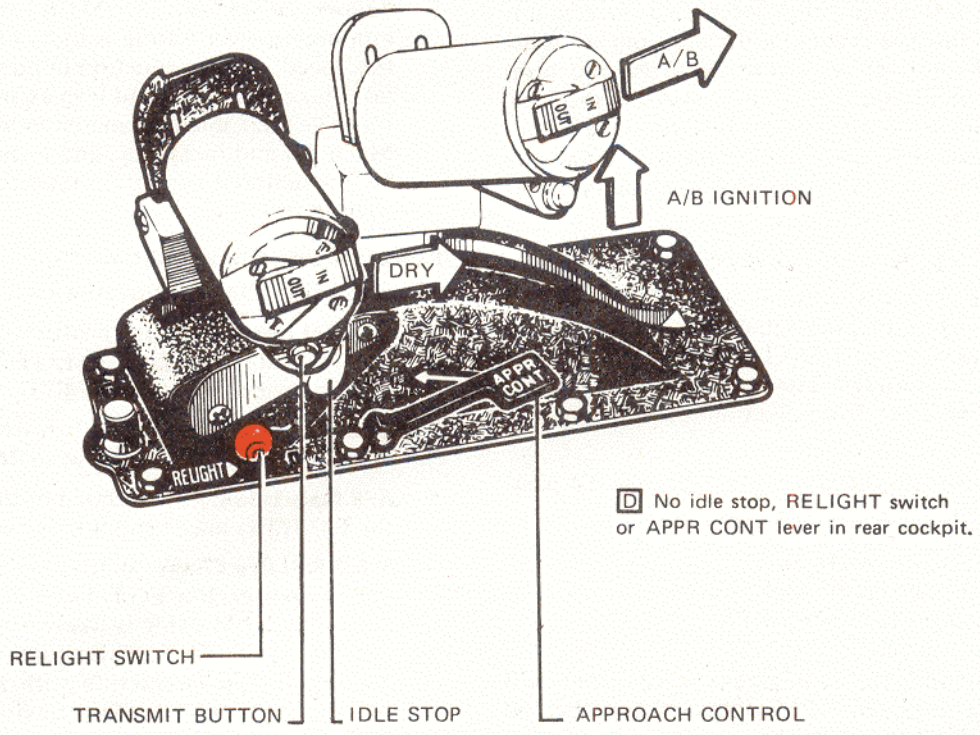
(3) a microswitch operates to electrically isolate the approach control to prevent inadvertent selection above this RPM figure, and

c. at 8100 RPM :

(1) the overspeed oil supply is mechanically opened, and

(2) the approach control system, if selected, is mechanically cut out.

Throttle Lever Operation



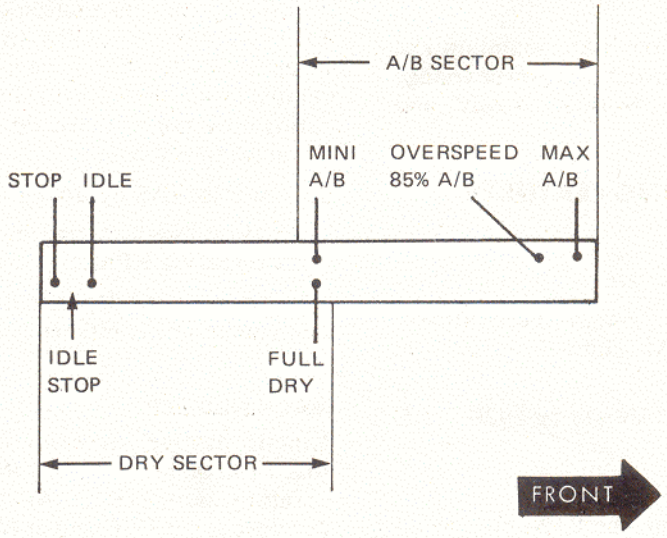


Figure 1-7

When the throttle has reached the end of its travel in the dry sector, it is in the full dry position.

A/B SECTOR

The throttle is moved into the A/B sector by advancing it to the full dry position and tilting the grip upwards. The throttle is then in the mini burner position. As the throttle is advanced from the mini burner position it operates a microswitch at the 85% A/B position. This microswitch must be made before the overspeed will operate on take-off. When the throttle reaches the end of its travel in the A/B sector, it is in the max burner position.

ENGINE HANDLING - SURGE AVOIDANCE

The ATAR 9C5 engine may surge if mishandled under conditions of high incidence and/or yaw at airspeeds below about 300 KIAS. It is more likely to surge at high altitudes. The engine may also surge during A/B ignition or deselection. To avoid engine surge :

a. ensure that the RPM is stabilized with T4 passing 600°C before lighting the A/B;

Note

Under conditions of high 'g', engine speed may be lower than 8460 RPM.

b. after lighting the A/B, pause in the mini A/B position until the RPM stabilizes and the red A/B INJ light extinguishes.

WARNING

Do not select or deselect A/B with the RPM swinging.

c. at high incidence and low IAS, maintain the aircraft in balanced flight and, if a power change is essential, move the throttle slowly and smoothly.

NORMAL OPERATING FEATURES

RPM

The normal RPM indications are :

a. ***Full Dry RPM.*** At full dry power and in all sectors of A/B the RPM should remain at 8460 ± 50 RPM.

b. ***Idle RPM.*** The idle RPM should be 2920 ± 100 RPM.

Note

- When the engine is started, the RPM may be lower than 2820. This is normal and should rectify itself within 5-6 minutes of starting.
- If the idle RPM is above 3020, check that the EMERGENCY THROTTLE is at its rearwards limit.

c. ***A/B Selection.*** On selecting A/B the RPM normally swings less than ± 250 RPM.

d. ***Overspeed Operation.*** When overspeed operates, the RPM should increase to 8710 ± 50 RPM.

e. ***Power at M1.6.*** At M1.6 or above, the minimum power setting is to be full dry. Above this speed, with a reduction in power setting, intake buzz may occur and lean extinction is possible. The buzz intensity increases with increasing Mach No and incidence, and a slight noise may be encountered in the air intakes during turns even at full dry.

EXHAUST GAS TEMPERATURE (T4)

The normal EGT(T4) indications are :

a. ***Normal operation.*** In throttle sectors between full dry and max burner the EGT(T4) should remain between 680°C and 740°C.

b. ***Overspeed Operation.*** When overspeed operates, EGT(T4) may increase to 760°C.

c. ***A/B Operation.*** On selecting or increasing A/B, the EGT(T4) may temporarily rise to 780°C.

d. ***M0.9 Full Dry Climb.*** When climbing at M0.9 at full dry power, low EGT(T4) sometimes accompanied by RPM swing is likely to occur between 25 000 and 40 000 ft. This situation is related to maximum stop interaction with governor control causing operation of the flexible coupling. It depends on ambient conditions and is normally more prevalent at high altitudes.

CONTINUOUS HUNTING OF RPM AND EGT(T4)

When operating at high altitude and low IAS at full dry or full A/B throttle position, a continuous hunting of RPM and EGT(T4) indications may be noted. At full dry, this fluctuation may attain ± 10 degrees EGT(T4) and ± 60 RPM. In full A/B, an RPM drop of up to 200 RPM may be noted. This RPM drop is related to almost fully open nozzle flaps. The engine rating must not be allowed to drop below this value. To accomplish this :

a. increase IAS by diving the aircraft, and

b. reduce engine rating by cancelling A/B and/or decreasing RPM.

These events are dependent on ambient conditions and engine intake efficiency and may not always occur.

MACH NUMBER

Kinetic heating increases with aircraft speed. At M2.0 (36 000 ft, − 56°C) the fuselage impact temperature is + 118°C. At M2.1 the impact temperature is + 137°C and at M2.2 it reaches + 155°C. These temperatures also occur at the front rows of the engine compressor blades. When operating at high impact temperatures at speeds in excess of M2.0, the following engine problems occur :

a. the No 2 and No 3 engine bearings, which are cooled by 7th stage compressor air, overheat; and

b. the compressor blades creep. Any creep is additive to previous creep and after a time the compressor tolerances will be exceeded. The estimated engine life at M2.0 is 10 hours and at M2.2 is 30 minutes.

CAUTION

The aircraft is limited to M2.0 or the illumination of the MACH warning light, whichever occurs first.

ENGINE MONITORING DEVICES

The engine monitoring devices consist of the following :

a. ***RPM Indicator.*** The RPM indicator (refer to Fig 1-8) is a two-needle instrument driven by a tachogenerator mounted on the engine accessory gear box.

RPM Indicator



Figure 1-8

b. ***EGT(T4) Indicator.*** Four thermocouples measure temperature at the turbine outlet (T4) and position a single needle on the EGT(T4) indicator (refer to Fig 1-9) graduated from 0°C to 1000°C.

c. ***Oil Warning Light.*** The OIL warning light is on the centre column of the main fail panel.

d. ***Fuel Warning Light.*** The FUEL warning light is located on the left column of the main fail panel.

EGT (T4) Indicator



Figure 1-9

e. ***A/B Injection Light.*** The red A/B INJ light is on the right side of the instrument panel. It illuminates for 1-2 seconds during A/B light up.

f. ***A/B On Light.*** The amber A/B ON light illuminates when the A/B is operating. It is located beside the A/B INJ light.

g. ***Ignition Light.*** The red IGN light illuminates during engine starting or relight to indicate that the ignition circuits are energised.

ENGINE OIL SYSTEM

Synthetic type oil is fed from a 9 litre (2 gal) main tank to the engine via low, medium and high pressure sub-systems to provide lubrication, cooling and a means of operating various engine components. A schematic diagram of the system is shown at Fig FO 1-16.

LOW PRESSURE SYSTEM

Low pressure (LP) oil is used to lubricate and cool :

a. the engine accessory gearbox,

b. the No 1 engine bearing,

c. the reduction gearbox,

d. the aircraft power take off, and

e. the angle drive.

After being used, the oil is collected in a sump, deaerated and pumped to the tank.

Metered LP oil from the lost oil pump and seventh stage air are used to lubricate and cool No 2 and 3 engine bearings. The air/oil mixture is then used to cool the rear face of the LP turbine disc. The amount of oil lost is normally 1.2 litres/hour (0.26 gal/hour); the maximum allowable oil consumption is 1.5 litres/hour (0.33 gal/hour).

MEDIUM PRESSURE SYSTEM

Medium pressure oil drives four servos in the MFCU. These are the :

a. speed governor servo,

b. dozer servo,

c. double stop servo, and

d. temperature control servo.

HIGH PRESSURE SYSTEM

High pressure oil is used to operate the nozzle jack system and the overspeed piston through a solenoid valve.

FAILURES

Oil Pressure Switch

This switch operates the OIL light on the main fail panel if the LP system pressure drops below about 69 kPa (10 psi).

Emergency Oil Supply

In case of an oil failure, an electrically driven oil pump delivers oil from a 3.4 litre (6 pint) oil tank. The oil pump delivers 8-11 litres/hour (14-19 pints/hour) to the No 1 bearing. This provides 18-28 minutes of lubrication independent of engine speed.

FUEL SUPPLY SYSTEM

A complete understanding of the fuel system and fuel transfer sequence, together with careful monitoring of the fuel gauge, debitmeter and fuel transfer lights, is essential to enable a pilot to calculate the amount of fuel available and analyse any faults in the fuel system. The fuel system (refer to Fig FO 1-17) consists of :

a. internal tanks;

b. external tanks;

c. L.P. pumps;

d. fuel selection switches to control pumps, cocks and tank pressurisation;

e. tank jettison and fuel dump buttons; and

f. fuel indicators and warning lights.

INTERNAL TANKS

The internal tanks (refer to Fig 1-10) are :

a. two fuselage tanks,

b. two internal wing tanks,

c. two leading edge tanks,

d. a rocket bay tank (RBT) divided into two parts,

e. a gun bay tank (GBT), and

f. a negative 'g' accumulator.

Note

Leading edge tanks are not fitted to all aircraft.

FUSELAGE TANKS

The left and right fuselage tanks, which are constructed of rubber and nylon material, are located on the outboard side of the respective engine intakes. Each tank has a capacity of 113.5 gal and is divided into a front and a rear cell. The cells are interconnected. The front cell houses a float valve at the 106 gal level. The rear cell contains a L.P. boost pump and two float valves; one at the 97 gal and one at the 86 gal level. The float valves at the 106 gal level control fuel transfer from the external wing tanks. The 97 gal level float valves control fuel transfer from the external centreline tank and/or the GBT; the 86 gal level float valves control fuel transfer from the internal wing tanks and from each part of the RBT. The L.P. boost pumps deliver fuel to the high pressure pump at about 207 kPa (30 psi).

INTERNAL WING TANKS

Each wing contains an integral fuel tank of 120 gal capacity located between the main and rear spars.

LEADING EDGE TANKS

The leading edge tanks have a capacity of 27.5 gal and form an integral part of the inboard leading edge of each wing. Leading edge tanks are not fitted to all aircraft.

ROCKET BAY TANK

The rocket bay tank (RBT) is constructed of light alloy sheet metal and is partitioned to form two parts. Each part contains 60 gal.

GUN BAY TANK

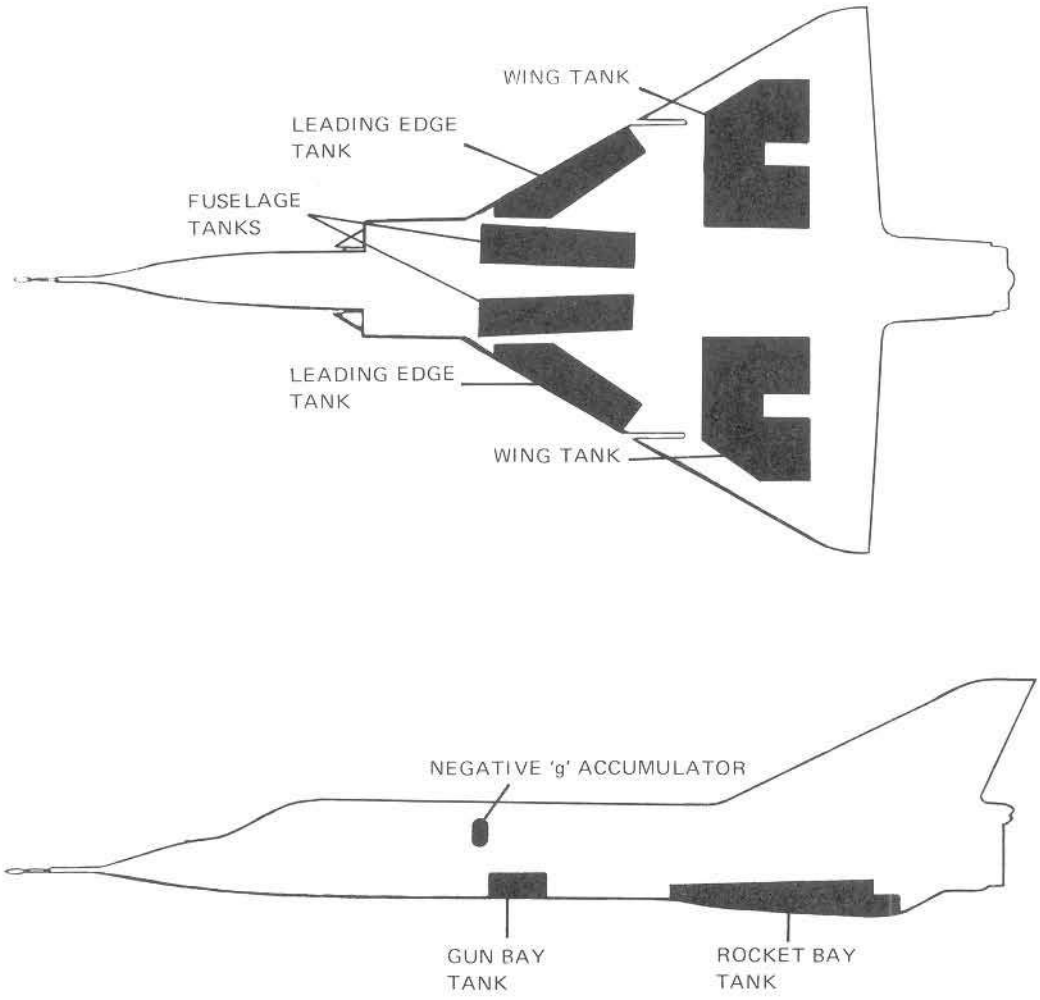
The gun bay tank (GBT) is a removable metal tank located in the lower fuselage forward of the main wheel wells. The tank contains 72 gal.

NEGATIVE 'g' ACCUMULATOR

The negative 'g' accumulator is a small tank located between the fuselage tanks. It supplies fuel to the engine when the LP boost pumps are not covered by fuel, ie during inverted or negative 'g' flight conditions. The negative 'g' accumulator supplies fuel in positive 'g' flight only when the fuselage tanks are empty.

The accumulator has a capacity of 13 gal which per-

Internal Fuel Tanks



LOCATION	CAPACITY	
	GAL	LITRES
Main fuselage tanks	227	1032
Internal wing tanks	240	1090
Rocket bay tank	120	546
Gun bay tank	72	327
Negative 'g' accumulator	13	59
Internal capacity without LE tanks	672	3055
Leading edge tanks	55	250
Internal capacity with LE tanks	727	3305

Figure 1-10

mits about 15 seconds of negative 'g' flight dependent on the power setting.

An expansion valve is fitted to allow for fuel expansion in hot weather.

TOTAL INTERNAL CAPACITY

The total internal fuel capacity (refer to Fig 1-10) is :

a. 727 gal for aircraft with leading edge tanks, and

b. 672 gal for aircraft without leading edge tanks.

EXTERNAL TANKS

The external tanks (refer to Fig 1-11) are :

a. 110 gal tanks,

b. 286 gal tanks,

c. 374 gal tanks, and

d. RPK10 tank/bomb carrier (refer to AAP 7213.003-34).

[D] A 242 gal tank replaces the 286 gal tank on the centreline station.

External Fuel Tanks

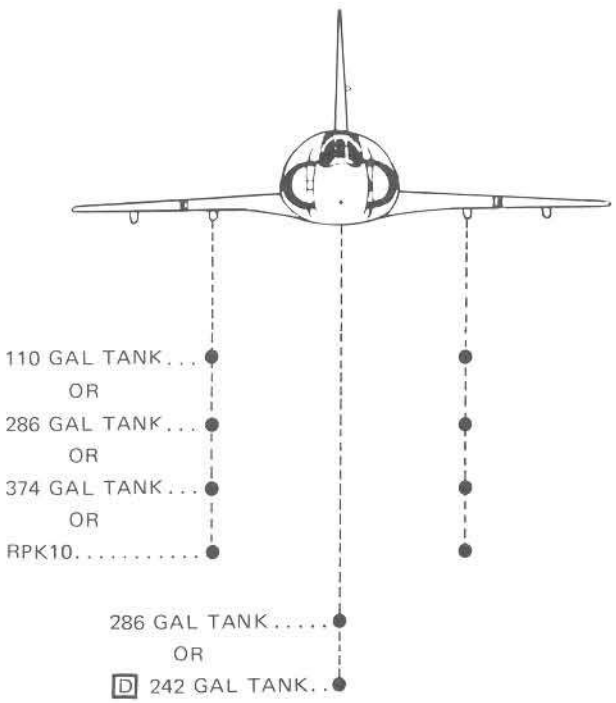


Figure 1-11

110 GAL TANK

110 gal tanks, fitted with fins, may be jettisoned if initiators are fitted. Tanks not fitted with fins cannot be jettisoned.

286 GAL TANK

The 286 gal tanks may be carried on either the centreline station or the inboard wing stations. These tanks may be jettisoned.

[D] Nosewheel clearance on retraction is insufficient to allow a 286 gal tank to be fitted to the centreline station.

374 GAL TANK

The 374 gal tanks may be carried only on the inboard wing stations. These tanks may be jettisoned.

[D] 242 GAL TANK

The 242 gal tank may only be mounted on the centreline station. The tank may be jettisoned.

LIMITATIONS

Flight limitations, when operating with external tanks fitted, are contained in Section 5.

FUEL DUMP

Fuel may be dumped from the 242 gal, 286 gal and 374 gal tanks by pressing the FUEL DUMP button (refer to Fig 1-12) located on the left panel. Fuel should be dumped at speeds less than 300 KIAS and at altitudes above 6000 ft. Pressing the button opens the dump valves; the valves cannot be reset in flight.

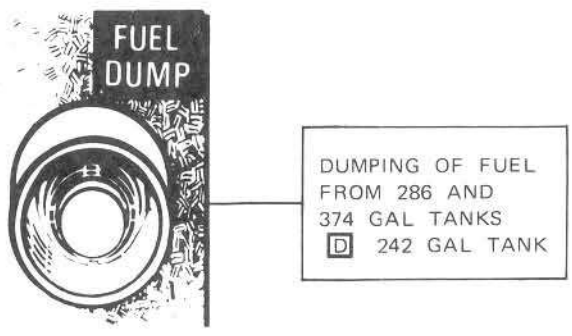
The 286 gal tank takes about 4 minutes to drain and the 374 gal tank takes about 5 minutes.

Note

Asymmetric dumping is common as dump valves are prone to stick. A stuck dump valve may be induced to open by repeatedly pressing the FUEL DUMP button and applying positive and negative 'g' to the aircraft.

[D] The FUEL DUMP button is not fitted to the rear cockpit.

Fuel Dump Button



[D] Button in front cockpit only

Figure 1-12

JETTISON

Tanks and stores may be jettisoned by operating the jettison buttons (refer to Fig 1-13) marked FUS, WING and TANK located on the left side of the instrument panel. Operation of these buttons has the following effect:

a. ***FUS.*** Jettisons :
   (1) the centreline tanks, or
   (2) centreline bombs, or
   (3) Matra and pylon.

b. ***WING.*** Accomplishes :
   (1) launch of S.W. in a safe condition,
   (2) jettison of external wing tanks, except non-jettisonable 110 gal tanks, and
   (3) jettison of bombs from RPK 10 tank/bomb carriers.

c. ***TANK.*** Jettisons external wing and centreline tanks, except the non-jettisonable 110 gal tanks and RPK 10 tank/bomb carriers.

WARNING

- Ensure the jettison panel cover is closed prior to entering the cockpit.
- External stores may be inadvertently jettisoned whilst strapping in if the buttons are pressed. Ensure knee pad protrusions do not come into contact with the buttons with the panel open.

Jettison Buttons

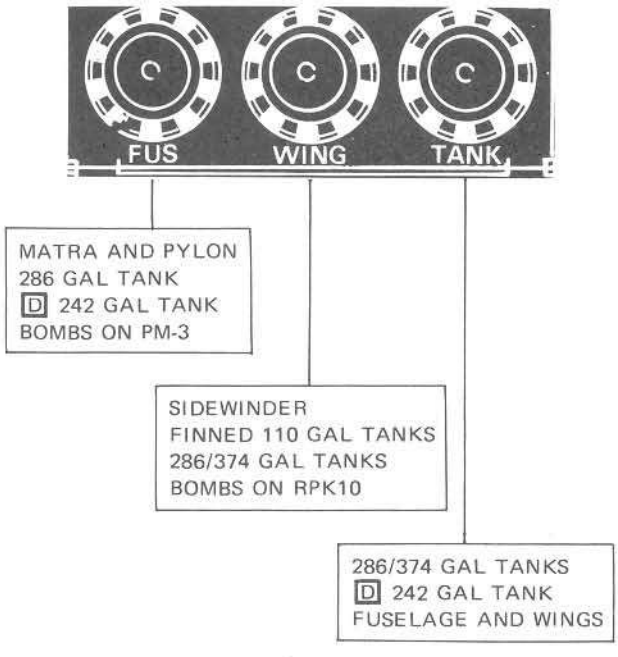


Figure 1-13

JETTISON ENVELOPE

Before attempting to jettison 242 gal, 286 gal and 374 gal tanks, the speed brakes are to be retracted and, if practicable, the undercarriage is to be retracted. The jettison envelopes for full, part empty and empty tanks are contained in Section 5.

TOTAL FUEL CAPACITIES

The total fuel capacities, expressed in Imperial gallons, are :

Configuration	Without GBT	Without GBT + LE	With GBT	With GBT + LE
Clean	600	655	672	727
Two 110 gal/RPK10	820	875	892	947
One 286 gal	886	941	958	1013
Two 286 gal	1172	1227	1244	1299
Three 286 gal	1458	1513	1530	1585
Two 110 gal/RPK10 + one 286 gal	1106	1161	1178	1233
Two 374 gal	1348	1403	1420	1475
Two 374 gal + one 286 gal	1634	1689	1706	1761
One 110 gal + AN/ALE-32	710	765	782	837
One 110 gal + AN/ALE-32+ one 286 gal	996	1051	1068	1123
D One 242 gal	842	897	914	969
D Two 286 gal + one 242 gal	1414	1469	1486	1541
D Two 110 gal + one 242 gal	1062	1117	1134	1189
D Two 374 gal + one 242 gal	1590	1645	1662	1717

LP BOOST PUMPS

The DC powered LP boost pumps deliver fuel to the high pressure fuel pump at 207 kPa (30 psi). The left boost pump receives power from the manual load shed bus bar and the right boost pump receives power from the generator bus bar.

One pump is located in the rear cell of each main fuselage tank. The pumps are controlled by two switches, labelled L.P. PUMPS, located on the left console. The left pump is controlled by the rearmost switch and the right pump by the foremost switch. The pumps are protected by circuit breakers, labelled LP PUMP PORT and LP PUMP STBD, on the right console.

D L.P. PUMP switches are not fitted to the rear cockpit.

CONTROLS

MAIN L.P. COCK

The main LP cock is controlled by a guarded switch, labelled MAIN L.P., located on the left console. The cock is powered by the main DC bus through a circuit breaker, labelled MAIN L.P. COCK, on the starboard console. On engine shutdown, the MAIN L.P. switch should not be selected OFF before the engine stops rotating or the HP fuel pump and shaft may be damaged due to cavitation.

CAUTION

On engine shutdown, the MAIN L.P. switch is not to be selected OFF before the engine stops rotating.

The MAIN L.P. switch should not be operated during flight except in cases of emergency, eg to shut down the engine during landing if the throttle is jammed or ineffective. Should the switch be inadvertently selected OFF during flight, reselecting the switch ON at engine speeds above 3000 RPM may cause the HP fuel pump drive to shear. This will result in total loss of engine power with no possible chance of a relight.

WARNING

If the MAIN L.P. switch is inadvertently selected OFF in flight, it is not to be reselected ON at engine speeds above 3000 RPM.

AFTERBURNER COCK

The A/B cock controls fuel flow to the A/B section of the engine (refer to Fig FO 1-17). It is operated by a switch labelled A/B, located on the left console. This switch is normally in the ON position. To close the A/B cock, pull the A/B switch upwards and move it inboard to the OFF position.

CROSSFEED COCK

The crossfeed cock (refer to Fig FO 1-17) is an electrically operated cock situated in a fuel line joining the two fuselage tanks. With the CROSSFEED switch ON, the cock is open and the fuel may flow between the two tanks. With the CROSSFEED switch OFF, the cock is closed and the two sides of the aircraft fuel supply system are separated and operate independently.

WING DROP TANK TRANSFER SWITCH

The wing drop tank transfer switch, labelled WING DT TRANSFER, controls pressurization to the wing drop tanks. The switch is located on the upper left console and is gated in the ON position.

With the WING DT TRANSFER switch ON, the external wing tanks are pressurized and feed first. With the switch OFF (ungated and down) the external wing tanks are not pressurized and do not feed, and the external wing tank transfer lights are illuminated. The centreline tank is pressurized regardless of the switch position and will feed when the fuel level in the fuselage tanks is 97 gal. Thus the pilot may select the centreline tank to feed and, if necessary, jettison the tank before selecting the external wing tanks to feed.

GUN BAY TANK TRANSFER SWITCH

The GB TANK TRANSFER switch controls a cock in the fuel line from the gun bay tank (refer to Fig FO 1-17). When the switch is ON and the fuel level in the fuselage tanks is below 97 gal, fuel is transferred from the GBT.

If a centreline tank and a GBT are both fitted, the GB TANK TRANSFER switch must be OFF to ensure that the centreline tank transfers first. When both tanks are fitted, the respective fuel transfer lights are extinguished after engine start and remain extinguished until transfer from the respective tank is completed. However, because the GB TANK TRANSFER switch provides the earth connection for the centreline tank transfer light, the centreline tank transfer light is illuminated when the GB TANK TRANSFER switch is on.

When the smoke modification is fitted, the GBT is filled with oil and the GB TANK TRANSFER switch controls oil flow and therefore smoke in the normal ON/OFF sense.

FUEL INDICATORS AND WARNING LIGHTS

The fuel system indicators and warning lights are located on the right instrument panel and right panel (refer to Fig FO 1-3 and FO 1-5). They are the :

a. fuel gauge,

b. fuel transfer lights,

c. debitmeter,

d. FUEL warning light, and

e. 130 gal warning light.

FUEL GAUGE

The fuel gauge (refer to Fig 1-14) indicates the amount of fuel in the two fuselage tanks and the negative 'g' accumulator. Two pointers marked P (left) and S (right), move over a circular dial graduated from 6 to 130 in 10 gal increments. A fuel GAUGE TEST button is located above the fuel gauge.

If the GAUGE TEST button is pressed when the inverter is running, the pointers move in a counterclockwise direction; when the button is released, the pointers return to indicate the amount of fuel in the

Fuel Gauge



Figure 1-14

tanks. The maximum reading is 120 gal. This is the amount of fuel in each fuselage tank (113.5) plus half the amount of fuel in the negative 'g' accumulator (6.5 gal).

FUEL TRANSFER LIGHTS

Each fuel transfer light represents a tank. When a light illuminates, the corresponding tank is empty or has stopped feeding. A dimmer system and a press to test button are included in the transfer light assembly.

An extinguished fuel transfer light does not necessarily indicate that fuel is being transferred because :

a. a jammed float valve in the fuselage tank will stop transfer but fuel pressure will still be present to activate the fuel transfer pressure switch,

b. of blown bulbs or an unserviceable fuel transfer pressure switch, and

c. accelerations or descents may produce erroneous indications.

Note

The end of transfer for any given tank is positively indicated when the appropriate gauge pointer falls below the transfer value for that tank.

DEBITMETER

The debitmeter is a veeder type, fuel-remaining indicator with a setting wheel on the right side. Powered from the main DC bus, it measures the fuel flow to the engine and subtracts this amount from the figure set on the meter prior to engine start. The meter must be checked against the known fuel state before engine start.

If fuel is dumped, the meter should be reset to the known internal fuel remaining as the gauge pointers fall.

Note

- The debitmeter system tolerance is ±3%.
- The debitmeter does not directly indicate fuel remaining. It is essential to monitor the fuel transfer sequence using the fuel gauges, transfer lights and debitmeter to determine fuel remaining.

FUEL WARNING LIGHT

The FUEL warning light on the main fail panel illuminates if the fuel pressure at the high pressure pump inlet falls below 69 kPa absolute (10 psi absolute) depending on altitude.

WARNING

An overshoot should not be attempted when the FUEL warning light is on.

130 GALLON WARNING LIGHT

The 130 gal warning light is located above the fuel gauge and is labelled 130G. The light illuminates when the contents of either main fuselage tank is 65 gal or less.

FUEL TRANSFER

Fuel is supplied to the engine from the fuselage tanks via the LP pumps (refer to Fig FO 1-17). Fuel from the other internal and the external tanks, is transferred to the fuselage tanks in a specific order using regulated ninth stage air pressure. The transfer of fuel from the internal and external tanks is controlled by float valves in the fuselage tanks. The valves are fitted to the fuel line terminations for the corresponding internal and external tanks.

When the fuel level in the fuselage tanks is above a float valve, the valve is closed and fuel does not transfer. When the fuel level falls below the valve, the valve opens and fuel transfers from the appropriate tank. Thus, the fuel level in the fuselage tank is maintained at the float valve level for a particular tank while fuel transfers from that tank.

NORMAL TRANSFER SEQUENCE

With the WING DT TRANSFER switch ON, the external wing tanks are pressurized at 69 kPa (10 psi) and fuel transfers through the 106 gal float valves when the fuel in the fuselage tanks reaches this level. The centreline tank (10 psi) and/or the GBT (7.25 psi) feed through the 97 gal float valves. The leading edge (if fitted), internal wing and RBT (8.7 psi) are interconnected and feed in that order through the 86

gal float valves. When transfer from the internal and external tanks is complete, the fuselage tanks supply the engine until both are empty. When the fuselage tanks are empty, the FUEL warning light illuminates and the negative 'g' accumulator then supplies the last 13 gal of fuel.

The end of the transfer of the external tanks, internal wing/RBT or GBT is indicated by :

a. the appropriate gauge pointer falling below the transfer level for that tank, and

b. as confirmation, the corresponding fuel transfer light illuminating, indicating that transfer from that tank has ceased (refer to Fuel Transfer Lights).

The two separate sides of the fuel system theoretically supply the engine symmetrically. However in practice, LP pump outputs are imperfectly balanced resulting in some asymmetry in feeding. The fuel levels in the fuselage tanks may be balanced by opening the CROSSFEED cock.

Note

When fuel consumption is very high, eg when using A/B at low altitude, it is possible that fuel will be transferred at a rate slower than the engine consumption. Under these circumstances, the fuel levels in the fuselage tanks will fall below the normal transfer values. The fuel levels should return to normal when fuel consumption is reduced.

ALTERNATIVE TRANSFER SEQUENCE

The alternative transfer sequence enables the fuel from the centreline tank to be used first allowing jettison of the tank, if required, or an increase in permissible 'g' limits early in the mission depending on the configuration. When the WING DT TRANSFER switch is selected OFF (ungated and down), the external wing tanks are not pressurized and the corresponding transfer lights are illuminated. The centreline tank and, provided the GB TANK TRANSFER switch is selected ON, the GBT feeds through the 97 gal float valves when the fuel in the fuselage tanks is 97 gal. When fuel transfer from the centreline tank and GBT is complete, as indicated by the gauge pointers falling below 97 gal and confirmed by the appropriate transfer lights, the WING DT TRANSFER switch is selected ON. The external wing tanks are pressurized, fuel is transferred and the fuel level in the fuselage fuel tank rises to 106 gal. The remaining transfer is as for the normal transfer sequence.

FUEL MANAGEMENT

The fuel gauge does not give a direct reading of fuel remaining until fuel transfer from the internal wing tank and RBT is complete when the gauge pointers fall below 86 gal and a total of 172 gal remains. Prior to this time, the fuel remaining must be determined by monitoring the transfer sequence.

Fuel transfer is managed by use of the CROSSFEED, GB TANK TRANSFER and WING DT TRANSFER switches or by use of the L.P. PUMP switches.

NORMAL TRANSFER SEQUENCE

Basic fuel monitoring consists of checking the aircraft debitmeter reading against the known fuel remaining in the aircraft as the gauge pointers fall below each transfer level. The following fuel figures and the corresponding fuel gauge levels must be known or calculated for the appropriate configuration before each flight :

a. total fuel before start,

b. fuel remaining at the end of transfer if only one external wing tank feeds,

c. fuel remaining at the end of transfer from all external tanks,

d. fuel remaining at the end of transfer from the GBT,

e. fuel remaining at the start of transfer from the internal wing and RBT,

f. fuel remaining at the end of transfer if only one internal wing tank and the corresponding half of the rocket bay tank feeds, and

g. fuel remaining at the end of transfer of both internal wing tanks and RBT halves - 172 gal for all configurations.

Fuel figures for the usual configurations are :

Transfer Event	Fuel Gauge Indication	Configuration			
		Two 110 gal	Two 110 gal + LE	Two 110 gal + GBT	Two 110 gal + LE + GBT
Total before start	Steady 120	820	875	892	947
End one ET	Below 106	682	737	754	809
End both ET	Below 106	572	627	644	699
End GBT	Below 97	-	-	554	609
Start IWT/RBT	Steady 86	532	587	532	587
One side IWT/RBT	Below 86	352	380	352	380
End IWT/RBT	Below 86	172	172	172	172

The configuration of two 110 gal + GBT is used in the following example of fuel management.

Before Start

Before start, the :

a. gauge pointers are both on 120 gal,

b. debitmeter is set on 892 gal. and

c. transfer lights give no meaningful indications.

After Start/Taxi

After start, the following management is required :

a. Both gauge needles fall below 120 gal as fuel is used from the fuselage tanks until the level is 106 gal. If a gauge needle remains on 120 gal, a failed boost pump or a stuck float valve is indicated (refer to Section 3).

b. Before the fuel level in the fuselage tanks reaches the 106 gal transfer level, check the operation of the CROSSFEED cock as follows :

(1) Ensure that the fuel levels in the fuselage tanks are unequal.

(2) Select CROSSFEED switch ON. Observe that the fuel levels equalize.

(3) Select CROSSFEED switch OFF.

Note

If the fuel levels are not unequal, some asymmetry may be induced by selecting one L.P. PUMP switch to OFF. Ensure that the pump is switched ON after the CROSSFEED check is completed.

c. Except for the centreline tank transfer light, the transfer lights should all be extinguished. However, if the GB TANK TRANSFER switch is OFF, the centreline transfer tank light will be extinguished.

Note

The transfer lights may not extinguish at idle RPM, however at normal taxiing RPM the lights should extinguish.

Run-up

During the run-up, check that :

a. both gauge pointers are on 106 gal, and

b. all appropriate transfer lights are extinguished.

External Wing Tank Transfer

The gauge pointers remain on 106 gal while the external wing tanks transfer. On most flights, LP pump imbalance results in some fuel asymmetry. However, provided the gauge pointer falls below 106 gal with the corresponding transfer light illuminated and the debitmeter reading below the one external wing tank transfer figure (754), the pilot may assume that one side has completed transfer and the other side is still transferring. In this case :

a. select CROSSFEED switch ON, and

b. ensure the fuel pointer for the faster feeding side rises to 106 gal and stabilizes.

Both gauge pointers remain at 106 gal until the slower feeding tank completes transfer. The slower side transfer light illuminates and both fuel pointers fall below 106 gal. At this time :

a. the fuel remaining is 644 gal,

b. the debitmeter reading should be about 644 gal, ±3%, and

c. the CROSSFEED switch is selected OFF.

If both gauge pointers fall below 106 gal at a debitmeter reading significantly above 644 gal then either the debitmeter is unserviceable or an amount of fuel equal to the debitmeter reading less 644 is not available (refer to Section 3). Reset the debitmeter to 644 gal.

Gun Bay Tank Transfer

Provided the GB TANK TRANSFER switch is ON, the gauge pointers stabilize at the 97 gal transfer level and the debitmeter reading is 626 gal nominal. The gauge pointers remain at 97 gal while the GBT transfers. When transfer is complete :

a. 554 gal remain:

b. the GBT transfer light illuminates;

c. the gauge pointers commence to fall to the next (86 gal) transfer level; and

d. if the fuel levels in the fuselage tanks require balancing, select the CROSSFEED switch ON until the levels are equal then select the CROSSFEED switch OFF.

If the end of transfer at the 106 and/or the 97 gal transfer level is not monitored, an accurate debitmeter check can be made as 540 gal remain when the gauge pointers are at 90 gal.

Note

- The 540 gal figure is valid for all configurations without leading edge tanks, with or without the GBT. For aircraft with LE tanks the fuel figure is 595 gal.
- The CROSSFEED switch is to be selected OFF at commencement of fuel transfer from external wing tanks and internal wing tanks. A gauge pointer falling below the appropriate level gives early warning of a tank failure.

Internal Wing/RBT Transfer

The gauge pointers stabilize at the 86 gal transfer level and the debitmeter reading is 532 gal nominal when the internal wing/RBT commence to transfer. When one gauge pointer falls below 86 gal with the corresponding transfer light illuminated and the debitmeter reading below 352 gal (the one-side fuel transfer figure), the pilot may assume that the faster feeding side has completed transfer and the slower feeding side is still transferring. In this case :

a. select the CROSSFEED switch ON, and

b. ensure that the gauge pointer indicating the lower fuselage tank level rises to 86 gal and stabilizes.

Note

If a gauge pointer moves below the 86 gal transfer level at a debitmeter reading above 352 gal (the one-side fuel transfer figure), then transfer failure or a split tank has occurred. Refer to Section 3, Fuel System Emergencies.

Both gauge pointers remain on 86 gal until fuel transfer from the slower feeding side is complete. The second transfer light then illuminates and the gauge pointers fall below 86 gal. The fuel gauge is now a direct reading instrument indicating total fuel remaining. The debitmeter reading should be 172 gal nominal.

Note

When internal wing/RBT transfer is complete, the fuel gauge is a direct reading instrument and the debitmeter may be disregarded.

Fuel Figures

The total figure for the two 110 gal + GBT configuration is derived as follows:

a.	Internal fuel without LE tanks	600 gal.
b.	GBT	72 gal.
c.	Two 110 gal tanks	220 gal.
d.	Total	892 gal.

Application of the principle shown enables the pilot to calculate the figures for any configuration. The derivation of the various transfer values is:

Transfer Event	Fuel Gauge Indication	Fuel Used From Last Figure	Tank Fuel Used From	Fuel Remaining
Before start	120	NIL	-	892
Start ET	Steady 106	(120 - 106) x 2 = 28	Fuselage	892 - 28 = 864
End one ET	Below 106	110	One 110 gal	864 - 110 = 754
End both ET	Below 106	110	One 110 gal	754 - 110 = 644
Start GBT	Steady 97	(106 - 97) x 2 = 18	Fuselage	644 - 18 = 626
End GBT	Below 97	72	GBT	626 - 72 = 554
Start IWT/RBT	Steady 86	(97 - 86) x 2 = 22	Fuselage	554 - 22 = 532
One side	Below 86	(120 + 60) = 180	WT + RBT	532 - 180 = 352
End IWT/RBT	Below 86	(120 + 60) = 180	WT + RBT	352 - 180 = 172

Note

If leading edge tanks are fitted, add 55 gal to all fuel remaining figures of 532 and above. Add 27.5 gal to the one side IWT/RBT fuel feed figures. The 172 gal figure remains unchanged.

Asymmetric Fuel Feed

The output from the two LP pumps will often differ. The higher output pump tends to close the check valve of the lower output pump and fuel flow on that side of the system is slowed. This results in asymmetric fuel feed which may upset the lateral trim of the aircraft. This out-of-trim condition is generally most noticeable on missions when 286/374 gal wing tanks are carried. Fuel asymmetry should not normally be greater than 20% of the total fuel consumed. Normal fuel management procedures apply when asymmetric fuel feeding is experienced. However, if fuel asymmetry is considered excessive, a check for further malfunction is to be made before using the crossfeed (refer to Section 3).

If, with the CROSSFEED switch OFF, one external wing tank completes transfer before the other and the fuel level in the fuselage tanks falls to 86 gal, fuel is transferred from the internal wing tank on that side. When the CROSSFEED switch is subsequently selected ON, the fuel levels in the fuselage tanks will equalize at 106 gal until all fuel is transferred from the external wing tanks. The fuel remaining at end of external wing tank transfer will be less than normal by the amount previously used from the internal wing tank.

ALTERNATIVE TRANSFER SEQUENCE

The alternative transfer sequence is used when a centreline tank and two external wing tanks are carried and it is desired to transfer fuel from the centreline tank before the fuel from the external wing tanks. The procedure and sequence of events are described in the following paragraphs.

Before engine start, the WING DT TRANSFER and the GB TANK TRANSFER switches are selected OFF. The fuel transfer check of the external wing tanks prior to take-off is not to be carried out.

Note

- If the WING DT TRANSFER switch is ON after start, the external wing tanks are pressurized and fuel is transferred from the external wing tanks until the pressure dissipates. The subsequent fuel remaining figures will be affected by the amount used and, if accurate fuel management is the major consideration, the normal transfer sequence should be continued.
- If fuel from the GBT is transferred before fuel from the centreline tank and the external wing tanks, the CG moves aft of the aft limit and handling difficulties will result.

After engine start, ensure that all fuel transfer lights are extinguished except those for the external wing tanks, which should be illuminated.

Note

The GB TANK TRANSFER switch provides an earth for the centreline tank transfer light. If the switch is ON, the centreline tank light is illuminated but the centreline tank is still pressurized.

The engine uses fuel from the fuselage tanks until the 97 gal level is reached. Fuel is then transferred from the centreline tank to the fuselage tanks and the gauge pointers stabilize on 97 gal.

When fuel transfer from the centreline tank is complete, the fuel transfer light illuminates and the gauge pointers fall below 97 gal. Select the WING DT TRANSFER and the GB TANK TRANSFER switches ON and check that the :

a. external wing tank lights extinguish, and

b. gauge pointers rise to 106 gal and stabilize.

Leave the WING DT TRANSFER and the GB TANK TRANSFER switches ON for the remainder of the flight. Fuel transfer now follows the normal transfer sequence.

Compared to the 106 and 86 gal float valves, the 97 gal float valves are small, therefore the tendency for engine demand to exceed fuel transfer is greater at this level. During take-off and initial climb with the centreline tank transferring, the level in the fuselage tanks may fall to 86 gal. If this occurs, fuel is transferred from both the centreline and the internal wing tanks. When engine demand is reduced, check that the fuel level in the fuselage tanks rises to 97 gal indicating that the centreline tank is transferring.

Note

The subsequent fuel remaining figure at commencement of internal wing tank transfer is less than the normal fuel figure by the amount of fuel consumed from the internal wing tanks during the take-off and initial climb.

REFUELLING

No provision is made on the aircraft for single-point refuelling.

SAFETY PRECAUTIONS

The following safety precautions are to be taken :

a. Maintain a fire extinguisher ready for use.

b. Earth the aircraft.

c. Earth the tanker.

d. Earth the hose nozzle.

INTERNAL TANKS

The internal tanks are refuelled through either of two filler openings located on the top of the aircraft, using the following procedure :

a. Connect an external 28 VDC power supply.

b. Relieve the pressure in the LP pump by operating the drain cock which is located between the main U/C doors on the centreline of the aircraft.

c. Release the pressure in the negative 'g' accumulator by operating the drain cock which is located 1.2 m (4 ft) in front of the LP pump drain cock and behind the nose wheel well.

d. Pull down the two refuelling handles located behind the wheel wells (right handle only if GBT is not fitted).

e. Place MAIN LP switch in OFF position.

f. Place CROSSFEED switch in OFF position.

g. Partly fill the main fuselage tank on one side then place the CROSSFEED switch in the ON position. Ensure that both fuel gauge needles indicate the same amount of fuel.

h. Place L.P. PUMPS switches in ON position.

i. Continue to fill the tanks. When the internal wing, RBT and GBT are full, fuel flows back to the fuselage tanks via the vent lines and the relevant transfer lights extinguish.

j. When the fuselage tanks are full :

(1) replace the filler caps,

(2) place L.P. PUMPS switches in OFF position, the relevant transfer lights illuminate,

CAUTION

Venting will occur and fuel will blow out of the filler neck if the L.P. PUMPS switches are placed in the OFF position before replacing the fuel caps.

(3) close the refuelling handles and close the doors,

CAUTION

Fuel siphoning may occur during taxiing or in flight if the refuelling handles are not closed. If syphoning occurs, the fuel supply is rapidly depleted via a vent located in the lower rear left fuselage.

(4) place the CROSSFEED switch in the OFF position,

(5) reset the debitmeter,

(6) select LP PUMP switches ON for one minute, then

(7) check for leaks from each cap and under the aircraft generally, then

(8) disconnect external 28 VDC power supply.

EXTERNAL TANKS

External tanks are refuelled through the filler opening of each tank. External tanks are normally filled at the same time as the aircraft tanks, however the aircraft should not be left standing for extended periods with filled 374 gal tanks. Replace the filler caps after refuelling and enter fuel quantity in Form EE500.

ELECTRICAL SYSTEM

The electrical system (refer to Fig FO 1-18) includes DC and AC systems. The power consumption of the main aircraft equipment is listed at Fig 1-15.

DC SYSTEM

The DC system is normally powered by the generator. If the generator fails, the alternator automatically provides DC power to the main bus through the transformer-rectifier unit. If the generator fails and the transformer-rectifier unit does not operate, the battery powers the main bus.

BATTERY

The battery is a 24 V nickel cadmium type with a capacity of 40 A·h. It is fitted with an over-charging current protector and is located in the equipment bay.

[D] The battery is at the rear of the nose wheel well.

GENERATOR

The 28.5 V, 9 kW generator is installed on the aircraft gearbox. It includes a voltage regulator, over-voltage protection, under-current detection and a reverse current relay.

TRANSFORMER-RECTIFIER

The 4 kW transformer-rectifier is powered by the alternator and provides 25.5 to 27.5 VDC. It does not include a voltage regulator and is inoperative when the aircraft is on the ground.

DC BUS BARS

Battery Bus

The battery bus, which is directly connected to the battery, is always energised, even with the BATT switch OFF. In normal operation, the battery bus is supplied by the main DC bus.

Main DC Bus

The main DC bus is powered by the battery through the BATT switch and, when the generator is on line, by the generator through the GEN switch. The generator has a higher output than the battery and, through the action of the generator reverse current relay, powers the main DC bus, while charging the battery.

If the generator fails, the main DC bus is automatically powered by the alternator through the transformer-rectifier. If the generator and the transformer-rectifier fail, the main DC bus is powered by the battery through the BATT switch.

To check if the transformer-rectifier is operating, select the BATT switch OFF. If the lights on the main fail panel and associated cockpit lights extinguish, the transformer-rectifier is not operating.

CAUTION

If the transformer-rectifier is not operating, when the BATT switch is re-selected ON, the ENG and A/B fire warning lights illuminate for 3-5 seconds.

Auto Load-Shedding DC Bus

The auto load-shedding DC bus is supplied by the main DC bus. Power supply is automatically cut off in case of a generator failure in flight.

Manual Load-Shedding DC Bus

The manual load-shedding DC bus is supplied by the main DC bus.

AC SYSTEM

The AC system is powered by a constant frequency alternator and two DC powered inverters. The AC system supplies power to the operational equipment. If the generator fails, the transformer-rectifier oper-

Power Consumption Schedule

NON-SHEDDED EQUIPMENT

DC	(W)	AC	(V.A)
*Emergency hydraulic pump	2700	**Transformer rectifier	4500
*Shock-cone motor	1000	Chaff disp motor	1560
Right LP pump	1200	Doppler	450
Landing lights	900	TACAN	250
Primary UHF set	112	Computer voltages	210
[D]	380	Twin gyro platform	150
Pitot heat	400	IFF	100
Incidence lights	100	Air data computer	70
Power supplies (contactors)	100	Radar altimeter	70
Cockpit lighting	100	Nav computer	65
[D]	200	AC protection box	30
Engine monitoring	90	Cockpit/Equip air cond	20
Compass (emg. heading)	80	Ionization probe	15
Standby A/H inverter	70	Shock-cones (MICE)	15
Fuel transfer control	70	PHI lighting	10
Visor heat	55		
Hydraulic pressure system	25		
[D] ICS	20		
Horn	15		
Emergency oil pump	15		
***In-flight relight	3000		

EQUIPMENT SHED
AFTER MANUAL LOAD-SHEDDING

DC	(W)	AC	(V.A)
Left LP pump	1200	Yaw damper)	
Secondary UHF set	380	Pitch damper)	80
Inverter	230	Servo detection)	
Dampers servo-controls	150	Fuel gauges	30
Nav computer	85	Incidence servo motor	5
Nav/Form lights	65		
Twin gyro platform	60		
TACAN	50		
Air data computer	30		
****Missiles	1460		
****CYRANO radar	600		
****Autocommand-Roll stab	230		
****Optical sight	200		
****Radar altimeter	10		

EQUIPMENT SHED
AFTER AUTOMATIC LOAD-SHEDDING

DC	(W)	AC	(V.A)
Missiles	1460	CYRANO radar	3800
CYRANO radar	600	ECM pod	400
Autocommand-Roll stab	230	AC Roll stab	270
Optical sight	200	Missiles (S.W.)	230
Radar altimeter	10	Optical sight	210

*Does not operate permanently.
**Operates in the event of generator failure.
***In-flight relight is in fact the sum of non-shedded equipment consumption plus the average emergency hydraulic pump consumption.
****This equipment is on the auto load-shedding DC bus but is also shed when the LOADSHED switch is selected OFF.

Figure 1-15

ates, and both AC and DC power to operational equipment is automatically cut off by the operation of the AC and DC auto load-shed.

ALTERNATOR

The alternator provides 115 V, 400 Hz, 9 kV•A three phase power. It is installed on the aircraft gearbox and includes an electro-mechanical device to give constant rotational speed at the output. The constant rotational speed is achieved by using a constant speed output gearbox with an automatic gear change which operates at an engine speed of about 5900 RPM as speed increases and 5650 RPM as speed decreases.

The alternator is not effectively cooled on the ground. If overheating occurs, the alternator drops off line. To prevent the alternator overheating on the ground :

a. avoid throttle settings between 5500-6000 RPM,

b. limit the use of high RPM, and

c. use idle RPM, when required to hold on the ground. If holding is required for extended periods, appropriate AC services should be turned off to reduce the alternator electrical load.

INVERTERS

The main inverter is supplied with 28.5 VDC power from the manual load-shedding DC bus and provides 125 V•A, 115 V, 400 Hz three phase power. A small 10 V•A inverter provides power to the stand-by artificial horizon.

AC BUS BARS

Alternator Bus

The alternator bus can be supplied by an external power unit or the alternator.

Auto Load-Shedding AC Bus

The auto load-shedding AC bus is supplied by the alternator bus. In flight, its power supply is automatically cut off when a DC generator failure occurs.

Inverter Bus

The inverter bus is supplied from the main inverter which is powered from the manual load-shedding DC bus.

EXTERNAL POWER

An external power receptacle under the left wing root permits connection to an external AC/DC power unit. A protection relay prevents AC supply in the event of power unit phase reversal.

Connecting these external power sources automatically cuts out the corresponding aircraft generation system, ie battery, generator and alternator with the exception of those services powered by the battery bus.

LIGHTING

INTERNAL LIGHTING

Power for cockpit lighting is supplied by the main DC bus and adjusted by means of :

a. three rheostats on the lightning control panel to the rear of the left console (refer to Fig FO 1-2 and FO 1-6),

b. a dual rheostat at the top of the centre pedestal (refer to Fig FO 1-3), and

c. white lamps are fitted for instrument and console illumination and flat translucent perspex lenses are fitted to the floodlights.

[D] The dual rheostat is adjacent to the throttle quadrant (refer to Fig FO 1-6).

Lighting Control Panel

The lighting control panel consists of three rheostats. The forward two are labelled COCKPIT LIGHTS and the rear rheostat is labelled PANEL LIGHTS.

a. The forward rheostat, labelled UV, controls the instrument panel lights which consist of a shaded ultra-violet light installed on each side of the windshield arch.

b. The centre rheostat, labelled RED, controls the console floodlight illumination (three lamps on each cockpit wall). It also controls the spotlight illumination of the hydraulic pressure gauge, the circuit breaker panel and the flying aids panel.

c. The rear rheostat controls the internal red lighting of the communications selection, radio control, TACAN, pressurization and weapons system control panels and the IFF.

[D] Rear Cockpit Lighting Control Panel

The rheostats are located in relatively the same area as the front cockpit and give lighting to the rear cockpit in the same manner. The ultra-violet lights are installed on the bottom canopy frame.

Dual Rheostat Control

The dual rheostat control is located on the centre pedestal above the Doppler indicator. The inner knob is a rheostat which controls the white floodlighting of the left and right instrument panels provided by a light on each side of the windshield arch. The outer ring is a rheostat which controls the internal red lighting of the:

a. PHI indicator,

b. main and stand-by altimeters,

c. PHI control panel, and

d. Doppler control panel.

[D] The PHI control panel is not fitted to the rear cockpit. Doppler is not fitted.

[D] Rear Cockpit Dual Rheostat Control

This rheostat has a similar function to the front cockpit control. The inner knob controls three lights which provide the white floodlighting to the instrument panel. The lights are arranged symmetrically around

the inside of the instrument coaming. A further dimmer rheostat located immediately behind the incidence light panel may be used as a balance rheostat for the white floodlighting. The outer ring controls the internal lighting of the PHI and main altimeter.

Clock and Compass Rheostat

A rheostat located behind the clock controls the external red lighting of the clock and the internal red lighting of the stand-by compass and the 'g' meter.

Wander Light

A wander light installed on the right cockpit wall comes on when removed from its housing. It provides red lighting and may be used to illuminate any part of the cockpit. In an emergency a hook located on the right windshield arch under the ultra-violet lamp maintains the light in the instrument panel direction. The wander light is powered from the battery bus.

[D] A wander light, which works in the same manner as the front cockpit wander light, is installed on the right wall of the rear cockpit. The hook for the emergency use of the light is located at the right side of the lower cockpit frame.

EXTERIOR LIGHTING

The exterior lighting is controlled by switches located on the left cockpit wall as illustrated on Fig FO 1-2 and detailed below.

Landing/Taxi Lights

Two lights are located on the nosewheel leg and are powered by the main DC bus. The lights are controlled by a switch, labelled LDG. LIGHT, with three positions labelled TAXI-OFF-LDG. On TAXI only the left light is illuminated. On LDG, both lights are illuminated. The lights should extinguish automatically when the U/C retracts.

WARNING

The undercarriage switch should not be relied on as a means of switching off the landing/taxi light after take-off. If switch failure occurs, the heat generated by the lights in the wheel well creates a serious fire hazard.

Navigation Lights

The navigation lights are controlled by a switch, labelled NAV. LIGHTS, with three positions marked STEADY-OFF-FLASH. The DIM-OFF-FULL label no longer applies.

Formation Lights

A blue formation light is located on each wing upper surface near the navigation lights. Power is supplied by the manual loadshed DC bus and control is by a switch, labelled FORM. LIGHTS, with three positions marked DIM-OFF-FULL.

[D] All external lighting controls are located in the front cockpit.

CONTROLS AND INDICATORS

BATTERY, GENERATOR, ALTERNATOR AND INVERTER SWITCHES

These switches marked BATT, GEN, ALT and INV are located on the right panel (refer to Fig FO 1-5). When the BATT switch is on, the battery is connected to the main DC bus. The GEN and ALT switches are only used to isolate these two power sources in case of failure. Turning off these two switches triggers the corresponding protective devices. The GEN switch is safety-wired on to prevent the generator over-voltage protection from operating.

RESETTING BUTTONS

The battery, generator and alternator reset buttons are located below their respective switches on the right panel. These buttons permit reset after a momentary failure of their protecting relays. In the battery and generator systems, the protecting relays only close when the pressure exerted on the resetting button is released and the cause for the cut-out has disappeared.

CAUTION

The resetting buttons must only be pressed momentarily.

MANUAL LOAD-SHED SWITCH

The manual load-shed switch is a gated switch labelled LOADSHED (refer to Fig FO 1-4) which is located on the right of the instrument panel coaming. It cuts off power supply to the manual load-shedding DC bus, the inverter bus and the auto load-shedding DC bus.

PREHEAT SWITCH

The preheat switch has two positions, PREHEAT and OFF, and is located on the left console (refer to Fig FO 1-2). When the switch is selected OFF, power is supplied by the external power unit to the bus bars. When the switch is selected to PREHEAT the engine cannot be started but power is supplied to the :

a. battery DC bus,

b. radar and missiles for pre-heating,

c. gyro centre, and

d. telebrief installation.

[D] The PREHEAT switch is not fitted.

CIRCUIT BREAKERS

The circuit breakers (refer to Fig 1-16 and 1-16A), which protect certain equipment, are grouped on a panel located on the right console. They consist of bimetallic strips. One minute should be allowed to elapse after the CB operates before attempting a reset to allow the CB to cool. Holding the CB in will not close the switch if the fault still exists.

Circuit Breaker Panel - IIIO

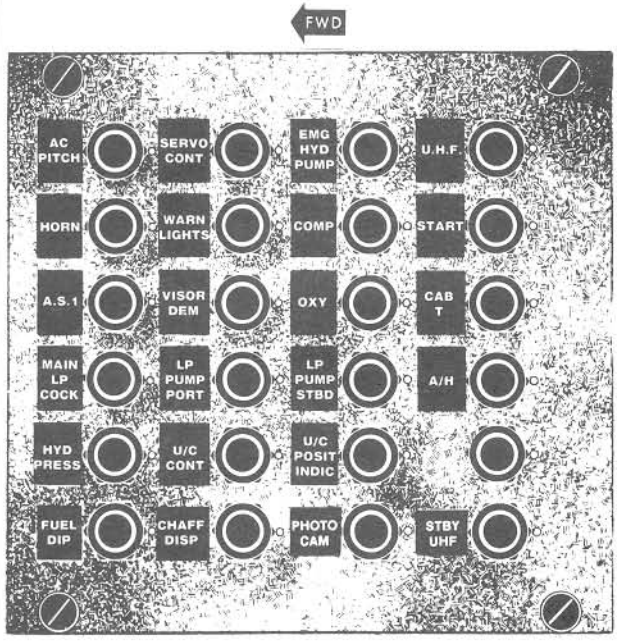


Figure 1-16

Circuit Breaker Panel - IIID

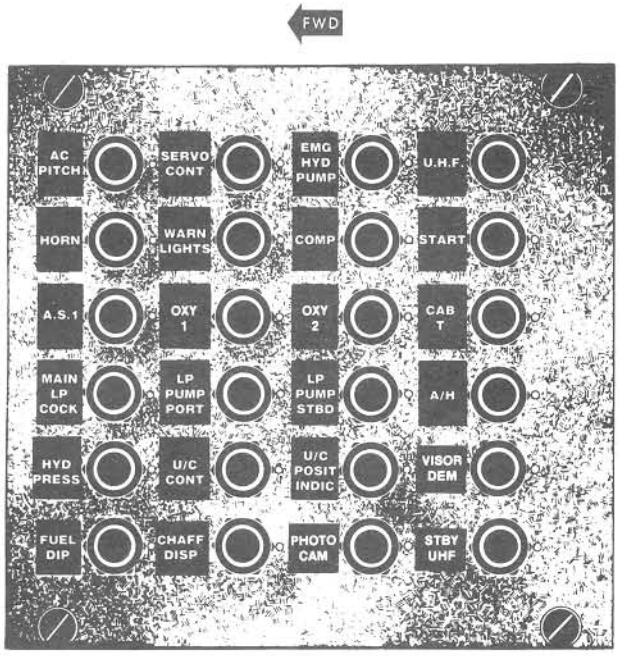


Figure 1-16A

MAIN FAIL PANEL

When illuminated, the BATT, GEN and ALT lights on the main fail panel (refer to Fig FO 1-5) indicate that the corresponding power sources are no longer supplying current to the bus bars. When one of these lights illuminates, the main FAIL light (refer to Fig FO 1-3) on the instrument panel also illuminates.

Note

The warning horn sounds when the GEN and ALT lights illuminate. If the main FAIL light is pressed, it extinguishes and the warning horn ceases to sound, but the specific warning light remains illuminated.

GROUND POWER CONNECTION LIGHT

When the light marked GRD CONN, which is located on the right panel, is illuminated, the pre-conditioning door or the ground power door is open.

[D] The pre-conditioning door is not fitted.

OPERATION ON THE GROUND

BEFORE STARTING WITH EXTERNAL POWER

The external power unit is connected, the BATT, ALT and INV switches are selected on and the GEN switch should be safety-wired on. Connection of the external power unit causes the external power receptacle contactors to open and isolate both the battery and the generator from the main DC bus and the alternator from the AC bus.

Note

When the external power unit is connected, the ENG and A/B fire warning lights and the amber A/B ON light may illuminate for a few seconds.

PREHEAT Switch OFF

When the PREHEAT switch is OFF the :

a. GRD CONN, BATT, GEN and ALT lights are on,

b. battery supplies power to the battery bus,

c. other bus bars are supplied by external power, and

d. MATRA missile is pre-heated.

PREHEAT Switch to PREHEAT

With the switch to PREHEAT the :

a. battery supplies power to the battery bus,

b. external power unit pre-heats the radar and missile,

c. gyro centre is operated normally, and

d. external power unit supplies power to the telebrief installation and its indicator light located on the communications selection panel on the left console.

All other lights are extinguished including the GRD CONN light. The engine cannot be started with the PREHEAT switch on PREHEAT and external power supplied to the aircraft.

ENGINE STARTING

The bus bars (except the battery bus) are supplied by the external power unit. Before engine start the PREHEAT switch must be OFF. The engine is then started.

AFTER START

When external power is disconnected, the external power receptacle contactors close and connect the aircraft power generation systems. As the DC power lead is removed the BATT and GEN warning lights extinguish. The ALT warning light extinguishes as the AC lead is removed. The GRD CONN light extinguishes as soon as the external power door is closed.

Note

The pre-conditioning door is normally closed.

ENGINE STARTING WITHOUT EXTERNAL POWER

The BATT switch is selected ON and the BATT warning light is extinguished. The ALT and GEN warning lights are illuminated. The LOADSHED

switch is selected ON. During the start the :

a. GEN light extinguishes when the RPM reaches 2000-2100, and

b. the ALT light extinguishes when the RPM reaches 2700.

The LOADSHED switch is selected OFF after the generator is on line.

Note

Starting the engine without external power places a high load on the battery. As well as selecting the LOADSHED switch ON avoid switching on DC services until after the generator is on line.

ELECTRICAL FAILURES

In the event of alternator or DC generator failure the aircraft is non-operational; the optical sight, missiles and the radar are unusable. However, the guns may still be fired and the bombs dropped because they are powered from the main DC bus.

HYDRAULIC SYSTEM

The flight controls and utility systems (refer to Fig FO 1-19) are powered by two hydraulic systems identified as the HYD 1 and HYD 2 systems. Both systems utilize engine-driven pumps which provide the same pressure, but the HYD 1 system has an associated emergency hydraulic system (EMG HYD) which operates at a lower pressure.

The elevon and rudder servo control jacks in the flight control system have dual barrels and are powered by both HYD 1 and HYD 2 pressure. The servo control jacks are controlled by two pre-servo jacks through a system of rods. The pre-servo jacks normally operate only on HYD 1 or EMG HYD but can operate on HYD 2 pressure if required. Their function is to act as booster units and to reduce friction in the control system.

HYD 1

The HYD 1 system powers one side of the dual-barrel elevon and rudder jacks and the pre-servo jacks. It also powers the following utility systems :

a. normal undercarriage operation,

b. wheel brakes,

c. speed brakes, and

d. park/emergency brake.

HYD 1 pressure is also used to power the oscar dashpot system which is a modifying device within the pitch channel of the flight control system.

HYD 2

The HYD 2 system powers the other side of the dual-barrel elevon and rudder jacks, the pitch dampers, and the emergency undercarriage extension. If required, it can also power the pre-servo jacks.

EMG HYD

The EMG HYD system is kept under pressure and powers the pre-servo and elevon and rudder jacks in the event of HYD 1 failure. The EMG HYD system does not, however, power the utility hydraulics if HYD 1 fails.

SYSTEM COMPONENTS

RESERVOIRS

The HYD 1 and HYD 2 reservoirs are located on the left and right side of the fuselage respectively, in front of the engine chamber. The usable fluid capacity is 18.2 litres (4 gal) for the HYD 1 reservoir, and 15.4 litres (3.25 gal) for the HYD 2 reservoir. Both reservoirs are pressurized with air bled from the compressor and reduced to 11.6 psi.

The reservoirs are fitted with valves to allow fluid supply during inverted flight. The HYD 1 reservoir incorporates a baffle which traps 3.86 litres (0.85 gal)for the EMG HYD system.

CAPACITOR UNIT

The capacitor unit is a probe, located on the HYD 1 reservoir wall which controls an electro-cock installed at the utility system inlet. When the level in the HYD 1 reservoir drops to 10.9 litres (2.4 gal), the capacitor unit isolates the utility system by closing the electro-cock. This unit is a safety device designed to maintain HYD 1 pressure to the flight controls if the utility systems are leaking.

HYD 1 AND HYD 2 PUMPS

The HYD 1 and HYD 2 pumps, have a 42 litres/min (9.2 gal/min) output at a rated pressure of 3000 psi. The HYD 1 pump is driven by the angle drive and the HYD 2 pump is driven by the aircraft gearbox. Both pumps are self-regulating in that they are constant pressure, variable ouput units.

EMG HYD PUMP

The EMG HYD pump is an electro-pump which delivers 6 litres/min (1.3 gal/min) at 2150 psi. The pump is located in the left wing in front of the wheel well. It is powered by the main DC bus and protected by the EMG HYD PUMP CB. The pump is

not self-regulating and its output is controlled by pressure switches which cause the pump to cut in at 1750 psi and to cut out at 2150 psi.

Before the engine is started, the EMG HYD PUMP CB is pushed in and the pump begins to cycle, maintaining the HYD 1 pressure between 1750 and 2150 psi. The pump cycles frequently due to pressure drop caused by hydraulic fluid being bled off through the oscar 'g' valve.

After the engine is started, the engine-driven pump pressurizes the HYD 1 lines to 3000 psi and the EMG HYD pump ceases to operate.

The EMG HYD pump draws a high current when operating. If the engine is being started on the battery, the pump should not be operated until after the start is finished. If two or more aircraft are connected to an external power source, the current drain caused by the operation of the EMG HYD pumps could cause the supply voltage to drop excessively, thereby jeopardizing the chances of a successful engine start.

Note

If the engine is being started on the battery, the EMG HYD PUMP CB should be out.

Excessive voltage drop is usually indicated by sluggish operation of the pump and cycling of the radios. In such a situation, the EMG HYD PUMP CB should be pulled out and reselected after engine start.

UTILITY SYSTEM ACCUMULATOR

The utility system accumulator is pressurized to 1400 psi. In the event of HYD 1 failure, the accumulator's capacity is sufficient to provide a limited amount of normal braking.

EMERGENCY BRAKE ACCUMULATOR

The emergency brake accumulator is pressurized to 1250 psi and is located in the emergency brake line of the utility system. If normal braking is lost through hydraulic failure, pressure is trapped in the emergency brake circuit. By operating the PARK EMG BRAKE on the right panel, the trapped pressure may be used to achieve wheel braking. The PARK EMG BRAKE is also used as a park brake.

SERVO-CONTROL ACCUMULATORS

The servo-control accumulators are used to reduce pressure surges in the flight control hydraulic circuits. The HYD 1 and HYD 2 accumulators are charged to 1400 psi and the EMG HYD accumulator is charged to 1050 psi.

HEAT EXCHANGERS

Operation of the hydraulic systems generates high kinetic heating which results in substantial expansion of the hydraulic fluid. The hydraulic fluid is cooled by being passed through a fuel heat exchanger. Fluid from both the HYD 1 and HYD 2 systems passes through the double barrel heat exchanger before returning to the reservoirs.

Note

The fluid within the emergency brake line is not circulated and kinetic heating results in fluid expansion.

COCKPIT INDICATORS

MAIN FAIL PANEL

A warning light is provided for each system on the second row of the main fail panel. The HYD 1 light (left) and the HYD 2 light (centre) illuminate when the pressure falls below 2000 psi and extinguish when the pressure builds up above 2350 psi. The EMG HYD light illuminates when the pressure falls below 1300 psi and extinguishes when the pressure rises above 1650 psi.

When any one of these lights illuminates the main FAIL light also illuminates. When either the HYD 2 or the EMG HYD lights illuminates, the warning horn sounds.

DUAL HYDRAULIC PRESSURE GAUGE

The dual hydraulic pressure gauge (refer to Fig 1-17) and its two-position selector switch is located on the right panel. The gauge is powered by the main DC bus through the HYD PRESS CB.

D The gauge and switch in the rear cockpit is on the right of the instrument panel.

Dual Hydraulic Pressure Gauge

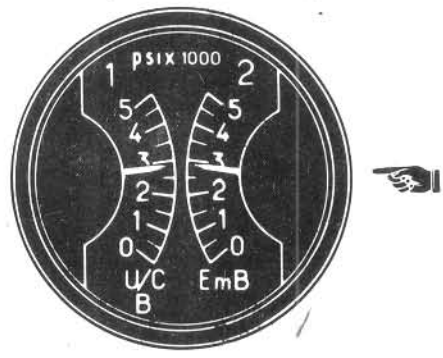


Figure 1-17

The indications corresponding to switch positions are :

Switch Position		L Gauge	R Gauge
SERVO		HYD 1 pressure	HYD 2 pressure
U/C BRAKE	EMERG BRAKES	U/C, wheel brakes and speed brakes pressure	Emergency brake pressure

The pressure normally indicated in all systems is 2900 psi. With HYD 1 failed, and the selector switch set to SERVO (up), the left pressure gauge indicates emergency pressure of 1750 to 2150 psi. Since the HYD 1 and EMG HYD systems have a common pressure pick-off, the EMG HYD pressure may only be read if HYD 1 pressure falls below 1750 psi and the EMG HYD pump comes on-line (as is the case before engine starting). If the HYD 1 pump fails, the reading is not HYD 1 = 0 but HYD 1 = 1750 to 2150 psi, ie the pressure in the servo-control system supplied by the emergency pump.

In flight, the selector switch is normally set to the down position. This enables the U/C B and Em B pressures to be monitored. Warning of a HYD 1, HYD 2 or EMG HYD failure is given by the appropriate lights.

CAPACITOR UNIT FAILURE

The capacitor unit may operate erratically and cause the electro-cock to isolate the ancillaries for no apparent reason. This type of failure is detected only when the U/C is lowered or the speed brakes are extended. The failure is indicated by the U/C B pressure dropping to zero while the other pressures remain normal. In the event of a capacitor unit failure, carry out the procedures required for a HYD 1 failure.

CAUTION

- Operation of the electro-cock presents the pilot with the same symptoms as a full HYD 1 failure but without a positive warning.
- Pilots are to check that U/C B pressure returns to normal every time a service provided from the HYD 1 system is used.

Note

When the EMERG U/C handle is used, the return line hydraulic fluid is diverted to the HYD 1 reservoir. The pilot should check to see if this has caused a build up of U/C B pressure.

HYD 1 AND HYD 2 FAILURE

A combined HYD 1 and HYD 2 failure could occur if the engine seizes, if the kinematic drive train fails or if both hydraulic pumps fail. Under these circumstances, the EMG HYD pump provides EMG HYD pressure to the flying controls. Because of the high power consumption by the EMG HYD pump, battery life is limited to about eight minutes.

Note

- If the hydraulic gauge gives unusual pressure readings, check the HYD PRESS CB.
- When either the HYD 1 or HYD 2 system fails, the elevon servo control jacks are supplied only through one barrel. Consequently maximum performance manoeuvres at high IAS may not be possible. This lack of performance is more noticeable in the case of a HYD 2 failure because the pitch dampers are inoperative.
- If the emergency involves engine shut-down on landing, select the HORN switch OFF prior to landing to avoid distraction.

FLIGHT CONTROL SYSTEM

The aircraft's wide flight envelope and its wing planform require a flight control system designed to cope with the following factors :

a. reduction in control efficiency at supersonic speeds,

b. movement of the centre of pressure,

c. instability of the delta wing at low speed, and

d. high aerodynamic loads on the control surfaces.

Control is achieved by the conventional control column and rudder pedals which, depending on selection, transmit orders either mechanically or electrically to the hydraulic actuators.

CONTROL COLUMN HAND GRIP

The top of the hand grip (refer to Fig 1-18) contains the pitch and roll trim switch and armament controls consisting of :

a. The fold-forward trigger which operates the sight camera and the guns by pressing two pressure push-buttons on the front of the hand grip. The first pressure operates the lower

Control Column Hand Grip

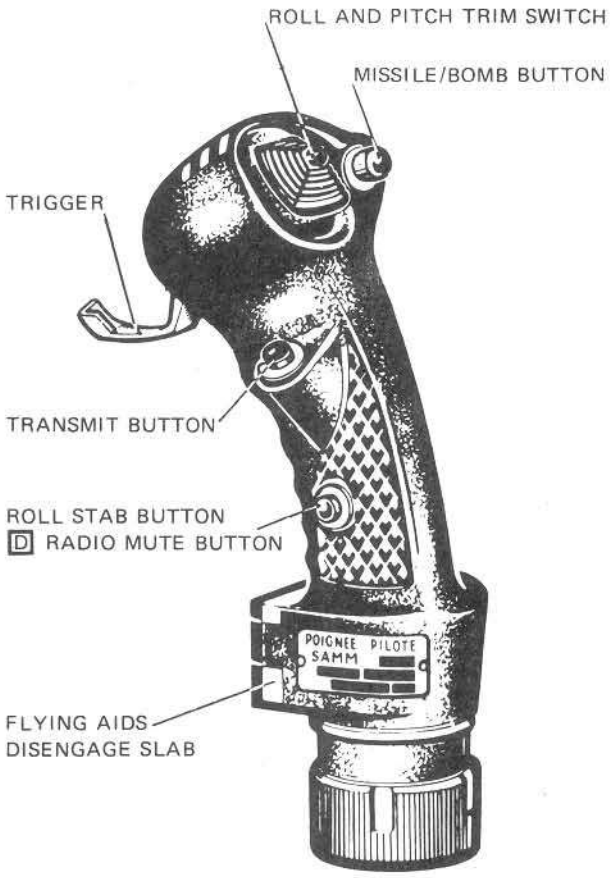


Figure 1-18

camera button. The second pressure operates the top button which fires the guns.

b. The missile/bomb button which is protected by the trigger when the trigger is folded back to the rest position. This button fires Matra, Sidewinder and the target rocket, and releases the bombs, dependent upon the selection of the weapons system selector.

The left side of the hand grip contains :

a. at the top, a transmit button;

b. at the centre, a roll stab engage/disengage button, and

c. at the base, the flying aids disengage slab which disengages autocommand and roll stab.

[D] The button at the centre is a radio mute button. Roll stab is not fitted.

SPIN RECOVERY MARKS

Three sets of spin recovery marks, consisting of yellow and black stripes, are located on the left and right cockpit walls and the control column hand grip. When the three sets of marks are in line, the neutral pitch position for spin recovery has been achieved.

CONTROL SURFACES

ELEVONS

The elevons perform the functions of both elevators and ailerons. The elevons on each mainplane are constructed in two sections which operate together as a single surface.

RUDDER

The rudder is of conventional construction and is hydraulically powered. It also serves as a yaw damper.

PITCH DAMPERS

The pitch dampers are on the trailing edge of the wing, inboard of the elevons. They serve the dual purpose of :

a. damping oscillations in the pitching plane, and

b. assisting the elevons in the pitching plane.

SERVO-CONTROLS

ELEVON JACKS

The elevons are powered by four double-barrel jacks (refer to Fig 1-19), one jack to each elevon section. One barrel of each jack is fed HYD 1 pressure and the other is fed HYD 2 pressure. Both barrels are connected in series to a single piston rod and operated by mechanically interconnected slide valves. For safety reasons the jacks are powered by both HYD 1 and HYD 2 pressure during normal operations.

RUDDER JACKS

The rudder jack is similar to the elevon jacks except that the HYD 2 barrel is equipped with an electronically operated slide valve to accept yaw damping inputs. During normal operations the jack is powered by both HYD 1 and HYD 2 pressure.

PITCH DAMPER JACKS

The pitch damper jacks are powered only by HYD 2 pressure through a single barrel. The slide valves are operated electronically.

HYDRAULIC FAILURES

The effect of a hydraulic failure on the power output of the control surface jacks, as a percentage of power

Elevon Jack

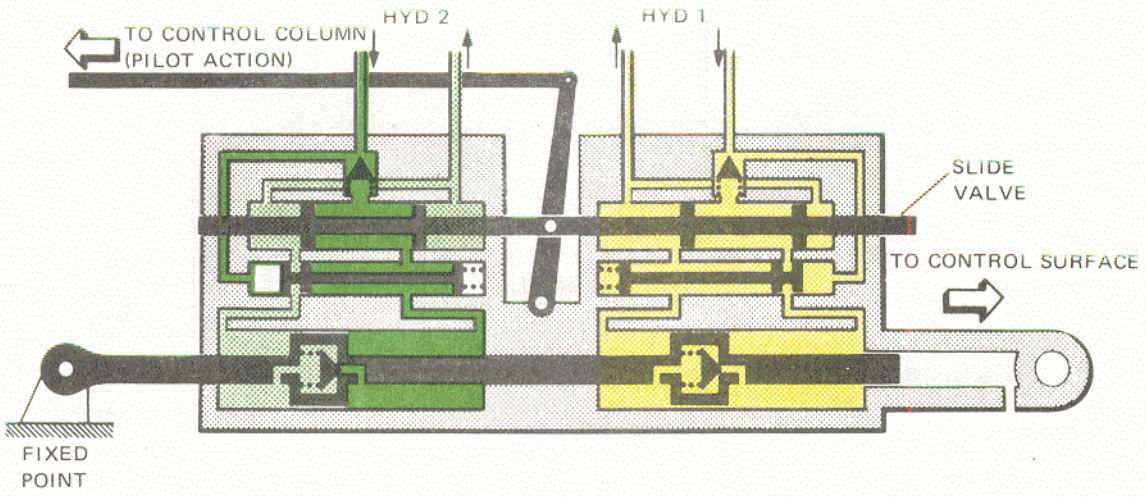


Figure 1-19

available before the failure, is shown below.

Failure	Elevons	Rudder	Pitch Dampers
HYD 1	72	72	100
HYD 1 & EMG HYD	50	50	100
HYD 2	50	50	-

PRE-SERVO CONTROLS

PRE-SERVO JACKS

Movement of the control column does not directly operate the elevon jacks. Control column movements are divided into pitch and roll channels and these movements are passed through booster units known as pre-servo jacks (refer to Fig 1-20). The function of the pre-servo jacks is :

a. to take up frictional forces imposed by the mechanical linkages, thus reducing pilot effort, and

b. to accept command signals when operating in the electronic mode.

The pre-servo jacks are similar in operation to the elevon jacks except that the HYD 1 barrels are fitted with additional slide valves which may be operated electronically. In normal operations, only the HYD 1 barrels are used.

HYDRAULIC FAILURES

HYD 1 Failure

The EMG HYD takes over in the HYD 1 barrel and the pre-servo continues to operate in either mechanical or electronic mode.

HYD 1 and EMG HYD Failure

The HYD 1 barrels become inoperative and operation is automatically transferred to the HYD 2 barrels.

HYD 2 Failure

The HYD 2 barrels are inoperative and are no longer on stand-by.

MECHANICAL CONTROL COMPONENTS

ARTIFICIAL FEEL UNIT

The artificial feel unit (AFU) is a simple spring unit which provides an artificial feel force according to the control displacement from the trim position. AFUs are fitted to the pitch, roll and yaw channels.

TRIM ACTUATORS

The trim actuators vary their respective AFU neutral settings. They are controlled electronically

Pre-servo Jack

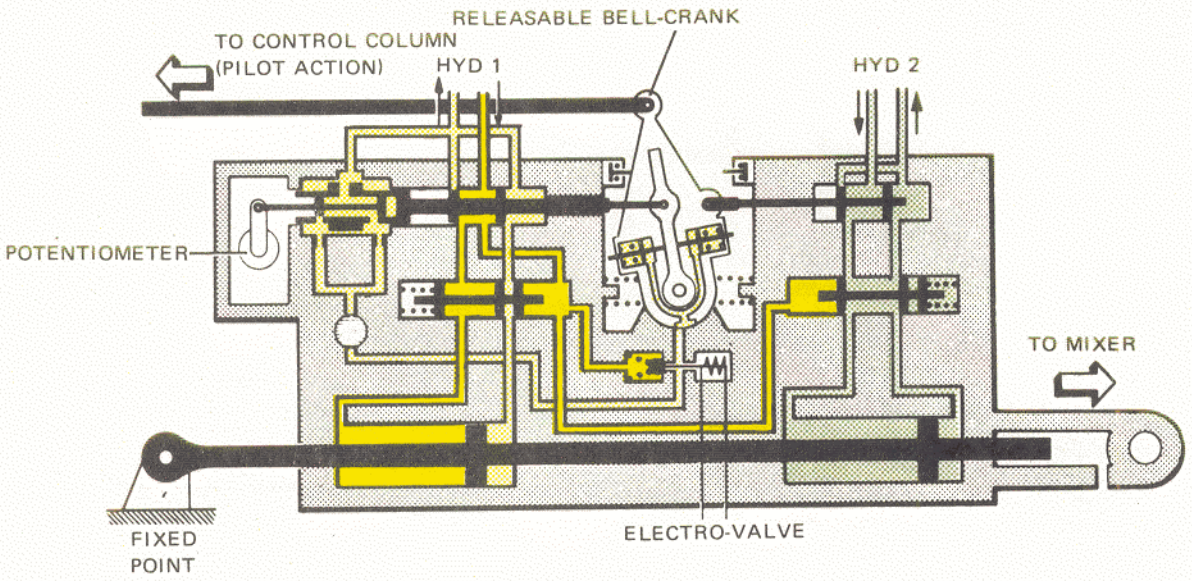


Figure 1-20

in pitch and roll by a five-position switch located at the top of the control column hand grip, and in yaw by a switch on the left console. The trim neutral position is indicated when the appropriate trim light on the left console is extinguished.

Note

- The take-off pitch trim position is set by trimming back until the light extinguishes and illuminates again, and then trimming forward until the light extinguishes.
- The take-off roll and yaw trim positions are set by trimming until the lights extinguish, and then continuing to trim in the same direction for a further 1.5 - 2 seconds.

DASHPOT JACK

The dashpot jack is designed to reduce the chance of over-controlling in pitch at high IAS and high 'g'. It is a small two-way hydraulic damper which stiffens the control column in proportion to the speed at which it is moved. To reduce the stiffening effect at low speed, a valve, operated by an IAS capsule between 200-500 kn, controls hydraulic fluid bleed between the barrels of the dashpot. Thus, on take-off or landing, the IAS valve is fully open, presenting the minimum restriction to bleed oil through the dashpot. Above 500 KIAS, the IAS valve is fully closed and allows no bleed oil to pass through it. Because the dashpot uses HYD 1 return fluid, it operates even if the HYD 1 pressure is zero.

OSCAR 'g' VALVE

The oscar 'g' valve is a component which stiffens the control column in pitch in proportion to the 'g' loading. It consists of a small hydraulic jack which incorporates a 'g' valve. As 'g' increases, the valve closes and allows HYD 1 pressure to operate against the jack. The jack applies a force through the pitch channel in the opposite direction to the force being applied by the pilot. The valve is inoperative when the HYD 1 pressure falls to zero.

AMEDEE

The amedee is a variable reduction ratio bell crank which increases the control link gearing ratio at the extremities, thus reducing control column sensitivity in both pitch and roll near the neutral position.

MIXER

The mixer consists of a multiple bell crank assembly connected to the pitch and roll pre-servos. The unit (refer to Fig 1-21) algebraically combines the outputs from the pre-servos and mechanically transmits the required demands to the elevon jacks. The mixer also sends an electrical pitch signal to the pitch dampers.

Deflection of Elevons and Pitch Damper Surfaces

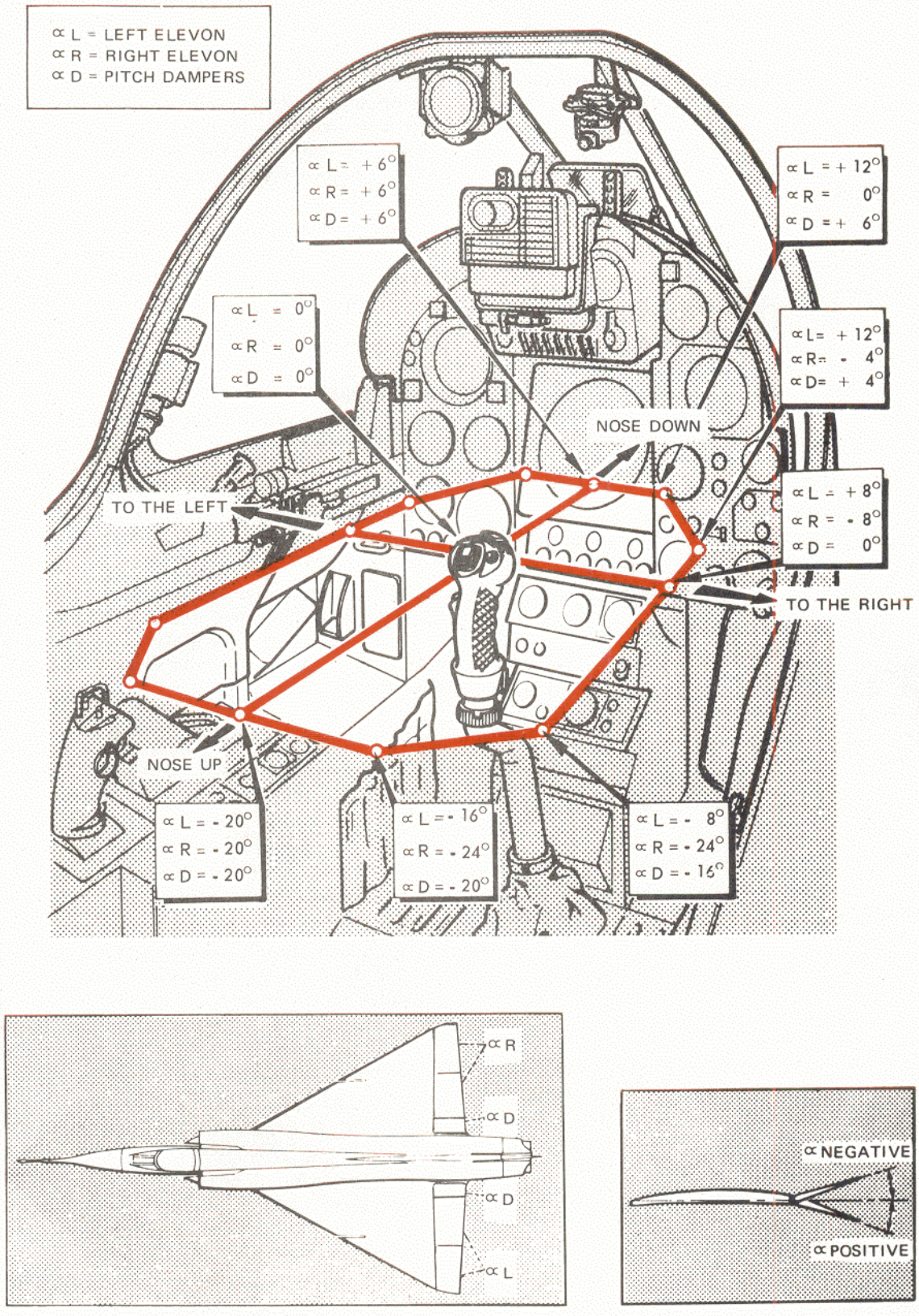


Figure 1-21

MECHANICAL OPERATION

Displacement of the control column is resolved into pitch and roll outputs (refer to Fig FO 1-20), which are transmitted through separate channels to individual pre-servos. The pitch and roll demands are then re-combined in the mixer unit

PITCH CHANNEL

The pitch signal is mechanically transmitted to the pitch pre-servo. The sensitivity of the channel, ie the stick force felt by the pilot, is modified by the amedee, AFU, trim unit and oscar dashpot.

ROLL CHANNEL

The roll signal is mechanically transmitted to the roll pre-servo. Roll sensitivity is modified by the amedee, AFU and trim unit.

WARNING

If jamming or stiffness of the controls in either pitch or roll occurs, the emergency disengage switch should be set to EMERG.

YAW

Displacement of the rudder pedals mechanically transmits a signal to the rudder jack (refer to Fig 1-22). The sensitivity of the signal is modified by the AFU and trim unit.

ELECTRONIC OPERATION

Electronic operation of the flight controls is achieved in pitch through auto-command and altitude lock, and in roll through roll stabilization. When the controls are operated electronically, the mechanical linkages do not transfer orders to the pre-servos but the mechanical control system always remains aligned with the electronic system in case of electronic system failure.

In pitch, any force on the control column by the pilot is converted into an electrical signal which, after amplification and modification, drives a torque motor that operates the slide valve in the pre-servo.

In roll, the electronic system operates in a similar manner but the aircraft is slaved to a pre-set heading. The electronic signal to the roll pre-servo is transmitted by the gyro reference system.

The inboard control surfaces are controlled electronically so that their mean position matches the position of the elevons to assist in pitch control. The surfaces also move about the mean position to provide damping in pitch. The rudder is controlled electronically to move about the mean position achieved mechanically to provide damping in yaw.

[D] Roll stabilization is not fitted.

DAMPER OPERATION

Electronic damping circuits are provided for both pitch and yaw, and are selected by the appropriate plunger on the flying aids panel on the front left panel.

Pitch Dampers

The pitch dampers (refer to Fig 1-23) are individually powered by two single-barrel, electrically-controlled jacks provided with HYD 2 pressure.

The pitch order from the mixer is converted to an electrical signal by a potentiometer and passed through an amplifier to the jacks. The pitch dampers follow the motion of the elevons when pitch action is demanded.

A pitch rate gyro detects oscillations in pitch in the 3-10 cycles/sec range and sends an opposition signal through the amplifier to the pitch damper jacks. The pitch dampers then operate up to ±1.5° about the mean elevon position and damp out the aircraft pitch oscillations.

Yaw Damper

When the yaw damper (refer to Fig 1-22) is engaged, HYD 2 pressure unlocks a releasable bell crank, thus disengaging the mechanical linkage from the rudder pedals to the servo jack. The mechanical signal from the rudder pedals is now converted to an electrical signal by a potentiometer and this is used to operate the slide valves of the servo jack.

A yaw rate gyro detects yawing oscillations and operates the rudder up to ± 2° about the mean position to oppose the oscillations. This signal is superimposed on top of the electrical signal that operates the jacks.

AUTOCOMMAND

The autocommand acts only in pitch and has the following functions:

a. It maintains a pitch attitude for about two minutes, permitting the pilot to release the control column for this period of time. Beyond this period the pitch attitude slowly varies due to gyro drift.

b. It cancels the oscar dashpot and AFU effects, and applies a simpler force law to the control column. The force to be applied to the control column is about 3 kg (6.6 lb) per 'g'. This figure varies slightly throughout the speed range to provide realistic stick forces.

c. It reduces the pitch up that occurs when the aircraft is decelerated through the transonic region with 'g' applied.

d. It cancels small nose-up and nose-down trim changes which may occur when the undercarriage or speed brakes are operated or when the pitch dampers fail.

e. It incorporates an altitude lock which maintains the altitude at which the aircraft was flying when

Rudder Control - Yaw Damper

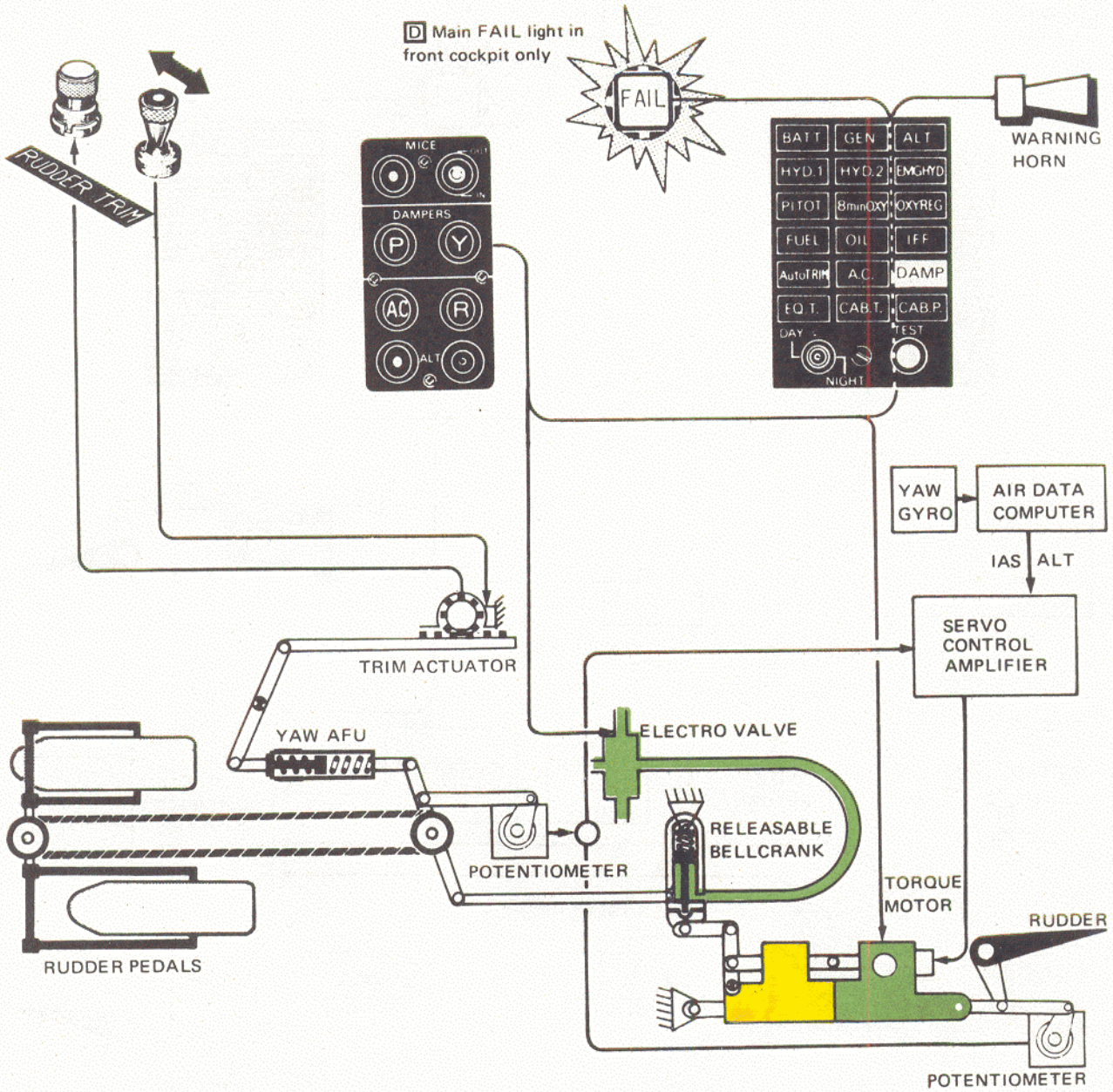
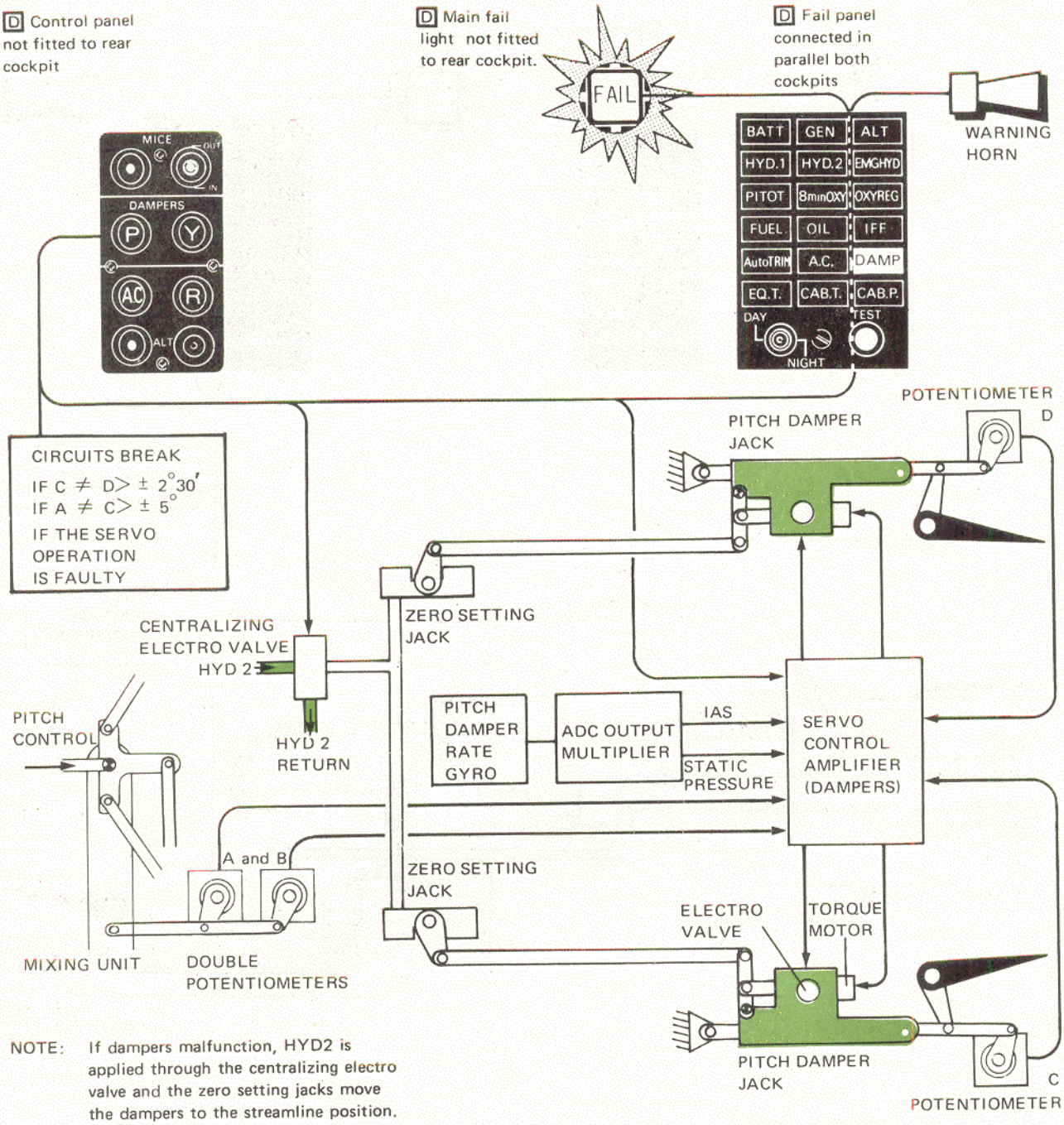


Figure 1-22

Pitch Damper



NOTE: If dampers malfunction, HYD2 is applied through the centralizing electro valve and the zero setting jacks move the dampers to the streamline position.

Figure 1-23

the system was engaged (accuracy ± 54 ft at sea level, ± 220 ft at 40 000 ft).

ENGAGEMENT

The autocommand uses both AC and DC power from the auto load shedding buses. After engine start, when internal AC and DC is powering the aircraft, engage the autocommand pitch and roll circuit breaker (marked AC PITCH ROLL). After a one minute warm-up time, engage the A.C. plunger on the flying aids panel.

NORMAL OPERATION

In mechanical operation (refer to Fig FO 1-20), pitch signals are transmitted by rods from the control column to a bell crank on the body of the pitch pre-servo. The movement of this bell crank operates the slide valves within the pre-servo. When autocommand is selected (refer to Fig FO 1-21), HYD 1 pressure locks this bell crank to the body of the pitch pre-servo.

Movements of the control column in pitch are detected by the linkage dynamometer located at the base of the control column. The force applied to the control column is transmitted as an electronic signal to an amplifier, where it is modified according to altitude, MN and IAS. The amplified signal is then transmitted to a torque motor on the pitch pre-servo. The torque motor operates slide valves which in turn operate the pre-servo jack. Movement of the pitch pre-servo causes the mechanical connections, including the modifying devices between the control column and the pre-servo, to move. Operation of the flight controls from the pre-servo to the elevons is the same as the mechanical operation.

Attitude Maintenance

Attitude maintenance is achieved by using a rate gyro. This gyro has ± 20° freedom of movement around the selected attitude and its sensitive axis is aligned vertically through the aircraft. Any divergence from the desired aircraft attitude is detected by the gyro, which transmits a corrective signal, modified by flight conditions, to the pitch pre-servo.

The gyro is sensitive to low frequency oscillations (0 - 3 cycles per second) and the autocommand dampens slight pilot-induced oscillations caused during trim or attitude changes. However, the rate gyro is not sensitive to the higher frequency oscillations, and does not operate as a pitch damper.

Attitude Changes

Movement of the control column sends a signal through the amplifier to the pre-servo. This signal is also sent to precess the gyro to the new attitude. Because the gyro precession rate is slower than the attitude change, the new attitude must be selected and maintained for 2 - 3 seconds to allow the gyro time to precess.

Feel and Control Effectiveness

During an attitude change or a turn, the gyro precession rate is slower than the attitude change rate. The autocommand amplifier then receives signals from the dynamometer and the gyro which are in opposition to each other. To achieve the desired rate change of attitude ('g') the pilot must overcome the opposition from the gyro with a greater force on the control column. This extra force required to balance the opposing signal from the gyro is the 'feel'.

For a certain control displacement, the required amplitude of elevon displacement varies with flight conditions because control surface effectiveness varies with altitude, Mach number and IAS. Aneroids are used to vary the autocommand potentiometers to achieve the correct ratio of input to output signal. The precession rate of the gyro is also modified by the potentiometers, so that a constant stick force per 'g' is felt irrespective of flight conditions.

Autocommand Gain Switch

This switch marked GAIN A.C. is located above the flying aids panel. The switch has two positions - FWD and AFT. Its function is to improve the performance of the autocommand for configurations in which the centre of gravity is further aft than normal, eg when 286 or 374 gal wing tanks are fitted.

AUTO TRIM SYSTEM

The auto trim system consists of a dynamometer which detects any forces on the mechanical linkages. If a compression or extension of the linkages is detected, a signal is sent via the amplifier to the pitch trim unit, which is driven until the force is reduced to zero.

With the autocommand engaged and undercarriage up, the auto trim device keeps the mechanical system aligned with the electronic system. This prevents abrupt pitch trim changes, which are due to an out of trim force being applied by the AFU, on disengagement. The pitch trim switch is inoperative with autocommand engaged and undercarriage up.

Auto TRIM Warning Light

Whenever the trim dynamometer detects a force on the mechanical linkages which cannot be removed, it operates the Auto TRIM light on the main fail panel. The auto trim only works through a trim range corresponding to an elevon position from 2° down to 7° up. The Auto TRIM warning light may therefore blink as a result of large control column movements, eg during aerobatics or tactics.

Undercarriage Down

With the undercarriage down, the pitch trim switch becomes operative. By operating the pitch trim switch, a signal is sent to the amplifier and there combined with the signal from the dynamometer at

the base of the control column. The result of this combination is used to drive the pitch pre-servo.

WARNING

Failures of the autocommand system may result in serious flight control problems. The use of autocommand is normally prohibited at heights less than 1000 ft above terrain and during ground attack manoeuvres. However, some flight control emergencies can occur in the manual system which can be by-passed electronically by using autocommand.

DISENGAGEMENT

The normal method of disengagement occurs electrically by operating the flying aids disengage slab on the front of the control column, however the autocommand also disengages when the A.C. plunger is pulled.

EMERGENCY DISENGAGEMENT

When the autocommand is electrically disengaged, the electro-valve in the pitch pre-servo closes and unlocks the bell crank from the body of the pre-servo. If this valve does not close, HYD 1 pressure continues to lock the bell crank to the pre-servo and the control column jams.

When the emergency disengage switch, located on the left side of the instrument panel coaming, is selected from NORMAL to EMERG, a dual selector electro-valve isolates HYD 1 pressure from the pitch and roll pre-servos. The bell crank is released and the pre-servos continue to operate using the HYD 2 barrels.

WARNING

The emergency disengage switch should be set to the EMERG position if jamming of the control column occurs in either pitch or roll.

SAFETY FEATURES

If the autocommand amplifier, alternator, or generator fails, the A.C. plunger pops, the A.C. warning light on the main fail panel illuminates and the horn sounds.

During autocommand operation, the elevon position is electrically transmitted to the amplifier and compared with the pitch demand signal. If the difference is too great, the autocommand disengages. Similarly, autocommand engages only if both signals are in close agreement. Thus any force that is applied to the control column must be released before autocommand will engage.

Note

If the controls jam in pitch and the pilot tries to move the controls with a force exceeding 20 kg (45 lb), a microswitch in the pitch pre-servo trips and the autocommand is disengaged.

ALTITUDE LOCK

Altitude lock uses two pressure differential sensing units to measure variation from selected altitude. The signal from one unit is modified for flight conditions in the autocommand amplifier and then passed to the pitch pre-servo. The second unit is part of the safety system.

Engagement

Altitude lock is engaged by pressing the ALT plunger located under the A.C. plunger on the flying aids panel. Engagement can be performed :

a. in level flight, or

b. upon passing the desired altitude when climbing or descending at less than approximately 1200 ft per min (the rate of climb or descent is smoothly stopped and the aircraft returns to the desired altitude).

Engagement cannot be performed when :

a. the undercarriage is down,

b. the autocommand is not engaged, or

c. the aircraft is in the transonic range (M 0.95 - M 1.15).

Disengagement

The altitude lock is manually disengaged by pressing the red ALT button located on the flying aids panel adjacent to the ALT plunger. Disengagement is automatically performed :

a. when autocommand is disengaged,

b. when the undercarriage is lowered, or

c. between M 0.95 and M 1.15.

Override Action

If the pilot takes command of the aircraft and changes altitude from that selected, altitude lock and autocommand disengage when the pressure differential exceeds 7 mb. Autocommand and altitude lock can be re-engaged in that order.

Note

A differential pressure of 7 mb corresponds to 200 ft at sea level and 700 ft at 40 000 ft.

Safety Features

Altitude lock has two safety features :

a. ***Total Error Altitude Lock Safety.*** If the pressure differential between actual altitude and that at which the altitude lock was engaged exceeds 7 mb, autocommand and altitude lock disengage.

b. ***Differential Altitude Lock Safety.*** The static pressure detector associated with altitude lock is duplicated, and the two static pressure values

are compared. Any discrepancy in excess of 7 mb between the two static values of S2 and S3 (refer to Fig 1-28) causes autocommand and altitude lock to disengage. This safety feature is effective only below M 0.95.

Note

At M0.95, an airspeed switch in the ADC cuts power to the altitude lock hold-in solenoid causing the ALT plunger to pop. Altitude lock may be reselected at M1.15.

ROLL STABILIZATION

The lateral stability of the aircraft is not sufficient to hold wings level with the control column free. When engaged, roll stabilization (roll stab) (refer to Fig FO 1-22) holds a constant heading (the aircraft heading on engagement) and maintains the wings level.

[D] Roll stabilization is not fitted.

OPERATION

When roll stab is engaged and the aircraft either banks or varies heading, the gyro centre produces a correcting signal which is amplified and passed to the torque motor of the roll pre-servo jack.

Note

The roll information utilized by the roll stab is the same as that being fed to the Bezu ball. Consequently any gyro centre errors show up on both the Bezu ball and the roll stab.

ENGAGEMENT

When the roll stab plunger (marked R) on the flying aids panel is pressed and remains in, the system is ready for operation. To engage roll stab, press the roll stab button on the control column (refer to Fig 1-18) and :

a. if the bank is 2° or less, roll stab is immediately engaged, or

b. if the bank exceeds 2°, the roll stab is engaged when the bank is reduced to less than 2°.

DISENGAGEMENT

Normal disengagement is achieved by pressing the roll stab button on the control column. The roll stab is also disengaged if the R plunger on the flying aids panel is pulled.

EMERGENCY DISENGAGEMENT

If the roll stab fails to disengage normally, the flying aids disengage slab on the front of the control column should be operated. If this also fails, the emergency disengage switch should be selected from NORMAL to EMERG.

Note

If the roll stab fails to disengage and the pilot applies an 8 kg (18 lb) force in roll, a microswitch on the roll pre-servo trips and the roll stab disengages.

UTILITY SERVICES

There are five hydraulic utility services which are operated by pressure from the HYD 1 and HYD 2 systems. HYD 1 operates the normal undercarriage extension, normal wheel braking, speed brakes, and park and emergency braking. HYD 2 operates the emergency undercarriage extension.

UNDERCARRIAGE SYSTEM

COCKPIT CONTROLS

Undercarriage Lever

The undercarriage lever, marked U/C CONT, is located on the left panel. It operates the undercarriage extension and retraction sequences through an electro-hydraulic system. Above the U/C CONT lever is a red pushbutton. Pressing this button isolates the undercarriage ground safety microswitch on the left main wheel oleo.

WARNING

Operation of the red button and selection of undercarriage up while the aircraft is moving at speed on the ground could result in the aircraft rolling onto its back.

Emergency Undercarriage Handle

This handle, marked EMERG U/C, is positioned above the U/C CONT lever. It can only be used to extend the undercarriage, and employs a mechanical-hydraulic system. When operated, the handle must be left in the out position unless further failures dictate otherwise. Correct actions are detailed in Section 3.

[D] The EMERG U/C handle is in the front cockpit only.

WARNING

To prevent an inadvertent undercarriage retraction on the ground, the U/C CONT lever should be set to the down position after the undercarriage has been lowered using the emergency method.

Undercarriage Circuit Breakers

The circuit breaker marked U/C CONT protects the undercarriage sequencing circuits. The circuit breaker marked U/C POSIT INDIC protects the indicating circuits.

UNDERCARRIAGE FLIPPER DOOR HANDLES

The undercarriage flipper door handles are used to open the flipper doors on the ground.

The nose wheel door is lowered by means of a black and yellow handle on the left side of the nose wheel well.

The main wheel doors are lowered by means of two T-shaped handles housed just in front of the main undercarriage legs.

Note

With hydraulic pressure available (engine running or pressure in the accumulator), the three doors close only when all three flipper door handles are moved to the up position.

During the external inspection before flight, check that the left main flipper door handle is down, then set the nose and right main flipper door handles to the up position. During pre-start checks, check that the U/C B pressure is zero and ask the groundcrew to set the left flipper door handle (third handle) to the up position. If the U/C B pressure is not zero, the speed brake should be operated to reduce it to zero.

If an U/C door handle has been inadvertently left down or the U/C doors fail to retract after the engine is started, the engine is to be shut down and the U/C B pressure bled to zero with the speed brakes before making any attempt to correct the position of the U/C handles or the U/C CONT CB.

Ensure that U/C B pressure has been bled to zero before permitting the ground crew to approach the aircraft following a dry ventilation, mistart or shutdown.

WARNING

With hydraulic pressure available, the flipper doors close very quickly and, if this happens inadvertently, the safety of persons under the aircraft could be jeopardized.

HEAVY LANDING TELL-TALE

A lead tell-tale located between the undercarriage leg rear face and wing spar provides visible indication that the aircraft has been subjected to a possible heavy landing. If the lead has been marked, the undercarriage should be inspected.

UNDERCARRIAGE INDICATORS AND WARNING SYSTEMS

Undercarriage Position Indicator

The undercarriage position indicator is located on the top left side of the centre pedestal. It contains:

a. A red light at the top which illuminates if one or more flipper doors are not up and locked. The light functions regardless of U/C position.

b. Three green lights at the bottom which represent the undercarriage legs. The centre light indicates steady green when the nose wheel is down and locked. The other two green lights blink when the corresponding main undercarriage leg is down and locked by the lateral jacks, and indicate steady green when the legs are locked back by the longitudinal jacks.

CAUTION

On landing, the double flasher unit controlling the main U/C indicator lights is disabled. Consequently, a blinking green light whilst airborne will be extinguished when the aircraft lands. The light extinguishing does not necessarily indicate that the lateral jack has unlocked.

c. An outer dimming ring and a press-to-test button in its centre. The indicator is provided with only one set of bulbs.

[D] The indicator is located on the instrument panel.

Undercarriage Warning Light

The undercarriage warning light, marked U/C, is located on the left of the instrument panel. It flashes red if all three undercarriage legs are not down and locked, when the throttle is retarded below 8000 RPM with an IAS less than 240 kn ± 10 kn.

Note

- The U/C warning light should not be used to determine the U/C extension speed. Refer to the ASI.
- As the 240 kn airspeed capsule is located in the nosewheel well, the air pressure change which occurs when the nosewheel flipper door opens may alter the IAS at which the U/C warning light flashes. With the nosewheel down or the flipper door open, IAS may have to be as low as 210 kn before the U/C warning light continues to flash through the extension cycle. When the nosewheel is locked down and the main wheels are locked laterally, the U/C warning light extinguishes.

Undercarriage Beeper

Operation of a pushbutton, labelled U/C DOWN, on the left side of the instrument panel transmits a steady 800 Hz tone through both radios if the undercarriage is down and locked (the main undercarriage legs may be locked in either the forward or aft position). This device provides a further check that the undercarriage is down and locked.

If the undercarriage is extended using the EMERG U/C handle :

a. the flipper doors remain open and the red UNSAFE indicator light is illuminated,

b. the beeper is inoperative, and

c. the U/C warning light flashes until the undercarriage is down and locked.

Note

If the EMERG U/C handle is used to lower the U/C, the beeper is inoperative but the U/C warning light confirms the U/C condition providing IAS is below about 210 kn, the throttle position is below 8000 RPM and the light was checked serviceable prior to gear selection.

U/C Positions and Indications.

The U/C positions and the corresponding indications are :

U/C Position	Indicator	U/C Warning Light	U/C DOWN Beeper
Retracted	All lights out	Out, only flashes if IAS $<240 \pm 10$ kn and RPM <8000	Inoperative
Extended	1 red out 3 green on	Out	Operative
Extended in emergency	1 red on 3 green on	Out	Inoperative

OPERATION

The U/C CONT lever operates the undercarriage system (refer to Fig 1-24) using DC power from the main bus and hydraulic pressure from the HYD 1 system.

Normal Extension

Operation of the U/C CONT lever results in the following sequence :

a. the flipper doors open,

b. the three legs extend and are locked down by the extension jacks, and

c. the main legs move back and are locked by their longitudinal jacks; simultaneously, all flipper doors close.

When the aircraft is supported by the landing gear, the U/C CONT lever is mechanically locked in the down position to prevent inadvertent retraction on the ground. The lever locking device can be overridden by depressing the red button above the undercarriage lever.

Retraction

The retraction sequence is the reverse of the extension sequence. When the U/C CONT lever is selected up :

a. the flipper doors open, the main leg longitudinal jacks unlock and the main legs move forward,

b. the three extension jacks unlock and the legs retract, and

c. the flipper doors close.

Operating Time

The normal operating time for the undercarriage is six seconds for extension and seven seconds for retraction.

Emergency Extension

Pulling the EMERG. U/C handle manually selects HYD 2 pressure and isolates all electrical actuation and sequencing. It opens the flipper doors and lowers the undercarriage regardless of the U/C CONT lever position. As there is no electrical sequencing, the lateral and longitudinal jacks on the main wheels operate simultaneously, and the flipper doors remain down.

WHEEL BRAKES

NORMAL BRAKING

Normal braking and directional control whilst taxiing is achieved by differential toe-operated brakes (refer to Fig 1-25). Operation of a brake pedal meters HYD 1 pressure to the single disc brake. Below 8000 RPM the metering device limits braking pressure to a maximum of 942 psi. When the engine speed exceeds 8000 RPM, the maximum braking pressure is increased to 2000 psi. Change-over to the higher maximum (second) brake pressure can be felt as a slight depression of the pedals when full pedal deflection is being used. The second brake pressure holds the aircraft with full dry power selected, but with A/B selected, adhesion is lost and the aircraft skids.

CAUTION

- Afterburner should not be selected until the aircraft begins to roll.
- A/B checks must be made on a runway or with the aircraft correctly restrained and supported. If A/B is selected for an excessive time on a rolling check, the brakes may not stop the aircraft due to the energy absorption limitations.

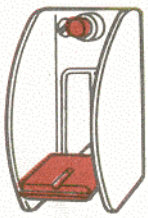
ANTI-SKID SYSTEM (MINISTOP)

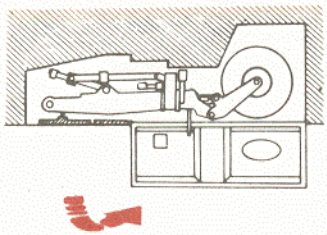
The aircraft brakes are equipped with an anti-skid system known as ministop which is energised by the main DC bus. Ministop is turned on or off by the

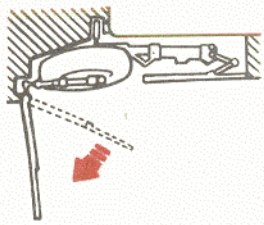
Normal Undercarriage Extension

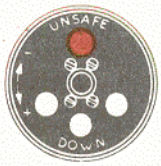
PHASE 1. DOORS OPEN

U/C
CONT



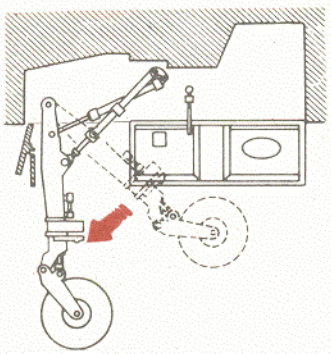


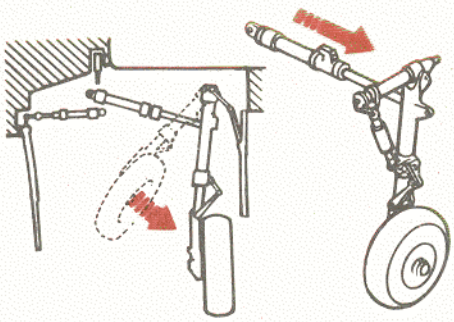






PHASE 2. THREE U/C LEGS EXTEND. NOSEWHEEL LONGITUDINAL AND MAINWHEEL LATERAL EXTENSION JACKS LOCK.







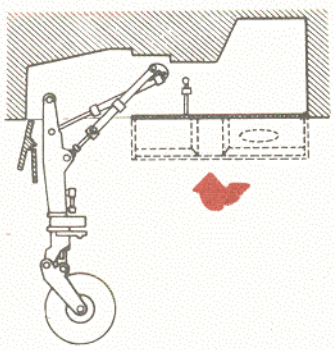
L AND R
LIGHTS BLINK

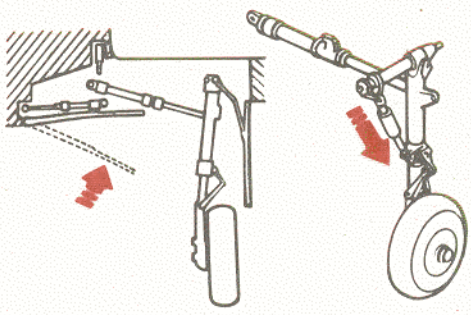




DOWNLOCK
AUDIO TEST
BUTTON
(BEEPER)
D FRONT
COCKPIT ONLY

PHASE 3. SIMULTANEOUSLY, DOORS CLOSE, MAIN U/C LEGS MOVE BACK AND MAIN LEG LONGITUDINAL JACKS LOCK.





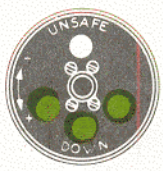






Figure 1-24

Braking System and Ministop

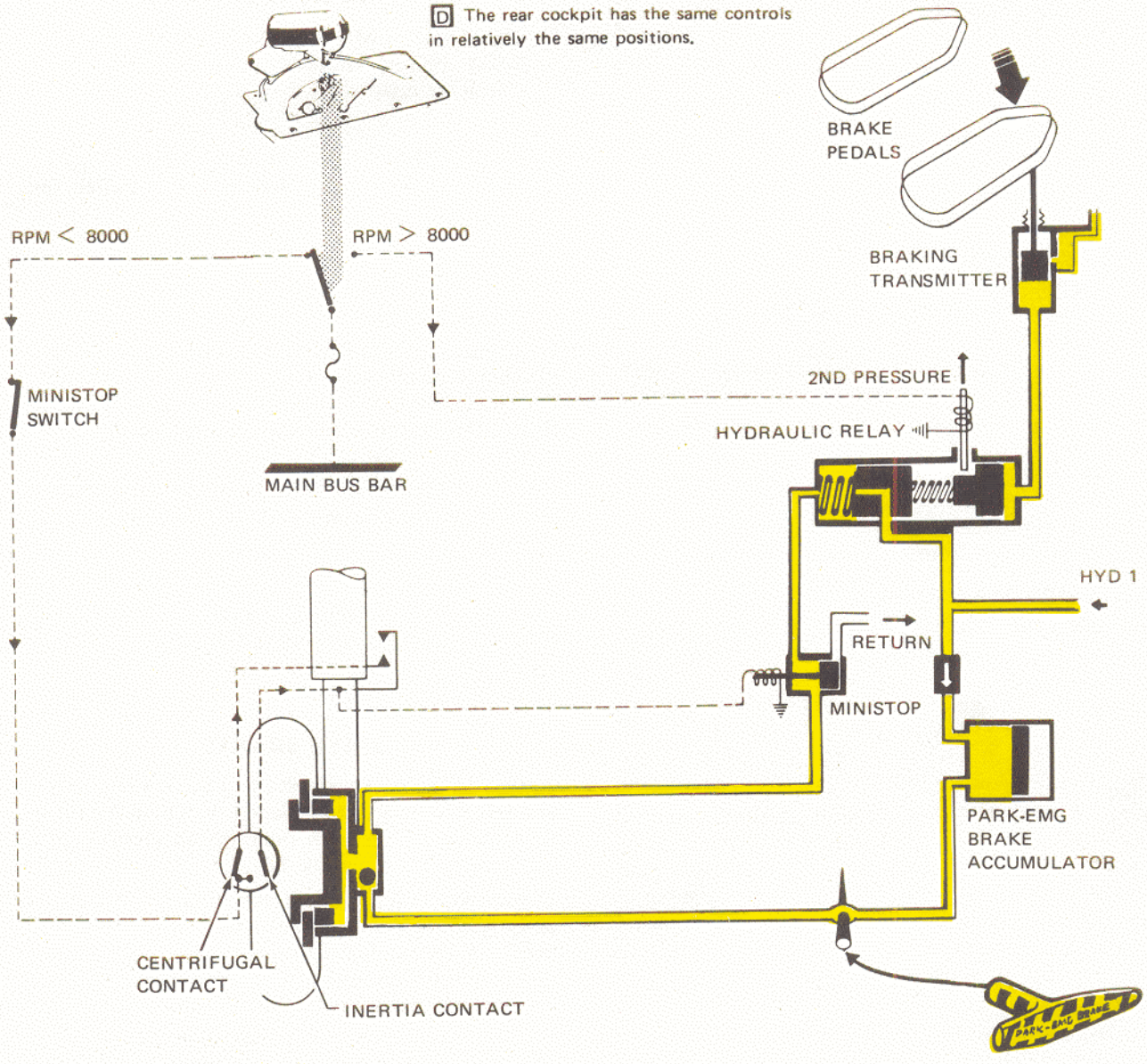


Figure 1-25

MINISTOP switch at the front of the left console. This switch is safety-wired ON.

Each wheel hub contains an inertia switch and a centrifugal switch. The inertia switch closes as a skid condition starts to occur. The centrifugal switch closes when the wheel rotation is less than 600 RPM and opens when the rotation is greater than 600 RPM.

The centrifugal switch is wired in series with a microswitch on the oleo leg. When the throttle is advanced beyond the 8000 RPM position, ministop is cancelled.

Operation of Ministop

Ministop prevents the main wheels from skidding when maximum braking pressure is applied, regard-

less of runway conditions, thus avoiding undue tyre wear and the possibility of a blown tyre. At the start of a skid the inertia switch closes and operates the ministop solenoid. The ministop solenoid isolates braking pressure from the main wheels. With the skid condition removed, the inertia switch opens, the ministop solenoid becomes inoperative and normal braking pressure is applied to the main wheels.

Ministop also prevents the pilot applying the brakes during the landing phase. When the undercarriage is extended, a microswitch on the oleo leg closes and completes a circuit through the centrifugal switch to the ministop solenoid. The ministop solenoid isolates braking pressure from the main wheels. When the aircraft lands, the oleo leg is compressed, the microswitch opens, the ministop solenoid becomes inoperative and normal braking may be applied to the main wheels.

If the aircraft is taxiied at high all-up weight, ie with 286 or 374 gal tanks, through turns at speeds higher than normal, the aircraft rolls away from the turn. The oleo on the inside of the turn may extend far enough to close the microswitch and operate the ministop solenoids through the centrifugal switches. The ministop solenoids then isolate braking pressure from the wheels.

EMERGENCY BRAKE SYSTEM

The emergency brake system is normally powered by HYD 1 pressure but includes an emergency accumulator and a non-return valve to provide emergency braking in the event of a HYD 1 failure. Pressure in the emergency brake system can be read on the right hydraulic pressure gauge with the gauge switch in the down position.

When the PARK EMG BRAKE handle located on the right panel is pulled out, a pressure proportional to handle travel is applied directly to both wheels. With the handle pulled out fully, a pressure of 2000 psi is applied to the brakes. There is no differential braking and ministop is inoperative.

When using the PARK EMG BRAKE following a HYD 1 failure, the handle should be pulled out smoothly and gently about one half inch. If the handle is pulled out all the way, excessive braking occurs and burst tyres may result.

The emergency brake accumulator has sufficient capacity for 10 emergency brake applications.

CAUTION

The PARK EMG BRAKE handle should be pulled out smoothly and gently and only about one half inch.

Due to the position of ball valves in the brake system, the emergency brakes and the toe operated brakes must be operated separately or all braking may be lost.

WARNING

The PARK EMG BRAKE handle and the brake pedals should never be operated simultaneously.

PARKING BRAKE

If the PARK EMG BRAKE handle is pulled out about one inch and turned a quarter turn clockwise, it remains in this position and acts as a park brake. Pressure applied to the wheel brakes is then 1300 psi, which is sufficient to hold the aircraft with full dry power applied.

When releasing the PARK EMG BRAKE, the handle should be allowed to return on its own; it should not be pushed home. If the handle is pushed, buckling of the flexible cable may occur, leading to ultimate failure of the cable.

[D] The EMG BRAKE handle in the rear cockpit is an emergency brake only and cannot be employed as a park brake.

RIM FUSES

To prevent a tyre bursting as a result of overheating due to heavy braking, four rim fuses are fitted to each main wheel rim. The fuses melt at 186°C and allow the tyres to deflate.

SPEED BRAKES

The speed brakes are powered by the HYD 1 system and selected by a spring-loaded switch on the throttle. The selector switch operates an electro valve powered by the main DC bus.

The speed brakes are actuated by a hydraulic jack directly connected to the bottom surface of the speed brake. A mechanical linkage fastened to both surfaces operates the top surface. The interconnection between the speed brakes is hydraulic.

[D] A switch in the front cockpit enables the rear cockpit speed brake switch to be by-passed. Located on the left console and marked AIRBRAKES OVERRIDE, it has two positions:

a. FRONT: the rear throttle toggle switch is inoperative, and

b. REAR: each toggle switch is operative.

WARNING LIGHT

An amber speed brake warning light (marked AIR BR) is located on the left side of the instrument panel. This light illuminates whenever the speed brakes are not fully retracted.

OPERATION

The speed brakes are operated as shown at Fig 1-26.

Speed Brakes

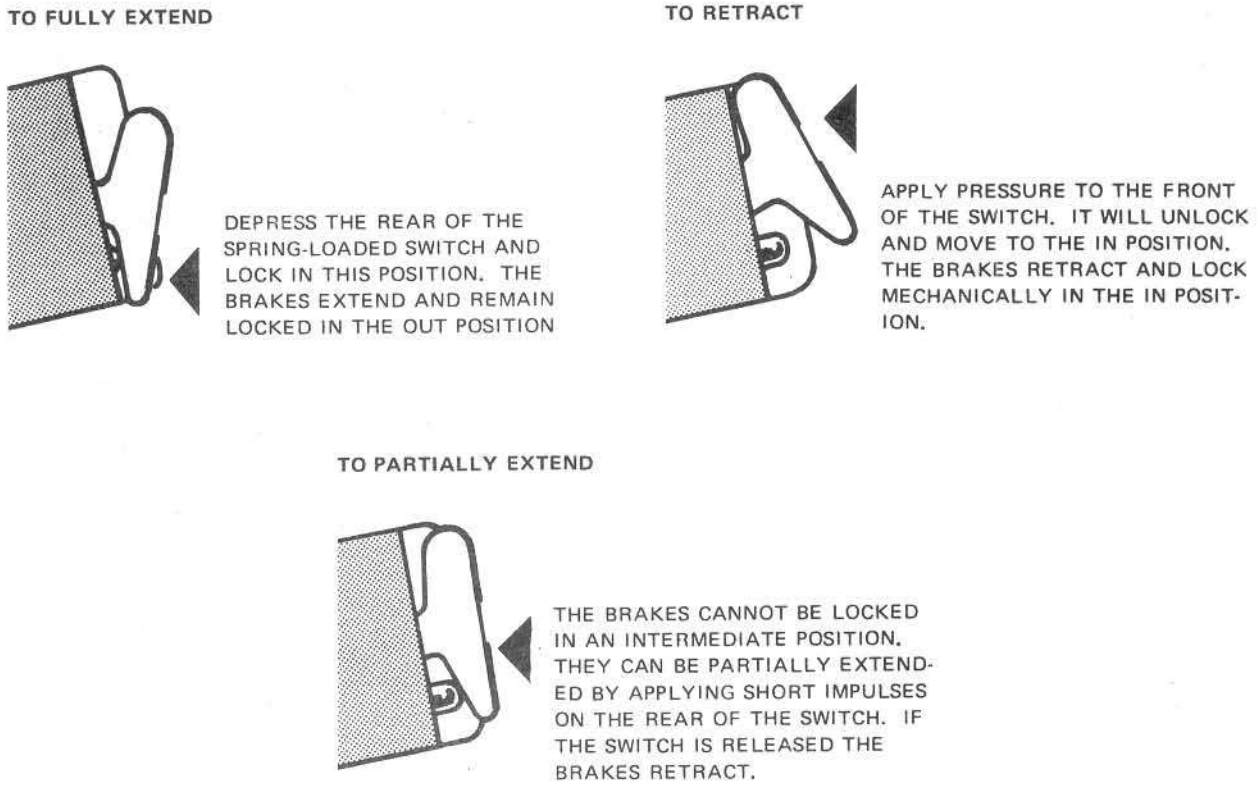


Figure 1-26

The speed brakes can be operated at any speed throughout the flight envelope but should be retracted for landing. Speed brake operation causes a slight nose down trim change which is more marked when 286 or 374 gal tanks are fitted.

BRAKE CHUTE

A nylon brake chute of cruciform shape is housed in a container which is mounted in a fairing at the base of the fin.

The brake chute is controlled by operating a lever marked BRAKE CHUTE (refer to Fig 1-27) on the left wall of the cockpit.

Pulling the BRAKE CHUTE lever to the rear (1) position deploys the chute and pushing the lever to its forward (2) position drops the chute.

The linkage to the chute mechanism is mechanical. A pair of hook jaws is normally in the open position to permit the brake chute to separate from the aircraft in the event of an unscheduled deployment. The jaws close on the shackle of the chute strap only when the lever is moved to the aft position. The maximum speed for deployment of the brake chute is 210 KIAS. Deployment above this speed will almost certainly result in failure.

The life of a brake chute is inversely proportional to the speed of deployment - the higher the speed the shorter the life. The normal operating speed is from 140 KIAS to 170 KIAS and chutes streamed within

Brake Chute Operation

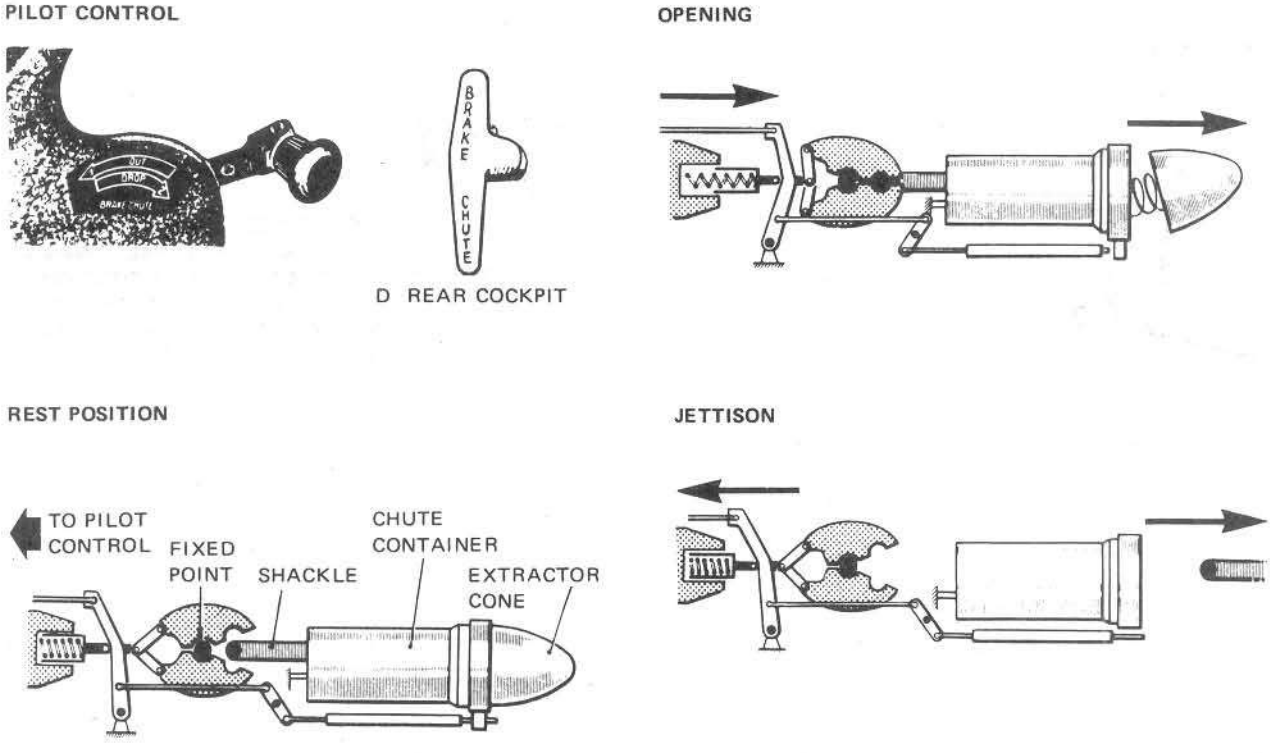


Figure 1-27

this range should last 60 flights. The life is reduced proportionally as deployment speed increases above 170 KIAS, until at 210 KIAS, the chute can only be used twice if the total number of streams is less than 30 or once if more than 30.

The maximum speed for brake chute drop is 190 KIAS. This is because of the limited mechanical advantage of the actuation system. Sustained A/B operation at low level in the speed range 550-600 KIAS, significantly increases the probability of drag chute failure because the plastic drag chute cone may melt and then fuse to the canister body.

[D] The BRAKE CHUTE handle in the rear cockpit is on the left panel.

Note

- There is a risk of inadvertent brake chute drop if the control is not moved smoothly to the rear (1) position and held there firmly until the chute is deployed.
- Avoid sustained afterburner operation at low level in the speed range 550 - 600 KIAS except where required to complete operational tasks.

AIR DATA SYSTEM

The air data measuring and distribution system includes :

a. a number of total and static pressure inlets and distribution lines,

b. an impact temperature probe,

c. an incidence probe, and

d. an air data computer and its output multiplier.

PRESSURE INLETS

There are several pressure inlets (refer to Fig 1-28) which are dealt with in the following paragraphs.

PITOT HEAD

The pitot head or nose probe in the front of the nose cone incorporates a pressure balanced probe on its extremity. The probe has one total pressure inlet and three static pressure inlets. The equipment supplied by the total pressure inlet and the three static pressure inlets is shown at Figure 1-28.

The pitot head is heated by selecting the PROBE HEAT switch on the right panel to ON. The circuit is protected by a circuit breaker marked A.S.I. located on the right console.

The PITOT warning light on the main fail panel will be on if either the PROBE HEAT switch is OFF or the A.S.I. CB is out. If the PITOT warning light illuminates during flight with the PROBE HEAT switch selected ON and the A.S.I. CB in, the probe heating system has failed.

[D] The PROBE HEAT switch is not fitted to the rear cockpit.

TOTAL PRESSURE PROBES

Two total pressure probes are located on the fuselage in front of the windscreen. The equipment supplied by the probes is shown at Figure 1-28. Both total pressure probes are heated to prevent icing. Failure of the heating circuit to the left probe is indicated by the PITOT warning light.

WARNING

The pilot receives no warning of heating element failure in the right total pressure probe.

If a descent is carried out after icing of the right probe occurs, the airspeed value passed to the approach control, autocommand and U/C warning light will be less than the actual aircraft airspeed. Thus :

a. with autocommand selected, over controlling in pitch occurs;

b. the U/C warning light should be compared to the ASI and incidence lights before the undercarriage is lowered; and

c. with approach control selected, the engine nozzle flaps close in an attempt to increase airspeed which could cause approach speeds of up to 250 KIAS.

If icing of either total pressure probe is suspected :

a. de-select auto-command,

b. monitor the U/C warning light during descent (it is the only indicator of icing of the starboard probe), and

c. avoid the use of approach control as excessively high threshold speeds may result.

REAR FUSELAGE STATIC PRESSURE INLET

The rear fuselage static pressure inlet is located on the left side of the fuselage near the wing trailing edge. It feeds the approach control system.

IMPACT TEMPERATURE PROBE

The impact temperature probe is located under the fuselage on the right side. It feeds the air data computer.

INCIDENCE PROBE

The incidence probe is located on the left side of the fuselage, forward of the cockpit. It feeds the air data computer output multiplier and the incidence amplifier. The incidence probe is heated when the PROBE HEAT switch is selected ON but heating failure is not indicated.

STATIC PRESSURE ERROR

Static pressure inlets are affected by change of incidence, aircraft yaw and shock-waves which may cause erroneous instrument readings. Static pressure errors are kept small, even at high angles of attack, by use of a pressure balanced probe.

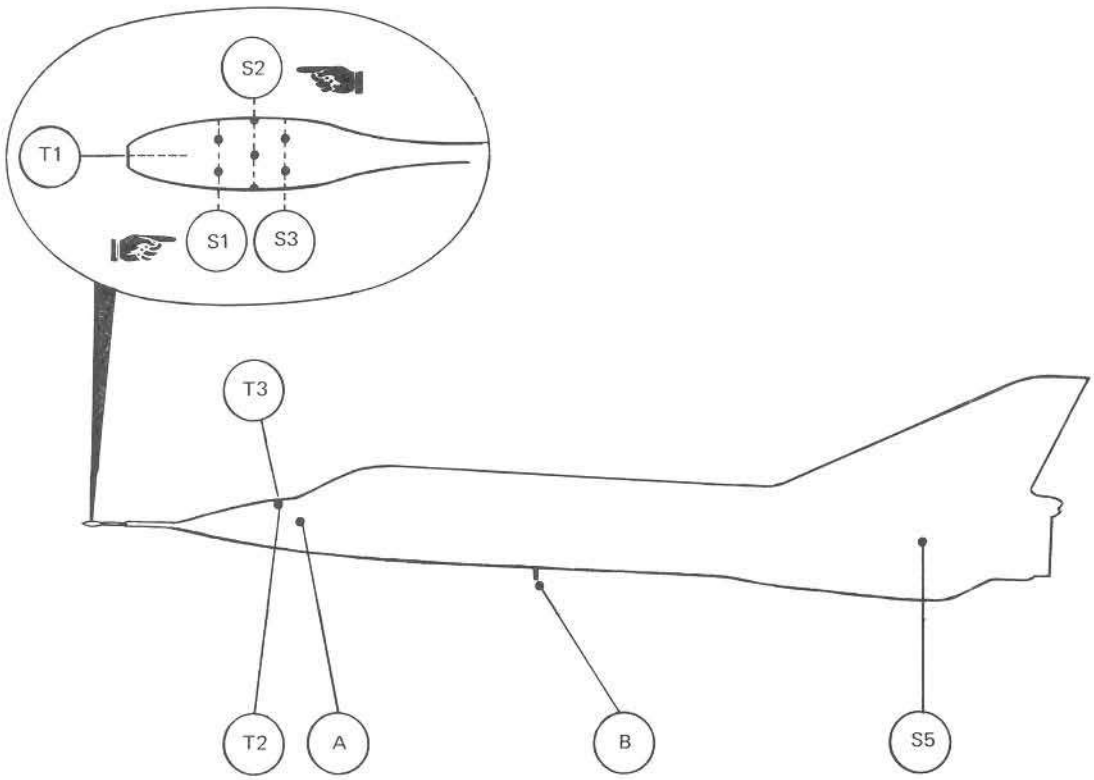
EFFECT ON AIRSPEED

CAS and IAS can be considered equal in subsonic flight.

EFFECT ON MACH NUMBER

The static pressure error effect on Mach number is shown in Fig 1-29. True Mach No (MN) and indicated Mach No (IMN) can be considered equal in subsonic flight. In transonic flight, from M 0.95, MN is slightly greater than IMN but the difference does not exceed M 0.01. However, an abrupt static pressure drop occurs at M 1.05 and the IMN increases abruptly from 1.04 to 1.07. In supersonic flight,

External Probes and Inlets



S1 STATIC INLET 1
ASI/Machmeter (D front cockpit)
Altimeter (D front cockpit)
VSI (D front cockpit)

S2 STATIC INLET 2
Air data computer
Autocommand - Altitude hold
D Rear cockpit ASI/Machmeter
D Rear cockpit altimeter
D Rear cockpit VSI

S3 STATIC INLET 3
Altitude hold safety device

S5 REAR FUSE STATIC INLET
Approach control

T1 TOTAL PRESSURE INLET 1
Air data computer
Dashpot IAS capsule
D Rear cockpit ASI/Machmeter

T2 LEFT TOTAL PRESSURE PROBE
ASI/Machmeter (D front cockpit)

T3 RIGHT TOTAL PRESSURE PROBE
Autocommand pressure central
Approach control
U/C warning microswitch

A INCIDENCE PROBE
ADC output multiplier
Incidence amplifier

B IMPACT TEMPERATURE PROBE
Air data computer

Figure 1-28

Static Pressure Error Effect on Mach Number

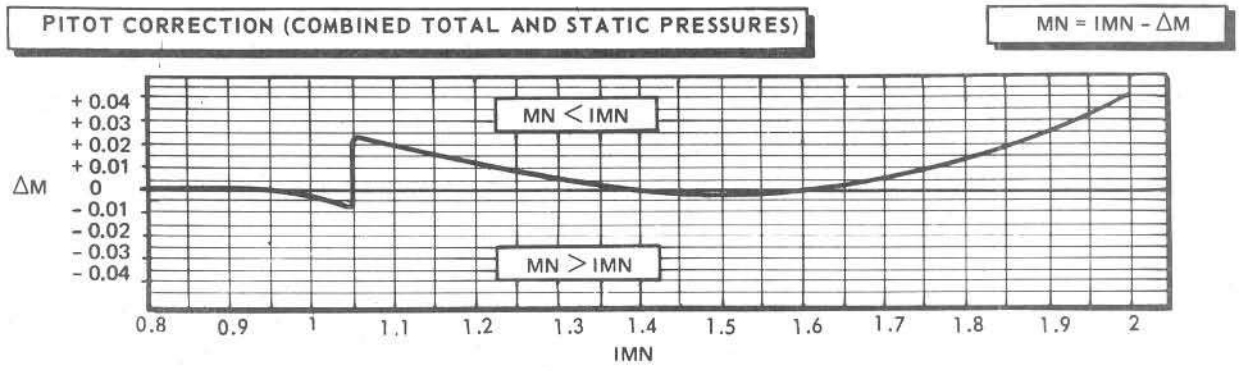


Figure 1-29

IMN is slightly higher than MN at speeds below M 1.34, substantially correct between M 1.35 and M 1.65 but again higher than MN above M 1.65. At M 2.0, IMN reads M 2.04.

EFFECT ON ALTIMETER

The static pressure errors also affect altimeter readings. In subsonic flight the indicated altitude can be considered as being true altitude up to M 0.98. In transonic flight (between M 0.98 and M 1.03), the indicated altitude is 200 ft lower than the true altitude. At M 1.05 when the abrupt static pressure drop occurs, the altimeter reading abruptly increases about 800 ft; the indicated altitude then exceeding the true altitude by 600 ft. In supersonic flight above M 1.05, the altitude error reduces to insignificance between M 1.35 and M 1.65. Above M 1.65, the altimeter will read higher than the true altitude.

AIR DATA COMPUTING SYSTEM

The air data computing system consists of two major components; a computer and an output multiplier. Both components are located in the equipment bay and receive power from the alternator bus and the manual load-shedding DC bus.

The function of the air data computer is to convert static pressure, total pressure and impact temperature to a form that can be used by various aircraft equipment (refer to Fig 1-30).

COMPUTER

The computer consists of a static pressure module, a dynamic pressure module and a computation module.

Static Pressure Module

The static pressure module receives static pressure inputs from the nose probe. A mechanical servo is positioned as a result of this pressure and modified by cams to give linear electrical outputs, representing static pressure, height, and the log of static pressure.

Dynamic Pressure Module

The dynamic pressure module receives total and static pressure inputs from the nose probe. These two pressures are combined as in an airspeed indicator, and the resultant dynamic pressure positions a servo which is modified by cams to give linear electrical outputs. These outputs represent dynamic pressure and the log of dynamic pressure.

Computation Module

The computation module receives the sum of log dynamic and static pressures as an electrical signal. A servo, operating as a function of this signal together with temperature, gives true MN and TAS. The temperature input also operates a set of switches at + 27°C for the engine overspeed, and + 125°C for the MACH warning light.

Air Data Computing System - Block Diagram

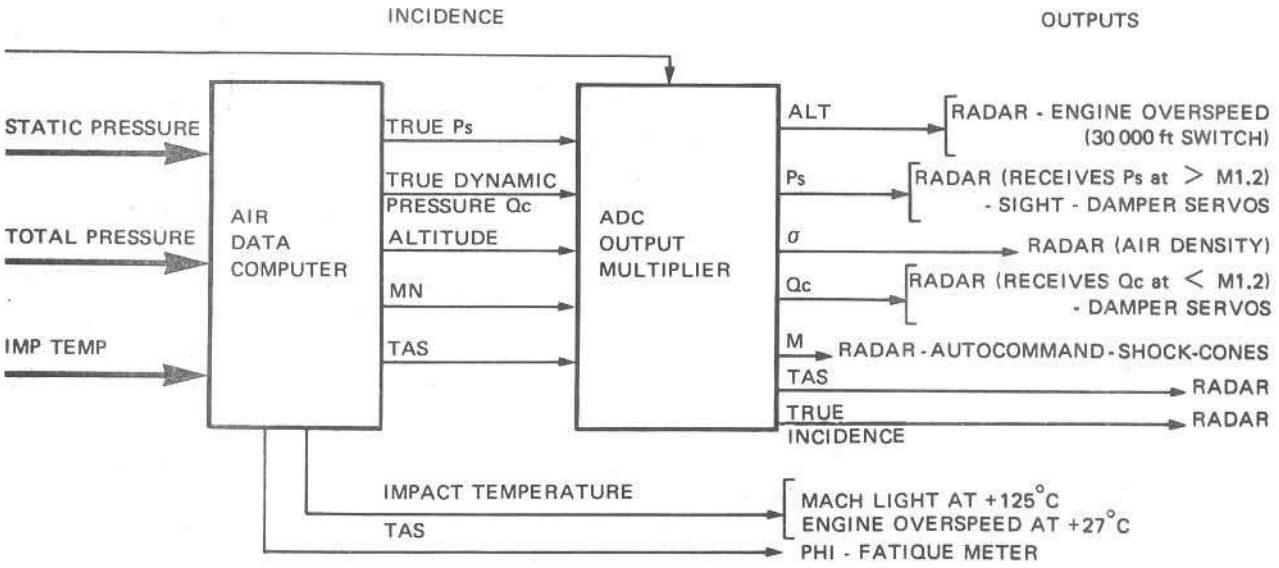


Figure 1-30

Electrical outputs fed from the computation module to the output multiplier are :

a. true static pressure,
b. true dynamic pressure,
c. altitude,
d. MN, and
e. TAS.

In addition, TAS is fed directly to the PHI computer and a cut-out switch is provided to switch off the fatigue meter below 200 KTAS. In order to obtain maximum accuracy, the static pressure error is corrected in the air data computer by means of a special cam.

OUTPUT MULTIPLIER

The output multiplier receives inputs in the form of electrical signals from the air data computer and the incidence probe. These signals are recorded and multiplied by the output multiplier, and then fed to appropriate aircraft equipment. To do this the output multiplier uses its six modules as follows :

a. ***Height Module.*** The height module switches the engine overspeed on at 30 000 ft and also supplies altitude information to the radar.

b. ***Static Pressure Module.*** The static pressure module supplies static pressure information to the gunsight, radar and the pitch dampers, and air density information to the radar.

c. ***Dynamic Pressure Module.*** The dynamic pressure module supplies dynamic pressure information to the pitch and yaw dampers and the radar.

d. ***Mach Module.*** The Mach module disconnects the height lock between M 0.95 and M 1.15, supplies information to operate the shock-cones, and supplies MN to the radar.

e. ***TAS Module.*** The TAS module supplies TAS information to the radar.

f. ***Incidence Module.*** The incidence module uses indicated angle of attack information from the incidence probe. This is modified by MN and TAS to give true angle of attack, which is supplied to the radar.

[D] The output multiplier has only four modules, the TAS and incidence modules being omitted.

FLIGHT INSTRUMENTS

With the exception of the PHI and Bezu Ball, which are described herein, the operating principles of the aircraft instruments (refer to Fig FO 1-3) are similar to those in use in other RAAF aircraft.

ALTIMETER

The static pressure for the altimeter is obtained from the nose probe. The altimeter has a normal three-pointer presentation, a striped warning sector and a millibar setting knob. The operating range is from sea level to 80 000 ft.

WARNING

In a descent, the striped sector begins to appear at 26 000 ft (not 16 000 ft as in other RAAF aircraft) and is completely visible at 10 000 ft.



Figure 1-31

AIRSPEED INDICATOR/MACHMETER

The airspeed indicator/machmeter (refer to Fig 1-33) displays IAS and Mach number readings. The static pressure is obtained from the nose probe and the dynamic pressure from the left total pressure probe in front of the windscreen. A single pointer on a rotating disc indicates IAS, which is read on the peripheral fixed ring graduated from 80 to 850 knots. A moveable index, controlled by a knob on the lower right side of the instrument, allows selection of any reference airspeed, eg approach speed or a limiting speed. Mach number is read on a rotating dial graduated from M 0.7 to M 2.5. This scale can be seen in a small window in the pointer disc, and IMN is read against two reference marks on the pointer axis.

[D] The dynamic pressure for the instrument in the rear cockpit is supplied by the nose probe.

VERTICAL SPEED INDICATOR

The static pressure for the VSI (refer to Fig 1-34) is obtained from the nose probe. It indicates vertical speed within the range +6000 ft/min to −6000 ft/min. It is erratic in supersonic flight.

Airspeed Indicator/Machmeter



Figure 1-33

Vertical Speed Indicator

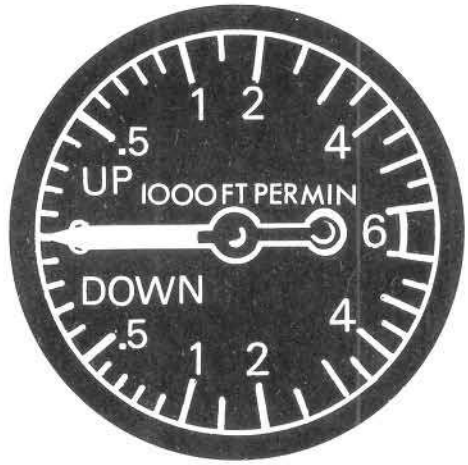


Figure 1-34

STANDBY ARTIFICIAL HORIZON

The standby A/H (refer to Fig 1-35) is powered by its own inverter from the main DC bus, and is protected by the A/H circuit breaker (CB). The standby A/H is energized by engaging the A/H CB. The lower half of the display, representing the ground, is black and the top half, representing the sky, is light blue. Parallel lines drawn every 10°, facilitate the reading of pitch attitude. Angle of bank is read on a scale at the bottom of the instrument, and is graduated in 10° increments up to 60°. It has 360° freedom in roll and an 85° limit in pitch. Erection cut-out occurs at a 10° bank angle. A knob on the lower right of the instrument can be rotated to alter the elevation adjustment of the datum and, when pulled out, cages the A/H to re-erect.

CAUTION

The caging knob must be pulled out before engaging the A/H CB to energize the instrument.

[D] The A/H CB is installed in the front cockpit only.

ACCELEROMETER

The accelerometer (refer to Fig 1-36) is a standard three-pointer resetting type, reading from +10 'g' to −5 'g'.

Standby Artificial Horizon

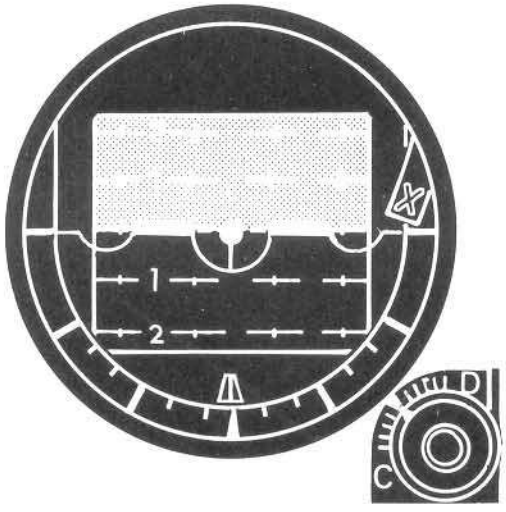


Figure 1-35

Accelerometer

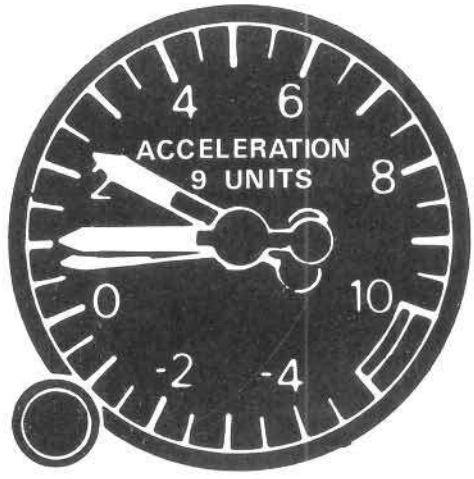


Figure 1-36

[D] REAR COCKPIT ACCELEROMETER

The accelerometer fitted to the rear cockpit is a standard three pointer re-setting type which reads from − 5 'g' to + 10 'g'. It is not internally lit.

STANDBY COMPASS

An E2B standby magnetic compass is fitted to the right canopy bow.

[D] The standby compass is fitted in the front cockpit only.

CLOCK

A combination clock-stopwatch is fitted to the left canopy bow and has a control knob on the bottom of the instrument. The front of the knob activates a stopwatch which includes a small elapsed time needle measuring from 0 to 15 minutes. The rear of the knob winds the clock when the lever is up, and resets the hands when the lever is down and the red dot is showing.

INCIDENCE LIGHTS

Five basic ranges of angle of attack are displayed to the pilot by three indicator lights coloured green, amber and red located on the left side of the gunsight (refer to Fig FO 1-3). The lights have a hinged cover for night flying and the circuit can be tested by means of a test button, marked INCID TEST, on the instrument panel left of the Bezu ball. The lights are operated through an amplifier which receives information from the incidence probe.

The incidence probe has two sets of holes bleeding air to separate chambers. Differential pressure in the chambers rotates the probe to align with the airflow. The probe drives two potentiometers, one of which energizes the incidence lights, while the other supplies information to the gunsight and radar through the AC output multiplier.

The system is powered from the main DC bus and the inverter bus through the ASI circuit breaker, PROBE HEAT switch and INV switch.

The incidence probe provides continuous information. However, the incidence lights give only stepped information. With increasing angle of attack the lighting sequence is: GREEN only, GREEN-AMBER, AMBER only, AMBER-RED, RED only. For each lighting phase, the KIAS for a given weight, load factor and configuration may be determined. Displacement of the CG and the position of speed brakes and undercarriage alter the speeds for light illumination.

Example

The KIAS for each lighting phase is shown in Fig 1-37 for an aircraft with:

a. an AUW of 7185 kg (15 840 lb) - 132 gal remaining,

b. a load factor of 1 'g',

c. a clean configuration including a gun bay tank, and

d. CG position of about 48%.

Incidence Light Operation

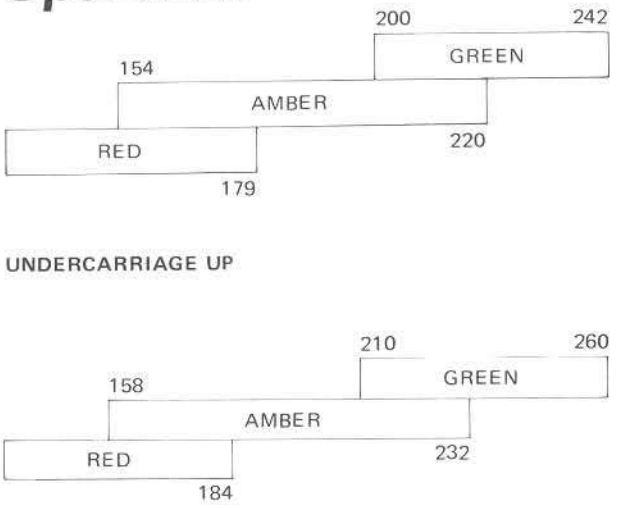


Figure 1-37

EMERGENCY EQUIPMENT

FIRE WARNING SYSTEM

There are two fire warning sub-systems in the aircraft (refer to Fig 1-38). These are the:

a. forward engine fire warning (ENG) sub-system, and

b. rear engine or A/B fire warning (A/B) sub-system.

Both sub-systems operate on the same principle; bimetallic temperature sensing switches which operate in series and control a relay. The switches are normally closed. Immediately any one switch opens, the control relay is de-energized and supplies power to the applicable warning light through one set of its contacts.

Fire Warning System

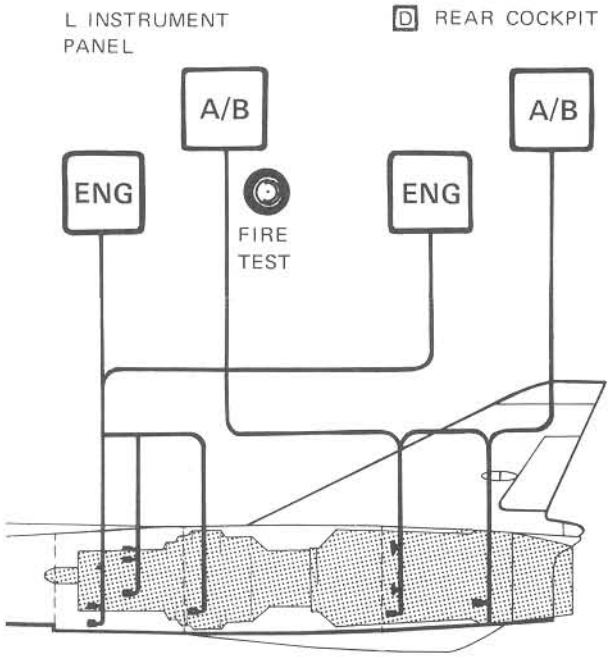


Figure 1-38

If the sensing switch closes again, the warning light is not extinguished immediately, but remains on for 3-5 seconds. This time delay is controlled by a temperature dependant resistor (thermistor) in series with the control relay coil. The purpose of the thermistor is to ensure that a definite fire warning is given, even for a momentary overheat condition.

The forward engine detector has a temperature setting of 200°C; the A/B detector has a temperature setting of 300°C.

The detectors have two modes of operation :

a. For a slow increase in temperature the two bimetallic strip contact arms of each detector heat up and deform uniformly until one contact reaches a stop. Continued heating causes the other arm to move further and so open the contacts. This gives the preset temperature detection.

b. For a rapid increase in temperature, one contact arm heats quicker than the other arm which is covered with a fibreglass sleeve. The uncovered arm distorts rapidly, moves away from the covered contact arm and opens the contacts giving a rapid fire warning. In this case the switches operate before the set temperatures are reached.

PRESS TO TEST CIRCUIT

A press-to-test button, labelled FIRE TEST, is located immediately to the right of the A/B fire warning light. Operation of the FIRE TEST button tests the operation of the fire warning lights and the circuit continuity. When the FIRE TEST button is operated the fire warning lights remain on for 3-5 seconds.

D The FIRE TEST button is fitted to the front cockpit only.

Note

When external power is connected to the aircraft or when the BATT switch is selected from OFF to ON, the ENG and A/B fire lights illuminate and remain on for 3-5 seconds.

MACH WARNING LIGHT

The Mach warning light (MACH) is located at the top of the right instrument panel (refer to Fig FO 1-3). The MACH warning light illuminates when the impact temperature is greater than 125°C.

FAILURE WARNING SYSTEM

The failure warning system consists of a main fail panel, a main FAIL light and a warning horn.

MAIN FAIL PANEL

The main fail panel (refer to Fig FO 1-5) is located on the right panel and consists of 18 warning lights which are described under the relevant systems.

MAIN FAIL LIGHT

The main FAIL light (refer to Fig FO 1-3) is located on the left side of the instrument panel. When any warning light on the main fail panel illuminates, the main FAIL light also illuminates. Pressing the main FAIL light cancels the illumination and the warning horn, if it is sounding. The main FAIL light is then ready to illuminate for another emergency.

D The rear cockpit has no main FAIL light but is provided with a CANCEL HORN button.

WARNING HORN

The warning horn transmits a loud signal to the earphones in the event of certain failures. The volume of this signal cannot be adjusted. Operation of the warning horn is controlled by a HORN switch located on the right panel (refer to Fig FO 1-5). The warning horn operates when one of the following lights on the main fail panel illuminates :

GEN	ALT
HYD 2	EMG HYD
8 min OXY	OXY REG
OIL	IFF
A.C.	DAMP
CAB. T.	CAB. P.

CONTROLS

A TEST button located on the main fail panel tests the warning lights and warning horn operation.

A DAY-NIGHT switch is located on the main fail panel. When set to NIGHT it dims the main fail panel, the main FAIL light, the U/C warning light, the MACH warning light and the GYRO warning light.

CANOPY

The cockpit is fitted with a rear-hinged plexiglass jettisonable canopy. It is self-locking in the open position and two bungee cords are utilized to balance the canopy weight and aid in canopy opening.

The canopy is manually raised and lowered, and is locked and unlocked with a handle (marked CANOPY) located on the right side of the cockpit. A part-open latch is fitted to the canopy to aid cockpit ventilation while the aircraft is being taxied.

On the ground the cabin pressure (CAB P) warning light remains illuminated until the CANOPY locking lever is placed in the locked position. However, the CAB P light is extinguished by placing the canopy locking lever in the locked position, regardless of canopy position. Therefore, the canopy should be visually and physically confirmed as locked.

[D] A single canopy, which is not fitted with a part-open latch, covers both cockpits. The canopy is hinged about its rear top point and is held open by two nitrogen-operated jacks. A bungee cord connects each jack to the slanting frame to prevent the jack tilting during an ejection. This precludes all risks of damage to the seat sequencing mechanism.

[D] The rear cockpit may be fitted with a blind flying hood. An intermediate windshield, secured between the front and rear cockpits, protects the pilot in the rear seat from wind blast in the event of canopy jettison and front seat ejection blast.

CANOPY OPERATION

To close the canopy :

a. Manually support the canopy (which is locked in the up position).

b. Unlock the canopy by moving the CANOPY lever rearwards.

c. Lower the canopy to the closed position (do not let it drop).

d. Pull the canopy closed by applying a downwards pressure on the part-open latch.

e. Lock the canopy by moving the CANOPY lever forwards and check that the CAB P light extinguishes.

Checking that the CANOPY lever is fully forward and the CAB P light is extinguished does not guarantee that the canopy is closed and locked. By day, the unlocked position may be obvious, but by night a visual check is inadequate. Consequently, after moving the CANOPY lever forward and checking the CAB P light is extinguished, confirm that the canopy is correctly locked by trying to push the canopy upwards.

CAUTION

Confirm that the canopy is locked by trying to push the canopy upwards.

Experience has shown that a canopy which locks only if extra force is applied, will be even more difficult, or even impossible to open after flight.

To open the canopy :

a. Unlock the canopy by moving the CANOPY lever rearwards.

b. Lift the canopy until it is locked in the up position.

The canopy can be opened from the outside by fitting a special key into an opening in the port side of the fuselage adjacent to the cockpit.

To lock the canopy in the part open position :

a. Raise or lower the canopy until it is almost closed.

b. Pull the part-open latch outwards and rotate it clockwise. Fit the base of the canopy part-open latch into the locking device on the top of the windscreen.

[D] CANOPY OPERATION

Mechanical opening or closing of the canopy is accomplished by an electrical actuator which can be controlled from inside or outside the front cockpit. A microswitch prevents the canopy being opened or closed from the outside when the canopy is locked or the hooks are closed. On the ground, the CAB P warning light remains illuminated until the canopy is correctly locked in the closed position.

WARNING

The front seat pilot is to obtain clearance from the rear seat occupant before operating the canopy.

CAUTION

The canopy actuating mechanism may be damaged if the aircraft is taxiied with the canopy unlocked.

RAAF SUPPLEMENT NO. 78

MIRAGE

EXTERNAL CANOPY JETTISON CABLE

Instruction

This supplement is to be inserted facing page 1-69.

Information

Mirage Mod. 1176 removes the LH external canopy jettison cable.

Action

Read the following in lieu of the paragraph beginning **'To jettison the canopy from the outside...'** at the top right of page 1-69.

> To jettison the canopy from the outside, break the plexiglass panel located behind the canopy on the right hand side of the fuselage and pull the exposed ring.

Date: 18 FEB 87

A lever (CANOPY LOCK), which mechanically controls the canopy locking hooks is located on the front cockpit right wall. When the CANOPY LOCK lever is pulled rearwards the canopy is unlocked; when pushed forwards the canopy is locked. When the CANOPY LOCK lever is operated, it moves a rotatable disc which exposes two push buttons (CANOPY MOTOR) that are masked when the lever is in the LOCK position. The push buttons are located next to the CANOPY LOCK lever.

WARNING

To avoid injury, remove the fingers from the CANOPY MOTOR buttons before operating the CANOPY LOCK lever. The rotatable disc acts as an effective guillotine.

The lower CANOPY MOTOR button, marked with a downward-pointing arrow, controls canopy closing. The canopy can be stopped at any intermediate point during closing by releasing the lower button. The upper CANOPY MOTOR button, marked with an upward-pointing arrow, controls canopy opening. Depressing the upper button results in total canopy opening, the opening sequence being continued by the use of a self-held relay. Limit switches are provided to disconnect power to the electrical actuator when the canopy reaches the fully closed or fully open positions.

The canopy may be opened externally by :

a. a toggle switch, which operates in the normal up-down sense, reached through a Dzus-fastened door on the left air intake, or

b. operating a handle located in the nose wheel well to disengage the electrical actuator and then manually raising the canopy.

In an emergency, the canopy can be opened manually from the front cockpit. The electrical actuator is disengaged by pushing forwards the CANOPY MOTOR DISENGAGE lever located on the left cockpit wall adjacent to the pilot's left elbow. The front section of the canopy is then manually elevated.

SEALING

Sealing is achieved by means of a pressure seal which is cemented around the cockpit. Inflation of this seal brings it in contact with the canopy under-surface creating an air tight seal. Inflation of the seal is controlled by the canopy seal/ram air lever. This lever is normally left in the forward (SEAL INFLATE) position and the seal inflates whenever the CANOPY locking lever is in the locked position and the PRESSURIZATION switch is ON.

CANOPY JETTISON

The canopy is jettisoned by operating a black and yellow striped lever marked CANOPY JETTISON (refer to Fig FO 1-2) on the left side of the cockpit. To jettison the canopy :

a. break the safety-wire,

b. rotate the lever forwards, and

c. with the palm of the hand, push the lever fully forwards.

To jettison the canopy from the outside, break one of the plexiglass panels located behind the canopy on each side of the fuselage and pull the exposed ring.

WARNING

If either canopy jettison device is operated while stationary on the ground, the canopy leaves the aircraft with considerable force, describes an arc and strikes the aircraft behind the equipment hatch.

[D] The trajectory of the canopy is unknown.

Note

Operation of the ejection seat jettisons the canopy. The firing of the seat is delayed one second to allow for canopy jettison operation.

Operation of a canopy jettison control fires an initiator (refer to Fig 1-39). The pressure generated by the initiator :

a. opens the locks holding the canopy in the down position,

b. operates two small side canopy ejector boxes causing canopy opening to begin,

c. operates a nitrogen-inflated jack which forces the rear part of the canopy upwards, and

d. unlocks the pivot arm.

[D] Operation of a canopy jettison control fires two initiators (refer to Fig 1-40). The pressure generated by the initiators :

a. opens the locks holding the canopy in the down position,

b. disconnects the nitrogen-operated jacks, and

c. operates two canopy ejector boxes which open the canopy slightly.

The canopy is then removed by the airstream.

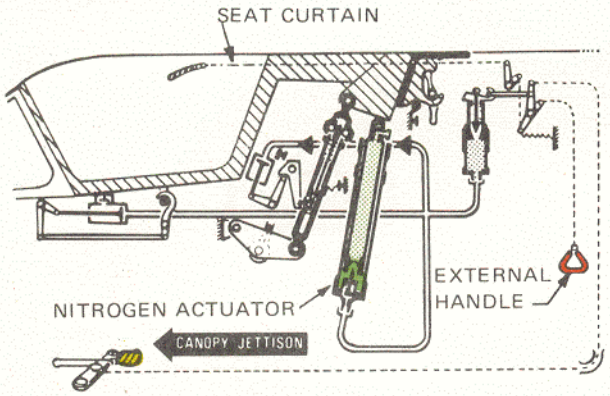
CANOPY BREAKER

The canopy breaker is a knife located on the canopy frame level with the pilot's left shoulder. It is secured in its sheath by a pinned clamp.

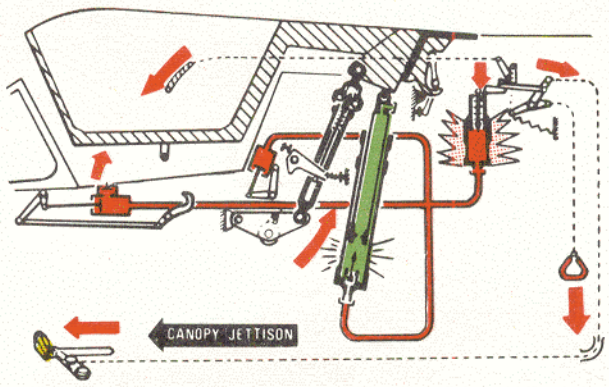
[D] The canopy breaker is located under the right instrument panel of each cockpit.

Mirage IIIO Canopy Jettison

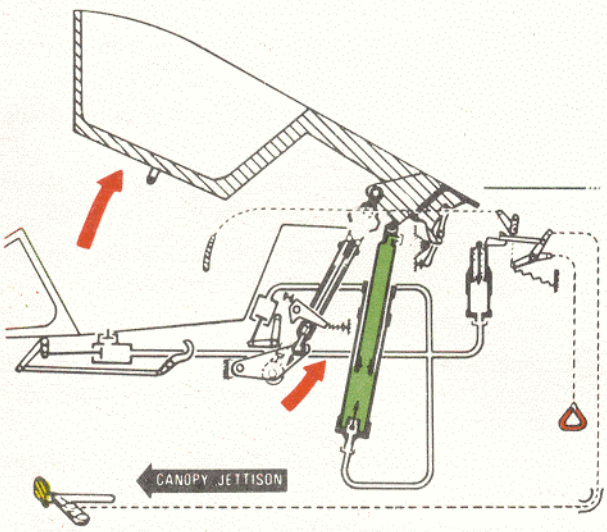
REST POSITION



INITIATOR FIRED



BUNGEE SEPARATED –
JACK CONTINUES TO EXTEND



CANOPY SEPARATION

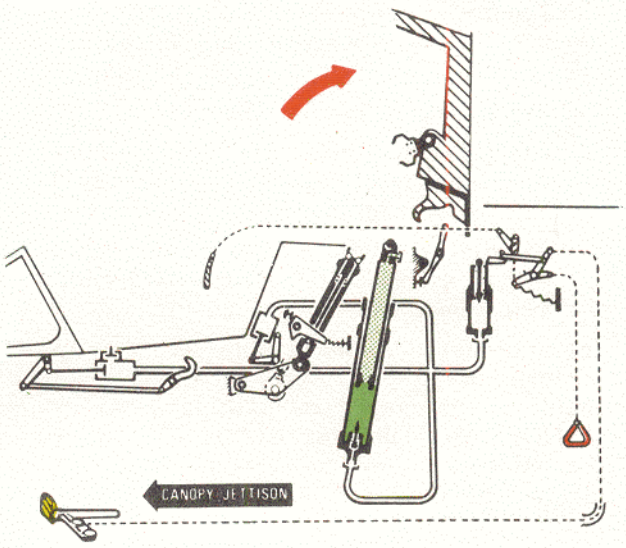
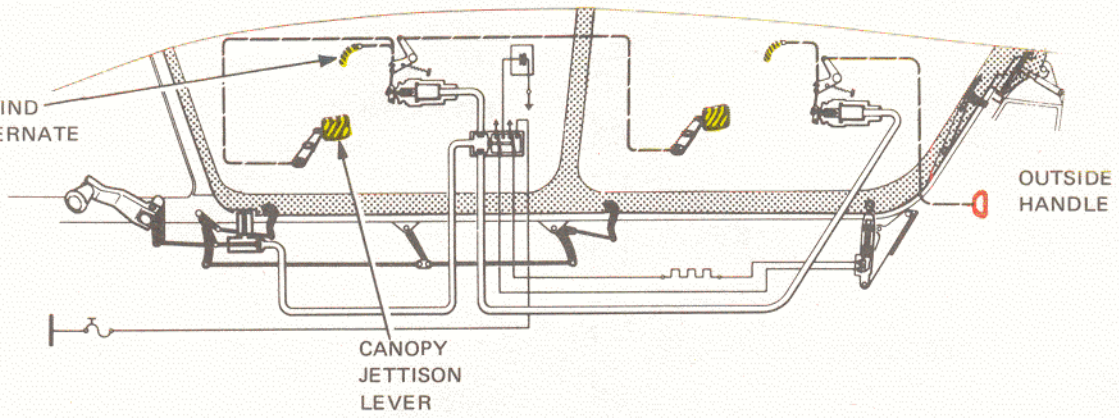


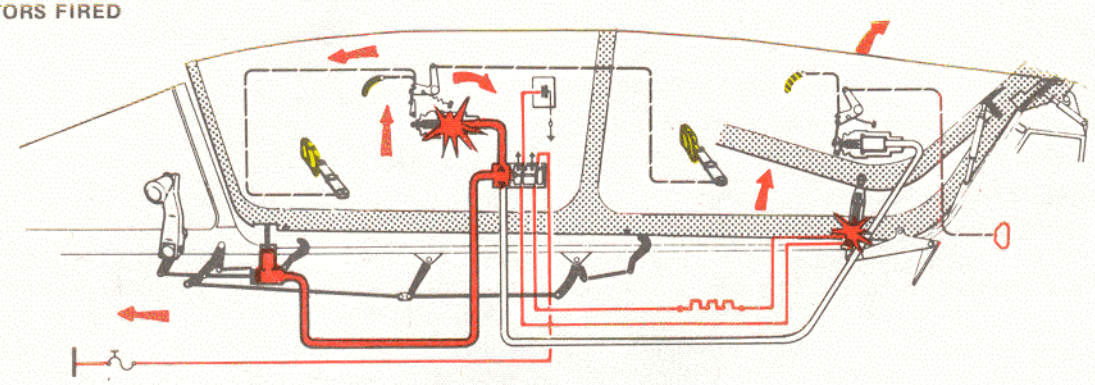
Figure 1-39

Mirage IIID Canopy Jettison

REST POSITION



INITIATORS FIRED



CANOPY SEPARATION

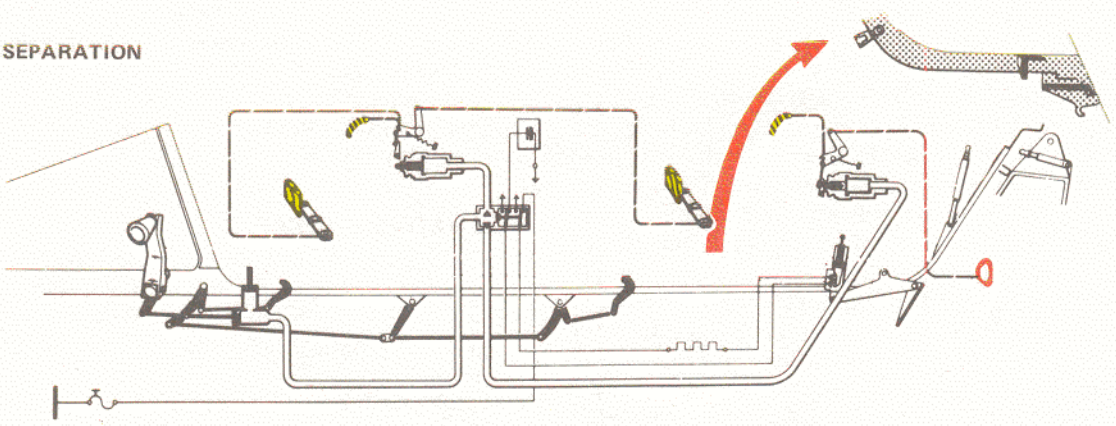


Figure 1-40

EJECTION SEAT

The Martin Baker OM6 ejection seat is designed to provide safe escape from the aircraft as follows :

a. At most combinations of aircraft altitude, attitude, flight path and speeds between 0 and 700 KIAS and down to ground level;

b. In a level attitude at zero rate of descent and zero airspeed with the canopy clear of the ejection path; or

c. At an airspeed greater than 90 KIAS with the canopy attached.

DESCRIPTION

SEAT

The seat (refer to Fig 1-41 and 1-41A), is completely self-contained and includes the pilot's parachute. The seat slides on two rails guided by channelled members attached to either side of the gun. The gun is fixed to Frame 10. It is equipped with three cartridges which are fired sequentially as the seat rises. Maximum acceleration is about 12 'g' and maximum velocity about 22 m/sec (72 ft/sec). A rocket pack then fires to increase the seat trajectory.

[D] The gun is fixed on the oblique frame in the rear cockpit.

SEAT STABILIZER CHUTE

The 1.5 m (5 ft) diameter seat stabilizer chute with its 600 mm (22 in) diameter controller drogue is housed inside the seat upper container. It is deployed by a drogue gun bullet fired about 0.5 sec after ejection. The bullet is attached to the controller drogue by a lanyard. When the seat stabilizer chute is deployed, it decelerates and stabilizes the seat during the period prior to parachute deployment, and extracts the pilot's parachute.

PILOT'S PARACHUTE

The parachute is housed in a horseshoe-shaped rigid pack located on the ejection seat backrest at shoulder level. It has a 7.3 m (24 ft) diameter canopy and its own auxiliary chute to allow manual deployment if the automatic system fails. The seat stabilizer chute is connected to the pilot's parachute by a lanyard which is routed through a scissor shackle at the top of the seat. During ejection, the seat stabilizer chute decelerates and stabilizes the seat through the scissor shackle until the seat is between 14 500 ft and 11 500 ft. When the seat descends below this height and after a two second delay, the scissor shackle opens, allowing the seat stabilizer chute to extract the parachute. If the automatic system fails, the pilot must pull the manual separation handle, which operates a guillotine and the seat harness locks, thus separating his parachute from the scissor shackle and seat.

The parachute assembly and canopy have been designed to reduce the opening shock of a high-speed ejection below the barostatic time-release unit (BTRU) operating altitude.

SEAT HARNESS

The seat is equipped with a combination parachute and restraint harness. It is connected to the parachute and seat by means of three locks and two clips. Attached to the wide waist belt are the parachute D-ring and quick release box.

QUICK RELEASE BOX

An inertia-proof Mk 6 quick-release box (QRB) provides a central anchor point for the four combined seat/parachute straps. An operating knob on the front face of the QRB is rotated through one-quarter turn clockwise and pressed to release the harness. Before inserting the lugs into the QRB, turn the operating knob anti-clockwise as far as possible.

WARNING

If the QRB is open, the pilot is disconnected from the parachute as well as the seat.

LEG RESTRAINTS

The leg restraints (bowyangs) are strapped around the pilot's legs just below the knees. A restraining strap is routed from an anchor point on the floor through a seat snubbing unit and a ring on the bowyangs into a quick release unit on the seat. Operation of the bowyang release lever or manual separation handle activates the taper plug quick release units which release the leg restraint lines. To provide optimum leg restraint, the restraint lines should be crossed, ie one restraint line should pass from the left snubber unit through the right bowyang ring and then to the right taper plug quick release unit (refer to Fig 1-42).

Note

Operation of the manual separation handle fires the guillotine cartridge which severs the parachute withdrawal line; the manual separation handle should only be used in an emergency.

NEGATIVE 'g' STRAP

The negative 'g' strap is a Y-shaped strap attached to the seat front. Each branch of the Y terminates in a loop, through which the lap straps of the pilot's harness are passed before being secured to the quick release box.

Ejection Seat

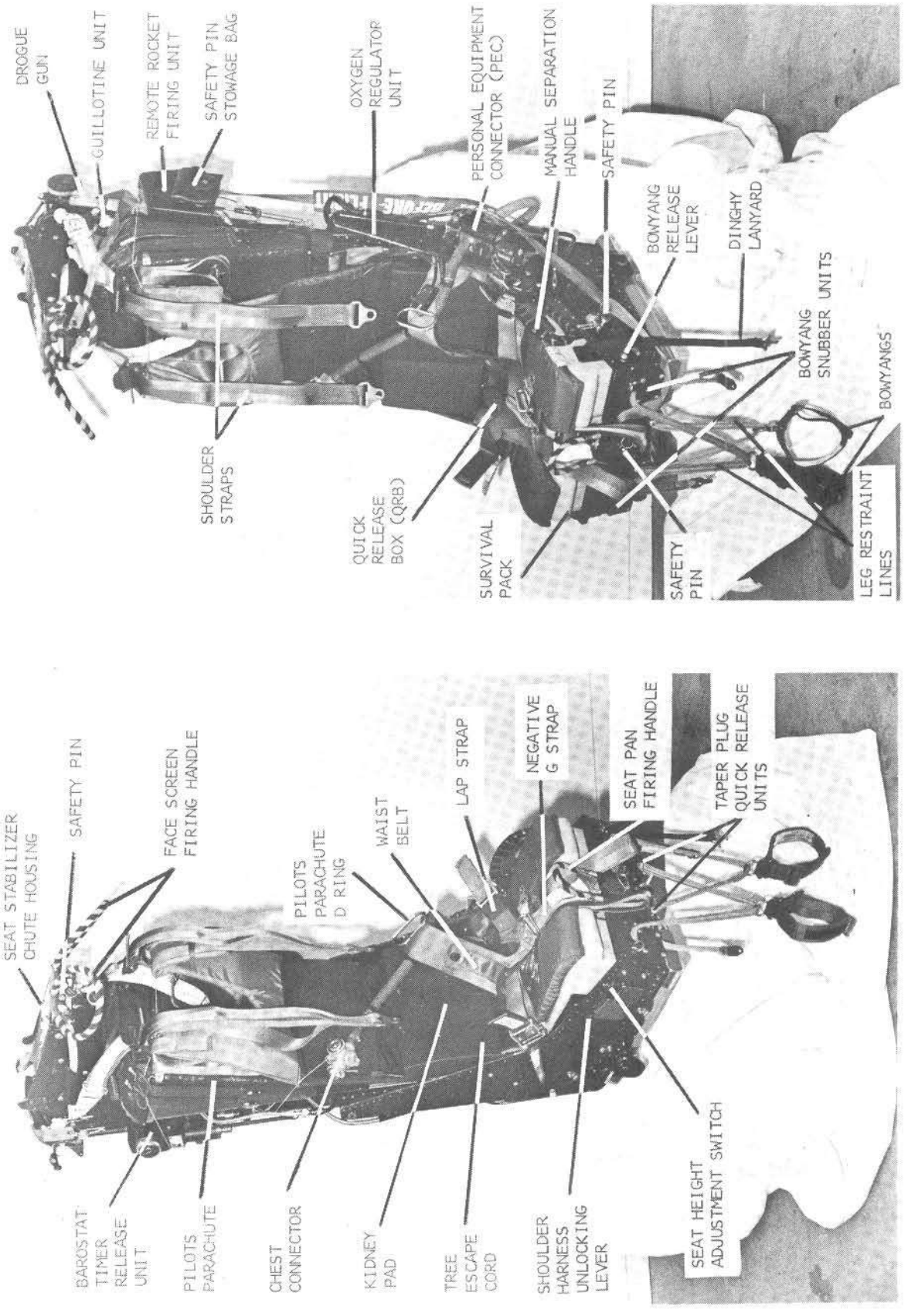
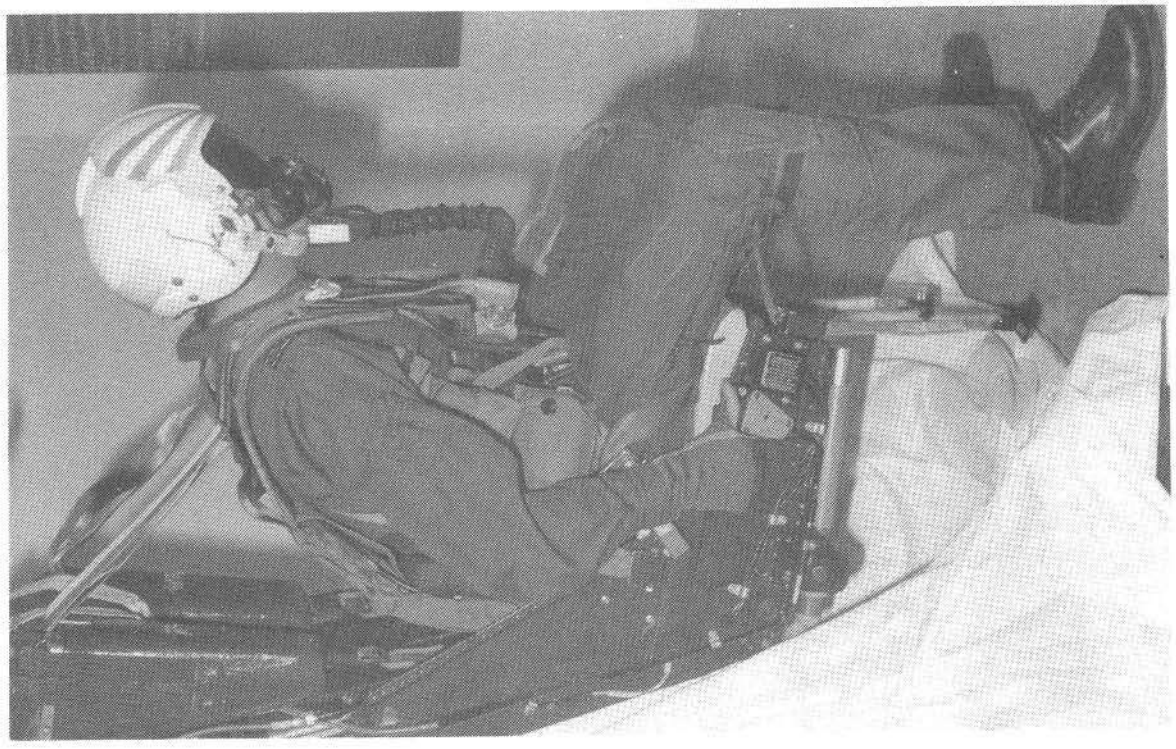


Figure 1-41

Ejection Seat



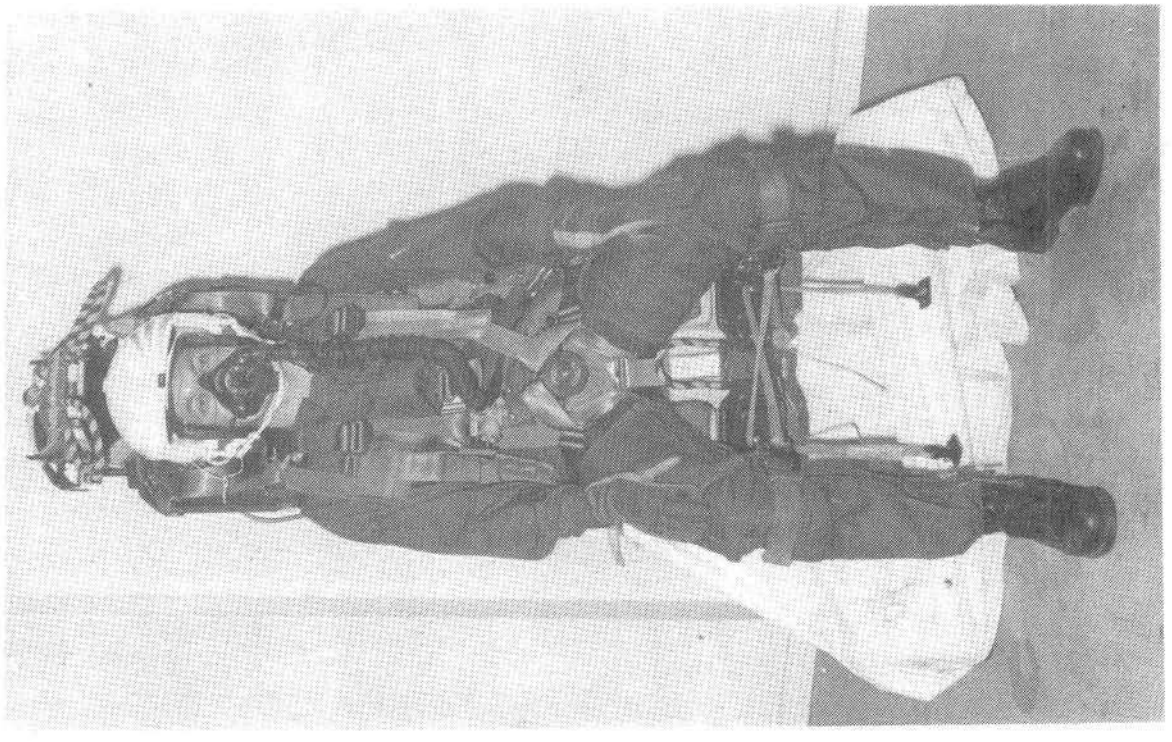


Figure 1-41A

SURVIVAL KIT

The survival kit is contained in the seat pan and, together with a cushion, forms the pilot's seat. The survival kit is attached to the lower part of the harness by two quick release connectors (squeeze to release type).

OXYGEN REGULATOR UNIT

The oxygen regulator unit is fixed to the left side of the seat. It includes two regulators and an emergency oxygen bottle which supplies oxygen to the pilot after ejection.

PERSONAL EQUIPMENT CONNECTOR

The personal equipment connector (PEC) is fixed to the left side of the seat. It consists of two main parts; the body which is bolted to the seat, and the cover which is removable. The oxygen, radio and visor-heat leads pass through this unit. To quickly disconnect the pilot services, the cover (plus the leads) is released after operation of an unlocking pawl.

Leg Restraint System

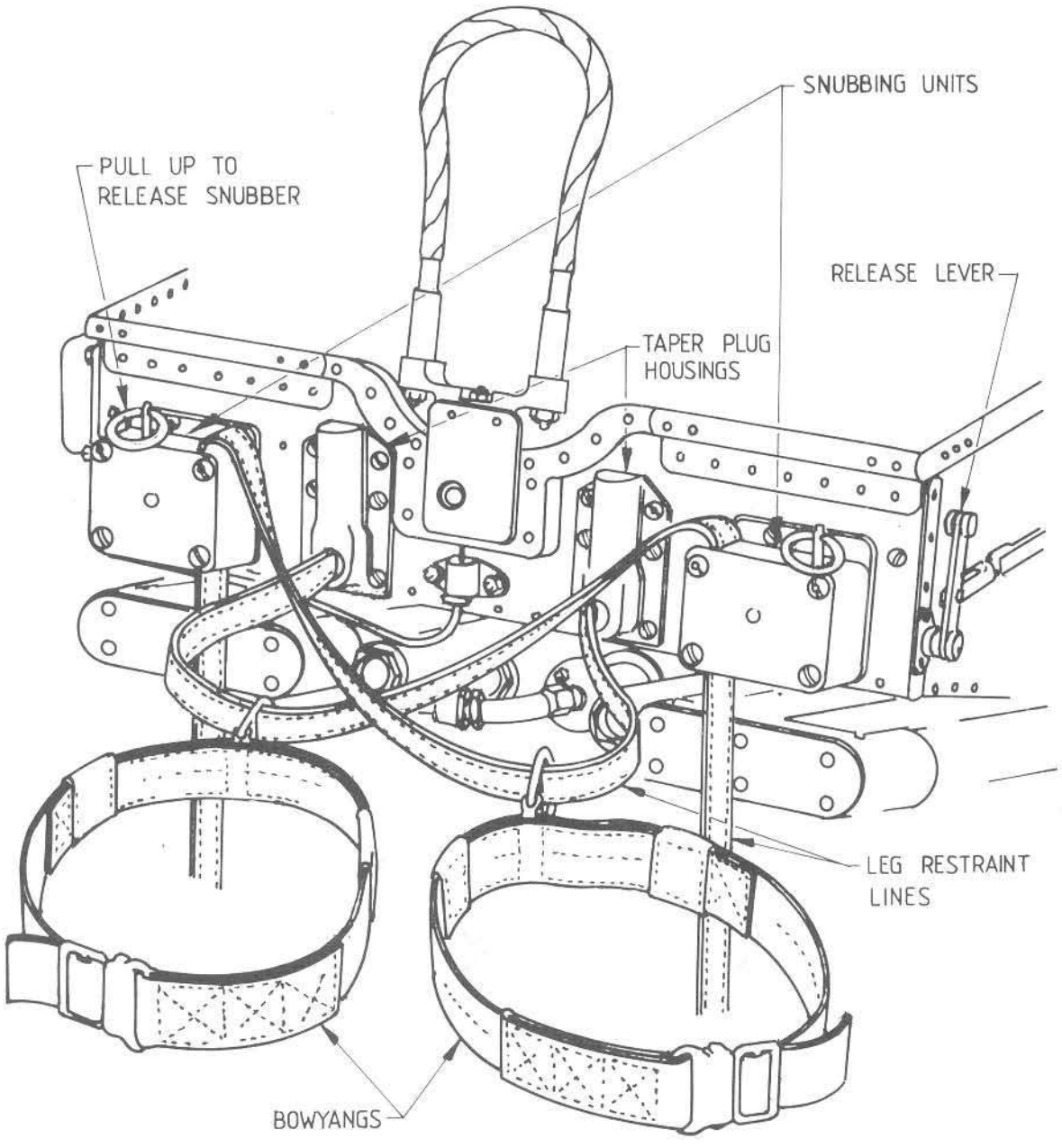


Figure 1-42

MANUAL CONTROLS

EJECTION CONTROLS

Two handles are provided to actuate the ejection sequence; the face screen firing handle and the seat pan firing handle. The face screen firing handle requires an actuating force of about 18 kg to 32 kg (40 lb to 70 lb), and has a travel of 420 mm (16.5 in). The seat pan firing handle requires an actuating force of about 7 kg to 30 kg (15 lb to 65 lb), and has a travel of about 76 mm (3 in). Either handle may be used as circumstances demand (refer to Fig 1-43).

WARNING

The face screen firing handle assembly is rather bulky and requires a 43 mm (1.7 in) gap between the top of the ejectee's helmet and the canopy plexiglass to prevent the head from being pulled forward as the handle is actuated. If the face screen firing handle assembly snags the helmet visor cover and pulls the head forward, the correct ejection posture must be re-established within the one second canopy to ejection seat firing delay.

SEAT HEIGHT ADJUSTMENT SWITCH

The seat height adjustment switch is mounted on a box located on the front right side of the seat pan. The actuator is an electrical screw jack.

WARNING

The rocket pack initiator hose, firing unit or propellant tubes may be damaged if any foreign object is on the cockpit floor under the ejection seat when the seat pan is motored to the full down position. Any damage to the rocket pack assembly may cause a serious rocket malfunction upon ejection.

The OM6 ejection seat attempts to compensate automatically for variations in occupied seat centre of gravity position by subtly adjusting the rocket pack thrust angle pending seat pan height adjustment.

SHOULDER HARNESS UNLOCKING LEVER

The shoulder harness unlocking lever is located on the right side of the seat pan. To unlock the shoulder harness, push the spring-loaded lever forward and allow it to return to the intermediate detent. In this position, the shoulder harness locks automatically if a vertical or longitudinal acceleration of 2 'g' to 3 'g' is applied. To lock the harness manually, push the lever outboard to clear the detent, and allow it to return to its most rearward position (refer to Fig 1-41A).

BOWYANG RELEASE LEVER

The bowyang release lever is located on the front left side of the seat pan. When the lever is pulled rearwards, the leg restraining straps are released at the seat taper plug quick release unit.

PEC HANDLE AND UNLOCKING PAWL

The PEC is removed by pressing the unlocking pawl and pulling on the handle. This action disconnects the oxygen, radio and visor heat leads.

MANUAL SEPARATION HANDLE

The manual separation handle is located on the top left hand edge of the seat pan. Squeezing the trigger inside the handle unlocks the handle which can then be rotated upwards about a pivot point to the rear of the handle. This action fires the guillotine cartridge which severs the parachute withdrawal line to separate the parachute from the seat stabilizer chute. At the same time, the three seat harness locks, the PEC and the two leg restraint quick release units are released. At this time, the pilot is attached to the seat by two clips only; these clips release under a load of about 18 kg (40 lb) applied by the pilot when he pushes himself free from the seat.

The manual separation handle rotates up through about 40° and requires an actuating force of about 30 kg (65 lb) (refer to Fig 1-44).

Note

The manual separation handle and the parachute D-ring are used only in an emergency when the seat does not function automatically.

PARACHUTE D-RING

The parachute D-ring is located on the waist belt. Pulling the parachute D-ring a distance of about 20 cm (8 in) releases a spring-loaded auxiliary chute which, in turn, withdraws the pilot's parachute.

Face Screen Handle and Seat Pan Handle - Operated Position

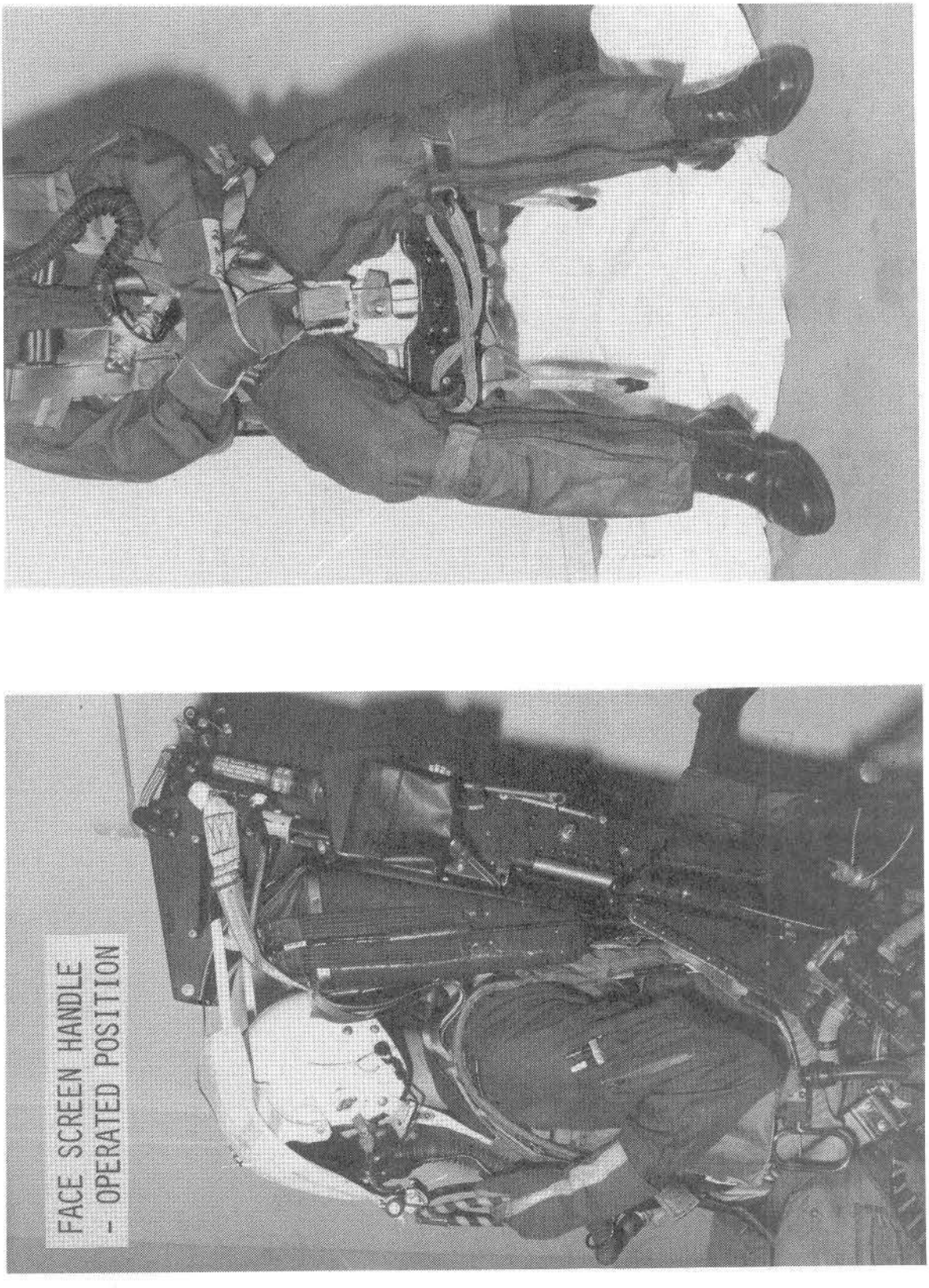


Figure 1-43

Manual Separation Handle - Operated Position



Figure 1-44

EJECTION SEAT OPERATION SEQUENCE

When either ejection handle is pulled (refer to Fig FO1-23), the aircraft canopy is immediately jettisoned. One second later the first seat cartridge is fired. The seat moves up the rails, the leg restraining straps tighten and the pilot's legs are drawn in firmly against the seat. The second and third cartridges fire progressively. As the seat moves up the rails, the emergency oxygen bottle starts to supply oxygen to the pilot and the IFF is triggered to transmit on EMER. The barostatic time release unit (BTRU) and the drogue gun are armed during initial seat movement by the action of the telescopic rods attached to the seat rails. The remote rocket initiator static cable is extended by seat movement and fires the rocket pack as the ejection gun completes its stroke.

Note

The rocket pack fires for 0.5 sec and propels the seat slightly to the left of the ejection vertical axis for optimum deployment of the controller drogue and to ensure that the ejectee does not parachute down into a possible fireball after a nil-wind, near-zero-speed/zero-altitude ejection.

The drogue gun fires 0.5 sec after the seat starts its travel and the drogue bullet deploys the controller drogue. The controller drogue deploys the seat stabilizer chute which decelerates and stabilizes the seat. Following ejection at high altitude, the BTRU operates two seconds after the seat descends to an altitude of 14 500 to 11 500 ft. If ejection takes place below this height, the two-second delay begins to run as soon as the BTRU is armed by initial seat movement.

The BTRU operation :

a. releases the leg restraining straps,

b. opens the PEC,

c. opens the three harness locks (the harness is then attached to the seat by the two restraining clips only), and

d. opens the scissor shackle, which allows the stabilizer chute to withdraw the pilot's parachute and release the face blind.

The pilot is momentarily held in the seat by the restraining clips until parachute deployment provides a load of about 18 kg (40 lb) to free him from the seat.

EMERGENCY PROCEDURES

If the automatic separation function of the seat fails, a manual separation (refer to Fig 1-44A) is possible by pulling the :

a. manual separation handle, and

b. parachute D-ring.

WARNING

This manual separation sequence must be followed exactly.

If the canopy fails to jettison, the seat fires through it provided the seat firing sear has been withdrawn.

WARNING

If the canopy jettison safety pin has not been removed, neither the face screen firing handle nor the seat pan firing handle can be pulled even though all other safety pins may have been removed.

SURVIVAL PACK

A Martin-Baker rigid survival pack is fitted to the ejection seat. The outer rigid shell is made of yellow fibreglass. It is about 180 mm (7 in) deep and is attached to the parachute harness by two quick release connectors (squeeze to release type, refer to Fig 1-45). Inside the rigid shell is a fabric container in which the life raft and survival aids are stowed. The raft and the fabric container are joined to a nylon lowering line. The other end of the lowering line is connected, via a quick release connector, to the pilot's life jacket.

When the quick release connectors securing the pack to the harness are released, the pack falls to the end of the lowering line which withdraws the pack closure pin and automatically inflates the life raft. The inflation of the life raft forces the pack open and allows the life raft and fabric survival aids container to hang on the lowering line below the pilot.

Note

The two quick release connectors which attach the survival pack to the parachute harness are the same as the squeeze to release type connector which secures the black dinghy lanyard to the LPU. To avoid confusion for the ejectee suspended under a parachute, the dinghy lanyard connector is normally hidden under the waist belt and left side lap strap so that it cannot be released.

Manual Separation

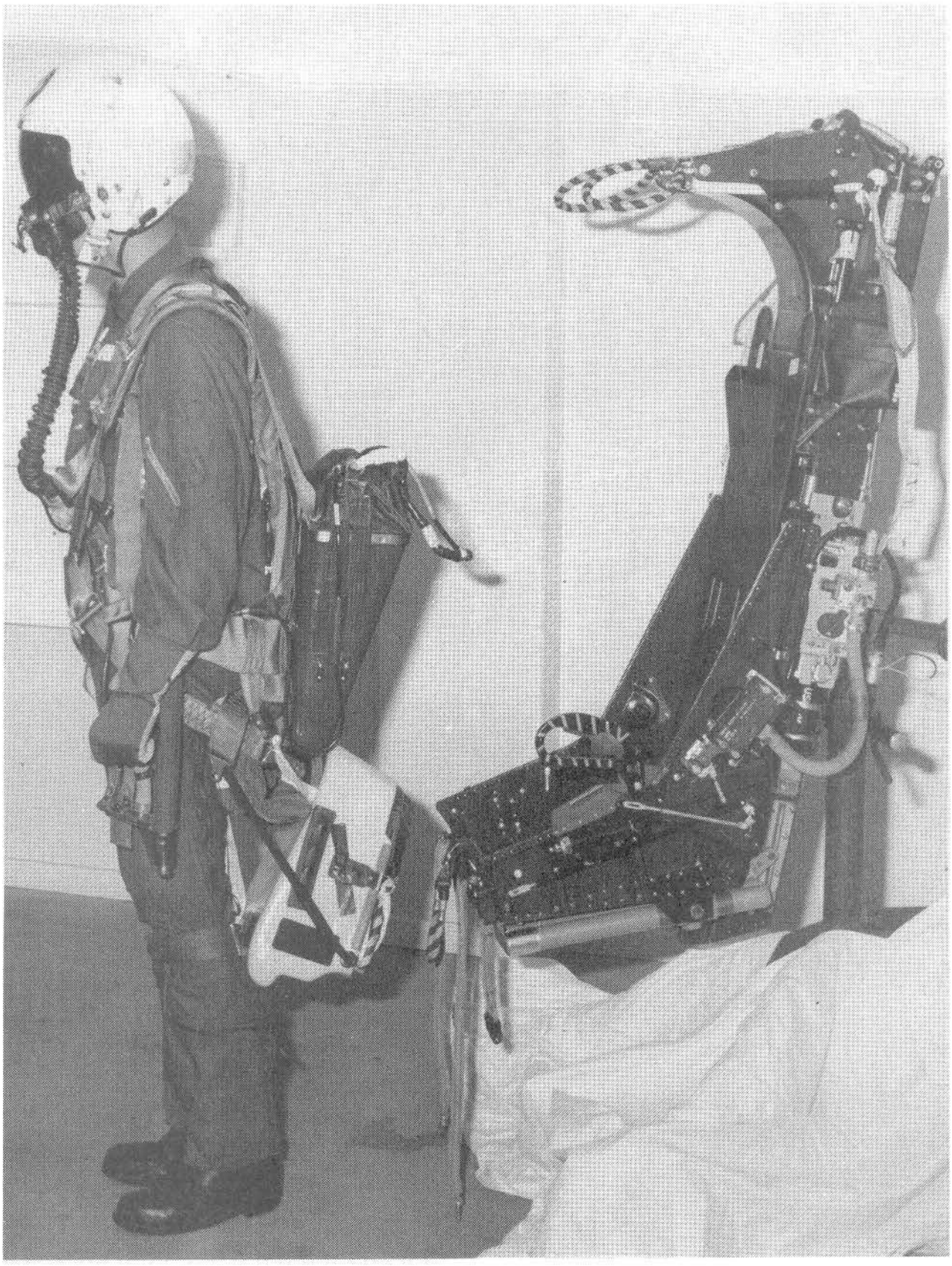


Figure 1-44A

Survival Pack Attached to Parachute Harness



Figure 1-45

The survival aids stowed in the pack are :

a. six 250 ml water containers,
b. two day and night distress signal flares,
c. two tins of matches (about 25 in each tin),
d. one reversible sun hat,
e. one 0.6 litre (1 pint) water carrier,
f. one first aid kit,
g. one survival manual,
h. two packets of hard candy,
i. one set of leak stoppers,
j. one type D survival knife,
k. one wrist survival compass,
l. one pair of anti-glare goggles,
m. one pair of woollen socks,
n. one pair of cloth gloves,
o. one heliograph signalling mirror,
p. one packet of beef cubes,
q. one pocket knife,
r. one empty aluminium tin (ex ration tin),
s. one mosquito hat, and
t. one ground-air emergency code.

The one-man life raft with bailer attached may be any one of the following types :

a. B2B (coloured orange/grey),
b. LRU3/P (coloured orange),
c. MB4 (coloured orange), or
d. MK21S (coloured black/orange).

Note

A hollow metal piercing tool, secured to the right side of the cockpit near the side windscreen panel, may be used by the pilot to puncture the dinghy if it inflates during flight.

TREE ESCAPE EQUIPMENT

The tree escape equipment (refer to Fig 1-46) allows the pilot to lower himself to the ground if his parachute becomes entangled in trees. The equipment consists of a harness worn by the pilot under his 'g' suit and associated equipment packed in the backpack of the parachute harness. The harness, worn by the pilot, consists of a metal triangle with two nylon loops.

The equipment packed in the backpack consists of :

a. a nylon loop and metal clip which attaches the equipment to the two front risers of the parachute,
b. a braking mechanism which controls the pilot's rate of descent, and an associated metal hook which accepts the metal triangle on the pilot's harness, and
c. 45 m (150 ft) of nylon cord contained in a cloth bag in the backpack, the last 6 m (25 ft) of the cord marked with a black stripe.

EJECTION

Assuming fully serviceable equipment and proper training, the factors which govern a pilot's chances of a successful ejection are height above terrain (ejection altitude), and the velocity and attitude of the aircraft as the seat is ejected. The ejection seat design features establish the minimum conditions at which the equipment can complete its functions before seat impact with the ground.

MINIMUM SAFE EJECTION ALTITUDE

Minimum safe ejection altitude (MSEA) is the terrain clearance above which ejection should take place to ensure a safe descent, allowing time for the pilot to take action if a malfunction of the automatic systems occurs (provided that he is properly trained). It does not allow time for the pilot to take action if a complete ejection system failure occurs. The MSEA for Mirage aircraft is 2000 ft AGL in level flight, or 10 000 ft AGL if the aircraft is out of control, in a dive or a spin.

ABSOLUTE MINIMUM EJECTION ALTITUDE

Absolute minimum ejection altitude (AMEA) can only be established for one set of conditions for each type of equipment, being the terrain clearance **below** which there is no chance of a successful ejection. Successful ejection at the AMEA depends on perfect completion of every phase of the ejection sequence; any delay in separation, any time device malfunction, or slow deployment of the parachute for any reason invariably proves disastrous. The conditions for AMEA are level flight and the minimum IAS required to ensure proper parachute deployment. AMEA for the aircraft is zero feet, with a minimum of 90 KIAS with the canopy attached, or zero KIAS with the canopy detached and well clear of the ejection path.

Successful ejection can be expected near the ground only if the aircraft is in level flight or climbing with wings level.

WARNING

The chances of a successful ejection at altitudes between MSEA and AMEA increase as the altitude increases. It is emphasized that, in this context, altitude refers to actual terrain clearance.

Tree Escape

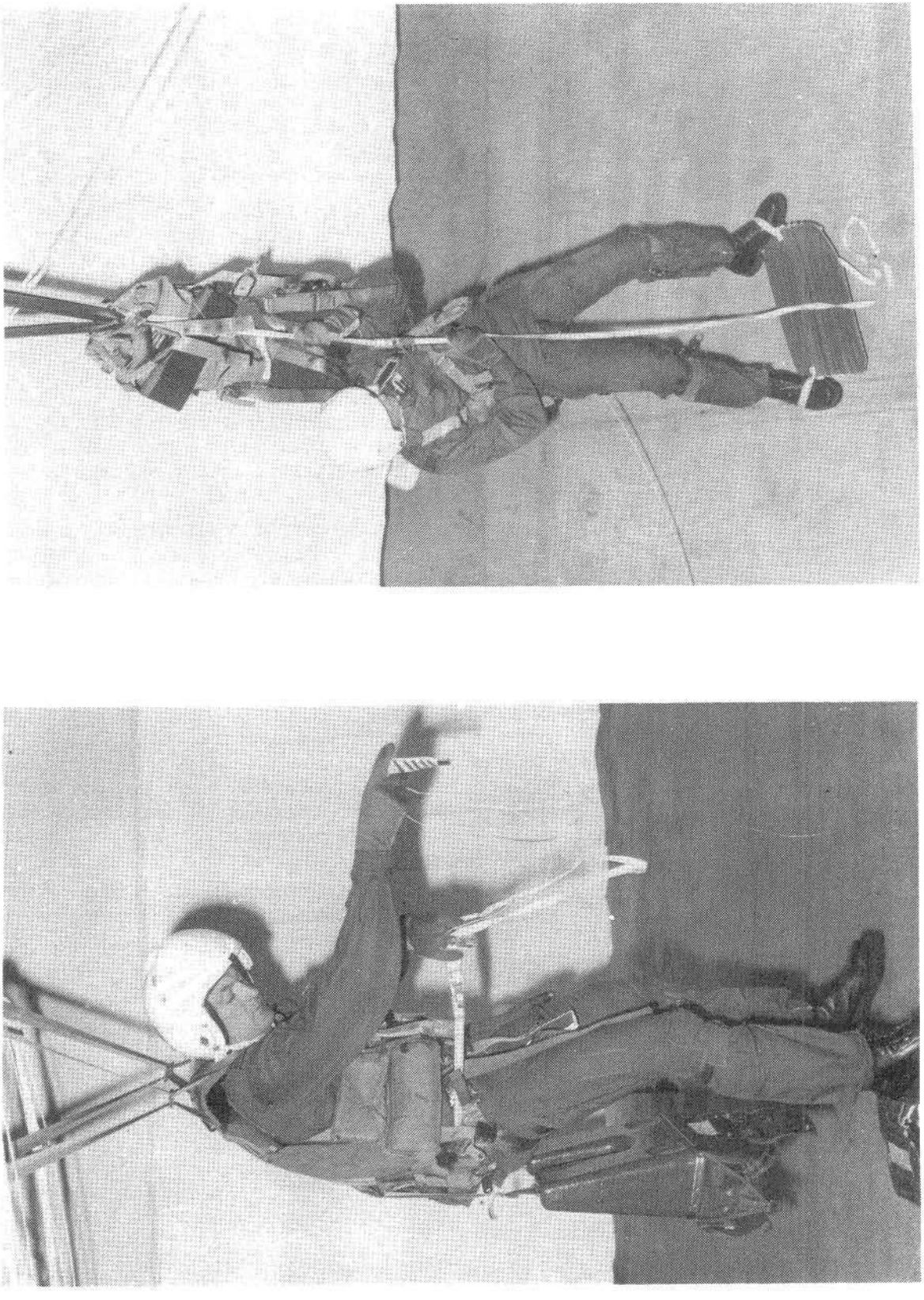


Figure 1-46

AIR CONDITIONING SYSTEM

The air conditioning system consists of a cabin air conditioning and pressurization system, an equipment air conditioning system, an emergency ventilation system, controls and warning lights.

[D] The cockpit air conditioning system provides conditioned air for the nose cone. A separate equipment air conditioning system is not fitted.

CABIN AIR CONDITIONING AND PRESSURIZATION SYSTEM

The cabin air conditioning and pressurization system provides :

a. cabin pressurization,

b. cabin air conditioning,

c. inflation of the canopy seal,

d. demisting,

e. inflation of the anti-'g' suit,

f. radar pressurization, and

g. [D] nose cone air conditioning.

Hot pressurized air from the ninth stage of the engine compressor (refer to Fig FO 1-24) is cooled in the pre-cooler by the action of ram air. After passing through the pre-cooler, some air is by-passed for radar pressurization.

The main system air is fed through a venturi which limits the delivery rate. A by-pass supplies air to the canopy seal and the anti-'g' suit. The main system air then passes through a shut-off valve controlled by the PRESSURIZATION switch. The air stream is then split and flows through two lines; a hot line and a cold line.

Hot Line

The hot line air passes through the temperature control valve to the cabin via the water separator. The duct and the cabin temperature sensors send signals to an amplifier which controls the position of the temperature control valve to give a cabin temperature as selected by the temperature control rheostat. The temperature control valve either opens to allow more hot air to the cabin or closes to reduce the hot air flow and force more air to be diverted through the cold line.

Cold Line

The cold line air is cooled as it passes through the following components which are connected in series :

a. a secondary heat exchanger,

b. a compressor coupled to an expansion turbine,

c. a main heat exchanger,

d. a water evaporator, and

e. the expansion turbine.

The hot and cold lines re-join, and the air is mixed to meet the temperature requirements of the temperature regulation system as selected on the cabin temperature control rheostat. After passing through a water separator this air enters the cabin through the windshield outlets, outlets at the pilot's feet and through the diffuser on the left rear cabin wall.

[D] Air enters the cabin through the windshield outlets, the diffuser and outlets on both sides of the canopy.

During ground operation, some pressurized air is by-passed into the ram air outlet line of the secondary heat exchanger to induce ram air circulation utilizing the giffard effect. This air is cut off by the operation of a microswitch when the undercarriage is retracted.

CABIN PRESSURIZATION

With the PRESSURIZATION switch ON, the canopy seal inflated and ram air inlet closed, the cabin is pressurized by air delivered from the cabin distribution outlets. A pressure regulator discharges air from the cabin into the equipment bay to maintain the cabin pressure at :

a. ambient pressure from 0 to 6500 feet AMSL,

b. 6500 feet between 6500 and 18 000 feet AMSL, and

c. 29.6 kPa (4.3 psi) differential above 18 000 ft AMSL.

If cabin altitude exceeds 30 000 feet, the cabin pressurization system is unserviceable.

A safety valve protects the cabin against excessive overpressures or underpressures.

[D] The pressure regulator allows part of the pressurized air to escape. Above 18 000 ft a cabin pressure differential of 26.9 kPa (3.9 psi) is maintained.

CABIN AIR CONDITIONING

The PRESSURIZATION switch must be ON. Cabin air temperature is determined by regulating the temperature control valve in the hot line of the pressurization system. The valve controls the amount of hot air flowing in the hot line and the amount of air diverted to the cold line to be cooled. There are three methods of regulating the temperature control valve.

[D] There are four methods of regulating the temperature control valve.

Automatic Function

In the automatic function, the required cabin temperature is set on the cabin temperature control rheostat. A control amplifier, which takes temperature information from sensors in the cabin and duct, positions the temperature control valve to maintain the cabin temperature at the set value. To prevent icing of the water separator, the cabin temperature is always maintained above 4°C by the limiting amplifier.

Note

- In tropical climates or very damp weather conditions, the cockpit temperature control rheostat should be set to the full hot position and demist selected before descent. This is essential if a rapid descent from high altitude is planned.

- The 10 o'clock position of the temperature control rheostat is generally suitable for take-off. In damp weather, full cold should not be used on take-off because condensation may obscure the front windscreen.

Manual Function

In the manual function, the control amplifier is disconnected from the system and the regulation valve is controlled directly by the pilot. The control knob is rotated to the 6 o'clock position for manual operation. Temperature control is achieved by flicking the knob to the hot (outboard) or cold (inboard) position as required. The knob is spring loaded to the neutral (6 o'clock) position, but it may be retained by detent on the cold side. When the cold detent is engaged, a limit amplifier controls inlet duct air temperature to between 2° and 4°C.

Emergency Cold

Use of the EMERGENCY COLD switch feeds a signal direct to the temperature control valve and all the air is fed through the cold line. The switch is used if the auto and manual functions are ineffective.

Note

Automatic, manual, and emergency cold functions are AC operated and, in the event of an alternator failure, cabin temperature control is not available. However, the PRESSURIZATION switch is DC operated and the system may be switched ON and OFF.

[D] Rear Cabin Operation

Manual temperature control is possible from the rear cabin. When the AIR CONDITIONING switch is selected to MANUAL, the front cabin controls are inoperative and the temperature control valve is controlled by operating the MANUAL switch. Selecting the MANUAL switch to either HOT or COLD for short periods changes the position of the temperature control valve. This is continued until the required temperature is obtained. The water separator auxiliary regulation is by-passed.

INFLATION OF CANOPY SEAL

When the canopy seal/ram air lever is in the fully forward position, the canopy seal is inflated and the ram air cock is closed. When the lever is moved rearwards, the ram air cock opens progressively and the canopy seal remains inflated. The lever is stopped by a detent after about 2/3 of its travel. To override the detent, the lever is pulled inboard. When the lever is moved fully rearwards, the canopy seal is deflated and the ram air cock is fully open. The canopy seal pressure is released when the CANOPY locking handle is moved rearwards to open the canopy and it is unnecessary to actuate the canopy seal/ram air lever.

INFLATION OF ANTI-'g' SUIT

An anti-'g' valve located near the PEC, meters 9th stage air to the 'g' suit. The amount of air flowing is dependent upon the amount of 'g' being pulled. After engine start, the 'g' valve and the 'g' suit connection can be tested by pressing the chrome button on top of the 'g' valve.

RADAR PRESSURIZATION

Warm air from the pre-cooler is by-passed from the cabin pressurization system and passed through a pressure reducer/regulator to the radar nose. A pressure disc in the nose operates at about 8000 ft and, in conjunction with the pressure regulator, maintains the radar nose pressure at 14.21 psi (980 mb) absolute. If the disc ruptures, the pressurizing air is dumped and a pressure sensitive switch operates to remove power from the radar.

[D] NOSE CONE AIR CONDITIONING

In flight, conditioned air is supplied to the nose cone from the cabin system to condition TACAN only. On the ground, conditioned air may be supplied by a ground conditioning unit to condition TACAN only. The IFF is fitted with a blower and its conditioning line is blanked off. Since the sub-system is connected downstream of the temperature control valve in the cabin system, the sub-system is slaved to the cabin temperature regulator in flight. On the ground, the sub-system is directly connected to the ground conditioning unit through a coupling inside the lower nose access door. The cabin cannot be pre-conditioned through this coupling as a non-return valve prevents the air entering the cockpit.

DEMISTING

When the DEMIST handle is in the rear position, air enters the cabin through the windscreen inlets, floor inlets and the diffuser. When the handle is placed in the forward position, the diffuser is inoperative and a greater volume of air is delivered to the windscreen.

EQUIPMENT AIR CONDITIONING SYSTEM

The equipment air conditioning system controls the temperature of :

a. the radar through an air-fluid heat exchanger,

b. the Matra R530 missile,

c. the TACAN, the electronic unit and the gyro centre output multiplier in the equipment bay, and

d. the Doppler transmitter/receiver in the nose wheel well.

[D] A separate equipment air conditioning system is not fitted.

The system also provides pressurization to the fuel tanks and the hydraulic reservoirs.

Hot compressed air from the engine left and right lower pick offs (refer to Fig FO 1-25) is passed through a dual pre-cooler. The fuel tank and hydraulic reservoir pressurization air flows through one unit and the equipment conditioning air flows

through the other. The equipment conditioning air is then routed through a venturi to reduce the flow before being fed through the shut-off valve which is controlled by the EQUIPMENT CONDITIONING switch. The air flow is then split and flows through two lines; the hot line and the cold line.

Hot Line

In the hot line, the flow of air is controlled by the temperature control valve slaved to the temperature regulation system.

Cold Line

In the cold line, the air passes through a heat exchanger and an expansion turbine. The volume of air diverted through the cold line is controlled by the position of the temperature control valve.

The ground operation of the heat exchanger is similar to the operation of the heat exchanger in the cabin air conditioning and pressurization system.

The hot and cold lines re-join and the air is mixed. The air is then routed through an air-fluid heat exchanger to cool the hydraulic fluid from the Cyrano radar. The air is also routed to ventilate the Matra R530 missile head, the rear radio bay and the empty tail warning radar bay, the electronic unit, the TACAN and gyro centre output multiplier in the equipment bay and the Doppler transmitter-receiver.

[D] The rear radio bays are not air conditioned.

Temperature Control

The temperature is controlled by an amplifier which positions the temperature control valve, thus regulating the amount of hot air being passed through the hot line and the amount of air being diverted through the cold line to be cooled in the expansion turbine.

Emergency Cold

The EQUIPMENT CONDITIONING switch operates the shut-off valve (DC) and supplies AC power to the control system via the EMG COLD switch. Actuation of the EMG COLD switch moves the temperature control valve to the fully closed position. The flow of air through the hot line ceases and the total volume of air is then passed through the cold line. With an AC power failure, the temperature control valve remains in the pre-failure position.

EMERGENCY VENTILATION SYSTEM

The emergency ventilation system may be used to :

a. clear smoke and fumes from the cockpit,

b. provide cooling when the cooling turbine fails, and

c. demist the interior of the cockpit quickly.

The emergency ventilation system is effective when the ram air cock is opened by moving the canopy seal/ram air lever rearwards. Air enters a port located on the right side of the aircraft nose and passes through the ram air cock into a Y-shaped outlet. The Y-shaped outlet directs the air onto the front windscreen and the left front glass pane. The temperature of the air is dependent on the forward speed and altitude of the aircraft. The ram air cock should only be opened when the aircraft is below 20 000 ft and at airspeeds less than 450 KIAS.

CONTROLS

The air conditioning system is controlled by the following controls, which are located on the right side of the cabin :

a. PRESSURIZATION switch,

b. cabin temperature control rheostat,

c. EMERGENCY COLD switch,

d, canopy seal/ram air lever,

e. DEMIST lever,

f. EQUIPMENT CONDITIONING switch, and

g. EQUIPMENT CONDITIONING EMG COLD switch.

[D] The EQUIPMENT CONDITIONING switch and EQUIPMENT CONDITIONING EMG COLD switch are not fitted.

The RADAR-DN CONE switch may still exist in unmodified aircraft. In the dummy nose cone position (DN CONE), it compensates for the heat load due to normal radar operation. The switch, when present, is to be placed to the position corresponding to the type of nose cone on the aircraft.

[D] REAR CABIN CONTROLS

The rear cabin air conditioning system controls are on the right console. They are :

a. the emergency air conditioning control panel which can override the front cabin control panel. Its two switches are :

   (1) an AIR CONDITIONING switch with two positions, NORMAL and MANUAL, and

   (2) a MANUAL switch with two positions, HOT and COLD, and

b. a DEMIST lever which works independently of the lever in the front cabin.

WARNING LIGHTS

The air conditioning system has the following warning lights on the main fail panel :

a. ***Cabin Temperature Light.*** The cabin temperature light (CAB T) illuminates when the duct temperature is above 60°C or the cabin temperature is above 32°C, and

b. ***Cabin Pressurization Light.*** The cabin pressurization light (CAB P) illuminates and the

horn sounds when the cabin pressure is below the pressure equivalent of 30 000 ft or when the CANOPY LOCK lever is not fully forward.

CAUTION

The CAB P light is extinguished by placing the CANOPY LOCK lever forwards regardless of canopy position.

[D] The canopy must be closed with the CANOPY LOCK lever fully forward before the CAB P light will extinguish.

c. ***Equipment Bay Temperature Light.*** The equipment bay temperature warning light (EQ.T) on the main fail panel illuminates when the temperature of the air at the radar heat exchanger inlet is above 50°C.

Note

[D] The EQ.T warning light on the main fail panel is inoperative.

FAILURES

CABIN COOLING TURBINE

Failure of the cabin cooling turbine can be serious at low level as the increase in temperature leads to pilot heat stress.

This failure is characterised by a reduction in the flow of air from the pressurization system and an increase in the temperature of this air. Other possible symptoms are a burning smell, vibration and noise.

If the standard emergency procedures to counter cabin temperature increase fail, operation of the ram air/canopy seal deflate system will not cool the cabin unless the ram air is cold and the IAS is decreased. Temperature in the cabin with ram air operating and the canopy seal deflated is a function of IAS. When the IAS is decreased, the pressure in the cabin decreases and hence the temperature decreases. Therefore to decrease the cabin temperature when the cabin cooling system fails at low altitude, the pilot should climb into cooler air and reduce IAS. If meteorological conditions or insufficient fuel reserve prevent a climb, and if the operation of the ram air/seal deflate provides little relief, jettison the canopy.

WARNING

The nature of heat stress is insidious in that the pilot is unaware of the deterioration of his condition. Pilots should take care to prevent cabin heat build up, if the cabin cooling turbine fails.

CABIN PRESSURE FAILURE

The only warning of a pressurization malfunction is the CAB P warning light on the main fail panel which illuminates when the cabin pressure is below the pressure equivalent of 30 000 ft. The light also illuminates when the CANOPY LOCK handle is not in the locked position.

LIMITATIONS

When the cockpit air conditioning and pressurization system is in use, the RPM limitations at Section 5 are to be observed to avoid overtemperatures and high loads on the expansion turbine bearings.

COMMUNICATIONS EQUIPMENT

The communications equipment consists of a primary UHF set, a secondary UHF set, a communications selection panel and telebriefing equipment.

[D] The Mirage IIID equipment is covered under [D] COMMUNICATIONS EQUIPMENT.

PRIMARY UHF (GREEN) AND SECONDARY UHF (RED) SETS

Both radios are ARC-159 sets and consist of :

a. one transmitter and two receivers,

b. a control panel situated on the forward left console, and

c. an antenna.

The primary set is located in the equipment bay and the secondary set in a bay in the lower left fuselage aft of the pitch damper. Each set has its own antenna. The antenna for the primary set is at the top of the fin, the antenna for the secondary set is at the lower leading edge of the fin.

ARC-159 SPECIFICATIONS

The specifications for the ARC-159 are :

a.	Frequency band	225-399.975 MHz.
b.	Available channels	7000.
c.	Frequency spacing	25 kHz.
d.	Preset frequencies	20.
e.	Power supply :	
	(1) Green—Main DC Bus.	
	(2) Red—Manual loadshed bus.	
f.	Operating voltage	27.5 VDC.
g.	Power consumption :	
	TX	112 W
	RX	28 W
h.	Power output	10 W.

TRANSMITTER/RECEIVERS

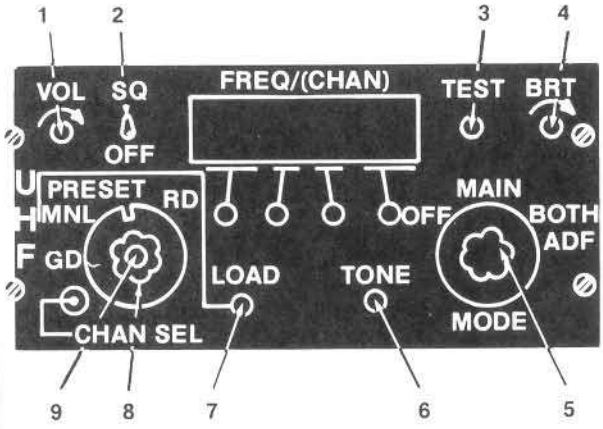
The ARC-159 contains one transmitter and two receivers; one of which is preset on the GUARD frequency.

Selection can be made of one or both receivers.

CONTROL PANEL

The control panel (refer to Fig 1-47) provides pilot selection and control of the radio facilities. The controls and their functions are described in the following paragraphs.

Control Panel - Primary UHF Set



1. Volume control knob
2. Squelch switch
3. Test button
4. Brightness control knob
5. Mode selector knob
6. Tone button
7. Load button
8. Frequency mode selector knob
9. Channel selector knob

Figure 1-47

Mode Selector

This rotary switch has four positions as follows :

a. ***OFF.*** Power is not supplied to the equipment.

b. ***MAIN.*** Main receiver and transmitter energized; reception and transmission on selected frequency only.

c. ***BOTH.*** Main receiver, transmitter and guard receiver energized; transmission on selected frequency only, but reception on selected frequency and guard frequency simultaneously.

d. ***ADF.*** The ADF function is not connected.

Tone Button

Pressing the tone button transmits a continuous tone which is audible through the headset. Use of this button facilitates accurate UHF direction finding.

Volume Control Knob

Reception volume is increased by rotating the VOL control knob clockwise.

Squelch Control

When selected ON, the squelch control reduces background noise. In the OFF position, the range and sensitivity of the set is improved.

Test Button

When the test button is depressed, the frequency/channel display lights will all indicate 8.

Brightness Control

The BRT control varies the brightness of the readout displays and the panel edge lighting.

Frequency Mode Selector

This rotary switch has four positions as follows :

a. ***GD.*** This position selects the guard transmitter and receiver (normally 243 MHz).

b. ***MNL.*** By selecting manual, frequencies can be manually set on the display by the use of the four frequency selector switches located below the display window.

c. ***PRESET.*** In the preset position, the operating frequency can be selected from 20 preset channels. The channel selector switch is located on top of the frequency mode selector. The selected channel number is indicated on the display.

d. ***RD.*** In the read position, the selected channel frequency is indicated on the display.

Load Button

If the frequency of a preset channel is to be changed, the channel selector switch is set to the channel to be changed, and the frequency mode selector switch is set to MNL. The desired frequency is set on the display and the LOAD button is pressed. The frequency mode selector is then returned to PRESET.

OPERATION

Preset Mode

To operate in the preset mode, make the following selections :

a. MODE selector—BOTH.

b. TEST button—Press (88888).

c. BRT control knob—As required.

d. Squelch switch—SQ.

e. VOL knob—As required.

f. Frequency mode selector—PRESET.

g. Channel selector—As required.

Manual Mode

To operate in the manual mode, select the controls as for the preset mode except that the frequency mode selector is selected to MAN and the frequency selectors are set as required.

Guard Frequency Operation

Transmission on guard frequency is achieved by selecting :

a. the frequency mode selector to GD, or

b. the frequency mode selector to MNL and manually selecting 243 MHz on the display, or

c. the frequency mode selector to PRESET and selecting the appropriate channel.

Reception on guard frequency is achieved by each of the preceding transmission methods or by selecting the MODE selector to BOTH.

CAUTION

Fluctuating or weak ground power can cause the set to select guard frequency.

Note

When the ARC-159 radios were fitted, a mute function was incorporated in the communications selection panel. The radio not selected is muted (the volume is lower than that corresponding to the volume control setting).

COMMUNICATIONS SELECTION PANEL

The communications selection panel (refer to Fig 1-49) is situated on the left console just aft of the red set control panel and contains a communication selector and a telebrief connection light.

The communications selector allows selection of five combinations of the UHF radio installations and also selection of telebrief and TACAN reception. Because audio levels vary considerably in the various reception sources, a high resistance has been installed on each available line to avoid interference on the reception circuit. To restore a suitable audio level an amplifier has been installed between the communications selector panel and the pilots headphones.

COMMUNICATIONS SELECTOR

The communications selector is divided into two sectors, normal (N) and emergency (EMG). Each sector is marked with dots or letters which denote the various selection positions.

IIIO Communications Selection Panel

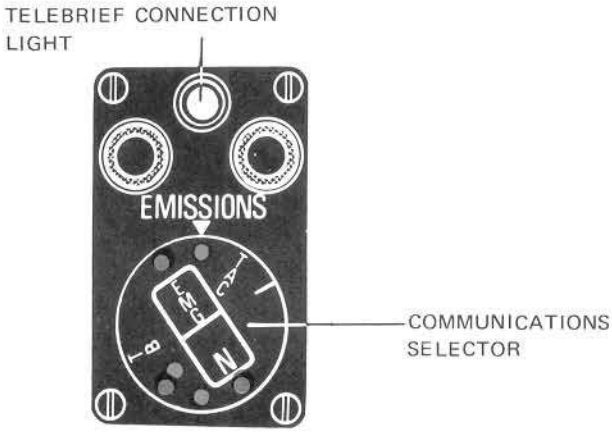


Figure 1-49

Normal (N) Sector

Selection in the N sector means all reception comes through the amplifier. Switch positions are :

a. ***Green Dot.*** Reception from both radio sets and TACAN is automatically available if these facilities are selected ON. However, transmissions are made on the green set only.

b. ***Red Dot.*** Reception is as for green dot, but transmissions are made on the red set only.

c. ***Red and Green Dot.*** Reception is available as for green dot, and simultaneous transmissions are made on both sets.

Note

If both red and green sets are selected to the same frequency, and red and green dot is selected, transmissions will result in a loud squeal and a very weak modulated signal.

d. ***TB.*** Selection of this position allows communication between pilot and ground crew through telebrief facility only. An amber light on the communications selection panel illuminates when the ground telebrief connection is plugged in and the communications selector is on TB position.

e. ***White Line.*** The white line etched on the selector 180° from the TB position, is another telebrief function which may be used if the normal TB function is unserviceable. It cuts out a limiting resistor and the telebrief indicator light. It is more prone to noise interference but may give better performance than the normal position in some cases.

Emergency (EMG) Sector

The emergency sector may be selected when the audio amplifier fails. Failure of the audio amplifier is indicated by unsatisfactory reception on both radio sets. When the emergency sector is selected, the amplifier is by-passed and each UHF equipment is used separately. Switch positions are :

a. ***Green Dot.*** Transmission and reception are available on green set only.

b. ***Red Dot.*** Transmission and reception are available on red set only.

c. ***TAC.*** Reception of TACAN identification code only is possible.

Note

- Missile tone for both Matra and Sidewinder can be heard on all selections of the communications selector.
- When the U/C DOWN button is pressed, the undercarriage 'beeper' is heard on any selection where a receiver is operating.

TELEBRIEF EQUIPMENT

The telebrief facility provides secure telephone communication between the pilot and groundcrew during engine start or pilot and operations during alert periods. Power for the facility is supplied from the main DC bus.

OPERATION

The ground plug is connected into the telebrief socket at the rear left fuselage and TB is selected on the communications selector. The amber telebrief connection light on the selector panel illuminates. Press the microphone button before speaking. When the aircraft moves forward, the ground connector is disconnected and the access door closes automatically.

D COMMUNICATIONS EQUIPMENT

PRIMARY UHF (GREEN) SET

The primary radio (green) set in the Mirage IIID is an ARC-159. It is housed in the left rear fuselage bay which is heat insulated only. The control panel for the set is located on the left console in the front cockpit only. The panel is identical to that used in the Mirage IIIO (refer to Fig 1-47). The VOL control knob on the control panel is inoperative and volume is controlled by the potentiometer on the communications selection panel.

SECONDARY UHF (RED) SET

The secondary (red) set in the Mirage IIID is also an ARC-159. It is housed in the right rear fuselage bay which is heat insulated only. The control panel for the set is identical to the primary UHF control panel (refer to Fig 1-47), and a panel is located on the left console in each cockpit. Note the following :

a. The setting of a selector box in the rear cockpit determines whether the set is controlled from the front or rear cockpit control panel.

b. The VOL control knob on the control panel is inoperative. Volume is controlled by the potentiometer on the communications selection panel.

SELECTOR BOX

The selector box (refer to Fig 1-50) is located on the left console in the rear cockpit. The control is a rotary switch with two positions labelled FNT and ↑. In the FNT position, the red set is controlled by the control panel in the front cockpit. In the ↑ position, the rotary switch points at the red set and the red set is controlled by the control panel in the rear cockpit.

Selector Box - Secondary UHF Set

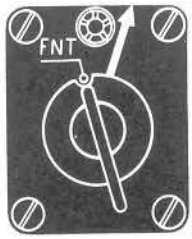


Figure 1-50

COMMUNICATIONS SELECTION PANEL

The communications selection panel (refer to Fig 1-51) is located on the instrument panel in the front cockpit and on the pedestal in the rear cockpit. The panel contains a communications selector and three volume potentiometers.

IIID Communications Selection Panel

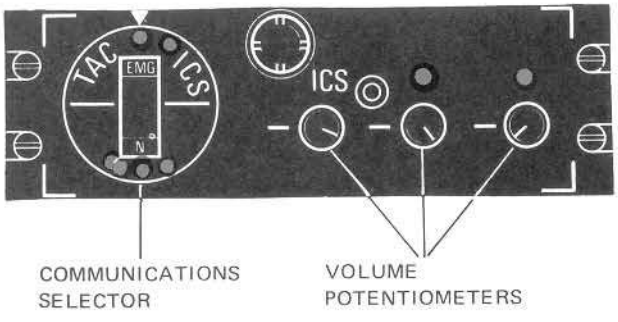


Figure 1-51

COMMUNICATIONS SELECTOR

The communications selector permits selection of five combinations of the UHF radio installations, TACAN reception and crew intercommunication system (ICS).

Normal (N) Sector

Operation of the radios in the normal sector is identical to operation of the Mirage IIIO radios in the normal sector. In the normal sector, the following is also available :

a. An ICS, and

b. Reception of TACAN identification codes if the TACAN/S.W. switch is selected to TACAN or S.W. tone if the switch is selected to S.W.

Note

If S.W. pylons are fitted but S.W. are not carried, selecting the TACAN/S.W. switch to S.W. may cause interference on the ICS.

Emergency (EMG) Sector

Operation of the radios in the emergency sector is identical to operation of the Mirage IIIO radios in the emergency sector. In the emergency sector, the following is also available :

a. ***ICS.*** If ICS is selected, ICS only is available in that cockpit.

b. ***TAC.*** In this position, reception of TACAN identification codes is available if the TACAN/S.W. switch is selected to TACAN.

c. ***Ground Telephone.*** A ground communications connector is located inside the DC/AC ground connector door. The connector accepts a normal headset jack which permits 'hot mike' telephone communication between both pilots and the ground crew provided :

(1) the green set selector switch is selected to MAIN or BOTH,

(2) the communications selector is set to green dot, EMG sector.

Note

There is no telebrief function in the Mirage IIID.

VOLUME POTENTIOMETERS

Three potentiometers are provided to control the volume from the two radio sets and the ICS.

Note

On some aircraft it is not possible to control radio reception volume while external power is connected.

CREW INTERCOMMUNICATION SYSTEM

Power for the crew ICS is supplied from the battery

RAAF SUPPLEMENT NO 51

MATRA MAGIC R550

Instruction

This supplement is to be inserted facing Page 1-87.

Action

Read Matra Magic R550 where ever Sidewinder (SW) is mentioned.

Date: JAN85

bus. The system uses the communications selection panels in each cockpit and the headsets. The ICS can be used in all positions in the N sector but only in the ICS position in the EMG sector of the communications selector.

Both communications selection panels are provided with an ICS volume adjustment potentiometer. A junction box facilitates connection between the front and rear cockpit communications selection panels.

The system is always 'hot'. A 'cold' mike can only be achieved by using the switch on the pilot's microphone.

Note

- The audio warning horn can be heard on all positions of the communications selector on each communications panel including the neutral position.
- The undercarriage beeper is heard on any selection where a receiver is operating when the U/C DOWN button is pressed.

WEAPON AND NAVIGATION SYSTEMS

The Mirage Weapon and Navigation System (WNS) is designed for both air-to-air and air-to-ground missions. The Mirage IIID has a limited operational capability, its primary role being an operational conversion aircraft for pilot training to the Mirage IIIO operational aircraft.

In the air-to-air role, the Mirage IIIO has the capability to intercept and destroy targets with Matra, Sidewinder or guns. The Matra can be used under all weather conditions. The Mirage IIID has the capability to intercept and destroy targets with Sidewinder missiles or guns but only in VMC conditions and with a visual estimation of target range for weapon release.

For air-to-ground missions, the Mirage IIIO WNS can be used to navigate the aircraft at low level in IMC to deliver conventional air-to-ground weapons at a target. The Mirage IIID must be navigated visually to the target. Weapons that can be carried by both models in the ground attack role are MK82 500 lb bombs and a 30 mm gunpack.

The WNS automatically performs a number of tasks for the pilot. Information from various sources is collected, processed and displayed as required on the radar scope, the gunsight or the PHI indicator. Equipment involved in the automatic functioning of the WNS (refer to Fig FO 1-26) is the :

a. Cyrano IIB radar,
b. gyro reference system,
c. PHI,
d. gunsight,
e. Doppler, and
f. WNS computer systems

[D] Radar and Doppler are not fitted.

COCKPIT LAYOUT

The cockpit layout of WNS controls and instrumentation is described in the following paragraphs. The description follows a left to right direction around the cockpit.

LEFT CONSOLE

The left console (refer to Fig FO 1-2) contains the :

a. PREHEAT switch.
b. radar control stick,
c. MISS VOLUME rheostat, and
d. gunsight electrical cage button and the sight override button on the throttle.

[D] The left console (refer to Fig FO 1-6) contains the :

a. TACAN/S.W. monitor switch,
b. MISS VOLUME rheostat,
c. manual range rheostat, and
d. gunsight electrical cage button on the throttle.

INSTRUMENT PANEL

The instrument panel (refer to Fig FO 1-3 and FO 1-7) contains the :

a. ARM MASTER switch,
b. Bezu ball,
c. radar scope or the AN/ALE-32 chaff dispenser control panel,
d. PHI indicator and mode selector, and
e. radar altimeter indicator in modified aircraft only.

[D] The radar altimeter is not fitted.

CENTRE CONSOLE

The centre console (refer to Fig FO 1-3) contains the :

a. GYRO CENT switch,
b. Doppler control panel, groundspeed and drift indicators, and
c. target altitude rheostat.

[D] The GYRO CENT switch is on the right panel. Doppler and the target altitude rheostat are not fitted.

RIGHT CONSOLE

The right console (refer to Fig FO 1-4 and FO 1-8) contains the :

a. TACAN control panel,
b. selective armament switches,
c. heading reference control panel,
d. weapons system control panel,
e. CLOSING SPEED switch, and
f. AN/ALQ72 ECM control panel.

[D] The closing speed switch is not fitted.

CONTROL COLUMN

The control column (refer to Fig 1-52) contains the :

a. camera button,
b. guns button,
c. missile/bomb button, and
d. trigger.

REAR OF SEAT

The radar programme boxes H and G, gunsight junction box, voltage regulator and camera overrun control box are located behind the ejection seat.

[D] The camera overrun control box is located on the left side of the rear ejection seat.

WEAPON SYSTEM CONTROLS

The weapon system controls include those grouped on the weapon system control panel and those armament switches involved in the release of the various weapons.

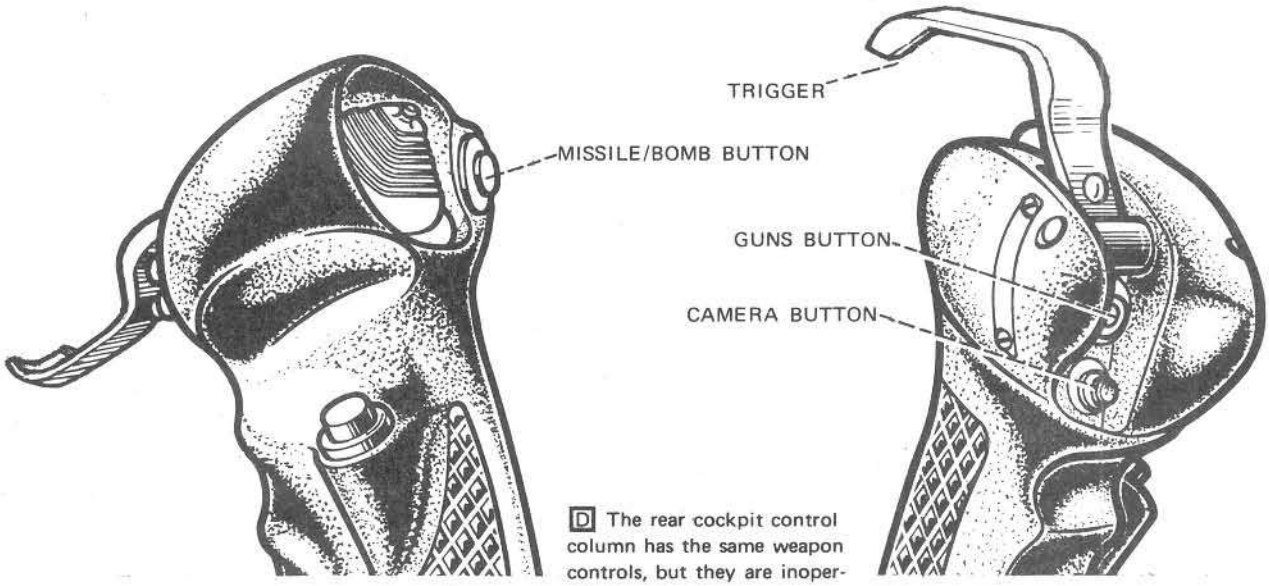
WEAPON SYSTEM CONTROL PANEL

The weapon system control panel (WSCP) (refer to Fig FO 1-27) located on the right console, groups together most of the Cyrano IIB radar mode controls, the gunsight controls and the various weapons selections. The WSCP is divided into four sections. These are the :

a. weapon system section,
b. MISS section,
c. RADAR section and,
d. BOMBS section.

[D] The RADAR section is not fitted.

Control Column



[D] The rear cockpit control column has the same weapon controls, but they are inoperative.

Figure 1-52

RAAF SUPPLEMENT NO 49

MATRA R550 WEAPON SYSTEM CONTROLS

Instruction

This supplement is to be inserted facing Page 1-88.

Information

All RAAF Mirage aircraft are being modified to carry and employ the Matra R550 'Magic" IR air to air missile.

Action

For Mirage aircraft modified for R550 operations, read the following:

MATRA R550 WEAPON SYSTEM CONTROLS

Weapons System Selector

1. When the weapons system selector is rotated from the G/S OFF position, the gunsight camera and Matra R550 circuits are enabled (refer to Fig 1-52A).

Air to Air Modes

2. In SW the Matra R550 missiles scan and lock on to IR targets. After radar lock on, the radar-nav computer computes pitch and roll sight orders for a Sidewinder attack. The fire zone computer has not been reprogrammed with Matra R550 missile performance. The green fire zone light is indicative of entry into the Sidewinder firing envelope only.

3. In GUNS and MISS, the Matra R550 missile electrical circuits are activated, but the missile homing heads do not scan or lock on to IR targets.

Dogfight Mode

4. Regardless of weapon system selection, an additional air to air mode can be selected by depressing the Dogfight button. (Previously referred to as the Sight Override Button). On Dogfight mode, the Matra R550 missiles scan and lock on to IR targets. The gunsight displays sight orders and depression for AIR-AIR GUNS. The missile seeker heads initiate a wide scan.

Air to Ground Modes

5. In all Air to Ground modes the Matra R550 missile electrical circuits are activated, but the missile homing heads do not scan or lock on to IR targets.

Single/Salvo Selector

6. When Single is selected with either SW or Dogfight modes, and two missiles are carried, the left hand missile is fired first. With Salvo selected, the right hand missile is fired first. If the selected missile has not locked-on at firing, a transfer box immediately sends a firing signal to the other missile if it is locked on.

Missile Stnd-by Switch

7. The Stnd-by Switch is a gated switch, and when selected On, releases nitrogen coolant from the Matra R550 launcher into the missile homing head. The Matra R550 rate gyro, gyroscope and homing head modulator rotors run-up. The Stnd-by Switch may be selected On at any stage during flight, but must be selected on at least 1 minute before launch to ensure correct missile guidance, or 2 minutes before launch to allow full cooling of the homing head sensor.

Electrical Cage/Boresight Button (previously known as the Electrical Cage Button)

9. The Electrical Cage/Boresight Button is the inboard button on the front of the throttle handle. In AIR-AIR GUNS or Dogfight mode when the radar is not locked on, pressing the button selects the normal gunsight electrical cage function. If either SW or Dogfight modes are selected and Matra R550 missiles are carried, pressing the button also reduces the missile homing head to narrow scan. When the button is pressed, the homing head unlocks and after 0.3 secs will relock to any IR target within it's reduced scan field of view. The narrow scan search pattern can be considered as missile boresight. The homing head will resume wide scan as soon as the electrical cage/boresight button is released.

Dogfight Button (previously known as the Sight Override Button)

10. The Dogfight button is the raised (outboard) button on the front of the throttle handle. Dogfight mode can be selected by pressing this button when the weapons selector is in any position except Off. Once pressed, Matra R550 missiles (if carried) commence a wide scan and will lock on to any IR targets within their field of view. At the same time, the gunsight switches to AIR-AIR GUNS mode. While the Dogfight button is held in, the radar scans in AIR-AIR range. When the button is released, the radar remains locked on or reverts to AIR-AIR sweep if a lock-on is not taken. Deselection of the Dogfight mode is achieved by depressing the Dogfight mode light on the LH instrument glare shield, or by rotating the weapon system selector to another position. When Dogfight mode is deselected after a radar lock has been taken, and the

weapon selector is in the AIR to AIR sector, the radar will retain the lock. If an Air to Ground mode is selected, the radar breaks lock on deselection of Dogfight mode and the radar resumes normal Air to Ground sweep. Selection of Dogfight mode initiates all MISS STBY functions regardless of the position of the MISS STND-BY switch.

Missile Volume Control Rheostat

11. Matra R550 lock-on tones will only be heard when SW or Dogfight modes are selected.

Normal/Pre-heat Switch

12. When this switch is selected to Normal and external power connected to the aircraft, the missile launchers will receive power and supply heating voltages to the missile battery and gyro.

Missile Lock On Lights

13. Two amber missile lock on lights are located on the LH instrument glare shield.

Dogfight Mode Light

14. A green Dogfight mode light is located on the LH instrument glare shield between the two missile lock on lights. The light is illuminated whenever the Dogfight mode has been selected. This mode can only be selected by depressing the light or by rotating the weapon system selector to another position.

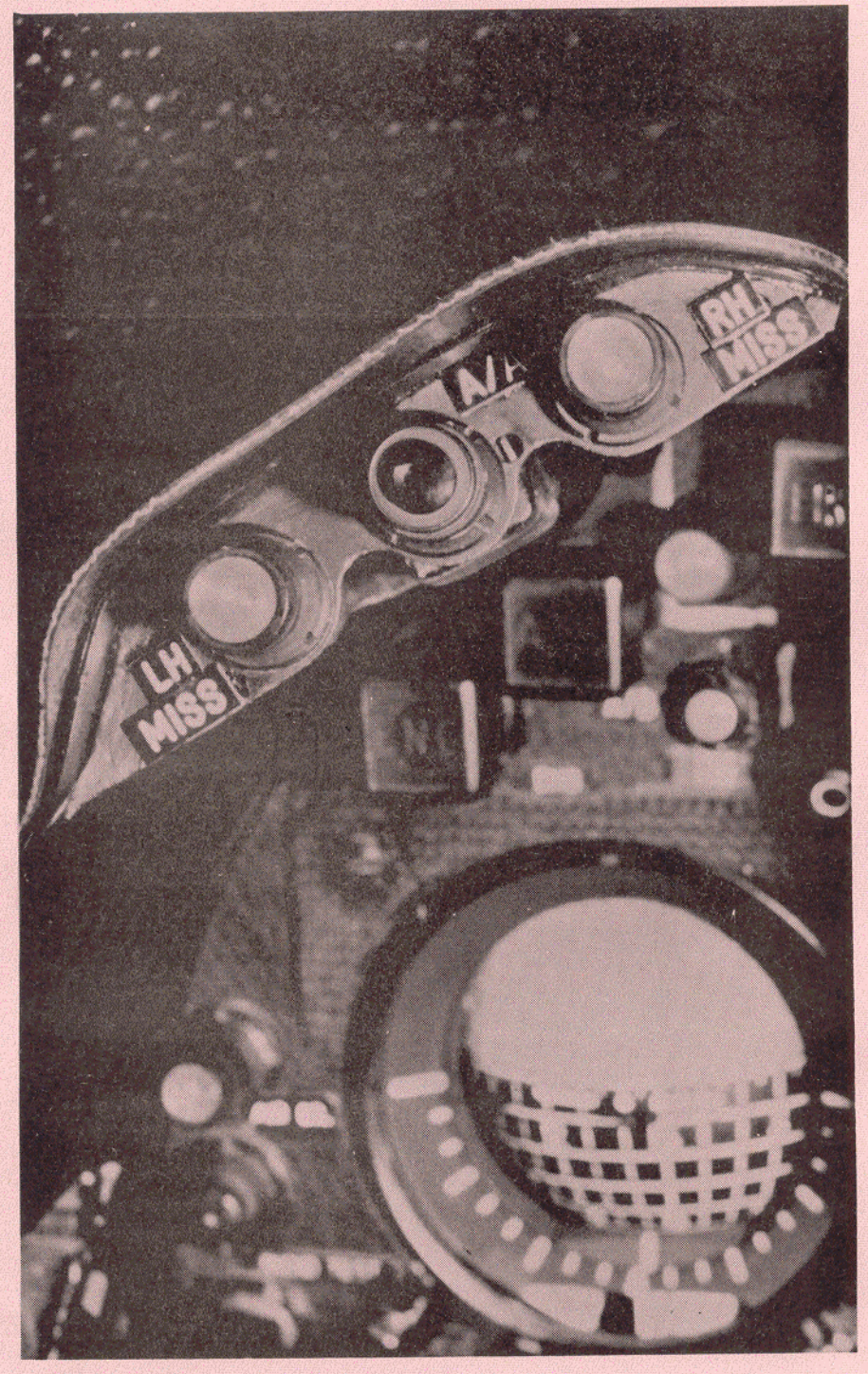


Figure 1-52A (Sheet 1 of 2)

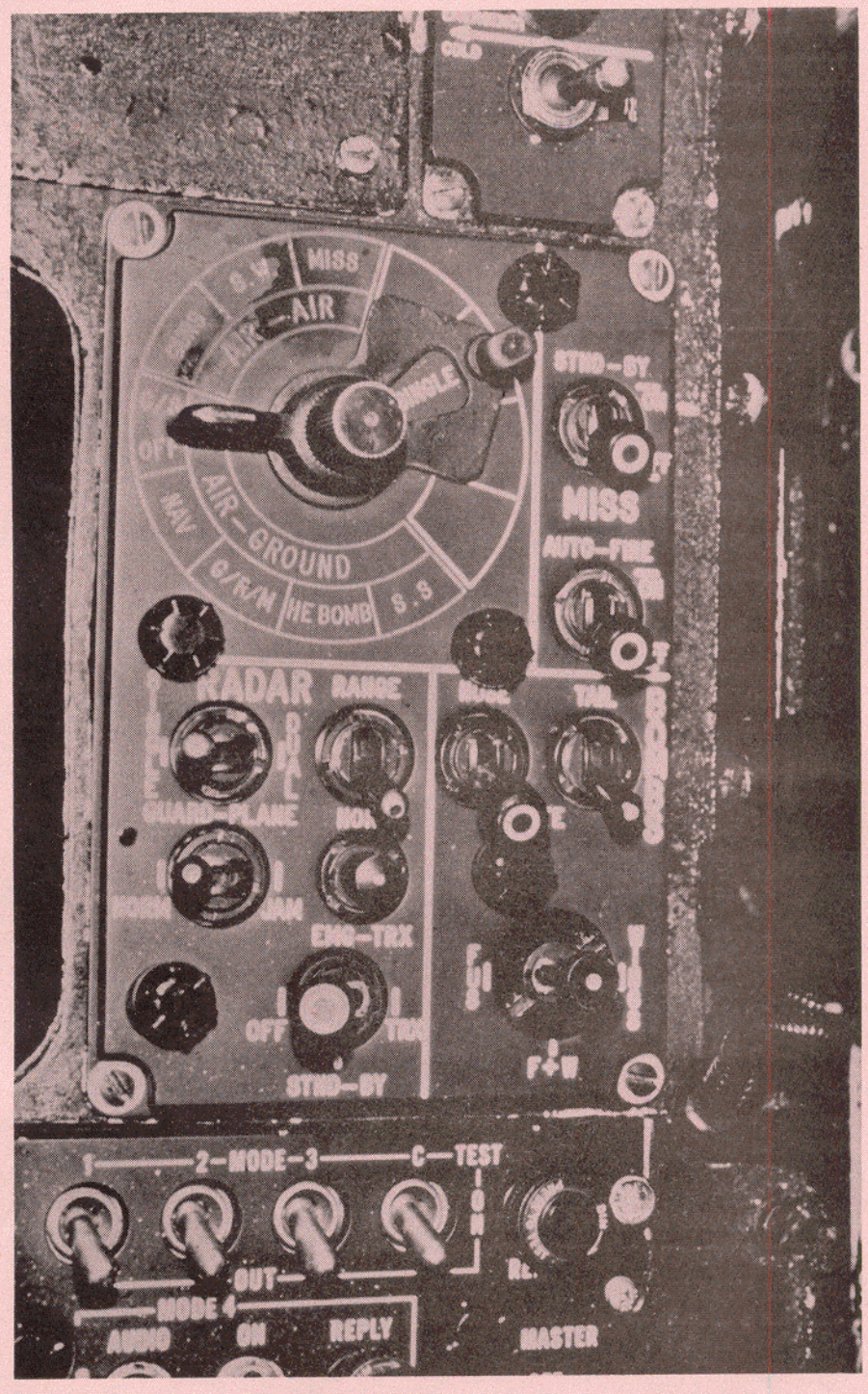


Figure 1-52A (Sheet 2 of 2)

WEAPON SYSTEM SECTION

The weapon system section is divided into AIR-AIR and AIR-GROUND modes. When the weapons system selector is moved from the G/S OFF position, the gunsight, camera and Matra R550 circuits are energized.

Note

Although the weapons system selector is in the G/S OFF position, guns can be fired or bombs can be released if the GUNS or BOMBS armament switches are on.

Air-to-Air Modes

Moving the weapons system selector to the AIR-AIR sector selects the air-to-air functions of the radar and sight. Within the AIR-AIR sector three modes can be selected:

a. ***MISS.*** Positioning the weapon system selector to MISS activates the Matra R530 weapons system and the Matra R550 electrical circuits, but the R550 homing heads do not scan or lock-on to IR targets. After radar lock-on, pitch and roll signals from the system's computations are presented to the pilot as an optical sight presentation (sight orders) which enables him to position the aircraft at the ideal firing point for the Matra.

[D] This mode is not fitted.

b. ***S.W.*** When S.W. is selected, the Matra R550 missiles scan and lock-on to IR targets. After radar lock-on, the radar-nav computer computes pitch and roll sight orders for a Sidewinder attack. The fire zone computer has not been reprogrammed with Matra R550 missile performance. The green fire zone light is indicative of entry into the Sidewinder firing envelope only.

Note

If S.W. sight orders are not required, the weapons system selector may be left in GUNS.

[D] Matra R550 missiles may be fired after the target is acquired visually and an estimation of target range is made by the pilot. Sight orders and the zone light are not available.

c. ***GUNS.*** With GUNS selected, the guns weapon system computes sight orders down to 1.1 NM. The Matra R550 missile electrical circuits are also activated, but the missile homing heads do not scan or lock-on to IR targets. At ranges less than 1.1 NM, the sight becomes a computing gyro gunsight with range fed from the radar. The R550 tone can still be heard and the R550 can be fired normally.

[D] With GUNS selected, the sight operates as a conventional gyro gunsight and computes firing information according to the altitude from the air data computer and the range set by the pilot on the manual range rheostat (200 to 1200 metres).

Dogfight Mode

Regardless of weapon system selection, an additional air to air mode can be selected by depressing the Dogfight button. (Previously referred to as the Sight Override Button.) In Dogfight mode, the Matra R550 missiles scan and lock-on to IR targets. The gunsight displays sight orders and depression for AIR-AIR GUNS. The missile seeker heads initiate a wide scan.

Air-to-Ground Modes

Moving the weapons system selector to the AIR-GROUND sector selects the air-to-ground function of the radar and sight. When this sector is selected, the sight depression rheostat provides adjustment of the depression angle so that the sight can be used as a reference for delivery of conventional weapons. In all air-to-ground modes, the Matra R550 electrical circuits are activated, but the missile homing heads do not scan or lock-on to IR targets. The S.S. (Special Store) position is not used. Three positions can be selected as follows:

a. ***NAV.*** In this mode, the sight displays aircraft attitude and heading. By selecting the heading error switch, the moving reticule indicates to the pilot the direction (DR or TACAN) of a selected station.

b. ***G/R/M (Guns/Rocket/Missiles).*** This selection depresses the sight reticule to a basic setting of 26.0 mils. The basic setting can be varied from −5 to +45 mils by the sight depression rheostat providing depressions suitable for gunnery or bombing under certain conditions.

c. ***HE BOMB.*** Selecting HE BOMB depresses the reticule to a basic setting of 111.5 mils. The basic setting can be varied from −5 to +45 mils by the sight depression rheostat providing depressions suitable for bombing.

Note

The radar operates in the air-to-ground mode with the weapons system selector in the G/S OFF position.

SINGLE/SALVO Selector

The SINGLE/SALVO selector is attached to the base of the weapon system selector. When SINGLE is selected:

a. In the S.W. or Dogfight modes and with two missiles carried, the left-hand missile is fired first. If the selected missile has not locked-on at firing, a transfer box immediately sends a firing signal to the other missile if it is locked on.

Note

When the aircraft is loaded with TDU-11B target rocket on the left outboard wing station and R550 on the right outboard wing station, select SINGLE to fire the target rocket. After firing the target rocket, it is necessary to select SALVO to receive missile tone and to fire the R550 since the TDU-11B target rocket does not activate the launcher changeover relay.

b. In the HE BOMB mode, single bombs are released from the PM-3 and a single bomb or a stick is released from the RPK10 depending on the RPK10 intervalometer setting. The SINGLE/SALVO selector has no effect on bomb release from the SUU-20A/A.

When SALVO is selected:

a. In the S.W. or Dogfight modes and with two missiles carried, the right-hand missile is fired first. If the selected missile has not locked-on at firing, a transfer box immediately sends a firing signal to the other missile if it is locked-on. Before launch, the tone of the right missile is heard by the pilot.

b. In the HE BOMB mode, SALVO selection permits multiple bomb release.

From the PM-3, the rear bomb is released first and the front bomb is released 0.3 seconds later. From the RPK10, bombs are released alternately from each wing at 0.15 second intervals until the load is exhausted.

Note

When dropping bombs in salvo or stick releases, the missile/bomb button must be held down until the total release is complete.

Gunsight Brightness Rheostat

The gunsight brightness rheostat is mounted on top of the same base as the weapons system selector and the SINGLE/SALVO selector. The rheostat is rotated anti-clockwise to give maximum sight brightness.

MISSILE SECTION

The MISS section contains two gated ON/OFF toggle switches; the stand-by (STND-BY) switch and the Matra automatic firing (AUTO-FIRE) switch. The switches have the following functions:

a. ***STND-BY Switch.*** The STND-BY switch operates the R550 and R530 circuitry. The STND-BY switch is a gated switch which, when selected ON, releases nitrogen coolant from the Matra R550 launcher into the missile homing head and allows the Matra R550 rate gyro, gyroscope and homing head modulator rotors to run-up. The STND-BY switch may be selected ON at any stage during flight, but must be selected ON at least 1 minute before launch to ensure correct missile guidance, or 2 minutes before launch to allow full cooling of the homing head sensor. When the switch is selected ON with a Matra R530 missile carried, power is supplied to the missile circuits, and various alignment and preheating functions begin. The switch must also be selected ON in order to fire a MK26 target rocket.

b. ***AUTO-FIRE Switch.*** The AUTO-FIRE switch is used only if automatic firing of the Matra R530K missile is desired. With the switch ON, the Matra fires automatically at the computed optimum time (Topt). The AUTO-FIRE switch may be over-ridden by the missile/bomb button.

[D] The MISS section contains the STND-BY switch only. The switch is used in conjunction with S.W.

CAUTION

When Matra or S.W. are carried, the STND-BY switch must be selected ON before taxiing the aircraft to avoid damage to the gyro assembly, and must be left ON until just prior to engine shut down.

Note

When a training Matra missile is carried, the radar scanning program may be interrupted by the 'missile gone' signal after firing the Matra and the radar breaks lock. To re-establish normal radar presentation, select the STND-BY switch to OFF momentarily.

RADAR SECTION

The RADAR section contains the following controls which affect the operation of the Cyrano IIB radar :

a. ***Radar Master Switch.*** This switch activates the radar circuitry. It has three positions; OFF, STND-BY and TX.

b. ***Emergency Transmit Button.*** This button, labelled EMG TX, may be used if radar transmission fails. Pressing the button may restore transmission under certain circumstances. Pressing the button disconnects power from the modulator and allows the safety circuits to reset. Transmission is not restored until the button is released.

c. ***Anti-jam Switch.*** This switch has two positions, NORM and JAM. When JAM is selected, the radar and the Matra missile can operate in a limited ECM environment.

d. ***Range Switch.*** This switch has two positions; NORM and RANGE. It may be used in both air-to-air and air-to-ground modes. When RANGE is selected, the radar operates in an automatic lock-on mode (see also Sight Override Button).

e. ***SINGLE/DUAL Switch.*** This switch has two positions; SINGLE and DUAL. When selected to SINGLE, it alters the dual-plane antenna scanning program in air-to-air and Ground Map 50 modes causing the antenna to sweep in a single scanning plane. When selected to DUAL, the antenna sweeps in two planes. The exact nature of the dual scan depends on whether the radar is in the air-to-air or air-to-ground mode. The switch has no effect in Ground Map 15 mode which operates in SINGLE.

BOMBS SECTION

The BOMBS section controls the fusing and release of bombs and contains the bomb fusing switches and the bomb station selector.

TAIL/SAFE Fusing Switch

Selecting the TAIL/SAFE fusing switch to TAIL energizes the tail fusing units which retain the arming links when the bombs are released. The tail fuses of low drag bombs are thus armed. When high drag bombs are released, the tail fusing units retain the arming links; the tail fuse and the bomb tail opening lanyards are withdrawn and fuse arming occurs during retardation after tail opening.

With the TAIL/SAFE fusing switch selected to SAFE, the tail fusing units are not energized, the tail fuse is not armed and high drag bomb tails will not open. Therefore if both nose and tail fuses are fitted to high drag bombs, the pilot has the option of both high and low drag delivery modes.

Note

When the bombing switches are made safe during post release checks, the fusing units retain the arming links. This provides confirmation of bomb fuse arming in the event of unexploded bombs.

NOSE/SAFE Fusing Switch

The NOSE/SAFE fusing switch is a gated switch. When NOSE is selected, the nose fusing units are energized and the bomb is armed on release. When high drag bombs with both nose and tail fusing are carried, the nose fuse is not to be armed for low level high drag deliveries. If the nose fuse is armed and the tail fails to open, the aircraft will be within the fragmentation envelope of the bomb when the bomb detonates. The gated construction of the NOSE/SAFE fusing switch should remind the pilot to this potentially dangerous situation.

WARNING

- Do not select the NOSE/SAFE fusing switch to NOSE when making low level high-drag bomb deliveries.
- When the NOSE/SAFE fusing switch is selected to SAFE the nose fusing units are not energized.

[D] The bomb fusing is controlled by a single three position switch which provides fusing as follows :

a. ***INST.*** Both nose and tail fusing are selected.

b. ***DELAY.*** Tail fusing only is selected.

c. ***SAFE.*** The fusing solenoids are not energized and the bombs are dropped safe.

Bomb Station Selector

The selector has three positions marked FUS, F+W and WINGS. These positions have the following effect :

a. ***FUS.*** Bombs on the centreline station can be released. The HIPATS-1 target system can be ejected and released.

b. ***F+W.*** This position can only be used with the SINGLE/SALVO switch in SALVO. With bombs on the PM-3 and each RPK10 outboard station, the rear bomb on the PM-3 is released immediately the missile/bomb button is pressed. The front bomb on the PM-3 and the first bomb from the left RPK10 are released 0.3 seconds later. The remaining bombs are then released from alternate RPK10 stations at 0.15 second intervals.

c. ***WINGS.*** Only bombs on the underwing RPK10 tank/bomb carriers can be released.

Note

- With the SINGLE/SALVO switch in SINGLE and F+W selected, no bombs will be released from the aircraft.
- FUS must be selected to release BDU-33 practice bombs from the SUU-20A/A dispenser. With F+W selected, no bombs can be released from the SUU-20A/A dispenser.
- FUS must be selected for the HIPATS-1 target to be ejected and normally released.

ARMAMENT CONTROLS AND INDICATORS

There are additional switches in the Mirage weapon systems other than those grouped on the WSCP. These include the:

a. ARM MASTER switch,
b. selective armament switches,
c. trigger,
d. missile/bomb button,
e. sight depression rheostat,
f. electrical (elec) cage/boresight button,
g. dogfight button,
h. MISS VOLUME control rheostat, and
i. PREHEAT switch.

[D] The PREHEAT switch and dogfight override button are not fitted but a manual ranging rheostat is added.

Armament Master Switch

This is a two position toggle switch labelled ARM MASTER located on the upper left portion of the instrument panel (refer to Fig FO 1-3 and FO 1-7). All armament circuits are de-activated when the ARM MASTER switch is selected OFF. The switch must be selected ON to fire or release a weapon.

Armament Master Light

The armament master light, located above and to the left of the ARM MASTER switch, illuminates when the switch is selected ON but this does not necessarily indicate that the armament circuits are energized.

[D] An armament master light is also located in the rear cockpit.

Selective Armament Switches

The selective armament switches (refer to Fig FO 1-4 and FO 1-8) are four guarded switches located on the forward section of the right console. They select the weapons circuitry which is activated when the ARM MASTER switch is selected ON. From left to right they are labelled MISSILES, ROCKETS, GUNS and BOMBS, and select the following weapons:

a. ***MISSILES.*** Matra, S.W., and target rocket,
b. ***ROCKETS.*** No application,
c. ***GUNS.*** Defa gun, and
d. ***BOMBS.*** MK82, BDU -33 bombs, Karinga and HIPATS.

Trigger

The first pressure on the trigger operates the gunsight camera provided the weapons system selector is in any position except G/S OFF. The second pressure fires the guns (and the camera continues to operate) provided both the GUNS and the ARM MASTER switches are ON. When the trigger is released, the camera runs a further 0, 2.5 or 5.0 seconds depending on the camera overrun setting.

Note

First pressure trigger movement is small but, with practice, the gunsight camera may be operated easily without inadvertently firing the guns.

Missile/Bomb Button

The missile/bomb button, on the control column hand grip, must be pressed:

a. to release MK82 or BDU-33 bombs,
b. to fire R530, R550 or the target rocket,
c. to eject the HIPATS-1 target from the canister, and
d. to release the HIPATS-1 target plus tow cable.

The function of the missile/bomb button is determined by the weapons system selector.

The gunsight camera operates while the missile/bomb button is pressed. When the button is released, the camera runs a further 0, 2.5 or 5.0 seconds depending on the camera overrun setting.

Sight Depression Rheostat

The sight depression rheostat enables the sight reticule depression to be varied from −5 to +45 mils around the respective basic settings in the AIR-GROUND modes.

Electrical Cage/Boresight Button

The electrical cage/boresight button is the recessed (inboard) button on the front of the throttle handle. In the AIR-AIR GUNS or Dogfight mode when the radar is not locked on, pressing the button fixes the sight sensitivity current at the equivalent of 3.5 hm radar range. When the radar is locked on and the range is 6 hm, the sight sensitivity in electrical cage is 3.5 hm; a radar range greater than 6 hm gives a sensitivity greater than 3.5 hm and a radar range less than 6 hm gives a sensitivity less than 3.5 hm.

If either S.W. or Dogfight modes are selected and Matra R550 missiles are carried, pressing the button also reduces the missile homing head to narrow scan. When the button is pressed, the homing head unlocks and after 0.3 seconds relocks to any IR target within its reduced scan field of view. The narrow scan search pattern can be considered as missile boresight. The homing head resumes wide scan as soon as the electrical cage/boresight button is released.

Dogfight Button

The Dogfight button is the raised (outboard) button on the front of the throttle handle. Dogfight mode can be selected by pressing this button when the weapons selector is in any position except OFF. When the Dogfight button is pressed, Matra R550 missiles (if carried) commence a wide scan and lock on to any IR targets within their field of view. At the same time, the gunsight switches to AIR-AIR GUNS mode. While the Dogfight button is held in, the radar scans in AIR-AIR range. When the button is released, the radar remains locked on or reverts to AIR-AIR sweep if a lock-on is not taken. Deselection of the Dogfight mode is achieved by depressing the Dogfight mode light on the LH instrument glare shield, or by rotating the weapon system selector to another position. When Dogfight mode is deselected after a radar lock has been taken, and the weapon selector is in the AIR-AIR sector, the radar retains the lock-on. If an AIR-GROUND mode is selected, the radar breaks lock on deselection of Dogfight mode and the radar resumes normal AIR-GROUND sweep. Selection of Dogfight mode initiates all MISS STBY functions regardless of the position of the MISS STND-BY switch.

Missile Volume Control Rheostat

The MISS VOLUME control rheostat (refer to Fig FO 1-2 and FO 1-6) is located on the left console. The rheostat controls the volume of the Sidewinder IR tone or the Matra firing and masking tone to the headset. The R550 lock-on tones can only be heard when S.W. or Dogfight modes are selected.

Preheat Switch

The preheat switch (refer to Fig FO 1-2) is located at the rear of the left console. It has two positions, labelled PREHEAT and OFF. It was designed to be used in conjunction with the GAMO II external power supply but the GAMO II has been withdrawn from service.

When the switch is selected to PREHEAT, external power is used to:

a. heat the R530 and/or R550 missile battery,
b. preheat the Cyrano radar,
c. supply heating voltages to the R550 gyro,
d. operate the gyro reference system, and
e. supply power to the telebrief circuits.

If PREHEAT is selected whilst operating on normal AC or DC external power sources, the main AC and DC electrical bus bars do not receive power. However, the TGP receives power and can be operated normally.

[D] The PREHEAT switch is not fitted.

[D] Manual Ranging Rheostat

This rheostat (refer to Fig FO 1-6), located on the left console, controls the sight sensitivity in the air-to-air guns mode from 200 to 1200 metres.

Missile Lock-on Lights

Two amber missile lock-on lights are located on the LH instrument glare shield.

Dogfight Mode Light

A green Dogfight mode light is located on the LH instrument glare shield between the two missile lock-on lights. The light is illuminated whenever the Dogfight mode has been selected. This mode can only be deselected by depressing the light or by rotating the weapon system selector to another position.

CYRANO IIB RADAR

Mirage IIIO aircraft are fitted with the Cyrano IIB radar which has application in both the air-to-air and air-to-ground roles. It is housed in a fibre-glass radome attached to the front of the aircraft fuselage.

AIR-TO-AIR ROLE

In the air-to-air role, the Cyrano IIB radar is used to locate targets at ranges up to 27 NM in 60° or 30° scanning modes. The radar has two automatic lock-on modes (spiral scan and air-to-air range), two manual lock-on modes and a semi-automatic lock-on mode (anti-jam). The semi-automatic lock-on mode is used in a limited ECM environment.

When the radar locks-on to a target, the information is presented to the pilot as a display on the gunsight (sight orders). The sight display enables the pilot to place the aircraft in position to release the selected weapon.

AIR-TO-GROUND ROLE

In the air-to-ground role, the Cyrano IIB radar is used in the ground mapping mode and is used for navigation. The radar can be used in this mode at high or low level, in 60° and 30° scanning modes at a

range of 50 NM. The 15 NM ground mapping mode can only be used at low level.

RADAR SPECIFICATIONS

The Cyrano radar employs a 400 mm (15.8 in) diameter cassegrain type antenna which, by rotating the polarization of the transmitted pulse, eliminates antenna horn shadow. The leading particulars of the radar are as follows :

a. Transmission band — 3 cm (I Band).

b. Frequency — Preset between 9065-9470 MHz.

c. PRF
   Air-to-Air — 2000 Hz.
   Air-to-Ground — 645 Hz.

d. Pulse width
   Air-to-Air — 0.5 μsec
   Air-to-Ground — 1.75 μsec

e. Power output — 200 kW max.

f. Maximum range
   Air-to-Air — 27 NM.
   Air-to-Ground — 50 NM.

g. Anti-jam PRF — Basic 2000 Hz PRF modulated at a 400 Hz rate.

Note

When Matra is used, the PRF of the Cyrano 11B radar is adjusted by the harmonisation box.

h. Beam width — 5°.

i. Power requirements — 200 VAC 400 Hz 3 phase 27 VDC.

RADAR NOSE CONE

The following components, which are housed in the radar nose cone, are pressurized by ninth stage engine compressor (P2) air :

a. the radar antenna with its driving mechanisms and UHF circuits,

b. the transmitter unit,

c. a transistorized power supply,

d. the range tracking section,

e. the receiver section,

f. the fire zone computer,

g. the radar nav computer, and

h. the radar cooling and pressurization system.

The equipment temperature is controlled by hydraulic fluid which is cooled by a heat exchanger and circulated by a pump located in the nose cone. A compressor, located in the nose cone, pressurizes the radar wave guides to reduce UHF corona effect and inflates a seal between the fuselage and the nose cone.

Note

The radar hydraulic cooling fluid pressure should be between 10 and 35 psi. This pressure can be checked at the external pressure gauge on the right side of the nose cone.

RADAR DISPLAY

RADAR SCOPE

The radar scope is located on the radar panel in the centre of the instrument panel. It displays the radar situation. On the face of the scope are two superimposed polaroid discs. One is fixed and has an etched centreline running at right angles to a similarly etched base line. The other disc is movable, and can be rotated to darken the scope for night radar operations. A rubber glare shield is mounted around the radar scope to prevent glare effects from external light. A vertical line of lights which indicate the elevation of the radar antenna is mounted on the left of the radar panel. A series of rheostats and switches which control the scope presentation are mounted along the bottom of the radar panel.

RADAR PANEL INDICATORS

The radar panel indicators (refer to Fig FO 1-29) are lights located on the radar panel which indicate the state of the radar. These indicators are described in the following paragraphs.

Antenna Elevation Lights

The antenna elevation lights are a vertical line of 19 lights located on the left side of the radar panel. They are marked with figures from −35 to +55 in increments of 5. The zero elevation light is marked on its left side by a small phosphorescent line. By use of the antenna elevation buttons on the radar control stick, the radar antenna can be elevated or depressed in the air-to-air and air-to-ground modes as follows :

a. In air-to-air modes, the elevation lights indicate in degrees, the mean antenna position. One press of the antenna elevation buttons raises or lowers the mean antenna position by 2½°. The maximum movement is 60° from the zero position.

b. In air-to-ground ground mapping modes (GM 50 and 15), one press of the antenna elevation buttons raises or lowers the antenna ½° from its previous position, ie each light represents 1° of antenna movement. The maximum movement is 12° from the zero position.

The antenna elevation lights only indicate down to a maximum of −35. However the antenna can travel down to a full −60° depression in AIR-AIR which

Corresponds to an antenna look angle of −12° in the ground map mode.

Anti-Collision Mode Indicator (ANTI)

The ANTI indicator is inoperative.

Blind Dive Mode Indicator (DIVE)

The DIVE indicator is inoperative.

Contour Map Mode Indicator (CONTOUR-M)

The CONTOUR-M indicator is inoperative.

Range Scale Indicators (15 NM 5 and 50 NM 10)

The range scale indicators are located at the top of the radar panel, and illuminate to show the range scale selected. If 15 NM is selected, the 15 NM 5 light illuminates; if 50 NM is selected, the 50 NM 10 light illuminates. The scale is represented by the upper figure, whilst the distance between range markers is represented by the lower figure.

Ground Mapping Mode Indicator (GROUND MAP)

The GROUND MAP mode indicator illuminates when the weapons system selector is positioned to G/S OFF or any of the AIR-GROUND modes.

Target In-Zone Indicator (ZONE)

The ZONE indicator illuminates, in air-to-ground modes, when the PHI computer determines that the aircraft's position is within 50 NM or 15 NM range (depending on the range scale selected) of the selected PHI station. If the STROBE rheostat is rotated clockwise, the estimated point marker (EPM) will appear, indicating the PHI station.

Anti-Jam Mode Indicator (JAMMER)

The JAMMER indicator illuminates when the anti-jam switch is selected to JAM.

Radar Overheat Warning Indicator (OVERHEAT)

The radar OVERHEAT warning indicator illuminates if the temperature in the radar supply rises above 60°C, or if the rate of flow of hydraulic cooling fluid drops below 5 litres/min.

If the OVERHEAT light illuminates, the radar master switch should be immediately switched to STND-BY and, if the OVERHEAT light does not extinguish within 30 seconds, the radar must be switched OFF.

Note

If the OVERHEAT light is illuminated, the radar continues to function and may still be used if absolutely necessary.

If the loss of hydraulic cooling fluid supply causes the OVERHEAT light to illuminate, the scope presentation and radar panel indicators (except for the OVERHEAT light) will be extinguished. In this case, the radar is switched off electrically by the overheat condition. Selecting the radar master switch OFF only extinguishes the OVERHEAT light.

CAUTION

If the radar master switch is selected OFF, avoid harsh manoeuvres because the antenna is no longer stabilized and could be severely damaged.

Radar Transmission Failure Indicator (TRANSMIT)

The TRANSMIT failure indicator illuminates whenever radar transmission fails. If the radar master switch is placed directly to the TX position when switching on the radar, the TRANSMIT failure indicator illuminates after about 30 seconds and extinguishes after 3 or 4 minutes, provided that the radar transmission circuits operate. Furthermore, if SPIRAL scanning mode is selected and the strobe is positioned beyond 21 NM, radar transmission ceases and the TRANSMIT and SILENCE lights illuminate.

Note

- If the TRANSMIT failure indicator illuminates, use of the EMG TX button on the WSCP may restore radar transmission.
- If the TRANSMIT failure indicator illuminates when in SPIRAL, ensure that the strobe position is inside 21 NM before using the EMG TX button.

Discreet Mode Indicator (SILENCE)

The SILENCE indicator illuminates when the radar master switch is at STND-BY, and the radar is ready to transmit. It also illuminates in conjunction with the TRANSMIT light when SPIRAL scanning mode is selected and the range gate marker (strobe) is positioned beyond 21 NM range.

Range Switch Selection Indicator (G/R RANGE)

The G/R RANGE indicator illuminates whenever the range switch on the WSCP is selected to RANGE or when the sight override button is pressed.

Altitude Warning Light

The altitude warning light is a small red light on the right side of the radar panel. This light illuminates in conjunction with the red fly-up light, when the aircraft is below the preset altitude on the radar altimeter.

Note

The radar altimeter is not fitted to all aircraft.

RADAR OPERATION SEQUENCE LIGHTS

The radar operation sequence lights are located on

the right side of the sight head. They consist of a vertical row of four coloured lights. From the top, the lights are coloured red, green, amber and blue. Normally only one light is illuminated at any one time, and each light is illuminated by a particular function of the radar. The operation of these sequence lights, after radar lock-on, is described in the following paragraphs.

Red Sequence Light

The red sequence light illuminates in the air-to-air modes when the radar is locked on and one or more of the following flight parameters are exceeded :

a. The bank angle exceeds 80°.

b. The load factor exceeds − 1 to + 4 'g'.

c. The dive angle versus altitude exceeds certain limits below 26 250 ft as shown below :

Altitude (feet)	Ideal Dive Angle (Degrees)
9000	49
5000	36
3500	30
2000	22.5
1500	20
1000	16.5
500	11
0	0

WARNING

The actual dive angles which cause the red sequence light to illuminate may be substantially higher than the ideal dive angles, particularly at low level. Therefore this system must be regarded with caution.

Note

All other sequence lights are extinguished if the red light is illuminated.

Green Sequence Light

The green sequence light is the fire zone light, controlled by the fire zone computer. It illuminates under the conditions described below for the particular air-to-air weapon :

a. ***Matra.*** Missile antenna deflection must be less than the allowable limit for launch; time of flight must be within the Δ t min to Δ t max limits; the aircraft launch speed must be such that there is no danger of the aircraft overtaking the missile.

b. ***Sidewinder.*** The aircraft must be within computed missile range of the target; the 'g' loading must be less than 1.5 'g' above 40 000 ft and less than 2 'g' below 40 000 ft.

c. ***Guns.*** The radar range to the target must be less than 1.1 NM.

Amber Sequence Light

The amber sequence light illuminates whenever the radar is locked on but the aircraft is outside the fire zone.

Note

In AIR-AIR GUNS when the closing rate exceeds 50 m/sec (97.2 kn), the green and amber sequence lights flash alternately.

Blue Sequence Light

The blue sequence light illuminates when the correct switch selections have been made for launching a Matra missile or when NAV is selected by the weapon system selector on the WSCP.

RADAR CONTROLS

The radar controls are those switches and controls which affect the operation of the radar. They consist of :

a. the weapons system selector on the WSCP,

b. those controls on the radar section of the WSCP,

c. those controls on the control stick and its base,

d. the radar display controls on the radar panel,

e. the target altitude rheostat on the centre console,

f. the drift angle (DA) setting knob on the Doppler control panel,

g. the sight override button on the throttle, and

h. closing speed switch.

WSCP RADAR SECTION

The switches and controls on the radar section of the WSCP (refer to Fig FO 1-27) are described in the following paragraphs.

Radar Master Switch

The radar master switch has three positions. These are :

a. OFF - radar circuitry inactive.

b. STND-BY - transmission circuitry inactive, receiving circuitry active. A normal scope presentation is evident (because there is no transmission there are no target returns).

c. TX - radar is both transmitting and receiving. Target returns are evident on the radar scope.

Note

When the switch is selected from OFF to TX, the radar does not transmit for 3 to 4 mins. During this period the radar is timing in.

EMG TX Button

The EMG TX button is a radar transmission reset button. It is of use only if the safety circuits throw the radar transmitter off line due to momentary overloads. If the TRANSMIT light has not extinguished after one press, it is unlikely that transmission will be restored.

Anti-jam Switch

Selecting this switch to JAM, allows lock-on to an electronic (noise) jamming signal. The range gate then is in an automatic lock-on mode, wobbulating from 2.5 hectometers (hm) to 16 nautical miles (NM) in range and locking-on to any target appearing in the 'stop programme'.

Range Switch

When this switch is selected to RANGE, the radar operates in an automatic lock-on mode in both air-to-air and air-to-ground modes. In air-to-air, 6 NM scale is automatically selected and the antenna rotates in a 5° cone about a fixed radar axis which is depressed 72 mils from the aircraft's fuselage reference line. The radar range gate searches out from 2.5 hm to 2.7 NM at a rate of 1 cycle per second and automatically locks-on to any target within this range. The range gate searching is represented on the scope by the strobe. When NORM is selected, the scanning programme of the radar is the one selected on the radar control stick. In air-to-ground, the scope is automatically selected to 6 NM scale and the radar axis is aligned to the aircraft's longitudinal axis. The range gate cycles between 3.2 NM to 6 NM. Automatic lock-on to targets within this range and the 5° radar beam is possible.

Note

In practice, the range switch has limited application in air-to-ground modes.

SINGLE/DUAL Switch

In all air-to-air and GM 50 scanning modes, when the SINGLE/DUAL switch is selected to DUAL, the radar antenna sweeps in two planes about the mean antenna elevation axis, and covers 10° in elevation. When SINGLE is selected, the antenna ceases sweeping in two planes and sweeps in a single plane about the mean antenna elevation axis and covers 5° in elevation.

Note

The SINGLE/DUAL switch does not affect operation in Ground Map 15 scanning mode which operates in SINGLE plane.

RADAR CONTROL STICK

The radar control stick (refer to Fig FO 1-30) is mounted on the left console directly behind the engine throttle quadrant. It consists of a pistol grip pivoted on a flat base. A retaining lip on top of the radar control stick enables the stick to be stowed by a clip on the cockpit wall. A number of controls are located on the pistol grip. These are described in the following paragraphs.

Antenna Elevation Control Buttons

The antenna elevation control buttons are located on top of the radar control stick (one on each side of the retaining lip). These buttons control antenna elevation in air-to-air and air-to-ground modes. The outboard button is slightly raised in relation to the inboard button and controls the upward movement of the antenna. The inboard button controls the downward movement.

Lock-on Lever

The lock-on lever, located on the top-front of the stick, is a two position control. By pressing the top of the lever, a wobbulating strobe lock-on function is selected and the antenna scanning ceases ('stop programme' presentation). The strobe wobbulates ± 2.5 hm around the mean strobe position set by the pilot and locks on to a target in that area. Pressing the bottom of the lever stops the antenna scanning programme and, to obtain a lock-on, the right edge of the strobe must be positioned just under and in the centre of the target echo in the 'stop programme' presentation (direct lock-on).

Manual Gain Control

The manual gain control is a knurled wheel rheostat mounted on the inboard side of the radar control stick which allows fine adjustment of the radar receiver gain to compensate for variations in the strength of the received signal. A small lever, mounted on the rheostat, enables rapid maximum gain positioning of the gain control. Manual gain control is available in all air-to-air and air-to-ground modes with the exception of spiral scan.

Break Lock Lever

The break lock lever is located at the bottom-front of the radar control stick. When it is pressed, during the automatic tracking of a target, the radar unlocks. The antenna then resumes sweeping in the selected scanning mode. Pressing the lever whilst the radar is in a scanning mode causes the antenna to 'stop programme', ie produces the same presentation as pressing the lock-on lever. This can be used for spotlighting targets.

Range Gate Marker (Strobe) Positioning

In the air-to-air scanning modes, the range gate marker (strobe) is positioned in azimuth and range by use of the radar control stick. The strobe is moved to the left in azimuth by moving the stick outboard and moved to the right by moving the stick inboard. The range of the strobe is varied by rotating the stick around its vertical axis: clockwise rotation decreases the range, counter-clockwise rotation increases the range. The strobe's rate of movement is

controlled by three micro switches in each direction and is directly related to the degree of control displacement. Stick movements may be combined to alter the strobe position in azimuth and range simultaneously.

Antenna Scan Selector

The antenna scan selector is the lever in front of the radar control stick. It is used to select the three radar scanning modes. The three mode positions are labelled and are :

a. **60.** In this scanning mode, the antenna sweeps 60° either side of the radar axis. The radar axis is aligned with the aircraft's longitudinal axis and the antenna is stabilized in pitch and roll.

b. **30.** In this scanning mode, the antenna sweeps 30° either side of the antenna axis and is stabilized in pitch, roll and bearing. The antenna axis may be positioned to a maximum of 60° either side of the aircraft's longitudinal axis by moving the radar control stick. If the antenna is positioned at an angle greater than 60°, the scanning programme stops and the antenna axis locks to the aircraft's longitudinal axis. The range gate (strobe) is positioned 40° right of the scope centreline.

Note

With 30° scanning mode selected, the antenna axis is represented by the right edge of the range gate marker (strobe).

c. ***SPIRAL.*** With SPIRAL selected, the antenna scans in a concentric circular pattern covering 20° in azimuth and elevation. The strobe wobbulates 2 NM either side of the strobe mean position in a figure of eight pattern. This is an automatic lock-on mode.

RADAR PANEL - RADAR DISPLAY CONTROLS

These controls are grouped on the radar panel (refer to Fig FO 1-29) below the scope. At the base of the panel is a row of seven rheostat controls. Above the rheostat controls are two switches, the auto reset button and the rapid erasure button. The following paragraphs describe these controls and their function.

Scope Intensity Control (INTENS)

The scope intensity control marked INTENS, is the left control in the row of knurled rheostat controls. Clockwise rotation of this control increases the intensity of the radar scope brilliance or luminosity.

Radar Panel Lighting Control (DIMMER)

The radar panel lighting control (DIMMER) is located next to the INTENS rheostat. It controls the brightness of the various indicators and controls on the radar panel.

Range Marker Brightness Control (MARKER)

The range marker brightness control (MARKER) controls the brightness of the range markers on the scope.

Artificial Horizon Position Control (H)

The artificial horizon position control is raised higher on the panel than the surrounding controls and is marked H at its base. It controls the vertical position of an artificial horizon which can be made to appear on the scope.

Range Gate Marker Brightness Control (STROBE)

The range gate marker brightness control (STROBE) controls the brightness of the range gate marker (strobe) on the scope in air-to-air modes. In air-to-ground modes it controls the brightness of the Estimated Position Marker (EPM).

Artificial Horizon Brightness Control (HORIZON)

The artificial horizon brightness control (HORIZON) controls the brightness of an artificial horizon on the scope. The position of this artificial horizon may be adjusted by the H rheostat.

Radar Presentation Persistence Control (STOR)

The radar presentation persistence control (STOR) controls the degree of radar presentation persistence on the scope.

Note

Clockwise rotation of controls increases the effects described in the preceding paragraphs.

Range Scale Switch

The range scale switch is a two position switch located above the INTENS rheostat control. It is marked 15 NM and 50 NM and has the following effect :

a. ***15 NM.*** In air-to-air scanning modes a 6 NM range scale is presented on the scope with one range marker at 5 NM. In air-to-ground scanning modes a 17 NM range scale is presented with range markers at each 5 NM.

b. ***50 NM.*** In air-to-air scanning modes a 27 NM range scale is presented on the scope with range markers at each 5 NM. In air-to-ground scanning modes a 50 NM range scale is presented on the scope with range markers at each 10 NM.

Groundmap Freeze Switch (FRE ↑)

When the groundmap freeze switch (FRE ↑) is selected on (up selection), the ground echo display becomes stationary or frozen. As a result, the scope origin moves off the base line of the scope and moves up the scope at a rate equal to aircraft TAS (supplied by the ADC output multiplier).

Auto-Reset Button (A-RE)

The auto-reset button is used in the air-to-ground modes. When the ground map freeze switch is selected up, pressing the button suppresses all radar echoes and the scope origin returns to the radar base line.

Rapid Erasure Button

The rapid erasure button is an unmarked control directly below the radar scope. Pressing this button removes all images from the scope until the button is released.

TARGET ALTITUDE RHEOSTAT

The target altitude rheostat is located on the centre console (refer to Fig FO 1-3). It is mounted on a dial graduated from 1 to 15, each number representing height AMSL in thousands of feet. The rheostat is used in the air-to-ground function of the radar, ie Ground Map 50 and 15. It allows fine adjustment of the antenna axis in elevation and affects the length of the EPM according to start range from the aircraft to the target altitude.

DRIFT ANGLE (DA) SETTING KNOB

The DA Setting knob on the Doppler control panel is used to check the Doppler/radar scope interface before take-off.

SIGHT OVERRIDE BUTTON

The effect of the sight override button on the air-to-air radar operation is described under ARMAMENT CONTROLS AND INDICATORS.

CLOSING SPEED SWITCH

The CLOSING SPEED switch is located on the cockpit right wall (refer to Fig FO 1-4). When the switch is selected to ON after radar lock on, a heads-up display of target closing speed is presented through the gunsight. This information is displayed in a window five mils above the top of the fixed cross.

The scale limits are − 100 to + 1600 kn closing speed. With the radar locked on, closing speed readout is available in all of the air-to-air modes and in the air-to-ground mode provided the range switch is selected to RANGE.

ANTENNA SCANNING PROGRAMMES

AIR-TO-AIR

In the air-to-air function, the Cyrano IIB radar is a monopulse system with five antenna programme selections. These are :

a. 60° scanning,

b. 30° scanning,

c. spiral,

d. anti-jam, and

e. air-to-air range.

60° Antenna Scanning Programme

The 60° air-to-air antenna scanning programme (refer to Fig 1-53) is a search function selected by positioning the weapons system selector on the WSCP to any of the AIR-AIR modes, and positioning the antenna scan selector to 60°. This ties the antenna mean axis to the aircraft axis so that running the strobe beyond ± 60° of the aircraft axis has no effect on the scanning program. At 0° elevation, the antenna elevation limits (β) are ± 60° and the antenna azimuth maximum (C) is 120°. The range scale may be set at either 27 NM or 6 NM depending on the position of the range scale switch.

The antenna scanning programme may be modified by the SINGLE/DUAL switch to either a dual bar scan or a single bar scan. When the programme is stopped by use of either the lock-on or break-lock lever, the stop programme is 5° wide and centred about the right edge of the strobe provided the ANT AZ pointer is within 60° of the aircraft axis. When the pointer is beyond this limit and the stop programme is selected, the antenna locks to the scope centreline.

30° Antenna Scanning Programme

The 30° air-to-air antenna scanning programme (refer to Fig 1-54) is a search function selected by positioning the weapon system selector on the WSCP to any of the AIR-AIR modes, and positioning the antenna scan selector to 30°. At 0° elevation, the antenna elevation limits (β) are ± 60° and the antenna azimuth maximum is 120° with the width of scan being 60°, ie 30° either side of the antenna mean position. The range scale may be set at either 27 NM or 6 NM by the range scale switch. The antenna mean axis is a line to the right edge of the range gate marker (strobe) and is controlled by the radar control stick. The antenna sweeps 30° in azimuth either side of the strobe, which must be positioned within 60° of the aircraft axis. If the strobe is positioned outside this limit, the antenna scanning ceases, the antenna locks on to the aircraft axis and the strobe is positioned 40° right of the scope centreline. With ANT AZ selected on the PHI, the bearing pointer indicates the out-of-limit azimuth position of the strobe. The antenna scanning programme may be modified by the SINGLE/DUAL switch to either a dual bar scan or a single bar scan.

Note

In both 60° and 30° antenna scanning programmes with dual bar scan, the top antenna sweep is left to right and the bottom antenna sweep is right to left.

SPIRAL Antenna Scanning Programme

The SPIRAL antenna scanning programme (refer to Fig 1-55) is an automatic lock-on function. It is selected by positioning the weapons system selector on the WSCP to any of the AIR-AIR modes and the antenna scan selector to SPIRAL. The antenna describes a double concentric circular pattern, covering 20° in azimuth and elevation about the mean strobe position. The strobe is positioned

60° Antenna Scanning

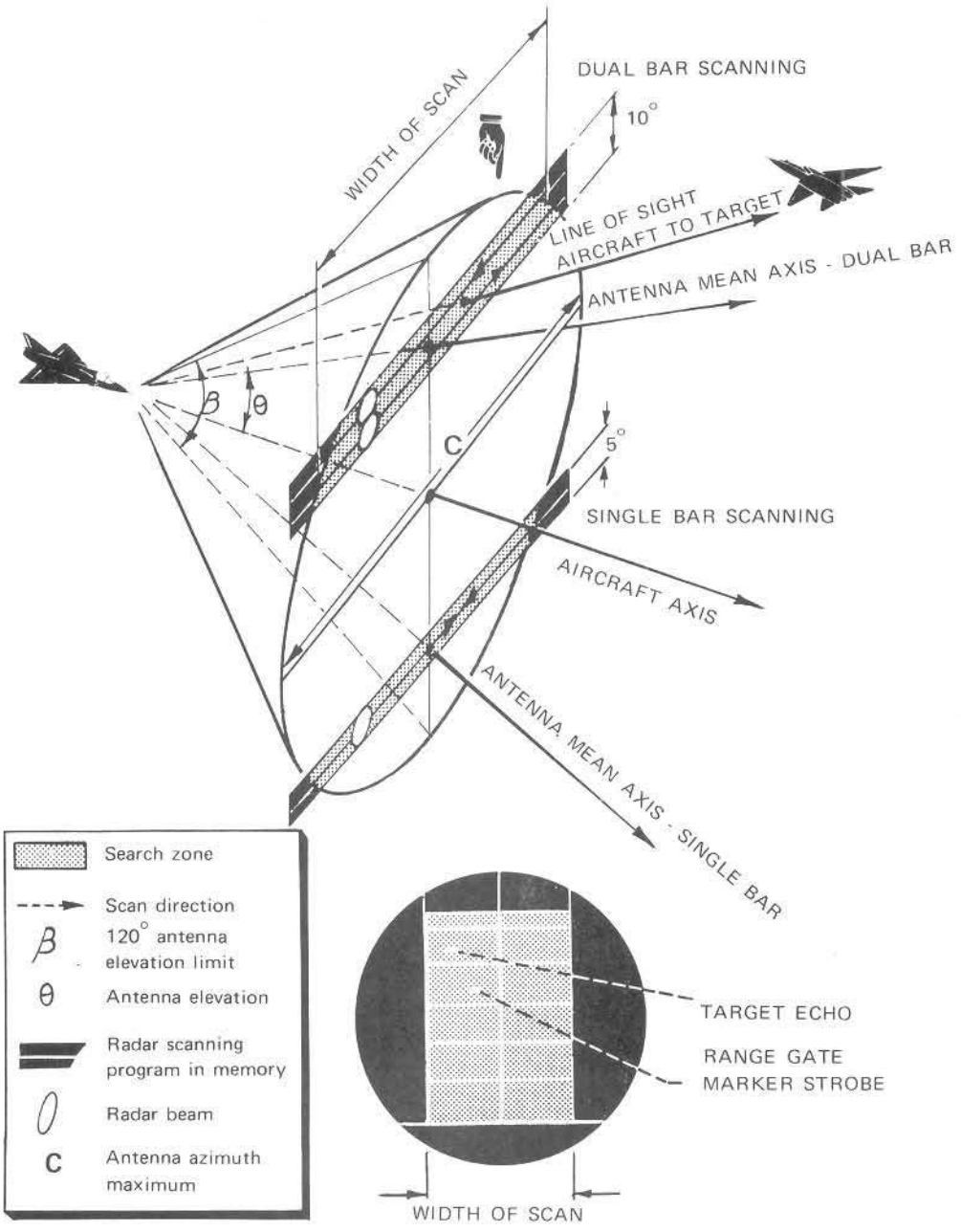


Figure 1-53

30° Antenna Scanning

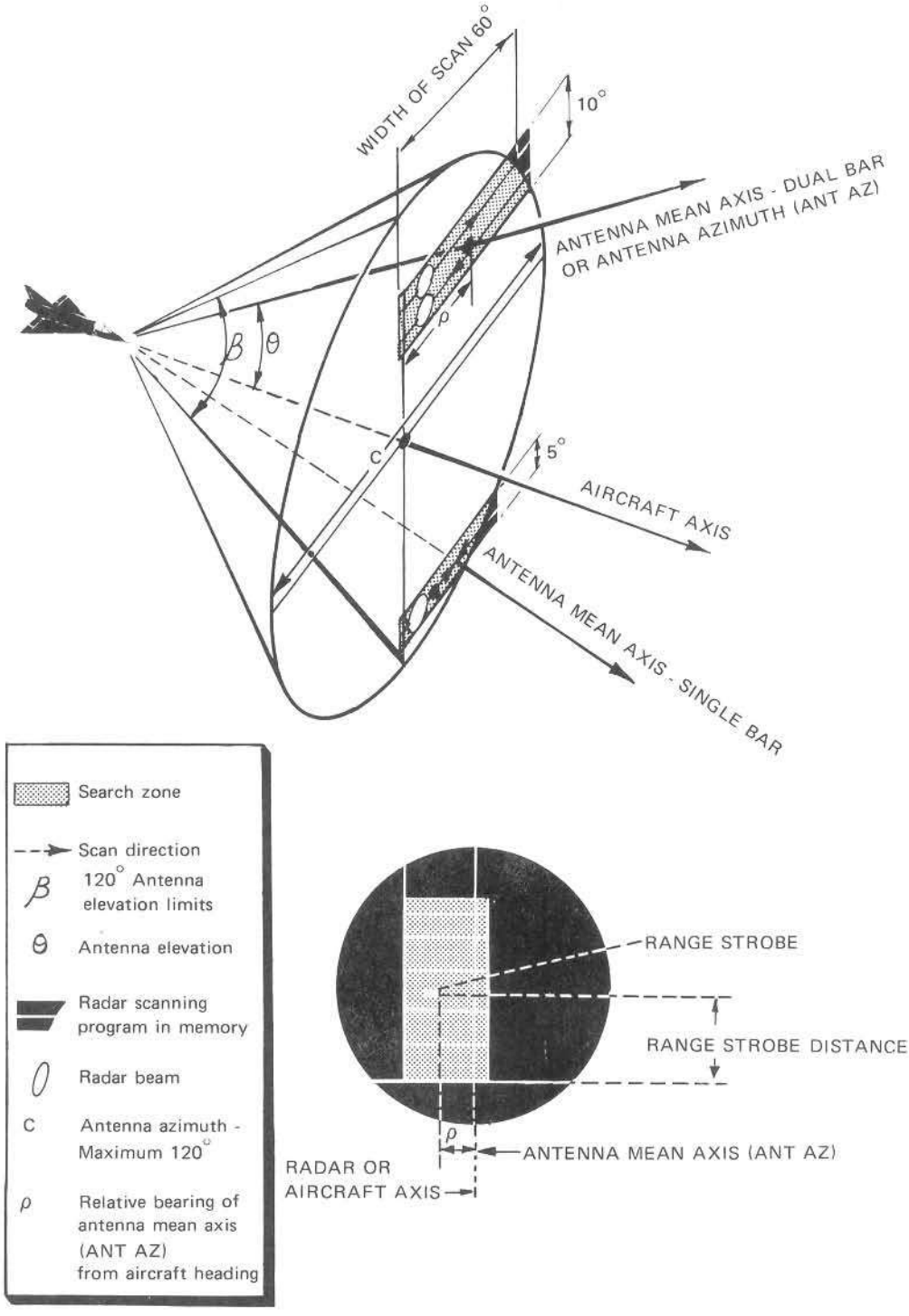


Figure 1-54

Spiral Antenna Scanning

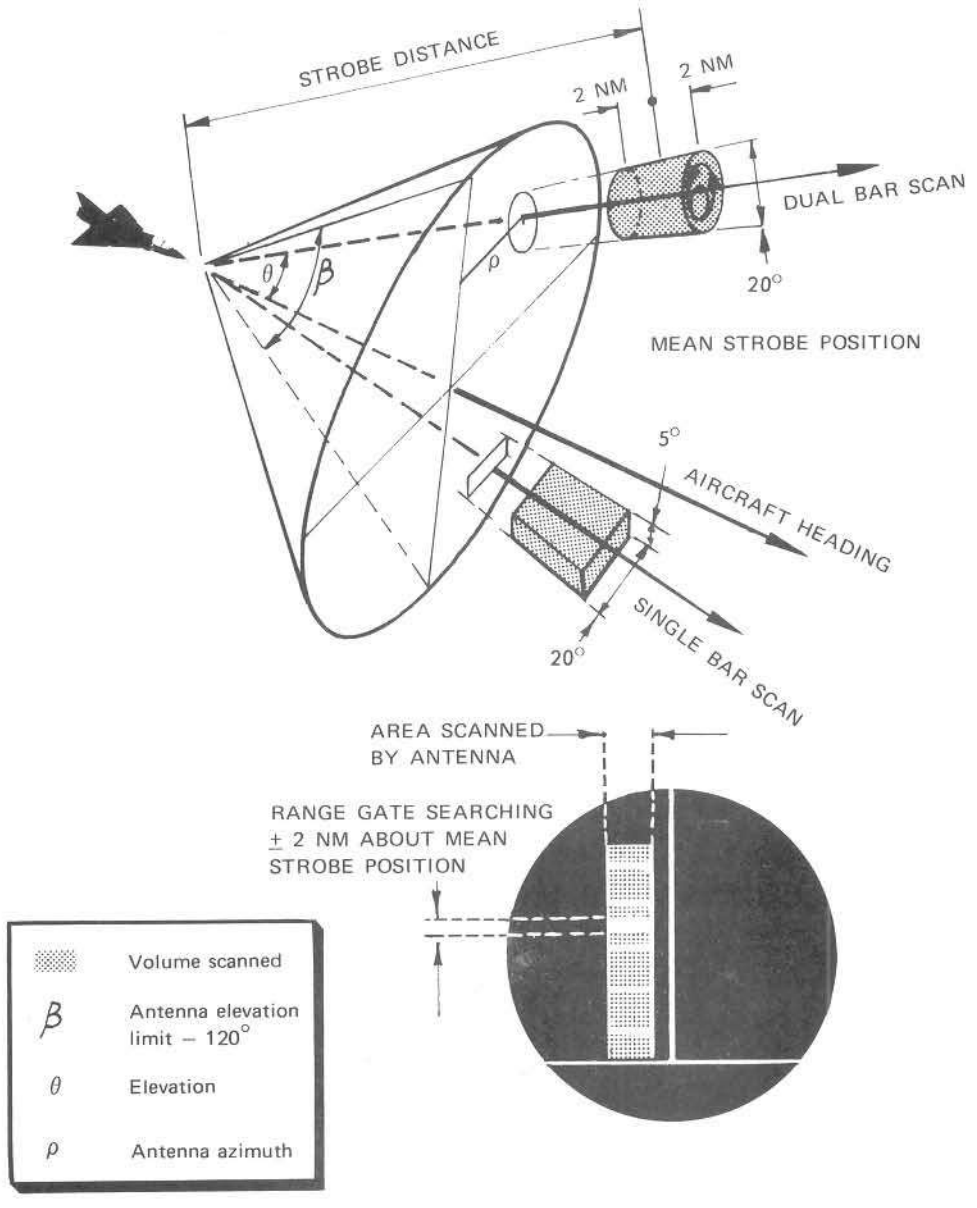


Figure 1-55

manually and wobbulates within the antenna pattern ± 2 NM about the strobe's mean range. The antenna automatically locks on to any target appearing in this area. The mean strobe bearing must be within 60° of the aircraft heading or the antenna programme ceases, the antenna locks to the radar axis and the strobe is positioned 40° right of the scope centreline. If the strobe is positioned in range beyond 21 NM, the SILENCE and TRANSMIT lights illuminate and radar transmission ceases. The antenna scanning programme may be modified by the SINGLE/DUAL switch to either a double conical pattern or a single bar pattern sweeping 20° in azimuth.

Anti-Jam

The anti-jam function of the radar is a semi-automatic lock-on mode which may be selected whilst the radar is searching in 60° or 30° air-to-air scanning programmes. It is selected by positioning the anti-jam switch on the WSCP to JAM. The JAMMER indicator on the radar panel is illuminated and the antenna scanning programme continues in the 60° or 30° search mode. As soon as electronic jamming (noise) is detected on the scope there are two phases of operation. These are :

a. ***Isolation of Strongest Jamming Signal.*** This is achieved by reducing receiver gain using the manual gain control on the radar control stick and adjusting elevation, until a single jamming strobe is evident on the scope.

b. ***Manual Lock-on to Strongest Jamming Signal.*** By manually positioning range gate with the right edge of the strobe in the centre of the jamming strobe and pressing the manual lock-on lever the radar locks-on to the single jamming strobe. Sight presentation now gives azimuth and elevation commands. The range gate searches automatically from 2.5 hm to 16 NM in the 'stop programme' presentation and locks-on automatically to any target in this area.

Note

The manual gain control must be returned to the full gain position after lock-on to the single jamming strobe. Failure to do so results in poor burn through ranges.

The SINGLE/DUAL switch affects the antenna scanning programme in anti-jam in the same manner as in 60° and 30° antenna scanning programmes.

Air-to-Air Range

The air-to-air range function (refer to Fig 1-56) of the radar is an automatic lock-on mode, which may be selected whilst the radar is searching in the 60° or 30° air-to-air scanning modes. It is selected by positioning the range switch on the WSCP to RANGE. The G/R RANGE indicator on the radar panel illuminates and the normal antenna scanning programme ceases. The antenna locks on to an axis which is depressed 72 mils from aircraft longitudinal axis (FRL). The antenna describes a 2.5° radius circular scanning pattern about this axis. The range gate searches in this pattern from 2.5 hm to 2.7 NM automatically at about one cycle per second and automatically locks-on to any target appearing within that area. After lock-on, the radar nav computer issues correct sight orders for the air-to-air weapon selected except in GUNS where sight orders disappear when the range is less than 1.1 NM. If the ANT AZ is positioned within the 60° front sector, the strobe sweeps along the centreline; if the ANT AZ is positioned outside the 60° front sector, the strobe is removed 40° to the right.

Pressing the sight override button on the throttle switches the radar to AIR-AIR RANGE when the weapons systems selector is in the air-to-air modes. If the button is released when the radar is locked on, the sight orders revert to the mode selected on the WSCP but the radar remains locked on. The break-lock lever on the radar control stick is operated to restore normal scanning.

GROUND MAP MODE

The Cyrano IIB radar operates in the ground map mode with the weapons system selector positioned at G/S OFF, NAV, G/R/M, HE BOMB or SS. Four antenna programme selections are available. These are :

a. 60° scanning,

b. 30° scanning,

c. spiral, or

d. range.

Within the ground map mode, the scope presentation may be varied by selection of :

a. Ground Map 50,

b. Ground Map 15, or

c. Ground Map Freeze.

60° AND 30° Antenna Scanning Programmes

With the antenna scan selector in either 60 or 30, the scope presentation is Plan Position Indicator (PPI). Two scales are available, Ground Map 50 or Ground Map 15. The scales are selected by the range scale switch. In 60° scan with Doppler off, the antenna sweeps 60° either side of the aircraft axis and the scope presentation displays a 60° sweep either side of the etched centreline. In 30° scan with Doppler off, the antenna sweeps 30° and the scope displays a 30° sweep. With Doppler locked on, the scope presentation is offset to sweep about the aircraft axis while the etched centreline represents the aircraft track; the difference being the drift displayed on the Doppler drift indicator. The angle between the heading (steering index) and track (bearing pointer) indicators on the PHI also represents drift. The scope presentation is offset whenever the Doppler drift indicator is moved from zero and the Doppler mode selector is in any position except OFF.

Air-to-Air Ranging

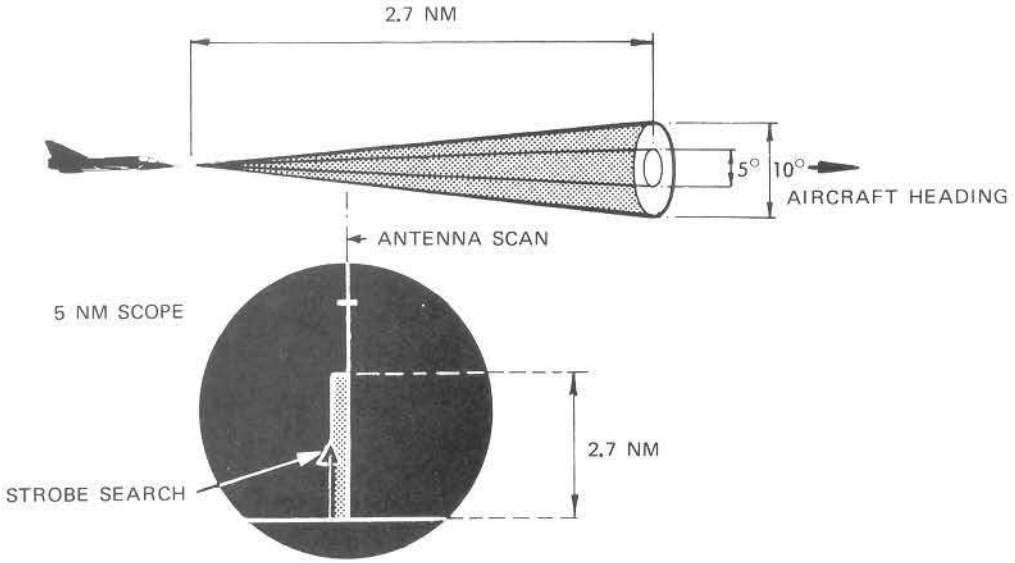


Figure 1-56

SPIRAL Antenna Scanning Programme

Although SPIRAL can be selected on the antenna scan selector, it has no function in the air-to-ground mode of the radar. The scope presentation is compressed because the radar antenna functions in the same scanning programme as for air-to-air but has no automatic lock on function.

RANGE Antenna Scanning Programme

If the range switch is selected to RANGE, a scope presentation similar to air-to-air ranging is displayed. This programme is designed for use in the delivery of air-to-ground missiles and has no application in the air-to-ground operation of the Mirage.

Ground Map 50

When Ground Map 50 (refer to Fig 1-57) is selected, the PPI presentation ranges out to 50 NM ahead of the aircraft. Range markers are evident at each 10 NM and the GROUND-MAP and 50 NM 10 indicators on the radar panel are illuminated. The scope, PHI and Doppler presentations are shown at Fig 1-58 where the PHI is on DR and Doppler is locked on with the aircraft flying with 10° of left drift.

Note

Actual map scale is about 1 : 1 000 000.

The SINGLE/DUAL switch controls the antenna scanning pattern. The pattern, in DUAL is similar to the air-to-air pattern, ie top sweep left to right, but the antenna axis on upper and lower sweeps is depressed, so that on zero antenna elevation it cuts the target altitude plane at 37.5 NM and 20 NM respectively. The antenna depression angle is automatically adjusted by information from the ADC and the target altitude setting to ensure that this is so, regardless of height. In SINGLE, the antenna axis at zero antenna elevation cuts the target altitude plane at 37.5 NM.

Note

The target altitude plane is defined as a plane parallel to the earth's surface through the target. It may be adjusted in height by the target altitude rheostat to coincide in height AMSL with any selected station. By adjusting the target altitude plane, the antenna axis is moved in very small increments. The total movement is 3.75 degrees. The target altitude plane exists only in the Ground Map 50 and 15 modes. Inaccurate setting of the plane affects the accuracy of the Estimated Point Marker (EPM).

The antenna is stabilized in pitch and roll, and elevation may be varied ± 12° about the zero elevation position, in ½° increments.

Ground Map 15

When Ground Map 15 is selected, the PPI presenta-

Ground Mapping 50 NM

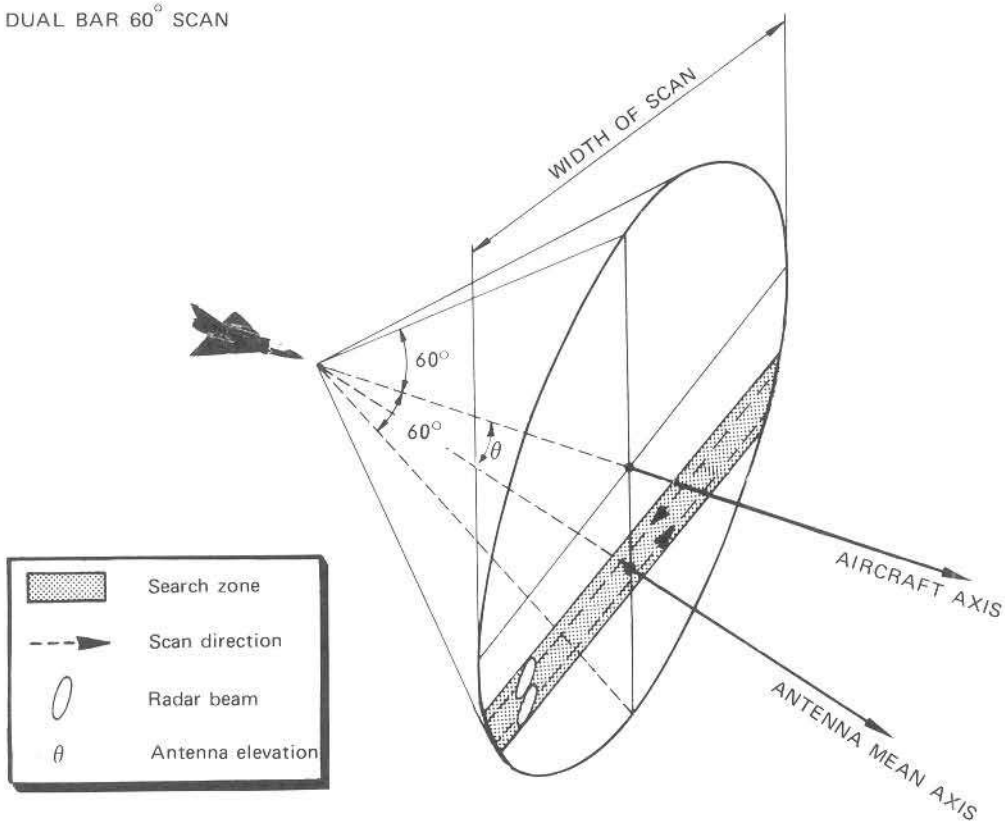


Figure 1-57

tion ranges out to 15 NM ahead of the aircraft. Range markers are evident at each 5 NM, and the GROUND MAP and 15 NM 5 indicators on the radar panel are illuminated.

Note

Actual map scale is about 1 : 300 000.

The SINGLE/DUAL switch has no control over the antenna scan pattern in GM 15. The antenna operates in single bar scan and is stabilized in pitch and roll. With zero antenna elevation set, the antenna axis sweeps parallel to the target altitude plane.

Ground Map Freeze

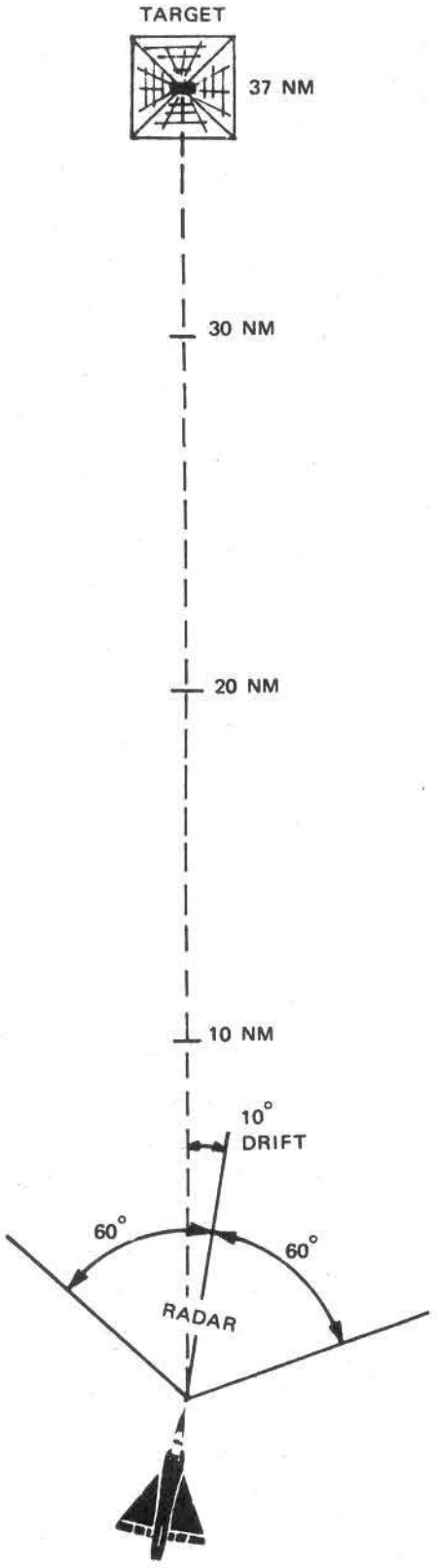
Ground map freeze (refer to Fig 1-59) is selected by positioning the FRE ↑ switch to the up position. The presentation freezes and the scope origin moves out in range at the aircraft TAS to one third of the scope distance. At this point the origin stops and the ground returns move down the scope at the same rate. The presentation is returned to normal by turning the switch off. The process is repeated by pressing the A-RE button.

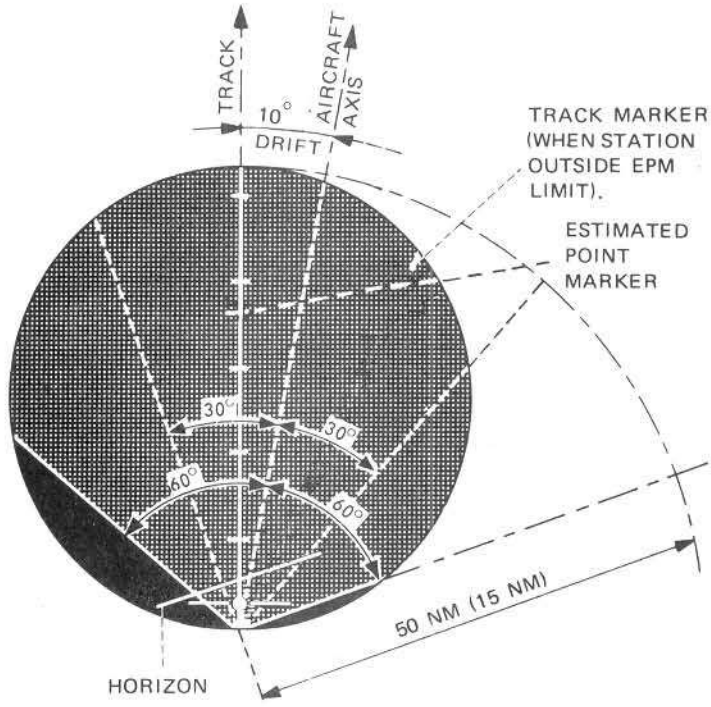
RADAR FAILURES

TRANSMIT LIGHT

If the TRANSMIT light illuminates during flight with the radar master switch selected to TX, all echoes disappear from the scope. It may be possible to restore transmission by pressing the EMG TX button on the WSCP. The EMG TX button may be pressed once. If transmission has not been restored after one press, select the radar master switch to STND-BY. If a time delay is acceptable, the radar master switch can be selected OFF and then selected

Ground Mapping - Scope Presentation with PHI and Doppler Indications for 10° Left Drift







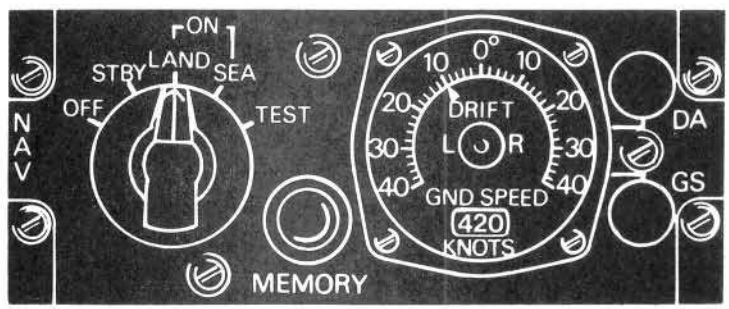


Figure 1-58

Ground Map Freeze - Scope Presentation

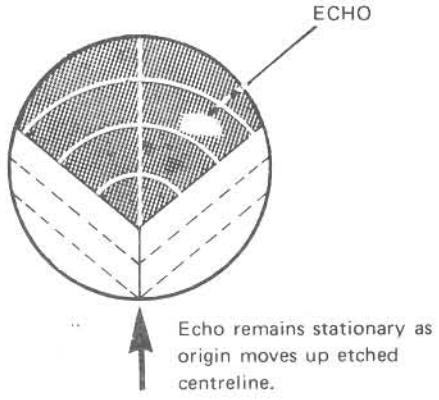


Figure 1-59

to TX. In this case, transmission may be restored after three to four minutes. If transmission is not restored or if several transmission failures occur, the radar master switch is to be selected to STND-BY for the remainder of the sortie.

Nose Cone Pressurization Loss

If nose cone pressurization is lost, the radar switches off, the scope goes blank and all the associated lights are extinguished. There is no action that the pilot can take to restore transmission. However, if the failure occurs during the climb, it is possible that the radar will switch on as the aircraft descends through the altitude at which the failure occurred. This is usually due to a ruptured pressure disc which allows pressurizing air to escape to atmosphere. A pressure switch within the radar nose operates and removes power from the radar.

OVERHEAT LIGHT

If the radar OVER-HEAT light illuminates during flight, the radar continues to function. In a case of operational necessity, the radar master switch may be left ON. However, when breakaway has been initiated or when there is no longer an operational necessity to use the radar, select the radar master switch to STND-BY. If the OVER-HEAT light does not go out within 30 seconds, select the radar master switch OFF and return to base avoiding harsh manoeuvres.

If illumination of the OVER-HEAT light is accompanied by loss of all scope presentation, it is probable that hydraulic cooling fluid has been lost. Select the radar master switch OFF and return to base avoiding harsh manoeuvres.

CAUTION

If the radar master switch is selected OFF, the antenna is no longer stabilized.

GYRO CENTRE FAILURE

Air-to-Air Function

If the gyro centre fails during radar search, the antenna is no longer stabilized, and target acquisition and lock-on will be extremely difficult particularly if the TGP has toppled. If the failure occurs after lock-on, sight orders are incorrect and Matra launch using sight orders is not feasible because a missile tone is not available. Sidewinder may be launched visually using radar in the air-to-air range mode to obtain a lock-on and provide accurate range information. Guns may also be fired visually using the air-to-air range function in a similar way to S.W. At ranges less than 1.1 NM on a gun attack, the gyro centre failure has no effect.

Air-to-Ground Function

In the air-to-ground mode, the antenna is not stabilized, the scope display is distorted or incomplete, and the radar is not available as an aid to navigation.

Note

If the TGP is in error, the artificial horizon in the radar scope will not show the correct aircraft attitude in both air-to-air and air-to-ground modes.

ADC FAILURE

Air-to-Air Modes

An ADC failure is indicated by the MICE plunger popping out or by incorrect operation of the PHI distance counter. Sight orders provided by the navigation computer are erroneous and Matra cannot be fired because a missile tone is not available. By selecting air-to-air range, it is possible to fire Sidewinder and guns normally, using radar to provide range information in the same way as for a gyro centre failure. However, at ranges less than 1.1 NM on a gun attack, the depression indicated by the reticule is slightly incorrect because altitude information from the ADC is not available.

Air-to-Ground Modes

The air-to-ground mode of Ground Map 15 operates normally although the position of the EPM may be incorrect. The antenna elevation in 50 NM scope is also incorrect, because the antenna plane position to intersect the target altitude plane varies with aircraft altitude. However, the errors on 50 NM scope are likely to be small.

WNS COMPUTER SYSTEMS

The WNS (refer to Fig FO 1-31 and FO 1-32) includes a number of analog computers which receive, process and distribute information, thus enabling the various automatic components of the WNS to function. These computers are the :

a. air data computer and ADC output multiplier,

b. PHI computer,

c. radar nav computer,

d. fire zone computer, and

e. Matra computer and harmonization box.

[D] The radar nav, fire zone and Matra computers are not fitted.

AIR DATA COMPUTER

The air data computer (ADC) receives total and static pressures from the pitot probe, impact temperature from the impact probe and indicated incidence from the incidence probe. This data is converted into electrical signals representing static and dynamic pressure, pressure altitude, Mach No and TAS. These signals are passed to the ADC output multiplier which amplifies and distributes them to various components requiring this information. The ADC, as well as passing TAS to the output multiplier, passes the signal directly to the PHI computer.

PHI COMPUTER

The PHI computer determines the aircraft's position as a bearing and distance from an origin or from a station whose co-ordinates are set in the station storage unit (SSU). Inputs from the ADC (TAS), the heading reference system (Grid Hdg) and the wind speed resolver (preset wind velocity) or Doppler ground speed and drift are used to compute the aircraft's DR position, which is compared with resistances representing the origin or station co-ordinates set in the SSU. This comparison is made in a grid format which is then converted to polar co-ordinates and displayed on the PHI as magnetic bearing and distance.

RADAR NAVIGATION COMPUTER

The radar nav computer determines the optimum flight path to a target during the radar tracking phase. After lock-on, it receives inputs representing the target angular velocity, range and closing speed. These inputs are compared with the aircraft's attitude, which is supplied by the Bezu Output Multiplier Box (BOMB). After being modified by aircraft performance inputs from the ADC, pitch and roll orders are presented to the pilot visually through sight orders, to bring the aircraft into the firing plane at a rate acceptable to the aircraft's performance. This rate is further modified by the 'g' limiting accelerometer, which allows pitch orders to increase 'g' loading at a maximum increment of 1 'g' between − 1 and + 4 'g' limits. After Matra firing, the radar nav computer presents break away orders when the fire zone computer predicts missile impact.

FIRE ZONE COMPUTER

The main role of the fire zone computer is to continuously compute the parameters of a simplified missile fire zone and indicate aircraft entry to the fire zone by illumination of the green fire zone light. With the weapons system selector rotated to MISS (Matra), it also determines a launch point (Topt) within the zone from which the missile has the greatest kill probability (Pk). The fire zone computer only computes for a positive closing speed even though the green light may be illuminated for a target moving away. In addition, it computes missile to aircraft range enabling the radar nav computer to determine the instant and direction of breakaway to avoid damage from the detonating missile, or target break up. The fire zone computer assumes at all times that the target is flying straight and level. Changes to the fire zone due to target manoeuvres are not calculated.

Note

The fire zone computer does not take into account target manoeuvres, aircraft angle-off to the target or negative closing speed.

MATRA COMPUTER AND HARMONIZATION UNIT

The purpose of the Matra computer is to ensure the missile flight orders are such that the optimum track to the target is achieved by the missile. An output from the ADC representing altitude is added to the target closing rate which is derived from the radar. This computation results in a navigation constant (K) being fed to the missile navigation circuits, thus optimising the flight path of the missile. The computer also alters the time delay to the warhead, depending on target closing rate. The warhead time delay is set to maximum for a line astern attack and to minimum for a head on attack.

The harmonization unit aligns the Matra and radar frequencies and target tracking circuits after radar lock-on, ie the missile and radar RF and PRF, antennae and range gates. The unit also contains the mask computer, which alerts the pilot by audio signal that the Matra missile receiver cannot acquire the target. If the missile is fired without target acquisition, it will be unguided.

Note

The 'mask zone' is computed from the radar antenna axes independent of the Matra antenna.

WEAPONS SYSTEM NAVIGATION

Weapons system navigation is the manner in which the aircraft is guided by the sight presentation to an ideal position for missile or guns firing. Weapons system navigation applies to the following air-to-air modes :

a. Matra,

b. Sidewinder,

c. Guns, and

d. Anti-jam.

CYRANO IIB RADAR TRACKING THEORY

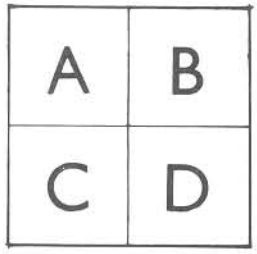
The Cyrano IIB radar is known as a monopulse system. It is so called because, after lock-on, error information to the radar is obtained at each RF pulse. With each radiated pulse, a monopulse radar can determine the elevation and azimuth errors between the antenna boresight and the target aircraft. To enable the weapons navigation system to function, the radar nav computer must be given target position information. This information is fed to the computer by the range and tracking circuits, which enables the radar to automatically track a target after lock-on is achieved. Automatic tracking is achieved in two phases. These are :

a. automatic tracking in azimuth and elevation, and

b. automatic range tracking.

Automatic Tracking in Azimuth and Elevation

During radar transmission, the UHF energy is divided into four sources which are equal in phase and amplitude. The sum of the energies in the four sources A, B, C and D gives the total transmitted energy. The return signals, one in each channel, are equal only if the target is centred on the antenna axis. The difference in amplitude of the return signals enables the elevation and bearing errors to be determined, ie



A + B + C + D = Total Energy

Elevation Error = (A + B) − (C + D)

Azimuth Error = (A + C) − (B + D)

Error signals are processed and used as control voltages for the antenna servo mechanism, which centres the antenna on the target thus reducing the errors to zero.

Automatic Range Tracking

Automatic range tracking is achieved by modifying the range gate distance to keep it centred about the target echo. The range gate is divided into two sections; the echo energy in each section is detected electronically, compared by the radar range circuits and adjusted to keep the echo energy equal in each section. Thus the range gate is kept centred on the target. To prevent the radar from immediately transferring lock to another echo that may appear in the range gate, the system incorporates a memory circuit, which stores tracking information for a period proportional to the target angular velocity (normally about 3 seconds). If the echo is lost for longer than this period, the radar lock is broken. Range, closing speed and target angular velocity are derived from the range and tracking circuits and transmitted to the radar nav computer for sight presentation computation.

WEAPON SYSTEM COMPUTATIONS

Approach Navigation

The approach navigation used in Matra, Sidewinder and gun attacks by the radar nav computer ensures that the projected target position coincides with the ideal missile impact point at any given instant. Any deviation from the ideal situation generates an error signal in the radar nav computer which modifies the sight presentation until the error signal is reduced to zero.

Lead Pursuit Navigation

The radar nav computer employs lead pursuit navigation as soon as the Matra missile is fired or at Topt, whichever occurs first, or in the case of S.W. and guns, at 8 NM range from the target. This is modified by a small advance which adjusts the interceptor's roll out distance behind the target.

Navigation in Matra

As soon as the radar is locked-on (amber sequence light on), the approach navigation is commenced. Through the sight presentation, the target and interceptor speed vectors are manoeuvred so as to be in the firing plane, and sight orders are such as to provide a missile collision course with the target. The fire zone computer continuously computes the predicted missile impact point with the target and illuminates the green in-zone sequence light (amber light out) when it computes that the target is within the missile's maximum time of flight (Tmax). It also computes the optimum firing point (Topt), which is defined as that point within the firing zone at which the missile has the greatest probability of kill (Pk). The Matra computer continually adjusts the missile navigation constant (K) to ensure that the missile

flies the optimum track to the target. The Matra computer also adjusts the missile warhead delay.

The harmonization box aligns the Matra and Cyrano frequencies and tracking circuits, and alerts the pilot by audio signal when the missile has locked-on to the target. The Matra may be fired when the green sequence light illuminates and the Matra acquisition tone is heard. If AUTO-FIRE is selected, the missile fires automatically at Topt. As soon as the missile is fired (either manually or at Topt), the missile gone signal is received by the radar nav computer which then adjusts the sight presentation to direct the aircraft on to a lead pursuit course (with a small advance).

The fire zone computer now measures interceptor to missile range and plots this against interceptor to target range. When the computer calculates that these ranges are equal (missile impact) or when it calculates that the missile has reached its minimum time of flight (Tmin), the fire zone computer signals the radar nav computer to issue break away orders which, if followed, directs the interceptor away from the impact area.

Note

If the missile is not fired by the time the computed optimum firing point (Topt) is reached, the radar nav computer issues lead pursuit sight orders (with a small advance) at that point.

Navigation in Sidewinder

In S.W., if radar lock-on is achieved outside 8 NM, the radar nav computer gives the approach navigation sight presentation. At 8 NM, the presentation is changed from the approach navigation to a lead pursuit navigation, with a four second advance. The sight presentation brings the interceptor astern of the target. The fire zone computer continually compares missile performance with interceptor to target range and, as soon as the interceptor is within missile range of the target, the green in-zone sequence light illuminates. The sight presentation continues to be computed by the radar nav computer down to zero range.

Note

The fire zone computer does not take into account target manoeuvres, aircraft angle-off to the target or negative closing speed.

Navigation in Guns

In guns, if radar lock-on is achieved outside 8 NM, the sight presentation is changed at 8 NM from approach navigation to a lead pursuit course, with a six second advance. This course is designed to bring the interceptor astern of the target close to gun range. The amber sequence light remains on until 1.1 NM range is reached; at this point the fire zone computer illuminates the green in-zone sequence light, the radar nav computer ceases to function and the sight orders disappear. The sight then becomes a radar computing gyro gunsight.

Anti-jam Navigation

When a jamming target is tracked in the anti-jam mode with Matra selected, the radar nav computer employs proportional navigation to compute the sight presentation in azimuth and elevation. The sight presentation leads towards a collision course with the jamming target, ie constant bearing. Whilst the radar is locked-on to a jamming signal, the fire zone computer and range drum are inoperative and closing speed is not available. The Matra missile is given a navigation constant of two and a warhead delay of 80 microseconds by the Matra computer. When the target echo becomes stronger than the jamming signal, the radar nav computer computes normal Matra approach navigation, the range drum gives the range to target and the Matra missile navigation constant and warhead delay is adjusted accordingly. With S.W. or guns selected, the radar nav computer employs a lead pursuit navigation which is identical to that used in normal S.W. and gun attacks at ranges less than 8 NM. This results in the interceptor flying towards the jammer's stern.

OPTICAL SIGHTING SYSTEM

The optical sighting system consists of the CSF 97K gyro gunsight, a junction box, a voltage regulator and cockpit controls. The system uses radar ranging and can be used for air-to-air and air-to-ground missile attacks.

[D] The range, which can be varied from 200 to 1200 metres, is set manually on the range rheostat located on the left console.

CSF 97K GYRO GUNSIGHT

The gyro gunsight (refer to Fig FO 1-33) is the main component of the optical sighting system and is mounted in line with the pilot's forward line of vision. Various controls and indicators (refer to Fig 1-60) are located on the gunsight and the gyro and optical assemblies are contained within the gunsight.

CONTROLS AND INDICATORS

Combining Glass

The combining glass displays the entire sighting situation, projected at infinity.

Radar Operation Sequence Lights

This bank of four coloured lights is located to the right of the combining glass. They indicate radar interception phases or weapon switch selection.

[D] The bottom light, ie the blue light, is the only one used. It illuminates when NAV mode is selected and indicates normal operation.

Radar Altimeter Lights

This bank of three coloured lights is located to the

Sight Head

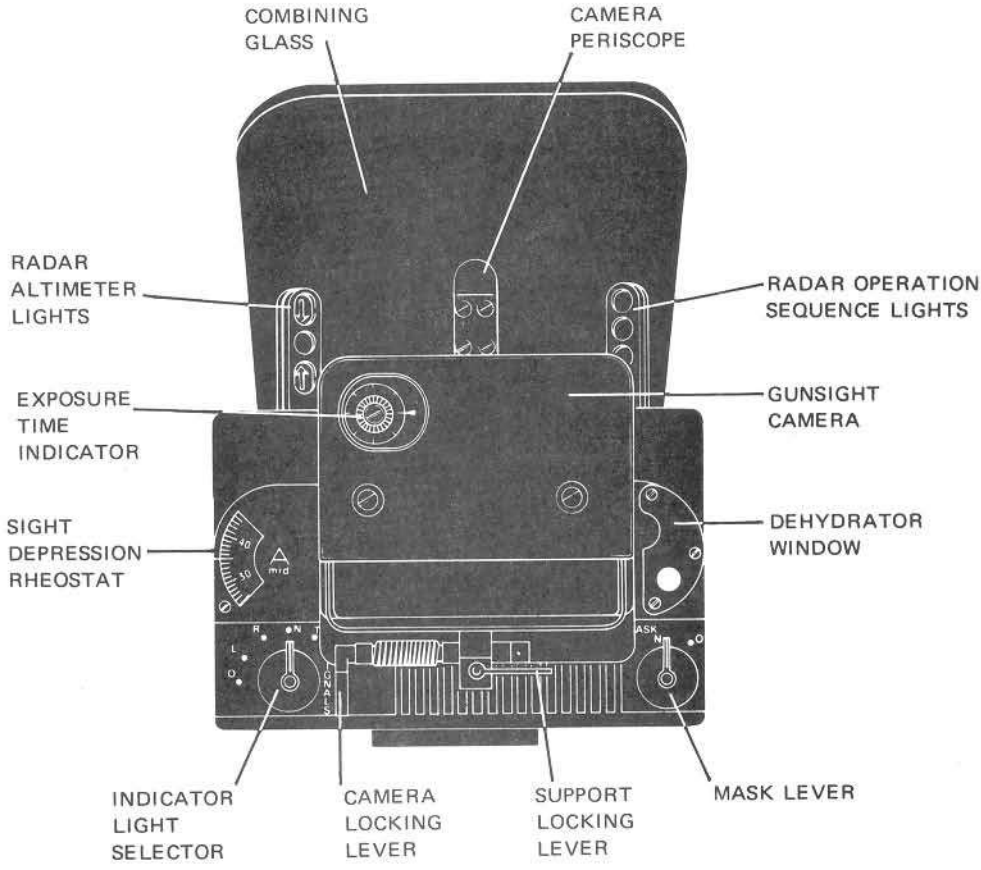


Figure 1-60

left of the combining glass. They operate in conjunction with the altitude selected on the radar altimeter. Their indications are :

a. the amber arrow means fly down,

b. the green light means on height, and

c. the red arrow means fly up.

[D] The radar altimeter is not fitted.

Sight Depression Rheostat

This rheostat enables sight reticule depression to be varied − 5 to + 45 mils around the basic setting in all AIR-GROUND sectors.

Indicator Light Selector

This is a five position switch, labelled SIGNALS, which controls the illumination of the radar operation sequence lights and the radar altimeter lights. Its five positions are :

a. TEST - all lights on (selector spring-loaded to return to N).

b. N - normal operation; all lights indicate according to signals received.

c. R - selection of right lights only (radar sequence lights).

d. L - selection of left lights only (radar altimeter lights).

e. O - off selection; no sight head light functions.

Camera Support and Locking Lever

In the centre of the sight head is the gunsight camera support and its locking lever. The gunsight camera support holds the Omera gunsight camera or the crash pad which is locked to the support by the camera locking lever.

Dehydrator Window

This window is located on the right side of the camera support. The air within the sight head must be absolutely dry and to achieve this the sight head is hermetically sealed. Air passing in or out of the sight head due to atmospheric pressure changes is drawn through a drying cell containing silica gel. Moisture saturation of the gel can be checked through this window. It will turn from blue to pink when damp.

Mask Lever

Located on the lower right of the sight head, the MASK lever controls the appearance of the range/heading scale in the sight display. It is a two-position switch whose operations are :

a. N - range/heading scale visible, and

b. O - range/heading scale not visible.

Filament Lamp Access

A push-pull ventilated door located below the camera support provides access to the two filament lamps.

GYRO ASSEMBLY

The gyro assembly (refer to Fig FO 1-33) consists of a circular gyro mirror and a dome mounted on the same axis. The dome of this rotating assembly moves around five deflection coils, which form the fixed part of the gyro assembly. The gyro assembly is driven at 3000 RPM by a 115 VAC electric motor. The current flowing through the deflection coils creates a magnetic field which, by its action on the dome, displaces the gyro mirror by an amount proportional to the strength of the current in the coils. The five deflection coils are elevation and gravity coils A and B, azimuth coils C and D and the sensitivity coil.

Elevation and Gravity Coils.

The elevation coils and the gravity coils are both wound on the same axis and form the elevation and gravity coils A + B (refer to Fig FO 1-33). The elevation coils displace the gyro mirror in the vertical plane which causes the reticule to move in the vertical plane. The gravity coils either add or subtract to the effect of the elevation coils. The elevation coils facilitate the following displays :

a. Fixed depression values of the reticule below the FRL as shown in Figures 1-61 and 1-62.

b. Sight orders in the pitching plane in the air-to-air modes.

[D] Sight orders are not available.

The gravity coils are only energized in the AIR-GROUND modes of NAV, G/R/M and HE Bomb. The current flow in these coils is controlled by the variable depression rheostat on the sight head and allows the depression set by the elevation coils to be varied within the limits of − 5 to + 45 mils.

Azimuth Coils

Variation of the current through the azimuth coils C and D displaces the mirror and moves the reticule in the azimuth plane. The azimuth coils control the heading error display in the air-to-ground nav mode.

Sensitivity Coil

This coil offers varying sensitivity to the gunsight only when the weapon system selector is set to AIR-AIR GUNS. In all other modes, the coil receives maximum current which holds the sight at a fixed sensitivity equivalent to 1.5 to 2 hm radar range. The main function of the sensitivity coil is to receive current from the radar proportional to radar range. When the radar is locked on and the aircraft to target range is :

a. less than 1.1 NM but greater than 12 hm, the sensitivity of the sight is held at 12 hm, or

b. less than 12 hm, the sensitivity current increases in proportion to the reducing range, thus reducing gyro lag and therefore sight lead.

When the radar is not locked on :

a. the sensitivity coil receives a fixed current equivalent to 6 hm radar range, and

b. pressing the elec cage button on the throttle fixes the sensitivity of the sight equivalent to 3.5 hm radar range.

Note

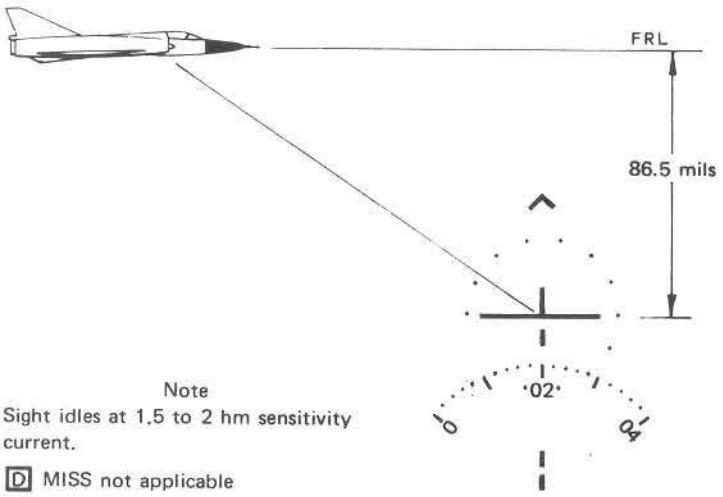
Pressing the elec cage button with the radar locked on will give the equivalent of 3.5 hm only when the radar range is at 6 hm. At any other radar range, pressing the elec cage button gives a sensitivity equivalent to some proportion of the actual radar range, ie a radar range greater than 6 hm gives a sensitivity greater than 3.5 hm and a radar range less than 6 hm gives a sensitivity less than 3.5 hm.

[D] The main function of the sensitivity coil is to receive target range input signals from the manual range rheostat. This rheostat, which is set by the pilot, is calibrated from 200 to 1200 metres. In AIR-AIR GUNS, with the manual range rheostat setting at 6 hm, pressing the electrical cage button located on the throttle fixes the sensitivity of the sight to the equivalent of 3.5 hm.

The maximum deflection of the reticule in AIR-AIR GUNS is 9° (157.5 mils). The gyro assembly incorporates a limiting system which consists of seven flexible strips arranged every 22.5° in the lower 180° of the gyro mirror. In the air-to-air guns mode, as the gyro mirror approaches maximum deflection, it makes contact with one of the strips, which increases the flow of current in the sensitivity coil thus arresting the mirror deflection. As the mirror clears the strip the original current is restored. This system

Gunsight Display - AIR-AIR

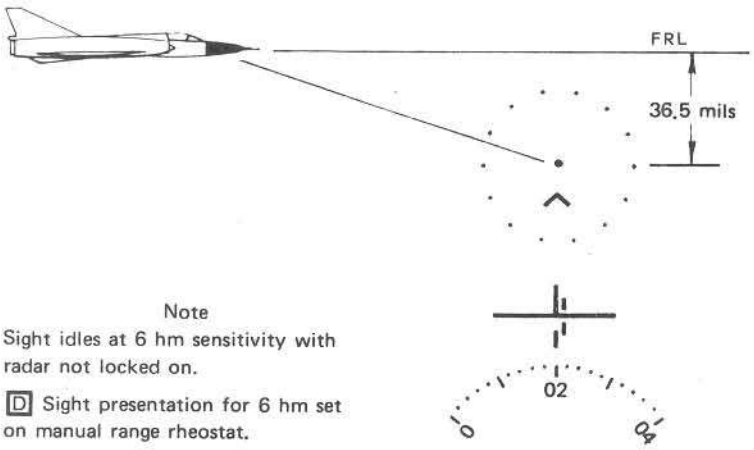
S.W. and MISS



Note
Sight idles at 1.5 to 2 hm sensitivity current.

[D] MISS not applicable

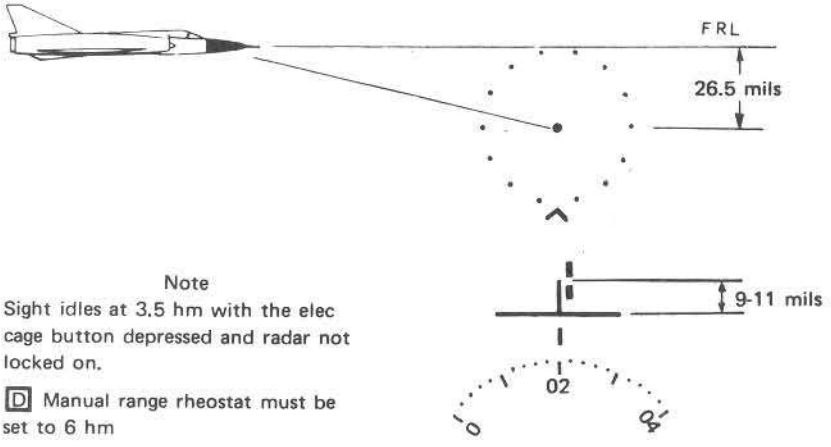
GUNS



Note
Sight idles at 6 hm sensitivity with radar not locked on.

[D] Sight presentation for 6 hm set on manual range rheostat.

GUNS ELEC CAGE



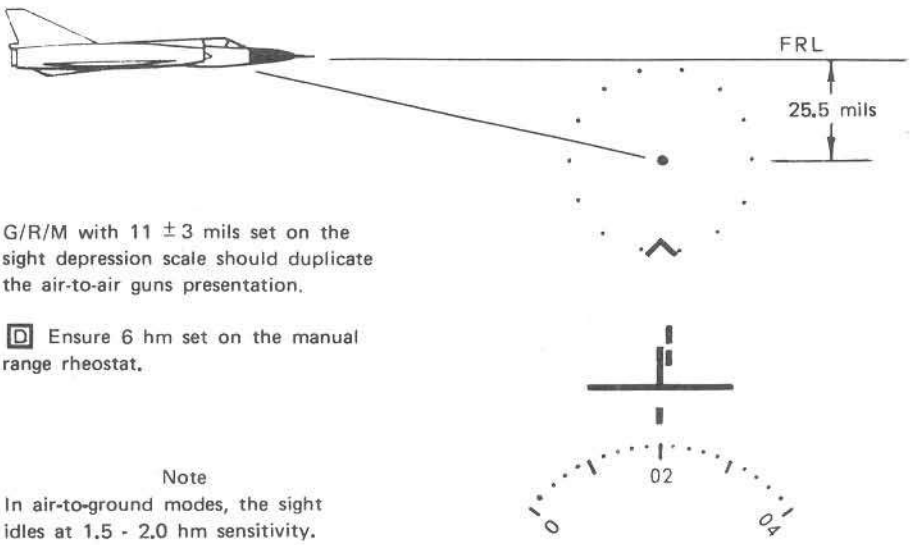
Note
Sight idles at 3.5 hm with the elec cage button depressed and radar not locked on.

[D] Manual range rheostat must be set to 6 hm

Figure 1-61

Gunsight Display - AIR-GROUND

G/R/M WITH ZERO MILS DEPRESSION SET

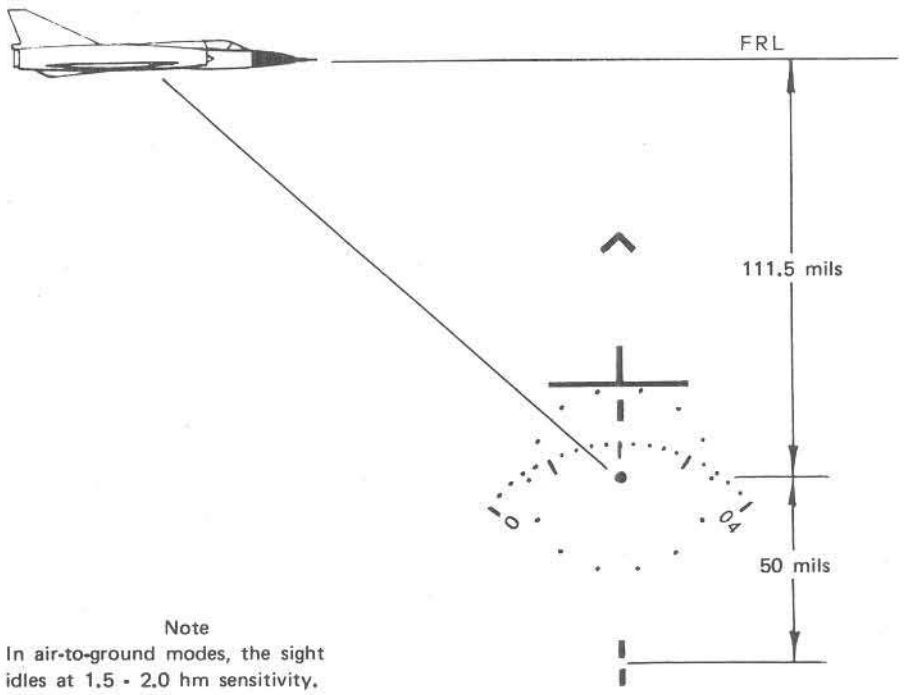


G/R/M with 11 ± 3 mils set on the sight depression scale should duplicate the air-to-air guns presentation.

[D] Ensure 6 hm set on the manual range rheostat.

Note
In air-to-ground modes, the sight idles at 1.5 - 2.0 hm sensitivity.

H. E. BOMB WITH ZERO MILS DEPRESSION SET



Note
In air-to-ground modes, the sight idles at 1.5 - 2.0 hm sensitivity.

Figure 1-62

also acts as an anti-toppling device for the gyro mirror.

Note

Whilst firing in AIR-AIR GUNS, the limiting system is de-activated to prevent excessive operation due to vibrations.

Thermal Regulation System

A thermal regulation system is included in the gyro assembly in order to reduce errors in lead computation due to variation in resistance of the gyro coils. The system has two thermostats set to operate at 62°C and 65°C and three heating elements. Between 0°C and 30°C ambient temperature, the system reaches operating temperature (62°C-65°C) in eight minutes.

Note

The sight will not compute correctly until the operating temperature is reached.

OPTICAL ASSEMBLY

The optical assembly located within the sight head consists of two filament lamps, two image discs, four mirrors and a lens.

Filament Lamps

The two filament lamps are situated in a small compartment in the lower front of the sight head. A ventilated door, located immediately below the Omera camera mount, provides access to the lamps. The brightness of the sight display is adjusted by means of the gunsight brightness rheostat on the WSCP (refer to Fig FO 1-27).

Image Discs

The image discs within the sight head are perforated with various shapes. Light from the filament lamps is reflected through the perforations onto the various mirror systems. The image discs are :

a. ***Moving Image Disc.*** This disc is driven by a roll and pitch servo mechanism which rotates the disc to facilitate display of roll and pitch information from the TGP for navigation (NAV), and roll and pitch orders from the radar nav computer for sight orders. The images on the moving disc include a reticule with a centre pipper and fourteen 'diamonds' and a set of wings.

b. ***Fixed Image Disc.*** The images on the fixed image disc are a fixed cross, an inverted V, a range/heading scale and a closing speed scale.

[D] The closing speed scale is not fitted.

Mirrors

The four mirrors within the sight head are the :

a. ***Gyro Mirror.*** This mirror may be adjusted in elevation by the elevation coils, or in azimuth by the azimuth coils.

b. ***Semi-reflecting Mirror.*** This mirror is sectionalized to allow light from the fixed image system to pass through from the underside and, simultaneously, reflect light from the gyro mirror (moving image system) from its upper surface.

c. ***Upper Mirror.*** This mirror is fixed to an upper portion of the sight head.

d. ***Lower Mirror.*** This mirror is fixed to a lower portion of the sight head.

Mirror Systems

The mirrors may be divided into two systems :

a. ***Moving Images System.*** This system incorporates the gyro mirror and the semi-reflecting mirror. Images from the moving image disc are reflected from the gyro mirror (where the images are adjusted for elevation if necessary) and then onto the semi-reflecting mirror. They are reflected by this unit, through the lens, onto the combining glass.

b. ***Fixed Image System.*** This system incorporates the fixed upper and lower mirrors and the semi-reflecting mirror. Images from the fixed image disc are reflected via the upper and lower mirrors, through the semi-reflecting mirror. They then pass through the lens and onto the combining glass.

Lens

The lens used in the optical system being of convex shape magnifies the images from the optical system.

JUNCTION BOX

The junction box, which is located behind the ejection seat, is the controlling centre of the sight head. It receives and distributes electrical signals used by the gyro gunsight system. The inputs received by the junction box are :

a. ***Weapons System Control Panel.*** Sight information according to the mode selected by the weapons system selector.

b. ***PHI System.*** Heading error signals.

c. ***Electrical Cage Button.*** Electrical cage sensitivity signal.

d. ***Gyro Reference System.*** Pitch and roll signals, and heading information for use in navigation function.

e. ***Air Data Computer.*** Altitude signals.

f. ***Radar and Weapons System Computers.*** Target range and closing speed, pitch and roll signals for sight display and signals for the operation of the radar operation sequence lights.

g. ***Sight Override Button.*** Changes sight presentation from MISS or S.W. (depending on weapons system selector position) to AIR-AIR GUNS while the button is pressed.

[D] The junction box is mounted on a rack between the rudder pedals of the rear cockpit.

VOLTAGE REGULATOR

The voltage regulator maintains DC power to the gunsight at a constant voltage level and is located to the left of the ejection seat.

[D] The regulator is located behind the ejection seat in the rear cockpit.

GUNSIGHT COCKPIT CONTROLS

The gunsight cockpit controls are those controls not on the sight head but which control various gunsight displays. These controls are discussed below.

Weapons System Selector

By selecting different AIR-AIR and AIR-GROUND modes with this selector, varying sensitivities and hence, sight depressions, are fed into the moving reticule. With the selector at G/S OFF, the gunsight and camera are inoperative.

Gunsight Brightness Rheostat

This control is located on top of the weapons system selector and controls the brightness of the sight display.

Electrical Cage Button

The electrical cage button is located in a recess in the front of the throttle handle. By pressing this control, a sensitivity current equal to 3.5 hm is fed to the sensitivity coils causing the reticule to move up 9-11 mils. It can be used only in air-to-air guns mode.

Sight Override Button

This button is a raised button located on the throttle just outboard of the electrical cage button. With the weapons system selector in either MISS or S.W., pressing this button causes the sight to operate in the AIR-AIR GUNS mode and the radar to operate in the RANGE function. In MISS or S.W., the appropriate missile tone can still be heard with the button pressed. Releasing the button allows the sight and radar to revert to the mode selected by the weapons system selector, however after button release, the radar will remain locked-on. The button does not operate in the AIR-GROUND modes.

Heading Error Switch

This ON-OFF switch is located on the right edge of the instrument panel. In NAV mode, selection of this switch shifts the moving reticule in the direction of the selected TACAN or DR station.

Closing Speed Switch

This ON-OFF switch is located on the right cockpit wall. When in air-to-air or air-to-ground ranging modes, selection of this switch after radar lock-on, causes the closing speed scale to come into view on the gunsight combining glass enabling the pilot to read closing speed in knots.

GUNSIGHT DISPLAY

The gunsight display is a combination of fixed and moving images. The moving images consist of the moving reticule and the moving scales.

Fixed Images

The fixed images (refer to Fig 1-63) comprise the inverted V and the fixed cross. The inverted V is depressed 46.5 mils and the fixed cross 86.5 mils below the FRL. The fixed cross is the datum point for the moving reticule when no current flows in the elevation and azimuth coils. The moving reticule has a field of movement of 157.5 mils in any direction from the centre of the fixed cross (18° cone).

Fixed Images

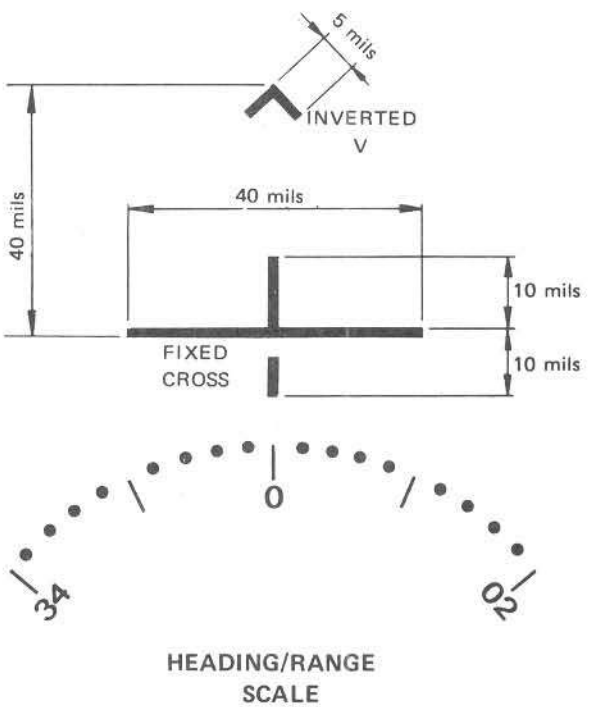


Figure 1-63

Moving Reticule

The moving reticule (refer to Fig 1-64) consist of the :

a. ***Reticule.*** The reticule consists of a pipper encircled by fourteen diamonds. The diameter of the circle is fixed at 50 mils. It is used normally as a sighting reference to release weapons. In MISS, S.W. and GUNS modes (with the target beyond 1.1 NM), the reticule, after radar lock-on, displays visual pitch information issued by the radar nav computer. When visual pitch information is displayed, a pipper displacement of 50 mils from the centre of the fixed cross represents a 1'g' pitch.

Moving Reticule

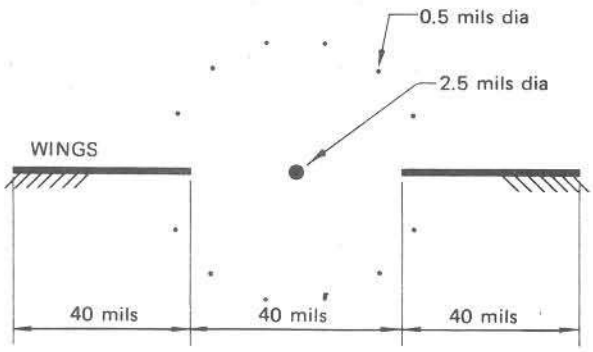


Figure 1-64

b. ***Wings.*** In MISS, S.W. and GUNS modes with the target beyond 1.1 NM, the wings, after radar lock-on, display roll information issued by the radar nav computer (maximum deflection of the wings is 45°). In AIR-AIR GUNS at ranges less than 1.1 NM the wings are automatically masked.

Note

When the wings are not visible the bombing marker is visible 50 mils below the pipper (refer to Fig 1-65).

[D] ***Wings.*** In the NAV mode, the wings appear as an artificial horizon which receives and displays information from the TGP (attitude). When the HDG ERR switch is on, the moving reticule shifts in the direction of the selected TACAN or DR station.

Note

In all modes except NAV, the wings are not visible. However the bombing marker is visible 50 mils below the pipper.

Moving Reticule with Wing Masked

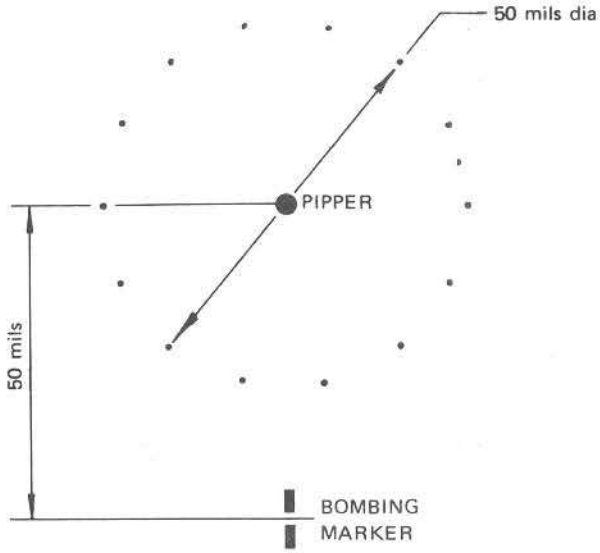


Figure 1-65

Moving Scales

There are two moving scales in the display. These are the :

a. ***Heading/Range Scale.*** The scale functions in the NAV and air-to-air modes as follows :

(1) In NAV mode, the scale gives the aircraft heading measured by the flux valve and stabilized by the gyro centre. The scale is graduated in increments of two degrees, each twenty degrees being annotated. The bottom of the fixed cross is the heading index.

Note

In all air-to-ground modes except NAV, the heading/range scale rotates continuously and should be covered by selecting the MASK lever to 0.

(2) In air-to-air modes when the radar is not locked-on, the range of the strobe is given on the scale in nautical miles. When the radar is locked-on and the range is greater than 1.1 NM, the range is given in nautical miles. At ranges less than 1.1 NM, the scale gives the range in hectometres (1 hm = 328 ft). The scale is graduated in increments of 0.2 NM or 0.2 hm according to range.

Note

Until the radar has timed-in, the range scale rotates continuously. If the radar is locked-on in the air-to-ground ranging mode, the slant range along the radar axis is given on the scale.

[D] In all modes except NAV, the heading/range scale is inoperative and rotates continuously in a clockwise direction.

b. ***Closing Speed Scale.*** The scale is selected by setting the CLOSING SPEED switch on the right cockpit wall to ON. The scale is graduated from − 100 to + 1600 as follows:

(1) − 100 to + 500 kn - in increments of ten knots, numerals each 50 kn, eg 300, 350 etc,

(2) + 500 to + 1000 kn - in increments of fifty knots, numerals each 100 kn, eg 500, 600 etc, and

(3) + 1000 to + 1600 kn - in increments of one hundred knots, numerals each 200 kn, eg 1000, 1200 etc.

Note

- At least two closing speed figures of the moving scale are always visible in the window.
- The CLOSING SPEED switch should be selected OFF when the scale is not required.

AIR-TO-AIR MODES

The three AIR-AIR modes are MISS, S.W. and GUNS. The modes are selected by positioning the weapons system selector on the WSCP.

[D] MISS mode is not fitted.

AIR-AIR MISS

In this mode, a target may be intercepted with the Matra missile as shown at Fig 1-66.

Gunsight Display - AIR-AIR MISS

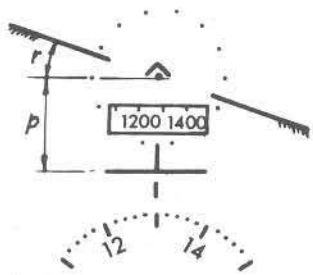
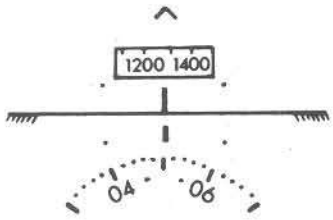
DISPLAY	MEANING	SEQUENCE LIGHTS	RADAR
	Sight is idling at 1.5 - 2 hm. The moving range scale indicates the range strobe distance in nautical miles.	Blue light on - indicates Matra ready.	Not locked on.
	The sight receives inputs from the radar and displays sight orders as follows: a. The banked wings correspond to a roll order 'r'. b. The distance between the pipper and the fixed cross corresponds to a pitch order 'p'. c. The moving range scale indicates target range is 13 NM d. The closing speed scale indicates the closing speed is 1280 kn. The pilot must climb and bank to the right to cancel sight orders.	Amber light on - indicates radar locked on but target not in fire zone.	Locked on.
	Sight orders are cancelled. Target range is 5 NM. Closing speed is 1280 kn.	Green light on - indicates target in fire zone.	Locked on.

Figure 1-66 (Sheet 1 of 2)

Gunsight Display - AIR-AIR MISS

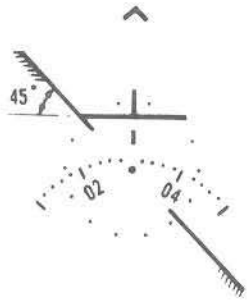
DISPLAY	MEANING	SEQUENCE LIGHTS	RADAR
	Breakaway orders - Maximum deflection of wings. The pilot must breakaway down and to the right.	No lights.	Locked on.

Figure 1-66 (Sheet 2 of 2)

AIR-AIR S.W.

In this mode, a target may be intercepted with the S.W. missile as shown at Fig 1-67.

IIIO Gunsight Display - AIR-AIR S.W.

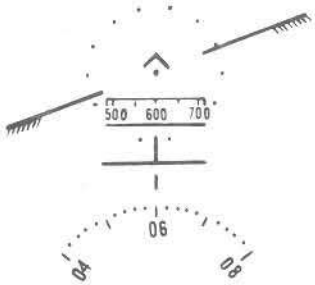
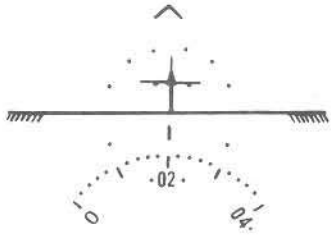
DISPLAY	MEANING	SEQUENCE LIGHTS	RADAR
	Sight is idling at 1.5 - 2 hm. The moving range scale indicates the range strobe distance in nautical miles.	No lights,	Not locked on.
	The sight receives inputs from the radar and displays sight orders as follows: a. Target range is 6 NM. b. Closing speed is 600 kn. c. The pilot must climb and bank to the left to cancel sight orders.	Amber light on - indicates radar locked on, target not in fire zone.	Locked on.
	Sight orders are cancelled. Target range is 2 NM Target appears at top of fixed cross.	Green light on - target in fire zone.	Locked on.

Figure 1-67

[D] The interception with S.W. by Mirage IIID is shown at Fig 1-68.

IIID Gunsight Display - AIR-AIR S.W.

DISPLAY	MEANING	SEQUENCE LIGHTS
	Sight idling at fixed sensitivity of 1.5 - 2 hm. The moving range scale rotates continuously in a clockwise direction. Aiming reference is top of fixed cross.	No lights.

Figure 1-68

AIR-AIR GUNS

In this mode (refer to Fig 1-69) with the radar locked on and range less than 1.1 NM, the sight becomes a lead computing system with radar ranging.

Note

In the AIR-AIR sector of the weapons system section, target closing speed can be selected. This is displayed through the gunsight, as either a positive or negative value.

[D] In this mode (refer to Fig 1-70), the sight becomes a gyro gunsight fed with range information as assessed by the pilot and set on the manual range rheostat, ie 200-1200 metres. The rheostat is normally set at 6 hm.

Note

When the CSF 97K is used as a predictor gunsight, it cannot compensate for velocity jump or bank angle. The sight is, therefore, only accurate over a limited speed range.

IIIO Gunsight Display - AIR-AIR GUNS

DISPLAY	MEANING	SEQUENCE LIGHTS	RADAR
	The sight operates as a conventional gunsight. The pipper position corresponds to a fixed target range of 600 metres for a stabilized pursuit course (350 metres with the elec cage button depressed).	No lights.	Not locked on.

Figure 1-69 (Sheet 1 of 2)

IIIO Gunsight Display - AIR-AIR GUNS

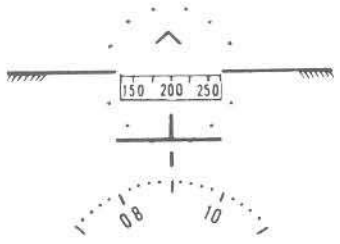
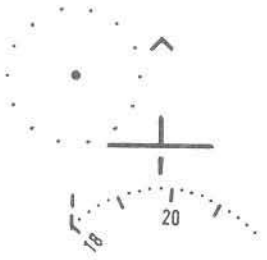
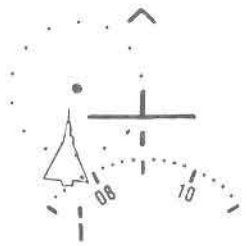
DISPLAY	MEANING	SEQUENCE LIGHTS	RADAR
	The radar displays sight orders as follows: a. Target range 9 NM b. Closing speed 200 kn. c. The pilot must climb to cancel sight orders.	Amber light on.	Locked on.
	Range scale now reads target range in hectometres (19.8 hm). Fixed range of 12 hm fed to sight for computation.	Green light on.	Locked on.
	Target range 9 hm. Correct target range now being fed to sight.	Green light on.	Locked on.

Figure 1-69 (Sheet 2 of 2)

IIID Gunsight Display - AIR-AIR GUNS

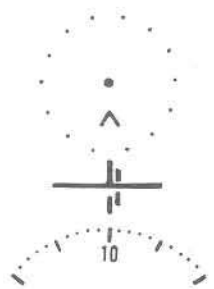
DISPLAY	MEANING	SEQUENCE LIGHTS
	The sight operates as a conventional gunsight. The pipper position corresponds to a fixed target range as selected by the pilot on the manual range rheostat (normally 6 hm). If the elec cage button is pressed, the pipper and the bombing marker will rise 9-11 mils regardless of the manual range rheostat setting. The scale is inoperative and rotates continuously.	No lights.

Figure 1-70

AIR-TO-GROUND MODES

Navigation (NAV)

In NAV, the sight display includes aircraft attitude and heading information. The display presented during straight and level flight on a heading of 020° with the sight depression rheostat set at 35 mil is shown at Fig 1-71. The display presented when turning left is shown at Fig 1-72. A display showing a heading error which requires a turn right correction is shown at Fig 1-73.

Navigation Display - Straight and Level

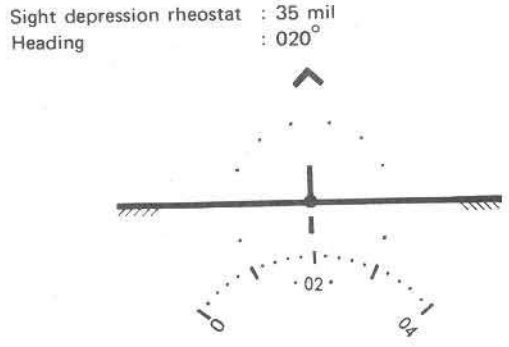


Figure 1-71

Navigation Display - Turning Left

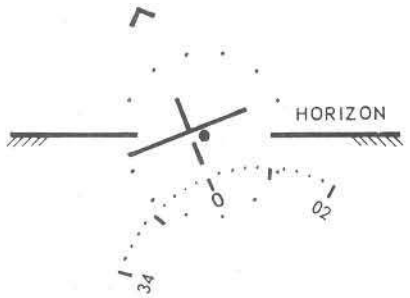


Figure 1-72

AIR-GROUND Delivery Modes (G/R/M, HE BOMB)

In these modes, the sight reticule sensitivity is held at 1.5 to 2 hm, ie the maximum sensitivity current, thus providing a suitable air-to-ground sighting reference. In :

a. G/R/M with 11 mil set on the sight depression rheostat, the sight presentation should correspond to AIR-AIR GUNS, and

b. HE BOMB with zero mil set on the sight depression rheostat, the top of the reticule should be tangential with the horizontal arm of the fixed cross.

Navigation Display - Heading Error

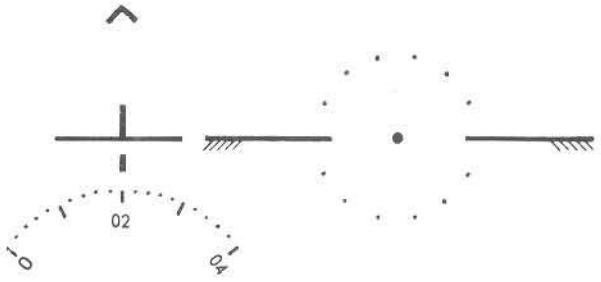


Figure 1-73

OPTICAL SIGHT FAILURES

In the event of an optical sight failure, select another position and check for normal sight operation. The weapons system selector should not be set to G/S OFF because of possible damage to the gyro-mirror assembly during manoeuvring.

Sight Operation Without ADC Information

Without ADC information, sight presentation in Matra or Sidewinder functions is erroneous and Matra cannot be launched. Sidewinder can be launched on a visual attack as discussed under radar malfunctions. In the air-to-air guns mode the gyro corrections given by the sight for pursuit type firing are correct for an altitude of 21 850 feet.

Sight Operation Without Gyro Centre Information

Without gyro centre information, sight presentation in either missile mode is incorrect. In the navigation mode, the sight head gives a zero pitch attitude indication and the heading scale rotates continuously.

DOPPLER RADAR NAVIGATION EQUIPMENT

The Doppler radar navigation equipment uses the Doppler effect to accurately measure the aircraft's groundspeed and drift. The groundspeed and drift are displayed on the Doppler radar control panel and are used by the PHI navigation computer to provide an accurate navigation plot. The Doppler radar navigation equipment is powered from the alternator bus bar through a three phase/single phase transformer.

The Doppler radar navigation equipment is designed to operate :

a. from 40 ft to 50 000 ft altitude,

b. from 80 kn to 800 kn,

c. up to ± 25° indicated drift angle (mechanical stop),

d. up to ± 25° pitch angle (mechanical stop), and

e. in wings level flight (not roll stabilized).

The components of the Doppler radar navigation equipment (refer to Fig 1-74) are :

a. transmitter/receiver,

b. antenna assembly,

c. control panel, and

d. DOP MEM light.

TRANSMITTER/RECEIVER

The transmitter/receiver is located at the rear of the nose wheel well. The transmitter transmits pulses at 13 325 MHz and the PRF is modulated to overcome altitude holes. A frequency tracking unit in the transmitter/receiver measures the Doppler frequency and calculates the groundspeed. The frequency tracking unit also controls the azimuth servo on the antenna assembly from which the drift angle is calculated and monitors the signal/noise ratio.

ANTENNA ASSEMBLY

The antenna assembly is installed under the cockpit and is protected by a radome, the profile of which coincides with that of the aircraft. The antenna is stabilized in pitch by means of a mercury levelling system but is not stabilized in roll.

CONTROL PANEL

The control panel (refer to Fig 1-75) is located on the centre pedestal. It contains a selector switch, a groundspeed and drift indicator, a MEMORY light, and drift angle (DA) and groundspeed (GS) setting controls.

Selector Switch

The selector switch is a five-position rotary switch which permits the following selections :

a. ***OFF.*** In this position, the equipment is not supplied with power. The drift angle resolver is also short-circuited and prevents the DA setting knob having any effect on the radar display in the Ground Map mode.

b. ***STBY.*** When the switch is placed in this position, power is supplied to the Doppler radar navigation equipment and a 60 second time switch is activated. The STBY position is used during taxiing to inhibit transmission or in flight when the mission requires radar silence. With the switch in the STBY position, the Doppler radar navigation equipment unlocks, and the MEMORY light on the control panel and the DOP MEM light on the instrument panel illuminate.

c. ***LAND.*** This is the normal operating position during flight and applies power to the modulator circuit allowing transmission after a 60 second delay. The set locks on to the surface when above 40 ft AGL and 80 KIAS, and operates on a signal scale factor of 34.5 Hz per kn over land.

d. ***SEA.*** In SEA, a correction factor of + 2.5% is added to the ground speed which is indicated in LAND. This is to compensate for a shift in the Doppler signal caused by the low reflectivity of the sea's surface. The SEA position should be used for sea states above Beaufort 1 (4 inch waves). Below Beaufort 1, the memory lights will probably illuminate indicating an unworkable signal.

e. ***TEST.*** When the switch is placed in this position, either in flight or on the ground, a Doppler frequency signal is applied to the video circuit of the receiver. When this signal is acquired by the tracking circuit, the antenna aligns itself with the aircraft fore and aft axis, the drift pointer reads 0° ± 2°, the groundspeed counter reads 121 kn ± 3 kn and the MEMORY light is extinguished. This should occur within 30 seconds. The DOP MEM light on the instrument panel remains illuminated. The TEST position tests the transmitter circuits and can be used for trouble shooting while in flight.

Groundspeed and Drift Indicator

Groundspeed is displayed on a three-drum veeder-type counter and drift is indicated by a pointer moving in front of a dial graduated from 40°L to 40°R. However, the set only indicates from 25°L to 25°R because of mechanical stops in the antenna assembly.

Memory Light

Illumination of the amber MEMORY light on the control panel indicates that the signal being received is unusable or that the selector switch is in the STBY position. This light remains illuminated when the Doppler fails as a result of a high voltage overload condition. To reset, select the selector switch OFF then ON.

Drift Angle and Groundspeed Setting Controls

When the Doppler unlocks, the drift angle indication can be adjusted by pressing and rotating the DA setting knob; the groundspeed can be adjusted by pressing and rotating the GS setting knob. These settings have no effect on the PHI navigation information because, immediately the Doppler radar navigation equipment unlocks, the PHI uses the wind velocity set on the PHI control panel and airspeed information from the ADC. The DA setting knob affects the Ground Map presentation by offsetting the radar display from the aircraft longitudinal axis by the amount of drift shown on the Doppler indictator regardless of whether the set is in STBY or memory. Setting the selector switch OFF short circuits the drift resolver.

DOP MEM LIGHT

The amber memory light on the instrument panel, labelled DOP MEM, has the following functions :

a. It illuminates in conjunction with the MEMO-

Doppler Radar - Transmission Principle

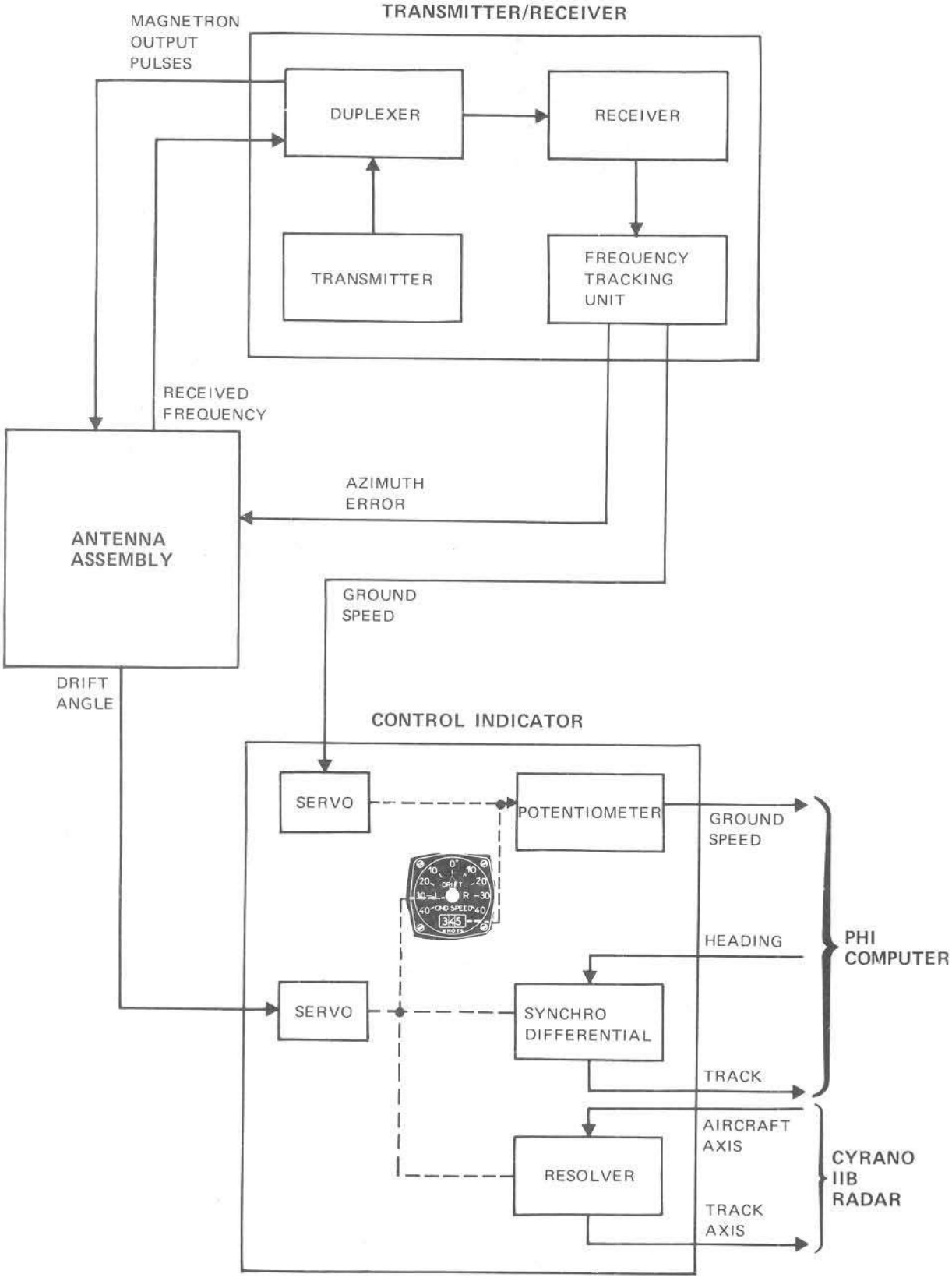


Figure 1-74

Doppler Radar Control Panel

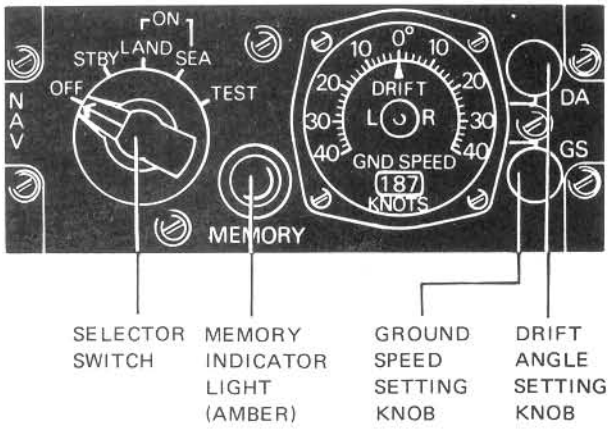


Figure 1-75

RY light on the control panel when the Doppler is in STBY or has broken lock.

b. It remains illuminated when the MEMORY light is extinguished during TEST.

c. It remains illuminated when the Doppler regains lock (and the MEMORY light extinguishes) until the ground speed counter is within ± 25 kn of the actual groundspeed, when it extinguishes.

d. It remains illuminated when the Doppler fails and the MEMORY light is extinguished as the result of an overtemperature or low voltage overload condition.

DOPPLER THEORY

The antenna radiates four beams along the edges of a rectangular-based pyramid (refer to Fig 1-76) and receives signals reflected back from the surface below the aircraft. The beams are radiated in pairs, each pair consisting of two diagonally opposed beams. Transmission takes place first for one pair of beams and then for the other pair, at the rate of one cycle per second. The frequency of the reflected signal (Fr) is compared in the receiver with frequency of the transmitted signal (Ft). The difference (Ft − Fr) between the two frequencies is the Doppler frequency (FD), which is dependent upon groundspeed.

Groundspeed Measurement

Groundspeed is calculated from the Doppler frequency by the transmitter/receiver. To measure groundspeed accurately, the depression angle of the beams from the horizontal must be kept constant. To maintain a constant depression angle, the antenna is stabilised in pitch by a servo-mechanism controlled by mercury level switches. When the aircraft adopts a nose up or nose down attitude, one or other of the mercury level switches is activated, which allows current to flow to the pitch servo-motor. The servo-motor drives the antenna until it is level again; the mercury level switch opens and power to the servo-motor is interrupted. The mercury level switches, which are very sensitive, cause the antenna assembly to be driven in pitch as the result of acceleration or deceleration resulting in erroneous indications of ground speed.

Drift Measurement

In nil wind conditions, with the antenna lined up in the fore and aft axis of the aircraft, the Doppler frequency measured in each pair of beams would be the same. However, in wind conditions, with the antenna lined up in the fore and aft axis of the aircraft, the Doppler frequency measured in each pair of beams would be different (refer to Fig 1-76). If the antenna is rotated until it lines up with the track of the aircraft, the Doppler frequency in each pair of beams will again be the same. The transmitter/receiver calculates the Doppler frequency in each pair of beams and then calculates a Doppler frequency error. This signal is used to drive the azimuth servo-motor until the error is zero. The antenna is then aligned with the track of the aircraft and the angle through which the antenna has been driven is the drift angle.

NORMAL OPERATING PROCEDURES

Energizing

The Doppler radar navigation equipment is energized as follows :

a. Rotate the selector switch on the control panel to STBY and wait one minute. The MEMORY indicator light on the control panel and the DOP MEM light on the instrument panel should illuminate.

Note

In very hot weather conditions, the Doppler should be left OFF until just prior to take-off to avoid overheating.

b. Rotate the selector switch to TEST, wait 30 seconds and then check that the :

(1) MEMORY light on the control panel extinguishes,

(2) ground speed shown on the counter is 121 kn ± 3 kn, and

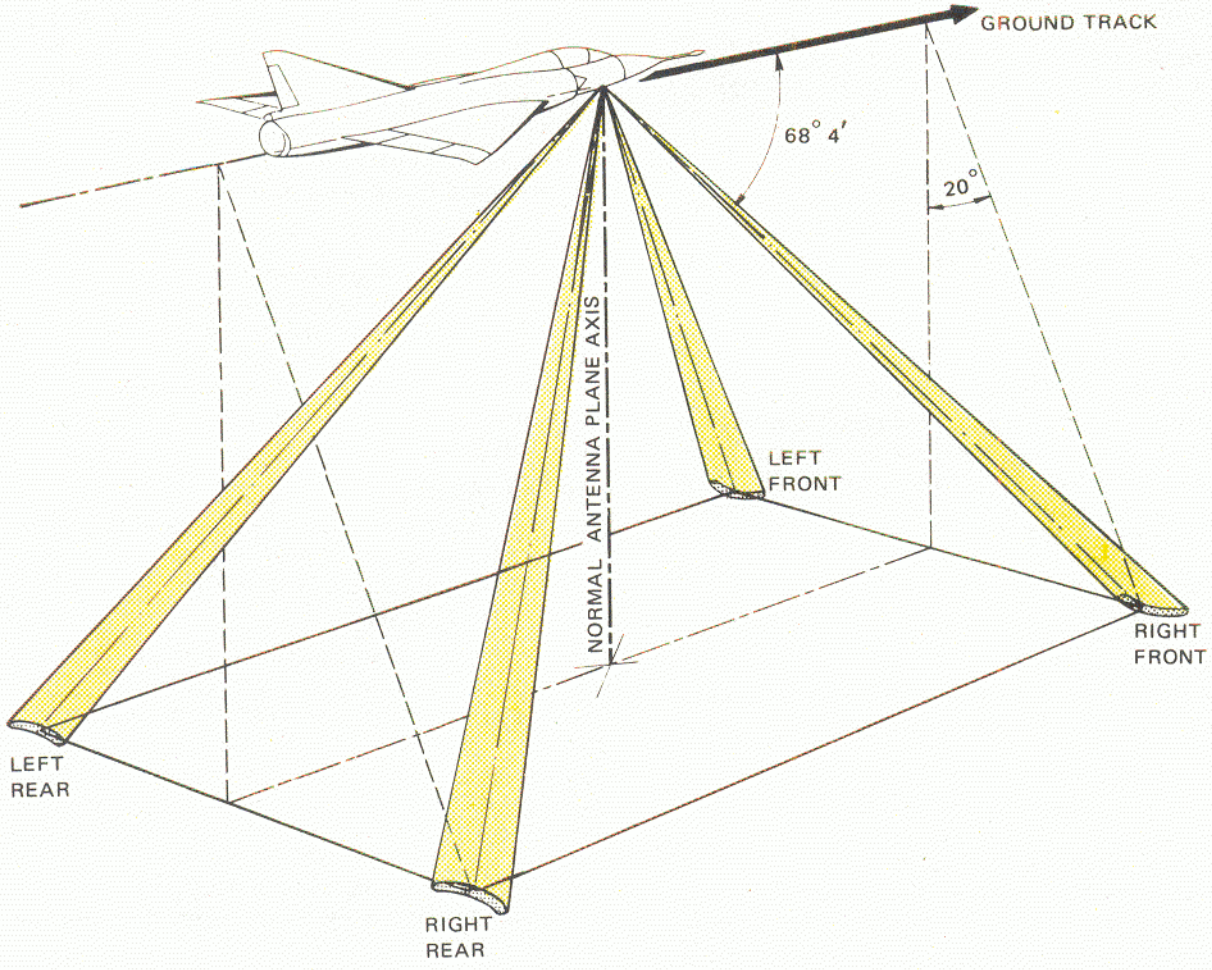
(3) drift indicator pointer reads 0° ± 2°.

c. Return the selector switch to STBY or LAND; the MEMORY light should illuminate immediately.

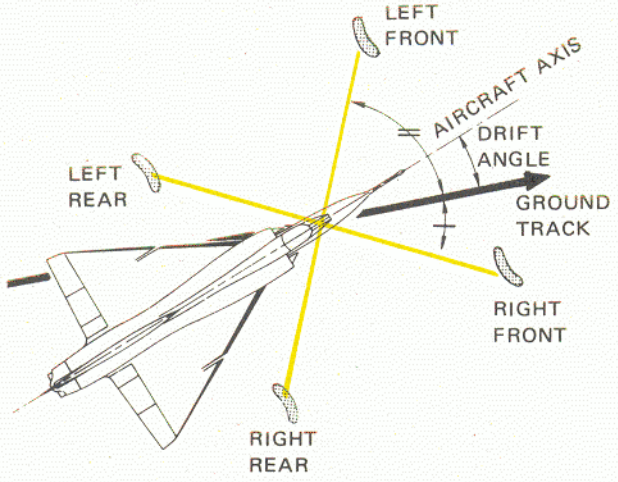
Note

When the memory lights are illuminated, the drift and ground speed readings shown on the Doppler control panel indicator should not change. If the readings change, the set is probably locking on to internal noise and is unserviceable.

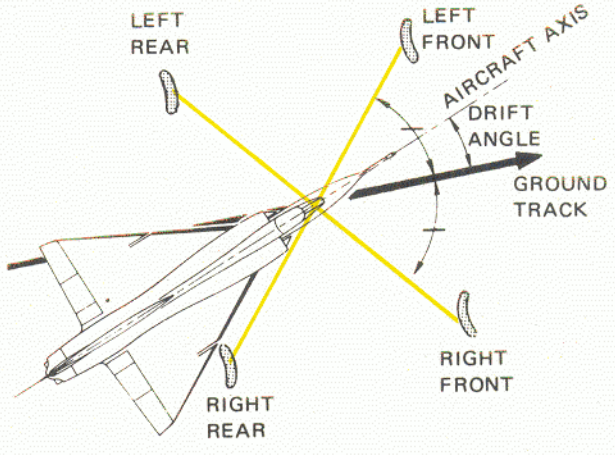
Doppler Radar - Operating Principle



ANTENNA ILLUMINATION PATTERN



ANTENNA OFFSET FROM GROUND TRACK



ANTENNA IN LINE WITH GROUND TRACK

Figure 1-76

Before Take-off

Before take-off, rotate the selector switch to the LAND position (Doppler transmission begins).

In Flight

The Doppler memory lights on the control panel and instrument panel extinguish about 30 seconds after the aircraft reaches 40 ft AGL. The drift and ground speed can then be read on the Doppler indicator.

Note

If it is necessary to fly over the sea for a long time, set the selector switch to the SEA position to maintain accurate calculation of the ground speed.

Operation in Standby

To navigate in discreet mode without radar transmission by the Doppler radar, set the selector switch to STBY. The Doppler memory lights illuminate, and the drift and ground speed readings remain constant on the values measured at the moment of switching to STBY.

The PHI computer carries out DR navigation using the true airspeed from the ADC, and the wind speed and direction set on the PHI control panel. The accuracy of navigation in these circumstances is satisfactory provided that the wind speed and direction are correct and remain unchanged.

Doppler Unlock Mode

When the selector switch is set to the LAND or SEA position and the return signals become too weak to be useful to the tracking unit, the memory lights illuminate. Under these circumstances, the PHI computer switches to the DR mode and the Doppler radar operates in the same manner as if the STBY position is selected. Weak return signals may be encountered at high altitudes because of the nature of the terrain over which the aircraft is flying or in a turn. When conditions return to normal, the memory lights extinguish and the PHI computer operates again using Doppler radar information. Because the antenna is not stabilized in roll, the Doppler unlocks or at least gives erroneous readings during a turn.

If the Doppler radar unlocks, the scope presentation remains offset by the amount of drift shown on the indicator. However, if the selector switch is selected OFF, the scope presentation centralizes immediately. The scope presentation may also be centralised by use of the DA setting knob on the Doppler radar control panel.

In-flight Test

The Doppler radar may also unlock due to faults in the equipment. To determine whether the unlock indication is due to the nature of the terrain over which the aircraft is being flown or an equipment fault, proceed as follows:

a. Set the selector switch to TEST. The Doppler memory lights illuminate and then the MEMORY light on the control panel extinguishes within 30 seconds; the indicator displays the test readings.

b. If the ground speed and drift readings on the control indicator are 121 kn ± 3 kn and 0° ± 2° respectively, the unlock indication has been caused by weak return signals and the Doppler radar equipment is functioning correctly. However, power output or receiver sensitivity is not checked by the TEST function and these factors could cause the unlock condition.

c. Return the selector to LAND or SEA.

The Doppler radar navigation equipment is faulty if, in the 30 seconds following selection of TEST, the MEMORY light has not extinquished and the ground speed and drift readings have not started to move to the TEST values or the readings are still at their initial or some other value with the memory lights still illuminated.

DOPPLER FAILURE

Failure of Doppler radar equipment is indicated by illumination of the Doppler memory lights. The reason for the failure can be determined by using the in-flight test procedure.

If the Doppler radar equipment fails the in-flight test, place the selector switch to OFF and then to TEST again. Wait 60 seconds for the time delay and then a further 30 seconds for correct indication of the TEST values. If the correct indications are not obtained, place the selector switch to OFF. This short circuits the drift resolver (located in the panel), and enables the radar scope scanning circuits to continue functioning without drift information, ie the scanning axis on the scope coincides with the aircraft axis.

Other symptoms of possible failure are:

a. memory lights do not illuminate when the aircraft is banked, particularly at high altitudes, and

b. drift angle displayed on the indicator does not change after heading change.

The above symptoms can be caused by a thermal overload. The pilot should then wait for 2 to 3 minutes while the blower motor cools the set. If the equipment does not automatically recycle, set the selector switch to OFF.

Note

In the case of a thermal overload, all power to the equipment, except the internal blower, is disconnected. The MEMORY lamp on the control panel cannot light but the DOP MEM light on the instrument panel illuminates. The readings on the indicator freeze on the values recorded before unlocking. When the equipment cools sufficiently, it automatically recycles.

Effects on the Navigation System

Without Doppler radar, the PHI carries out an air navigation plot using the true air speed supplied by the ADC, the wind speed and direction set on the PHI control panel, and the grid heading fed from the BOMB. In this condition, the navigation plot remains correct only to the extent that wind speed and direction are correct and remain constant. On the radar scope, the angle that the scanning axis (aircraft axis) makes with the antenna or sweep axis no longer indicates the actual drift but indicates the drift occurring when the Doppler changed to memory or standby. When the Doppler fails, set the Doppler selection switch to OFF. Scope scanning then aligns with the scope axis which represents the aircraft axis. Doppler failure does not affect the use of the Cyrano radar in the air-to-ground mode.

PHI NAVIGATION SYSTEM

The PHI-5C-3 (Position and Homing Indicator) is an accurate airborne navigation system specially designed for high performance fighter aircraft. The system consists of the :

a. PHI computer,

b. PHI control panel,

c. station storage unit.

d. PHI, and

e. PHI - Cyrano radar coupler.

The system plots the aircraft's position by automatic dead reckoning in relation to an origin or any one of 11 preset positions in a grid co-ordinate system. The PHI displays the navigation situation in terms of bearing and distance from the selected station.

The sources of information fed into the computer are contained entirely within the aircraft making it independent of ground installations. The inputs are :

a. TAS from the air data computer,

b. grid heading from the gyro centre,

c. pre-set station co-ordinates from the SSU,

d. grid origin, usually home base, from the SSU,

e. forecast wind speed and direction, and

f. Doppler drift and ground speed.

The PHI computer receives AC power from the alternator bus and DC power from the manual load-shedding DC bus. The PHI receives DC power from the main DC bus.

[D] The equipment is installed in the front cockpit only, with the exception of the PHI which are installed in both cockpits; the rear PHI is only a repeater of the front PHI, the mode selector having no function.

PHI COMPUTER

The PHI computer is installed in the equipment bay and includes mechanical and electronic sub-assemblies which produce the computations and switching necessary for the navigation, as well as the necessary storage for resetting the navigation. Latitude information (required to provide corrections for the earth's rotation) is also supplied by the computer to the electronic unit.

[D] The PHI computer is installed on the underside of the fuselage in front of the nose wheel.

PHI CONTROL PANEL

The control panel (refer to Fig 1-77) is located on the right console. It is lit by miniature light bulbs embedded in the plexiglass. The control panel consists of the components described in the following paragraphs.

Station Storage Unit Housing

The station storage unit (SSU) housing is a receptacle for the station storage unit. The receptacle is protected by a spring loaded cover. A release button is located below the SSU housing. Pressing the button unlocks the station storage unit which is ejected by a spring.

Sequence Light

A green press-to-test light, labelled SEQUENCE illuminates for 7 seconds when :

a. a reset has been performed (when the PHI mode selector is switched from SET to DR); or

b. the pilot changes the wind setting.

Wind Direction Setting Knob

The WIND-DIRECTION setting knob sets the wind direction on a three-drum counter in 10° increments from 0° to 360°.

Wind Speed Setting Knob

The WIND-SPEED setting knob sets the wind speed on a three-drum counter in one knot increments from 0 to 200 kn.

Grivation Setting Knob

The GRIVATION setting knob sets grivation on a three-drum counter. Two of these drums give a value from 0° to 57° and the third gives the direction (W or E).

Note

To set inputs with any of the above controls, press the knob before turning.

Station Selector

The station selector can be rotated to any one of 12 positions. The station number is read in a window located above the selector. The grid origin (usually home base) always corresponds to No 1 station.

Note

A mechanical stop prevents station changes while the SEQUENCE light is on.

PHI Control Panel

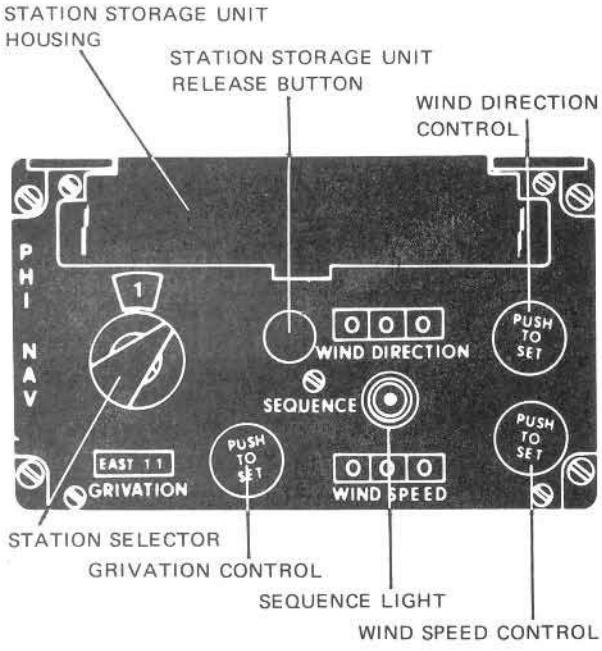


Figure 1-77

STATION STORAGE UNIT

The station storage unit (SSU) (refer to Fig 1-78) is a small flat box in which the cartesian co-ordinates of 11 stations, selected in relation to the PHI grid origin (home base generally), are preset. The 22 setting potentiometers are protected by a cover. The SSU is inserted in the PHI control panel.

PHI

The PHI (refer to Fig 1-79) is located on the right side of the instrument panel. The lighting consists of miniature light bulbs embedded in the plexiglass. The PHI includes a compass card, bearing pointer, steering index, distance counter, and the lubber line and radar antenna scanning limits engraved on the protective glass. The PHI controls are discussed below.

Bearing Setting Knob

This control, labelled BRG, is used to reset the computer for bearing corrections.

Distance Setting Knob

This control, labelled DIST, is used to reset the computer for distance corrections.

Station Storage Unit

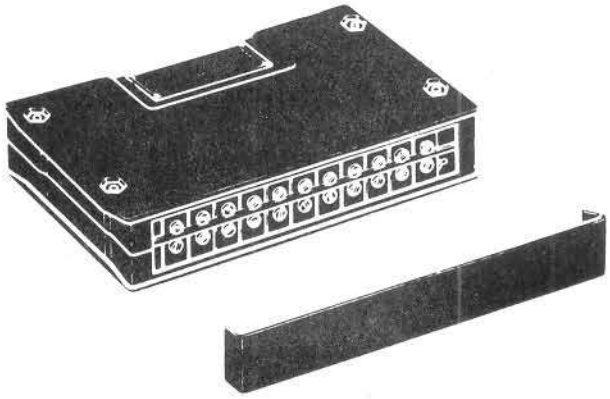


Figure 1-78

PHI

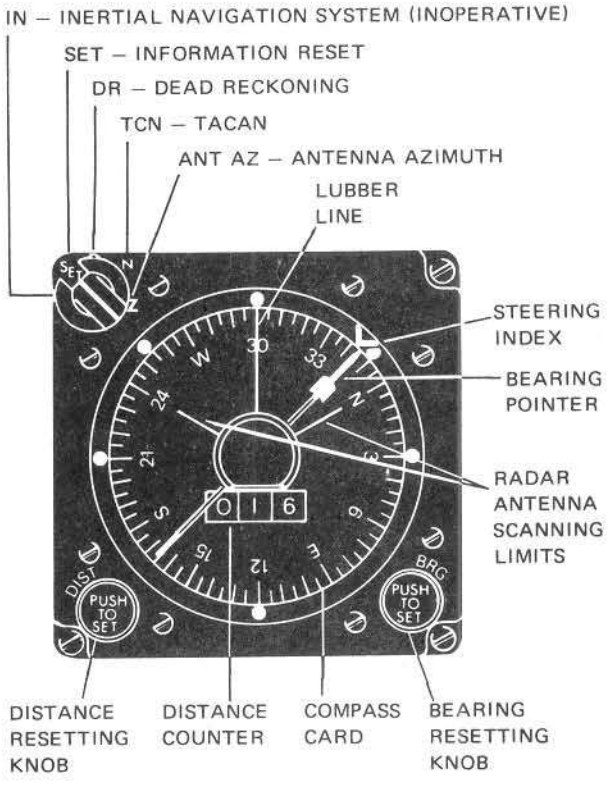


Figure 1-79

PHI Mode Selector

This control is a five-position selector switch allowing selection of one of the following modes of operation :

a. IN - not in use.Selection of this position is prevented mechanically.

b. SET - enables pilot corrections to be made to the distance and bearing indications on the indicator and thus the computations in the computer.

c. DR - the pilot reads the information computed from the ground speed, the aircraft grid course (grid heading + drift) and the selected station co-ordinates when the Doppler is receiving a usable return signal (Doppler supplies ground speed and drift). When the Doppler is on STBY or is unlocked this information is computed from TAS, the aircraft grid heading, the set wind and the co-ordinates of the selected station.

[D] the pilot reads the information computed from the TAS, the aircraft grid heading, the set wind and the co-ordinates of the selected station.

d. TCN - TACAN information is displayed on the indicator.

e. ANT AZ - In this mode of operation, the steering index indicates the position of the radar antenna axis in relation to the aircraft axis and the bearing pointer indicates the DR bearing to the selected PHI station.

[D] ANT-AZ is not used.

PHI-CYRANO RADAR COUPLER

The PHI-Cyrano radar coupler provides a signal interface between the radar and the PHI computer for the operation of the estimated point marker in the ground map mode.

OPERATION

Grid Navigation Principles

The origin of the PHI navigation is generally home base (refer to Fig 1-80); grid north is usually true north at the origin of the grid. A point (P) on the grid can be designated by its cartesian co-ordinates X and Y or by its polar co-ordinates, ie the distance of the point from the origin (OP or r) and the bearing of the point from grid north (θ). The stations preset in the station storage are designated by either their cartesian co-ordinates or their polar co-ordinates.

The PHI grid covers an area of 2000 square miles. The area of coverage can be increased by using several station storages whose station co-ordinates are preset for grids having a different origin, but located on the same parallel of latitude. These grids partially overlap, eg grids 1 and 2 in Fig 1-80. The computer is capable of computation up to 1200 NM from the origin without changing grids. The actual display of the distance requires the use of an auxiliary station because the distance counter cannot go beyond 999 NM.

Heading and Grivation

Depending on the position of the gyro reference heading selector, the magnetic, gyromagnetic or grid heading can be repeated by the PHI compass card. This heading information is fed by the Bezu output multiplier. The aircraft grid heading is necessary for all computations in the computer and indicator.

Because a transfer gyro is not available to align the gyro centre directional heading to true north, the grid north reference is not available and has to be calculated by adding the grivation set on the PHI control panel to the magnetic heading.

Grivation is the angle between the grid north and the magnetic north; it varies continuously during a flight due to convergence and variation changes, while the grid north is constant. Grivation, which is the algebraic sum of magnetic variation and meridian convergence, is normally determined during flight planning and set by the pilot in one degree increments along the route at pre-determined points.

Note

Transfer gyros have been withdrawn from service.

Navigation Computer Principle

When the destination base has been selected in the SSU, the two main parameters supplied to the pilot for navigation are :

a. the difference between the aircraft heading and the one to be held in order to reach the desired point, and

b. the distance between the aircraft and its destination.

Note

These indications are repeated in the radar (in the AIR-GROUND modes) and the track error is repeated in the sight in NAV mode using the HDG ERR switch.

PHI Grid Navigation Principle

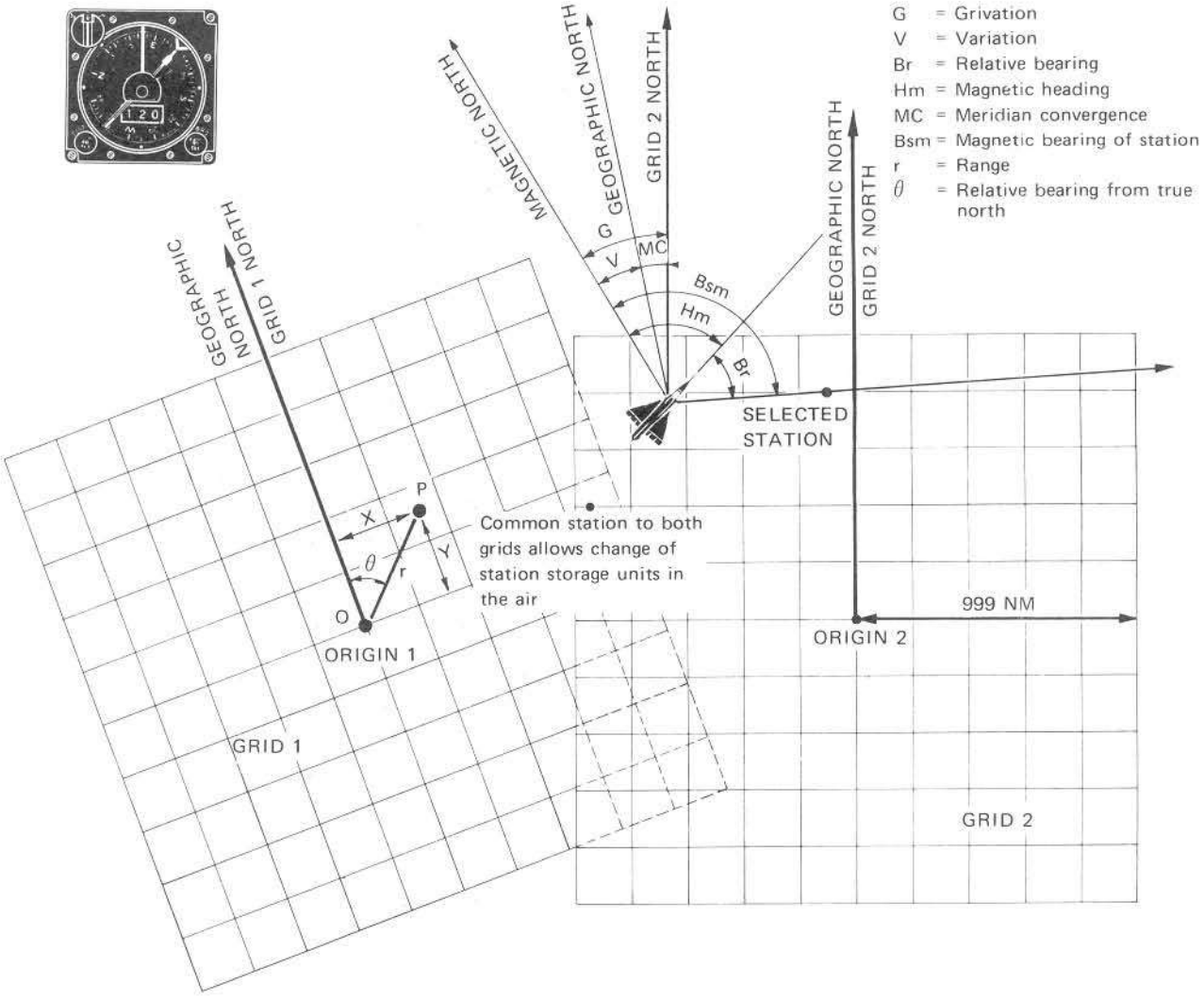


Figure 1-80

These two parameters are determined by the computer in two steps:

a. actual point computation, and

b. computation of the heading and distance to go to the destination.

Actual Point Computation

When the Doppler receives a useable return signal, two switches in the PHI navigation computer (refer to Fig 1-81) enable the computer to receive ground speed and grid track from the Doppler. The grid track is obtained by adding the drift supplied by the Doppler to the computed grid heading. Using the grid track and ground speed, integrated for the duration of the flight, the computer determines the distance gone vector by its N-S and E-W components. This is vector C in Fig 1-81.

The TAS from the ADC and the computed grid heading are fed to the PHI computer with the Doppler unlocked or on standby. From the grid heading and TAS, integrated for the duration of the flight, the computer determines the 'no wind distance gone' vector. This is vector 'A' in Fig 1-81. To this vector the computer adds a wind vector (vector 'B') obtained from wind speed and direction values set by the pilot, and also integrated for the duration of the flight. Addition of these vectors (A + B) gives vector C, the N-S and E-W components of which represent the DR point co-ordinates.

PHI Navigation Unit Operation Diagram

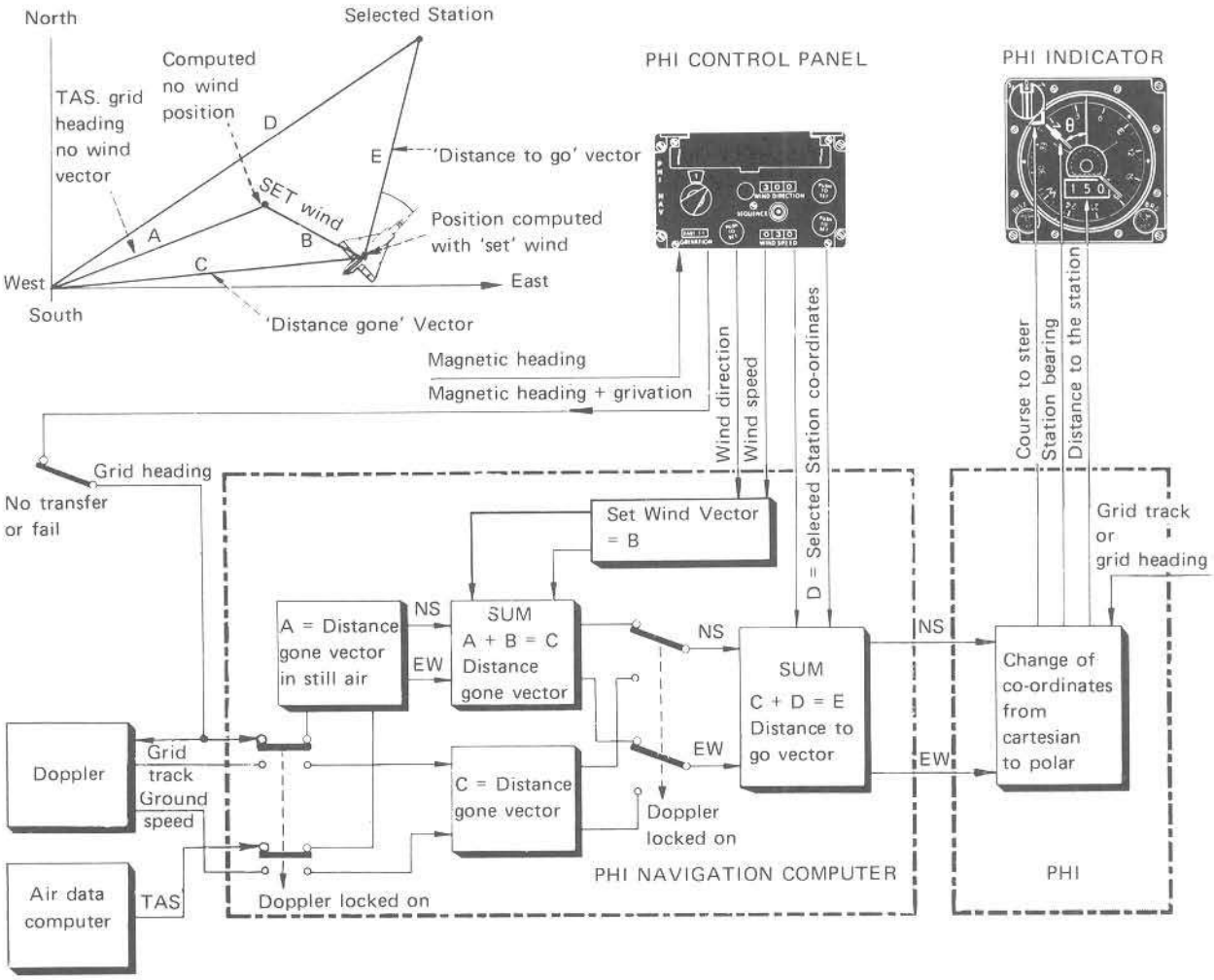


Figure 1-81

Computation of Heading and Distance To Go

The selected station co-ordinates are fed into the computer, and the amounts by which they differ from those of the DR point give the N-S and E-W components of the distance to go to the selected station.

Note

By definition, Station No 1 co-ordinates are zero and by choosing this station, the pilot can read the distance gone from the grid origin. The N-S and E-W distances are changed by the computer into polar co-ordinates for display on the indicator.

SET Mode

The dead reckoning (DR) navigation mode (when the Doppler is unlocked) introduces errors in determining actual position due to the difference between the set wind and the true wind. If a visual fix can be obtained or if TACAN information is available, the DR navigation errors can be corrected by making use of the SET mode.

When the PHI mode selector is on SET, the station selector is locked. The data for computation of the aircraft position is still supplied and stored in mechanical storage (storage capacity: 70 NM or seven minutes at 600 KTAS) and is fed to the normal computation circuit at the end of the resetting cycle.

ie when the SEQUENCE light extinguishes (seven seconds after DR is selected).

The resetting sequence entails a zero resetting of the wind integrator potentiometer slides. In navigation mode (Doppler on standby or unlocked), these potentiometers turn according to the elapsed time and they may reach their end position after 60 minutes. Before this period expires, the pilot must either reset his position or change the wind value. When the Doppler is receiving a useable return signal, the wind integration potentiometers are prevented from turning, and can only be freed if the Doppler breaks lock or the Doppler selector switch is set to STBY. The wind integration potentiometers are reset to zero by updating in SET or adjusting the W/V knobs.

The SEQUENCE light remains illuminated for seven seconds after the resetting sequence, that is :

a. When the distance value or the bearing value has been modified in the SET mode by means of the DIST or BRG knobs and DR is reselected.

b. When the wind speed or direction is modified in DR mode.

TCN Mode

When the PHI mode selector is in the TCN position, the indicator displays the following information :

a. the pointer indicates the bearing of the selected TACAN beacon, and

b. the counters indicate the distance to the selected beacon, and

c. the steering index (bug) indicates Cyrano antenna azimuth.

Note

A flat covers the counters when either distance or bearing information is not reliable.

ANT AZ Mode

When the PHI mode selector is on ANT AZ with 30° or spiral scan selected, the PHI steering index, which is actuated by the radar control stick, enables the Cyrano antenna to be positioned in azimuth. The counter continues to indicate TACAN distance to the station, and the bearing pointer shows the TACAN bearing of the station.

[D] The ANT AZ mode is inoperative and, if selected, the pointer freezes and the red flag covers the distance to go counters.

DISPLAY OF DATA

Data supplied to the PHI is displayed to the pilot in various ways (refer to Fig 1-79).

Lubber Line

The lubber line represents the aircraft axis and is used as a reference mark for heading and bearing readings.

Compass Card

The compass card rotates behind the lubber line, indicating :

a. gyro-magnetic heading when the gyro reference heading selector is on N (normal) or NOTR (no transfer). This is a repetition of the heading information given by the flux valve through the BOMB magnetic monitoring system and stabilized by the gyro centre;

b. random grid heading (supplied by the gyro centre), when the gyro reference heading selector is on DG (directional gyro); and

c. magnetic heading (supplied by the flux valve), when the gyro reference heading selector is on FAIL (gyro failure) or EMG (AC supply failure). For an AC failure the compass card servo motor is no longer supplied by the PHI computer, but by an emergency supply source located in the BOMB.

Bearing Pointer

The information given by the bearing pointer depends on the position of the PHI mode selector :

a. In DR mode, the pointer indicates the magnetic bearing of the selected station (one of the 11 preset stations or the origin); the angle between the pointer and the lubber line gives the relative bearing of the selected station. With the Doppler locked on, the pointer indicates the aircraft track.

b. In the SET mode, the pointer is mechanically controlled by the BRG resetting knob.

c. In the TCN mode, the pointer indicates the magnetic bearing of the selected TACAN beacon; the angle between the pointer and the lubber line gives the TACAN beacon relative bearing.

d. In the ANT AZ mode, the pointer indicates DR magnetic bearing to the selected PHI station.

[D] The ANT AZ mode is inoperative.

Scanning Limits

Two marks engraved on the PHI, 60° on each side of the axis lubber line, indicate the radar antenna maximum deflection. In 30° or spiral scan, if the bearing pointer is outside the scanning limits, the radar ceases to scan.

Steering Index

In the DR mode, the information supplied by the index, which is dependent upon the Doppler operating mode, is :

a. ***Doppler on Standby or Unlocked.*** The index and the pointer indicate the magnetic bearing of the selected station.

b. ***Doppler Receiving a Useable Return Signal.*** The angle between index and lubber line is the

track error and indicates that the aircraft must be turned to place the index under the lubber line to correct for drift. The angle between index and pointer represents the drift and the pointer represents the aircraft track.

In the set mode, the steering index is not used. It follows the pointer movement when the pointer is reset by the BRG setting knob and remains displaced from it at an angle corresponding to the drift. In TCN mode, the index supplies Cyrano radar antenna azimuth information and the pointer indicates the magnetic bearing of the TACAN beacon. In ANT AZ mode, the index supplies the same information as in the TCN mode but the pointer represents DR bearing to the selected PHI station.

[D] The steering index always gives the same information as the bearing pointer. When updating the PHI, it is preferable to adjust the bearing on the bearing pointer because the steering index is sluggish and normally lags behind the pointer.

Distance Counter

The distance counter gives :

a. ***In DR Mode.*** The horizontal distance in NM from the aircraft to the station selected on the PHI control panel.

b. ***In SET Mode.*** The distance manually adjusted with the DIST control knob.

c. ***In TCN and ANT AZ Modes.*** The slant distance from the aircraft to the TACAN beacon.

Red Warning Flag

The red warning flag operates only in TCN or ANT AZ mode. When it covers the range counter it indicates that TACAN information is not reliable (when the TACAN mode selector is on position T/R) or TACAN is operating in the discreet mode (TACAN mode selector on REC).

PHI RADAR PRESENTATION

The PHI radar presentation consists of the following in the air-to-ground mode :

a. ***Track Marker.*** The radar indicator, using information supplied by the PHI (DR or TCN depending on selection), displays magnetic track to the station. This is indicated in the form of a 1 cm long marker. When the range to the station is greater than the selected scale, it will be evident at the top of the radar presentation. The track marker always remains within ± 15° of the scope centreline. If magnetic track error to the station is greater than 15°, the track marker will not exceed the bearing limit.

b. ***Estimated Point Marker (EPM).*** When the station is within the selected scope scale, the target in-zone (ZONE) indicator illuminates, and the track marker is replaced by the Estimated Point Marker (EPM). The EPM consists of a strobe with a small right angle segment, with the corner representing the estimated point. It is not limited in bearing as is the track marker.

GROUND OPERATION

As the navigation computer is supplied through the manual load-shedding bus, it is automatically energized when the BATT switch is on. For ground operation :

a. Select the GYRO CENT switch to ON.

b. Insert the SSU into its receptacle. Press down until the SSU is locked.

c. Set the station selector to the station number where the aircraft is located.

d. Rotate PHI mode selector to SET.

e. Zero the distance counter with the DIST PRESS TO SET knob.

f. Rotate PHI mode selector to DR. The green SEQUENCE light illuminates for seven seconds. Do not touch any control during resetting.

g. When the SEQUENCE light extinguishes, set the wind direction and speed by means of the WIND-DIRECTION and WIND-SPEED knobs (the wind direction value is set in multiples of ten, the right hand drum being fixed at zero). The SEQUENCE light illuminates once more for seven seconds.

Note

The SEQUENCE light illuminates when either wind setting knob is depressed. The light goes out seven seconds after the last knob has been released.

h. Set the grivation with the GRIVATION control to zero EAST (there is no need to wait until the SEQUENCE light is off).

i. If desired, set the station selector on each of the 11 pre-set stations and check that the distance and bearings are correct. Bearings are given as true bearings.

j. Set the station selector to the required station.

k. Set the required grivation.

l. Set the Doppler selector switch to STBY.

IN FLIGHT OPERATION

Turning Points

The DR computations start as soon as the aircraft reaches 150 KIAS. The pilot heads towards his first turning point by :

a. bringing the steering index in line with the PHI lubber line (when the Doppler is receiving a useable return signal), or

b. flying a heading to maintain a constant station bearing, shown by the steering index and the pointer on the PHI compass card (Doppler on STBY or memory).

Change of Station

To change to another preset station :

a. Check that the SEQUENCE light is extinguished and the mode selector is at DR.

b. Set the station selector to the selected station. The station selector is locked during the resetting sequence when the SEQUENCE light is illuminated and when the mode selector is on SET. Distance, bearing and heading to fly to the station appear on the PHI.

c. Steer the aircraft to maintain the steering index on the lubber line.

Change of SSU in Flight

When the aircraft has to travel a distance greater than 1000 NM from grid origin, or when the number of stations to be used is higher than 12, or when an offset is not possible within 1200 NM of grid origin, the SSU will have to be changed in flight.

To obtain a reliable earth rotation correction, the second SSU must have an origin located on the same parallel and have the second grid partially covering the first grid (refer to Fig 1-80).

One station, located in the area covered by both grids, is preset on both SSU. This common station must have the same number on both SSU.

To change the SSU in flight, head towards the station common to both SSU and, when near this station :

a. rotate the PHI mode selector to SET,

b. press the SSU release button,

c. remove the SSU and insert the replacement unit,

d. press (without turning) the DIST or BRG PRESS TO SET knob to start the resetting sequence,

e. rotate the PHI mode selector to DR, and

f. wait until the SEQUENCE light extinguishes.

Note

If the DIST or BRG PRESS TO SET knob is not pressed before switching the PHI mode selector to DR, it will be necessary to replace the previous SSU and repeat the above procedure.

Display of TACAN Information

With the mode selector on TCN, the distance to the selected TACAN beacon and its magnetic bearing appear on the indicator. While the mode selector is on TACAN, the DR computations are carried out in the PHI but the results are not displayed or stored. When DR is selected, distance, bearing and heading to fly to the station (set in the PHI) are shown again on the indicator.

Visual Reset

A reset can be carried out when flying over a known landmark. Rotate the mode selector to SET. The distance travelled is then stored (the storage is reliable for 70 NM or seven minutes at 600 KTAS).

When the pilot knows the distance and bearing of the landmark in relation to the set station :

a. rotate the mode selector to SET,

b. set the distance from the known point to the station on the PHI (with the DIST PRESS TO SET knob),

c. set the station bearing (with the BRG PRESS TO SET knob), and

d. select DR; the SEQUENCE light illuminates for seven seconds.

Note

When the light extinguishes, the distance stored while the mode selector was on SET is fed back into the circuit. The data which has been manually set, is modified for the distance travelled while in SET and thus indicates the correct position of the selected station (the indicator reading may change suddenly when the SEQUENCE light extinguishes, depending on the relative bearing of the station).

If the resetting point corresponds to the selected station :

a. rotate the mode selector to SET,

b. press the DIST PRESS TO SET knob and set to zero, and

c. select DR : the SEQUENCE light illuminates for seven seconds.

Resetting Using TACAN Information

Resetting with reference to a TACAN beacon can be carried out, if the beacon is one of the 11 preset stations in the PHI storage unit or Station 1 :

a. make sure the SEQUENCE light is extinguished;

b. select the station corresponding to the TACAN beacon;

c. rotate the mode selector to TCN;

d. if necessary, wait for a steady reading;

e. note the TACAN information;

f. move the mode selector quickly to SET (passing over DR position has no effect). When SET is selected, the information concerning track and distance covered is stored;

g. set TACAN distance and bearing; and

h. reselect DR; the distance travelled while the selector was in the SET position now modifies the PHI data. The SEQUENCE light illuminates for seven seconds.

Resetting Wind Inputs in Flight

To reset wind inputs in flight, keep the mode selector

on DR, and set the new wind speed and direction. The SEQUENCE light illuminates immediately either wind setting knob is pressed and stays alight until seven seconds after the last knob is released. This allows the computations of the track corrections, carried out when the Doppler is on STBY or unlock, to recommence at zero with the new set wind.

Note

PHI computation is limited to 100 min in relation to the set wind. PHI indications or the wind must be updated during this time otherwise it will be necessary to reset the wind integrator.

Reset the wind integrator by depressing (without turning) one of the wind setting knobs, with the PHI mode selector on DR. The SEQUENCE light illuminates for seven seconds and the wind integrator runs for a further 100 minutes.

Display of the Radar Antenna Position

With the PHI mode selected to ANT AZ, the antenna position set by means of the radar control stick is repeated by the bearing pointer. Two marks 60° each side of the lubber line show the azimuth limits of antenna scan. The DR computations are carried out and TACAN bearing of the selected station (steering index) and TACAN distance to the station (counter) is displayed.

Note

The PHI enables much more accurate setting of the desired antenna azimuth than the radar scope. In contrast to the scope strobe which positions 40° right in relation to the radar lubber line when the antenna is out of limits, the PHI continues to give the angular travel required to return the antenna within the limits (± 60°).

NAVIGATION

Homing

Homing to the selected station is achieved by :

a. keeping the steering index on the lubber line of the PHI (when Doppler is receiving a useable return signal), or

b. steering a heading enabling the aircraft to maintain the desired track indicated by the PHI steering index and pointer (when Doppler is on STBY or memory mode).

Sight Head Indicators

With the weapon system selector set to NAV, the blue indicator light on the sight head is permanently illuminated, indicating normal operation. It can be extinguished by putting the sight head light selector on L or O. Flight attitudes and heading are displayed on the sight head as follows :

a. The angle between the moving reticule wings and the fixed cross horizontal bar represents the bank angle.

b. The elevation angle between the fixed cross and the moving reticule pipper represents variation in the aircraft pitch attitude and is reduced to one fifth of the display on the Bezu ball.

c. The distance between the fixed cross and the moving reticule pipper is the heading error (computed by the PHI system) towards the selected station.

d. The moving scale indicates in two degree increments the aircraft gyro-magnetic heading.

The pilot establishes the desired flight attitude by referring to the flight instrument panel. For example, to establish level flight or climb with a constant angle of incidence, he :

a. adjusts the moving reticule to coincide with the fixed cross by means of the sight depression rheostat, and

b. flies the aircraft keeping the pipper over the centre of the fixed cross and the moving reticule wings horizontal.

PHI COMPUTER FAILURE

If the pointer, index and distance counters give wrong indications or do not move and the compass card indicates the correct aircraft heading, ensure that the SSU is correctly inserted in the SSU housing. If the SSU is correctly inserted, rotate the PHI mode selector to TCN. If the red warning flag is visible when the TACAN is not operating, the PHI is unserviceable.

Effects on the Weapon System

Failure of the PHI computer causes the sight to give the wrong heading error information. The HDG ERR switch must be set to OFF.

GYRO REFERENCE SYSTEM

The primary function of the gyro reference system is to provide stabilized gyro-magnetic heading data for the PHI, Bezu ball and for the aircraft weapons and navigation system. The system also provides pitch and roll information for the Bezu ball, gunsight (sight orders), and radar and flight control (roll stab) systems. The gyro reference system receives power from the alternator bus and the main DC bus.

The gyro reference system (refer to Fig FO 1-35) includes the :

a. gyro centre switch,

b. twin gyro platform,

c. electronic unit,

d. Bezu output multiplier box,

e. magnetic flux valve,

f. Bezu ball,

g. gyro reference control panel, and

h. gyro failure warning light.

[D] The transfer light on the gyro reference control panel and GYRO fail light are not fitted.

GYRO CENTRE SWITCH

The GYRO CENT switch is located on the centre pedestal (refer to Fig FO 1-3). When the switch is set to ON the gyro reference system is energized. The twin gyro platform and the electronic unit combine to form the gyro centre.

[D] The GYRO CENT switch is located on the right panel.

TWIN GYRO PLATFORM

The TGP (refer to Fig 1-82) employs two horizontal (directional) gyros whose spin axes are maintained at 90° to each other (orthogonal). These gyros are mounted in four gimbals which, in ascending order, are :

a. gyro inner gimbal (two),

b. gyro vertical gimbal (two),

c. platform pitch gimbal (two), and

d. platform roll gimbal (one).

The gyro inner and vertical gimbal axes are called the sensing axes. The platform pitch gimbals are mechanically linked together and are servo driven. The platform roll gimbal encloses the structure within the case and is also servo driven. The four gimbal configuration ensures that the gyros maintain full freedom about their sensing axes. This results in a fully manoeuvreable platform.

The TGP employs a system which prevents the gyros erecting to false datums after pre-set threshold values of bank angle and/or rate of turn and longitudinal acceleration are exceeded. When these values are exceeded, the erection system is switched off. However, if the aircraft carries out prolonged manoeuvres below these threshold values, then the gyros will erect to a false datum at a rate of approximately 1°/minute. This results in incorrect pitch and/or roll information being transmitted by the TGP. This error is indicated by the Bezu ball when the aircraft is brought back to the straight and level attitude.

The TGP is mounted in the equipment bay and is fitted 3° 28′ nose down with respect to the aircraft's longitudinal axis. This positioning of the TGP establishes the aircraft's radar horizon when the aircraft is flying but results in the Bezu ball giving a nose down attitude indication when the aircraft is on the ground.

IIIO Twin Gyro Platform Diagram

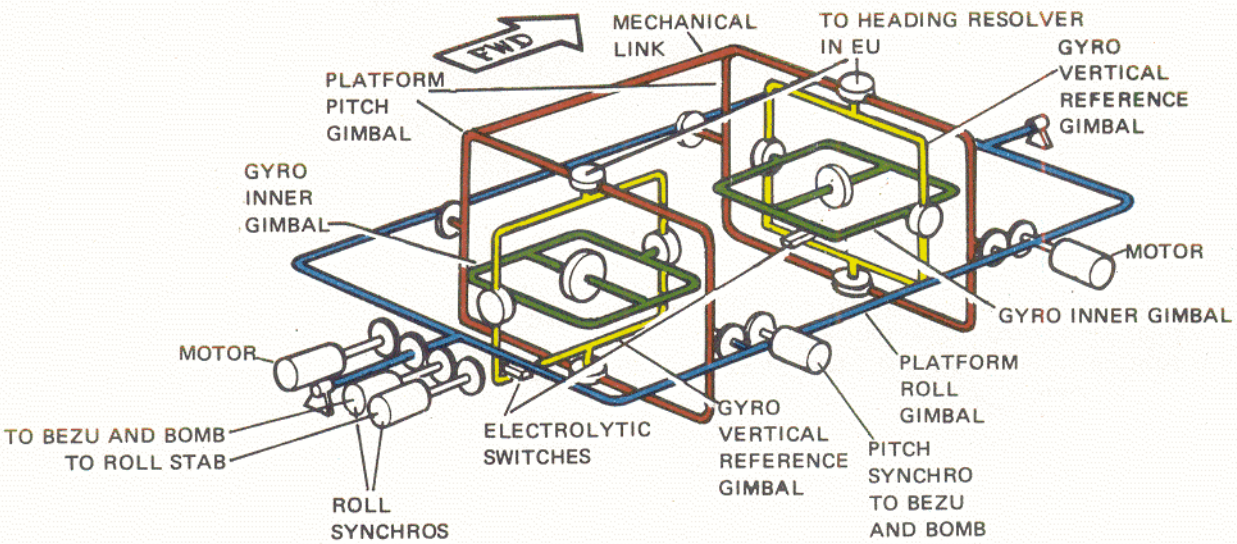


Figure 1-82

[D] TWIN GYRO PLATFORM

The twin gyro platform fitted to the IIID (refer to Fig 1-83) is different in design compared to the IIIO TGP, and consists of one electrically driven horizontal (directional) gyro and one electrically driven vertical (pitch and roll) gyro. These gyros are mounted in separate platform pitch gimbals which are mechanically linked together and servo driven. The platform roll gimbal which encloses the gyro assemblies is also servo driven. The gyro reference unit supplies pitch, roll and heading information.

There are two outputs of roll, two of pitch and one of gyro heading from the TGP. Roll synchro output goes to the Bezu ball and potentiometer output is relayed to the gunsight for roll display in NAV mode. Pitch information is supplied to the Bezu ball and gunsight in a similar manner. Gyro heading is by synchro detector output to the BOMB.

The TGP is mounted in the lower fuselage at the rear of the gun bay. It is mounted parallel to the longitudinal axis of the aircraft. This accounts for the 3° pitch attitude difference from the Mirage IIIO.

ELECTRONIC UNIT

The electronic unit (EU), is a control and monitoring unit for the TGP and is mounted in the equipment bay. Allowance for earth rate precession (ERP) is made by setting a latitude control on top of the EU to the PHI grid origin latitude (Station 1). This setting, which is updated for latitude change from Station 1 by the PHI computer, compensates for apparent drift (ERP). This ensures that the heading information is correct.

[D] The EU is located behind the right panel in the rear cockpit. It has fewer functions than the IIIO EU and does not compensate for ERP. This is done by the BOMB.

BEZU OUTPUT MULTIPLIER BOX

The BOMB is situated in the equipment bay. It has three main functions :

a. to supply gyro-magnetic heading, which is the directional heading fed by the TGP and monitored by the flux valve;

b. to repeat and distribute heading, roll and pitch data to various equipments; and

c. to supply, in case of alternator failure, the necessary power to repeat flux valve headings on the compass card of the PHI when EMG is selected (refer to Fig FO 1-34).

[D] The BOMB has the same functions except it has no roll and pitch output and has the additional function of introducing a correction for ERP on the gyro centre directional heading by setting the ***mean*** flight latitude between Station 1 and the destination.

Pitch and Roll Information

Pitch and roll information detected by the TGP, is transmitted by the BOMB to the following equipment :

a. Bezu ball.

b. Optical sight - signals for the heads up display.

c. Radar - stabilization information.

d. Radar nav computer - aircraft attitude signals for generation of sight orders in the radar nav computer. Pitch information from the BOMB is compared with altitude inputs from the air data computer to represent the formula ALT (1-COSP) which illuminates the red sequence light when pitch limits are exceeded (refer Radar Operation Sequence Lights). The red sequence light is also illuminated (when the roll limit of 80° is exceeded) by a signal supplied directly from the BOMB.

e. Roll stabilization (Roll stab) - roll information only.

[D] Pitch and roll information is fed directly from the TGP to the Bezu ball, and to the gunsight in NAV only.

Heading Information

Heading information detected by the gyro reference system is distributed from the BOMB to various equipment in the weapons navigation system (refer to Fig FO 1-35).

Gyro magnetic heading is supplied to the following equipment in the weapons navigation system :

a. Bezu ball.

b. Cyrano radar.

c. PHI.

d. TACAN.

e. Optical sight (heads up display).

f. PHI control panel.

g. Directional stabilizer (roll stab).

Grivation is added to the gyro magnetic heading in the PHI control panel. The result is grid heading which is used in the :

a. PHI computer (if Doppler is inoperative), and

b. Doppler control unit.

If Doppler is operating, the grid heading is modified by Doppler drift. This results in grid track being fed into the PHI computer from the Doppler control unit.

[D] The Cyrano radar, roll stab and Doppler are not fitted.

MAGNETIC FLUX VALVE

The pendulum type magnetic flux valve is located above the base of the fin. It supplies magnetic heading to the BOMB. The flux valve can rotate freely within its container up to the limits of ± 12° in pitch and ± 5° in roll. Beyond these limits the valve will stick until flight is resumed within the limits.

IIID Twin Gyro Platform Diagram

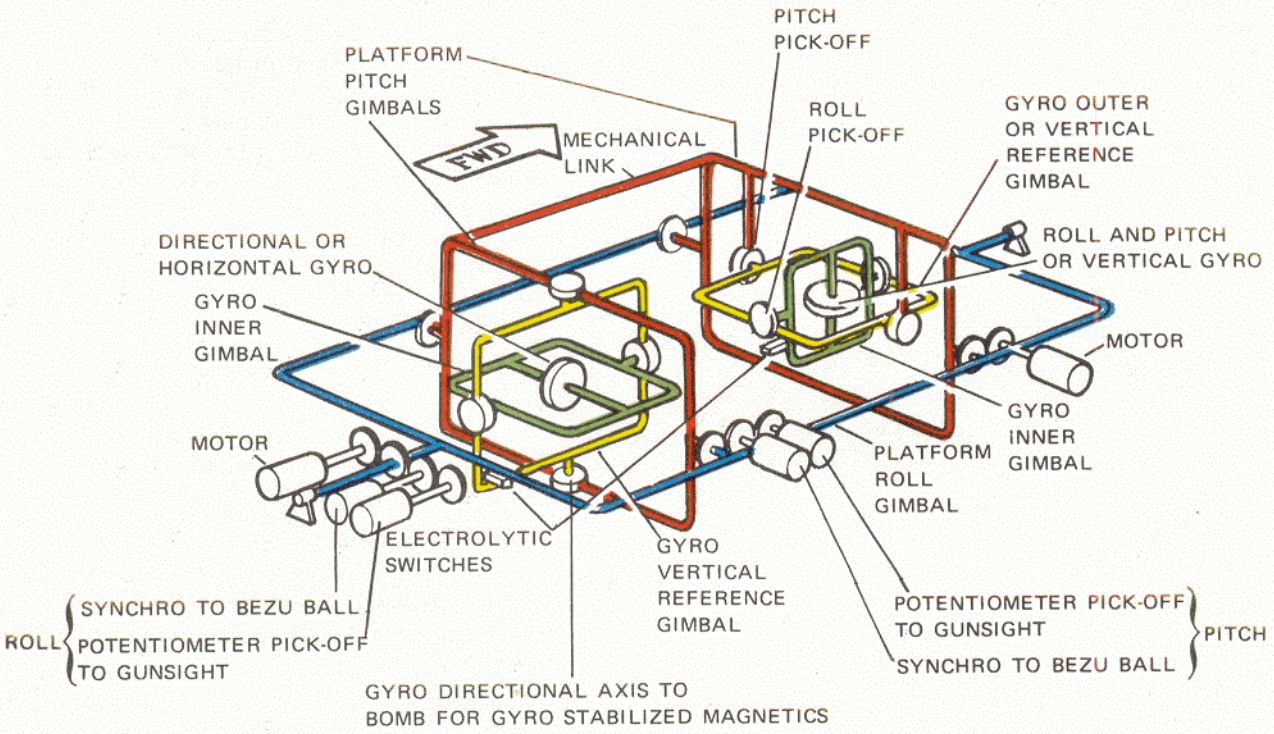


Figure 1-83

BEZU BALL

The Bezu ball (refer to Fig 1-84) is a fully manoeuvreable flight attitude indicator presented in the form of a sphere. It repeats heading, roll and pitch information from the gyro centre. The sphere is divided into two hemispheres. The upper hemisphere, which is blue-grey, represents the sky. It is marked with small crosses. The lower hemisphere, which is black, represents the earth. It is marked with small dashes. Both hemispheres are engraved with meridians and parallels at 10° intervals. Heading indications on the equator are graduated in 5° intervals. The bank angle is indicated by a roll index, which is read against a scale graduated in 10° intervals on the lower face of the indicator. A fixed miniature aircraft silhouette is located in the centre of the instrument face, and a ball skid indicator is fitted to the base.

The Bezu ball consists of three servo loops, one each for heading, pitch and roll. The heading servo motor, associated gear train and synchro are mounted inside the sphere on a circular plate which acts as the equator. Thus, for a heading change, the sphere is driven around the equator. The pitch servo drives the complete sphere around its horizontal axis. The roll servo drives the complete assembly which carries the roll index.

WARNING

The Bezu ball is a repeater of the gyro centre. As it employs servos internally, it may fail without any warning.

Bezu Ball Set Knob

The setting knob on the front of the Bezu ball may be pulled out and rotated to change the heading information on the Bezu ball. The effect of changing the information is only apparent when the heading selector is in the DG position. Therefore, the Bezu ball setting knob should only be operated when the heading selector is on DG. Prior to take-off, select DG and by means of the setting knob, make the heading on the Bezu ball read the same as the magnetic heading of the aircraft. If the magnetic system fails, the inertial stability of the TGP can then be used as a directional gyro.

[D] The rear cockpit Bezu ball is a direct repeater of the front indicator and the set knob is inoperative.

Bezu Ball Attitude Indicator

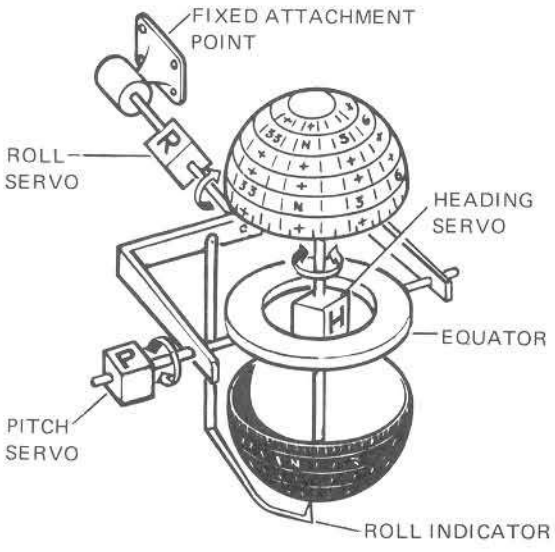


Figure 1-84

Bezu Ball Cover

A Bezu ball cover is provided to eliminate the distraction caused by a frozen or incorrectly indicating Bezu ball. The cover is retained in position by a 'Velcro' stick-on strip. When the cover is not in use, it is stored on the outer wall of the left rudder pedal well near the pilot's left knee.

GYRO REFERENCE CONTROL PANEL

The gyro reference control panel (GYRO C) (refer to Fig 1-85) is located on the right console and has the following controls and indicators :

a. TRANSF button,

b. FAST EREC button,

c. transfer light, and

d. gyro reference heading selector.

[D] The control panel is in the front cockpit only and has no transfer light.

TRANSF Button

The TRANSF button permits rapid resetting of the gyro-magnetic heading to the magnetic heading given by the flux valve.

[D] On the ground the TRANSF button should have no effect as the normal 10 second run up cycle should align the heading to gyro-magnetic.

FAST EREC Button

When the FAST EREC button is operated, the twin gyro platform (TGP) is precessed to the horizontal position at a rate faster than normal (15° - 20° per minute) by increasing the voltage to the levelling switches. The aircraft must be in straight and level unaccelerated flight before the FAST EREC button is pressed. The button should not be held down for longer than 3 minutes because of possible overheating of the levelling switches.

[D] The FAST EREC button is inoperative.

Gyro Reference Control Panel

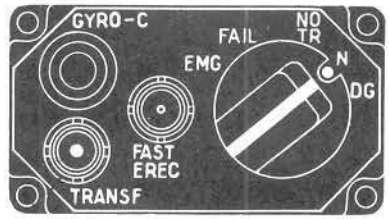


Figure 1-85

CAUTION

To avoid damaging the TGP, do not press the FAST EREC button for longer than 3 minutes.

Transfer Light

The transfer light is inoperative.

Gyro Reference Heading Selector

The gyro reference heading selector (refer to Fig 1-85) has five positions :

a. ***No Transfer (NO TR).*** NO TR is generally used because a transfer gyro is not available. Gyro-magnetic heading is fed to the Bezu ball, PHI, TACAN, radar, gunsight and PHI control panel. Gyro-magnetic heading is modified in the PHI control panel by the GRIVATION PUSH TO SET knob to provide a grid heading which is fed to the PHI computer.

[D] See the function for the N position.

b. ***Gyro Fail (FAIL).*** The FAIL position is selected when the gyro centre fails (GYRO light on) or is suspect. The Bezu ball is isolated in this position and should be covered with the black cover provided. Power is disconnected from the gyro centre and unstabilized magnetic heading is fed to the PHI, TACAN, radar, gunsight and PHI control panel. The magnetic heading is modified in the PHI control panel by the grivation to ob-

tain a grid heading which is fed to the PHI computer.

[D] The GYRO fail light is not fitted.

c. ***Emergency (EMG).*** EMG is selected when the alternator fails or when the manual LOADSHED switch has been selected ON after a generator and transformer rectifier failure. In both cases, DC power is supplied from the main DC bus through the GYRO CENT switch and the COMPASS CB to the BOMB emergency power supply which provides sufficient AC power for unstabilized magnetic heading to be displayed on the PHI compass card. The gyro centre is not supplied with power and no other equipment is supplied with magnetic heading. The Bezu ball is unreliable and should be covered.

[D] The front cockpit PHI only receives AC power. The Bezu ball is unreliable and should be covered. If EMG is selected when the AC system is serviceable, a harmful beat frequency oscillation is set up which causes violent Bezu ball oscillations and subsequent damage.

CAUTION

[D] Do not select EMG unless an AC failure exists.

d. ***Directional Gyro (DG).*** DG is selected when the magnetic information is suspect. With DG selected, the PHI compass card displays the random TGP grid heading and false information is fed to the PHI computer. The TGP grid heading fed to the Bezu ball can be modified by the Bezu ball set knob. This knob allows the pilot to set any desired reference heading on the Bezu ball, eg magnetic. Gyro-magnetic heading is fed to TACAN, gunsight and radar.

Note

The Bezu ball set knob should not be moved while the heading selector is in any position other than DG. Moving the set knob repositions the Bezu reference heading but the change cannot be observed on the Bezu ball.

[D] In DG, the PHI receives gyro-magnetic heading while the Bezu ball receives TGP heading. This heading is a random TGP grid heading. The Bezu ball set knob enables the pilot to set any desired reference on the Bezu ball, eg magnetic. Gyro-magnetic heading is fed to the TACAN and gunsight.

Note

[D] The rear cockpit Bezu ball is a direct repeater of the front indicator and the set knob is inoperative.

e. ***Normal (N).*** The N position is designed to be used with grid heading available from a transfer gyro. Since transfer gyros have been withdrawn from service, this position should not be used, as incorrect information will be fed to the PHI computer. Gyro-magnetic heading is fed to the Bezu ball, PHI, TACAN, radar, and gunsight.

[D] The N and the NO TR positions have the same functions, as the Mirage IIID has no provision for a transfer gyro to be used. Gyro-magnetic heading is fed to the Bezu ball, PHI, TACAN, gunsight and PHI control panel. Grivation must be set into the control panel to supply a grid heading to the PHI computer.

These functions of the gyro reference heading selector are summarized below :

Selector Setting	Equipment			
	Bezu Ball	PHI	Gun-sight	PHI Com-puter
NO TR	GM	GM	GM	GM + grivation
FAIL	Inoperative	M	M	M + grivation
EMG	Inoperative	M	Inop-erative	Inop-erative
DG	Random TGP referenced by pilot setting (usually ACFT magnetic HDG)	Random TGP (unusable) D GM	GM	Random TGP (false informa-tion) D GM + grivation
N	GM	GM	GM	Random TGP (false informa-tion) D GM + grivation

GM – Gyro Stabilized Magnetic Heading
M – Magnetic Heading (Not stabilized)
Random TGP – Random TGP because no transfer gyro used (unaligned grid)

GYRO FAILURE WARNING LIGHT

The GYRO failure warning light (refer to Fig FO 1-3) is located on the left side of the instrument panel. The light illuminates if the 200 V supply to the electronic unit fails or if there is no internal power supply to the gyro centre when the GYRO CENT switch is ON. The light only illuminates if the heading selector is on the NO TR, N or DG positions.

Note

When the GYRO failure light is pressed, it illuminates at high intensity regardless of the position of the DAY/NIGHT switch. However, the light intensity for an actual GYRO failure is determined by the position of the DAY/NIGHT switch.

[D] The GYRO failure warning light is not fitted.

ENERGIZING THE GYRO REFERENCE SYSTEM

The gyro reference system is energized by selecting the GYRO CENT switch ON. The system becomes operational after an initial erection cycle of three minutes. Before selecting the GYRO CENT switch ON the following precautions must be observed :

a. Ensure that AC and DC power are connected. Select the PHI mode selector to DR, press in and turn the PHI DIST PRESS TO SET knob, then release. If the range drum returns to its former reading, the aircraft is being supplied with three phase AC power.

b. Ensure that the heading selector is not on FAIL or EMG as power cannot be applied to the gyro centre in these positions. Normally NO TR will be selected. To energize the gyro reference system, select the GYRO CENT switch ON and start the clock. During the initial erection cycle, the aircraft must remain stationary and the power supply to the gyro centre must not be interrupted.

Three Minute Erection Cycle

During the three minute initial erection cycle, two basic operations are performed. These are :

a. ***Case Slaving.*** The platform gimbals are driven to their 0° pitch and roll position and held there for 110 seconds. This places the gyro vertical reference gimbals within the functional range of the electrolytic switches.

b. ***Orthogonality.*** The gyro spin axes are precessed until they are perpendicular to one another in the horizontal plane.

The sequence of events during the programmed three minute erection cycle (refer to Fig 1-86) is :

a. ***0-30 Seconds.*** When power is supplied to the gyro centre, the platform pitch and roll gimbals are driven to their 0° pitch and roll position with

Three Minute Erection Cycle

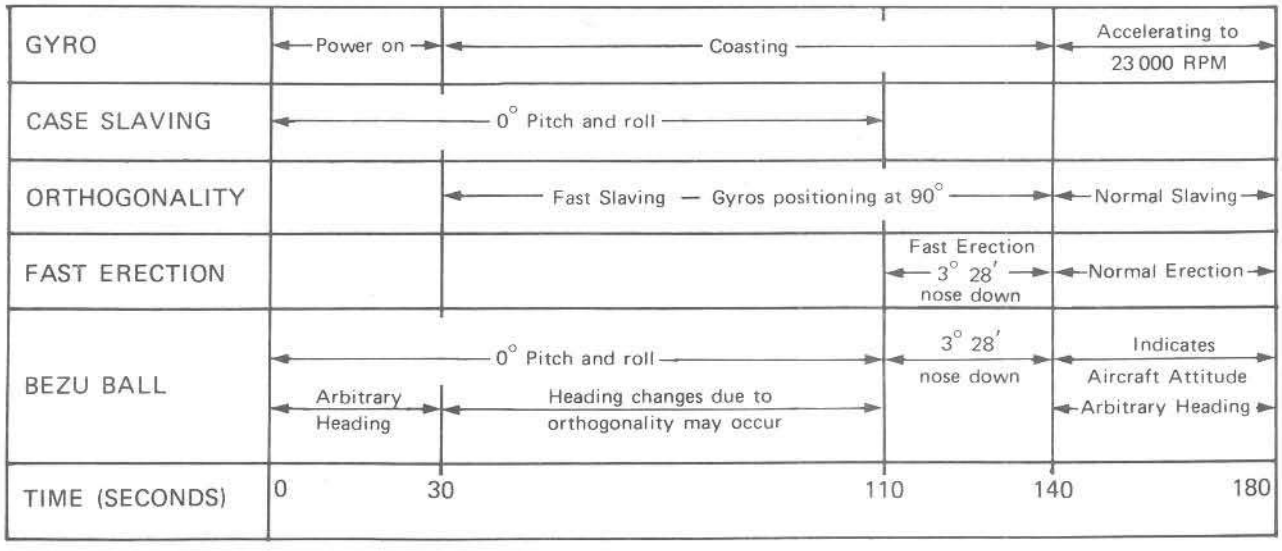


Figure 1-86

respect to the case and held there for the first 110 seconds of the cycle. This is known as case slaving. During the first 30 seconds, the two gyros are accelerated to a speed sufficient to give them some rigidity but not enough to resist precession.

b. ***30-140 Seconds.*** The gyro power is turned off and the gyros coast while orthogonality slaving is carried out, ie the gyros are precessed (through the resolvers on each gyro axis) until they are aligned at 90° to each other in the horizontal plane. When displaced at 90°, a null exists and this is automatically maintained.

c. ***110-140 Seconds.*** At 110 seconds the case slaving is released and the gyros are then free to be erected. From 110 to 140 seconds the gyros are erected with reference to the electrolytic switches and hence their reference to the earth's horizon, and the Bezu ball indicates the aircraft's attitude, ie 3° 28′ nose down.

d. ***140-180 Seconds.*** The gyros are now supplied with power and accelerate to their operating RPM (23 000 RPM).

CAUTION

- If the Bezu ball moves violently through large displacements of pitch, roll or heading during any portion of the erection cycle, the GYRO CENT switch must be turned OFF immediately because a malfunction is indicated and damage to the TGP could occur.
- On the ground, the GYRO CENT switch should always be switched OFF before either external power is removed or the engine is shut down because of possible damage to the TGP.

Note

- If large pitch or roll errors on the Bezu ball are evident on completion of the erection cycle and all other equipment appears normal, it can be assumed that either the TGP or the Bezu ball is unserviceable and an investigation into the cause is required.
- If small errors are evident and the display is stabilized, the TGP may have completed its initial erection cycle before the gyros were fully erected to the vertical.

Indications on the Bezu Ball

During the erection cycle, the Bezu ball indications are as follows :

a. ***0-30 Seconds.*** When first switched on, the Bezu ball comes to the 0° pitch and roll attitude and moves to a random heading where it oscillates rapidly ± 5° either side of the heading. This oscillation gradually diminishes in amplitude over about 15 seconds and then stabilizes on an arbitrary heading.

b. ***0-110 Seconds.*** The ball shows zero pitch and roll.

c. ***30-140 Seconds.*** The heading shown on the ball may move slowly while the gyros are being positioned (orthogonality).

d. ***110-140 Seconds.*** The ball moves to indicate aircraft attitude, with respect to the earth's horizon, ie 3° 28′ nose down.

With the heading selector set to DG, slight high frequency heading oscillations, which appear as a blurring of the markings, may occur on the BEZU ball. This is due to an incompatibility between the BEZU ball and the aircraft heading system and, provided the amplitude of heading oscillations is less than ± 2°, the BEZU ball is to be accepted as serviceable.

Re-erection Cycle

If the GYRO CENT switch is selected OFF after the initial erection cycle has been completed and the aircraft is moved, it should not be selected ON again for about three minutes, if a full erection cycle is required. This is because :

a. from 0 to 105 seconds after being switched OFF, the initial erection cycle will not recycle;

b. from 105 to 140 seconds, the system may or may not recycle; and

c. after 140 seconds, the initial erection cycle will recycle.

If an alternator failure occurs while airborne and takes longer than 105 seconds to reset, the TGP will probably go through the full erection cycle again and case slaving will lock the platform pitch and roll gimbals to the 0° pitch and roll position. This will be evidenced by the Bezu ball freezing in pitch and roll.

On the ground, the GYRO CENT switch can be reselected ON between 0 and 10 minutes after switching OFF and moving the aircraft, provided the initial erection cycle was complete before switching OFF. After 10 minutes from switching OFF, the GYRO CENT switch must not be turned ON again, or the aircraft moved, for a further 20 minutes, making a total elapsed time from switch OFF of 30 minutes. This will allow the gyros to completely run down.

[D] Ten Second Erection Cycle

As soon as the GYRO CENT switch is set to ON, the platform immediately becomes stabilized to the zero reference of the roll and pitch synchros, while the vertical gyro is mechanically caged. The duration of this initial erection cycle is 10 seconds. On completion of the erection cycle, the vertical gyro is precessed to the gravitational vertical axis by two electrolytic switches at a rate of approximately 1°

per minute. The electrolytic switches sense any change greater than 8 minutes from the vertical axis and apply necessary correction torques to the gyro rotor.

The directional gyro runs up to speed during the erection cycle and is erected to the platform horizontal by air currents generated by the gyro. Heading changes may be seen on the Bezu ball and PHI during the cycle. These changes are normal as the BOMB has within it a thermal relay which is energised for 20 seconds after the GYRO CENT switch is selected ON; during this time, the magnetic heading of the aircraft is monitored at a follow up rate of 35° per second.

Note

Observation of the Bezu ball during the initial erection cycle can readily determine whether the system is operating in a correct manner. Any malfunctions will be transmitted through the servo system of the Bezu ball.

MAGNETIC ALIGNMENT

When the gyro centre has completed its erection cycle, the heading synchros must be aligned to the aircraft's magnetic flux valve. After the initial erection cycle is complete :

a. Select the heading selector to NO TR.

b. Press the TRANSF button. The PHI card and the Bezu ball headings are driven around until they indicate the aircraft's magnetic heading. Hold the TRANSF button down for 5 seconds after the readouts stabilize to ensure that the alignment is complete.

   [D] Press the TRANSF button. The PHI card and Bezu ball headings should remain stationary and coincide with the aircraft's magnetic heading.

c. Select N. There should be no change in the heading readouts.

d. Select DG. The PHI card moves to a random heading (TGP).

   [D] The PHI card remains stationary. Use the Bezu ball set knob to align the Bezu ball with the aircraft heading. Check that there is no movement of the Bezu ball when reselecting N.

Note

With DG selected, slight high frequency heading oscillations, which appear as a blurring of the markings, may occur on the Bezu ball. This is due to an incompatibility between the Bezu ball and the aircraft heading system and, provided the amplitude of heading oscillations is less then ± 2°, the Bezu ball is to be accepted as serviceable.

e. Check FAIL and EMG. The Bezu ball is frozen and the PHI indicator shows unstabilized magnetic heading.

   [D] Check FAIL. The Bezu ball and PHI indicator show unstabilized magnetic heading.

f. Operate in NO TR.

   [D] After the gyro centre has been switched on it is only necessary to wait 10 seconds.

CAUTION

[D] Do not select EMG unless an actual failure exists. If EMG is selected with a serviceable AC system, a harmful beat frequency oscillation is set up which causes violent Bezu oscillation and consequent damage to the servo gear trains.

Note

- Heading readouts are correct in N, but the PHI computer receives false information.
- A magnetic alignment, carried out in the proximity of hangars or ground power units, may be inaccurate. Therefore, check the magnetic heading after line up on the runway and, if necessary, carry out another magnetic alignment by pressing the TRANSF button.
- The heading selector must not stay on the FAIL or EMG positions for more than 2 minutes because in this position the gyro centre is not energized and a full erection cycle will occur on re-introduction of power.

NORMAL OPERATION

The BOMB receives magnetic heading from the flux valve (refer to Fig FO 1-35), and a gyro stabilized randon heading from the gyro centre, and produces the gyro-magnetic heading which is initially aligned by a heading transfer before flight. This alignment can also be performed in stabilized level flight.

The magnetic monitoring of the gyro-magnetic heading is a slow servo-control device (about 0.7° per minute) which cancels the error between gyro-magnetic and magnetic heading. Thus the gyro-magnetic heading follows accurately and instantaneously any variations in the aircraft's heading, but the equilibrium position is always related to the magnetic heading given by the flux valve. Grivation is applied to the gyromagnetic heading by the setting in the PHI control panel to give grid heading to the PHI computer. The system is then normally operated with the heading selector on NO TR.

[D] The slow servo control operates at about 0.8°/min.

Taxiing

While taxiing, check that all aircraft movements are

repeated by the Bezu ball, ie in pitch when braking and in heading during turns. Switch the weapon system selector to NAV and check that the sight heading scale repeats gyro-magnetic heading, and that the moving reticule follows the Bezu ball in roll and pitch. At the end of the runway check the aircraft heading against the runway heading and, if necessary, transfer to correct the heading.

In Flight

In flight, doubts may arise about the displayed heading after an aircraft manoeuvre (heading selector on NO TR), eg if the heading is different from the heading indicated by the stand-by compass. Press the TRANSF button when the aircraft is in level unaccelerated flight. Wait until the heading display on the Bezu ball stabilizes before releasing the button.

If the flying aids are being used, disengage the aids before pressing the TRANSF button. If the TRANSF button is pressed with the flying aids engaged, the aids may disengage and, if an out-of-trim condition exists, the aircraft will diverge from its flight path. The effect is particularly critical during a radar navigation mission when 286 gal tanks are fitted.

CAUTION

Do not press the TRANSF button with the flying aids engaged.

After sustained aerobatic manoeuvres or continuous turns in one direction, eg application weapon deliveries, the Bezu ball will indicate pitch and roll errors. To re-erect the TGP, adopt a straight and level unaccelerated attitude and press the FAST EREC button. Do not hold the FAST EREC button down for longer than three minutes.

[D] After sustained aerobatic manoeuvres or sustained hard turns in one direction, the Bezu ball may indicate false pitch, roll and heading information. Return to straight and level unaccelerated flight, select the GYRO CENT switch OFF for one minute to allow recycling of the initial erection program, then switch it ON again. After a further 10 seconds the Bezu ball should indicate correct information. The FAST EREC button is inoperative.

GYRO REFERENCE SYSTEM FAILURES

If the Bezu ball does not follow aircraft manoeuvres while taxiing, abort the mission.

Gyro Centre or Bezu Ball Failures

If the pilot suspects the operation of the gyro centre or the Bezu ball :

a. Bring the aircraft to straight and level unaccelerated flight with reference to the stand-by A/H.

b. Press the FAST EREC button for several seconds; the Bezu ball should be seen to oscillate slightly when the TGP is erect.

   [D] The FAST EREC button is inoperative.

c. If the system is still suspect, rotate the weapons system selector to NAV and compare the heading indications given by the Bezu ball with indications given by the sight, the PHI and the stand-by compass. Check pitch and roll against the stand-by A/H and the sight.

   [D] Rotate the weapons system selector to NAV and compare the indications given by the Bezu ball with indications given by the stand-by A/H, the sight and the PHI.

If the sight and the PHI agree with the stand-by compass, the Bezu ball is defective in heading. Mask the Bezu ball and fly with reference to the stand-by A/H and the PHI.

If the attitude display on the sight head agrees with the stand-by A/H but not with the Bezu ball, mask the Bezu ball and fly with reference to the stand-by A/H.

Compare the PHI heading with the stand-by compass. If the heading is erroneous put the heading selector on FAIL and fly with reference to the stand-by A/H and the non-stabilized magnetic heading displayed by the PHI.

The Bezu ball can fail internally, without warning, in either pitch, roll or heading, or any combination of the three. The most dangerous failure, because it is difficult to detect, is a pitch and roll reference failure before take-off on a night mission.

WARNING

The Bezu ball can fail internally without warning. The stand-by A/H should therefore be monitored at all times.

If the Bezu ball topples, tumbles or oscillates or the GYRO fail light illuminates, select FAIL and refer to the stand-by A/H. Unstabilized magnetic heading will be displayed on the PHI. The Bezu ball should be covered.

Power Supply Failures

The GYRO light illuminates for either an internal power failure to the TGP or the EU. It also illuminates for an alternator or combined generator and transformer-rectifier failure.

Note

Rotating the heading selector to FAIL or EMG or selecting the LOADSHED switch to ON isolates power from the TGP, EU and the GYRO light.

If the GYRO light illuminates and no other failure is indicated :

a. set the heading selector to FAIL, leaving the GYRO CENT switch ON; and

b. note that navigation computations and display of navigation and TACAN data remain correct. However, this position puts the Bezu ball out of circuit and magnetic monitoring is only available within ± 12° of pitch and ± 5° of roll.

In the event of an alternator failure or generator and transformer-rectifier failure :

a. set the heading selector on EMG, leaving the GYRO CENT switch ON;

b. fly using the standby A/H and the magnetic heading displayed on the PHI; and

c. cover the Bezu ball.

Note

- No navigation information is available.
- If the power supply failure lasts for more than 10 minutes or if the manual LOADSHED switch has been ON for more than 10 minutes, the GYRO CENT switch is not to be selected ON again until 30 minutes has elapsed.
- [D] The PHI computer receives grid heading (magnetic plus grivation) in all modes except EMG.

If the COMP CB pops out or is not engaged and the heading selector is set to :

a. NO TR, FAIL, DG or N, the PHI is not supplied with 28 VDC and the compass card no longer operates. This is the only item affected; the PHI operates normally and the pointer gives relative bearing. The Bezu ball operates normally except for FAIL; or

b. EMG, the emergency power supply in the BOMB is no longer supplied with 28 VDC; the emergency heading function then becomes inoperative.

Reset the COMP CB to restore normal operation of these units.

TACAN (AFN-126)

The AFN-126 TACAN is an airborne interrogator-receiver designed to operate in conjunction with a surface beacon to provide accurate range and bearing information from that surface beacon. It operates in the UHF frequency band and is therefore limited to line of sight distances, the practical upper limit being about 200 NM. Bearing becomes inaccurate in the cone of confusion directly over the beacon. To enable the selected beacon to be identified, an assigned three letter morse-code group is transmitted by the beacon every 37.5 seconds. The AFN-126 equipment has 126 channels available.

TRANSMITTER-RECEIVER

The transmitter-receiver unit houses the transmitter, receiver, range and bearing circuit, beacon identification circuits and a self test module. It is located at the right rear of the aircraft equipment bay.

[D] The TX/RX is located in the nose cone.

ANTENNA INSTALLATION

Two antennae are installed; one on top and one under the fuselage. The two antennae are provided so that a reliable signal can be received when one antenna is shielded from the beacon by the airframe. If the signal at one antenna becomes unreliable, the automatic antenna selector, located at the left rear of the equipment bay, causes the antenna switching relay, positioned at the bottom of the fuselage behind the gun bay recess, to connect the other antenna. If this antenna provides a reliable signal it remains connected; however, if the signals at both antennae are unreliable, the antennae are alternately connected until one provides a steady signal.

[D] The automatic antenna selector is located in the nose cone.

CONTROL PANEL

The control panel (refer to Fig 1-87) is situated on the forward right console and has the controls and functions described in the following paragraphs.

Master Switch

The master switch incorporates a volume control and has five positions :

a. ***OFF.*** No power to the set.

b. ***STBY.*** Activates a timer which applies high tension voltage after 90 seconds.

c. ***REC.*** Only the receive and bearing circuits are energized thus preventing interrogation signals being answered.

d. ***T/R SHORT.*** Both range and bearing information available. Limits range to 75 NM.

e. ***T/R NOR.*** For normal operation.

TACAN Control Panel

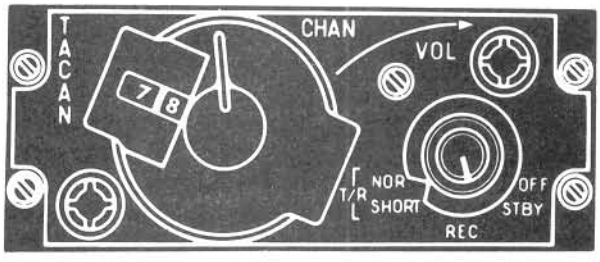


Figure 1-87

f. ***VOLUME.*** To control volume of beacon identification. This may be heard when the communications selector is on Green Dot N, Red Dot N, Red/Green Dot N or EMG TAC.

Note

The 90 second timer protects the set from the application of high tension voltage before warm-up and the master switch may be selected from OFF to any other position as required.

Channel Selector

The channel selector has dual concentric knobs which allow selection of 126 stations.

DISPLAY OF INFORMATION

The information from the TACAN system is displayed on the PHI. When TCN is selected by the PHI mode selector :

a. the bearing pointer and steering bug indicate the bearing to the selected beacon,

b. the range counter indicates the slant range in nautical miles to the selected beacon, and

c. the red warning flag covers the distance counter when :

(1) TACAN is OFF,

(2) TACAN is in REC mode,

(3) range circuit is not locked onto a reliable signal, or

(4) the range circuit has failed.

When ANT AZ is selected on the PHI mode selector :

a. the steering bug indicates the bearing to the selected TACAN station, and

b. the range counter indicates the slant range to the selected TACAN station.

[D] The ANT AZ position has no effect. With ANT AZ selected, TACAN information is lost and the red warning flag covers the range counter.

Note

[D] The rear cockpit PHI indicator is a direct repeater of the front cockpit PHI indicator. Therefore, the information displayed by the rear indicator is related to the mode selected by the front pilot. Normally the rear indicator mode selector is left in the DR mode.

ACCURACY

The accuracy of the TACAN/PHI system is :

a. Range

TACAN	0.1 NM ± 0.2% range
PHI	1.0 NM ± 0.5% range
TOTAL	1.1 NM ± 0.7% range

b. Bearing

TACAN	2°
PHI	1°
TOTAL	3°

When using TACAN, cross check for false lock-on with other available means. If a false lock-on is suspected, switch to another channel, check it for correct bearing and then switch back to the desired channel. If a false lock-on persists, utilize other aids available.

WARNING

The TACAN system is subject to false lock-on which results in erroneous bearing indications. Due to an inherent characteristic of the system, the error occurs in multiples of 40°.

CAUTION

To prevent TACAN overheat damage, operation without equipment bay cooling must be restricted to five minutes.

[D] To prevent TACAN overheat damage, operation without nose cone cooling must be restricted to five minutes.

IFF/SIF

The IFF/SIF equipment installed in the Mirage is the APX-64 or the APX-46. Only the APX-64 is described here; the APX-46 being similar. Where switches are duplicated, they have the same function.

This equipment provides automatic selective identification of the aircraft in which it is installed, when properly challenged by surface or airborne radar sets. It can also provide momentary identification of position upon request and transmit a specially coded response to indicate an emergency. In operation, the radar identification system receives coded interrogation signals and transmits coded response signals to the source of the challenge. Three modes of operation are provided for response to interrogation signals. These are Mode 1 for security identification, Mode 2 for aircraft identification and Mode 3 for traffic identification. Power for the equipment is supplied by the alternator bus bar.

The IFF/SIF equipment consists of :

a. a transponder in the equipment bay,

b. a flush mounted antenna in the nose wheel flipper door, and

c. a control panel located at the rear of the right console.

[D] The transponder is in the nose cone.

CONTROL PANEL

The controls on the control panel (refer to Fig 1-88) each have a specific function and can be used individually or in conjunction with the other controls. The controls are detailed in the following paragraphs.

IFF - APX-64 Control Panel

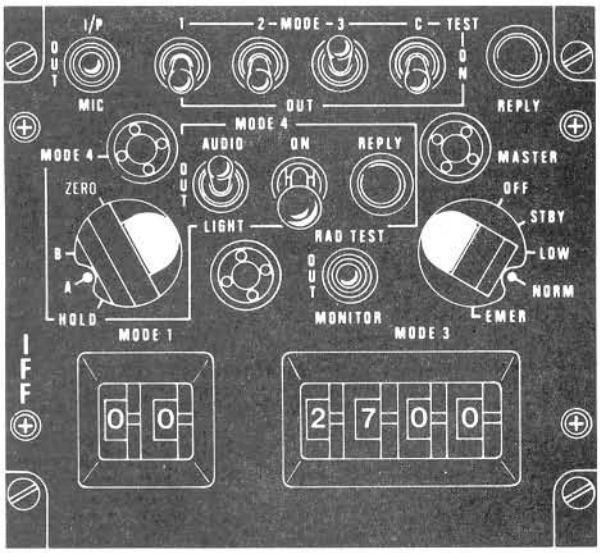


Figure 1-88

IFF MASTER Switch

This switch has five selections :

a. ***OFF.*** No power to the set.

b. ***STBY.*** The circuitry is being warmed up for operation. It can receive interrogating signals but will not transmit.

Note

A two minute timer prevents transmission if the switch is selected from OFF to LOW, NORM or EMER.

c. ***LOW.*** Normally used when operating close to the ground radar station.

d. ***NORM.*** Normal operating position.

e. ***EMER.*** Emergency; the set transmits a special continuous signal. To select the EMER position, raise the semi-circular plunger and turn the selector to EMER.

I/P Switch

This switch has three positions :

a. ***I/P.*** The identification of position (I/P) switch is utilized upon request to provide momentary identification of position. The switch is spring-loaded back to the OUT position. When selected to the I/P position, the set transmits a response on Modes 1, 2 and 3 for 30 seconds after the switch returns to the OUT position.

Note

On the APX-46, Mode 2 is not activated with the switch in the I/P position.

b. ***OUT.*** Centre position; switch inoperative.

c. ***MIC.*** The set transmits its selected code while either microphone button is pressed, ie no 30 second over-run after button release.

Mode Selection Switches

There are three mode selection switches which operate in the normal ON/OFF sense.

Mode Code Sprockets

The mode coding is selected as follows :

a. ***MODE 1.*** Immediately below MODE 1 is a window showing two numbers. Rotate the setting sprockets to display the desired MODE 1 code.

b. ***MODE 2.*** Mode 2 codes are preset by ground crew and cannot be changed in the air. There are 4096 codes available.

c. ***MODE 3.*** Immediately below MODE 3 is a window showing four numbers. Rotate the setting sprockets to display the desired MODE 3 code eg, to set Mode 3 Code 12, set 1200 in the MODE 3 window and select MODE 3 to ON. The setting sprockets are numbered from 0 to 7.

Note

- All other switches on the control panel relate to Mode 4 operation and have no operator use.
- Mode 4 is designed for secure military operations and is not fitted to the APX-46 or APX-64. The IFF warning light on the main fail panel only works in conjunction with Mode 4 operations and is therefore inoperative.

OPERATION

Normal

Operation of the IFF/SIF equipment is as follows :

a. Set the MASTER switch to NORM. The IFF is ready to transmit after a two minute warming up period.

b. Select the response mode requested by the ground controller, ie MODE 1, MODE 2 or MODE 3.

c. Select the coded response requested by the ground controller for Mode 1 or Mode 3.

Emergency

Pull out the semi-circular plunger on the MASTER switch and rotate the selector to the EMER position. On the APX-64, the emergency signal is then transmitted through the three modes with Code 7700 overriding the code set on the Mode 3 code sprockets. On the APX-46, the emergency signal is not transmitted on Mode 2; Mode 3 transmits the code set on the sprockets.

Note

Operation of the ejection seat automatically selects IFF emergency operation without any action by the pilot, provided power is supplied to the equipment from the main DC bus and the alternator bus. If the MASTER switch is OFF, two minutes must elapse before the set responds to interrogation.

RADAR ALTIMETER

The radar altimeter is fitted to Mirage IIIO A aircraft only and provides extremely accurate indication of altitude from 5 to 5000 ft above terrain. The radar altimeter is supplied with power from the alternator bus and the radar altimeter reference lights are supplied from the auto load-shedding DC bus. It is not a terrain avoidance instrument but indicates height above terrain directly below the aircraft. The system is capable of locking onto objects at very short ranges and is adjusted to a minimum lock-on distance of 10 ft, to ensure that the system does not lock-on to centre line stores or the nose wheel. The altimeter remains locked on to the terrain below for roll angles up to 70°, dive angles up to 80° and climb angles up to 60°; the difference in angles is due to the geometry (forward tilt) of the beam. The equipment consists of the units described in the following paragraphs.

TRANSMITTER/RECEIVER

The transmitter/receiver is located in the equipment bay. The transmitter feeds a pulse to the switching unit which in turn passes it to the transmitter antenna. The system has two modes of operation; search and track. In search mode, the system sweeps from 5 to 5000 ft seeking an altitude range. When a return is received in this band, the system automatically introduces the track function and remains locked-on to the return. The time interval between transmission and reception is measured and converted to a DC voltage which is used to position the height indicator needle. If a closer return is detected at any time, the radar locks-on to the new target.

SWITCHING UNIT

The switching unit has two altitude modes of operation; low and high altitude. At low altitudes, the switching unit reduces the power output from the transmitter to prevent receiver damage from a high powered return. The changeover height is 195 ft with the aircraft climbing and 165 ft with the aircraft descending.

RADAR ALTIMETER HEIGHT INDICATOR

The radar altimeter height indicator (refer to Fig 1-89) is located immediately right of the radar scope. The dial is a logarithmic/linear scale graduated from 0 to 5000 ft, ie the scale between units is linear, while the overall scale is logarithmic. The control knob on the bottom right of the indicator serves three functions:

a. ON/OFF switch,

b. positions the altitude reference bug, and

c. activates the self test function.

Radar Altimeter Height Indicator

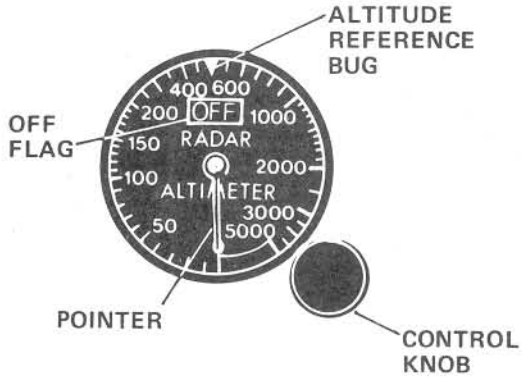


Figure 1-89

TRANSMITTER AND RECEIVER ANTENNAE

Two separate and independent antennae are located under the fuselage behind the nose wheel bay; one transmits radar pulses, the other detects reflected energy.

RADAR ALTIMETER REFERENCE LIGHTS

A set of three radar altimeter reference lights is positioned on the left side of the gunsight. By rotating the control knob on the indicator, the reference bug may be set against any desired reference altitude. When flying above this reference altitude, the top light, which is an amber fly down arrow, is illuminated. When flying below the reference altitude, the bottom light, which is a red fly up arrow, illuminates and in addition, a red light on the radar indicator panel, to the right of the scope, illuminates. When

flying within ± 25 ft of the reference altitude at low level and within ± 190 ft of the reference altitude above 400 ft, a green 'on altitude' light between the arrows is illuminated. For the reference lights to operate, the weapon system selector must be selected to an AIR-GROUND mode.

Note

When the equipment is in the search mode or the return signal is unreliable, a disable circuit extinguishes all the radar altimeter reference lights. Simultaneously, an OFF flag appears on the face of the indicator. Reference must be made to the indicator for positive indication of the radar altimeter status.

OPERATION

The equipment is switched on by rotating the control knob clockwise until the altitude bug appears; there is no positive click to indicate the ON position. When the set is switched ON, the needle moves clockwise around the dial and comes to rest in the fully clockwise position where it remains while the set times in (30 seconds to 2 minutes). The needle may then return to zero or fluctuate between zero and maximum deflection. When the set has timed in, pressing the control knob activates the self test function and drives the needle towards the zero position. This shows that power is being supplied to the indicator. An OFF flag is visible on the face of the indicator whenever :

a. there is no power to the system,

b. the set is not locked on, or

c. the aircraft is at an altitude greater than 5000 ft above terrain.

Above 20 000 ft, the transmitter is automatically disabled by a barometric switch and the OFF flag remains visible. The set is switched off by rotating the control knob until the altitude bug is obscured by the black mask on the glass. When re-selected ON by moving the bug into view again, the system requires a full timing in period.

RADAR NAVIGATION - DEPARTURE

The Cyrano IIB ground map radar is used as an aid to IMC navigation. Although it is not always as conclusive as visual map reading, it gives, when coupled with other navigation aids, additional information to assist the pilot in confirming his position.

PRE-FLIGHT PREPARATION

Radar navigation exercises are most demanding and the pilot work load is extremely high. Pre-flight preparation should therefore be thorough. A detailed flight plan should be made and the route to be flown should be studied in detail. This study should include radar predictions, scope photos (if available) and forecast meteorological conditions enroute.

DEPARTURE PROCEDURES

Pre-start Checks

A thorough check should be made of the :

a. gyro reference system,

b. gunsight (select NAV), and

c. PHI :

(1) check all stations on the SSU and note stations with any significant errors, and

(2) set grivation and wind resolvers.

Taxi Checks

Normal radar, Doppler and radar altimeter checks are to be completed. The PHI should be selected to Station 1 and TCN selected on the PHI mode selector.

After Take-off

When above 1000 ft AGL engage the flying aids. Before selecting the next PHI station compare PHI Station 1 with the TACAN to ensure the PHI system is operating correctly and that the correct grivation is set. Select the next PHI station.

Set Heading Methods

There are many departure procedures available, however the three considered most practical are the :

a. direct turn on to departure heading,

b. intercepting an outbound radial, and

c. departing through a visual gate.

The selection of the procedure is determined by many factors including the :

a. meteorological conditions,

b. number of aircraft, and

c. first leg height, ie climb or low level.

RADAR NAVIGATION - HIGH ALTITUDE

At high altitude the radar displays a plan view of the ground below rather than an elevation view. For this reason, the pilot is more dependent on identifying features such as large towns, lakes, rivers and coastlines than on identifying his position from the local elevation characteristics.

SCOPE TECHNIQUE

The basic technique for high level radar navigation is to direct the antenna (in single bar scan) at the area in which a particular feature is expected to be seen and use manual gain to adjust the radar display. To see low reflection areas such as lakes and large rivers, a relatively high gain setting is needed. To identify areas of high intensity returns, such as large towns and industrial complexes, the gain should be

slowly reduced until only these returns remain.

WARNING

Sole concentration upon the scope without instrument cross reference can lead to dangerous non-recoverable situations.

Note

- The scope artificial horizon may be used as an aid to accurate flying, in particular as a reference for bank angle.
- The flying aids should be used to reduce the pilot work load and to ensure that accurate flight is maintained.

NAVIGATION TECHNIQUES

Timing

At high level, where terrain clearance is not important and when accurate timing is not necessary, it is sufficient to amend ETA in the normal manner. The distance-to-go annotations along track can be used as a basis for time corrections in the absence of good radar pin points. Where accurate timing is necessary, eg during co-ordinated strikes, Doppler groundspeed is maintained by adjusting airspeed. If Doppler is inoperative and weather permits, use prominent features such as rivers and railroads along track to establish an accurate time and track check.

Note

High level navigation over coastal areas is relatively simple, but over land where there is a lack of radar features, the proven technique of maintaining planned heading and airspeed may be the only method of ensuring the location of the next radar feature. Doppler drift and groundspeed enable a more accurate track to be flown.

Updating

The radar coverage can be an area up to 50 NM ahead of the aircraft, therefore updating techniques must depend on features within this area and not beneath the aircraft. Once the aircraft's position is established, it is a simple matter to amend ETA by any of the normal methods. The types of updating can be broadly categorized as follows :

a. ***Distance Update.*** When there are no on-track features and the turning point is outside radar coverage, a distance update can be made, provided there are no obvious track errors. Fix the distance when any feature within the scope area lies under an appropriate range cursor. The range error incurred by not updating bearing readout at distances greater than 50 NM is negligible.

b. ***Bearing and Distance Update.*** Using a turning point or an on-track feature, turn the aircraft so that the feature tracks down the scope centreline, ie the aircraft track with Doppler lock-on (refer to Fig 1-58). Correcting the distance read out and setting the steering index at the PHI indicator lubber line automatically corrects the track readout for drift. If the feature is a turning point, this action brings the EPM onto the feature.

Updating the PHI System

The most convenient method is to update when a feature lies under a convenient range marker and then work back along track to determine the aircraft's actual ground position. It is preferable and more accurate to update using the 30 or 40 NM range marker. When the feature is under the range marker :

a. Select SET on the PHI mode selector.

b. Adjust the range readout for the aircraft's ground position at the instant SET was selected. The bearing is adjusted as described for bearing and distance update.

c. Select DR on the PHI mode selector. The PHI computer remains in memory for seven seconds and then the PHI read-out adjusts to allow for aircraft travel during the period in which SET was selected, plus the seven seconds sequencing period.

Note

The EPM should not be used as an updating aid due to inaccuracies in the EPM position.

Turning Point Procedures

Timing, fuel, heading for the next leg and PHI system accuracy should be checked before reaching the turning point. Normally, the turning points selected will be good radar features, enabling an accurate update to be made before reaching it. The turn is then made on timing, PHI distance readout or on the position of a radar feature beyond the turn point.

Note

Due to the inability to update the bearing with precision, the PHI needle may swing left or right within 15 miles of the station.

The PHI system can be updated over the turning point by setting the range readout to zero provided that the station checked correctly before start. If the station was incorrectly set and the PHI is updated overhead the turning point, the whole grid orientation is moved and the remaining turning points and diversion airfields are affected.

During the turn onto the next heading, set the wind for the next leg and the new target altitude. Roll the

aircraft out on the magnetic heading for the next leg, and compare the PHI readout and actual station bearing/distance to go. If a precise last station overhead was achieved and the PHI indication was incorrect, a PHI update is made at the beginning of the new leg.

After checking Doppler lock-on, lay off drift and carry out a heading system check. Finally, a radar orientation should confirm the track made good.

Note

- With NAV selected on the weapons system selector, the heads-up display can be utilized.
- Do not update the PHI if the applicable SSU station was in error on the pre-start check.

Descent Techniques

Descent point identification is simplified with radar-navigation, since the low level IP or target will usually be prominent on the radar scope, thus allowing an accurate descent distance to be determined. Before reaching the descent point, update the PHI system (if necessary) and check fuel contents, timing and planned levelling altitude. The low level winds and local QNH should be updated.

The descent angle is determined by factors such as cloud base, operational environment and intention at the completion of the descent. A descent for continued IMC navigation is normally restricted to 10°. For descents below a known cloud base to visually acquire a target in a hostile environment, a 20° dive is used.

Planning

For planning purposes, allow a descent distance of 1 NM per 1000 ft for a 10° dive and 1 NM per 2000 ft for a 20° dive plus a further 5 NM for levelling off, eg for a 10° dive from 25 000 ft allow a 30 NM descent distance.

Note

These figures are true for a constant dive angle.

The use of the flying aids assists in maintaining the required aircraft attitude during the dive.

WARNING

All descents must be pre-planned and flown to a specific altitude due to the possibility of small, often unnoticed but dangerous, TGP errors developing during the descent.

Technique

The pilot commences the descent at the calculated distance, selecting the appropriate attitude and using the Bezu ball and flying aids to maintain an accurate descent. Normal instrument flying techniques are used in levelling off at the new altitude.

RADAR NAVIGATION - LOW LEVEL

Low level radar navigation is a method of navigating an aircraft to a target using a constant safe altitude above the highest terrain along track. The safety height is calculated for radar and DR navigation according to FLIP Planning, Part 2 and allows the aircraft to proceed even if adverse weather is encountered.

The most important aim in low level radar navigation is to maintain an accurate heading and speed (Doppler ground speed and drift is the prime aid in achieving this aim). Time, PHI distance-to-go and the radar are used to confirm the exact position of the aircraft. With accurate flying and full use of the flying aids, navigation is made easier if timing and track are kept to within 10 seconds and 2 NM. GM50 is used primarily for this method. GM15 is used for the final approach to points already identified on GM50, for updating, for time checks and turning points.

SCOPE TECHNIQUE

Flat Terrain

When flying at low level, the radar is presented with an elevation aspect of the terrain ahead of the aircraft. The scope technique used over flat terrain is similar to the technique used at high level, ie the pilot directs the antenna at the expected position of the feature and adjusts the radar display with manual gain.

Rough Terrain

The major identifying features at low level over rough terrain are elevation features; thus the most important radar control is antenna elevation which is used in conjunction with a high gain setting. Ridge line profiles, which provide excellent time and track checks, can be identified by raising and lowering the antenna.

Climbing and Descending

An altitude change is normally planned, initiated at a specific point and level flight resumed at a planned altitude. The terrain obstacle dictating the climb is identified and followed down through the GM scales. The climb is commenced when the planned point is reached. In the case of a section of four aircraft in radar trail, the whole section climbs when the leader reaches the climb point. Conversely, the leader waits until No 4 has passed the feature before the whole section descends.

NAVIGATION TECHNIQUES

Timing

Accurate timing is essential. The Doppler ground speed should be observed and maintained at the desired value to minimize deviations. If the timing is incorrect, make speed corrections as follows:

a. Determine the time in seconds late or early.

b. Add or subtract that figure to the ground speed and apply it for a time equal to the number of miles travelled every minute.

eg Vg 420 kn, error 20 sec early.

Correction: fly at 400 KIAS for 7 minutes (or 380 KIAS for 3½ minutes).

Updating

The technique for updating is the same as the updating technique described for high level navigation. Primarily, the features used for update are elevation features, eg spot heights. When a terrain feature has been isolated using the normal antenna elevation control, the target altitude rheostat may be used as a fine antenna elevation control to accurately identify the highest point.

Turning Point Procedures

The procedures to be used at a turning point are detailed in high altitude navigation. In summary :

a. ***Before Turning Point.*** Check the following :

(1) fuel,

(2) PHI accuracy,

(3) timing, and

(4) next heading and initial leg altitude.

b. ***During the Turn.*** Select the following :

(1) next PHI station,

(2) target altitude of next turn point, and

(3) leg forecast winds.

c. ***After Turn.*** Proceed as follows :

(1) roll out on heading;

(2) check PHI accuracy, update if required;

(3) lay off Doppler drift;

(4) carry out heading system check; and

(5) radar orientation, ground map and terrain clearance.

Note

- If the turning point selected has pronounced vertical development across track, the radar altimeter can be used to determine when the aircraft passes overhead the turning point.
- Operationally, a tactical advantage can be gained by turning short of a terrain feature, thus employing the shielding effect of the feature.

The basis of the radar navigation mission is thorough planning. Planning, in conjunction with accurate flying, full use of the flying aids and the use of the radar as an aid under IMC conditions enables a planned route to be flown safely and accurately.

The ground map radar can be used to monitor a TACAN or other straight-in approach, thus ensuring a safe recovery under most weather conditions.

OXYGEN SYSTEM

The oxygen system (refer to Fig FO 1-36) is limited in Low Altitude (LA) operation to 50 000 ft for normal operations or 55 000 ft if a pressure waistcoat is worn. The system has a High Altitude (HA) design capability of operation to 80 000 ft if a full pressure suit is worn. The HA capability has been removed by modification but can be re-installed if required. For this reason the information on HA operation is retained.

The oxygen system consists of the :

a. aircraft supply system,

b. cockpit control panel,

c. warning system,

d. pilot's supply circuit, and

e. regulator assembly.

DESCRIPTION

AIRCRAFT SUPPLY SYSTEM

The normal supply of oxygen is from two cylinders located behind the equipment bay. Each cylinder has a capacity of 6.6 litres and is charged to 14 985 kPa (2175 psi) through a NATO fitting mounted on the right engine intake. At the rear of the charging point there is a restrictor which limits the charging rate. A valve fitted to each cylinder closes when the pressure drops below 500 kPa (72.5 psi) to prevent the ingress of moisture or dirt.

[D] The aircraft oxygen cylinders are located behind the rear cockpit.

The aircraft cylinders (refer to Fig FO 1-36) supply high pressure oxygen via the main supply cock located on the left cockpit wall beside the ejection seat to the contents gauge on the pilot's control panel and a pressure reducing valve. The main supply cock is difficult to reach when the pilot is strapped in so it is turned on before cockpit entry. The reduced pressure of 500 kPa (72.5 psi) is then supplied to the regulator assembly via the emergency supply shuttle valve. The emergency supply pressure at the shuttle valve is 331 kPa (48 psi), therefore flow from the emergency cylinder cannot take place until the reduced pressure from the aircraft supply system is below 331 kPa (48 psi).

The aircraft supply system is connected to the input side of the regulator by a quick disconnect assembly (QDA). The QDA permits the regulator assembly to be disconnected from the aircraft's supply automatically during ejection, or manually during servicing.

COCKPIT CONTROL PANEL

The cockpit control panel (refer to Fig 1-90), mounted on the right console, consists of:

a. A normal - 100% selector with two positions:
   (1) N - Automatic air dilution below 33 000 ft cabin altitude. Above this altitude 100% oxygen is supplied.
   (2) 100% - Pure oxygen supplied to the pilot regardless of cabin altitude.

b. A contents gauge graduated in quarters, which indicates the pressure of oxygen remaining in the aircraft cylinders.

c. An electro-magnetic flow indicator (blinker) which is controlled by contacts in the normal regulator and operates only when the N-EMG selector is in the N position. A white blinker is displayed when oxygen is flowing and a black blinker when oxygen is not flowing. For normal breathing the blinker alternates white and black.

d. A normal-emergency selector with two positions:
   (1) N - Normal regulator in operation.
   (2) EMG - Normal and emergency regulators operate in parallel and provide a minimum safety overpressure of 5 mb; the blinker and OXY REG light are inoperative.

Oxygen Control Panel

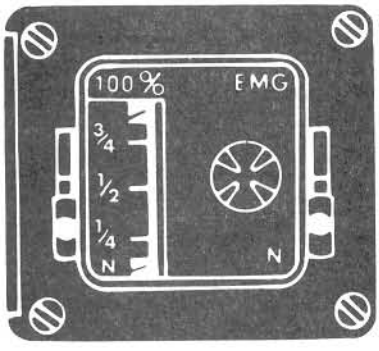


Figure 1-90

WARNING SYSTEM

Malfunction of the oxygen system is indicated to the pilot by the OXY REG and 8 min OXY warning lights on the main fail panel. These two lights, powered from the main DC bus, are connected to the main FAIL light and the warning horn.

OXY REG Light

Any malfunction within the normal regulator, while it is operating in the N-N or N-100% function, is indicated, in addition to the appropriate blinker indication, by the illumination of the OXY REG warning light on the main fail panel. This light illuminates if the blinker remains continuous black or continuous white for more than 15 seconds.

8 min OXY Light

The 8 min OXY light illuminates if:

a. pressure in the emergency oxygen bottle has fallen to 13 913 kPa (1960 psi) leaving only 8 minutes supply of oxygen, or

b. the emergency supply cock is not in the fully ON position, or

c. the visor seal cock is not in the fully ON position, or

d. the quick disconnect assembly (QDA) disconnects from the regulator.

OXY Circuit Breaker

The OXY circuit breaker on the cockpit circuit breaker panel protects the electrical circuits of the oxygen warning system. If this CB operates, the OXY REG light illuminates, the main FAIL light and the horn are actuated, the blinker becomes inoperative and indicates steady black, but the oxygen supply to the pilot continues as normal.

EMG Selection

If the emergency regulator (EMG) is selected, the amplifier operating the blinker is by-passed, and the blinker and failure warning system remain inoperative.

PILOT'S SUPPLY CIRCUIT

The pilot's supply circuit consists of the personal equipment and the chest connector.

Personal Equipment Connector (PEC)

The PEC is located on the left side of the ejection seat and connects the pilot's equipment to the ejection seat and to the output hose of the oxygen regulator assembly. The PEC is automatically disconnected when the pilot separates from the seat on ejection. A handle on the PEC allows manual release for rapid cockpit egress or for servicing.

Chest Connector

The pilot's oxygen hoses are connected to the PEC hose through the chest connector. The chest connector includes an ON-OFF cock, operated by the pilot

before and after each mission, and two quick release connectors. The helmet or oxygen mask hose is attached to one connector and the HA suit or pressure waistcoat hose is attached to the other. For normal LA operation, the HA connection is blanked off.

REGULATOR ASSEMBLY

The regulator assembly is a compact unit attached to the left side of the ejection seat. It consists of:

a. a HA/LA altitude selector,

b. a visor seal cock,

c. a HA test button,

d. a normal regulator,

e. an emergency regulator, and

f. an emergency supply system.

HA/LA Altitude Selector

The HA/LA altitude selector is located on the side of the regulator assembly. It has two positions:

a. high altitude (HA); the fully down position, and

b. low altitude (LA); the fully up position.

The altitude selector must be selected to LA when low altitude equipment is being worn. As current RAAF operations are all at low altitude, a metal bar is fitted under the altitude selector to maintain it in the LA (fully up) position.

Visor Seal Cock

To allow inflation of the Type 21EFA helmet visor seal, an ON-OFF visor seal cock is located on the top face of the regulator assembly. The 8 min OXY light on the main fail panel illuminates if the visor seal cock is selected OFF. The cock is safety-wired in the ON position, but as HA flying equipment is not normally used, the cock outlet is blanked off (refer to Fig FO 1-36). For HA operations the visor seal cock is selected ON and oxygen from either the normal or the emergency supply is piped from the regulator assembly via a pressure reducing valve and the PEC to the partial pressure helmet, where it inflates the visor seal when necessary.

HA Test Button

With HA equipment in use, HA selected on the altitude selector and the N/EMG selector set to EMG, pressing the HA test button causes the emergency regulator to deliver an overpressure to the breathing circuit of 30 to 50 mb. This overpressure partially inflates the partial pressure suit, indicating that the suit is correctly connected and that the emergency regulator is operative. The HA test button is inoperative when the altitude selector is set to LA.

Normal Regulator

The cabin pressurization system maintains the cabin altitude (CA) at 300 mb above atmospheric pressure from 18 000 ft to 80 000 ft AMSL. With the altitude selector set to LA, the normal regulator functions as follows:

a. ***From Sea Level to 33 000 ft CA.*** The regulator takes air from the cabin and on demand provides an air-oxygen mixture at 1 mb above cabin pressure.

b. ***From 33 000-36 000 ft CA.*** Air dilution ceases at 33 000 ft and the pilot receives 100% oxygen at 1 mb above cabin pressure.

c. ***From 36 000-40 000 ft CA.*** The overpressure is progressively increased from 1 mb to 5 mb above cabin pressure.

d. ***From 40 000-50 000 ft CA.*** The overpressure is progressively increased from 5 mb to 40 mb above cabin pressure.

e. ***Above 50 000 ft CA.*** An overpressure proportional to altitude is provided.

The normal regulator supplies the overpressure in subparagraphs c, d and e in accordance with the mask overpressure law.

With the altitude selector set to HA, the normal regulator supplies 100% oxygen to the high altitude suit at 5 mb overpressure from ground level to 80 000 ft AMSL (refer to Fig FO 1-37). The normal regulator can provide up to 50 mb overpressure during a cabin decompression up to 50 000 ft AMSL.

Note

With the altitude selector at HA, the normal regulator can provide more than 50 mb overpressure if the emergency regulator fails; however, the regulator has been tested up to 50 000 ft AMSL only.

Emergency Regulator

The emergency regulator is connected in parallel to, and provides a back-up for, the normal regulator. With the altitude selector set to LA, the emergency regulator cannot provide more than 5 mb overpressure with the N/EMG oxygen selector set to EMG. Therefore, above 40 000 ft CA the normal regulator overrides the emergency regulator. With the altitude selector set to HA above 38 000 ft, the emergency regulator provides the higher overpressure and overrides the normal regulator.

Emergency Supply System

The emergency supply system consists of:

a. the emergency cylinder of 0.4 litre capacity charged to 16 984 kPa (2465 psi),

b. a combined ON-OFF cock, shuttle valve and pressure reducing valve which reduces pressure to 331 kPa (48 psi),

c. a pressure gauge on the top face of the regulator which indicates sufficient contents when the pointer is in the white sector of the dial, and

d. a NATO fitting on the top of the regulator assembly for recharging the emergency cylinder.

Oxygen is supplied from the emergency cylinder :

a. when the aircraft supply system fails or the pressure in the aircraft cylinders is below 48 psi,

b. on ejection, and

c. if the main supply cock is not selected ON.

Note

The main supply cock must be selected on before the emergency supply cock, otherwise the emergency supply may be exhausted.

LOW ALTITUDE OPERATION

NORMAL OPERATION

For a low altitude mission, with low altitude equipment (refer to Fig FO 1-36 and FO 1-37), check the :

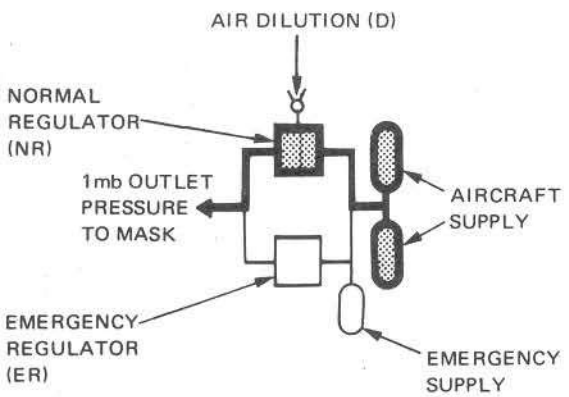
a. altitude selector is gated to LA,

b. control panel selectors are at N-N, and

c. visor seal cock is safety-wired ON.

The normal regulator (refer to Fig 1-91) supplies the pilot with an air-oxygen mixture at an overpressure of 1 mb. The proportions of air and oxygen in the mixture vary with cabin altitude.

LA Operation - Normal



D is a function of altitude.
Oxygen selector position – N/N

Figure 1-91

EMERGENCY OPERATION

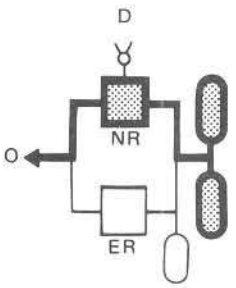
Cabin Decompression

The graph at Fig FO 1-37 shows a cabin decompression or ejection at about 45 000 ft AMSL. In the case of a cabin decompression, the CAB P warning light and the main FAIL light illuminate and the warning horn sounds as the cabin pressure drops below 300 mb which is the equivalent of 30 000 ft AMSL. The absolute pressure drops to about 190 mb where it is maintained by the normal regulator as pressure breathing. The pressure supplied by the normal regulator (refer to Fig 1-92) decreases in accordance with the mask overpressure law as the atmospheric pressure increases during descent. At 36 000 ft AMSL the absolute and atmospheric pressure are almost equal and the regulator assembly maintains, on demand, an overpressure of 1 mb while the aircraft descends.

Note

Absolute pressure is the sum of ambient pressure and regulator pressures.

LA Operation - Cockpit Decompression



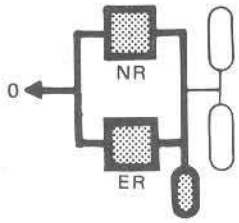
O = 1 mb up to 36 000 ft AMSL increasing to 5 mb at 40 000 ft AMSL and 40 mb at 50 000 ft AMSL
D ceases at 33 000 ft AMSL.

Figure 1-92

Ejection

On ejection, the emergency cylinder supplies 100% oxygen to the regulators at 331 kPa (48 psi). Above 40 000 ft AMSL, (refer to Fig 1-93) the normal regulator supplies pressure breathing at the higher overpressure up to 40 mb at 50 000 ft AMSL. Below 40 000 ft AMSL, both regulators operate in parallel and supply 100% oxygen at 5 mb overpressure. Oxygen is supplied to the pilot on demand below

LA Operation - Ejection



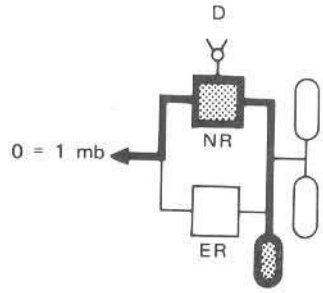
0=5mb from MSL to 40 000 ft AMSL and progressively increases from 5mb at 40 000 ft AMSL to 40mb at 50 000 ft AMSL

NR operates above 40 000 ft AMSL and provides overpressure above 5 mb in accordance with mask overpressure law.

NR and ER operate in parallel below 40 000 ft AMSL and provide 5 mb overpressure.

Figure 1-93

LA Operation - Aircraft Supply Less Than 48 psi



D is a function of altitude.
Oxygen selector position – N/N

Figure 1-94

40 000 ft AMSL until seat separation or until the emergency cylinder is empty.

Aircraft Supply Less Than 48 psi

If, through normal usage, the aircraft supply system drops slowly below 48 psi, the shuttle valve operates and the emergency supply feeds through the normal regulator (refer to Fig 1-94). Except for the contents gauge showing empty, no warning is given to the pilot. Oxygen is supplied at 1 mb overpressure and dilution occurs dependent on cabin altitude. When the emergency supply pressure drops below 1960 psi, the 8 min OXY warning light and the main FAIL light illuminate and the horn sounds, but the emergency regulator remains inoperative. When the N/EMG oxygen selector is set to EMG, the emergency regulator operates in parallel with the normal regulator and 100% oxygen is supplied at 5 mb overpressure. Resetting the N/EMG oxygen selector to N will not return the regulators to normal operation.

Main Supply Line Fracture

If the main supply line fractures and the pressure falls rapidly below 331 kPa (48 psi), oxygen at a reduced pressure of 331 kPa (48 psi) is supplied from the emergency oxygen bottle (refer to Fig 1-93). Simultaneously, the following changes occur automatically in the regulator assembly :

a. air dilution ceases and 100% oxygen is supplied;

b. a safety overpressure of 5 mb is supplied by the normal regulator;

c. the emergency regulator operates in parallel with the normal regulator up to 40 000 ft cabin altitude and supplies, on demand, oxygen at 5 mb overpressure; and

d. the amplifier operating the blinker is by-passed and, therefore, neither the blinker nor the OXY REG warning light is operative.

Except for the contents gauge indications or feeling the 5 mb overpressure, the pilot has no warning that this sequence has occurred until the pressure in the emergency cylinder drops to 13 913 kPa (1960 psi). At this pressure, the 8 min OXY and main FAIL warning lights illuminate and the warning horn sounds. When the emergency cylinder is empty, the pilot experiences difficulty in breathing and has to :

a. remove the oxygen mask, or

b. disconnect the oxygen mask hose from the chest connector.

Normal Regulator Failure

If a failure of the normal regulator occurs, the blinker remains on either a steady black or steady white indication. When the blinker has been inoperative for 15 seconds, the OXY REG warning light and main FAIL light illuminate and the warning horn sounds.

Steady White Blinker

A steady white display on the blinker indicates that the normal regulator is supplying a continuous flow of oxygen to the pilot's mask. The continuous flow of oxygen may be caused by a leak in the regulator air mix assembly or a leak between the regulator and the pilot's mask. If the leak is in the regulator air mix assembly, the fault may be isolated by selecting 100% . The blinker of the flow indicator then indi-

cates normally. A leak between the regulator and the pilot's mask cannot be rectified in flight. In this case the amount of air dilution is unpredictable.

Steady Black Blinker

A steady black display on the blinker indicates that the normal regulator is not supplying oxygen. The pilot may experience some difficulty with breathing. Select 100% and EMG on the control panel. The emergency regulator operates and 100% oxygen is supplied at 5 mb overpressure (refer to Fig 1-95).

LA Operation - Normal Regulator Failure

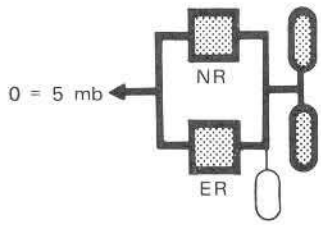


Figure 1-95

QDA Disconnection

If the QDA becomes disconnected in flight, the pilot may recognise the problem by the 5 mb overpressure applied to the mask and the associated rapid depletion of the aircraft's oxygen contents. When the QDA is disconnected :

a. the 8 min OXY light illuminates and the warning horn sounds,
b. the aircraft's oxygen contents are depleted in about one minute,
c. the emergency supply (refer to Fig 1-93) provides oxygen for an absolute maximum of eight minutes, or less if the demand is high,
d. 100% oxygen is provided automatically to the pilot's mask at a minimum overpressure of 5 mb, and
e. DC power is not supplied to the oxygen electrical warning circuit.

The OXY REG warning light and the blinker do not function; the blinker remains black.

HIGH ALTITUDE OPERATION

The pilot must wear high altitude equipment. He :

a. selects the altitude selector to HA,
b. sets the oxygen selectors to 100% and EMG, and
c. checks the visor seal cock is safety-wired ON.

The regulators operate in parallel (refer to Fig 1-96) and supply 100% oxygen with an overpressure of 5 mb. Because 100% is selected, there is no dilution. With EMG selected, the blinker and OXY REG warning light are electrically isolated and do not operate.

Normal HA Operation

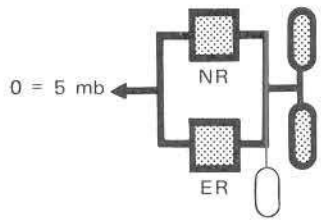


Figure 1-96

Emergency Regulator Test

The emergency regulator can only be tested when the pilot is wearing high altitude equipment. To test the emergency regulator, carry out the following procedure :

a. set the main oxygen cock to ON,
b. set emergency supply cock to ON,
c. set HA/LA altitude selector to HA,
d. set visor seal cock to ON,
e. check that the emergency cylinder gauge needle is in the white sector,
f. select 100% and EMG,
g. check contents,
h. set visor seal demist switch to NORM,
i. set chest cock to ON,
j. check that oxygen is available, and
k. signal the ground crew member to press the HA test button.

When the ground crew member presses the test button on top of the regulator assembly, the system simulates a cabin altitude of 43 000 ft and the flying suit inflates. Inflation of the flying suit indicates that the emergency regulator is working and that the suit

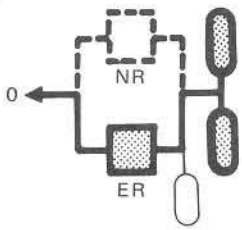
is connected correctly. The excess pressure in the suit is vented to atmosphere through the decompression relief valve when the HA test button is released.

EMERGENCY OPERATION

Cabin Decompression

Figure FO 1-37 shows a cabin decompression or ejection at about 69 000 ft AMSL. When the cabin pressure drops below 300 mb, the CAB P warning light and the main FAIL light illuminate and the horn sounds. The cabin pressure drops immediately to atmospheric pressure but the HA flying equipment pressure is maintained at 210 mb absolute during descent by the emergency regulator (refer to Fig 1-97) until the atmospheric and absolute pressures are almost equal. At about 38 000 ft AMSL, an overpressure of 5 mb, ie equivalent to the overpressure for normal HA operation, is maintained by the normal and emergency regulators operating in parallel for the remainder of the descent.

HA Operation - Cockpit Decompression



NR is automatically off above 38 000 ft AMSL
0 = 5 mb below 38 000 ft AMSL, pressure absolute ie 210 mb from 38 000 ft to 80 000 ft AMSL
Oxygen selector position – 100%/EMG

Figure 1-97

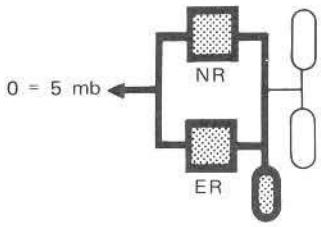
Ejection

On ejection (refer to Fig 1-98), the seat stabilizer chute allows rapid descent to about 13 000 ft ±1500 ft AMSL while the emergency supply and the emergency regulator maintain the HA flying equipment at 210 mb absolute pressure during the descent to 38 000 ft AMSL. At 38 000 ft AMSL, 210 mb is almost equivalent to atmospheric pressure. Below 38 000 ft AMSL, an overpressure of 5 mb is maintained by both regulators opening in parallel until seat separation at about 11 500 ft AMSL.

Aircraft Supply Less Than 48 psi

When the main cylinder pressure drops to less than 48 psi (refer to Fig 1-98), supply is automatically

HA Operation - Ejection - Aircraft Supply Less Than 48 psi



NR is automatically off above 38 000 ft AMSL
0 = 5 mb below 38 000 ft AMSL, pressure absolute ie 210 mb from 38 000 ft to 80 000 ft AMSL
Oxygen selector position – 100%/EMG

Figure 1-98

provided from the emergency cylinder. The pilot is not warned of the changeover from the main supply to the emergency supply until the emergency supply reaches 13 913 kPa (1960 psi) when the 8 min OXY warning light and the main FAIL light illuminate and the warning horn sounds. The aircraft must be descended below 10 000 ft cabin altitude before the emergency supply is exhausted to ensure pilot survival.

Normal Regulator Failure

If the normal regulator fails, the pilot is not warned because the blinker and OXY REG warning light are electrically isolated when the N/EMG oxygen selector is set to EMG during HA operations. If failure occurs, oxygen supply is automatically continued through the emergency regulator.

PHOTOGRAPHIC EQUIPMENT

RECONNAISSANCE CAMERA

The Mirage photo reconnaissance nose cone can be fitted only to the Mirage IIIO aircraft. The installation consists of a Fairchild KA56B1 panoramic camera and a control box.

KA56B1 CAMERA

The camera (refer to Fig 1-99) is mounted in the photo reconnaissance nose and is reached through a

KA56B1 Camera and Housing

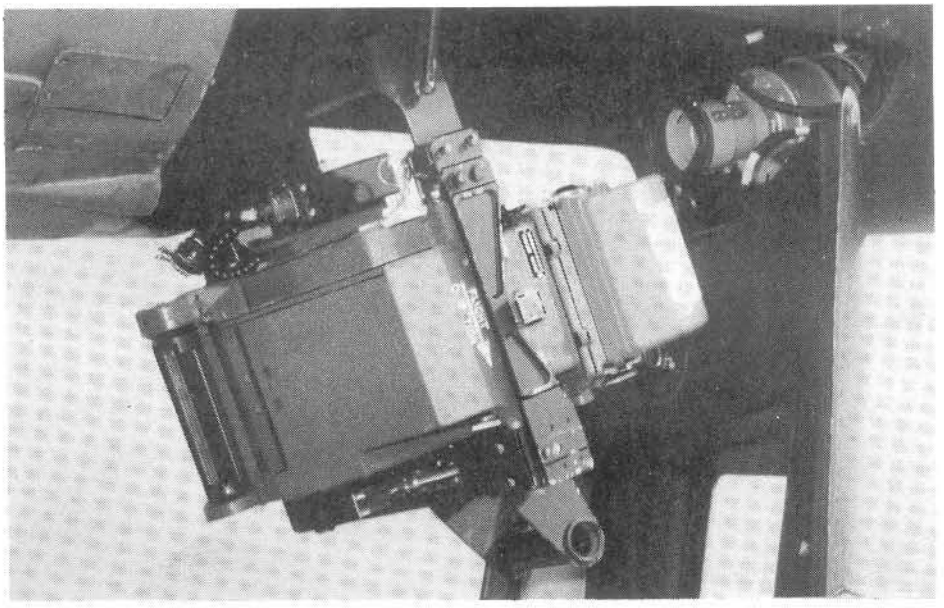


Figure 1-99

hatch on the bottom of the nose cone. The hatch is locked with two latches. The camera can be lowered from inside the nose cone when the hatch is open.

Advantages of the Camera

The advantages of the camera are :

a. The camera obtains wide coverage with a high cycling rate, correct IMC across the whole format and high resolution.

b. Horizon to horizon cover is obtained on one strip of film.

c. Some sort of photo cover of the target is obtained in spite of small errors in navigation.

Disadvantages of the Camera

The disadvantages of the camera are :

a. The camera is designed for low altitude use only, which exposes the aircraft to small arms fire.

b. The maximum speed/height ratio of the camera is 2.4. If a greater ratio is flown, the overlap is reduced (losing stereoscopy) and IMC is inadequate.

c. Overlap and IMC is incorrect, if the proper speed/height is not set and flown accurately.

d. The aircraft must be flown straight and level, because maximum IMC is at the aircraft's nadir. Bank gives distortion because of insufficient IMC vertically below the aircraft, and too much IMC at the aircraft's nadir.

e. In poor light conditions, high speed and low altitude flight may not allow sufficient light to the film and degradation may be apparent. Greater exposure times are not available with a high speed/height ratio.

f. Photo scale varies throughout the format, rendering interpretation and mensuration difficult.

g. Scale is small (4 × altitude AGL) with the short, 3 inch lens fitted. To obtain large scale photographs the aircraft must fly close to the ground.

h. Excessive overlap and film wastage occurs with a speed/height ratio of less than 0.38, eg 600 knots at 1500 ft.

Leading Particulars

The camera leading particulars are :

a. Weight (loaded) - 85 lb.

b. Size - camera - 24 in h × 19 in w × 20 in d.

c. Size - junction box - 6 in h × 12 in w × 8½ in d.

d. Shutter speeds - $^1/_{100}$ to $^1/_{5000}$ sec when compatible with cycling rate.

e. IMC rate - 0.3 to 11.88 in/sec.

f. Shutter type - Focal plane (variable slit).

g. Cycling rate - 1 to 6 CPS.

h. Lens - 3 in focal length, f4.5 aperture (maximum), 30 lines/mm dynamic resolution, 74° acceptance angle.

i. Format 4.5 × 9.4 in.

j. Magazine capacity - 700 ft (770 frames).

k. Flight line coverage - 90 NM with 700 ft of film at 1000 ft altitude using 56% overlap (500 ft gives 67 NM).

Principle of Operation

The KA56B1 is a low altitude panoramic camera, with a 75 mm (3 in) wide angle lens. The principle of operation is shown at Fig 1-100. A rotating prism collects rays of light from one side-horizon and directs them through the lens onto the film. As the prism rotates from side to side, the film moves past the lens at a speed synchronised with the prism lateral rotation, ie the film moves while the photograph is taken.

KA56B1 Camera - Principle of Operation

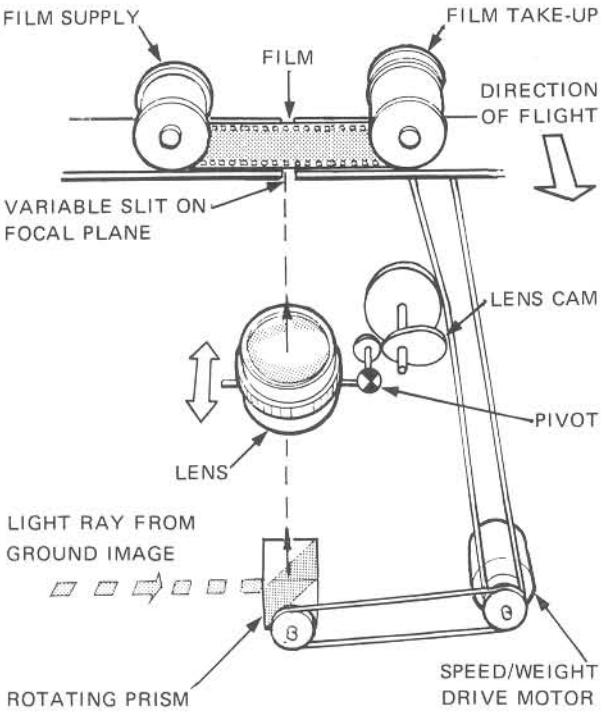


Figure 1-100

Exposure Control

A variable width slit, situated between the lens and the film, controls the amount of light admitted to the film. A photo-electric eye automatically varies the width of the slit, according to the amount of light reflected from the target.

Speed of Operation

To achieve the desired 56% overlap of photographs at varying aircraft speeds and heights, the camera can operate at speeds varying from one cycle per second (CPS) up to six CPS. The maximum cycling rate occurs at a speed/height ratio of 2.4 (600 kn ÷ 250 ft) and the minimum cycling rate occurs at a speed/height ratio of 0.38 (310 kn ÷ 800 ft). The speed/height combination is set by the pilot. When an altitude above terrain greater than 1000 ft is selected or where the selected speed/height ratio is less than 0.38, the cycling rate is constant at one cycle per second.

When the speed of the film past the slit increases, less light is available to act on the film; therefore the speed/height setting must also adjust the width of the slit, ie as the film goes faster, so the slit is opened wider.

Image Motion Compensation

The relative movement between the aircraft and the ground would normally result in blurred photographs. A device known as Image Motion Compensation (IMC) has been incorporated to prevent blurring. The KA56B1 maintains IMC across the film for 0.066 to 2.4 speed/height ratio. IMC is accomplished by displacing the lens in the longitudinal axis as the film is exposed. Lens movement is zero when the prism is at the horizon, increases as the prism rotates to the nadir and then decreases to zero as the prism sweeps out to the horizon on the other side of the aircraft. The lens then resets and another sweep starts.

Auxiliary Data Annotation System (ADAS)

Grid co-ordinates from the PHI station at which the flight commences, grid heading and exposure number are recorded in the one-inch space between exposures.

Magazine Capacity

The film is 127 mm (5 in) wide. Each negative is 114 mm (4.5 in) by 239 mm (9.4 in). The magazine can hold 305 m (1000 ft) of thin base film, however, magazines are currently loaded with a maximum of 213 m (700 ft) of normal base film which, with 56% overlap and at 1000 ft altitude, covers a flight line of about 90 NM.

Lens

The lens has a focal length of 75 mm (3 in), and an acceptance angle of 74°. The fore and aft coverage below the aircraft is 1.5 times the altitude AGL.

PHI Readout

The aircraft position and heading are transmitted by the PHI computer and gyro centre output multiplier to three counters in a data recording unit attached to the camera. The information is fed to the counters in the form of N/S and E/W grid co-ordinates and grid heading. The counters are photographed on to the film at the end of each scan. The readings are in NM N/S and E/W from an origin, which is the PHI station at which the counters are zeroed before flight.

The positive or negative nature of the readings designate the sector area. The counters read from 000 forwards as positive readings and form 000 backwards as negative readings; ie 999, 998. The E/W co-ordinates are read first then the N/S. The third counter is the grid heading. The following

readings are examples :

a. 996 047 is – 4 NM E/W and + 47 NM N/S, and

b. 047 852 is + 47 NM E/W and – 148 NM N/S

Applying the readings to a PHI grid gives the correct position of the aircraft. Whilst it is appreciated that the readings can be interpreted incorrectly, the ambiguities can be resolved by debriefing the pilot.

The debrief should indicate to the photo interpreter the PHI station used, any updating of the PHI system in flight and any equipment unserviceabilities.

KA56B1 Camera Control

The KA56B1 camera control (refer to Fig 1-101) consists of a POWER switch, a POWER light, an OPERATE switch, an OPERATE light, GROUND SPEED and ALT ABOVE TERRAIN setting thumbwheels, a CLOUD BELOW switch, a FRAMES EXPOSED counter and a FAIL light.

When the POWER switch is selected to POWER, the POWER light illuminates but the camera does not operate until the OPERATE switch is selected to OPERATE; when the OPERATE switch is selected to OPERATE, the OPERATE light is illuminated.

The GROUND SPEED and ALT ABOVE TERRAIN setting thumbwheels are set manually by the pilot.

The CLOUD BELOW switch is a three-position switch with settings of 4/8, ZERO and 2/8. Light reflected into the camera lens from cloud below the aircraft results in incorrect exposure of the film. The amount of reflected light depends upon the amount of cloud. Therefore, the exposure is corrected when the CLOUD BELOW switch is set by the pilot. This action adjusts the size of the slit in the shutter.

A camera FAIL light is installed beside the FRAMES EXPOSED counter. If the counters stop operating but the FAIL light does not illuminate, the camera is not operating. The camera may be restarted by setting the OPERATE switch to OFF and then selecting OPERATE again. The FRAMES EXPOSED counter is set to zero when a reloaded magazine is placed in the camera.

The camera will not function if the FAIL light illuminates, or if the POWER light or the OPERATE light extinguishes.

KA56B1 Camera Control Box

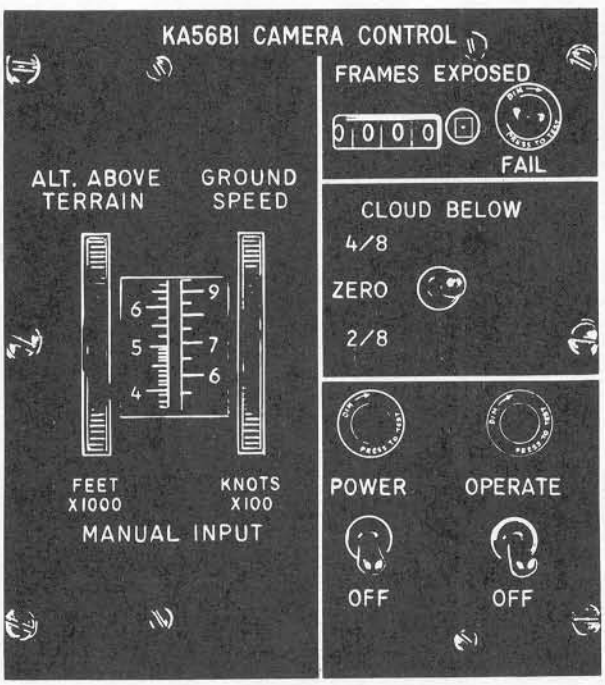


Figure 1-101

GUNSIGHT CAMERA

The Omera Type II O gunsight camera (refer to Fig 1-60) is an electric cine camera intended for filming the pilot's view through the combining glass of the sight head. Camera operation is initiated by either the trigger or the missile/bomb button. The system includes the camera, photocell and control box.

Leading Particulars

The leading particulars of the camera are :

a. Power source - 28.5 VDC from the auto-load shed bus.

b. Film size - 16 mm.

c. Frames per second (not adjustable) - 16.

d. Film capacity - 29 ft.

e. Operating time - 72 sec.

f. Object lens - 50 mm.

g. Aperture - f 4 or 5.6.

h. Shutter speed (adjustable) - $^{1}/_{100}$ to $^{1}/_{1200}$ sec.

Components

The camera is rectangular and is mounted on the rear of the sight head assembly. The components include :

a. ***Periscope.*** The periscope contains a lens system and, for black and white film, a yellow filter. The yellow filter reduces the aperture value of the lens from f 4 to f 5.6. It must be removed prior to using colour film.

b. ***Exposure Time Indicator.*** This indicator is a knurled knob with graduations from 100 to 1200, which represent the shutter speed in hundredths of a second. The position of the knob is set automatically by a small motor in the camera body in response to the photocell. If the automatic function of the indicator fails, the exposure time may be set manually by the pilot.

c. ***Film Remaining Indicator.*** This is a small wheel located at the bottom of the camera and is graduated from 0 to 9 metres. This indicates the amount of film remaining but it is not visible to the pilot.

d. ***Power Supply Cable.*** The power supply cable emerges from the lower right side of the camera. It is attached to a female connector located to the right of the sight head.

e. ***Mounting Brackets.*** A mounting bracket on either side of the camera body holds the camera in its bracket assembly on the rear of the sight head.

f. ***Film Drive Mechanism.*** The film drive mechanism consists of an electric motor and associated drive mechanism necessary to feed the film through the gate at a constant 16 frames per second. When the camera stops, the shutter is always in the closed position. It has two additional features :

(1) When the trigger or missile/bomb button is fully pressed, a small triangular slide appears in the gate, casting a witness mark on the side of the film.

(2) A pressure pad, which presses the film each time the shutter opens, prevents the film vibrating when the guns are fired.

PHOTOCELL

The photocell, which is attached to the front of the sight head, consists of a rectangular box with a glass lens facing forward. The design of the camera ensures that the light entering the lens and the light

falling on the photocell is of the same intensity. The photocell develops an output current which is proportional to the light intensity. This current is transmitted to the control box. The photocell has three additional features :

a. ***Shutter.*** A protective shutter which falls between the photocell and the lens when the unit is de-energized. It is electrically lifted when the camera is installed and power is supplied to the system.

b. ***Film Sensitivity Knob.*** This knob, which is located on the upper left side, allows the system to be adjusted to use films with different ASA ratings.

c. ***Power Supply Cable.*** A power supply cable which emerges from the bottom of the unit, is attached to a female connector on the front of the sight head. It is of different design to the camera power supply cable.

CONTROL BOX

The control box, which is mounted to the right and rear of the ejection seat supplies power to the camera drive motor. It also receives the output current from the photocell and converts the current into command signals which position the time exposure indicator and hence adjust the shutter speed. Mounted on the front of the control box is the over-run control which maintains camera drive signals for a preset length of time. The time settings on the knob are 0, 2.5 and 5 seconds.

[D] The control box is at the left rear of the rear ejection seat.

Note

When the camera is not installed a crashpad should be fitted to the camera bracket.

OPERATION

The camera system is energized whenever a mode is selected by the weapons system selector.

RADAR SCOPE CAMERA

Instrument Modification 7581.004-105 adapts the gunsight camera to permit photography of the radar scope. The camera, fitted with a wide angle lens and a new stoppage cam, is installed using a special bracket and an interconnecting cable (refer to Fig 1-105). An ON/OFF switch is fitted to the right side of the bracket. A modified control box produces 28 VDC pulses at 1.2 second intervals which advance the film by one frame per pulse. Film speed is 48 frames per minute.

Operation

The camera is operated as follows :

a. Ensure that the radar scope visor mask is correctly fitted.

Radar Scope Camera

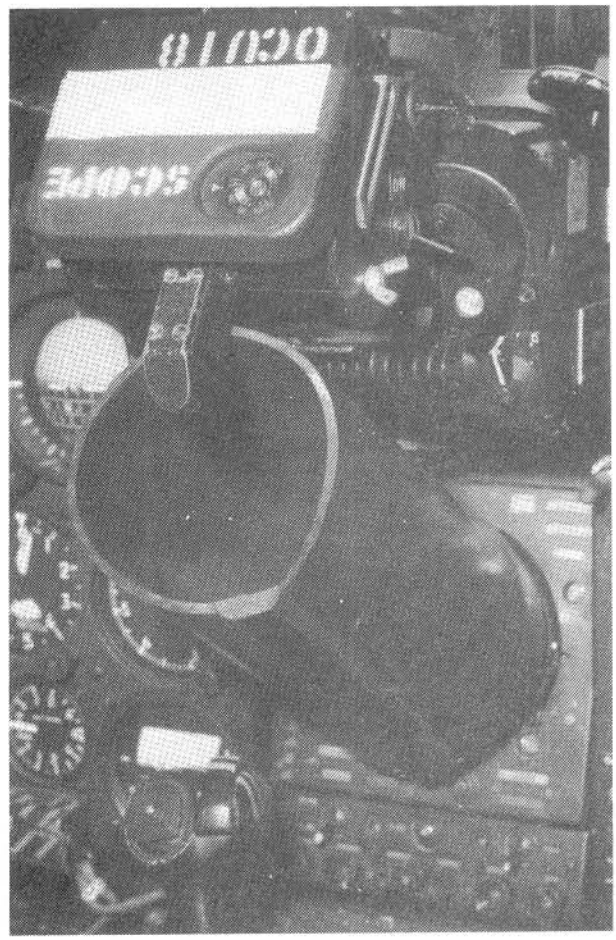


Figure 1-105

b. Set the exposure control to $^{1}/_{100}$ second.

c. Select the ON/OFF switch to ON.

The camera does not operate when the missile/bomb button or the trigger is pressed.

[D] PHOTOSONICS 1VN CAMERA POWER SUPPLY

A nineteen pin socket is located in the side panel below the circuit breaker panel in the front cockpit. This socket provides 28 VDC power for the hand held 1VN camera. A circuit breaker, labelled PHOTO CAM, on the circuit breaker panel, controls power to the socket. The circuit breaker should only be in when the camera is fitted.

Cockpit Layout - Typical

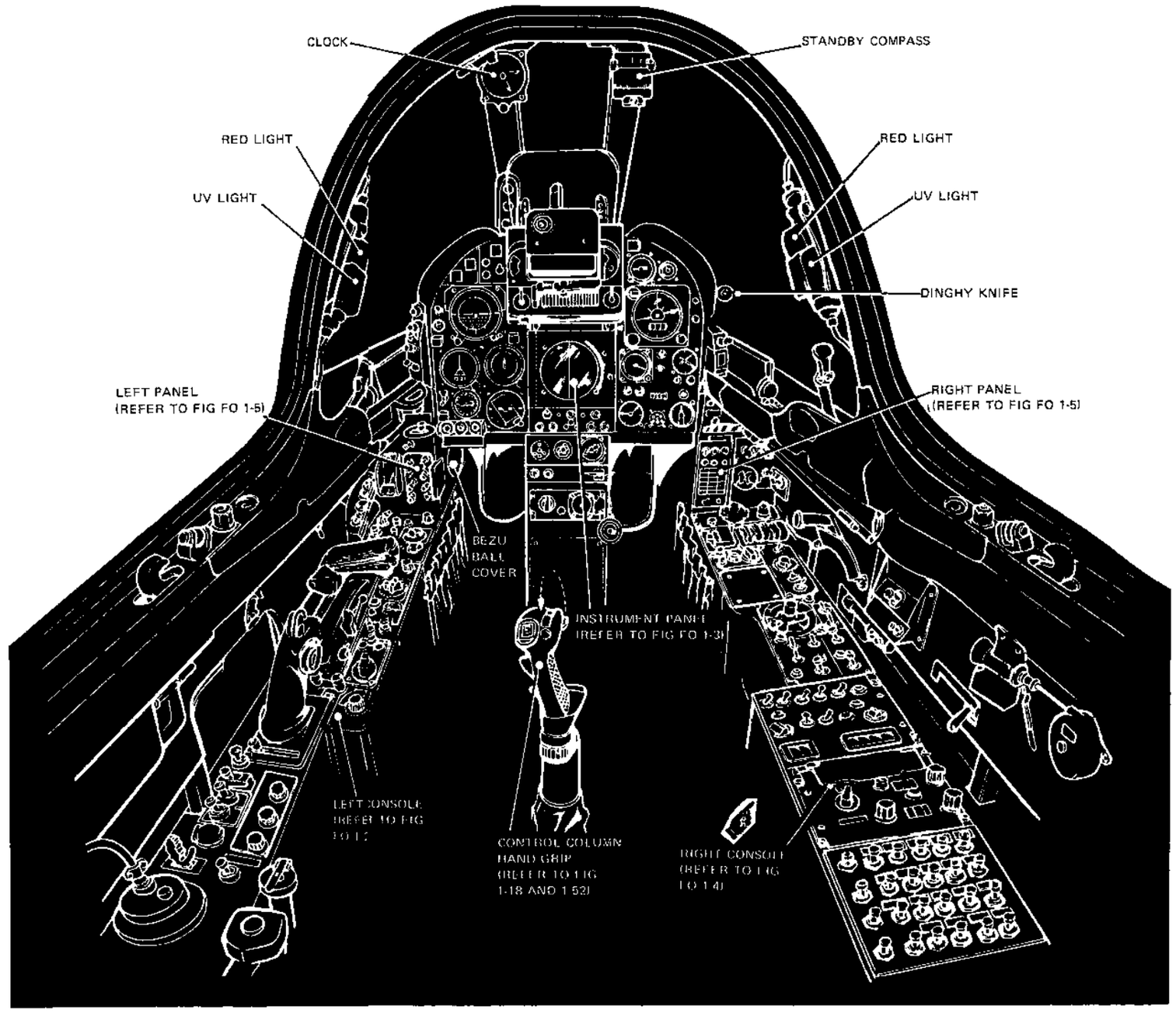


Figure FO 1-1

IIIO Left Console

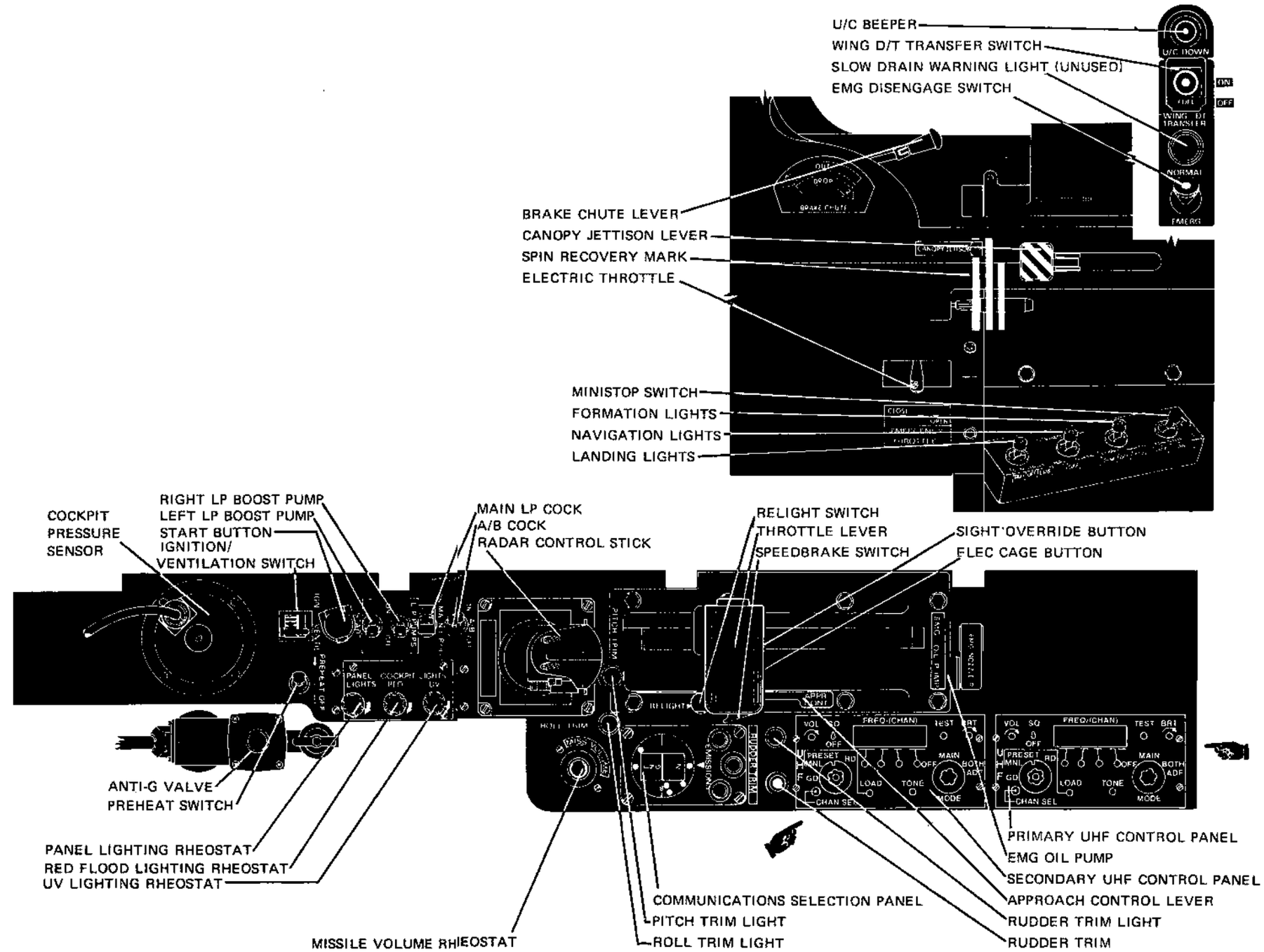


Figure FO 1-2

IIIO Instrument Panel

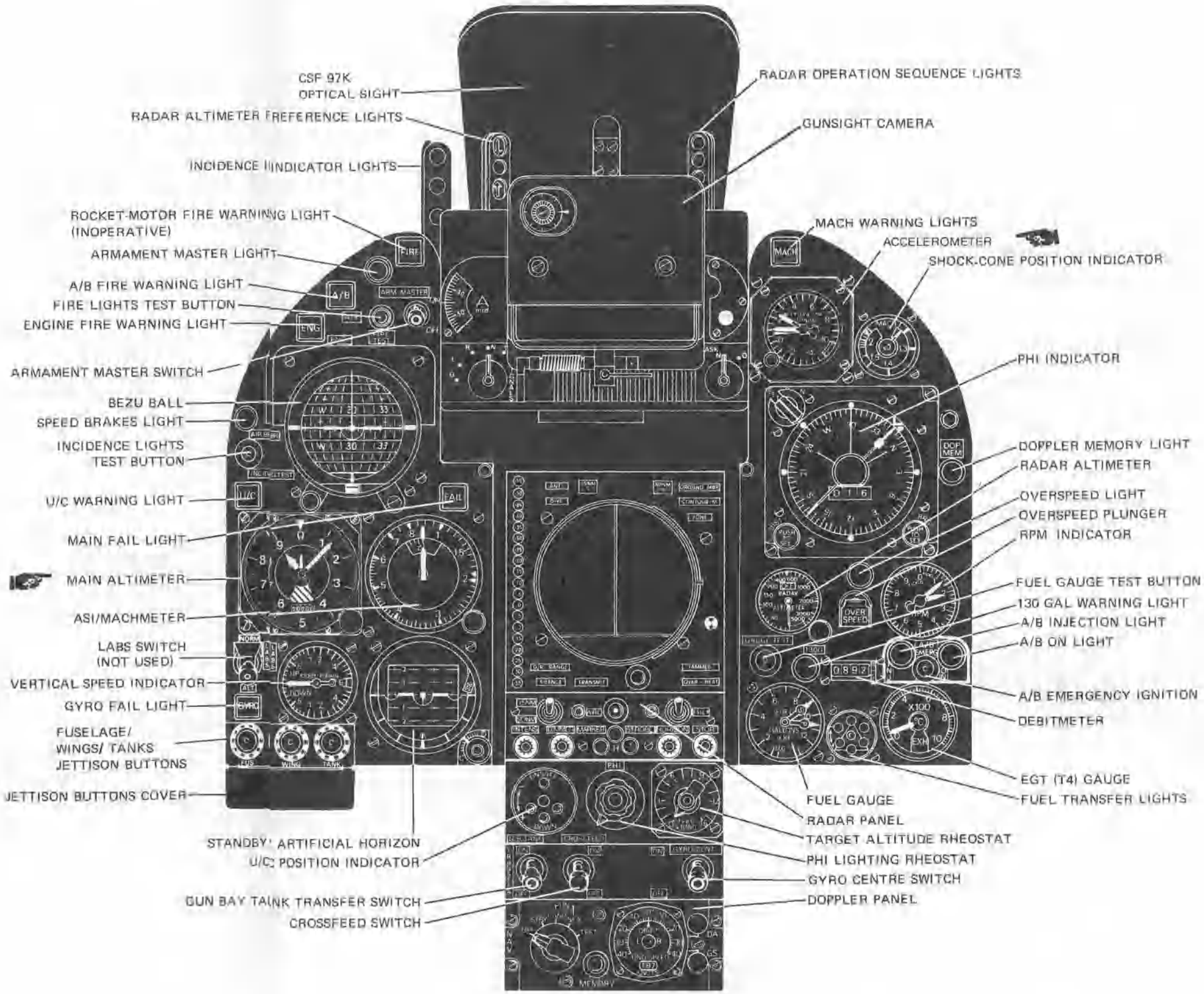


Figure FO 1-3

IIIO Right Console

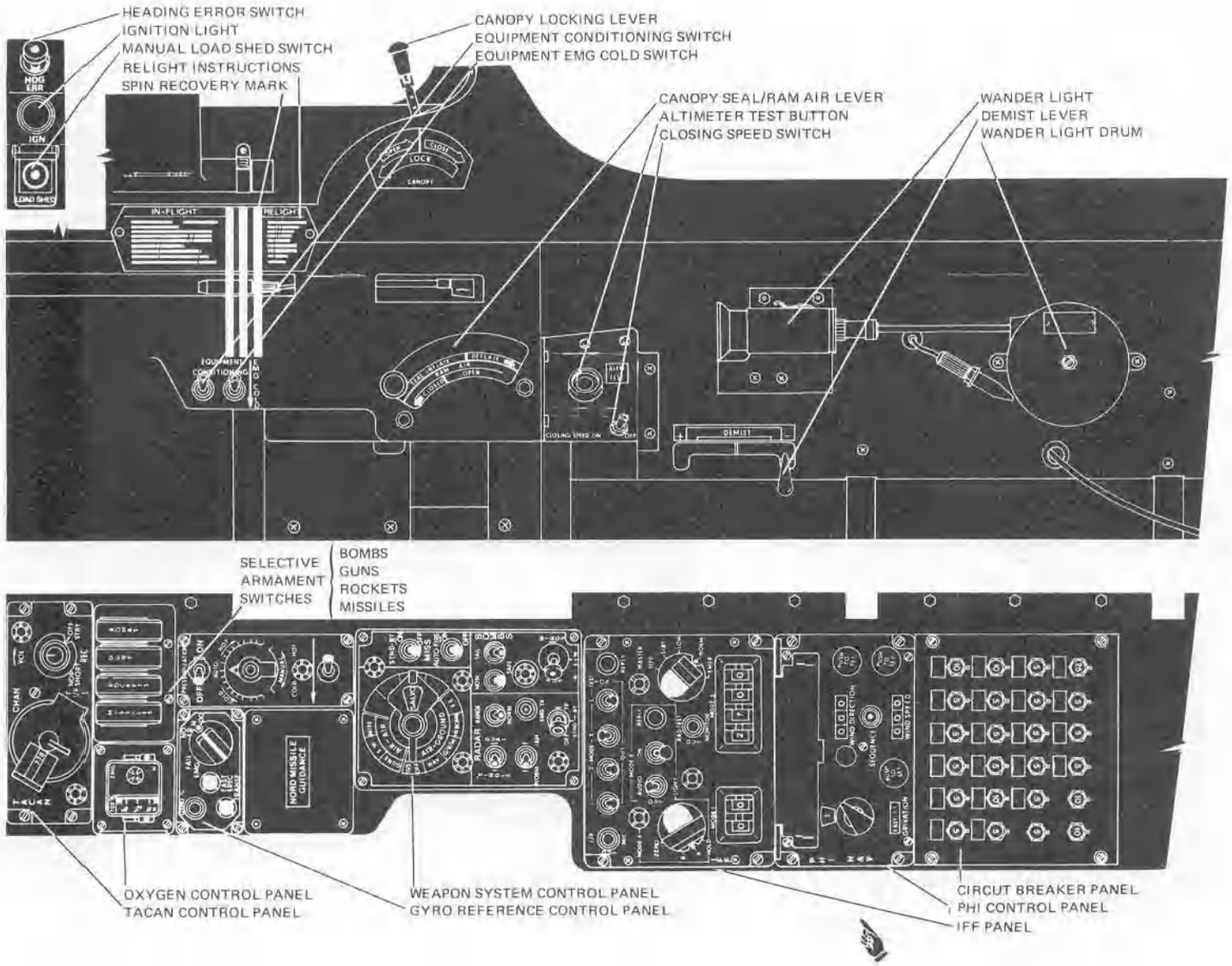


Figure FO 1-4

Left and Right Panels

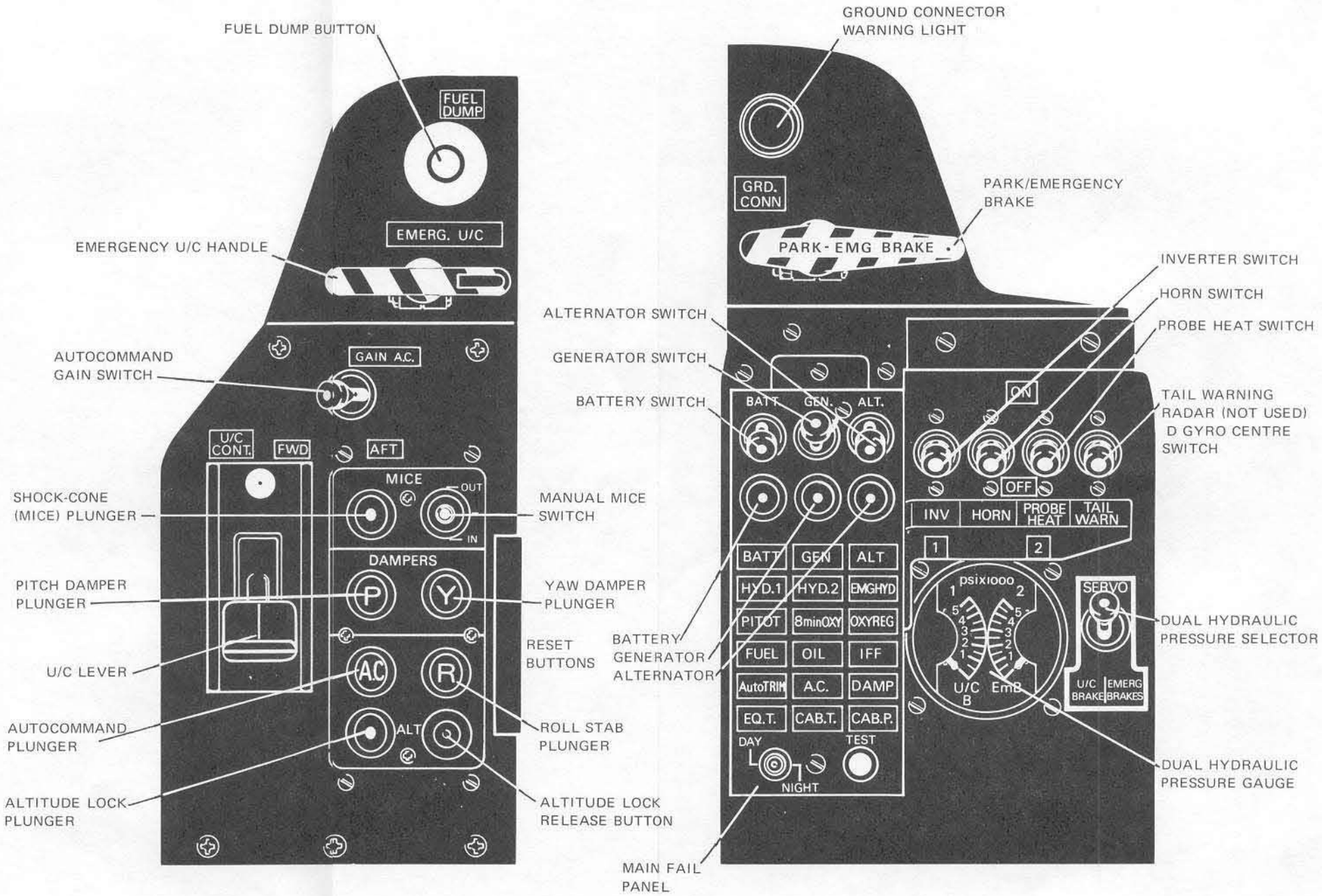


Figure FO 1-5

IIID Left Console - Front

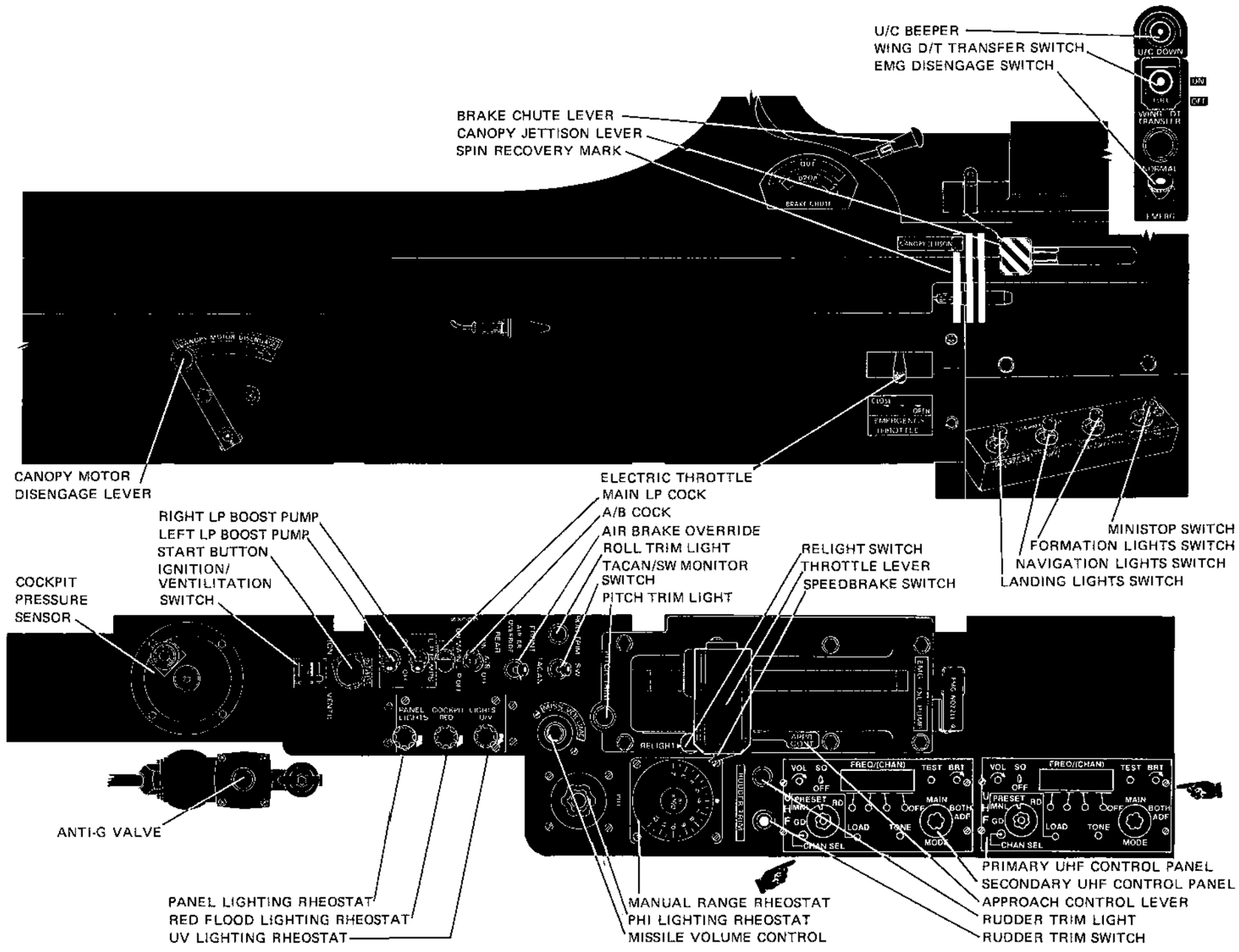


Figure FO 1-6

IIID Instrument Panel - Front

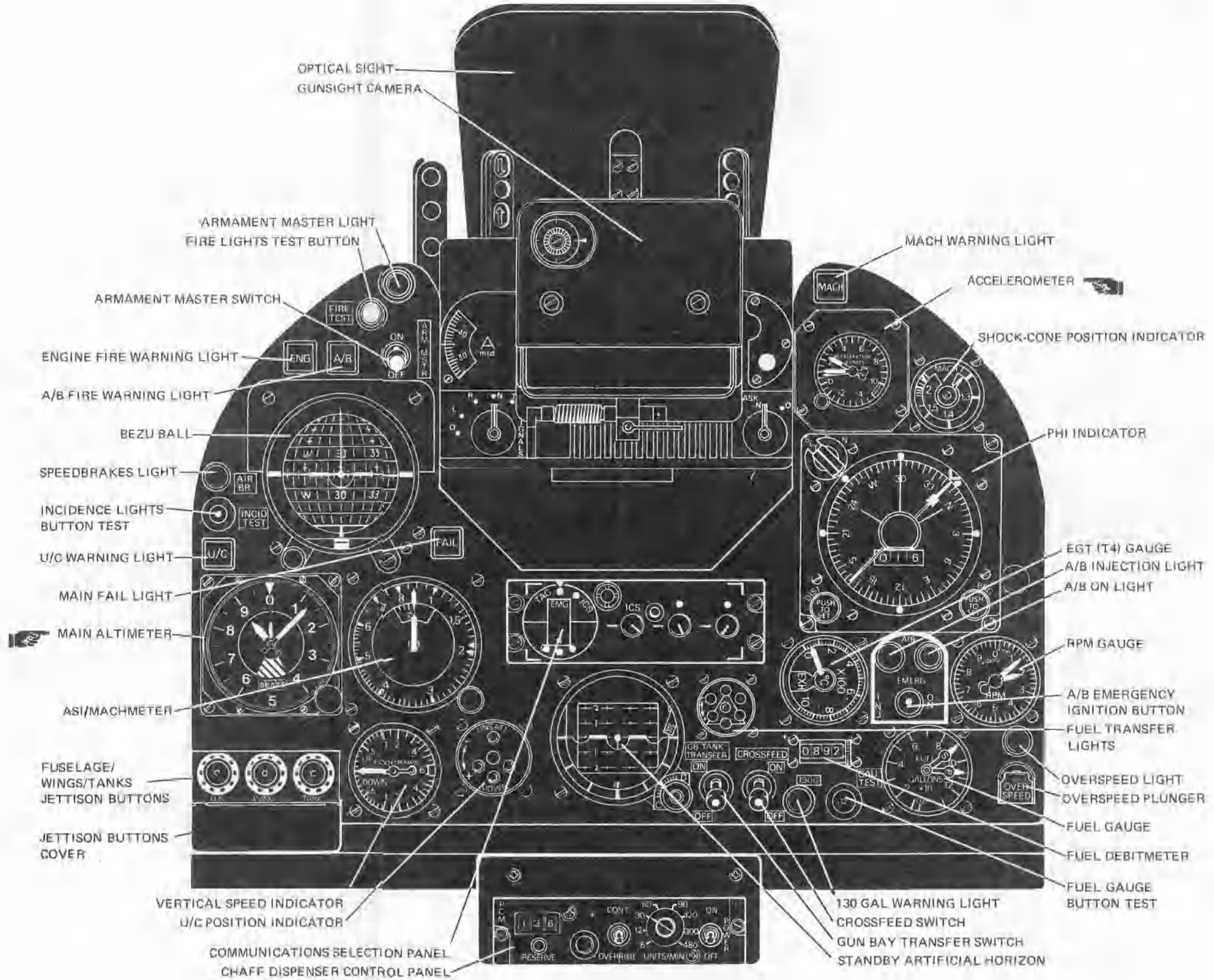


Figure FO 1-7

IIID Right Console - Front

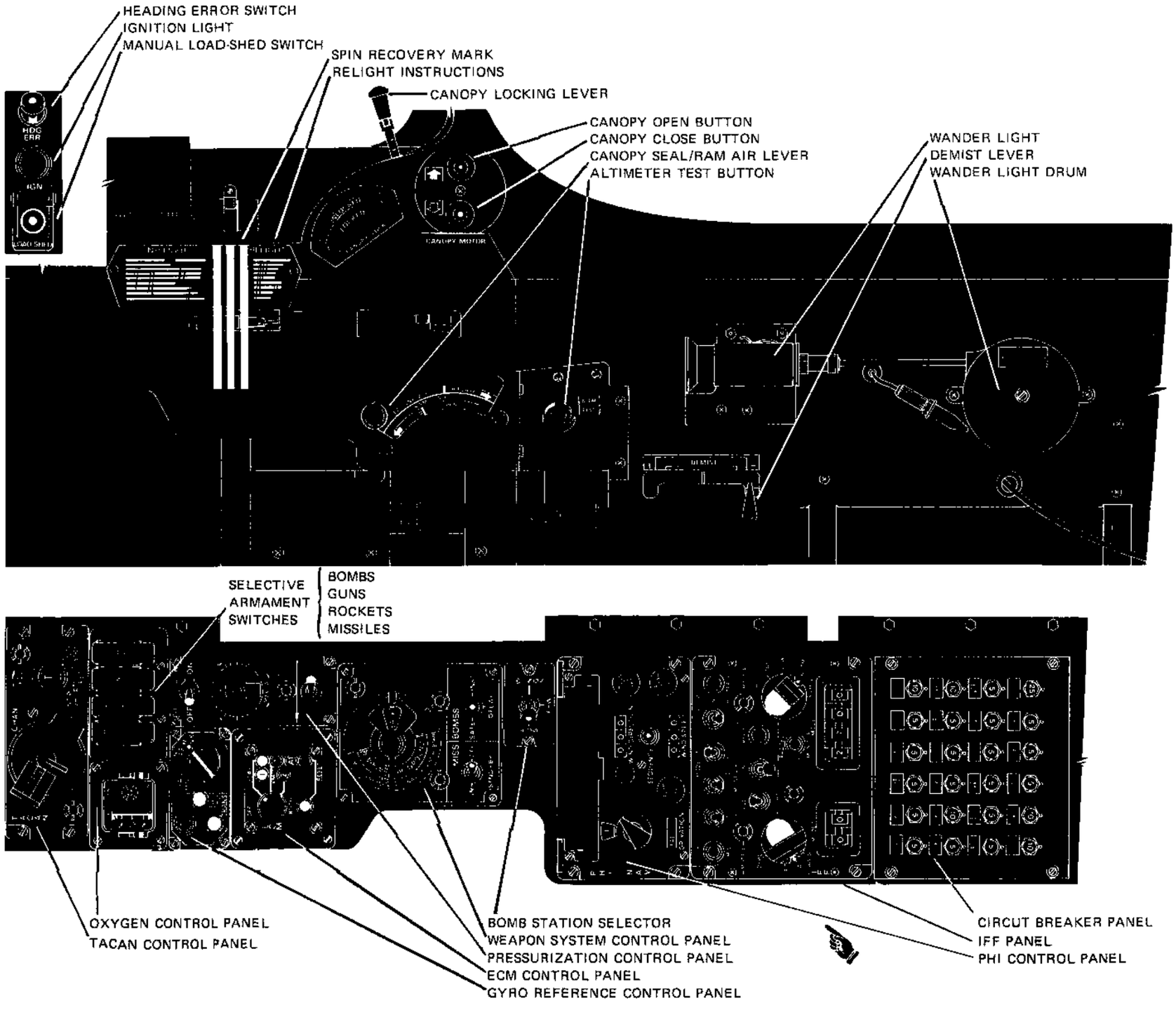


Figure FO 1-8

IIID Left Console - Rear

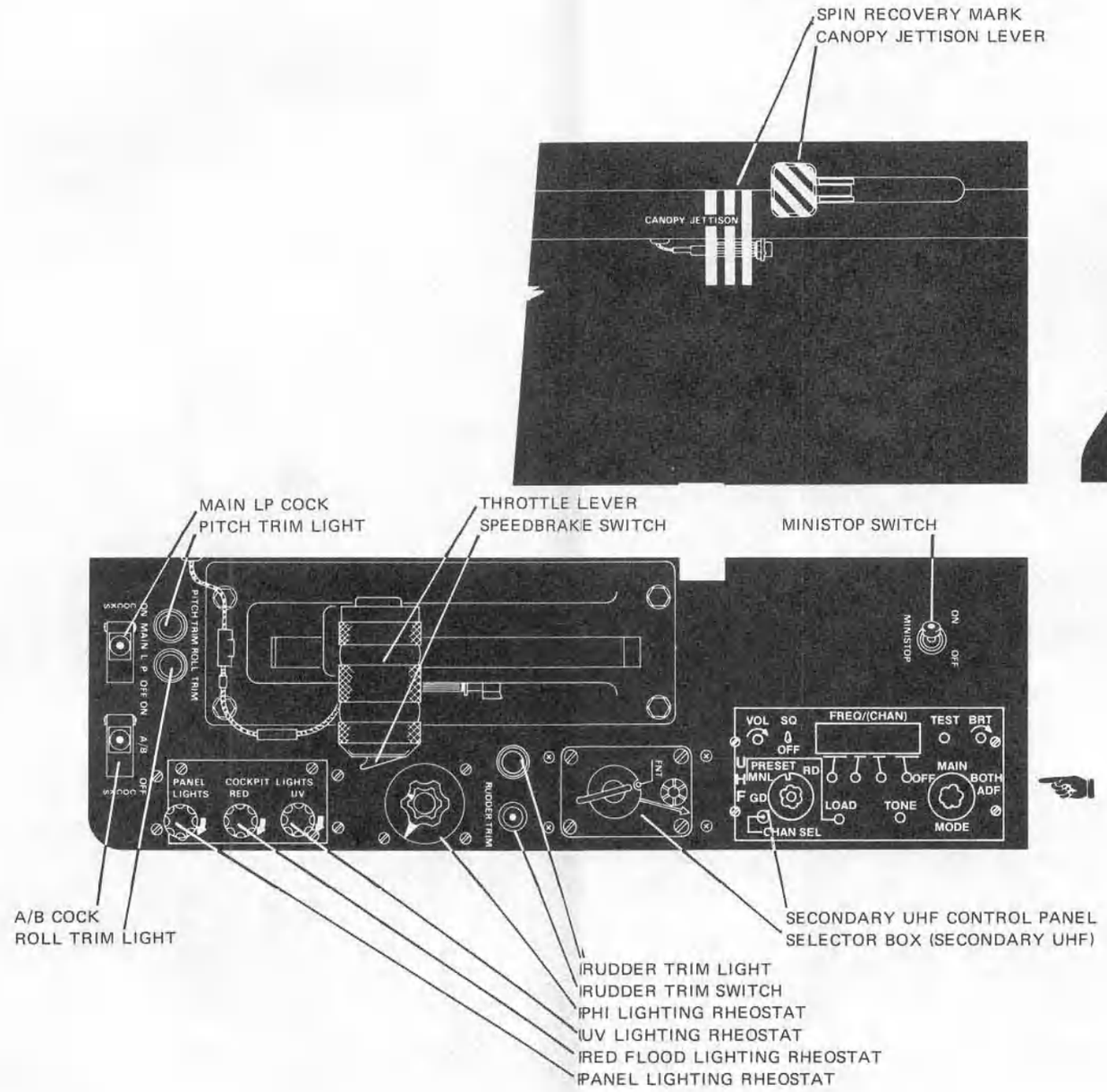


Figure FO 1-9

IIID Instrument Panel - Rear

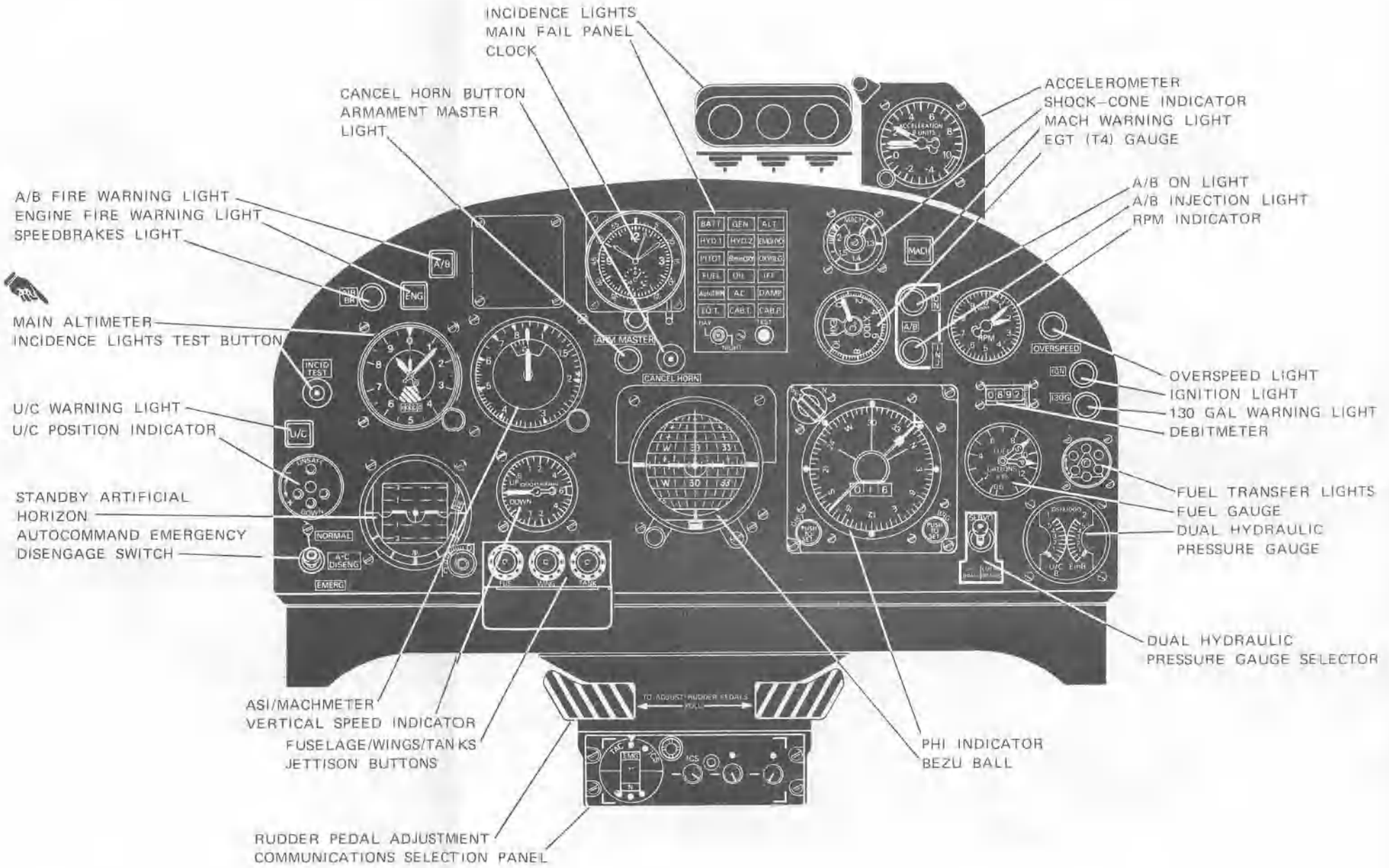
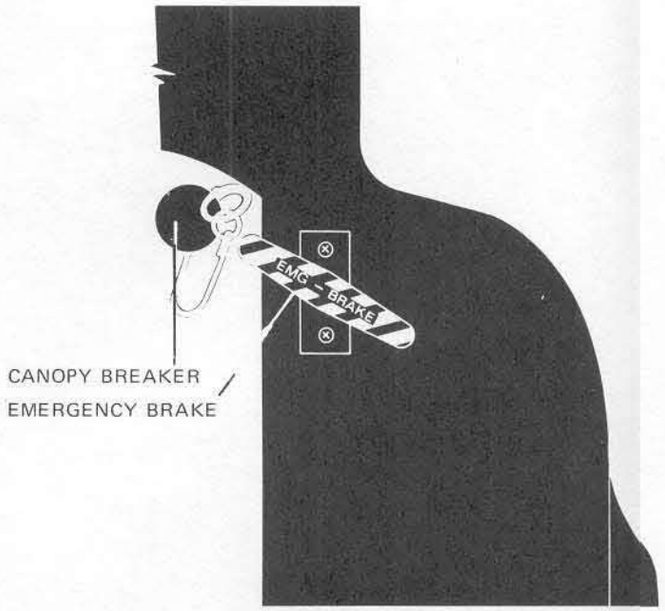


Figure FO 1-10

IIID Right Console - Rear



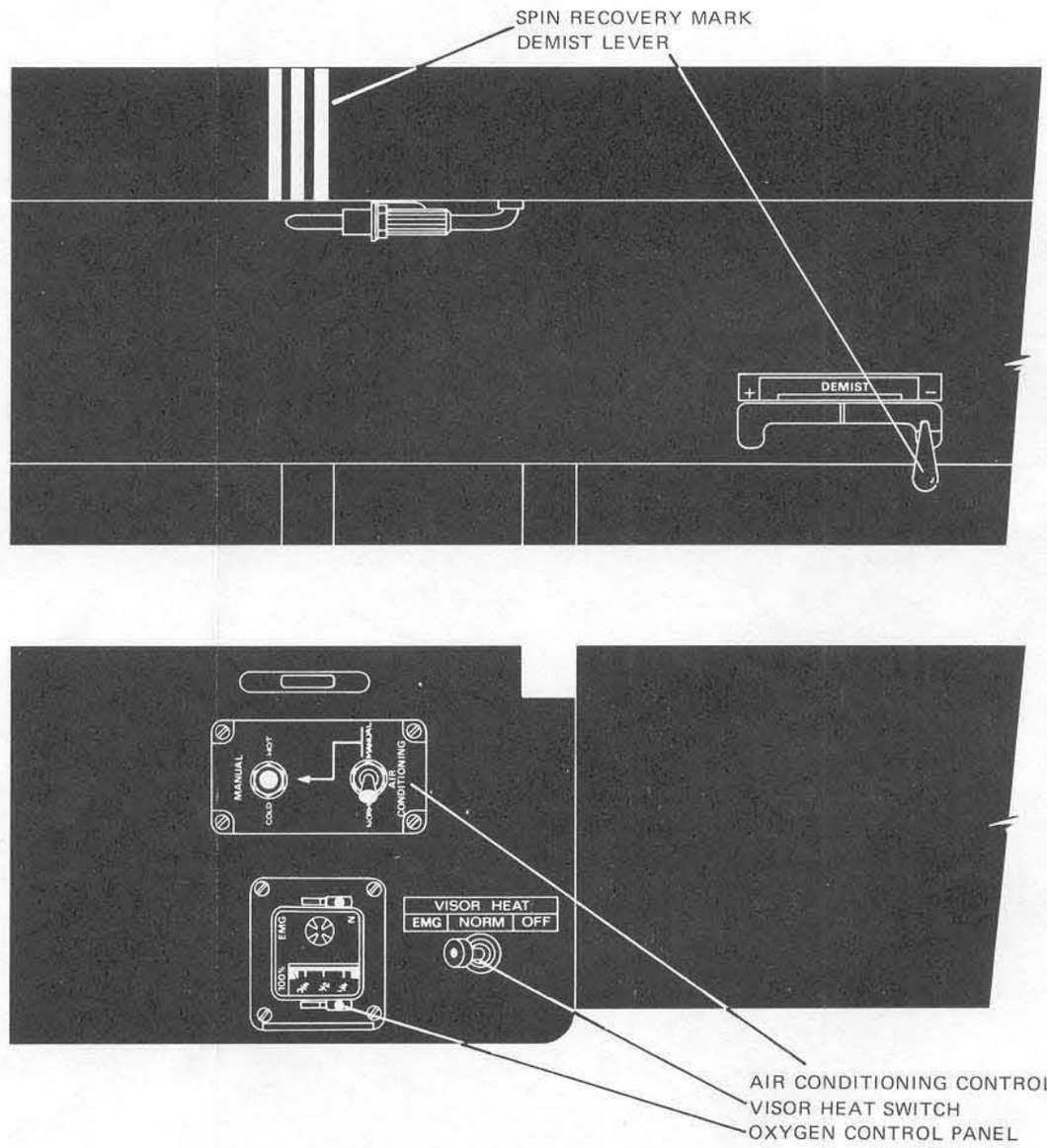


Figure FO 1-11

Engine Fuel Control System

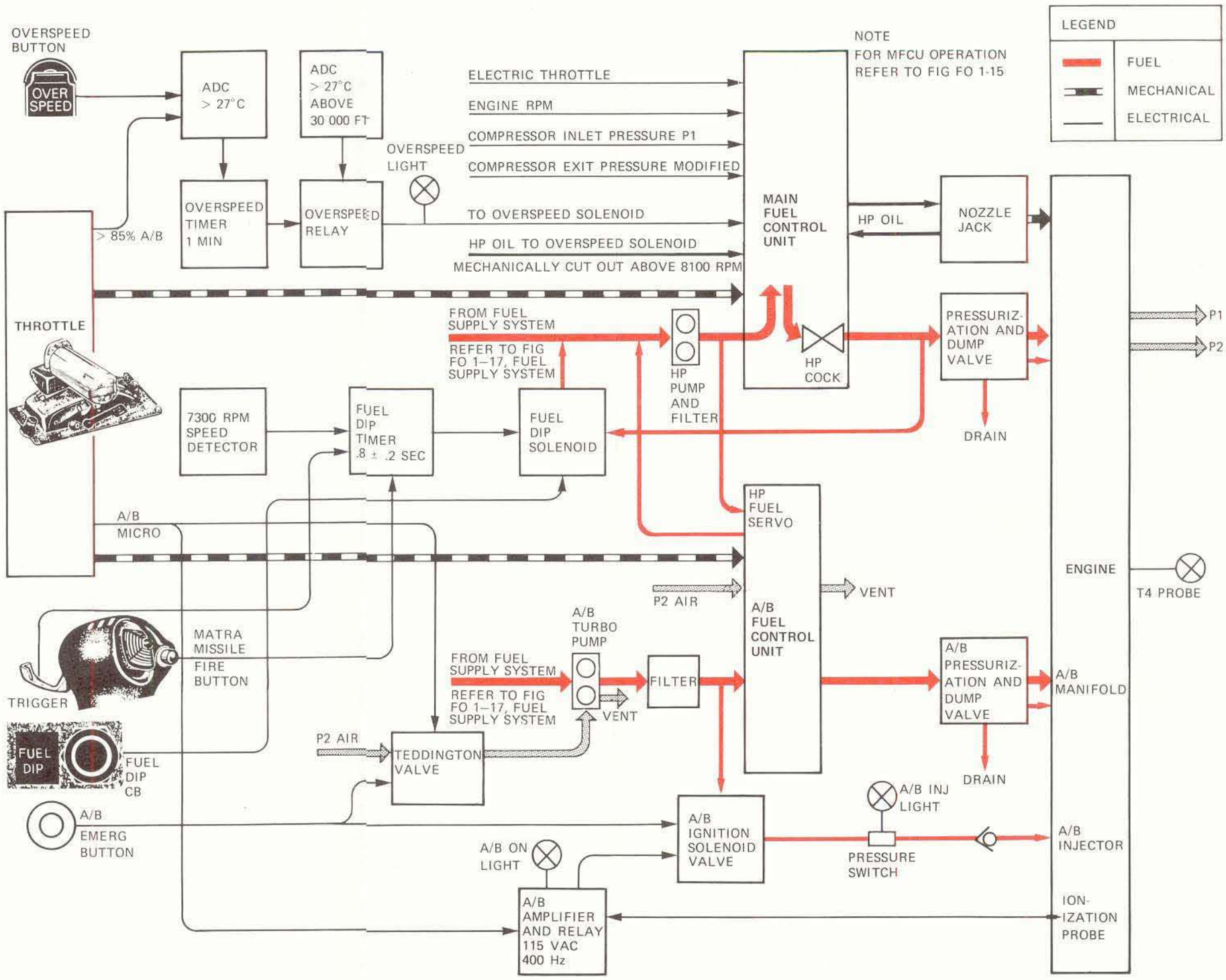


Figure FO 1-12

Starting System

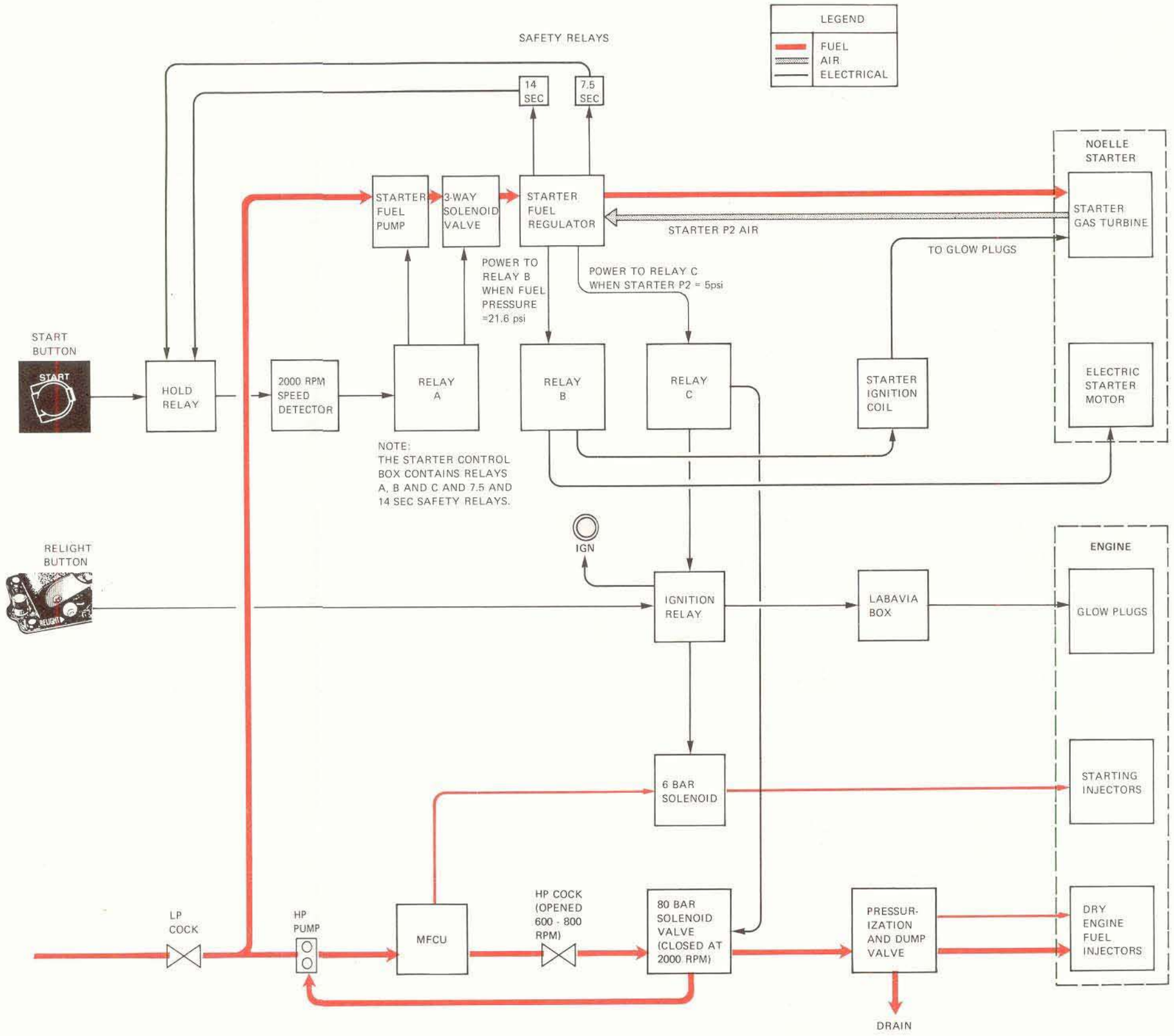


Figure FO 1-13

Starting Cycle

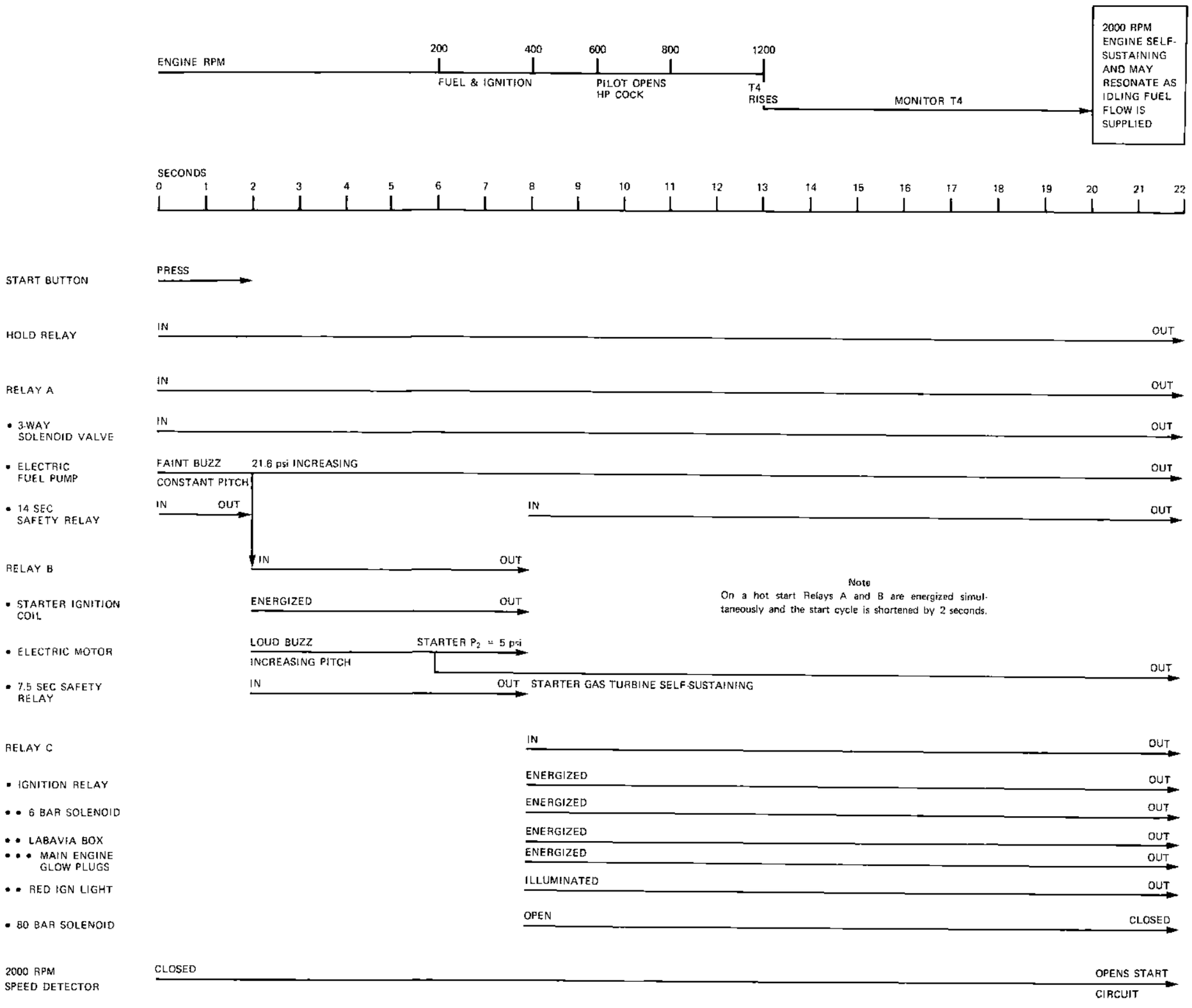


Figure FO 1-14

Normal and Emergency Fuel Regulation

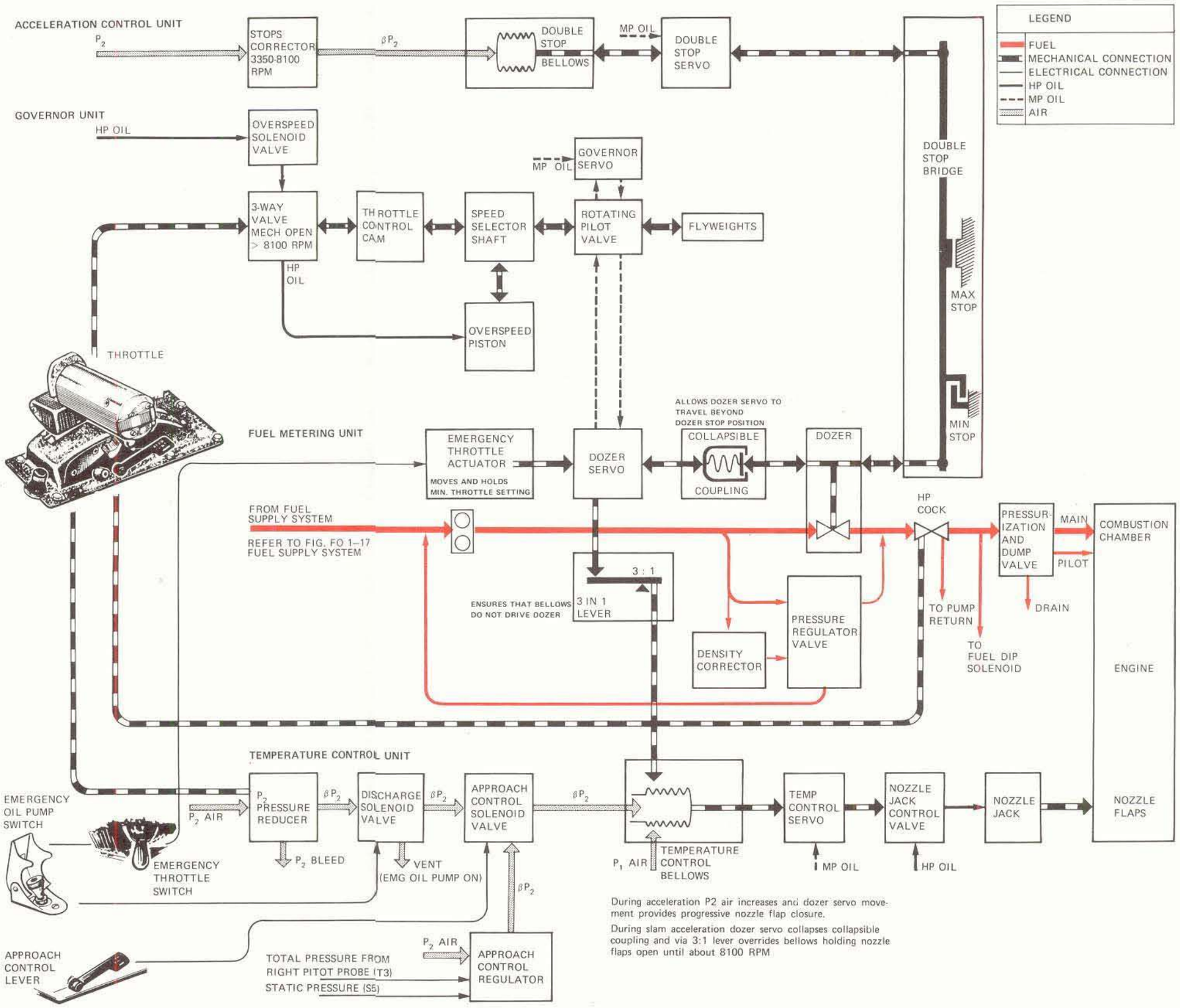


Figure FO 1-15

Oil System

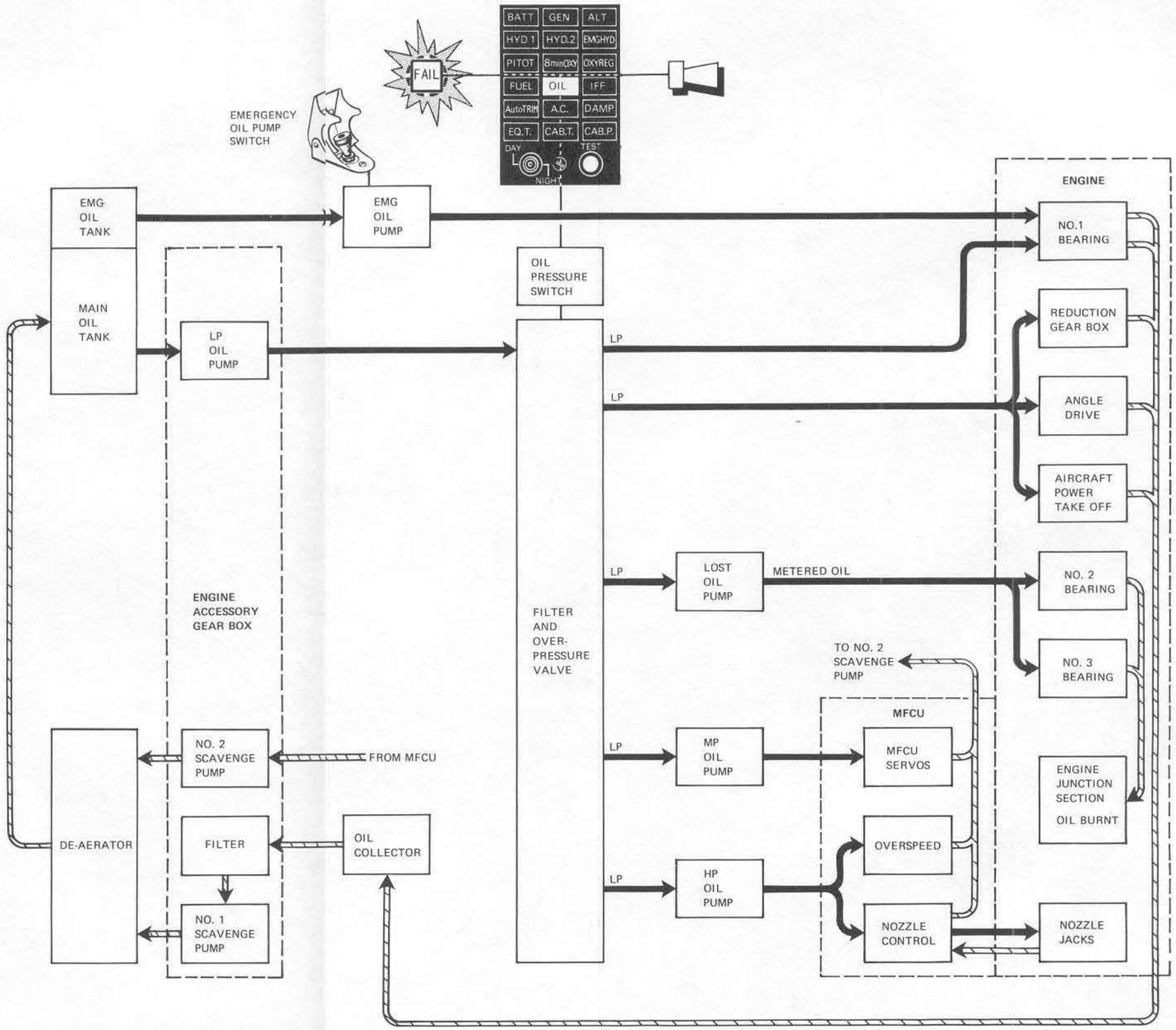


Figure FO 1-16

Fuel Supply System

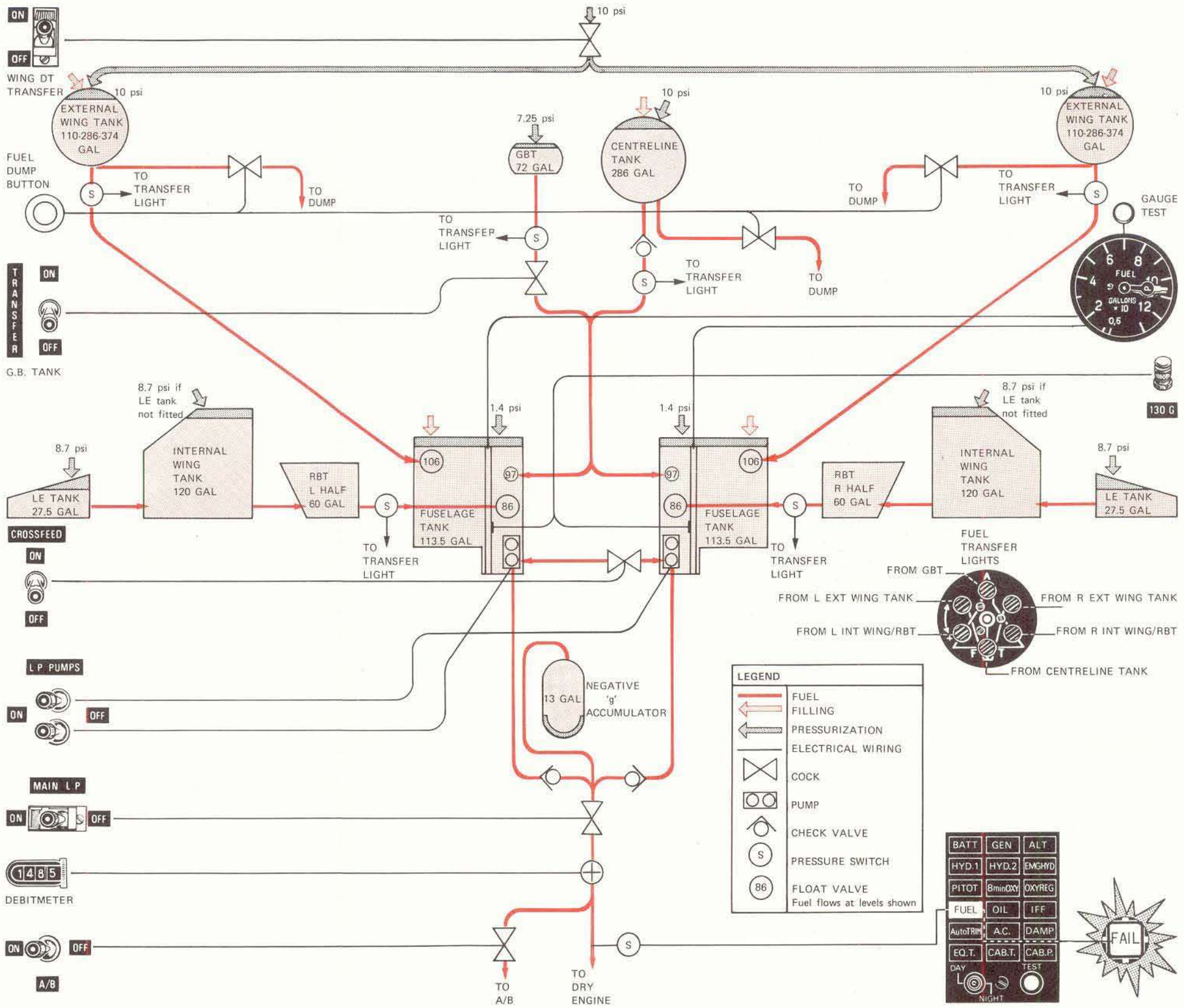


Figure FO 1-17

Electrical System - Typical

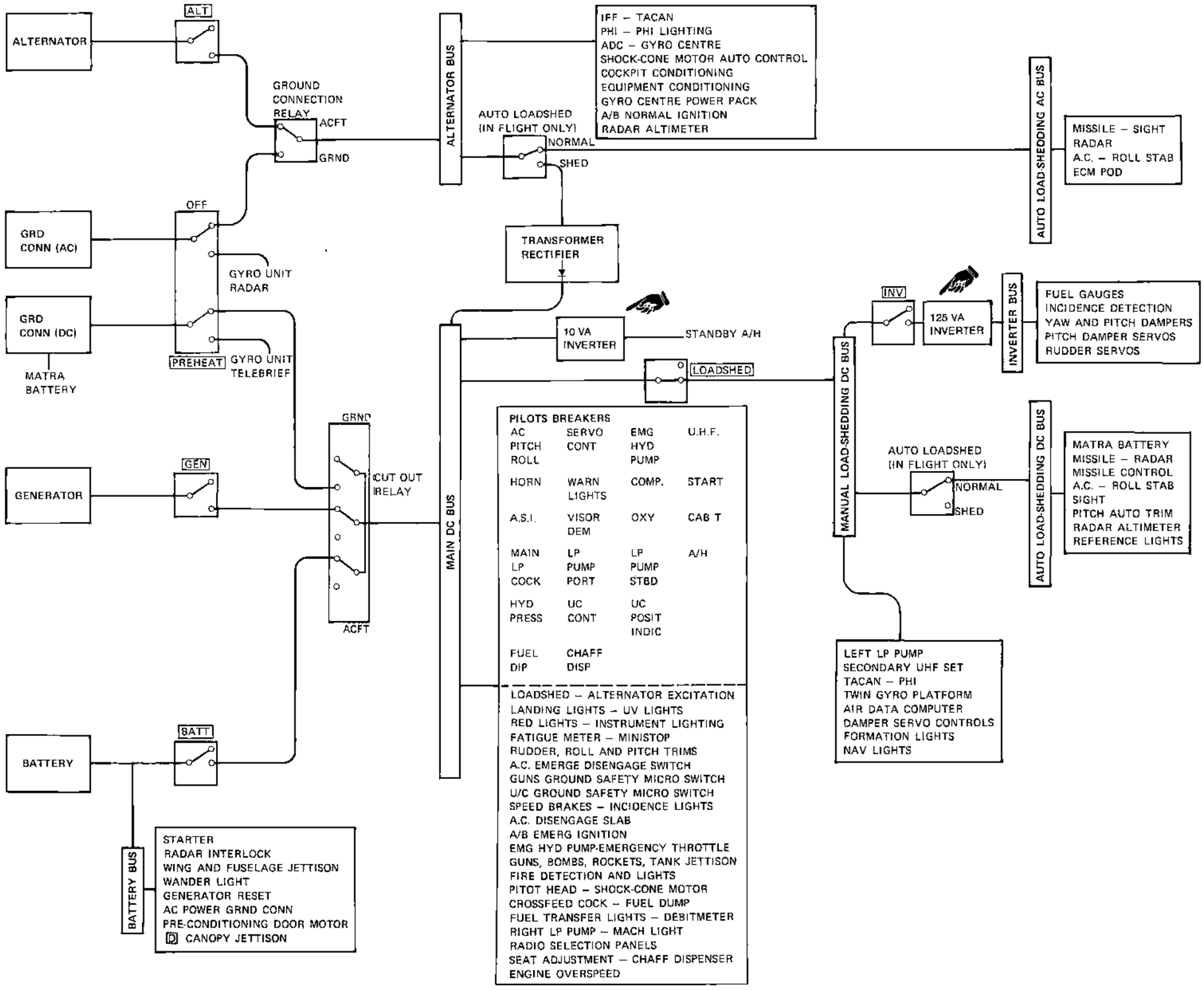


Figure FO 1-18

Hydraulic Systems

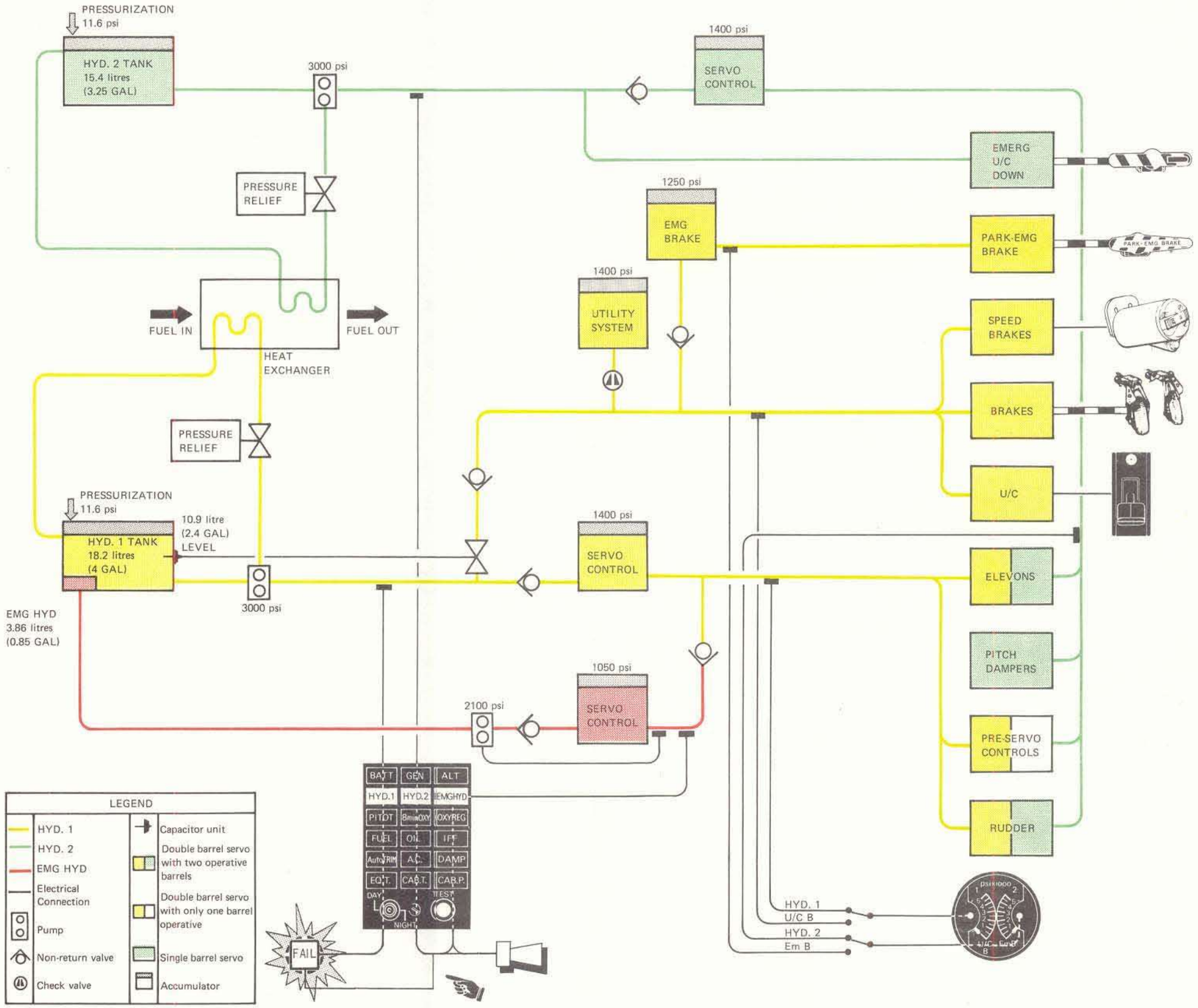


Figure FO 1-19

Mechanical Operation - Pitch and Roll

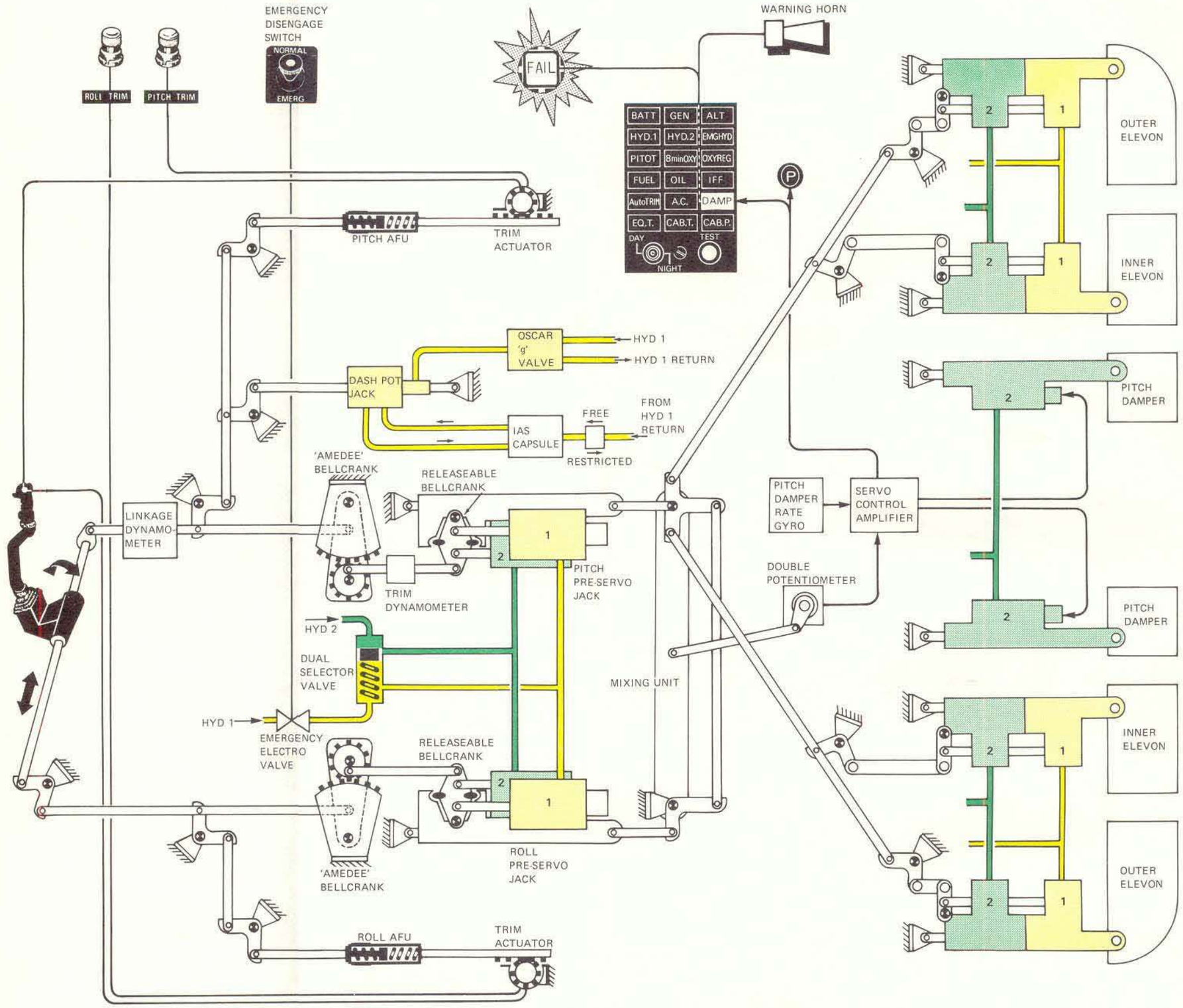


Figure FO 1-20

Autocommand with Altitude Lock

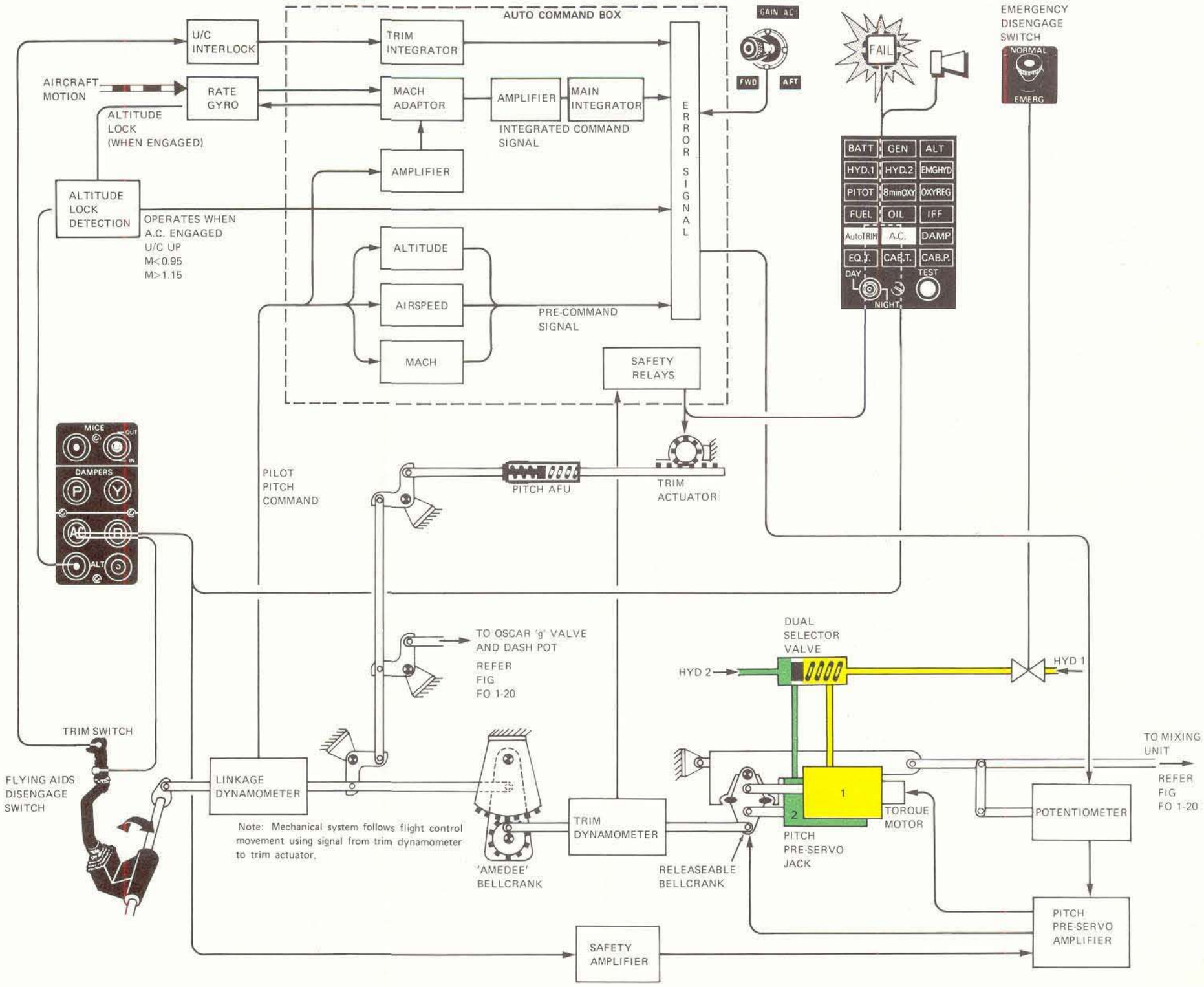


Figure FO 1-21

Roll Stabilization

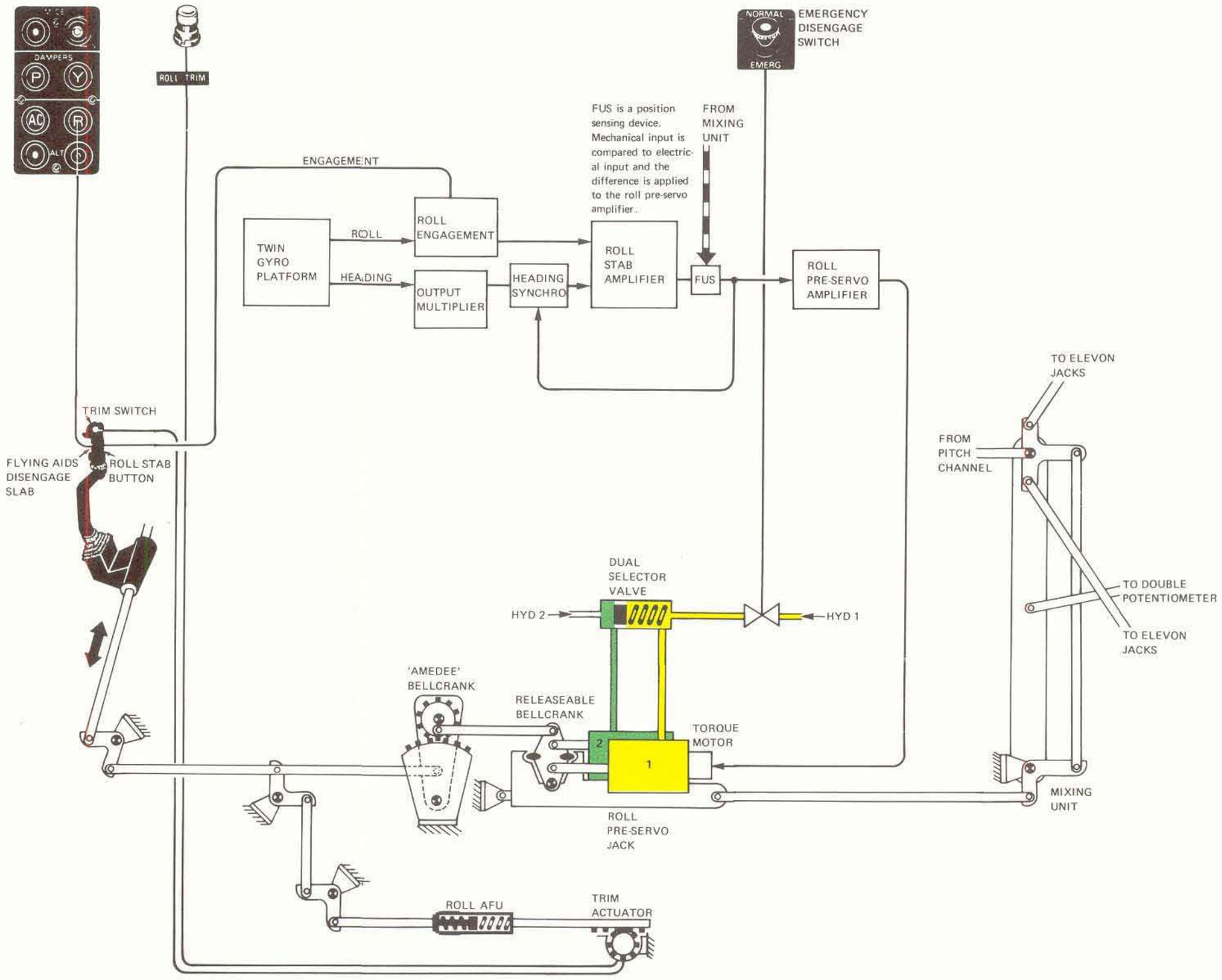


Figure FO 1-22

Ejection Seat Operation Sequence

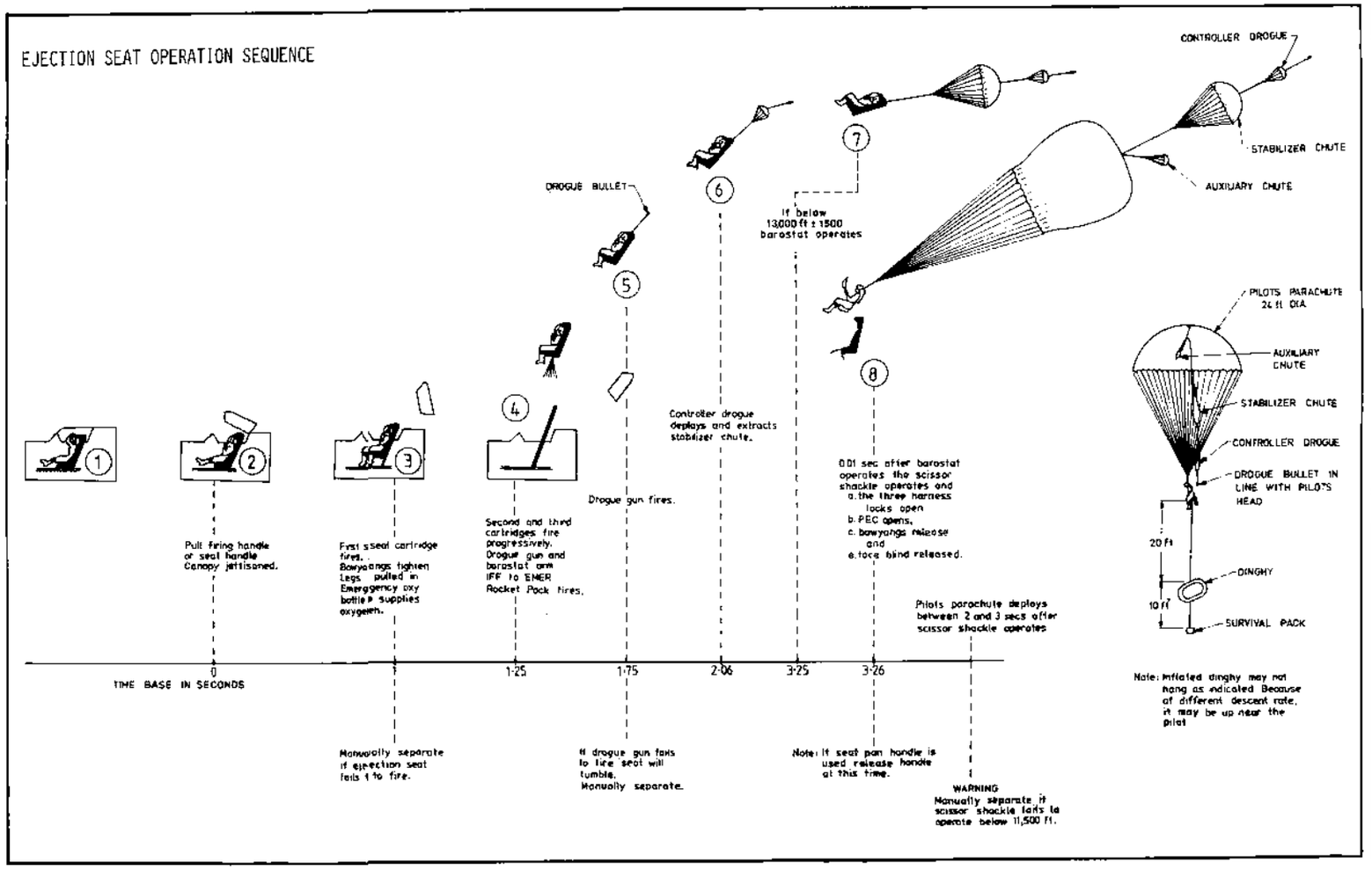


Figure FO 1-23

Cockpit Air Conditioning and Pressurization System

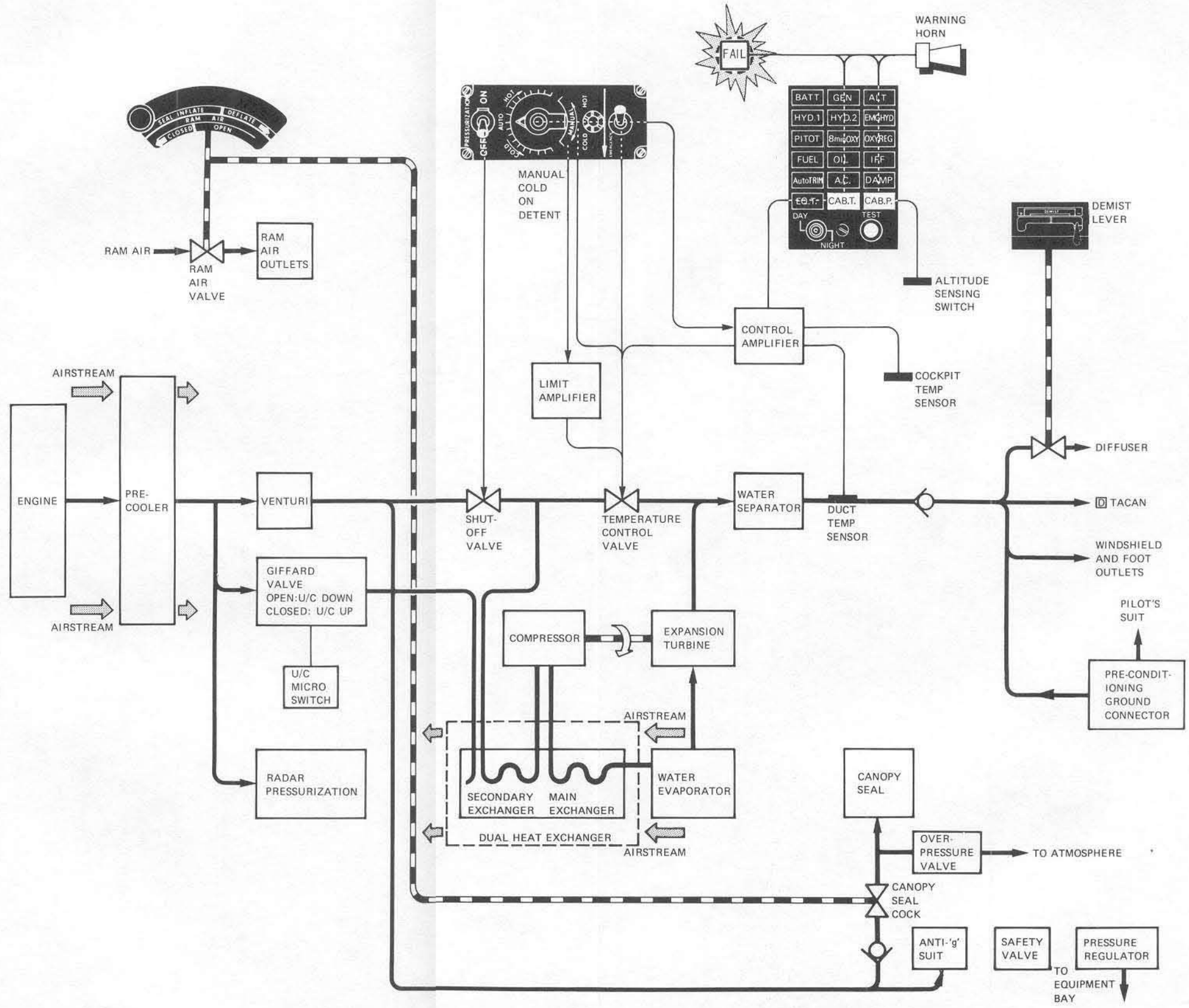


Figure FO 1-24

Equipment Air Conditioning System

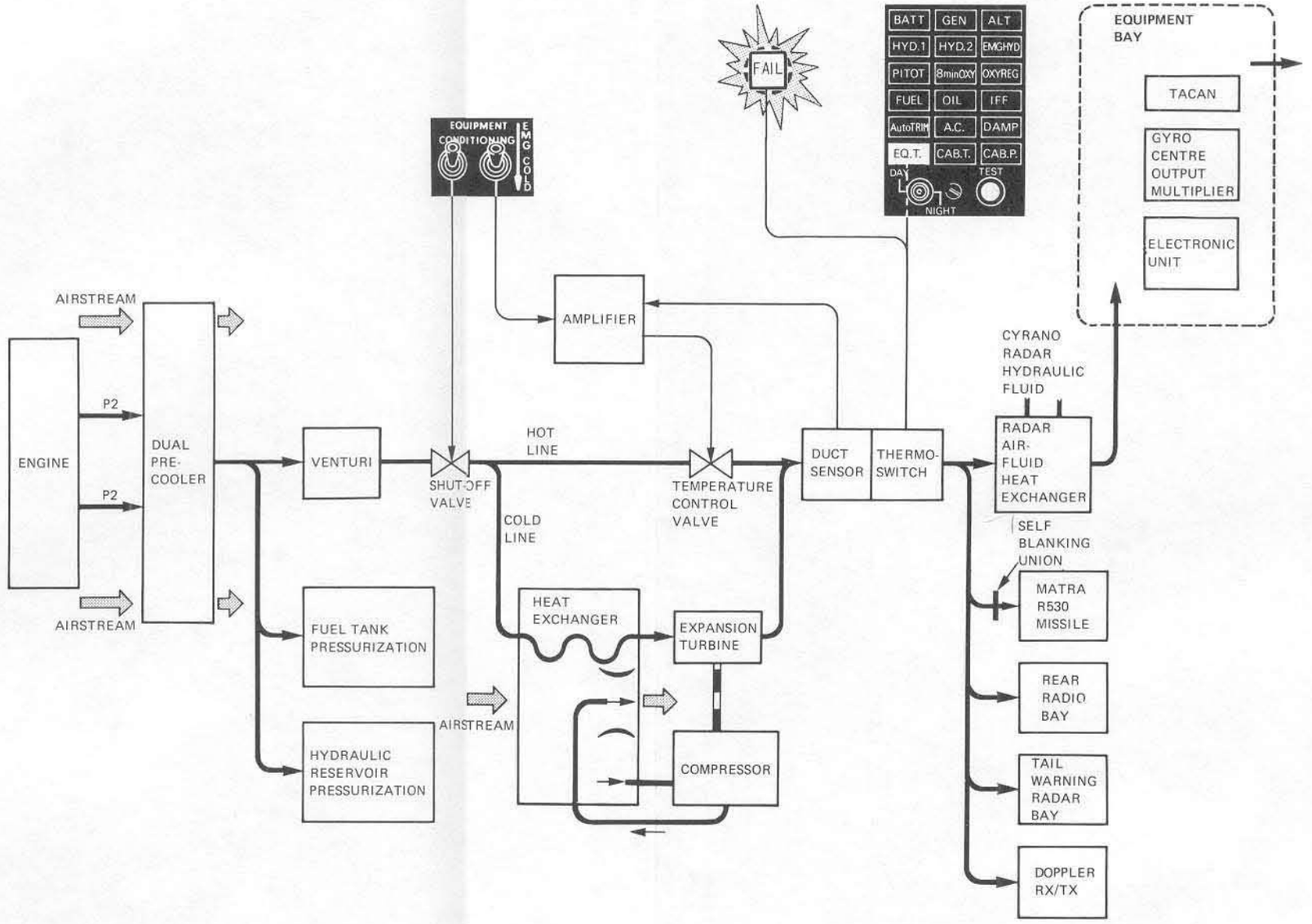


Figure FO 1-25

IIIO Weapon System Installation

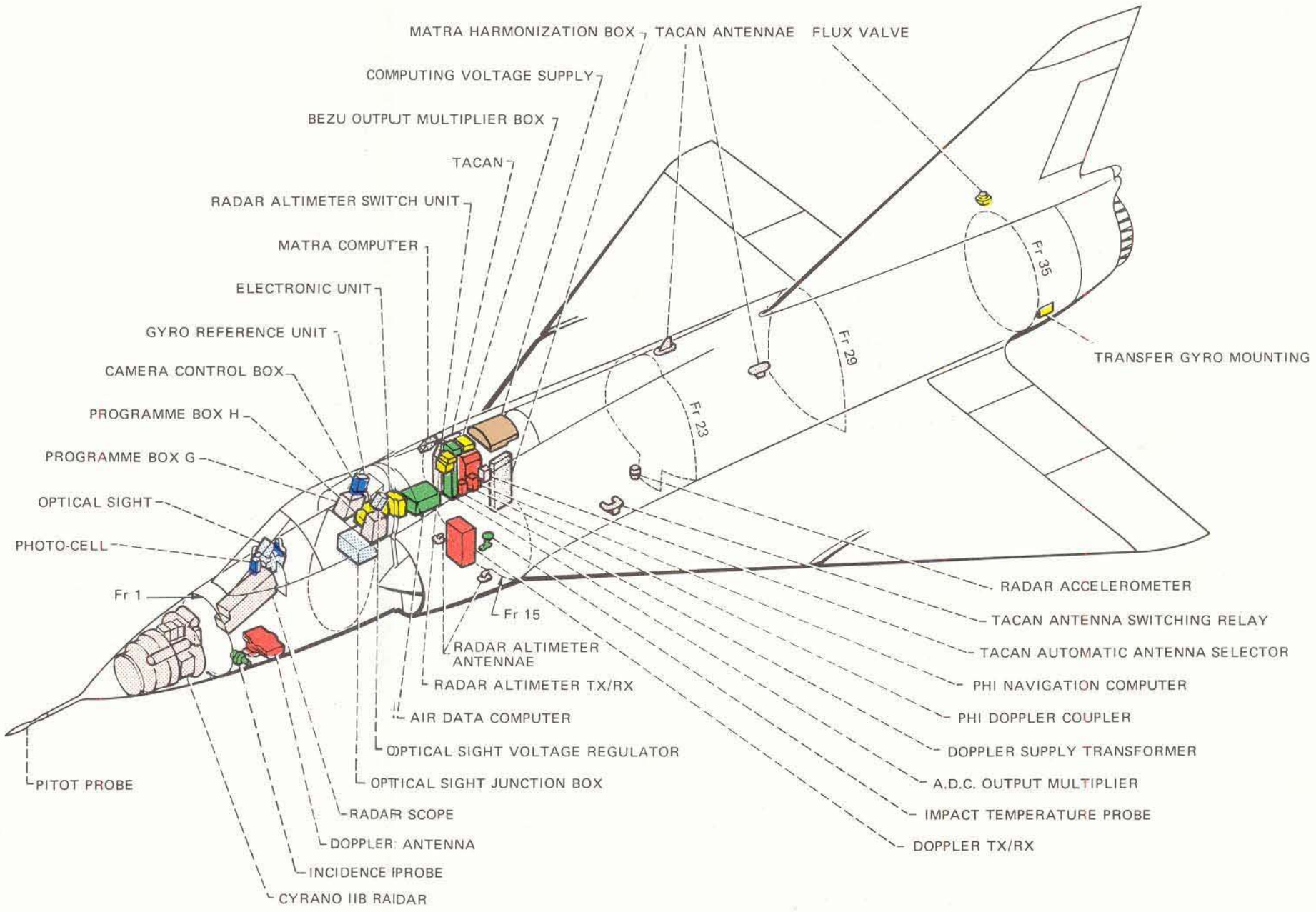
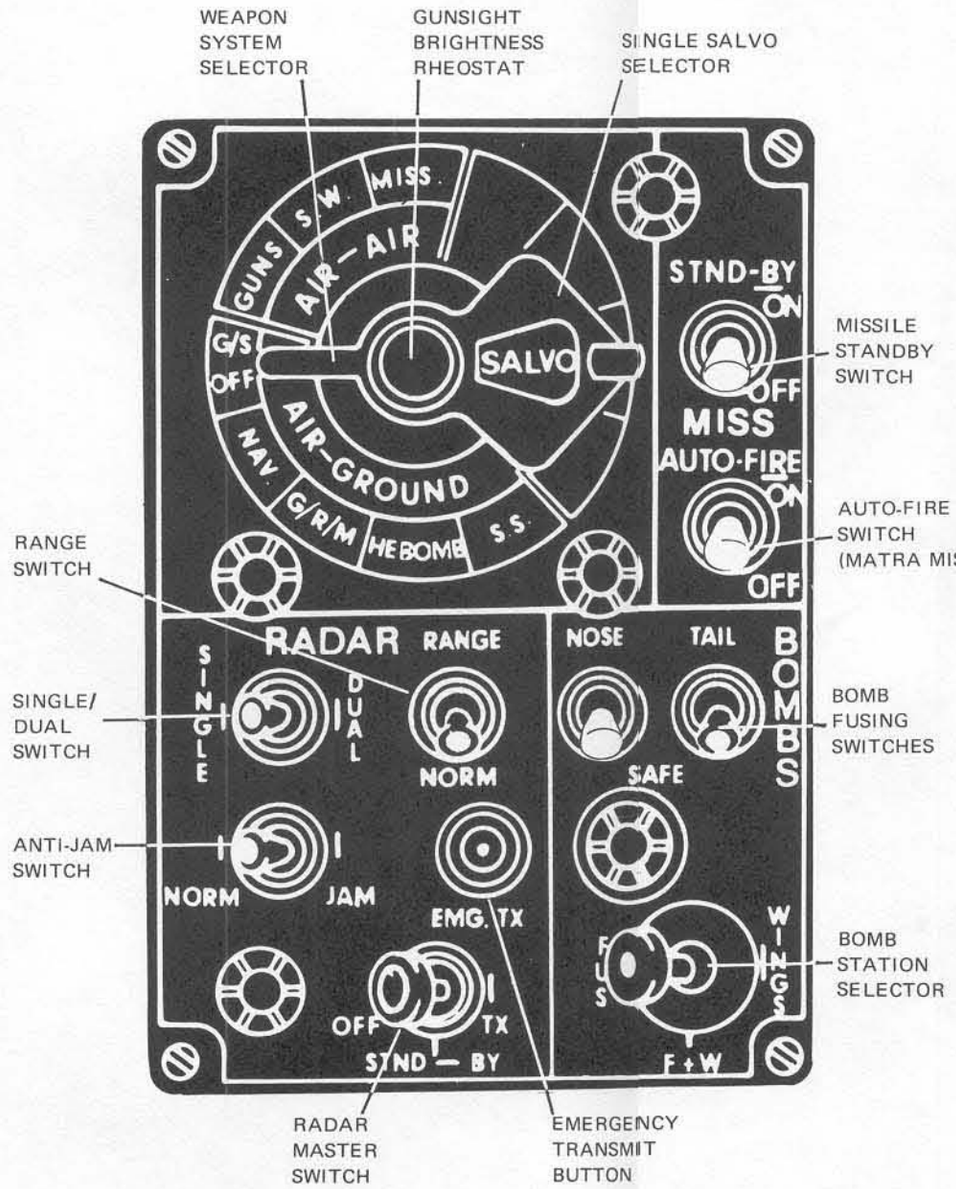


Figure FO 1-26

Weapon System Control Panel

IIIO



IIID

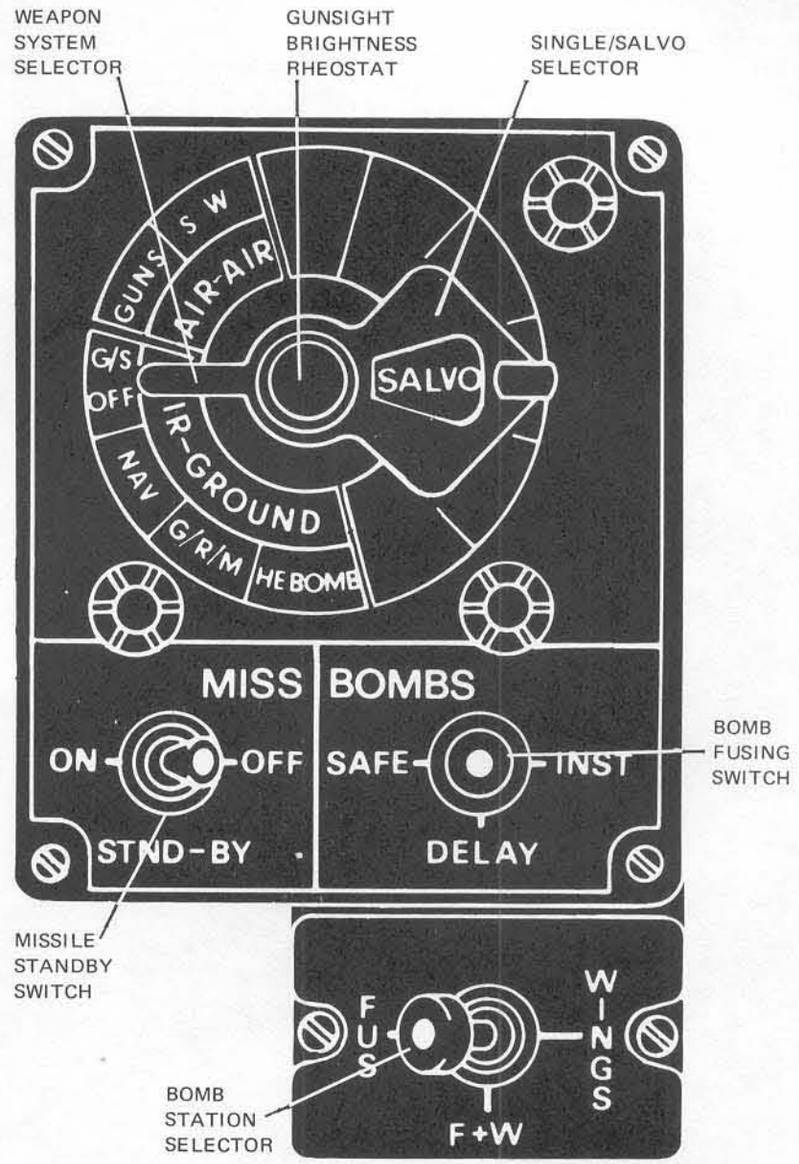


Figure FO 1-27

Weapon System Control Panel - Operation Diagram

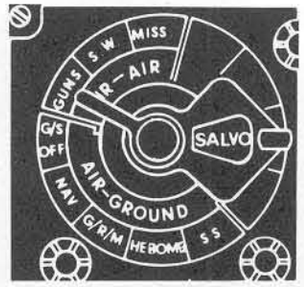


MISS
Sight : On
Radar : Air to Air function.
Matra : Selection of radar computer and firing system.





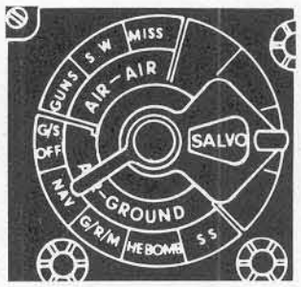
S.W.
Sight : On.
Radar : Air to Air function.
S.W. : Selection of radar computer and firing system.
Single : The left missile is launched first.
Salvo : The left missile is launched 2 sec. after the right one.



GUNS
Sight : On
Radar : Air to Air function.
Guns : Radar computer in Guns.



G/S OFF
Sight : Off.
Camera : Off.
Radar : Air to Ground function.

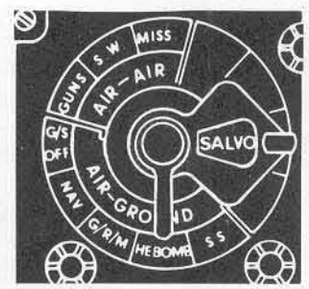


NAV
Sight : In navigation mode.
Radar : Air to Ground function.

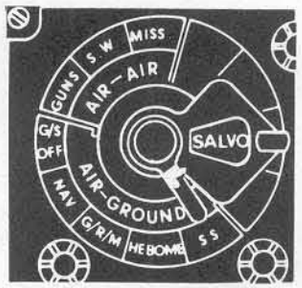


G/R/M
Sight : On (Adjustable sight depression)
Radar : Air to Ground function.
Further selection by armament switches.





HE BOMB
Sight : On (Adjustable sight depression)
Radar : Air to Ground function.
Single : At each press of button:
a. Either 1,2 or 4 bombs from RPK 10 (number selected on pre-flight), or:
b. One bomb from PM-3
Salvo: Bomb release at 0.15 sec. intervals from alternate RPK10.
Bomb release at 0.3 sec. intervals from PM-3



S.S.
Special store selection.
(not used)

Figure FO 1-28

Radar Panel

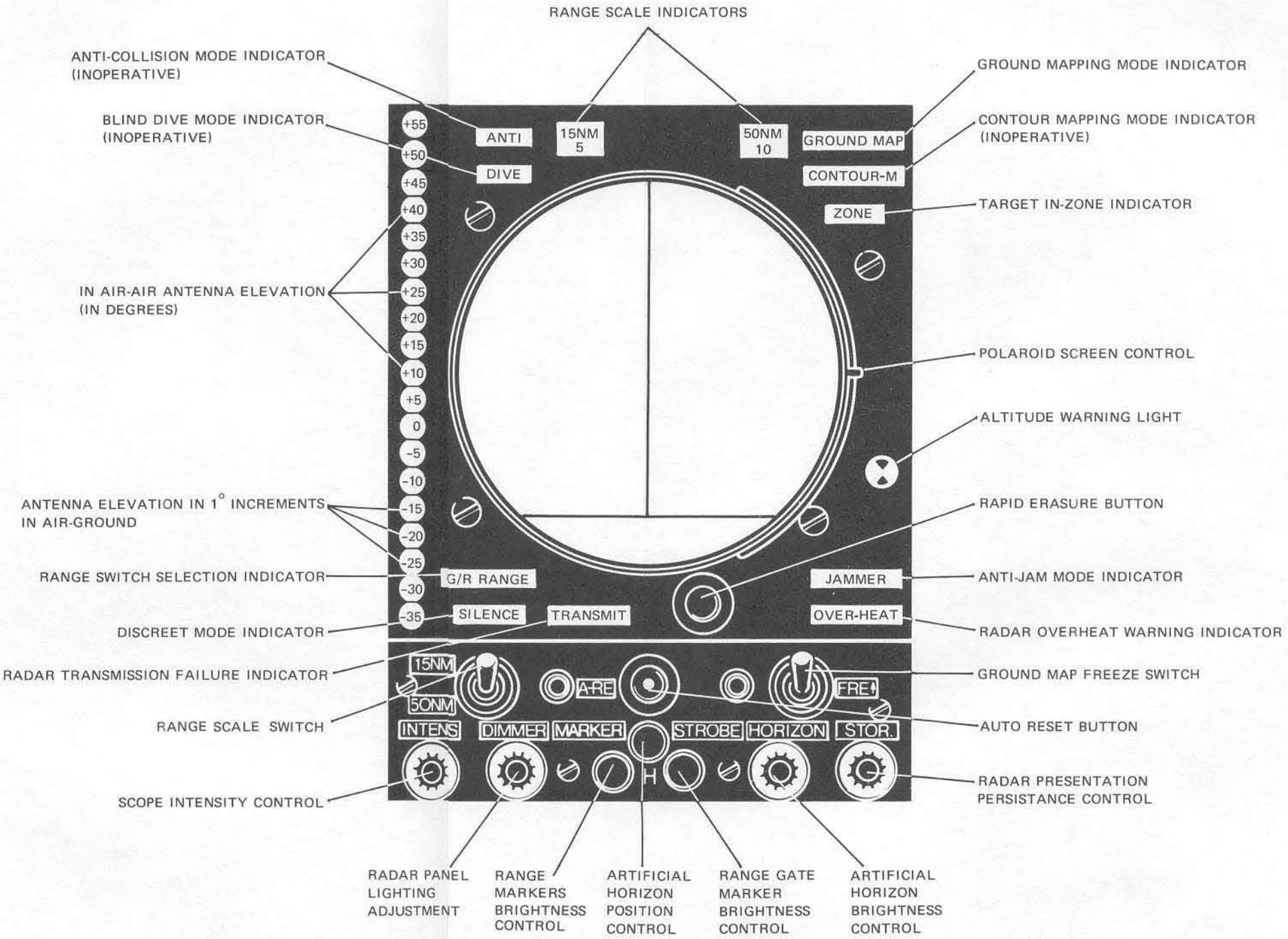


Figure FO 1-29

Radar Control Stick

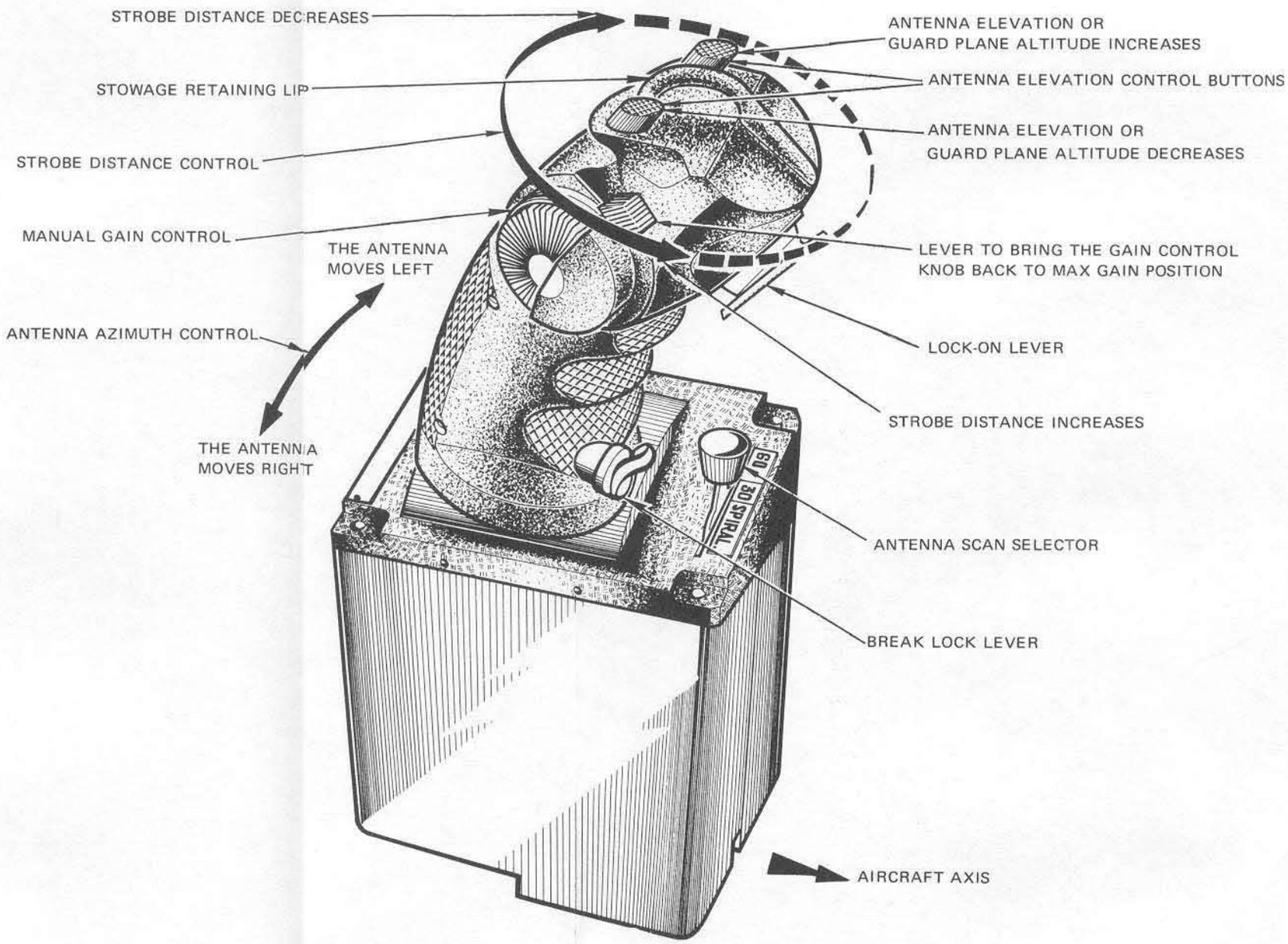


Figure FO 1-30

Weapon System - Air to Air

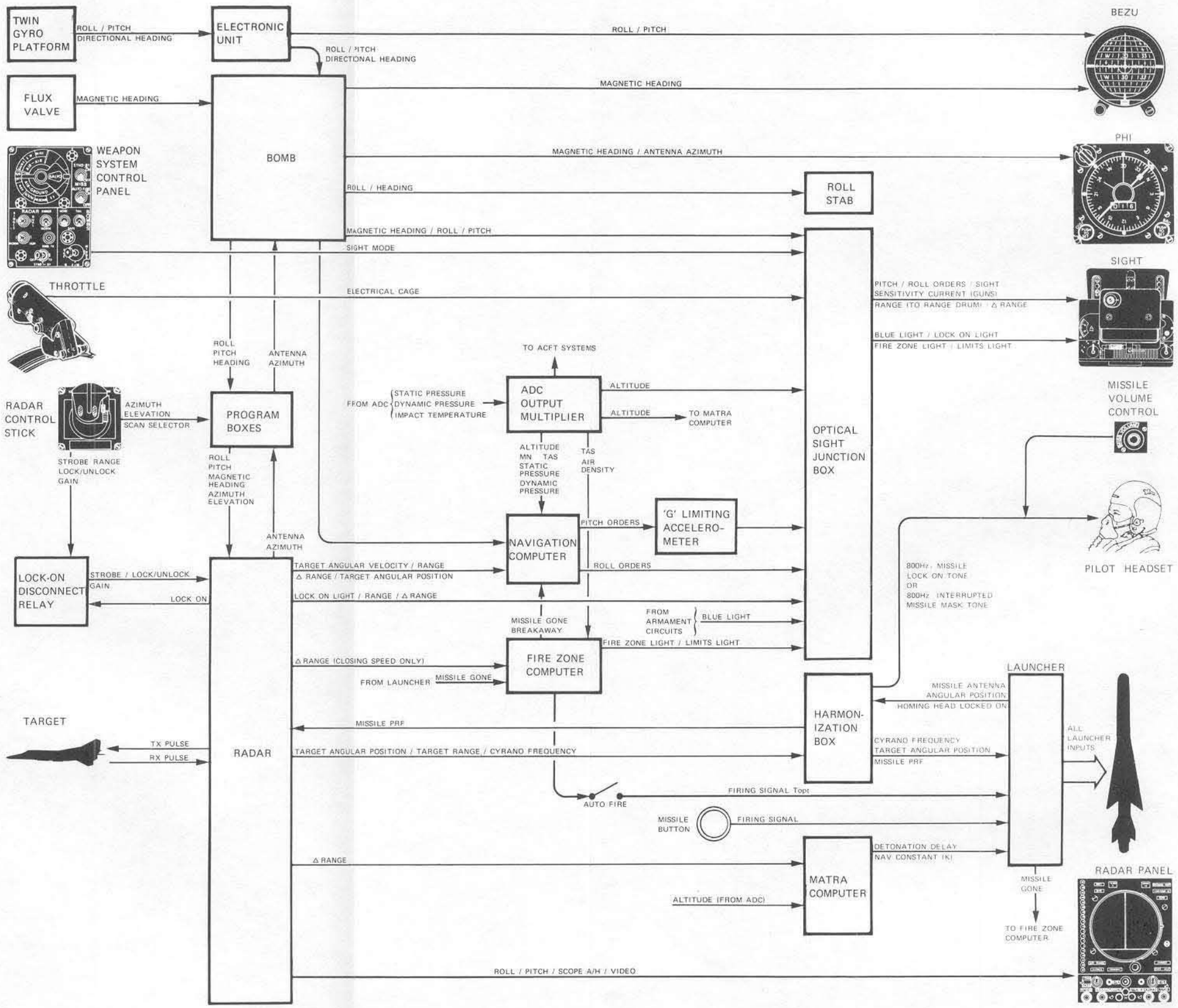


Figure FO 1-31

Weapon System - Air to Ground

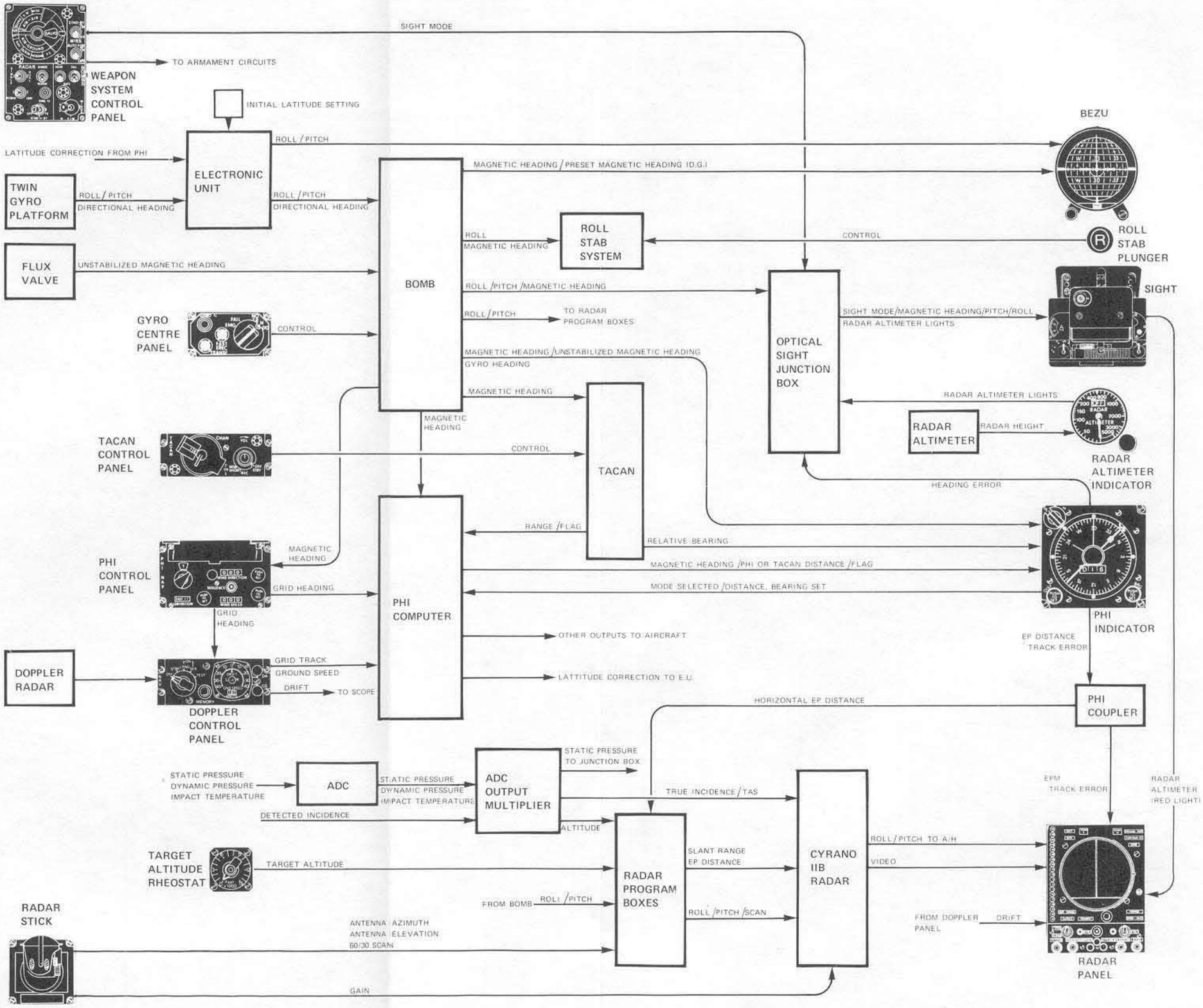


Figure FO 1-32

Optical Sight Operation

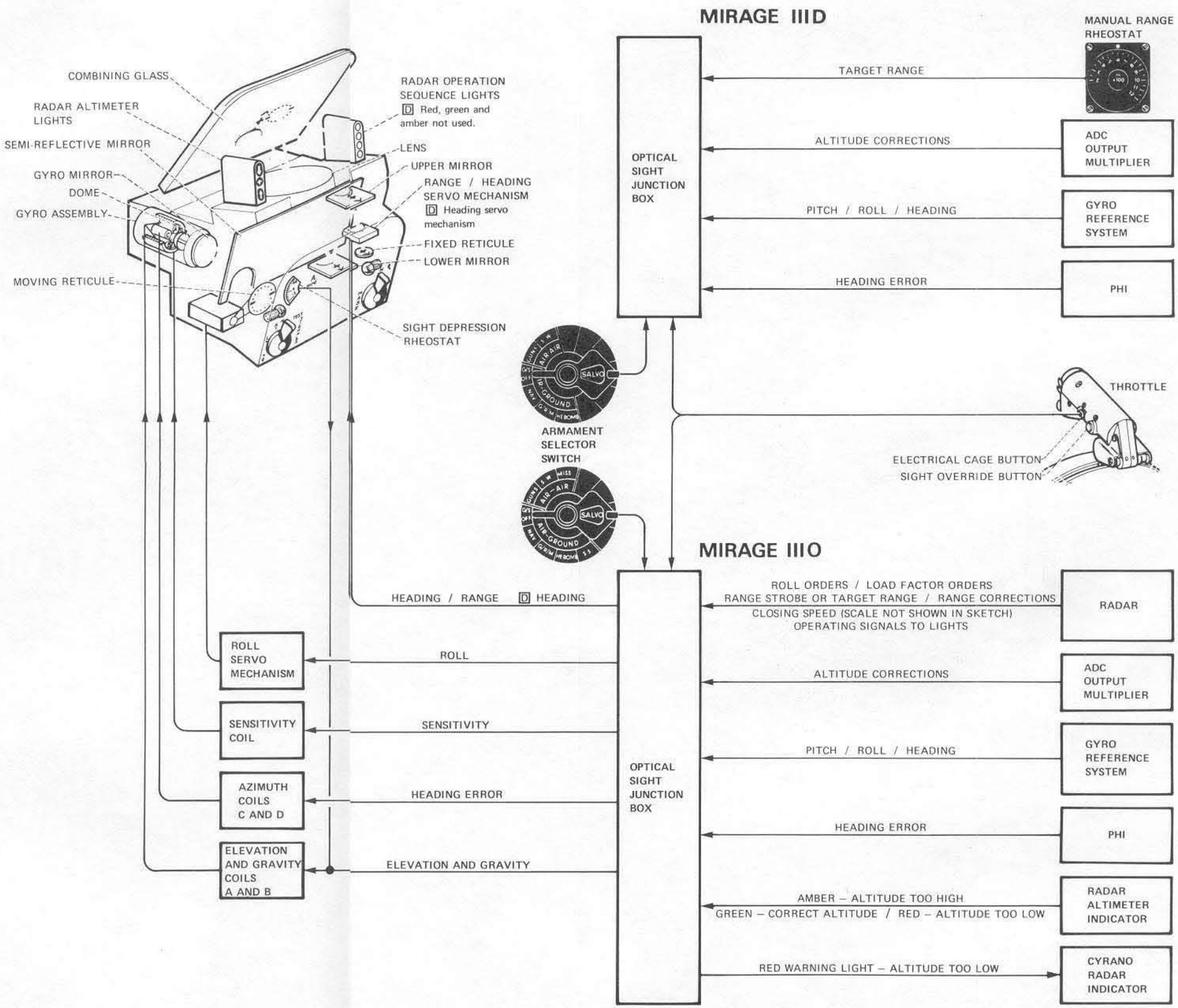


Figure FO 1-33

Gyro Reference System - AC Failure

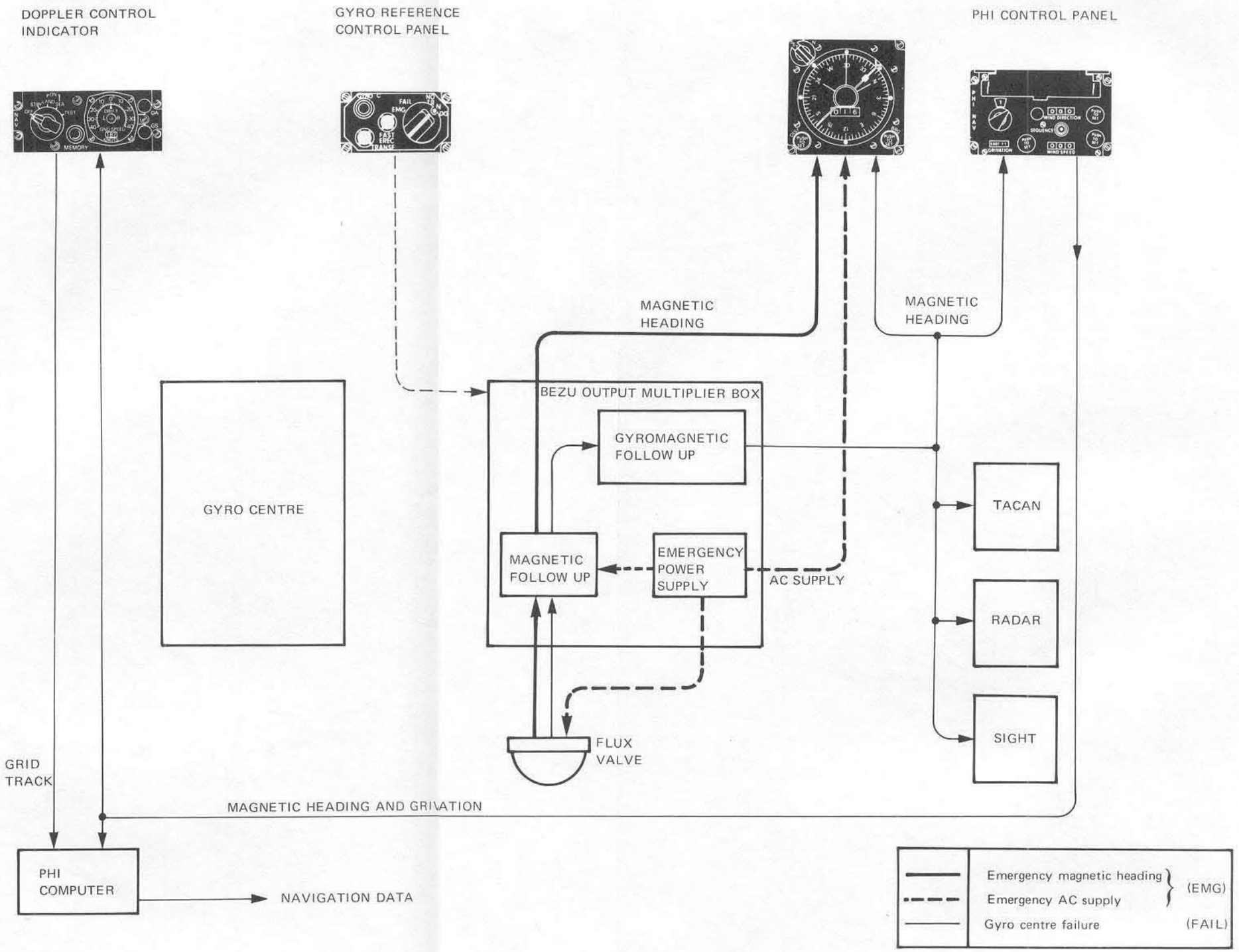


Figure FO 1-34

Gyro Reference System

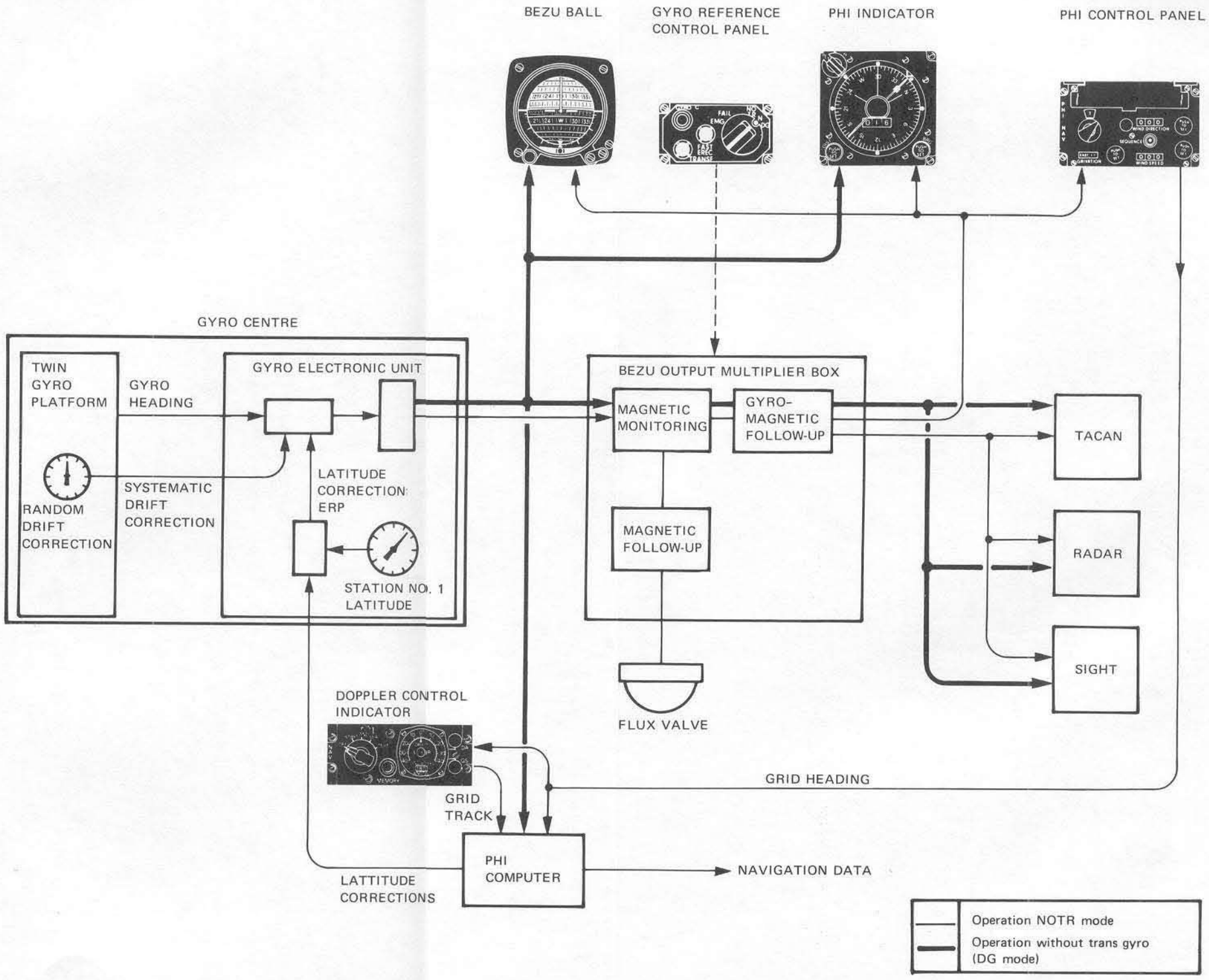


Figure FO 1-35

Oxygen System - Typical

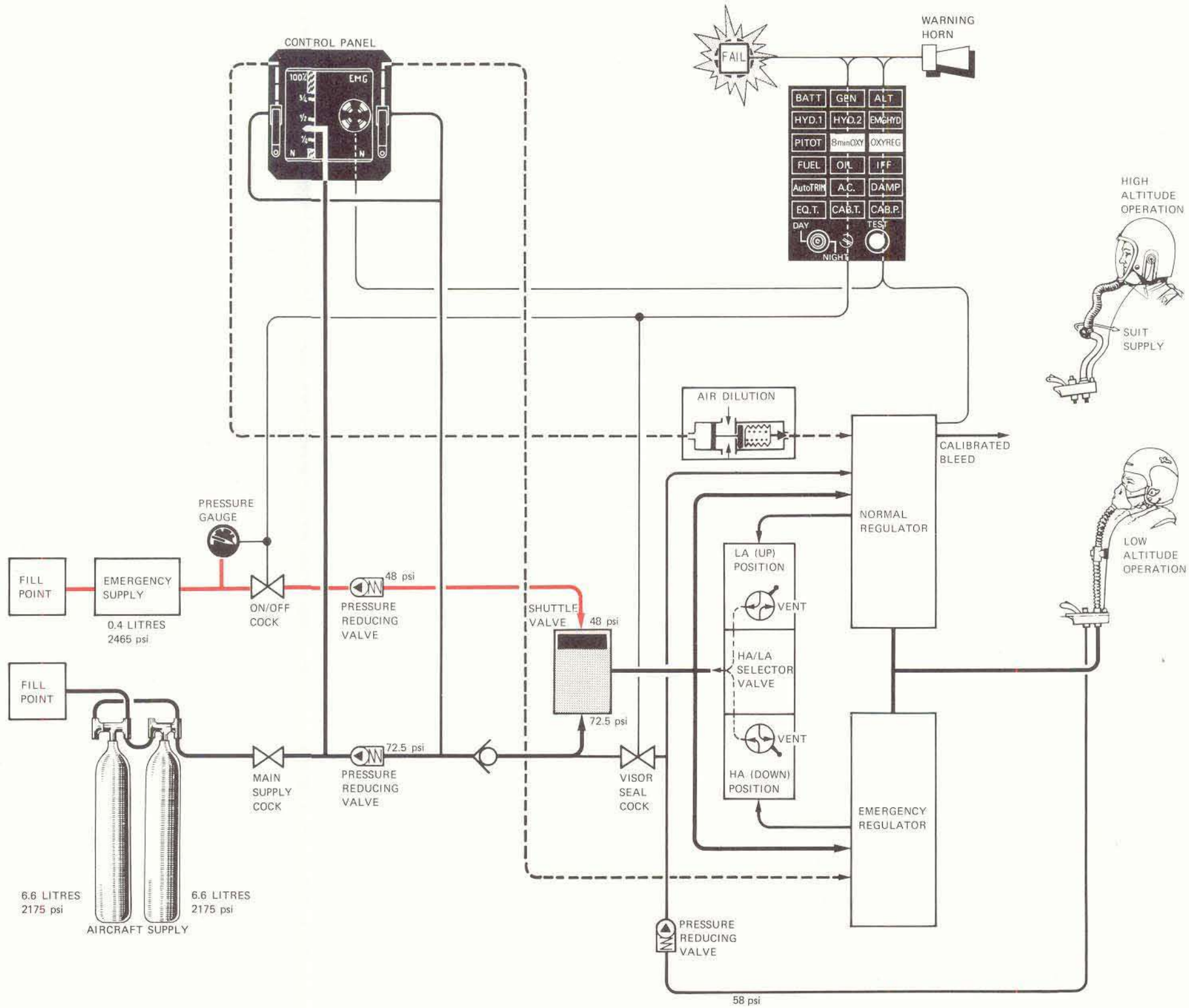


Figure FO 1-36

Oxygen System Operation

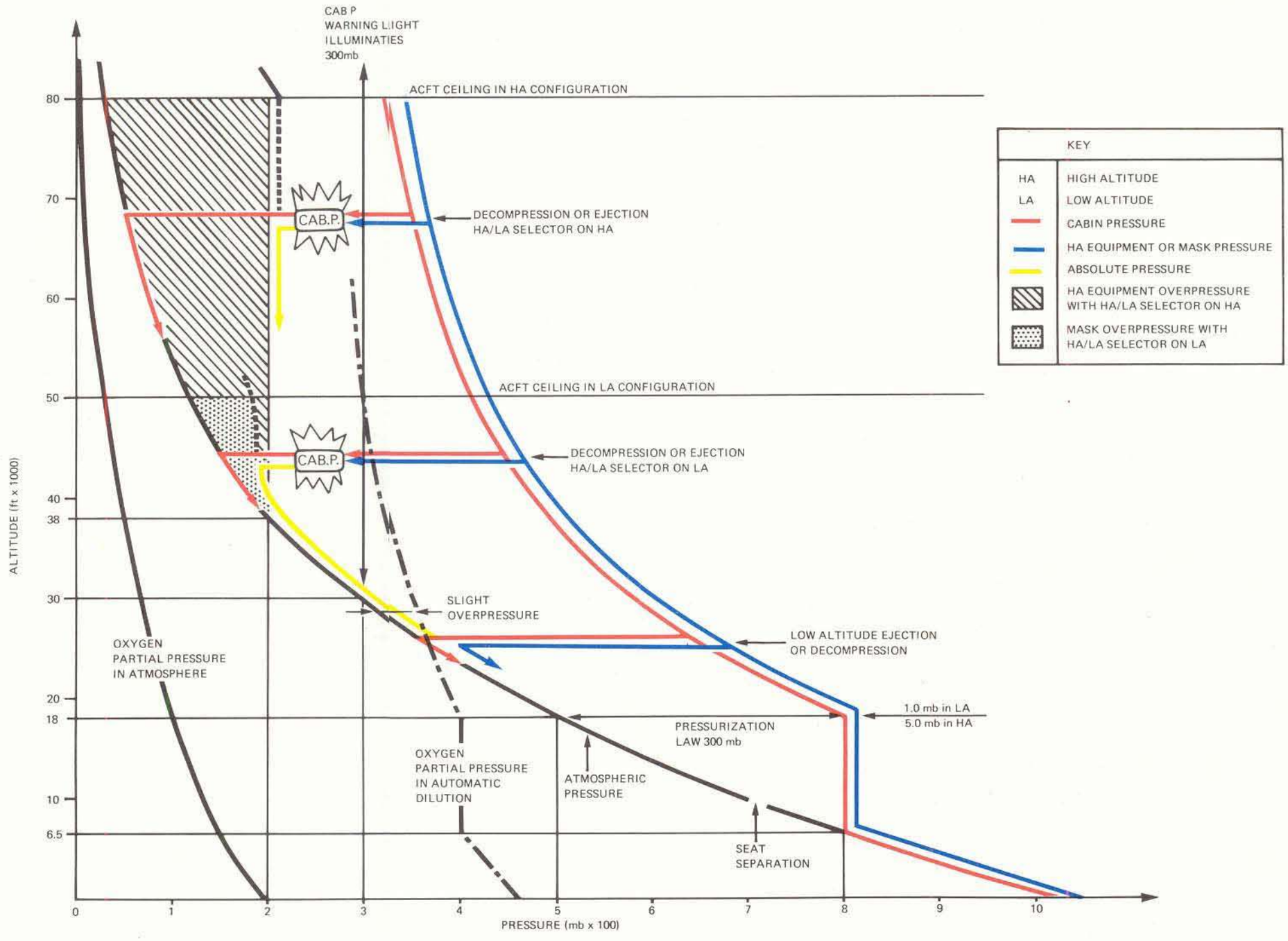


Figure FO 1-37

SECTION 2
NORMAL PROCEDURES

SECTION 2

NORMAL PROCEDURES

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SECTION 2
NORMAL PROCEDURES

PREPARATION FOR FLIGHT

FLIGHT RESTRICTIONS

Refer to Section 5 for operating limitations concerning the aircraft and the engine.

FLIGHT PLANNING

DI(AF) AAP 7213.003-1-1 contains the performance data of the aircraft. This data allows for estimates of the fuel consumption, corrected airspeed, RPM and altitude for the proposed mission to be made.

[D] As no performance data figures have been compiled for the Mirage IIID, the performance data for the Mirage IIIO is used. From figures taken during flight trials it has been found that the Mirage IIID performance is slightly better, about 3% -5% for all configurations, than that indicated.

WEIGHT AND BALANCE

Refer to Section 5 and DI(AF) AAP 7213.003-5 Mirage IIIO and IIID Loading and Balance Summary for weight and balance limitations.

PRE-FLIGHT CHECKS

BEFORE EXTERIOR INSPECTION

Check Form EE500 for serviceability status. Ensure that the aircraft has been serviced with the required amounts of fuel, oil, hydraulic fluid, oxygen and weapons, and is fitted with a brake chute.

Ensure that personal equipment, anti-'g' suit, oxygen mask and helmet are in good condition.

At the Aircraft Before External Power is Connected, Check :

1. All armament switches—Off.
2. Wheels—Chocked.
3. Fire extinguisher nearby.

CAUTION

Ensure that the aircraft's taxi path from the lines is clear of obstructions.

EXTERIOR INSPECTION

The exterior inspection is based on the fact that maintenance personnel have completed all scheduled before-flight inspections; therefore, duplicate inspections and operational checks of systems have been eliminated, except for those required in the interest of flight safety. Check surfaces for damage or signs of fuel, oil, hydraulic or other fluid leaks which may have developed since the before-flight inspection. Check that all access panels and fasteners are secured, and that all protective covers are removed. Check external stores and weapons in accordance with the weapons checklist. Perform the exterior inspection in the following sequence :

1. Left U/C flipper door handle—Fully down.

WARNING

If the left U/C flipper door handle is up and pressure remains in the utility system, the doors will close rapidly when the nose wheel and right U/C flipper door handles are selected up. This may jeopardize the safety of persons under the aircraft.

2. Equipment bay hatch—Flush and secured.
3. Left intake :
   a. Auxiliary intake panel hatch—Flush.
   b. Auxiliary intake door—Free and flush.
   c. Intake—Clear.
4. Shock-cone—In.
5. Nose wheel well :
   a. Flipper door handle—Up.
   b. Emergency U/C lowering valve—Reset.
   c. Hydraulics—No leaks.
   d. Oleo strut—Four fingers between pin and index mark.
   e. Torque link—Connected, pins correctly locked.
   f. Tyre—Condition.
   g. Locating pin—Up.
6. Landing lights—Condition.
7. Incidence probe—Freedom of movement and cleanliness.
8. Fuselage total pressure probes—Covers removed, clean, no obstructions.
9. Pitot probe—Cover removed, clean, no obstructions.
10. Radar cooling hydraulic pressure—10-35 psi.
11. Right intake—As for left.
12. Impact temperature probe—Clear.

13. Right flipper door handle—Up, cover closed.
14. Right wheel well :
    a. Engine access panels—Secure.
    b. Hydraulics—No leaks.
    c. Oleo extension—About 4 fingers.
    d. Tyre—Condition.
    e. Brake pads—Condition.
    f. Heavy landing indicators—Unmarked.
    g. Fairing door—Rigidity.
15. A/B turbo-pump outlet—Cover removed.
16. Right wing nav and form lights—Condition.
17. Control surfaces—Freedom of movement.
18. Elevon servo jacks—No hydraulic leaks.
19. Pitch dampers—No excessive movement.
20. Refuelling handles—Both up, doors closed.
21. Lower TACAN antenna—Condition.
22. Right side radio hatch—Locked.
23. Brake chute access panels—Secure.
24. Rear nav light—Condition.
25. Tail pipe :
    a. Turbine—Condition.
    b. T4 probes and ionization probe—Condition.
    c. A/B manifold and liners—Condition.
    d. Nozzle flaps—Condition - no oil leaks.

CAUTION

Flecks of silver metal in the cold flap area indicate melting of the fusible clips on the A/B manifold line caused by a flash-back from the A/B manifold or an overheat in the junction section.

26. Brake chute :
    a. Safety pin—Removed.
    b. Release pin—Protruding about 12 mm (½ in).
    c. Lugs—Straight.
27. Rear fuselage static pressure inlet—Clear.
28. Left side radio hatch—Locked.
29. Left wing and wheel well—As for right except left flipper door handle remains down.
30. [D] Pressure regulator static vent cover—Removed.
31. [D] Exterior canopy opening switch cover—Secured.
32. [D] Canopy declutch handle (nosewheel well)—Secure.
33. [D] Nose cone access doors—Flush and secure.

BEFORE ENTERING COCKPIT

Before entering the cockpit, the safety pin harness consisting of the seat gun sear pin, drogue gun pin, remote rocket initiator sear pin and canopy jettison pin is to be removed and stowed by the attending airman.

WARNING

- With safety pin harness removed, the canopy jettison is armed.
- With safety pin harness removed, the stores jettison button cover may be accidentally opened.

Before entering the cockpit, check:

1. Ejection safety pins are installed in:
    a. Face screen handle,
    b. Seat pan handle, and
    c. Manual separation handle.
2. Stores jettison button cover—Up.
3. Main oxygen cock—On.
    a. Contents—more than ¼.
    b. OXY REG light—On.
    c. Main FAIL light—On.
4. Emergency oxygen cock—On.
   8 min OXY light—Out.
5. HA/LA switch—Gated to LA.
6. Visor seal cock—Safety-wired ON.
7. Emergency oxygen contents gauge—White sector.
8. Ejection seat:
    a. Leg restraint lines and taper plugs—Correctly routed through their snubbing units and fitted into their respective housings.
    b. Manual separation handle—Down and safety pin fitted.
    c. PEC—Secure.
    d. Drogue gun link-rod—Attached correctly.
    e. Drogue gun safety pin—Removed.
    f. Remote rocket initiator—Static cable secured to drogue-gun link-rod and safety pin removed.
    g. Parachute withdrawal line—Correctly routed through guillotine unit.
    h. Parachute pack opening line—Correctly routed clear of guillotine unit.
    i. Seat locking pin—Flush.
    j. Canopy jettison safety pin—Removed.
    k. Firing cables and canopy jettison mechanism—Correctly routed and connections secure.
    l. Main gun sear pin—Removed.

m. Scissor shackle—Secure and flat.

n. Drogue chute withdrawal line—Correctly routed, ie on top.

o. Barastat link-rod—Attached correctly.

p. IFF trip string—Connected.

q. [D] Rear seat-pan handle—Less than 25 mm forward of vertical.

WARNING

The drogue gun and barostat link-rods are to be visually checked only; moving the link-rods could operate the mechanism.

CAUTION

The pilot is to ensure that no attempt is made to reshape a seat-pan handle which is greater than 25 mm forward of vertical. Continued flexing could fatigue the handles which may cause separation under stress.

9. Gun camera overrun knob—As required.
10. Fuselage fuel caps—Secure.

[D] Rear Seat Checks

If flying solo, carry out the following rear seat checks :

1. Main oxygen cock—Off.
2. Emergency oxygen cock—Off.
3. Chest cock—Off.
4. Chest connector—Stowed.
5. Ejection seat:
   a. All items—Secure.
   b. All pins, except canopy jettison—In.
   c. Seat height—Full down.
   d. Seat-pan handle—Less than 25 mm forward of vertical.
6. Speed brake, U/C lever and stand-by A/H safety pins and harness—Removed.
7. Gun camera overrun knob—As required.
8. A/B COCK—ON.
9. MAIN L.P. COCK—ON.
10. Lighting controls—All off/min.
11. Speed brake switch—In.
12. Radio selector—FNT.
13. U/C lever—Down.
14. MINISTOP switch—ON (safety-wired).
15. A.C. DISENG switch—NORMAL (safety-wired).
16. Incidence lights—Cover closed.
17. Canopy breaker—Secure.
18. AIR CONDITIONING switch—NORMAL (safety-wired).
19. DEMIST lever—Off.
20. Wander light—Off, secure.
21. General inspection—No loose objects to restrict rudder pedals or control column.

INTERIOR INSPECTION

When seated, check :

1. AC and DC power—On.
2. Weapon system selector—NAV.
3. GYRO CENT switch—ON.
   a. Clock—Start.
   b. Bezu ball response—Correct.
4. Strap in:
   a. Adjust seat height and rudder pedal length.

WARNING

The rocket pack initiator hose, firing unit or propellant tubes may be damaged if any foreign object is under the ejection seat when the seat pan is motored down.

   b. Connect the dinghy lanyard.
   c. Route the leg restraining lines through the rings of the bowyangs which should be attached to the legs just above the calves. Then secure the taper-plugs into their quick-release units. Check that full travel of the rudder pedals is available; if not, adjust the length of the leg restraining lines.

WARNING

Ensure that the bowyangs are crossed, the restraining line from the left snubber unit should pass through the right bowyang ring and then to the right taper plug quick-release unit.

   d. Strap on the combined parachute/restraint harness ensuring that the main oxygen hose goes under the waist belt.
   e. Lean forward whilst the attending airman adjusts the shoulder harness.
   f. Ensure that all straps are re-tightened.

PRE-START CHECKS

LEFT CONSOLE

1. IGN/VENTIL switch—IGN.
2. PREHEAT switch—OFF.
3. L.P. PUMPS—OFF.
4. MAIN L. P. COCK—OFF.
5. A/B COCK—ON.
6. Cockpit lighting rheostats—As required.
7. PITCH and ROLL TRIM lights—Press to test.
8. MISS VOLUME rheostat—As required.
9. Throttle—Check stop, full and free movement, close to stop.

10. Speed brake switch—In.
11. RELIGHT button—Off (safety-wired).
12. APPR CONT lever—Down.
13. Communications selector—As required.
14. RUDDER TRIM light - Press to test.
15. Red radio set—MAIN or BOTH.
16. Green radio set—MAIN or BOTH.
17. EMG OIL PUMP switch—OFF (Cover safety-wired down).
18. EMERGENCY THROTTLE switch—Condition.
19. LDG LIGHT switch—OFF.
20. NAV LIGHTS switch—As required.
21. FORM LIGHTS switch—As required.
22. MINISTOP switch—ON (safety-wired).
23. U/C CONT lever—DOWN.
24. MICE (shock-cones) plunger—In.
25. Flying aid plungers—Out.
26. GAIN A.C. switch—As required.
27. EMERG U/C handle—In.
28. BRAKE CHUTE lever—Forward and stowed.
29. CANOPY JETTISON lever—Rear (safety-wired).
30. WING DT TRANSFER switch—As required.
31. Emergency disengage switch—NORMAL.
32. [D] CANOPY MOTOR DISENGAGE lever—Engaged (rear).
33. [D] AIR BR OVERRIDE switch—As required.
34. [D] TACAN/SW switch—As required.
35. [D] Manual range rheostat—As required.

LEFT INSTRUMENT PANEL

1. FIRE TEST button—Press to test.
   a. Fire lights extinguish in 3-5 sec.
2. ARM MASTER switch—OFF.
3. Armament master light—Press to test.
4. AIR BR light—Press to test.
5. INCID TEST button—Press to test.
6. U/C flasher—Press to test.
7. Bezu ball :
   a. Attitude aligned to earth's horizon.
   b. Pitch attitude applicable to erection cycle time.
8. Altimeter—Set.
9. ASI/Machmeter—Needle on red dot, set index.
10. GYRO fail light—Press to test.
11. VSI—Zero.
12. Stand-by A/H :
    a. Cage.
    b. A/H circuit breaker—In.

Note

[D] If solo, have attending airman cage rear A/H.

CENTRE CONSOLE

1. Radar controls—As required.
2. U/C position indicator lights—All on (3 greens, 1 red).
3. PHI/cockpit lighting rheostats—As required.
4. Target altitude rheostat—As required.
5. G.B. TANK TRANSFER switch—As required.
6. CROSSFEED switch—As required.
7. Doppler MEMORY light—On.

RIGHT INSTRUMENT PANEL

1. Accelerometer—Note reading then reset.
2. MACH warning light—Press to test.
3. Shock-cone indicator—Condition, needle on M1.2 stop.
4. PHI mode selector—SET - reset Station 1 if necessary, then DR.
5. DOP MEM light—On.
6. Radar altimeter—Off.
7. Overspeed light—Press to test.
8. OVERSPEED plunger - Out.
9. RPM gauge—Zero.
10. 130G light—Press to test.
11. Debitmeter—Set correctly.
12. Fuel transfer lights—Press to test.
13. A/B lights—Press to test.
14. EGT (T4) gauge - Normal.

RIGHT CONSOLE

1. Dinghy piercing tool—Secure.
2. HDG ERROR switch—OFF.
3. IGN light—Press to test.
4. Manual LOADSHED switch—Off (switch up and guard down).
5. GRD CONN warning light—On.
6. Hydraulic gauge selector switch—Down :
   a. U/C B pressure—Zero, if residual pressure, bleed down.
   b. Call for third handle up.
   c. PARK/EMG BRAKE—Apply, note pressure drop.
7. Hydraulic gauge selector switch—SERVO (up).
8. BATT switch—On.
9. GEN switch—On (safety-wired).
10. ALT switch—On.
11. INV switch—ON.
    a. Fuel GAUGE TEST button—Press to test.
12. HORN switch—OFF.
13. PROBE HEAT switch—OFF.
14. Main fail panel TEST button—Press and check :
    a. All main fail panel lights—On.
    b. Main FAIL light—On.
15. TACAN :
    a. Master switch—OFF.
    b. Channel selector—As required.
    c. Volume—As required.

16. Oxygen selectors—N/N, check quantity.
17. Armament switches—OFF and guarded.
18. Gyro reference system :
    a. Ensure :
        (1) Gyro centre—3 minutes running time.
        (2) Bezu wings level, about 3° nose down.
    b. Heading selector—NOTR.
    c. Transfer button—Press.
        (1) Ensure heading readouts stabilize.
        (2) Check Bezu and PHI indicate magnetic heading.
    d. Heading selector—N, check no heading change.
    e. Heading selector—DG.
        (1) PHI card moves to random heading.
        (2) Bezu—Align to magnetic heading.
    f. Heading selector—FAIL.
        (1) Bezu is inoperative.
        (2) Check PHI and gunsight indicate unstabilized magnetic heading.
    g. Heading selector—EMG.
        (1) Bezu and gunsight inoperative.
        (2) Check PHI indicates unstabilized magnetic heading.
    h. Heading selector—NOTR.

[D] Gyro reference system :

a. Ensure :
    (1) Gyro centre—10 seconds running time.
    (2) Bezu wings level, 0° pitch.
b. Heading selector—NOTR.
c. Transfer button—Press.
    (1) Check Bezu and PHI stationary on magnetic heading.
d. Heading selector—N, no heading change.
e. Heading selector—DG.
    (1) PHI does not change.
    (2) Bezu—Align to magnetic heading.
f. Heading selector—FAIL.
    (1) Bezu information erroneous.
    (2) Check PHI and gunsight indicate magnetic heading.

CAUTION

[D] Do not select EMG unless an actual AC failure exists.

Note

[D] With EMG selected, the PHI in the rear cockpit is not supplied with AC power.

19. PRESSURIZATION switch—OFF.
20. Temperature control—As desired.
21. EMERGENCY COLD switch—OFF (safety-wired).
22. Gunsight :
    a. Brightness rheostat—Set intensity.
    b. Checks—As required.
23. Radar :
    a. Master switch—OFF.
    b. Other switches—As required.
24. EQUIPMENT CONDITIONING switches—Up (both).
25. Canopy seal/ram air lever—CLOSED.

Note

Do not slam the canopy seal/ram air lever forwards to the CLOSED position as it may jam.

26. CLOSING SPEED switch—As required.
27. DEMIST lever—Off (Rear).
28. IFF :
    a. Master switch—STBY.
    b. Mode selection switches—As required.
    c. Mode code selector—As required.
29. PHI :
    a. WIND SPEED and DIRECTION knobs—Set.
    b. GRIVATION knob—Set.
    c. Sequence light—On 7 sec, then off.
30. CB panel—All in except AC PITCH ROLL and EMG HYD.
31. EMG HYD CB—In.
    a. HYD 1 pressure—1750 to 2150 psi.
    b. EMG HYD light—Out.
32. Trim—Check operation, all neutral (lights out).

CAUTION

Jerky trim operation in pitch or roll may indicate unserviceability of the flight controls and should be investigated.

33. EMG HYD CB—Out.

Note

Due to electrical surges from the external power supply and the EMG HYD pump operation, aircraft radios can cycle to a random frequency and may have to be recycled.

34. Helmet—On.
    a. Oxygen hose to chest connector—Connect, ensure lock ring secure.
    b. Chest cock—Open.
    c. Radio lead—Connect.
35. Oxygen control panel :
    a. Oxygen selectors—N/100%.
       (1) Oxygen blinker—Check operation.
    b. Oxygen selectors—EMG/100%.
       (1) Oxygen blinker—Not operative.
       (2) EMG regulator—Operating (5 mb overpressure).
    c. Oxygen selectors—N/N.

Note

To prevent rapid loss of oxygen, check that the blanking plug is fitted when the pressure waistcoat is not worn.

Ejection Seat and Canopy

36. Seat safety pins :
    a. Seat pan firing handle pin—Remove and hand to airman.
    b. Manual separation handle pin—remove and hand to airman.
    c. Face screen firing handle pin—Airman to remove, show to seat occupant, and stow all three pins in stowage pouch on side of seat.

WARNING

When the seat pins are removed, the seat ejection system is fully armed.

CAUTION

All safety pins are to be correctly stowed.

37. Canopy breaker—Secure.
38. Canopy—Closed or latched.

CAUTION

[D] The front seat pilot is to obtain clearance from the rear seat occupant prior to operating the canopy.

Note

[D] With the rear seat occupied and after intercom communication has been established, the front seat pilot should check the continuity of the fire warning system and the incidence lights with the rear seat pilot. The rear seat pilot checks his lights as they are called by the front seat pilot. The front seat pilot then calls for 'stand-by A/H' and both pilots cage their A/H as the front seat pilot presses the circuit breaker in.

ENGINE STARTING

Engine starting should normally be performed with the canopy closed or latched. However, in hot weather, at the captain's discretion, the engine may be started with the canopy open.

CAUTION

- When starting with the canopy open, ensure that all potential loose objects are securely stowed to prevent possible engine ingestion.
- [D] When both seats are occupied, it is the captain's responsibility to ensure that all potential loose objects in both cockpits are secure before starting with the canopy open.

STARTING WITH EXTERNAL POWER

Obtain start clearance from attending airman, then :

1. MAIN L.P. COCK—ON (cover down).
2. L.P. PUMPS—ON (both).
   a. FUEL warning light—Out.
3. START button—Press for about 2 sec and start clock.
4. IGN light—On (4-8 sec).

When RPM 600-800 :

5. Throttle—Idle.
6. RPM and EGT—Steady increase. Check :
   a. Fire warning lights—Out.
   b. OIL, HYD 1 and HYD 2 light—Out.
   c. EGT—700°C max on start.

CAUTION

If the EGT(T4) rises too rapidly towards 700°C, move the throttle to stop immediately and have the problem investigated.

7. RPM—Within idle limits (cold idle may be as low as 2600).

CAUTION

- Do not attempt more than three consecutive starts.
- If the engine speed exceeds 250 RPM during an unsuccessful start, delay the next start attempt until the RPM is less than 250. Attempting a start with engine speed above 250 RPM may cause reduction gearbox coupling shaft failure.

STARTING WITHOUT EXTERNAL POWER

Engine starting may be carried out using only aircraft battery power as follows :

1. Perform all possible Pre-start checks with BATT switch off.
2. EMG HYD PUMP CB—Out.
3. Manual LOADSHED switch—On (down).
4. BATT switch—On.
5. U/C B pressure—Zero (third handle up).
6. Carry out normal start.
7. Manual LOADSHED switch—Off (cover down).
8. Carry out remaining Pre-start checks.

CAUTION

- Following a start without AC power, the gyro centre requires three minutes running time before transfer.
- [D] Following a start without AC power, the gyro centre requires 10 seconds running time before transfer.

AFTER START CHECKS

Before taxiing, carry out the following checks:

1. Ground power—Signal for disconnect.
2. BATT, GEN and ALT failure lights—Out.
3. A.C. PITCH ROLL CB—In.
4. EMG HYD CB—In.
5. EMG HYD Light—Out.
6. [D] PRESSURIZATION switch—ON.
7. Hydraulic system pressures—All four checked.
8. HORN switch—ON.
9. GRD CONN light—Out.
10. U/C flipper door red light—Out.
11. Damper plungers—In.
12. L.P. PUMPS—Check:
    a. Both—OFF (FUEL light on).
    b. Right—ON (FUEL light out).
    c. Right—OFF (FUEL light on).
    d. Left—ON (FUEL light out).
    e. Right—ON.
13. Flying aids—Check:
    a. A.C. and R plungers—In.
       (1) ALT plunger—Will not engage.
       (2) Control column—Moves aft, check full pitch movement, elevons respond.
    b. Pitch trim—Check operation.
    c. Roll/stab button—Check engage/disengage of roll/stab.
    d. Emergency disengage switch—EMERG.
       (1) Plungers—Pop.
       (2) Main FAIL light illuminates, horn sounds. Cancel.
       (3) Control column—Slight jerk, full and free movement, elevons correct response.

e. Emergency disengage switch—NORMAL.
f. A.C. and R plungers—In.
g. Flying aids disengage slab—Press.
   (1) Plungers—Pop.
   (2) Main FAIL light illuminates, horn sounds. Cancel.
h. Pitch trim— Neutral.

Note

- When moving the control column, confirm that the hydraulic servo pressures recover normally.
- If the autocommand is unserviceable, the flight controls check with the emergency disengage switch at EMERG must still be performed.
- The flying aids check may be performed during taxiing, if expedient.

14. Chocks—Wave away.

CAUTION

- The canopy is to be closed or latched prior to taxiing.
- [D] The aircraft must be taxied with the canopy closed and locked to prevent damage to the actuating mechanism.

15. Brakes and dampers—Check operation
16. Stores jettison or armament systems—Armed as required (hands visible).

TAXIING

To leave the lines, increase power to 6000 RPM. After rolling forward about two feet, check the brakes. As the aircraft pitches during brake operation, the airman checks the pitch dampers for correct operation and indicates their serviceability to the pilot.

Note

Correct pitch operation of the Bezu ball and the standby A/H should be checked as the aircraft pitches.

Directional control on the ground is achieved by differential braking. Power is used to maintain speed as required. Excessive taxiing speeds are to be avoided, as greater loadings are applied to the tyres by increases in taxiing speeds and AUW.

TAXI CHECKS

After leaving the lines :

1. Radar :
   a. Master switch—ON at least 4 min before take-off.
   b. Checks—As required.
2. Radar altimeter—Checks as required.
3. Doppler:
   a. Selector switch—STBY
   b. After 1 minute, Selector switch—TEST.
      (1) 121 ± 3 kn, 0° ± 2°, then
      (2) Select LAND or SEA.

Note

When operating in high ambient temperatures the Doppler can rapidly overheat when selected on the ground. In this case selection of Doppler to TEST should be delayed until just prior to take-off.

The engine range, 4700-5200 RPM is prohibited due to harmful engine vibrations. The RPM range 5500-6000 should also be avoided to prevent heat build up in the alternator. Use 6000 RPM during turns and reduce power to 4500 RPM when normal taxiing speed has been achieved.

CAUTION

When taxiing, avoid RPM settings between 4500 and 6000.

If the PRESSURIZATION switch is selected ON at high RPM, the cooling turbine bearings may be overloaded. Extended ground operation with RPM above 7000 may cause the cooling turbine to overheat.

CAUTION

- The PRESSURIZATION switch is to be selected ON below 4000 RPM. If the switch is inadvertently left OFF until airborne, select idle RPM, when flight conditions permit, before selecting the switch ON.
- During ground running, never exceed 7000 RPM for more than three minutes with the PRESSURIZATION switch ON.

BEFORE TAKE-OFF

PRE-TAKE-OFF CHECKS

The following checks are to be carried out before lining up for take-off :

1. Trims—All neutral (lights out).
2. Speed brake switch—In (light out).
3. Fuel :
   a. L.P. PUMPS—ON (both).
   b. A/B COCK—ON.
   c. WING DT TRANSFER switch—As required.
   d. G.B. TANK TRANSFER switch—As required.
   e. CROSSFEED :
      (1) Gauge pointers—Both off 120 gal, levels unequal.

(2) CROSSFEED switch—ON.
(3) Gauge pointers—Levels equal.
(4) CROSSFEED switch—OFF.

f. Fuel gauge—Contents decrease consistent with configuration.
g. Transfer lights—Correct operation.
h. Debitmeter—Operating.

4. Instruments—All functioning correctly.
   a. Bezu and standby A/H—Pitch attitude 3° nose down.

      [D] Pitch attitude 0°.

   b. PROBE HEAT switch—ON (light out).
   c. TACAN master switch—NOR.
   d. PHI mode selector—TCN.
5. Oxygen :
   a. Oxygen selectors—N/N.
   b. Contents—Sufficient.
   c. Check flow.
   d. Check connections.
6. Seat :
   a. Harness—Secure, leg restraints attached.
   b. Safety pins (three)—Removed and stowed.
7. Hydraulics :
   a. Check pressures.
   b. Hydraulic gauge selector switch—Down.
8. Controls :
   a. Full and free movement.

      [D] Front and rear seat pilots are to independently check for full and free movement.

   b. A.C. plunger—Out.
   c. P and Y DAMPER plunger—In.
   d. Emergency disengage switch—NORMAL.
9. Brake chute lever—Forward, toggle out.
10. Canopy—Locked :
    a. CANOPY lever—Forward, toggle stowed.
    b. CAB P light—Out.
    c. PRESSURIZATION switch—ON.
11. Stores jettison buttons cover—As required.
12. OVERSPEED plunger—As required.
13. [D] Take-off brief—Completed.

CAUTION

- Confirm that the canopy is locked by trying to push the canopy upwards.
- If the canopy is difficult to lock before take-off, the sortie is to be abandoned.

TAKE-OFF

Before take-off :

1. IFF master switch—As required.
2. Gyro reference system :
   a. Check ACFT headings against runway direction.
   b. Transfer if necessary.
3. Warning and failure lights—All out except A.C.
4. Wheel brakes—Applied.
5. Throttle—Full dry, then check :
   a. Brakes—Second pressure about 8000 RPM.
   b. RPM—Within limits.
   c. EGT—Within limits.
6. Brakes—Release.
7. Throttle :
   a. Mini A/B, check correct A/B ignition, then
   b. Max A/B.

During the early phase of the take-off, directional control is maintained with gentle application of brake. The rudder and elevons become progressively effective for directional control as IAS increases. Above about 80 KIAS, differential braking should not normally be required. Raise the nose to about 2-4° by 130 KIAS using 10-15 kn anticipation for introducing back stick. Control forces are light and care should be taken to avoid over-controlling. Using 10-15 kn anticipation, smoothly rotate the aircraft to 10° and positively lift off at the calculated lift-off speed, eg 165 KIAS clean or 175 KIAS with two 110 gal tanks. For an instrument departure or when operating in trail, maintain 10° climb attitude until climb speed is reached. When departing visually following undercarriage retraction, a 7-10° climb attitude may be used to improve acceleration.

[D] During take-off, initially raise the nose to about 5-7°. Smoothly rotate to 13° for lift-off and maintain 13° until climb speed is achieved.

Note

- The IIID is slightly more responsive in pitch than the IIIO.
- The IIID is lighter than the IIIO for any given configuration therefore acceleration during and after take-off is more rapid.

CROSS-WIND TAKE-OFF

Refer to Section 5 for limitations applicable to the aircraft's configuration. During a cross-wind take-off, a slightly higher nose wheel lift-off speed is recommended to improve aircraft controllability. In very strong or gusting crosswind conditions, a single smooth rotation to achieve lift-off speed is recommended. During the initial take-off roll, the aircraft tends to weathercock into wind; to reduce the need for differential braking, apply rudder and elevon to keep the aircraft straight and, as the airspeed increases, reduce the amount of rudder and elevon progressively until lift-off.

TAKE-OFF WITH EXTERNAL STORES

Refer to the take-off distance chart in AAP 7213.003-1-1 for take-off distances and check speeds for applicable weight and aircraft configuration. At high AUW, the CG is near the aft limit and the aircraft is very responsive in pitch. This leads to a tendency to over control and the aircraft may become

airborne before reaching the calculated lift-off speed. At about 25-30 KIAS before the calculated lift-off speed, initiate rotation and continue to rotate the aircraft smoothly and progressively to 10° to achieve lift-off at the calculated speed. Over-rotating at nosewheel lift-off reduces acceleration and extends the ground roll due to the increase in induced drag. When safely airborne with the undercarriage up, the nose attitude should be lowered slightly to improve acceleration.

WARNING

When the nose is lowered after lift-off, a minimum pitch attitude of 7° nose up should be maintained to ensure that the aircraft maintains a climb gradient.

The main wheels are behind the CG and a rapid rotation for lift-off can impose a load of up to 150% of the normal main wheel undercarriage load.

WARNING

Rapid rotation for lift-off should be avoided.

Note

- During undercarriage retraction, there is a marked nose up trim change, which requires a strong forward pressure to counteract.
- When ground level temperatures are expected to be in excess of 27°C, the OVERSPEED plunger should be engaged.

DECISION SPEEDS

Before the sortie, the GO-NO GO speeds and the appropriate refusal speed should be calculated. For take-off/abort data refer to AAP 7213.003-1-1 Mirage Performance Data. During conditions of high density altitude and AUW, the operation of the overspeed may be critical to safe operations during take-off, therefore particular care should be exercised when calculating GO-NO GO speeds, and in particular, whether the take-off should be continued if the overspeed is not obtained within a reasonable distance from brakes release.

AFTER TAKE-OFF

When the aircraft is airborne and climbing, proceed as follows:

1. Wheel brakes—Apply and release.
2. U/C CONT lever—Up.

CAUTION

At normal AUW, the acceleration is rapid and retraction of the undercarriage requires about 6 sec or 40 kn of airspeed. If the U/C CONT lever is not selected up by 200 KIAS, some re-adjustment to the aircraft's climb attitude may be necessary to prevent excessive air loads on the undercarriage doors.

3. All undercarriage lights—Out before 240 KIAS.
4. LDG LIGHT—OFF.
5. Rudder trim—Reset as required.
6. Stores Jettison Button Cover—As required.

CLIMBS

For information regarding the aircraft's climb performance for the various configurations refer to AAP 7213.003-1-1. The most commonly used climb schedules are:

- ***Full Dry.*** The full dry climb schedule is 400 KIAS/M0.9. A climb speed of 400 KIAS may be obtained by initially setting a climb attitude of about 10°. The climb attitude gradually decreases until about 24 000 ft where 400 KIAS is equivalent to M0.9. The attitude must then be increased to hold M0.9 until about 30 000 ft when the climb attitude again decreases.

- ***Mini A/B.*** The mini A/B climb schedule is 400 KIAS/M0.9 and the climb attitudes are about 3° to 4° higher than the dry climb schedule.
- ***Max A/B.*** The max A/B climb schedule is 450 KIAS/M0.9. Passing about 420 KIAS after take-off, select an attitude between about 20° to 30° depending on air temperature. The climb attitude decreases until about 16 000 ft when 450 KIAS is equivalent to M0.9, then increases again. Use 2000 ft to 3000 ft anticipation to level off at the desired altitude.

Note

- If the approximate attitudes mentioned are not achieved, the aircraft may go transonic or supersonic early in the climb.
- Do not climb at greater than M0.94 as at this speed the transonic drag significantly reduces performance.

[D] Add 3° to the climb attitudes quoted for the IIIO.

DESCENTS

For information regarding the aircraft's performance for the various configurations/types of descents, refer to AAP 7213.003-1-1. The descent techniques described in the following paragraphs may be applied regardless of the aircraft's configuration.

NORMAL DESCENT

Above 5000 ft

- RPM—7500.
- Speed—350 KIAS/M0.9
- Speed brake switch—OUT.
- DEMIST lever—As required.

Below 5000 ft

When levelling off at 5000 ft or below, leave the speed brakes extended until IAS is reduced to 300 kn. Further descent should be made at

300 KIAS using the speed brakes and power as required. The aircraft travels about 1 NM for each 1000 ft of altitude lost.

OPERATIONAL DESCENT

- RPM—7000.
- Pitch attitude— − 20°.
- Speed brake switch—OUT.
- DEMIST lever—On.

Note

When an operational descent is planned after an appreciable time at altitude, the DEMIST lever should be selected on prior to descent and full AUTO HOT should be used to avoid misting.

ECONOMICAL DESCENT

- RPM—Flight idle.
- Speed—300 KIAS.
- Speed brake switch—IN.
- DEMIST lever—On.

Note

- Advance power to 7000 RPM at or above 10 000 ft during all types of descents to provide advance warning of fuel control freezing. This increases fuel consumption by less than 10 gallons.
- The higher the altitude, the higher will be the idle RPM.

During an idle power descent, EGT(T4) may be as low as 150°C to 200°C.

BEFORE LANDING

Before descending or entering the circuit pattern carry out the following checks :

1. Hydraulics—Check pressures.
2. Fuel :
   a. Quantity—Sufficient.
   b. CROSSFEED switch—ON.
   c. L.P. PUMPS—ON.
3. DEMIST lever—As required.
4. A.C. plunger—Out.
5. Radar—As required.
6. Altimeter—Set as required.
7. PHI mode selector—TCN.

LANDING

NORMAL LANDING

Refer to Fig 2-1 for normal landing pattern procedures with AUW below 20 000 lbs. Carry out landing checks as follows :

1. Speed—Below 240 KIAS.
2. U/C Flasher—Flashing (RPM below 8000).
3. Speed brake switch—In.
4. U/C CONT lever—Down.
5. Three steady greens—Checked.
6. U/C flasher—Out.
7. Hydraulic pressures—Recovering.
8. LDG LIGHT—LDG.
9. Fuel—Contents remaining.
10. U/C DOWN beeper—Press for audio tone (with acknowledgement of landing clearances).

While following the procedures outlined in Fig 2-1 for a normal landing, it is important that power is used to control IAS and attitude is used to control rate of descent. When the aircraft is straightened on finals at 190 KIAS, 300 ft AGL and on the glide slope, it is almost in the landing attitude.

When the incidence is reduced on rolling out, the aircraft accelerates rapidly unless power is quickly reduced to maintain the desired speed. Speed should be progressively reduced to achieve 175 KIAS at the threshold. The aircraft should be flared with power on and then the power should be smoothly reduced aiming for a touchdown with the minimum sink rate.

Maintain a minimum of 6000 RPM to touchdown in order to reduce the risk of a heavy landing. When the main wheels are in contact with the ground a slight relaxation of the back pressure prevents the aircraft from skipping.

If the aircraft is high on the glide slope at roll out, the natural correction of lowering the attitude and reducing power may result in a power off flare from a steeper than normal approach. In this case, the speed bleed-off is rapid and the resultant excessive sink rate could cause a heavy landing. Landing from a power off flare after a steep approach requires fine judgement and is not recommended as a normal technique.

The effect of a rapid back stick movement in the Mirage is an initial reduction in lift as the elevons are raised. The aircraft then rotates about its CG and the lift is regained in 1 or 2 seconds as angle of attack is increased. While the aircraft is rotating nose-up, the main wheels are driven downwards, adding to the vertical velocity already imparted by the loss of lift. In a situation where a high sink rate develops just prior to touchdown, the natural reaction is to apply up to full back stick to avoid a heavy landing. If this is done in the last seconds before touchdown, the heavy landing will be aggravated and the chances of scraping the rocket bay tank and external fuel tanks will be increased. Any tendency to develop an excessive sink rate on finals should be corrected as early as possible by normal techniques. However, if a heavy landing is imminent (touchdown within about one second), maintain pitch attitude or, if judgement permits, roll the aircraft forwards on to the runway by

Circuit Entry and Landing

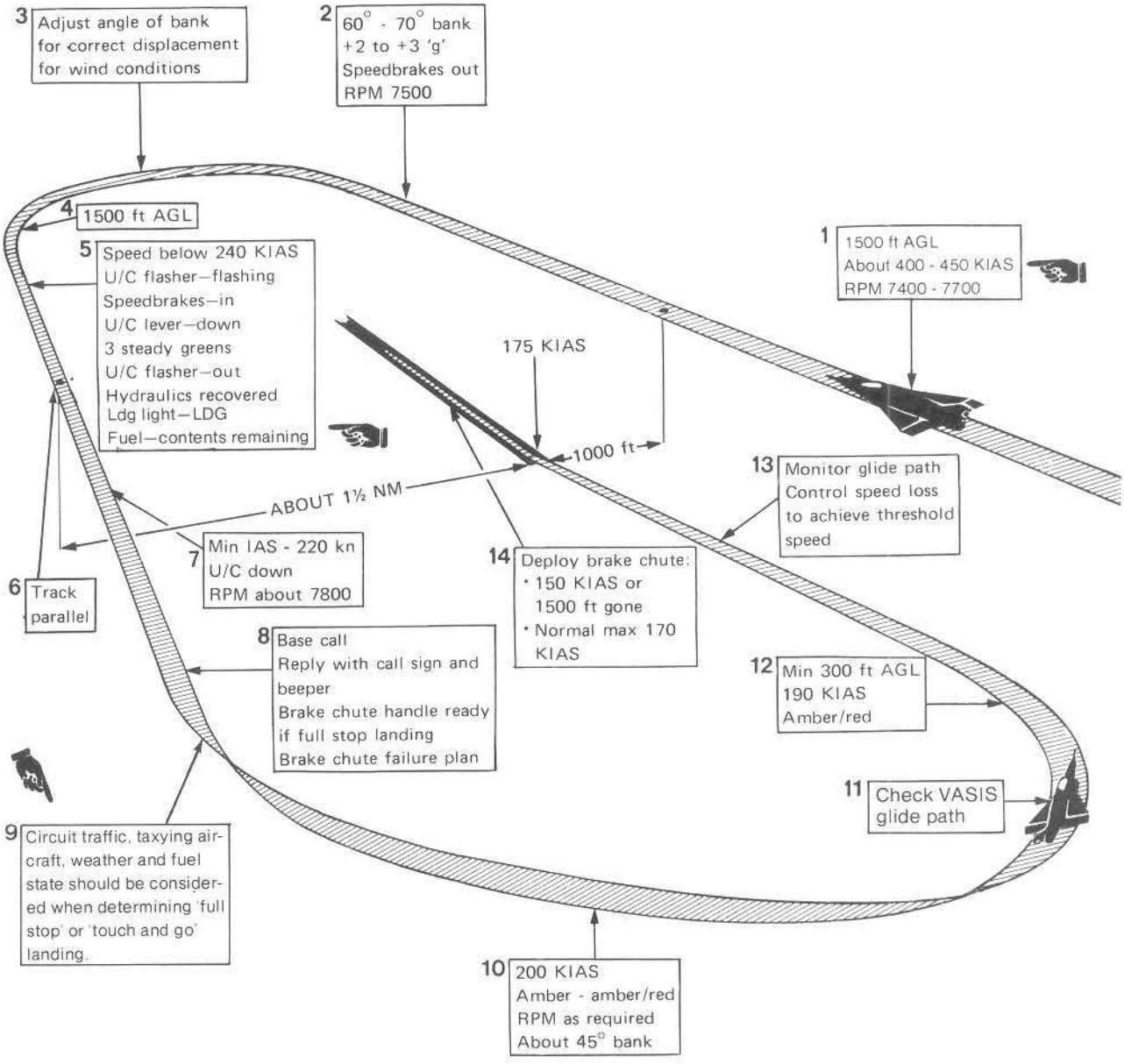


Figure 2-1

reducing the pitch attitude to about 5° to 7° nose-up.

CAUTION

- Avoid applying back stick as a last attempt to prevent a heavy landing as this action will aggravate the situation, if taken immediately prior to touchdown.
- Not all heavy landings, especially those involving side loadings, mark the heavy landing indicators. Any suspected heavy landing is to be recorded in the EE500 regardless of the condition of the heavy landing indicators.

Note

Ensure that the speed brakes are retracted for landing as they lead to increased sink rates.

The brake chute is to be deployed on all landings except when specifically authorised and briefed not to do so. Deploy the brake chute by smoothly moving the lever to the rear and holding it firmly in the rear-most position until the chute is deployed. Deployment of the brake chute results in a nose down pitch change which should be countered by the application of back stick.

CAUTION

- Do not deploy the brake chute above 210 KIAS. As deployment speed increases above 170 KIAS the possibility of a brake chute failure increases rapidly.
- To prevent the strap from being burnt, release the brake chute before the aircraft's forward speed falls below 40 KIAS and before the introduction of power to taxi.

All the factors concerning the landing should be considered prior to touchdown and a decision made on the action to be taken if the brake chute fails. Under normal conditions, with an otherwise serviceable aircraft, weather permitting and with adequate fuel remaining, the most prudent course of action is to execute a go around. Refer to Section 3 for action in the event of brake chute failure.

Note

- Pilots are to be prepared for a brake chute failure on every landing.
- The speed the BRAKE CHUTE handle is selected to OUT is to be noted for entry in EE 500.

After touchdown, raise the nose to 10-12° pitch attitude for aerodynamic braking. Rapid deceleration occurs with the operation of the brake chute, and the nose wheel should be lowered gently to the ground by about 100 KIAS before effective elevon control is lost. Wheel brakes, rudder and elevons are used as required to maintain directional control during the landing roll.

CAUTION

To avoid dragging the tail, do not exceed 12° pitch attitude on landing.

[D] Do not exceed 15° pitch attitude on landing.

CROSS-WIND LANDING

Cross-wind landings may be easily performed in moderate (up to 12 kn) cross-wind conditions by using the crab technique. When the cross-wind is extreme (12 kn to limit for configuration) a combination of wing down and crabbing technique is recommended with an increase in threshold speed of 5 KIAS. The brake chute can be used up to the limits but caution must be excercised as it produces a strong weather cocking tendency. This tendency may be countered by lowering the nose slightly before deploying the brake chute. In very strong cross-wind conditions, especially on a wet runway, the nose wheel should be lowered to the ground before the brake chute is deployed.

CAUTION

The nose wheel limiting speed is 190 KIAS and it should not be lowered at higher speeds.

When the nose wheel is on the ground, keep the aircraft straight by using rudder and elevon in a natural sense.

One brake only may be used with the nose wheel off the ground, however this practice should be avoided if possible as it may result in the nosewheel contacting the ground heavily.

CAUTION

- Use of both brakes with the nose wheel off the ground will produce a sudden pitch down of the nose which could result in damage to the nose wheel.
- Release the brake chute immediately directional control becomes difficult to maintain.

TOUCH AND GO LANDING

The checks required for a touch and go landing are shown at Fig 2-2.

Touch and Go Landing

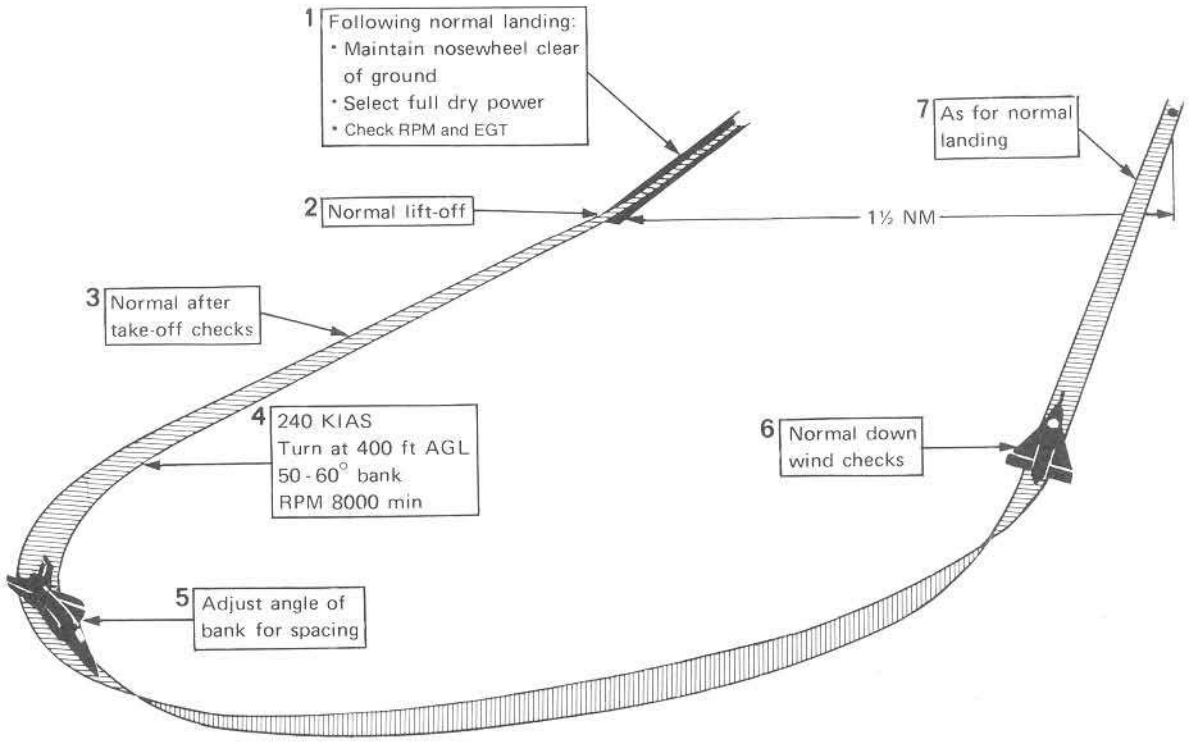


Figure 2-2

GO AROUND

The decision to go around should be made as early as possible. When the decision to go around is made, select 10° nose up, apply full dry power and as the rate of descent is checked, carry out normal after take-off checks.

[D] Select 13° nose up.

AFTER LANDING

Approaching the completion of the landing roll, release the brake chute on the side of the runway and when clear of the flight strip :

1. IFF master switch—OFF.
2. DEMIST lever—Off.
3. Radar master switch—OFF.
4. PRESSURIZATION switch—OFF.
5. TACAN master switch—OFF.
6. HORN switch—OFF.
7. PROBE-HEAT switch—OFF.
8. Radar altimeter control knob—OFF.
9. Doppler selector switch—OFF.
10. Jettison buttons cover—Up.
11. LDG LIGHT switch—OFF or TAXI.
12. Canopy—Latched, if required.

ENGINE SHUT DOWN

When the aircraft is stationary in the lines, check :

1. PARK/EMG BRAKE—On.
2. GYRO CENT switch—OFF.
3. A/H, EMG HYD PUMP, SERVO CONT and AC PITCH ROLL circuit breakers—Out.
4. Gunsight :
   a. Brightness rheostat—Low intensity.
   b. Weapons system selector—G/S OFF.
5. [D] PRESSURIZATION switch—OFF.
6. INV switch—OFF.
7. ALT switch—OFF.
8. Exterior lights—OFF.
9. UHF—OFF (both).
10. Throttle—Stop and simultaneously start clock.

When the engine has run down and stopped, a signal

is given by the attending airman.

11. Clock—Stop.

CAUTION

The minimum allowable engine run down time is 20 seconds.

12. L.P. PUMPS—OFF.
13. MAIN L.P. COCK—OFF.

CAUTION

Do not turn the LP fuel cock to OFF until the engine stops rotating because the main fuel pump and shaft may be damaged due to cavitation.

If the LP fuel cock is turned OFF before engine run-down, the aircraft is to be placed unserviceable in the EE 500 to ensure that the main fuel pump is removed for inspection.

14. Speed brake switch—Blip to bleed U/C B pressure to zero.

WARNING

Ensure that the marshaller signals that the speed brakes are clear before operating the speed brake switch.

15. Chocks—In place.
16. PARK/EMG BRAKE—Off.
17. BATT switch—OFF.
18. Canopy handle—OPEN.

CAUTION

[D] The front seat pilot is to obtain clearance from the rear seat occupant before operating the canopy.

BEFORE LEAVING AIRCRAFT

Before leaving the aircraft, the following checks should be completed :

1. Seat safety pins—Inserted.
2. Oxygen supply line—Disconnect.
3. Chest cock—Close.
4. Radio connection—Disconnect.
5. Anti-'g' suit hose—Disconnect.
6. Leg restraint lines—Release, pull taper-plugs clear of bowyangs, and refit taper-plugs into their respective housings.
7. Parachute/safety harness—Release.
8. Dinghy lanyard—Disconnect.
9. Check run down time and shut down fuel for entry in Form EE 500.
10. Emergency oxygen cock—OFF.
11. Normal oxygen cock—OFF.

GUNSIGHT CHECKS - ALL MISSIONS

Before strap-in, switch on the TGP, turn the gunsight on and, if possible, allow an eight minute warm-up period before carrying out the following checks :

1. Gunsight lights :
   a. Mask lever—N.
   b. Indicator light selector—Test, check all lights on.
   c. Gunsight brightness rheostat—Adjust.

Note

Set the gunsight brightness rheostat fully clockwise (minimum) before switch-on.

2. Weapon system selector—MISS and S.W.:
   a. Pipper—Centred on fixed cross (± 3 mils).
   b. Roll bars—Not visible.
   c. Range/heading scale—Visible and rotating.
   d. Sight override button—Press and hold.
      (1) Check sight changes to AIR-AIR GUNS.

Note

The sight remains in the AIR-AIR GUNS mode until the sight override button is released.

3. Weapon system selector—GUNS :
   a. Pipper—50 mils vertically above fixed cross (ie horizontal arm of fixed cross bisects centre of bombing marker - tolerance ± 1 mil).
   b. Elec cage button—Press.
      (1) Check pipper rises 9-11 mils.
4. Weapon system selector—NAV :
   a. Sight depression rheostat—35 mils.
   b. Pipper—Centred on fixed cross.
   c. Roll bars—Visible.
   d. Range/heading scale—Shows aircraft heading after transfer.

Note

Mil setting in this mode is approximate, being dependent on aircraft attitude.

5. Weapon system selector—G/R/M :
   a. Sight depression rheostat :
      (1) Adjust pipper to AIR-AIR GUNS position; depression 11 ± 3 mils.
      (2) Set pipper on apex of inverted V; depression 20.5 ± 3 mils.

(3) Set bottom of moving reticule tangential to horizontal arm of fixed cross; depression 35 mils.

Note

Any errors should be constant throughout the depression range.

6. Weapon system selector—HE BOMB :
   a. Sight depression rheostat :
      (1) Zero (± 3 mils)—Top of moving reticule tangential to horizontal arm of fixed cross.
      (2) 45 mils—Bombing marker 25 mils (1 rad) above nose probe.
      [D] 45 mils—Bombing marker touches nose probe.
7. Weapon system selector—As required.

RADAR CHECKS

NON-RADAR MISSION

If radar is fitted to the aircraft, it must be switched on to prevent antenna damage during flight. The following checks are then required :

1. Weapon system selector—As required.
2. Range switch—RANGE.

Note

Setting the range switch to RANGE locks the radar antenna to the aircraft axis.

3. Radar master switch—STND-BY during taxi.

After 30 sec :

4. G/R RANGE and antenna elevation lights—On.

After Further 30 sec :

5. Scope A/H, 5° oscillating trace and searching strobe—Visible.
6. INTENS control—Reduce intensity as required.

Note

The intensity should be reduced until the scope A/H, 5° oscillating trace and searching strobe are just visible.

7. SILENCE light—Illuminates 3-4 min after switch-on.

After Landing :

8. Radar master switch—OFF.

CAUTION

- If the radar OVER-HEAT light illuminates during flight, place the radar master switch to OFF. Any harsh manoeuvres could damage the antenna.

CAUTION

- If the alternator or generator drops off line during flight, the radar is automatically switched off. Harsh manoeuvres could damage the unstabilized antenna.

INTERCEPT MISSION

Pre-start

Where possible, the full gunsight check should be completed before taxiing. The following checks of the radar controls must be carried out during the pre-start check :

1. Radar stick—Unstowed.
2. Manual gain control knob—Fully forward.
3. Antenna scan selector—60.
4. Scope visor—Fitted.
5. Polaroid screen control—Fully clockwise (as required for night flying).
6. Range scale switch—50 NM.
7. Scope controls—All about 12 o'clock position.

Note

Markers on scope control knobs are normally in the 12 o'clock position when the control is neutral.

8. Weapon system selector—S.W.
9. Range switch—NORM.
10. SINGLE/DUAL switch—DUAL.
11. Anti-jam switch—NORM.

Taxi

During taxi :

1. Radar master switch—TX at least 4 min before take-off.

Note

The hydraulic motor operation is audible.

2. PHI mode selector—ANT AZ.

30 Seconds After Switch-on :

3. Elevation lights—On.
4. Antenna scanning—Starts, antenna movement is audible.
5. TRANSMIT light—ON.
6. Range/heading scale—Ceases to rotate.

60 Seconds After Switch-on :

7. Normal scan starts :
   a. Scope brightens.
   b. Scope A/H and normal scope presentation appear.
8. Scope controls—Adjust as required.
9. Strobe control—Manipulate and check scope azimuth and range against the PHI and sight

range scale.

Note

PHI bearing pointer should be within the 120° sector with bearing corresponding to the strobe position on the scope. Scope range and range/heading scale should agree within ± 0.5 NM at 5 NM.

10. Antenna elevation control and lights—Check operation and movement.
11. Lock-on lever—Press, check stop program intensity.

Note

Two vertical traces, equidistant either side of the strobe right edge, should appear. Intensity should not vary greatly from normal scan settings.

12. Antenna scan selector—30, check antenna azimuth and strobe range control (PHI to agree). Within scan limits, the scan should be equidistant either side of the right edge of the strobe. Check antenna out-of-limit indication and radar scope centreline.

Note

The stationary trace present when the antenna is out of limits, indicates the radar scope centreline which may differ slightly from the etched centreline. The difference should be noted to achieve accurate positioning during intercepts.

13. Antenna scan selector—SPIRAL.
    a. Strobe wobbulation—± 2 NM.
    b. Lock-on lever—No effect.
    c. Antenna azimuth and strobe range control—Check (PHI agrees).
14. Antenna scan selector—60.
15. Range scale switch—15 NM.
16. Check 6 NM scope function.
17. Range scale switch—50 NM.
18. Range switch—RANGE :
    a. G/R RANGE light—On.
    b. Strobe searches—2.5 hm to 2.7 NM.
    c. Expanded scope scale—6 NM.

    There is no normal antenna control, but when the antenna azimuth is outside the 120° sector, the strobe is 40° right of centreline of the scope.
19. Range switch—NORM.

3-4 Minutes After Switch-on :

20. TRANSMIT light—Out.
21. Ground echos appear.
22. Manual gain control knob—Check function.
23. Lock-on lever—Lock-on to echo.
24. Range/heading scale—Check lock-on distance.
25. Note sight orders and sequence lights operation.
26. SINGLE/DUAL switch—SINGLE, check operation.

    The presentation in this mode should be the same as the top sweep in dual-bar scan for the same antenna elevation setting.
27. Antenna scan selector—SPIRAL :
    a. SILENCE light—On, when range strobe is greater than 21 NM.
    b. Check auto lock on to ground echoes.
28. Antenna scan selector—60.
29. Range switch—RANGE:
    a. Manual gain—Check.
    b. Auto lock on—Check.
30. Range switch—NORM.
31. Sight override button—Press, check :
    a. Gunsight switches to AIR-AIR GUNS.
    b. Radar switches to RANGE.
    c. Auto lock on to ground echoes.
    d. Sight orders and sequence light operation.
    e. S.W. tone still audible.
32. Break lock lever—Press.

WARNING

Radar energy can be damaging to nerve tissue (particularly the eyeball retina). Exercise caution when operating the radar in the transmit function during taxiing. If there is any likelihood of ground personnel entering the antenna danger zone, place the selector to STND-BY.

Note

When the radar is locked on using the sight override button, it remains locked on if the button is released, however the sight reverts to the S.W. mode.

GROUND ATTACK MISSION

Pre-start

A full gunsight check should be completed before start. Check :

1. Radar stick—Unstowed.
2. Manual gain—Fully forward.
3. Antenna scan selector—60.
4. Radar scope visor—Fitted.
5. Polaroid screen control—Fully clockwise (as required for night flying).
6. Range scale switch—50 NM.
7. FRE ↑ switch—Off.
8. Scope controls—All about 12 o'clock position.
9. Target altitude rheostat—Zero.

10. Weapon system selector—Required AIR-GROUND mode.
11. SINGLE/DUAL switch—SINGLE.
12. Range switch—NORM.

Taxi

During taxiing :

1. Radar master switch—TX, at least 4 min before take-off.

30 Seconds After Switch-on :

2. Elevation, GROUND-MAP, 50 NM/10 and TRANSMIT lights—On.

60 Seconds After Switch-on the Scope Blooms :

3. INTENS control—Adjust.
   Increase until scope blooms at the outer extremities, decrease until bloom disappears and scope is completely blank.
4. MARKER control—Adjust.
   Increase until the 10 NM marker is just visible.
5. STOR. control—Adjust.
   Adjust to half a scan of persistence.

Note

The INTENS control may require re-adjustment. Remember the final position of the control.

6. Check antenna vertical movement in ground map.
7. Range scale switch—15 NM :
   a. 15 NM/5 light—On.
   b. Intensity—Compare with 50 NM display.
8. Range scale switch—50 NM.
9. Doppler DA knob—15° :
   a. Note scan displacement in correct direction (drift indicator to right, scope to left).
10. Range switch—RANGE :
    a. G/R RANGE light—On.
    b. Elevation lights—On.
    c. Strobe searches—3.3 to 6 NM.
11. Range switch—NORM.

Selecting the 30° scan in either scale causes blooming of the outer edges of the sweep. However, since the smaller scan is rarely used, it is preferable to adjust intensity in the 60° setting. After three to four minutes, the red TRANSMIT light extinguishes. Ground returns should appear on the scope. If the system is initially switched to STND-BY, neither the TRANSMIT nor the SILENCE light illuminates until 3 to 4 minutes have elapsed. When the system is ready to transmit, the SILENCE light illuminates. When TX is selected, the SILENCE light extinguishes.

Remember the position of the INTENS control for each scale found during the pre-take off check and set it in the correct position as the scale is changed. The average gain control setting is considerably lower on the 15 NM scale. In fact, on 50 NM scale, the gain is usually fairly close to maximum. When changing from 50 NM to 15 NM scale, it is easy to mistake the extra brilliance for high intensity when in fact it is too much gain. Therefore, do not vary the intensity from the two pre-determined positions, but make full use of the gain control. The most common fault in scope adjustment is too much gain, especially in the 15 NM scale.

Note

If the TRANSMIT fail light illuminates and transmission is not restored after pressing the EMG. TRANS button a few times, the system should be switched to AIR-AIR mode momentarily, then returned to AIR-GROUND. This may restore transmission.

GUNSIGHT CAMERA CHECKS

COCKPIT

Before strapping-in, the pilot should check the camera installation and settings as follows :

1. Camera—Correctly fitted in bracket and locked.
2. Weapon system selector—G/S OFF.
3. Camera lead—Connected to rear plug.
4. Photo electric cell lead—Connected.
5. Film sensitivity knob—Correct setting.
6. Over-run control knob—As required.

OPERATION

The exposure time indicator setting varies during flight. If the system appears to be inoperative, the exposure must be set manually. To operate the camera :

1. Weapon system selector—Any mode except G/S OFF.
2. Trigger—Press (1st pressure), or
3. Bomb release button—Press.

RADAR SCOPE CAMERA CHECKS

COCKPIT

Before strapping-in check :

1. Camera—Fitted securely.
2. Photo electric cell lead—Disconnected and secured.
3. Camera lead—Connected.
4. Camera—Operation.
5. Exposure time indicator—Normally 100.

OPERATION

1. Operate the camera by placing the switch mounted on the camera bracket to the ON position.

KA56 CAMERA

PRE-FLIGHT

Check :

1. Film magazine—Installed.
2. Prism glass—Clean.

PRE-START

Inform the photographer of the gyro magnetic heading indicated on the PHI card in NO TR mode. The photographer will set the heading into the heading counter on the camera body and close the camera hatch. Set controls as follows :

1. FRAMES EXPOSED counter—Value appropriate to ground test.
2. Radar master switch—STND-BY.
3. Camera power switch—POWER (amber POWER light on).
4. Operate switch—OPERATE (green OPERATE light on).
5. FRAMES EXPOSED counter—Counting.
6. Red camera FAIL light—Out.
7. Operate switch—OFF.
   Set operate switch OFF as soon as possible to reduce film wastage.
8. Power switch—OFF.
9. Radar master switch—OFF.

AFTER START

After start, check :

1. Radar master switch—STND-BY.

IN-FLIGHT OPERATION

Before IP, check :

1. Power switch—POWER (amber POWER light on).
2. ALT ABOVE TERRAIN thumb wheel—As required.
3. GROUND SPEED thumb wheel—As required.
4. CLOUD BELOW switch—As required.
5. Operate switch—As required over target.
6. After last target, clear camera with further 3-5 exposures.
7. Power switch—OFF.

AFTER LANDING

After landing, check :

1. Radar master switch—OFF.

ALERT AND SCRAMBLE PROCEDURES

ALERT 7

When ordered to Alert 7, take the following action :

1. Sign EE 500.
2. External power—On.
3. Carry out normal external pre-flight and normal pre-start checks except :
   a. GYRO CENT switch—OFF.
   b. BATT switch—OFF.
4. Missiles—Check S.W. tone.
5. MISS STND-BY switch—OFF.
6. Both radios—Check with strip ops, set appropriate studs.
7. Communications selector—TB.
8. Report alert state to strip ops.
9. EMG HYD PUMP CB—Out.
10. Standby A/H CB—Out.
11. Oxygen—Check all modes, then main, emergency and chest cocks—Off.
12. External power—Off.

ALERT 2

When ordered to Alert 2, proceed as follows :

1. External power—On.
2. Main and emergency oxygen cocks—On.
3. GYRO CENT switch—ON.
4. Strap in.
5. MICE plunger—In.
6. BATT switch—ON.
7. Standby A/H CB—In.
8. Gyro reference system—Transfer (3 min running).
9. Armament checks on live missiles and guns plug in—Raise hands until cleared.
10. Nav lights (night)—FLASH.
11. Report 'On State' to strip ops.

SCRAMBLE PROCEDURES

When ordered to scramble, proceed as follows :

1. Canopy—Down and lock.
2. LDG LIGHT (night)—TAXI-OFF.
3. MAIN L.P. cock switch—ON.
4. L.P. PUMPS switches—ON.
5. Normal Start.
6. Ground power—Out.
7. Chocks—Away.
8. AC PITCH ROLL and EMG HYD PUMP CB—In.
9. IFF master switch—NORM.
10. Radar master switch—STND-BY/TX (As required).
11. MISS STND-BY switch—ON.
12. PRESSURIZATION switch—ON.
13. TACAN master switch—NOR.
14. PROBE HEAT switch—ON.
15. HORN switch—ON.
16. GRD. CONN light—Out.

17. Doppler selector switch—LAND.
18. U/C red flipper door light—Out.
19. DAMPER plungers—In and check.
20. Communications selector—Green dot.
21. Obtain scramble clearance.
22. Canopy—Checked locked.
23. Controls—Check full and free movement.
24. Fail panel lights—All out except A.C.
25. Normal run-up and take-off.

WARNING

The radar scope blooms one minute after switch on. This may occur during take-off and could prove a distraction during night operations. Ensure scope polaroid screen is in correct position for night operations.

RELEASE FROM ALERT 2

1. Check strip ops to confirm whether gyro centre is to be left running.
2. Signal thumbs down to airman.
3. Armament systems—Hands up while safetied.
4. Normal shut-down checks.

Note

Ensure all oxygen cocks are off.

SECTION 3
EMERGENCY PROCEDURES

SECTION 3

EMERGENCY PROCEDURES

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SECTION 3

EMERGENCY PROCEDURES

This section contains procedures which, if followed, will enable the pilot to recover from an emergency situation. The procedures ensure maximum safety for the crew and/or aircraft until a safe landing or other appropriate action is accomplished. Multiple emergencies, adverse weather and other peculiar conditions may dictate modification of these procedures.

Critical check list items are printed in **BOLD FACE TYPE.** These items are considered to be those which must be performed immediately to prevent aggravation of the emergency. The timescale for completion of critical checklist items will not normally permit direct reference to a checklist and bold face items should therefore be committed to memory. Subsequent checks should normally be performed with reference to the checklist.

Each emergency checklist procedure is designed to cover the worst situation for a given emergency. When the nature and severity of an encountered emergency are established, common sense and sound judgement are to be used in determining whether all, or part only, of the published procedure is relevant, or whether a variation to the procedure is required.

When an emergency occurs, notify other crew/flight members and the controlling agency as soon as possible of the existence of the emergency and the intended course of action.

In all emergency situations, three basic rules must be observed to optimise chances of a safe recovery:

1. Maintain positive control of the aircraft. If in formation, nominate whether you wish to lead or fly wing and then do so.
2. Analyse the situation and then take the correct action.
3. Land as soon as practicable.

Note

- Apart from emergencies on take-off and landing, and illumination of the fire warning lights, the most serious failure is an OIL light.
- When a failure results in illumination of a warning light and (where applicable) the horn sounding, the main FAIL light also illuminates. The horn and main FAIL light are cancelled by pressing the main FAIL light. This allows indication of further failures.
- When landing without normal braking, the pilot should consider shutting down the engine during the landing roll. The engine should be shut down if the aircraft leaves prepared surfaces.

Note

- Emergency regulation is used in a number of emergencies. The emergency regulation is activated by the switch labelled EMG OIL PUMP.
- All undercarriage emergencies and all fire emergencies are under the main headings, ie Fire on Take-off is not under Take-off Emergencies but under Fire.

IN-FLIGHT ENGINE EMERGENCIES

FLAMEOUT/RELIGHTS

Indications of flameout are thrust loss, uncontrollable decay of RPM and EGT(T4) towards windmilling values and a sudden decrease in engine noise.

Hot Relight

If flameout is suspected below 25 000 ft and an immediate relight is desired :

1. **THROTTLE—IDLE.**
2. **RELIGHT SWITCH—ON.**
3. **SPEED—CONVERT TO HEIGHT.**
4. **EXTERNAL STORES—JETTISON IF REQUIRED.**

If No Engine Response and Height Permits :

5. **PROCEED WITH NORMAL RELIGHT.**

If Height is Insufficient :

6. **EJECT.**

WARNING

- The Atar engine is not subject to unprovoked flameouts within the flight envelope. Unless a reason for the failure is immediately apparent, attempts to restore normal operation will most likely be abortive.
- Do not persist with relight attempts to the detriment of ejection potential (MSEA is 2000 ft AGL).
- If gliding at 200-250 KIAS, difficulty may be experienced in arresting aircraft descent prior to ejection.

Normal Relight

Normally it is not advisable to relight after an engine explosion. However, the loud explosive noises from the engine may be due to air intake disturbances. The best glide speed is 300 KIAS.

A comparison of idle and windmilling RPM at 300 KIAS follows :

Altitude	Idle RPM	Windmilling RPM
50 000 ft	7200	5300
40 000 ft	6700	3100
25 000 ft	6200	2300

EGT(T4) is normally 150-250°C at idle RPM. With the engine flamed out, EGT(T4) continues to decay towards 0°C.

WARNING

Do not attempt a relight if the engine has seized or a mechanical failure involving the loss of the HP fuel pump is indicated.

If the engine flames out :

1. **THROTTLE—STOP.**
2. PRESSURIZATION switch—OFF.
3. Oxygen selectors—100%/N.

Before RPM Falls Below 2500 :

4. LOADSHED switch—ON (refer to standby AH).
5. IGN/VENTIL switch—IGN.
6. L.P. PUMP switches—ON.
7. MAIN L.P. COCK switch—ON.

CAUTION

If the MAIN L.P. COCK switch is inadvertently selected OFF in flight it is not to be selected on above 3000 RPM.

8. A/B COCK switch—OFF.
9. Achieve relight conditions :
   a. Below 25 000 ft.
   b. 200-250 KIAS.
   c. 1700-2100 RPM.
10. RELIGHT switch—On.
    a. Start clock.
    b. Red IGN light—Illuminated, if not
    c. Check START CB—In.
11. Throttle—Idle.

After 30 Seconds, If No Relight :

12. RELIGHT switch—Off.

Pause Then :

13. Throttle—Stop.

Note

It is possible to obtain ignition after the RELIGHT switch has been selected off and before the throttle is moved to stop. This can occur as a result of the diminishing spray pattern presenting a more favourable fuel/air ratio to the igniters than was obtained during operation of the six-bar solenoid valve in the relight sequence.

14. Wait 30 seconds before attempting a relight for the second time.

After Relight, When RPM is Above 3500 and EGT(T4) is Rising :

15. Throttle—Advance and check normal response.
16. RELIGHT switch—Off.
17. LOADSHED switch—OFF.
18. Oxygen selectors—N/N.
19. PRESSURIZATION switch—ON.
20. DAMPER plungers—Engage.

Note

- Selecting the LOADSHED switch ON before RPM falls below 2500 prevents the TGP from toppling when the alternator drops off line. Above 2500 RPM the electrical system operates normally.
- It is essential to select the LOADSHED switch ON before 2100 RPM to avoid battery drain after the generator drops off line.
- If a TACAN fix is required, the pilot may maintain RPM above 2500 and delay selecting the LOADSHED switch ON. Depending on altitude this may result in excessive height loss.
- Unstabilized magnetic heading is available from either the PHI with the heading selector in EMG or from the standby compass.

Relight In Emergency Regulation

If the engine has been shut down with the EMG OIL PUMP switch on :

1. EMERGENCY THROTTLE switch—Full decrease for 10 seconds.
2. Carry out a normal relight.
3. When the RPM is above 3500 use the EMERGENCY THROTTLE switch again.

OIL FAIL LIGHT

A drop in oil pressure activates the OIL fail light and warning horn. If no action is taken, the main engine fuel control unit is affected. RPM, EGT(T4) and thrust fluctuations occur within 5 minutes in subsonic

flight or almost immediately in supersonic flight. Emergency regulation must be selected as soon as RPM anomalies occur, even to the extent of selecting the throttle to idle above M1.6. It is undesirable to use less than 7000 RPM with emergency regulation as under or overfuelling may occur. At low altitudes where low RPM occurs with the throttle at idle, 7000 RPM should be set if possible before the EMG OIL PUMP switch is selected ON. The throttle must be selected to idle when the emergency throttle is being used after an oil failure.

Below 4000 ft :

1. RPM—Set 7000.
2. EMG OIL PUMP switch—ON.
3. RPM—As required for flight using EMERGENCY THROTTLE switch.
4. Throttle—Idle.
5. Land as soon as possible.

Note

- Below 4000 ft, activation of the EMERGENCY THROTTLE may be continuous.
- Above 4000 ft, especially in the case of an oil failure, the EMERGENCY THROTTLE should be activated in short impulses to allow the RPM to stabilize during the pauses.

Above 4000 ft :

1. Throttle—Idle.
2. EMG OIL PUMP switch—ON (below 40 000 ft and M1.6).
3. Use EMERGENCY THROTTLE switch with short impulses (below 30 000 ft).

WARNING

- Do not select the EMG OIL PUMP switch ON with the engine in overspeed.
- If RPM exceeds 9000, set throttle to stop.
- When the EMG OIL PUMP switch is selected ON, 20 minutes of lubrication is provided for the No 1 bearing. It is essential to plan to land within 20 minutes of selection.

CAUTION

Unless operationally essential, do not exceed 8760 RPM for more than five seconds when the OIL warning light is illuminated as engine damage may result.

Note

If the engine is operated above 8760 RPM for more than five seconds when an actual oil failure exists, the details are to be recorded in the Form EE500.

FUEL CONTROL SYSTEM FAILURES

Fuel control system failures can be caused by :

- throttle malfunctions such as the lever jamming or the teleforce cable breaking, resulting in RPM freeze, and
- internal failures in the MFCU leading to RPM fluctuations, abnormal response to throttle movement or an RPM freeze.

RPM Freeze

If Power Variation Is Necessary :

1. Throttle—Full dry.

When Subsonic and Below 40 000 ft :

2. EMG OIL PUMP switch—On.

Note

When the EMG OIL PUMP switch is selected ON, the nozzle flaps open and thrust is reduced.

When Below 20 000 ft :

3. EMERGENCY THROTTLE—Operate as necessary.

Note

The EMERGENCY THROTTLE is inoperative below the frozen RPM value but may allow an RPM increase in certain cases.

4. Land as soon as possible.

WARNING

If the throttle is jammed or the linkage is broken, it may be necessary to use the MAIN L.P. COCK switch to shut down the engine.

RPM Fluctuations

RPM fluctuations indicate a fuel control unit failure.

1. Throttle—Idle.

When Subsonic and Below 40 000 ft :

2. EMG OIL PUMP switch—ON.

Below 20 000 ft :

3. EMERGENCY THROTTLE—Operate with short impulses.

Note

RPM fluctuations up to ± 60 RPM at full dry power are permitted provided EGT(T4) remains above 660°C. These variations usually occur between 25 000 and 40 000 ft.

LANDING WITH EMERGENCY REGULATION

1. Jettison external stores as necessary.
2. RTB at 300 KIAS or as required to land within 20 minutes.
3. If possible, fly a straight-in approach using GCA or TACAN.

4. Level at 1500 ft AGL and 240 KIAS.

At Descent Point :

5. RPM—8000.
6. U/C CONT lever—Down.
7. Maintain 200 KIAS minimum until landing is assured.

Note

- Do not use approach control when using emergency regulation.
- Speed brakes should be used if necessary for speed control rather than reducing RPM.

On Landing :

8. EMERGENCY THROTTLE switch—CLOSED for 6 sec minimum.
9. BRAKE CHUTE lever—Out.
10. Throttle—Stop.
11. MAIN L.P. COCK switch—OFF.

OVERSHOOT WITH EMERGENCY REGULATION

WARNING

Commence the overshoot above 300 ft and above 200 KIAS.

1. **U/C CONT LEVER—UP.**
2. **SPEED BRAKE SWITCH—IN.**
3. **STORES—JETTISON,** if necessary.
4. **EMERGENCY THROTTLE SWITCH—OPEN (FULL INCREASE).**
5. **IAS—MAINTAIN ABOVE 200 kn.**

Note

- The RPM will stabilize at about 8700-8900 RPM.
- With certain failures when oil pressure remains, more thrust may be obtained in an emergency by selecting the EMG OIL PUMP switch to OFF. The nozzle flaps may close and increase thrust.

DRIVE/GEAR FAILURES

Depending on the effect on aircraft operation, failures of engine drives and gears can be grouped in three basic categories. An engine seizure or failure of the drive to, or in, the reduction gearbox encompasses all three categories, as shown in Fig 3-1. The failure categories are :

- Failures in the drive train to the engine accessory gearbox, which inevitably result in flameout (with no possibility of relight), an RPM indication of zero and an OIL light. Other services may be lost depending on the component which has failed (refer to Fig 3-1).

Note

A partial failure of the engine accessory gearbox could cause loss of one or more services without the loss of the HP fuel pump. For example, an oil failure and/or loss of RPM control coupled with a tachogenerator failure is a possibility.

- Failure in the drive train to the aircraft gearbox, which result in loss of generator, alternator and HYD 2, but do not cause engine flameout.
- Failures of drives to individual services components.

The cockpit indications of the various drive/gear failures are summarized in Fig 3-2.

Engine Flameout, RPM Zero, OIL Light On

If the engine flames out (loss of thrust, EGT decreasing towards zero), the RPM indicates zero and the OIL light illuminates :

1. Check HYD 1 and HYD 2 fail lights.

If Neither HYD 1 Nor HYD2 Lights Are On :

2. The failure is probably of the engine accessory gearbox. A relight is not possible. Refer to Fig 3-1 for services available/lost.

Note

Depending on windmilling speed, the ALT and/or GEN and A.C. warning lights may illuminate.

3. Either :
   a. Glide towards a suitable area—Eject.
   b. Consider forced landing.

Note

At normal glide speeds with the engine windmilling HYD 1 and HYD 2 should maintain normal pressure.

If the HYD 1 Light Is On, HYD 2 Light Is Out :

4. The failure is probably of the angle drive. A relight is not possible. Refer to Fig 3-1 for services available/lost.

Note

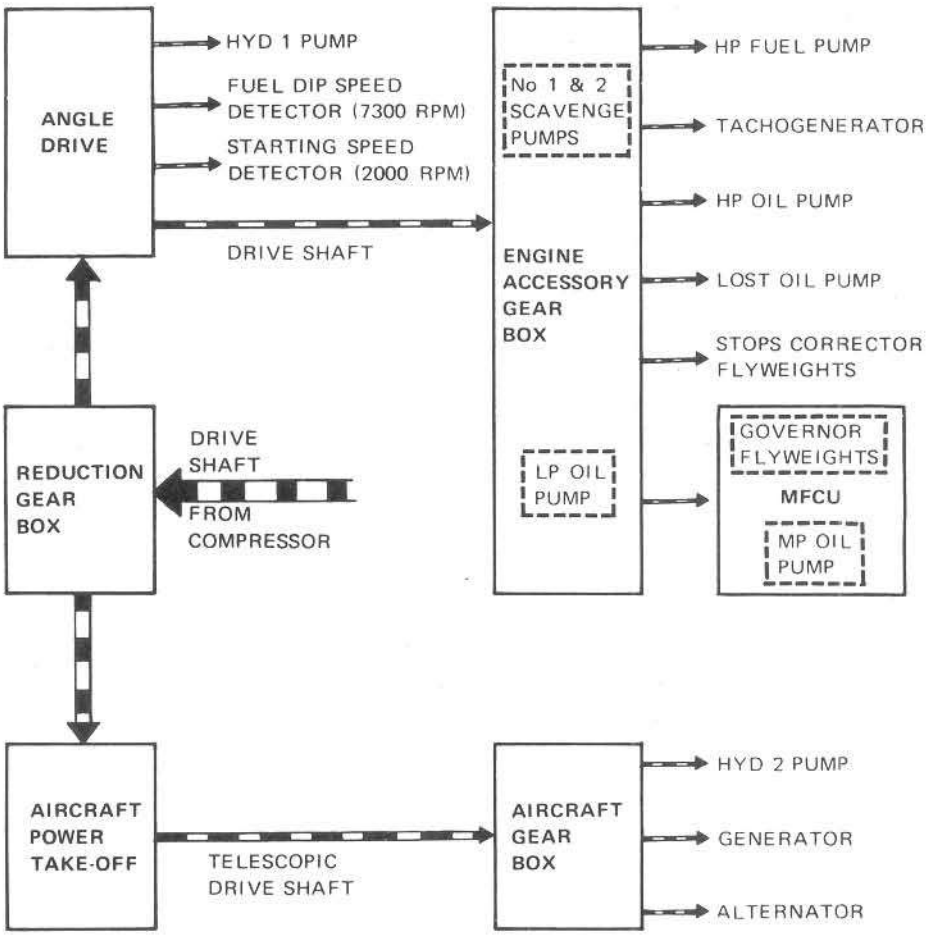
- Depending on windmilling speed, the ALT and/or GEN and A.C. warning lights may illuminate.
- HYD 1 pressure will be about 1800 psi.

5. Glide towards a suitable area—Eject.

WARNING

A forced landing is not to be attempted as depletion of the HYD 2 system occurs during the emergency U/C extension.

Drives and Gearing



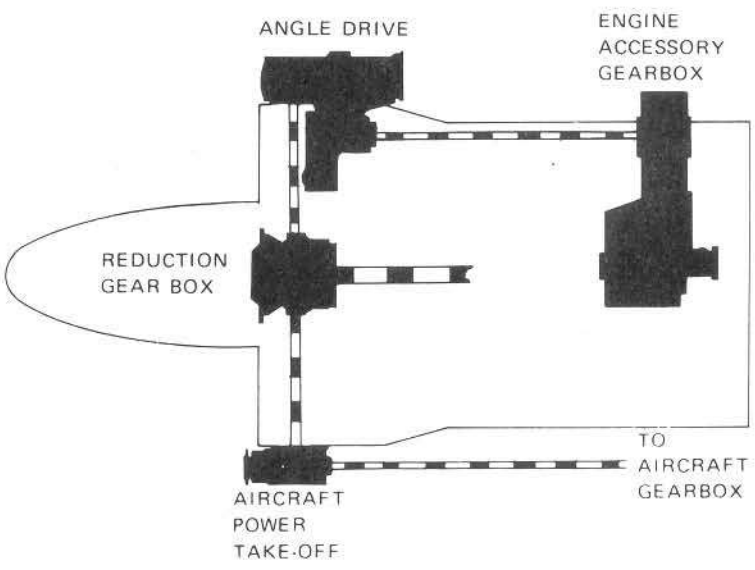


Figure 3-1

Drive/Gear Failure Indications

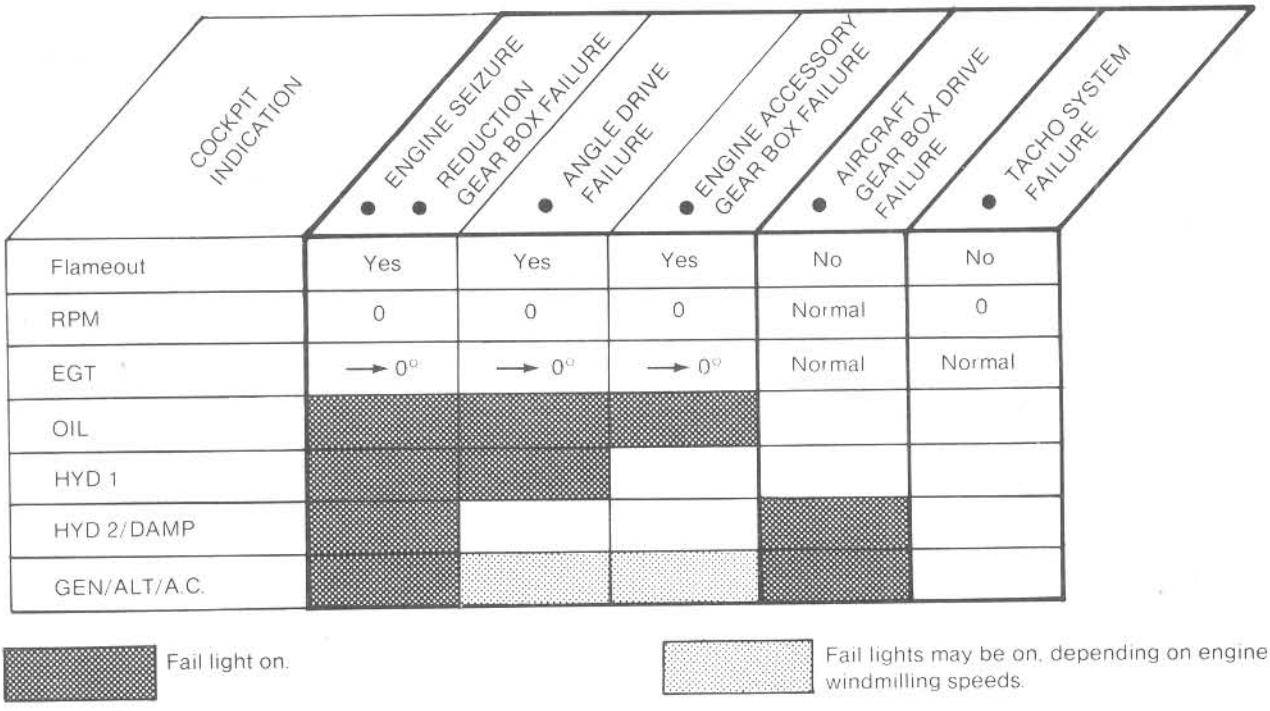


Figure 3-2

If Both the HYD 1 and HYD 2 Lights Are On :

6. The failure is either of the reduction gear box or is an engine seizure. A relight is not possible. Refer to Fig 3-1 for services lost.

Note

The GEN, ALT, A.C., and DAMP fail lights will also be on.

7. Glide towards a suitable area—Eject.

Note

The EMG HYD pump is operating. Battery life is limited to about eight minutes after which flight controls will lock.

Illumination of GEN, ALT, HYD 2 Fail Lights

If the GEN, ALT and HYD 2 fail lights illuminate, proceed as follows :

1. Check RPM, EGT and HYD 1.

If RPM, EGT and HYD 1 Normal :

2. The failure is probably of the aircraft power take-off or the aircraft gear box. Refer to Fig 3-1 for services available/lost.

Note

The A.C. and DAMP fail lights will also be on.

3. **CONSERVE ELECTRICAL POWER.**
4. Land as soon as possible.
5. U/C CONT lever—Down, before loss of battery power (about 30 min).

   Before lowering U/C consider time since failure, fuel remaining and aircraft position.

WARNING

- Emergency U/C extension is unavailable and, if battery power is depleted, normal U/C extension is also unavailable.
- Wheels-up landings are prohibited.

THRUST VARIATIONS

The two most probable causes of thrust variations are an oil pressure drop or excessive oil in the engine accessory gearbox. An oil pressure drop causes the OIL fail light to illuminate. Excessive oil in the engine accessory gearbox induces thrust and RPM variations, the EGT(T4) drops to 500-550°C with full dry selected and the nozzles will probably jam fully open.

If variations in thrust and RPM with EGT(T4) at 500-550°C with full dry selected occur, the nozzles should be assumed to be jammed open.

1. Land as soon as possible.
2. Monitor the OIL light.

If RPM and Thrust Variations Continue To Increase :

3. Proceed as for a fuel control unit failure.

Note

Thrust variations may also occur if both boost pumps have failed or are selected OFF.

ENGINE SURGE

Terminology

The term surge is used when referring to a condition of unstable air flow in an engine which affects the whole engine, ie compressor, combustion chamber, turbine and nozzle. The term compressor stall is used to describe a lesser condition in which one or more stages of a compressor are stalled. Thus, a surge always involves a compressor stall, but the converse is not true. Trials conducted in France and Australia have shown that three different types of surge may be encountered when operating the Atar engine :

- **Momentary Surge.** A momentary surge is one which manifests itself as a small change in engine speed and a 'b-r-r-r-p' sound from the engine intake. There is no immediate change in EGT(T4) and the engine recovers without any further action by the pilot.
- **Partial Surge.** A partial surge is accompanied by a large change in both engine speed and EGT(T4). The intake noise continues until the surge is cleared. The surge is cleared by retarding the throttle to idle and diving to increase airspeed.
- **Total Surge.** A total surge is one which will not clear during a dive at idle throttle or one which causes immediate flameout. A total surge leading to flameout produces a very rapid decrease in both engine speed and EGT(T4) and no intake noise. Engine recovery from a total surge can only be achieved by shutting down the engine and subsequently relighting within the relight envelope.

Causes of Surge

Factors which can induce a surge in the Atar engine or which affect surge susceptibility are :

- high $N/\sqrt{T}$,
- high incidence and/or high rate of change of incidence,
- ignition or extinction of afterburner,
- weapon firing,
- fuel control system characteristics,
- EGT, and
- aircraft yaw.

Recovery

1. **THROTTLE—IDLE.**
2. Dive aircraft to increase IAS to 300-500 KIAS.

Note

Surge clearance is unlikely below 300 KIAS and 500 KIAS may be required.

3. Observe engine instruments to identify surge type :
   a. Partial Surge - RPM about 6000, EGT(T4) about 600°C.

Note

Some French reports indicate that EGT(T4) may rise to 750°C or more, with RPM blocked at a low-thrust value. This has not been experienced in Australian tests, but might occur during a spin or when the throttle is not retarded to idle.

   b. Total surge - RPM rapidly decaying, EGT(T4) rapidly decaying below 200°C leading to flameout.

If EGT(T4) Decreases and Intake Noise Ceases :

4. Throttle—Slowly advance and check EGT(T4) and RPM response.

Note

Owing to the increase of idle RPM with altitude, the throttle may require advancing several inches before engine response is obtained.

If the Stall is Not Cleared Within 40 Seconds or If EGT(T4) is Greater Than 750°C or If the Engine Flames Out :

5. Throttle—Stop.
6. Carry out relight within relight envelope.

Note

Avoid operating the aircraft in a manner likely to induce a surge.

A/B FAILURE

With the throttle in the A/B sector :

- if the A/B fails to ignite or abnormal extinction occurs, either in flight or on the ground; or
- if RPM exceeds 8900 or drops below 8000 when A/B is selected; or
- if EGT(T4) exceeds 780°C; or
- if the red A/B INJ light remains on for more than 10 seconds :

1. Throttle—Dry sector.
2. Do not reselect A/B.

If fuel dipper operation continues after trigger release :

1. ARM MASTER switch—OFF.
2. All other armament switches—OFF.
3. FUEL DIP CB—Out (if fitted).

If the Fuel Dipper Operation Continues :

4. External stores—Jettison if required.
5. Do not use A/B, approach control or emergency regulation.
6. Fuel—Burn off until contents less than 250 gal.
7. Plan to land off a straight-in approach.
8. U/C CONT lever—Down at descent point.
9. IAS—Maintain 200 kn minimum on finals (about 8000-8200 RPM).

Overshoot with Fuel Dip Engaged.

WARNING

Commence the overshoot above 300 ft, and above 200 KIAS.

1. Throttle—Full dry.
2. Speed brake switch—In.
3. U/C CONT lever—Up as soon as possible.
4. Stores—Jettison, if necessary.
5. IAS—Maintain above 200 kn.

NOZZLE FLAP ASYMMETRY

An asymmetry in nozzle flap displacement or position produces a thrust deflection resulting in pitch or yaw movements particularly during A/B operation.

If Abnormal Yaw and Pitch Changes are Evident With Changes of Power or Speed :

1. P and Y DAMPER plungers—Pull.

If Symptoms Continue, A Nozzle Flap Failure Is Indicated :

2. Do not use A/B.
3. Land as soon as possible using lowest practical RPM.

WARNING

The failure may be caused by an oil leak at the nozzle flap actuators. In this case, the malfunction may lead to an oil failure.

FIRE

FIRE ON THE GROUND

If either of the two fire warning lights illuminate or if fire is indicated by the ground crew or some other means :

1. Declare an emergency to ATC.
2. Proceed as for ABANDONING THE AIRCRAFT ON THE GROUND.

FIRE WARNING ON TAKE-OFF

Undercarriage Down

1. **ABORT.**
2. Proceed as for ABANDONING THE AIRCRAFT ON THE GROUND.

Undercarriage Up

1. **EXTERNAL STORES—JETTISON.**
2. **THROTTLE—FULL DRY.**
3. **A/B COCK—OFF.**
4. **CLIMB TO EJECTION ALTITUDE.**

If Fire is Confirmed :

5. **EJECT.**

If Fire Not Confirmed :

6. Land as soon as possible using minimum power.

FIRE IN FLIGHT

If either or both fire warning lights illuminate in flight :

1. **THROTTLE—IDLE.**
2. **A/B COCK—OFF.**

If the Fire Warning Light Extinguishes :

3. FIRE TEST button—Press to test.
   - If the fire warning system tests serviceable, the warning may have been due to either an overheat condition which has ceased or reduced in intensity, or an electrical fault.
   - If the fire warning system fails to test serviceable, the warning may be due to either a fire which has destroyed the warning circuit or an electrical fault.

WARNING

- The probability of a fire is increased, if the fire warning system tests unserviceable after a fire warning light extinction.
- If the fire warning system tests serviceable after the extinction of a fire light, a fire may still be present.

4. Check for indications of fire :
   a. Fumes, smoke or smoke trail in a turn.

WARNING

An aircraft fire may burn with little or no smoke.

   b. Aircraft system malfunction :
      (1) Dampers or A.C. failure.
      (2) Instrument or radio failure.
      (3) Failure of the fire warning system to test.
      (4) Flight control problems, etc.
   c. Abnormal RPM or EGT(T4) indications.
   d. Report from external agency, etc.

If Fire is Confirmed:
5. Throttle—Idle.
6. Eject.

If Fire is Not Confirmed:
7. Continue to actively check for fire.
8. Use minimum power.
9. Land as soon as possible.

UNDERCARRIAGE

RETRACTION FAILURES

Lever Jammed Down
1. IAS—Maintain below 270 kn.
2. Reduce AUW before landing.

Partial Cycle or No Cycle
1. IAS—Maintain below 240 kn.
2. HYD 1, U/C B pressures—Check.

If Hydraulic Pressures are Abnormal:
3. Proceed as for Hydraulic Failure.

If Hydraulic Pressures are Normal:
4. U/C CONT lever—DOWN.
5. U/C CONT C/B—In.
6. U/C Indications—Check.

If Three Green Lights are Not Obtained:
7. Proceed as for Extension Failure.

Three Greens Indicated:
8. Reduce AUW for landing.

WARNING

If a landable condition is obtained, the U/C is not to be cycled up.

EXTENSION FAILURES

Landable Conditions
A landable condition is indicated by one of the following:

- Mainwheel U/C lights illuminated (steady or blinking).
- U/C DOWN beeper operates (EMERG U/C handle must be in).

WARNING

The minimum U/C condition required for landing is both mainwheels locked laterally (mainwheel U/C lights blinking).

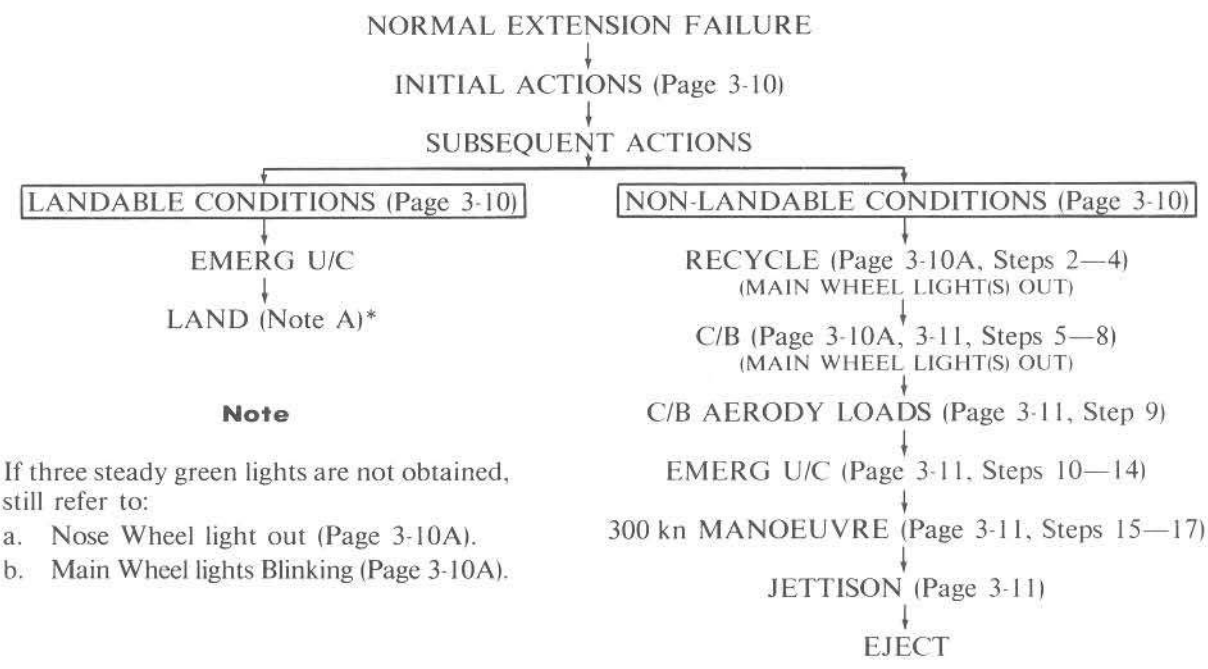
Normal Extension Failure — Initial Actions

If Three Green Lights are Not Obtained:
1. U/C Down beeper—Press.

If No Tone Heard:
2. U/C position lights test button—Press.
3. HYD 1, U/C B pressures—Check.

If Hydraulic Pressures are Abnormal:
4. Proceed as for Hydraulic Failure.

Normal Extension Failure — Flow Chart



Note

*A. If three steady green lights are not obtained, still refer to:
   a. Nose Wheel light out (Page 3-10A).
   b. Main Wheel lights Blinking (Page 3-10A).

Figure 3-2A

If Hydraulic Pressures are Normal, and Full U/C Extension is Not Confirmed:
5. U/C POSIT IND and U/C CONT CBs—In.

If All Lights Remain Out:
6. Continue with Main Wheel Light(s) out checklist.

For Nose Wheel Light Out:
7. Continue with Nose Wheel Light Out checklist.

For Main Wheel Light(s) Blinking:
8. Continue with Main Wheel Light(s) Blinking checklist.

For Main Wheel Light(s) Out:
9. Continue with Main Wheel Light(s) Out checklist.

Nose Wheel Light Out
1. Ensure 'Normal Extension Failure—Initial Actions' complete.

If the Nose Wheel Light Remains Out:
2. EMERG U/C handle—Pull.

Note

- After EMERG U/C extension, the red flipper door light remains on.
- Operation of the U/C DOWN beeper requires resetting of the EMERG U/C handle which must then be pulled out again.

3. Raise radar antenna to full up (IIIO only).
4. Perform normal landing.
5. Lower nose gently by 130 kn minimum.
6. Use minimum braking.
7. Keep engine running to maintain hydraulic pressure until the nose is supported.

If Nose Continues to the Ground:
8. Throttle—STOP.

Main Wheel Lights Blinking
1. Ensure 'Normal Extension Failure—Initial Actions' complete.
2. EMERG U/C handle—Pull.

Note

- After EMERG U/C extension, the red flipper door light remains on.
- Operation of the U/C DOWN beeper requires resetting of the EMERG U/C handle which must then be pulled out again.

If Main Wheel Light(s) Continue to Blink:
3. Land with fuel as close as possible to 172 gal (max forward C of G).
4. Lower nose wheel before deploying brake chute.

CAUTION

Deploying the brake chute with a nose-up attitude may result in an uncontrollable pitch up.

5. Apply normal braking.

When stopped:
6. Set 6000 RPM.
7. Shut the engine down when cleared by the ground crew.

If the Nose Rises Before or After Coming to a Stop:
8. Throttle—STOP.

CAUTION

Except for an emergency, remain in the cockpit until cleared by the ground crew.

Note

Normally, the blinking main wheel light will extinguish on touchdown. This does not necessarily indicate that the corresponding main gear jack has unlocked.

Main Wheel Light(s) Out
Indications:
- Main wheel indicating light(s) out.
- U/C DOWN beeper not operating.
- U/C flasher remains on with RPM below 8000 and IAS less than 210 kn.

1. Ensure 'Normal Extension Failure — Initial Actions' complete.
2. U/C CONT lever—UP.

When Cycle Complete:
3. U/C CONT lever—DOWN.

If Mainwheel Light(s) Still Out:
4. U/C CONT lever—UP.

After 1 Second:
5. U/C CONT C/B—Pull.

Wait 15 Seconds, Then:

6. U/C CONT lever—DOWN.
7. U/C CONT C/B—Reset.

If Mainwheel Light(s) Still Out:

8. U/C CONT C/B—Pull.
9. YAW aircraft to apply aerodynamic load, slowly increasing both amount and frequency of rudder inputs to full at speeds of up to 300 kn, or greater, if required.
10. U/C CONT C/B—Reset.

If Mainwheel Light(s) Still Out:

11. IAS—Reduce below 240 kn.
12. Repeat Steps 2—10 as fuel permits and at pilot's discretion.

If Mainwheel Light(s) Still Out:

13. U/C CONT lever—UP.

When Cycle Complete:

14. EMERG U/C handle—Pull.

When Cycle Stops:

15. U/C CONT lever—DOWN.

Note

- After EMERG U/C extension the red flipper door light remains on.
- Operation of the U/C DOWN beeper requires resetting of the EMERG U/C handle which must then be pulled out again.

If Mainwheel Light(s) Still Out and Fuel Permits:

16. IAS—Increase to more than 300 kn.
17. Apply negative 'g' with yawing, then rapidly apply positive 'g'.

Note

A minimum of 300 KIAS and +4 'g' may be required to obtain a gear locked condition.

CAUTION

This manoeuvre may rapidly bleed off performance to the lower limits of the airframe and engine envelope.

18. External Stores—JETTISON.
19. Repeat Steps 16 and 17.

If Mainwheel Light(s) Still Out:

20. Eject.

WARNING

Landing with either one or both main wheels up is prohibited.

HYDRAULIC FAILURES

Rapid or large flight control inputs following either a HYD 1 or HYD 2 failure can simultaneously induce symptoms of a combined HYD 1/HYD 2 failure with associated but transitory double failure warning.

WARNING

When hydraulic system failures occur, rapid or large flight control inputs should be avoided to prevent system pressure depletion or control system saturation.

HYD 1 FAILURE

The HYD 1 failure light and the main FAIL light illuminate. The warning horn does not sound.

1. **DO NOT OPERATE THE SPEED BRAKES.**
2. RTB, monitor HYD 2 pressure.
3. HYD 1 pressure—Check :
   a. If 1750-2150 psi, EMERG HYD pump is operating.

Note

The failure affects the utility systems and reduces the effectiveness of the control servos.

   b. If HYD 1 pressure is 0 psi, EMG HYD failure light illuminates and horn sounds :
      (1) EMG HYD PUMP CB—Out.
4. Autocommand—Disengage.
5. EMERG U/C handle—Pull.
6. Three steady greens and one red—Checked.
7. U/C CONT lever—Down.
8. MINISTOP switch—OFF.

If U/C B Pressure is 1500 psi or Greater :

9. BRAKE CHUTE—OUT on landing.
10. Brakes—One moderate application may be available if U/C B is greater than 1500 psi.

WARNING

If the MINISTOP switch is left ON, all brake pressure may be depleted on the first brake application.

Note

If U/C B pressure is 2900 psi, 25 applications are available.

11. Shut engine down on clearing runway.

If U/C B Pressure is Less Than 1500 psi :

12. EmB pressure—Check, 2900 psi.

If Crosswind is Present :

13. Consider landing on the downwind side of the runway as the aircraft tends to weathercock into the wind.

On Touchdown :

14. Throttle—Idle or stop.

    When landing without foot brakes, especially if crosswind is present, directional control may be difficult to maintain and the aircraft may leave the runway. In this case, it is mandatory to shut down the engine.

15. Deploy brake chute normally.

WARNING

- If the crosswind is greater than 10-15 kn, use the brake chute with caution. Lower the nosewheel and apply full rudder and elevon before deploying the brake chute or using the PARK EMG BRAKE.
- If directional control is difficult to maintain, drop the brake chute.

When the Nosewheel is on the Ground :

16. PARK EMG BRAKE—Apply smoothly as required.

    If some U/C B pressure remains, differential foot braking may be available to avoid leaving the runway.

CAUTION

Do not use foot brakes and PARK EMG BRAKE together or a total loss of braking may result.

17. Steer with elevons and rudder.

Note

To steer left with elevon, move control column to left and vice versa.

If Aircraft is About to Leave the Runway :

18. Throttle—Stop.
19. L.P. COCK switch—OFF.
20. L.P. PUMP switches—OFF.

When Stopped :

21. BATT switch—OFF.

TOTAL LOSS OF UC/B AND EmB PRESSURES

If a leak occurs at the EmB accumulator or in the EmB hydraulic line, it may result in total loss of U/C B and EmB pressures. If this occurs, no braking is available.

1. Call for barrier to be raised.
2. Land normally.

WARNING

Do not deploy the drag chute.

3. Maintain approximately 100 KIAS.
4. Aim for a central barrier engagement.

Prior to Barrier Engagement :

5. Throttle—Stop.

CAPACITOR COCK FAILURE

The capacitor unit may operate erratically and cut off the ancillaries for no apparent reason. A capacitor cock failure results in an inability to extend the undercarriage by the normal method, and to operate the foot and speed brakes.

No positive warning is given and the failure will only be detected when lowering the U/C or extending the speed brakes: the U/C B pressure drops to zero while the other pressures remain normal.

1. Proceed as for HYD 1 failure.

CAUTION

Check that U/C B pressure returns to normal every time a utility service of the HYD 1 system is used.

Note

When the EMERG. U/C handle is used, the return line hydraulic fluid is diverted to the HYD 1 reservoir. The pilot should check to see if this causes a build up of U/C B pressure.

HYD 2 FAILURE

The HYD 2 warning and main FAIL lights illuminate, the horn sounds and the HYD 2 pressure drops.

1. Land as soon as practicable.
2. HYD 1 pressure—Monitor.
3. P and Y DAMPER plungers—Pull, if not already popped.

WARNING

EMERG. U/C extension is not available and should not be used inadvertently or normal extension will also be lost.

Note

- The DAMP warning light illuminates. The pitch dampers cease to operate and remain locked in the position they were in at time of failure.
- Auto-command still operates.

EMG HYD FAILURE

The EMG HYD and main FAIL lights illuminate, the horn sounds and hydraulic pressures are normal.

1. EMG HYD PUMP CB—Out.
2. No flight restrictions apply.

HYD 1 and HYD 2 FAILURE

A combined HYD 1 and HYD 2 failure could occur as a result of engine seizure, reduction gearbox failure or failure of both hydraulic pumps. The battery has the capacity to operate the EMG HYD pump for only eight minutes. This allows time to fly to a suitable area for ejection.

1. Fly to suitable area.
2. Eject.

Note

If the hydraulic gauge gives unusual pressure readings, check the HYD PRESS circuit breaker. A failure indication may be caused by a malfunction of the hydraulic pressure gauge.

RAAF SUPPLEMENT NO 47

STARTER MOTOR GEARBOX FAILURE

Instruction

This supplement is to be inserted facing Page 3-13.

Information

The fitment of new starter gearboxes to the Atar IAW Modification STI ATAR/196 will not reduce to zero the probability of a gearbox failure.

Action

The following information is to be read following the checks on 'Excessive Torching'.

Starter Motor Gearbox Failure. If, on start the starter motor operates but:

The engine does not rotate within 10sec of pressing the start button, or

The engine RPM rises to a low figure and decays whilst the starter motor continues to operate:

1. THROTTLE - STOP.
2. START CB - Pull.

No further start attempts are to be made.

Date: OCT83

GROUND EMERGENCIES

MIS-START

If, on start :

- RPM is less than 2000,
- EGT(T4) is greater than 700°C, or
- excessive rumble develops :

1. **THROTTLE—STOP.**
2. L.P. PUMPS—OFF.

After Engine Rundown :

3. MAIN L.P. COCK—OFF.

If the Starter Continues to Operate After About 25 Seconds Have Elapsed :

4. START CB—Pull.

CAUTION

If the electric motor continues to run after the START CB is pulled, Relay B is probably stuck in the closed position and ground crew must disconnect the plug from the start control box in the left wheel bay.

Before Attempting a Second Start

1. Determine from ground crew that a successful start is possible.
2. Have ground crew check tailpipe for excess fuel.
3. Carry out dry ventilation if necessary.

CAUTION

- Only three start attempts are permitted. A dry ventilation is counted as a start attempt.
- Do not attempt a start until engine speed is below 250 RPM.

Excessive Torching On Start

If excessive torching occurs on a start :

1. RPM—7500, or
2. Throttle—Stop.

CAUTION

Approach control is not to be used in an attempt to clear burning fuel from the engine.

Note

- When accelerating the engine to 7500 RPM, the pilot is to consider the effects of jet blast and remain alert for a possible shut-down signal from the groundcrew. In confined spaces, a maximum of 6000 RPM should be used.
- If 7500 RPM cannot be applied because the aircraft is in a confined parking space and the excess burning fuel cannot be cleared from the engine at lower RPM, the engine is to be closed down and the fire extinguished by the groundcrew.

Starter Motor Gearbox Failure

If, on start the starter motor operates but:

- The engine does not rotate within 10 seconds of pressing the start button, or
- The engine RPM rises to a low figure and decays whilst the starter motor continues to operate:

1. THROTTLE—STOP.
2. START CB—PULL.

No further start attempts are to be made.

BRAKE FAILURE

Air in the brake transmitters can cause a spongy feel and lack of effectiveness of the foot brakes. Pumping the brakes may increase effectiveness; however, if required, the emergency brake should be used to stop the aircraft. Ministop malfunctions can cause loss of normal braking.

1. **MINISTOP SWITCH—OFF.**

WARNING

Ministop malfunctions can cause loss of normal braking.

2. Re-apply normal braking.

If Normal Braking is Still Unavailable :

3. PARK-EMG BRAKE—Pull gradually.

WARNING

Simultaneous operation of both foot and park brakes may render the brakes totally ineffective.

ABANDONING THE AIRCRAFT ON THE GROUND

1. **THROTTLE—STOP.**
2. **MAIN L.P. COCK—OFF.**
3. **L.P. PUMP SWITCHES—OFF.**
4. Unstrap/Emergency unstrap.
5. BATT switch—OFF.
6. Vacate aircraft.

WARNING

The BATT switch (electrical power) must be ON for about four seconds after the MAIN L.P. COCK is switched OFF to allow the cock to close fully.

Emergency Unstrap

1. Oxygen hose and mic-tel lead—Disconnect.
2. Oxygen chest connector—Unclip from harness.
3. QRB—Release.
4. Bowyangs—Release.
5. Canopy—Open.
6. Dinghy lanyard—Release.

If Canopy Cannot be Opened Manually:

7. Canopy jettison lever—Forward, or
8. Use canopy breaker.

WARNING

If the emergency unstrap is associated with an aircraft fire, the pilot should leave the canopy closed until he has completed the unstrap sequence and he is ready to leave the aircraft.

Canopy Breaker Procedure

If the canopy cannot be opened manually or with the CANOPY JETTISON lever, use the canopy breaker located on the left canopy rail as follows :

- Hold the canopy breaker with both hands.
- Strike above the head and sufficiently to the rear so that the opening does not have to be enlarged towards the rear.
- Continue to break the canopy always striking upwards and close to the arch.

[D] The canopy breaker is below the instrument panel adjacent to the pilot's knee.

TAKE-OFF EMERGENCIES

In general, any incident on take-off involves a decision on whether to continue the take-off or abort. The decision involves a number of factors; the major factors being the type of incident, where it occurs and the aircraft configuration. The following emergencies are based on a decision point at the moment of selecting undercarriage up. This decision point is relevant to a 2440 m (8000 ft) runway. Depending on pilot experience, the decision point may be varied to suit different runway lengths and conditions. It is essential that the decision point is considered prior to every take-off.

If the engine is shut down on landing or during an aborted take off, subsequent maximum braking (MINISTOP switch—ON) will most likely result in total loss of footbrake pressure and therefore loss of directional control. Leaving the engine at idle will ensure that differential braking is available during the retardation.

If the engine is to be shut down and further foot braking is required, the MINISTOP switch should be selected OFF. As a general guideline, the engine should be shut down in the following instances :

- A landing/abort due to fire,
- If the aircraft is about to leave the runway, or
- When a barrier engagement is imminent.

ABORT

The considerations on aborting a take-off are :

- ***Speed at which the Abort is Initiated.*** The pilot should decide on a speed for the particular configuration, above which he will employ full abort procedure.
- ***Jettisoning External Stores.*** The same considerations of speed and runway length apply. When using full abort procedure, the most benefit will be gained from jettisoning external stores.
- ***Ejection Potential.*** The pilot should always keep in mind the potential to eject at an IAS greater than 90 kn. For example, at maximum AUW on a 2440 m (8000 ft) runway, it may be preferable to jettison stores, pull up and eject, if a failure occurs at a high IAS below lift-off speed.

Abort Procedure

1. **THROTTLE—IDLE (STOP FOR FIRE).**
2. **EXTERNAL STORES—JETTISON**, if required.
3. **BRAKE CHUTE—OUT.**
4. **BRAKES—APPLY**, as necessary.
5. **AIM FOR BARRIER CENTRE.**

WARNING

Whenever moderate to heavy braking has been used, the wheel brakes will be extremely hot. The pilot should ensure that personnel attending the aircraft are aware of the dangers associated with hot brakes.

CAUTION

Do not leave the park brake on after heavy braking, as the pads will weld to the discs.

Maximum Braking Speeds

The energy absorption potential of the brakes when used fully, ie ministop in operation and in conjunction with the brake chute can be expressed in terms of a critical speed for a particular AUW. Refer to AAP 7213.003-1-1 for maximum braking speeds.

WARNING

If the brakes are used at a higher speed than the maximum permissible braking speed for the particular AUW, they will fail completely towards the end of the deceleration and, dependent on IAS, directional control may be lost.

RAAF SUPPLEMENT NO 75

FLIGHT MANUAL
MIRAGE IIIO AND IIID
IIID REAR COCKPIT CANOPY BREAKER

Instructions

This supplement is to be inserted facing page 3-14.

Information

STI Mirage/653 - Mirage IIID Rear Cockpit Canopy Breaker

Some of 77SQN aircrew training staff have complained of the difficulty in obtaining full lateral stick deflection during Mirage IIID rear cockpit flights because of insufficient leg clearance in the starboard rudder tunnel. Their right legs are contacting the canopy breaker which is positioned in the top right hand corner at the starboard rudder tunnel. The problem affects the pilots of large stature and is currently overcome by the pilot removing the canopy breaker and carrying it on his person for the duration of the flight. This STI is raised to relocate the canopy breaker knife in the rear cockpit to enable full unrestricted lateral stick deflection.

Action

Description and Features by Which the Modification can be Recognized

- This modification is identified by the fitment of the canopy breaker knife and sheath to the rear cockpit right hand console.

Effect on Aircrew Operations

- This modification removes the obstruction to the pilots right leg and allows full movement of the control column in the roll deflection.

Date: SEP86

Note

When aborting from a high take-off speed and with a high AUW, the deceleration of the brake chute is initially the most effective braking force.

Jettison Considerations

When aborting a take-off, the decision has to be made to either jettison or retain external stores (in particular full fuel tanks).

The advantages of jettisoning stores are :

- the aircraft weight is reduced and the energy to be absorbed by the wheel brakes is less,
- in the case of a burst tyre directional control is made easier, and
- in the case of an aircraft fire there is not the dangerous situation of explosive stores and full external fuel tanks.

The advantages of retaining stores are :

- the undercarriage can be damaged by stores during jettison,
- empty tanks may absorb impact during a landing incident or improve barrier engagement, and
- jettisoning tanks just prior to barrier engagement may result in burning tanks catching up with the aircraft.

Jettison Procedures

In general, the following procedures apply :

- if the aircraft can be stopped on the runway, do not jettison full tanks, or
- if the aircraft cannot be stopped on the runway, jettison external stores.

ENGINE FAILURE DURING TAKE-OFF

Undercarriage Still Selected Down

1. **ABORT**, if feasible.

Undercarriage Selected Up or Abort Not Feasible

1. **EXTERNAL STORES—JETTISON**, if required.
2. **EJECT.**

A/B FAILURE DURING TAKE-OFF

Nosewheel Still on Ground

1. **ABORT.**

Nosewheel Raised

1. **THROTTLE—FULL DRY.**
2. **EXTERNAL STORES—JETTISON**, if required.
3. **CONTINUE TAKE-OFF.**

If Red A/B INJ Light Remains Illuminated :

4. **A/B COCK—OFF.**

WARNING

The A/B COCK switch is adjacent to the L.P. COCK switch. Positively identify the A/B COCK switch before selecting if OFF.

OIL LIGHT AND/OR LOSS OF RPM CONTROL ON TAKE-OFF

Loss of RPM control may be caused by :

- loss of oil pressure,
- breakage or seizure of the throttle linkage, or
- main fuel control unit failure.

The factors to be considered when the OIL light illuminates in flight are detailed under Loss of Oil Pressure.

Undercarriage Still Selected Down

1. **ABORT.**

Undercarriage Selected Up

1. **EXTERNAL STORES—JETTISON**, if required.
2. **A/B—LEAVE ENGAGED.**
3. Climb straight ahead until either :
   a. RPM fluctuations begin, or
   b. IAS reaches 300 kn.
4. RPM—7000.
5. EMG OIL PUMP—ON.
6. Use the EMERGENCY THROTTLE.
7. Throttle—Idle.
8. Land as soon as possible, using the Emergency Regulation technique.

RPM DROP DURING TAKE-OFF

Undercarriage Still Selected Down

1. **ABORT.**

Undercarriage Selected Up

1. **EXTERNAL STORES—JETTISON**, if required.
2. Climb straight ahead.

If A/B Flames Out :

3. Throttle—Full Dry.
4. Land as soon as possible, using Emergency Regulation if required.

BLOWN NOSEWHEEL TYRE

Pronounced vibration of the aircraft nose (nosewheel shimmy) will result.

1. **ABORT.**

BLOWN MAIN TYRE

Before Lift-Off

A pronounced yaw will occur.

1. **ABORT.**

During Lift-Off

1. **CONTINUE.**

2. **LEAVE U/C EXTENDED**
3. If possible, have the damage inspected from another aircraft.
4. Land after burning off fuel.

Note

A blown tyre may possibly cause a fracture of the brake hydraulic line. The pilot may experience a failure of that brake on landing.

DISTRACTION ON TAKE-OFF

The following incidents could distract the pilot during take-off.

Mist

A cold temperature selected in warm and humid conditions results in a smoke-like mist entering the cockpit. Real smoke would most likely be accompanied by an acrid smell and high temperature. If necessary, turn the PRESSURIZATION switch OFF.

Warning Horn and Light

If the pilot holds his breath for more than 15 seconds, the oxygen warning system operates. Usually this causes the pilot to recommence breathing and the warnings disappear.

Burning Smell

If a take-off is made after prolonged high power engine running on the ground, a 'burnt linen' smell may be evident during the take-off roll.

LANDING EMERGENCIES

Many landing emergencies arise from a failure during flight, eg HYD 1 failure or blown tyre on take-off. Consequently, time is available to plan the action required during landing and landing roll.

In cases where the engine is to be shut down during the landing roll, consideration should be given to selecting the HORN switch OFF prior to landing to avoid distraction at a critical stage of the landing roll. The GYRO CENT switch may also be selected OFF to avoid the TGP toppling as the alternator drops off line.

BRAKE CHUTE FAILURE

There are four common causes of brake chute failure :

- Immediate jettison on deployment caused by failure of the jaws to close correctly or by the main strap breaking. In this case, the pilot feels no deceleration.
- Defective chute canopy caused by broken or tangled shroud lines. In this case, deceleration may be so weak that the pilot may suspect that the parachute has jettisoned. However, even with a number of shroud lines broken, some braking is available and the parachute should be retained. Under these circumstances, the canopy tends to drag on the ground more readily at low speed.
- If the parachute is damp when it is installed or if rain subsequently enters the container, the moisture in the parachute could freeze at altitude. Subsequently on landing, when the BRAKE CHUTE handle is selected to OUT, the cover/extractor comes off but fails to withdraw the parachute which remains stuck in its container. Should a go-around be necessary, select the BRAKE CHUTE handle to DROP before introducing power as the parachute may thaw rapidly and then deploy immediately. In this event, the chute is then free to fall from the aircraft.
- Melting of the plastic material of the drag chute cap may result from sustained afterburner usage at low altitude whilst the aircraft is operating at high incidence and/or high speed. The resultant plastic flow may cause the cap to adhere to the chute canister and thus prevent the parachute from deploying.

There are two possible courses of action available in the event of a brake chute failure, ie either to overshoot or to continue with a full stop landing.

It is important that, before landing, pilots are mentally prepared for a brake chute failure. Under normal conditions with an otherwise serviceable aircraft, adequate fuel remaining and weather permitting, the most prudent course of action is to execute a go-around.

Factors Favouring an Overshoot

The more important factors in favour of an overshoot are :

- touch down from GCA approaches are generally long,
- tower facilities can be alerted for a no brake chute landing,
- the pilot is better prepared for a no brake chute landing, and
- a reduction in landing weight, as a result of fuel used, reduces the aircraft's momentum which must be overcome by braking.

Factors Favouring Continuing With Landing

The more important factors in favour of continuing with the landing are :

- bad weather in the circuit area, particularly when other aircraft are in the approach pattern, and
- the problems of fuel requirements for another circuit.

Go-Around After Brake Chute Failure

If the decision is made to go-around :

1. BRAKE CHUTE—DROP.
2. Throttle—Full dry (minimum).
3. Continue with go-around.

No Chute Landing

1. Throttle—Idle.
2. Use aerodynamic braking (12° nose up maximum).

   The nose must be held progressively higher to a maximum of 12° above the horizontal as indicated by the Bezu ball. At 12° nose up, depending on seat position, the pitot boom may cut the apparent horizon.
3. Discontinue aerodynamic braking at 120 KIAS or 4000 ft to run, whichever occurs first.
4. Lower the nose.
5. Use maximum (MINISTOP-ON) braking.
6. Continue braking to ensure aircraft can be stopped on runway.

If Weak Brakes are Apparent :

7. Throttle—Stop.
8. MINISTOP switch—OFF.

If Brakes are Still Ineffective :

9. PARK EMG BRAKE—Apply with caution.

Note

The PARK EMG BRAKE does not provide differential braking.

[D] The nose-up attitude for aerodynamic braking is 15°.

WARNING

Normally after a brake chute failure, the brakes will be hotter than usual. The pilot should park in a clear area without either braking system applied and have the fire crew inspect the brakes before taxiing to the flight line.

CAUTION

Do not exceed the recommended attitude for aerodynamic braking or the tail may be dragged on the ground and the engine cold flaps damaged.

LANDING WITH ONE BLOWN MAIN TYRE

1. Unless crosswind or brake chute considerations dictate otherwise, land on the side of the runway opposite the blown tyre.
2. Throttle—Idle, on touchdown.
3. Use brakes and elevon steering.

Note

The aircraft will yaw but should be controllable.

4. BRAKE CHUTE—OUT

If Crosswind Makes Directional Control Difficult :

5. BRAKE CHUTE—DROP.

If the Aircraft is About to Leave the Runway :

6. Throttle—Stop.
7. L.P. COCK switch—OFF.
8. L.P. PUMP switches—OFF.

CAUTION

With one or both main wheel tyres blown, the wheel brakes may be ineffective due to brake line rupture caused by flailing rubber.

LANDING WITH BOTH MAIN TYRES BLOWN

1. Stores—Jettison, if necessary.

On Touchdown :

2. Throttle—Stop.
3. BRAKE CHUTE—OUT.
4. Use gentle braking to maintain directional control.
5. Use full strip length to avoid excessive braking.

If the Aircraft is About to Leave the Runway :

6. Throttle—Stop.
7. L.P. COCK switch—OFF.
8. L.P. PUMP switches—OFF.

LANDING WITHOUT FOOTBRAKES

1. If crosswind is present, consider landing on the downwind side of the runway as the aircraft tends to weathercock into the wind.

On Touchdown :

2. Throttle—Idle or stop.

Note

When landing without foot brakes, especially if crosswind is present, directional control may be difficult to maintain and the aircraft may leave the runway. In this case, it is mandatory to shut down the engine.

3. Deploy brake chute normally.

WARNING

- If the crosswind is greater than 10-15 kn, use the brake chute with caution. Lower the nose wheel and apply full rudder and elevon before deploying the brake chute or using the PARK EMG BRAKE.
- If directional control is difficult to maintain, release the brake chute.

When Nosewheel is on Ground :

4. PARK EMG BRAKE—Apply smoothly as required.

   If some U/C B pressure remains, differential

foot braking may be available to avoid leaving the runway.

CAUTION

Do not use footbrakes and PARK EMG BRAKE together or a total loss of braking may result.

5. Steer with elevons and rudder.

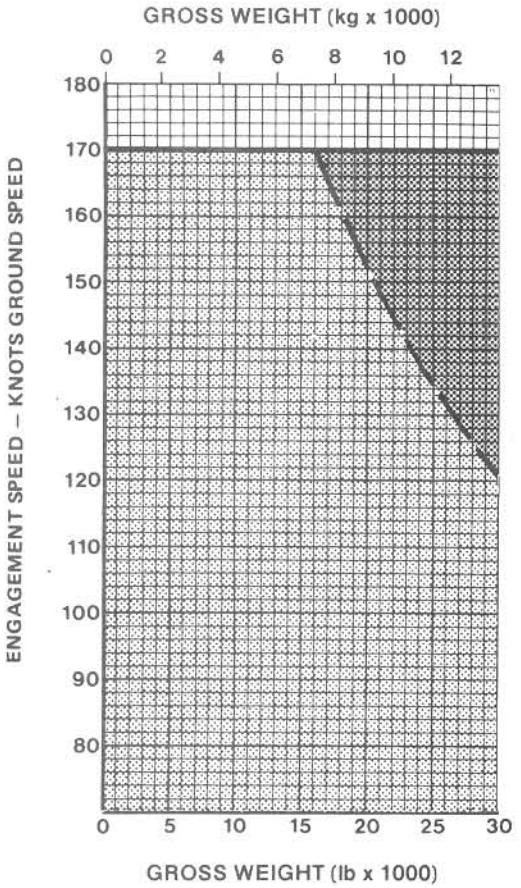
If Aircraft is About to Leave the Runway :

6. Throttle—Stop.
7. L.P. COCK switch—OFF.
8. L.P. PUMP switches—OFF.
9. BATT switch—OFF, when stopped.

BARRIER ENGAGEMENT

Maximum permissible barrier engagement speeds are shown in Fig 3-3 and 3-4.

Befab 21.2 Barrier - Engagement Envelope



ENGAGEMENT ENVELOPE – LIGHT OR HEAVY SETTING SELECTED BY ATC.

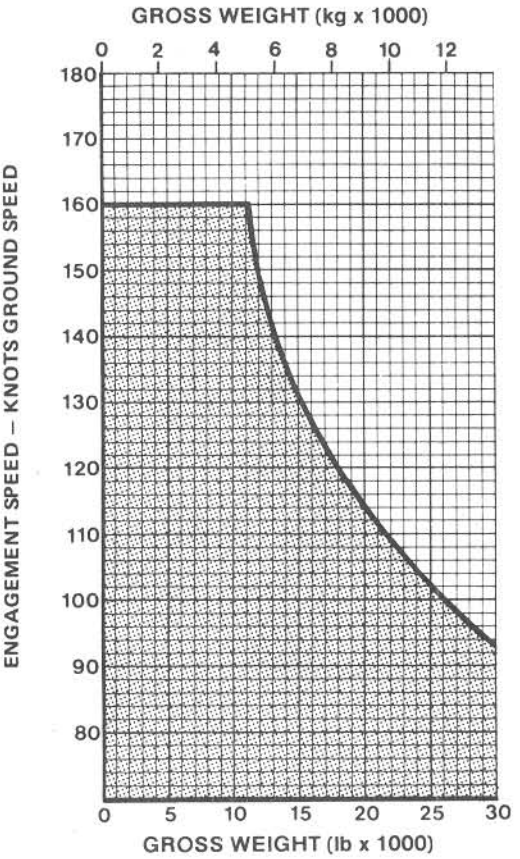
ENGAGEMENT ENVELOPE – HEAVY ONLY SELECTED.

NOTE:

The theoretical minimum engagement speed is zero knots, however, more reliable system operation is likely if entry speeds are kept above 50 knots.

Figure 3-3

Befab 6.3 Barrier - Engagement Envelope



ENGAGEMENT ENVELOPE

NOTE:

The theoretical minimum engagement speed is zero knots, however, more reliable system operation is likely if entry speeds are kept above 50 knots.

Figure 3-4

If Time Permits :

1. Seat harness—Tightened and locked.
2. Seat—Lowered.

When Engagement is Imminent :

3. **THROTTLE—STOP.**
4. Engage barrier :
   a. Tracking parallel to runway centre line.
   b. At centre.
   c. With nosewheel on ground.
   d. With brakes off.

WARNING

- Do not jettison the canopy.
- If brake failure is the reason for barrier engagement, maintain sufficient speed for directional control. Barrier engagement below 50 KIAS is not recommended.

Note

- It is preferable to engage the barrier slightly off centre and tracking parallel to the runway centreline than to engage the barrier centre at an angle to the runway centreline.
- If engagement speed is too high, barrier runout distance will be exceeded and retardation will be lost. Use steady wheel braking before engagement to shorten the arrestment distance. Ensure that neither aerodynamic nor wheel braking is taking place on engagement.
- After engagement, use braking only to prevent extreme divergence from track and release the brakes as the aircraft comes to a halt. After arrestment, the aircraft is normally pulled back a small distance due to the energy stored in the elastic straps. Do not counteract the backward movement by braking as the aircraft may pitch up and suffer tail damage.

When Arrestment is Complete :

5. Proceed as for ABANDONING THE AIRCRAFT ON THE GROUND.

HIGH AUW LANDINGS

There is no effective weight limitation for landing, but above 9072 kg (20 000 lbs) the following precautions should be observed :

- If it is not possible to dump the fuel from 286 or 374 gal tanks and an emergency exists, the tanks should be jettisoned.
- During the approach, higher RPM than normal are required.
- High nose attitudes must be avoided as they may cause sudden and excessive sink rates.
- Do not hold off excessively.
- External tanks can be prevented from scraping during touch-down by limiting the incidence to amber/red during the approach until reaching the threshold.

CAUTION

Add 5 KIAS to normal threshold speed for each 100 gallons of fuel remaining over 300 gallons to a maximum of 190 KIAS.

In the event of an emergency landing with a high AUW :

1. Dump fuel from the 286 and/or 374 gal tanks if possible, otherwise jettison the tanks.
2. Jettison bombs, but not missiles.
3. Land from a straight in approach or a wide circuit.
4. Fly with power on until touch down.

NO ASI APPROACH AND LANDING

In the event of an ASI failure, the approach should be made in formation with another aircraft. If no other aircraft is available, proceed as follows :

1. Level at 1500 ft on long finals (outside 10 NM).
2. Reduce speed to incidence amber/green (IAS less than 240 kn).
3. Perform landing checks.
4. Use power to maintain incidence steady amber.
5. Fly a normal straight in approach.
6. Inside ½ NM fly to amber/red incidence.

Note

If the ASI failure is caused by ice, the airspeed indications to the approach control may be suspect.

FLAMEOUT LANDING

Due to the extremely high sink rate and the high approach speed required, good conditions and a high degree of pilot skill and currency are needed to successfully complete a flameout landing. A flameout landing should only be attempted on an airfield fully equipped for normal Mirage operations. If such an airfield is not available or if the pilot is not completely confident of his ability to complete the forced landing, he should point the aircraft towards a clear area and eject.

The flameout pattern key points (refer to Fig 3-5) are :

- ***High Key Point.*** 15 000 ft over the upwind end of the runway, heading 135° or 225° relative to the duty runway centreline.
- ***Low Key Point.*** 1 NM abeam of the runway threshold at 10 000 ft, heading 180° relative to the landing direction.
- ***5000 ft Key Point.*** Middle of final turn. The final turn is a constant turn with 30° to 45° of bank. The desired touch down point is about

one third of the way down the runway. The pilot should maintain the aircraft flight path towards the threshold while holding between 240 to 270 KIAS. The action of flaring the aircraft, transfers the final touch down point further down the runway.

WARNING

If a successful forced landing is not assured by the 5000 ft key point, the pilot should point the aircraft towards a clear area, arrest the rate of descent and eject.

Note

If the desired flight path cannot be maintained while holding a minimum of 240 KIAS, an undershoot situation is developing.

Speed

Regardless of the aircraft configuration, maintain 240 to 270 KIAS throughout the pattern, from high key point down to flare out. If on late final the IAS decreases, do not try to re-establish speed because the aircraft will probably reach a steep nose-down attitude without increasing IAS and it may be impossible to perform a precise flare out.

Undercarriage Extension

Lower the U/C on reaching a key point. It takes 20 seconds for the U/C to extend when the engine is windmilling.

WARNING

The limit for U/C extension is the 5000 ft key point.

Landing

It is important to maintain an IAS of 240 kn until flare out (400-500 ft AGL). If flare out is initiated with an IAS lower than 220 kn or at too low an altitude, it is difficult to check the rate of descent which is about 8500 ft/min and the U/C may be damaged upon landing.

The desired touch down point is one third of the way down the runway.

Note

- If relight has been attempted, the LOAD-SHED switch will be ON, the pitch dampers are inoperative, the pitch control is less efficient and more control column displacement than usual will be required in the flare.
- With the dampers inoperative, it is essential to flare out as smoothly as possible to avoid pilot induced oscillations.
- Windmilling RPM provides sufficient hydraulic power for normal flight control movements but U/C extension takes about 20 seconds.

LOSS OF CONTROL AND SPIN RECOVERY

Pilots should be fully conversant with the information contained in Section 6 regarding aircraft flight characteristics before and after loss of control and during spins. In all cases when loss of control is experienced the aircraft will recover if the controls are quickly centralized. Loss of control may be avoided if back pressure on the control column is relaxed immediately the initial symptoms of adverse yaw, wing rock or pitch up are experienced.

LOSS OF CONTROL

Immediately departure from controlled flight is experienced, recover as follows :

1. **PITCH CONTROL—SET ABEAM SPIN RECOVERY MARKS (NEUTRAL).**
2. **AILERONS AND RUDDER—CENTRAL.**
3. **SPEED BRAKES—IN.**
4. **THROTTLE—AS REQUIRED BY ENGINE BEHAVIOUR.**
5. When oscillations cease and IAS is above 200 kn recover to normal flight.

WARNING

- Incidence limits for particular configurations must be observed to avoid the possibility of losing control of the aircraft.
- Lateral control inputs at the point of control loss may cause the aircraft to enter a spin.
- A positive push force is required to get the pitch controls to the neutral position if the autocommand is engaged or if the pilot has trimmed nose up.

CAUTION

[D] The Mirage IIID is more prone to departure and loss of control at high incidence than is the IIIO.

SPIN RECOVERY

If loss of control recovery is unsuccessful and a stabilized spin develops :

1. **EXTERNAL STORES—JETTISON.**
2. **IDENTIFY SPIN DIRECTION (VISUAL YAW, GUNSIGHT, BEZU).**

Flameout Pattern

BEST GLIDING SPEED – 300 KIAS				
ALTITUDE FT	45 000	35 000	25 000	15 000
DISTANCE NM	30	20	10	0

Note: Distances are given for aircraft arriving over the airfield at 15 000 ft

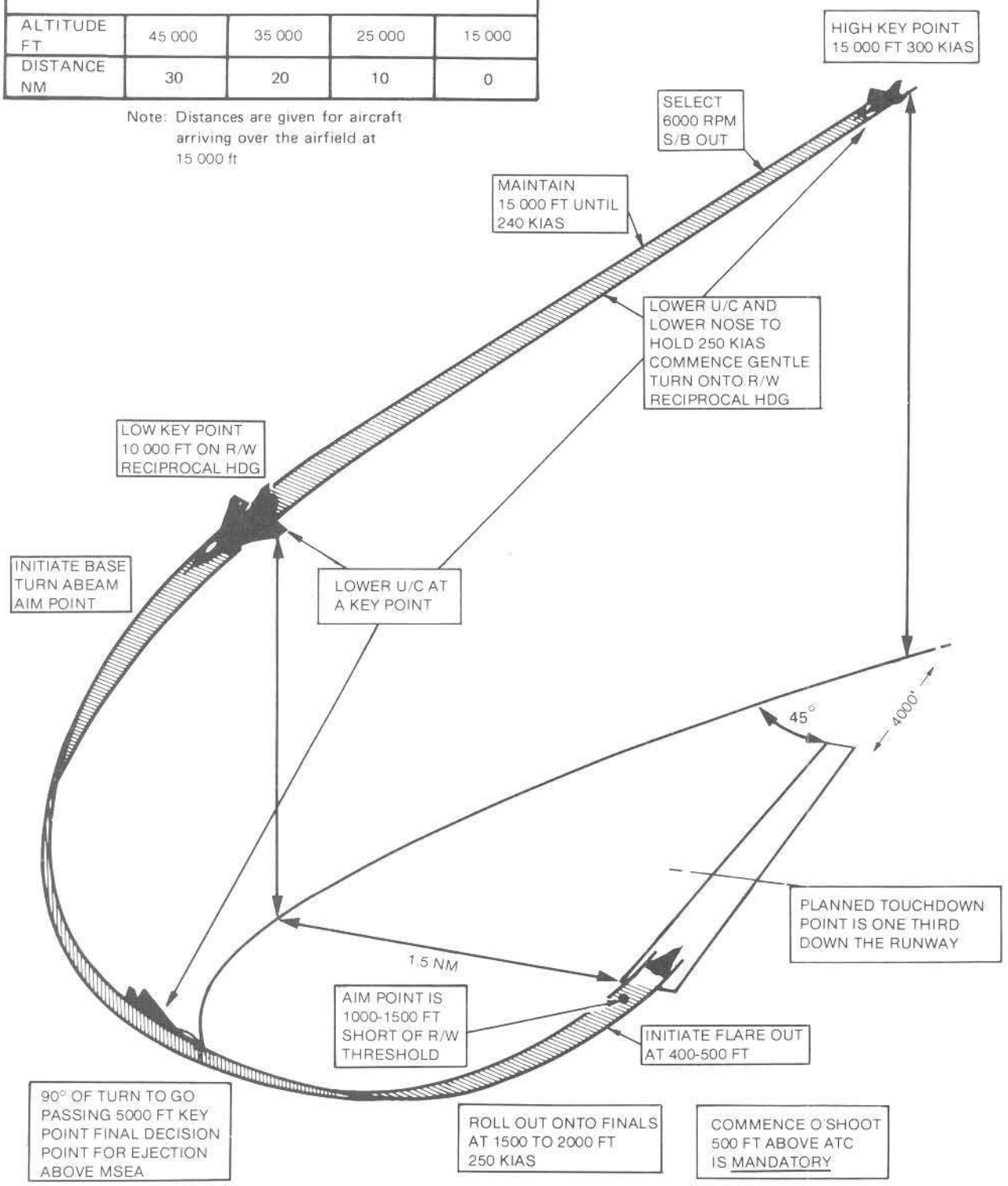


Figure 3-5

3. **PITCH CONTROL—CONFIRM ABEAM SPIN RECOVERY MARK.**
4. **AILERON—APPLY FULL IN SPIN AILERON.**
5. **THROTTLE—IDLE.**
6. **CENTRALIZE AILERONS IMMEDIATELY WHEN :**
   a. **YAW ROTATION STOPS POSITIVELY, OR**
   b. **AIRSPEED INCREASES ABOVE 200 KIAS, OR**
   c. **SPIN DIRECTION IS REVERSED.**
7. When IAS is above 200 kn—Recover to normal flight.
8. Take appropriate action to restore normal engine operation.

WARNING

- During spin recovery, the rate of roll may increase and may be misinterpreted by the pilot as a continuation of the spin. Cessation of yaw and a steadily increasing airspeed are the only positive indications of recovery. The control column must be centralized in roll when the airspeed increases above 200 KIAS.
- Altitude loss from the point of control loss to the bottom of pullout after spin recovery can be in the order of 15 000 feet.
- In all cases if the aircraft is out of control passing 10 000 ft AGL/AMSL, eject.
- Intentional spinning is prohibited.

EJECTION

EJECTION ENVELOPE

The ejection seat is capable of safe operation from level, zero-zero conditions with the canopy clear of the ejection path (ground level - 90 KIAS with the canopy attached) to unconditional operation at 80 000 ft/700 KIAS. Above 550 KIAS, however, the pilot may be injured. The ideal ejection conditions are above 10 000 ft and below 250 KIAS.

PROCEDURE

1. Adopt correct ejection posture.
2. Firing handle—Pull.

WARNING

The canopy fires immediately and the seat fires one second later. This time interval seems long but the pilot must not change his posture prematurely.

3. Seat pan handle—Release before pilot/seat separation, or
4. Face screen firing handle—Release upon pilot/seat separation.

WARNING

Failure to release the face screen firing handle may result in head injuries.

Note

In the case of a premeditated ejection, the canopy may be jettisoned at pilot discretion prior to the initiation of the ejection sequence.

[D] PROCEDURE WHEN BOTH COCKPITS OCCUPIED

The decision to eject rests with the aircraft captain. However, in an emergency situation where time is critical, self-survival becomes paramount. It is the responsibility of the aircraft captain to thoroughly brief the passenger on all ejection procedures before flight. The recommended procedures are :

- ***Premeditated Ejection with Intercom.*** The captain warns the passenger that ejection is imminent. When ejection parameters have been met, the captain declares, 'Eject, Eject, Eject'. The rear seat occupant ejects first. As soon as the canopy has fired, the front seat pilot initiates ejection.
- ***Premeditated Ejection without Intercom.*** The front seat pilot indicates his intention to eject by pressing the FIRE TEST button and then jettisoning the canopy. Again the rear seat occupant ejects first.
- ***Time Critical Ejection.*** No hard and fast rules can be laid down, however, the captain declares 'Eject, Eject, Eject' where possible, followed by his immediate ejection initiation. The rear seat occupant aims for ejection initiation immediately.

WARNING

[D] Where possible, the rear seat occupant ejects first because injury may result from the front ejection seat blast. The criteria may be varied at the captain's discretion.

Note

[D] When the captain of the aircraft is occupying the rear cockpit and decides to eject after an intercom failure, he indicates his intention to the passenger, if no other means is available, by ejecting.

Ejection Position

The correct ejection posture is :

- buttocks well back in seat,
- legs forward with lower thighs supported by the seat.

- shoulders pressed against seat back,
- head against head rest, and
- chin tucked in to straighten spine.

When using the face screen firing handle, keep the head hard back against the head rest and the elbows as close to the body as possible; pull the handle fully out and down with both hands.

WARNING

- The face screen handle assembly tends to drag the head forwards as it comes out of its housing.
- When using the seat pan handle, grasp the handle with the right hand, grasp the right wrist with the left hand and pull the handle straight up to its full travel of 76 mm (3 in).

NOTE

If the seat is lowered prior to ejection, it may be necessary to move the rudder pedals to ensure that the thighs rest on the seat.

Choice of Handles

The pilot should formulate a mental plan of his actions in different ejection situations. The following factors should be considered when deciding which handle to use :

- the face screen firing handle provides wind blast protection and the correct ejection posture is more easily maintained,
- use of the seat pan handle permits control of the aircraft to the point of ejection, and
- pilot stature and seating position.

EJECTION OVER LAND

If landing into trees, retain the survival kit for protection. If landing in open terrain, unfasten both side survival kit attachments. After landing, operate the quick release box to release the parachute.

EJECTION OVER WATER

After ejection when nearing the water :

- Unfasten both side survival pack attachments. The survival kit and dinghy fall free, and the dinghy inflates. Both items remain attached to the pilot's lifevest by the dinghy lanyard. Remove mask, helmet and gloves. The helmet can be attached to the dinghy lanyard and the gloves stowed in a flying suit pocket.
- When entering the water, and not before, release the parachute.
- Climb aboard the dinghy at the narrow end, ie pull the dinghy underneath the body.
- Pull aboard the survival kit which is attached to the lanyard and the bailer which is attached by a cord to the dinghy.

Note

Upon ejection, the seat ejection automatically switches the IFF on and the mode to EMER. A lanyard, integral with the seat, actuates a distress switch which starts transmission on receipt of an interrogation signal.

EJECTION SEAT FAILURES

Face Screen Firing Handle Failure

If the face screen firing handle does not operate :

1. Correct ejection posture—Maintain.
2. Seat pan firing handle—Pull.

WARNING

Retain the face screen firing handle in the left hand while pulling the seat pan handle. If the face blind streams with the wind, it may blanket the drogue gun and foul the controller drogue during deployment.

Both Firing Handles Fail

1. Altitude—Over 15 000 ft if possible.
2. Manual separation handle—Squeeze trigger and lift handle (left hand).
3. CANOPY JETTISON lever—Push forwards.
4. Trim—Forward.
5. Bail out.

When Clear of Aircraft

6. Parachute D-ring—Pull (right hand).

Note

The pilot's parachute takes two or three seconds to open after the parachute D-ring has been pulled.

Automatic Seat Separation Failure

If not separated from seat when descending through 11 500 ft, manually separate as follows:

WARNING

The following operations must be performed in the correct sequence.

1. Manual separation handle—Squeeze trigger and lift handle (left hand).
2. Lean forwards and push seat away.
3. Parachute D-ring—Pull (right hand).

Controller Drogue Inoperative (Seat Tumbling)

1. Manual separation handle—Squeeze trigger and lift handle (left hand).
2. Lean forwards in the seat.
3. Parachute D-ring—Pull (right hand).

No attempt should be made to separate manually from the seat except when terrain elevation exceeds the present BTRU altitude or there is a definite failure of the automatic sequence.

Note

If the automatic sequence fails in a stabilized drogue descent, a further 60 seconds will elapse from 11 500 ft to sea level.

WARNING

Do not touch the quick-release box in flight.

EJECTION CONSIDERATIONS

Pilot's Position

Spinal injuries have resulted from incorrect body

position during ejection. The incorrect position may be due to :

- upper torso slumping caused by loose harness;
- reduced thigh support due to seat adjustment too low;
- movement of the body to grasp the face screen firing handle when handle access is restricted due to the helmet being too close to the canopy;
- involuntary retraction of the legs towards the seat; or
- movement of the body due to the pilot's impatience while waiting for the seat to eject.

On the ground, the pilot should :

- tighten the harness moderately, particularly the lap straps.
- check that the kidney pad is in position, and
- check the seat position for ejection (highest possible position compatible with access to the main firing handle).

Note

The seat position for ejection may not be the same as the ideal seat position for flight.

Before ejection, if time permits, the pilot should :

- lower both helmet visors,
- set the seat to the position for ejection previously established on the ground.
- maintain the legs in the forward position, and
- remember that ejection occurs one second after the firing handle is pulled.

Low Altitude Ejection

When flying at low level with a high airspeed, the chances of a successful ejection can be greatly increased by zooming the aircraft to exchange airspeed for altitude, and ejecting while the aircraft is in a positive climb. The zoom should not exceed a 20° nose-up attitude since this results in a near vertical seat trajectory, thus providing more altitude and time for seat separation and pilot's parachute deployment.

AMEA Versus Airspeed and Dive Angle

The AMEA changes dramatically with increasing airspeed and dive angle. Figure 3-6 indicates the absolute minimum terrain clearance in feet below which ejection will be unsuccessful.

Minimum Ejection Altitude Versus Airspeed and Dive Angle

KCAS	Dive Angle				
	90°	60°	45°	30°	15°
600	4800	4100	3400	2400	1150
500	4200	3550	2900	2050	1000
400	3500	2900	2400	1650	800
300	2700	2300	1900	1300	600
200	2000	1600	1300	900	450

AMEA is terrain clearance in feet based on wings level and a two second reaction time.

Figure 3-6

WARNING

The absolute minimum terrain clearance figures must not be used as the basis of a decision for delaying ejection when flying out of control at altitudes below 10 000 ft.

AMEA Versus Sink Rate

The AMEA (refer to Fig 3-6A) are provided to show seat capability (with and without reaction time) as affected by the aircraft sink rate. The graphs do not include safety factors to cover equipment malfunctions or delays in separating from the seat.

WARNING

The graphs must not be used as the basis of a decision for delaying ejection when likely to descend below 2000 ft, since accident statistics strongly indicate that the number of successful ejections decreases as the altitude decreases below 2000 ft.

High Altitude Ejection

After high altitude ejection, considerable time will elapse during drogue chute descent before automatic seat separation and parachute deployment at 11 500 ft. For example, the time for the stabilized seat to reach 11 500 ft from various ejection altitudes is as follows :

a. 50 000 ft—150 seconds.
b. 40 000 ft—120 seconds.
c. 30 000 ft—90 seconds.
d. 20 000 ft—40 seconds.

Minimum Ejection Altitude Versus Sink Rate

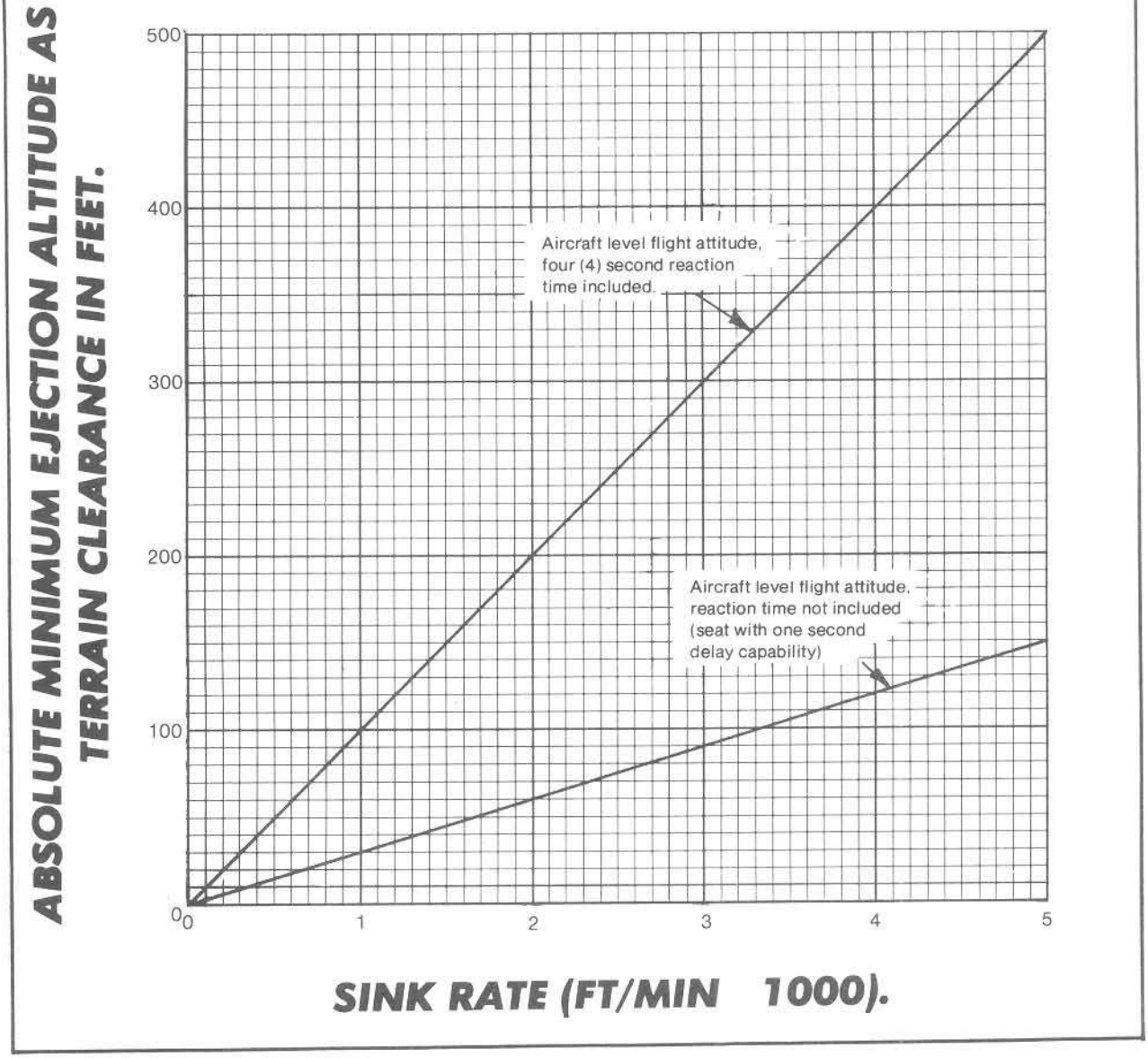


Figure 3-6A

FUEL SYSTEM FAILURES

RUPTURED FUEL TANK

Fuel tank or fuel line rupture is indicated by :

- one gauge pointer falling at an unusually high rate and/or an abnormally high debitmeter reading (CROSSFEED switch OFF), or
- fuel leaking from the aircraft.

The fuel transfer light for the ruptured tank may be illuminated.

If Fuel Usage From One Side of The System Seems Abnormally High or Fuel is Leaking From the Aircraft :

1. L.P. PUMP switch for fast side—OFF, ideally before gauge pointer reaches next transfer level.
2. CROSSFEED switch—OFF.

If Gauge Pointer Continues to Fall, Fuel is Leaking From That Side :

3. L.P. PUMP switch for fast side—ON.
4. Other L.P. PUMP switch—OFF.

Note

- The engine is fed from the leaking side to minimise waste.
- If fuel is critical, commence a climb to gain as much energy from the available fuel as possible.

When the Gauge Pointer for the Leaking Side Approaches Zero :

5. Other L.P. PUMP switch—ON.
6. L.P. PUMP switch for depleted side—OFF.
7. Land as soon as possible.

CAUTION

- Failure to select the L.P. PUMP switch for the depleted side OFF could result in a fire due to the pump operating without lubrication.
- The CROSSFEED switch must be OFF to prevent fuel being lost through the rupture.

FLOAT VALVE STUCK OPEN

A float valve stuck in the open position is indicated by :

- the gauge pointer corresponding to the side with the stuck valve rises to 120 gal until the tank transfer is complete,
- fuel vents from the aircraft, and
- the appropriate fuel transfer light remains out until the tank empties.

If a Gauge Pointer Rises to 120 gal and Fuel is Venting :

1. L.P. PUMP switch for serviceable (low) side—OFF.
2. CROSSFEED switch—OFF.
3. Attempt to release the valve by rocking the aircraft.

Note

If fuel is critical, an A/B climb should be considered to minimise wastage.

When the Gauge Pointer Corresponding to the Stuck Valve Falls Below 120 gal :

4. CROSSFEED switch—ON.
5. Both L.P. PUMP switches—ON.
6. Reset debitmeter when both gauge pointers leave the transfer level.

FUEL TRANSFER FAILURE

A fuel transfer failure with a resultant loss of available fuel may be caused by :

- a tank pressurization failure, or
- a float valve stuck in the closed position.

The indications of a tank pressurization failure are :

- one gauge pointer moves below the transfer level at an abnormally high debitmeter reading, and
- the appropriate transfer light illuminates.

The indications of a float valve stuck closed are :

- one gauge pointer moving below the transfer level at an abnormally high debitmeter reading,
- the appropriate fuel transfer light remains extinguished, and
- the fuel transfer lights test serviceable.

If a Gauge Pointer Falls at an Abnormally High Debitmeter Reading :

1. L.P. PUMP switch for fast side—OFF.
   a. Pointer stops; transfer failure may be indicated.
   b. Pointer continues to fall; proceed as for ruptured tank.

Note

- If a gauge pointer moves below a transfer value at a debitmeter reading above the one tank/one side fuel figure, a failure has occurred.
- If one pointer moves at a debitmeter reading below these figures, confirmation of the failure is not possible until the other pointer also moves below the transfer level.

2. Fuel transfer lights—Check in straight and level flight :
   a. If the light is illuminated, a pressurization failure is indicated and fuel is not available from that tank.
   b. If the appropriate light is extinguished, a stuck float valve is indicated.
      (1) Fuel transfer lights—Press-to-test.

Note

If the fuel transfer light is unserviceable, it is not possible to diagnose the failure but the following actions remain unaltered.

If a Stuck Float Valve is Indicated :

3. Attempt to release the valve by rocking the aircraft.
   a. If the valve is released, the gauge pointer rises to the transfer level.
   b. If the valve is not released, the fuel remaining in that tank is unavailable.

If a Pressurization Failure is Indicated or Attempts to Release a Suspected Stuck Valve Fail :

4. Both L.P. PUMP switches—ON.
5. CROSSFEED switch—ON.
6. If necessary, reset the debitmeter when both gauge pointers leave the transfer level.

Note

- In all cases of fuel transfer failure, it is not possible to determine the actual amount of fuel unavailable until both gauge pointers leave the transfer level.
- The debitmeter is reset to the known remaining fuel.
- If complete loss of tank pressurization occurs, all transfer lights illuminate and only the fuel from the fuselage tanks is available.

L.P. PUMP FAILURE

A failed L.P. pump is indicated as follows :

- Fuel feed ceases on the side containing the failed pump and, provided the CROSSFEED switch is OFF, the gauge pointers cease to drop. The other side feeds normally.
- Even with the fuel balanced at start of transfer, the external or internal wing tanks on the side of the system containing the serviceable pump may feed out close to the one tank/one side fuel figure.
- Depending on altitude and power setting, if the serviceable L.P. PUMP switch is selected OFF,

thrust variations will be felt, RPM and EGT(T4) may oscillate and the FUEL warning light may illuminate.

- The appropriate transfer lights for the failed side remain extinguished.

If Asymmetric Fuel Feed Occurs and a L.P. PUMP Failure is Suspected :

1. Appropriate L.P. PUMP CB—In.
2. L.P. PUMP switches—ON.
3. CROSSFEED switch—ON.
4. RTB.

After Landing :

5. L.P. PUMPS—Check.

Note

- All fuel is available.
- One L.P. pump supplies sufficient fuel for overshoot but no margin is available for pump failure or low output. Overshoot is not recommended unless an emergency exists.

FUEL WARNING LIGHT

If the FUEL warning light illuminates :

1. Throttle—Cancel A/B and reduce RPM.
2. LP PUMP CBs—In (both).
3. L.P. PUMP switches—ON (both).
4. RTB below 30 000 ft.

Note

- Avoid high power settings and rapid throttle movements.
- If engine demand is high, there is a risk of flameout due to fuel starvation.
- Overshoot is not guaranteed.

GRAVITY FEED

With both pumps inoperative, the fuel supply is sufficient to ensure :

- engine start (if required),
- economical cruise at 30 000 ft,
- Mach 0.96 at 20 000 ft with full dry power, and
- penetration and GCA.

CROSSFEED FAILURE

If the CROSSFEED fails :

1. Throttle—Dry sector.
2. Balance fuel using L.P. PUMP switches.

Before Landing :

3. L.P. PUMP switches—ON (both).

ELECTRICAL FAILURES

BATTERY FAILURE

The BATT warning light illuminates.

This can occur if the battery fails completely or if there is an excessive charge rate from the generator to the battery.

1. BATT reset button—Press.

If Reset is Unsuccessful :

2. BATT switch—Leave ON.
3. RTB.

Note

- If the generator subsequently fails, a total electrical failure will result, as the transformer-rectifier control relays require DC power to operate.
- If the BATT light goes out momentarily when attempting a reset, there is an excess charge from the generator. Do not attempt a further reset but leave the battery switch selected ON and all systems will function normally. If the generator subsequently fails, the battery automatically comes back on line.

GENERATOR FAILURE

The GEN warning light illuminates, the horn sounds and the autocommand disengages.

Note

The aircraft may pitch down as the autocommand disengages if the failure occurs at a high Mach number or at a high altitude.

The failure may be due to :

- generator output below 40A,
- an overvoltage condition, or
- a failure of the generator or its control circuits.

If the generator fails :

- the auto loadshed services are not available and the aircraft is operationally restricted; radar, gunsight and missiles being inoperative;

Note

If the failure is due to low current output, the auto loadshed services remain on and the GEN switch must be selected OFF to avoid discharging the battery.

- the transformer-rectifier unit operates; and
- the flight instruments remain unaffected.

When the GEN warning light illuminates :

1. Throttle—Cancel A/B.
2. GEN reset button—Press.

Note

If the generator resets, the fault is due to an over-voltage condition.

If the Reset is Unsuccessful :

3. GEN switch—OFF.

4. RTB.
5. BATT switch—OFF, to test the transformer-rectifier.

If the GEN and A.C. Warning Lights Stay On With the BATT Switch Off :

6. The transformer-rectifier is operating. The following auto load shedding items will not operate :
   a. gunsight, missiles and radar; and
   b. autocommand, altitude lock and roll stab.
7. BATT switch—ON.
8. Left (rear) L.P. PUMP switch—OFF.
9. CROSSFEED switch—ON.

   Steps 8 and 9 ensure that the transformer-rectifier is not overloaded. Operationally the only capability remaining is gun firing and bombing. There is no effect on aircraft behaviour in flight or on the navigation or control instruments. On landing, a micro-switch on the right U/C strut disconnects the transformer-rectifier.

If the GEN and A.C. Warning Lights Extinguish With the BATT Switch OFF :

10. The transformer-rectifier is not operating and the battery is supplying DC power.
11. BATT switch—ON.

Note

If the transformer-rectifier is not operating, when the BATT switch is reselected ON the fire lights illuminate as power is resupplied to the fire warning circuit.

12. Heading selector—EMG.
13. L.P. PUMP switches—OFF, below 30 000 ft.
14. Manual LOADSHED switch—ON, or
15. Non-essential DC equipment—OFF.

Note

- The TGP is isolated by selecting the LOAD-SHED switch ON or the heading selector to EMG.
- The GYRO CENT switch must be left ON or emergency heading will not be available on the PHI indicator.

If the manual LOADSHED switch is selected ON the following services are not available :

- The inverter which provides :
  - the pitch and yaw dampers,
  - the fuel gauge (but not the debitmeter), and
  - the incidence indicator.
- The air data computer which provides :
  - the shock-cones automatic control,
  - the Mach warning light, and
  - the engine overspeed.
- The navigation computer.
- The gyro centre.
- The standby UHF radio set.
- The left LP fuel pump.
- TACAN.
- The navigation and formation lights.

Note

- If HYD 1 is operating (EMG HYD pump off), the battery life is at least 30 minutes. If HYD 1 is not usable and the EMG HYD pump is operating, battery life is about eight minutes.
- Battery life may be extended by careful use of the electrical services.
- Flight safety is not affected when the GEN warning light illuminates.
- If the Bezu ball, TACAN or IFF is required, set the manual LOADSHED switch OFF, heading selector to NOTR and second L.P. PUMP to OFF.

Selecting the manual LOADSHED switch ON affects the handling of the aircraft; the dampers no longer operate and the shock-cones remain in the position they were in when the manual LOADSHED switch was operated. For these reasons, it is advisable not to use the manual LOADSHED at high Mach number or high IAS. After operating the manual LOADSHED, make sure that the shock-cones are in when the aircraft is in subsonic flight. If necessary, move the shock-cones manually.

Note

If the LOADSHED switch has been ON for more than 10 minutes, do not reselect the GYRO CENT switch ON until a total period of 30 minutes has elapsed.

When the manual LOADSHED is operated, only the following items can be used :

- the main UHF radio set,
- the stand-by artificial horizon,
- the debitmeter, and
- unstabilized magnetic heading (heading selector on EMG).

ALTERNATOR FAILURE

The ALT warning light illuminates, the warning horn sounds, the autocommand and roll stab disengage and the shock-cones maintain their position.

Note

The aircraft may pitch down as the auto-command disengages, if the failure occurs at a high Mach number or at a high altitude.

1. Bezu ball—Disregard, use standby A/H.
2. Throttle—Cancel A/B.

3. Heading selector—EMG.
4. IFF MASTER switch—OFF.
5. Radar master switch—OFF.
6. Weapon system selector—G/S OFF.
7. TACAN master switch—OFF.
8. Radar altimeter control knob—Off.
9. Doppler selector switch—Off.
10. ALT reset button—Press.

Note

The chance of a successful reset is enhanced if engine RPM is below 6000.

If Unsuccessful, Wait 2 Minutes Then :

11. ALT reset button—Press again.

If Still Unsuccessful :

12. ALT switch—OFF.
13. Bezu ball—Cover.
14. RTB.

The following are unavailable :

- autocommand and altitude lock,
- roll stab,
- gyro centre,
- air data computer (shock-cone automatic control and damper gains),
- IFF and TACAN,
- radar,
- sight,
- missiles,
- A/B normal ignition system,
- air conditioning system regulation (the air conditioning regulator valve remains at the setting it was in at the time of AC failure), and
- ECM and chaff dispenser, if fitted.

Note

- If an alternator failure occurs in supersonic flight, the shock-cones have to be manually retracted.
- In an emergency, A/B can be used by putting the throttle in the A/B sector and pressing the A/B EMERG button until ignition of the A/B. Do not press the button for more than 10 sec. The amber A/B ON light does not illuminate.

INVERTER FAILURE

There is no direct warning of an inverter failure, however the failure is indicated by the DAMPER plungers popping out, the DAMP warning light illuminating and the warning horn sounding. The fuel gauge pointers remain in their pre-failure position.

If the DAMPER Plungers Pop Out :

1. Fuel GAUGE TEST button—Press.

If Inverter Failure is Confirmed :

2. INV switch—OFF.
3. RTB.

Note

- The fuel gauge, dampers and incidence lights are inoperative.
- Flight limitations as for damper failure apply.

TOTAL ELECTRICAL FAILURE

A total electrical failure can result from :

- a generator failure when the battery has failed or is flat, ie less than 18 volts or does not remain on line, or
- exhausting the battery after a generator failure when the transformer-rectifier is unserviceable.

All indicator lights are off and only the following are available :

- The pitot/static instruments.
- RPM and EGT(T4) indicators.
- Standby compass.
- Emergency undercarriage extension.
- Ram air and demist.
- Normal (without ministop) and emergency brakes.
- The brake chute.

If a Total Electrical Failure Occurs :

1. Fly with reference to the standby A/H, if required.

Note

The standby A/H may run down in two minutes and thus should only be used as an attitude reference for a minimum time.

2. BATT reset button—Press.

If in IMC and Control Cannot be Maintained :

3. Eject.

WARNING

The LP fuel pumps are inoperative and harsh throttle movements should be avoided.

RADAR FAILURES

TRANSMIT LIGHT ILLUMINATES

If the TRANSMIT light illuminates with the radar master switch selected to TX, all echoes disappear from the scope.

1. EMG TX button—Press.

CAUTION

Only one press of the EMG TX button should be attempted as further attempts may cause radar damage.

If Transmission is Not Restored or if Several Transmission Failures Occur :

2. Radar master switch—STND-BY.
3. Continue as required.

OVERHEAT LIGHT ILLUMINATES

Radar Remains Operative

If the OVERHEAT light illuminates but the radar continues to function :

1. The radar master switch may be left ON, if operationally necessary.
2. Radar master switch—STND-BY, as soon as possible.

If the OVERHEAT Light Does Not Extinguish Within 30 Secs of Selecting STND-BY :

3. Radar master switch—OFF.

CAUTION

Avoid harsh manoeuvres with the radar master switch OFF.

Radar Inoperative

If the flow of cooling fluid to the radar ceases, the radar scope becomes blank and all the radar indicator lights are extinguished except the OVERHEAT light. In this case, power is supplied to the radar antenna which remains fixed, but normal radar operation is not possible.

1. Radar master switch—STND-BY, if manoeuvring flight operationally necessary.
2. Radar master switch—OFF, as soon as manoeuvring no longer necessary.

NOSE CONE PRESSURIZATION FAILURE

If the radar switches off, ie the antenna scan ceases, the scope becomes blank and all lights extinguish, the probable cause is loss of nose cone pressurization. If the failure occurs at altitude or in the climb, the radar may switch on again during the descent.

OXYGEN FAILURES

OXY REG LIGHT ON (L/A MODE ONLY)

The OXY REG light illuminates and the warning horn sounds 15 seconds after the blinker stops on either black or white.

Note

If the pilot's mask is leaking or the pilot holds his breath or breathes lightly, causing the blinker to remain black or white for 15 seconds or more, the OXY REG warning light operates and the horn sounds. The involuntary gasp by the pilot as he hears the horn is usually enough to operate the blinker and cancel the warning.

1. Check contents, blinker, connectors and mask.

   If the normal regulator fails, the blinker ceases to operate and shows continuous white or black.

If Blinker Stays White :

2. Oxygen flow is continuous.
3. Contents—Monitor.
4. No other action can be taken.

If Blinker Stays Black :

5. Oxygen flow is nil.

   The pilot has difficulty in breathing.

6. Oxygen control selectors—100%/EMG.

   The emergency regulator now operates and supplies 100% oxygen with an overpressure of 5 mb. The pilot should feel the 5 mb pressure as a puff in the face mask. The blinker remains inoperative but the warning light is extinguished.

7. OXY CB—Check in.

If the Warning Light Does Not Go Out :

8. Descend to low altitude and remove mask.

8 MIN OXY LIGHT ON

The 8 min OXY light illuminates and the horn sounds when :

- the pressure in the emergency oxygen bottle falls to 1960 PSI (leaving only 8 minutes supply of oxygen), or
- the QDA (Quick Disconnect Assembly) is disconnected. The aircraft oxygen supply will be depleted in about one minute, leaving only 8 minutes supply of oxygen, or
- the emergency cock is off, or
- the visor seal cock is off.

When the 8 min OXY light illuminates :

1. Contents—Check.

   If gauge shows zero, 8 minutes supply of oxygen remains.

2. Descend to low altitude, if contents zero.

When the Oxygen Supply is Exhausted :

3. Remove mask.

PRESSURIZATION AND AIR CONDITIONING FAILURES

CAB T WARNING LIGHT

The CAB T warning light illuminates and the horn sounds when the temperature of the air supplied to the cabin is greater than 32°C.

1. CAB T CB—In.
2. Cabin temperature control—Full AUTO COLD.

If Unsuccessful :

3. Cabin temperature control—Full MANUAL COLD.

If Still Unsuccessful :

4. Cabin EMERGENCY COLD switch—EMERGENCY COLD.

If Temperature Still Too High :

5. Altitude—Less than 20 000 ft.
6. IAS—Less than 450 kn.
7. RAM AIR lever—OPEN (rear).

CABIN COOLING TURBINE FAILURE

WARNING

The nature of heat exhaustion is insidious in that the pilot is unaware of the deterioration of his condition. Pilots should take care to prevent cabin heat build up, if cooling air is lost.

If air conditioning system failure at low level causes pilot heat stress :

1. PRESSURIZATION switch—OFF.
2. IAS—Reduce to 250 kn.
3. Commence climbing to about 15 000 ft.
4. RAM AIR lever—OPEN (rear).

After Relief From Heat Stress :

5. Land avoiding high speeds.

If Unable to Climb or Relief is Not Obtained :

6. CANOPY JETTISON lever—Forward.

Note

Before jettisoning the canopy, the pilot should advise air traffic control of his intentions as intelligible radio communications are subsequently impossible.

JAMMING IN FULL COLD

Under moist atmospheric conditions and at low altitude, the air conditioning system can jam in full cold. This results in mist in the cabin.

1. CAB T CB—In.
2. Cabin temperature control—MANUAL HOT.

In an Emergency or If the Above Procedures Have No Effect :

3. PRESSURIZATION switch—OFF.

CAB P WARNING LIGHT

The CAB P warning light illuminates and the horn sounds when the cabin altitude exceeds 30 000 ft or when the CANOPY locking lever is not fully forward.

1. CANOPY lever—LOCK (forward).
2. PRESSURIZATION switch—ON.
3. Canopy SEAL/RAM AIR lever—INFLATE/CLOSED.

CAUTION

If the canopy SEAL/RAM AIR lever or the PRESSURIZATION switch need reselecting, set idle RPM.

CABIN MISTING

Cabin misting is due to water vapour in the conditioning air and may occur when the cabin temperature control is set to cold and high power is used or after a rapid descent from high altitude. Misting can cause a distraction on take-off.

If Misting Occurs on Take-off :

1. PRESSURIZATION switch—OFF.

If Misting Occurs After a Descent :

1. Cabin temperature control—HOT.
2. DEMIST lever—On (forward).

FUMES IN THE CABIN

Fumes in the cabin may be caused by a cabin component failure or a pressurization system fault.

1. N/100% oxygen control selector—100%.

If Failure of an Electrical Component is Suspected :

2. Electrical services—All OFF.
3. RTB.

If a Pressurization Fault is Suspected :

4. PRESSURIZATION switch—OFF.
5. Altitude—Below 30 000 ft.

Note

Do not use ram air unless the pressurization system is the source of the fumes, as the cabin air circulation is severely reduced.

EQ. T WARNING LIGHT

The EQ. T warning light illuminates whenever the equipment conditioning system is supplied with air at a temperature higher than 50°C.

1. EQUIPMENT CONDITIONING EMG COLD switch—EMG. COLD.

If the EQ. T Warning Light Does Not Go Out in One Minute :

2. EQUIPMENT CONDITIONING switch—OFF.

Note

- The equipment bay is no longer cooled. To prevent damage to the equipment, return to base at less than M0.9 and below 45 000 ft.
- Under such conditions, the equipment bay air conditioning obtained through air coming from the cockpit is just sufficient to keep the gyro centre and its output multiplier within limits.

3. TACAN master switch—OFF.
4. RTB

Note

TACAN may be used for a maximum of 5 minutes for recovery.

FLYING AIDS FAILURES

DAMPER FAILURE

The P and/or Y DAMPER plungers may pop out.

Note

If the pitch damper cuts out at high altitude or in a turn, a nose down pitch results, followed by pitch oscillations.

1. HYD 2 pressure—Check.
2. SERVO CONT CB—In.
3. Fuel GAUGE TEST button—Press.

Note

Failure of the gauge to test indicates the inverter has failed.

4. Control column—Near neutral.
5. P and/or Y DAMPER—Reset.
   - Try to reset several times, if necessary.
   - Resetting the dampers when the aircraft is in a turn or in supersonic flight is not possible because of the total error safety devices fitted. If the pitch dampers will not reset, elevon effectiveness is reduced and allowance should be made for this reduction during the landing phase.

If Nil Reset is Obtained :

6. Observe the following limits :
   a. Maximum altitude 50 000 ft.
   b. Maximum speed 500 KIAS.
7. Return subsonic below 40 000 ft/2 'g', and anticipate reduced elevon effectiveness on the flare when landing.

Damper Malfunction

The dampers may malfunction without causing their plungers to pop out. This normally generates some porpoising with a fairly high frequency (pitch damper) or 'tail wiggling' (yaw damper). Cancel the corresponding damper, if necessary, by pulling the plunger out.

Note

- If the ADC is at fault, a damper may malfunction in one part of the flight envelope but operate normally elsewhere.
- The porpoising generated by a defective damper may be amplified by a pilot trying to stop the oscillations thereby leading to pilot induced oscillations. This is more likely to occur in transonic flight or at low altitude with a high IAS. In this case, release the control column, slow the aircraft down and cancel the damper.

AUTOCOMMAND FAILURES

Autocommand Light

Air bubbles in the hydraulic system reaching the level of the pitch pre-servo electrical slide valve may cause the pitch pre-servo to stick. The sticking can show up after engine start when autocommand is engaged. It is evidenced by a succession of rapid movements in the pitch control or by the autocommand disengaging and the A.C. light illuminating when the control column is moved.

1. A.C. plunger—Out.
2. Control column—Move in pitch several times.
   This may clear the hydraulic system.
3. A.C. plunger—Attempt reset.

Note

- There are no flight restrictions.
- If this failure occurs in flight, the aircraft will porpoise at a rate of one cycle each 5-6 seconds.

If Porpoising Continues :

4. A.C. plunger—Out.

Control Column Jams or Jerks

1. **FLYING AIDS DISENGAGE SLAB—PRESS.**
   If the aircraft is in a critical situation, ie gunnery pass, a force of 45 lb applied to the column should effect disengagement.

If the Autocommand Cannot be Disengaged, or If the Column Jams :

2. **EMERGENCY DISENGAGE SWITCH—EMERG.**

WARNING

This action is to be taken if the control column jams even if autocommand is not engaged.

CAUTION

When flying without autocommand, ensure the AC PITCH ROLL circuit breaker is engaged. Failure to do so will result in damage to the autocommand system.

Auto Trim Light

When an auto trim failure occurs, the auto TRIM light illuminates. If the auto TRIM light is illuminated, a nose up or nose down control column jerk may occur when the autocommand is manually or automatically disengaged in flight. The effects of disengagement are more severe at low altitude and high speed.

Auto TRIM Light Illuminates on Ground :

1. A.C. plunger—Do not engage.

Auto TRIM Light Illuminates in Flight

1. Altitude—5000 ft minimum.
2. IAS—300 kn max and not transonic.
3. Control column—Hold firmly.
4. Flying aids disengage slab—Press.
   If the situation permits, disengage the auto-

command under flight conditions where the control surfaces are not very effective, ie IMN greater than 1.4 or IAS less than 250 kn.

Note

The Auto TRIM light illuminates whenever the control column is further aft than 7° (limit of trim travel). This can occur at high altitude and high MN or during aerobatics.

GYRO REFERENCE SYSTEM FAILURES

INFLIGHT ATTITUDE ERRORS

When the Bezu ball attitude is erroneous compared with the visual or standby A/H attitude.

1. Hold wings level.
2. FAST EREC button—Press (3 minutes limit).

If Unsuccessful :

3. Bezu ball—Cover.
4. Use standby A/H.

[D] INFLIGHT ATTITUDE ERRORS

1. Hold wings level.
2. GYRO CENT switch—OFF for 1 minute then ON. After 10 sec the TGP should be fully erect and operational.

If Unsuccessful :

3. Bezu ball—Cover.
4. Use standby A/H.

INFLIGHT HEADING ERRORS

1. Hold wings level.
2. Disengage flying aids.

WARNING

Use of the TRANSF button with roll stabilization engaged may lead to violent roll inputs to controls.

3. TRANSF button—Press.
4. Check with standby compass.

If Unsuccessful :

5. Heading selector—DG (for gyro heading).

GYRO LIGHT OR ERRATIC BEZU BALL

If the GYRO light illuminates or the Bezu ball behaves erratically :

1. Monitor standby A/H.
2. Heading selector—FAIL.
3. Land as soon as practicable.

CAUTION

- If the GYRO CENT switch is selected OFF for more than 10 minutes, it should be left OFF for a total of 30 minutes before it is re-selected ON.
- [D] Do not select EMG unless an actual failure exists. If EMG is selected with a serviceable AC system, a harmful beat frequency oscillation is set up which causes violent Bezu oscillation and consequent damage to the servo gear trains.
- [D] If the front cockpit indicators only receive heading information, the Bezu ball is suspect and should be covered.

Note

Unstabilized magnetic heading is fed to the PHI and the gunsight.

RADIO MALFUNCTIONS

Continuous Cycling

1. Selector switch—OFF, use other radio.

Note

In cases of continuous cycling, the radio may become serviceable after a cooling period.

No Side Tone/Unsatisfactory Reception on Both Radios

1. Communications selector—EMG sector.

Note

In EMG sector, only one set at a time can be heard.

No Communications on Pre-Set Frequency

1. Select the frequency manually.

If Unsuccessful :

2. Select GUARD (G), if available.

'g' SUIT REMAINS INFLATED

If the 'g' valve sticks open and the suit remains inflated, or the suit inflates inadvertently :

1. Release 'g' loading, if applicable.
2. 'g' suit—Attempt to disconnect.

Note

This may be impossible and care must be taken not to disconnect the oxygen in the process.

If Immediate Disconnection is Not Achieved :

3. Wait until pressure reduces sufficiently to allow disconnection.

If Pressure Remains Unbearable :

4. Attempt to puncture one of the 'g' suit bladders.

JETTISON BUTTONS

Tanks and stores can be jettisoned by operating the FUS, WING or TANK jettison buttons on the left side of the instrument panel.

The jettison capability of each button is :

1. FUS :
   a. Centreline 286/242 gal tank.
   b. Matra and pylon.
   c. Centreline bombs safe.

Note

The ECM pod is not jettisonable.

2. WING :
   a. Wing tanks except 110 gal non-jettisonable tanks and RPK10.
   b. Sidewinder launched safe.
   c. Bombs safe from RPK10.
3. TANK :
   a. All external tanks except 110 gal non-jettisonable tanks and RPK10 tank/bomb carriers.

FUEL DUMP

Fuel may be dumped from 242, 286 and 374 gal tanks.

1. IAS—Less than 300 kn.
2. Altitude—Above 6000 ft, if possible.
3. FUEL DUMP button—Press.
4. Debitmeter—Reset to known fuel remaining when the gauge pointers move below the transfer level.

Note

- The dump valves are prone to stick. Repeated presses and rocking the aircraft may free a stuck valve.
- A slight buffeting is felt as the fuel is dumped and the fuel stream is visible in the rear vision mirror.
- Dumping may take five minutes.

CAUTION

Holding the FUEL DUMP button in a depressed position for more than five seconds may result in damage to the wiring system.

SECTION 4
CREW DUTIES

SECTION 4

CREW DUTIES

NOT APPLICABLE

SECTION 5
OPERATING LIMITATIONS

SECTION 5

OPERATING LIMITATIONS

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During Normal Operation

Under stabilized flight conditions with the throttle at full dry or in the A/B sector, EGT (T4) should remain in the narrow green band. The (T4), with overspeed engaged, should indicate in the broard green band.

EGT (T4) Indicator

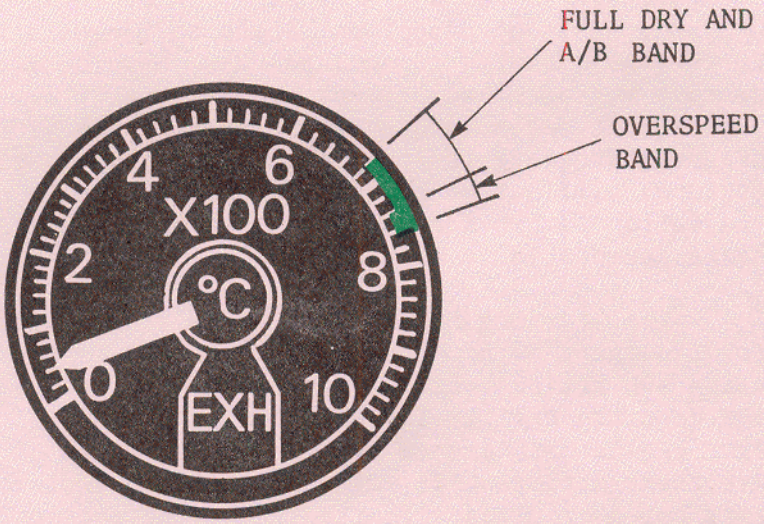


Figure 1-9

Date: SEP85

RAAF SUPPLEMENT NO 57

ENGINE EGT (T4) LIMITS

Instructions

This supplement is to be inserted facing page 5-1.

Information

1. Atar engines have historically been adjusted on T4 (exhaust gas) temperature. However, because of the uneven temperature distribution in the area of T4 measurement and the limited number of T4 probes (four), this temperature is not a true indication of engine thermal performance and its use as a basis of adjustment leads to inconsistent results. The French Air Force (FAF), having recognized this, have decided to change in the near future to a method of adjustment by mass fuel flow. This technique produces more consistent and accurate engine performance within a fleet but suffers the disadvantage that the only cockpit related power indication (T4 temperature) will not be consistent from engine to engine. Compensation for this variation is provided by installation of a decal on the T4 gauge to delineate acceptable T4 zones for each engine.

2. The Atar Engine Task Group has recommended that the FAF method of engine adjustment be adopted. Investigation is now being carried out to establish the actions which are prerequisite to its introduction. These include accurate calibration of squadron engine test stands, revision of squadron engine maintenance practices and review of aircrew acceptance checks. Because these actions will take some time to implement this AL has been raised to carry out a trial on a limited number of engines under a special management plan.

Action

For those aircraft fitted with engines calibrated by the Mass Fuel Flow Method read the following in lieu of 'During Normal Operations' on page 5-1.

SECTION 5

OPERATING LIMITATIONS

This section includes all limitations that must be observed for the safe and efficient operation of the engine, airframe, stores and accessories.

DELIBERATE FLAMEOUTS

Deliberate flameouts are not permitted.

ENGINE OPERATING LIMITS

RPM LIMITS

The RPM (indicated RPM) limitations are as follows :

a. ***Idle RPM.*** The idle RPM is 2920 ± 100. If the RPM are greater than 3020 RPM, check that the EMERGENCY THROTTLE is CLOSED.

Note

When the engine is started, the RPM may be as low as 2600. The engine should stabilize on the normal value within 5-6 minutes.

b. ***Full Dry and A/B RPM.*** At full dry and in the A/B sector, the RPM is 8460 ± 50. The normal maximum power rating is 8510 RPM.

c. ***Overspeed Operation.*** When the overspeed system operates, the RPM increases to 8710 ± 50. The maximum allowable rating with overspeed engaged is 8760 RPM.

d. ***Maximum RPM.*** The engine limit speed is 9000 RPM. If the RPM exceeds 9000, cancel the A/B or reduce the power. If the overspeed still persists, set the throttle to stop.

WARNING

Above 9000 RPM, permanent engine damage will occur and catastrophic failure is possible.

e. ***Emergency Throttle.*** Using the EMERGENCY THROTTLE switch :

(1) the maximum allowable rating is 9000 RPM, provided normal oil supply is available,

(2) the maximum desirable rating with oil failure is 8760 RPM, and

(3) when an oil failure exists, ratings between 8760 and 9000 RPM are permissible for a maximum of 5 seconds.

CAUTION

When an oil failure exists, operating above 8760 RPM for longer than 5 seconds may cause engine damage and should be restricted to operational necessity.

f. ***A/B Selection.*** As A/B is selected, the RPM will swing. The limits of this swing are 8000-8900.

g. ***Above M1.6.*** Above M1.6, the engine speed is not normally reduced below full dry power. However, when EGT(T4) is excessive, engine speed may be reduced to 8000 RPM regardless of Mach number. In emergency conditions, the engine can be stop-cocked at speeds up to M2.0 in 1 'g' flight.

h. ***Prohibited Range.*** Stabilized settings in the 4700 to 5200 range are prohibited because of harmful engine vibrations.

i. ***Alternator Constant Speed Drive.*** The alternator constant speed drive (CSD) incorporates a clutch which operates at engine speeds between 5650 and 5900 RPM. To prevent overheating of the CSD, stabilized settings in the 5500 to 6000 RPM range should be avoided.

EGT(T4) LIMITS

The EGT(T4) limitations are discussed in the following paragraphs.

Engine Start

The EGT(T4) must not exceed 700°C during engine start. If necessary, the engine is to be stop-cocked to prevent the EGT(T4) exceeding this limit.

Note

If there is air in the oil system, the EGT(T4) and RPM may fluctuate at idle power after start. This fluctuation should cease at a higher RPM setting. If it does not, the aircraft is unserviceable.

During Normal Operation

Under stabilized flight conditions with the throttle at full dry or in the A/B sector, EGT(T4) should remain between 680°C and 740°C (760°C with overspeed). In flight, at the maximum stabilized engine speed (8460 ± 50 RPM in full dry or A/B), the minimum allowable EGT(T4) is 680°C at speeds below M1.8 and 660°C above M1.8, however if the full dry EGT(T4) :

a. stays between 650° and 680°C, the mission can

be continued and the aircraft placed unserviceable after landing;

b. falls below 650°C, the aircraft is to be returned to base.

During Overspeed Operation

The EGT(T4) upper limit is increased to 760°C during overspeed operation.

On A/B Selection

On selecting A/B or increasing power in A/B, the EGT(T4) may temporarily rise to 780°C. If this temperature is exceeded, A/B is to be cancelled and not re-selected.

During M0.9 Climb

When climbing at M0.9 at full dry power, low EGT(T4) occasionally combined with RPM fluctuations is likely to occur between 25 000 and 40 000 ft. The engine may be considered serviceable if :

a. engine fluctuations of ± 60 RPM are not exceeded,

b. EGT(T4) remains above 660°C, and

c. all other engine parameters are normal.

AFTERBURNER IGNITION LIMITS

On A/B ignition, the A/B should be de-selected if the :

a. EGT(T4) exceeds 780°C,

b. RPM swing exceeds 8000-8900, or

c. A/B INJ light illuminates for more than 10 seconds.

A/B ignition is limited as follows :

a. ***Below 35 000 ft.*** A/B ignition is permitted at any IAS.

b. ***35 000 to 50 000 ft.*** A/B ignition is permitted at IAS above 250 kn.

c. ***50 000 to 75 000 ft.*** The lower limit of A/B ignition increases from 250 KIAS at 50 000 ft to 310 KIAS at 75 000 ft.

CAUTION

- Failure to observe these limits may result in engine damage, compressor stall or flame out.
- Above 75 000 ft, engine overspeed will occur.

In flight, RPM must be stabilized at maximum dry power before igniting the afterburner (EGT(T4) above 600°C). However, in cases of operational necessity, the throttle may be moved from idle to mini A/B at take-off while the engine is still accelerating.

Above 35 000 ft with IAS below 250 kn, dry power only is permitted. The use of A/B is permitted over the remainder of the flight envelope.

WARNING

- Before moving the throttle from the mini A/B position towards max A/B, pause while the RPM stabilizes after afterburner ignition.
- If the afterburner flames out, set the throttle at full dry.

Note

If the IAS falls below 250 kn above 35 000 ft with A/B selected, the aircraft should be recovered by reducing the incidence thus increasing airspeed to above 250 kn before moving the throttle.

STARTING LIMITS

Only three attempts to start, including ventilations, are permitted. If the RPM exceeds 250, the next start attempt must be delayed until the RPM falls below this figure.

ALTITUDE LIMIT

The maximum allowable altitude is 75 000 ft. This altitude limit has been established because of the danger of overspeeding the engine. With the throttle at idle at 75 000 ft, the engine speed may exceed 9000 RPM depending on IAS.

MACH LIMIT

The engine is limited to Mach 2 or the illumination of the Mach warning light whichever comes first.

FLIGHT ENVELOPE LIMITATIONS

CLEAN CONFIGURATION

The flight envelope for an aircraft in a clean configuration is shown at Fig 5-1.

Maximum Altitude

Above the maximum altitude of 75 000 ft, there is a risk of engine overspeed even with the throttle at idle.

Maximum Speed

The maximum speed is expressed as :

a. ***IAS.*** 750 KIAS (structural limit) up to M2.0 which normally occurs at about 34 000 ft, and

b. ***IMN.*** M2.0 (impact temperature limit) or illumination of the MACH warning light (whichever occurs first) up to 75 000 ft.

Minimum Speed

The Atar engine has a tendency to surge at very low IAS. The following minimum speeds are to be observed :

a. ***Below 35 000 ft.*** 150 KIAS or the limit of

Clean Aircraft Envelope

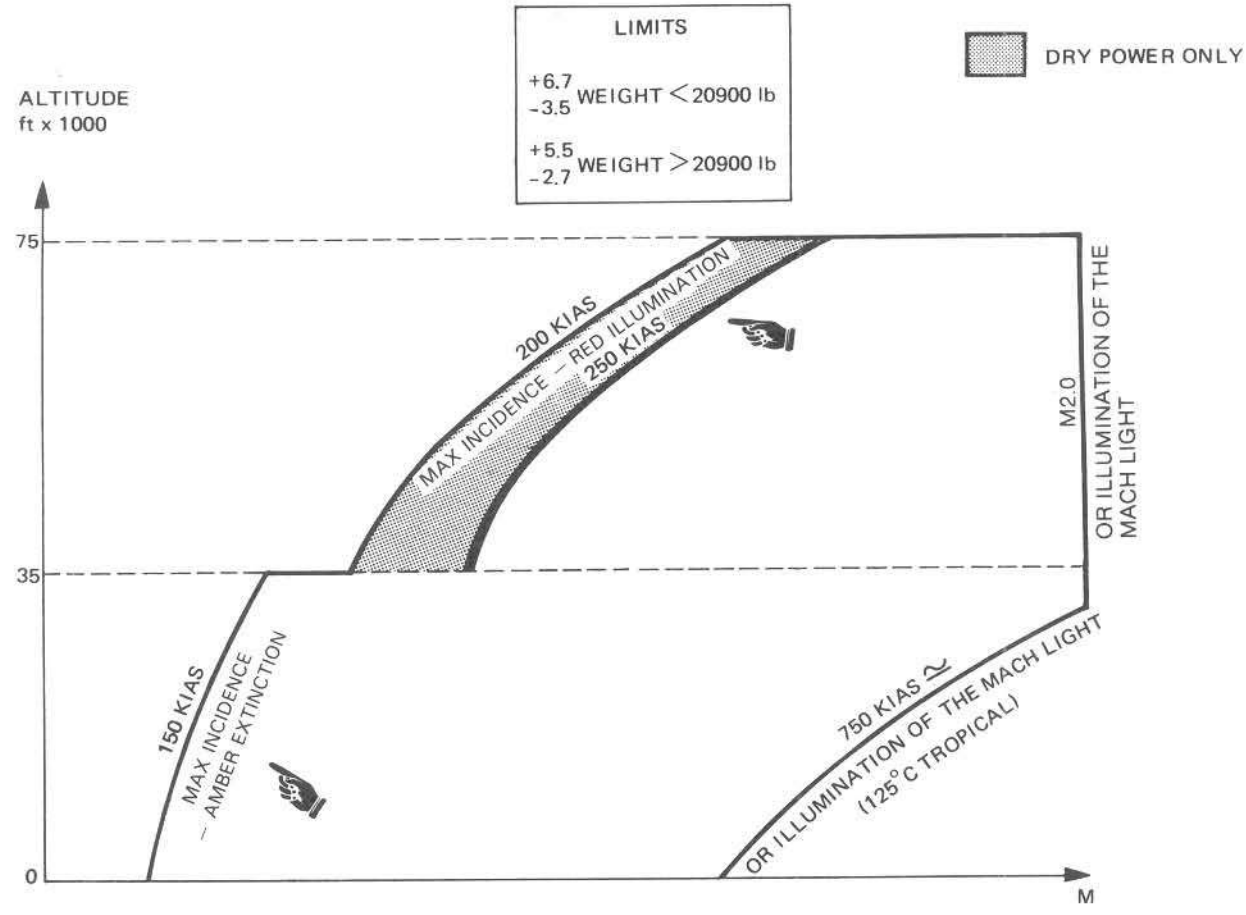


Figure 5-1

amber/red incidence whichever occurs first.

b. ***Above 35 000 ft.*** 200 KIAS or the limit of amber incidence whichever occurs first.

WITH EXTERNAL STORES

The external stores configurations and associated limitations are shown in Figure FO 5-1.

Minimum Speed

With 242, 286 or 374 gal tanks, RPK10, two MK82 fuselage-mounted bombs or a pannier, the minimum speed corresponds to the limit of red illumination incidence. With other stores, limitations are identical to those of a clean aircraft.

Maximum Permissible Altitudes and Speeds

The maximum permissible altitudes expressed in feet and speeds expressed in KIAS and IMN for approved configurations of external stores are shown adjacent.

LOAD FACTORS

The maximum load factors which are normally permitted correspond to the safe load. This limitation is to be observed by the pilot. If the limit load factor, ie a safe load × 1.2 is exceeded, the aircraft structure and the external store attachment points, when external stores are fitted, must be thoroughly inspected.

Configuration	Max Altitude (ft × 1000)	Max IAS	Max IMN
Matra R530	75 000	750	2.0
S.W.	60 000	730	2.0
Two 110 gal tanks	60 000	750	1.9
One 242/286 gal tank empty	45 000	600	1.2
Two 286 gal tanks empty	45 000	600	1.2
Pannier	45 000	600	1.2
One 242/286 gal tank feeding	40 000	600	1.2
Two 286 gal tanks feeding	40 000	600	1.2
Two 374 gal tanks	40 000	550	0.95
RPK10 without bombs	55 000	650	1.5
RPK10 with bombs	40 000	600	0.95
Two MK82 on PM-3	40 000	600	0.95
SUU-20A/A	40 000	650	1.2
AN/ALQ-72 ECM Pod	50 000	600	1.5
AN/ALE-32 Chaff dispenser	50 000	750	1.9
SUU-11B/A Gunpod	40 000	450	0.95
HIPATS-1 empty or target stowed	40 000	500	0.9
HIPATS-1 with target deployed	30 000	350	0.83

WARNING

- If the load factor exceeds + 8 'g' or − 4.1 'g' permanent distortions may occur. The extreme load factor, corresponding to rupture, is about + 11 'g'.
- The maximum allowable load factor on the engine is + 10 'g'.

Clean Aircraft or Aircraft With Air-to-Air Missile

The maximum allowable load factors are + 6.7 'g' and − 3.5 'g'.

Aircraft With Two 110 gal Tanks

When an aircraft is fitted with two 110 gal tanks (or RPK10 without bombs) with or without air-to-air missiles, the maximum allowable load factors are + 5.5 'g' and − 2.7 'g' when the AUW is greater than 20 990 lb. When the AUW is less than 20 990 lb, the allowable load factors are + 6.7 'g' and − 3.5 'g'. In these configurations, the AUW of 20 990 lb corresponds approximately to end of external fuel transfer.

Aircraft With Stores

The allowable load factors for an aircraft with stores are shown below. The allowable factors for an aircraft with RPK10 (without bombs) are the same as those for an aircraft with two 110 gal tanks.

CAUTION

If recovery 'g' loadings of more than 6.0 'g' are planned when carrying the SUU-20A/A, pilot induced oscillations may occur and the aircraft may be inadvertently overstressed.

Note

- If several stores are installed, the limitation which specified the least 'g' loading is to be applied.
- The autocommand is capable of exceeding the 'g' limitations over the whole flight envelope.

Configuration		Max Permissible 'g'	
Clean		+6.7	-3.5
With air-air missiles		+6.7	-3.5
Two 110 gal tanks or Two RPK10 without bombs	Trans	+5.5	-2.7
With or without missiles	Empty	+6.7	-3.5
Two 286 gal tanks or One 286 gal tanks	Trans	+4.5	-2.2
[D] One 242 gal tank	Empty	+6.0	-3.0

Configuration		Max Permissible 'g'	
Two 374 gal tanks	Trans	+3.7	−1.75
	Empty	+5.5	−2.2
AN/ALE-32 Chaff dispenser		+6.7	−3.5
AN/ALQ-72 ECM pod		+6.0	−2.7
SUU-20A/A		+6.7	0
Two MK82 bombs on PM-3		+5.5	−2.2
RPK10 with bombs		+4.5	−2.2
SUU-11B/A Gunpod		+5.0	−1.0
HIPATS-1 empty or target stowed		+6.0	−1.0
HIPATS-1 target deployed		+3.0	0

Negative 'g' Flight

Negative 'g' flight is allowed for 15 seconds in full dry power. With A/B, it is allowed for the time required for a flare-out at the top of a climb, ie about 5 seconds.

INCIDENCE LIMITATIONS

To achieve the maximum allowable angle of attack, the pilot should fly the aircraft so that the amber light is only momentarily extinguished. For example, a clean aircraft has an incidence limit of amber extinction. If the incidence is increased, amber is eventually extinguished leaving pure red, thus exceeding the incidence limitation.

When the incidence limit is red illumination, the aircraft should be flown so that the red light is only momentarily illuminated.

CAUTION

It is possible to exceed the load factor limitation and still remain within the incidence limitation.

Refer to Fig 5-1 for minimum speed and maximum incidence in straight and level 1 'g' flight.

During inflight manoeuvres the following limitations apply :

a. In the clean configuration, or with missiles, or with 110 gal tanks, it is prohibited to exceed amber extinction.

b. With 286 gal tanks, 374 gal tanks, pannier, SUU-20A/A and RPK10, it is prohibited to exceed red illumination.

[D] With 242 gal C/L tank, 286 gal tanks, 374 gal tanks, pannier, SUU-20A/A and RPK-10, it is prohibited to exceed red illumination.

Note

At take-off and during final approach with external stores, the red illumination incidence limit may be slightly exceeded.

MANOEUVRES

Single Rolls

In all the configurations, single rolls are permitted in the following envelope :

a. IAS - greater than 250 kn,

b. ALT - less than 50 000 ft, and

c. incidence limit - red illumination.

Consecutive Rolls

In all configurations consecutive rolls are permitted in the following envelope :

a. IAS - greater than 350 kn,

b. ALT - less than 20 000 ft, and

c. IMN - less than 0.9.

The aircraft must be trimmed to 1 'g' flight before the rolls and the trim position must not be altered during the manoeuvres.

Permissible Load Factors and Maximum Roll Speeds During Rolls

In supersonic flight, in all configurations, rolls are permitted from 0 'g' to 2 'g'. The maximum supersonic roll rate is 150°/sec; this is 50% of the maximum subsonic rate.

In subsonic flight, rolls may be performed with the load factor limitations shown below, provided that the red illumination incidence limit is not exceeded. The maximum subsonic roll rates, expressed in maximum roll speed and aileron deflection are shown below.

Note

- Rolls with autocommand only differ slightly from those without autocommand. During a manoeuvre, an easily controllable nose down force of about 2 to 4 lb generally occurs.
- Full aileron should not be selected to perform a roll as an excessive roll rate may result, particularly when supersonic.

Configuration		Load Factor 'g'	Aileron Deflection	Roll Speed °/sec
Clean		0 to +5	2/3	300
Matra R530		0 to +5	2/3	300
S.W.		0 to +5	2/3	300
Single S.W.		0 to +5	1/2	180
RPK10 without bombs		0 to +5	1/2	180
Two 110 gal tanks		0 to +5	1/2	180
RPK10 with bombs		0 to +3	1/2	150
Two 286 gal tanks or One 286 gal tank	Feeding	0 to +3.5	1/2	150
[D] One 242 gal tank	Empty	0 to +4.5	1/2	200
Two 374 gal tanks	Feeding	0 to +3	1/3	120
	Empty	0 to +4	1/2	180
Two MK82 on PM-3		0 to +4	1/2	100
SUU-20A/A		0 to +4	1/2	180
AN/ALE-32 Chaff dispenser		0 to +5	1/2	180
AN/ALQ-72 ECM pod		0 to +4	1/2	180
SUU-11B/A Gunpod		0 to +5	2/3	300
HIPATS-1 empty or target stowed		−1 to +6	1/2	180
HIPATS-1 target deployed		0 to +3	1/2	

Rapid Turn Reversal

In all configurations, rapid turn reversals are to be performed under positive load factor and at incidence angles less than red illumination. They are to be limited to roll angle variations of :

a. 90° for altitudes greater than 35 000 ft and IAS less than 250 kn,

b. 180° over the rest of the envelope, and

c. 1/2 aileron deflection (max) when HIPATS-1 target is deployed.

Supersonic Dive

To avoid exceeding the flight envelope limitations, especially with afterburner, dive angles greater than 30° are prohibited in supersonic flight.

Prohibited Manoeuvres

The following manoeuvres are prohibited:

a. take-off with part-empty external tanks,

b. manoeuvres involving a sustained forward acceleration in an unloaded condition while fuel remains in 374 gallon external tanks,

c. manoeuvres involving rapid 'g' application while fuel remains in 374 gallon external tanks,

d. manoeuvres involving yaw above 35 000 ft when IAS is less than 250 kn,

e. use of autocommand below 1000 ft AGL,

f. manoeuvres involving an attitude greater than ±20° in pitch with HIPATS-1 target deployed, and

g. ground attack manoeuvres while fuel remains in the 374 gallon external tanks.

WEIGHT

The maximum AUW for take-off is 27 500 lb. At high AUW, care is to be exercised when taxiing to avoid excessive side loading on the undercarriage. A smooth rotation for lift-off is essential as a sharp rotation causes excessive down loads on the undercarriage and blown tyres may result. Refer to DI(AF) AAP 7213.003-1-1 for AUW for various aircraft configurations.

CG POSITION

The various external and internal configurations lead to different CG positions (refer to DI(AF)AAP 7213.003-34, Sect 6, Balance Charts) ranging between 50.8 and 53.2% at engine start. To achieve good stability in flight, especially during the acceleration phase, the following aft CG limitations should be observed :

a. clean or with external stores other than fuel tanks :

(1) without a gun bay tank - 54% , or

(2) with a gun bay tank - 53.3% ,

b. with one 286 gal fuselage tank or two 110 gal tanks - 54% , and

c. with two 286 gal or two 374 gal underwing tanks - 52.8% .

Note

The configuration of two 374 gal tanks and the Matra missile is prohibited by the 52.8% limitation.

With two 374 gal tanks, an empty gunbay tank and a lightly built pilot, it is possible that the rear CG limit could be slightly exceeded early in the flight until some fuel has been used from the drop tanks. If full forward trim is insufficient, slight forward pressure on the stick may be required until the CG is within the limits.

[D] The various external and internal configurations are within the permitted CG limits. The configurations that are closest to the aft CG limit condition with both seats occupied are :

a. two 374 gal tanks and two Sidewinders - 53% , and

b. two 374 gal tanks and one 242 gal tank - 52.2% .

[D] These CG limit configurations require smooth handling at the beginning of the flight. A certain inaccuracy will be noted in 'g' loads both during turns and when assuming climb attitudes.

WARNING

[D] It is forbidden to fly with the rear seat unoccupied while carrying 374 gal tanks with the gun bay tank empty.

APPROACH CONTROL

The following limitations are placed on the approach control :

a. The APPR CONT lever should not be selected above 300 KIAS because the approach control unit bellows may be damaged.

b. Whenever the engine speed is reduced below 7200 RPM, manually disengage the APPR CONT lever before reopening the throttle.

c. With the APPR CONT lever engaged, avoid sudden throttle movements, especially those throttle movements involving sudden decreases followed by sudden increases in RPM.

UNDERCARRIAGE

The nose wheel limit speed is 190 kn (ground speed). It should not be lowered onto the runway at higher speeds. The main wheel limit speed (lift-off speed) is 193 kn true ground speed at a maximum AUW limit of 27 500 lb.

High AUW Landings

High AUW landings should only be carried out in an emergency. Refer to Section 3.

Speed and 'g' Limitations

The maximum permissible speed :

a. for undercarriage extension and retraction is 240 KIAS,

b. with the flipper doors open (red UNSAFE light on) is 240 KIAS, and

Note

When the U/C is selected down by the emergency method, the flipper doors are open and the maximum permissible speed is 240 KIAS.

c. with the flipper doors closed and the undercarriage extended is 270 KIAS.

The undercarriage cannot be retracted when 2 'g' is exceeded.

CROSSWIND LANDING

The maximum permissible cross wind component for landing is :

a. 25 kn in clean configuration or with missiles, and

b. 20 kn with external tanks.

BRAKE CHUTE

The normal brake chute deployment speed is 140-170 KIAS. The maximum deployment speed is 210 KIAS. As the deployment speed increases from 170 KIAS up to the maximum, the likelihood of failure significantly increases. The maximum release speed is 190 KIAS due to the limited mechanical advantage of the system. The minimum release speed is 40 KIAS (estimated) to avoid heat damage to the brake chute strap.

110 GALLON TANKS

The following flight limitations are to be observed when both finned and unfinned 110 gal tanks are fitted :

a. max speed - 750 KIAS or M1.9,

b. max altitude - 60 000 ft,

c. max incidence - amber extinction, and

d. load factor :

(1) tanks feeding - + 5.5 'g', – 2.7 'g', and

(2) tanks empty - + 6.7 'g', – 3.5 'g'.

286 GALLON TANKS

The following flight limitations are to be observed when 286 gal tanks are fitted :

a. maximum speed - 600 KIAS/M1.2,

Note

Sustained speed above 550 KIAS should be restricted to operational necessity.

b. maximum altitude :

(1) tank feeding—40 000 ft, and

(2) tank empty—45 000 ft.

c. maximum incidence - red illumination, and

d. maximum load factor :

(1) tank feeding - + 4.5 'g', − 2.2 'g', and

(2) tank empty - + 6.0 'g', − 3.0 'g'.

Note

- Ground attack manoeuvres are permitted with part-empty tanks but there is a tendency for the aircraft to overpitch as 'g' is applied. The 'g' aimed for during recovery should be 0.5 'g' lower than the maximum permissible 'g'.
- During recovery from ground attack dives, the maximum 'g' attained should not exceed + 5.5 'g'.

[D] The limitations for 286 gal tanks also apply to the 242 gal tanks.

374 GALLON TANKS

The following flight limitations are to be observed when 374 gal tanks are fitted :

a. maximum speed - 550 KIAS/M0.95,

b. maximum altitude - 40 000 ft,

c. maximum incidence - red illumination, and

d. load factor :

(1) tank feeding - + 3.7 'g', − 1.75 'g', and

(2) tank empty - + 5.5 'g', − 2.2 'g'.

374 gallon tanks are intended to be used for ferry purposes only and serious problems can be experienced with controllability of the aircraft with operational type manoeuvres involving accelerations or the application of 'g'.

CAUTION

When operating with fuel remaining in the 374 gallon tanks, particularly when about half full, an extreme rearward fuel movement accompanied by a dangerous rearward CG movement can result from:

a. sustained forward acceleration in an unloaded condition, and

b. rapid application of 'g'.

WARNING

While fuel remains in the 374 gallon tanks all operational manoeuvring is prohibited. Specifically, any manoeuvres involving sustained forward acceleration in an unloaded condition and/or rapid application of 'g' are prohibited.

Note

With an aircraft configuration of two 374 gal drop tanks, an empty GB tank and a lightweight pilot, the aft CG limit may be exceeded until some fuel is used from the external tanks. Under these conditions, it may not be possible to trim the aircraft to alleviate the situation; therefore, a slight forward pressure on the control column is required until the CG is again within limits.

[D] If a Mirage IIID is flown with the rear seat unoccupied, two full 374 gal tanks fitted and the gun bay tank empty, the maximum permissible CG position is exceeded during or just after take-off. Furthermore, even if the flight is started with the gun bay tank full, a similar situation arises when the gun bay tank is empty, if the 374 gal tanks fail to feed.

WARNING

[D] Operation of the Mirage IIID with the rear seat unoccupied, two full 374 gal tanks fitted and the gun bay tank empty is prohibited.

286 AND 374 GALLON TANKS - JETTISON ENVELOPE

Before attempting to jettison 286 gal and 374 gal tanks, the speed brakes are to be retracted and, if practicable, the undercarriage is to be retracted.

[D] The foregoing also applies to the 242 gal tank. The jettison envelope for all configurations of 242, 286 and 374 gal drop tanks is detailed in the following paragraphs.

Full Tanks

Full tanks may be jettisoned in straight and level flight at 250 KIAS.

WARNING

A nose down pitch change occurs when full or near full tanks are jettisoned, the effect becoming more pronounced as IAS increases.

Part Empty Tanks

Jettison trials of part-empty fuel tanks have not been conducted by the RAAF. The following recommended jettison conditions are derived from limited trials made in France. Whenever possible, however,

the remaining fuel is to be dumped before the tanks are jettisoned.

Immediate jettison is permissible if the aircraft is in a stabilized climb at speeds between 300 and 450 KIAS or a M0.85 climb at climb angles between 5° and 10°. If the aircraft is in stabilized level flight, the specified climb must be achieved and held for a minimum of 30 seconds before the tanks are jettisoned. If the aircraft is in a descent or decelerating, the specified climb must be achieved and held for a minimum of one minute before the tanks are jettisoned.

Empty Tanks

Empty tanks may be jettisoned when :

a. the aircraft is in straight and level flight,

b. the undercarriage is retracted, if possible;

c. the speed brakes are retracted;

d. IAS is 300-500 kn with IMN less than 0.9; and

e. altitude is 40 000 ft maximum.

FUEL DUMP

Fuel should normally be dumped at less than 300 kn and, if near populated areas, above 6000 ft.

PANNIER

Carriage

The carriage limits for the 286 gal tank size pannier are :

a. maximum speed - 600 KIAS/M1.2,

b. maximum altitude - 45 000 ft,

c. maximum incidence - red illumination,

d. load factor - + 4.5 'g' to − 2.2 'g', and

e. Maximum load - 454 kg (1000 lb) evenly distributed.

Jettison

The recommended jettison envelope is straight and level flight at 250 KIAS.

COCKPIT AIR CONDITIONING LIMITATIONS

To prevent failure of the cockpit cooling turbine, the following restrictions apply to the use of the cockpit air conditioning system :

a. ***During Taxiing.*** Select the PRESSURIZATION switch ON before 4000 RPM and do not exceed 7000 RPM except for short periods.

b. ***Before Take-off.*** Never exceed 7000 RPM for more than three minutes.

c. ***After Landing.*** Select the PRESSURIZATION switch OFF below 4000 RPM.

LIMITATIONS DUE TO FAILURE

AUTO TRIM FAILURE

When the Auto TRIM light illuminates, a nose up or nose down stick jerk may occur when the autocommand is manually or automatically disengaged. These effects are more severe at low altitude and high speed, and the following limitations are to be observed when disengaging autocommand with the Auto TRIM light illuminated :

a. altitude - 5000 ft minimum, and

b. IAS - 300 kn maximum and not transonic.

DAMPER FAILURE

The flight limitations because of damper failure are :

a. maximum altitude - 50 000 ft,

b. maximum speed - 500 KIAS, and

c. return to subsonic flight below 40 000 ft and at less than 2 'g'.

Note

When flying without dampers, the aircraft may porpoise gently or set up slight Dutch rolling oscillations. These are the natural characteristics of an undamped aircraft. When landing, the pilot should anticipate reduced elevon effectiveness on the flare.

EMERGENCY OIL PUMP

Oil Failure

Following an oil failure, the EMG OIL PUMP switch must be selected ON as soon as possible to avoid disintegration of the No 1 bearing. However, the emergency oil pump must not be activated above 40 000 ft, at speeds greater than M1.6 or with the throttle above idle.

CAUTION

In cases of oil failure, the EMG OIL PUMP switch must be selected ON as soon as the aircraft is below 40 000 ft and at M1.6 or less.

Other Failures

The limitations on selection of the emergency oil pump for engine control failures are the same as for oil failure.

CAUTION

- In the case of an oil failure or an MFCU failure resulting in RPM fluctuations, set the throttle to idle before selecting the EMG OIL PUMP to ON.
- In the case of RPM freeze, select full dry before selecting the EMG OIL PUMP to ON.

EMERGENCY THROTTLE OPERATING LIMITS

In the case of an oil failure, the emergency throttle may be used below 30 000 ft; the maximum allowable engine speed is 9000 RPM (refer to Fig 5-2). For engine speed control failures, the emergency throttle may be used below 20 000 ft; the maximum allowable engine speed is 8400 RPM above 4000 ft and 9000 RPM below 4000 ft.

CAUTION

With an oil failure, operation above 8760 RPM is limited to 5 seconds unless operationally essential.

4.	Incidence	Same as for aircraft with a centreline tank and no stores	
5.	Max roll rate	150^{o}/sec	150^{o}/sec
6.	Load factors	Tanks transferring - Symmetrical 4.5g Asymmetrical 3.5g	
		Tanks empty - Symmetrical 6.0g Asymmetrical 4.0g	

Firing and Jettison Limitations

4. For all authorized configurations, the firing and jettison envelopes are identical to the asymmetric carriage (1 x R550) envelope.

5. The maximum missile launch load factor is 6g or the configuration limit if a lesser limit applies.

Date: 7OCT83

Carriage Envelope

3. The following carriage envelopes are approved for the above configurations:

a.	Clean Aircraft	2 x R550	1 x R550
	1. Max Speed	750 KIAS/M2.0	700 KIAS/M1.85
	2. Min Speed	Same as a clean aircraft without stores	
	3. Max altitude	65 000ft	50 000ft
	4. Incidence	Same as a clean aircraft without stores	
	5. Max roll rate	150°/sec	150°/sec
	6. Load factors	Same as a clean aircraft except between 500 KIAS and M1.1: Symmetrical limit 5.5g Asymmetrical limit 3.7g	
b.	2 x 110G Tanks (or clean RPK-10)		
	1. Max speed	750 KIAS/M1.9 (110G S/S) 650 KIAS/M1.3 (clean RPK-10)	700 KIAS/M1.85 (110G S/S)
	2. Min speed	Same as for aircraft with 2 x 110G tank tanks or RPK-10s only	
	3. Max altitude	60 000ft (110G S/S) 55 000ft (clean RPK-10)	50 000ft
	4. Incidence	Same as for aircraft with 2 x 110G tanks or RPK-10s only	
	5. Max roll rate	150°/sec	150°/sec
	6. Load factors	Same as for aircraft with 2 x 110G tanks or RPK-10s except between 600 KIAS and M1.1: Symmetrical limit 6.0g Asymmetrical limit 4.0g	
c.	Centreline Tank Configuration		
	1. Max speed	600 KIAS/M1.2	600 KIAS/M1.2
	2. Min speed	Same as for aircraft with a centreline tank and no stores	
	3. Max altitude	Centreline tank transferring - 40 000ft Centreline tank empty - 45 000ft	

RAAF SUPPLEMENT NO 45

MATRA R550 WEAPONS CLEARANCES

Instruction

This supplement is to be inserted facing Page 5-9.

Information

All RAAF Mirage aircraft are being modified to carry and employ the Matra R550 'Magic' IR air to air missile.

Action

For all Mirage aircraft modified for R550 operations, read the following:

MATRA R550 WEAPONS CLEARANCES

Approved Configurations

1. The following configurations have been approved for operations with Matra R550 missiles:

   a. Clean + 2 x R550

   b. Clean + 2 x R550 + 1 x R530

   c. 2 x 110G + 2 x R550

   d. 2 x 110G + 2 x R550 + 1 x R530

   e. 2 x 110G + 1 x 286G + 2 x R550

   f. Clean + 1 x 286G + 2 x R550

2. Notes

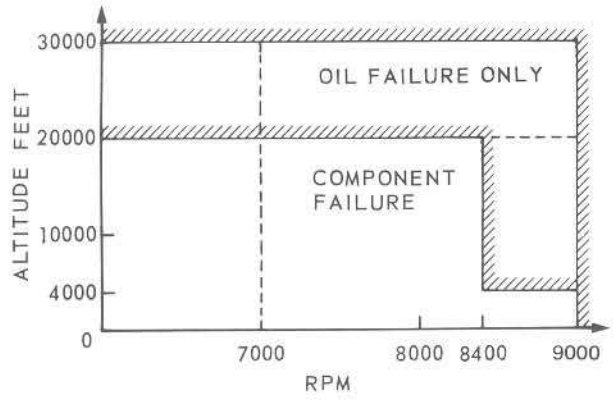
   a. Matra R530 clearance is not applicable to Mirage IIID.

   b. Clean RPK-10 tanks can be substituted for 110G supersonic tanks.

   c. 242G centreline tank is substituted for 286G tank on Mirage IIID.

   d. Clearances apply to all combinations of dry or wet leading edges, gun bay tanks, dummy gun bay tanks or gun packs for the Mirage IIID and Mirage IIIO.

Emergency Throttle Operating Limits



NOTE:
Operation of the unit outside the graph may result in an overspeed above 9000 RPM

Figure 5-2

WEAPONS CLEARANCES

MATRA

Carriage Limitations

The carriage limitations for Matra are :

a. maximum altitude - 75 000 ft, and

b. maximum speed - 750 KIAS/M2.0.

Launch Limitations

The launch limitations for Matra are :

a. maximum altitude - 60 000 ft,

b. maximum speed - 700 KIAS/M2.0,

c. minimum speed - 300 KIAS/M0.8, and

d. load factor - + 0.2 'g' to + 2.0 'g'.

Jettison Envelope

The Matra should be jettisoned at 250 KIAS.

SIDEWINDER 1A

Carriage Limitations

The carriage limitations for Sidewinder 1A are :

a. maximum altitude—60 000 ft,

b. maximum speed—730 KIAS/M2.0, and

c. maximum subsonic roll rate—300°/sec for Sidewinder 1A carried on both left and right outboard wing stations or 180°/sec for a single Sidewinder 1A carried on left or right outboard wing station. Carriage of a single Sidewinder 1A on left or right outboard wing stations is authorized providing a Sidewinder Pylon and Aero 3B Launcher is fitted to the unloaded station.

Launch Limitations

The launch limitations for Sidewinder 1A are :

a. maximum altitude - 55 000 ft,

b. maximum speed - 700 KIAS/M1.7,

c. minimum speed - 270 KIAS/M0.9, and

d. load factor - zero 'g' to + 4 'g'.

Jettison Envelope

The Sidewinder may be jettisoned throughout the carriage envelope.

GUNS

Carriage Limitations

The guns are carried internally and have no carriage limitations.

Firing Limitations

The guns may be fired throughout the aircraft flight envelope however, at high 'g' loadings, the probability of stoppages is increased.

MK82 LOW DRAG, HIGH DRAG AND GBU-12 LASER GUIDED BOMBS

Approved Configurations

The approved configurations for carriage and release of MK82 and GBU-12 bombs are shown at Fig 5-3 and FO 5-1.

Landing With Bombs

Landing with bombs is permitted if the release circuits have not been activated. When an unsuccessful attempt to release bombs occurs, the aircraft may be landed with bombs, only if all jettison attempts fail.

When landing with bombs on PM-3 the following restrictions apply :

a. ***Two Bombs or Rear Bombs Only.*** Nil restriction.

b. ***Front Bomb Only.*** Depending on configuration, the forward CG limit may be exceeded.

When landing with bombs on RPK10, the following restrictions apply :

a. ***Two Bombs on One RPK10.*** Use 190 KIAS threshold speed.

Note

Care is necessary in strong crosswinds.

b. ***Bomb(s) on Rear Station(s).*** Nil restrictions.

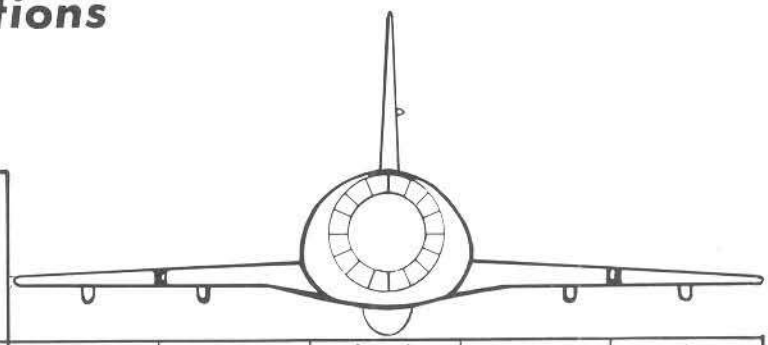
c. ***Bomb(s) on Front Station(s).*** Depending on configuration, the forward CG limit may be exceeded.

d. ***Four Bombs on One RPK10.*** Do not land.

WARNING

With four bombs on one RPK10, lateral control is lost below 300 KIAS.

Approved Configurations



	CONFIG-URATION NUMBER	
INBOARD WING STATIONS – CLEAN Refer to Notes at Sheet 3	1 2 3 4 5 6 7 8 9	
INBOARD WING STATIONS – LOAD SYMMETRICALLY WITH 110, 286 OR 374 GAL TANKS OR RPK10 WITHOUT BOMBS Refer to Notes at Sheet 3	10 11 12 13 14 15	
INBOARD WING STATIONS – LOADED WITH AN/ALE-32/110 GAL TANK Refer to Notes at Sheet 3	16 17	
INBOARD WING STATIONS – LOADED WITH RPK10 AND ONE OR TWO BOMBS PER CARRIER Refer to Notes at Sheet 3	18 19 20 21 22 23 24	

Figure 5-3 (Sheet 1 of 3)

RAAF SUPPLEMENT NO 1

APPROVED CONFIGURATIONS

Instructions

This supplement is to be inserted facing Page 5-10.

Information

At the time of issue of this manual all of the Approved Configurations have not been cleared. Investigations into the clearances are being carried out.

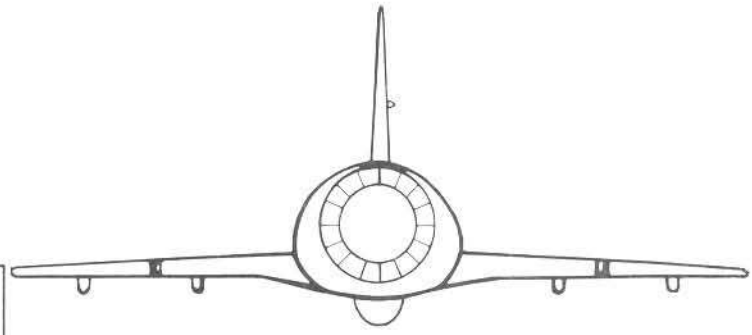
Action

The following is to be read in conjunction with Approved Configurations on Page 5-10:

> Configuration Numbers 12 through 15 (inclusive) are not cleared with 374gal tanks fitted.
>
> Configuration Numbers 21 through 24 (inclusive) are not cleared.

Date: June 1978

Approved Configurations



	CONFIG-URATION NUMBER					
FUSELAGE STATION PM-3 WITH GBU-12 ON REAR STATION ONLY.	25					
INBOARD WING STATIONS ONE GBU-12 PER CARRIER ON OUTBOARD FORWARD STATIONS ONLY	26					
	27					
FUSELAGE STATION PM-3 WITH SUU-11B/A GUN-POD/ LUNEBERG LENS ON FORWARD STATION ONLY [O] REAR STATION ONLY [D]	28					
	29					
	30					
	31					
	32					
INBOARD WING STATIONS LOADED SYMMETRICALLY WITH 110 GAL TANKS OR RPK-10s WITHOUT BOMBS. CENTRELINE LOADED WITH HIPATS-1	33					
INBOARD WING STATIONS LOADED SYMMETRICALLY WITH 286 GAL TANKS. CENTRELINE STATION LOADED WITH HIPATS-1	34					
INBOARD WING STATIONS ONE GBU-12 ON PORT OUTBOARD AND ONE MK 82 LOW DRAG ON STARBOARD OUTBOARD. (FORWARD STATIONS ONLY)	35					
	36					
REFER TO NOTES AT SHEET 3	37					

Figure 5-3 (Sheet 2 of 3)

Approved Configurations (Key)

	MATRA		PM-3
	SIDEWINDER		RPK 10
	MK26 TARGET ROCKET		MK82 HIGH OR LOW DRAG BOMB
	AN/ALE-32		110 GAL TANK/UNLOADED RPK10
	AN/ALQ-72		286 GAL TANK 286 GAL PANNIER [D] 242 GAL TANK
	SUU-20A/A		
L	SUU-11B/A GUNPOD/LUNEBERG LENS	WT	110, 286, 374 GAL TANKS OR UNLOADED RPK10
	GBU-12 LGB	T	HIPATS-1 AERIAL TARGET

NOTES

1. Take-off is permitted with a store on only one outboard wing station.
2. Wing tank configuration only is acceptable for Mirage PR flights - centre-line tanks cannot be used.
3. With bombs on the outboard stations of RPK10, S.W., launcher rails or pylons are not to be fitted.
4. Refer to DI(AF) AAP 7213.003-5, Mirage IIIO and IIID Loading and Balance Summary, Figure 1-2 to calculate the fuel state where the limit of 47.5% MAC is exceeded.
5. All configurations can include a full GP, an empty GP or a GBT.
6. Partial down-load of stores on the outboard wing and centreline stations are approved.
7. If only one bomb is carried on the PM-3, it is mounted on the front station (except for configurations 25 and 27).
8. If one bomb is carried on each RPK10, it is mounted on the front outboard station.
9. Supervisors are to ensure that the max AUW of 27 500 lb is not exceeded.
10. The clearance to operate in these configurations is conditional upon the carriage, release and jettison envelopes.
11. In some configurations, if a MK82 bomb is hung up on the front station of the PM-3 or RPK10, and fuel or rounds remain in the GB position, the forward CG limit of 47.5% MAC can be exceeded.
12. The mirror image to configuration 34 is not approved.

[D] 13. With 286 gal tanks and the SUU-11B/A or the SUU-20A/A on the rear station of the PM-3, a full gun-bay tank or a gun pack with 120+ rounds and a rear seat passenger must be carried to avoid exceeding the rear CG limit during take-off.

14. When carrying a mixed load of BDU-33 HD and LD practice bombs on the SUU-20A/A, the pilot is to ensure that all the HD bombs are released before the release of an LD bomb.
15. When carrying HIPATS the approved configurations can include a radar nose cone, a dummy nose cone or a PR nose cone.
16. Whilst carrying HIPATS the Mirage IIID need not have the rear seat occupied.
17. HIPATS-1 is to be loaded to the rear station of the PM3 Bomb Beam.

Figure 5-3 (Sheet 3 of 3)

If the configuration and fuel state indicates the forward CG is exceeded :

a. Use a maximum of 40° angle of bank in the circuit.

b. Approach to land at not less than 185 KIAS and avoid a steep approach.

c. Touch down at not less than 170 KIAS.

Note

- Landing with fuel remaining above 250 gal avoids exceeding CG limits, regardless of configuration.
- When the CG is outside the forward limits, pitch control is reduced. In normal operations with bombs, handling difficulties are not significant.

MK82 LOW DRAG BOMBS ON PM-3

Carriage

When the MK82 low-drag bomb is carried on the PM-3, it is cleared for carriage as follows :

a. maximum speed - 600 KIAS/M0.95,

b. maximum altitude - 40 000 ft,

c. load factor - + 5.5 'g' to − 2.2 'g', and

d. two in tandem or one on the front station.

Release

When the MK82 low-drag bomb is carried on the PM-3, it is cleared for release as follows :

a. maximum speed - 550 KIAS/MO.95,

b. minimum altitude - that required for fuse arming and for safe aircraft/bomb separation (refer to Safe Escape Tables),

c. maximum altitude - 20 000 ft, and

d. maximum dive angle - 45°.

In order to ensure safe bomb separation from the aircraft, the following conditions must be observed :

a. The aircraft must be accelerating smoothly and linearly at the time of release and continue to accelerate for several seconds after bomb release.

b. 'g' at release is not to be less than zero.

Jettison

When the MK82 low-drag bomb is carried on the PM-3, it may be jettisoned as follows :

a. maximum speed - 550 KIAS/MO.95,

b. minimum altitude - minimum safe release height, and

c. maximum altitude - 20 000 ft.

MK82 LOW DRAG BOMB ON RPK10

Carriage

When the MK82 low-drag bomb is carried on the RPK10, it is cleared for carriage as follows :

a. maximum speed - 600 KIAS/MO.95,

b. maximum altitude - 40 000 ft,

c. load factor :

(1) symmetric - + 4.5 'g' to − 2.2 'g', and

(2) asymmetric - + 3.0 'g' (rolling pull-out at 100°/sec),

d. maximum roll rate - 150°/sec, ½ aileron deflection,

e. two on front outboard stations or four (two pairs in tandem) on outboard stations.

Release

When the MK82 low-drag bomb is carried on the RPK10, it is cleared for release as follows :

a. speed - 300 KIAS to 550 KIAS/M0.95,

b. minimum altitude - that required for fuse arming and for safe aircraft/bomb separation,

c. maximum altitude - 20 000 ft,

d. load factor - + 0.5 'g' to + 3.0 'g',

e. roll rate - as close to zero as possible,

f. pitch attitude - 10° nose-up to 45° nose-down, and

g. speed brakes - extended or retracted, but not selected immediately before or after release.

Jettison

When the MK82 low-drag bomb is carried on the RPK10, it may be jettisoned as follows :

a. maximum speed - 550 KIAS/M0.9,

b. minimum altitude - minimum safe release height,

c. maximum altitude - 20 000 ft,

d. load factor - + 0.5 'g' to + 3.0 'g',

e. roll rate - as close to zero as possible, and

f. pitch attitude - 10° nose down to 10° nose up.

MK82 HIGH DRAG BOMB ON PM-3

Carriage

When the MK82 high-drag bomb is carried on the PM-3, it is cleared for carriage as follows :

a. maximum speed - 600 KIAS/MO.95,

b. maximum altitude - 40 000 ft,

c. load factor - + 5.5 'g' to − 2.2 'g'.

Release

When the MK82 high-drag bomb is carried on the PM-3, it is cleared for release as follows :

a. speed - 350 to 500 KIAS,

b. altitude - 100 ft AGL to 10 000 ft,

c. pitch attitude - level to 30° nose-down,

d. load factor - zero 'g' to + 1 'g'.

Jettison

When the MK82 high-drag bomb is carried on the PM-3, it may be jettisoned as follows :

a. speed - 300 KIAS to 550 KIAS,

b. maximum altitude - 40 000 ft,

c. pitch attitude - level flight, and

d. load factor - zero 'g' to + 1 'g'.

MK82 HIGH DRAG BOMB ON RPK10

Carriage

When the MK82 high-drag bomb is carried on the RPK10, it is cleared for carriage as follows :

a. maximum speed - 600 KIAS/M0.95,

b. maximum altitude - 40 000 ft, and

c. load factor :

(1) symmetric - + 4.5 'g' to − 2.2 'g',

(2) asymmetric - + 3.0 'g'.

Release

When the MK82 high-drag bomb is carried on the RPK10, it is cleared for release as follows :

a. speed - 380 to 500 KIAS,

b. altitude - 100 ft AGL to 10 000 ft,

c. pitch attitude - level to 30° nose down, and

d. load factor - zero 'g' to + 1 'g'.

Jettison

When the MK82 high-drag bomb is carried on the RPK10, it may be jettisoned as follows :

a. speed - 300 KIAS to 550 KIAS,

b. maximum altitude - 40 000 ft,

c. pitch attitude - level flight, and

d. load factor - + 1 'g'.

GBU-12 LASER GUIDED BOMB ON PM-3

Carriage

When the GBU-12 laser guided bomb is carried on the PM-3, it is cleared for carriage as follows :

a. maximum speed - 600 KIAS/M0.95,

b. maximum altitude - 40 000 ft,

c. load factor - + 5.5 'g' to − 2.2 'g', and

d. one on the rear station only.

RAAF SUPPLEMENT NO 76

RELEASE OF MK 82 AND LGB's FROM RPK-10

Instructions

This supplement is to be inserted facing page 5-12.

Action

Read the following in lieu of the data on pages 5-12 and 5-13.

For MK 82 Low Drag Bombs and GBU-12 Laser Guided Bombs on RPK-10:

Release Pitch Attitude - 45° Nose-up to 45° Nose-down.

Date: November 1986

Release

When the GBU-12 laser guided bomb is carried on the PM-3, it is cleared for release as follows :

a. speed - 300 KIAS to 500 KIAS/M0.95,

b. minimum altitude - that required for fuse arming and for safe aircraft/bomb separation,

c. maximum altitude - 20 000 ft, and

d. pitch attitude - 45° nose down to 30° nose up.

In order to ensure safe bomb separation from the aircraft, the following conditions must be observed :

a. The aircraft must be accelerating smoothly and linearly at the time of release and continue to accelerate for several seconds after bomb release.

b. load factor - + 0.5 'g' to + 2.0 'g'.

Jettison

When the GBU-12 laser guided bomb is carried on the PM-3, it may be jettisoned as follows :

a. speed 300 KIAS to 550 KIAS/M0.95.

b. minimum altitude - minimum safe release height,

c. pitch attitude - 30° nose-up to 45° nose-down, and

d. maximum altitude - 20 000 ft.

GBU-12 LASER GUIDED BOMB ON RPK10

Carriage

When the GBU-12 laser guided bomb is carried on the RPK10, it is cleared for carriage as follows :

a. maximum speed - 600 KIAS/M0.95,

b. maximum altitude - 40 000 ft,

c. load factor :

(1) symmetric - + 4.5 'g' to − 2.2 'g', and

(2) asymmetric - +3.0 'g' (rolling pull-out at 150°/sec),

d. maximum roll rate - 150°/sec, ½ aileron deflection, and

e. two on front outboard stations only.

Release

When the GBU-12 laser guided bomb is carried on the RPK10, it is cleared for release as follows :

a. speed - 300 KIAS to 550 KIAS/M0.95,

b. minimum altitude - that required for fuse arming and for safe aircraft/bomb separation,

c. maximum altitude - 20 000 ft,

d. load factor - + 0.5 'g' to + 2.0 'g',

e. roll rate - as close to zero as possible,

f. pitch attitude - 30° nose-up to 45° nose-down, and

g. speed brakes - extended or retracted, but not selected immediately before or after release.

Jettison

When the GBU-12 laser guided bomb is carried on the RPK10, it may be jettisoned as follows :

a. speed - 300 KIAS to 550 KIAS/M0.9,

b. minimum altitude - minimum safe release height,

c. maximum altitude - 20 000 ft,

d. load factor - + 0.5 'g' to + 2.0 'g',

e. roll rate - as close to zero as possible, and

f. pitch attitude - 10° nose-down to 10° nose-up.

BDU-33 ON SUU-20A/A

Approved Configurations

The approved configurations for carriage and release of BDU-33 practice bombs from the SUU-20A/A dispenser are shown in Fig 5-3.

Carriage

The SUU-20A/A practice bomb dispenser is cleared for carriage as follows :

a. on the rear station of the PM-3 bomb beam only,

b. from sea level to 40 000 ft,

c. up to 650 KIAS/M1.2, and

d. load factor - from zero 'g' to + 6.7 'g'.

Release

Height, speed, dive angles and release mode limitations for release of the BDU-33C/B (AUST) high and low drag practice bombs from the SUU-20A/A dispenser are as follows :

a. High drag practice bomb :

(1) mode - single or ripple,

(2) altitude - 200 ft AGL to 5000 ft,

(3) speed - 350 KIAS to 500 KIAS/M0.82,

(4) dive angle - 20° maximum, and

(5) load factor - + 0.5 'g' to + 1.5 'g'.

b. Low drag practice bomb :

(1) mode - single or ripple,

(2) altitude - 200 ft AGL to 15 000 ft,

(3) speed - 350 KIAS to 500 KIAS/M0.95,

(4) dive angle - 45° maximum, and

(5) load factor - + 0.5 'g' to + 1.5 'g'.

Note

Bombs cannot be released SAFE.

Jettison

A separate dispenser or bomb jettison facility is not available. However, if jettison of bombs is required, it can be accomplished by employing normal release procedures up to 40 000 ft.

AN/ALQ-72 ECM POD

Carriage

The AN/ALQ-72 carriage limitations are :

a. maximum speed — 600 KIAS/M1.5,

b. maximum altitude - 50 000 ft,

c. load factor - + 6.0 to − 2.7 'g', and

d. maximum roll rate - 180° per sec - ½ aileron deflection.

AN/ALE-32 CHAFF DISPENSER

Carriage

The carriage limitations are :

a. maximum altitude - 50 000 ft,

b. maximum speed - 750 KIAS/M1.9,

c. load factor - + 6.7 to − 3.5 'g', and

d. maximum roll rate - 180° per sec - ½ aileron deflection.

Dispensing Limitations

The limitations during dispensing from the AN/ALE-32 are :

a. maximum speed - 525 KIAS/M1.5,

b. minimum speed - 320 KIAS/M0.9,

CAUTION

At speeds less than 320 KIAS/M0.9, chaff and packet debris may strike the undersurface of the pod or wing.

Note

At speeds greater than 400 KIAS/M1.2, slight to moderate airframe buffet occurs.

c. maximum altitude - 50 000 ft, and

d. load factor - zero 'g' to + 3.7 'g'.

HIGH PERFORMANCE AERIAL TARGET SYSTEM STAGE 1 (HIPATS-1)

Carriage

The carriage limitations for the target stowed or the canister empty are:

a. maximum speed—500 KIAS/MO.9.

b. load factors:

(1) tanks feeding (286 gal):

+4.5 'g' to −1.0 'g' (symmetrical)
+4.0 'g' to −0.7 'g' (asymmetrical)

(2) tanks feeding (110 gal):

+5.5 'g' to −1.0 'g' (symmetrical)
+4.0 'g' to −0.7 'g' (asymmetrical)

(3) tanks empty:

+6.0 'g' to −1.0 'g' (symmetrical)
+4.0 'g' to −0.7 'g' (asymmetrical)

c. maximum subsonic roll rate (tanks feeding)—+150° per second.

d. roll rate—½ aileron deflection at maximum indicated IAS.

e. maximum altitude—40 000 ft.

f. maximum incidence—red illumination.

Target Launch

The launch limitations are:

a. maximum speed—220 KIAS.

b. altitude—2000 to 20 000 ft.

c. attitude—straight and level (+1.0 'g').

Target Tow

The target tow limitations are:

a. speed—200 to 350 KIAS/MO.83.

b. maximum load factors: +3.0 'g' to 0 'g' (symmetrical).

c. maximum altitude—30 000 ft.

d. turn reversal—½ aileron deflection (max).

e. attitude—±20° pitch.

f. maximum incidence—red illumination.

g. maximum engine power—full dry.

Note

The most restrictive limitation applying either to HIPATS-1 or 286 gal tanks must be used.

Target Release/Jettison

The release/jettison limitations are:

a. maximum speed—220 KIAS.

b. attitude—straight and level flight (+1.0 'g').

c. minimum altitude—300 ft AGL.

Note

The HIPATS-1 canister cannot be jettisoned.

SUU-11B/A GUNPOD WITH LUNEBERG LENS

Carriage

The SUU-11B/A Gunpod carriage limitations are :

a. maximum speed—450 KIAS/MO.95,

b. maximum altitude—40 000 ft,

c. load factor—+5.0 'g' to 0 'g', and

d. maximum roll rate—300° per sec—2/3 aileron deflection.

External Stores Limitations

THE FOLLOWING NOTES ARE READ IN CONJUNCTION WITH SHEETS 2, 3 AND 4 OF FIG FO 5-1

NOTES:

1. When more than one store is carried, the limitation is derived from the store with the lowest limitation.
2. The limit in supersonic flight, in all configurations, is 150°/sec provided that load factor is within zero 'g' and +2.0.
3. Sustained speed above 550 KIAS should be restricted to operational necessity.
4. Tank Jettison Envelope is:
   a. Full. Straight and level, speed 250 KIAS.
   b. Part Empty.
      (1) Stabilized climb, 300 to 450 KIAS, 0.85 IMN, climb angle +5° to +10°.
      (2) Level flight — initiate climb and hold for 30 seconds minimum.
      (3) Descending flight — initiate climb and hold for > one minute.
   c. Empty. Straight and level, speed 300 to 500 KIAS, < 0.9 IMN.
5. Before jettisoning, the speed brakes are to be retracted and, if practicable, the undercarriage should also be retracted.
6. If in an emergency the conditions outlined in Note 4 cannot be met, pilots should be aware that tank behaviour after jettison is unknown and airframe damage may result.
7. Ground attack manoeuvres, eg dive bombing and strafing, are permitted while fuel remains in 110 and 286 gal tanks only.
   [D] The above also applies to 242 gal tanks.
8. When recovering from dive attacks with part empty fuel tanks, the 'g' aimed for during recovery from dives should be 0.5 'g' lower than the limits quoted.
9. Firing is permitted throughout the carriage envelope with the probability of success dependent upon target performance and basic weapon limitation.
10. The Sidewinder can be fired SAFE throughout the carriage envelope by pressing the WING jettison button.
11. Minimum height of release is determined by the fuse arming time and/or aircraft safe escape from the bomb fragmentation envelope.
12. The SUU-20A/A dispenser and/or BDU-33 bombs cannot be jettisoned and the bombs cannot be released safe.
    [D] When carrying 286 gal tanks with the SUU-20A/A, a full gun-bay tank or a gun pack with 120 + rounds and a rear seat passenger must be carried to avoid exceeding the rear CG limit during take-off.
13. MK82 bombs should normally be jettisoned within the IAS envelope as shown with the aircraft in level unaccelerated flight, speedbrakes in and undercarriage up. In an emergency however, the bombs can be jettisoned within the carriage envelope Jettison of MK82 HE bombs below the minimum safe release height should be avoided if practicable.
14. Additional limitations are :
    a. Speed. Dispensing speed preferably between 320 KIAS/0.9 IMN and 400 KIAS/1.2 IMN. Above 400 KIAS/1.2 IMN slight to moderate buffeting of the aircraft will occur. At speeds below 320 KIAS/0.9 IMN, chaff and open packages may strike the under surface of the pod, wing or elevon.
    b. Fuel Handling. The crossfeed switch must be ON until fuel is exhausted from the right 110 gal tank.
    c. Take-off Trim Setting. Pitch and rudder trim are set normally while the roll trim is set to the initial illumination of the left roll light.
15. When the ECM pod is operating, the radar must be switched to STND-BY and vice versa.
16. When only one bomb is carried, it is carried on the front station.
17. When only two bombs are carried, they are carried on the front stations.
18. The SUU-11B/A Gunpod Luneberg lens cannot be jettisoned or released.
    [D] When carrying 286 gal tanks with the SUU-11B/A, a full gun-bay tank and a rear seat passenger must be carried to avoid exceeding the rear CG limit during take-off.

FIGURE FO 5-1 (Sheet 1 of 4)

External Stores Limitations

FOR KEY TO SYMBOLS REFER TO FIG 5-3 (SHEET 2)

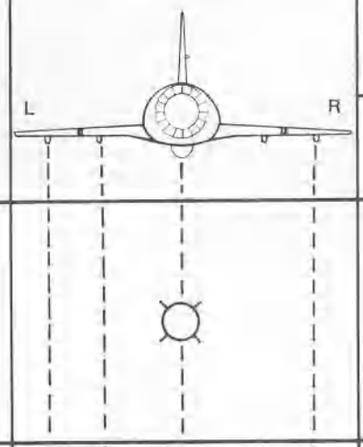
STORE	SUSPENSION	STATION LOADING (1)	CARRIAGE							RELEASE								JETTISON			INCIDENCE LIMITS	NOTES
			SPEED		ACCEL 'g'		MAX SUBSONIC ROLL RATE (°/sec) (2)	AILERON DEFLECT	MAX ALTITUDE	ACCEL 'g'		KIAS		IMN		ALTITUDE		KIAS		IMN		
			KIAS	IMN	SYM	ASYMM				MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MAX		
MATRA R530K AND MATRA R530KE	MATRA LAUNCHER TYPE 14		750	2.0	+6.7 -3.5	+5.0 0.0	300	$\frac{2}{3}$	75 000	+0.2	+2.0	300	700	0.8	2.0	3000	60 000	250	250	—	AMBER EXTINCTION	(9)
SIDEWINDER 1A (OPERATIONAL OR TRAINING)	AERO 3B LAUNCHER		730	2.0	+6.7 -3.5	+5.0 0.0	S.W. ON BOTH OUTBOARD WING STATIONS: 300	$\frac{2}{3}$	60 000	0.0	+4.0	270	700	0.9	1.7	7000	55 000	—	(10)	—	AMBER EXTINCTION	(10)
							SINGLE S.W. ON EITHER OUTBOARD STATION: 180	$\frac{1}{2}$														
MK26 MOD O TARGET ROCKET	AERO 3B LAUNCHER		730	2.0	+6.7 -3.5	+5.0 0.0	300	$\frac{2}{3}$	60 000	+0.2	+2.0	270	700	0.9	1.7	7000	55 000	140	700		AMBER EXTINCTION	
AN/ALE-32 CHAFF DISPENSER	PYLON		750	1.9	+6.7 -3.5	+5.0 0.0	180	$\frac{2}{3}$	50 000	0.0	+3.7	320	525	0.9	1.5	SEA LEVEL	50 000	N/A	N/A	N/A	RED ILLUMINATION	(14)
AN/ALQ-72 ECM POD	PM-3 BOMB BEAM (FRONT STATION)		600	1.5	+6.0 -2.7	+5.0 0.0	180	$\frac{1}{2}$	50 000	AS FOR CARRIAGE		320	600	0.9	1.5	SEA LEVEL	50 000	N/A	N/A	N/A	RED ILLUMINATION	(15)

Figure FO5-1 (Sheet 2 of 6)

External Stores Limitations

FOR KEY TO SYMBOLS REFER TO FIG 5-3 (SHEET 2)

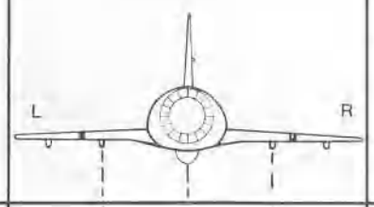
STORE	SUSPENSION	STATION LOADING (1)	TANK CONTENTS	CARRIAGE							JETTISON			INCIDENCE LIMITS	NOTES
				SPEED		ACCEL 'g'		MAX SUBSONIC ROLL RATE (°/SEC)	AILERON DEFLECT	MAX ALTITUDE	KIAS		IMN		
				K KIAS	IMN	SYM	ASYMM				MIN	MAX	MAX		
110 GAL FUEL TANK	PYLON (NON-JETTISONABLE)		EMPTY	750	1.9	+6.7 -3.5	+5.0 0.0	180	1/2	60 000	N/A	N/A	N/A	AMBER EXTINCTION	
			FULL OR PART EMPTY	750	1.9	+5.5 -2.7	+5.0 0.0	180	1/2	60 000	N/A	N/A	N/A	AMBER EXTINCTION	
RPK10 TANK/BOMB CARRIER UNLOADED	PYLON		EMPTY	650	1.5	+6.7 −3.5	+5.0 0.0	180	1/2	55 000				RED ILLUMINATION	
			FULL OR PART EMPTY	650	1.5	+5.5 −2.7	+5.0 0.0	180	1/2	55 000				RED ILLUMINATION	
286 GAL FUEL TANK	PYLON	OR	EMPTY	600	1.2	+6.0 -3.0	+4.5 0.0	200	1/2	45 000		(4)		RED ILLUMINATION	(3) (4) (5) (6) (8)
			FULL OR PART EMPTY	600	1.2	+4.5 -2.2	+3.5 0.0	150	1/2	40 000		(4)		RED ILLUMINATION	(3) (4) (5) (6) (8)
286 GAL PANNIER	PYLON		FULL, PART EMPTY OR EMPTY	600	1.2	+4.5 -2.2	+3.5 0.0	150	1/3	40 000		(4)		RED ILLUMINATION	(3) (4) (5) (6) (8)
374 GAL FUEL TANK	PYLON		EMPTY	550	0.95	+5.5 -2.2	+4.0 0.0	180	1/2	40 000		(4)		RED ILLUMINATION	(4) (5) (6) (7)
			FULL OR PART EMPTY	550	0.95	3.7 -1.75	+3.0 0.0	120	1/3	40 000		(4)		RED ILLUMINATION	(4) (5) (6) (7)

Figure FO5-1 (Sheet 3 of 6)

External Stores Limitations

FOR KEY TO SYMBOLS REFER TO FIG 5-3 (SHEET 2)

STORE	SUSPENSION	STATION LOADING (1) 	CARRIAGE							RELEASE								JETTISON								INCIDENCE LIMITS	NOTES
			SPEED		'g'		MAX SUBSONIC ROLL RATE (°/sec) (2)	AILERON DEFLECT	MAX ALTITUDE	'g'		KIAS		IMN	MAX DIVE ANGLE	ALTITUDE		KIAS		IMN	ALTITUDE		'g'			
			KIAS	IMN	SYM	ASYMM				MIN	MAX	MIN	MAX	MAX		MIN	MAX	MIN	MAX	MAX	MIN	MAX	MIN	MAX		
SUU-20A/A BOMB DISPENSER	PM-3 BOMB BEAM (REAR STATION)		650	1.2	+6.7 0.0	+4.0 0.0	N/A	N/A	40 000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	RED ILLUMINATION	(12)
SUU-20 A/A BOMB DISPENSER WITH BDU-33 BOMBS (LOW DRAG)	PM-3 BOMB BEAM (REAR STATION)		550	0.95	+6.0 0.0	+4.0	N/A	$\frac{1}{2}$	40 000	+0.5	+1.5	350	500	0.95	0 to −45°	200	15 000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	RED ILLUMINATION	(12)
SUU-20 A/A BOMB DISPENSER WITH BDU-33 BOMBS (HIGH DRAG)	PM-3 BOMB BEAM (REAR STATION)		550	0.95	+6.0 0.0	+4.0	N/A	$\frac{1}{2}$	40 000	+0.5	+1.5	350	500	0.82	0 to −20°	200	5000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	RED ILLUMINATION	(12)

Figure FO5-1 (Sheet 4 of 6)

RAAF SUPPLEMENT NO 77

RELEASE OF MK 82 AND LGB's FROM RPK-10

Instructions

This supplement is to be inserted facing page F05-1E.

Action

In Figure F05-1 Sheet 5 against MK 82 Low Drag Bombs on RPK-10 Carrier, read the following under MAX DIVE ANGLE:

MAX DIVE ANGLE + 45° to - 45°

Date: November 1986

External Stores Limitations

FOR KEY TO SYMBOLS REFER TO FIG 5-3 (SHEET 2)

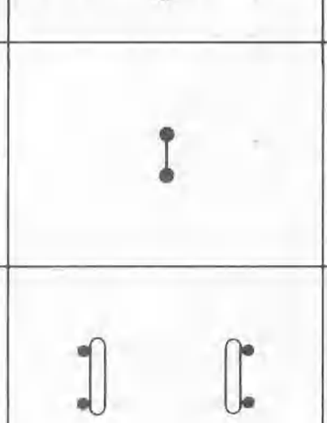
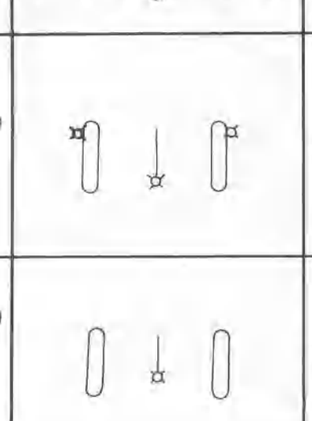
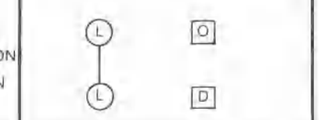
STORE	SUSPENSION	STATION LOADING (1)	CARRIAGE							RELEASE								JETTISON							INCIDENCE LIMITS	NOTES
			SPEED		'g'		MAX SUBSONIC ROLL RATE (°/sec) (2)	AILERON DEFLECT	MAX ALTITUDE	'g'		KIAS		IMN	MAX DIVE ANGLE	ALTITUDE		KIAS		IMN	ALTITUDE		'g'			
			KIAS	IMN	SYM	ASYMM				MIN	MAX	MIN	MAX	MAX		MIN	MAX	MIN	MAX	MAX	MIN	MAX	MIN	MAX		
MK82 BOMBS HE, HES, LCPB LOW-DRAG	PM-3 BOMB BEAM		600	0.95	+5.5 −2.2	+4.0 0.0	100	1/2	40 000	0	+1.0	0	550	0.95	0 to −45°	(11)	20 000	—	550	0.95	(11)	20 000	—	—	RED ILLUMINATION	(11) (13) (16)
	RPK10 TANK/BOMB CARRIER		600	0.95	+4.5 −2.2	+3.0 0.0	150	1/2	40 000	0.5	+3.0	300	550	0.95	+10 to −45°	(11)	20 000	—	550	0.9	(11)	20 000	+0.5	+3.0	RED ILLUMINATION	(11) (13) (17)
MK82 BOMBS HE, HES, LCPB. HIGH-DRAG	PM-3 BOMB BEAM		600	0.95	+5.5 −2.2	+4.0 0.0	—	1/2	40 000	0	+1.0	350	500	—	0 to −30°	100	10 000	300	550	0.95	(11)	40 000	+0	+1.0	RED ILLUMINATION	(11) (13) (16)
	RPK10 TANK/BOMB CARRIER		600	0.95	+4.5 −2.2	+3.0 0.0	—	—	40 000	0	+1.0	380	500	—	0 to −30°	100	10 000	300	550	—	(11)	40 000	—	+1.0	RED ILLUMINATION	(11) (13)

Figure FO5-1 (Sheet 5 of 6)

External Stores Limitations

FOR KEY TO SYMBOLS REFER TO FIG 5-3 (SHEET 2)

STORE	SUSPENSION	STATION LOADING (1)	CARRIAGE							RELEASE						JETTISON								INCIDENCE LIMITS	NOTES
			SPEED		'g'		MAX SUBSONIC ROLL RATE (°/sec) (2)	AILERON DEFLECT	MAX ALTITUDE	KIAS			IMN	MAX DIVE ANGLE	ALTITUDE		KIAS		IMN	ALTITUDE		'g'			
			KIAS	IMN	SYM	ASYMM				MIN		MAX	MAX		MIN	MAX	MIN	MAX	MAX	MIN	MAX	MIN	MAX		
GBU-12C/B LASER GUIDED BOMBS	PM-3 BOMB BEAM AND RPK10 TANK/BOMB CARRIER		600	0.95	+4.5 −2.2	+3.0 0.0	150	1/2	40 000	+0.5		550	0.95	+45° to −45°	(11)	20 000	300	550	0.95	(11)	20 000	+0.5	+2.0	RED ILLUMINATION	(11) (13)
	PM-3 BOMB BEAM AND RPK10 TANK/BOMB CARRIER		600	0.95	+5.5 −2.2	+4.0 0.0	150	1/2	40 000	+0.5		550	0.95	+45° to −45°	(11)	20 000	300	550	0.95	(11)	20 000	+0.5	+2.0	RED ILLUMINATION	(11) (13)
SUU-11B/A GUNPOD LUNEBERG LENS	PM-3 BOMB BEAM O FRONT STATION D REAR STATION		450	0.95	+5.0 −1.0	N/A	300	2/3	40 000	N/A		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	RED ILLUMINATION	18

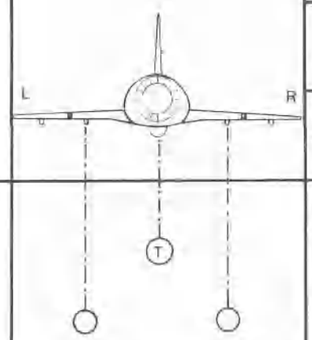
			CARRIAGE (TARGET STOWED OR CANISTER EMPTY)							ICH			CARRIAGE (TARGET DEPLOYED)					NORMAL OR EMERGENCY RELEASE						
			SPEED		'g'		MAX SUBSONIC ROLL RATE	AILERON DEFLECT	MAX ALTITUDE	SPEED	ALTITUDE		SPEED		'g'	AILERON DEFLECT	MAX ALTITUDE	ATTITUDE		SPEED	'g'	ALTITUDE		
			KIAS	IMN	SYM	ASYMM				KIAS	MIN	MAX	KIAS	IMN	SYM			MIN	MAX	KIAS	SYM			
HIPATS-1 TARGET SYSTEM	PM-3 BOMB BEAM		500	0.9	+6.0 −1.0	+4.0 −0.7	180	1/2	40 000	220	000	20 000	200 350	0.83	+3.0 0.0	1/2	30 000	−20°	+20°	220	+1.0	700	RED ILLUMINATION	

Figure FO5-1 (Sheet 6 of 6)

SECTION 6
FLIGHT CHARACTERISTICS

SECTION 6

FLIGHT CHARACTERISTICS

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SECTION 6

FLIGHT CHARACTERISTICS

The information contained in this section concerning Loss of Control and Spins of clean and supersonic tank configured Mirage III O/D aircraft is based on flight test results and a comparison of practical experience with Mirage IIIC and IIIE characteristics. It is necessary to emphasize that not all the following characteristics will be observed at one time, nor will the Mirage III O/D necessarily exhibit identical behaviour to other Mirage III variants.

Deliberate loss of control or spinning manoeuvres are prohibited and the following information is provided to promote a full understanding of the aircraft's flight characteristics and the recommended recovery techniques. Aircraft behaviour with external stores is based on model studies and a comparison with Mirage IIIC characteristics.

HIGH INCIDENCE HANDLING

Unaccelerated Flight

The Mirage III does not exhibit the classical stall behaviour of conventional straight winged aircraft. In level flight, slight airframe buffet becomes noticeable as the airspeed is reduced below 220 KIAS (amber incidence). As the airspeed is reduced further, the buffet remains nearly constant and the incidence increases up to and beyond the approved limit. Overall drag increases and, at a constant power setting, the aircraft enters a high rate of descent with little change initially in attitude but progressively increasing incidence. Recovery from this condition is easily achieved by applying forward stick and/or by applying full power. Height loss during the recovery can be in the order of thousands of feet if at high altitude, or hundreds of feet if at low altitude.

The flying controls remain effective throughout the deceleration. As incidence is increased near to and beyond the limit, application of lateral stick deflection produces an aircraft reaction known as adverse yaw ie, a tendency for the aircraft to yaw in the direction opposite to that of the intended turn. The amount of adverse yaw experienced increases in proportion to the aircraft incidence and the rate of lateral stick input. Balanced flight at high angles of incidence is desirable both to reduce aerodynamic drag and hence increase performance, and to prevent engine compressor stalls due to engine intake blanking. Adverse yaw is easily controlled with co-ordinated application of rudder in the direction of the intended turn. In unaccelerated flight, aircraft handling remains predictable up to the incidence limits and beyond, provided control inputs are smooth and co-ordinated for balanced flight.

CAUTION

At speeds greater than 350 KIAS to 400 KIAS the aircraft 'g' limits are reached before incidence limits are exceeded (refer to Section 5 for 'g' limits).

WARNING

Manoeuvring beyond the approved incidence limits may result in loss of control of the aircraft.

CAUTION

[D] The Mirage IIID is more prone to departure and loss of control at high incidence than is the IIIO.

LOSS OF CONTROL

Most cases of loss of control of the aircraft are likely to occur under dynamic flight conditions when the pilot is under a heavy workload eg, during Air Combat Tactics. The onset of loss of control can be so rapid that the warning signs may not be apparent or, if present, may not be observed by the pilot, regardless of his experience on type.

The following description of aircraft behaviour at loss of control is divided into three groups depending on whether the aircraft is pitching and yawing (level turn), pitching, yawing and rolling (turn reversal) or only pitching (pulling out of a dive). It is important to recognize that loss of control may be experienced without any of the following clinical warning signs, or with a combination of two or more signs, depending on variables such as rate of pitch, roll or yaw, sideslip angle and aircraft configuration.

Loss of Control in a Level Turn

In a steady turn, between 200 KIAS to 300 KIAS, pitch-rate is increased by rearward movement of the control column. As the incidence limit is exceeded, the aircraft refuses to turn (yaw) in the intended direction and tends to pitch up. The aircraft recovers immediately at this point if the control column is moved centrally forwards to reduce the incidence to within limits.

If backstick is maintained or increased beyond the point of pitch up, the aircraft yaws out-of-turn in a fan-shaped manoeuvre and the airspeed decreases rapidly. If the pilot then attempts to correct this manoeuvre by applying roll control opposite to the direction of yaw, a relatively flat, pitch oscillatory spin normally develops but other spins can occur (see Spins).

Loss of Control in Turn Reversal

Loss of control can occur during a turn at low speed (150 KIAS to 250 KIAS) when too much lateral control is applied in an attempt to rapidly effect a turn reversal ie, insufficient or no rudder is applied to balance the turn. The aircraft yaws and rolls

Adverse Yaw

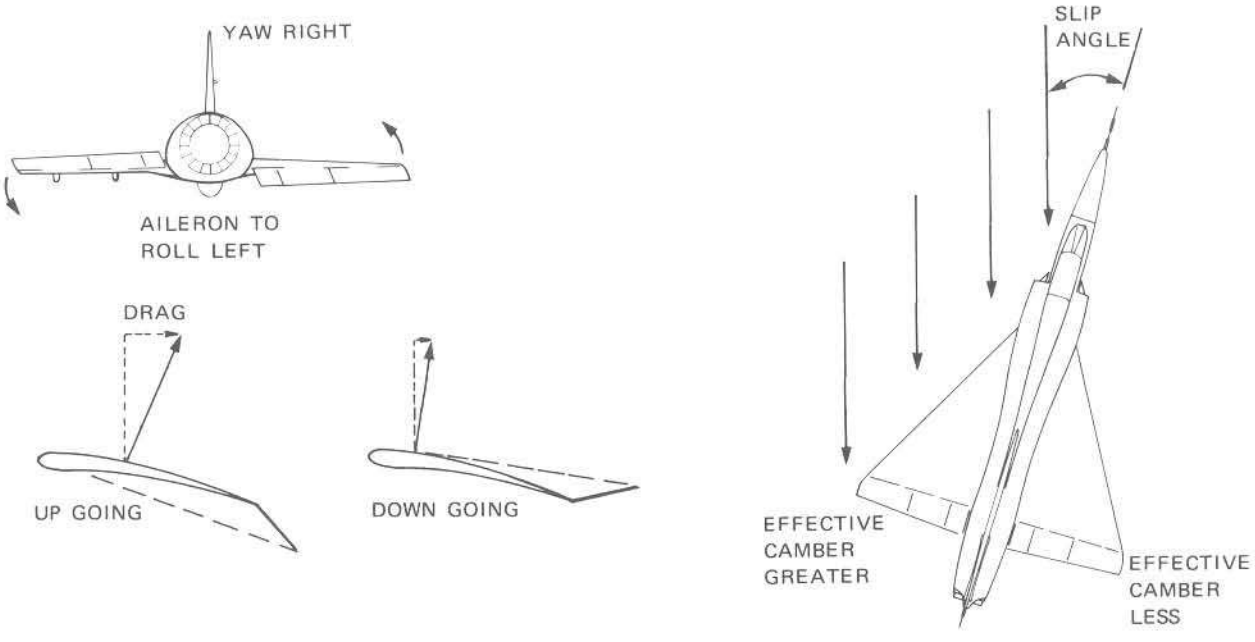


Figure 6-1

under to a nose low attitude in the opposite direction of the intended reversal. If the controls are centralised immediately as the aircraft begins to yaw, recovery occurs after about one turn with the aircraft in a nose low attitude. A nose low, conventional spin normally develops if the controls are not centred.

Loss of Control During a Wings Level Pull-out

If the aircraft is not balanced, the onset of loss of control during a wings level pull-out in which the incidence limit is exceeded is marked by wing rock, a reduction in pitch rate, and the nose swinging laterally. In balanced flight during the same manoeuvre, there may be insufficient warning to prevent the nose from pitching up uncontrollably. Loss of control may be prevented if forward stick is applied immediately the initial symptoms are noticed. However, onset of pitch-up may be so rapid (depending on preceding pitch rate), that the imminent loss of control cannot be anticipated. Airspeed drops rapidly as the nose pitches up and a flat spin will most likely develop, although other spins can occur.

Recovery from Loss of Control

In all cases of loss of control the aircraft recovers if the controls are centralised quickly. Loss of control may be avoided if back pressure on the control column is relaxed when initial symptoms (adverse yaw, wing rock) appear. A spin almost certainly develops if lateral stick is applied in an attempt to recover the aircraft at the point of loss of control, or if spin recovery action (in-spin aileron) is applied prematurely after loss of control. Loss of control of the aircraft does not normally result in a spin if the stick is moved quickly forwards to neutral (abeam the spin recovery marks), and the ailerons and rudder are centralised simultaneously. However, recovery from loss of control is not always instantaneous and the aircraft may execute several oscillations in pitch, yaw and roll before recovery, with accelerations reaching −3 'g'. These pre-recovery gyrations are very disorientating and can be mistaken as a spin. If spin recovery controls are applied prematurely after loss of control, or if an attempt is made to prevent loss of control with aileron and back stick, a spin eventually develops. Complete recovery is always marked by a reduction in vibration and buffet, and by the speed increasing steadily above 200 KIAS.

WARNING

- Lateral control inputs at the point of control loss, or premature application of in-spin aileron after control loss may cause the aircraft to enter a spin.
- With autocommand engaged, a positive push-force is required to get the stick to the neutral position because of the autocommand automatic trim function. Even without autocommand engaged the pilot may have trimmed

nose-up and a positive effort must be made to push the stick forwards to neutral.

- The risk of an engine compressor stall or flame-out during loss of control is reduced if the throttle is immediately placed to idle.
- Altitude lost from the beginning of loss of control to the bottom of the pullout following recovery, can be of the order of 10 000 feet at 30 000 feet. Altitude loss is less at lower altitudes.
- Recovery is slower if the speed brakes are left extended.
- If the aircraft is out of control and descending through 10 000 ft AGL/AMSL, eject.

SPINS

The application of full back stick and full aileron in the opposite direction to the yaw induces a spin at the point of control loss. An unintentional spin is difficult to establish because of the conscious effort required to overcome the control forces at full stick deflection. The aircraft takes several turns to stabilize in a spin, depending on the attitude at entry in relation to the vertical axis. As described in the Loss of Control section the type of spin is mostly dependent on the manoeuvre performed immediately before loss of control is experienced. The three types of spins described in the following paragraphs have been observed in Mirage aircraft.

Conventional or Nose Low Spin

The conventional or nose low spin usually results from a brutally mishandled manoeuvre at low airspeed. Entry to the spin is characterized by relatively mild departure from controlled flight and the nose pitching well below the horizon as control is lost. The following characteristics are typical of the nose low spin :

a. the nose oscillates in pitch by $\pm 20°$ about a mean attitude of 45° below the horizon,

b. time per turn is relatively slow at 4 to 6 seconds,

c. pitch, roll and yaw oscillations are relatively gentle and cockpit instruments can be read easily,

d. altitude loss is 1500 feet to 2000 feet per turn,

e. the ASI reads zero, and

f. the aircraft recovers in two to three turns from the application of recovery controls in a near vertical attitude and negative 'g' is very noticeable.

Pitch Oscillatory Spin

The pitch oscillatory spin usually eventuates from a mishandled turn, when the aircraft performs an out of turn fan type manoeuvre. Entry into this spin is accelerated if the pilot attempts to counteract the initial yaw with aileron. The following characteristics are typical of the pitch oscillatory spin :

a. The nose oscillates in pitch $\pm 20°$ about a mean attitude of 10° to 20° below the horizon.

b. When the nose of the aircraft passes below the horizon, the pilot feels negative acceleration and roll movement in the opposite direction of the spin.

c. When the aircraft pitches up through the horizon, positive acceleration is felt, and the aircraft rolls in the direction of the spin.

d. Time per turn is three seconds and rate of yaw varies noticeably with the pitch oscillations. The change in rate of yaw is noticeable as lateral accelerations.

e. Altitude loss is 1000 feet to 2000 feet per turn.

f. The spin accelerates and tends to flatten out.

g. Recovery takes five to eight turns.

Flat Spin

The flat spin is the most stable and disorientating of the three spins; it normally results from loss of control during a wings level pull-out from a dive. The nose is near the horizon and oscillates $\pm 10°$ in pitch.

a. The pilot feels a strong forward longitudinal acceleration of up to 2 'g'.

b. Time per turn is two to three seconds.

c. Lateral airframe vibration is severe and instruments are difficult to read.

d. Height loss is about 1000 feet per turn.

e. Recovery takes more than six turns.

SPIN RECOVERY

The detailed spin recovery action is in Section 3. Centralizing the controls immediately loss of control is experienced will normally recover the aircraft before a stabilized spin condition is reached. If it is established that the aircraft has entered a stabilized spin (as described previously), the use of in-spin aileron effects a more rapid recovery. When the direction of spin is positively identified, full in-spin aileron should be applied and the position of the control column should be confirmed abeam the cockpit spin recovery marks ie, pitch neutral. The risk of engine compressor stall or flameout during a spin is high and the throttle should be moved to idle to reduce this possibility. If the speedbrakes are extended, recovery from the spin is prolonged. If applicable, the speedbrakes should be retracted at loss of control.

During spin recovery the rate of roll may increase. At the point of recovery, the aircraft exhibits characteristics similar to those described in the recovery from loss of control ie, oscillations in pitch, roll and yaw with up to -3 'g'. The increase in rate of roll can be misinterpreted as a continuation of the spin. Continued application of full in-spin aileron after recovery results in the aircraft rapidly entering a spiral dive. This is indicated by a high roll rate and a rapid increase in airspeed coupled with a corresponding loss of altitude. Complete recovery from either a loss of control condition, or a spin is indicated by a positive cessation of yaw and a steadily increasing IAS above 200 kn.

If a spin is entered, the height lost during recovery may be as little as 5000 feet to 10 000 feet at lower altitudes but height losses of up to 15 000 feet can occur.

WARNING

- During spin recovery, the rate of roll may increase and this may be misinterpreted by the pilot as a continuation of the spin. Cessation of yaw rotation and a steadily increasing airspeed is the only positive indication of recovery. The control column must be centralized in roll when the airspeed increases above 200 KIAS.
- Altitude lost from the point of control loss to the bottom of the pullout after spin recovery can be of the order of 15 000 feet.
- If the aircraft is not under control passing through 10 000 feet AGL/AMSL, eject.
- Intentional spinning is prohibited.

Identifying the Direction of Spin

With the gunsight in the Air-to-Air or Air-to-Ground (excluding NAV) positions, the direction of spin is determined from the relative position of the pipper to the fixed cross. If the fixed cross is to the left of the pipper, the aircraft is spinning to the left and in-spin aileron is applied to 'fly' the pipper to the fixed cross. The opposite applies for a right spin.

The Bezu can be used to identify the direction of spin. If the heading is increasing, the spin is to the right and vice versa. However, as indicated in the paragraphs detailing spin characteristics, aircraft vibration may make reading of the instruments difficult and the pilot may have to rely on external visual reference to identify the direction of spin.

Effect of External Stores on the Spin

External stores tend to have a stabilizing effect on the spin, driving the spin towards a flat fast spin. Therefore, if possible, external stores must be jettisoned to aid recovery. External stores such as Sidewinders and 110 gallon tanks prolong the recovery. Wind tunnel studies of spins with other than 110 gallon tanks indicate that the spin is very fast and that recovery may take more than 10 turns. When external stores are carried, high forward accelerations during spins may prevent successful ejection.

Effect of Autocommand

With autocommand engaged, the full aft travel of auto-trim corresponds to a trim position of the control column well aft of the normal trimmed position. If autocommand is in operation on entry to the spin, it should be disengaged. Positive effort may still be required to move the control column to the neutral position in pitch because of full aft trim.

Rudder Effectiveness

During the spin, the rudder is in an area of highly turbulent airflow and therefore is ineffective for producing anti-spin yawing moments. The use of rudder to effect a spin recovery is not recommended.

Neutral Control Position

The control column is in the neutral position when it is aligned with the centre of the radar scope and the yellow and black markings on the cockpit walls.

D The control column is in the neutral roll position when the centre of the control column is aligned with the left edge of the standby A/H.

Inverted Spins

Recovery action for an inverted spin is identical to the action taken for an upright spin.

EFFECTS OF EXTERNAL STORES

110 Gallon Tanks

With 110 gal tanks fitted, both smooth and violent spins may be encountered. The latter gradually become smooth as rotation increases. If stall recovery action is ineffective at the stall and a spin develops, the following action should be taken :

a. Determine the direction of yaw.

b. Apply full in-spin aileron with pitch to neutral. This procedure is effective provided it is applied continuously. The yawing rate decreases slowly and 15 to 20 seconds may elapse before yawing stops.

c. Return aileron to neutral when :

(1) yaw rotation stops positively; or

(2) spin direction is reversed; or

Note

These two occurrences may be preceeded by a sudden negative acceleration with the aircraft tending to enter a steep dive.

(3) the IAS increases above 200 kn; then

d. Recover from the nose low unusual attitude.

e. Restore normal engine operation.

Sidewinders

With Sidewinders fitted, the spin is slower than that encountered in the clean configuration and the nose down attitude is steeper. Spin recovery action is identical with that for a clean aircraft but recovery takes longer.

Other Underwing Stores

Wind tunnel observations of aircraft fitted with underwing stores, other than 110 gal tanks, indicate that spins are established very quickly, that the spins are very fast and that the aircraft may continue to spin for more than 10 turns before the recovery action of full in-spin aileron becomes effective. A forward acceleration of up to 6 'g' may be experienced and therefore correct recovery action is difficult to maintain. The chances of a successful ejection are

greatly diminished because canopy jettison and ejection seat gun behaviour is unreliable and the pilot's posture is unsuitable for ejection.

Spin Recovery with External Stores

Spin recovery action is as follows :

a. Jettison external stores.

b. Carry out the standard spin recovery action outlined for a clean aircraft; recovery time will probably be longer.

WARNING

It is most important that the incidence limits for the configuration are observed to avoid the possibility of an inadvertent spin.

INERTIA COUPLING

The Mirage is subject to inertia coupling in flight. At high rates of roll, divergence in pitch and yaw may occur, increasing rapidly after the initial onset. The roll rate at which this divergence occurs, ie the rate at which a steady rate of roll may diverge into pitch and yaw is termed the critical roll rate. Thus, when the TAS is sufficiently high for high rates of roll to be achieved, particularly in supersonic flight, it is necessary to restrict the rate of roll below the critical rate, restrict the incidence and restrict the angle

through which the roll is continued to prevent the onset of divergence. The following points also apply :

a. pitch divergence is more likely to occur at low subsonic Mach number and low IAS, whilst yaw divergence is mainly a feature of supersonic flight at high Mach number and high IAS;

b. aft movement of the CG decreases the critical roll rates; and

c. heavy underwing stores, such as full fuel tanks increase the yaw and pitch moments of inertia and significantly lower the critical roll rates.

WARNING

Limitations in roll, with and without load factor applied, must never be intentionally exceeded.

RECOVERY ACTION

If the rolling limitations are exceeded inadvertently and large fluctuations in 'g' and pitch or yaw are experienced, recovery action must be immediate. Recovery action is as follows :

a. neutralize the elevons in roll;

b. regain 1 'g' flight as soon as possible; and

c. if the aircraft is in a state of autorotation, apply opposite roll control to stop the rolling motion.

If the pilot suspects that inertia coupling has occurred, the aircraft must be inspected. Even if the accelerometer readings are well within the laid down limits, there is no guarantee that the fin has not been damaged. If the dampers are inoperative, inertia coupling occurs at a lower roll rate than normal. Therefore, if a damper malfunction occurs, rapid rolls must not be attempted. At 350 KIAS with the pitch dampers inoperative, a single roll through 360° in two seconds can result in a final yaw angle of 35°-40°.

NORMAL FLIGHT CHARACTERISTICS

Large variations of stability and control exist throughout the flight envelope. Aircraft stability varies with Mach Number and CG location. Control effectiveness is influenced by dynamic pressure or IAS and to a lesser degree by Mach number.

SUBSONIC REGION

Landing Configuration

With the undercarriage down and in ground effect, the aircraft is longitudinally unstable. Control forces are light and care must be taken to prevent pilot induced oscillations during take off and landing. At speeds below 250 KIAS, buffet is evident. The incidence lights must be monitored in the circuit as it is possible to exceed limitations with no noticeable increase in buffet levels. At incidence angles beyond the limit of amber extinction, high rates of descent can be generated requiring high power levels to recover. The aircraft must be recovered by reducing incidence, rolling wings level and applying power as necessary to reduce the descent rate.

Lateral control at low IAS is good but adverse yaw effects causes the roll rate to be reduced if high roll rates are demanded without the use of coordinating rudder. Moderate rudder deflection is required to coordinate normal turns at circuit speeds. At low IAS directional stability is high and high angles of bank, with coordinating rudder, are required for small heading changes.

Speed Instability

Speed instability occurs below the minimum drag IAS of 300 kn. Above this speed, every IAS figure has a corresponding power setting. If higher power is set, the aircraft accelerates to the speed corresponding to the power setting. Below the minimum drag speed the reverse occurs. As IAS reduces, increasing power is required to stabilize and hold the lower IAS. During the approach, the throttle must be constantly adjusted to maintain the correct approach speed. The approach control facility counters speed instability and reduces the pilot's work load during an instrument approach.

Clean Configuration

For speeds below M0.92, the wing centre of pressure remains substantially fixed. As the aircraft accelerates in the subsonic range forward trim is required to maintain level flight. Lateral and directional control response is good and control forces are moderate. Rudder should be used to coordinate turns especially at speeds below 250 KIAS. Above 350 KIAS, rudder should be used with discretion to avoid excessive loads on the fin. Maximum pitch efficiency of the flight controls is achieved at M0.9 for all altitudes. The elevon roll efficiency (roll rate per degree of elevon deflection) is a maximum at M0.85 at all altitudes.

SUPERSONIC REGION

In supersonic flight, the centre of lift moves aft and the control column movement has to be progressively increased to maintain level flight. The trim must be set more and more aft, which is contrary to the trim variation during subsonic acceleration. Therefore in supersonic level flight, the control column is set in a progressively more aft position as the Mach No increases. The elevon deflection available to produce nose up pitch is therefore progressively limited. The pitch controls are also less efficient since, to increase the load factor by 1 'g', more elevon deflection is required in supersonic flight than in subsonic flight. Without autocommand, the control column forces are high. The rate of roll decreases as Mach number increases, however it remains adequate at M2.0. Rudder efficiency decreases similarly at supersonic speeds. At M1.7, full rudder deflection can be applied without obtaining excessive skid.

Level Flight Acceleration

Level flight acceleration is normally carried out at the tropopause. The time for accelerating from M1.0 to M2.0 in level flight at the tropopause varies considerably with the tropopause temperature (refer to DI(AF) AAP 7213.003-1-1). For a given temperature, the acceleration time increases with altitude. At 38 000 ft in ISA conditions, the time taken to accelerate from M1.0 to M1.93 is about five minutes. Knowledge of the tropopause altitude and temperature is therefore an important operational factor, which must be taken into account for optimum performance. During an acceleration from M1.0 to M2.0 the following points are noteworthy :

a. The neutral position of the control column moves rearwards as the Mach number increases.

b. The roll and yaw trims may have to be adjusted.

c. Automatic engagement of the engine overspeed is related to the temperature; it operates at about M1.4 in a standard atmosphere at the tropopause.

d. The cockpit temperature increases during the acceleration. This is particularly noticeable if the engine is throttled back, as the aircraft skin is hot and heat is radiated into the cockpit, while the air conditioning flow is greatly reduced.

e. There is a large increase in fuel consumption; at M2.0 at 36 000 ft, the consumption rate is about 57 gal/minute, which is equivalent to the consumption at ground level for 600 KIAS with mini A/B.

f. The fuel consumption decreases appreciably as the altitude increases; at 50 000 ft and M2.0, the fuel consumption is about 35 gal/minute.

g. The automatic shock-cone extension may malfunction. Above M1.25 it is essential to compare the shock-cone machmeter and the aircraft machmeter to detect any malfunction in shock-cone extension.

Note

- Above M1.25 the shock-cone machmeter must be compared with the aircraft machmeter.
- Level flight supersonic acceleration is largely academic as, in practice, energy manoeuvring techniques give significantly better acceleration times and fuel consumptiom.

High Altitude

As altitude increases, the control column has to be moved further aft to maintain level flight at the same Mach number. The clean aircraft limit is reached at 70 000 ft when the control column is fully back to maintain level flight. Without autocommand, the force required to maintain level flight is high, due to the fact that the position of the control column is outside the trim range. The efficiency of the pitch control also decreases with the altitude since, as altitude increases, more control deflection is required to increase the load factor by a given amount.

WARNING

At very high altitudes engine overspeed is possible and incidence limits can also be easily exceeded resulting in loss of aircraft control.

Supersonic Manoeuvre Limits

In supersonic flight, the load factor available (refer to Fig 6-2) is ultimately limited by :

a. the elevons reaching the nose up pitch limit, or

b. elevon jack saturation.

Elevon Jack Saturation

As the IAS/Mach number increases, the air load on the elevons increases and the elevon jacks do not have sufficient power to move the elevons through the full pitch range. The point where the air load becomes excessive is known as the jack saturation threshold. When the jack saturation threshold is reached and more pitch movement is demanded, the slide valves move in response to the control column demand but the elevon jacks and elevons do not follow.

Figure 6-2 shows elevon effectiveness as a function of 'g' loads available throughout the flight envelope and the appropriate manoeuvre limit. The figure shows that :

a. the available 'g' in supersonic flight is limited and decreases as altitude increases,

b. above about 35 000 ft, depending on Mach number, the manoeuvre limit is due to maximum elevon deflection; below about 35 000 ft the limit is due to jack saturation, and

c. below about 20 000 ft, the first onset of jack saturation occurs in the transonic region at loadings above about 5.5 'g'.

Effect of External Loads

External loads may affect the aerodynamic characteristics of the wings thereby modifying the zero lift elevon position and elevon effectiveness. The 110 gal tanks cause the aircraft aerodynamic centre of lift to move forward, and also the zero lift elevon position is offset ½° nose down relative to the corresponding position for the clean aircraft. This results in an increase of about 15% in elevon effectiveness compared with the clean aircraft. In practice, with two 110 gallon tanks fitted a load factor of up to 2 'g' more than the load factor for a clean aircraft may be available in certain areas of the flight envelope. Information in the effects of other stores is not available, however the effects may be different.

RAAF SUPPLEMENT NO 73

FLIGHT CHARACTERISTICS WITH 374 GALLON EXTERNAL TANKS

Instruction

This supplement is to be inserted facing page 6-16.

Information

A recent incident has highlighted the potential for the aft CG limit to be exceeded during certain manoeuvres while fuel remains in the 374 gallon external tanks.

Action

Read the following in lieu of the paragraph on handling characteristics under the heading 'TWO 374 GALLON WING TANKS' in the left hand column of page 6-16:

During manoeuvring flight with fuel remaining in the 374 gallon tanks, particularly when about half full, extreme rearward fuel movement accompanied by a dangerous rearward CG movement can occur.

Rear the following in lieu of the 'Warning' in rearward CG movement in the right hand column of page 6-16:

WARNING

While fuel remains in the 374 gallon tanks all operational manoeuvring is prohibited. Specifically, any manoeuvres involving sustained forward acceleration in an unloaded condition and/or rapid application of 'g' are prohibited.

Date: FEB86

Mirage IIIO Manoeuvring Limits

SOURCE:
MIRAGE IIIE TEST

CONFIGURATION:
CLEAN AIRCRAFT
AUW 17990 lb
CG 48%
ICAO ISA ASSUMED

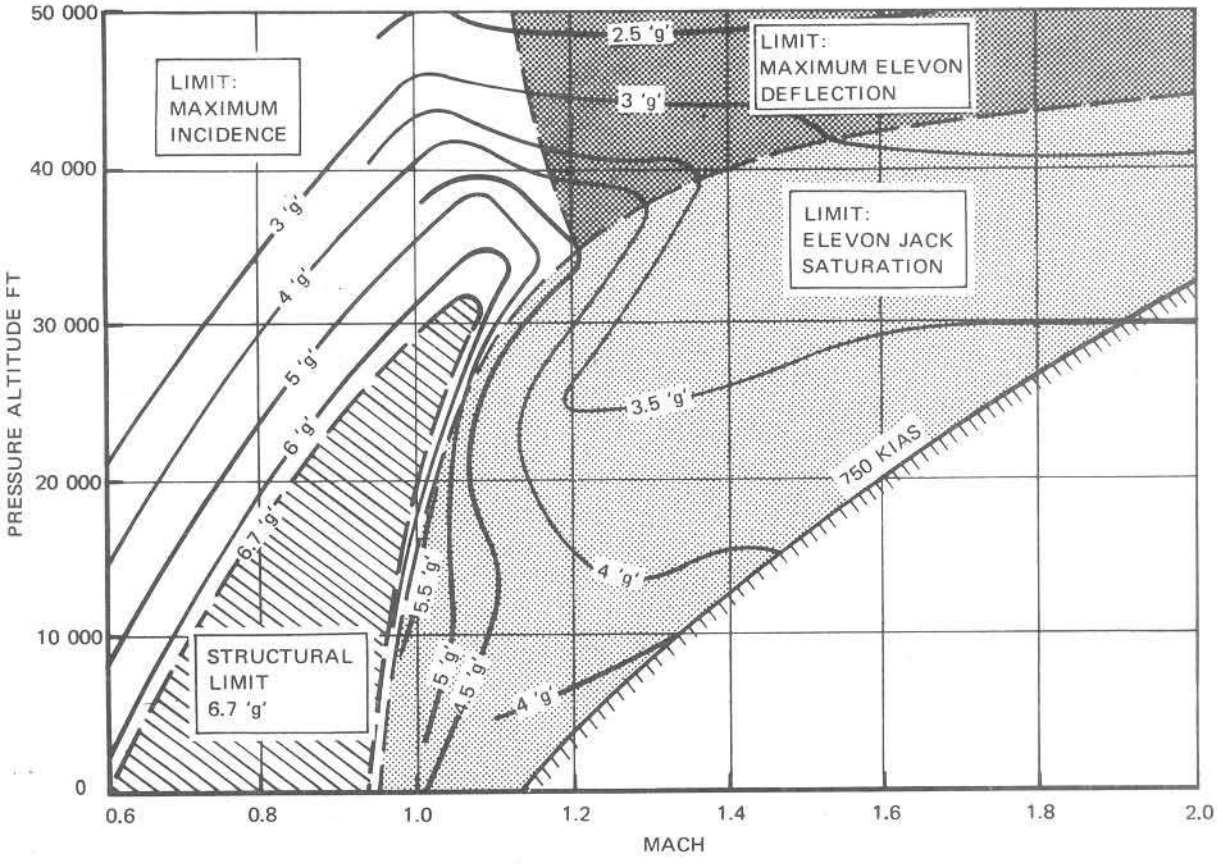


Figure 6-2

TRANSONIC REGION

At about M0.92, a normal shock wave begins to form on the wing upper surface and the centre of pressure begins to move rearwards.

The transonic speed range lies between M0.92 and M1.04. In this range, flight control characteristics change as follows :

a. Above 20 000 ft, the neutral position of the control column moves backwards during an acceleration.

b. Below 20 000 ft, the neutral position of the control column moves forwards during an acceleration.

c. At about 20 000 ft, the neutral position of the control column does not change.

d. The efficiency of the pitch control decreases as speed increases above M0.92. Above M0.94, there is a marked decrease in efficiency. Maximum efficiency of the flight controls is achieved at M0.9 for all altitudes.

e. The natural damping characteristics of the aircraft are very poor, ie the aircraft starts oscillating easily and continuously with dampers disengaged.

f. The indications given by the ASI/Machmeter are affected by static jump.

Transonic Deceleration Pitch Up

During deceleration from supersonic to subsonic flight with a load factor applied, the aircraft pitches up as the centre of lift moves forward and the elevons regain efficiency. This pitch up is commonly known as the 'transonic tuck' and occurs between M0.96 and M0.92. The rate of pitch up is faster than normal pilot reaction can counteract. The precise Mach number at which pitch up occurs and the increase in 'g' encountered depends on the rate of deceleration, the 'g' applied and the IAS. For example :

a. At 36 000 ft with about 3 'g' applied, an increase of 1 'g' is experienced with the control column steady.

b. At 20 000-25 000 ft, the incidence limit coincides with the minimum airspeed at which maximum 'g' is available. The high incidence causes the centre of lift to move rapidly, pitch up can be more severe and an additional 1-2 'g' may be experienced.

c. Below about 20 000 ft, the transonic pitch up can become most severe if the aircraft is operating above the jack saturation threshold, ie above about 5.5 'g' (refer to Fig 6-2). In this case, the return of elevon efficiency coupled with the reduced air loads allows the demanded elevon movement and up to a 2.5 'g' pitch up can result.

d. At lower altitudes and high IAS, the pitch up is usually less severe but care must be taken to avoid pilot induced oscillations after the pitch up.

Aircraft performance is severely degraded in the transonic region. If maximum performance is desired, eg as in air combat manoeuvres, the following guidelines should be used :

a. ***Decelerating.*** Use a combination of nose position, idle power and speed brakes out if necessary to reduce speed quickly. Reduce loading to + 4 'g' approaching M0.98. Reapply 'g' as required after the 'transonic tuck' is felt or when below M0.92. Use of autocommand is recommended as the severity of the pitch up is reduced.

CAUTION

A maximum load factor of + 4 'g' should be observed during transonic deceleration.

Note

The use of nose position and full dry power will normally reduce speed at an acceptable rate.

b. ***Accelerating.*** When accelerating through the transonic region, unload to between zero and + ½ 'g' and use max A/B. Manoeuvre as required once above M1.1 to M1.2.

EFFECT OF AUTOCOMMAND

With the autocommand engaged, a force, which varies in proportion to the load factor, is applied to the control column, ie 3 kg (6.6 lb) per 'g'. Under any flying condition, 3 kg (6.6 lb) represents a mean figure that is modified slightly throughout the flight envelope to provide a realistic control column force.

The control column forces with autocommand engaged are generally lighter than those in manual control. This assists in reducing pilot fatigue during prolonged high 'g' flight such as air combat manoeuvres.

When autocommand is engaged, it also assists in countering the pitch-up which occurs during a transonic deceleration. The commencement of pitch up is detected by the autocommand rate gyro. The rate gyro provides an elevon down signal thus reducing the severity of the eventual pitch up.

Autocommand engagement cancels small nose-up and nose-down trim changes which may occur when the undercarriage or the speed brakes are activated or when the pitch dampers disengage.

SPEED BRAKE OPERATION

The speed brakes can be operated at any speed throughout the flight envelope, but should not be extended for landing as an increased sink rate will result. Speed brake extension causes a very slight nose-down trim change and airframe buffet which is hardly noticeable in the clean configuration even at high IAS. However, trim change is more marked with drop tanks fitted.

CAUTION

If the speed brakes are extended when 'g' is applied, some oscillation may occur after the pitch down. Allowance is to be made for this when manoeuvring at high 'g'.

DIVING FLIGHT

In a steep dive the Mirage gains airspeed very rapidly, especially with afterburner selected. It is easy to exceed the airframe limit of 750 KIAS and also to place the aircraft in a situation where recovery may be impossible.

DIVE PERFORMANCE

The airspeed attained in a dive depends on :

a. the dive angle,

b. the dive entry altitude and speed,

c. engine power setting,

d. speed brake position, and

e. aircraft configuration.

Figure 6-3 shows the effect of dive angle and dive entry speed on the airspeed attained in dives from 40 000 ft, eg a 30° dive entered at 525 KIAS results in 750 KIAS at sea level.

Dive Angle and Entry Speed Effect

DATA SOURCE:
MIRAGE IIIE FLIGHT TEST
BY MARCEL DASSAULT
AND PREDICTION.

DIVE CONDITIONS:
RPM – IDLE
SPEEDBRAKES – IN

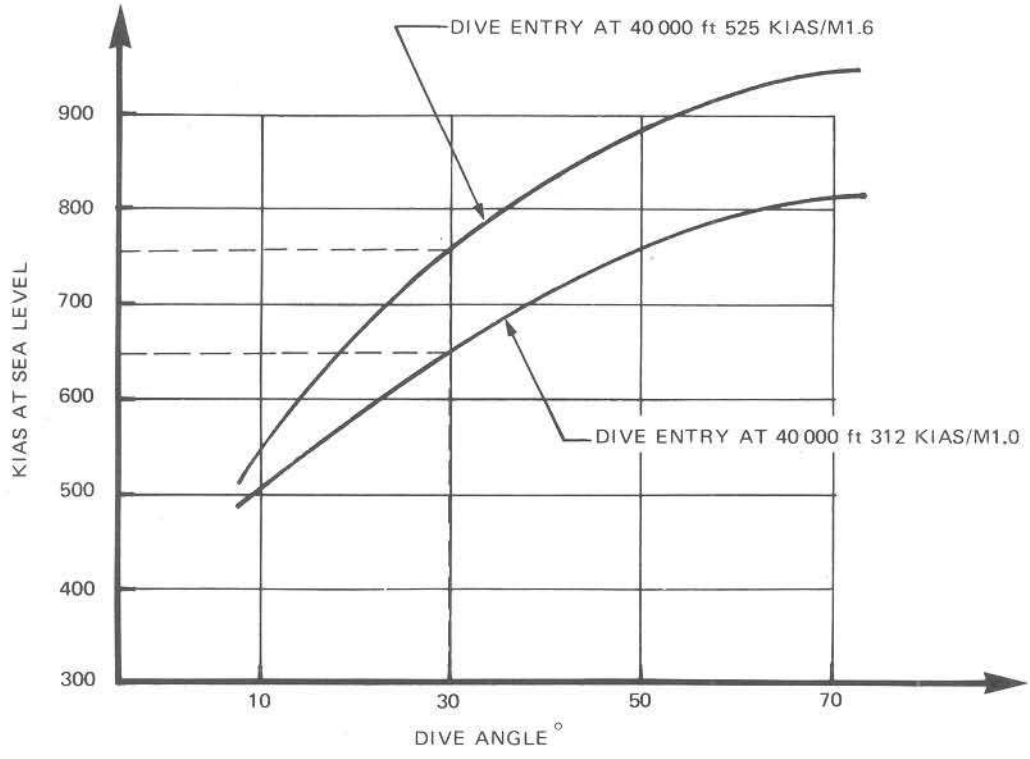


Figure 6-3

Figure 6-4 shows the effect of full power compared to idle power, and also compares the effect of speed brake position at idle power, on the dive speed attained. Compared to idle power the speed attained with full dry is 150 to 200 KIAS greater. The effect of speedbrakes is to reduce the speed attained (on idle power) by 100-250 KIAS depending on the dive angle.

Effect of Power and Speed Brakes

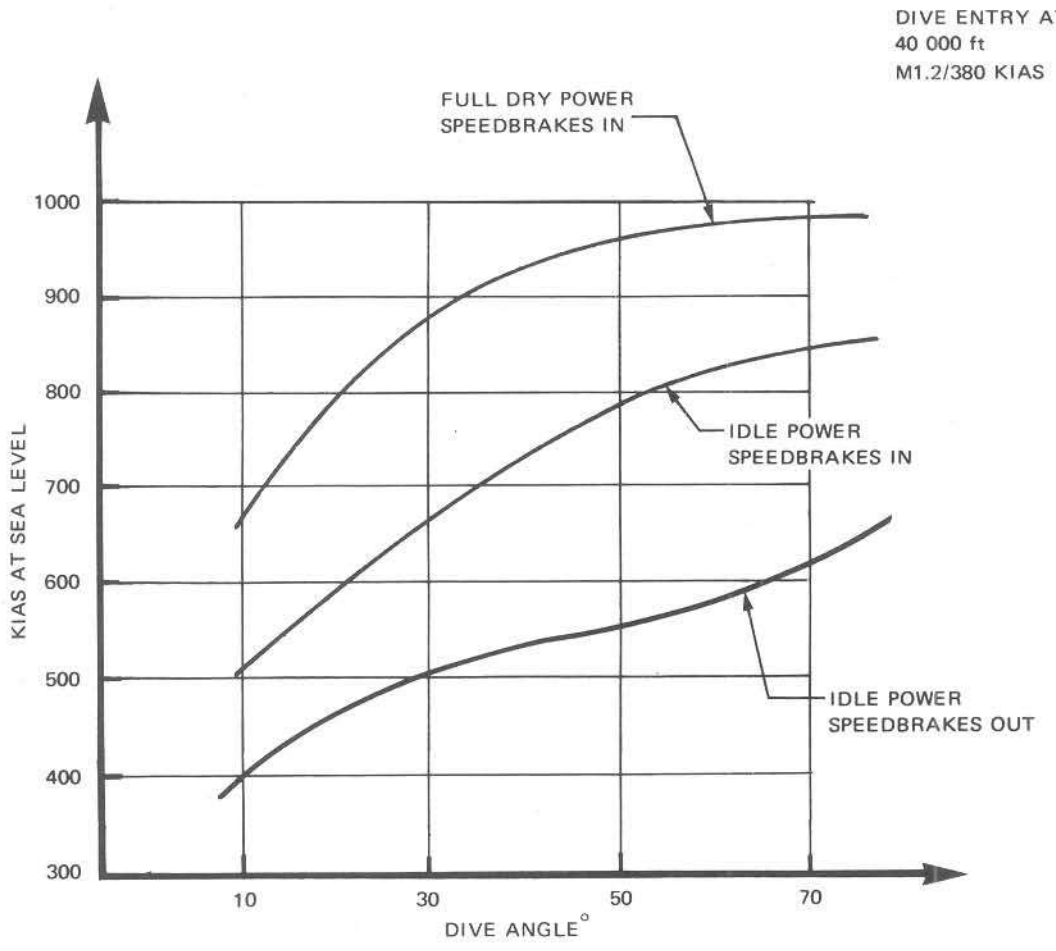


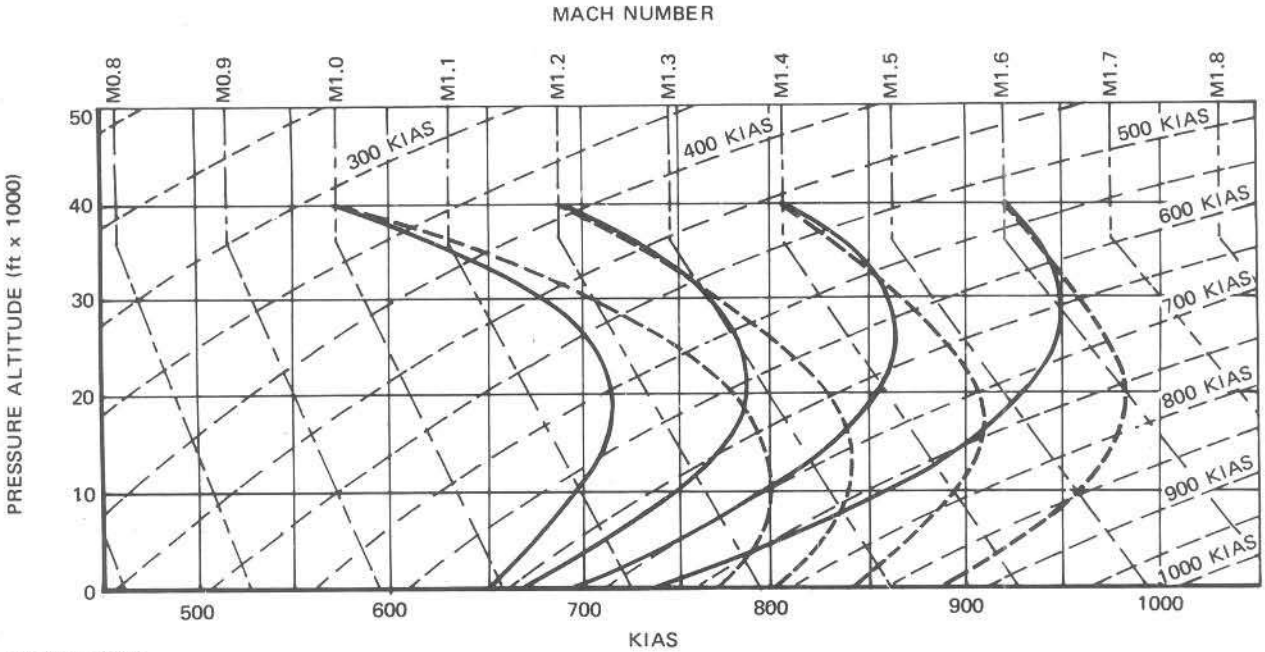
Figure 6-4

Figure 6-5 shows the dive performance at idle power, with speed brakes in, for both 30° and 50° dives started at 40 000 ft at various speeds. At 50° dive angle, acceleration continues until sea level. In a 50° dive when the dive entry speed is M1.0, 750 KIAS is exceeded at about 5000 ft. In a 30° dive, the airspeed remains below 750 KIAS regardless of initial dive speed.

WARNING

In an inadvertent dive with afterburner selected, the limits are exceeded earlier than indicated.

Dive Performance



CONDITIONS:
SPEEDBRAKES IN
AUW 8160 kg (17990 lb)
CG 48%
30° DIVE ANGLE
50° DIVE ANGLE

Figure 6-5

SUPERSONIC DIVE RECOVERIES

Figure 6-2 highlights the poor supersonic manoeuvring capability of the Mirage and shows that any supersonic dive recovery takes place in the area of elevon jack saturation. Consideration should also be given to the following failures which could affect the altitude loss in supersonic dive recoveries :

a. ***Speedbrake Failure.*** In the case of a 30° dive, initiating recovery at 10 000 ft with an IAS of 750 kn and power at idle, the altitude loss is 3500 ft (refer to Fig 6-6).

b. ***Engine Failure.*** In the case of an RPM freeze at full dry with the speedbrakes out, a 30° dive entered at 40 000 ft and M2.0 gives 750 KIAS at 10 000 ft. Recovery altitude loss is less than 5000 ft.

c. ***Hydraulic Failure.*** A hydraulic failure will not affect the airspeed attained in the dive but will drastically affect the recovery, eg :

(1) Provided the EMG HYD system operates, a HYD 1 failure causes about 30% loss in elevon effectiveness and the speed brakes are also inoperative.

(2) A HYD 2 failure involves about 50% loss in hydraulic power and the inboard control surfaces are inoperative. The total loss of control effectiveness is about 65% .

Figure 6-6 shows the altitude loss during recoveries initiated at 10 000 ft both with normal hydraulic power and with a nominal 50% loss in hydraulic power. With 50% loss in hydraulic power, altitude loss during recovery from a 30° dive initiated at 750 KIAS is 8000 ft, while recovery from a 40° dive at 750 KIAS is impossible.

Height Loss During Recovery

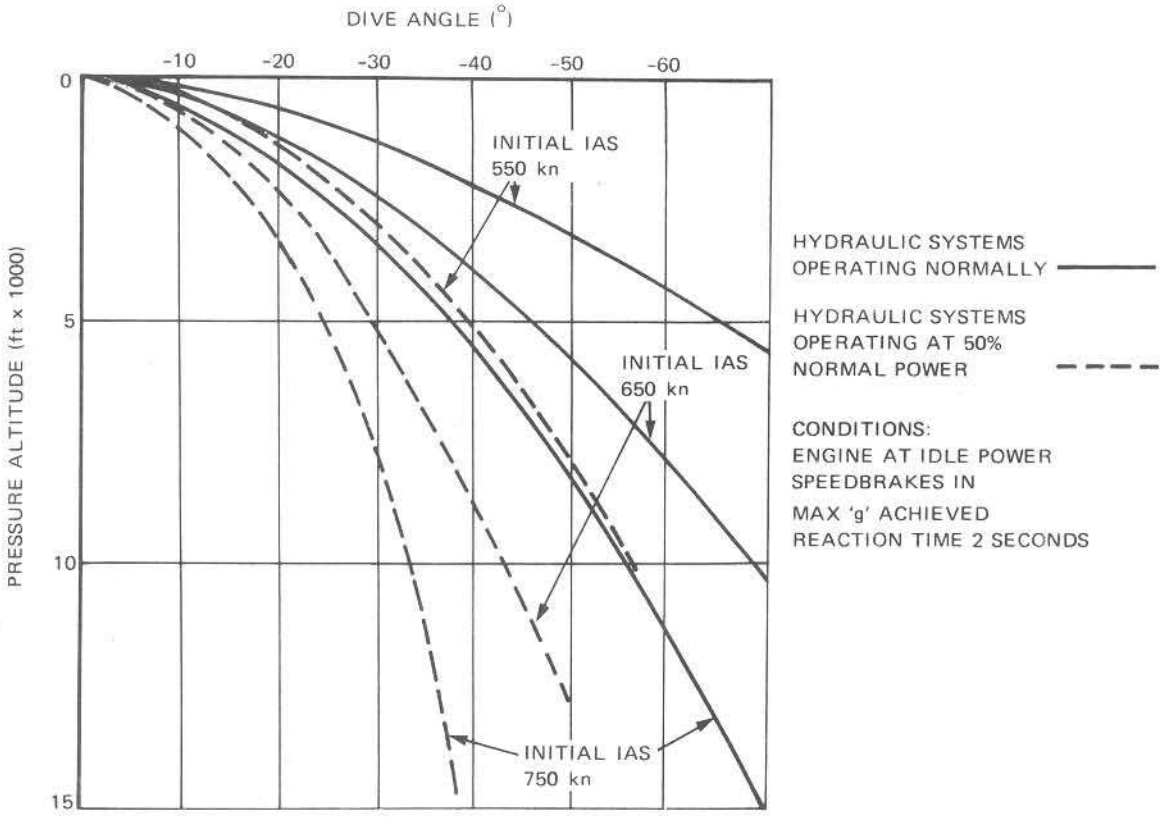


Figure 6-6

Figure 6-7 shows the speed increase during dive recoveries from 10 000 ft with the same recovery initiation parameters as in Fig 6-6. Airspeed gain during recovery with 50% hydraulic power is not significantly greater than that with normal hydraulic power.

A study of Figures 6-3 to 6-7 shows that recovery from supersonic dives at angles greater than 30° is possible, but that above 30° there may be no margin for aircraft system malfunction and the aircraft may exceed 750 KIAS. However, in the worst case of a 30° dive and recovery excluding the use of afterburner :

a. the airframe limit of 750 KIAS is not significantly exceeded,

b. the altitude loss during recovery with normal hydraulic power should not exceed 5000 ft, and

c. the altitude loss during recovery with a HYD 2 failure does not exceed 10 000 ft.

During an inadvertent dive with afterburner selected, 750 KIAS may be exceeded even at dive angles greater than 30°. The recovery technique for a high speed dive is to simultaneously :

a. apply maximum 'g',

b. set throttle to idle, and

c. select speed brakes out.

WARNING

- Supersonic flight at dive angles in excess of 30° should be avoided especially at medium to low altitude.
- Supersonic dives at angles greater than 30° may result in speeds greater than 750 KIAS and safe recovery may be prejudiced.
- [D] The Mirage IIID accelerates more rapidly than the IIIO and airspeed limits are more easily exceeded.

Airspeed Gain During Recovery From 10 000 ft

HYDRAULIC SYSTEMS OPERATING NORMALLY ———

HYDRAULIC SYSTEMS OPERATING AT 50% NORMAL POWER – – – – –

CONDITIONS:
ENGINE AT IDLE POWER
SPEEDBRAKES IN

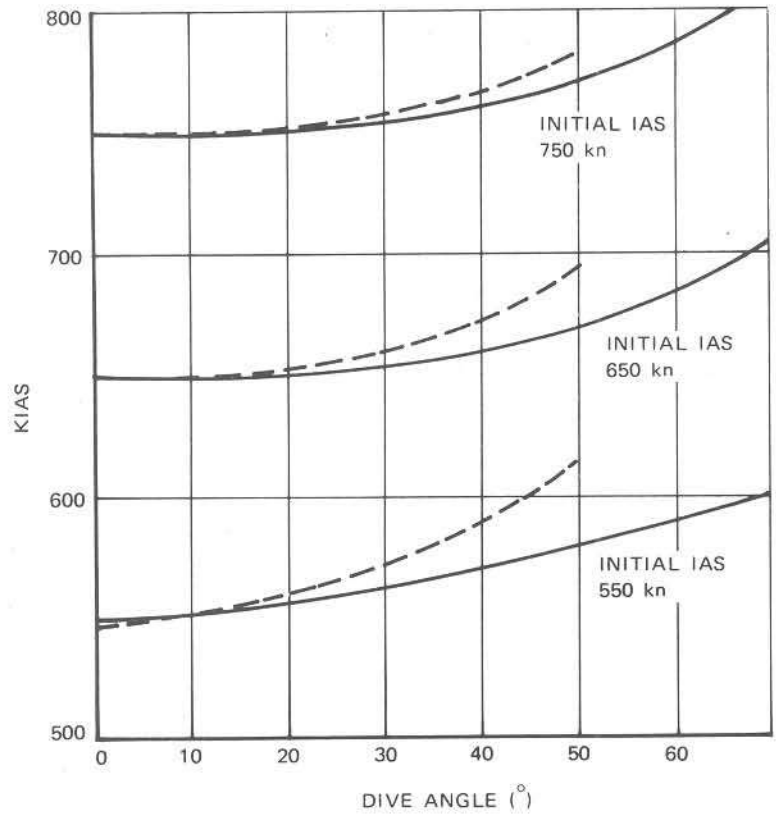


Figure 6-7

MANOEUVRING FLIGHT

MAXIMUM PERFORMANCE MANOEUVRING

The manoeuvre limitation is either the maximum allowable 'g' or the appropriate incidence limit for the configuration. Rolling 'g' limits, roll rate restrictions and IAS limits must also be observed. Refer to AAP 7213.003-1 Section 5 and AAP 7213.003-1-1.

The lowest airspeed at which the aircraft can attain maximum allowable 'g' is the speed where the instantaneous maximum rate, minimum radius turn is achieved.

The incidence limit of amber extinction is achieved at about 400 KIAS with a load factor of 6.7 'g'. However, the incidence at amber extinction is lower than the incidence at C_L max, therefore more than 6.7 'g' can be applied at 400 KIAS if amber extinction is exceeded.

In practice, depending on configuration and altitude, 6.7 'g' can be attained at airspeeds as low as 350 KIAS. Hence, during manoeuvres, it is essential to monitor :

a. the 'g' meter at airspeeds above 350 KIAS, and

b. the incidence lights below 400 KIAS.

WARNING

At airspeeds above about 450 KIAS the available 'g' may exceed the structural strength of the aircraft.

Note

Between 350-400 KIAS both the 'g' meter and the incidence lights are to be monitored.

The incidence lights equate to a considerable variation in incidence. The significance of the various illuminations depends on altitude and are approximate indications only. The lights signify :

a. ***Amber.*** Amber approximates to an optimum energy turn, ie a reasonable turn rate is achieved for the least energy loss, and

b. ***Amber Extinction.*** At speeds up to where the 'g' limit can be attained, amber extinction signifies the instantaneous minimum radius turn.

WARNING

Above 400 KIAS, 'g' limits will be exceeded before the incidence limit of amber extinction is reached.

Note

The low speed, transonic and supersonic flight characteristics must also be considered as applicable during manoeuvres.

AEROBATICS

When performing aerobatics the following factors are to be considered :

a. The high thrust required and associated high fuel usage.

b. The high drag at speeds below 350 KIAS when the aircraft is at high incidence.

c. The rapid acceleration in a dive, even with a high load factor, especially with A/B selected.

d. The transonic speed range which may be inadvertently entered at medium altitude because of the rapid acceleration characteristics, eg 530 KIAS is equivalent to M0.96 at 10 000 ft. This can lead to overstress.

e. The poor outside visual reference requires the use of the Bezu ball particularly during vertical manoeuvres.

f. The 'g' and incidence limits applicable to the configuration and AUW.

g. The heaviness of the control column with the autocommand not engaged; the aircraft should be trimmed for level flight at about 350-400 KIAS.

Prior to performing aerobatics, the radar range switch should be selected to RANGE to lock the radar antenna to the aircraft's longitudinal axis and reduce the loading on the antenna drive motor at high 'g' loadings.

CAUTION

Violent manoeuvres can damage the mechanical stops of the radar antenna if power is not applied to the antenna. Consequently aerobatics or other manoeuvres involving rapid changes in flight path should not be carried out if the radar antenna is not stabilized.

The following aerobatics are based on a reference altitude of 10 000 ft.

Loop

The loop is entered with a minimum power setting of full dry and 450 KIAS. A minimum of 4 'g' is maintained in the pull-up until amber incidence is indicated and then a minimum of amber incidence is maintained over the top of the loop. The IAS is 200 kn at the top of the loop with an altitude of about 18 500 ft, and 260 kn when vertical during recovery. If mini A/B is engaged during the entry, it should be disengaged if it appears that the speed will fall below 150 KIAS.

Roll Off the Top

The roll off the top is entered with a minimum of full dry power and 480 KIAS. A 4.5 'g' pull-up is main-

tained into amber incidence. In the inverted wings level attitude, perform a half roll using rudder to maintain balance. The IAS is 350 kn when climbing vertically, and 220 kn on the top of the loop with an altitude of about 19 500 ft.

Pull Through Manoeuvres

A knowledge of the aircraft performance during pull through type manoeuvres is essential (refer to AAP 7213.003-1-1 Performance Data). Because of the high induced drag at high incidence and the power range available, care must be exercised when attempting maximum performance pull through manoeuvres. For example, a 6 'g' pull through from 20 000 ft at 400 KIAS may require only dry power while for a 6.7 'g' pull through A/B may be required to maintain speed. The power required varies considerably with temperature and configuration. During maximum performance pull through manoeuvres:

a. The aircraft accelerates rapidly if maximum 'g' is not obtained quickly.

b. If the IAS builds up, power must be reduced quickly.

Note

If the IAS builds up, the 'g' loading increases for a given control column position. This can lead to overstress.

c. At medium to high altitudes, it is essential to monitor Mach number to avoid the transonic region.

d. Height loss is about 6500-7000 ft when the manoeuvre is entered at 20 000 ft.

e. To achieve minimum height loss, speed should be kept below about 350 KIAS and the incidence should be maintained at amber extinction. Above about 350 KIAS, height loss is greater and below 350 KIAS the height loss is similar but the turn rate is reduced.

Rolling Manoeuvres

Rolling manoeuvres are best performed at speeds between 400-480 KIAS. The aircraft should be trimmed for level flight and the trim should not be altered during the rolls. To perform three or four successive rolls, set a nose attitude of + 10° on the Bezu ball before commencing the rolls. The aircraft should be in level flight at the end of the manoeuvre. Within this speed range, two-thirds deflection of the controls in roll, is sufficient to obtain a 300° per second rate of roll. Rolling limitations must be observed.

Speed Control

During looping manoeuvres, the specified minimum 'g' at entry must be maintained into the desired incidence illumination otherwise IAS may reduce below 150 KIAS.

Negative 'g'

Manoeuvres involving negative 'g' cause the OIL warning and main FAIL lights to illuminate and the horn to sound. When this occurs, recovery from the manoeuvre should be initiated. The light and horn warnings cease as soon as positive 'g' flight is resumed.

FLIGHT WITH EXTERNAL LOADS

Because of the variety of external loads that can be fitted to the Mirage, only those external stores which exhibited noteworthy characteristics in flight tests are discussed. In all other cases, it may be assumed that the aircraft behaves normally and no handling abnormalities are noticeable.

TWO 286 GAL WING TANKS

Above 520 KIAS at about 2000 ft altitude, light general airframe buffet is experienced with two 286 gal wing tanks fitted. This buffet is of no significance.

In cruise at 38 000 ft with two 286 gal external tanks fitted, speed drops off rapidly below 285 KIAS. A substantial increase in power is required to regain the optimum 290 KIAS. This effect is more pronounced early in the cruise at 38 000 ft when the fuel weight is high.

Above 40 000 ft, MN should not be allowed to fall below M0.9. If this does occur, extreme caution should be exercised in manoeuvring the aircraft. Even an attempt to maintain level flight during moderate subsonic manoeuvres using angles of bank in excess of 20° causes a rapid speed decrease resulting in a potentially dangerous low speed, high incidence and high power situation. It is necessary to recover airspeed by diving the aircraft.

Jettison

No significant longitudinal trim change is evident at recommended jettison speeds. At speeds above 300 KIAS an increasingly marked nose down trim change is evident. At higher speeds the nose down trim change becomes marked and very rapid.

Note

Refer to Section 5 for operating limitations and jettison envelopes applicable to external stores.

Asymmetric Jettison

At speeds up to 400 KIAS, asymmetric jettison causes the aircraft to yaw and roll in the direction of the retained tank. At higher speeds, there is a sharp reaction in roll. Roll and yaw rates are not disturbing and are easily corrected. With only one tank jettisoned, sufficient lateral and directional trim is available to correct out-of-trim forces at speeds up to 500 KIAS and during an approach and landing. Landings have been made in this configuration in

cross-winds up to 15 kn. Provided the slip indicator is monitored and directional trim changes are corrected, aircraft handling characteristics during the approach and landing are satisfactory for normal threshold speeds, with 280 to 350 gal of fuel remaining.

TWO 374 GAL WING TANKS

During manoeuvring flight with fuel remaining in the 374 gallon tanks, particularly when about half full, extreme rearward fuel movement accompanied by a dangerous rearward CG movement can occur.

Jettison

Jettison and asymmetric jettison characteristics are similar to those outlined for two 286 gal wing tanks.

286 GAL CENTRELINE TANK

There are no abnormal handling characteristics with the 286 gal centreline tank fitted.

Jettison

Longitudinal aircraft trim changes during jettison of the centreline tank are not significant, but a slight, unmistakable jolt is detected as the tank leaves the aircraft.

[D] The above also applies for the 242 gal centreline tank.

TWO 110 AND ONE 286 GAL EXTERNAL TANKS

Flight with two 110 gal and one 286 gal external tanks fitted is essentially similar to flight with two 286 gal tanks except that both handling and performance are improved.

[D] The above also applies for two 110 and one 242 gal external tanks.

TWO 374 AND ONE 286 GAL EXTERNAL TANKS

The handling characteristics of the aircraft in the climb at speeds above 370 KIAS with two 374 and one 286 gal external tanks fitted are satisfactory with and without autocommand. Above 20 000 ft, only gentle turns can be completed without losing altitude unless A/B is used. The aircraft rate of climb above 25 000 ft is low with full dry power and accurate flying is necessary to reach the aircraft ceiling. Under instrument flying conditions or in turbulence, handling characteristics impose a practical ceiling at maximum fuel load of 25 000 ft.

In smooth air conditions, the minimum IAS for stabilized level flight at a selected constant power setting, is approximately 280 kn. The minimum practical cruise IAS at all altitudes is 300 kn. At M0.9, the aircraft exhibits a slight but noticeable longitudinal pitching oscillation. The amplitude of the oscillation increases with further increases in MN and is accompanied by slight buffet above MO.92.

At M0.92, the pitching oscillation can be reduced, but not eliminated by pilot control. Similar characteristics are obtained with autocommand engaged. The short period de-stabilizing effect of the fuel contained in the external fuel tanks is not considered to be noticeably worse than that for the two 374 gal wing tank configuration.

Jettison and asymmetric jettison characteristics are similar to those outlined for two 286 gal wing tanks and the centre line tank.

[D] The above also applies for two 374 and one 242 gal external tanks.

WARNING

While fuel remains in the 374 gallon tanks, all operational manoeuvring is prohibited. Specifically, any manoeuvres involving sustained forward acceleration in an unloaded condition and/or rapid application of 'g' are prohibited.

BOMB DISPENSER TYPE SUU-20A/A

In straight and level flight, dives and recoveries, no unusual behaviour is noticed with a Bomb Dispenser Type SUU-20A/A fitted. However, during recovery from steep dives at speeds of 500 KIAS and above, small 'g' overshoots may occur during nominal 4.0 'g' recoveries. At bomb release, the pilot may detect a slight thump in the cockpit as each ejector cartridge fires.

TWO MK82 BOMBS ON PM-3

Aircraft behaviour is normal and no handling abnormalities are noticed that could be attributed to the presence of two MK82 bombs. Handling during the dive is satisfactory and good aircraft response to control movements allows accurate sight corrections to be made. The firing of the ejector cartridges at bomb release can be felt in the cockpit. Handling limitations for dive entry and recovery, when MK82 bombs are carried, are detailed in Section 5.

FOUR BOMBS ON RPK10 WITH 286 GAL CENTRELINE TANK

There is a slight reduction in longitudinal stability which may lead to a tendency to over-rotate on take-off. No other abnormal handling is evident. Control response is good at normal dive speeds. The firing of the bomb ejector cartridges can be felt and an easily controlled rolling moment is generated as each bomb is ejected.

Asymmetric Bomb Load

Considerations for flight with an asymmetric bomb load are:

a. ***One Bomb.*** One bomb has little effect and normal approach speeds can be used.

b. ***Two Bombs.*** At normal flight speeds no handling problems are evident. Safe landing in a favourable crosswind is possible but a touch

down speed of 190 KIAS is to be used to ensure adequate lateral control.

Note

With a cross wind from the opposite side to the bombs, lateral control during landing is limited.

BOMB CARRIAGE CLEARANCE

The Mirage III0 aircraft has been flown with the CG as far forward as 45.73% MAC, and landed with the CG at 45.95% MAC. As the present 47.5% MAC limitation does not appear to be structural and the handling at forward CG positions does not appear to be adversely affected, the critical case must be the elevon effectiveness for flare. Results show that a safe landing flare can be accomplished without using full elevon deflection; however with a forward CG and an asymmetric load of two bombs, landing in a crosswind from the opposite side to the hung bombs may present lateral control problems because the control column position is near fully aft.

For certain configurations involving a hang-up of MK82 500 lb bombs where the forward centre of gravity limit of 47.5% MAC is exceeded at low fuel states, the flight limitations in Section 5 are to be observed.

SECTION 7
ALL WEATHER OPERATION

SECTION 7

ALL WEATHER OPERATION

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SECTION 7

ALL WEATHER OPERATION

In general, this section consists of procedures and information which differ from, or are supplementary to, the normal operating procedures in Section 2. In some cases however, repetition has been necessary for emphasis, clarity or continuity of thought.

INSTRUMENT FLIGHT PROCEDURES

The Bezu ball is the primary attitude and heading indicator and its presentation enables accurate maintenance of both aircraft attitude and heading.

For speeds equal to or greater than 300 KIAS, instrument turns are to be completed using 40° angle of bank. At speeds less than 300 KIAS instrument turns are to be completed using 30° bank.

The aircraft has low stability in roll and a comprehensive instrument cross reference is essential to ensure accurate instrument flight. Flying aids should be used to assist accuracy and reduce pilot workload.

WARNING

Roll stabilization may disengage without warning.

BEFORE TAKE-OFF

Before taking off under IMC, check the following:

a. When lined up on the runway, carry out a transfer and check that magnetic heading on the Bezu ball and the PHI agrees with the runway heading.

b. Cage and set the desired pitch attitude on the standby A/H.

c. Check the accuracy of the readout on TACAN function of the PHI indicator.

TAKE-OFF

A normal take-off is made. Full cross reference to instruments should be achieved by the point of lift-off. The undercarriage is not retracted until the altimeter reading starts to increase.

WARNING

- Instrument cross reference is to include the standby A/H.
- Take-offs without external references to help maintain direction are prohibited.

CLIMB

After lift-off, maintain + 10° attitude on the Bezu ball until approaching the appropriate climb speed. The normal climb schedules are used as the situation dictates (refer to Section 2).

[D] After lift off, maintain 13° attitude on the Bezu Ball.

CRUISING FLIGHT

Cruise Speed

Normal cruising under instrument flight conditions is flown at 400 KIAS/M0.9. The transition altitude is about 24 000 ft.

Nose High Unusual Attitudes

In most cases of nose high unusual attitudes, the aircraft may be recovered from the situation using full dry power. In cases where the speed decays rapidly below 150 KIAS, visually centralize the controls and smoothly reduce the power to idle. The aircraft will recover nose low and when speed increases towards 200 KIAS, recover from the dive. Incidence and 'g' limitations should be monitored during the recovery.

Nose Low Unusual Attitudes

Level the wings immediately and positively recover to level flight. Reduce power to idle and extend the speed brakes commensurate with aircraft attitude and IAS. Speed build up may be rapid, especially when the A/B is engaged, and the aircraft may accelerate to supersonic speed. If supersonic speed is attained, a large altitude loss during recovery will occur. Incidence and 'g' limitations should be monitored during the recovery.

TACAN Accuracy

The TACAN presentation may suffer from bearing and range variations, particularly during turns and with undercarriage down and/or external stores mounted. Bearing may vary up to ± 10° for short intervals. Range is relatively reliable, with a tendency to over-read by 1-2 NM.

HOLDING

Holding should be accomplished at 300 KIAS with a maximum angle of bank of 30°.

DESCENTS

The normal descent schedule is used for instrument penetrations and approximates a rate of one NM per 1000 ft of altitude. If the rate of descent has to be increased, the speed can be increased and/or the power reduced.

Levelling Off

The check altitude is 2000 ft above the levelling-off

altitude. When levelling above 5000 ft, select the speed brakes in and raise the nose attitude slowly at the check altitude to establish a smooth reduction in the rate of descent as power is adjusted to maintain 350 KIAS. When levelling below 5000 ft, raise the nose attitude at the check altitude to reduce the rate of descent. When the speed reduces to 300 KIAS, select the speed brakes in and adjust the power to maintain 300 KIAS. Ideally, a rate of descent of 1000 ft per minute should be achieved just prior to commencing the level-off.

Note

In tropical areas or after an extended time at high altitude, select the DEMIST lever on prior to descent.

TACAN APPROACH

When level below 5000 ft, a speed of 300 KIAS is maintained while the aircraft is flying the TACAN pattern. The aircraft should be in the landing configuration at 7 to 8 NM finals. The minimum speed after undercarriage extension until 6 NM finals is 220 KIAS. At 6 NM, the power is reduced to 7500 RPM, approach control may be selected, and attitude and trim are adjusted to maintain altitude. The attitude change as the aircraft slows from 220 to 190 KIAS is about 3-4°. At the descent point, an attitude change of 1° nose down on the Bezu ball is sufficient to establish the desired rate of descent, ie about 900 ft/min for nil wind conditions.

At the minimum descent altitude (MDA), the aircraft is levelled off and flown to the missed approach point (MAP), if visual contact with the runway is not gained. At the MAP a standard overshoot is initiated. The aircraft is directionally stable and during final approach heading corrections should be made positively using rudder to balance the aircraft.

Note

- The speed range for an instrument approach is significant and continual trim adjustment is required throughout the approach to maintain accurate attitude and performance.
- Approach control should be disengaged prior to touch down or prior to initiating a standard overshoot.
- Depending on weather and letdown limitations, the descent may be varied to reach MDA at an appropriate distance from the MAP.

GCA APPROACHES

GCA procedure (refer to Fig 7-1) is similar to that of a TACAN approach.

Typical GCA Pattern

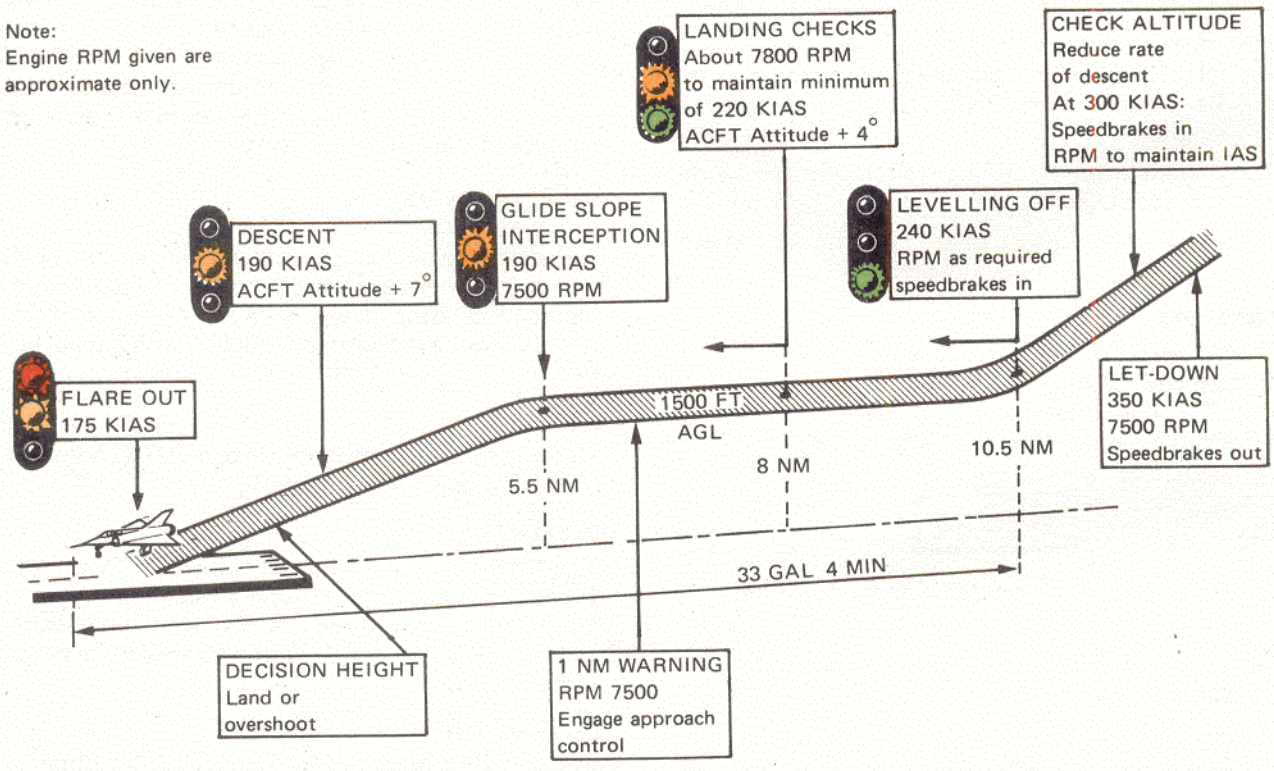


Figure 7-1

SHORT GCA

A short GCA pattern (refer to Fig 7-2) is normally flown after overshooting from a missed approach, when fuel remaining is critical. The overshoot is initiated with full dry power and the undercarriage retracted. A 30° banked climbing turn to 1000 ft at 240 KIAS is commenced in the overshoot.

The pattern is flown at 1000 ft maintaining 240 KIAS. The undercarriage is lowered on base leg and speed then reduced to 220 KIAS until approaching the glide path. A standard GCA approach is flown on finals, except that the descent point is nearer the runway for the lower glide path interception altitude.

Note

When approaching the glide path, reduce speed to avoid excessive speed on finals.

FUEL USAGE

The approximate fuel usages for the respective approaches are :

a. normal letdown, GCA, overshoot and low level GCA from 40 NM - 145 gallons;

b. overshoot at GCA minima with further low level GCA - 90 gallons; and

c. overshoot at GCA minima followed by a short GCA - 50 gallons.

BEZU BALL FAILURE

The Bezu ball has no failure warning device. If the failure is due to power supply failure at the gyro centre, the GYRO fail warning light illuminates. If the failure is in the indicator, the Bezu ball remains immobile during manoeuvres.

[D] No warning is given of power supply failure at the gyro centre.

BEZU BALL COVER

In the case of a Bezu ball failure, the indicator should be covered with the disc located on the cockpit wall adjacent to the pilot's left knee. This disc is provided with a cut-out to leave the slip ball visible and a set of graduations combined with a rotating disc to compute timed turns based on :

a. 30° angle of bank,

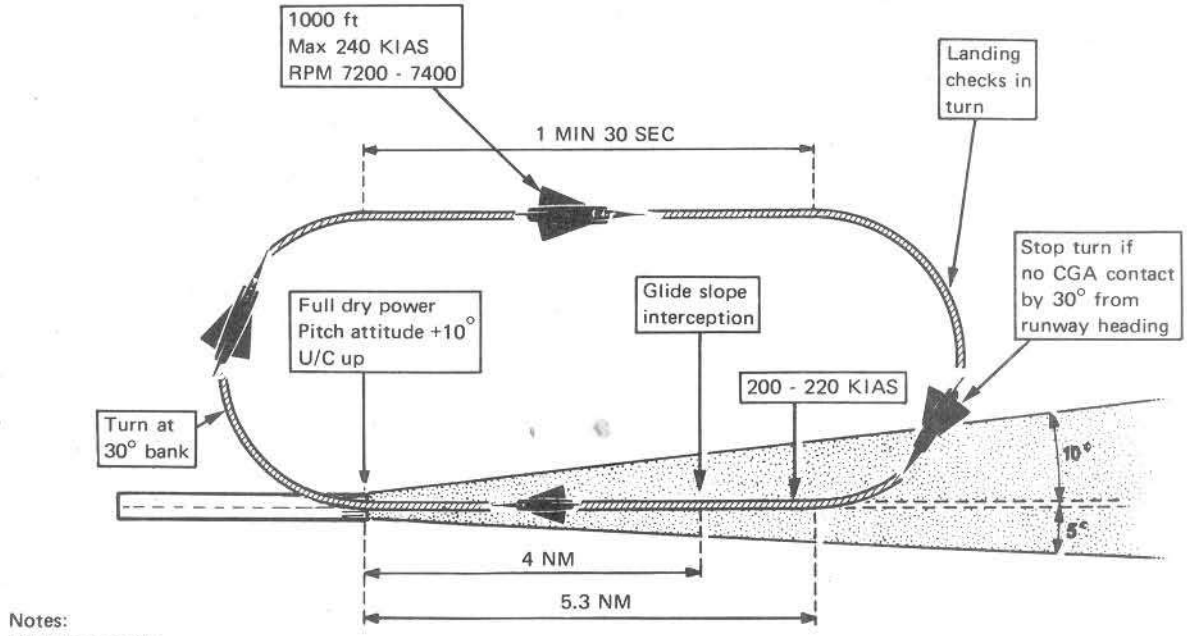
b. 300 KIAS, and

c. altitude below 25 000 ft.

STANDBY A/H

Early detection of a Bezu ball failure can be made by frequent comparison between the indications of the Bezu ball and those given by the standby A/H. The standby A/H incorporates a failure warning device in the form of a red flag with a superimposed white cross. When the standby A/H is used as the primary attitude indicator, heading information must be obtained from the PHI indicator.

Short GCA Pattern



Notes:
Fuel usage with
U/C up - 50 gal/5 min 30 sec
[D] Add 3° to Bezu Ball attitudes
[D] Less power will be required

Figure 7-2

ICE AND RAIN

ICING

No persistent icing has been encountered with the Mirage IIIO or IIID aircraft.

RAIN

Visibility is always good through the side glass panels. In heavy rain, the water stream on the windshield front glass panel restricts forward visibility completely. The low pressure tyres give good adhesion on a wet runway.

TURBULENCE AND THUNDERSTORMS

Intentional flight through thunderstorms should be avoided if possible. The radar provides an excellent means of navigating between or around storm cells.

WARNING

Severe aircraft damage and/or engine flameout is possible during flight in thunderstorms.

The pilot is seated well forward of the aircraft CG and consequently, when the aircraft is flying through turbulence, any pitching or yawing motion will be amplified at the cockpit. Autocommand assists in maintaining better pitch control. The pilot should ensure that his harness is locked.

Note

- The recommended turbulence penetration speed is 330-350 KIAS.
- If turbulent conditions are experienced on the GCA or TACAN approach, the final approach should be flown at 200 KIAS without approach control.

NIGHT FLYING

LIGHTING

Normal cockpit lighting consists of red instrument lighting and ultra violet lighting. The rheostats afford a wide range of adjustable intensity. As the lights are fixed and fragile, do not try to adjust them.

The cockpit lighting consists of:

a. two ultra violet lights, 10 external red lights and the wander light;

b. external lighting of the clock;

c. internal lighting of the control boxes, the optical sight, the standby compass and the accelerometer; and

d. internal lighting of the PHI and altimeters.

All indicator lights including the fail panel should be set to the night setting and the polariod cover adjusted for suitable radar scope brightness.

The exterior lighting consists of:

a. the landing and taxi lights;

b. navigation lights; and

c. formation lights.

TAXI LIGHT

The taxi light provides adequate illumination for taxiing.

LANDING LIGHT

The landing light may be used for all take-offs and landings. A distinctive glow which is distracting in hazy weather or in cloudy conditions is visible from the cockpit when the light is on and the undercarriage is extended. If the landing light proves distracting the taxi light may be used.

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