NATOPS FLIGHT MANUAL

NAVY MODEL

AV-8A

AIRCRAFT

MCDONNELL AIRCRAFT
N00019-71-C-0495

THIS MANUAL SUPERSEDES NAVAIR 101B-0601-15A, NAVAIR 101B-0601-15B AND NAVAIR 101B-0601-16.

Basic and all changes have been merged to make this a complete publication.

ISSUED BY AUTHORITY OF THE CHIEF OF NAVAL OPERATIONS AND UNDER THE DIRECTION OF THE COMMANDER, NAVAL AIR SYSTEMS COMMAND

FOR OFFICIAL USE ONLY

1 January 1973
CHANGE 2 - 15 OCTOBER 1973

LIST OF EFFECTIVE PAGES

Insert latest changed pages; dispose of superseded pages in accordance with applicable regulations.

NOTE: On a changed page, the portion of the text affected by the latest change is indicated by a vertical line, or other change symbol, in the outer margin of the page.

Dates of issue for original and changed pages:

Original . . . 0 . . 1 Jan 73
Change . . . 1 . . 15 Jun 73
Change . . . 2 . . 15 Oct 73

Total number of pages in this manual is 422 consisting of the following:

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Zero in this column indicates an original page.

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A-8 Blank	0
A-9	2
A-10 Blank	0
Index 1	2
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Zero in this column indicates an original page.

INTERIM CHANGE SUMMARY

The following Interim Changes have been canceled or previously incorporated in this manual:

INTERIM CHANGE NUMBER(S)	REMARKS/PURPOSE

The following Interim Changes have been incorporated in this Change/Revision:

INTERIM CHANGE NUMBER	REMARKS/PURPOSE

Interim Changes Outstanding - To be maintained by the custodian of this manual:

INTERIM CHANGE NUMBER	ORIGINATOR/DATE (or DATE/TIME GROUP)	PAGES AFFECTED	REMARKS/PURPOSE

DEPARTMENT OF THE NAVY
OFFICE OF THE CHIEF OF NAVAL OPERATIONS
WASHINGTON, D.C. 20350

LETTER OF PROMULGATION

1. The Naval Air Training and Operating Procedures Standardization Program (NATOPS) is a positive approach toward improving combat readiness and achieving a substantial reduction in the aircraft accident rate. Standardization, based on professional knowledge and experience, provides the basis for development of an efficient and sound operational procedure. The standardization program is not planned to stifle individual initiative, but rather to aid the Commanding Officer in increasing his unit's combat potential without reducing his command prestige or responsibility.

2. This manual standardizes ground and flight procedures but does not include tactical doctrine. Compliance with the stipulated manual procedure is mandatory except as authorized herein. In order to remain effective, NATOPS must be dynamic and stimulate rather than suppress individual thinking. Since aviation is a continuing, progressive profession, it is both desirable and necessary that new ideas and new techniques be expeditiously evaluated and incorporated if proven to be sound. To this end, Commanding Officers of aviation units are authorized to modify procedures contained herein, in accordance with the waiver provisions established by OPNAVINST 3510.9 series, for the purpose of assessing new ideas prior to initiating recommendations for permanent changes. This manual is prepared and kept current by the users in order to achieve maximum readiness and safety in the most efficient and economical manner. Should conflict exist between the training and operating procedures found in this manual and those found in other publications, this manual will govern.

3. Checklists and other pertinent extracts from this publication necessary to normal operations and training should be made and may be carried in Naval Aircraft for use therein. It is forbidden to make copies of this entire publication or major portions thereof without specific authority of the Chief of Naval Operations.

W.D. Houser

W.D. HOUSER
Vice Admiral, USN
Deputy Chief of Naval Operations
(Air Warfare)

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FOREWORD

SCOPE

The NATOPS Flight Manual is issued by the authority of the Chief of Naval Operations and under the direction of Commander, Naval Air Systems Command in conjunction with the Naval Air Training and Operating Procedures Standardization (NATOPS) Program. This manual contains information on all aircraft systems, performance data, and operating procedures required for safe and effective operations. However, it is not a substitute for sound judgement. Compound emergencies, available facilities, adverse weather, or terrain may require modification of the procedures contained herein. Read this manual from cover to cover. It's your responsibility to have a complete knowledge of its contents.

APPLICABLE PUBLICATIONS

The following applicable publications complement this manual:

NAVAIR 01-AV8A-1B (checklist)
NAVAIR 01-AV8A-1T (tactical manual)
NAVAIR 01-AV8A-1T(A) (tactical manual supplement)
NAVAIR 01-AV8A-1T(B) (tactical manual pocket guide)

HOW TO GET COPIES

AUTOMATIC DISTRIBUTION

To receive future changes and revisions to this manual automatically, a unit must be established on the automatic distribution list maintained by the Naval Air Technical Services Facility (NATSF). To become established on the list or to change distribution requirements, a unit must submit NAVWEPS Form 5605/2 to NATSF, 700 Robbins Ave., Philadelphia, Pa. 19111, listing this manual and all other NAVAIR publications required. For additional instructions refer to BUWEPSINST 5605.4 series and NAVSUP Publication 2002.

ADDITIONAL COPIES

Additional copies of this manual and changes thereto may be procured by submitting Form DD 1348 to NPFC Philadelphia in accordance with NAVSUP Publication 2002, Section VIII, Part C.

UPDATING THE MANUAL

To ensure that the manual contains the latest procedures and information, NATOPS review conferences are held in accordance with OPNAVINST 3510.11 series.

CHANGE RECOMMENDATIONS

Recommended changes to this manual or other NATOPS publications may be submitted by anyone in accordance with OPNAVINST 3510.9 series.

Routine change recommendations are submitted directly to the Model Manager on OPNAV Form 3500-22 shown on the next page. The address of the Model Manager of this aircraft is:

Commanding Officer
Marine Attack Squadron 513
Marine Aircraft Group 32,
2nd Marine Aircraft Wing
MCAS, Beaufort, South Carolina 29902
Attn: AV-8A Model Manager

Change recommendations of an URGENT nature (safety of flight, etc.,) should be submitted directly to the NATOPS Advisory Group Member in the chain of command by priority message.

YOUR RESPONSIBILITY

NATOPS Flight Manuals are kept current through an active manual change program. Any corrections, additions, or constructive suggestions for improvement of its content should be submitted by routine or urgent change recommendation, as appropriate, at once.

NATOPS FLIGHT MANUAL INTERIM CHANGES

Flight Manual Interim Changes are changes or corrections to the NATOPS Flight Manuals promulgated by CNO or NAVAIRSYSCOM. Interim Changes are issued either as printed pages, or as a naval message. The Interim Change Summary page is provided as a record of all interim changes. Upon receipt of a change or revision, the custodian of the manual should check the updated Interim Change Summary to ascertain that all outstanding interim changes have been either incorporated or canceled; those not incorporated shall be recorded as outstanding in the section provided.

CHANGE SYMBOLS

Revised text is indicated by a black vertical line in either margin of the page, adjacent to the affected text, like the one printed next to this paragraph. The change symbol identifies the addition of either new information, a changed procedure, the correction of an error, or a rephrasing of the previous material.

NATOPS/TACTICAL CHANGE RECOMMENDATION
OPNAV FORM 3500/22 (5-69) 0107-722-2002

DATE

TO BE FILLED IN BY ORIGINATOR AND FORWARDED TO MODEL MANAGER

FROM (originator)	Unit
TO (Model Manager)	Unit

Complete Name of Manual/Checklist	Revision Date	Change Date	Section/Chapter	Page	Paragraph

Recommendation (be specific)

☐ CHECK IF CONTINUED ON BACK

Justification

Signature	Rank	Title

Address of Unit or Command

TO BE FILLED IN BY MODEL MANAGER *(Return to Originator)*

FROM	DATE
TO	

REFERENCE
(a) Your Change Recommendation Dated ____________

☐ Your change recommendation dated ________ is acknowledged. It will be held for action of the review conference planned for ________________ to be held at ________________.

☐ Your change recommendation is reclassified URGENT and forwarded for approval to ____________ ____________ by my DTG ________________.

/S/ ________________ MODEL MANAGER, | ________________ AIRCRAFT

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WARNINGS, CAUTIONS, AND NOTES

The following definitions apply to "WARNINGS", "CAUTIONS", and "NOTES" found through the manual.

WARNING

An operating procedure, practice, or condition, etc., which may result in injury or death, if not carefully observed or followed.

CAUTION

An operating procedure, practice, or condition, etc., which, if not strictly observed, may damage equipment.

NOTE

An operating procedure, practice, or condition, etc., which is essential to emphasize.

WORDING

The concept of word usage and intended meaning which has been adhered to in preparing this Manual is as follows:

"Shall" has been used only when application of a procedure is mandatory.

"Should" has been used only when application of a procedure is recommended.

"May" and "need not" have been used only when application of a procedure is optional.

"Will" has been used only to indicate futurity, never to indicate any degree of requirement for application of a procedure.

GLOSSARY

A

A/C - Aircraft

ac - Alternating current

ACM - Air Combat Maneuvers

ACU - Acceleration Control Unit

ADC - Air Data Computer

ADD - Airstream Direction Detector (AOA)

ADF - Automatic Direction Finder

ADIZ - Air Defense Identification Zone

AGE - Aerospace Ground Equipment

AGL - Above Ground Level

AL - Amendment List

AMSL - Above Mean Sea Level

AMSU - Air Motor Servo Unit

AOA - Angle of Attack

APU - Auxiliary Power Unit

ARTC - Air Route Traffic Control

ATC - Air Traffic Control

B

BB - Ballistics Box

BATT - Battery

BINGO - Return fuel state; Divert

BIT - Built In Test

BRC - Base Recovery Course

C

CAP - Combat Air Patrol

CAS - Calibrated Airspeed

CATCC - Carrier Air Traffic Control Center

CBU - Cluster Bomb Unit

CCA - Carrier Controlled Approach

CCP - Communication Control Panel

CEP - Circular Error of Probability

CG - Center of Gravity

CL - Conventional Landing

C/L - Center Line

CNI - Communication Navigation Identification

COAT - Compensated Outside Air Temp.

CORRECTED RPM - Fan speed divided by the square root of Θ

COT - Cockpit Orientation Trainer

CRT - Cathode Ray Tube

CSD - Constant Speed Drive

CSU - Communication Switch Unit

CTO - Conventional Takeoff

D

dc - Direct current

DG - Directional Gyro

DWG - Display Waveform Generator

E

EAC - Expected Approach Clearance

ECCM - Electronic Counter-Countermeasure

ECM - Electronic Counter Measures

EHT - Extra High Tension

ELR - Engine Life Recorder

EM - Electro Magnetic

ETA - Estimated Time of Arrival

F

FEBA - Forward Edge of the Battle Area

FCF - Functional Check Flight

FCLP - Field Carrier Landing Practice

F.C.U. - Fuel Control Unit

FL - Flight Level

FM - Frequency Modulation

FMLP - Field Mirror Landing Practice

FOD - Foreign Object Damage

GLOSSARY (CONT)

FRL – Fuselage Reference Line

G

G – Gravity

GCA – Ground Control Approach

GCI – Ground Control Intercept

GTS – Gas Turbine Starter

H

HC – Hand Controller

HP – High Pressure

HT – Height

HUD – Head Up Display

Hz – Hertz

I

IAS – Indicated Air Speed

I/C – Intercommunication

ICAO – International Civil Aviation Organization

IF – Inflight

IFF – Identification Friend or Foe

IFR – Instrument Flight Rules

IGV – Inlet Guide Vane

IMN – Indicated Mach Number

INS – Inertial Navigation System

INAS – Inertial Navigation and Attack System

IP – Identification Point – Inertial Platform

I/P – Identification of Position

ISA – International Standard Atmosphere

J

JPT – Jet Pipe Temperature

JPTL – Jet Pipe Temperature Limiter

K

KCAS – Knots, Calibrated Airspeed

KHz – KiloHertz

KIAS – Knots, Indicated Airspeed

L

LDGP – Low Drag General Purpose (bomb)

LOX – Liquid Oxygen

LP – Low Pressure

LPH – Landing Platform Helicopter

LSO – Landing Signal Officer

M

MAC – Mean Aerodynamic Chord

MAG – Magnetic

MAG VAR – Magnetic Variation

MDC – Miniature Detonating Cord

MFS – Manual Fuel System

MHz – MegaHertz

MSL – Mean Sea Level

N

NAMT – Naval Air Maintenance Trainer

NATOPS – Naval Air Training and Operating Procedures Standardization

NCP – Navigation Control Panel

ND – Nose down

NDC – Navigation Display and Computer

NLG – Nose Landing Gear

NM – Nautical Miles

NOTAMS – Notice To Airmen

N/S – North and South

NU – Nose Up

NWIP – Naval Warfare Intercept Procedures

NWP – Naval Warfare Publications

NWS – Nose Wheel Steering

NC – Navigation Control

GLOSSARY (CONT)

O

OAT – Outside Air Temperature

OFT – Operational Flight Trainer

OTC – Officer in Tactical Command

P

PC – Power Control

PCU – Power Control Unit

PEC – Personal Equipment Connector

PIO – Pilot Induced Oscillation

PMBR – Practice Multiple Bomb Rack

PPC – Present Position Computer

PROP – Proportioner

PRL – Pressure Ratio Limiter

PSI – Pounds per Square Inch

PSU – Power Supply Unit

Puffer ducts – Reactor Control Valves

PLF – Precise Local Fix

Q

Q – Dynamic Pressure, psf

QA – Quality Assurance

QRB – Quick Release Box

R

RAT – Ram Air Turbine

RBI – Range and Bearing Indicator

RESCAP – Rescue Combat Air Patrol

REV – Reversionary Navigation Modes

RF – Random Fix

RPS – Rudder Pedal Shaker

RΘ – Range and bearing

RVL – Rolling Vertical Launching

RVTO – Rolling Vertical Takeoff

S

SAR – Search and Rescue

SAS – Stability Augmentation System

SATS – Short Airfield for Tactical Support

SIF – Selective Identification Feature

SL – Short Landing

SSR – Secondary Surveillance Radar

Stab Aug – Stability Augmentation

STBY – Standby

STO – Short Take Off

STOL – Short Take Off and Landing

T

TACAN – Tactical Air Navigation

TAS – True Airspeed

TET – Turbine Entry Temperature

TOP – Tanks Over Pressurized

TRANS – Transfer

TVC – Thrust Vector Control

U

UC – Under Carriage (Landing gear)

UHF – Ultra High Frequency

U/P – Unplanned

U/PD – Unplanned Destination

V

VFR – Visual Flight Rules

VHF – Very High Frequency

VL – Vertical Landing

VSI – Vertical Speed Indicator

V/STOL – Vertical/Short Takeoff and Landing

VTO – Vertical Take Off

VTOL – Vertical Take Off and Landing

W

WAC – Weapon Aiming Computer

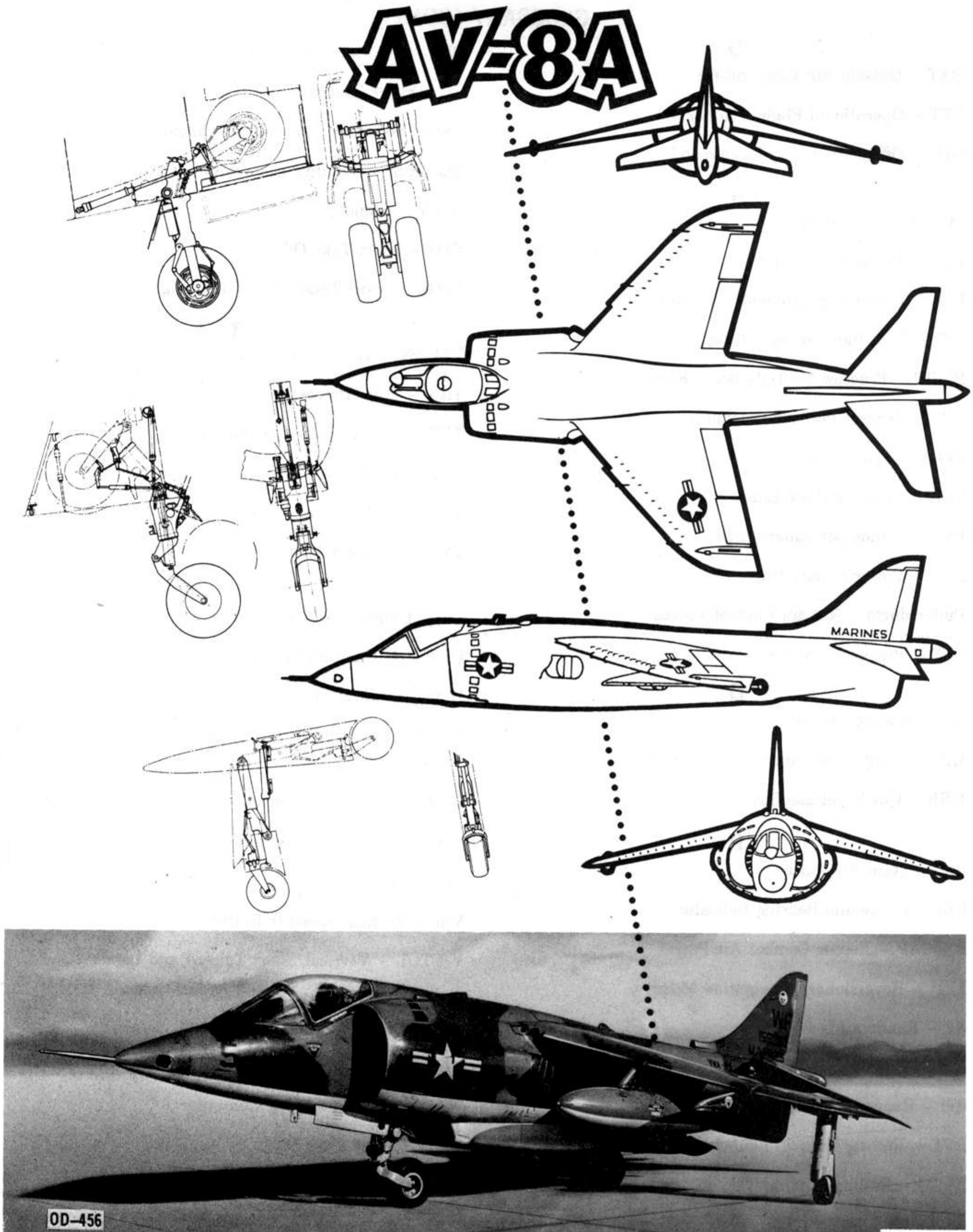
WOD – Wind Over Deck

WOW – Weight On Wheels

WST – Weapon Systems Trainer

X

XFMR-RECT – Transformer-Rectifier



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SECTION I
AIRCRAFT

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NOTE

All references in this manual quoted in knots will equate to IAS.

PART 1 GENERAL DESCRIPTION

AIRCRAFT

DESCRIPTION

The AV-8A Harrier aircraft (see figure 1-1) is a transonic, single cockpit, single engine, jet propelled day night tactical fighter built by Hawker Siddeley. The aircraft is designed for close air support, intermediate range intercept, and attack missions to deliver conventional weapons. A navigation attack system is provided, to increase the overall effectiveness of the aircraft as a weapons system. The aircraft is powered by a Rolls Royce axial flow, twin spool turbo fan engine. Four exhaust nozzles, can be positioned and controlled for V/STOL operation. The aircraft features shoulder mounted swept back wings with trailing edge flaps and ailerons. The longitudinal and lateral flight controls are hydraulically powered to provide the desired control effectiveness throughout the speed range. The hydraulic system has back up features for emergency operation. High pressure nitrogen is provided for the landing gear system during emergencies. The cockpit is pressurized and enclosed by a sliding canopy. A Martin Baker Type 9A MK1 rocket assisted seat is provided for pilot ejection.

AIRCRAFT DIMENSIONS

The approximate dimensions of the aircraft are as follows:

Wing Span - 25 feet 4 inches

Length - 46 feet 1 inch

Height (top of fin) - 11 feet 3 inches

AIRCRAFT GROSS WEIGHT

The approximate gross weights of the aircraft are as follows. For specific gross weights refer to the handbook of Weight and Balance Data NAVAIR 01-1B-40.

Estimated Operating Weight (Basic airplane plus the weight of oil, unuseable fuel, and pilot)

158384 thru 158395	12,330 pounds
158694 thru 158711	12,460 pounds
158948 thru 158977	12,315 pounds

Estimated Takeoff Gross Weight (Estimated operating weight plus weight of internal fuel)

158384 thru 158395	17,490 pounds
158694 thru 158711	17,620 pounds
158948 thru 158977	17,475 pounds

MAIN DIFFERENCES

For technical modifications incorporation, and main differences between AV-8A aircraft, refer to Technical Directive Summary, figure 1-2.

SERIAL NUMBERS

Refer to Serial Numbers illustration figure 1-3 for aircraft assigned serial numbers.

ARMAMENT

The aircraft is equipped to carry and deliver an assortment of conventional stores from 4 wing stations and a center line station. Infrared missiles can be carried on two outboard wing stations. Two gun pods, each containing a 30MM Aden gun, can be attached on each side of the lower fuselage. Refer to tactical manual, NAVAIR 01-AV8A-1T for additional information concerning armament deployment.

AIRCRAFT SECURITY REQUIREMENTS

The occasion may arise when it will be necessary to land at a civilian field that does not have a military installation associated with it, or when the aircraft is to be presented in a static display. In order to prevent the compromise of classified information, accidental damage to the aircraft, or injury to observers, the following guide lines are provided.

Static Displays

1. Dummy missiles may be carried on displays.
2. Dummy conventional stores may be carried, in any combination.
3. External tanks must be secured.
4. Canopy must be secured and locked.
5. All external access areas must be secured.
6. No smoking rules must be enforced.

RON at Civilian Fields

1. Make necessary security guard arrangements.
2. Secure all external access areas.
3. Secure and lock canopy.

COCKPIT

DESCRIPTION

The cockpit is an enclosed, pressurized, climate controlled area, that contains a vertically adjustable ejection seat. The main instrument panel is arranged to receive the head up display unit and the navigation display and computer in the center of the panel. Also contained in the center, are warning lights and navigational aids. On the left side is the armament and missile control panels, in addition to the flight information indicators. The right side contains primarily engine operating indicators. The left console is provided with flight control, landing gear position indicators, throttle and nozzle quadrant and pressure indicators. The power reset and engine start switches, communication control panels, oxygen indicators and anti-G suit control valves are located on the right console. The cockpit is also provided with a warning/caution lights panel to alert the pilot for immediate action and for advisory warnings. See figure A-1, appendix A.

PART 2 SYSTEMS

AIR CONDITIONING AND PRESSURIZATION SYSTEM

DESCRIPTION

The air conditioning and pressurization system includes cockpit air conditioning and pressurization, canopy sealing, windshield/camera window washing, equipment air conditioning, and anti-G suit pressurization (figure 1-4).

CAUTION

The FLOOD position of the cabin air switch should be used with discretion due to the high temperature involved.

COCKPIT AIR CONDITIONING AND PRESSURIZATION

Sixth stage engine high pressure compressor bleed air enters a fail-open shutoff valve, a filter and then passes through a ram air cooled heat exchanger (precooler) to the air conditioning compressor. Compressor discharge air passes through a ram air cooled heat exchanger (intercooler) to the air conditioning turbine. Turbine discharge cold air is warmed by mixing with bleed air furnished through a valve regulated by the cockpit temperature controller and a duct temperature sensor. The air is further heated for defogging through a separate manual engine bleed air control valve when the cabin air switch is placed to FLOOD or automatically when cockpit altitude exceeds 38,000 feet. The conditioned air then passes through a water separator to the distribution manifolds and louvers. Cockpit pressure scheduling (figure 1-5) is maintained by two pressure regulator valves in the cockpit forward and aft pressure bulkheads. Discharge air from the forward pressure regulator valve is ducted to cool the inertial platform unit. Ram air is automatically supplied to the cockpit if the air conditioning supply fails or is turned off. If cockpit altitude exceeds 32,000 feet the CP light on the warning/caution lights panel will illuminate.

COCKPIT ALTIMETER

A cockpit altimeter is mounted on a bracket below the right windshield (figure A-1, appendix A) and indicates cockpit pressure altitude from 0 to 45,000 feet.

GENERAL ARRANGEMENT

TYPICAL

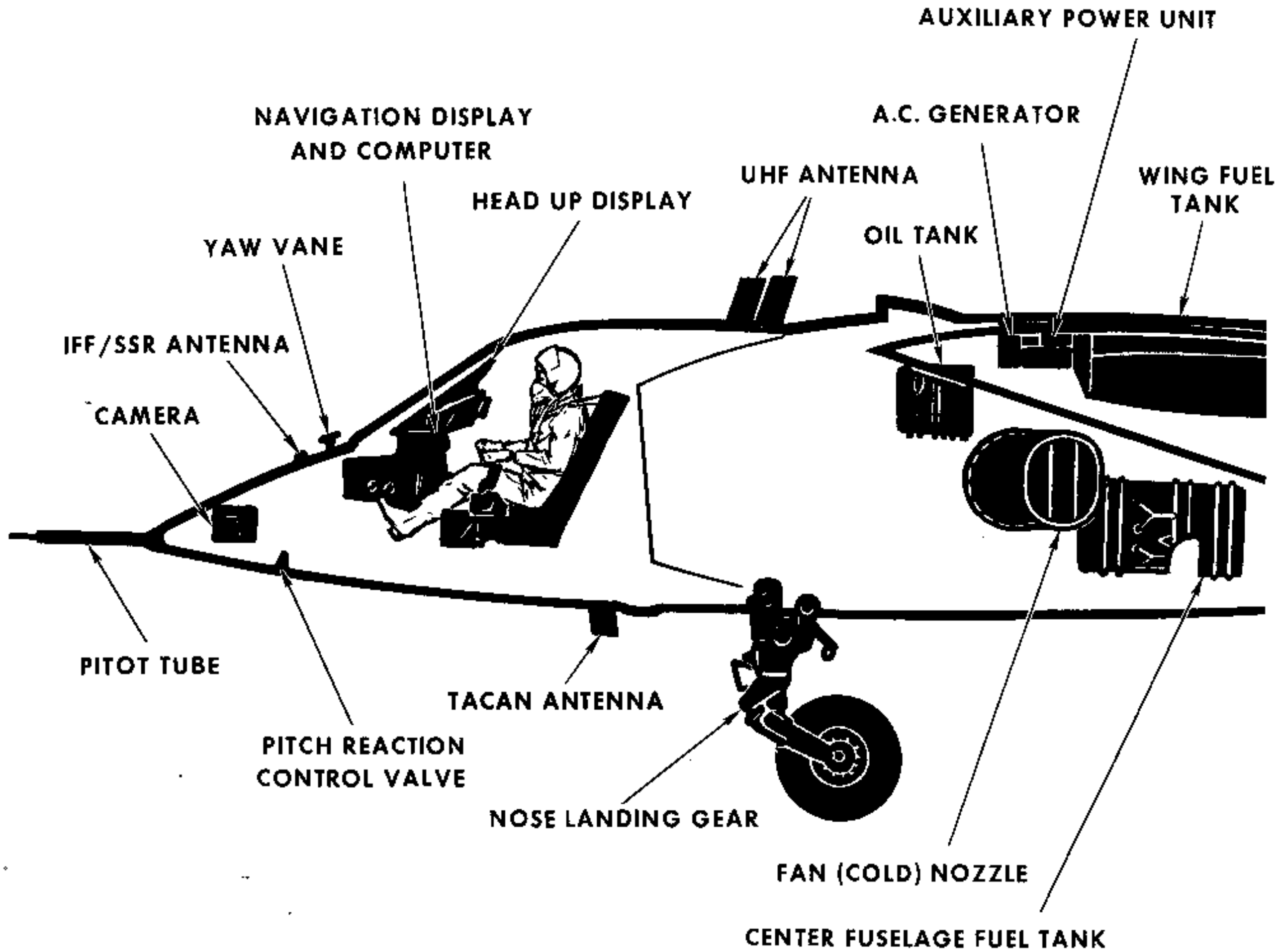


Figure 1-1 (Sheet 1 of 2)

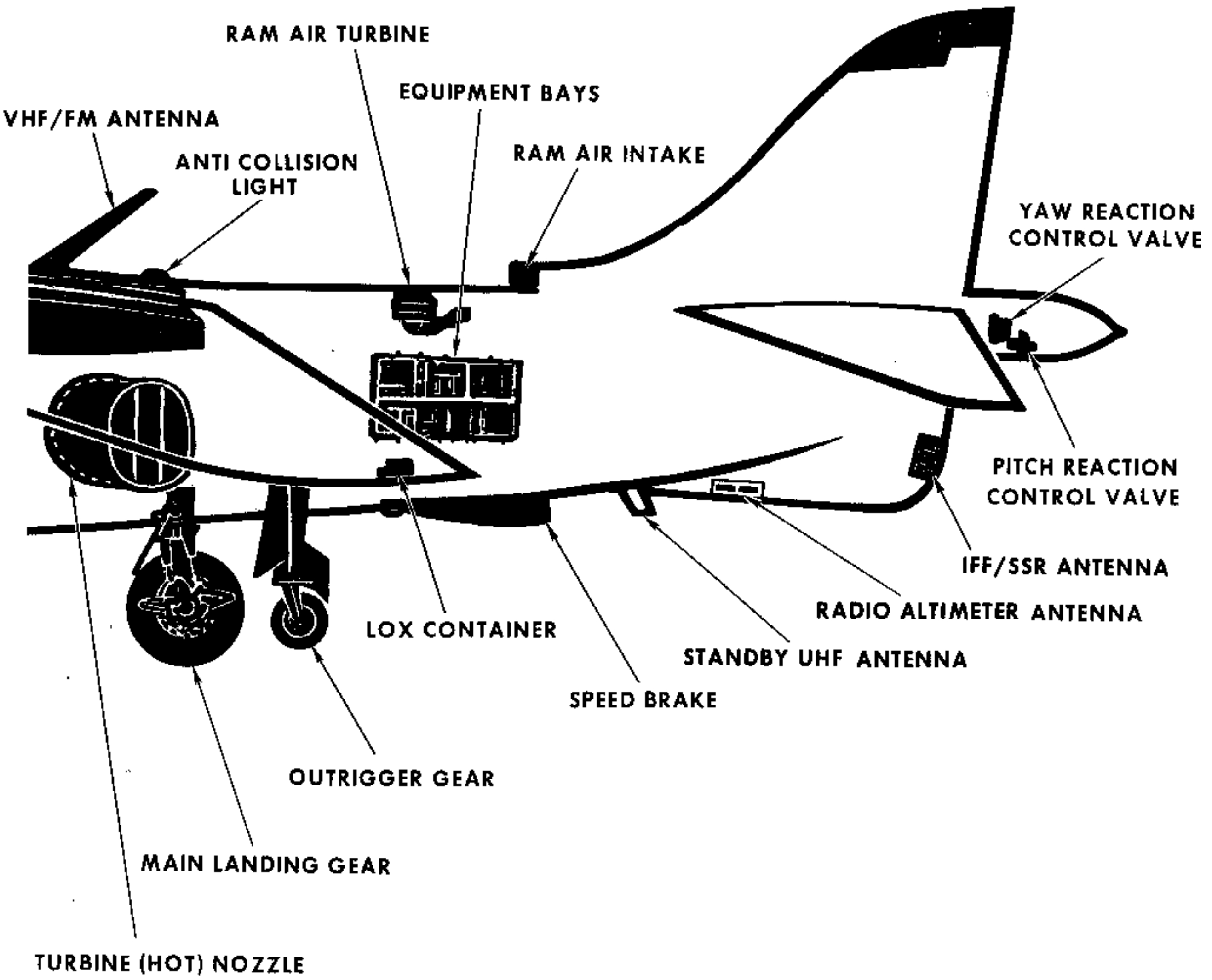


Figure 1-1 (Sheet 2 of 2)

TECHNICAL DIRECTIVE SUMMARY

In accordance with BUWEPS Instruction 5215.8, Technical Directive concerning modification, inspection, maintenance or operating procedures and limits of all Naval aircraft and related equipment are titled as follows:

Airframe Change (AFC) or Airframe Bulletin (AFB)
Power Plant Change (PPC) or Bulletin (PPB)
Aviation Armament Change (AAC) or Bulletin (AAB)
Avionics Change (AVC) or Bulletin (AVB)
Accessory Change (AYC) or Bulletin (AYB)
Support Equipment Change (SEC) or Bulletin (SEB)
Photographic Change (PHC) or Bulletin (PHB)
Air Crew System Change (ACC) or Bulletin (ACB)
Air Launched Missile Change (AMC) or Bulletin (AMB)
Target Control System Change (TCC) or Bulletin (TCB)
Clothing and Survival Equipment Change (CSEC) or Bulletin (CSEB)
Aircraft Service Change (ASC)
Air Crew Survival Equipment Bulletin (ACSEB)

NOTE

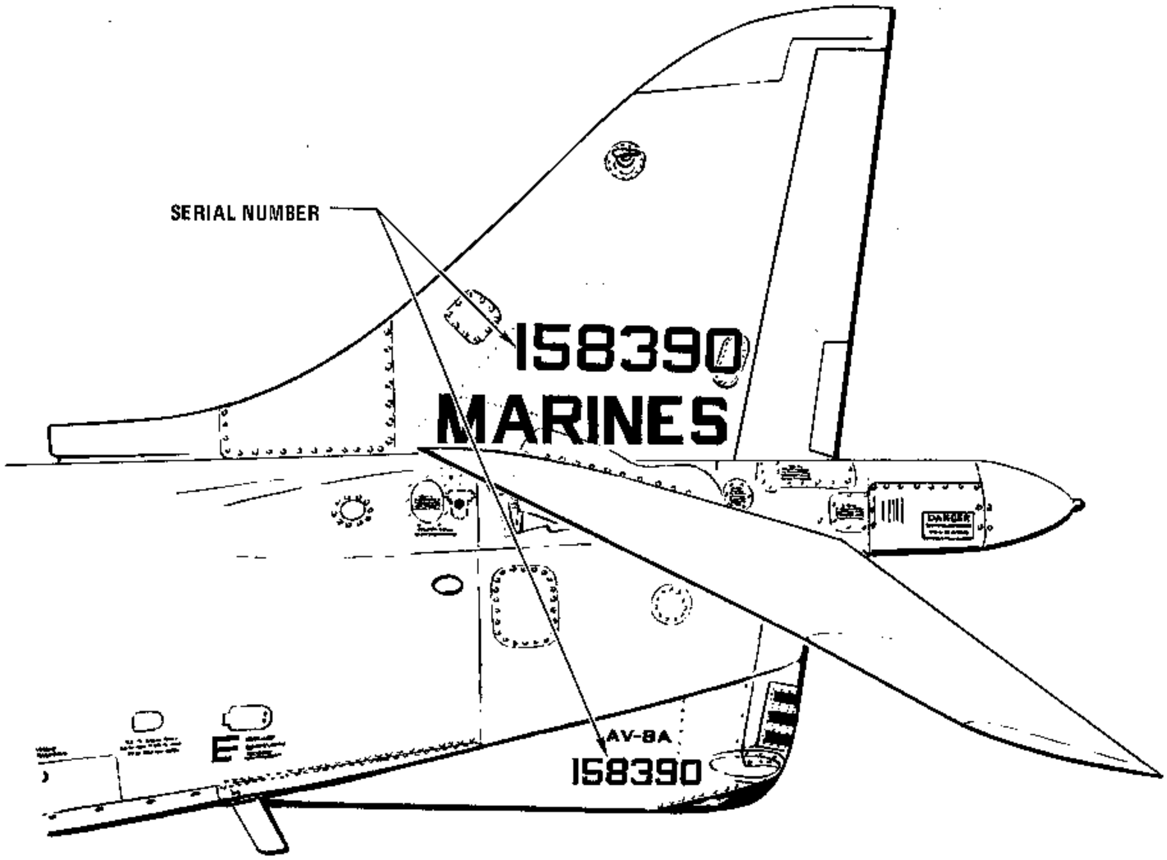
THE FOLLOWING AFC'S FORM A PART OF AIRPLANE 13 (158694) CONFIGURATION AND HAVE BEEN INCORPORATED IN PRODUCTION: 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 15, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26 (PART 1 AND 3 THRU 7), 28, 29, 30, 36, 37, 40, 45, 49, 50, 51, 52, 53, 54, 56, 57, 58, 59, 60, 61, 62, 63, 64, 66, 67, 69, 70, 71, 72, 79 (PART A), 80, 84, 90, 91, 103.

TECHNICAL DIRECTIVE	ECP	TITLE	PRODUCTION EFFECTIVITY	RETROFIT EFFECTIVITY
	528	Incorp 12 kva single gen system	158948 and up	none
AFC 82	661	Adds charging gages for PC–1, PC–2 and emergency accumulators	158958 and up	all
AFC 83	665	Removes master caution function from IFF warning	158952 and up	all
AFC 85	678	Adds bendix LOX convertor	158957 and up	all
AFC 95	617	Provisions for vent air to standard USN exposure suit	158962 and up	all
AFC 96	485 660	Incorp AN/APN–194 radar alt	158958 and up	all
AFC 384	691	Modifies engine temp limiter		

AV8A–1–(38)B

Figure 1–2

BLOCK NUMBERS



BLOCK 1 (29)

158384 thru 158395
158694 thru 158710

BLOCK 2 (30)

158711
158948 thru 158976

BLOCK 3 (30)

158977
159230 thru 159258

Figure 1-3

AV8A-1-(53)A

AIR-CONDITIONING AND PRESSURIZATION SYSTEM

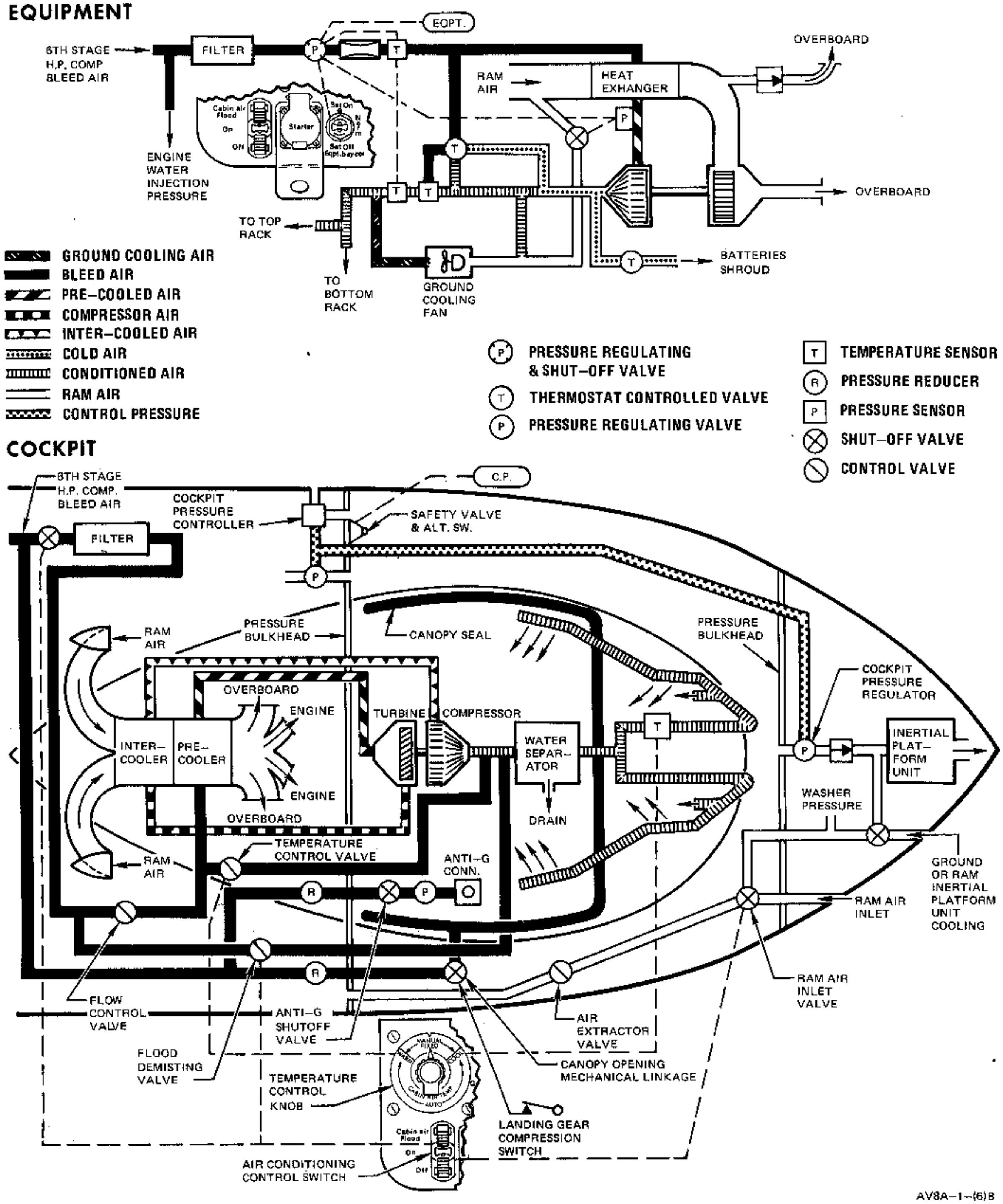


Figure 1-4

CANOPY SEAL

The canopy seal is automatically inflated by engine bleed air through a pressure reducer when a compression switch on the main landing gear is opened as the strut extends on takeoff.

EQUIPMENT AIR CONDITIONING

Sixth stage engine high pressure compressor bleed air passes through a filter to an equipment air conditioning shutoff and pressure regulating valve. This valve is controlled by the equipment bay cool switch on the right console. The valve is opened by placing the switch to SET ON momentarily and is closed by placing the switch to SET OFF momentarily. The valve will also open if dc power is lost. The valve will close when equipment rack temperature exceeds 55°C and inlet bleed air exceeds 160°C or if heat exchanger exit pressure exceeds 70 ±2 psi. If the valve is closed the EQPT light on the warning/caution lights panel will illuminate. With the valve open the bleed air passes through a venturi to a heat exchanger cooled by ram air from the intake at the base of the vertical stabilizer. From the heat exchanger the air passes through a turbine which drives a fan in the ram air exhaust thus increasing the ram air flow, particularly during ground operation, and further cooling the bleed air by forcing it to do work. A portion of this turbine discharge cold air is diverted to the batteries cooling shroud. The remaining turbine discharge cold air is then warmed to the proper temperature by mixing with hot bleed air diverted prior to the heat exchanger and regulated by a thermostatically controlled valve. A portion of this conditioned air is bypassed through a ground cooling fan when AC power is supplied. The conditioned air is then piped to the top and bottom equipment racks.

ANTI-G

The anti-G system delivers 6th stage high pressure compressor bleed air through a pressure reducer, a shutoff valve, a control valve, and the personal equipment connector on the ejection seat to the anti-G suit. The temperature of the bleed air is reduced by radiation from the piping. With the system selected ON and the engine running, the suit remains deflated up to approximately 1½ G. Above this acceleration, the air pressure applied to the suit increases in proportion to increasing G. While acceleration is constant, the suit remains inflated at a constant pressure and, as acceleration decreases, the suit will deflate in proportion to the decrease in G.

Anti-G Shutoff Lever

The shutoff lever on the right console (figure A-1, appendix A) permits selection of the anti-G system ON or OFF.

Anti-G Control Valve

The control valve aft of the shutoff valve may be set to H or L. The H position permits a maximum of 7 psi and the L position permits a maximum of 5½ psi to be applied to the anti-G suit. A button on top of the valve allows the pilot to manually inflate his suit for test or fatigue relief.

WINDSHIELD/CAMERA WINDOW WASHER

A 1-gallon tank of cleaning fluid in the nose is pressurized by engine bleed air to 8 psi. Camera window washing is activated for approximately 6 seconds after actuation of the nose landing gear up microswitch. Windshield washing is activated for approximately 6 seconds when the WASH pushbutton on the left instrument panel (figure A-1, appendix A) is pushed and released.

NORMAL OPERATION

COCKPIT AIR CONDITIONING AND PRESSURIZATION

With the cabin air switch ON and the cabin air temperature knob in the AUTO sector, movement of the knob clockwise increases cockpit temperature. With the knob in the MANUAL FIX sector, clockwise movement decreases the temperature. In the AUTO mode cockpit temperature is regulated while in the MANUAL mode the position of the temperature regulating valve is directly controlled. The AUTO mode is normally used. Defogging is accomplished by placing the cabin air switch to FLOOD.

CAUTION

> The FLOOD position of the cabin air switch should be used with discretion due to the high temperatures involved.

CANOPY SEAL

The canopy seal operation is automatic.

EQUIPMENT AIR CONDITIONING

If EQPT caution light is illuminated with the engine running, momentarily actuate the equipment bay cool switch to SET ON. Operation of the system is automatic.

ANTI-G

Operation is automatic with the engine running and the anti-G shutoff lever ON.

COCKPIT PRESSURE SCHEDULE

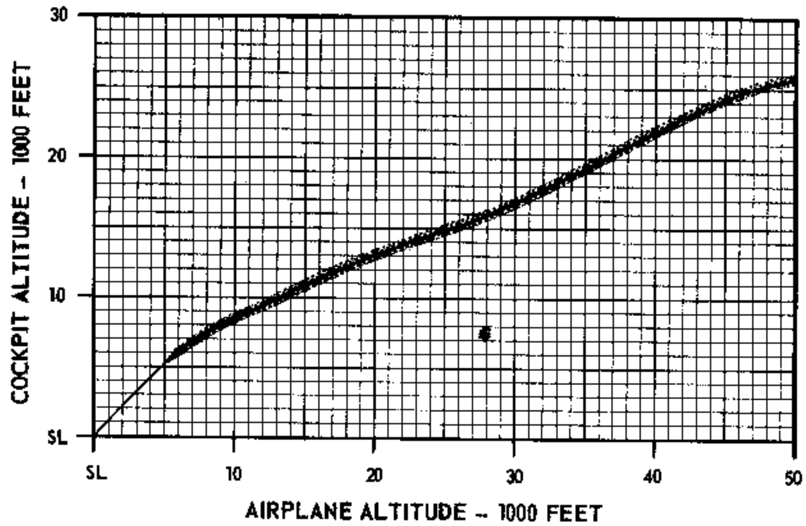


Figure 1-5

WINDSHIELD/CAMERA WINDOW WASHER

Camera window washing is automatic as the landing gear retracts. Momentary actuation of the WASH button cycles the windshield washer.

EMERGENCY OPERATION

COCKPIT AIR CONDITIONING AND PRESSURIZATION

If automatic temperature regulation fails, the temperature may be adjusted directly by rotating the cabin air temperature knob so that the MANUAL sector is under the pointer. Ram air is automatically supplied if the system fails or if the cabin air switch is placed OFF. The cabin air temperature knob must be held fully to the right or left until the desired temperature is reached.

CANOPY SEAL

There is no canopy seal emergency procedure in flight. If canopy seal remains inflated on the ground (failure of main landing gear compression switch), it should deflate when the canopy release handle is pulled.

EQUIPMENT AIR CONDITIONING

Ram air cooling is automatically supplied if the normal system fails or is turned OFF.

ANTI-G

If the system malfunctions, disconnect the anti-G suit and place the anti-G shutoff lever to OFF for the remainder of the flight.

WINDSHIELD/CAMERA WASHER

There is no emergency method of operation.

LIMITATIONS

The following airspeed/altitude limitations should be observed when operating with ram air equipment cooling:

Below 5,000 feet - 0.7 Mach maximum
5,000 to 10,000 feet - 0.8 Mach maximum
10,000 to 15,000 feet - 0.9 Mach maximum

AIR DATA COMPUTER

The air data computer receives inputs from the pitot-static system and the total temperature probe and furnishes the following outputs:

a. Engine pressure ratio limiter - 10,000 feet altitude signal.
b. Aileron stop solenoid - 250 knots IAS signal.
c. Autostabilizer - 250 knots IAS signal.
d. Navigation display and computer - 200 knot TAS signal and TAS.
e. IFF - Pressure altitude
f. Weapon aiming computer - Pressure altitude, IAS, and TAS.
g. Head-up display - Pressure altitude, IAS, and Mach.
h. Rudder pedal shaker and wheels warning light - 165 knots.
i. Q-feel - 250 knot IAS signal.

ADC BIT TEST

Two test buttons are provided for the ADC on the left windshield frame.

TOTAL TEMPERATURE PROBE

The total temperature probe is mounted on the left side of the vertical stabilizer and furnishes temperature data to the air data computer and the calibrated outside air temperature/outside air temperature gage in the cockpit. The probe heater is energized through a microswitch on the landing gear as the strut extends on takeoff.

NORMAL OPERATION

With the ADC switch ON, operation of air data computer is automatic. With HUD on, press ADC BIT 1 (rear) button. IAS winds up to 180 ±8 knots. Altitude (with 29.92 in. hg. set on HUD control panel) winds up to 9300 ±150 feet. Set HUD to GEN mode, select Mach and press ADC BIT 2, Mach winds up to 0.50 ±0.03 Mach. Altitude winds up to 30,950 ±300 feet.

EMERGENCY OPERATION

There is no emergency operation of the air data computer.

LIMITATIONS

There are no limitations for the air data computer.

BRAKE SYSTEM

DESCRIPTION

The twin-wheel main landing gear is equipped with hydraulic operated disc brakes. The brakes operate simultaneously and progressively as either brake pedal is depressed. Cables from each brake pedal and the brake lock lever, are attached to a lever box. A common cable connects the lever box to a brake control valve. An anti-skid system and parking brake are also incorporated into the normal brake system. Hydraulic pressure is supplied by the PC-1 system. A nitrogen charged accumulator provides sufficient hydraulic pressure for normal and anti-skid braking if PC-1 pressure is not available. Two hydraulic pressure indicators located on the left console, provide brake accumulator pressure, and applied brake pressure. The BRAKE ACC indicator has a range from 0 to 4, multiplied by 1000. The BRAKE PRESS indicator has a range from 0 to 2, multiplied by 1000. If excessive heating occurs in a main wheel, a fusible plug melts and the tire will deflate.

PARKING BRAKE

The brake lock lever (outboard of the throttle) when engaged with a stop plate, opens the brake control valve and closes the anti-skid valve, to retain pressure at the brake. Pressure must first be applied to the brake pedals, before the brake lock can be pulled aft to engage the spring loaded trigger against the stop plate. To unlock the brakes, depress the trigger and move lever forward past the stop plate.

ANTI-SKID SYSTEM

The anti-skid system is an electro-hydraulic system that controls hydraulic pressure to the brakes to prevent skid above 15 knots. An impending skid is detected by measuring wheel deceleration. This is provided by an exciter ring, that rotates with the wheel and a magnetic motion sensor located in close proximity; both are contained on the right brake unit. As the exciter ring rotates, the sensor develops an electrical signal at the frequency of the wheel speed. This signal is routed to a control unit which develops and transmits a signal to operate the anti-skid valve. The anti-skid valve, when operating in conjunction with the control unit, regulates brake pressure. The anti-skid system is controlled by an anti-skid switch labeled ANTI-SKID ON/ANTI-SKID OFF N.W.S. ON which is located left of the main instrument panel. Power is supplied to the anti-skid system when the main landing gear is down, the parking brake is disengaged, and the anti-skid switch is ON.

NORMAL OPERATION

The brakes are conventionally operated by toe action on the rudder pedals. Brake pressure is directly controlled by the amount of pedal depression. With the pedal depressed, hydraulic fluid is passed through the open brake control valve to the anti-skid control valve, which opens to apply normal brake pressure. When anti-skid is selected, 28 volt dc is supplied by the No. 2 bus (dual generator system), and the main 28 volt dc bus (single generator system), to the control unit and the anti-skid valve. An amber skid light on the warning/caution lights panel illuminates, when the landing gear is extended and anti-skid system is OFF. An ANTI-SKID test button, left of the main instrument panel allows the pilot to test the system prior to approach and landing. With the landing gear down and brake pressure normal (1350 ±50 psi), apply continuous brake pressure; press and release test button (located above the anti-skid switch), check that brake pressure drops below 200 psi (1 to 3 seconds) then starts to build up. The pressure should be 1350 psi after 8 to 11 seconds. If the system does not recover during test, the system is malfunctioning. This test can be made on the ground, but due to pressure release the aircraft may roll forward a few feet.

CAUTION

Below 15 knots (anti-skid inoperative) it is easy to inadvertently skid the main wheels by harsh use of the brakes.

EMERGENCY OPERATION

There is no emergency operation associated with the normal or anti-skid brake system. The brake system accumulator automatically takes over whenever PC-1 system hydraulic pressure drops below 2950 psi. However, brake accumulator pressure can be conserved by turning anti-skid off, using nozzle braking and refrain from pumping the brakes. Do not taxi.

LIMITATIONS

Conventional braking is not available below 1250 psi. Wheel braking must not be used in conjunction with powered nozzle braking. The parking brake, when engaged, maintains pressure on the brakes for approximately 12 hours.

CANOPY SYSTEM

DESCRIPTION

The cockpit area is enclosed by a sliding type canopy which consists of a shell molded from a single piece of transparent plastic and mounted in a metal frame. The canopy is mounted on rails which slope upward toward the rear of the aircraft. The canopy is pre-loaded to the open position by an elastic cord and pulley system. A canopy opening brake is encountered by the canopy before it is fully opened. The brake dissipates the initial momentum imparted by the elastic cords. Except for the aid provided by the elastic cord pre-load, the canopy is normally opened and closed manually without hydraulic or pneumatic boost. The canopy operating mechanism is mechanically linked to a boarding step on the right forward fuselage so that as the canopy opens the step extends and as the canopy closes the step retracts. When moved to the fully closed position, the canopy is automatically locked by two latches at the intersection of the lower leading edge of the canopy bow and the windshield frame. Each lock has an associated locking indicator in the cockpit. External and internal controls are provided for both normal and emergency operation. The controls for normal operation are the external normal canopy release handle, the internal canopy release handle and the canopy bow handles. The release handles unlock the canopy and the canopy bow handles are used as grips to open and close the canopy. Once unlocked externally, the canopy can be opened and closed by means of the boarding step.

Emergency operation of the canopy consists of detonating a small explosive charge of miniature detonating cord (MDC) which serves to break away or shatter the molded plastic shell. After the shell is removed, the pilot can depart through the canopy frame during ground egress, or the ejection seat is allowed to clear the aircraft during ejection without having to cut through the canopy shell. The MDC is a thin explosive cord attached around the edge of the plastic shell near the canopy frame and also looped around the center of the canopy just above the pilot's helmet. The MDC is routed to a detonator at the rear of the canopy. The explosive is fired by withdrawing the detonator sear by means of one of the three emergency controls or automatically on ejection. While on the ground a safety pin is inserted in the detonator. The pin must be removed before flight and stowed in the storage provision on the right side of the detonator cover. The emergency canopy controls are the two external canopy jettison handles, one on each side of the aircraft on the forward canopy frame, and the MDC firing handle inside the cockpit. A canopy seal, routed over the canopy sills and around the windshield arch, is automatically inflated by a solenoid operated pneumatic valve whenever the aircraft becomes airborne. The valve is also mechanically operated to deflate the seal whenever one of the normal canopy controls is operated. This is to ensure seal deflation in case of electrical failure.

EXTERNAL CANOPY CONTROLS

External Normal Canopy Release Handle

The external NORMAL CANOPY RELEASE handle is on the left side of the fuselage below the windshield. Operating a push-type latch causes the handle to pop out from a slot in the fuselage, and then pulling down on the handle releases the two canopy locks. After the canopy is unlocked, the elastic cord pre-load causes the canopy to slide back to a lightly braked position while partially extending the boarding step. Downward pressure on the step then will fully open the canopy.

INTERNAL CANOPY CONTROLS

Internal Canopy Release Handle

The internal canopy release handle, labeled HOOD, is on the right side of the main instrument panel. Pulling out on the handle releases the canopy locks to allow the canopy to be moved manually.

Canopy Bow Handles

Two canopy bow handles are on the underside of the canopy bow on either side of the rearview mirror. After the canopy is unlocked, the handles afford a means of opening or closing the canopy from within the cockpit.

Canopy Lock Indicators

Two canopy lock indicators are provided, one just forward of the left canopy lock (forward of the TAKE-OFF checklist) and one just forward of the right canopy lock (forward of the LANDING checklist). Each indicator contains a window through which can be seen a white pointer. When the tip of the white pointer is aligned with the index labeled LOCKED, the canopy lock is in the locked position. To assure both locks are locked, both indicators must be checked.

EXTERNAL EMERGENCY CANOPY CONTROLS

External Canopy Jettison Handles

Two external canopy jettison handles are provided for ground removal of the plastic canopy shell to aid in ground egress. The handles are stowed within yellow and black striped access doors marked RESCUE on the lower forward canopy frame on each side of the aircraft (figure 1-6). Access to a handle is gained by pressing a push-type latch aft of the door. The door hinges open exposing the loop-type handle which is formed by looping the end of a 4 foot cable and covering the loop handle with alternate yellow and black sleeving. The remaining length of cable is folded and enclosed in plastic sleeves for storage and the other end connects to a MDC detonator sear cable. When the cable is payed out from its stowed position and the handle is pulled toward the nose of the aircraft, the MDC is fired to remove the plastic canopy shell.

CANOPY EMERGENCY CONTROLS/ DETONATOR LOCATIONS

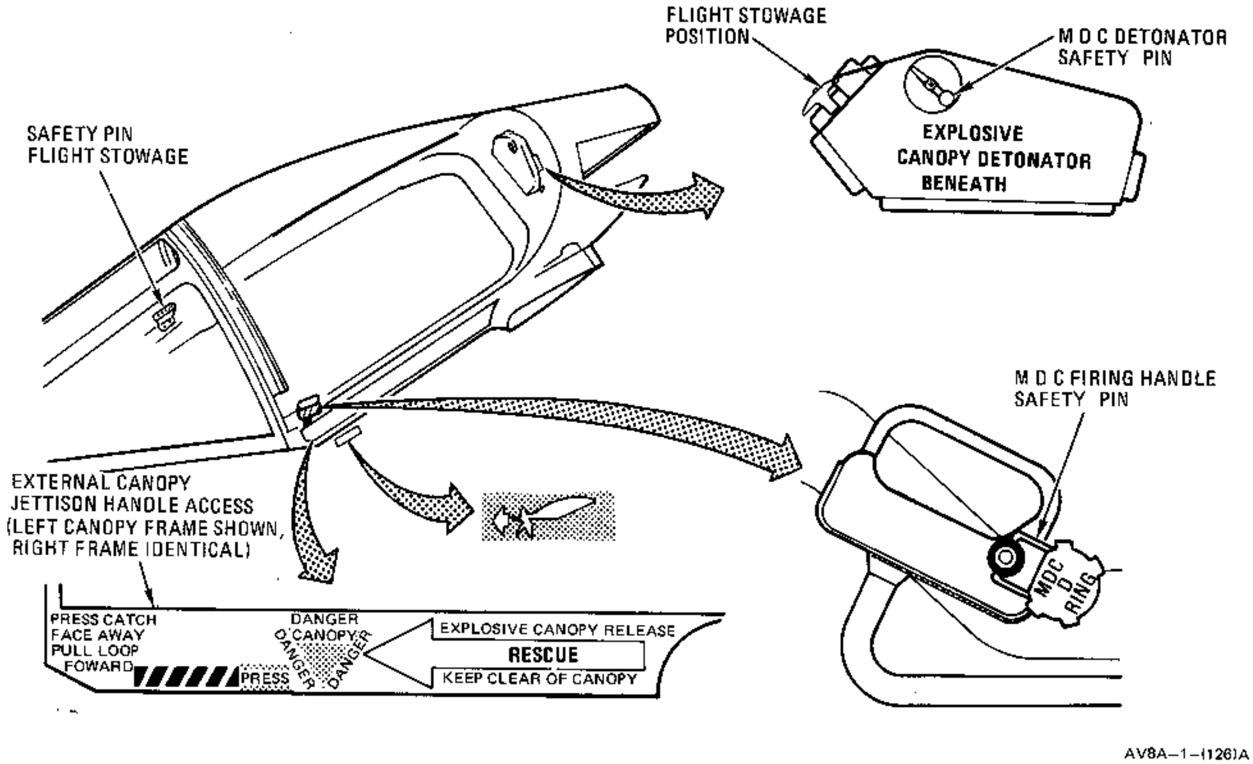


Figure 1-6

INTERNAL EMERGENCY CANOPY CONTROLS

MDC Firing Handle

The MDC firing handle (figure 1-6) is retained by a spring-loaded detent in a yellow and black striped housing that is welded to the defogging duct at the left forward corner of the canopy frame. The handle, also striped yellow and black, is attached to a cable which connects, after routing through a device giving 5 inches of slack, to the MDC detonator sear. After the cable slack is taken up and the handle is pulled, the MDC fires to remove the plastic canopy shell. The purpose of the cable slack is to provide clearance for the pilot's hand when the MDC fires.

NORMAL OPERATION

Normal operation of the canopy is through the use of the external and internal canopy release handles, and the canopy bow handles. Refer to applicable canopy control, Canopy System.

CAUTION

When boarding the aircraft clear area under the boarding step before pulling the external canopy release handle. Use the designated handholds and steps and do not use the air inlet duct as a step or the canopy seal for a handhold. Do not use hands on the canopy shell when opening or closing the canopy, and exercise care not to disturb the MDC pattern on the top of the canopy by contact with the flight helmet.

EMERGENCY OPERATION

The canopy cannot be jettisoned. Instead, the plastic canopy shell is shattered by firing the MDC. Emergency operation of the canopy is accomplished through use of the external canopy jettison handles or the MDC firing handle. Refer to applicable control, Canopy System. The canopy shell is shattered automatically during ejection by firing the MDC. Refer to Ejection Seat for interconnection between ejection seat and emergency canopy system during ejection.

WARNING

When an emergency handle is pulled to fire the MDC, a mild explosion results which is potentially dangerous unless proper precautions are observed. Before pulling the MDC firing handle, pull down the helmet visor (if time permits), close eyes and keep the hands and body as far away as possible from the MDC pattern on the canopy. When pulling an external canopy jettison handle, the operator should face away from the aircraft with his head down.

LIMITATIONS

The canopy must not be opened in flight. The canopy may be kept open on the ground for engine running and taxiing, provided that the engine speed is below 70% rpm. The canopy must not be opened or remain open on the ground when windspeed is above 40 knots.

WARNING

Ejection must not be attempted with the canopy open as collision between the seat and/or pilot and the canopy structure will result.

COMMUNICATION NAVIGATION IDENTIFICATION (CNI) EQUIPMENT

DESCRIPTION

The CNI equipment consists of a communication control panel, a ground intercom, a main UHF system, a standby UHF system, a UHF homer, a VHF (FM) system, an identification (IFF) system, a tacan set, and a sound recorder system.

COMMUNICATION CONTROLS

Some of the controls for the communication systems are on the communications control panel in the forward end of the right console (figure 1-8). The panel contains the switches and knobs for operation of the communication systems. The functions of the switches and knobs are described in the following paragraphs.

Function Selector Knob

This is a four-position rotary knob with positions of UHF, FM, BOTH, and STBY which is used to select the required communication facility (figure 1-7). If UHF or FM is selected, the transmitting circuits (press-to-transmit) are connected to the radio selected, regardless of the positions of the receiver audio switches. With the knob in BOTH, the UHF and VHF (FM) receivers are controlled by the receiver audio switches so that either facility or both, simultaneously, can be used. In STBY, standby UHF is selected.

Receiver Audio Switches

There are two two-position receiver audio switches labeled UHF and FM. The switches control the audio output of the selected receiver except when overridden by the function selector knob.

Tacan Audio Switch

The two-position switch labeled TACAN can be used to connect the tacan identification audio coded signal to the pilot's headset when TACAN is selected.

Ground Intercom Switch

This is a two-position switch which, when in the I/C position, provides intercommunications between the pilot and the three ground intercom positions.

Standby UHF Switch

This is a two-position switch with positions of ALT (alternate), and GUARD. In ALT, the preset alternate channel is selected. When placed to GUARD, the guard channel is selected. The standby UHF provides a line of sight range of 100 miles for every 10,000 feet of altitude.

Transmit Selector Switch

This is a two-position switch labeled ALT (alternate) and NORM (normal). Placing the switch to NORM allows transmission on the selected transmitters by depressing the microphone button on the throttle. Placing the switch to the ALT position allows transmission on the selected transmitters by use of the emergency transmitter button on upper left console, if the microphone button on the throttle is malfunctioning or is inoperative.

Standby UHF Power Selector Switch

This is a red two-position switch with positions of NORM (normal) and EMER (emergency), and is lever locked to the NORM position. The power selector switch controls power to the standby UHF set, the auto-tone on eject oscillator, and the amplifiers in the communication control panel. With the switch in NORM, power is supplied from the alert 28 volt dc bus. In EMER, power is supplied from the emergency battery No. 3 bus.

CAUTION

If the switch is left in EMER, it will run down No. 3 battery regardless of other cockpit switch positions.

Sound Recorder Switch

The sound recorder switch with positions labeled PILOT and ALL controls the signals to the sound recorder. With the switch to PILOT, only the pilot's transmissions are recorded. In the ALL position, all signals received and transmitted are recorded.

Receiver Volume Control Knob

This rotary-type knob, labeled Rx, is used to adjust the volume of incoming signals.

Ground Intercom Volume Control Knob

This rotary-type knob, labeled I/C, is used to adjust the volume of ground intercom.

GROUND INTERCOMMUNICATION

There are three ground intercom connectors on the aircraft. They are located at the rear of the right console, at the rear of the equipment bay, and behind a spring-loaded access door on the left front nozzle fairing. The latter connector can be utilized to monitor the VHF system, or either of the UHF facilities selected channels. Also, it can be used for communication between the pilot and ground personnel during engine operation. Operation of the ground intercom is controlled by the I/C switch and the I/C volume control knob on the communications control panel.

UHF COMMUNICATION SYSTEM

The UHF communication system provides air-to-air or air-to-ground radio communication and homing facilities in the UHF range, 225.0 to 399.95 MHz. The system provides line of sight transmission and reception range of approximately 250 miles from air-to-ground, and 550 miles from air-to-air, depending on the altitude. The system operates on 3500 channels spaced 50 kHz apart with a capability for 20 preset channels, plus a separate guard channel (243.0 MHz). A second receiver preset to the guard frequency (243.0 MHz) is integrated with the main receiver. This permits a listening watch to be maintained during operation of other UHF channels. After the UHF communications system is turned on and the required channels selected on the UHF control panel, the system is then controlled by the function selector knob and the receiver audio switches on the communication control panel. Controls for the UHF communication system are on the UHF control panel on the right console (figure 1-8). The controls and their functions are described in the following paragraphs.

NOTE

A frequency card holder is on the cockpit starboard wall. It is hinged outboard and by operation of a release catch it can be swung down from the stowed position to rest on the wall shelf. The fold-over frequency cards can then be referred to.

Function Selector Knob

The function selector knob is a four-position rotary knob with positions of OFF, MAIN, BOTH, and ADF. In OFF, the system is inoperative. With MAIN selected, the UHF transmitter and main receiver are operational. With the knob in BOTH, the guard receiver becomes operational in addition to the transmitter and main receiver. In ADF, the homing facility is operational in addition to the transmitter and the main receiver.

COMMUNICATIONS SWITCHING

FUNCTION SELECTOR KNOB	RECEIVER AUDIO SWITCHES				STBY UHF
	UHF		FM		
	ON	OFF	ON	OFF	
UHF	R/T	R/T	R	–	–
FM	R	–	R/T	R/T	–
BOTH	R/T	–	R/T	–	–
STBY	R	–	R	–	R/T

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Figure 1-7

Manual/Preset/Guard Selector

This is a three-position selector used to give tuning authority to the manual frequency selectors, or the preset channel selector, or to tune the transmitter and the main receiver to the guard frequency (243.0 MHz).

Preset Channel Selector Knob

This is a rotary knob used to select any one of the 20 preset channels. The selected channel number appears in the window beneath PRESET.

Manual Frequency Selector Knobs

Five frequency selector knobs are used to manually select the required frequency when the three-position selector is in manual. From left to right, the knobs change frequency in steps of 100 MHz, 10 MHz, 1 MHz, .1 MHz, and 50 kHz.

Volume Control Knob

The volume control knob is used to adjust the audio output level of the receiver.

Squelch Switch

The squelch switch is a two-position switch with positions of ON and OFF. Placing the switch to ON enables a squelch circuit to reduce main receiver background noise.

Tone Button

The tone button is a pushbutton which, when depressed, enables transmission of a 1020 Hz tone signal on the selected frequency.

UHF HOMER

The UHF homing facility is brought into operation when the function selector knob is placed to the ADF position, and either the UHF receiver audio switch or the function selector knob on the communication control panel is set to the UHF position. The vertical pointer on the UHF cross-pointer homing indicator, on the main instrument panel (figure A-1, appendix A), gives fly left or fly right indications. This enables the aircraft to home towards a transmission on the selected frequency. The horizontal pointer indicates signal strength, moving across the scale from bottom to top with increasing signal strength as the aircraft approaches the source of transmission. Two flags cover the tips of the pointers when signals are unreliably weak or when the homing facility is not functioning. A UHF homer symbol is also displayed on the head-up display (HUD) if the homer selector switch on the HUD control panel is placed to the up position.

UHF Homer Sensitivity Switch

The UHF homer sensitivity switch, adjacent to the homing indicator, has positions of MAX and MIN. The switch is placed to MAX at the start of a homing sequence, when the signal strength is low. The switch is placed to MIN when a strong signal is being received and the aircraft is near the source of transmission.

NOTE

During a homing sequence the UHF can still be used for normal communications on the frequency in use, but homing indications stop while the microphone button is depressed.

VHF (FM) COMMUNICATION SYSTEM

The VHF (FM) communication system provides communication in the VHF frequency range of 30.00 to 75.95 MHz. The system contains a main receiver and transmitter, a fix-tuned guard receiver, and has a homing capability (which is presently not used). The main receiver and transmitter operate on any one of 920 channels spaced at intervals of 50 kHz. The guard receiver is fix tuned in the 40.0 to 41.0 MHz frequency range, and is integrated with the main receiver to permit a listening watch to be maintained during the operation of other VHF channels. After the VHF system is turned on and the required frequencies are selected on the VHF control panel, the system is then controlled by the function selector knob and the receiver audio switches on the communication control panel. Controls for the VHF communication system are on the VHF control panel on the right console (figure 1-8). The controls and their functions are described in the following paragraphs.

Function Selector Knob

The function selector knob is a five-position rotary knob with positions of OFF, T/R, T/R GUARD, HOMING, and RETRAN. With the knob in OFF, power is removed from the system. Selecting T/R, switches on the transmitter and the main receiver. Selection of T/R GUARD switches on the guard receiver in addition to the transmitter and the main receiver. The HOMING and RETRAN knob positions are not used.

Frequency Selector Knobs

There are two frequency selector knobs for selecting the required operating frequency. The left knob changes frequency in steps of 1 MHz, as indicated by the first two digits of the megacycles indicator. The right knob changes frequency in steps of 50 kHz, as indicated by the last two digits of the megacycles indicator. The guard receiver is fix-tuned.

Receiver Test Pushbutton

Depressing the RCVR TEST pushbutton, with the VHF system turned on, causes a tone to be injected into the main receiver to provide an audible indication of the correct functioning of the main receiver circuits.

Volume Control Knob

The volume control knob adjusts the receiver audio output level.

Squelch Adjustment

This screwdriver adjustment adjusts the level at which main receiver signals are squelched.

TACAN SYSTEM

The tacan (tactical air navigation) system operates in conjunction with a tacan ground or airborne beacon for navigational purposes. The system provides an indication of the position of the aircraft relative to the beacon by a display of range and bearing information on the tacan indicator. The tacan information is also displayed on the range and bearing indicator on the navigation display and computer (NDC), and tacan steering is displayed on the HUD when TAC is selected on the NDC heading switch.

CNI CONTROLS AND INDICATORS

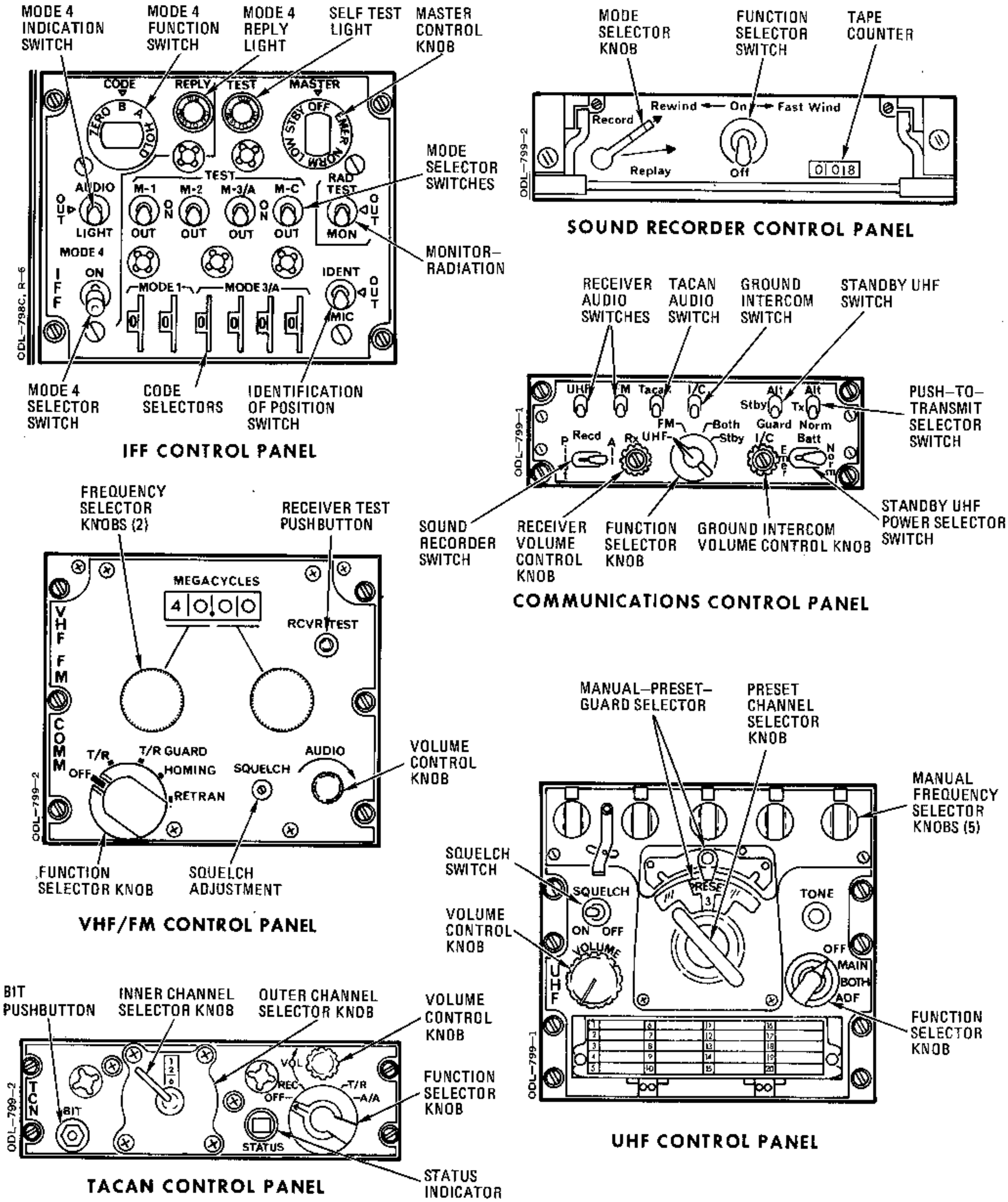

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Figure 1-8

When operating in conjunction with aircraft having air–to–air capability, the A/A mode provides line of sight distance between the aircraft. Before operating in the A/A mode, the frequencies used by each aircraft must be coordinated. The maximum distances from the beacon at which reliable tacan signals can be obtained depends on the altitude of the aircraft and the height of the beacon antenna. The tacan system operates on any one of 126 preset frequencies within the band of 926 MHz to 1213 MHz. The channels are 1 MHz apart, and each channel comprises two frequencies which are 63 MHz apart. The tacan system controls are on the tacan control panel on the right console (figure 1–21), the tacan indicator on the main instrument panel (figure A–1, appendix A), and the range and bearing indicator and the MAG/TRUE/TAC switch on the navigation display and computer (figure 1–21). The controls on the tacan control panel are the function selector knob, the channel selector knob, the volume control knob, the BIT pushbutton, and the status indicator.

Function Selector Knob

The function selector knob is a four–position rotary knob used for selecting tacan modes of operation as follows:

OFF	Deenergizes the tacan system.
REC	Tacan receives bearing signals from the ground station for display on the tacan indicator, on the HUD (if TAC is selected), and the NDC range and bearing indicator. In this mode, the range counter on the tacan indicator is covered by the OFF flag.
T/R	Tacan receives bearing signals from the tacan ground station. The ground beacon is identified by the morse code audio signal in the headset if selected on the communication control set. The tacan interrogates the ground station to establish slant range from the aircraft to the ground station. Bearing and range information is displayed on the tacan indicator and on the NDC range and bearing indicator. Tacan range is not displayed on the HUD above 14 miles.
A/A	Tacan interrogates other aircraft which contain a tacan in the air -to–air mode and tuned 63 channels apart from the channel settings of the interrogating aircraft. The interrogation provides line of sight distance information for display on the tacan indicator and the NDC range and bearing indicator.

Channel Selector Knob

The channel selector knob provides for selection of 126 tacan channels. The control consists of an outer knob used to select the hundred and tens digit of the desired channel number, and an inner knob used to select the units digit of the channel number.

Volume Control Knob

The volume control knob adjusts the volume of the tacan station identity tone signal.

BIT Pushbutton And Status Indicator

Momentarily depressing the BIT (built–in test) pushbutton initiates the BIT sequence of operation. The bearing pointer and range counters on the tacan indicator read zero, and after approximately 6 seconds GO appears on the status indicator indicating a good tacan system.

Tacan Indicator

The tacan indicator is on the main instrument panel, forward of the control stick. A bearing pointer on the indicator indicates the bearing of the received tacan station signal, and a 3–digit counter indicates the range. The compass card on the indicator indicates magnetic aircraft heading. The tacan indicator is used only as a standby instrument. Tacan information is displayed on the range and bearing indicator on the navigation display and computer when the heading switch on the NDC is placed to TAC. When the function selector knob on the tacan control panel is placed to REC, or if the range of the tacan station beacon exceeds 300 NM, the OFF flag on the tacan indicator will cover the range counter.

IDENTIFICATION SYSTEM

The identification system provides automatic identifications of the aircraft when challenged by an IFF (military), or SSR (civil secondary surveillance radar) ground radar station. In response to interrogation signals, the system also provides coded altitude data derived from the air data computer, and coded emergency signals. The coded emergency signals are transmitted automatically if the seat is ejected from the aircraft. The transmitted replies from the aircraft, in response to interrogation, are received by the ground radar station and displayed with the radar echo on the radar display unit. Proper reply indicates the answering target is friendly. Three modes of operation are provided for response to interrogation signals. These are mode 1 and mode 2, used for military identification, and mode 3/A, used for civil/military identification. Controls are provided on the IFF control panel for a fourth mode, mode 4. The codes for mode 1 and 3/A can be set in the cockpit, but the code for mode 2 must be set before flight. Mode 2 can be set from code 0000 to 7777. The controls and indicators for operation of the IFF are on the IFF control panel (figure 1–8). The controls consist of the master control knob, the mode 1, mode 2, mode 3/A, and mode 4 selector switches, the mode 1 and mode 3/A code selectors, the identification of position switch, the mode 4 indication switch (with positions AUDIO–OUT–LIGHT), the mode 4 function knob (with positions ZERO–B–A–HOLD), the monitor–radiation test enable switch, and the mode C selector switch (labeled MC–ON–OUT). The indicators on the IFF control panel consist of the self test indicator light (labeled TEST), and the mode 4 reply indicator light (labeled REPLY). There is also an IFF light on the warning/caution lights panel, above the right console.

Master Control Knob

The master control knob is a five-position rotary knob which controls the operation of the system as indicated below:

OFF	Identification system deenergized.
STBY	Power applied to the system, but replies are inhibited.
LOW	Identification system operates with reduced sensitivity.
NORM	Identification system fully operational.
EMER	Allows the system to respond with an emergency reply to interrogations in modes 1, 2, and 3/A. Upon seat ejection the emergency operation automatically becomes active.

Mode 1 Selector Switch

The three-position mode 1 selector switch controls the operation of mode 1 as follows:

M-1	Self test position. Illuminates the TEST light if mode 1 is operating properly.
ON	Enables the IFF transponder to accept mode 1 interrogations from a military ground radar station, and transmit coded reply information as selected by the two mode 1 code selector thumbwheels. The thumbwheels can select code numbers 00 to 73, allowing 32 possible codes to be transmitted in response to interrogation signals.
OUT	Disables mode 1 and no replies are transmitted to the interrogator signals.

Mode 2 Selector Switch

The three-position mode 2 selector switch controls the operation of mode 2 as follows:

M-2	Self test position. Illuminates the TEST light if mode 2 is operating properly.
ON	Enables the IFF transponder to accept mode 2 interrogations from a military ground radar station, and transmit coded reply information as selected by the four mode 2 code selector rotary knobs on the front of the IFF transponder. The mode 2 code selectors are preset before flight, and the code set in is allocated to the particular aircraft in which the transponder is installed. The code selectors can select code numbers 0000 to 7777 allowing 4096 possible codes to be transmitted in response to interrogation signals.
OUT	Disables mode 2 and no replies are transmitted to the interrogation signals.

Mode 3/A Selector Switch

The three-position mode 3/A selector switch controls the operation of mode 3/A as follows:

M-3/A	Self test position. Illuminates the TEST light if mode 3/A is operating properly.
ON	Enables the IFF transponder to accept mode 3/A interrogations from a civil/military ground radar station, and transmit coded reply information as selected by the four mode 3/A code selector thumbwheels. The thumbwheels can select code numbers 0000 to 7777 allowing 4096 possible codes to be transmitted in response to interrogation signals.
OUT	Disables mode 3/A and no replies are transmitted to the interrogation signals.

Mode C Selector Switch

The three-position mode C selector switch controls the operation of mode C as follows:

M-C	Self test position. Illuminates the TEST light if mode C is operating properly.
ON	Enables the IFF transponder to accept mode C interrogations from a civil ground radar station, and automatically transmit coded altitude information derived from the air data computer.
OUT	Disables mode C and no replies are transmitted to the interrogation signals.

Mode 4 Selector Switch

The two-position selector switch controls the operation of mode 4 as follows:

ON — Enables the IFF transponder to accept mode 4 interrogations from a military ground radar station, and transmit coded reply information received from the mode 4 computer.

OUT — Disables mode 4 and no replies are transmitted to the interrogation signals.

Mode 4 Indication Switch

This switch has positions of AUDIO, OUT, and LIGHT. In AUDIO, an audio signal indicates that mode 4 interrogations are being received, and illumination of the mode 4 REPLY light indicates when replies are being transmitted. In LIGHT, the mode 4 REPLY light illuminates when mode 4 replies are transmitted, and no audio is present. In OUT, both light and audio indications are inoperative.

Mode 4 Function Switch

This switch has positions of ZERO, B, A, and HOLD. In the A position, the system's transponder responds to mode 4 interrogations from an interrogator using the same setting as set into the A position. In the B position, interrogations from an interrogator using the same code setting as that set into the B position are answered. The code settings for the A and B positions are inserted before flight. Both code settings can be zeroized at any time by placing the mode 4 function switch to ZERO. The HOLD position on the mode 4 function switch is not used in flight.

Monitor-Radiation Test Switch

This switch has positions of RAD (RADIATION) TEST, MON (MONITOR), and OUT. With the switch placed to RAD TEST, the transponder replies to test mode interrogations from external test equipment during ground servicing. The switch is spring-loaded and will return to the center position when released. The MON position is used in flight to activate the monitor circuits of the self test set and cause the TEST light to illuminate when a correct reply is made by the transponder to external interrogation signals on the selected mode. With the switch to OUT, the radiation test and monitor circuits are inoperative. The self test set will operate regardless of the position of the monitor-radiation test switch, if the mode selector switches are placed to the TEST positions.

Mode 1 And Mode 3/A Code Selectors

The mode 1 code selector thumbwheels are used to select mode 1 codes from 00 to 73. The mode 3/A code selector thumbwheels are used to select mode 3/A codes from 0000 to 7777. The code selectors enable coded reply settings to be manually selected during flight.

Identification Of Position Switch

The identification of position switch is a three-position toggle switch utilized by the pilot upon request to provide momentary identification of position. The positions and their functions are as follows:

IDENT — Holding the switch momentarily to this position allows the system to respond with identification of position replies on modes 1, 2, and 3/A. The response is continued for approximately 20 seconds after the switch is released.

OUT — Disables identification of position capability.

MIC — In MIC, the identification of position facility is controlled by the communication control panel function selector knob, the push-to-transmit switch, and the MIC switch on the throttle. When the function selector knob is placed to UHF or BOTH and the push-to-transmit switch or the MIC switch is depressed, identification signals are transmitted in response to interrogation signals on modes 1, 2, and 3/A. The response is continued for approximately 20 seconds after the switch is released.

IFF Warning Light

The amber IFF warning light is on the warning/caution lights panel. The IFF light illuminates to indicate a mode 4 malfunction. On aircraft before AFC 83, the master caution lights on the main instrument panel will flash at the same time.

SOUND RECORDER

The sound recorder, on the right console, records on tape either transmissions by the pilot, or all speech or sound from the communications systems. The recorder is switched on automatically by audio input signals and off again, after a preset period, in the absence of further signals. Sidetone in the pilot's headset indicates that a recording is being made. Type C60 or C90 twin track magnetic tape cassettes providing 30 or 45 minutes recording time respectively on each track are normally used with this recorder. The second track is used by inverting the cassette in the recorder. The controls and indicators for the sound recorder are on the sound recorder and on the communication control panel (figure 1-8). The controls and their functions are described in the following paragraphs.

Function Selector Switch

The function selector switch is a four-position toggle switch with positions of OFF, ON, REWIND, and FAST WIND. In OFF, the sound recorder is inoperative. In the ON position, the sound recorder is operative. In REWIND, the tape is run backwards, and in FAST WIND the tape is run rapidly forward.

Mode Selector Knob

This knob has two positions, RECORD and REPLAY. The knob is placed to RECORD when the pilot wants to record on the tape. The knob is placed to REPLAY when the pilot wants to play back the tape recording.

Tape Counter

The sound recorder tape counter has a 3 digit display which indicates the amount of tape used. If a C60 cassette (30 minute) is used, the counter displays the figure 999 when the tape is fully used. When a C90 cassette (45 minute) is fitted, the counter having zeroed once, displays the figure 500 when the tape is fully used.

NOTE

Recorded material on the tape is automatically erased when the used tape is rerun in the RECORD mode.

Sound Recorder Switch

The sound recorder switch, on the communication control panel, has positions of PILOT and ALL. In PILOT, only the pilot's speech is recorded. In ALL, any speech or sound from the communication systems is recorded. With the mode selector knob to RECORD, the recorder is actuated by voice and will run approximately 10 seconds after speech or transmissions cease. The intensity of sound needed to actuate the recorder and the overtime run are adjustable by two screws on the side of the recorder (pulled out of the console).

Sound Recorder Volume Control

The volume control used for the sound recorder is on the communication control panel, and is labeled Rx. The volume control adjusts the level of the tape replay audio.

NORMAL OPERATION

NORMAL OPERATION OF GROUND INTERCOM SYSTEM

Operation of the ground intercommunication system consists of placing the ground intercom switch to the I/C position. This provides intercommunications between the pilot and the three ground intercom positions. The level of audio is adjusted with the ground intercom volume control knob.

NORMAL OPERATION OF UHF COMM SYSTEM

After aircraft power is activated, make the following settings on the communication control panel: Place the function selector knob to UHF, (or to BOTH if transmissions are to be made on VHF and UHF simultaneously, and select the appropriate receiver audio switch to receive signals). Place the receiver volume control knob to mid position, the push to transmit selector switch to NORM, the standby UHF switch to GUARD, and the standby UHF power selector switch to NORM.

Operation In Preset Mode

For UHF operation in preset mode, proceed as follows:

1. Set the function selector knob to MAIN (or to BOTH for added 243.0 MHz guard reception).
2. Set the manual/preset/guard selector to PRESET.
3. Select the desired preset channel with the preset channel selector knob.
4. Set volume and squelch as required.

PRE-TUNING TO INSERT PRESET FREQUENCIES

For pre-tuning to insert preset frequencies, proceed as follows:

1. Dial in desired frequency on manual selectors.
2. Select preset and desired channel.
3. Select function selector to MAIN or BOTH.
4. Press memory button under channel labeling flap.
5. Repeat for all channels.

Operation In Manual Mode

For UHF operation in manual mode, proceed as follows:

1. Set the function selector knob to MAIN (or to BOTH for added 243.0 MHz guard reception).
2. Set the manual/preset/guard selector to MANUAL.
3. Obtain the desired frequency by manually rotating the manual frequency selector knobs.
4. Set volume and squelch as required.

Operation In Guard Mode

For UHF operation in guard mode, proceed as follows:

1. Set the function selector knob to MAIN or BOTH.
2. Set the manual/preset/guard selector to GUARD.

NOTE

When operating in the guard mode, the main receiver and transmitter are tuned to the guard frequency automatically (243.0 MHz). The guard receiver is disabled.

NORMAL OPERATION OF VHF (FM) COMM SYSTEM

After aircraft power is activated, make the following settings on the communication control panel: Place the function selector knob to FM, (or to BOTH if transmissions are to be made on VHF and UHF simultaneously, and select the appropriate receiver audio switch to receive signals). Place the receiver volume control knob to mid position, the push to transmit selector switch to NORM, the standby UHF switch to GUARD, and the standby UHF power selector switch to NORM. On the VHF control panel, set the function selector knob to T/R, (or to T/R GUARD, if a guard listen watch is desired). Set the desired frequency with the frequency selector knobs, and then adjust the audio volume control as desired.

NORMAL OPERATION OF TACAN SYSTEM

To operate the tacan receiver and transmitter, set the function selector knob to REC if only bearing information is desired, or to T/R if both bearing and distance information is desired. Allow a warmup period of about 90 seconds. Set the channel selector knob to the channel of a tacan station within operating range. Set the tacan audio switch on the communication control panel to TACAN. The tacan information will be displayed on the tacan indicator, and on the NDC range and bearing indicator if the heading switch is placed to the TAC position. The identification signal tone for the selected tacan station should be heard in the headset. Adjust the audio signal to the desired level. For air-to-air ranging, set the function selector knob to the A/A position. The tacan interrogates the aircraft which contain the tacan in the A/A mode and is tuned 63 channels apart from the channel setting of the interrogating aircraft. Line of sight distance (range) is provided for display on the tacan indicator and the NDC range and bearing indicator.

NORMAL OPERATION OF IFF SYSTEM

To operate the system rotate the master control knob to STBY for 1 minute and then select NORM position. Set the mode 1, mode 2, mode 3/A, and mode C selector switches to ON unless otherwise directed. Set the mode 1 and mode 3/A code selector switches as directed. The system is now ready for interrogation and response signals. If an emergency occurs, rotate the master control knob to the EMER position. In this position the system accepts mode 1, 2, and 3/A interrogations and transmits an emergency reply, regardless of any mode selector switch selections. The same emergency signals are automatically replied when the pilot ejects from the aircraft. For I/P switch operation, place the I/P switch momentarily to IDENT, or place the function selector switch on the communication control panel to UHF or BOTH, and depress either the push to transmit switch or the MIC button on the throttle. The IFF system responds with I/P signals.

NORMAL OPERATION OF SOUND RECORDER

The sound recorder performs two functions: It records speech and other audio in the communications systems, and when desired will replay the speech and audio that has been recorded. The procedures for recording and replaying audio are described in the following paragraphs.

Inserting And Removing Cassette

To insert and remove cassette, slide the locking bar at the bottom of the recorder down, lift the handle and pull out the recorder. With the function selector to OFF, insert the cassette (tape side last) or remove (tape side first). Slide the recorder home and lock.

Recording

When the function selector switch on the recorder is placed to ON, the mode selector switch is placed to RECORD, and the sound recorder switch on the communication control panel is placed to ALL, any speech or sound from the communication systems will be recorded. The recording will include all incoming and outgoing radio transmissions, pilot speech, and any audio warnings and tacan identification signals received. To record only the pilot's speech, place the function selector switch to ON, the mode selector switch to RECORD, and the sound recorder switch to PILOT. All other incoming or outgoing signals are not recorded.

Replaying

The tape on the recorder can be rewound or rapidly wound by first placing the function selector switch to ON and then either selecting REWIND or FAST WIND, respectively. The tape can be stopped when desired by placing the switch back to ON. With the switch in the ON position and the mode selector switch placed to REPLAY, the recording on the tape is replayed. The replay signal level is adjusted with the receiver volume control knob on the communication control panel.

EMERGENCY OPERATION

There is no emergency operation for the ground intercommunication system, the VHF system, the tacan system, or the sound recorder.

EMERGENCY OPERATION OF UHF SYSTEM

If there is a power failure or a malfunction in the UHF communication system, the standby UHF can be utilized. On the communication control panel, place the function selector knob to STBY. Place the standby UHF power selector switch to EMER if there is a power failure. This allows power from the emergency battery No. 3 bus to the standby UHF. Set the standby UHF switch to ALT to select the preset UHF channel, or to GUARD to select the preset guard channel.

EMERGENCY OPERATION OF IFF SYSTEM

If an emergency exists, place the master control knob on the IFF control panel to EMER. The system will respond with an emergency reply to interrogations in modes 1, 2, and 3/A. Upon seat ejection the emergency operation automatically becomes active.

LIMITATIONS

There are no limitations for the ground intercommunication system, UHF system, VHF system, IFF system, tacan system, or the sound recorder.

EJECTION SEAT

DESCRIPTION

The type 9A MK 1 ejection seat (figure 1-9) provides the occupant with a means of safe escape from the aircraft at practically all altitudes. The ejection seat is an automatic device that primarily regulates the opening of the personal parachute at a predetermined altitude. The basic structure of the seat is the main beam assembly. The seat bucket is attached to the main beams and provides a mounting for the survival kit which forms the cushion for the occupant. The bucket is attached to the main beams by four lugs that ride in tracks on the main beams. The seat is equipped with a single firing handle which is used to fire the seat during the ejection sequence. This is the ejection handle, located between the occupant's knees on the seat bucket. When the handle is pulled, the ejection gun on the back of the seat is fired. A rocket motor on the bottom of the seat fires soon after the seat leaves the rails to give added ejection height. The top of the seat provides a mounting for the drogue chutes and drogue chute restraining scissors. The drogue gun and time release mechanism are located on either side of the seat near the top. Automatic operation of the seat is dependent upon these two units. They are equipped with trip rods that pull the sears from the units during the ejection sequence. A reel and snubber unit, used for retaining the shoulder harness, is located at shoulder level and provides free forward and aft shoulder movement or, when locked, shoulder restraint during crash or bail-out conditions. The seat is linked to the canopy by the canopy interconnect. The interconnect serves to fire the emergency canopy system upon ejection so that seat will not have to break through the canopy. However, if the emergency canopy system is inoperative, the seat is capable of ejecting through the canopy. The drogue chutes on the top of the seat stabilize the seat after ejection and deploy the personal parachute. An emergency oxygen bottle is installed on the right side of the seat just aft of the personal equipment connector (PEC) used for connecting the pilot's personal equipment leads. The following controls are incorporated on the seat bucket: the emergency harness release handle, the shoulder harness handle, the emergency oxygen control handle and the pitch control knob. Also, two snubber release handles, located adjacent to the leg restraint snubber units, provide a means of releasing the snubbers on the leg restraint lines. The emergency harness release handle permits manual release of the harness during manual separation procedures. The shoulder harness handle controls the upper harness movement. The pitch control positions the rocket thrust angle in accordance with the weight of the seat occupant. A seat position switch on the right console controls the seat actuator motor. A safety pin storage rack is provided on the right console side of the cockpit between the windshield and landing checklist.

MAIN BEAM ASSEMBLY

The main beam assembly is a strong lightweight structure built to withstand high G loads. It is built up from a pair of vertical beams strengthened and bridged by three cross beams. The top cross beam receives the thrust of the ejection gun piston, and carries the scissor shackle and the cross rod of the seat firing mechanism. The center cross beam forms the fixed anchorage point for the seat raising actuator, and the third, the lower cross beam, provides the lower support for two tubular members positioned forward of and parallel to the main vertical beams to complete the structure. These tubes carry two sliding members onto which the seat pan is attached. The lower end of the seat raising actuator is attached to the lower seat pan sliding member. Each vertical beam has three slipper pads attached to the inner face which engage with the guide

EJECTION SEAT

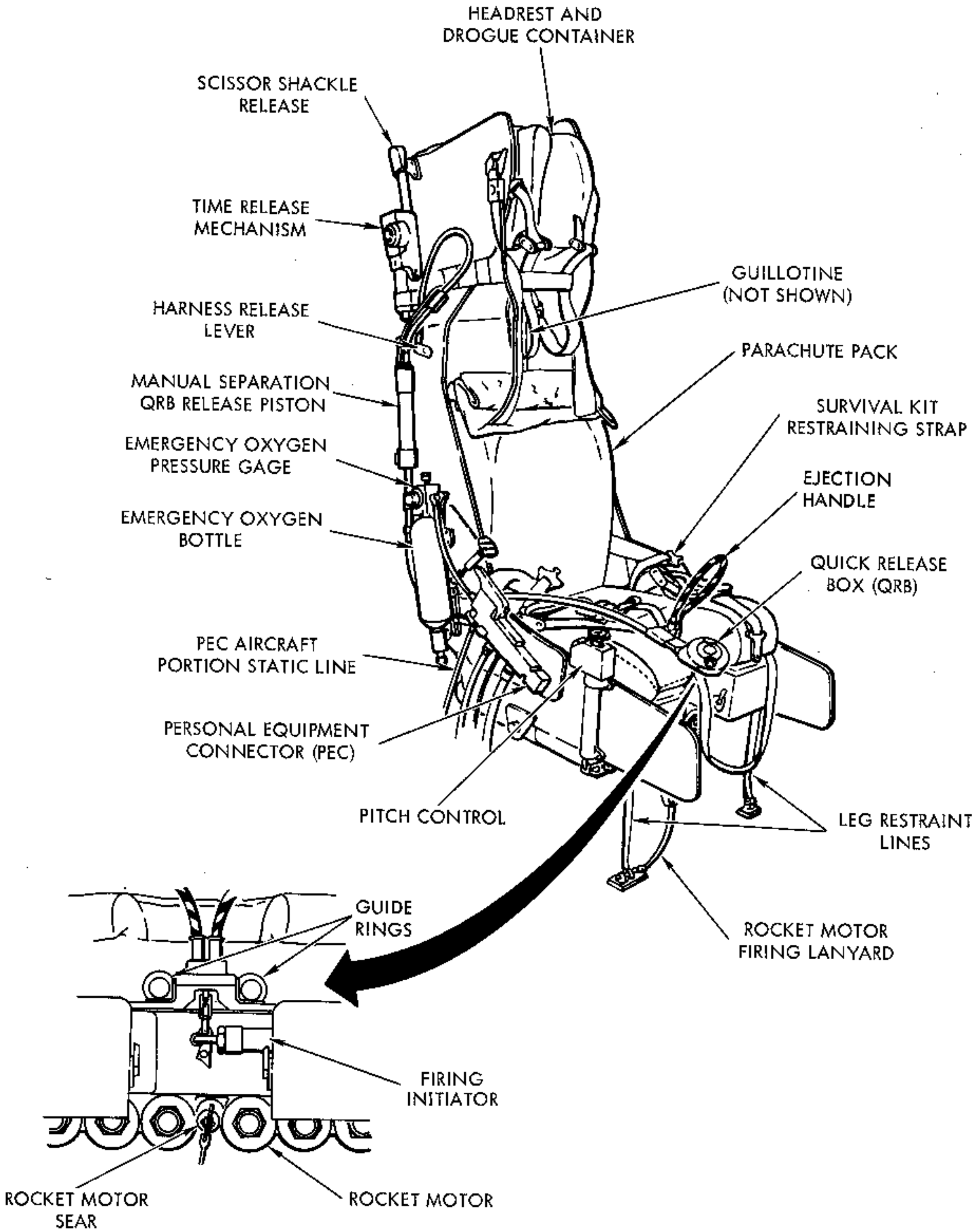


Figure 1-9 (Sheet 1 of 3)

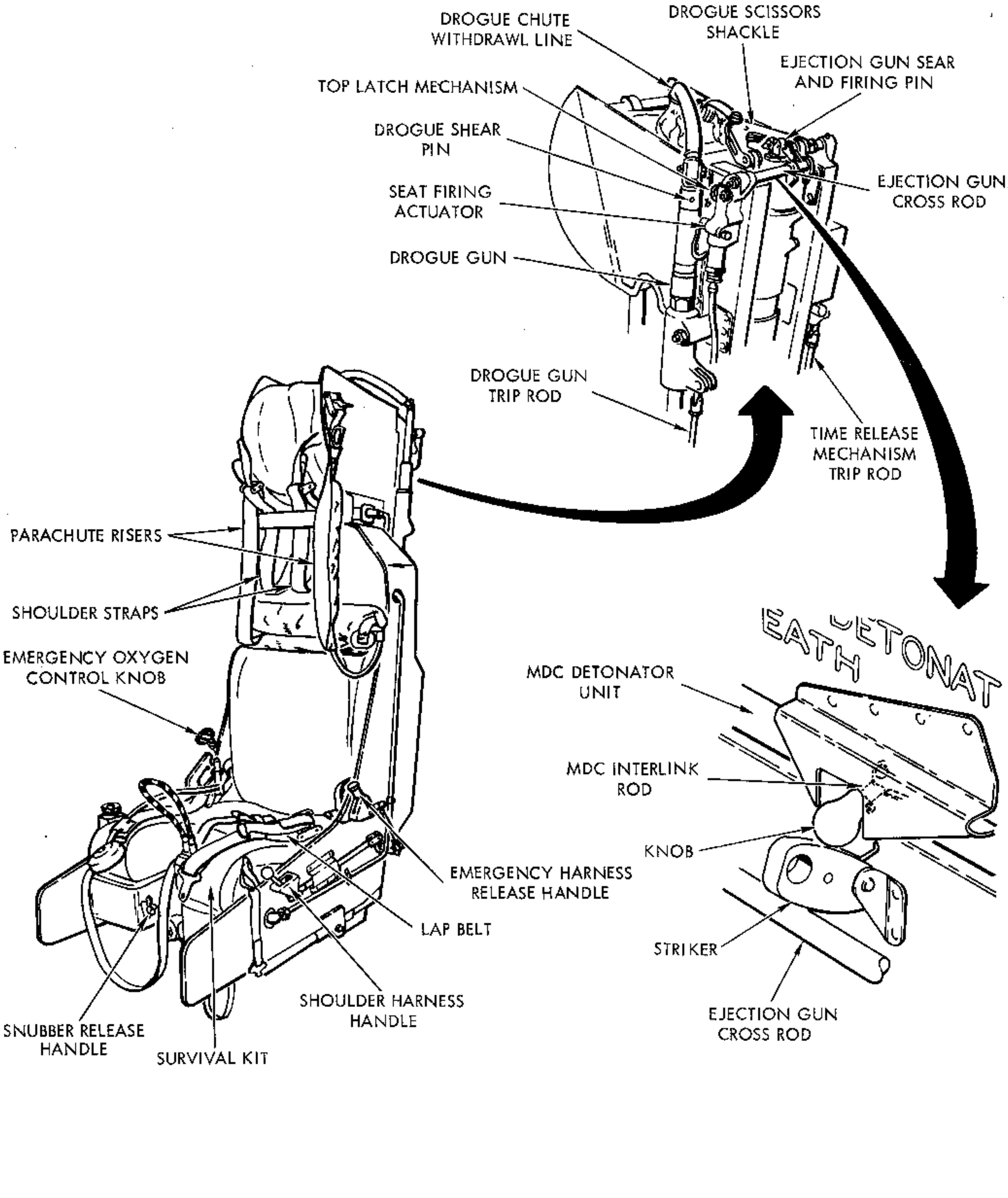


Figure 1-9 (Sheet 2 of 3)

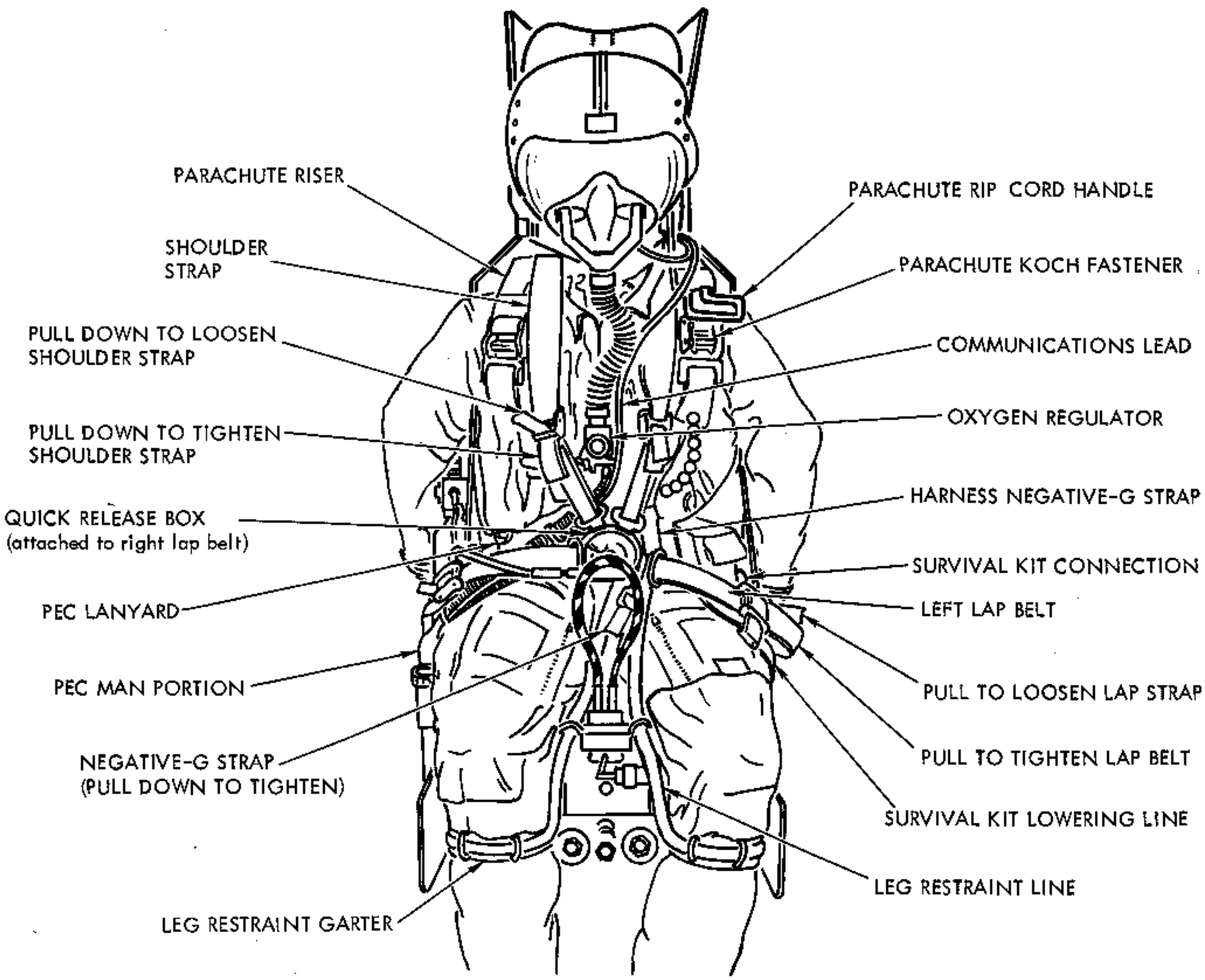


Figure 1-9 (Sheet 3 of 3)

rails of the ejection gun. Attached to the left vertical beam is the top latch assembly, the seat firing actuator, and the drogue gun. The top latch mechanism is attached to the top of the left vertical beam and is used to secure the seat structure to the ejection gun inner cylinder tube. To the right vertical beam is attached the time release mechanism and the harness release lever.

SEAT PAN

The seat pan is of light riveted construction formed to provide a square shaped base recessed to accommodate the survival kit. The back of the pan is integral with the base and is recessed and shaped to accept the rigid parachute pack. The sides of the pan project forward to form leg guards and the front of the seat pan is built up to form two horns which house the snubber units for the leg restraint lines and are contoured to accommodate the occupant's legs when pulled back by the restraint lines. Attached to the left side of the pan is the shoulder harness handle and the emergency harness release handle. To the right side is attached the emergency oxygen bottle, rocket motor pitch control and the manual separation QRB release piston. The inside faces of the two horns carry the leg restraint lines snubber release handles and above, on each side of the ejection handle, is a garter ring for the leg restraint lines. Two harness sticker straps spring clips mounted one on each side of the seat pan complete the assembly.

EJECTION GUN

The ejection gun mounted on the ejection seat between the main beams is attached to the bulkhead of the cockpit by two mounting lugs. The gun is attached to the seat by the seat slippers and top latch mechanism. It is used to jettison the seat from the cockpit during the ejection sequence and is operated by three pyrotechnic cartridges. The gun is composed of four major assemblies, which are the firing mechanism, inner tube, intermediate tube, and outer tube. During the ejection sequence, gas pressure produced by the primary and auxiliary cartridges, cause the tubes of the gun to telescope. When the inner and intermediate tubes are fully extended in the outer tube during upward travel of the seat, separation of the inner tube from the intermediate tube occurs. Separation of the tube is permitted by the incorporation of a shear rivet in the inner tube guide bushing which shears when the inner tube strikes the bushing. Water seals, located on the gun around the primary and auxiliary cartridges and on the inner and intermediate tubes, prevent water from entering the gun during underwater ejection from the aircraft.

ROCKET MOTOR

A rocket motor, comprising an igniter unit tube and 12 tubes of propellant connected to a chamber which has eight downward facing nozzles, is underneath the seat pan. A static line cable (stowed in a helical dispenser) is connected from a floor attachment to the igniter sear in the rocket motor firing unit. The length of the static line is such that rocket firing occurs at the point of ejection gun separation.

WARNING

The rocket motor and igniter sear are under the seat. Do not use this area for stowage. Exercise routine caution when performing any function in the vicinity of the rocket motor; e.g., pulling rocket motor safety pin, adjusting leg restraint lines, etc. Even though a substantial downward pull force is required to actuate the igniter sear, inadvertent actuation could possibly occur as a result of lowering the seat on a foreign stowed object, jerking a leg restraint line that is entangled in the sear mechanism, etc.

Pitch Control

To ensure optimum performance from the rocket motor, its pitch angle relative to the seat pan must be adjusted in accordance with the weight of the occupant. A knurled knob and indicator window (right side of seat), over a scale calibrated in pounds, allows the pilot's equipped weight to be set, thus adjusting the motor about its fulcrum mounting. The maximum setting is 220 pounds.

EJECTION HANDLE

The ejection handle is positioned centrally on the front of the seat pan between the pilot's legs. Pulling the handle removes the sear of a firing initiator mounted just below the handle. The cartridge in this initiator produces gas pressure which is routed to the shoulder harness retraction mechanism, and also to the seat firing actuator on top of the seat. The seat firing actuator rotates the ejection gun cross rod which withdraws the ejection gun sear to release the seat firing pin. Movement of the ejection handle is checked after about 2 inches of travel so that the occupant can retain his grip and prevent arm flailing when exposed to the airstream.

CANOPY INTERCONNECT

The ejection seat has a device which engages the MDC firing mechanism when the seat starts to rise, thus ensuring the canopy is shattered before contact with the seat. Initial movement of the seat causes the cross rod of the seat firing actuator to engage the striker attached to the fixed structure. The ejection seat striker then strikes a knob which is connected by linkage to the MDC firing mechanism. The knob is positioned over the operating lever only when the canopy is in the closed position.

NOTE

With the MDC detonator unit safety pin removed, the interconnection operates irrespective of whether the MDC firing handle is secured with its safety pin or not.

DROGUE GUN

The drogue gun is on the left side of the ejection seat headrest and is used to extract the controller drogue chute from its container 0.5 second after ejection. Upon ejection, a trip rod fixed to the aircraft structure pulls a sear from the drogue gun to initiate the 0.5 second time delay. After the time delay has elapsed, a cartridge is fired and the resultant gas pressures propel a piston out of the drogue gun barrel. Attached to this piston is a lanyard which pulls the controller drogue chute from its container. When deployed, the controller drogue chute pulls the stabilizer drogue chute from its container. A scissors shackle on top of the seat retains the deployed drogues until the shackle is released by the time release mechanism. A shear pin through the drogue gun body retains the gun piston until the gun fires.

DROGUE CHUTE RESTRAINING SCISSORS

The drogue chute restraining scissors are on the top of the seat, and are attached to the top cross members of the main beam assembly. This mechanism is used to connect the drogue chutes to the top of the seat when they are deployed during ejection. A movable jaw of the scissors is used to release the drogue chutes from the seat when the time release mechanism actuates. This mechanism allows the drogue chutes to deploy the personal parachute when actuation of the time release mechanism occurs.

TIME RELEASE MECHANISM

The time release mechanism is on the right side of the ejection seat headrest. Its function is to delay deployment of the personal parachute and seat separation until the occupant has descended from the upper atmosphere, and/or has slowed enough to prevent excessive opening shock of the personal parachute. The time release mechanism is armed upon ejection by a trip rod secured to the aircraft. Initiation of the timing sequence follows immediately, providing the altitude is below 10,000 feet. Initiation is delayed until this condition is obtained. Two and one-quarter seconds after initiation, the time release mechanism releases the drogue chutes from the restraining scissors allowing the personal parachute to be pulled from its container. At the same time, it releases the quick release box (QRB) to unlock the harness and leg restraint lines to allow the occupant to be pulled from the seat when the personal parachute deploys.

STICKER CLIPS

The sticker clips are on each side of the inner seat bucket. Each clip is made of spring steel with a detent point to hold the survival kit sticker strap lugs. The sticker clips clamp on the sticker strap lugs and retain the occupant in the seat until the personal parachute blossoms and pulls the occupant clear of the seat. This prevents a collision between seat and occupant.

SEAT POSITIONING SWITCH

The ejection seat may be adjusted vertically only. Fore and aft seat positioning is compensated for by adjusting the rudder pedals. Vertical seat positioning is accomplished by actuating a momentary contact switch on the right console. The switch has positions SEAT LOWER and SEAT RAISE. The seat can be adjusted up or down through a total distance of 4.5 inches. Limit switches automatically cut off electrical power when the seat reaches its limits of travel.

SHOULDER HARNESS SNUBBER AND POWER RETRACTION UNIT

A shoulder harness snubber and a power retraction unit is provided on the back of the seat pan to control the shoulder straps during normal flight and ejection. The snubber is a spring-loaded retraction reel which contains a ratchet and pawl device which enables the ratchet to lock to prevent forward movement of the shoulder harness, or unlock to allow forward movement, depending on the position of the shoulder harness handle. In addition, the snubber automatically locks to prevent forward movement of the shoulder harness during horizontal deceleration (crash) and vertical acceleration (ejection). The power retraction unit operates only on ejection to wind in the shoulder harness to force the pilot's shoulders back to a good ejection position. The power unit operates from gas derived from the firing initiator when the seat ejection handle is pulled.

Shoulder Harness Handle

The shoulder harness handle on the left front of the seat controls movement of the shoulder harness during normal flight. With the handle in the forward position, the shoulder harness cannot be moved forward but is allowed to ratchet to the back of the seat. When the handle is moved aft and then forward to the detented middle position, the harness is allowed to wind freely in either a forward or backward direction. The shoulder straps contain buckles for small slack adjustments. The buckles primarily provide a quick takeup of a small amount of slack which is normally felt after leaning forward and then leaning back, which results from the reel not returning to its original position. If slack is once taken up, and then it is again required to take up slack due to subsequent use of the shoulder harness handle, the buckles must be loosened, and after the reel is allowed to take up as much slack as possible, the buckles should be tightened again.

LEG RESTRAINERS

Two leg restraint lines ensure that the pilot's legs are automatically drawn back and restrained against extensions to the sides of the seat pan during ejection to provide cockpit clearance and prevent subsequent flailing. The lower ends of the lines are attached to the cockpit floor by shear rivets. The lines then pass through snubber units at the front corners of the seat pan. During strapping-in the upper ends of the lines are threaded through rings (two rings to each leg with each line routed through outboard ring first) spaced symmetrically at the front of the garters worn by the pilot just below the knee and then through guide rings (one on each side of the ejection handle), and are finally threaded over the left lap belt lug before insertion into the QRB. When initiating ejection the feet should be left on the rudder pedals. The lines then draw the pilot's legs back. The restraint lines are free to pull through the garter rings as separation from the seat occurs. Each garter has a quick-release fastener so that the garters and the leg restraint lines can be disconnected rapidly from the legs in an emergency.

Snubber Release Handles

The snubber units allow the leg restraint lines to pass freely downwards but prevent them passing upwards through the units. Spring-loaded snubber release handles, one on each side of the frontal recess of the seat, allow the occupant to adjust the lines to give sufficient leg movement for application of full rudder.

PILOT HARNESS AND SEAT HARNESS

The pilot's harness is a combined parachute harness and life jacket that is put on before entering the cockpit. When seated, the pilot's harness is attached to the parachute pack and to the survival kit, which are both housed in the seat and remain in the aircraft between flights. The seat harness consists of two shoulder straps with an automatic tightening facility, two lap belt straps, the right one terminated by a quick-release box (QRB), two leg restraint lines and a negative-G restraint strap. A pull on the free end of each lap belt strap adjusts its tightness. The strap may be loosened by pulling on the buckle release tag.

PARACHUTE

The back of the seat pan contains a rigid plastic parachute pack with fabric flaps held closed by a release pin which is removed as the drogues pull on a parachute withdrawal line after ejection. The pack is contoured so that when the shoulder straps are automatically tightened when ejection is initiated, the pilot assumes the correct ejection posture. The two parachute risers exit from the top of the pack, and each have a Koch fastener which mates with a corresponding fitting on the shoulders of the pilot's harness. Each Koch fastener is released by lifting the safety flap clear and rotating down the horizontal release bar. The left riser carries a rip cord handle, just above the Koch fastener, for emergency manual deployment of the parachute.

QUICK RELEASE BOX (QRB)

The quick release box (QRB), on the end of the right lap belt strap, is designed to secure and tighten all of the various seat harness at one point, so they can be released simultaneously when required. The following seat harness components lock into spring-loaded locks in the QRB when the QRB is set to FASTEN and the two arrows heads, one on the fixed and the other on the moving portion of the QRB, are in line: the shoulder harness straps connect directly into the QRB by their lugs; the left lap belt strap by its lug after one end of the two leg restraint lines and the negative-G line are looped around the lap belt lug. Once locked, the QRB releases to unlock under the following conditions:

a. Automatically, when the time release mechanism operates during the ejection sequence.
b. Manually, when the emergency harness release handle is operated during manual separation.
c. Manually, when the face of the QRB is rotated to UNDO.

Before entering the cockpit, check that the QRB is at FASTEN and that the two arrow heads, are in line. If the arrow heads are not in line, the QRB automatic release cable has been partially withdrawn. In this case, when the harness lugs are inserted in the QRB they may appear to be locked securely but may come unlocked later. To align the two arrow heads, rotate the moving portion of the QRB beyond FASTEN to pull the cable back to the QRB. When the QRB is set to FASTEN the arrow heads should then line up. Before strapping-in, check that the arrow heads on the QRB are in line.

GUILLOTINE AND HARNESS RELEASE

If automatic separation from the seat fails to take place when the seat is at or below the time release mechanism operating height, it may be achieved manually by operating an emergency harness release handle. Operating the handle fires a cartridge which produces gas to actuate a gas-operated guillotine and a gas-operated manual separation QRB release piston. The guillotine, below the seat head rest, normally retains the parachute withdrawal line in its jaws until the automatic opening of the scissors shackle allows the drogue chutes to pull the line clear and deploy the personal parachute. When the gas pressure operates the guillotine cutter, the withdrawal line severs to free the parachute from the drogue chutes (which remain shackled to the seat). When the gas pressure operates the manual separation QRB release piston, the piston pulls the cable between the time release mechanism and the QRB to release the QRB. Releasing the QRB and operating the guillotine removes all restraints between the ejection seat, and the pilot and parachute. The pilot is then free to push clear of the seat and manually operate the parachute rip-cord handle.

Emergency Harness Release Handle

The emergency harness release handle is aft and left of the seat. To actuate the handle it must first be lifted and then moved forward and down. The emergency harness release handle should never be actuated before ejection for the following reasons:

a. Actuating the emergency harness release handle creates a hazard to survival during uncontrollable flight, since negative G forces may prevent the crew from assuming the correct ejection position.
b. Actuating the emergency harness release handle creates a hazard to survival if the pilot decides that he has insufficient altitude for ejection and is required to proceed with a forced landing without enough time to refasten his harnessing.
c. Actuating the emergency harness release handle

prior to ejection causes the occupant to separate from the seat immediately after ejection, and severe shock loads will be imposed on the body.

PERSONAL EQUIPMENT CONNECTOR (PEC)

The PEC, on the right side of the seat, provides simultaneous connection for the communications line, the anti-G line, and the normal and emergency oxygen lines. The PEC consists of three parts, the aircraft portion which remains in the aircraft at all times, the seat portion which is permanently fixed to the right side of the seat and the man portion which is part of the flying clothing. The man portion handle is provided with a lanyard for fastening to a clip on the pilot's harness. This ensures PEC disconnection during separation from the seat after ejection. A dust cover is provided to protect the seat portion when the aircraft is not being flown. When not in use it is stowed in a clip on the rear bulkhead at the right side of the head rest. A rubber guard is provided to protect the man portion connections when not in use and must be removed and stowed in the flying suit before strapping-in. The normal oxygen supply and the anti-G supply are connected by flexible hoses to the aircraft portion. A static line operates the latch holding the aircraft portion to the seat portion, so that these two parts separate on ejection (or when the seat is removed for servicing). As they separate, an automatic valve closes the oxygen passage of the aircraft portion, to prevent any loss of main system oxygen. There is a similar automatic valve which closes the bottom of the oxygen passage in the seat portion. During ejection, this prevents escape of the emergency oxygen, which is fed into the seat portion above this valve. After ejection, the man portion remains connected to the seat portion until separation from the seat, initiated by the time release mechanism. At this point, the pull of the pilot's harness lanyard unlocks and disconnects the man portion thereby disconnecting the emergency oxygen supply.

SEAT MOUNTED EMERGENCY OXYGEN BOTTLE

A 7 to 10 minute supply of gaseous oxygen is contained in a bottle on the right side of the ejection seat pan. On top of the bottle is a supply release and pressure-reducing mechanism, together with a charging point and a pressure gage. The single pointer pressure gage calibration has a red refill sector from 0 to 1800 psi and a white full sector from 1800 to 2500 psi. The supply is fed directly from the bottle to the seat portion of the PEC and is triggered automatically during ejection by a handle on the aircraft portion of the PEC as it disconnects. Since the emergency oxygen bottle is fixed to the seat, the emergency supply is lost after separation from the seat.

Emergency Oxygen Control Knob

The emergency oxygen bottle can be triggered manually by pulling the emergency oxygen control knob on the aft right side of the ejection seat. The black and yellow striped knob is hinged to its operating rod, so that after being pulled it topples freely to indicate that the knob has been pulled. The duration of supply after manual operation can be extended beyond 10 minutes if the prevailing emergency condition permits the selection of NORMAL on the pilot-mounted regulator.

SURVIVAL KIT

A survival kit (figure 1-10) fits into a recess in the seat pan of the ejection seat. The kit is loosely held to the seat pan by sticker strap lugs which fit into the sticker clips on the inside of the seat pan. The sticker straps are in turn connected to the survival kit retaining straps which are on the aft top corners of the kit. The retaining straps connect to the sides of the pilot's harness and serve to secure the kit to the pilot. The retaining strap connectors are of the quick disconnect type. A kit lowering line, on the forward left corner of the kit, also connects to the pilot's harness. In addition, the back of the kit is connected to the bottom of the parachute container by two straps. This makes it impractical to egress from the cockpit without both survival kit and parachute. After the parachute opens, the survival kit remains attached to the pilot's harness by the two retaining strap connectors. Releasing these allows the survival kit to fall below the pilot and remains attached by the 22 foot lowering line connected to the third quick release fitting.

CAUTION

Before releasing the survival kit, check that the lowering line is connected to the harness.

The lowering line connector, of the quick disconnect type, connects into the front lower part of the pilot's harness. Because the kit is so loosely connected to the seat pan by the sticker clips, the negative-G strap is looped over the front of the kit and secured by the QRB during strapping-in. This prevents front end movement of the kit during negative-G maneuvers. The survival kit, consisting of a fiberglass shell with canvas flaps on the bottom, contains a single man life raft and an assortment of survival aids. A cushion is secured to the top of the kit for pilot comfort. A release handle on the left bottom of the kit is used to operate the kit. A pull on the handle releases the flaps on the bottom of the kit. A continued pull on the handle triggers a CO_2 bottle which inflates the life raft.

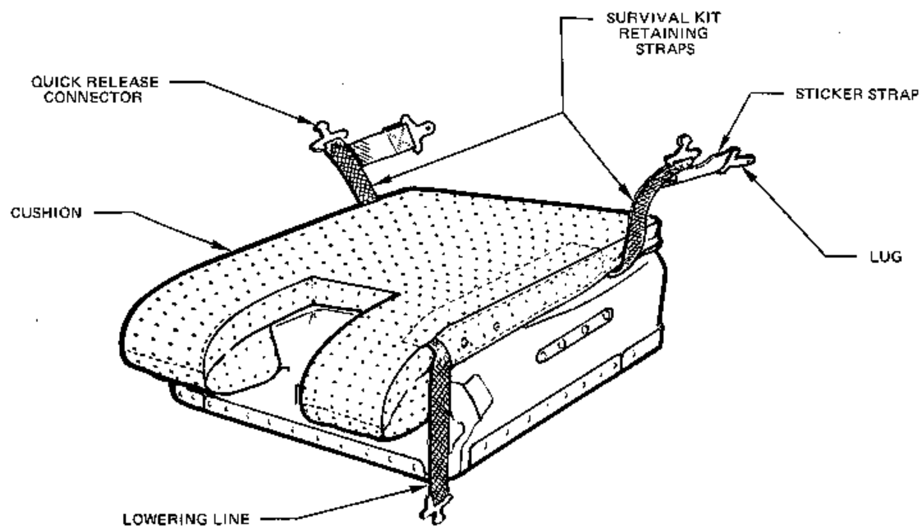
SAFETY PIN STOWAGE

A bracket for safety pin stowage is provided just forward of the windshield arch on the right side of the cockpit. The following safety pins are stowed on the bracket: ejection handle, ejection gun, guillotine, rocket motor and MDC handle.

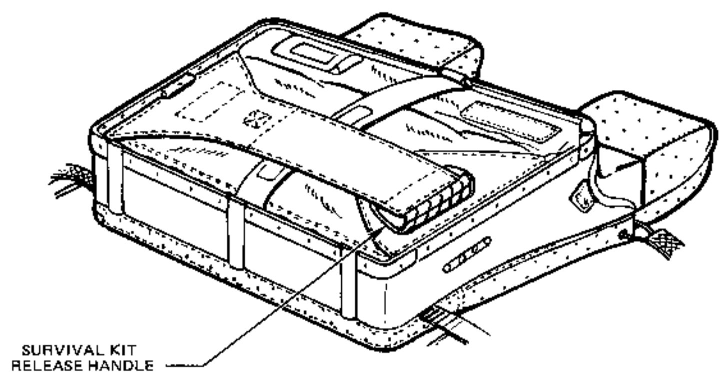
NORMAL OPERATION

Operation of the ejection seat consists of two phases, which are primary operation and secondary operation. Primary operation of the seat includes all operating events that occur during the ejection sequence. This sequence begins when actuation of the ejection handle causes the ejection gun to fire, and continues until a normal parachute descent of the occupant is accomplished. After the seat is initially fired during the ejection sequence, seat operation is completely automatic and requires no action by the occupant during the sequence. Secondary operation of the seat consists of controlling shoulder movement, seat bucket positioning, and leg restraint line adjustment with the snubber release handles. Shoulder movement is controlled by the positioning of the shoulder harness handle. Ejection from the aircraft is accomplished by propelling the seat from the aircraft with a cartridge ejection gun. The ejection sequence is initiated by pulling the ejection handle. Actuation of the ejection handle fires the seat initiator which produces gas pressure to operate the power retraction unit to withdraw the shoulder harness, and also operates the seat firing actuator which withdraws the ejection gun sear to fire the primary cartridge. Gas pressure generated by the cartridge causes the inner and intermediate tubes of the gun to extend upward. The upward travel of the inner tube actuates the top latch mechanism, which releases the seat from the aircraft. Continued movement of the inner tube propels the seat up the tracks. As the seat accelerates up the guide rails the following sequence occurs: the MDC detonates, shattering the canopy; the vertical-G loads lock the shoulder harness; the trip rods trip the drogue gun and time release mechanism; the ejection gun secondary cartridges fire in sequence; the aircraft portion of the PEC is disconnected by its static line as the emergency oxygen is turned on; the leg restraint lines draw in the pilot's legs and the snubber units maintain leg restraint after the line floor fittings

SURVIVAL KIT



TOP VIEW



BOTTOM VIEW

AV8A-1-(41)

Figure 1-10

shear; the auto-tone signal from the standby UHF is triggered and IFF squawks EMERG; and just prior to the inner tube of the ejection gun separating from the intermediate tube, the static line fires the rocket motor. As the rocket motor completes its burn, the drogue gun fires (approximately 0.5 second after it is tripped) to deploy the drogue chutes which decelerate and stabilize the seat as it descends through the upper atmosphere. When an altitude of approximately 10,000 feet is reached, a barostat releases the escapement mechanism, which in turn, unlocks the QRB to release the occupant's harnessing, leg restraint lines and the negative-G strap. The drogue chute pulls a parachute withdrawal line to deploy the personal parachute. The pilot is held to the seat by sticker clips until the opening shock of the parachute snaps him out of the seat. The leg restraint lines run freely out through the guide rings and out through the garter rings. The PEC lanyard, attached to the pilot's harness unlatches the man portion of the PEC to disconnect the personal leads (including emergency oxygen) from the seat. A normal parachute descent then follows. If the ejection is made below 10,000 feet the preceding events will occur approximately 2.25 seconds after the time release mechanism is tripped going up the rails. If the time release mechanism fails to operate after descending through 10,000 feet, actuate the emergency harness release handle on the left rear of the seat, push free of the seat, and pull the parachute rip cord.

WARNING

- Do not attempt ejection with the canopy open as contact of the pilot and seat with the canopy will result.
- Never open the canopy in flight.
- Flying boots must be worn to help protect the pilot's legs from burning during ejection.

EMERGENCY OPERATION

There are no provisions for emergency operation of the ejection seats; however, if the ejection seats fail to eject, the crewmember can abandon the airplane by following the procedures outlined in Emergency Procedures.

LIMITATIONS

To avoid actuator overheating, operation of the seat actuator should be limited to not more than 1 minute in any one period of 8 minutes. Assuming wings level and no aircraft sink rate, the ejection seats provide safe escape within the following parameters:

a. Ground level (zero altitude) - zero airspeed
b. Ground level to 100 feet - 400 knots maximum (based on seat limitations and human factors)
c. Above 100 feet - 400 knots maximum (based on human factors)

At airspeeds greater than 400 KCAS, appreciable forces are exerted on the body which makes escape more hazardous.

ELECTRICAL POWER SUPPLY SYSTEM

DESCRIPTION - DUAL GENERATOR SYSTEM

On airplanes 158384 through 158711, the airplane electrical power supply system consists of a primary ac electrical system powered by two ac generators, a secondary dc electrical system composed of two dc transformer-rectifiers for conversion of ac to dc, a power distribution (bus) system, an auxiliary power unit (APU) generator, and a receptacle for plugging in external power. Three batteries are included. Two of the batteries are used to smooth out operation of the transformer-rectifiers and for use when the transformer-rectifiers are inoperative. The third battery is for emergency use. The generators supply ac power to the No. 1 115/200 volt ac bus, the No. 2 115/200 volt ac bus, the No. 1 transformer-rectifier and the No. 2 transformer-rectifier. The transformer-rectifiers convert 115/200 volt ac power to 28 volt dc power, which is supplied to the No. 1 XFMR-RECT (transformer-rectifier) 28 volt dc bus, the No. 1 28 volt dc bus, the No. 2 28 volt dc bus, the alert 28 volt dc bus, and the No. 1 and No. 2 battery buses. Refer to Electrical Supply System (figure 1-11) for a simplified system schematic and refer to Electrical System (figure A-2, appendix A) for the individual bus loading.

AC ELECTRICAL POWER SUPPLY

The primary source of electrical power is derived from two 400 Hz, three-phase, 115/200 volt ac generators. The generators are engine driven and are rated at 4,000 volt-amperes each. The generators are located side by side at the top of the engine bay, each being mounted on, and driven by, the engine gearbox through an automatic two-speed gearbox. Each generator contains a constant speed drive (CSD) which, in conjunction with the two-speed gearbox, ensures that the generator is driven at a constant speed of 8,000 revolutions per minute within the speed range of the engine. The generators are cooled by air tapped from the left side of the engine low pressure compressor. Generator cooling is available as soon as the engine starts. The No. 1, or left, generator normally supplies power to the No. 1 115/200 volt ac bus and the No. 1 transformer-rectifier through closed contacts of the No. 1 generator line contactor and the No. 1 buses relay. The No. 2, or right, generator normally supplies power to the No. 2 115/200 volt ac bus and the No. 2 transformer-rectifier through closed contacts of the No. 2 generator line contactor. During engine start the

ELECTRICAL SUPPLY SYSTEM SIMPLIFIED

Airplanes 158384 thru 158711

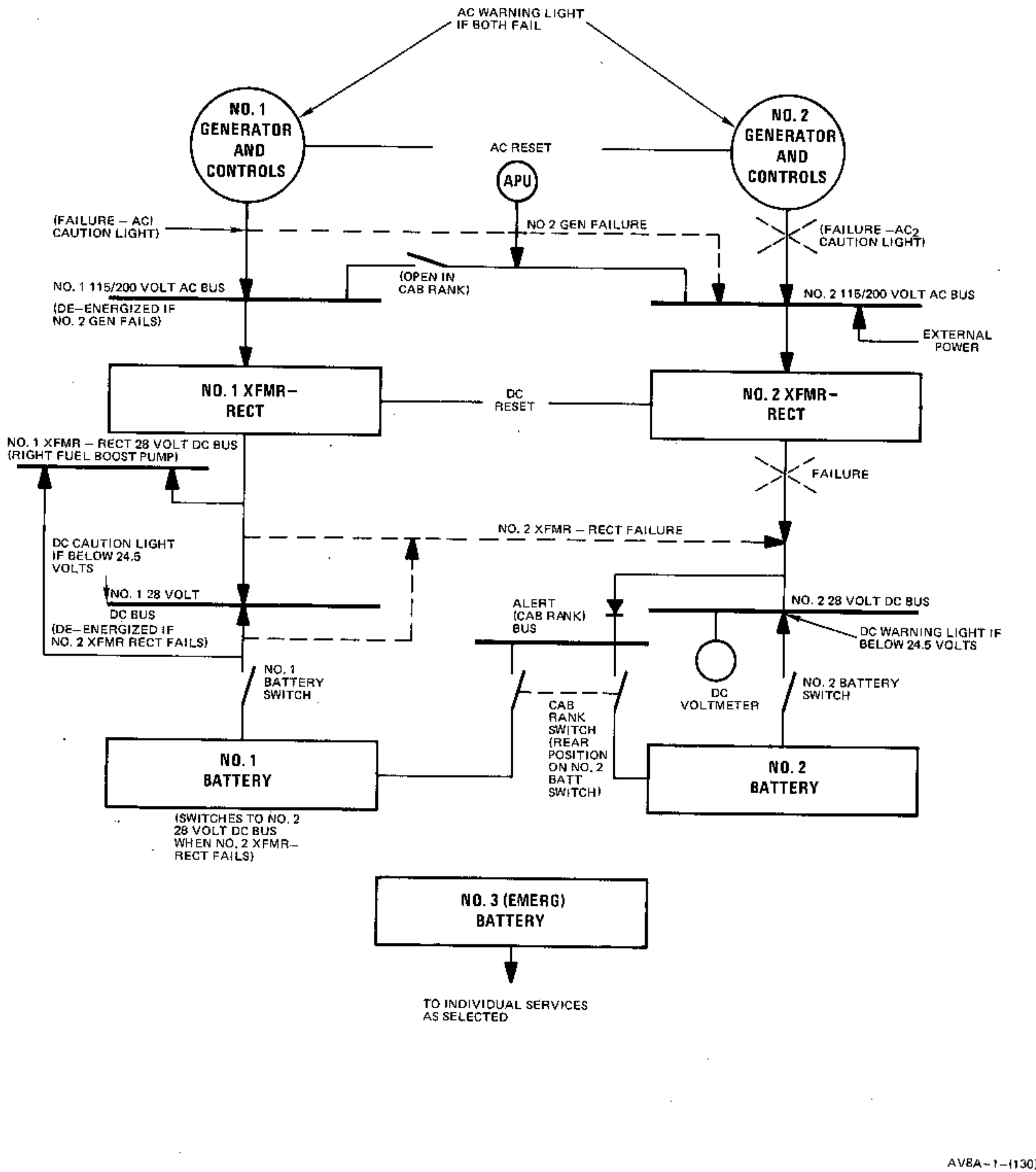


Figure 1–11

generators are brought up to speed by the two-speed gearbox and automatically come on the line (their line contactors energize) at the proper rpm. During engine start, the No. 1 buses relay energizes simultaneously with the No. 1 generator line contactor. The No. 1 buses relay also energizes in conjunction with external power and the APU generator. There are no generator control switches as such to connect the generator outputs to, or disconnect the generator outputs from, their associated buses, but battery switches No. 1 and No. 2 must be placed to the on position for engine start. Battery power is required to energize the generator field windings, and to operate the speed sensing, regulation and protective circuits during start. With both generators operating and on the line, the bus systems are split and the generators power their associated buses independently of each other. This is accomplished by a contact of the No. 2 generator line contactor opening the line connecting the two bus systems when the line contactor is energized. When the No. 2 generator is tripped off the line by the automatic fault protection circuits, the No. 2 generator line contactor is deenergized to tie both bus systems together and the No. 1 buses relay opens to deenergize the No. 1 115/200 volt ac bus and the No. 1 transformer-rectifier, with the result that the No. 1 generator is supplying power to the buses normally powered by the No. 2 generator. When the No. 1 generator is tripped off the line, the buses remain split and the No. 1 115/200 volt ac bus and No. 1 transformer-rectifier are deenergized. The result is the same as losing generator No. 2 in that the remaining generator powers the No. 2 buses. The reason for always powering the No. 2 buses with the good generator is that they carry the essential loads and must be powered by the operational generator. The protective circuits provide protection for the following type malfunctions: under/over voltage, under/over frequency and feeder faults. If any of these conditions occur, the protective circuits automatically detect it and remove the affected generator from its buses. If the malfunction is an under voltage or under frequency, the generator is automatically reconnected to its buses when the condition is cleared. If the malfunction is over voltage, over frequency or a feeder fault, the generator can be restored to its buses only after the condition is cleared and the AC RESET button is depressed. At less than maximum generator loads, the generators drop off the line at a lower engine rpm. When a generator, or generators, is disconnected from its buses by the fault protection circuits, the appropriate generator warning or caution light(s), either A.C. 1 (generator No. 1) A.C. 2 (generator No. 2), or A.C. (both generators) illuminates. Operating checks consist of monitoring the above warning lights to determine if the generators are connected to the line. External power can be used to energize the ac buses in place of the engine driven generators. In addition, an APU generator is provided which provides ac power to the aircraft while it is on the ground without the engine operating.

DC ELECTRICAL POWER SUPPLY

The dc electrical power supply consists of the No. 1 and No. 2 transformer-rectifiers, and batteries No. 1 through 3. The transformer-rectifiers, rated at approximately 70 amperes, receive 400 cycle, three phase, 115/200 volt ac power, and supply 28 volt dc power. Under normal operating conditions the No. 1 transformer-rectifier charges the No. 1 battery and supplies power to the following buses: No. 1 XFMR-RECT 28 volt dc bus, the No. 1 28 volt dc bus and the battery No. 1 bus. The No. 2 transformer-rectifier charges the No. 2 battery and supplies power to the following buses: No. 2 28 volt dc bus, alert 28 volt dc bus (CAB RANK bus) and the battery No. 2 bus. Switching arrangements are such that the No. 2 28 volt dc bus, which supplies the essential aircraft loads, is always energized. If the voltage on No. 2 28 volt dc bus drops below 24.5 volts (normally an indication of No. 2 transformer-rectifier failure) voltage sensing circuits detect the voltage drop and cause the DC bus relay to energize. This causes the No. 1 transformer-rectifier output to switch from the No. 1 28 volt dc bus to the No. 2 28 volt dc bus. If the malfunction is temporary, the DC bus relay can be deenergized by depressing the DC RESET button. Under normal conditions the DC bus relay is deenergized. When a low voltage (below 24.5 volts) condition is detected on the No. 2 28 volt dc bus by the voltage sensing circuits, the DC bus relay closes and the No. 2 28 volt dc bus is transferred from the No. 2 transformer-rectifier to the No. 1 transformer-rectifier. At the same time the No. 1 28 volt dc bus is removed from the No. 1 transformer-rectifier. If the cause of the low voltage condition is a failed No. 2 transformer-rectifier, the alert 28 volt dc bus is energized by the No. 1 transformer-rectifier through a diode (one way current device) connecting the No. 2 28 volt dc bus and the alert 28 volt dc bus. Two 24 volt 18 ampere-hour main batteries are provided. Both battery buses are tied directly to the respective batteries and are hot at all times with a battery installed. Battery No. 1 is associated with No. 1 transformer-rectifier and its dc buses, and battery No. 2 is associated with No. 2 transformer-rectifier and its dc buses. With the BATT NO. 1 switch placed on, battery No. 1 connects to the No. 1 transformer-rectifier and its buses. If failure of the transformer-rectifier occurs, battery No. 1 powers the buses. Placing the BATT NO. 2 switch to on connects battery No. 2 directly to the No. 2 28 volt dc bus. If both transformer-rectifiers trip off their buses, the dc bus relay energizes and the No. 1 battery powers the No. 2 28 volt dc bus and the alert 28 volt dc bus (along with the No. 2 battery). Placing the BATT NO. 2 switch to the alert bus (CAB RANK) position energizes the alert bus relay to connect both batteries directly to the alert 28 volt dc bus. At the same time the dc bus relay is energized and the No. 1 buses relay is prevented from being energized so that the APU generator, when operating, will power only the alert 28 volt dc bus, and charge No. 1 and No. 2 batteries. The alert bus (CAB RANK) position is used for operation by battery power only of certain equipment on the ground. The No. 3 battery is a 24 volt 2.5 ampere-hour battery used for emergency power. The No. 3 battery and the No. 3 battery bus are independent of the remainder of the electrical system. There is no battery switch and the bus is hot at all times. The battery is brought into use only during dc power failure of the main system by the appropriate emergency selection of the equipment on the No. 3 battery bus. See emergency power distribution, section V, for a list of equipment on this bus. The battery is replaced at short intervals so that a fully charged battery is available when required.

ELECTRICAL POWER DISTRIBUTION

The equipment powered by the electrical buses described above are protected by fuses and circuit breakers. With the exception of a few in the cockpit, most fuses and circuit breakers are not available to the pilot. See figure A-2, appendix A for fuses and circuit breakers associated with each bus.

CRASH RELAYS

Crash relays are provided to minimize the fire hazard created by the electrical system during crash landings. With BATT NO. 2 switch on, power from the No. 2 28 volt dc bus is routed to the control circuits of the two generators through closed contacts of two crash relays. In event of a crash or very hard landing the relays are energized by action of inertia switches. The relays when energized, disconnect the dc power from the generator control circuits, and the generators are de-excited and effectively isolated from their buses. Additional contacts in the crash relays cause No. 1 and No. 2 batteries to be shorted to ground and the engine fire extinguisher to discharge. Battery No. 3 is not affected by the crash relays.

APU GENERATOR

A 6000 volt-ampere, 400 Hz, 3 phase 115/200 volt ac apu generator is provided for ground use to supply power to the entire electrical system for purposes of operating aircraft electrical equipment, charging batteries No. 1 and 2, or supplying power external to the aircraft. When operating with BATT NO. 2 switch in the alert bus position (CAB RANK), the apu provides power only to the alert 28 volt dc bus, and to No. 1 and 2 batteries for charging. Power to equipment external to the aircraft is provided at an output receptacle on the left side of the main wheel well. The generator is driven by the gas turbine starter and controlled by the apu mode selector. Before the apu contactor is closed to connect the apu generator output to the aircraft buses, the apu generator output is checked for an over/under frequency or an over voltage condition by protective circuits. The protective circuits continue to operate once the apu generator output is applied to the aircraft buses and will disconnect the apu generator in case of malfunction. The apu generator cannot be started with external power on the aircraft.

EXTERNAL ELECTRICAL POWER RECEPTACLE

To provide adequate power for ground operation of aircraft electrical equipment, an external power input receptacle is provided on the left aft fuselage. The external power required is 400 Hz, three phase, 115/200 volt ac and 28 volts dc. There is no switch as such aboard the aircraft which connects or disconnects the external power to the aircraft buses, although the BATT NO. 2 switch must be in the on position in order to allow the external power contactor to be energized. In addition, after connecting the power cable and switching it on externally, the external power contactor will not energize and external power will not be applied to the aircraft buses until after a phase sequence unit checks that all phases of the external power are present and are in proper sequence. External power cannot be applied to the aircraft buses if power is already applied by either of the two main generators or the apu generator.

BATTERY SWITCHES

Two of the three batteries have control switches on the gang bar switch panel on the left console. The BATT NO. 1 switch has positions on and off, with the on position being the forward or ganged position and the aft position being the off position. Placing the switch to on connects the No. 1 battery to the output of the No. 1 transformer-rectifier and its associated buses, providing the dc bus relay is deenergized. If the dc bus relay is energized (less than 24.5 volts on the No. 2 28 volt dc bus) the No. 1 battery connects, instead, to the No. 1 XFMR-RECT 28 volt dc bus and the No. 2 28 volt dc bus. The BATT NO. 2 switch has positions on, off and alert bus (CAB RANK). The on position is the forward, or ganged, position which connects the No. 2 battery to the No. 2 28 volt dc bus and through the connecting diode to the alert 28 volt dc bus. The center position is off, and the aft position is alert bus. The alert bus position connects No. 1 and 2 batteries to the alert bus, energizes the dc bus relay and prevents the No. 1 buses relay from being energized. To get the BATT NO. 2 switch into or out of the alert bus position, the switch must be raised before it is moved. The No. 3 battery has no battery switch.

AC RESET BUTTON

The AC RESET button is on the forward right console. The button is pressed (for at least 2 seconds) to bring a generator back on the line if the cause of the generator dropping off the line is temporary.

DC RESET BUTTON

The DC RESET button is on the forward right console outboard of AC RESET button. The DC RESET button is pressed to reset either transformer-rectifier if they are tripped due a temporary high voltage condition. In the case of a temporary condition (whether high or low voltage) occuring on the No. 2 transformer-rectifier, the DC RESET button is also used to reset the dc bus relay. As described before, a low voltage (below 24.5 volts) on No. 2 28 volt dc bus causes the dc bus relay to energize, directing power from the No. 1 transformer-rectifier and No. 1 battery to the No. 2 28 volt dc bus instead of the No. 1 28 volt dc bus. If the fault is of a temporary nature, pressing the DC RESET button deenergizes the dc bus relay to bring the circuit back to the normal condition. The DC RESET button is also used to reset transformer-rectifiers that have been tripped during engine start.

APU MODE SELECTOR

The apu mode selector on the aft right console is used to start the apu generator. Placing the apu mode selector to one of the GROUND RUN positions (the knob has duplicate positions for each mode) and pressing the engine STARTER button starts the gas turbine starter and the apu generator. Placing the apu mode selector to either of the START positions deenergizes the right fuel boost pump and the apu contactor. Placing the apu mode selector to either of the OFF positions shuts down the gas turbine starter and the apu generator.

ENGINE STARTER BUTTON

The engine STARTER button aft of the apu mode selector on the aft right console is used to start the apu generator as previously described.

ELECTRICAL SYSTEM INDICATOR LIGHTS

The following red warning lights on the warning/caution lights panel pertain to the electrical system: AC and DC. Illumination of the AC warning light indicates that both main generators are off the line and separated from their buses. Illumination of the DC warning light indicates that both transformer-rectifiers are tripped and separated from their buses, or the voltage on No. 2 28 volts dc bus is below 24.5 volts. The following amber caution lights on the warning/caution lights panel pertain to the electrical system: AC 1, AC 2 and DC. Illumination of the AC 1 or AC 2 caution light indicates that the applicable main generator is off the line and disconnected from its buses. Illumination of the DC caution light indicates one of the transformer-rectifiers is tripped and disconnected from its buses. An ALT ON indicator light on the right aft console outboard of the apu mode selector illuminates whenever the output of the apu generator is connected to the aircraft buses.

VOLTMETER

A dc voltmeter is installed on the forward right console to the left of the AC RESET button. The voltmeter is calibrated from 21 to 29 volts and normally indicates the voltage on the No. 2 28 volt dc bus. To check the No. 1 battery on the ground, switch BATT NO. 1 and BATT NO. 2 on, and then switch off BATT NO. 2. When alert bus is selected by BATT NO. 2 switch, the voltage on the alert 28 volt dc bus is indicated on the voltmeter. When engine is not running or DC warning is illuminated, it will also show battery voltage.

DESCRIPTION - SINGLE GENERATOR SYSTEM

On airplanes 158948 and up, the airplane electrical power supply system consists of a primary ac electrical system powered by a single generator, a secondary dc electrical system composed of a dc transformer-rectifier for conversion of ac to dc, a power distribution (bus) system, an auxiliary power unit (APU) generator, and a receptacle for plugging in external power. Three batteries are included. Two of the batteries are used to smooth out operation of the transformer-rectifier and for use when the transformer-rectifier is inoperative. The third battery is for emergency use. The generator supplies ac power to the 115/200 volt ac bus and the transformer-rectifier. The transformer-rectifier converts 115/200 volt ac power to 28 volt dc power, which is supplied to the main 28 volt dc bus, the alert 28 volt dc bus, the No. 1 and No. 2 battery buses, and the No. 1 and No. 2 armament buses. Refer to Electrical Supply System (figure 1-11A) for a simplified system schematic and refer to Electrical System (figure A-2A, appendix A) for the individual bus loading.

AC ELECTRICAL POWER SUPPLY

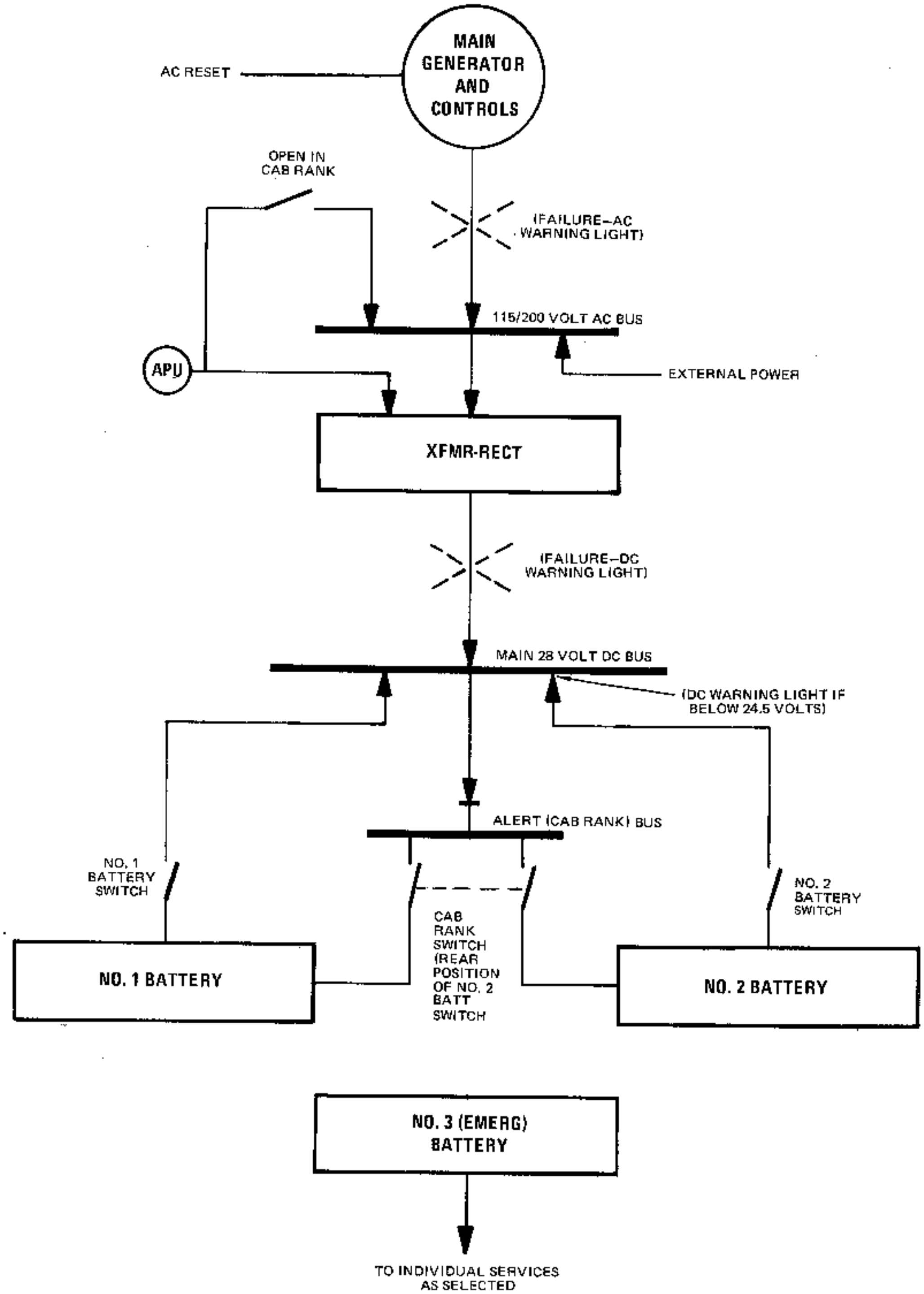
The primary source of electrical power is derived from a 400 Hz, three-phase, 115/200 volt ac generator. The generator is engine driven and is rated at 12,000 volt-amperes. The generator is located at the top of the engine bay, being mounted on, and driven by, the engine accessory gearbox. The generator contains a constant speed drive (CSD) which, in conjunction with the gearbox, ensures that the generator is driven at a constant speed of 8000 revolutions per minute within the speed range of the engine. The generator is oil-cooled by an oil system independent of the engines. The oil pump and reservoir is in the CSD, and the oil itself is cooled by a heat exchanger in the right center feed tank. The oil cooling system is ineffective when the right center feed tank drops below approximately 150 pounds of fuel in level unaccelerated flight. The generator supplies power to the 115/200 volt ac bus through the closed contacts of the main generator line contactor, and supplies power to the transformer-rectifier through the closed contacts of the main generator line contactor and alert relay No. 2. During engine start the main generator is brought up to speed and automatically comes on the line (the line contactor energizes) at the proper rpm. During engine start, the No. 2 alert relay energizes simultaneously with the generator line contactor, providing the BATT NO. 2 switch is not in the alert (CAB RANK) position. The No. 2 alert relay also energizes in conjunction with external power and the APU generator, and again, the BATT NO. 2 switch must be out of the alert position. There is no generator control switch as such to connect the generator output to, or disconnect the generator output from, the bus system, and except for the provision that the BATT NO. 2 switch must be out of the alert position so that the transformer-rectifier can be energized, neither battery switch has to be in the ON position. The protective circuits provide protection for the following type malfunctions: under/over voltage, under/over frequency and feeder faults. If any of these conditions occur, the protective circuits automatically detect it and remove the generator from its buses. If the malfunction is under frequency, the generator is automatically reconnected to its buses when the condition is cleared. If the malfunction is over or under voltage, over frequency or a feeder fault, the generator can be restored to its buses only after the condition is cleared and the AC RESET button is depressed. At less than maximum generator loads, the generator drops off the line at a lower engine rpm. When the main generator is disconnected from its buses by the fault protection circuits, the AC warning light illuminates. Operating checks consist of monitoring the above warning lights to determine if the generator is connected to the line. External power can be used to energize the ac buses in place of the engine driven generator. In addition, an APU generator is provided to supply ac power to the aircraft while it is on the ground without the engine operating.

DC ELECTRICAL POWER SUPPLY

The dc electrical power supply consists of the transformer-rectifier, and batteries No. 1 through 3. The transformer-rectifier, rated at 5 kilowatts, receives 400 cycle, three phase, 115/200 volt ac power, and supplies 28 volt dc power. Under normal operating conditions the transformer-rectifier supplies power to the main 28 volt dc bus. From the main 28 volt dc bus, power is then routed to the alert (CAB RANK) 28 volt dc bus through a diode (one way current device), and also routed to the No. 1 and No. 2 batteries and battery buses through the No. 1 and No. 2 battery relay contacts, respectively. Thus the above batteries are charged whenever the transformer-rectifier is energized and the battery switches are ON. Two 24 volt

ELECTRICAL SUPPLY SYSTEM SIMPLIFIED

AIRPLANES 158948 and up



AV8A-1-(175)A

Figure 1-11A

18 ampere-hour (one hour rating) main batteries are provided. Both battery buses are tied directly to the respective batteries and are hot at all times with a battery installed. In addition, No. 1 and No. 2 armament buses are tied directly to battery buses No. 1 and No. 2, respectively, and are therefore also hot. Placing a battery switch to ON connects the battery to the main 28 volt dc bus, and with the transformer-rectifier deenergized, causes the main 28 volt dc bus and alert 28 volt bus to be powered by the battery. Placing the BATT NO. 2 switch to the alert bus (CAB RANK) position energizes the alert bus relay No. 1 to connect both batteries directly to the alert 28 volt dc bus. At the same time the alert relay No. 2 is energized so that the APU generator, when operating, will power only the alert 28 volt dc bus, and charge No. 1 and No. 2 batteries. With the APU generator on the line and the No. 2 battery switch in alert, both battery relays No. 1 and No. 2 energize automatically to connect their respective batteries to the main 28 volt dc bus. With the APU generator off the line and battery No. 2 switch in alert, alert relay No. 3 is energized to prevent connecting battery No. 1 to the main 28 volt dc bus. This is accomplished by cutting off power to the battery No. 1 switch. The alert bus position is used for operation by battery power only of certain equipment on the ground. The No. 3 battery is a 24 volt 2.5 ampere-hour (one hour rating) battery used for emergency power. The No. 3 battery and the No. 3 battery bus are independent of the remainder of the electrical system. There is no battery switch and the bus is hot at all times. The battery is brought into use only during dc power failure of the main system by the appropriate emergency selection of the equipment on the No. 3 battery bus. See emergency power distribution, section V, for a list of equipment on this bus. The battery is replaced at short intervals so that a fully charged battery is available when required.

ELECTRICAL POWER DISTRIBUTION

The equipment powered by the electrical buses are protected by fuses and circuit breakers. With the exception of a few in the cockpit, most fuses and circuit breakers are not available to the pilot. See figure A-2A, appendix A for fuses and circuit breakers associated with each bus.

CRASH RELAYS

Crash relays are provided to minimize the fire hazard created by the electrical system during crash landings. In event of a crash or very hard landing the relays are energized by action of inertia switches. The relays when energized disconnect the dc power from the generator control circuits, and the generators are de-excited and effectively isolated from their buses. Additional contacts in the crash relays cause No. 1 and No. 2 batteries to be disconnected from the main 28 volt dc bus and the engine fire extinguisher to discharge. Battery No. 3 is not affected by the crash relays.

APU GENERATOR

A 6000 volt-ampere, 400 Hz, 3 phase 115/200 volt ac APU generator is provided for ground use to supply power to the entire electrical system for purposes of operating aircraft electrical equipment, charging batteries No. 1 and No. 2, or supplying power external to the aircraft. When operating with BATT NO. 2 switch in the alert bus position (CAB RANK), the APU provides power to the main 28 volt dc bus, the alert 28 volt dc bus, and to No. 1 and 2 batteries for charging. With the BATT NO. 2 switch in alert, the alert relay No. 2 is deenergized to prevent the 115/200 volt ac bus from being energized by the APU. Power to equipment external to the aircraft is provided at an output receptacle on the left side of the main wheel well. The generator is driven by the gas turbine starter and controlled by the APU mode selector. Before the APU contactor is closed to connect the APU generator output to the aircraft buses, the APU generator output is checked for an over/under frequency or an over voltage condition by protective circuits. In addition, a circuit monitors the duct temperature of the gas turbine starter and will shut off the starter if the limit is exceeded. The protective circuits continue to operate once the APU generator output is applied to the aircraft buses and will disconnect the APU generator in case of malfunction. The APU generator cannot be energized with external power on the aircraft.

EXTERNAL ELECTRICAL POWER RECEPTACLE

To provide adequate power for ground operation of aircraft electrical equipment, an external power input receptacle is provided on the left aft fuselage. The external power required is 400 Hz, three phase, 115/200 volt ac and 28 volts dc. There is no switch as such aboard the aircraft which connects or disconnects the external power to the aircraft buses, although either battery switch must be in the ON position in order to allow the external power contactor to be energized. In addition, after connecting the power cable and switching it on externally, the external power contractor will not energize and external power will not be applied to the aircraft buses until after a phase sequence unit checks that all phases of the external power are present and are in proper sequence. External power cannot be applied to the aircraft buses if power is already applied by the main generator.

BATTERY SWITCHES

Two of the three batteries have control switches on the gang bar switch panel on the left console. The BATT NO. 1 switch has positions ON and OFF, with the ON position being the forward or ganged position and the aft position being the off position. Placing the switch to ON, providing BATT NO. 2 switch is not in alert (CAB RANK), connects the No. 1 battery to the main 28 volt dc bus. The BATT NO. 2 switch has positions on, off and alert bus (CAB RANK). The ON position is the forward, or ganged, position which connects the No. 2 battery to the main 28 volt dc bus. The center position is off, and the aft position is alert bus. The alert bus position connects No. 1 and 2 batteries to the alert bus by energizing alert relay No. 1. In addition, the alert position energizes alert relay No. 3 which, unless the APU is on the line, locks out the ON position of the BATT NO. 1 switch. To get the BATT NO. 2 switch into or out of the alert bus position, the switch must be raised before it is moved. The No. 3 battery has no battery switch.

AC RESET BUTTON

The AC RESET button is on the forward right console. The button is pressed (for at least 2 seconds) to bring the generator back on the line if the cause of the generator dropping off the line is temporary. It is also used to extinguish warning lights which are left illuminated after engine start.

APU MODE SELECTOR

The APU mode selector on the aft right console is used to start the APU generator. Placing the APU mode selector to one of the GROUND RUN positions (the knob has duplicate positions for each mode) and pressing the engine STARTER button starts the gas turbine starter and the APU generator. Placing the APU mode selector to either of the START positions deenergizes the APU contactor to disconnect the APU generator output from the aircraft buses. Placing the APU mode selector to either of the OFF positions shuts down the gas turbine starter and the APU generator.

ENGINE STARTER BUTTON

The engine STARTER button aft of the APU mode selector on the aft right console is used to start the APU generator as previously described.

ELECTRICAL SYSTEM INDICATOR LIGHTS

The following red warning lights on the warning/caution lights panel pertain to the electrical system: AC and DC. Illumination of the AC warning light indicates that the main generator is off the line and separated from its buses. Illumination of the DC warning light indicates that transformer–rectifier is inoperative, or the voltage on the main 28 volts dc bus is below 24.5 volts. An ALT ON indicator light on the right aft console outboard of the APU mode selector illuminates whenever the output of the APU generator is connected to the aircraft buses.

VOLTMETER

A dc voltmeter is installed on the forward right console to the left of the AC RESET button. The voltmeter is calibrated from 21 to 29 volts and normally indicates the voltage on the main 28 volt dc bus. To check the voltage of the individual batteries on the ground without the transformer–rectifier operating, place the desired battery switch to ON while leaving the other battery switch OFF. When alert bus is selected by BATT NO. 2 switch and the APU generator is not on the line, the voltage on the alert 28 volt dc bus is indicated on the voltmeter. When alert bus is selected by BATT NO. 2 switch and the APU generator is on the line, the voltage on the main 28 volt dc bus is indicated on the voltmeter.

NORMAL OPERATION – DUAL GENERATOR SYSTEM

INFLIGHT SYSTEM

Normal operation of the system begins with the procedures involved in starting the engine as described in section III. The No. 1 and 2 battery switches should be on at all times during flight, and the warning/caution lights and the dc voltmeter should be monitored.

APU GENERATOR

Before starting the apu generator, external power must be disconnected. The apu generator is started by placing the apu mode selector to GROUND RUN and then pressing and immediately releasing, the engine STARTER button. When the apu generator contactor closes to connect the apu generator to the aircraft buses, the ALT ON light illuminates. If during operation of the apu generator the frequency and/or voltage limits are exceeded, protective circuits will deenergize the apu generator contactor and the ALT ON indicator extinguishes. The apu mode selector must be placed to OFF to prevent damage to the generator. To bring the apu generator back on the line, the apu mode selector is cycled from GROUND RUN to OFF to GROUND RUN. Re–illumination of the ALT ON light indicates the apu generator is back on the line. The apu generator is shut down by placing the apu mode selector to OFF or START. When the apu mode selector is placed to OFF at the end of a GROUND RUN cycle, a minimum of 1 minute must elapse before the start of another GROUND RUN.

CAUTION

If ALT ON light does not illuminate after apu start or extinguishes during operation of the apu generator, and recycling of the apu mode selector does not cause the ALT ON light to re–illuminate, shut down the apu generator as damage may result.

EXTERNAL GROUND POWER

External ground power cannot be connected to the aircraft buses if either of the main generators or the apu generator is on the line. To connect external power, the following sequence must be adhered to: turn off BATT NO. 1 and BATT NO. 2 switches, connect external power cable, place BATT NO. 1 and BATT NO. 2 switches to on, turn on external power at source, and press DC RESET button. To disconnect external power proceed as follows: turn off external power at source, turn off BATT NO. 1 and BATT NO. 2 switches, and disconnect the external power cable. All warning/caution lights, except for fire warning, are inoperative with external power connected and the low pressure fuel shut off valve OFF. When running on external power, switch on the anti–collision light to prevent No. 1 battery from being overcharged.

GROUND ALERT

Ground alert consists of energizing the alert bus by batteries 1 and 2 while utilizing the equipment and functions powered by the alert bus, and periodically recharging the batteries by operation of the apu generator. The procedure is as follows: place BATT NO. 1 switch to OFF and BATT NO. 2 switch to alert bus (CAB RANK). After 90 minutes, start the apu generator (see apu generator above). After operating the apu generator for 45 minutes, shut down and repeat the cycle. During ground alert, except for fire warning, the warning/caution lights are inoperative. The following equipment/functions operate from the alert bus:

APU Starting
Communications Control Panel
Amplifier Unit
Utility Light
Fire Warning and Extinguisher
HF Radio-Receive Only
Inertial Platform Heater
DC Voltmeter

NORMAL OPERATION - SINGLE GENERATOR SYSTEM

INFLIGHT SYSTEM

Normal operation of the system begins with the procedures involved in starting the engine as described in section III. BAttery No. 1 and 2 switches should be on at all times during flight, and the warning lights and the dc voltmeter should be monitored.

APU GENERATOR

Before starting the APU generator, external power must be disconnected. The APU generator is started by placing the APU mode selector to GROUND RUN and then pressing, and immediately releasing, the engine STARTER button. When the APU generator contactor closes to connect the APU generator to the aircraft buses, the ALT ON light illuminates. If during operation of the APU generator the frequency and/or voltage limits are exceeded, protective circuits deenergize the APU generator contactor and the ALT ON indicator extinguishes. The APU mode selector must then be placed to OFF to prevent damage to the generator. If the temperature limit of the gas turbine starter is exceeded, the starter (and APU generator) will automatically shutoff and be locked out until it is restarted. To bring the APU generator back on the line, the APU mode selector is cycled from GROUND RUN to OFF to GROUND RUN. Re-illumination of the ALT ON light indicates the APU generator is back on the line. The APU generator is shut down by placing the APU mode selector to OFF or START. When the APU mode selector is placed to OFF at the end of a GROUND RUN cycle, a minimum of 1 minute must elapse before the start of another GROUND RUN.

CAUTION

If ALT ON light does not illuminate during APU start or extinguishes during operation of the generator, and recycling of the APU mode selector does not cause the ALT ON light to re-illuminate, shut down the APU generator as damage may result.

EXTERNAL GROUND POWER

External ground power cannot be connected to the aircraft buses if the main generator is on the line. To connect external power, the following sequence must be adhered to: turn off BATT NO. 1 and BATT NO. 2 switches, connect external power cable, place BATT NO. 1 and BATT NO. 2 switches to on, turn on external power at source. To disconnect external power proceed as follows: turn off external power at source, turn off BATT NO. 1 and BATT NO. 2 switches, and disconnect the external power cable. All warning/caution lights, except for fire warning, are inoperative with external power connected and the low pressure fuel shut off valve OFF. When running on external power, switch on the anit-collision light to prevent No. 1 battery from being overcharged.

GROUND ALERT

Ground alert consists of energizing the alert bus by batteries No. 1 and 2 while utilizing the equipment and functions powered by the alert bus, and periodically recharging the batteries by operation of the APU generator. The procedure is as follows: place BATT NO. 1 switch to OFF and BATT NO. 2 switch to alert bus (CAB RANK). After 90 minutes, start the APU generator (see APU generator above). After operating the APU generator for 45 minutes, shut down and repeat the cycle. During ground alert, except for fire warning, the warning/caution lights are inoperative. The following equipment/functions operate from the alert bus:

APU Starting
Communications Control Panel
Amplifier Unit
Utility Light
Fire Warning and Extinguisher
VHF Radio
Inertial Platform Heater
DC Voltmeter
Main UHF Radio and Homing

EMERGENCY OPERATION - DUAL GENERATOR SYSTEM

SINGLE TRANSFORMER-RECTIFIER FAILURE

No. 1 transformer-rectifier tripped off the line is indicated by illumination of the DC amber caution light. No. 2 transformer-rectifier tripped off the line is indicated by illumination of both the amber DC light and the left amber PUMP light. If the fault is transient, the No. 1

transformer-rectifier can be reset, when the fault has cleared, by pressing the DC RESET button. If the fault is associated with the No. 2 transformer-rectifier, it must be reset by pressing the DC RESET button for 5 seconds. If the No. 1 transformer-rectifier remains off the line, the No. 1 XFMR-RECT 28 volt dc bus and the No. 1 28 volt dc bus will be powered by the No. 1 battery. If the No. 2 transformer-rectifier remains off the line, the No. 1 28 volt dc bus is lost, and the following buses are powered by the No. 1 transformer-rectifier: No. 1 XFMR-RECT 28 volt dc bus, No. 2 28 volt dc bus and alert 28 volt dc bus. See Emergency Power Distribution, section V.

DOUBLE TRANSFORMER-RECTIFIER FAILURE

Both transformer-rectifiers tripping off the line is indicated by illumination of the red warning DC light and followed by the amber DC light when the No. 2 28 volt dc bus drops below 24.5 volts. If the malfunction is associated with both generators off the line, an attempt should be first made to reset the generators. If the generators are reset successfully or if malfunction is not due to both generators dropping off line, attempt to reset the transformer-rectifiers by pressing the DC RESET button for 5 seconds. If reset is unsuccessful, all dc buses are lost except the No. 1 XFMR-RECT 28 volt dc bus, the No. 2 28 volt dc bus and the alert 28 volt dc bus, which are powered by No. 1 and No. 2 batteries. Turn off fuel boost pumps and all non-essential DC services. Turn on STBY UHF, switch ART HORIZ switch to emergency power, switch standby UHF power selector switch to EMERG when dc voltmeter indicates 21 volts and land as soon as practicable. See Emergency Power Distribution, section V. The following are considerations when operating with both transformer-rectifiers inoperative:

a. Batteries discharge slowly to 21 volts and then quickly decay.
b. Flight controls and engines operate satisfactorily without electrical power.
c. Put down landing gear early if practicable.
d. Nosewheel steering is automatically engaged.
e. The emergency battery (No. 3) lasts 30 minutes and supplies:
    Emergency landing gear lowering
    Attitude indicator emergency supply
    Utility floodlight power
    Emergency UHF
    Eject auto-tone generator

SINGLE GENERATOR FAILURE

A single generator off the line is indicated by illumination of the appropriate amber caution light, either AC 1 or AC 2. If the fault is transient, the generator can be brought back on the line by pressing the AC RESET button. If the fault is in the No. 1 generator and AC 1 light remains illuminated, the No. 1 115/200 volt ac bus is lost and No. 1 transformer-rectifier is lost causing the No. 1 XFMR-RECT 28 volt dc bus and No. 1 28 volt dc bus to be powered by the No. 1 battery. The boost pumps should be switched off and the aircraft landed as soon as practicable, turning on the boost pumps prior to landing. If the fault is in No. 2 generator and AC 2 light remains illuminated, generator No. 1 assumes operation of the buses normally powered by No. 2 generator, and buses associated with the No. 1 generator are deenergized. That is, the same buses are lost (described above) when either the No. 1 or the No. 2 generator is lost. The aircraft should be landed as soon as practicable. See Emergency Power Distribution, section V.

DOUBLE GENERATOR FAILURE

Both generators dropping off the line is indicated by illumination of the following warning/caution lights: AC, AC 1, AC 2, DC (red warning light) and DC (amber caution light). An immediate attempt should be made to reset the generators by pressing the AC RESET button. If ac reset is unsuccessful, all ac buses are lost, (IFF, C2J compass, TACAN, INS and HUD) and all dc buses are lost except the No. 1 XFMR-RECT 28 volt dc bus, the No. 2 28 volt dc bus and alert 28 volt dc bus, which are powered by No. 1 and 2 batteries. If ac reset is successful, proceed with dc reset as described in Double Transformer-Rectifier Failure. If ac reset is not successful, or if ac reset is successful and dc reset is not successful, proceed with procedure following unsuccessful dc reset in Double Transformer-Rectifier Failure.

NOTE

> In case of a No. 2 transformer-rectifier reset failure, the No. 1 28 volt dc bus is lost (including the left fuel boost pump) and the No. 1 battery is switched to the No. 2 side, but the right fuel boost pump remains with the No. 1 battery.

ELECTRICAL FIRE

If an electrical fire occurs, turn all electrical switches and batteries off. If fire persists, turn off generators by shutting down the engines. For subsequent airstart, BATT NO. 2 switch must be on. If fire ceases, individually reposition the electrical equipment switches on, beginning with the most essential equipment first. If the malfunctioning equipment is found, turn it off. Do not actuate the AC/DC RESET button.

CRASH RELAYS

In order for the crash relays to operate the BATT NO. 2 switch must be on. No. 3 battery is not disconnected from its bus by the action of the crash relays. After a forced landing, the battery switches should be shut off after the aircraft touches down.

EMERGENCY OPERATION - SINGLE GENERATOR SYSTEM

TRANSFORMER - RECTIFIER FAILURE

An inoperative transformer-rectifier or a low voltage condition on the main 28 volt dc bus is indicated by illumination of the DC warning light. If the fault is transient, the light goes out when the fault is cleared. If the fault does not clear, all normal dc buses are lost when batteries No. 1 and 2 are discharged. Turn off fuel boost

pumps and all non-essential DC services to emergency power, turn on STBY UHF, switch ART HORIZ switch to emergency power, switch standby UHF power selector switch to EMERG when dc voltmeter indicates 21 volts and land as soon as practicable. See Emergency Power Distribution, section V. The following are considerations when operating with the transformer-rectifier inoperative:

a Batteries discharge slowly to 21 volts and then quickly decay.
b Flight controls and engines operate satisfactory without electrical power.
c Put down landing gear early if practicable.
d Nosewheel steering is automatically engaged.
e The emergency battery (No. 3) lasts 30 minutes and supplies:
Emergency landing gear lowering
Attitude indicator emergency supply
Utility floodlight power
Emergency UHF
Eject auto-tone generator

GENERATOR FAILURE

The generator dropping off the line is indicated by illumination of the AC and DC warning lights. An immediate attempt should be made to reset the generators by pressing the AC RESET button. If ac reset is successful, the AC warning light goes out and the transformer-rectifier restores itself automatically, causing the DC warning light to go out. If reset is unsuccessful, all ac buses are lost, (IFF, C2J compass, TACAN, INS and HUD) and all normal dc buses are lost when batteries No. 1 and 2 are discharged. If ac reset is not successful, or if ac reset is successful and the DC warning light does not go out, proceed with procedure for Transformer-Rectifier Failure.

ELECTRICAL FIRE

If an electrical fire occurs, turn all electrical switches and batteries off. If fire persists, turn off generator by shutting down the engine. For subsequent airstart, BATT NO. 2 switch must be ON. If fire ceases, individually reposition the electrical equipment switches on, beginning with the most essential equipment first. If the malfunctioning equipment is found, turn it off. Do not actuate the AC RESET button.

CRASH RELAYS

In order for the crash relays to operate the BATT NO. 2 switch must be ON. No. 3 battery is not disconnected from its bus by the action of the crash relays. After a forced landing, the battery switches should be shut off after the aircraft touches down.

LIMITATIONS - ALL AIRPLANES

An external electrical supply must not be used for engine starting. It is recommended that the electrical system should not be operated to supply significant loads for extended periods on the ground when the engine is running in ambient temperatures above 35°C.

EMERGENCY EQUIPMENT

DESCRIPTION

The emergency equipment consists of the jettison controls and the warning/caution lights system.

JETTISON CONTROLS

There are two types of jettison circuits available: a circuit which jettisons non-sidewinder stores from external stations 1 through 5 either from individual stations or from all five stations simultaneously, and a circuit which jettisons sidewinders simultaneously from stations 1 and 5. The non-sidewinder jettison controls include the following: ground safety interlocks, No. 1 and No. 2 arm masters switches, jettison buttons and clear a/c bar. The sidewinder jettison controls include the following: ground interlocks, No. 2 arm masters switch, bombs/rockets sidewinder select switch and sidewinder jettison button. For jettison procedures, see External Stores Jettison Chart, section V.

Ground Safety Interlocks

The ground safety interlocks consist of the armament safety break switches and relay contacts controlled by the weight-on-wheels switch. When open, the armament safety break switches and weight-on-wheels switch relay contacts shutoff electrical power to the No. 1 and No. 2 arm masters switches, which in turn supply power to all jettison circuits. The armament safety break switches are controlled by an armament safety key which can be inserted in a keyway on the right center fuselage. Placing the key to the LOCKED position opens the armament safety break switches. The key is kept in the LOCKED position while the aircraft is on the ground, and must be removed before flight. The relay contacts controlled by the weight-on-wheels switch are wired in series with the armament safety break switches, and when the weight-on-wheels switch is open, the relay contacts are open to shutoff electrical power to the jettison circuits. The weight-on-wheels switch (on the main landing gear scissors links) is open whenever the weight of the aircraft is on the main landing gear (gear strut compressed). Once airborne, the switch closes and remains closed even after the gear is retracted. Thus, for the jettison circuits to have electrical power available, the armament safety break switches key must be removed and the aircraft must be airborne.

Jettison Buttons

Five jettison buttons, one for each pylon, are on the weapons control panel. The buttons are covered by black and yellow, diagonally striped, spring-loaded flaps which are hinged along their top edges. Each button is operated by pressing the lower part of the covering flap. When a button is pressed firmly any jettisonable store on the associated pylon, except sidewinders, is jettisoned.

CAUTION

Jettison buttons should not be pressed and held for longer than 3 seconds.

Clear A/C Bar

Just below the jettison buttons on the weapons control panel is the clear a/c bar. The clear a/c bar is a black and yellow striped panel which spans the width of the five jettison buttons and is hinged on its lower edge. The upper edge of the panel overlaps the lower portion of the five jettison button flaps. When the clear a/c bar is pressed firmly, all jettison buttons are actuated and any jettisonable stores, except sidewinders, on the associated pylons are jettisoned.

CAUTION

Jettison buttons should not be pressed and held for longer than 3 seconds.

No. 1 and No. 2 Arm Masters Switches

The No. 1 and No. 2 arm masters switches on the sidewinder control panel, in conjunction with ground safety interlocks, control power to the jettison circuits. They are lever lock type toggle switches which can be locked in either the ON position of the off (down) position. To jettison sidewinders the No. 2 arm masters switch must be ON. To jettison non-sidewinder stores, either the No. 1 or No. 2 masters switch must be ON.

NOTE

Battery master switches need not be on.

Sidewinder Jettison Button

The sidewinder jettison button, labeled J, on the sidewinder control panel is utilized to jettison sidewinders in conjunction with the ground interlocks, No. 2 arm master switch, and the bombs/rockets sidewinder select switch. The spring-loaded button, when pushed, fires all loaded sidewinders unarmed and unguided.

Bombs/Rockets Sidewinder Select Switch

The bombs/rockets sidewinder select switch on the sidewinder control panel is required to jettison sidewinder missiles. The two-position toggle switch has positions BOMBS/ROCKETS ON and SIDEWINDER ON. The switch must be in the SIDEWINDER ON position to jettison sidewinders with the sidewinder jettison button.

WARNING/CAUTION LIGHTS

Warning/caution lights are incorporated to reduce instrument surveillance to a minimum. With the exception of a fire warning light, labeled F, and a fuel level low warning light above the left glare shield and a fuel level low warning light above the right glare shield, all of the lights are on the warning/caution lights panel. Besides the warning/caution lights, the system includes two master caution lights, a mute button, an audio warning generator and a test button.

Warning/Caution Lights Panel

The warning/caution lights panel, (see warning caution indicator lights, section V) above the forward right console, contains provisions for nine warning lights and 18 caution lights. The warning lights have red lenses and are on the forward part of the panel. Illumination of a red warning light indicates failure of a critical system or a condition requiring urgent action. The system or condition involved is printed on the light. Illumination of a warning light is accompanied by two master caution lights flashing and an audio warning in pilot's headset. The caution lights have amber lenses and are on the aft section of the panel. Illumination of an amber caution light, like illumination of a warning light, indicates a failed system or a condition requiring prompt action, but the situation is less urgent than a warning light. Illumination of an amber caution light is accompanied by flashing of the two master caution lights but there is no audio tone in the headset. Illumination of the 15 SEC light is somewhat different from the other warning/caution lights in that, instead of the master caution lights flashing continuously, a 15 second cycle is commenced. The 15 second cycle consists of 3 seconds of flashing by the master caution lights, followed by a period of 12 seconds during which the master caution lights are extinguished. Following the 15 seconds, the master caution lights resume flashing if the condition causing the 15 SEC light to illuminate is not cleared. If another warning/caution light illiminates during the 12 second pause, both master caution lights immediately commence flashing. For further details on illumination of the 15 SEC caution light, see Engine, this section. All warning/caution lights have dual lamps as a precaution against a single filament failure. All unused lights are labeled SPARE. When activated, the lights illuminate steady, except for the IFF caution light which flashes. The lights can be dimmed by a dim button on the forward left corner of the panel. When in the DIM position, the warning/caution lights are mechanically dimmed by a screen sliding over the lamps. To prevent overuse of the lights on the ground before the engine is started, all lights, except for the fire warning lights, are inoperative with external power connected to the aircraft or when the mute button is pressed. Both the external power and mute button conditions are overridden when the low pressure fuel valve shutoff is opened, so that full warning/caution capability is available during engine start and engine operation. If the lights illuminate due to transient causes, they will go out automatically when the cause disappears. With the exception of the JPT warning light, the lights will go out after appropriate action removes the cause of illumination.

Master Caution Lights

Two red master caution lights, labeled C, one above the left glare shield and the other above the right glare shield, flash to give additional indication that a warning or a caution light is illuminated. The left master caution light is housed in a spring-loaded switch which gives short term cancelling capability. If the light is illuminated and then pushed and released, both master caution lights extinguish and the audio warning, if initiated, is silenced. The warning or caution light remains illuminated after the left master caution light is released and the system is reset. And thus, if another warning/caution light illuminates, the master caution lights re-illuminate and the audio tone is again heard. The right master caution light is housed in a push/pull switch which gives it a long term cancel capability. When the switch is pushed in, its light goes from flash to steady, the left master caution light continues flashing (but can be cancelled by pushing in) and the audio tone, if initiated, is silenced. The lights on the warning/caution lights panel remain illuminated, and any additional illumination of lights is indicated by the warning/caution lights themselves and by the left caution light flashing if previously cancelled. When the switch is pulled out, the system reverts to the condition prior to pushing it in.

Mute Button

The mute button is over the right glare shield and labeled M. It is an amber light housed in a push/pull switch. When the button is pushed on the ground before engine start, all warning/caution lights, except fire warnings, are muted. The mute button should be pulled out before engine start, but if it is not, the button is overridden by a microswitch on the low pressure fuel valve handle when the handle opens the valve. If the mute button is overridden and the button remains pushed in, the amber light stays illuminated until the button is pulled out.

Audio Warning Generator

An audio warning generator is installed to provide an audio warning sound in the pilot's headset whenever a red warning light illuminates. The operation of the generator can be cancelled by pressing either the right or left master caution lights, or, before engine start, the audio warning is muted by the presence of external power on the aircraft or by pushing the mute button. The intensity of the audio warning is controlled by the receiver volume control knob on the communications control panel.

Warning/Caution Lights Test Button

A warning/caution lights test button is provided to test operation of the lamps and the audio warning of the warning/caution lights system and to test the operation of the fire warning circuits. The spring-loaded button, labeled C.W.P. Test, is above the right console aft of the oxygen quantity indicator. The button can be used to test the system provided the system is not muted by the mute button or external electrical power, or the system is not cancelled by the right master caution light. When the button is pressed, all of the warning/caution lights, except the F and FIRE warning lights, illuminate steady. Also, both master caution lights flash and the audio warning is heard. After a short delay, the F and FIRE lights illuminate to indicate the fire warning circuits have been checked and found operational.

ENGINE

DESCRIPTION

The aircraft is powered by a Rolls Royce F402-RR-401 twin spool, axial flow, turbo fan engine with thrust-vectoring exhaust nozzles. One of the spools is a 3-stage LP compressor (FAN) driven by a 2-stage LP turbine and the other is an 8-stage HP compressor driven by a 2-stage HP turbine. Each spool is independent of the other, but they are co-axial and, to minimize gyroscopic effect, they contra-rotate. The engine, with water injection providing thrust boosting, develops a nominal (static test bed) thrust of 21,500 lb in optimum ICAO conditions or 20,500 lb without water injection. Air drawn through two intakes, enters the fan, the rotating first stage of which provides anti-icing protection. Leaving the fan the air is divided, one flow passing to an annular plenum chamber from which it is ducted through front, left and right, cold nozzles. The other flow passes through variable inlet guide vanes, through the HP compressor and a combustion chamber to the HP and fan turbines. It is then ducted through rear, left and right, hot nozzles. The bearings of the two hot nozzles are cooled by air bleeds from the plenum chamber; bleeds from the engine supply other services described in this and other sections. The engine bay is ventilated by ram air intakes at the forward end of the front nozzle fairings and the wing roots. Air flow is assisted, whenever the engine is running, by flow inducer nozzles supplied by air bleed from the fan; this ensures that the bay is adequately ventilated in slow and hovering flight. An engine mounted auxiliary power unit (APU), is used for engine starting. It can also be used to supply electrical power (when required) on the ground. Because there are no inlet guide vanes in front of the fan, an engine anti-icing system is not necessary. Thermocouples in the turbine exhaust sample gas termperature and supply data to a JPT gauge, a JPT Limiter (JPTL) and an Engine Life Recorder (ELR).

ENGINE FUEL SYSTEM

The main components of the engine fuel system consist of a fuel control unit (FCU), two manifolds, 18 flow distributors, two torch igniters, five primer jets, dump valve and tank. Fuel is available to the engine when a throttle lever is moved forward from the cutoff position, provided the LP fuel shutoff is ON. Flow, at engine speeds up to about 85%, is then controlled by movement of the lever and by an acceleration control unit metering valve. The effective area of a throttle valve orifice is set by the position of the throttle and a constant pressure drop across the orifice is maintained by the metering valves influence on a flow control pressure drop regulator. Above approximately 85%, throttle movement selects an RPM and the FCU output is automatically governed. The FCU supplies two manifolds, a primary and a secondary, which encircle the engine and from the manifolds fuel can enter an annular combustion chamber via the flow distributors.

FUEL CONTROL UNIT (FCU)

The main components of the FCU consist of gear pump, backing pump, manual fuel system, flow control pressure drop regulator, mechanical pressure drop regulator, metering valve and acceleration control unit (ACU), air bleed reset unit, fan mechanical governor, pressure ratio limiter, water injection bypass solenoid valve, torch igniter valve (primer jets supplied by FCU), manifold check valves, manifolds (supplied by FCU) and flow distributors.

Pumps

The gear pump and its backing pump are housed in one body and they are driven by the HP compressor shaft. Fuel from the backing pump passes through an LP filter to the gear pump. A tapping from downstream of the filter supplies fuel (to be used as a hydraulic medium) to the variable inlet guide vane (IGV) control unit; from this it is returned to upstream of the backing pump. The output of the pumps always exceeds engine demand and delivery is controlled by the mechanical pressure drop regulator which is sensitive to HP RPM. Excess pump supply fuel is bypassed to upstream of the backing pump and in the bypass line there is a pump pressure relief valve.

Pressure Drop Regulators

A flow control pressure drop regulator maintains a constant pressure drop across the variable orifice of the throttle valve in accordance with throttle movement, up to 85% RPM (nominal). This gives a fixed fuel flow and RPM creep will occur with change in altitude. At and above 85% RPM, the throttle valve orifice is fully open but a given throttle lever position demands a fixed RPM so control then passes to the fan mechanical governor and the ACU metering valve. A mechanical pressure drop regulator senses compressor speed as a bobweight load and maintains a pre-determined pressure differential across the ACU metering valve by regulating the volume of a bypass flow of fuel to upstream of the backing pump.

Metering Valve and Acceleration Control Unit (ACU)

Metering valve settings are normally influenced by the FCU components responding to changes in fuel pressure and air pressure differentials. When the engine is accelerated rapidly their influence is temporarily overridden and the metering valve opens to increase fuel flow. The ACU, sensing the pressure ratio between the fan and HP compressors will, via a servo amplifying valve, finalize the metering valve's position, to meet the throttle setting requirement. To prevent flame out during rapid deceleration, the orifice of the metering valve has a minimum flow stop.

Air Bleed Reset Unit

An Air Bleed Reset Unit, in parallel with the ACU and metering valve automatically provide a supplementary fuel flow when the reaction controls air bleeds create extra power demands.

Fan Mechanical Governor

The fan mechanical governor is driven by the fan shaft. It senses fan speed as a bobweight load and this can be opposed by a cam linked to the throttle. The governor acts, through a hydraulic servo, to vary the position of the FCU metering valve, at 85% RPM (nominal) and above, to allow up to 4% more RPM. Governor creep at altitude is almost eliminated by imposing a proportion of fan delivery air pressure on an evacuated bellows which opposes the load on a half ball valve imposed by the servo system pressure. A small negative RPM creep may occur as altitude increases. A water injection solenoid can reset the governor datum and a JPT limiter can bias the governor.

Pressure Ratio Limiter (PRL)

To prevent engine surge at high RPM and at low temperatures the PRL senses pressure rise across the HP compressor and as intake temperature falls it bleeds fuel from the downstream side of the metering valve to upstream of the pumps. The PRL is controlled automatically by a signal from an Air Data Computer (ADC), via a PRL cutout solenoid valve, which ensures that the PRL is cutout below 10,000 ft. It can be switched OFF, if necessary, using a limiters switch. The PRL is adjustable and is set to control at 99 to 101% (corrected RPM) and is checked on functional check flight.

Water Injection Bypass Solenoid Valve

When water injection is selected ON, the water injection bypass solenoid valve is energized open and provides a supplementary fuel flow to the secondary manifold to help engine acceleration. This will give an RPM increase of approximately 6% at idling RPM.

Torch Igniter Valve and Primer Jets

This solenoid valve is opened during the engine starting sequence and then supplies fuel to five primer jets.

Manifold Check Valves

These are two pressurizing valves which ensure that pump pressure output does not fall below 200 psi in low flow conditions. They also act as flow controllers to the two manifolds: at pressures up to 290 psi fuel flows to the primary manifold, above this pressure fuel also flows to the secondary manifold.

Manifolds

The two manifolds (which are supplied by the FCU) encircle the engine; the primary in front of the secondary. They are short lengths of stainless steel pipe with differing diameters, connected at junction boxes. The diameters differ to preserve a uniform fuel pressure and thus fuel flow.

Flow Distributors

There are 18 flow distributors, each with primary and secondary entry ports for fuel from the manifolds. The distributors are swirl chambers for the primary fuel and secondary flow passes along the core formed by the primary flow. Fuel is discharged, through the conical apex of the chambers, into vaporizers. Two torch igniters commence combustion.

Dump Valve and Tank

A spring-loaded open dump valve is held closed by primary manifold pressure when the engine is running. During engine shut down the valve ensures a rapid and smooth sequence by opening to allow fuel to drain from the secondary manifold and then (via the secondary manifold), the fuel from the primary manifold into a 1.05 gallon dump tank. A normal stop/start cycle dump is approximately 1.2 pints. The dump tank can be drained via a valve on the under side of the fuselage. There is a tank overflow outlet near the valve.

Manual Fuel System

If the MANL FUEL switch is positioned to ON, the manual fuel system is activated. This system bypasses the automatic features of the fuel control unit and provides an alternate route to the torch igniters and fuel nozzles. Once the manual fuel system is selected, engine RPM is controlled by the throttle only. The engine is cleared for use in all flight regimes with the manual fuel system activated.

MANL FUEL Switch

The MANL FUEL switch is on the left console outboard of the landing gear position indicators. The switch is on a raised bracket and is identified further by a stripped surface.

MFS Caution Light

An MFS caution light, on the caution light panel, illuminates any time the MANL FUEL switch is placed to ON.

MFS Warning Light (ECP 470)

An MFS warning light, on the warning light panel, illuminates any time the FCU is in the manual fuel mode and the manual fuel switch is OFF. If the MFS warning light illuminates the MANL FUEL switch should be placed to ON.

Dump Valve and Pressurizing Check Valves

The pressurizing check valves (one in each fuel manifold) prevents fuel flow to the engine until sufficient fuel pressure is attained in the FCU to operate the servo assemblies, which are used to compute the fuel flow schedules. The dump valve drains the fuel manifolds at engine shutdown to prevent post shutdown fires. The check valves also ensure the upstream portion of the system remains primed to permit faster starts.

INLET GUIDE VANES

Variable inlet guide vanes (IGV) direct airflow into the HP compressor to give optimum compressor performance. Their automatic control unit is adjusted by HP compressor RPM and intake air temperature using engine fuel as a hydraulic medium. An IGV position indicator, on the main instrument panel, indicates the IGV angle relative to the fore-and-aft axis of the engine. The indication varies from approximately 40° at idling RPM to 0° at high RPM (83% approximately).

INTERSTAGE BLOW-OFF VALVES

Two interstage blow-off valves open at low RPM to bleed air from the HP compressor into the plenum chamber. The valves close automatically as RPM increase, promoting rapid surge-free acceleration.

LUBRICATION SYSTEM

Oil is drawn from a tank (on the left side of the engine) and circulated by a gear pump through a scavenge return, dry sump system; the returning flow to the tank passing through a fuel-cooled cooler. The tank has three filling levels. It normally contains 19.2 pints, sufficient for 4 hour sorties, and this quantity is pressure replenished via a coupling on the left front side of the fuselage. Full is indicated by a transparent overflow pipe beside the coupling. For ferry flights it can be filled to 26 pints, sufficient for 7½ hour sorties, or, for extended ferry flights, to 33 pints, sufficient for 10 hour sorties. Ferry levels are obtained by capping the overflow pipe and gravity filling via a filler neck, under a panel on top of the fuselage. A dip stick is within the filler neck. Breather air is vented from the engine, the auxiliary gearbox and the oil tank via an air/oil separator and discharges just forward of the right cold nozzle. An oil pressure gauge is not fitted. The pump normally provides a pressure of 50 ±5 psi at 89% RPM. The minimum pressure for safe engine running is 30 psi and this will be indicated by an OIL light on the warning/caution panel. There is no specific provision for negative G flight but inversions of up to 15 seconds are permissible and this maximum must be followed by at least 5 seconds of normal flight. Two green lights and a press to test button are on a panel (which also accommodates refueling controls), covered by an access panel on the fairing forward of the left rear nozzle. When the button is pressed both lights should illuminate, indicating that there is oil for at least a 3 hour sortie. The lights are duplicated for safety and the system is suspect if only one light illuminates.

ENGINE AIR INDUCTION SYSTEM

The air induction system consists of two semicircular side inlet ducts that merge at the engine face. The inlet ducts utilize boundary layer doors and intake suction doors to compensate for the wide range of airflow requirements induced by the airplane V/STOL and high speed flight capabilities.

Boundary Layer Doors

Two doors on the fuselage skin of each air intake are spring-loaded closed during slow and hovering flight. In high speed flight, when boundary layer pressure is high, the doors are forced open against their springs and air is bled from the intakes, thus preserving smooth airflow to the engine. The bleed air is ducted internally to exhaust via louvers behind the top of the cockpit canopy. The pairs of doors normally function together, but the doors of each pair can operate independently to improve airflow to the engine.

Intake Suction Doors

Eight auxiliary air inlets around the outside of each air intake are covered by unrestrained hinged doors, which are held open by suction to increase air flow to the engine during slow and hovering flight when air intake pressure is low. During high speed flight, the doors are held closed by increased intake air pressure.

THRUST VECTORING

The four nozzles are mechanically interconnected and can be simultaneously rotated by a lever in the cockpit, from fully aft through a 98½° arc to a forward braking position to vector the engine thrust. The nozzle mechanism (figure 1-12) also operates a butterfly valve lever to supply bleed air to the reaction controls. The system is driven by two air motors which operate in parallel, supplied with air from the HP compressor. The air motor drives a gear box which positions all four nozzles through mechanical linkages. When the nozzles reach the selected position, the control valve is positioned to cut off the air supply so that the nozzles remain in the selected position. Air is supplied to the motors via a short double-walled flexible pipe. If the inner wall fails, pressure to the air motors is maintained by the outer wall. Indication of this failure is given by an air motor feed pipe leak indicator, which then protrudes about 1/2 inch from the side of the lower left fuselage.

Nozzles Control Lever

The nozzles are controlled by a lever in a quadrant inboard of the throttle, see figure 1-14. If the nozzle actuating air motors fail to move when the lever is moved, the initial 2 to 3 inches are taken up in opening the control valve. To prevent damage to the valve (if lever movement is continued) an override spring in the control linkage starts to compress so that a moderate force is felt. The spring will also be compressed if the air motors respond slowly to lever movement. When the lever is fully forward against a stop at the front end of the quadrant the nozzles are fully aft and they rotate down as the lever is moved aft. At 16° down from fully aft a microswitch in the control linkage changes the JPT limiter from maximum thrust to short lift. Maximum thrust datum is reselected as the nozzles are rotated up through approximately 12° from fully aft. When the lever is moved aft to a hovering stop the nozzles are set for hovering. The position of this stop gives a fuselage hovering attitude of about 7½°, i.e. the nosewheel slightly higher than the mainwheels. The engine datum is at 1½° to the fuselage datum. The nozzle angle for hovering is therefore 81° from the engine datum. A nozzle braking position, at 98½° from the engine datum, can be selected by lifting the nozzle lever over the hovering stop and pulling it back along a ramp. An adjustable short takeoff (STO) stop on the quadrant can be preset to allow rapid selection of nozzle angles from 45° to 75° (in 5° increments) as required, for STO or RVTO. The stop has a spring loaded control knob and is set by lifting the knob and moving the stop to the desired position, then releasing the knob to engage the stop in a locating hole (5° increment) in the quadrant. The selected nozzle angle is indicated on a scale alongside the stop. The STO stop can be overridden, in both directions, by lifting the nozzle lever over the stop. When the stop is not in use it should be moved aft to a locating hole where it is clear of the lever's travel. A nozzle lever friction damper at the rear of the quadrant is shear wired to prevent lever creep.

NOZZLES CONTROL MECHANISM

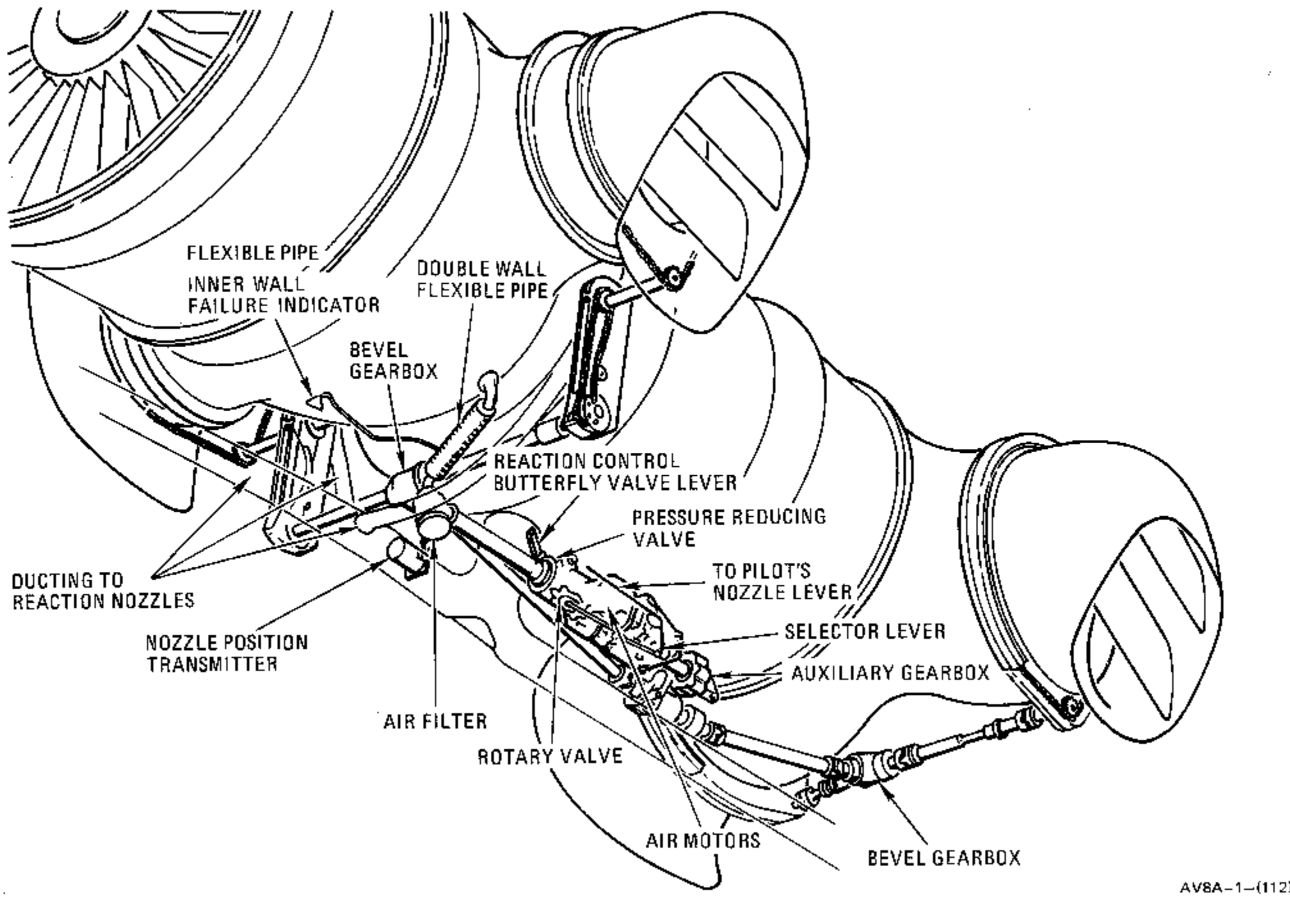


Figure 1–12

CAUTION

To avoid damage to the air motor rotary control valve do not move the nozzles by hand unless the nozzles lever is simultaneously moved to correspond with nozzle position.

Nozzles Angle Indicator

The angle of the nozzles is shown on a nozzle angle indicator on the right side of the main instrument panel and it is also indicated, externally, by scales around the cold nozzles.

WATER INJECTION SYSTEM

The water injection system (figure 1–13) enables RPM to be increased for a given turbine entry temperature (TET) to sustain short lift wet and lift wet ratings at temperatures up to ISA +15°C. The main components consist of a water tank, air turbine pump, water pressure switch, water manifold and injectors, the FCU LP mechanical governor and water injection bypass solenoid valves and conditioning air supply.

Water Injection Switch.

The water injection switch is on the right main instrument panel (adjacent to a water contents gage and a green water flowing indicator light). The switch has three positions, ON, OFF and JETT. When ON is selected, the water injection system is armed. When OFF is selected, the system is dearmed. When JETT is selected, (by lifting the switch and moving down) the water is jettisoned.

NOTE

The water contents gage is calibrated in Imperial gallons.

Water Tank

A tank in the fuselage, contains 59.4 gallons of distilled or demineralized water. Repeated use of other water will cause engine performance to deteriorate. The water flow duration is approximately 1½ minutes. The tank is normally replenished by gravity filling via a filler cap on the top surface of the fuselage. It can also be pump replenished via a coupling in the main wheel well. A water quantity probe extends down into the tank, its body containing reed switches (and resistors) which are actuated by a permanent magnet in a float around the probe body. This signals a quantity gauge transmitter,

WATER INJECTION SYSTEM

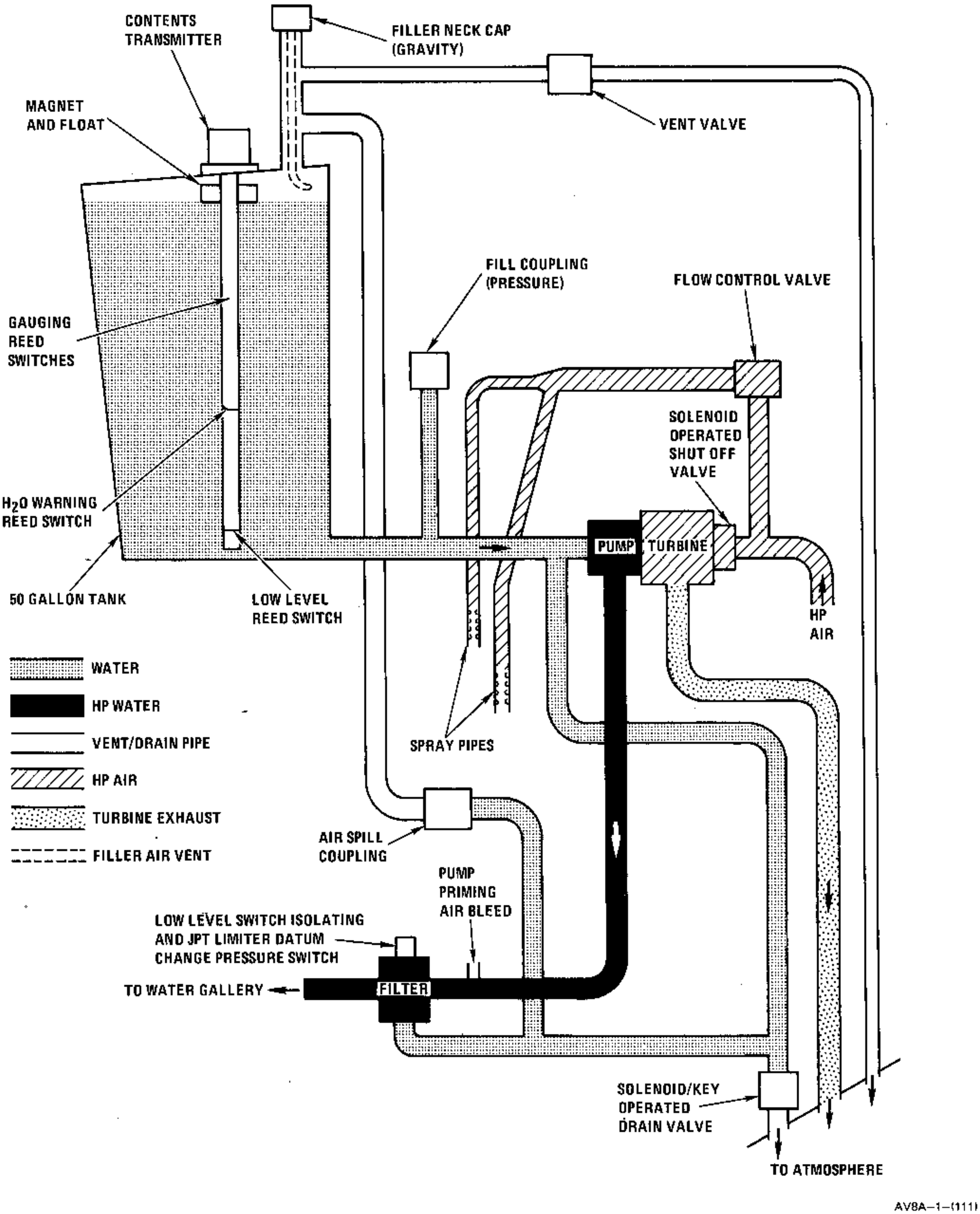


Figure 1–13

operates an 11-second water remaining warning and also ensures, by energizing a low level switch, that the system cannot produce delivery pressure if initially, there is less than 7.5 gallon of water in the tank. When the system is producing pressure, the low level switch is isolated to prevent lowering of the JPT limiter datum before the tank has been drained.

Air Turbine Water Pump

Water is supplied from the tank to the air turbine pump under gravity. With a dc supply and the low level switch deenergized, as the throttle is moved through and beyond a position corresponding to approximately 92% RPM a solenoid operated shutoff valve opens to admit HP bleed air to the turbine which drives the pump, the pump's output being delivered to a water pressure switch. Air is bled from the pump via a relief valve and two air bleeds.

Water Pressure Switch

When the pump output increases to about 240 psi, the water pressure switch closes and this isolates the low level switch circuit, lights a water on green light, raises the JPT limiter datum from short lift to short lift wet and changes the count rate of the engine life recorder from dry to wet.

NOTE

If the light does not appear, water is not flowing. The cause might be an arming circuit failure; if it is not, the fan mechanical governor datum will have been reset to allow increased RPM and fuel flow to the engine supplemented by the bypass solenoid valve. In this condition the lift rating JPT can be reached very quickly.

Water Manifold and Injectors

Water is delivered via a water manifold and 18 injectors at about 400 psi, 39.6 gal/min. distributed as follows:

a. Combustion chamber - 30 gal/min
b. Turbine stators cooling air - 7.2 gal/min
c. Turbine rotors cooling air - 2.4 gal/min

Water will continue to flow until RPM is reduced to below approximately 92%, the water is used or OFF is selected. An H_2O warning appears when 11-second supply remains; this is automatically cancelled when WATER OFF is selected.

Fan Mechanical Governor and Water Injection Bypass Solenoid Valve

The JPT limiter operates through the fan mechanical governor. The water injection bypass solenoid valve provides supplementary fuel so long as water is selected ON.

Water Injection System - Conditioning Air

Hot air, tapped from the bleed which drives the pump turbine, can be circulated around the system to prevent freezing. Delivery is controlled by a thermal switch which opens a flow control valve at +7° ±3°C and closes at 20° ±3°C.

Water Drain Valve

A solenoid/key operated gravity drain valve at the lowest point in the system allows water to be jettisoned via an outlet just forward of the main gear well. Once JETTISON has been selected from the cockpit, it cannot be stopped. A key must be used to re-close the valve after flight, once JETTISON has been selected.

Water Injection - Operating Sequence

Selecting ON arms the system electrically and at engine RPM of 85% (nominal) the fan mechanical governor is reset to increase RPM by up to 4%. If there is sufficient water in the tank, (7.2 gallons) movement of the throttle position through 92% RPM will cause a solenoid valve to open and admit bleed air to the air turbine. When pump pressure reaches 240 psi the water pressure switch closes; this isolates the low level switch circuit, lights the water on light, raises the JPT limiter datum and changes the engine life recorder count rate. Water is then consumed until the throttle is withdrawn below 92% or the system is switched OFF. The H_2O warning will illuminate when 11-second supply remains and stays on until OFF is selected even though all water is consumed. After use, OFF must be selected to reset the fan mechanical governor and to close the water injection bypass solenoid valve.

IGNITION SYSTEM

During ignition, fuel is pumped, via the torch igniter valve, into a vaporizing chamber through two primer jets adjacent to the two torch igniters and three auxiliary primer jets. A check valve permits a small flow of fuel at all RPM to keep the primer jets clear of carbon deposits and stabilize the flame during engine deceleration. A guarded on (NORM) ISOLATE IGNITION switch above the right console, allows the engine to be cycled without light up. When the airstart button on the front of the throttle is pressed the ignition system is energized and will remain so until the button is released. The crackle of the igniters can be heard if the airstart button is pressed before engine start up; this is a preflight check of the torch igniters. Ignition is automatic during starting cycle.

AUXILIARY POWER UNIT (APU)

The APU is used to start the engine when START has been selected and a starter button pressed. When ground run has been selected and a starter button depressed, the APU runs to provide ac power. The APU fuel and oil demands are met by the aircraft engine supplies. A counter in the sequence unit provides a record of the number of times the gas turbine has been used. The APU has three time limits on the starting sequence that must be met or the start will be unsuccessful:

a. Start button must be pressed within 15 seconds of selecting engine start.
b. The APU must be self sustaining within 15 seconds of starter button depression.
c. The engine must be self sustaining within 40 seconds of starter button depression with start selected.

After a successful or an abortive engine start, OFF must be selected to ensure that fuel flow to the APU is shut off. This must also be done after an abortive ground run start and to conclude ground running. An entry for the air intake duct and an exit for the exhaust are in the engine access doors, in front of the wing. During ground running, the generator is on the line (indicated by an ALT ON light). The duration of ground run is 90 minutes; if during this period the ALT ON indicator light should cease to show green, OFF should be selected to avoid possible damage to the APU generator.

ENGINE CONTROLS

Battery Switches

Two battery switches (Batt No. 1 and Batt No. 2) are on the left console gang bar switch panel. Both switches must be on before the APU and engine can be started.

Ignition Isolation Switch

The ignition isolation switch on the right console is guarded to the on (NORM) position. With the switch in normal, ignition is automatically provided during engine start. Placing the switch to OFF allows the engine to be wet or dry cycled without ignition.

Starter Button

The starter button is a guarded button and is located on the aft portion of the right console. Pushing this button initiates the APU and engine starting sequence.

CAUTION

The starter button should not be held down as it overrides all safety devices built into the GTS/APU when depressed.

Throttle

The throttle is located on the left console, see figure 1-14. Movement of the throttle is transmitted by mechanical linkage to the FCU. When the throttle is fully aft, the high pressure fuel shutoff valve is closed and cuts off fuel supply to the engine. Forward movement to an idling RPM position opens the shutoff valve and a ratchet stop prevents movement back except when a spring loaded trigger, on the front of the throttle, is squeezed. At the front of the quadrant there is a spring loaded full throttle stop. If the lever is pushed hard against this and compresses it, a LIMITERS OFF/ON switch is switched OFF; it must subsequently be switched ON by hand. There is a two position full throttle stop control on the quadrant, this limits movement to 97% or 99% RPM or it can be cleared forward to an OUT stop to allow full throttle movement. When water injection is in use, the RPM obtained can exceed that selected by 4%. This increase varies with ambient temperature and selected RPM. The full throttle stop is an inclined ramp which can be overridden if necessary, by a push force on the throttle of 15 to 20 pounds. The stop is used when it is not easy to monitor RPM indication and the throttle must be set by feel. An interference catch ensures that the throttle lever cannot be moved past a BRAKE LOCK position when the lock is engaged. A throttle damper friction control is aft of the throttle quadrant.

Low Pressure Fuel Shutoff Lever

A low pressure fuel shutoff lever with positions of OFF/LP and FUEL/ON is located on the left wall just aft of the left console. When the lever is OFF, the aircraft fuel system is isolated from the engine, the fuel flow proportioner is shut off and the caution/warning lights with the exception of FIRE, are isolated. The lever can be moved down to the ON position where it will be locked. In this position, a microswitch is made and the caution/warning lights are fully functional. A button on the end of the lever's handle must be depressed to release the ON lock.

ENGINE INSTRUMENTS

Fuel Flow Indicator

The ac operated fuel flow indicator on the lower right side of the main instrument panel displays rate of fuel flow in pounds per minute. The indicator has a pointer divided in units of 10 and a three drum repeater that permits readings to 1/5 pound per minute. If the indicator fails, the pointer will go to maximum and remain there.

NOTE

As the fuel flow indicator is ac powered, it will not be available during airstart.

Tachometer

The tachometer, on the right side of the instrument panel, has two pointers and scales. The large pointer indicates RPM in units of 10 from 0 to 100%. The small pointer indicates RPM in units of 1 from 0 to 10%. Fan (LP) RPM is normally indicated but, when a spring loaded HP/LP TACHO switch is held to HP, high pressure compressor RPM is indicated.

Jet Pipe Temperature (JPT) Indicator

The JPT indicator is on the right side of the instrument panel. Thermocouples in the jet pipe sense the exhaust gas temperature which is then displayed on the indicator. The JPT indicator is calibrated in hundreds from 0° to 900°C. Between 500° and 800°C it is further sub-divided into 10° increments. On aircraft block 41 and up, the JPT indicator

THROTTLE NOZZLE QUADRANT

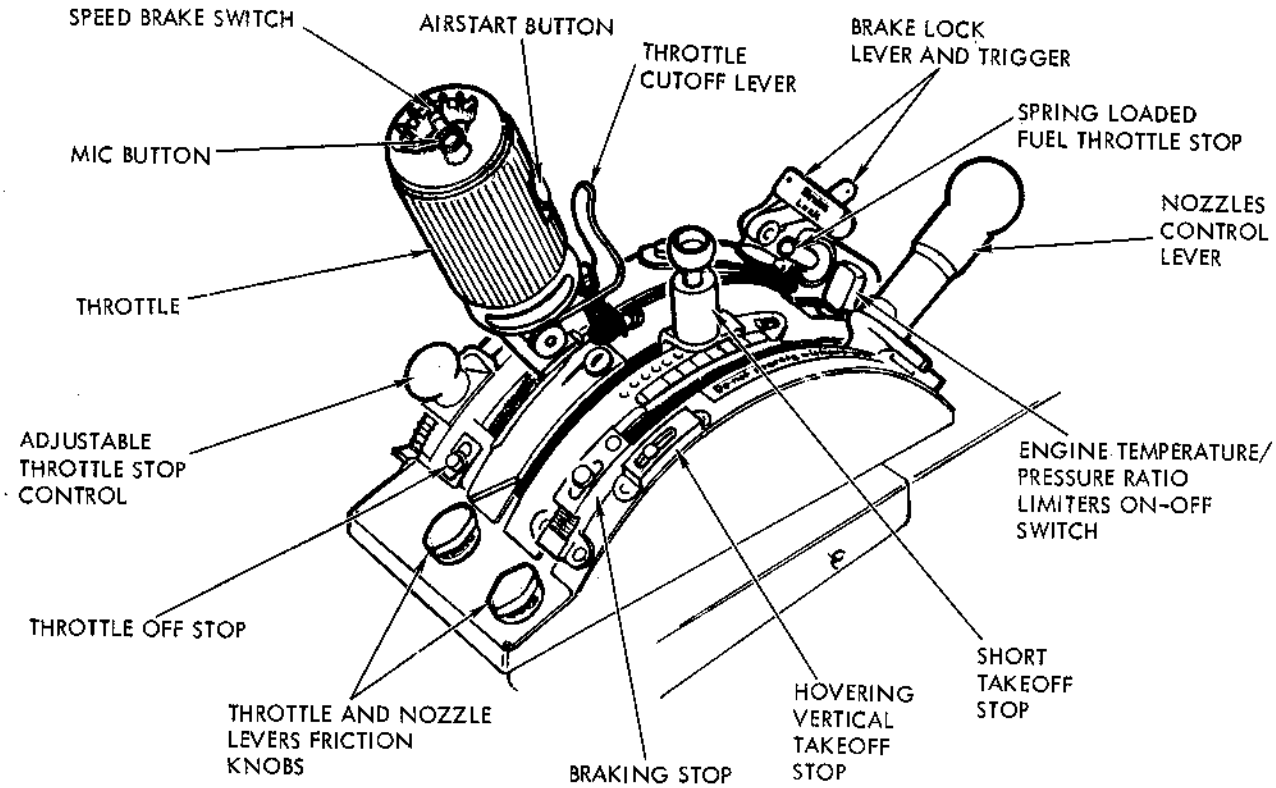


Figure 1-14

is calibrated in hundreds from 0° to 1200°C. Also a digital readout is provided to display JPT.

ENGINE VENTILATION AND FIRE PROTECTION SYSTEM

The engine bay is divided into two ventilated zones by an engine mounted fireproof bulkhead. The compressors, the engine fuel system and engine driven accessories gearbox are in zone 1 at the front; the combustion chamber, turbines and exhaust system are in zone 2 at the rear. The bay is ventilated via ram air intakes at the forward end of the front nozzle fairings and at the wing roots. This air flow is assisted by flow inducer nozzles supplied by bleed air from the fan so that the bay is ventilated when jetborne. Two automatic resetting fire-wire elements which are looped around the engine, and a monitoring unit, initiate warning of fire. One loop encircles both the engine and the jet pipe; the second is looped on top of the engine in zone 1. These elements are responsive to temperature and if either, or both sense a temperature of 150°C and above, a FIRE warning is activated; also, the head of a fire extinguisher push button will be lit by two internal lights, connected in parallel. When the push button is pressed, the contents of a methyl-bromide extinguisher bottle will be discharged through two spray rings, one in each zone. The system is supplied directly from the No. 2 battery bus, therefore no selection need precede use of the button. There are two horizontal inertia sensing switch units in the main landing gear well. These will automatically discharge the fire extinguisher bottle if a crash landing occurs and all other electrical circuits, with the exceptions of No. 3 emergency bus loads, are isolated. With a power supply available, the circuits can be tested. When the caution/warning button is pressed the FIRE warning light and the fire extinguisher button will light to indicate that both loops are serviceable. If extreme heat causes a dangerous pressure in the extinguisher bottle, a safety device will blow, allowing the bottle to discharge into the landing gear well. A green disc which is part of the assembly will be blown out by this and expose a red interior. A pin in the head of the extinguisher bottle protrudes when the bottle is discharged. Two red fire access spring-loaded panels, one on each side of the fuselage above the engine give access to zone 1 for fire fighting equipment. Access to zone 2 is gained via the ventilation ducts at the leading edge of the wing roots.

WARNING

Methyl-bromide is highly toxic.

ENGINE LIFE RECORDER (ELR)

Thermocouples in the jet pipe transmit JPT to the ELR in the equipment bay. This records and displays in a window, engine life consumed, as a digital count. It also displays a flag indication when the engine has been overtemperatured (dry law 774°C, wet law 784°C) and this also initiates a JPT warning light. The JPT warning light remains on until the recorder has been reset (using a button under a normally sealed cover) during subsequent servicing. Engine life is recorded in terms of turbine rotor blade creep life. This is related to JPT and time. A law unit module within the ELR can change the count rate curve from Dry Law to Wet but both curves relate to JPT achieved and count rate for a given JPT varies, Wet or Dry. When the ELR senses a JPT at or in excess of 695°C short lift dry or 720°C short lift wet, a 15 SEC warning is activated, indicating that JPT which impose high count rates are being approached or have been invoked. When the JPT has been reduced, this warning circuit is reset. For a given JPT the following Rating and Count Rate/Minute apply:

a. 610°C – Maximum Thrust – less than 1
b. 695°C – Normal Lift Dry – 8
c. 715°C – Short Lift Dry – 25
d. 720°C – Normal Lift Wet – 18
e. 745°C – Short Lift Wet – 75

NORMAL OPERATION

STARTING ENGINE

If the APU is not ground running, the engine can be started by selecting either of the two (mode selector) START positions and then firmly pressing the STARTER button. This will activate the gas turbine ignition unit and timer and the APU starter motor. APU light up will be heard after about 5 seconds. Within 10 seconds the throttle should be moved to its idling position. If the APU is running, the engine can be started by selecting START and firmly pressing the STARTER button. This takes the generator off the line and couples the APU output shaft to the power gearbox for engine start. A rising JPT will show that the aircraft engine is lighting up and the mode selector should be switched OFF when idling RPM is attained. The starting attempt should be abandoned immediately if: RPM ceases to rise before idling RPM (25% minimum) is reached. If JPT is rising rapidly above 350°C, abandon start (throttle OFF) before the JPT reaches the starting limit of 450°C. After engine start, place starter selector to OFF.

CAUTION

Do not hold starter button depressed as this bypasses safety features and may lead to GTS turbine disintegration.

ENGINE OPERATING CHARACTERISTICS

Jetborne

The nominal ratings of the engine consider an air bleed of 9 lb/sec. Losses from an installed engine in excess of 9 lb/sec are not considered. These include exhaust splay (the result of the nozzles thrust line being vectored slightly outboard from vertical), intake losses and engine air bleed demands. These are variables governed by the JPT and RPM Limitations. There are four ratings for jetborne operation (nominal thrust ICAO conditions):

a. Short Lift Wet – 21,500 lb
b. Short Lift – 20,500 lb
c. Lift Wet – 21,200 lb
d. Lift – 19,500 lb

When jetborne, increased bleed demand leaves less air for cooling and JPT is increased by 5.5°C/lb bleed. Thus, except when OAT is low, limiting JPT is normally reached before limiting RPM. At short lift ratings JPT is automatically limited to maximum values by JPT limiters (JPTL). Using lift ratings there is no automatic control and the limitations must be observed by monitoring JPT and using the throttle. The imposed time limit of 15 seconds, short lift wet or dry is based on the temperatures that accompany acceleration from idling RPM. When approaching it from an RPM higher than idling the JPT limit will probably be reached in less than 15 seconds and thrust loss and engine wear will then start to be imposed. The imposed time limit of 2¼ minutes using lift wet or dry is in addition to the 15 seconds short lift period but the absence of automatic JPT control must be remembered. Each 2½ minute period at jetborne ratings must be followed at least 5 minutes at maximum continuous rating or less.

NOTE

When water injection is in use, if the tank should be drained the JPTL datum will revert from wet to dry. The fan mechanical governor and the water injection bypass solenoid valve will not be reset until WATER OFF is selected.

Conventional Flight

There are two ratings for conventional flight operation:

a. Maximum thrust
b. Maximum continuous

Operation at maximum thrust rating is limited to 15 minutes duration and the JPT is controlled by the JPTL. No time restriction is imposed on maximum continuous and there is no automatic JPT control. Water injection is not associated with these two ratings. The maximum JPT during starting is 450°C and for ground idling it is 525°C.

JPT Limiter (JPTL)

The JPTL prevents the JPT from exceeding specified limits by reducing fuel flow and thus RPM when necessary. The limiters automatic action is controlled by thermocouples in the jet pipe and a limiter amplifier; these compare JPT with maximum thrust or lift rating datums. The resulting output biases the fan mechanical governor to trim fuel flow through the governor. The JPTL has three datums:

a. Short Lift Wet - 740°C $\pm$10°C
b. Short Lift - 710°C $\pm$10°C
c. Maximum Thrust - 600°C $\pm$10°C

The datum is changed from maximum thrust to short lift (with the engine nozzles in any position) whenever the main landing gear is locked down. It is similarly changed (regardless of the main gear lock) when the nozzles are rotated down through 16° from fully aft. The maximum thrust rating is resumed when they are rotated up through 10° to 15° from fully aft and the landing gear is raised. When water injection is switched on, the datum will be raised from short lift to short lift wet as long as water pressure has risen to and maintains 240 psi or more.

Limiters Switch

A LIMITERS OFF/ON switch, at the front of the throttle quadrant is normally left ON so that JPT will be retained within limits. It can be selected OFF by using the switch directly or by pushing the throttle lever against its spring loaded full throttle stop (with a 25 to 30 lb push-force) so that the lever engages the switch which must subsequently be reset by hand. When the switch is OFF a JPTL warning light will come on.

NOTE

The PRL is also shut off by the action of this switch.

A JPTL CHECK guarded NORM switch on the cockpit right wall allows servicing checks to be made with the engine running. It is not for the pilots use and must not be used in flight.

ENGINE OPERATING ENVELOPE

The engine operating envelopes (figure 1-15) show pertinent engine operating data for an ICAO standard day. The various envelopes are plotted to show an approximate area of operation; therefore, airstarts, minimum airspeed operation, etc. may occur, depending on prevailing flight conditions, on either side of the plotted operational area. However, under 1 G level flight conditions, satisfactory engine operations can be expected within the plotted envelopes.

EMERGENCY OPERATION

ENGINE FAILURES

Jet engine failures, in most cases, are caused by improper fuel scheduling due to malfunction of the fuel control system or incorrect techniques used during certain critical flight conditions. Engine instruments often provide indications of fuel control system failures before the engine actually flames out. If engine failure is due to a malfunction of the fuel control system or improper operating technique, air airstart can usually be accomplished, providing time and altitude permit.

RUNAWAY ENGINE

There is no provision made on the fuel control unit for stabilized engine rpm if the throttle linkage becomes disconnected. If a disconnect occurs, vibration may cause the fuel control to hunt or assume any setting from idle to maximum power. Therefore, at the first indication of a runaway engine while on the ground, secure the engine by placing the low pressure fuel shutoff valve to OFF. If a runaway engine occurs in flight and sufficient power is available, make a precautionary emergency approach and landing, refer to section V. Reverse thrust may be used to stop the aircraft and engine shutdown can be accomplished as outlined above.

AIRSTARTS

In general, airstart capability is increased by higher airspeeds and lower altitudes; however, airstarts can be made over a wide range of airspeeds and altitudes. An airstart is accomplished by establishing a glide of 200 to 350 knots below 25,000 feet, placing the throttle to off, then pressing the relight button (30 seconds maximum) while slowly returning the throttle to idle. The throttle must be left in idle until RPM and JPT stabilize. If light-off does not occur within 30 seconds after ignition, retard the throttle to OFF. Wait 30 seconds before initiating a restart. For MFS airstarts, descend below 20,000 feet, select MFS on and move the throttle to the idle detent. Do not allow the throttle to come past the idle detent.

OIL SYSTEM FAILURE

If the OIL light on the warning/caution panel comes on, indicating oil pressure is below 30 psi: make a conventional landing as soon as practicable using minimum power. Shut down engine as soon as possible after landing.

NOZZLES FAILURE

STO

Discontinue takeoff if possible; if not possible, continue takeoff but use conventional takeoff technique. Be prepared to eject.

ENGINE OPERATING ENVELOPE
ICAO STANDARD DAY

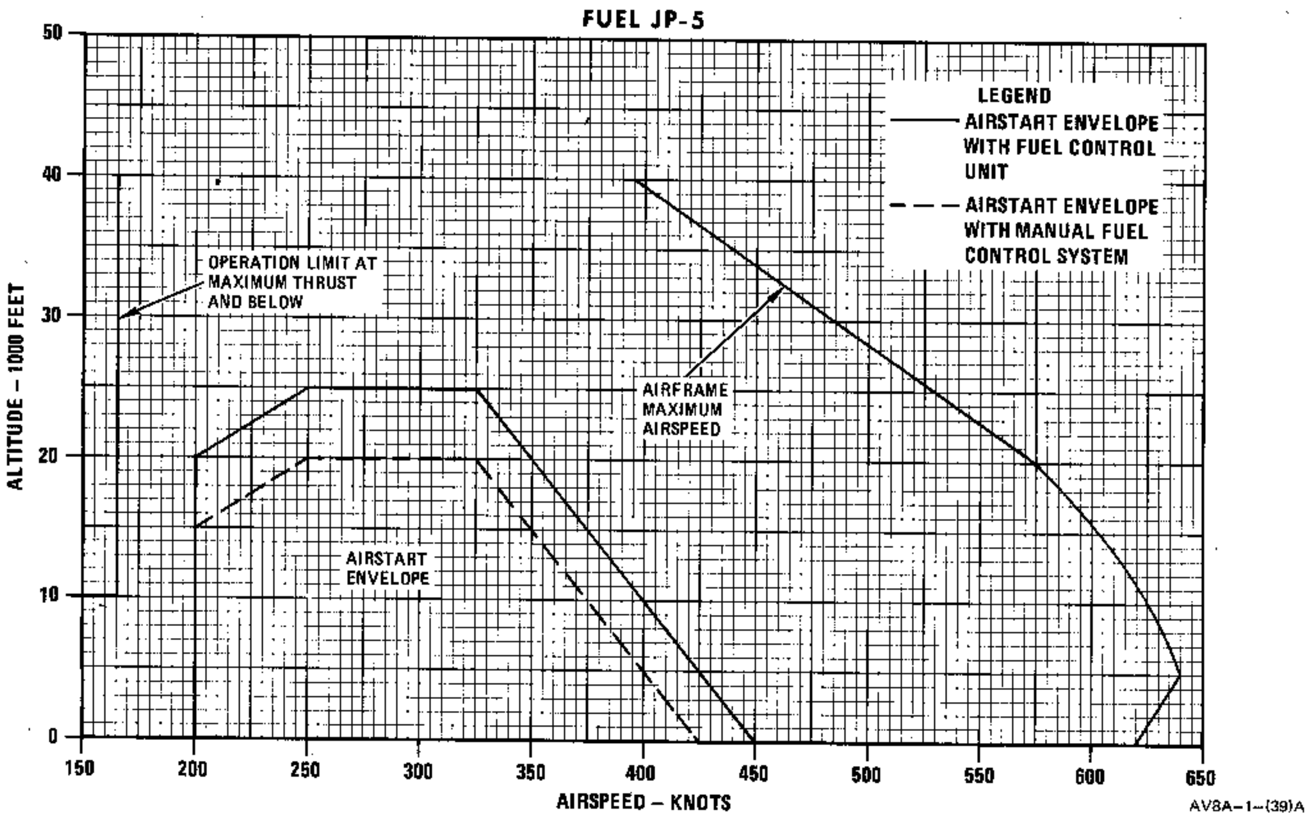


Figure 1—15

THRUST VECTOR CONTROL ENVELOPE LIMITS

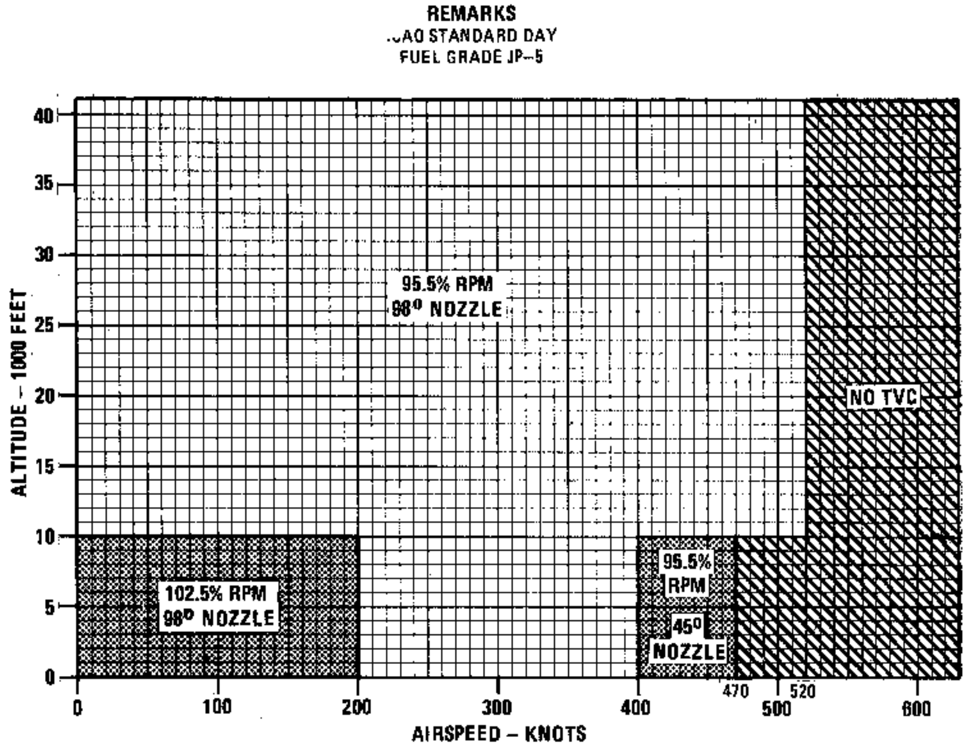


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Figure 1-15A

During Transition

Make a slow speed go-around and make a slow or conventional landing, as required.

CAUTION

If any nozzle malfunction occurs, reduce to below hover weight prior to attempting a landing.

LIMITATIONS

OPERATING LIMITATIONS

The achievement of planned engine life is dependent on strict observation of the limitations in figure 1-16.

JPT LIMITER

The JPTL limits the jet pipe temperature to 740° ±10°C for short lift wet, 710° ±10°C for short lift dry and 600° ±10°C for maximum thrust.

RPM

The maximum permissable indicated RPM is 107.0%. Due to structural limits however, it may be further restricted by the engine's ability to handle a given mass flow of air. The mass flow limit is reached at 106.5% on a standard day. Since the amount of air drawn into the engine for any given RPM will vary with temperature the maximum allowable indicated RPM will vary according to table:

OAT°C	INDICATED RPM%	
+18	107.0	
+15	106.5	
+10	105.5	
+5	104.5	
0	103.5	106.5% CORRECTED RPM
−5	102.5	
−10	102.0	
−15	101.0	
−20	100.0	

RPM corrected to standard day temperature is referred to as corrected or non dimensional RPM. Above 10,000 feet, the pressure ratio limiter regulates the corrected RPM to 100.0 ±1%.

ENGINE OPERATING LIMITATIONS

RATINGS	LIMITATIONS		
	MAX % RPM	MAX JPT°C	* COMBINED TIME LIMITS
SHORT LIFT WET	107.0 **	745	15 SEC / 2.5 MIN / 15 MIN
SHORT LIFT DRY	103.5	715	15 SEC / 2.5 MIN / 15 MIN
NORMAL LIFT WET	104.5	720	2.5 MIN / 15 MIN
NORMAL LIFT DRY	100.5	695	2.5 MIN / 15 MIN
MAX THRUST	95.5	610	15 MIN
MAX CONTINUOUS	89.0	525	UNLIMITED
GROUND IDLE	28.0 (25.0 MIN)	525	UNLIMITED
DURING STARTING	—	450	—

* COMBINED TIME LIMITS FOR SHORT LIFT, NORMAL LIFT AND MAX THRUST RATINGS ARE CUMULATIVE. ANY TIME SPENT IN A MORE RESTRICTIVE AREA OF OPERATION IS SUBTRACTED FROM THE TIME ALLOWED IN ANY OTHER AREA OF OPERATION. HOWEVER, ANY TIME REMAINING IN THE MORE RESTRICTIVE AREA CAN BE SUBSEQUENTLY UTILIZED.

** MAY REQUIRE PILOT ACTION TO MAINTAIN LIMIT UNDER CERTAIN AMBIENT CONDITIONS.

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Figure 1-16

PRESSURE RATIO LIMITER (PRL)

When the PRL is turned off above 10,000 feet, the following indicated RPM vs. altitude limitations must be observed:

10,000 feet – 95%
15,000 feet – 93%
20,000 feet – 91%
25,000 feet – 89%
30,000 feet – 88%
Above 35,000 feet – 87%

LIFT RATINGS

Each 2½ minute period of operation in the lift ratings must be separated by at least 5 minutes in or below the maximum continuous rating.

ENGINE STARTING

A starting attempt should be abandoned immediately if:

a. RPM stagnate below idling RPM.
b. JPT reaches 450°C (If JPT rises rapidly above 350°C, throttle OFF before 450°C.)
c. Light up has not occurred after 20 seconds of starter operation.

If the engine fails to light, a fuel drainage period of 1 minute must be allowed before a further starting attempt is made.

APU STARTING

Unless an external air supply is used to cool the electric starter motor, no more than three engine starting attempts (within a 20 minute period) may be made, with at least 1 minute between attempts.

OIL SYSTEM

Engine turbine oil MIL-L-23699 A and B (NATO Code 0-149 or 0-156) must be used. The OIL warning light operates at 30 psi (nominal). Maximum oil consumption is 3 pints per hour. Flight in less than 1 G conditions must not exceed 15 seconds continuous duration, to avoid oil starvation of the engine bearings.

FUELS

The engine is cleared for use with the following fuel grades and their corresponding NATO codes: JP1 (NATO F34), JP4 (NATO F40) JP5 (NATO F44). Flight above 20,000 feet using JP4, both boost pumps off and fuel proportioner off may result in engine flame out.

EFFECT OF OAT ON VARIABLE INLET GUIDE VANES
55 % RPM-STATIC

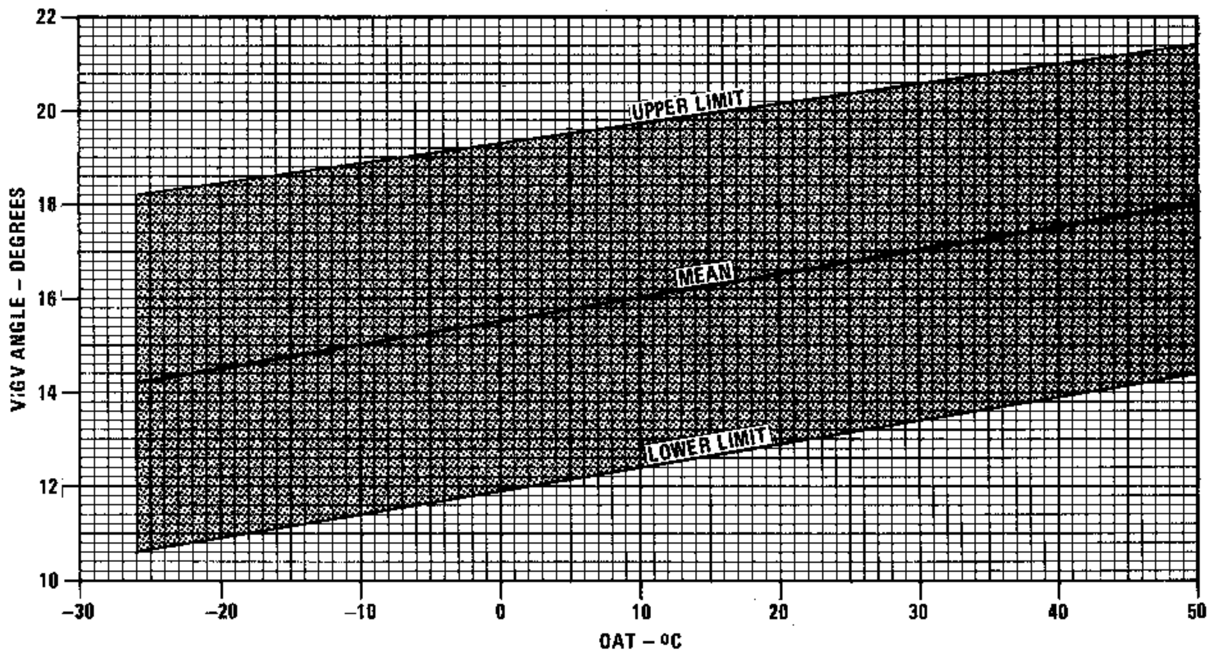


Figure 1–16A

WATER INJECTION

Distilled or demineralized water (per NAVAIR Instruction 13780.1) must be used whenever possible. Repeated use of other than distilled or demineralized water results in deterioration of engine performance. The water injection rate is 39.6 gallons per minute (nominal). Water injection is not to be used if OAT is below +5°C.

ENGINE HANDLING – NOZZLES AFT

The maximum thrust rating must not be exceeded with the nozzles aft, except during takeoff and landing. 80% RPM must not be exceeded during a push over or descent when speed is above 0.95 Mach, above 15,000 feet. When above 30,000 feet and 80% RPM sudden negative G maneuvers should not be attempted due to the danger of engine compressor stall. Rapid throttle movement is not permitted when the PRL is shut off above 10,000 feet. Except when the PRL is shut off, rate of throttle movement is unrestricted up to 40,000 feet and airspeeds above 200 knots. Above 40,000 ft and below airspeeds of 200 knots, the throttle should not be moved at a rate faster than that equivalent to moving from idling to the maximum thrust rating in 3 seconds. However, slam throttle movement is permitted during takeoff, approach, waveoff and landing.

ENGINE HANDLING – NOZZLES DEFLECTED

The throttle should not be moved at a rate faster than that equivalent to moving from idling to a short lift rating in 3 seconds. However, slam throttle movement to a short lift rating is permitted during takeoff, approach, waveoff and landing.

PRL PREFERRED SETTING

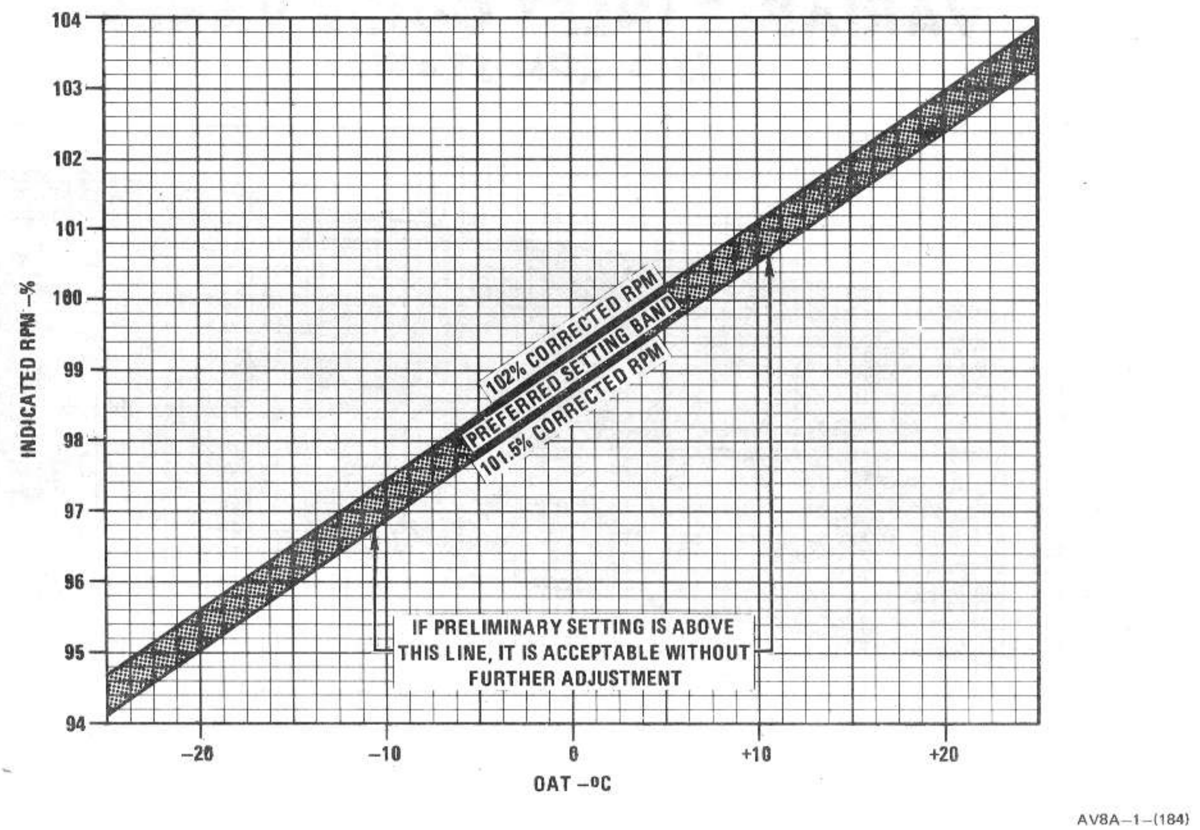


Figure 1-16B

FLAPS

DESCRIPTION

Electro-hydraulic operated trailing edge flaps, one located on each wing, are controlled by a common hydraulic actuator. Movement is transmitted to the flaps, via individual torsion shafts and a flap operating lever. The operating lever is also mechanically linked, to a step drum switch, which is used to restrict flap downward movement for the intermediate position. Flap movement between MID and FULL is also affected when fully down by airspeed, when airspeed increases above 250 KIAS, flap angle is progressively reduced. Flaps are controlled by a selector switch which provides for up (0°), MID (17° to 21°) and down (50°). Flap position is provided by an electrically driven indicator. Electrical power is supplied by the No. 2 dc bus on dual generator system, and the main 28 volt dc bus on single generator system. Hydraulic power is provided by the PC-1 system.

FLAP POSITION SWITCH

A three position flap switch, labeled FLAPS UP, MID and DOWN is located on the left console. When a selection is made, the switch provides dc voltage to energize the hydraulic selector valve and operate the hydraulic actuator, however, only an up or full down selection is applied directly to the selector valve. The MID selection is applied through a drum switch. The drum switch opens and breaks the voltage source to the selector valve, when the flaps achieve the intermediate (MID) position.

FLAP POSITION INDICATOR

The flap position indicator on the left console, has a range of 0-5 multiplied by 10 to register flap angle position. Electrical information is transmitted to the indicator by a transmitter, which is driven mechanically by a control rod, connected to the flap operating lever. Due to the non-linear movement of the transmitter, the indicator may read between 12° to 22° for the MID flap position.

LANDING GEAR WARNING LIGHT

The landing gear warning light, marked WHEELS, located on the warning/caution light panel illuminates any time a MID or DOWN flap selection is made at 165 knots or below and the landing gear has not been selected down. The master caution light also flashes and an audio warning is generated to alert the pilot.

NORMAL OPERATION

The flaps are operational when a flap position selection is made. When the DOWN position is selected, 28 volts dc is routed to energize the down solenoid of the flap hydraulic selector valve. Hydraulic fluid passes through the selector valve, to the piston head of the hydraulic actuator, which moves the operating lever and rotates the torsion shafts to lower both flaps simultaneously to 50°. When flaps UP is selected, 28 volts dc is routed to energize the up solenoid and passes hydraulic fluid to the piston control rod which raises the flaps to 0°. When the MID position is selected, the 28 volts dc is routed to the step drum switch. If the flaps are up the drum switch provides the energizing voltage to the down solenoid and the flaps lower to 17°. If the flaps are down, the drum switch provides the energizing voltage to the up solenoid and the flaps raise to 21°. The energizing voltage is maintained through the drum switch, until the flaps achieve MID position. At this point the switch opens and breaks the energizing voltage and the hydraulic actuator is locked. The hydraulic actuator remains locked until either an up or down selection is made.

EMERGENCY OPERATION

There is no emergency operation for the flap system.

LIMITATIONS

MID flap operation is restricted to 0.8 Mach below 15,000 feet. Full flap down (50°) is restricted to speeds below 300 KIAS. At maximum speed, flap angle is about 6°.

FLIGHT CONTROLS

DESCRIPTION

The aircraft primary flight controls (see figure 1-17) consist of the ailerons, stabilator and rudder for aerodynamic control and a reaction control system for jetborne control. The ailerons and stabilator are hydraulically powered by tandem actuators. The rudder is manually powered through mechanical linkage from the rudder pedals. Artificial feel systems provide simulated aerodynamic feel. The ailerons and stabilator trim systems, through the actuators, move the entire control surfaces. The rudder trim system moves a rudder trim tab. Secondary controls are the flaps and speed brake.

AILERON CONTROL SYSTEM

The lateral control system basically consists of the control stick, aileron stop, spring feel unit, trim actuator, cables, control rods, two tandem hydraulic actuators, two ailerons and two roll reaction control valves. Below 250 knots, the aileron travel (due to stick movement) is approximately 12° up and down. Above 250 knots, aileron travel (due to stick movement) is reduced to approximately 75%. Lateral movement of the control stick is transmitted mechanically by control rods and cables to the ailerons actuator control valves. The control valves meter hydraulic fluid to their respective tandem power cylinders in proportion to the

mechanical displacement. The control system uses tandem power cylinders to allow simultaneous use of both power control hydraulic systems. If a single hydraulic system fails, the remaining system will supply adequate power for control. A RAT extends anytime PC-2 pressure falls below approximately 1500 psi. If both PC systems fail, the RAT will supply adequate control down to 130 knots.

Lateral Control Feel and Stop

Aileron feel is provided by a non linear spring unit. In flight above 250 knots, an aileron stop at the base of the control stick restricts lateral stick movement to 75%. The solenoid operated stop is actuated by a switch in the air data computer. The stops are spring loaded and can be overridden, if the solenoid fails to deenergize when the airspeed is reduced below 250 knots.

Lateral Trim System

The lateral trim system consists of a trim switch on the control stick grip (figure 1-18) and an electric trim motor. When the switch is actuated, the trim motor repositions the feel spring unit which, in turn, moves the ailerons. Total trim travel is $\pm 4°$.

Aileron Trim Indicator

The aileron trim indicator, on the left console, indicates trim setting. The indicator has a 180° arc to represent trim position. The left end of the arc represents full left trim, the middle represents neutral trim and the right end represents full right trim.

STABILATOR CONTROL SYSTEM

The longitudinal control system basically consists of the control stick, inertia weight, spring feel unit, hydraulically operated Q feel unit, cables, control rods, a tandem hydraulic actuator, a horizontal tail surface (stabilator) and two pitch reaction control valves. Stabilator travel is approximately 11¼° leading edge up and 10¼° leading edge down. Longitudinal movement of the control stick is transmitted mechanically by control rods and cables to the stabilator actuator control valve. The control valve meters hydraulic fluid to the tandem power cylinders in proportion to the mechanical displacement. The control system uses tandem power cylinders to allow simultaneous use of both power control hydraulic systems. If a single hydraulic system fails, the remaining system will supply adequate power for control. A RAT extends anytime PC-2 pressure falls below approximately 1500 psi. If both PC systems fail, the RAT will supply adequate control down to 130 knots.

Longitudinal Control Feel

Longitudinal feel is provided by a PC-1 hydraulic Q feel unit with a non linear back up spring unit. This gives a stick force gradient which is constant up to 250 knots and then increases proportionately with dynamic pressure (Q). Hydraulic supply for the Q feel is controlled by a solenoid operated valve which is energized open by the air data computer at 250 knots. The Q feel system may be shut off by placing the guarded Q feel switch, on the left console, to OFF. If the Q feel switch is placed to OFF or PC-1 fails, the airspeed must not exceed 500 knots. An inertia weight in the control linkage increases control stick forces 1½ pound per G to supplement Q feel.

Longitudinal Trim System

The longitudinal trim system consists of a trim switch on the control stick grip, two standby trim switches and a dual electric trim motor. When the control stick trim switch is actuated, the main trim motor repositions the feel unit which, in turn, moves the stabilator. Total trim travel is 7½° stabilator leading edge up (nose down) and 4° stabilator leading edge down (nose up). A standby trim circuit that is independent of the main circuit is activated by lifting the guard over the standby switches. The cover is marked LIFT FOR STANDBY and CLOSE FOR MAIN and is located on the left console. When the guard is lifted, the main trim circuit is cut off and two standby switches are exposed. Both switches must be operated simultaneously to run the standby trim motor.

Stabilator Position Indicator

The stabilator position indicator is on the right side of the main instrument panel. The instrument is marked in 1° units that range from 0 to 10° nose up and from 0 to 12° nose down.

CONTROL STICK

The control stick is mounted to permit left, right, fore and aft movement (see figure 1-18). The control stick grip contains five controls: a four way trim switch, a bomb button, a gun trigger, a camera button and a nosewheel steering switch. The trim switch can be unganged by pressing a button on the forward left side of the switch and lifting the flap up and back. This exposes the two gang switches. These switches should not operate trims if only one is moved.

RUDDER CONTROL SYSTEM

The rudder control system basically consists of the rudder pedals, a centering unit, cables, control rods, trim actuator, trim tab, locking system, sideslip warning system, rudder and a dual reaction control valve. Rudder travel is 14¼° right and left. Movement of the rudder pedals is transmitted mechanically by control rods and cables to position the rudder.

Rudder Feel System

Rudder feel is provided by the linear spring centering unit and aerodynamic loads on the rudder surface. At low speeds and VSTOL the linear spring centering unit provides artificial rudder feel.

Rudder Trim System

The rudder trim system consists of a trim switch, on the left console, and electric trim motor and a rudder trim tab. When the switch is actuated, the trim motor positions the trim tab. Rudder trim is not effective until sufficient forward airspeed is available to generate an aerodynamic reaction by the trim tab.

FLIGHT CONTROLS

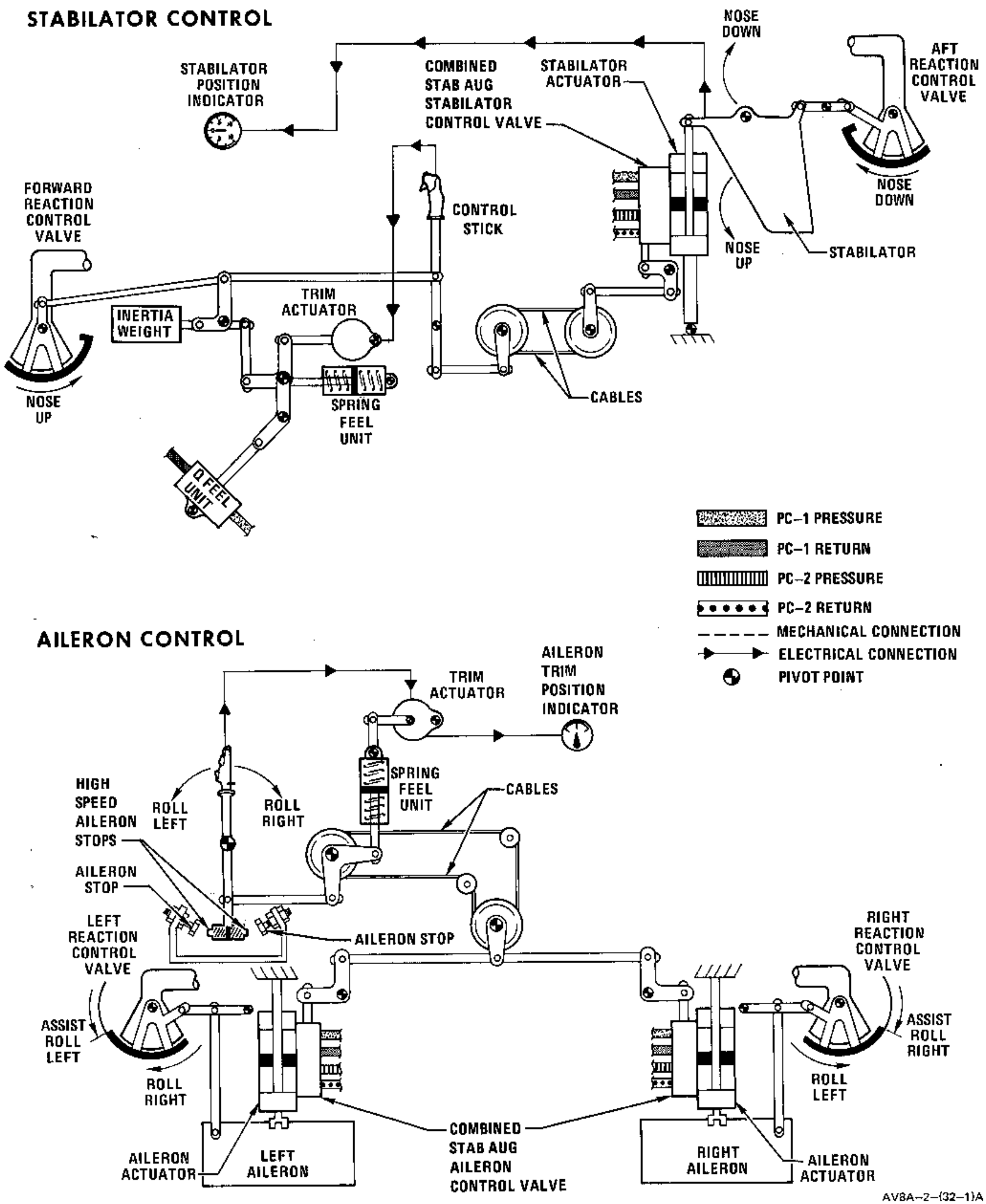


Figure 1-17 (Sheet 1 of 2)

FLIGHT CONTROLS

RUDDER CONTROL

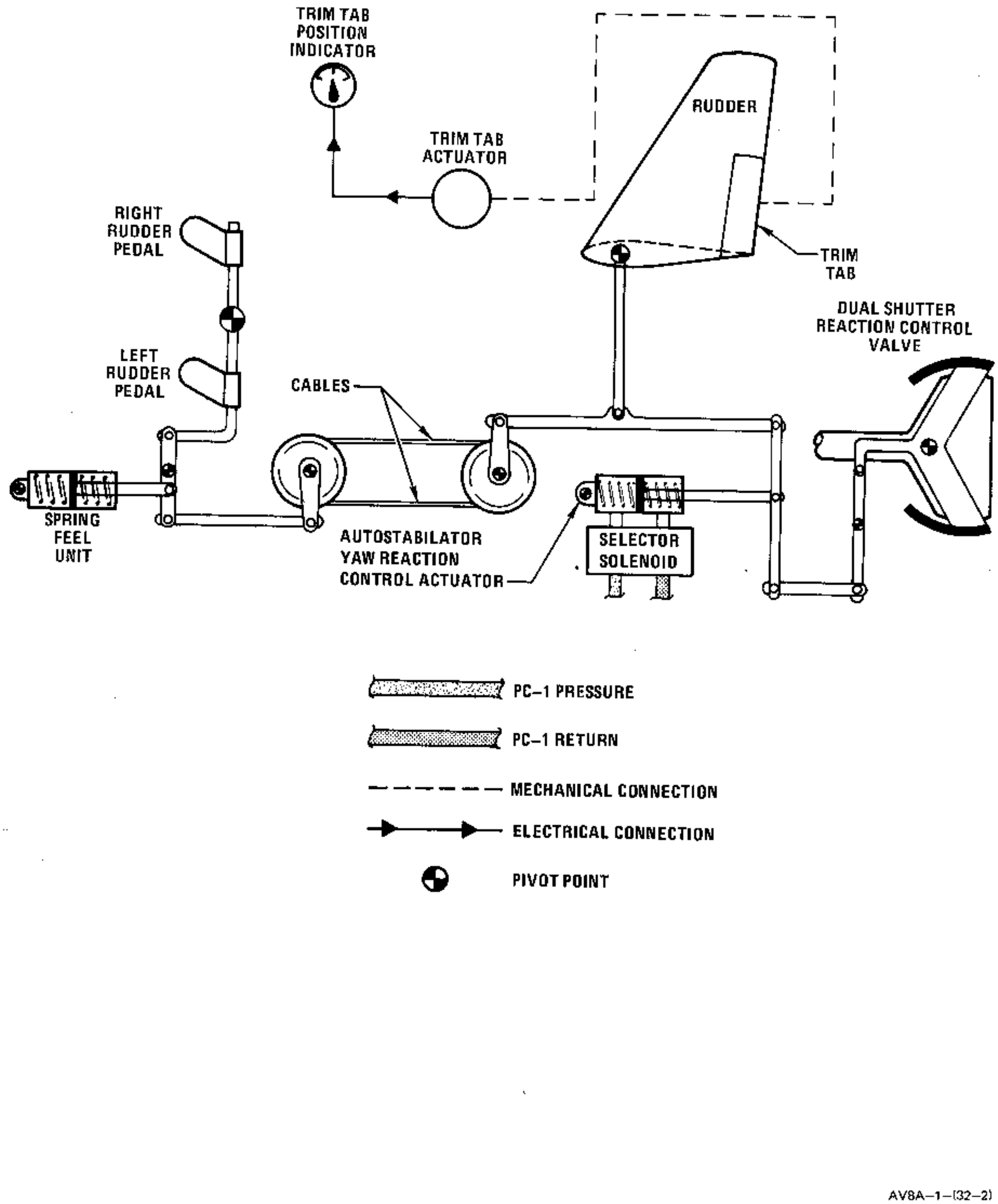


Figure 1-17 (Sheet 2 of 2)

CONTROL STICK GRIP

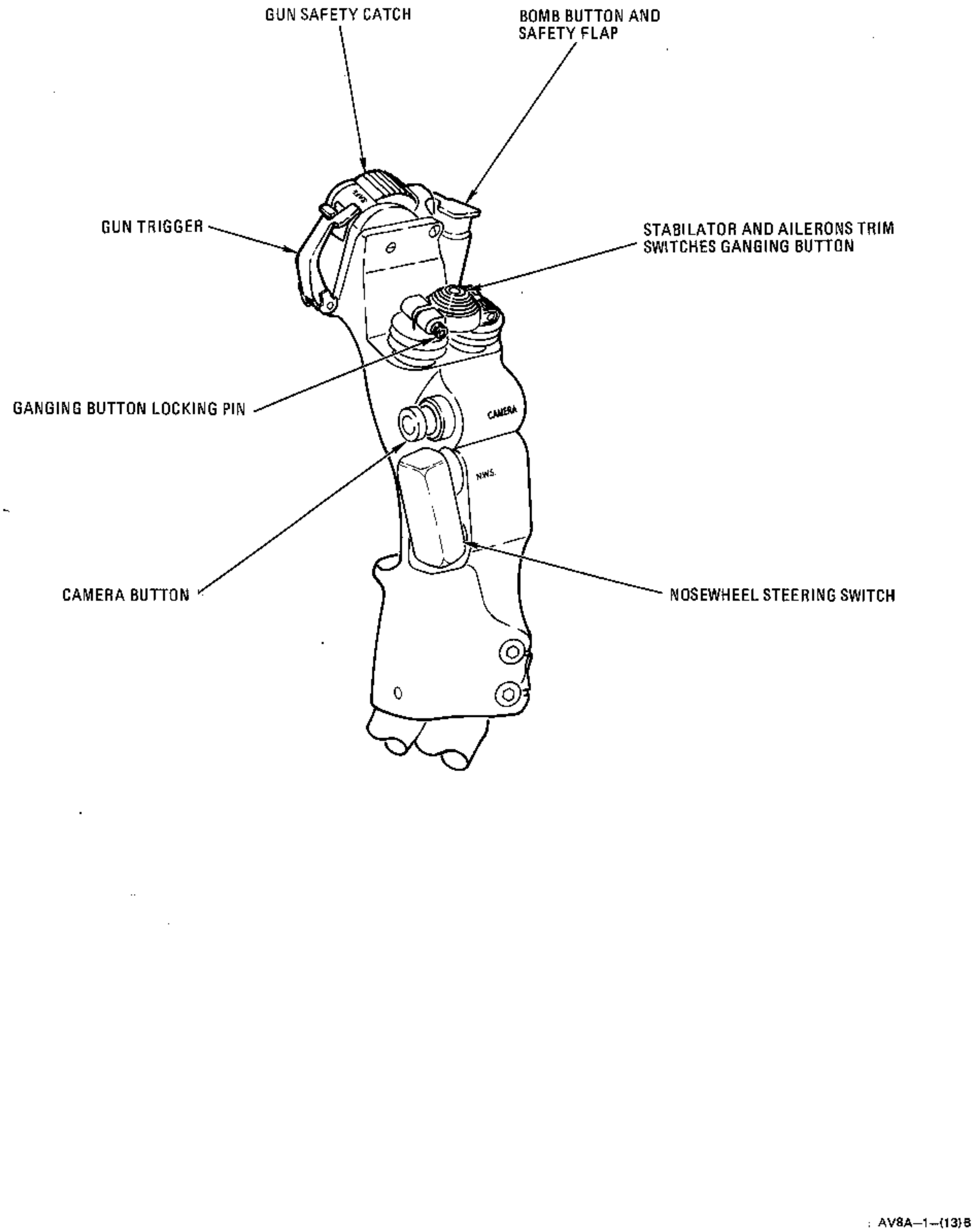


Figure 1-18

Rudder Trim Tab Indicator

The rudder trim tab indicator, on the left console, indicates trim tab setting. The indicator has a 90° arc to represent trim tab position. The left end of the arc represents full left trim, the middle represents neutral trim and the right end represents full right trim.

Rudder Pedal Shakers

At speeds of 150 knots and below and dependent on engine RPM, the aircraft is deficient in directional stability, therefore, uncontrollable movements in yaw or roll can develop. Because preservation of directional control is imperative when partially jetborne; rudder pedal shakers give early warning of movement sideways. In flight, at approximately 165 knots or below, if significant lateral G develops, one of the two shakers will oscillate its associated pedal, giving a vibration indication to the pedal that should be applied. Each shaker is an electric motor which can drive an eccentric to shake its pedal; power is applied to the appropriate motor by a sensor which monitors lateral acceleration. With the system switched ON, power is supplied through the main weight on wheels (WOW) switch and an airspeed switch set at 165 knots. With weight removed from the WOW switch (at 165 knots or below) the shaker will operate. A sensor, similar to the shakers sensor, provides an indication of sideforce to the head up display (HUD). A SHAKERS master switch is normally held in the ON position by a guard which can be swung back clear of the two position switch so that the system can be switched off. A RPS/YAW TEST pushbutton, on the left console allows the system to be tested on the ground. While taxiing with nosewheel steering engaged, depress the RPS/YAW TEST pushbutton and turn the aircraft using nosewheel steering. This imposes a sideforce from the side with the forward deflected pedal. Check that the rearward rudder pedal oscillates briefly. Check, also, that the HUD sideforce symbol briefly indicates sideforce in the direction of the applied rudder. In the air, the automatic action of the shakers can be checked at speeds below approximately 165 knots.

Rudder Pedals Adjustment

When the RUDDER PEDALS ADJUST knob is pulled, the rudder pedals can be pushed forward or allowed to move aft under spring pressure. The pedals should be restrained when they are being moved aft. When the knob is returned the pedals will lock in the selected position. Ensure the knob is returned fully without the use of force, retaining no feeling of springiness; press hard on both pedals to ensure they are locked.

Rudder Lock

The rudder is locked in a central position by centering the rudder pedals, pulling and turning a RUDDER LOCK handle 45° counterclockwise and then moving the rudder pedals gently until a rudder bar locking pin engages in a stop on the rudder bar. To release the lock, pull the handle and turn it clockwise to the vertical to disengage the locking pin. Let the handle recess forward into a slot to allow the spring loaded pin to withdraw from the stop.

REACTION CONTROLS

Control is maintained, when jetborne, by jet reaction valves. These are shutter valves supplied with bleed air ducted from the HP compressor, via a master butterfly valve which is interconnected with the engine nozzles control mechanism by a valve lever. Duct pressure is shown on a gauge in the cockpit. The master butterfly valve opens automatically when the nozzles are deflected from fully aft. Air supply is progressive over the engine nozzles range 0° to approximately 20° down, thereafter maximum airflow is provided.

Lateral Control

Lateral control is provided by two wing tip reaction valves (which are interconnected with the ailerons). These blow downward when the associated aileron is depressed. The downblowing valve becomes fully open at about half aileron travel and its effect is then augmented by the opposite wing tip reaction valve opening progressively and blowing upwards.

Longitudinal Control

Longitudinal control is provided by two downblowing reaction valves, one at the nose and one at the tail. The nose valve is linked directly to the control column, the tail valve to the stabilator. Neutral control coincides with +2° stabilator, at which time the nose valve is just closed.

Directional Control

Directional control is provided by a double reaction valve at the tail. This is connected to the rudder and blows in accordance with rudder movement.

STABILITY AUGMENTATION (STAB AUG)

The stability augmentation system (stab aug) provides assistance in maintaining stability during hover and transitional flight by sensing movements about the pitch, roll and yaw axes of the aircraft and initiating a controlled reaction to oppose the initial movement, thus augmenting the pilot's demands to the control surfaces and/or reaction control valves. A pitch/roll sub-system, provides the stability augmentation in the pitch and roll axes of the aircraft, while a yaw sub-system, provides the augmentation in the yaw axis.

Pitch and Roll

The pitch and roll stab aug is a limited authority two channel system. Mainly, it is a pitch and roll rate gyros and computer unit (which has built in test equipment, for servicing) and three stab aug actuators, one forming part of each tandem hydraulic actuator. When the system is engaged, the gyros supply information to the computer and this signals the valves of the stab aug actuators. The rams of the actuators then provide stability augmentation by supplementing the pilots demands to the main valves of each tandem hydraulic actuator through a differential mechanism. The authority of the stab aug is restricted. Its limits are, 1½° stabilator travel and ±2° aileron travel. When it is switched off, the stab aug actuators are centralized. The system can be switched off, using an AUTO STAB MASTER switch, which controls ac supply to the gyros and computer unit, but it is preferable for it to be left on. An AUTO STAB ENGAGE switch, which controls manual selection, passes a dc supply to the computer unit. With an ac supply and the AUTO STAB MASTER on, the gyros will take 17 seconds to run up. Selecting AUTO STAB ENGAGE should be delayed for this period. With the AUTO STAB MASTER on, both channels can be disengaged by switching the AUTO STAB ENGAGE switch off. The system is then ready to be switched on immediately and an ac 0 volt hold ensures that the stab aug actuators are centralized. This selection guards against the effects of possible systems failures. The dc supply to the system is controlled by two pressure switches which close when hydraulic pressures in the two systems rise. It is then controlled by the AUTO STAB ENGAGE switch; with this switch on, dc supply is withdrawn when the landing gear is raised, and if the flaps are at or less than 40° down. Also, it is a function of the ADC to withdraw dc supply at 250 knots. An AUTOSTAB PITCH ROLL TEST button allows the channels to be tested; this can be done only on the ground and with the engine running. If the landing gear is blown down, both channels will continue to function, or be available, provided that hydraulic supplies are normal. One channel will fail if one hydraulic supply system fails (PC 1 fails - lose pitch stab; PC 2 fails - lose roll stab). Since the pitch stab aug actuator forms part of the stabilator actuator and therefore functions with the downward blowing tail reaction valve only, it cannot provide stability augmentation when the stabilator setting is such that the valve is closed. (Normally in the hover.)

Yaw

Yaw stability augmentation is provided to improve lateral and directional handling in jetborne and partially-jetborne flight and to minimize sideslip during transition. At speeds down to 60 knots the yaw stab aug provides turning qualities similar to those of a naturally directionally stable aircraft. The system operates via the dual yaw reaction control valve at the tail, and comprises basically a gyro/computer unit (with a yaw rate gyro), a lateral accelerometer, a lateral stick position pick-off and a yaw actuator. When the system is selected ON and the aircraft is within the system's operating parameters, signals from the yaw rate gyro, the lateral accelerometer and the stick position pick-off are summed and fed via the computer to a torque motor on the electro-hydraulic yaw actuator which then operates the yaw reaction valve via a differential lever mechanism. Operation of the system does not move the rudder and is therefore not felt by the pilot via the rudder pedals. The authority of the yaw stab aug is limited to ±5° equivalent rudder deflection, corresponding to half-open travel of the yaw reaction valve in each direction. Full authority is obtained at 0.15 lateral-G. Applied aileron of 8° corresponds to 5° equivalent rudder deflection. Electrical supplies are from the No. 2 AC and DC bus (dual generators) or from the main 28 volt DC bus and 115/200 volt AC bus (single generator). The system will not operate unless both of these supplies are established. The yaw actuator is powered from No. 1 hydraulic system. The yaw stab aug is controlled manually by a master switch and an engage switch, which are the switches used to also control the pitch and roll stab aug. In the case of malfunction therefore, all three stab augs can be selected off by a single switch operation. With both switches selected on, the yaw channel is automatically engaged when the aircraft becomes airborne (landing gear compression microswitch); a DC supply from the computer also then energizes a solenoid on the yaw actuator, which hydraulically frees the actuator, allowing it to respond to torque motor inputs. The function of the landing gear compression microswitch ensures that the yaw actuator cannot operate to oppose the pilot's steering demands during taxiing. Automatic cut-out of the yaw stab aug occurs after take-off when the landing gear is selected up and the flaps are raised to less than approximately 45° extension. Automatic re-engagement occurs when the landing gear is selected down or when the flaps are lowered beyond approximately 45°. The yaw channel remains available when the landing gear is selected down using the emergency lowering system, provided hydraulic power is available. When the system is switched off in the air, by manual selection, automatic cut-out, or by electrical supply failure, the yaw actuator solenoid is deenergized and the actuator centers by spring pressure. On the ground, the yaw stab aug can be tested by use of the RPS/YAW TEST push-button. With the engine running (electrical and hydraulic supplies established), the master and engage switches on, the aircraft at rest and the control stick neutral, press and hold the button. This establishes a DC supply by-passing the landing gear compression microswitch and also transfers the rudder trim indicator to a transmitter at the yaw actuator. The rudder trim pointer should be at zero, indicating that the yaw actuator is centered. When the control stick is then moved slowly to full left and then full right, the stick position pick-off feeds signals to the yaw actuator which in turn operates the yaw reaction valve. This movement is shown by the rudder trim pointer as follows:

a. Control stick movement from center to left, opens the left reaction valve. The rudder trim pointer moves from zero to left.
b. Control stick movement from center to right reverses the sequence and opens the right reaction valve. The rudder trim pointer moves from zero to right.
c. Full rudder trim pointer deflection corresponds to full yaw stab aug authority; i.e. half-open reaction valve in each direction.

NOTE

This check assumes that the aircraft is standing level (laterally): it ensures only that the yaw actuator is responding to signals derived from the stick position pick-off and that no hard-over failure exists. If the test is made when the aircraft has a lateral tilt (standing on a sloping surface), when the control stick is neutral, the rudder trim pointer will show that the yaw actuator is not at center and that the yaw reaction valve is open to part or full stab aug authority. This can be confirmed by reference to the HUD sideforce indication. When the control stick is then moved laterally from center, the resulting rudder trim pointer movement confirms that the yaw actuator is operating and is not locked at its original setting.

During taxiing, a test of the lateral accelerometer and yaw rate gyro can be made by pressing and holding the test button during a turn, with the control stick neutral. Turning motion should make the rudder trim indication agree approximately with the indication given by the HUD sideforce symbol. During shipborne operation, the test button should be held depressed throughout one period of ship motion. The rudder trim pointer should move in sympathy with the HUD sideforce symbol.

NORMAL OPERATION

Normal operation of the flight controls is accomplished through the use of the control stick for longitudinal axis (ailerons) and lateral axis (stabilator) control, and the rudder pedals for vertical axis control.

EMERGENCY OPERATION

STABILATOR TRIM FAILURE

If stabilator trim appears to be running away or fails, trim control is available by utilizing the standby stabilator trim system. When the guard over the standby switches is raised, the main trim circuit is shut off and the two standby switches, used simultaneously, provide a completely independent standby trim system. No control authority is lost with trim in any position. Out of trim forces can be reduced above 250 knots by turning Q feel off. However, airspeed must be reduced below 500 knots if Q feel is off.

RUDDER TRIM FAILURE

If rudder trim fails, no control authority is lost. To reduce rudder pedal forces, decrease speed below 250 knots and select MID flaps.

Q FEEL FAILURES

Q feel failure is indicated by unusual stick forces and/or restrictions in pitch control. If Q feel fails, reduce speed below 500 knots and turn the Q feel switch OFF. If practicable, reducing the speed below 250 knots will provide normal pitch control.

STAB AUG FAILURE

Pitch and Roll

Stab aug failures are indicated by unexpected lateral or longitudinal trim changes, oscillatory motions or the lack of full range of control in one direction. If the stab aug fails, reduce airspeed and place stab aug ENGAGE switch to OFF.

Yaw

If the yaw stab fails (either cycling or goes hard over) it can be overridden by the pilot. In the case of a hard over failure, 50% control authority is lost in one direction. Switch stab engage OFF. Yaw stab is inoperative with PC 1 failure.

DUCT PRESSURE FAILURE

Duct pressure failure is indicated by abnormal pressure readings on the duct pressure indicator and excessive nose up trim changes when the nozzles are lowered. If duct pressure fails in V/STOL flight, land immediately or accelerate to conventional flight. If duct pressure fails in conventional flight, remain in conventional flight.

LIMITATIONS

REACTION CONTROL

Use of engine bleed for reaction control (nozzles deflected to 20° or beyond), must be followed by a cooling period of at least the same duration (nozzles aft). Continuous use of reaction control must not exceed 5 minutes in any one period.

FUEL SYSTEM

DESCRIPTION

The fuel system (see figure A-3, appendix A) consists of seven integral tanks (five fuselage tanks and two internal wing tanks). Provisions are made for two externally mounted (droppable) wing tanks. The tanks are divided into two feed groups: the left feed group consists of the left external wing tank (when installed), left internal wing tank, left and right front tanks and the left center feed tank. The right feed group consists of the right external wing tank (when installed), right internal wing tank, rear tank and right center feed tank. An air refueling probe may be installed for air refueling. Regulated engine bleed air transfers fuel from the tanks of the left and right feed groups to their respective center feed tanks. The fuel is then transfered to the engine by two boost pumps (one in each feed tank) and a fuel flow proportioner plus a backing pump in the fuel control. The aircraft is fueled by using single point ground pressure fueling, at approximately 1200 pounds per minute. There are no gravity fueling provisions made for the internal or external fuel tanks. All tanks have fuel gaging probes which provide total fuel quantity indications (in pounds) to two fuel quantity indicators. The center feed tanks are equipped with refueling level control valves that shut off fuel flow when all the tanks become full. Fuel may be dumped from the external and internal wing tanks.

Engine Driven Fuel Pumps

There are two engine driven fuel pumps in the fuel control unit. One is an impeller type backing pump and the other is a gear type main pump. The main pump is driven by the engine high pressure compressor shaft and the backing pump is driven by the main pump through an interconnecting shaft. The backing pump receives fuel from the fuel boost pumps and the fuel flow proportioner and then pumps this fuel to the inlet side of the main pump by way of a low pressure fuel filter. If the fuel boost pumps and the fuel flow proportioner fails, the engine driven pumps will provide an adequate fuel supply for reduced engine operation.

FUEL BOOST SYSTEM

Fuel is supplied to the engine by two electrical boost pumps and a hydraulically driven fuel flow proportioner. Each pump is a two speed unit. During normal operation, the pumps operate at low speed and the proportioner ensures that an equal amount of fuel is discharged from each feed tank. If one boost pump fails, the other is automatically switched to high speed and the proportioner will maintain approximate fuel balance between the two feed tanks. If both boost pumps fail, the flow proportioner (acting as a hydraulically driven pump) will continue to supply fuel to the engine. If the proportioner fails, the fuel levels will probably go slowly out of balance. In this case, the boost pump associated with the low level must be shut off until balance is regained. At maximum power and with at least 300 pounds of fuel in each feed tank, approximately 15 seconds of fuel is available to the boost pumps during negative G flight.

Boost Pumps

There are two electrically operated boost pumps, one in the lower portion of each center feed tank. The pumps are centrifugal-type driven by a two speed motor. Each pump is enclosed in a negative G chamber for limited inverted flight. Flap type bypass valves permit fuel flow through the pumps if they are not operating. The pumps are wired so that if one fails or is shut off the other will automatically switch to high speed. A PUMP (left) or PUMP (right) caution light comes on anytime the associated pump output pressure is less than 8 psi. With dual generators, the left pump is powered by No. 1 28 volt dc bus. The right pump is powered by No. 1 transformer rectifier 28 volt dc bus. Placing the No. 1 BATT switch to ON causes the right pump to operate. With single generator, both pumps are powered by the main 28 volt DC bus and operate when either BATT No. 1 or No. 2 switches are ON.

NOTE

During engine start with dual generators, the left pump is automatically shut off and remains off until the ac generators come on the line and the dc reset button is pressed.

Fuel Flow Proportioner

The function of the fuel flow proportioner is to equalize the flow of fuel from the two feed groups. The proportioner consists of two equal capacity vane type pumps with a common drive from a hydraulic motor. The hydraulic motor is driven by PC-1 pressure and is controlled by a dual, mechanically and electrically operated, shutoff valve. The mechanical half of the valve is connected to the low pressure fuel shutoff valve and prevents the proportioner from operating whenever the low pressure fuel shutoff valve is closed. The electrical half is controlled by a FLOW PROP switch on the right side of the main instrument panel. The switch provides a means of shutting off the proportioner if a fuel out of balance correction is needed. If the proportioner fails or is shut off, bypass valves permit fuel flow to the engine. A PROP caution light comes on if the proportioner fails or is shut off electrically. If the electrical power supply to the PROP switch fails, the proportioner will remain ON.

WARNING

If one feed tank is empty, the proportioner must be turned off. Failure to turn off the proportioner will prevent fuel feed from the other feed tank and engine flame out will occur, therefore check that the proportioner can be selected OFF after engine start.

FUEL TRANSFER SYSTEM

Fuel transfer is accomplished by utilizing regulated sixth stage engine bleed air. Transfer starts from the external wing tanks (if installed) to the internal wing tanks and then to the left and right front tanks (left feed group) or the rear tank (right feed group). From the front and rear tanks, fuel then transfers to the respective left or right center feed tank. If the pressurization system fails, the internal wing tanks, left and right front tanks and rear tanks will gravity feed to their respective left and right center feed tanks. The external wing tanks may also transfer during pressurization failure, due to siphoning effect. Fuel transfer is automatic anytime the engine is running; however, pressure transfer may be shut off by placing the TANK DEPRESS switch, on the left console, to ON.

PRESSURIZATION AND VENT SYSTEM

Sixth stage compressor bleed air pressurizes the system and transfers the fuel. The air enters the system through a check valve, a filter and two pressure control valves (one for each feed group). The control valve regulates air pressure to 6 psi. The pressure control valves also provide vacuum and pressure relief and operate at ¼ psi and 7¾ psi respectively. Self sealing connections in each pylon provide air pressure to the internal wing(s) when the external wing tank(s) is/are jettisoned. A float operated vapor release valve is in each feed tank and opens when the fuel level falls by approximately 16 pounds. This dissipates air or vapor pressure (through a check valve) to atmosphere, thereby, preventing pressure in the feed tanks from building up and stopping fuel transfer. If feed tank pressure exceeds 19 psi, the valve opens and will discharge air (or fuel) regardless of float position. During negative G flight, weighted arms hold the valves closed to prevent fuel loss. If the transfer pressure in either feed group falls below 2½ psi, a TRANS caution light will come on and the fuel quantity gage (for the associated feed group) will only read feed tank quantity. If the pressure in either internal wing tank exceeds 10 psi, a tanks over pressurized (TOP) warning light will come on. An external air pressure connection is provided for use during ground defueling.

Transfer Caution Lights (TRANS)

There are two TRANS caution lights located on the warning/caution panel. The left TRANS light indicates that the left feed group pressurization has dropped below 2½ psi. The right TRANS light provides the same indication for the right feed group. During inflight refueling, the TRANS lights may come on.

Tanks Over Pressurized Warning Light (TOP)

A TOP warning light is located on the warning/caution panel and indicates that the pressure in either feed group has exceeded 10 psi.

WING FUEL DUMP

External and internal wing fuel may be dumped in flight by selecting the JETTISON position on the wing fuel jettison switches. There are two lever-locked switches, above the warning/caution panel, and are marked PORT (LEFT) and STBD (RIGHT). Both switches may be used simultaneously (to reduce gross weight) or individually (to correct out of balance conditions). When dump is selected, a motor operated valve opens, and fuel is dumped from the trailing edge of the wing. The fuel is forced out of the wings by normal transfer pressure.

FUEL QUANTITY INDICATING SYSTEM

The fuel quantity indicating system provides readings in pounds of total internal and external fuel. The system components include a left and right fuel quantity indicator, a fuel remaining indicator, a left and right fuel low level warning light, a fuel quantity test button and a total quantity check button. For fuel quantities, see figure 1-19.

Fuel Quantity Indicators

There are two fuel quantity indicators, one for the left feed group and one for the right feed group. The indicators, on the right side of the main instrument panel, display total external and internal fuel in pounds. The indicators are marked with major units of 10 with further subdivision of single units. Each major unit must be multiplied by 100. Each indicator has a range from 0 to 55. The left indicator displays fuel quantity of the left feed group while the right indicator displays right feed group fuel quantity. If transfer pressure fails, or is not available, the indicator(s) will display feed tank(s) fuel quantity only. On aircraft block 41 and up, only one indicator with dual pointers is installed. The pointers are marked L and R representing the left and right feed group respectively.

Fuel Remaining Indicator

A fuel remaining indicator on the right main instrument panel is operated by ac power. It is set to total contents before flight. With ac power available, pull out the reset knob and rotate it clockwise to increase readings and counterclockwise to decrease readings. The amount of rotation of the knob will govern the speed at which the counters move. Ensure knob is neutral and fully home after resetting. During flight, the gage integrates fuel flow and subtracts from the total to show fuel remaining. It has no sensors in the tanks and will have to be reset if fuel and/or tanks are jettisoned.

Total Quantity Check Button

The total quantity check button, marked CONTENTS CHECK, is located on the right side of main instrument panel. This button permits checking total fuel quantity of a feed group after pressurization has failed.

Fuel Quantity Test Button

The fuel quantity test button, marked GAUGE CHECK, is located on the right side of the main instrument panel. When the button is held pressed, the fuel quantity indicators decreases approximately 300 pounds and the low level warning lights flash. When the button is released the indicators return to the normal position and the warning lights go out.

Fuel Low Level Warning Lights

There are two fuel low level warning lights on the glare shield. The left light is for the left feed group and the right is for the right feed group. Each light operates independent of the other but their operation is identical. If the fuel level in the feed tank drops to 750 pounds remaining, the associated low level light will come on steady. When the fuel level drops to 250 pounds remaining, the light will flash. The lights may be dimmed by rotating their covers counterclockwise. The fuel low level warning lights are amber.

EXTERNAL TANK JETTISON SYSTEM

Refer to Jettisoning Chart, section V and Emergency Systems, this section.

AIR REFUELING SYSTEM

An air refueling probe may be installed above the left air inlet. A self sealing coupling, with a check valve at the base of the probe, prevents fuel loss if the probe is damaged or if the nozzle valve fails. The probe nozzle has a weak link which ensures that if excessive strain occurs between the probe and tanker drogue, the link will fail. In this event, an emergency shutoff valve, in the probe nozzle, automatically closes to prevent fuel loss. Provision is also made to illuminate the probe and drogue during night refueling. Before making contact with the drogue, the TANK DEPRESS switch must be placed to ON. This action shuts off transfer pressure to the tanks and allows the center feed tanks refueling valves to open when fuel pressure from the tanker is applied. Refueling is indicated by two pair of green air refueling lights (on the left glare shield) illuminating. When the tanks are full, the refueling valves close stopping fuel flow. Refueling can also be stopped by withdrawing the probe from the drogue.

FUEL QUANTITY DATA TABLE

	GALLONS	POUNDS
RIGHT CENTER FEED TANK	47.0	319.5
LEFT CENTER FEED TANK	47.0	319.5
RIGHT FRONT TANK	62.0	421.5
LEFT FRONT TANK	62.0	421.5
REAR TANK	125.0	850.0
RIGHT INTERNAL WING TANK	208.0	1414.5
LEFT INTERNAL WING TANK	208.0	1414.5
TOTAL INTERNAL FUEL	759.0	5161.0
RIGHT EXTERNAL WING TANK	111.5	758.0
LEFT EXTERNAL WING TANK	111.5	758.0
ADDITIONAL INTERNAL WING TANK FUEL WITH DROP TANKS	8.5	116.0
TOTAL INTERNAL AND EXTERNAL FUEL	990.5	6793.0

NOTES

- FUEL WEIGHTS ARE BASED ON JP–5 AVERAGE WEIGHTS OF 6.8 POUNDS PER GALLON AT 60°F.
- EXTERNAL AND INTERNAL WING FUEL CAN BE DUMPED LEAVING FUSELAGE FUEL ONLY (APPROXIMATELY 2200 POUNDS).

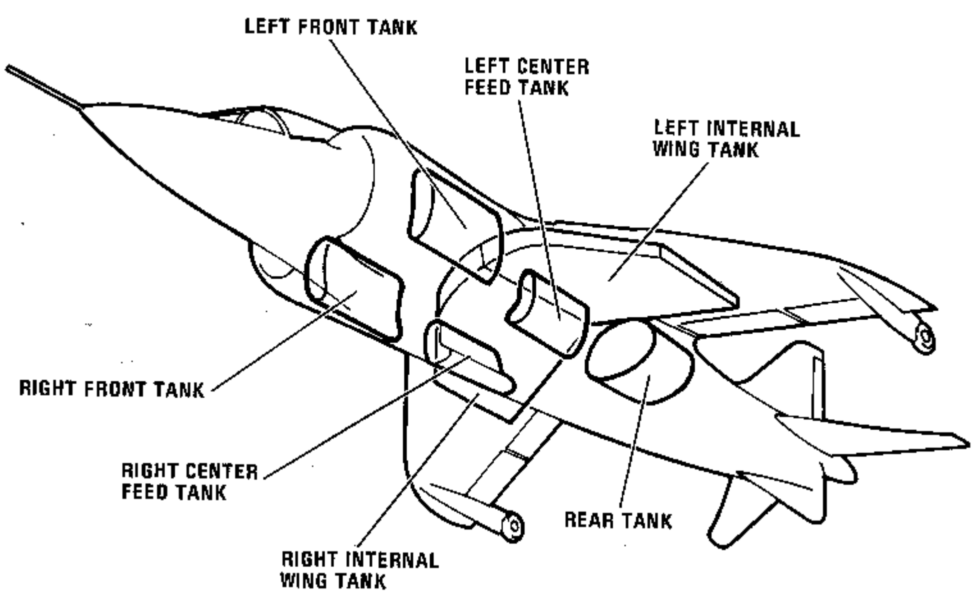


Figure 1-19

Tank Depressurization Switch

The TANK DEPRESS switch, on the left console, provides an inflight capability of depressurizing the tanks for air refueling. The lever-locked switch has positions of OFF and ON. To depressurize the tanks the switch must be lifted and moved to the forward ON position.

Air Refueling Probe Light

An air refueling probe light may be installed in the leading edge of the left wing root. The light is used during night air refueling to illuminate the refueling probe and drogue. The light is controlled by a switch on the left console, outboard of the tank depressurization switch. Moving the switch to the forward, ON position, turns the light on.

GROUND REFUELING SYSTEM

The aircraft can be refueled on the ground through a standard refueling/defueling pressure coupling. The coupling is mounted in the vicinity of the left rear engine nozzle. Access to the coupling is via a hinged door held down by five allen screws. Mounted just above the coupling are two toggle switches, which provide control for ground refueling. The switches supply the voltage to the solenoid operated refueling valves. The refueling valves are located in the center tanks, and open to pass fuel during the refueling operation. Two green lights, located adjacent to the toggle switches, indicate when the fuel is flowing. During refueling, the center tank fills first and overflows into the front and rear tanks and then into the wing tanks and, if fitted, the external tanks. Float switches are provided in the wing and external tanks to close the refueling valves and shut off the refueling when the proper fuel level is achieved. The No. 1 battery bus (dual generators) or the No. 2 battery bus (single generator) provides the power source during ground refueling (i.e., batteries need not be on).

Refueling Switches

The two toggle selector switches, marked FUEL CONTENTS, PORT and STARBOARD provide independent or simultaneous control of the feed groups, by controlling the power source to the associated refueling valves. This provides the servicing crew with the ability to balance the fuel load. When the selector switches are positioned outboard for ground refueling, the appropriate fuel gages and the TOP (tank over pressure) light on the warning/caution panel are also provided with power for operation. When the selector switches are positioned inboard for flight, the No. 2 bus provides the voltage to the refueling valves. Either position routes a voltage via the wing tank check valve microswitches (one on each wing) to the refueling valves.

NOTE

If a wing tank check valve is not open, the microswitch will prevent the associated refueling circuit from being energized.

Refueling Operation

The aircraft is refueled on the ground by connecting an external fuel hose to the pressure coupling. The low pressure valve switch and the tank depress switch in the cockpit must be off, the wing tank check valves must be open, the defueling valve must be closed, the float switches in the wing tanks, are if fitted, in the external tanks must be down; also fuel pressure at the valve inlet must be 15 pounds per square inch, before the refueling circuit can be energized. When a refueling selection is made and fuel is flowing, a green light illuminates and remains on until the system is full or refueling is terminated. A red light marked TANK OVER PRESS, located below the selector switch will illuminate if the fuel system is over pressurized. The refueling valves are connected via a common fuel line to the pressure coupling. Fuel under pressure, forces the valves to open and pass fuel into the center tank to start the refueling sequence. Under normal conditions the refueling rate is 1200 pounds per minute. The valves also serve to limit fuel flow to 200 pounds per minute, if the center tank pressure rises above 17 pounds per square inch. When the fuel reaches capacity, the float switches operate to break the voltage source and reseat the valves to shut off fuel flow. During refueling, displaced air is vented to the atmosphere. The refueling selector switches should be positioned down when refueling is completed. However, spring loaded strikers ensure that the switches are forced into the down position when the door is closed. Maximum tanker pressure is 50 psi, normal should be 30 to 40 psi.

CAUTION

Do not operate the auxiliary power unit when refueling. The APU exhaust creates a fire hazard.

NORMAL OPERATION

Operation of the fuel system is automatic any time the engine is running and the tank depressurization switch is off. Fuel sequencing is also automatic; however, if an out of balance condition occurs, it can be corrected by pulling one of the boost pump circuit breakers and turning proportioner OFF. After the out of balance condition is corrected the circuit breaker must be reset and proportioner turned ON.

EMERGENCY OPERATION

BOOST PUMP FAILURE

Failure of a boost pump is indicated by the associated PUMP caution light illuminating. The boost pump should be shut off by pulling the circuit breaker. The other pump will automatically switch to high speed and the proportioner will maintain approximate fuel balance. Avoid negative G flight with a failed boost pump.

FUEL FLOW PROPORTIONER FAILURE

Failure of the fuel flow proportioner is indicated by the PROP caution light illuminating. It is probable that the fuel levels will slowly go out of balance. To maintain balance, the boost pump associated with the low fuel level must be shut off until balance is regained.

Fuel Low Level Light Flashing

If a fuel low level warning light flashes (in level flight) at a fuel state higher than 250 pounds on the associated side and when all other indications are normal, it is most likely to be the result of a faulty circuit. Switch off the flow proportioner, in case one side runs dry; then check the low level lights by pressing the GAUGE CHECK button. If only one light continues to flash when the button is pressed, failure of the circuit is confirmed. Neither light must be relied upon. If both lights flash during the check, both circuits are serviceable and the warning is genuine. First consideration should be given to a possible vapor release valve which has failed closed.

Transfer Pressure Failure

Transfer pressure failure may occur in one or both sides of the fuel system and is indicated by either (or both) TRANS caution lights coming on and by the associated fuel quantity gauge indicating center tank contents only (300 pounds). Recovery action is similar for both single and double failures, but in the double failure case an immediate landing will be necessary due to fuel shortage if remedial action is unsuccessful. Restrict altitude to 30,000 feet if possible otherwise low pressure in the tanks will cause fuel cavitation. Avoid prolonged steep dives and violent maneuvers to minimize negative pressures in the tanks and to prevent the risk of uncovering the wing tank transfer pipe(s). Return to base at optimum range speed/altitude. If the quantity gauge on the affected side indicates a steady reading of approximately 300 pounds, transfer is taking place. If, however, the quantity gauge shows a continuing decrease, the low level warning light flashes at 250 pounds and fuel is known to remain in the transfer group, transfer has ceased. If drop tanks are carried and they still contain fuel, jettison them both if complete failure has occurred; if the failure is confined to one side, jettison and drop tank on the affected side. This may slightly increase transfer pressure and may also promote some gravity flow. If this action is unsuccessful and the failure is confined to one side, the boost pump on that side and the flow proportioner should be switched off when the quantity gauge indicates 250 pounds; this conserves fuel for landing. If one drop tank has been jettisoned, jettison the other when it is empty or before landing. Use the CONTENTS CHECK button to assess the landing weight and, in the case of a single failure, the out of balance of the fuel. Check that both boost pumps are switched on for landing. If out of balance exceeds 500 pounds make a conventional or slow (120 knots minimum) landing.

NOTE

If it becomes necessary to jettison fuel following transfer system failure, the rate of fuel jettison on the affected side will also be reduced.

Vapor Release Valve Failure

If a vapor release valve sticks in the open position, fuel, forced by transfer pressure, will be vented overboard at a rate of about 10–20 pounds per minute. If it remains closed, transfer pressure will fail due to a build-up of vapor back-pressure at the top of the center tank. In either case, the handling characteristics are satisfactory for conventional landing up to the maximum possible out of balance of fuel, provided there is no asymmetric drop tank fuel.

VALVE FAILS OPEN

This is indicated by increasing fuel out of balance coupled with an increasing difference between the fuel remaining indication and the total gauged quantities. The fault can only be alleviated and will be difficult to detect; the same indication could be given by other associated failures such as a leaking tank, burst pipe or partial failure of fuel transfer.

a. If range is critical, the rate of fuel loss can be reduced by selecting TANK DEPRESS, but since this action will stop transfer air pressure it should only be used when the altitude restrictions referred to in Transfer Pressure Failure permit. After a short delay, both TRANS caution lights will come on. The gauges will then register center tank quantities and should remain constant, while suction transfer is preserved by check valves. Use the CONTENTS check button at intervals to establish total fuel consumption, including fuel loss, and also to assess the quantities of the drop tanks, which should be jettisoned when they become empty.

b. If the failed side gauge continues to decrease from about 300 pounds, switch off the TANK DEPRESS switch, the boost pump on the serviceable side and also the flow proportioner should be switched off. When the failed side fuel low level light subsequently flashes, switch on the boost pump on the serviceable side and then switch off the boost pump on the failed side. Conserve the fuel on the failed side for landing. Both boost pumps should be on for landing; the flow proportioner should also be on for landing, provided that there is no risk of running one side dry.

c. If the fuel out of balance exceeds 500 pounds, land conventionally or slowly (120 knots minimum). If fuel remains in the wings, it will be possible to jettison fuel from the high side to restore balance for a vertical landing.

VALVE FAILS CLOSED

This is indicated by the fuel low level light flashing prematurely with all other indications normal. The boost pump on the affected side and the flow proportioner should be switched off to conserve the remaining 250 pounds of fuel on that side for landing. Take action as follows:

a. Return to base at optimum range speed/altitude for the known available fuel.

b. Apply negative and then positive–G. If the fuel low level light subsequently goes out the fault has cleared, but this may only be temporary.

If the fault persists take the following action, depending upon range requirements:

a. Range Critical. Leaving the flow proportioner switched off, switch on the failed side boost pump. When the PUMP caution light on the failed side subsequently comes on, it indicates that the center tank on that side is empty; switch off the pump. Thereafter, at intervals of about 10 minutes, switch the pump on again, leaving it on until the PUMP caution light comes on; this ensures that any partial transfer fuel flow is used. Do not rely on fuel from the failed side for landing.

b. Range Not Critical (Constant height). Switch off the flow proportioner and the pump on the failed side to conserve its fuel for landing. If the fuel low level light goes out, switch on the boost pump; if the light again flashes prematurely, reselect pump off. Repeat as necessary.

c. Range Not Critical (Descent). If a descent is acceptable, throttle back to idle and reduce to a safe altitude. If the fuel low level light stops flashing, increase power to maintain altitude. If the light stays out, it may be possible to balance the fuel by switching off the pump on the serviceable side. If the light does not stay out, it will be necessary to revert to step b.

Fuel Tanks Over–pressurization

Over–pressurization of one or both sides of the fuel system is indicated by the TOP light coming on.

a. If the warning occurs in normal flight, it is probable that a pressurization valve has failed in its capacity as a pressure–reducing valve. Select TANK DEPRESS to stop the flow of transfer air pressure; then, as fuel is used and pressure decreases, the warning should cancel itself. The TRANS caution lights will subsequently come on and TANK DEPRESS should then be selected off until the TRANS caution lights go out. It may be necessary to repeat these actions.

b. If after selecting TANK DEPRESS, the TOP warning has not cancelled itself or if only one TRANS caution light subsequently comes on, a more serious failure on the side having the unlit TRANS caution light has occurred; use the WING FUEL JETT switch on that side to relieve tank pressure and prepare for an immediate landing.

c. If the warning occurs during air refueling before the tanks have filled, this indicates that air is not venting from the system and contact with the tanker should be broken to avoid damage to the tanks. When the TRANS caution lights come on, resume refueling, if necessary.

d. If the warning occurs during air refueling when the tanks are full, and while still in contact with the drogue unit, it is an indication that the refueling system has not shut off and fuel is venting at about 240 pounds per minute; this is a fire hazard and contact with the drogue must be broken immediately.

Fuel Balancing

Fuel out of balance not caused by any of the failures discussed above, can be corrected by switching off the flow proportioner and the boost pump on the side with the least fuel, until balance is restored. If necessary, while fuel remains in the drop tanks or wing tanks, out of balance can quickly be corrected by using the appropriate WING FUEL JETT switch.

LIMITATIONS

Fuel Dump

Internal and external wing may be dumped with the engine nozzles aft at speeds of 200 to 550 knots when the flaps are up or at speeds of 200 to 250 knots with the flaps down.

Unusable Fuel

Fuel from the rear and front tanks will not transfer to the center tanks if the outlet pipes of the front and rear tanks become uncovered due to a nose down attitude. This causes fuel to be unusable in the amount of approximately 10 pounds/degree nose down/side. Cockpit indications will be: Fuel low level lights will flash. The fuel gages will indicate total fuel. There will not be any fuel transfer caution lights.

HYDRAULIC POWER SUPPLY SYSTEM

DESCRIPTION

Two separate and independent hydraulic systems are provided. The systems are the power control system one (PC-1) and the power control system two (PC-2). Both systems operate at 3000 $\pm$200 psi (nominal) and each system contains an engine driven pump, reservoir and flight control accumulators. In addition, an emergency system (RAT) is interconnected with the PC-2 system. The hydraulic accumulators, in each system also provide an emergency supply for short periods and prevent momentary pressure drops due to hydraulic surges. If a failure occurs in one system, the remaining system is capable of providing the back up (figure A-4, Appendix A).

POWER CONTROL SYSTEM ONE (PC-1)

The PC-1 hydraulic system supplies hydraulic pressure for the pitch and roll flight controls, the flaps, landing gear, speedbrake, nose wheel steering, wheel brakes, artificial feel, fuel flow proportioner and windshield wiper. When the stab aug is engaged, PC-1 supplies hydraulic pressure to the stabilator and yaw auto stab. The nitrogen charged reservoir holds the reserve fluid for the system. The engine driven pump when operating at maximum engine speed delivers 8 gallons per minute. The accumulators serve to smooth out the engine pump flow and to meet the instantaneous demands of the flight controls. During normal operation, fluid from the pump enters the priority valve (pressure regulator), which routes the hydraulic fluid to the systems powered by the PC-1. If the pressure falls to 1350 psi, the regulator confines the hydraulic fluid to the flight controls and fuel flow proportioner. If the pressure falls to approximately 600 psi a pressure switch closes, and the HYD 1 light comes on along with a flashing master caution light.

POWER CONTROL SYSTEM TWO (PC-2)

The PC-2 hydraulic system is very similar to the PC-1 system, except there is no priority valve (pressure regulator) and the RAT system is interconnected to automatically take over, if a failure occurs. The reservoir and the engine driven pump are identical to the units installed in the PC-1 system. The pump runs approximately 2/3 the speed of the PC-1 pump and delivers proportionally less fluid (4¾ gallons per minute). Consequently, the capacity of the reservoir is smaller. During normal operation, hydraulic fluid is passed through three branch lines to power the stabilator and ailerons, hold the RAT retracted, keep the accumulator fully charged and keep the emergency shuttle valve closed. The PC-2 system also powers the aileron stab aug integrated series servo. If the pressure falls to approximately 1600 psi, a pressure switch closes and the HYD 2 light comes on along with a flashing master caution light.

RAM AIR TURBINE (RAT)

Emergency hydraulic pressure for operating the PC-2 system is supplied by a ram air turbine (RAT). The RAT provides pressure when the differential pressure between PC-2 and the RAT accumulator exceeds 1500 psi. At this point, a shuttle valve is opened to allow hydraulic fluid from the RAT accumulator to extend the RAT into the airstream. The RAT accumulator supplies sufficient hydraulic pressure to operate the flight controls while the

RAT is coming up to speed. A cutout valve regulates RAT output pressure between 2500 and 3000 psi, and is indicated on the HYD 2 pressure gage by cycling between these values. This indicates the system is functioning. If RAT pressure falls below 600 psi, a pressure switch closes and the red HYD light comes on steady and the master caution light flashes and an audio signal is given. The red HYD light goes out if the RAT system recovers. If the PC-2 system recovers to above 1600 psi the HYD 2 light will go out, but the HYD 2 pressure gage will continue to cycle. The reset button can be depressed, which closes the shuttle valve and allows PC-2 to retract the RAT. After reset, the HYD 2 gage will indicate a steady 3000 psi. During engine shutdown, the RAT extends as the PC-2 pressure falls below 1500 psi. When the pressure is dissipated, the RAT retracts by spring action and the bay doors close.

WINDSHIELD WIPER

The center section of the windshield is provided with a conventional windshield wiper. When operating, the wiper sweeps horizontally (right to left) across the windshield and wiping speed is variable. The control knob is located on the center section of the main instrument panel and is labeled W/S WIPER PARK-RUN. Rotating the knob clockwise from PARK TO RUN, opens a hydraulic supply valve to the wiper motor; as the knob is rotated the wiper sweeps progressively faster. The wiper can be operated up to 550 knots on a wet windshield only.

HYDRAULIC PRESSURE INDICATORS

Two pressure gages located on the left console are provided to indicate hydraulic system pressure for PC-1 and PC-2 system. The HYD 2 gage also is used to indicate the RAT pressure during emergencies (cycling between 2500 - 3000 psi). The indicators are identical, and cover a range of 0 to 4000 psi. The indicators are marked from 0 to 4 and multiplied by 1000. Both indicators have a diaphragm operated pointer mechanism, and are mechanically linked to pressure transmitters.

HYDRAULIC SYSTEM WARNING LIGHTS

The pilot is alerted to hydraulic system failures by amber or red lights on the warning/caution light panel and flashing master caution lights. If either PC-1 or PC-2 systems fail, an associated amber light comes on. Each system utilizes a pressure switch which closes and connects a dc voltage that illuminates the individual lights. The pressure switch for PC-1 system is pre-set to close between 660 - 540 psi, while the PC-2 pressure switch is pre-set to close between 1760 - 1440 psi. If a failure occurs to both PC systems, a red HYD warning light comes on as both system pressure switches close and route the voltage to illuminate the red HYD light. If a failure occurs to the PC-2 system (PC-1 normal) and the RAT system does not maintain system pressure above 660 - 540 psi, the RAT pressure switch closes to illuminate the red HYD light. When the red HYD light is illuminated, the master caution light flashes and the pilot is also alerted by an audio warning. The No. 2 bus supplies the 28 volts dc power (dual generator system) and the main 28 volt dc bus (single generator system) supplies power to illuminate the proper warning lights.

NORMAL OPERATION

Normal operation of the hydraulic system commences when the engine is operating.

EMERGENCY OPERATION

If either hydraulic system fails, the remaining system supplies adequate power for control of the stabilator and ailerons. If PC-1 system fails, hydraulic pressure to the flaps, windshield wiper, speedbrake, feel system, stabilator and yaw auto stabs and fuel flow proportioner will not be available. Nose wheel steering and wheel brakes (normal and anti-skid) will be provided by accumulator pressure. Landing gear extension and speed brake retraction is provided by emergency air bottles. If PC-2 system fails and the RAT does not maintain a proper level of pressure, Auto-Stab aileron control will not be available. If a complete PC-1 and PC-2 failure occurs, the aircraft can be safely flown and landed on RAT power. In the event of complete PC-1, PC-2, and RAT failure the aircraft becomes uncontrollable.

LIMITATIONS

When operating on RAT, aircraft speed of 130 KIAS is required to supply adequate hydraulic pressure. When one hydraulic system is inoperative, do not exceed airspeed at 0.9 Mach.

INSTRUMENTS

DESCRIPTION

Only instruments which are not described under another system are described in the following paragraphs.

ALTIMETER

The altimeter on the left instrument panel (figure A-1, appendix A) indicates the airplane altitude above sea level. The instrument is operated by static pressure from the pitot-static system. The unit is a counter pointer type which displays whole thousands of feet altitude in a counter window with increments above that altitude indicated by a rotating pointer on the face. The pointer scale is graduated in 50 feet increments with major 100 foot scale divisions from 0 to 9. An adjustable barometric scale and altimeter setting knob is provided. A vibrator operates automatically (when ac power is available) to prevent sticking.

RADAR ALTIMETER SET (AFTER AFC 96)

The radar altimeter set (AN/APN-194) is a pulsed range-tracking radar which provides accurate altitude above the terrain from 0 to 5000 feet. The set consists of a receiver-transmitter unit, an interface unit, two identical antennas, and an indicator. The two antennas are on the bottom of the vertical fin. Radar altitude may be selected for display on the HUD. The set contains a self-test feature.

Radar Altitude Indicator

The indicator, on the right instrument panel (figure A-1, appendix A), displays altitude above the surface. The face of the indicator contains a dial scale, an altitude pointer, a movable low altitude index pointer and an OFF flag. The dial scale is logarithmic throughout its 0 to 5000 foot range. The OFF flag indicates that power is not supplied to the set, The transmitter is not enabled, the 5000 foot altitude range is exceeded, or the altitude indication is unreliable.

Function Control Knob

The knob on the lower left side of the indicator provides for control and test of the set. Rotating the knob clockwise past the off detent supplies power to the set (see Standby/Transmit switch). Further clockwise rotation positions the low altitude index pointer to increasing altitudes. Pushing in on the knob, when out of the off detent, activates the self-test and the pointer should indicate 100 $\pm$10 feet.

Standby/Transmit Switch

The switch is located adjacent to the radar altitude indicator. With the function control knob ON and the switch in TRANSMIT, the radar altitude set operates normally. With the function control knob ON and the switch in STANDBY, power is supplied to the set but the transmitter is inhibited. In this condition, the OFF flag will be displayed and radar altitude is not available to the indicator nor the HUD. Radar altitude is available without warm-up delay when the switch is moved to TRANSMIT.

Radio/Baro Switch

The switch on the HUD control panel (figure A-1, appendix A), when in RADIO provides for display of radar altitude on the HUD altitude display providing the radar altimeter is operating. When the switch is placed to BARO, barometric altitude is displayed.

Low Altitude Warning Light

A red low altitude warning light on the face of the radar altitude indicator illuminates when the aircraft descends below the altitude set on the low altitude index pointer.

AIRSPEED INDICATOR

The airspeed indicator on the left instrument panel (figure A-1, appendix A) provides an indicated airspeed readout. The instrument is operated by pitot and static pressures from the pitot-static system. The instrument has two pointers and two concentric scales. The longer pointer is used with the outer scale graduated in 5 knot increments with major 10 knot scale divisions from 0 to 9. The shorter pointer is used with the inner scale with major 100 knot scale divisions from 0 to 600; it should read 24 knots (approximately) at rest. A red bug on the outer edge can be set with a rotable catch to a specified datum speed (e.g., for STO).

VERTICAL VELOCITY INDICATOR

The vertical velocity indicator on the left instrument panel (figure A-1, appendix A) provides rate of climb or descent information. The instrument is operated by static pressure from the pitot-static system. The single pointer indicates rate of climb on the upper half of the dial and rate of descent on the lower half of the dial. Each half of the dial has a scale calibrated in 500 feet/minute increments from 0 to 2000 feet/minute and 1000 feet/minute increments from 2000 to 6000 feet/minute with major divisions at 1, 2, 4, and 6 thousand feet/minute.

ATTITUDE INDICATOR

The attitude indicator, on the left instrument panel (figure A-1, appendix A), is electrically operated. A power switch labeled ATT IND is on the left console. Power failure is indicated by a red flag on the face of the instrument. An alternate power supply (No. 3 battery) may be selected by placing the artificial horizon switch, located just below the indicator, from the guarded position to the right position. Pitch and roll indications are reliable for 9 to 12 minutes after power loss. A roll pointer at the top of the instrument indicates roll angle in 10° increments to 30° with additional marks at 60° and 90°. Rate-of-turn and slip are indicated at the bottom of the instrument by a needle and ball. A miniature airplane on the face of the instrument is adjustable +5° to −10° with the pitch trim knob on the lower right corner of the instrument. The airplane appears against an artificial gyro horizon background with markings each 5° of pitch and the words DIVE and CLIMB. Pulling out the pitch trim knob cages the gyro for fast erection. The knob should not be pulled until power has been applied for approximately 1 minute.

STANDBY COMPASS

A conventional magnetic compass graduated in 10° increments with major gradations each 30° from 0° to 330° is mounted on the left instrument panel glare shield (figure A-1, appendix A).

ANGLE OF ATTACK INDICATOR

The angle of attack (AOA) indicator on the left instrument panel (figure A-1, appendix A) is electrically operated from the AOA probe on the right forward fuselage. The instrument has a single pointer on a dial calibrated in units from −5 units to +25 units with bolder marks each 5 units and 0, 10 and 20 units marked. Instrument power failure is indicated by the pointer entering a red sector above +25 units. Units between −3 and +19 correspond to degrees angle of attack.

AOA Probe

The AOA probe mounted on the right forward fuselage senses airstream direction and rotates two potentiometers contained in the probe case. One potentiometer furnishes an AOA signal to the AOA indicator and the other potentiometer furnishes an AOA signal to the HUD.

AOA PROBE HEATER

The probe unit contains a heater which adjusts to OAT and is controlled by a switch labeled ADD Htr. on the left console (figure A-1, appendix A).

ACCELEROMETER

The accelerometer on the right instrument panel (figure A-1, appendix A) is a self-contained instrument that displays acceleration normal to the pitch and roll axes. The indicator has three pointers. One pointer indicates the instantaneous acceleration and the other two record the maximum positive and negative accelerations sustained. The two recording pointers may be reset by pushing a reset button on the instrument. The face of the instrument is calibrated in ½ G increments from 0 to +10 clockwise and −5 counterclockwise with even G's numbered.

ELAPSED TIME INDICATOR

An elapsed time indicator is mounted on the right instrument glare shield (figure A-1, appendix A). A pointer indicates elapsed time in minutes and a counter window indicates hours. The indicator may be started, stopped and reset by two buttons on the instrument.

CALIBRATED OUTSIDE AIR TEMPERATURE (COAT) GAGE

The COAT gage is mounted on the right console (figure A-1, appendix A) and operates from the total temperature probe (refer to Air Data Computer, this section). A single pointer indicates temperature on a dial calibrated in °C each 5°C from −10°C to +60°C with major markings each 10°C. A guarded switch to the left of the gage should normally be set at COAT. The OAT position is used for ground maintenance. The pointer will fall into a red sector below −10°C if instrument power fails. The instrument is accurate only at 0.4M. 4°C must be subtracted from the indicated reading for each 0.1M above 0.4M or added for each 0.1M below 0.4M.

SIDESLIP VANE

A sideslip vane is mounted externally forward of the center windshield for use during slow or hover flight.

NORMAL OPERATION

Instruments are automatic in operation except as noted below.

ALTIMETER

Set barometric setting.

RADAR ALTIMETER SET

With electrical power supplied to the aircraft, rotate the function control knob clockwise out of the off detent. Move the knob further clockwise to set the low altitude index pointer as desired. After a 2 ±1 minute warm-up period, the set is ready for operation. Place the standby/transmit switch to TRANSMIT. If display of radar altitude on the HUD is desired, place the radio/baro switch to RADIO. As the aircraft ascends through approximately 5000 feet, the OFF flag becomes visible and, as the aircraft descends through the preset altitude, the warning light illuminates. The self-test may be activated any time the set is on.

WARNING

High frequency radar waves can penetrate snow and ice fields. When operating in areas covered with snow and ice, the radar altimeter may indicate a greater terrain clearance than actually exists. This error will not exceed the depth of the snow or ice.

ATTITUDE INDICATOR

Place attitude indicator switch ON and adjust miniature airplane. Pull caging knob to erect 1 minute after switching ON.

EMERGENCY OPERATION

ATTITUDE INDICATOR

If warning flags appear, place artificial horizon switch to STBY (right) position.

AOA PROBE

If probe icing is anticipated or suspected, place the ADD Htr. switch ON.

LIMITATIONS

There are no limitations on the instruments.

LANDING GEAR SYSTEM

DESCRIPTION

The aircraft is equipped with a fully retractable landing gear system that consists of a nosewheel, a twin main wheel in tandem with the nosewheel, and two single outrigger wheels. The nosewheel retracts forward while the main wheels retract aft into fuselage bays. The outrigger wheels retract aft and are partially enclosed in a fairing assembly just inboard of the wings. The landing gear is electrically controlled by the No. 2, 28 volt dc bus (dual generator system), and the main 28 volt dc bus (single generator system), and actuated by the No. 1 hydraulic system. Accidental retraction of the landing gear when the aircraft is on the ground is prevented by a scissor switch on the main gear, and ground safety locks.

MAIN GEAR

The main gear is hydraulically retracted and extended. The gear is mechanically locked in the up and down positions. When the main gear is retracted, the fuselage bay is enclosed by flush fitting doors. The fuselage bay doors are mechanically connected to the main gear to open and closed on gear retraction and extension. The main gear strut has a long stroke to absorb high rates of descent during landings; however, if it were to remain that way weight is taken off the outriggers making the aircraft unstable on the ground. Therefore, on a normal landing the main gear strut automatically shortens to put weight on the outriggers. If the sink rate is excessive on touchdown the full stroke of the strut is utilized to absorb it. The main gear doors can be opened on the ground by a release button and lever on the door operating strut adjacent to the main strut. The door should be closed for rough field operations but if left open they will close on retraction.

NOSE GEAR

The nose gear is hydraulically retracted and extended, and is mechanically locked in the down position and hydraulically locked in the up position. The nose gear strut is mechanically shortened for stowage. Hydraulically operated doors are sequenced to close when the gear is fully extended or retracted. During high G flight, the nosewheel hydraulic uplock can be overcome and the nosewheel may drop and rest on the nose gear door which will cause an audible sound emitted from nosewheel area when G is released. The nose gear door is held closed by mechanical locks. When the G load is decreased, the nose gear will be hydraulically retracted and locked. The nose gear doors are open on the ground by a T valve inside a panel on the lower left side of the nose (utilizing wheel brake accumulator pressure).

NOTE

This handle must be fully seated before start or the nose gear doors will not close.

OUTRIGGER GEARS

The two outrigger gears are hydraulically retracted and extended. Both gears are mechanically locked in the extended and retracted position. The outriggers when retracted are enclosed in their fairings by the fairing doors attached to the outrigger gears. The outrigger wheels can caster outward through 180°.

CONTROLS AND INDICATORS

The landing gear is retracted or extended when the UP or DOWN push buttons (landing gear selector panel) are actuated. When one button is depressed, the other button is protruding. A solenoid operated safety lock prevents the UP button being pressed when the solenoid is not energized. The safety lock can be overridden for emergencies by turning the UP button clockwise through 60° and pressing in the normal manner. Landing gear position indicators are located adjacent to the landing gear selector panel. The indicators are marked NOSE, P (port outrigger), S (starboard outrigger), and MAIN. The indicators give a green indication when the associated gear is locked down, a red indication when the landing gear is in transit, and an up indication when the gears are locked up.

Emergency Landing Gear Control

Two high pressure nitrogen storage bottles, are used to pneumatically extend and lock the landing gear in an emergency. An emergency extension T-handle marked U/C is located on the main instrument panel above the normal gear control buttons. The center of the T-handle is a push button which must be depressed before the T-handle can be rotated to blow the gear down. When the handle has been operated, a red band on the control rod is visible. The bottles are fired electrically when the control is pulled. Power is supplied from all the batteries (one will suffice).

NOSEWHEEL STEERING

The nosewheel steering system is an electro-hydraulic operated system that provides directional control for ground operations in three modes; steer, castor and center.

The steering mode has a range of 45° left and right of rudder pedal center. A hydraulic shut off valve, shuts off hydraulic flow to the steering motor when a steering extreme is exceeded. The hydraulic flow is returned when a proper steering angle is achieved. The castor mode has a range of 179° left or right. Mechanical stops are used to contain this range. The center mode is automatic when an UP selection is made on the landing gear panel. The nosewheel will steer to a center position at which point landing gear retraction will commence. Rudder pedal movement is transmitted to the hydraulic steering motor via a steering mechanism. The steering mechanism is set for a steering condition when the hydraulic actuator is extended. Steering accuracy is provided by a vernier-nonlinear gearing mechanism to provide coarse and fine control on either side of rudder pedal center. With anti-skid system on, the nosewheel steering system is controlled by a two position spring-loaded switch on the stick grip. Depressing the switch selects the steering mode. With the anti-skid system off, nosewheel steering operates at all times. In these two conditions the steering motor is controlled by rudder movement. When the selector switch is released with the anti-skid on, the nosewheel is free to swivel about an arc of ±179° from center. During the castor mode, the hydraulic actuator is retracted to isolate nosewheel movement from the rudder pedal movement. Hydraulic power is provided by the PC-1 hydraulic system; three accumulators provide the emergency hydraulic power to provide steering if a failure occurs in the main hydraulic supply. A STEER ACC gage is provided to register accumulator pressure. The gage is located on the left console and under normal conditions indicates 2950 psi. Nosewheel steering is provided as long as the indicator maintains a reading above 1100 psi (nitrogen pre-charge pressure). A nosewheel steering indicator, on the left lower instrument panel, shows white when the nosewheel is off center and black when the nosewheel is centered.

NOTE

The nosewheel steering system is energized to OFF electrically. Thus with hydraulic pressure remaining in the accumulator and the batteries OFF the nosewheel steering is live. Before towing the aircraft, depressurize the nosewheel steering accumulator by using the red button on the nose gear strut.

NORMAL OPERATION

The landing gear retraction and extension is controlled by push button switches on the landing gear selector panel. The buttons are marked UP and DOWN. The switches have a change over action, one button will disengage when the other is depressed. An up selection energizes the landing gear selector valve UP solenoid, which directs hydraulic fluid to the landing gear up lines and thus retracts the landing gear. The landing gear selector valve will remain energized in the UP position, until the selector switch is depressed to the DOWN position. The down position energizes the landing gear selector valve down solenoid, which directs hydraulic fluid to the down lines and extension will begin. When the aircraft is on the ground, a solenoid operated safety lock is held energized by a scissor switch on the main gear. As long as the scissor switch is compressed the UP button will not engage. The DOWN position of the landing gear button is recessed to prevent an inadvertent down selection. Landing gear position indicators, one for each gear, provide the pilot with an indication for the gear sequence.

EMERGENCY OPERATION

High pressure nitrogen, supplied by two storage bottles is used to extend and lock the landing gear in an emergency. When the U/C button is depressed and the T-handle surrounding the U/C button is pulled, electrically this detonates a cartridge to allow high pressure nitrogen to extend the landing gear (extension time is 4 seconds). The speed brake will retract, if it is extended. The landing gear can be retracted on the ground, by rotating the UP selector button clockwise through 60° and depress. This operation overrides the solenoid operated safety lock and retracts the landing gear. Full retraction may not be possible if the nose landing gear is not centered, because the centering micro switch is bypassed.

NOTE

The landing gear cannot be retracted once it is lowered on the emergency system.

LIMITATION

Maximum permissible airspeed for extending the landing gear is 250 KIAS. After the landing gear is locked down, the airspeed is 350 KIAS.

LIGHTING EQUIPMENT

DESCRIPTION

EXTERIOR LIGHTING

The exterior lights consist of the navigation lights, anti-collision lights, landing lights and an air-to-air refueling light.

Navigation Lights

The navigation lights include a position light on each wing tip and a position light on the tip of the tail cone. The lights are controlled by two switches on the lights control panel on left console (figure A-1, appendix A), the navigation lights control switch and the navigation lights dimming switch. The navigation lights control switch has three positions: FLASH, STEADY and OFF. In FLASH, all three lights flash; in STEADY, the lights illuminate steady. The navigation lights dimming switch has positions BRIGHT and DIM. The switch controls brightness of the navigation lights when the navigation control switch is in either FLASH or STEADY.

Anti-Collision Lights

There are two anti-collision lights, one on top of the fuselage and one on the bottom of the fuselage aft of the main landing gear. Each light contains two lamps oscillated by a motor. One lamp sweeps ahead and the other aft, producing red flashes. They are controlled by the anti-collision lights control switch (figure A-1, appendix A) on the lights control panel. The forward position of the switch turns the lights on and the aft position turns the lights off.

NOTE

On aircraft with dual generator systems, the navigation and anti-collision lights are supplied from No. 1 28 volt dc bus and are lost if the No. 2 transformer-rectifier fails.

Landing Lights

There are two landing lights, both on the nose gear strut. The main landing light has two filaments, one of 500 watts for full brilliance during landing and the other of 280 watts for hovering. The main landing light is controlled by the main landing light switch (figure A-1, appendix A) on the subpanel outboard and above the left console and outboard of the aft end of the throttle quadrant. The switch has positions APPROACH, HOVER and OFF. In APPROACH, the 500 watt filament is illuminated, and in HOVER the 280 watt filament is illuminated. The other landing light is the auxiliary landing light which contains a high intensity 40 watt lamp. The light is controlled by the auxiliary landing light switch which is just outboard of the main landing light switch and has positions AUX and OFF. In AUX, the light is illuminated.

Air-To-Air Refueling Light

The air-to-air refueling light is in the leading edge of the left wing root and is used to illuminate the inflight refueling probe at night. The light is controlled by air-to-air refueling light switch (figure A-1, appendix A) which is immediately aft of the main landing light switch. The switch has positions PROBE LIGHT and OFF, which is the aft position. In PROBE LIGHT, the air-to-air refueling light is illuminated.

INTERIOR LIGHTING

The interior lighting consists of seven banks of red floodlights, seven red hooded lights, integral lights in various panels and indicators, and a utility light. Three banks of red floodlights are above the left console and two banks are above the right console, with three lights in each bank. A bank of red floodlights is under each glare shield, with each bank containing four lights. Throughout the cockpit, one light of each bank is on the emergency lighting circuit and therefore controlled by the emergency lighting switch. The seven red hooded lights, which illuminate a small area, provide illumination for the following: the two canopy lock indicators, the range and bearing indicator (RBI), the fuel remaining and fuel flow indicators, the UHF homing indicator, the DC voltmeter and AC and DC reset buttons, and the COAT gage. Integral lighting is provided for the landing gear position indicators and the following panels: communications control, HUD display, weapon control, navigation display and computer, navigation control, IFF control, sound record, VHF control, TACAN control and UHF control. The following have separate lighting with two lamps, one of which is in the emergency circuit: standby compass, the two cockpit checklists, and the TACAN indicator. Except for the utility light, which has its own control, all the above lights are controlled by the master lighting switch in conjunction with the cockpit lighting dimmer knobs. The lights in the emergency circuit, as indicated above, are controlled by the emergency lighting switch.

Main Lighting Switch

The main light switch, on the lights control panel (figure A-1, appendix A) on the left console, has positions NORM, BRIGHT and OFF. In NORM, all interior lights except the utility light and the emergency lights are turned on and their intensities are controlled by the cockpit lighting dimmer knobs. In BRIGHT, the same lights are turned on, but only three of the four dimmer knobs are functional. The following lights which are normally controlled by the right outer dimming knob illuminate at maximum intensity: the five banks of red floodlights over the right and left consoles, TACAN indicator light, canopy lock indicator lights, the DC voltmeter and AC and DC reset button light, COAT gage light, UHF homing unit light, and the checklist lights.

Cockpit Lighting Dimmer Knobs

The left and right cockpit lighting dimmer knobs are on two small pedestals at the base of the main instrument panel (figure 1-20). Each knob consists of a pair of concentric knobs. The outer knob of each pair is slightly larger than the inner knob. Clockwise rotation increases lighting intensity. The knobs are utilized in conjunction with the master lighting switch. The left outer knob controls the intensity of the following lights with the master lighting switch in either the NORM or BRIGHT position: standby compass light, the two banks of red floodlights under the left and right glare shields, the fuel flow and fuel remaining light, and the RBI light. The left inner knob controls the intensity of the following lights with the master lighting switch in either the NORM or BRIGHT position: communications control panel, HUD display panel, weapon control panel, navigation display and computer panel and navigation control panel. The right inner knob controls the intensity of the following lights with the master lighting switch in either NORM or BRIGHT: IFF control panel, sound recorder panel, VHF control panel, TACAN control panel, and UHF control panel. The list of lights in Master Lights Switch, above, which go to maximum brilliance when the master lighting switch is in BRIGHT, is controlled by the right outer dimming knob when the master lighting switch is in NORM.

Emergency Lighting Switch

The emergency lighting switch (figure A-1, appendix A) on the lighting control panel, with positions FRONT, ALL and OFF, control the emergency lighting. The following lights illuminate in the ALL position: one light in each of the seven red floodlight banks, the standby compass light and the checklist lights. In the FRONT position, only the two red floodlights under the glare shields and the standby compass lights are operative. The emergency lighting derives its power from No. 3 battery. In order not to discharge No. 3 battery unnecessarily, the emergency lights should not be used unless required.

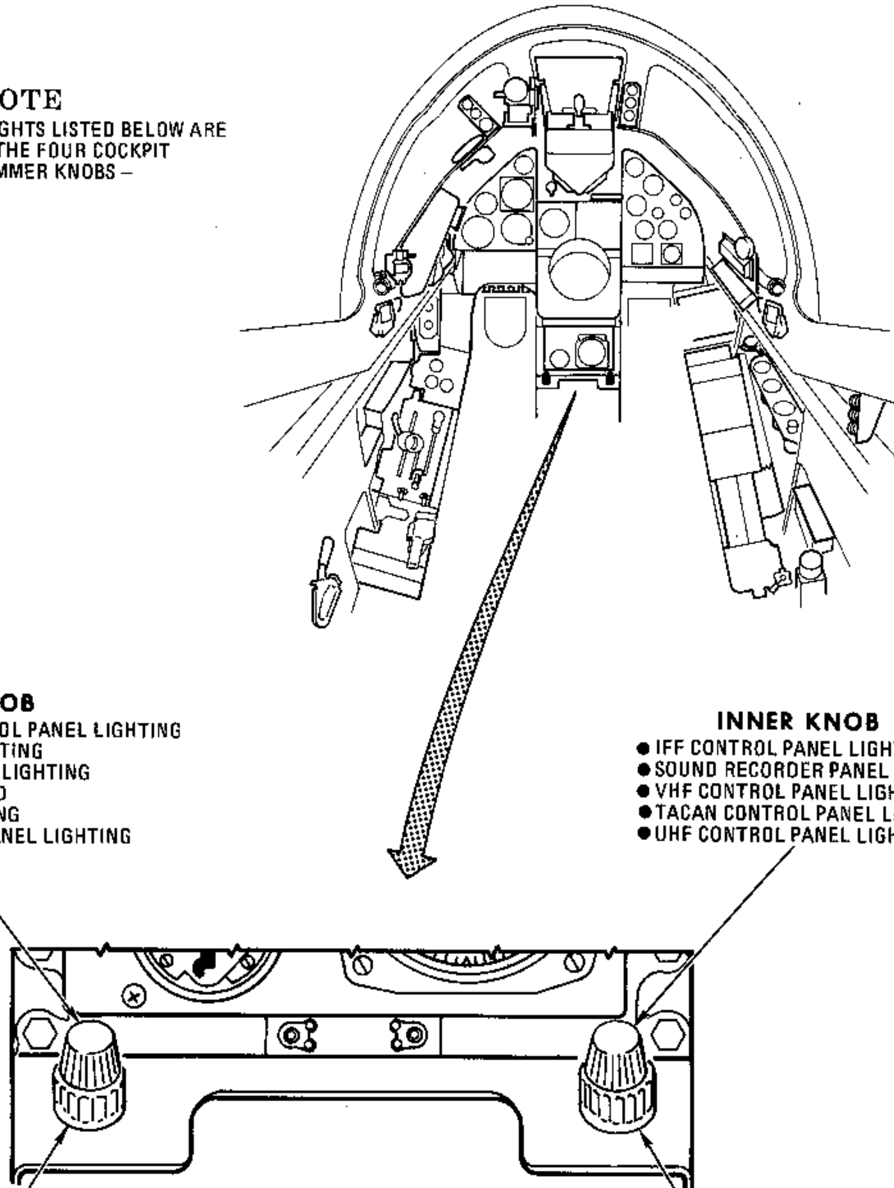
Utility Light

A utility light and container is on left forward corner of the cockpit. The light, which has a 3 foot coiled extension cord, can be removed from aft end of the container and used as a flashlight, or it can be placed on a clip under the left glare shield. It is turned on by pressing the lamp forward.

COCKPIT LIGHTING DIMMER KNOBS

NOTE

INTENSITIES OF THE LIGHTS LISTED BELOW ARE CONTROLLED BY THE FOUR COCKPIT LIGHTING DIMMER KNOBS –



INNER KNOB

- COMMUNICATIONS CONTROL PANEL LIGHTING
- HUD DISPLAY PANEL LIGHTING
- WEAPON CONTROL PANEL LIGHTING
- NAVIGATION DISPLAY AND COMPUTER PANEL LIGHTING
- NAVIGATION CONTROL PANEL LIGHTING

INNER KNOB

- IFF CONTROL PANEL LIGHTING
- SOUND RECORDER PANEL LIGHTING
- VHF CONTROL PANEL LIGHTING
- TACAN CONTROL PANEL LIGHTING
- UHF CONTROL PANEL LIGHTING

OUTER KNOB

- STANDBY COMPASS LIGHT
- RED FLOODLIGHTS UNDER LEFT AND RIGHT GLARESHIELDS
- FUEL FLOW AND FUEL REMAINING LIGHT
- RBI LIGHT

OUTER KNOB.

CONTROLLED ONLY WITH MAIN LIGHT SWITCH IN NORM –

- RED FLOODLIGHTS OVER LEFT AND RIGHT CONSOLES
- TACAN INDICATOR LIGHT
- CANOPY LOCK INDICATOR LIGHTS
- DC VOLTMETER LIGHT
- AC AND DC RESET BUTTON LIGHT
- COAT GAGE LIGHT
- UHF HOMING UNIT LIGHT
- CHECKLIST LIGHTS

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Figure 1–20

NORMAL OPERATION

Normal operation of the exterior and interior lighting is as described in the applicable paragraphs.

EMERGENCY OPERATION

Emergency operation of the interior lighting is as described under the Emergency Lighting Switch. There is no provision for emergency operation of the exterior lights.

LIMITATIONS

No limitations pertain to the lighting equipment.

NAVIGATION EQUIPMENT

DESCRIPTION

The navigational systems on the airplane consist of the compass system, the inertial navigation attack system (INAS), and the head-up display system (HUD).

COMPASS SYSTEM (C2J)

The compass system provides magnetic heading for the navigation display and computer for use during the initial stages of alignment of the inertial platform, for monitoring inertial platform heading, and for reversionary use after failure of the inertial navigation system. Also, the compass system provides magnetic heading outputs for the moving card of the tacan indicator and, when selected, for the HUD. The major components of the compass system are the gyro amplifier/master unit, the detector unit, and the compass control panel. The system also contains a mag/DG (directional gyro) switch and a compass master switch.

Gyro Amplifier Master Unit

The gyro amplifier master unit consists of a gyro amplifier and a master unit which are electrically independent. The gyro amplifier provides the gyro-stabilized heading reference for the compass system. It consists of an electrically driven gyro, a slaving amplifier, and a synchro assembly. The gyro is precessed to the magnetic heading reference of an external flux valve by the output from the slaving amplifier. The azimuth position of the gyro is transmitted from a synchro on a shaft geared to the gyro and gimbal assembly. The master unit provides four outputs repeating the compass heading, transmits corrections into the compass system, and provides the power for the gyro amplifier.

Detector Unit

The detector unit houses the flux valve which receives an excitation signal from the gyro amplifier master unit. The flux valve accurately detects its alignment relative to the lines of force of the earth's magnetic field and transmits this information thru the master unit to the compass control panel.

Compass Control Panel

The compass control panel (figure 1-21) above the right console, provides the controls for selecting the compass mode of operation, and for manually synchronizing the compass system. Also, the panel provides an indication of whether the system is synchronized when in the slaved mode (MAG). The compass control panel contains a sync indicator, a mode selector switch, and a synchronizing control knob.

MODE SELECTOR SWITCH

The mode selector switch is a two-position lever-lock toggle switch with positions of DG (directional gyro) amd MAG (magnetic). In DG (free gyro operation), the slaving amplifier and the flux valve are inoperative and the heading output is determined only by the position of the gyro. In this position, the gyro is not slaved and it drifts because of friction and the earth's rotation. In MAG (slaved gyro operation), the slaving amplifier and the flux valve are energized. This enables the gyro heading output to be synchronized with (slaved to) the flux valve signal.

SYNC INDICATOR METER

When in MAG (slaved), the sync indicator meter needle indicates the direction of misalignment between the slaving amplifier heading output and the flux valve error signal. The needle points to the dot or the cross depending on the sense of direction.

SYNCHRONIZING CONTROL KNOB

The synchronizing control knob manually synchronizes the gyro heading output with the flux valve signal. If the sync needle is deflected to the cross (+) position, turn the knob clockwise until the needle is centered. If the needle is to the dot position, turn the knob counterclockwise.

Compass Master Switch

The compass master switch, on the left console, activates the compass system when placed to ON.

MAG/TRUE/TAC Switch

The mag/true/tac switch, on the NDC range and bearing indicator (RBI), is a three-position toggle switch with positions of MAG, TRUE, and TAC. In MAG or TAC, magnetic heading is displayed on the head-up display. In TRUE, true heading signals from the inertial navigation attack system are displayed on the head-up display. In

TAC position, magnetic heading and tacan bearing information is displayed on the HUD.

INERTIAL NAVIGATION ATTACK SYSTEM

The INAS system is an inertial navigation system with the added capabilities for computed weapon delivery modes and performing range and steering computations. The inertial navigation portion of the INAS provides attitude signals (pitch, roll, and azimuth), present position, and range and bearing to a selected destination. The weapon aiming and release portion of the INAS utilizes inertially derived velocity and attitude signals, in conjunction with air data computer signals, to provide aiming mark deflections for transmission to the head-up display. Automatic or manual weapon release may be accomplished with the system. The major components of the INAS are: navigation display and computer (NDC), navigation control panel (NC), inertial platform (IP), weapon aiming computer (WAC), present position computer (PPC), power supply unit (PS), ballistics box (BB), and the hand controller (HC).

Inertial Platform

The inertial platform is a self-contained, temperature controlled unit. It contains three orthogonally-mounted accelerometers which sense acceleration in any direction, (north-south, east-west, and vertical), and three rate integrating gyroscopes. The input axes of the gyroscopes correspond to those of the accelerometers. The accelerometers and gyroscopes are supported within an array of four motor-driven gimbals. The attitude of the aircraft (pitch, roll, and heading) is measured at the gimbals, and the attitude signals are transmitted by synchros installed between the gimbals.

Present Position Computer

The present position computer receives the sensed north-south, east-west accelerations from the inertial platform and integrates them to produce velocity (groundspeed), and distance travelled (change in latitude and longitude). This information is supplied to the weapon aiming computer for weapon release during attacks, and to the navigation display and computer for display.

Weapon Aiming Computer

The weapon aiming computer solves the weapon release equations and provides the release pulses for automatic delivery modes. It receives steering signals from the navigation display and computer which it uses both for aiming calculations and navigational presentation. The aiming and navigational signals are displayed on the head-up display.

Power Supply Unit

The power supply unit generates the majority of the power requirements of the INAS. The unit receives power from the aircraft 28 volt dc and 200 volt, 400 Hz, ac supplies. If the 200 volt supply fails, the system reverts to aircraft 28 volt dc supply only, and generates the minimum power required to preserve the alignment of the inertial platform and the present position computer, but no displays are available without 200 volt ac supply.

Ballistics Box

The ballistics box and ballistic plugs provide information on the ballistic properties of the various weapons for use within the weapon aiming computer and the head-up display.

Head-Up Display Unit

The head-up display (HUD) unit is mounted above the navigation display and computer. The head-up display is capable of presenting a wide range of navigational and weapon aiming information in symbol form in the pilots head-up field of vision. The symbol display is focused to infinity so that it is superimposed on the external view ahead of the aircraft. The head-up display enables the pilot to fly the aircraft through any maneuver or flight profile without referring to the panel mounted instruments. During navigation, flight director symbols are presented on the head-up display. These symbols represent steering commands in azimuth to home the aircraft on to the destination selected on the navigation display and computer. At 14 NM from the selected destination or route point a range circle appears. As the range decreases the circle unwinds in a counterclockwise direction. Additional navigation information can be displayed on the head-up display unit by the appropriate selection on the head-up display control panel. For a detailed description of the head-up display operation and displays, refer to HEAD-UP DISPLAY SYSTEM, this section.

Navigation Display and Computer

The navigation display and computer, on the center of the main instrument panel (figure 1-21), contains the moving map display and the range and bearing display by which the navigation information from the INAS is presented. The navigation display and computer includes controls for the insertion of navigation route point destination, base and target coordinates, and offsets from these coordinates. Controls are provided for the updating of the INAS information, for the selection of different modes of INAS attacks and for the general operation of the navigation display and computer. The various controls and indicators are described in the following paragraphs.

MAP N/S DISCONNECT BUTTON

Depressing this button disconnects N/S (north and south) drive to moving map and inhibits destination stores BASE and 1 to 4 to the area into which a ferry flight is planned to terminate, and also allows N/S counters to be moved to synchronize map and counters N/S.

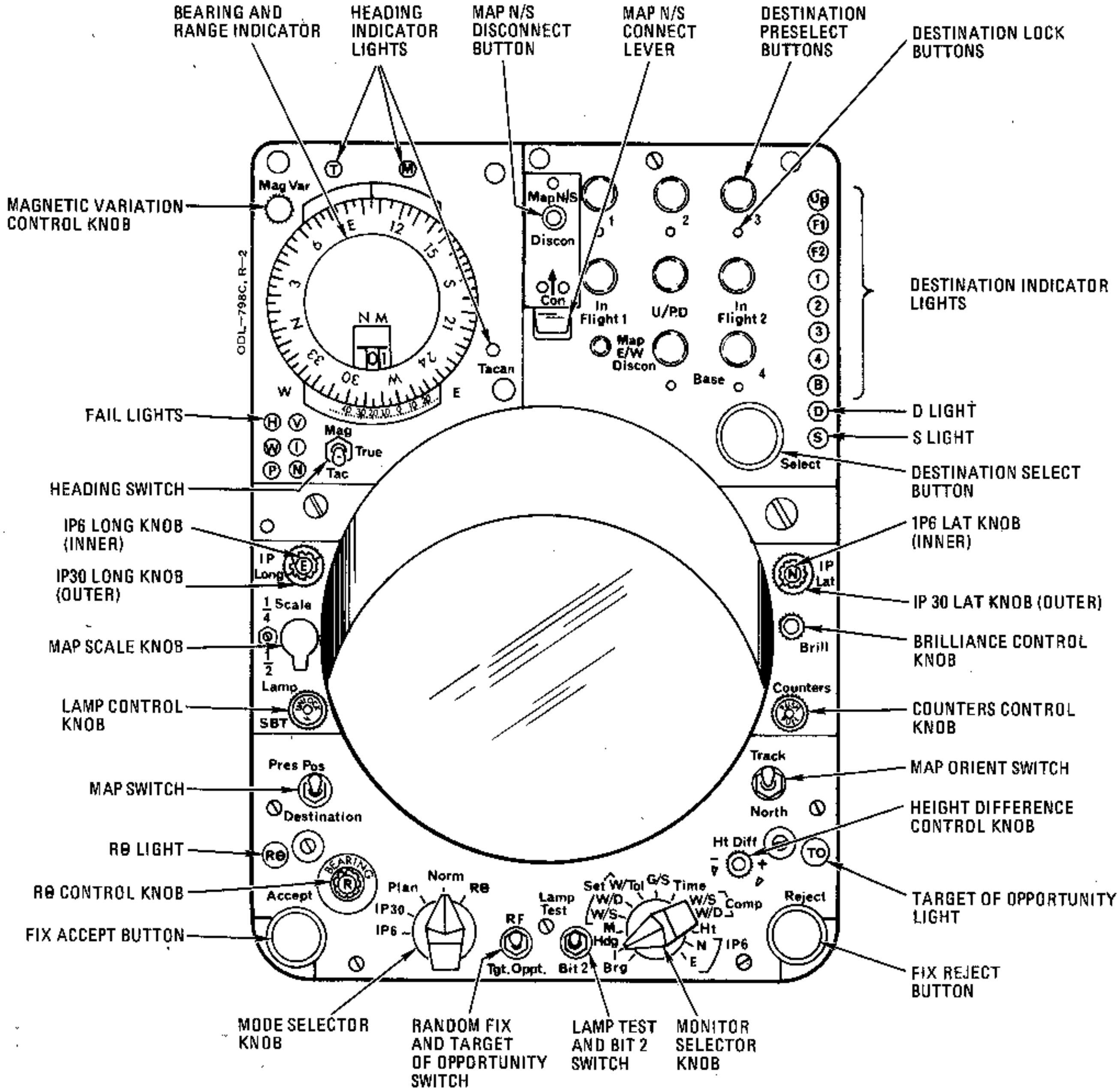
MAP N/S CONNECT LEVER

Pushing this lever upward reconnects N/S drive to map and destination stores BASE and 1 to 4.

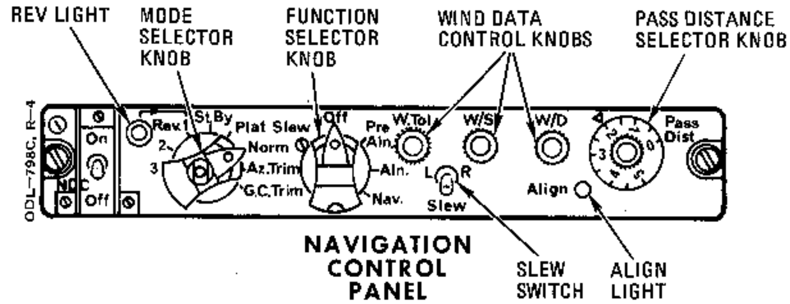
MAP E/W DISCONNECT BUTTON

Holding this button depressed freezes the map east west drive and allows the counters only to be moved in order to synchronize the map and counters east west. This can be done only with N/S disconnected.

NAVIGATION CONTROLS AND INDICATORS



NAVIGATION DISPLAY AND COMPUTER



NAVIGATION CONTROL PANEL

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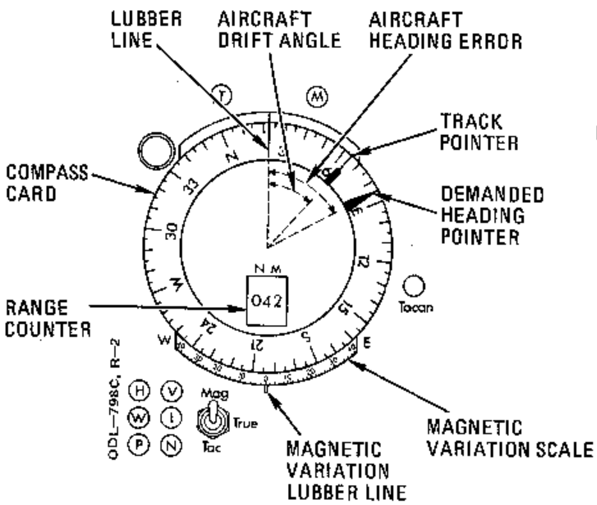
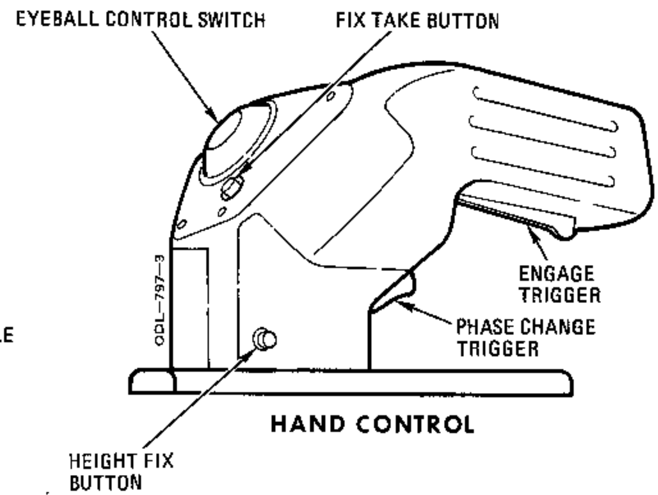
Figure 1-21 (Sheet 1 of 2)

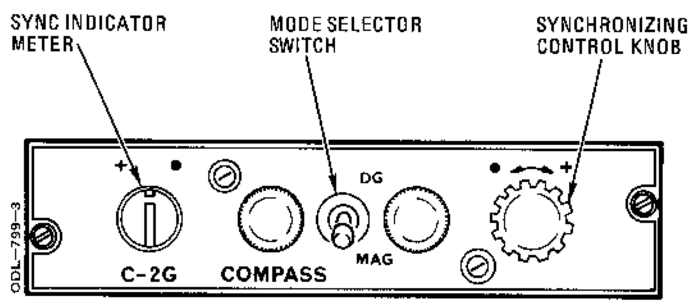
NAVIGATION CONTROLS AND INDICATORS



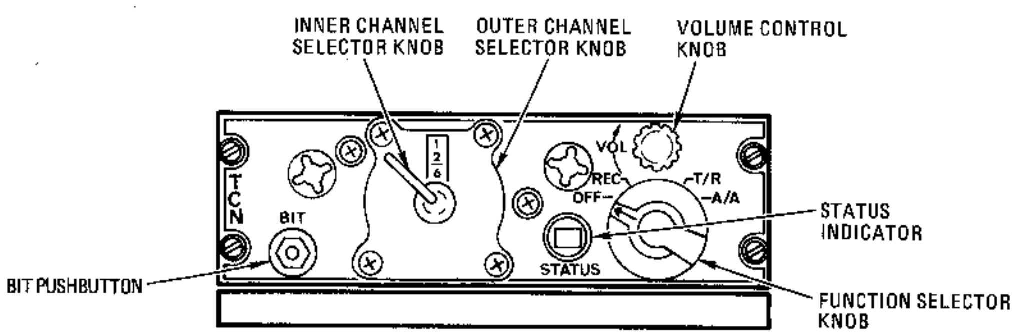
RANGE AND BEARING INDICATOR



HAND CONTROL



COMPASS CONTROL PANEL



TACAN CONTROL PANEL

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Figure 1-21 (Sheet 2 of 2)

DESTINATION PRESELECT BUTTONS

There are seven destination preselect buttons: 1, 2, 3, 4, BASE, INFLIGHT 1, INFLIGHT 2, and U/PD (unplanned). The 1, 2, 3, 4, and BASE buttons preselect one of the preset destinations for navigation computation, and are used when inserting destination coordinates. The INFLIGHT 1 button preselects the high resolution destination for navigation and weapon aiming computation, and is used when inserting inflight 1 coordinates. The INFLIGHT 2 button preselects destination inflight 2 for navigation computation and display, and is used when inserting inflight 2 coordinates. The U/PD button preselects an unplanned destination stored during flight for navigation computation and display, and is used when inserting unplanned destination coordinates.

DESTINATION LOCK BUTTONS

The 1, 2, 3, 4, and BASE destination preselect buttons each have a destination lock button which, when depressed, holds the relevant destination potentiometers at electrical zero. The lock buttons are used during destination insertion.

D AND S LIGHTS

The D light illuminates when the map switch is set to DESTINATION. The S light illuminates when the destination select button is depressed, and remains illuminated until selection of a new destination is complete.

DESTINATION SELECT BUTTON

Depressing the destination select button initiates navigation computation to the destination preselected.

IP 30 LATITUDE KNOB

The IP 30 latitude knob consists of an outer and an inner knob. The outer knob inserts IP 30 latitude offset from the destination selected. The inner (N) knob is used for IP 6 attacks. The knob inserts the north component of the real target, in feet, from the identification point (which in this attack is in the INFLIGHT 1 destination).

BRILLIANCE CONTROL KNOB

Rotating this knob varies the intensity of the moving map and counters.

COUNTERS CONTROL KNOB

Pulling this knob allows the longitude and latitude coordinates and monitor counters to be displayed on the moving map.

MAP ORIENT SWITCH

This is a two-position toggle switch. Placing the switch to TRACK orients the map to aircraft track. In NORTH, the map is oriented to true north.

HEIGHT DIFFERENCE CONTROL KNOB

This knob sets in the relative height between aircraft and target in planned attacks, or between the identification point (Inflight 1) and the real target in IP 6 attacks. It is used in conjunction with the monitor selector knob and the counters.

TARGET OF OPPORTUNITY LIGHT

This light illuminates when the TGT OPPT position is selected on the random fix and target of opportunity switch.

FIX REJECT BUTTON

Depressing this button reverts the navigation display and computer to its previous condition, after the fix take button has been depressed and it is decided not to accept the fix.

MONITOR SELECTOR KNOB

The monitor selector knob selects any number of navigation parameters to be manually selected for display on a separate monitor counter which is optically superimposed on the moving map. The knob positions that can be selected and their functions are:

BRG	Displays and stores at the monitor counters the bearing indicated by the vertical aiming line of the head-up display. This is used in rapid bearing alignment.
HDG I	Displays aircraft inertial heading.
HDG M	Displays aircraft magnetic heading (compass heading).
SET W/S	Displays the manually inserted wind speed set in by the W/S control knob on the navigation control panel.
SET W/D	Displays the manually inserted wind direction set in by the W/D control knob on the navigation control panel.
W/TOL	Displays the manually inserted wind tolerance set in by the W/TOL control knob on the navigation control panel.
G/S	Displays inertially computed ground speed.
TIME	Displays the time to go to the currently selected destination in minutes and decimals of a minute.
W/S COMP	Displays the inertially derived wind speed.
W/D COMP	Displays the inertially derived wind direction.

HT — Provides a readout for the setting on the HT DIFF control knob.

IP 6N — Displays the offset distance in feet (north) between the identification point (inflight 1) and the real target.

IP 6E — Displays the offset distance in feet (east) between the identification

point (inflight 1) and the real target.

LAMP TEST AND BIT 2 SWITCH

This three-position toggle switch is spring-loaded from LAMP TEST to center OFF. In LAMP TEST, the six fail lights on the navigation display and computer are tested. Placing the switch to BIT 2 initiates the BIT 2 dynamic test. This is not a pilot switch and it should never be placed to BIT 2 by the pilot.

RF/TGT OPPORTUNITY SWITCH

This three-position toggle switch is spring-loaded to the center off position from RF. In RF (random fix), the longitude and latitude counters and the map are driven by the hand controller eyeball to the actual fix coordinates. The TGT OPPT position is selected for an attack on a target of opportunity. This position is used in conjunction with the hand controller fix take button to store the fix coordinates. The steering instructions back to the fix position are displayed.

MODE SELECTOR KNOB

The mode selector knob is a five-position rotary knob with positions marked IP 6, IP 30, PLAN, NORM, and RΘ. The functions of the knob positions are as follows:

IP 6 — Initiates the initial transition phase of an IP 6 attack provided that range to the identification point (inflight 1) is less than 6 NM.

IP 30 — Adds the IP 30 offset, in terms of latitude and longitude differences, to the coordinates of the selected destination.

NOTE

If another destination is selected and the mode selector is left in IP 30, steering will be shown to that offset point from the new destination.

PLAN — Selects the INAS planned attack on the inserted target and initiates the transition phase of this attack, if range is less than 6 NM.

NORM — Selects the normal inflight navigation mode and resets the weapon aiming system to navigate and allows unplanned attacks.

RΘ — Selects a preset range and bearing (RΘ) offset for navigational computation and display. This can be used with destination and tacan. RΘ is cancelled when the select button is depressed to avoid the offset being used with a different destination.

FIX ACCEPT BUTTON

Depressing this button updates the present position computer by accepting the fix specified by operation of the hand controller fix take button.

RΘ CONTROL KNOB

The RΘ control knob consists of an outer control (bearing), and an inner control (range), which store the range and bearing of an RΘ offset point from any selected destination. Range is limited to 500 NM.

RΘ LIGHT

This light illuminates when the mode selector knob is placed to the RΘ position, and extinguishes when the knob is removed from RΘ or if another destination is selected.

MAP SWITCH

The map switch is a two-position toggle switch with positions of PRES POS and DESTINATION. Placing the switch to PRES POS controls the moving map so that the center reference circle and the latitude and longitude counters indicate computed aircraft present position. With the switch set to DESTINATION, the center reference circle and the latitude and longitude counters indicate the currently selected destination.

LAMP CONTROL KNOB

This is a twist to unlock, and a pull/push type of knob. Twisting the knob extinguishes the map light in use. Using the pull/push feature switches on an alternate light.

MAP SCALE KNOB

The map scale knob has positions of ¼ and ½. Placing the knob to the ¼ position switches the moving map scale to 1:250,000. In the ½ position the moving map scale switches to 1:500,000.

IP 30 LONGITUDE KNOB

The IP longitude knob consists of an outer and an inner knob. The outer knob inserts IP 30 longitude offset from the destination selected. The inner (E) knob is used for IP 6 attacks. The knob inserts the east component of the real target from the identification point (which in this attack is the INFLIGHT 1 destination).

FAIL LIGHTS

There are six fail lights which are labeled H, V, W, I, P, and N. The W, I, P, and N lights illuminate during BIT 1 testing, and extinguish if the unit passes the test. The H light illuminates when heading error tolerance is exceeded. The V light illuminates when wind tolerance error is exceeded. The I light illuminates when there is an inertial platform or present position computer failure. The P light illuminates when there is a power supply failure or the power supply is out of tolerance. The N light illuminates when there is a navigation display and computer failure.

HEADING SWITCH

The heading switch is a three-position toggle switch with positions of MAG, TRUE, and TAC (see figure 1-22). Placing the switch to MAG selects inertial heading plus manually inserted magnetic variation for display on the range and bearing indicator and displays MAG heading on the HUD. Placing the switch to TRUE selects inertial true heading for display on the range and bearing indicator and the HUD. Placing the switch to TAC selects demanded magnetic heading to the selected tacan beacon for display on the range and bearing indicator, also inertial plus manually inserted magnetic variation on the RBI and magnetic heading on the HUD.

HEADING DISPLAYS

SWITCH POSITIONS			INDICATOR DISPLAYS		
NC MODE SELECTOR	NC FUNCTION SELECTOR	NDC HEADING SWITCH	RBI	HUD	TACAN IND
REV 1	NAV	MAG TAC TRUE	C2J C2J C2J ± MAG VAR	C2J C2J INERTIAL	C2J C2J C2J
NORM	OFF OR AUTO--REV 1	MAG TAC TRUE	C2J C2J C2J ± MAG VAR	C2J C2J INERT FROZEN	C2J C2J C2J
NORM	PRE ALN OR ALIGN	MAG TAC TRUE	C2J C2J C2J ± MAG VAR	C2J C2J INERTIAL	C2J C2J C2J
NORM	NAV	MAG TAC TRUE	INERT ± MAG VAR INERT ± MAG VAR INERTIAL	C2J C2J INERTIAL	C2J C2J C2J

Figure 1-22

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RANGE AND BEARING INDICATOR

The range and bearing indicator (figure 1-21) displays the current aircraft heading, on the lubber line, and track on the tracker pointer. Also, it displays demanded heading, on the demanded heading pointer, and range, on the range counter, to the selected destination or offset. With TAC selected on the heading switch, the demanded heading pointer and range counter indicate range and bearing to the selected tacan beacon. Whenever the RBI is giving steering information to a destination (except the unplanned destination, RΘ offset, or when TAC is selected on the RBI) the track from the point of pressing the select button to the destination is stored. If there are deviations from that track the demanded heading pointer will give a steer back to the track such that it is always pointing 14 NM ahead on track. The maximum closing angle is 40° and inside of 14 NM from the destination track memory is cancelled. Demanded headings to achieve the original track can be mistaken for heading errors. At any time a new track may be drawn by pressing the select button.

NOTE

Track memory is available with IP 30.

MAGNETIC VARIATION CONTROL KNOB

The magnetic variation control knob inserts magnetic variation into the system. The setting is indicated by a scale (magnetic variation bezel) below the range and bearing indicator.

HEADING INDICATOR LIGHTS

The heading indicator lights, labeled T, M, and TACAN, illuminate to indicate the selected mode on the heading switch.

BIT INHIBIT SWITCH

This switch is on the right side of the NDC adjacent to the cannon plug connector. Placing it down overrides the BIT to allow alignment to continue.

MOVING MAP DISPLAY

The moving map display, in the center of the navigation display and computer, consists of a 35mm colored filmed map which is projected optically onto a screen and viewed through a 6-inch diameter lens. The viewing screen covers a map area of 14 NM diameter with ¼ (1:250,000) selected at the map scale switch, and 28 NM diameter with ½ (1:500,000) selected. The center reference circle indicates aircraft present position with PRES POS selected, or the destination coordinates with DESTINATION selected. The diameter of the circle represents 0.5 NM at ¼M scale or 1 NM at ½M scale. When the counters control knob is pulled, a reading of the latitude and longitude of the aircraft present position and any one of the parameters, as selected on the monitor selector knob are superimposed on the lower half of the projected map. The monitor counters normally consist of four digits, reading from 0000 to 3599. A decimal point may be inserted after the second or third digit. When necessary, an additional fixed zero may be added after the fourth digit to give readings from 00000 to 35990 in increments of 10. An abbreviation of the type of unit is added, such as kts or ft. Also, direction (N, S, E, W), and polarity (+ or −) are given where applicable.

Navigation Control Panel

The navigation control panel is on the right side of the main instrument panel (figure 1-21). The controls on the panel are used to switch the system on, select platform alignment modes, select reversion modes of operation, and set wind information. The panel contains a REV 1 light and an ALIGN light. The various controls and lights are described in the following paragraphs.

NDC SWITCH

The NDC (navigation display and computer) switch is a two-position switch with positions of ON and OFF. Placing the switch to ON places the NDC into operation.

MODE SELECTOR KNOB

The mode selector knob is a rotary knob with positions of REV 3, REV 2, REV 1, STBY, PLAT SLEW, NORM, AZ TRIM, and GC TRIM. The reversionary modes are discussed in more detail in later paragraphs, this system. The functions of the knob positions are as follows:

REV 3	Reverts the system to a mode in which the platform is converted into a continuously erecting vertical gyro and slaved to compass heading. This mode is used when the platform develops unacceptable drift rates.
REV 2	Reverts the system to provide a steering error display on the HUD which will indicate the course to steer to return to base. This mode is used when there is a complete failure of the navigation display and computer displays.
REV 1	Reverts the system to air data computed from airspeed and wind velocity, and compass heading. This mode is used during a malfunction in the platform or present position computer. This mode is automatically selected if other malfunctions occur which would damage the system.
STBY	Switches on the platform fine heaters from the aircraft 28 volts dc supply. This raises the platform temperature during standby, reducing the time required to warm up during pre-align. The rest of the system is switched off.
PLAT SLEW	Allows the slew switch on the panel to slew the platform in azimuth during rapid alignment.
NORM	Selects a normal alignment sequence and is the normal inflight position for the mode selector knob. During rapid alignment, with the NDC monitor selector knob in the BRG position, the navigation control panel slew switch drives the NDC monitor servo.
AZ TRIM	Used to correct drift of the azimuth gyro during calibration alignment.
GC TRIM	Used to correct drift of the E/W gyro during gyrocompassing calibration alignment.

FUNCTION SELECTOR KNOB

The function selector knob is a rotary knob with positions of OFF, PRE ALN, ALN, and NAV. The knob positions and their functions are as follows:

OFF	Switches off all the INAS units except the navigation display and computer.
PRE ALN	Initiates the pre-align function.
ALN	Initiates the align function.
NAV	Places the system into the navigation mode when alignment is complete. This is the normal inflight position of the knob.

WIND TOLERANCE CONTROL KNOB

The wind tolerance control knob sets the expected error in the forecast meteorological wind as manually set with the wind speed and wind direction control knobs.

WINDSPEED CONTROL KNOB

The windspeed control knob sets the forecast windspeed.

WIND DIRECTION CONTROL KNOB

The wind direction control knob sets the forecast wind direction.

SLEW SWITCH

The slew switch is a lateral two-position toggle switch, spring-loaded to off. The switch slews the inertial platform in azimuth if the navigation control panel mode selector knob is set to PLAT SLEW. The switch drives the NDC monitor servo if the mode selector knob is set to NORM and the NDC monitor selector knob is set to BRG.

PASS DISTANCE SELECTOR KNOB

The pass distance selector knob, calibrated in hundreds of feet, presets the intended pass distance for use in unplanned attack or in manual release attack with retarded bombs.

REV 1 LIGHT

The REV 1 light illuminates when the system is in the auto-reversionary 1 mode.

ALIGN LIGHT

The ALIGN light illuminates steadily during pre-align until platform temperature reaches 35°C when it flashes at a steady rate. When ALN is selected and the coarse erection steps are complete, the frequency of the flashes reduces as the alignment progresses, and when the misalignment error is within acceptable limits the light should flash at less than once per 10 seconds.

Hand Control

The hand control, on the left console (figure 1-21), has functions in both navigation and weapon aiming. In navigation, the hand control is used to minimize the time dependent inaccuracies inherent in a pure INAS by correcting the computed aircraft position to a visual fix. The controls on the hand control are described in the following paragraphs.

EYEBALL CONTROL SWITCH

When in navigation and alignment modes and with the engage trigger pressed, the eyeball control switch is used to perform the following: it inserts present position coordinates prior to alignment by driving the moving map and the latitude and longitude counters; it inserts destination and target coordinates during their storage by driving the map and the counters; it adjusts the map during random fixes. During weapon aiming with the engage trigger not pressed, the eyeball control switch positions the target bar and tracks the target in INAS weapon aiming modes, to generate corrections to the computed target.

ENGAGE TRIGGER

The engage trigger, when pressed, routes the eyeball outputs to drive the map and latitude and longitude counters.

PHASE CHANGE TRIGGER

The phase change trigger, when pressed, initiates successive phases of an attack. Its effect depends on the type of attack.

FIX TAKE BUTTON

The fix take button, when pressed, stops the drive to the moving map and latitude and longitude counters until the fix ACCEPT or fix REJECT button is pressed or until TGT OPPT is selected.

HEIGHT FIX BUTTON

The height fix button, when pressed, enters a height fix into the system (in attack modes).

INAS Interface

The INAS receives information from other systems in order to perform its functions. These systems are the tacan, air data computer, and the gyro-magnetic compass system.

TACAN

The range and bearing of a selected tacan beacon is displayed on the range and bearing indicator when the heading switch on the navigation display and computer is placed to TAC.

AIR DATA COMPUTER

The air data computer supplies true airspeed, indicated airspeed, and barometric height to the INAS.

COMPASS SYSTEM

The gyro-magnetic compass system provides magnetic heading to the navigation display and computer for use during the initial stages of inertial platform alignment, for monitoring the inertial platform, for magnetic heading display to the HUD, and for standby use in reversionary modes 1 and 3 if the INAS fails.

Reversionary Modes

Three reversionary navigation modes are available if the inertial platform, present position computer, or the navigation display and computer develop a failure in flight. Continuous illumination of the fail lights on the navigation display and computer, except W and N, indicate that a reversionary mode should be selected. The reversionary modes are REV 1, REV 2, and REV 3.

REV 1 MODE

The REV 1 mode may be selected manually or entered into automatically. The mode is manually selected when a malfunction occurs (which may be indicated by illumination of the I or P fail light). If REV 1 is selected manually it is possible to return to the normal inertial mode of operation if desired, as long as the function selector knob on the navigation control panel has not been set to OFF. The REV 1 mode is entered into automatically if an internal malfunction occurs which could damage the system. In this condition, normal inertial computations cannot be regained and the function selector knob can be set to OFF if desired. The automatic REV 1 mode is indicated by illumination of the REV 1 light on the navigation control panel, and by cancellation of the symbols on the head-up display. The symbols reappear when REV 1 is selected on the mode selector knob and the function selector knob is set to OFF. In REV 1 mode there is no substitute attitude or vertical velocity data provided, and there are no weapon aiming facilities available. However; in REV 1 mode, present position is now computed using airspeed from the air data computer, heading from the compass system plus manually inserted magnetic variation, and wind information set manually on the W/S and W/D controls. Destination cannot be changed, but any destinations already stored can be used. Planned and random fixes cannot be taken, but present position data can be up-dated with the hand control.

REV 2 MODE

The REV 2 mode is used when there is a complete failure of the displays on the navigation display and computer. With the mode selector knob on the navigation control panel in REV 2 position, the navigation display and computer displays and controls are inoperative, but steering and range signals are displayed on the head-up display (HUD) unit. The range circle represents 360 nautical miles. If only a partial failure of the navigation display and computer is indicated it can be left turned on after selecting REV 2, thus retaining the displays and facilities that are available. When REV 2 has been selected, the mode selector knob can subsequently be returned to NORM if desired, to regain any facilities that may be available. This can be done with the navigation display and computer turned to ON or OFF.

REV 3 MODE

The REV 3 mode is used when there is an inertial platform failure resulting in a slow drift of the platform. This drift is indicated by the illumination of the H and/or V fail lights on the navigation display and computer. In this mode, the platform reverts to continuous erection with azimuth slaved to the gyro-magnetic compass heading and the platform becomes virtually a master reference gyro. Set wind is used to monitor inertial outputs. All navigation and weapon aiming facilities are available in REV 3 mode but the performance is inferior to that of the normal mode of operation. Once REV 3 has been selected, the original alignment accuracy is lost and cannot be recovered by switching back to NORM. The REV 3 position of the mode selector knob has a mechanical guard to prevent inadvertent selection.

NORMAL OPERATION

INAS PRE-ALIGNMENT PROCEDURES

Prior to aligning the inertial platform, the following adjustments and settings should be performed: magnetic variation set in, pre-align settings performed, BIT checks performed, wind settings inserted, moving map adjusted, and present position coordinates inserted.

Magnetic Variation

Adjust the magnetic variation control knob until the bezel below the heading card of the range and bearing indicator shows the magnetic variation at base. In flight, the knob must be readjusted to set the local variation. Perform the pre-align settings next.

Pre-Align Settings

On the navigation control panel, set mode selector knob to NORM; set pass distance selector knob as required for unplanned attacks; and place NDC switch to ON. On the navigation display and computer, place lamp and BIT 2 switch to LAMP TEST and note that fail lights illuminate; place counters control knob to ON; set brilliance control knob for optimum brightness of the map display; place mode selector knob to NORM; place heading switch to TRUE; place BIT inhibit switch to NORMAL; and place random fix and target of opportunity switch to OFF (center). Place function selector knob on navigation control panel to PRE-ALN. Selection of PRE-ALN initiates rapid heating which raises the temperature of the platform at the rate of nearly 20°C per minute. The ALIGN light illuminates steadily to indicate that platform temperature is less than 35°C and automatic alignment does not start even if ALN is selected. When the ALIGN light begins flashing, it indicates that the platform temperature is above 35°C and the align function can start when ALN is selected.

BIT 1

During the first phase of pre-align, the BIT 1 checks proceed automatically, illuminating the I, N, and W fail lights, which then extinguish if the test is satisfactory. The ALIGN light is initially illuminated steady and later begins to flash. The displays on the navigation display and computer move in response to the test condition when BIT 1 begins, and revert when it is successfully completed.

NOTE

Base or a destination store coinciding with approximated aircraft location should be selected. Mag var may have to be set to zero. If the system does not pass BIT 1 press select button, U/PD button, switch NDC to OFF and ON, or set the function selector knob on the navigation control panel to OFF and back to PRE ALN. If this fails, place BIT inhibit switch to override.

Wind Settings

The procedure for setting the forecast wind is as follows:

1. Set monitor selector knob on navigation display and computer to SET W/S.
2. Adjust W/S control knob on navigation control panel until the required forecast wind speed is indicated on the navigation display and computer monitor counter.
3. Set monitor selector knob to SET W/D.
4. Adjust W/D control knob until the required forecast wind direction is indicated on the monitor counter.
5. Set monitor selector knob to SET W/TOL.
6. Adjust W/TOL knob until the expected tolerance in wind speed is indicated on the monitor counter.

Perform moving map display adjustment, if necessary.

Moving Map Display Adjustment

If the moving map display position does not agree with the latitude and longitude counters, proceed as follows:

1. After BIT clearance, depress the fix take button on hand control.
2. Select a destination on navigation display and computer, set map switch to DESTINATION, and with hand control drive the map to align the known line of latitude and longitude with the present position circle.
3. Depress MAP N/S disconnect button and depress and hold MAP E/W disconnect button.
4. With hand control, adjust latitude and longitude counters to agree with the map coordinates selected in step 2.
5. Release MAP E/W disconnect button and operate N/S connect lever.
6. Place map switch to PRES POS (present position) and press reject button.

   Note that the map and counters are aligned.

Present Position Coordinates Insertion

After completion of the BIT checks, the present position can be inserted as follows: place map switch to PRES POS, depress hand control engage trigger and adjust the eyeball to drive the latitude and longitude counters until they correspond to the present position. Release engage trigger.

ALIGNMENT PROCEDURES

Before the INAS can be used for navigation, weapon aiming, and weapon release computations, the inertial platform must be aligned and maintained with the three mutually perpendicular accelerometer input axes aligned to true north and east to the local gravity vector. Usually a normal procedure is performed which produces optimum system accuracy. However, if a faster alignment is desired, a rapid alignment can be performed with system accuracy being slightly reduced. Either of these two methods of alignment can be performed after the pre-align and BIT checks have been made.

Normal Alignment

To perform a normal alignment, proceed as follows:

1. Set navigation control panel mode selector knob to NORM.
2. Set function selector knob to ALN (align).
   The normal alignment process is automatic with the equipment switching from one step to the next at the required time. After approximately 11 minutes the ALIGN light should again be illuminated steady.
3. Set function selector knob to NAV.
   The ALIGN light extinguishes.

NOTE

Navigational accuracy with normal alignment is 2 NM/hour circular error of probability (CEP) in the 50° to 60° N latitude band.

Rapid Alignment

Rapid alignments are performed when there is no time for a normal alignment. With this type alignment, instead of a normal gyrocompassing heading alignment of the platform, the pilot manually slews the platform using heading or bearing information measured by some external means or internally by the system. The measured information may be obtained either at the end of a previous flight or by a normal alignment specifically made between sorties to allow subsequent rapid alignments to be performed, or it may be previously known. Most rapid alignment sequences must be preceded by an azimuth storing procedure. There are two basic forms of rapid azimuth alignment: rapid bearing and rapid heading. Variants of each of these provide a total of five methods as follows: rapid bearing stored, rapid bearing known, rapid heading head down, rapid heading known, and rapid heading head up. The rapid bearing stored method is the preferred method. The other four methods are less accurate, but may have advantages in practice. Procedures for the five methods are described in the following paragraphs.

RAPID BEARING, STORED METHOD: STORING

After a normal alignment while still in ALN position, perform the following:

1. Set HUD to GEN or NAV.
2. Set navigation control panel mode selector knob to NORM.
3. Set navigation display and computer monitor selector knob to BRG from HDG I.
4. While observing the display on the HUD, operate slew switch to place the aiming line on a selected distant object.
5. Record bearing of the object as shown on the monitor counters.
6. Mark the position of the aircraft on the ground. The aircraft may then be moved.

RAPID BEARING, STORED METHOD: ALIGNMENT

1. Set HUD to GEN or NAV.
2. Return the aircraft to the same position occupied for the storing procedure, and ensure the distant object is visible in the HUD.
3. Perform pre-align procedures.
4. Set monitor selector knob to BRG.
5. Read the monitor counters. If they do not indicate the recorded bearing, reset with the slew switch and with mode selector knob set to NORM.
6. Set mode selector knob to PLAT SLEW.
7. When ALIGN light starts to flash, set function selector knob to ALN and note time.
8. Wait 30 seconds after the aiming line in the HUD is steady (about 1 to 1½ minutes after selecting ALN) and then operate slew switch until the aiming line lies over the distant object and remains on it.
9. Two minutes after starting the align stage, set function selector knob to NAV.

NOTE

Accuracy can be improved by allowing alignment to continue for a minute longer.

RAPID BEARING, KNOWN METHOD: STORING

This method is used when the bearing of a conspicuous object from some point on the airfield is already known. The storing procedure is as follows:

1. Set mode selector knob to NORM.
2. Set monitor selector knob to BRG.
3. Operate slew switch to set monitor counters to the known bearing.

RAPID BEARING, KNOWN METHOD: ALIGNING

1. Set HUD to GEN or NAV.
2. Place the aircraft at the point on the airfield from which the bearing of the distant object is known. The heading must enable the distant object to be visible in the HUD.
3. Perform pre-align procedures.
4. Set monitor selector knob to BRG.
5. Read monitor counters, and if the known bearing of the selected object is not shown, set counters with slew switch. Set mode selector knob to NORM (for this operation only).
6. Set mode selector knob to PLAT SLEW.
7. When ALIGN light starts to flash, set function selector knob to ALN and note time.
8. Wait 30 seconds after the aiming line in the HUD is steady (about 1 to 1½ minutes after selecting ALN). Then, operate slew switch until the aiming line lies over the distant object and remains on it.
9. Two minutes after starting the align stage, set function selector knob to NAV.

NOTE

Due to tolerances in the analog system this method is not as accurate as the one where the bearing is measured by the particular aircraft being aligned.

RAPID HEADING, HEAD DOWN METHOD: STORING

1. Set monitor selector knob to HDG I.
2. Record inertial heading shown on the monitor counters.

NOTE

Do not move the aircraft or disturb its heading between storing and aligning. Touching the rudder pedals may disturb the heading by moving the steering nose wheel.

RAPID HEADING, HEAD DOWN METHOD: ALIGNING

1. Perform pre-align procedures.
2. Set mode selector knob to PLAT SLEW.
3. When ALIGN light starts to flash, set function selector knob to ALN and note time.
4. Set monitor selector knob to HDG I.
5. Wait 30 seconds after selecting ALN. Then, operate slew switch to set monitor counters to the recorded heading.
6. Two minutes after starting the align stage, set function selector knob to NAV.

RAPID HEADING, KNOWN METHOD

This method can be used if the heading of the aircraft can be accurately established by means of external equipment. This known heading is then recorded. No storing procedure is required. The aligning procedure is the same as for the rapid heading head down method.

RAPID HEADING, HEAD UP METHOD: STORING

1. Set monitor selector knob to HDG I.
2. Record inertial heading shown on the monitor counters.
3. Set monitor selector knob to BRG and check that the monitor counters do not move.

NOTE

Do not move the aircraft or disturb its heading between storing and aligning. Touching the rudder pedals may disturb the heading by moving the steering nose wheel.

RAPID HEADING, HEAD UP METHOD: ALIGNING

Use HUD BIT 2 to align the aircraft accurately on a known heading and carry out a rapid heading alignment.

NOTE

On any type of alignment, check that Hdg I is approximately correct prior to 30 seconds after selecting align. If not, adjust using the C2J compass synchronizing knob or the MAG VAR adjustment.

DESTINATION COORDINATES STORING

There are seven destination coordinates which can be stored prior to or during flight. The destinations are 1, 2, 3, 4, BASE, INFLIGHT 1, and INFLIGHT 2. Base and destinations 1 to 4 are primarily stored on the ground but can also be stored in flight if desired. The inflight 1 and inflight 2 destinations are normally stored in flight but can also be stored prior to flight. The inflight 1 store should be used for the coordinates of the target to be attacked or for the navigation point requiring the greatest accuracy. An unplanned destination can also be stored, and can only be set in flight. In addition, there are destinations which can be stored in the form of offsets from an associated destination. These offsets are RΘ offset, IP 30 offset, and IP 6 offset. Also, there are three present position storing functions which can be utilized when necessary.

Base Coordinates Storing

To store base coordinates, perform the following:

1. Depress base destination button on navigation display and computer.
2. Depress destination select button.
3. Set map switch to DESTINATION.
4. When map display and counters are stationary, depress hand control fix take button.
5. Depress base lock button.
6. Depress hand control engage trigger and actuate the eyeball until the map shows the base position, and the latitude and longitude counters show the base coordinates.
7. Release hand control engage trigger and release base lock button by preselecting the next destination to be stored.
8. Depress fix reject button.

NOTE

If the map and counters move away from the base coordinates, repeat the storing procedure overcorrecting the counters by one half the difference noted. Check the accuracy again, and repeat the correction until the counters reset to the correct coordinates.

Destinations 1 To 4 Storing

Destinations 1 to 4 are stored in the same way as base, using the appropriate destination buttons and setting in the required destination coordinates.

Inflight 1 And 2 Storing

The procedure for storing inflight 1 or inflight 2 coordinates is as follows:

1. Select inflight 1 or inflight 2 destination and set map switch to DESTINATION.
2. When map and counters are stationary, press hand control engage trigger and adjust the eyeball until the map and counters indicate the required coordinates.
3. Release hand control engage trigger.
4. Select another destination and then reselect inflight destination, to ensure that the map and counters return to the correct coordinates.

Unplanned Destination Storing

The unplanned destination (U/PD) store allows the coordinates of a point to be stored as the aircraft flies over it. The unplanned destination is stored with reference to base. The storing procedure is as follows:

1. Depress hand control fix take button when directly over the point.
2. Depress unplanned (U/PD) button.

   Note that the base (B) light and the unplanned (U/P) light are both illuminated.
3. When range counter has stopped and reads zero, depress fix reject button.
4. The unplanned destination is now stored and the original flight plan can be resumed by depressing the previous destination button (whose associated light is still illuminated).
5. If desired, depress destination select button to reset track memory.

A normal, inflight, or unplanned destination may be at least 1000 NM from the base in any direction. Each destination store covers at least 1000 NM in any direction. If the aircraft flies beyond the limits of a destination store, range and steering information to that destination are no longer retrievable, nor can the store itself be reset to the coordinates of another destination until the equipment has been switched off and realigned. The computation of range from aircraft present position to a destination is limited to a maximum of 500 NM. The distance between successive destinations must therefore not be more than 500 NM and the flight plan must consist of a series of legs between successive destinations which collectively define the route to be followed.

RΘ Offset

The RΘ offset point can be any point within 500 NM of the associated destination, and can be used as a destination or as an identification point over which a fix can be taken. The RΘ offset is stored utilizing the range and bearing indicator. The procedure for performing an RΘ offset is as follows:

1. Set range (R) control knob fully counterclockwise.
2. Set map switch to DESTINATION.
3. Set mode selector knob to RΘ.
   The RΘ light illuminates.
4. Adjust range (R) and bearing concentric controls to obtain the demanded heading pointer and range counter indicating the bearing and range of the RΘ point from the associated destination.
5. Return map switch to PRES POS and mode selector to NORM.

If another destination is selected the RΘ light extinguishes indicating that the RΘ facility has automatically been rejected. If the RΘ facility is required for the new destination, it can be reinstated by setting the mode selector to RΘ, and resetting the RΘ offset store to refer to the new destination.

IP 30 Offset

The IP 30 identification point is a point which the pilot wants to overfly on his way to a destination (usually an inflight 1 store). The offset from inflight 1 to IP 30 is set in terms of a difference of latitude and longitude, neither of which must represent more than 30 NM distance. To store an IP 30 offset, proceed as follows:

1. On navigation display and computer, select inflight 1 store or the required destination.
2. Set map switch to DESTINATION.
3. Set mode selector knob to IP 30.
4. Adjust IP 30 latitude and longitude concentric control knobs (outer) in turn until the latitude and longitude counters indicate the coordinates of the IP 30 identification point.
5. Return map switch to PRES POS and mode selector knob to NORM.

IP 6 Offset

The IP 6 offset is used for attacking a target within 6 NM of the inflight 1 destination, which is used for an identification point. To store an IP 6 offset, proceed as follows:

1. Set monitor selector knob to IP 6E.
2. Adjust IP 6 longitude concentric control knob (E, inner knob) and the monitor counter indicates the required eastward offset in feet. (E if the IP 6 target is east, W if it is west of the inflight 1 destination.)
3. Set monitor selector knob to IP 6N.
4. Adjust IP 6 latitude concentric control knob (N, inner knob) until the monitor counter indicates the required northward offset in feet. (N if the IP 6 target is north, S if it is south of the inflight 1 destination.)
5. Set monitor selector knob to HT (height).
6. Adjust HT DIFF control knob until the monitor counter indicates the required height offset in feet; positive if the inflight 1 destination is lower than the IP 6 target.
   If a planned attack is carried out, the height difference control knob is utilized to set a height offset between the aircraft and the target (positive if the aircraft is lower than the target).

PRESENT POSITION POTENTIOMETERS

The present position potentiometers have three possible functions. These are target of opportunity, random fix, and unplanned attack. The accuracy of the present position store is the same as inflight 1 store but it is limited in range to ± 30 NM. The present position store is spring-loaded to zero. Therefore, any information stored will be lost when the store facility is rejected.

Target Of Opportunity

This function is used if a target is seen and it is desired to return to it to carry out an attack. As the aircraft flies over the target, place RF/TGT OPPT switch to TGT OPPT and depress hand control fix take button. The coordinates are stored in the present position store and the aircraft should immediately return to launch an attack.

Random Fix

This function is described in the random fix update paragraph, this section.

Unplanned Auto Attack

See NAVAIR 01-AV8A-1T AV-8A TACTICAL MANUAL.

POSITION UPDATING

At appropriate times during a flight, the INAS should be updated by taking a fix. There are three updating methods available. These are known as planned fix, random fix, and planned attack fix.

Planned Fix

The planned fix is a fix mode on an identification point which is stored as a destination or destination offset. The planned fix is performed as follows:

1. Depress hand control fix take button when directly over the identification point.
   The moving map display and the counters will stop.
2. If there is no error between the fix and the computed positions, depress fix reject button.
3. If an error is present, as indicated on the counters and the range and bearing indicator, depress fix

accept button.
This will update the counters and the moving map present position.

NOTE

INFLIGHT 1 is the most accurate store to be used for this. If using any other store only accept if the error is greater than ¾ of a mile. The present position computer continues to compute while the update is in progress. When the update is complete the map and counters are reconnected to the PPC and will jump to the aircraft position.

Random Fix

The random fix is performed on an identification point which is not already stored. The random fix is performed as follows:

1. Depress hand control fix take button when directly over the identification point.
   The counters and the moving map display will stop.
2. If there is no error between the fix point and the displayed coordinates, depress fix reject button.
3. If an error is present, momentarily select RF on RF/TGT OPPT switch. (Range counter on RBI will show zero).
4. Depress hand control engage trigger and operate the eyeball control switch to drive the counters and the moving map to the actual fix point coordinates. (RBI range counters will increase to show range error).
5. Release hand control engage trigger.
6. Depress fix accept button.
   This updates the counters and the moving map present position. At completion of the update the map and counters will jump to the aircraft's position.

Planned Attack Fix

The planned attack fix is performed after completion of a planned or IP 6 attack, using the corrections which have been stored in the weapon aiming computer during the course of the attack. The planned attack fix is performed as follows:

1. On completion of the attack, depress hand control phase change trigger to engage the memory phase if this has not already been done.
2. Depress hand control fix take button and observe fix error on the bearing and range indicator.
3. If an error is present, depress fix accept button to update the present position computer.
4. If an error is not present, depress fix reject button.
5. Place mode selector knob on navigation display and computer to NORM position to resume navigation.

NOTE

Do not select a new destination until an update is completed or update with TAC selected on the RBI. If this is done, large errors will be introduced into the system.

FERRY FLIGHT PROCEDURES

The ferry flight facility allows the use of a map which covers the area of the ferry flight terminal and disconnects the map and preflight destination stores during the flight to that area. The inflight (IF) stores are used for the pre-planned legs of the flight, and upon arrival in the destination area the map and destination stores are reengaged.

Ferry Pre-Flight Planning

Select a latch-up point on the film of the terminal area of the ferry flight. The point should be approximately in the center of the center strip of the film, and is normally the intersection point of the latitude and longitude coordinates. Plan the route of the flight in legs of not more than 450 NM and note the coordinates of the change points for use when setting the inflight 1 and inflight 2 destination stores. The next to the last inflight store point should be just inside the area covered by the film, and the last inflight store point should be the same as the first preflight store. This allows the first leg of the map to be started while the map is being reengaged.

Ferry Settings In Flight

Prior to flight the latch-up point will have been selected, and the inflight 1 and inflight 2 destinations stored for the first two legs of the ferry flight. After the aircraft is in flight, fly the pre-planned legs of the flight resetting one inflight store while flying to the other. After starting the leg which is completely in the map coverage area, proceed as follows:

1. Depress hand control fix take button.
2. Select first preflight store.
3. Set map switch to DESTINATION.
4. Operate the eyeball on hand control to drive the latitude and longitude counters to the latch-up point. E/W disconnect may also be used.
5. Disengage the N/S disconnect button.
6. Set map switch to PRESENT POSITION.
   The demanded heading and range of the first preflight destination will be displayed and the navigation display and computer may now be used in the normal manner.

HEAD-UP DISPLAY SYSTEM

The Head-Up Display (HUD) system uses a cathode ray tube (CRT) and a lens system to project an information display of digital and analog symbols onto a semi-transparent glass reflector (combining glass) which is in the pilot's line of sight. The display is collimated, i.e. focused to infinity, so that it is superimposed on the external view ahead. The HUD enables the pilot to fly the aircraft through any maneuver or flight profile without referring to the panel mounted instruments. Information is presented in several distinct modes which cover the entire operational role of the aircraft. See figure 1-23. The HUD system consists of the following units:

a. Display Waveform Generator
b. Extra High Tension (EHT) Unit
c. HUD Unit
d. Solar Cell Unit
e. HUD Control Panel

Display Waveform Generator

The DWG consists of two main functional sections:

a. Waveform Generating Circuits. The waveform generating circuits form the main section of the DWG. The DWG contains a fixed program, all electronic store of binary coded information for a number of symbol waveforms. The required waveforms are called up by input signals from various information sources. These waveforms are passed sequentially through X and Y digital-to-analogue converters so as to provide fixed deflection waveform signals which are then passed to the HUD. The DWG also determines which symbols are displayed at any one time by using a simple bright-up code. The HUD displays only those information signals for which the DWG generates a bright-up signal. The display is written 50 times per second and all the information is updated at this frequency except barometric height, indicated airspeed and Mach number; these are updated only twice per second to aviod blurring with rapid changes.
b. Power Supply Unit. A relay in the DWG is operated by a 28 volt supply from No. 2 dc busbar via the HUD control panel mode selector switch. Contacts of the relay permit No. 2 ac busbar to feed a power supply unit, which provides the operating power supplies required by all the HUD units, except the HUD camera which is supplied by the armament master circuits. The HUD will not start to operate or continue to operate if aircraft ac or dc power should fail.

DWG Sources of Information. The DWG receives information from the following sources (figure 1-23):

SOURCE	SIGNAL
Air Data Computer	Barometric height Indicated Airspeed Mach number
Angle of Attack Indicator	Angle of attack
Ballistics Box	Weapon switching logic
Hand Controller (via WAC)	Target tracking
Inertial Platform	Roll angle, side slip, pitch angle
Navigation Display and Computer	Groundspeed
HUD Control Panel	Display layouts Pressure setting Speed error Wingspan
Throttle twistgrip (via WAC)	Stadiametric ranging
UHF Radio Installation	UHF homing
Weapon Aiming Computer (WAC)	Demanding heading Elevation angle Heading Range Velocity vector information Vertical speed Weapon aiming information
Gyromagnetic Compass	Compass heading

Extra High Tension Unit

The EHT unit transforms a 33 volt dc supply from the DWG to a stabilized 15,000 volt supply, at approximately 50 microamps, for the anode of the cathode ray tube (CRT) in the HUD unit.

Head-Up Display (HUD) Unit

The HUD enables the pilot to see in his normal head-up field of view the symbols traced out on the CRT. The unit consists of three main assemblies:

a. Cathode Ray Tube. A two inch diameter CRT, focused by an adjustable permanent magnet system, provides a fine bright image on an optically flat, green phosphor screen. Deflection coils control a beam to trace out on the screen the display symbols generated by the DWG. The sealed CRT compartment is pressurized to 5 psi and is fitted with a desiccator.
b. Collimating Lens and Mirror System (figure 1-23). The lens and mirror system projects the CRT screen display as a collimated image beam onto the HUD combining glass. The projected image beam is collimated so that its virtual source lies at a great distance ahead of the aircraft and therefore, effectively at the location of the distant objects in the pilot's view. This ensures that movement of the pilot's head does not introduce a parallax shift between displayed symbols and distant objects, and it also ensures that the pilot's eyes do not need to refocus when looking from symbols to objects and vice versa. An anti-reflection mesh is fitted over the HUD exit lens to reduce reflections of external light. The lens assembly is a sealed unit, ventilated via a desiccator beneath the starboard instrument panel.
c. Reflector and Reflector Drive Servo Mechanism. The reflector is semi-transparent. To keep CRT symbols in view without vertical head movement, the reflector is moved fore and aft automatically by a screw drive from a dc motor. The screw drives the reflector carriage over a distance of 2.75 inches, the reflector moving progressively from fully forward to fully aft as an aircraft symbol/target cross/target bar is depressed from 5° to 11° below the FRL. If the reflector servo drive fails, an override knob and lever on the port side of the carriage permits the reflector to be positioned manually. When the override knob is fully depressed, the servo circuits are switched out and the carriage drive is released. The reflector can then be moved manually and, when the knob is released, the carriage is locked in its new position.

HUD SYSTEM

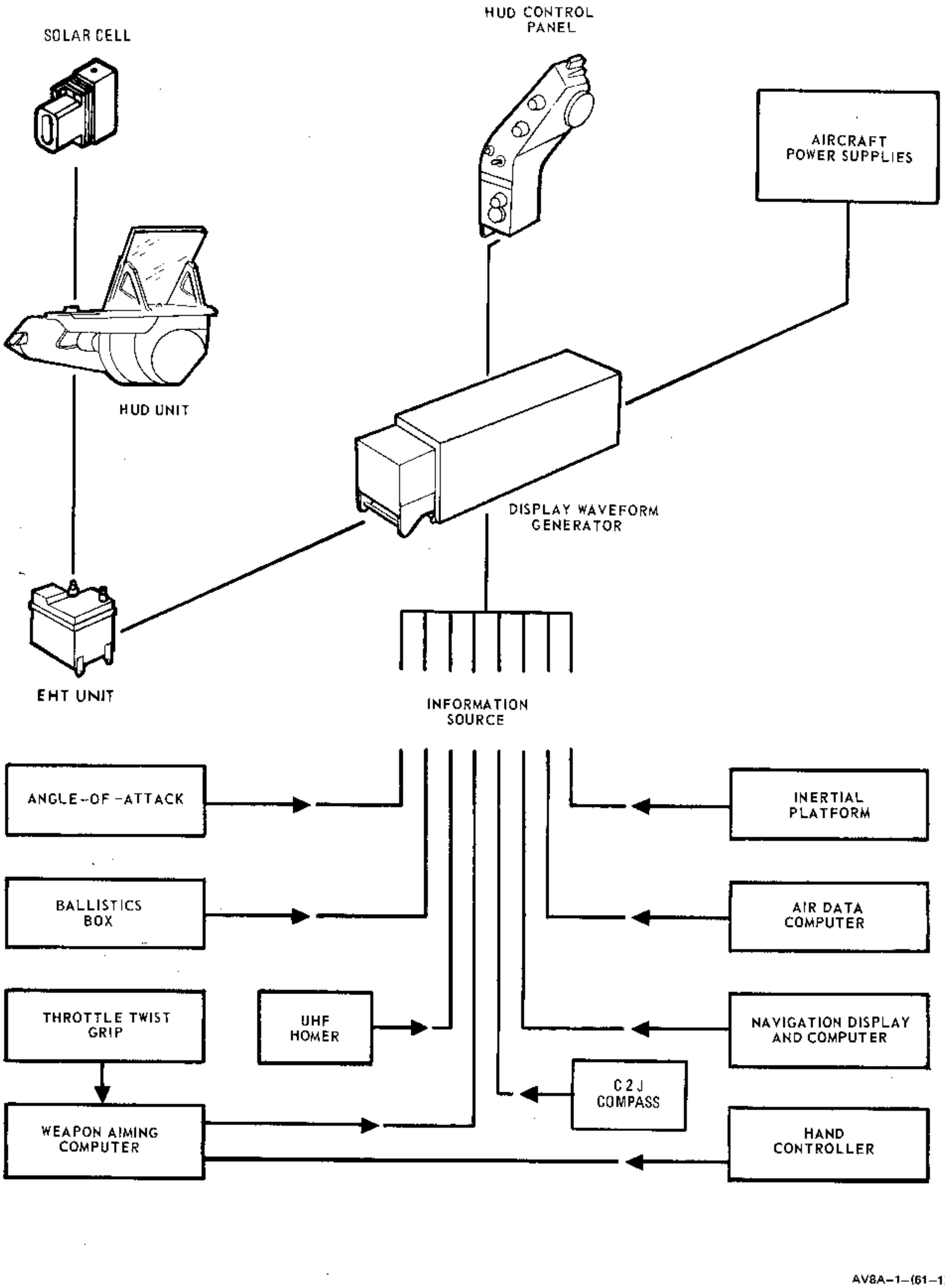
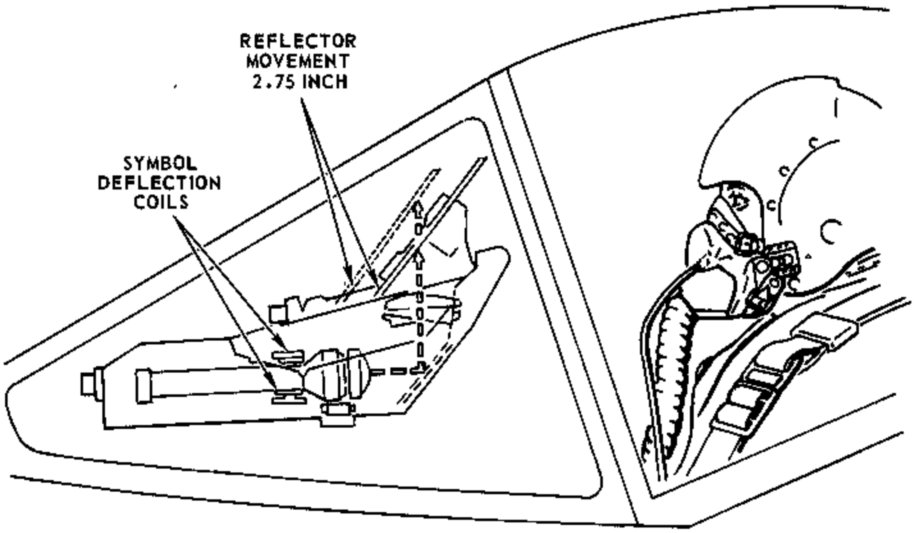


Figure 1-23 (Sheet 1 of 2)

HUD SYSTEM

(CONTINUED)



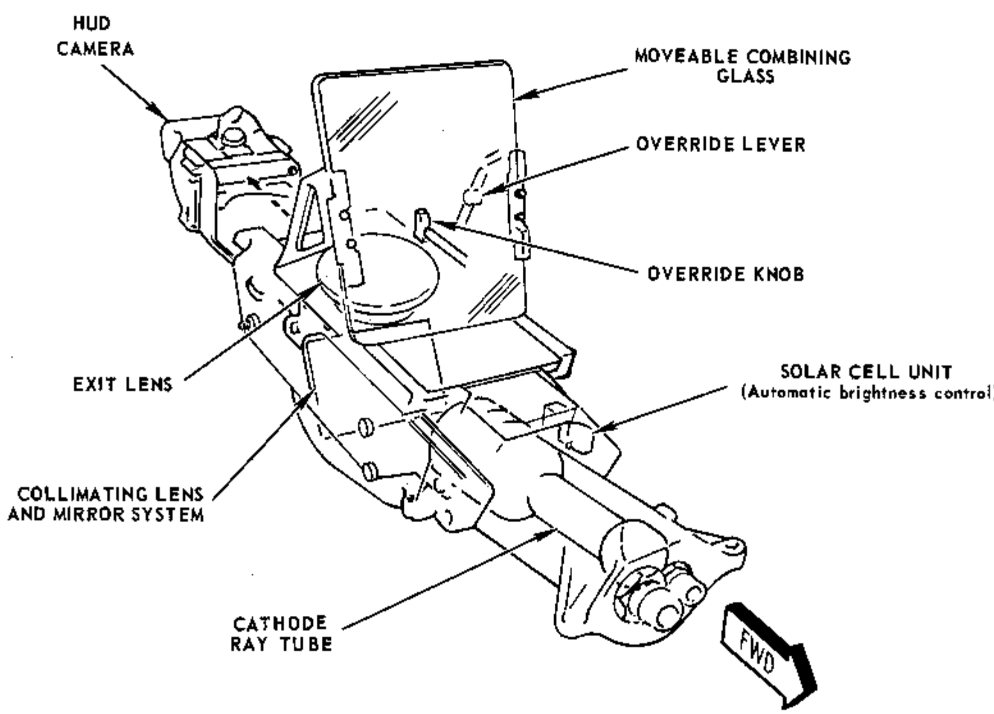


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Figure 1-23 (Sheet 2 of 2)

NOTE

If desired, the pilot can reconnect the HUD by raising the override lever. See figure 1-23.

Fields of View (figure 1-24). The collimated virtual image of the CRT screen, in which the display symbols can be seen, is viewed through the uncollimated virtual image of the exit lens, which can be considered as a fixed porthole. Since the angular viewing diameter of the porthole at the viewing distance of the pilot's eyes is less than that of the CRT screen some head movement is required to view all parts of the screen. The reflector is moved fore and aft to minimize this head movement.

Solar Cell Unit

A silicon photo-voltaic cell, on the front of the HUD, continuously monitors the brightness of the background against which the display is observed. The cell controls a circuit which automatically maintains the contrast level selected by the pilot.

HUD Control Panel

The HUD control panel is illustrated in figure 1-25. The controls and switches and their functions are as follows:

a. HUD Mode Selector Knob. The mode rotary selector switch, labeled OFF - V/STOL, GEN, NAV, REV, switches the HUD system on and selects the symbols required for normal flight modes. The NAV and GEN display are identical in appearance; the difference is that the NAV display is pitch and drift stabilized. The V/STOL, GEN, and REV display is caged in azimuth. The V/STOL and REV display is not removed by INAS automatic switching (phase changing).
b. Display Brightness Control. A potentiometer, controlled by a knob labeled DIM, adjusts the display intensity to a contrast level which is maintained automatically by the solar cell unit.
c. Error Scale Switch. The on position is labeled ERROR SCALE. The speed error symbol is displayed when the switch is on.
d. Set Speed Control. A potentiometer controlled by a knob, labeled SET SPEED, causes digits indicating demanded speed to be displayed when the knob is pushed against its spring-loading. The demanded speed displayed can be adjusted by rotating the SET SPEED control knob.
e. IAS/Mach Selector Switch. An IAS/Mach selector switch, labeled IAS/MACH, determines whether IAS or Mach number is displayed in all modes other than V/STOL. IAS is always displayed in V/STOL.
f. UHF Homer Selector Switch. A UHF selector switch labeled HOMER when in the up position, permits a UHF homer symbol to be displayed.
g. AOA Selector Switch. An AOA selector switch, labeled ADD, when in the up position, permits an angle of attack symbol to be displayed.
h. Radio/Baro Switch. After AFC 96, radar altimeter height can be displayed by positioning the radio/baro switch to RADIO. The range of the display is from 0 to 5000 feet in 5-foot increments. The number displayed is preceded by the letter R. The display is automatically removed if the input exceeds 4995 feet or the valid signal from the radar altimeter is lost. The radar altimeter receives standby power when the standby/transmit switch is in the STANDBY position. Radar height display is available in all modes except air-to-air.
i. WAC Switch. This switch is presently inoperative.
j. BIT Test Buttons 1 and 2. Two push buttons, labeled TEST 1 and 2, permits built-in test equipment (BIT) tests to be made. When one of the buttons is depressed an associated test is initiated and a test pattern is displayed for as long as the button is held depressed.
k. Barometric Pressure Datum Setting Control and Indicator. A knob labeled SET IN HG adjusts the barometric pressure datum. The selected datum is displayed on an indicator next to the knob. The datum setting range is from 23.60 to 32.42 inches of mercury.
l. Wingspan Setting Control and Air-to-Air Mode Knob. Refer to NAVAIR 01-AV8A-1T.
m. Display Preset Controls. Five potentiometer adjusting screws, labeled XA, XG, YA, YG and B permit ground adjustment of the display. They are normally covered by a protective shutter which is positioned by an adjacent manual selector.

HUD Normal Operation

To operate the HUD system rotate the HUD mode selector knob out of the OFF position and select the desired flight mode. The system may be used within 30 seconds after being switched on, and full accuracy is obtained within 2 minutes.

DISPLAY MALFUNCTIONING

A faulty display usually requires replacement of one of the HUD units and there is no action the pilot can take to correct the fault. If a display is not present, the pilot should check that all aircraft power is on, that the batteries are on, that the display intensity is set at a suitable level, and that the HUD mode selector knob is not positioned to OFF.

NOTE

- The HUD display is cancelled if failure of the INAS causes the automatic REV 1 mode to be entered. The display reappears only when REV 1 is selected at the navigation control mode selector knob and the function selector knob is set to OFF.

- There is no HUD presentation when the inertial platform is operating and the HUD mode selector knob is in any position except REV, if the STAB switch on the REV Sight/Nose Camera control panel is off (down).

HUD Symbols

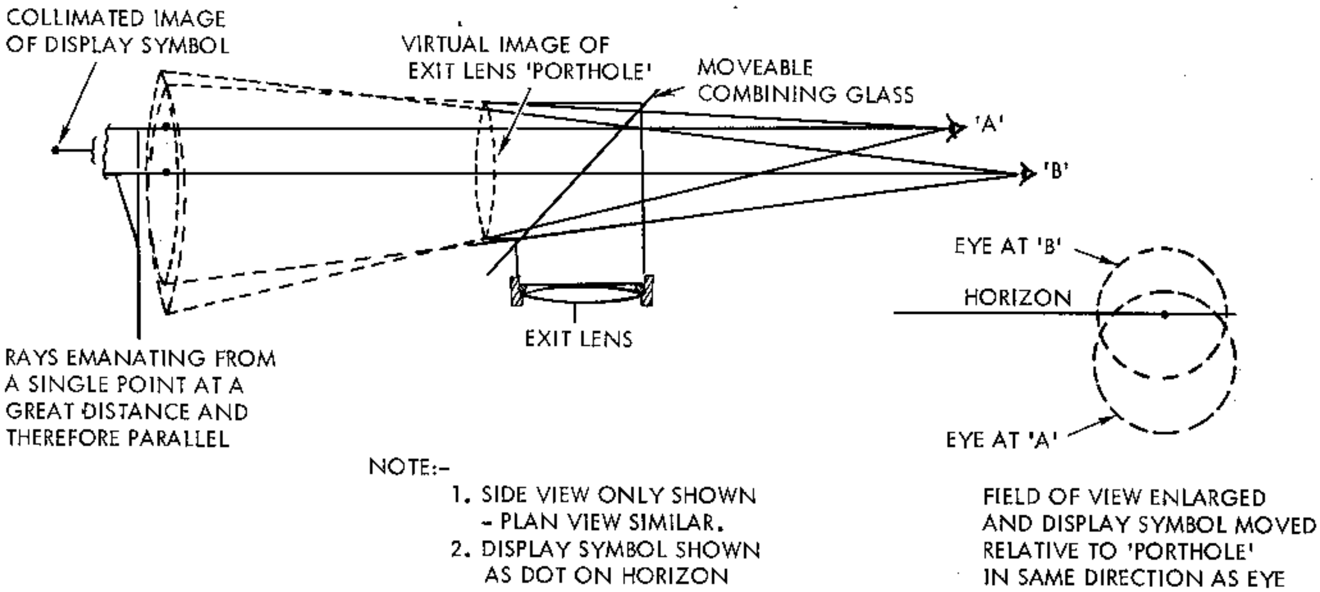
The symbols that are displayed on the HUD are described in the following paragraphs. See figure 1-26.

AIRCRAFT SYMBOL

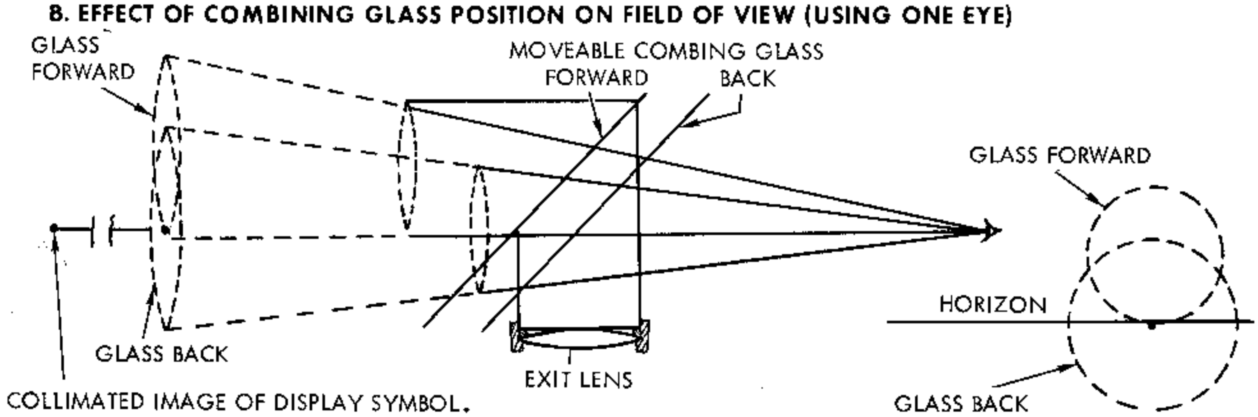
The aircraft symbol is a circle with stub wings which always remain parallel to the aircraft wing. The symbol is displayed in all modes except Air-to-Air Gunnery. When V/STOL or GEN is selected, the symbol is locked to the fuselage reference line (FRL) in azimuth and 6° below the FRL in elevation. When GEN is selected and the range to destination is less than 14 NM, the symbol is on the aircraft's velocity vector, indicating the direction in which the aircraft is flying. When NAV is selected, the symbol is on the velocity vector. For reversionary and weapon release displays refer to NAVAIR 01-AV8A-1T.

HUD FIELD OF VIEW

A. "PORTHOLE" EFFECT AND VARIATION IN FIELD OF VIEW WITH HEAD MOVEMENT (USING ONE EYE)



B. EFFECT OF COMBINING GLASS POSITION ON FIELD OF VIEW (USING ONE EYE)



C. FIELD OF VIEW USING BOTH EYES (NO HEAD MOVEMENT)

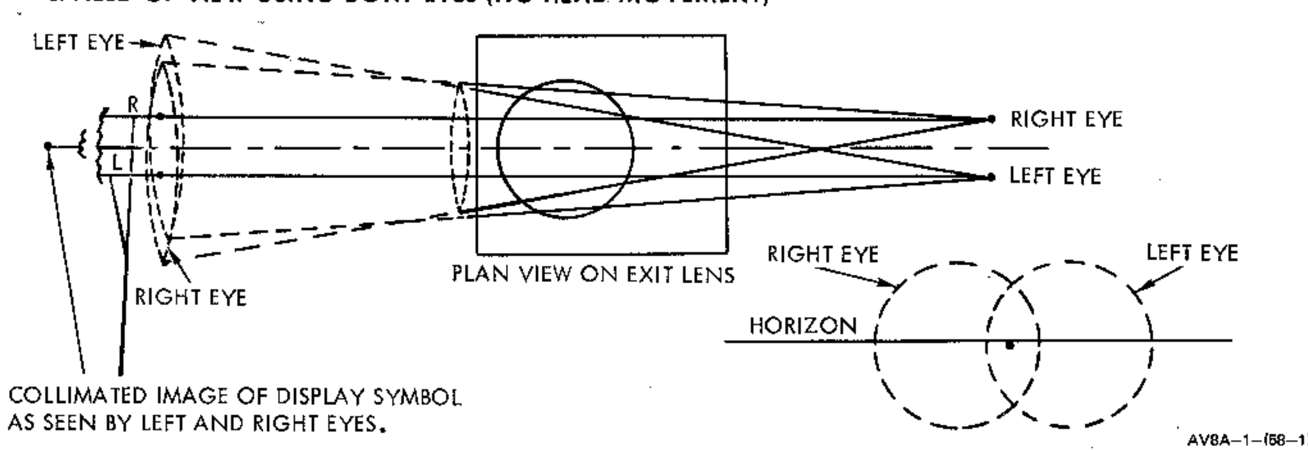
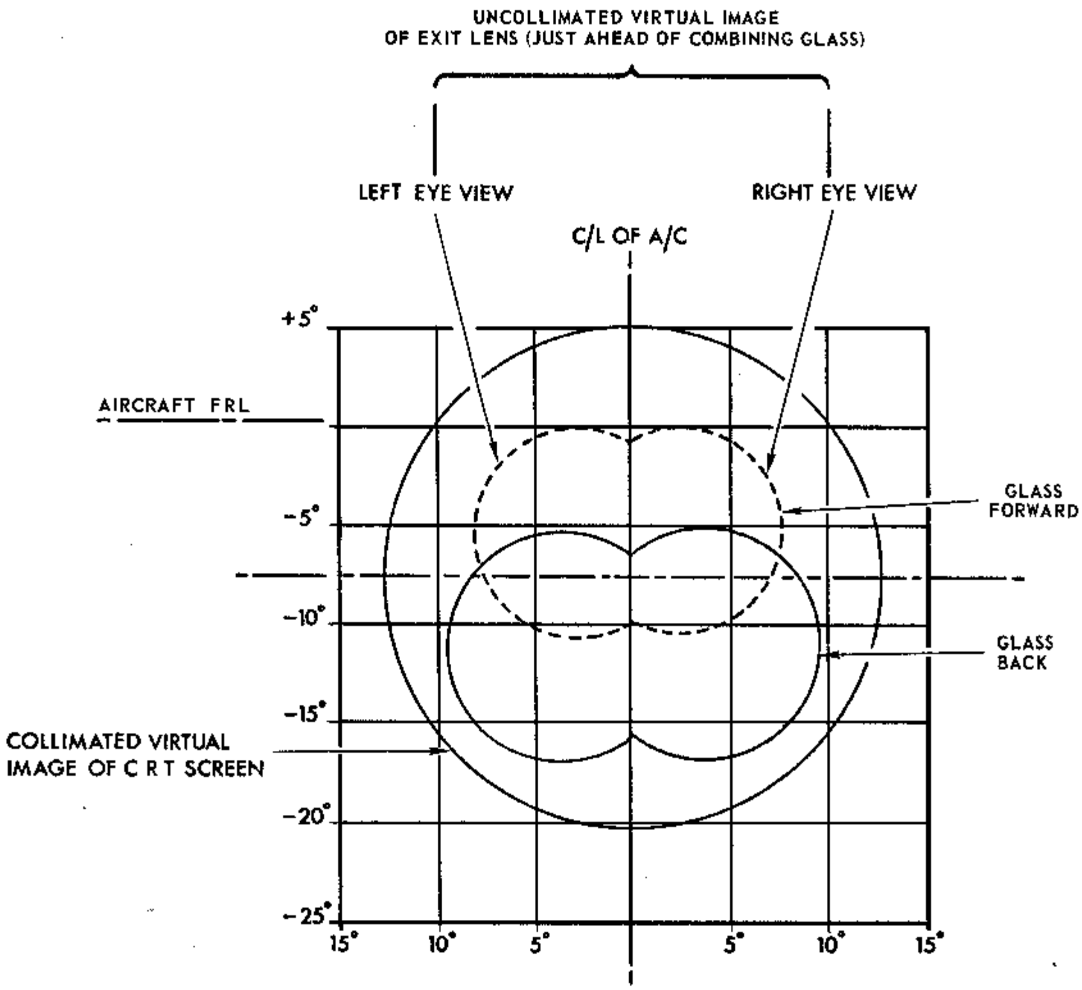


Figure 1-24 (Sheet 1 of 2)

HUD FIELD OF VIEW

(CONTINUED)



ANGULAR FIELD OF VIEW

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Figure 1-24 (Sheet 2 of 2)

HUD CONTROL PANEL

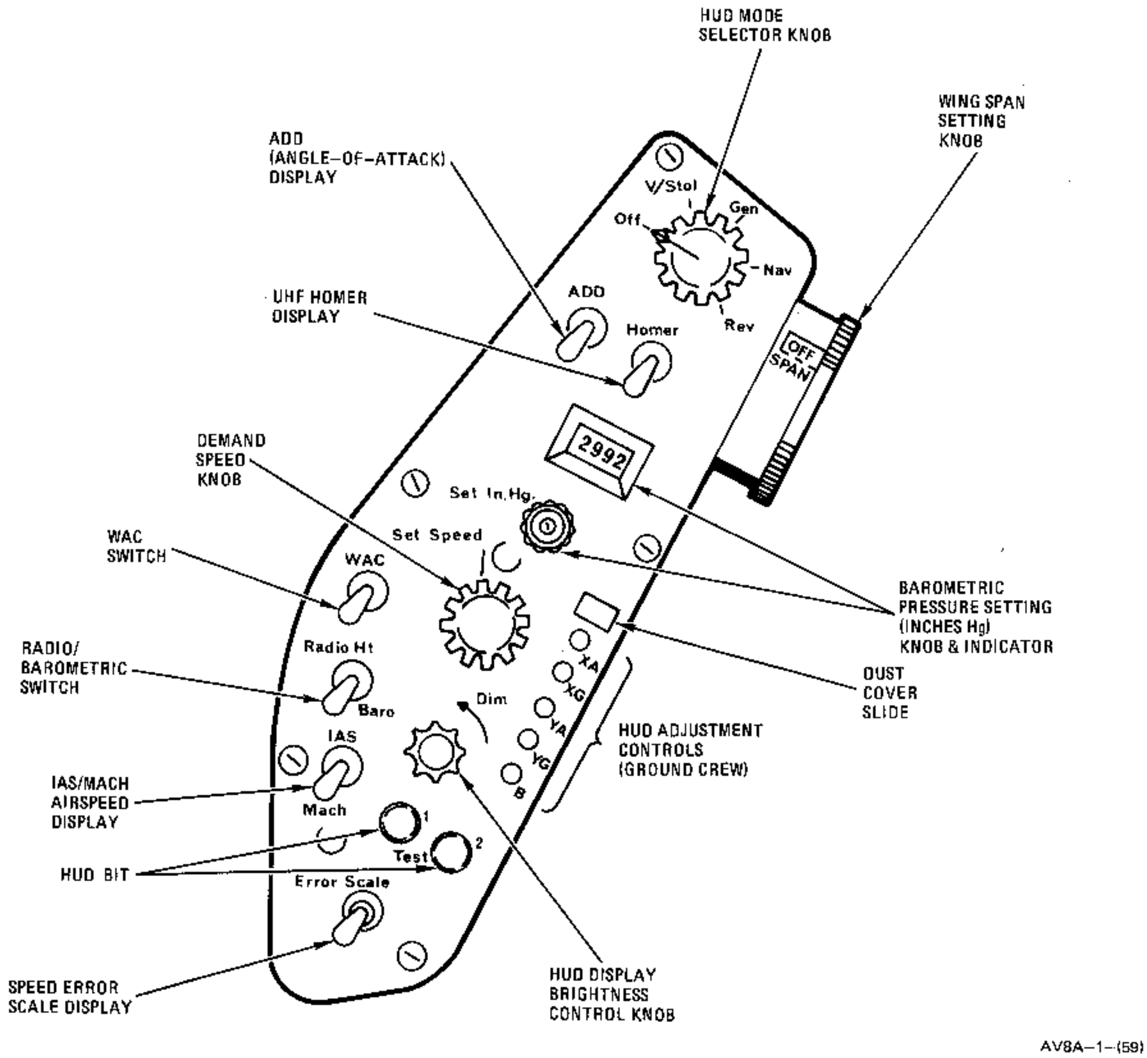


Figure 1-25

HORIZON BARS

The horizon bars always remain parallel to the natural horizon. In GEN and NAV, the angular displacement of the aircraft symbol from the horizon bars indicates dive/climb (flight path angle). In V/STOL, the angular displacement of the aircraft symbol from the horizon bars indicates aircraft attitude and the horizon bars datum is shifted appropriately. The angle between the aircraft symbol and the horizon bar is 1/5 of the angle between the aircraft flight path/attitude and the actual horizon. The horizon bars are present in all modes (including Sidewinder and REV 2) except Air-to-Air Gunnery and REV 1.

ELEVATION ANGLE BARS

Elevation angle bars appear in all modes except Air-to-Air. The bars are parallel to the natural horizon and are displayed at 30° intervals, although the angle between the bars is only 6° because of the 5:1 scaling. The positive elevation bars consist of four short dashes on either side of a central gap and the negative elevation bar consists of two long dashes on either side of the gap. A single number, indicating the tens of degrees represented by the bar, is written by the right-hand part of each bar on the side farthest from the horizon.

ZENITH AND NADIR SYMBOLS

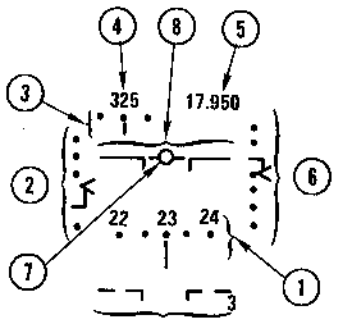
At 90° positive elevation angle an upright cross indicates zenith. At 90° negative elevation angle an inverted cross of Lorraine indicates nadir. The tail of each cross always points to the nearer horizon. These symbols appear in all modes except Air-to-Air.

GROUND SPEED

In V/STOL mode, ground speed is displayed by a pointer moving across a linear scale which comprises five dots spaced horizontally. The dots are not numbered, but from left to right they indicate 0, 15, 30, 45 and 60 knots. The pointer is removed from display when ground speed is 130 knots or greater.

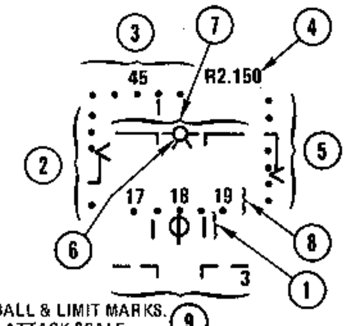
HUD SYMBOLS

GEN/NAV MODE DISPLAY



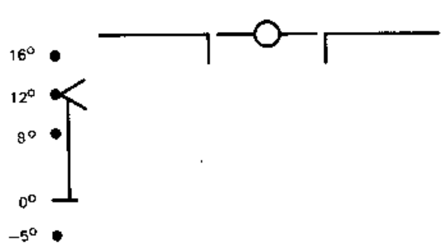
1. HEADING, EITHER TRUE, MAG OR TACAN (AS SELECTED)
2. ANGLE OF ATTACK (IF SELECTED).
3. SPEED ERROR SCALE (IF SELECTED).
4. INDICATED AIRSPEED OR MACH NUMBER (AS SELECTED).
5. BAROMETRIC HEIGHT (SHOWN) OR RADAR ALTIMETER (PREFIXED BY R), AS SELECTED.
6. VERTICAL SPEED SCALE.
7. AIRCRAFT SYMBOL.
8. HORIZON BAR
9. ELEVATION BAR

V/STOL MODE DISPLAY

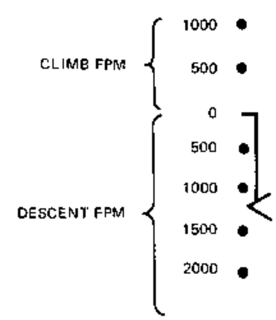


1. SIDESLIP BALL & LIMIT MARKS.
2. ANGLE OF ATTACK SCALE.
3. GROUND SPEED.
4. RADAR ALTIMETER HEIGHT (SHOWN) OR BAROMETRIC HEIGHT (LESS R SHOWN), AS SELECTED.
5. VERTICAL SPEED SCALE.
6. AIRCRAFT SYMBOL.
7. HORIZON BAR
8. HEADING
9. ELEVATION BAR

ANGLE OF ATTACK



VERTICAL SPEED



MODE/PHASE DISPLAY

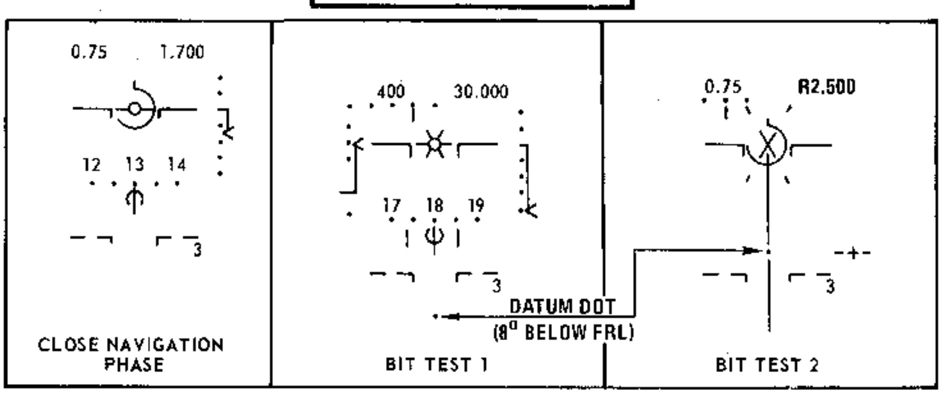


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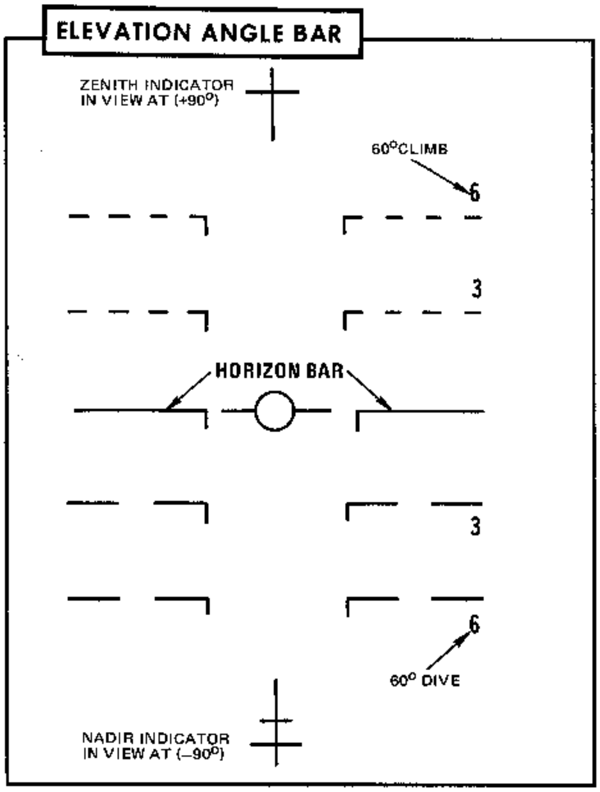
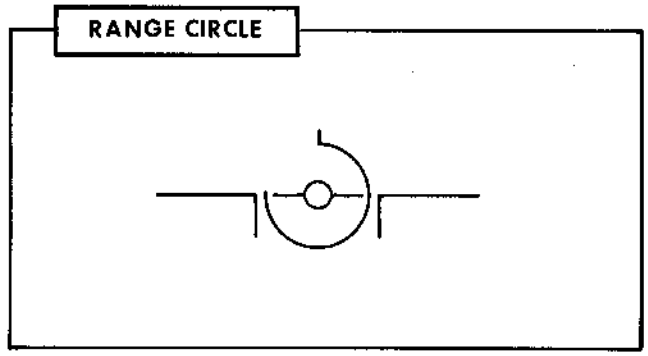
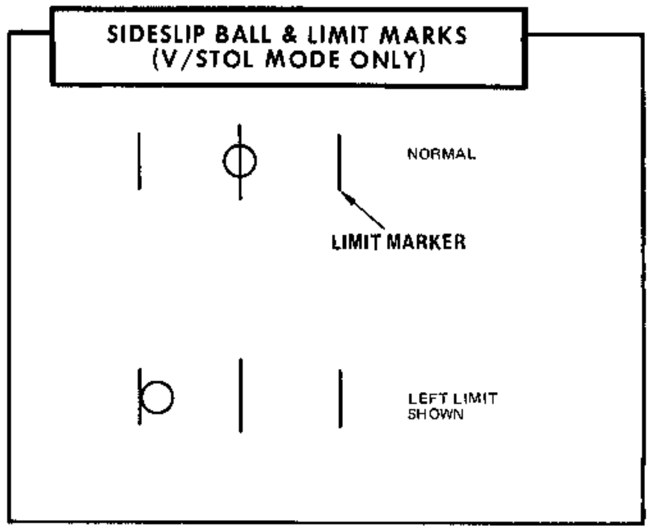
Figure 1-26 (Sheet 1 of 2)

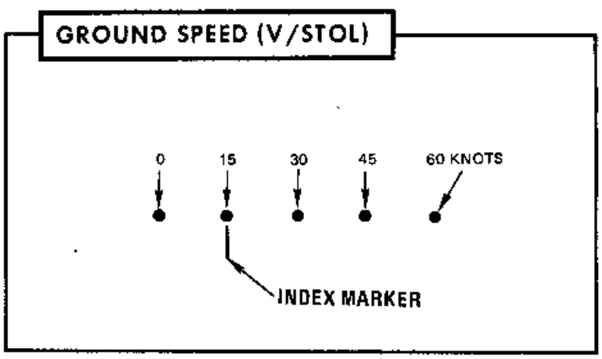
HUD SYMBOLS

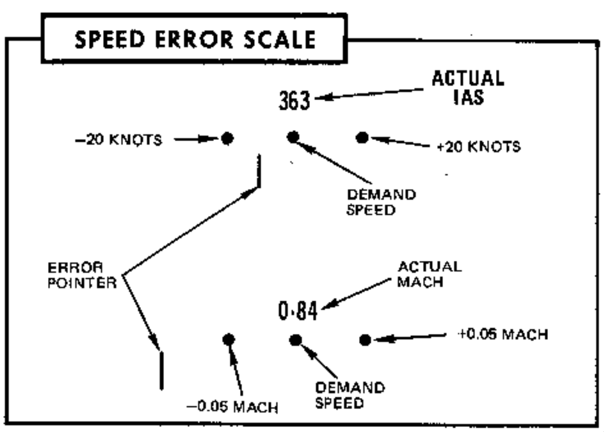
(CONTINUED)

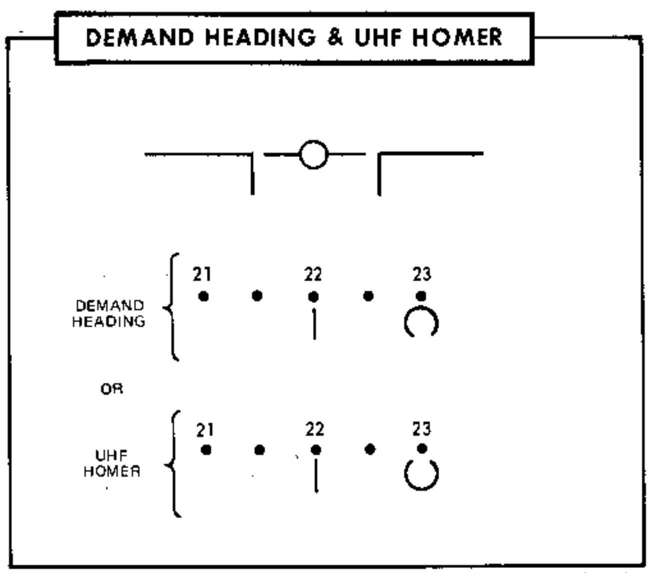












AV8A–1–(60–2)

Figure 1–26 (Sheet 2 of 2)

INDICATED AIR SPEED

IAS is displayed as a digital read-out from approximately 30 to 660 knots in 1 knot increments, updated only twice per second to minimize blurring in turbulence or when acceleration is high. IAS is displayed automatically in V/STOL, but it is not displayed during Air-to-Air. It is displayed in all other modes if the IAS/MACH selector switch is selected to IAS.

MACH NUMBER

With MACH selected, Mach number is displayed instead of IAS in all modes except Air-to-Air, which has no speed indication, and V/STOL, in which Mach number cannot be displayed. The Mach number display is a three digit readout from 0.30M to 1.40M in 0.01M increments. Mach number is updated twice per second.

SPEED ERROR SCALE

When the ERROR SCALE button is pushed, an error scale of three dots and a pointer appears below the speed digits. The center dot represents demanded speed and the dots on either side mark errors of either ±20 kt or ±0.05M, depending on whether IAS or MACH is selected. The pointer can overswing to limits which effectively increase the range to ±40 kt or ±0.1M. The speed digits show actual speed at all times except with the SET SPEED knob held depressed, then the digits show demanded speed. When the knob is rotated, the demanded speed is adjusted whether or not the knob is pressed. The speed error scale is removed by pressing the ERROR SCALE button a second time. The scale can be used in all modes except V/STOL and Air-to-Air.

VERTICAL SPEED

In V/STOL and GEN modes and in the Close Navigation phase of NAV mode, vertical speed is displayed on a vertical linear scale of six intervals each representing units of 500 fpm. The intervals are marked by dots except at the third position down where there is a short horizontal bar representing zero datum. The upper dot represents a climb of 1000 fpm and the lower dot a descent of 2000 fpm. A thermometer type scale vertical line with an arrowhead pointer operates up or down from the datum to indicate vertical speed. The pointer limits at stops beyond the scale by the equivalent of two divisions and the total range is, therefore, from 2000 fpm climb to 3000 fpm descent.

BAROMETRIC HEIGHT

Barometric height is indicated on a free-running digit display covering −1000 feet to +59,950 feet in increments of 20 feet up to 10,000 feet and 50 feet above 10,000 feet. When the height is below zero, a minus sign is displayed in front of the digits. To avoid blurring of the digits when vertical speed is high, the height display is updated only at half second intervals. Barometric height is displayed in all modes except Air-to-Air.

RADAR ALTIMETER HEIGHT

After AFC 96, radar altimeter height can be displayed by positioning the radio/baro switch to RADIO. The range of the display is from 0 to 5000 feet in 5-foot increments. The number displayed is preceded by the letter R. The display is automatically removed if the input exceeds 4995 feet or the valid signal from the radar altimeter is lost. The radar altimeter receives standby power when the standby/transmit switch is in the STANDBY position. Radar height display is available in all modes except air-to-air.

HEADING

In V/STOL, GEN and NAV a heading scale is displayed. Either true or magnetic heading is displayed depending on the position of the HDG switch located on the NDC panel. The scale consists of a horizontal line of dots marking 5° intervals and moving against a fixed marker. Digits above alternate dots indicate the first two digits of heading. The actual angle between the scale markings is one fifth of the angle indicated. The scale is viewed through an invisible electronic window which limits the number of dots visible to five. Depending on the actual heading, two or three sets of digits are visible.

SIDESLIP BALL AND LIMIT MARKS

This display is in the V/STOL mode only. A limit marker is placed on each side of the heading marker. Normal maximum permissible sideslip is indicated when the ball is touching one of the limit markers. The display is removed when the HOMER switch is on. The illustration (figure 1-26) shows a maximum left sideslip.

ANGLE OF ATTACK

The angle of attack display is presented in the V/STOL mode. It is displayed in other modes when the ADD switch is on. The display has four dots that comprises a scale from −50° at the bottom to 20° at the top. The zero marker is the horizontal line above the −5° dot with the upper three dots indicating 8°, 12°, and 16° respectively. The arrow head points to the actual angle of attack in degrees when airspeed is greater than 120 knots; below 100 knots, the scale is in units of angle of attack.

DEMAND HEADING

The demand heading symbol is a horseshoe, open end down, which is displayed in GEN and NAV modes. The symbol has the same scale as the heading scale up to a limit equivalent to 18° on the heading scale.

UHF HOMER

The UHF symbol can be selected at any time by switching the HOMER switch on. The Homer display overrides the demand heading symbol or the sideslip symbol. The display is a horseshoe, open end up, with the same scaling as the heading scale. The maximum deflection of the homer symbol is equivalent to 15° on the heading scale.

RANGE CIRCLE

A range circle is displayed in GEN and NAV modes (Close Navigation) when range to destination or target decreases to 14 NM. The display consists of a circle with a short vertical line at 12 o'clock to denote zero. As range decreases through 12 NM the circle unwinds in a counterclockwise direction at a rate of 3 NM per quadrant. The circle is always centered on the aircraft symbol.

Display Layout

The HUD displays obtained in the various modes are illustrated in figure 1-26. The symbols for speed, height, angle of attack, vertical speed, heading, demanded heading, UHF homer, sideslip and range always remain fixed relative to, and move in unison with, the aircraft symbol. Certain symbols are oriented relative to the natural horizon; these are the horizon bars, the elevation angle bars, and the zenith and nadir symbols. These symbols have full freedom in pitch and roll. The flight displays, GEN and NAV, are all overridden if a weapon-aiming mode is selected.

Built-In-Test (BIT)

The BIT Test display is shown in figure 1-26. The BIT test is initiated when the Test 1 and Test 2 buttons are pressed and the following are displayed:

a. Test 1. IAS is 400 knots ±3 knots, height is 30,000 feet ±250 feet and heading is 180° ±2°, AOA is shown, and VSI (−2000 fpm).
b. Test 2. Mach number is 0.75M ±0.02M.

DEGRADED MODE OPERATION

There is no emergency operation for the compass system (C2J), for the head-up display system, or for the inertial navigation attack system, but in case of failures the reversionary modes previously described may be utilized.

LIMITATIONS

There are no limitations for the compass system (C2J), or the HUD system. The INAS should not be switched on until at least 5 minutes have elapsed after a previous switch off. The aircraft should not be moved until at least 5 minutes have elapsed since the INAS was turned off. On the NDC the moving map provides a typographical display of the area 14 to 28 NM in diameter, depending on the position of the map scale switch. The total map film coverage is approximately 850 NM in both north/south and east/west directions. The latitude band limits of the map are 0° to 71° north and south. The latitude is divided into four bands: 0° to 45°, 35° to 55°, 42° to 62°, and 51° to 71°.

OXYGEN SYSTEM

DESCRIPTION

The liquid oxygen (LOX) system consists of a five liter vacuum insulated container, build-up coil, check and vent valves, pressure and quantity gages, man-mounted regulator and mask. The system delivers gaseous oxygen to the regulator at a nominal pressure of 60 – 90 psi. If delivery pressure falls below 45 – 50 psi the OXY light on the warning light panel will illuminate.

OXYGEN SHUTOFF VALVE

An oxygen shutoff valve is located on the right forward cockpit wall (figure A-1, appendix A).

OXYGEN QUANTITY AND PRESSURE GAGES

A 5 liter oxygen quantity gage calibrated from empty to full and an oxygen pressure gage calibrated in 10 psi increments from 0 to 150 psi are mounted on the right canopy rail sub-panel (figure A-1, appendix A).

OXYGEN REGULATOR (CRU-61)

The oxygen regulator is man-mounted and connected to the oxygen system through the personal equipment connector on the ejection seat.

Oxygen Selector Knob

With NORMAL selected, the regulator supplies a mixture of air and oxygen proportional to cockpit altitude below approximately 18,000 – 20,000 feet. Above this altitude 100% oxygen is supplied. With 100% selected, the regulator supplies 100% oxygen at all altitudes.

OXYGEN FLOW INDICATOR

The oxygen flow indicator on the left instrument panel (figure A-1, appendix A) shows a vertical white bar when oxygen is being drawn from the regulator (breathing in or safety pressure) and shows black when no oxygen is being drawn from the regulator (breathing out) or if electrical power to the instrument fails.

EMERGENCY OXYGEN

A 7 to 10 minute emergency supply of gaseous oxygen is contained in a bottle mounted on the right side of the ejection seat. A shutoff valve and pressure reducer are mounted on the top of the bottle. The supply, when actuated, flows to the regulator through the personal equipment connector. The shutoff valve is actuated automatically during the ejection sequence by the handle of the aircraft portion of the personal equipment connector (see figure 1-9). The emergency supply is not available after separation from the ejection seat.

Emergency Oxygen Supply Actuating Knob

The emergency oxygen supply can be actuated by pulling up the black and yellow striped knob on the right side of the ejection seat pan (see figure 1-9). After being pulled the knob will topple freely to indicate that the emergency supply has been actuated.

Emergency Oxygen Supply Gage

The pressure gage is mounted on the pressure reducing and shutoff valve on the top of the emergency oxygen bottle. The gage has a red refill sector from 0 to 1,800 psi and a white full sector from 1,800 to 2,500 psi.

NORMAL OPERATION

Normal operation consists of turning the oxygen shutoff valve ON and the oxygen selector knob to NORMAL.

EMERGENCY OPERATION

If smoke or fumes are detected, place the oxygen selector switch to 100%. If the normal supply fails actuate the emergency oxygen supply and switch off the main supply.

NOTE

There is no anti-suffocation system and breathing is not possible without oxygen. If normal supply fails, actuate the emergency supply, or at low altitude, disconnect the mask tube from the regulator to conserve emergency supply for high altitude use.

LIMITATIONS

There are no limitations for oxygen system operation.

PITOT-STATIC SYSTEM

DESCRIPTION

Pitot-static pressures are obtained from the pitot-static head on the nose boom and are furnished to the pitot-static operated flight instruments, the air data computer and the Q feel control unit.

PITOT-STATIC HEATER

The pitot-static heater is controlled by a switch on the left console labeled Pitot Htr.

NORMAL OPERATION

The pitot-static system operates automatically.

EMERGENCY OPERATION

If pitot-static icing is anticipated or suspected, turn the pitot-static heater ON.

LIMITATIONS

There are no limitations for the pitot-static system.

SPEED BRAKE

DESCRIPTION

The electro-hydraulic operated speed brake is hinged on the fuselage underside, aft of the main landing gear. The speed brake has a maximum travel of 66°; however, this travel is progressively reduced with increased airspeed and automatically reduced to 25° when a landing gear selection is made. Electrical control is provided by a switch located on the throttle lever. Speed brake position is shown by an indicator, located on the main instrument panel. When the speed brake is fully extended, the indicator shows white, when retracted or in trail, the indicator shows black. Automatic operation is accomplished in conjunction with landing gear selection. When landing gear down is selected, the speed brake assumes an extended position of 25°. Any prior speed brake position will be overridden. When landing gear up selection is made, the speed brake fully retracts. On the ground the speed brake is normally extended to 25°. A key operated ground lock is provided for ground handling safety. Hydraulic power is provided from the PC-1 system, but is not available if the emergency landing gear control is operated. If this operation is necessary, the speed brake is fully retracted by high pressure nitrogen. Electrical power is provided by the No. 2 dc bus (dual generator system) and the main 28 volt dc bus (single generator system).

SPEED BRAKE SWITCH

When the landing gear is up and locked, control of the speed brake is by a thumb actuated switch on top of the throttle lever. The three position speed brake switch (labeled AIRBRAKE) has a spring-loaded off position and momentary position of IN and OUT.

NORMAL OPERATION

Speed brake operation is controlled by speed brake or landing gear selection. The speed brake circuit is provided with a solenoid operated hydraulic selector valve. When the appropriate solenoid is energized, hydraulic power is utilized to extend or retract the speed brake. The circuit is wired so that speed brake selection is available only when the landing gear uplock microswitch is closed, otherwise the speed brake is operated automatically. After take off, selecting landing gear up, a dc voltage is applied to energize the in solenoid of the selector valve and the speed brake automatically retracts. The dc voltage is maintained until a speed brake or landing gear down selection is made. After the aircraft is airborne, (landing gear retracted), when a speed brake out selection is made, the energizing voltage is applied through the closed uplock microswitch to the out solenoid of the selector valve. This action deenergizes the in solenoid and the speed brake is extended. When a speed brake in selection is made, dc voltage is applied to the in solenoid and deenergizes the out solenoid to retract the speed brake. Landing gear down selection can be made with the speed brake extended or retracted. Energizing voltage to the selector valve is supplied through either a closed extend or retract microswitch. The microswitches provide the energizing voltage to the selector valve to position the speed brake automatically. When the speed brake assumes the proper position the microswitches deenergize the appropriate solenoid and the speed brake is maintained at approximately 25°.

EMERGENCY OPERATION

There is no specific speed brake emergency operation; however, when the landing gear is lowered by the emergency landing gear control, both solenoids of the selector valve are deenergized and hydraulic power to the speed brake is shut off. If the speed brake is out, high pressure nitrogen is discharged to retract the speed brake.

LIMITATIONS

There are no specific limitations for speed brake operation; however, the speed brake does not fully extend at airspeed above 440 KIAS.

PART 3 AIRCRAFT SERVICING

GENERAL INFORMATION

This section contains information pertinent to access doors, authorized AGE, consumable materials, capacities, pressures and cockpit procedures in conjunction with servicing.

AUTHORIZED AGE

The following is a list of authorized AGE required for servicing and ground handling; however, equivalent equipment may be substituted.

a. External electrical power source - NC-10B or MMG2
b. Hydraulic test stand - 1435-100
c. Universal tow bar - 4GB/9131 (Type NT-4)
d. Lightweight towing arm - 26VA/6034675
e. Wheel chocks - NAF601628-1
f. Jacking adapter, main wheel - E295256
g. Jacking adapter, nose wheel - C276206
h. Jacking adapter, outrigger - C276207
i. Axle jack, 2 each required for main and nose wheel, 1 each required for outrigger - 53D22020 (5 ton)

NOTE

If 5 ton capacity jacks are not available, jacks with 4 ton capacity may be used for the main and nose wheels and a 1 ton capacity jack may be used for the outrigger.

j. Liquid oxygen servicing unit - 1890-0051-52
k. Nitrogen pressure source - E40-6603-1

CONSUMABLE MATERIALS

The following is a list of authorized consumable materials required for servicing:

a. Fuel - MIL-J-5624 JP-5
b. Fuel - MIL-J-5624 JP-4 (alternate)
c. Fuel - NATO code F-34 (alternate)
d. Fuel - NATO code F-45 (alternate)
e. Engine oil - MIL-L-23699 A and B
f. CSD oil - Aeroshell turbine oil 390
g. Hydraulic fluid - MIL-H-5606
h. Liquid oxygen - MIL-0-27210 TYPE II
i. Grease, wide temperature range - MIL-G-25760
j. Gaseous nitrogen - BB-N-411 TYPE I CLASS 1 GRADE B
k. Windshield and camera washer fluid - KILFROST WWF/2
l. Distilled or de-mineralized water

CAPACITIES

The following is a list of tank/reservoir capacities:

FUEL

a. Internal fuel - 759 gallons, 5161 pounds
b. External wings - 223 gallons, 1516 pounds
c. Total internal and external fuel - 990.5 gallons, 6793 pounds

NOTE

With external wing tanks installed, the internal wing tanks will hold an additional 8.5 gallons of fuel.

HYDRAULIC RESERVOIR

The reservoir capacities are variable, depending on ambient temperature, refer to Hydraulic Reservoir Servicing, this section.

ENGINE OIL

a. Combat - 24 pints
b. Ferry - 26/33¼ pints

OXYGEN CONVERTER

a. 5.0 liters

WATER INJECTION SYSTEM

a. 59 gallons (50 imperial gallons)

WINDSHIELD WASHER

a. 1.2 gallon

PRESSURES

TIRES

Dry nitrogen should be used for tire inflation, since it is inert and therefore will not support combustion.

a. Main - 90 +7 −5 psi
b. Nose - 90 +7 −5 psi
c. Outrigger - 95 +7 −5 psi

These nominal tire inflation pressures cover takeoff weights up to 23,350 pounds. If this weight is exceeded, then the following pressures must be used for takeoffs up to 24,600 pounds:

a. Main - 95 +7 −5 psi
b. Nose - 100 +7 −5 psi

LANDING GEAR STRUTS

Refer to strut pressure vs extension chart, this section.

ACCUMULATORS

a. PC-1 - 1100 psi
b. PC-2 - 1100 psi
c. RAT system - 950 psi
d. Nosewheel steering - 1100 psi
e. Brakes - 1250 psi

COCKPIT PROCEDURES

All normal cockpit procedures pertinent to servicing the aircraft are included on the applicable illustrations, this section.

SERVICING POINTS

Refer to Servicing Diagram, this section.

LANDING GEAR GROUND LOCK INSTALLATION

Refer to Landing Gear Ground Lock Installation, this section.

SEAT AND CANOPY SAFETY DEVICES

Refer to Seat and Canopy Safety Pins, this section.

SPEED BRAKE GROUND LOCK INSTALLATION

To gain access to the equipment bay above the trailing edge of the speed brake, the speed brake shutoff valve must be turned to the LOCKED position. Refer to Speed Brake Ground Lock Installation, this section.

ARMAMENT SAFETY

When gun pods and stores are installed, the armament system can be made safe by use of a key operated armament safety break and disconnecting the gun electrical connection. Refer to Armament Safeties, this section.

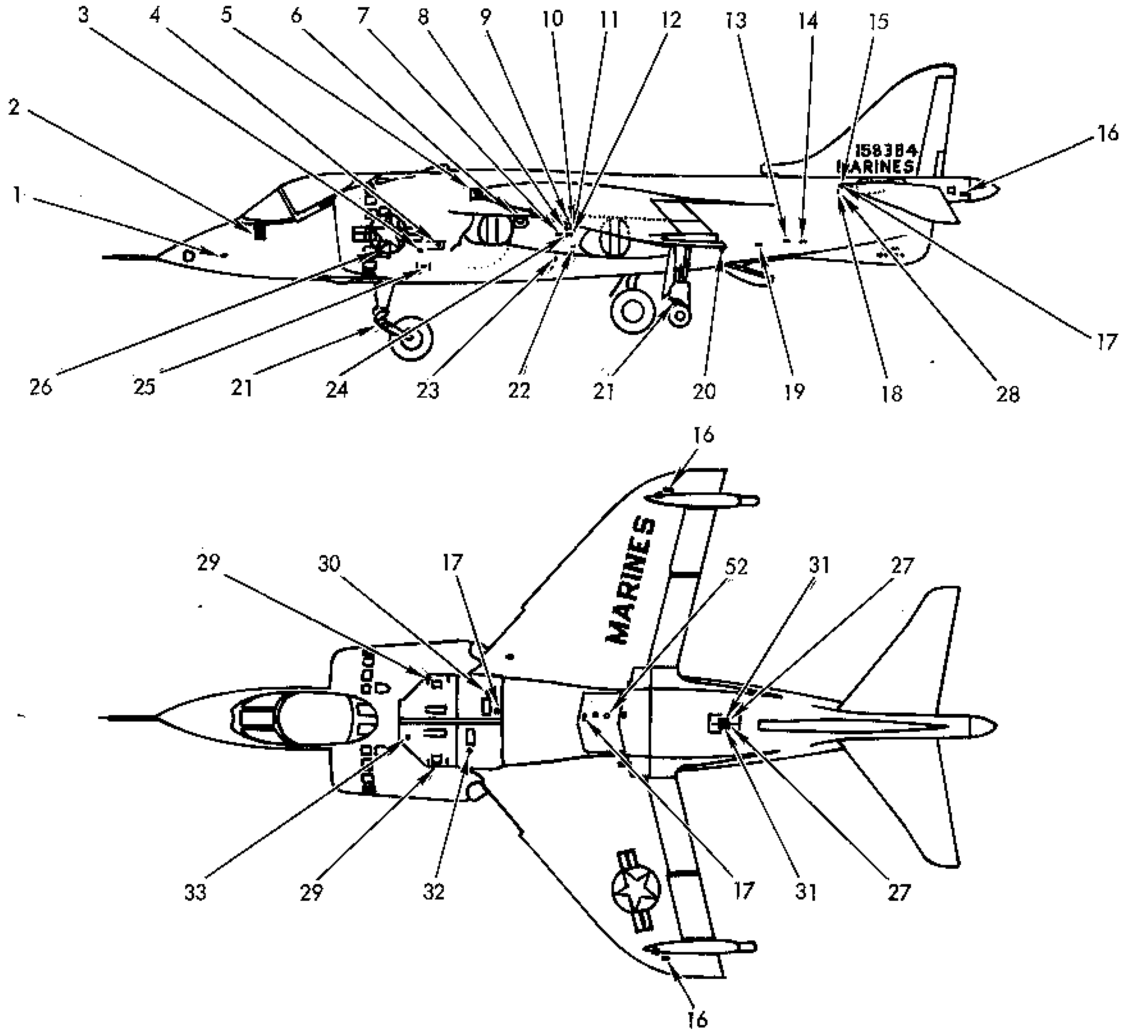
MINIMUM TURNING RADIUS

The minimum turning radius during towing is 12 feet. For minimum turning radius during taxi, refer to Minimum Turning Radius and Ground Clearance, this section.

GROUND HANDLING

This section contains information pertinent to aircraft turn-around and minor aircraft maintenance that may be necessary to prepare the aircraft for flight.

SERVICING DIAGRAM

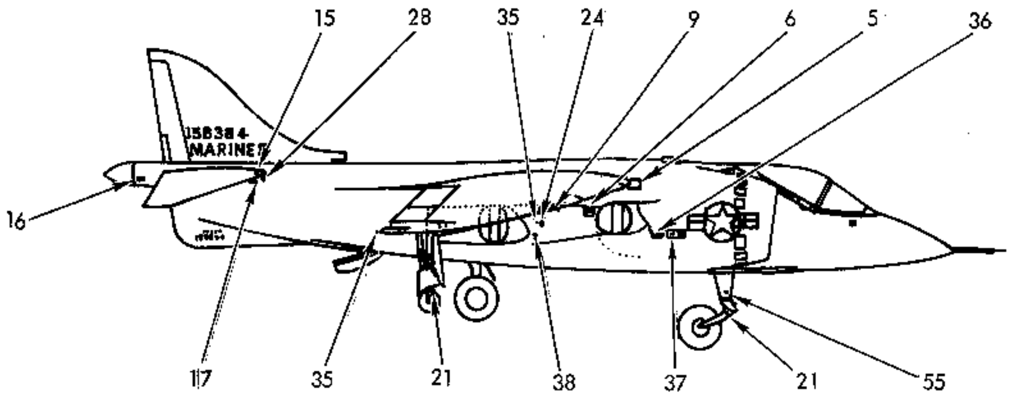


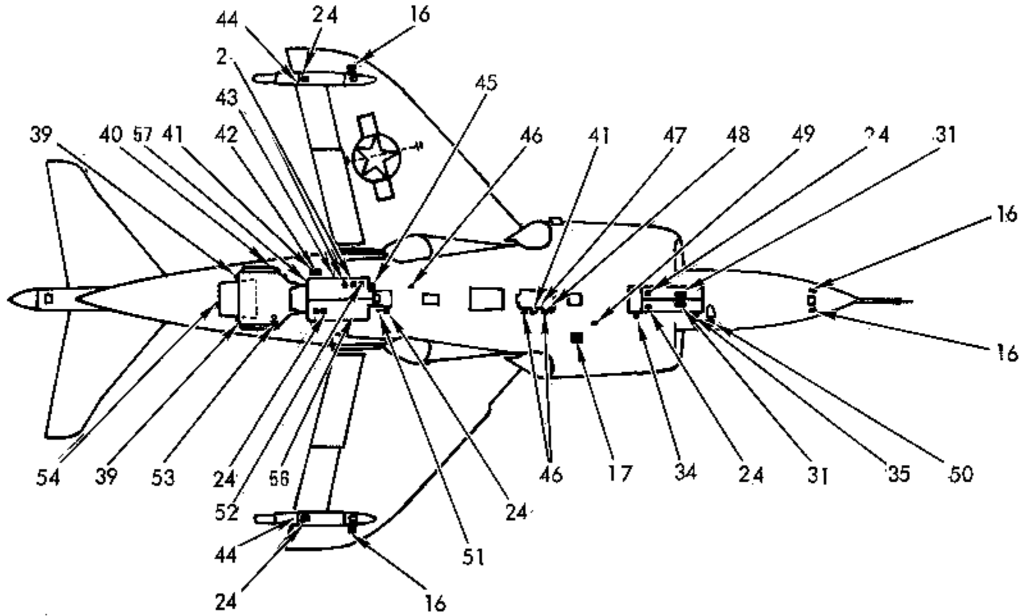
1 WINDSCREEN WASHING FLUID
2 NORMAL CANOPY RELEASE
3 INTERCOMMUNICATION
4 NO. 1 HYDRAULIC SYSTEM
5 FIRE ACCESS
6 HYDRAULIC RESERVOIR CONTENTS SIGHT
7 REFUELING AND DEFUELING PRESSURES
8 GROUND (EARTH) HERE
9 PRESS TO ILLUMINATE HYDRAULIC RESERVOIR
10 FUEL
11 RESERVOIR BLEED VALVE
12 ENGINE OIL CONTENTS CHECK
13 A.P.U. OUTPUT (NOT USED)
14 SERVICING GROUND SUPPLY 200 VOLTS 400 CYCLES
15 TO AVOID STABILATOR DAMAGE ENSURE FASTENERS FLUSH AND TORQUE LOADED TO 45 LB IN
16 POWER CONTROL AND JET BLAST
17 HYDRAULIC FILTER
18 STABILATOR ANGLE MARKINGS
19 AIRBRAKE GROUND LOCK
20 LIQUID OXYGEN 5 LITERS (BEFORE AFC 85)
21 TIE DOWN POINT
22 NO. 1 HYDRAULIC RESERVOIR PRESSURE
23 DEFUELING SHUTOFF
24 NITROGEN
25 ENGINE OIL
26 HYDRAULIC HAND PUMP
27 R.A.T. ACCESS REMOVE 4 BOLTS
28 PANEL MUST BE FITTED BEFORE MOVING STABILATOR
29 FIRE ACCESS
30 GAS TURBINE STARTER/APU INLET
31 KEEP CLEAR
32 GAS TURBINE STARTER/APU EXHAUST
33 CABIN AIR FILTER
34 TIRE PRESSURE 90 P.S.I. (6.33Kg/cm^2)
35 PITOT DRAIN
36 NO. 2 HYDRAULIC SYSTEM
37 DEFUELING PRESSURE CONNECTION
38 NO. 2 HYDRAULIC RESERVOIR PRESSURE
39 ENGAGE AIRBRAKE GROUND LOCK BEFORE REMOVING DOOR OR ENTERING BAY
40 OXYGEN VENT (STAND CLEAR WHEN CHARGING)
41 FILTER
42 EQUIPMENT BAY COOLING
43 ARMAMENT SAFETY KEY
44 TIRE PRESSURE
45 WATER DRAIN
46 FUEL TANK WATER DRAIN
47 AIR MOTOR
48 AIR MOTOR FEED PIPE INDICATOR
49 ENGINE FUEL DRAIN TANK
50 LANDING GEAR DOORS MANUAL OPENING VALVE
51 TIRE PRESSURE 90 P.S.I. (6.33Kg/cm^2)
52 WATER
53 LOX CONTENTS GAUGE
54 BATTERY
55 HYDRAULIC FILTER
56 EXTERNAL POWER RECEPTACLE (L. SIDE MWW)
57 LIQUID OXYGEN 5 LITERS (AFTER AFC 85)

AV8A-1-(54-1)A

Figure 1-27 (Sheet 1 of 2)

SERVICING DIAGRAM (CONTINUED)





SPECIFICATIONS

		NAVY	NATO
FUEL	PRIMARY	MIL-J-5624E, JP-5	F-44
	ALTERNATE	MIL-J-5624E, JP-4	F-40
	ALTERNATE	MIL-J-5624E, JP-1	F-34
OIL	ENGINE	MIL-L-23699 A and B	0-156
	CSD	AEROSHELL TURBINE OIL 390	
HYDRAULIC FLUID	LIQUID	MIL-H-5606	H-515
NITROGEN	GASEOUS	BB-N-411 TYPE I CLASS 1 GRADE B	
OXYGEN	LIQUID	MIL-O-27210 TYPE II	
WINDSHIELD AND CAMERA WASHER FLUID	LIQUID	KILFROST WWF/2	

AV8A-1-(54-2)A

Figure 1-27 (Sheet 2 of 2)

LANDING GEAR GROUND LOCK INSTALLATION

NOSE GEAR

1. REMOVE HANDLE
2. ENGAGE HOOKS UNDER JACK LEVER PIVOT MEMBERS.
3. SLIDE BLOCK ALONG HOOKS.
4. INSERT BLOCK BETWEEN STOPS AND LOWER JAWS.
5. INSTALL HANDLE PIN, FROM LEFT SIDE OF LOCK, THROUGH THE LOCK AND ROTATE HANDLE TO BE IN LINE WITH HOOKS.
6. INSTALL RETAINING PIN IN HANDLE PIN.
7. ENSURE LOCK CANNOT BE REMOVED WITH HANDLE PIN INSTALLED.

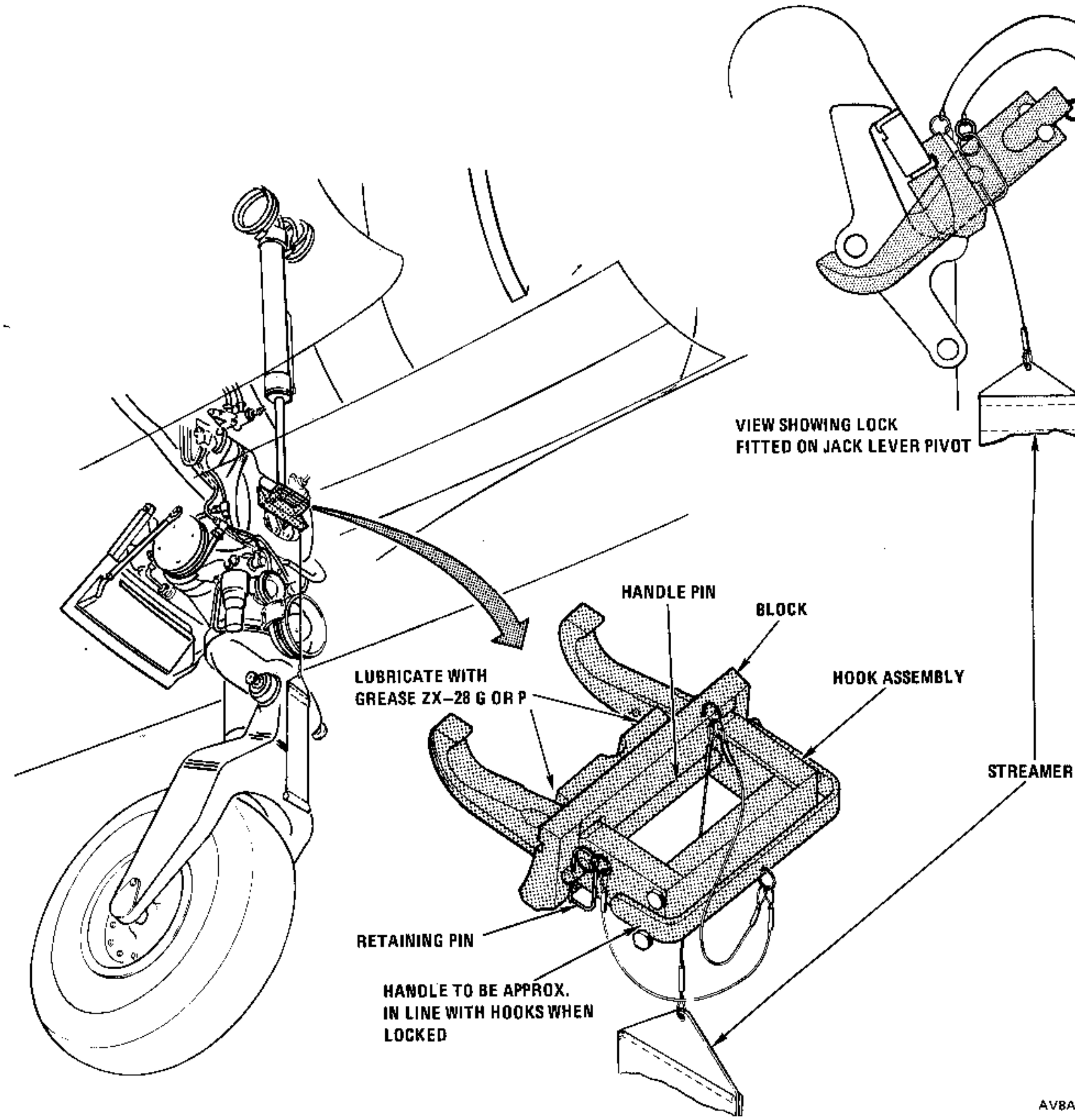


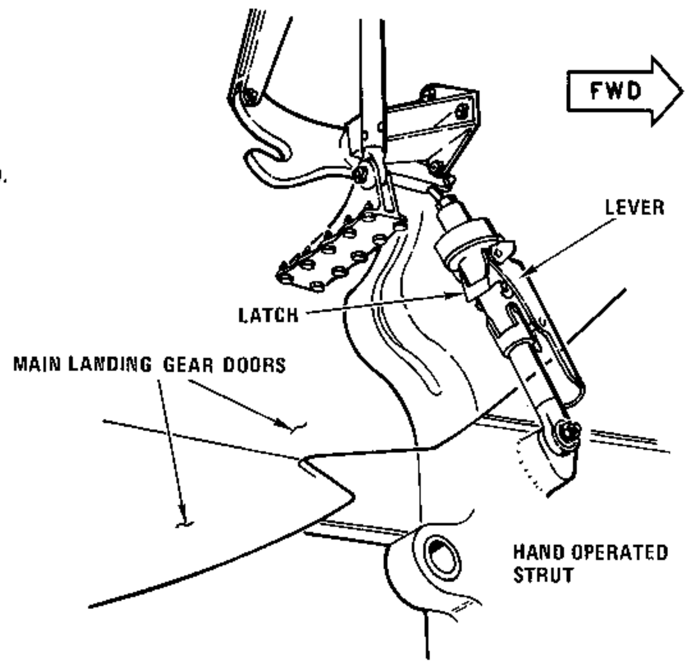
Figure 1–28 (Sheet 1 of 3)

LANDING GEAR GROUND LOCK INSTALLATION

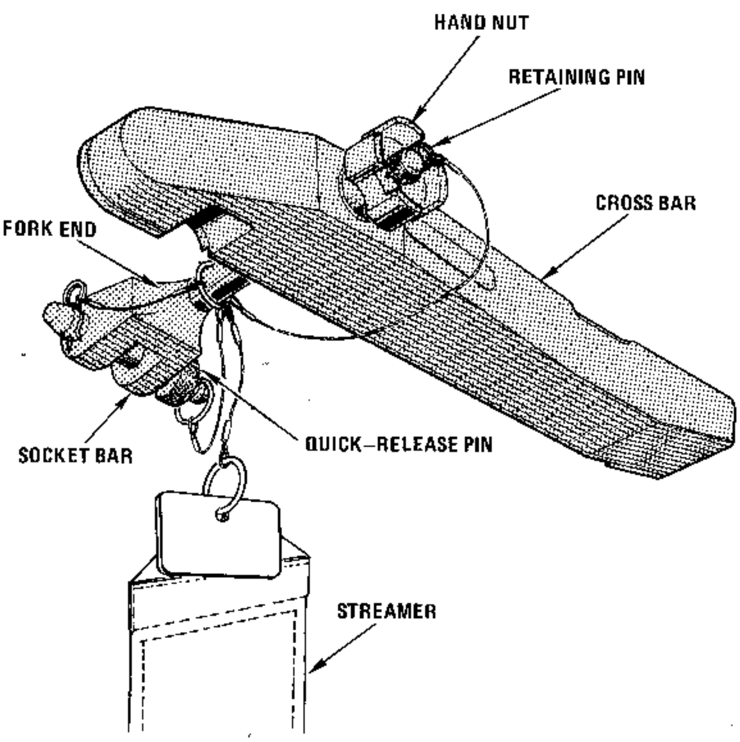
(CONTINUED)

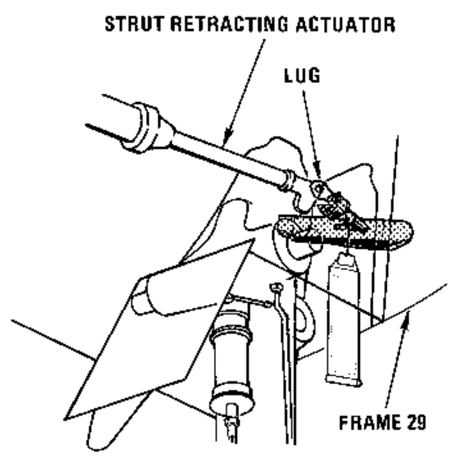
MAIN GEAR

1. OPEN MAIN LANDING GEAR DOOR.
   a. INSERT HAND THROUGH APETURE ON RIGHT SIDE OF STRUT.
   b. DEPRESS HAND OPERATED STRUT LATCH.
   c. MOVE LEVER FORWARD.
   d. ALLOW DOORS TO FALL OPEN WHILE STRUTS EXTEND.



2. REMOVE HAND NUT.
3. ATTACH SOCKET BAR TO STRUT RETRACTING ACTUATOR LUG.
4. THREAD CROSS BAR ON TO SOCKET BAR.
5. PLACE CROSS BAR BETWEEN MAIN LANDING GEAR TRUNNION AND FITTING ON FRAME 29.
6. TIGHTEN HAND NUT.
7. INSERT RETRAINING PIN IN HAND NUT CASTELLATIONS.





AV8A-1-(123-2)

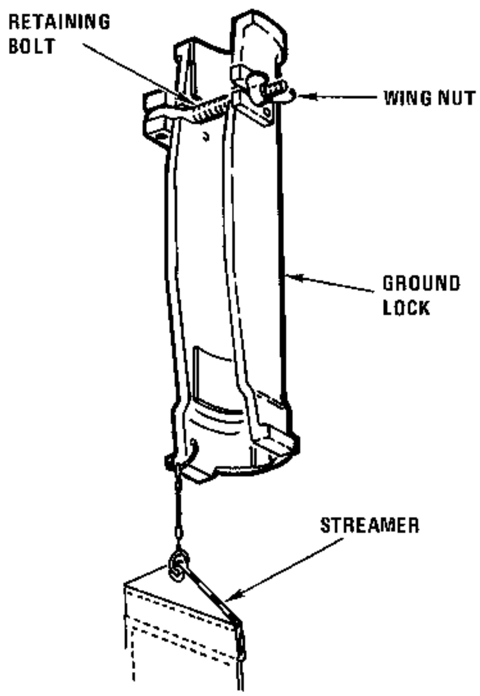
Figure 1-28 (Sheet 2 of 3)

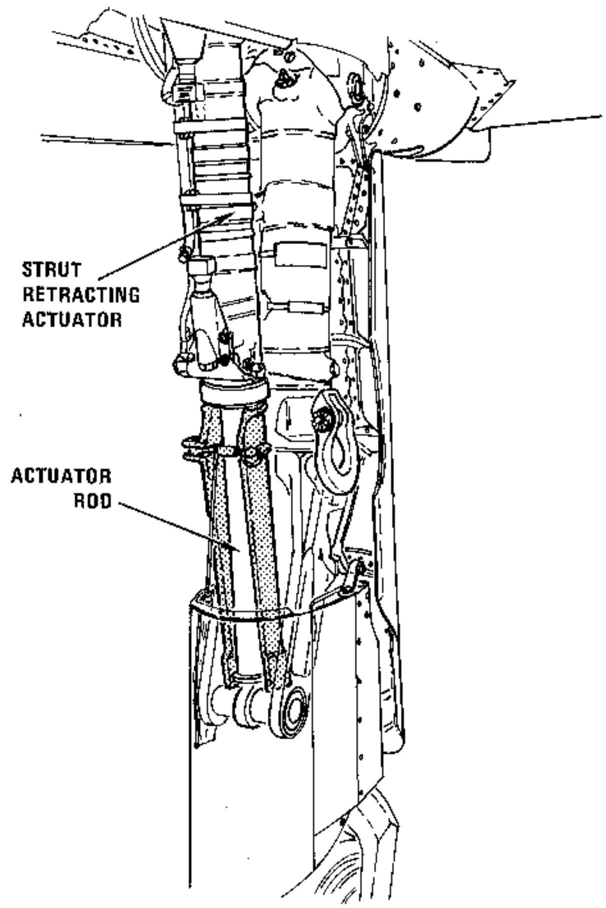
LANDING GEAR GROUND LOCK INSTALLATION

(CONTINUED)

OUTRIGGER

1. RELEASE WING NUT.
2. SWING RETRAINING BOLT CLEAR OF GROUND LOCK.
3. INSTALL GROUND LOCK AROUND ACTUATOR ROD.
4. RE-ENGAGE RETAINING BOLT.
5. TIGHTEN WING NUT
6. INSTALL RETAINING PIN INTO END OF RETAINING BOLT.

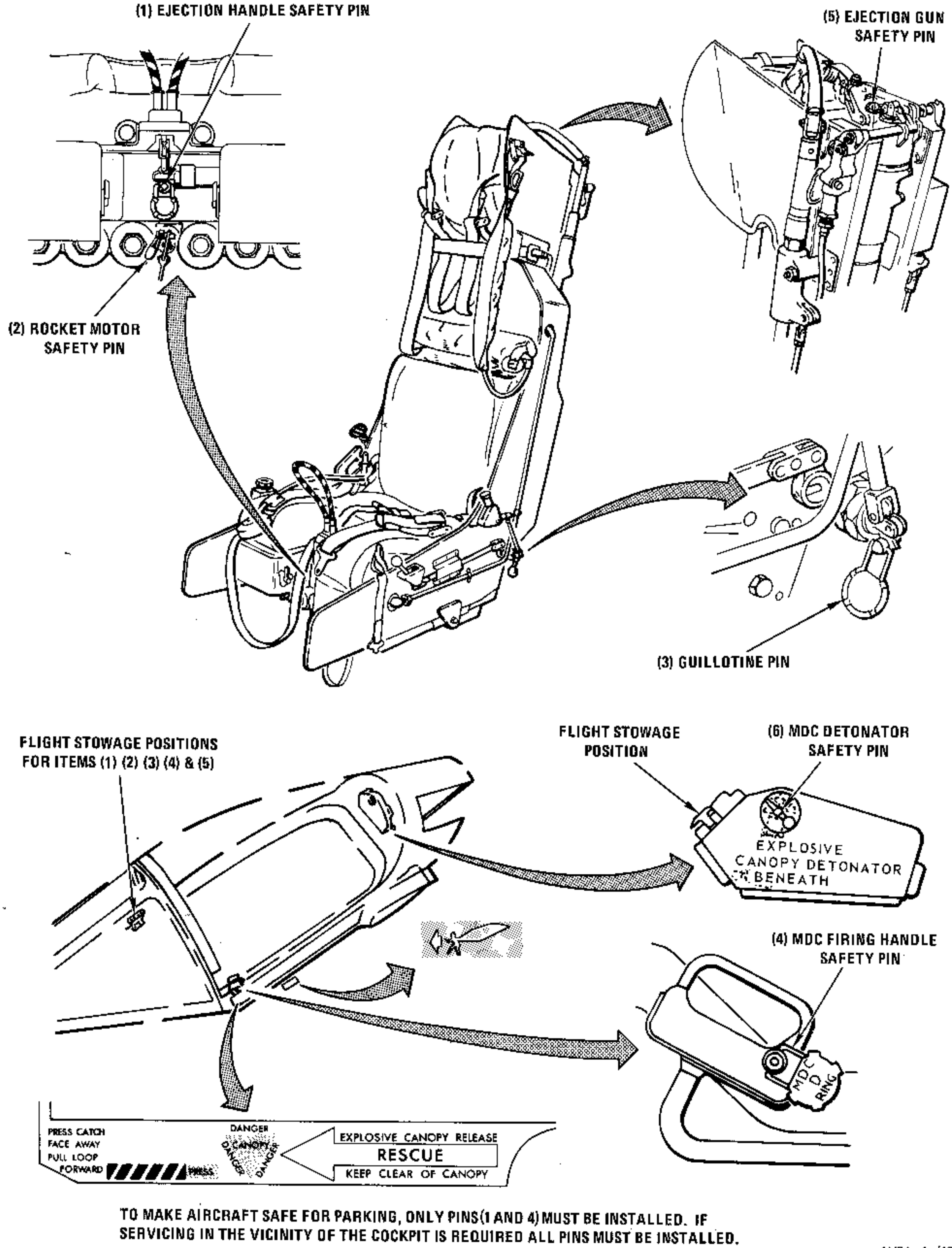




AV8A-1-(123-3)A

Figure 1-28 (Sheet 3 of 3)

SEAT AND CANOPY SAFETY PINS



TO MAKE AIRCRAFT SAFE FOR PARKING, ONLY PINS(1 AND 4) MUST BE INSTALLED. IF SERVICING IN THE VICINITY OF THE COCKPIT IS REQUIRED ALL PINS MUST BE INSTALLED.

AV8A–1–(122)A

Figure 1-29

SPEED BRAKE GROUND LOCK INSTALLATION

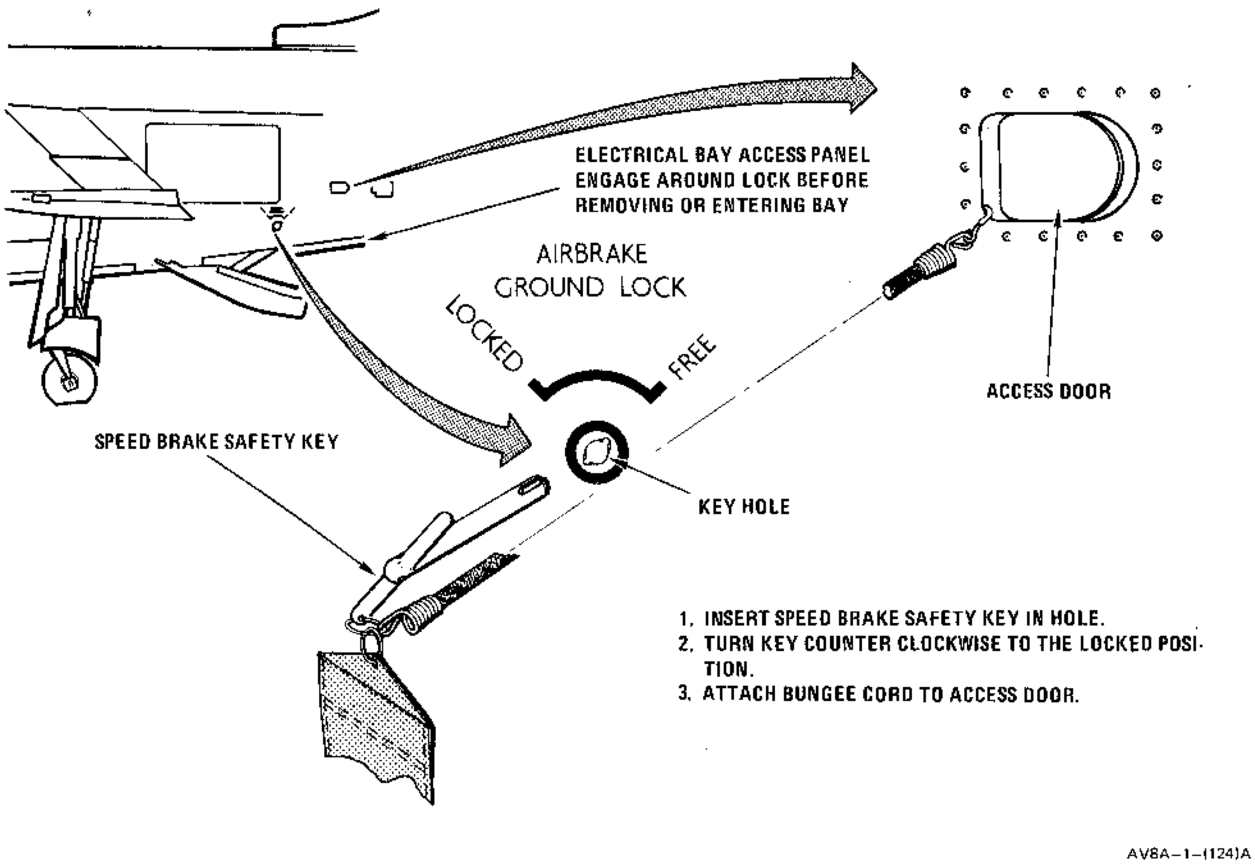


Figure 1-30

ARMAMENT SAFETIES

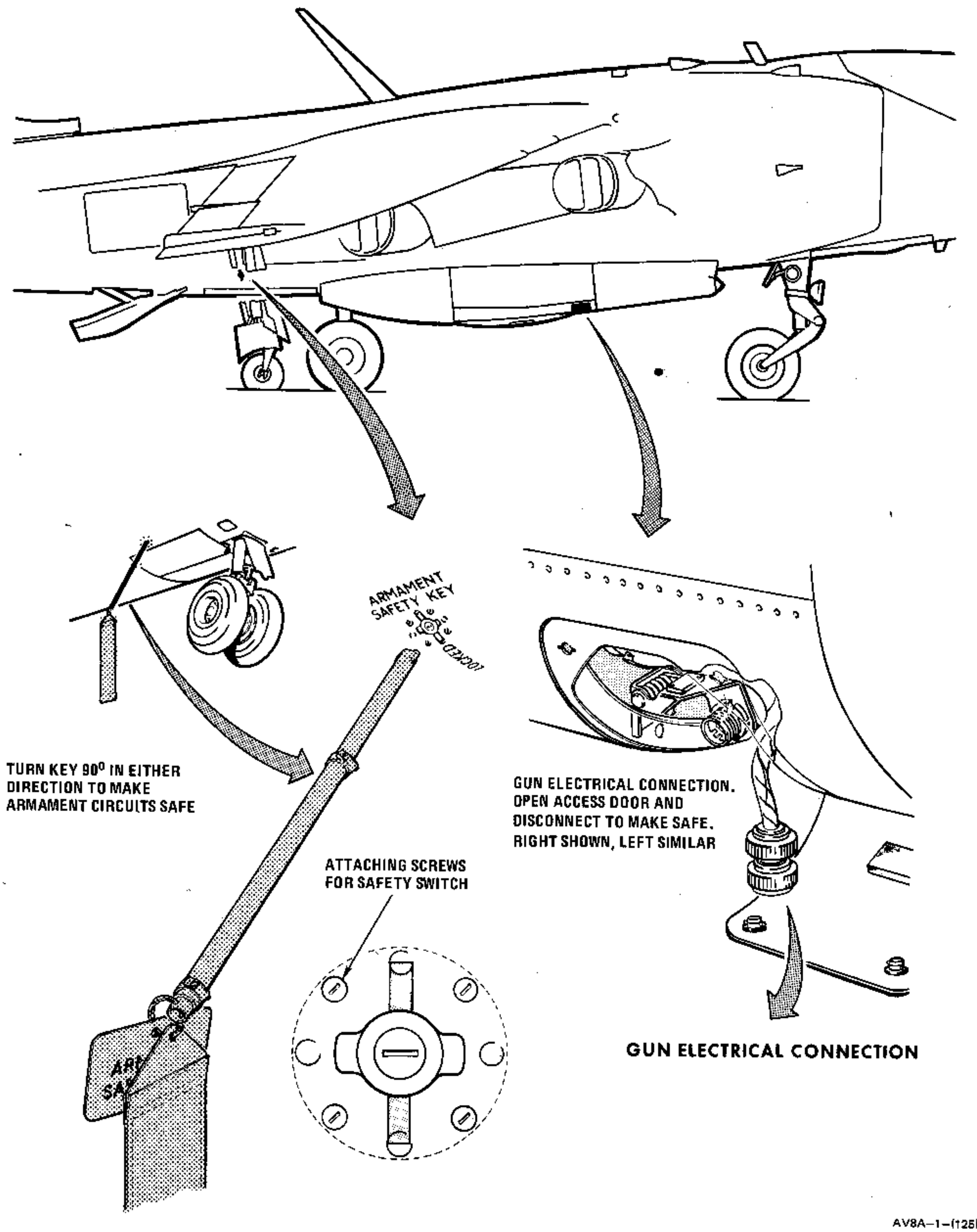


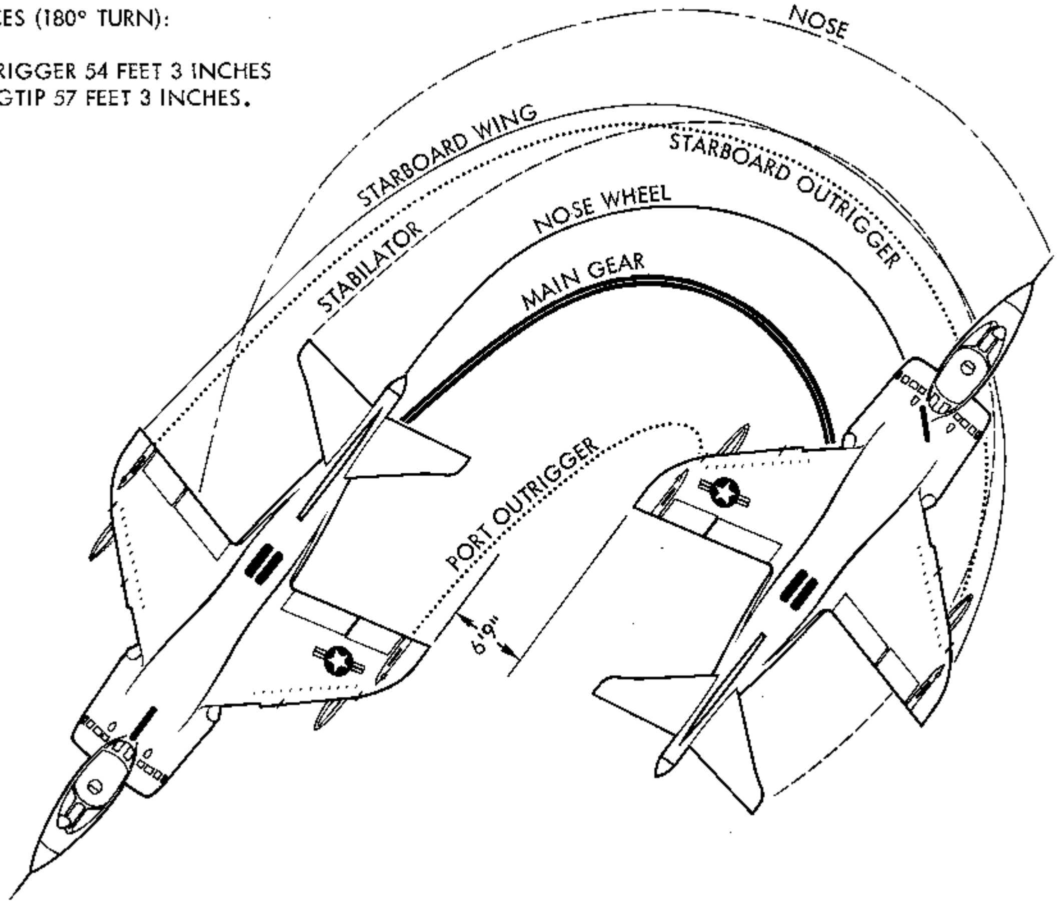
Figure 1-31

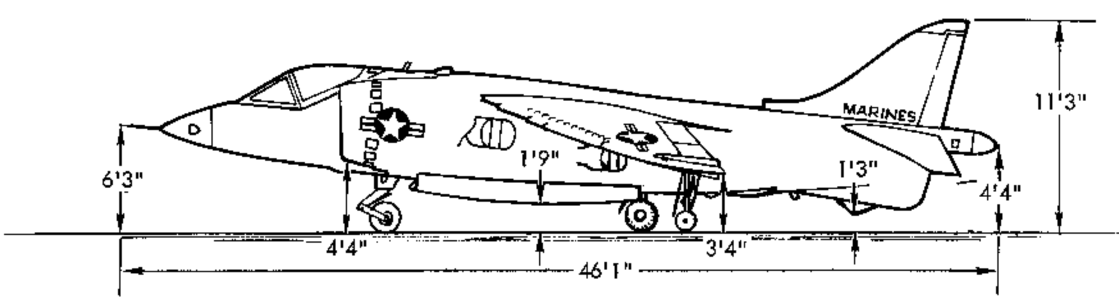
MINIMUM TURNING RADIUS AND GROUND CLEARANCE

NOTES

TURN USING MAXIMUM NOSE WHEEL STEERING ANGLE (45°)

OFFSET DISTANCES (180° TURN):
℄ TO ℄ 32 FEET.
OUTBOARD OUTRIGGER 54 FEET 3 INCHES
OUTBOARD WINGTIP 57 FEET 3 INCHES.

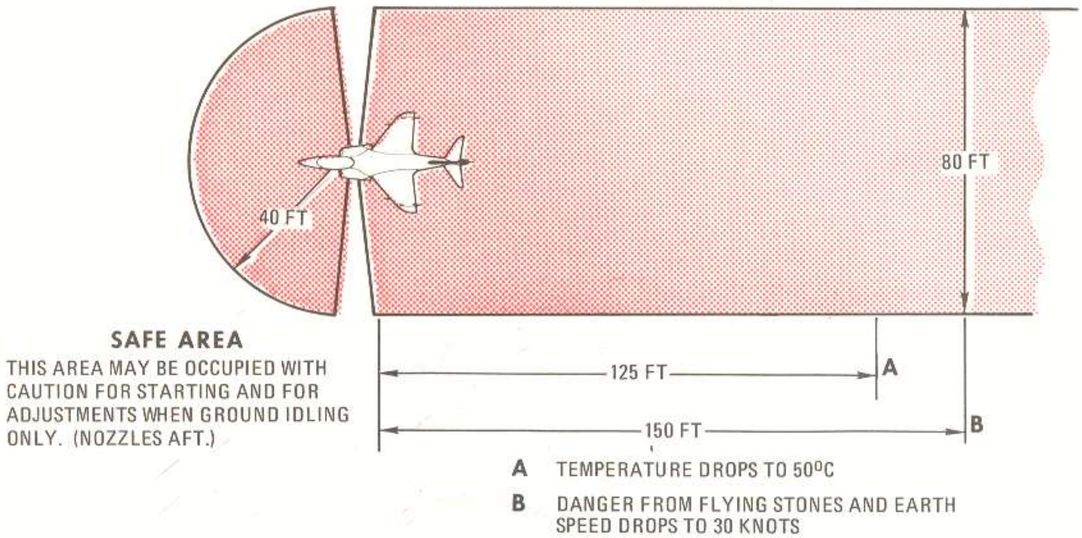




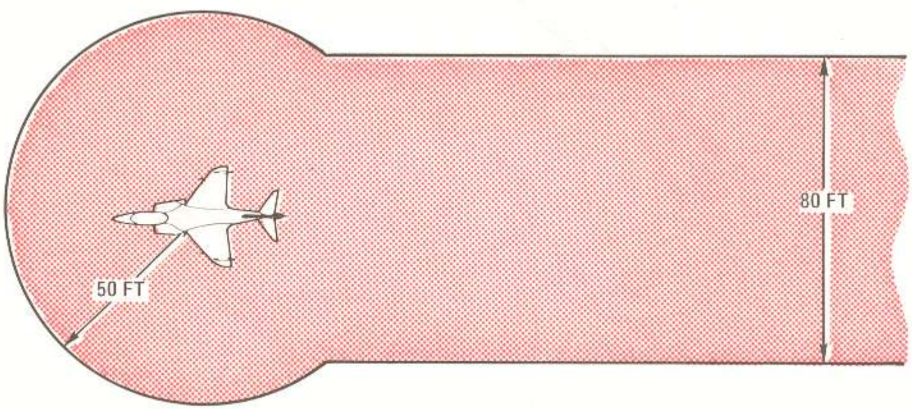
AV8A-1-(9)

Figure 1-32

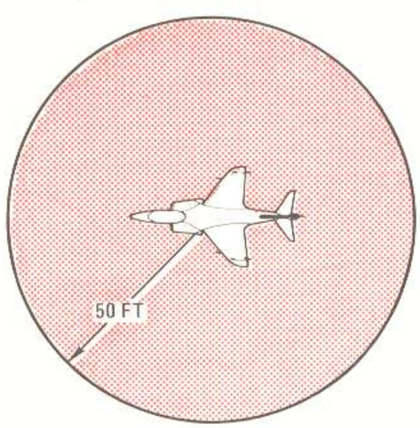
DANGER AREAS



NOZZLES AFT TO 45° DOWN



NOZZLES FROM 45° DOWNWARDS



NOTE

PERSONNEL SHOULD AVOID BEING OUT OF THE PILOT'S VIEW DURING VERTICAL TAKEOFF, VERTICAL LANDING OR HOVERING UNLESS THEY ARE BY A FIXED OBSTRUCTION KNOWN TO THE PILOT.

NOZZLES DOWN

AV8A-1-(151)
R

Figure 1-33

EXTERNAL FIRE ACCESS POINTS

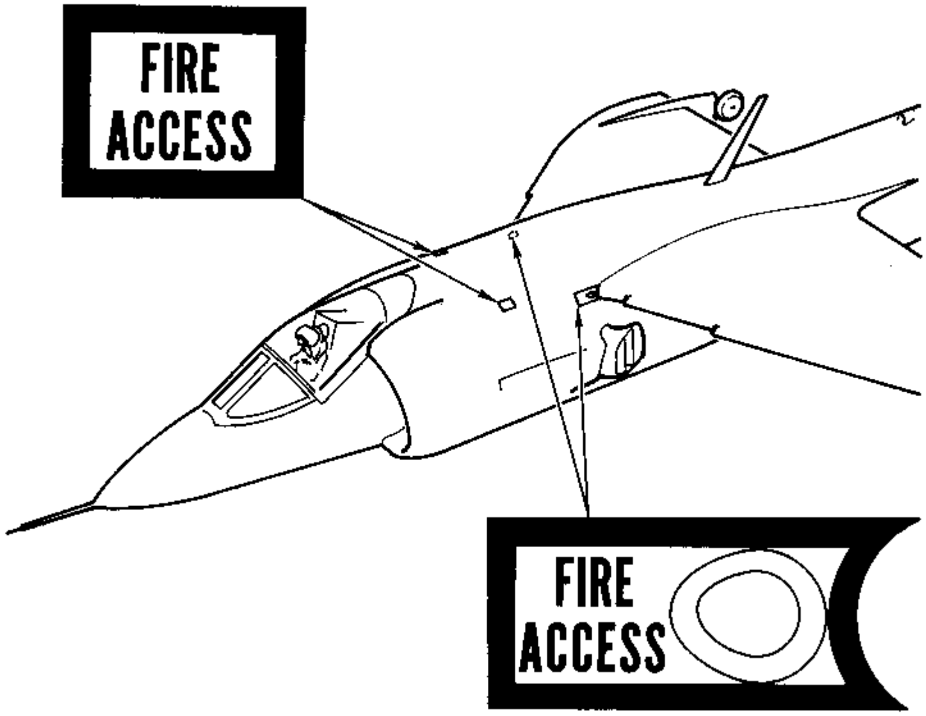
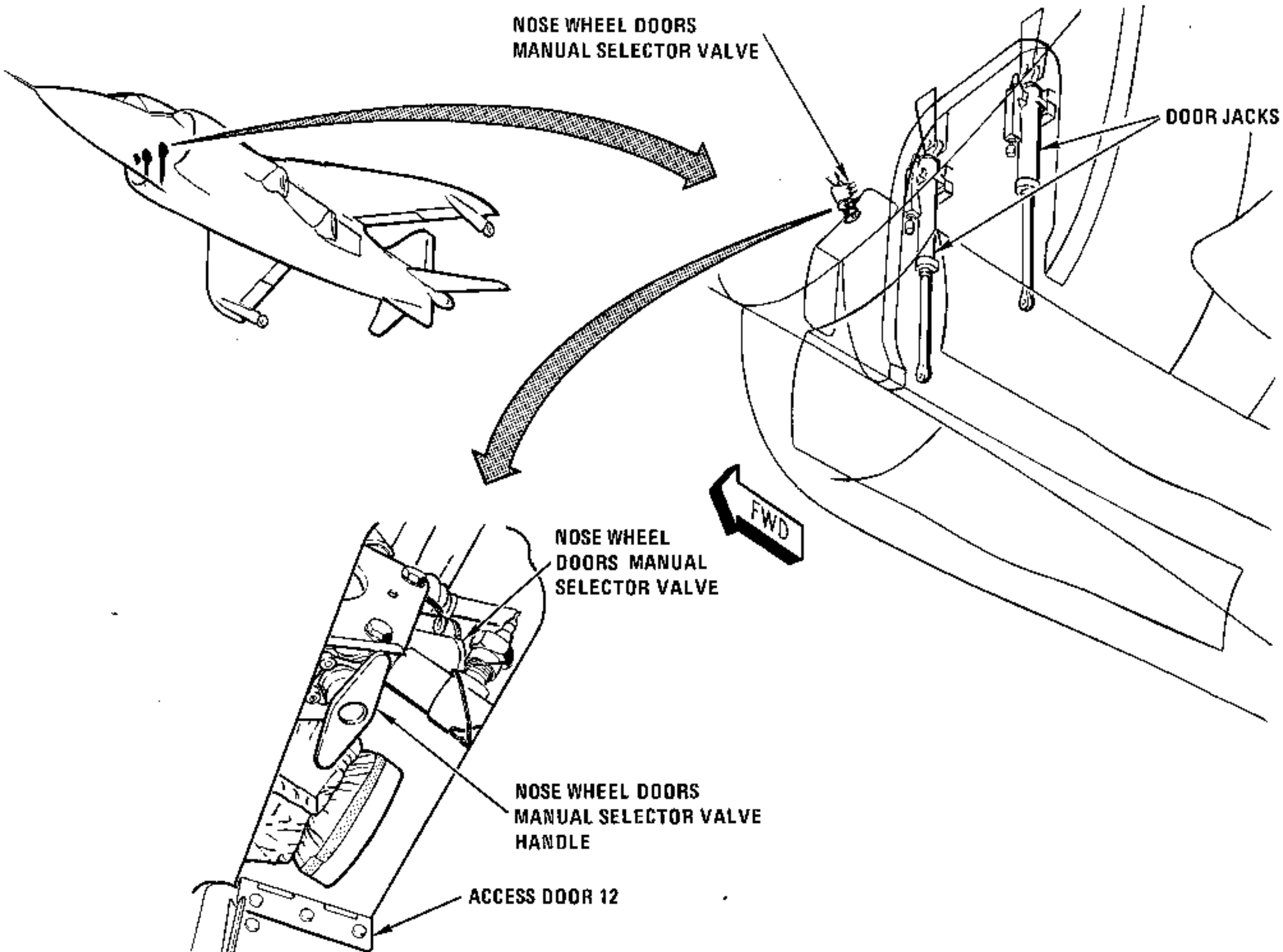


Figure 1-34

NOSEWHEEL DOORS OPENING AND CLOSING



GROUND SUPPORT EQUIPMENT

PART NO. TYPE DESIGNATION	NOMENCLATURE
B273837	HYDRAULIC PUMP HANDLE
NC-10B	EXTERNAL ELECTRICAL POWER SOURCE

1. NOSEWHEEL DOORS OPENING
   a. OPEN DOOR 12 (NAVAIR 01–AV8A–2–5).
   b. PULL NOSEWHEEL DOORS MANUAL SELECTOR VALVE HANDLE OUT TO OPEN DOORS. IF DOORS DO NOT OPEN, OPERATE HYDRAULIC HAND PUMP.
   c. INSTALL NOSEWHEEL DOORS MANUAL SELECTOR VALVE AND NOSEWHEEL DOOR JACK GROUND SAFETY LOCKS (NAVAIR 01–AV8A–2–5).

WARNING

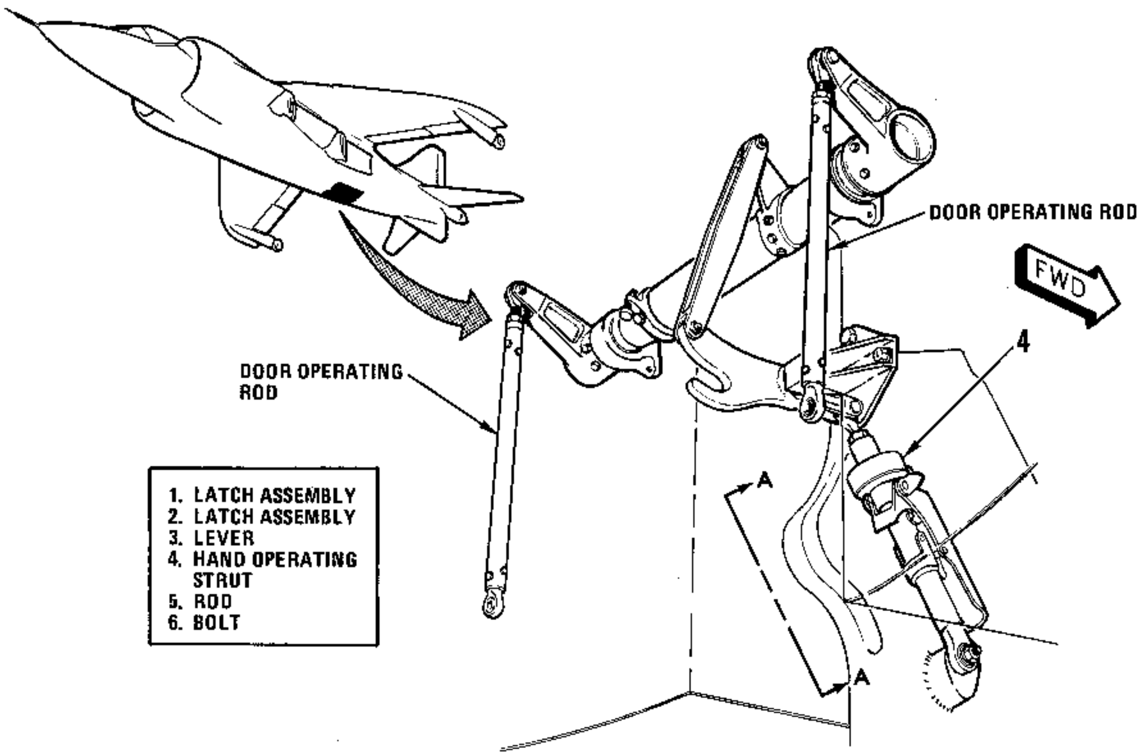
ENSURE PERSONNEL ARE CLEAR OF DOORS BEFORE ACTUATING NOSEWHEEL DOOR MANUAL SELECTOR VALVE.

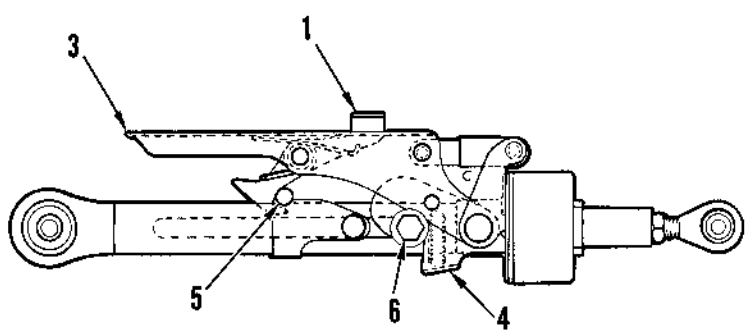
2. NOSEWHEEL DOORS CLOSING
   a. REMOVE NOSEWHEEL DOORS MANUAL SELECTOR VALVE AND NOSEWHEEL DOORWHEEL DOOR JACK GROUND SAFETY LOCKS (NAVAIR 01–AV8A–2–5).
   b. PUSH NOSEWHEEL DOORS MANUAL SELECTOR VALVE HANDLE FULLY IN.
   c. APPLY EXTERNAL ELECTRICAL POWER (NAVAIR 01–AV8A–2–5).
   d. DEPRESS DOWN BUTTON ON LANDING GEAR SELECTOR SWITCH.
   e. APPLY HYDRAULIC PRESSURE WITH HYDRAULIC HAND PUMP UNTIL DOORS ARE IN CLOSED POSITION.
   f. REMOVE EXTERNAL ELECTRICAL POWER (NAVAIR 01–AV8A–2–5).
   g. CLOSE DOOR 12 (NAVAIR 01–AV8A–2–5).

AV8A–1–(145)

Figure 1-35

MAIN LANDING GEAR DOORS OPENING AND CLOSING





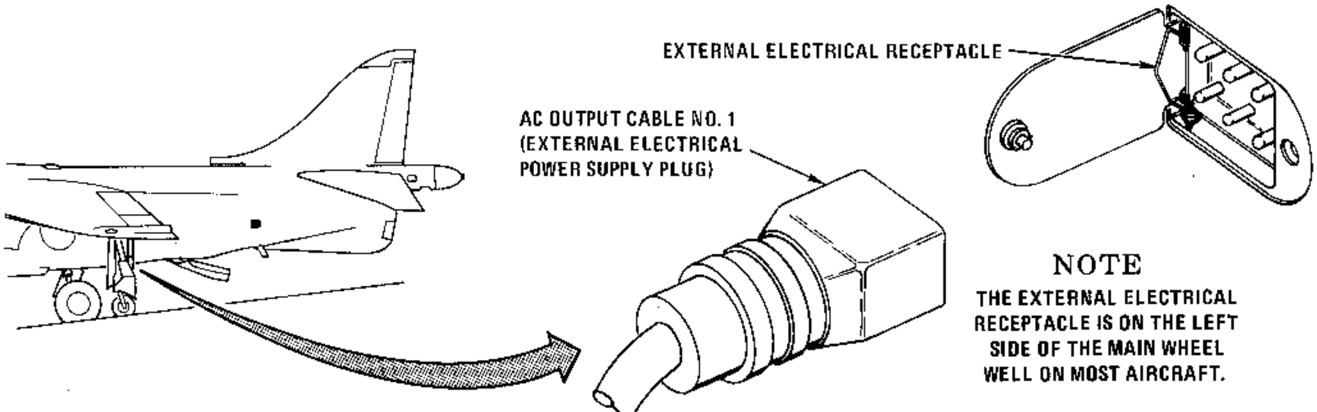
VIEW A-A

1. MAIN LANDING GEAR DOORS OPENING.
2. PROCEDURE.
   a. DEPRESS LATCH ASSEMBLY (1) ON HAND OPERATING STRUT (4).
   b. PULL LEVER (3) FORWARD AND ALLOW HAND OPERATING STRUT TO EXTEND BY WEIGHT OF DOORS.
   c. INSTALL MAIN LANDING GEAR GROUND SAFETY LOCK (NAVAIR 01-AV8A-2-5).
3. MAIN LANDING GEAR DOORS CLOSING.
4. PROCEDURE.
   a. MANUALLY LIFT DOORS TO CLOSE POSITION.
   b. DOORS WILL CLOSE AND LOCK WHEN LATCH ASSEMBLIES (1) AND (2) ENGAGE WITH ROD (5) AND BOLT (6) RESPECTIVELY WHEN DOORS REACH CLOSED POSITION.

AV8A-1-(146)

Figure 1-36

EXTERNAL ELECTRICAL POWER APPLICATION



NOTE

THE EXTERNAL ELECTRICAL RECEPTACLE IS ON THE LEFT SIDE OF THE MAIN WHEEL WELL ON MOST AIRCRAFT.

GROUND SUPPORT EQUIPMENT

PART NO./ TYPE DESIGNATION	NOMENCLATURE
NC-10B OR MMG2	POWER SOURCE, EXTERNAL ELECTRICAL

WARNING

TO AVOID INJURY TO PERSONNEL OR DAMAGE TO AIRCRAFT ENSURE SAFETY DEVICES ARE INSTALLED.

1. EXTERNAL ELECTRICAL POWER APPLICATION.

a. INSTALL GROUND SAFETY DEVICES. REFER TO NAVAIR 01-AV8A-2-5.
b. EXTEND SPEED BRAKE. REFER TO NAVAIR 01-AV8A-2-1.1 WP 022 00.

WARNING

TO AVOID INJURY TO PERSONNEL OR DAMAGE TO AIRCRAFT EQUIPMENT ENSURE SPEED BRAKE IS GROUND LOCKED.

c. GROUND LOCK SPEED BRAKE. REFER TO NAVAIR 01-AV8A-2-5.
d. GROUND AIRCRAFT TO EARTH. REFER TO NAVAIR 01-AV8A-2-5. (GROUND POINTS ARE ON FRAME 10 ON THE NOSE WHEEL BAY AND STARBOARD OF FRAME 39 BELOW THE DISTRIBUTION PANEL.)

CAUTION

TO PREVENT DAMAGE TO AIR TEMPERATURE PROBE FUSE 182 IN DISTRIBUTION PANEL MUST BE REMOVED, WHEN WEIGHT IS OFF MAIN LANDING GEAR STRUT.

e. IF WEIGHT IS OFF MAIN LANDING GEAR STRUT REMOVE FUSE 182 (NAVAIR 01-AV8A-2-3.4 WP 021 00).

CAUTION

TO AVOID DAMAGE TO AIRCRAFT EQUIPMENT PROTECTIVE COVERS MUST BE REMOVED FROM REAR EQUIPMENT COMPARTMENT AIR INTAKE AND EXHAUST BEFORE APPLYING EXTERNAL ELECTRICAL POWER.

f. REMOVE PROTECTIVE COVERS FROM REAR EQUIPMENT COMPARTMENT AIR INTAKE AND EXHAUST. REFER TO NAVAIR 01-AV8A-2-5.
g. OPEN DOOR 57.

CAUTION

TO AVOID DAMAGE TO AIRCRAFT EQUIPMENT DO NOT ATTEMPT TO APPLY EXTERNAL ELECTRICAL POWER TO AIRCRAFT WITH GTS/APU IN OPERATION.

h. ALIGN EXTERNAL ELECTRICAL POWER SUPPLY PLUG WITH EXTERNAL ELECTRICAL RECEPTACLE IN MAIN WHEEL WELL OR DOOR 57 AND PUSH IN UNTIL FULLY SEATED.
i. SET COCKPIT CONTROL SWITCHES TO POSITIONS INDICATED IN TABLE 1.

NOTE

REFER TO NAVAIR 01-AV8A-2-2.3 WP 006 00 IF STEP J OR M FAIL.

j. SET BATT NO. 1 AND BATT NO. 2 SWITCHES TO ON (FORWARD).

DC LIGHT (AMBER) COMES ON
DC LIGHT (RED) COMES ON
BATT VOLTMETER – APPROX. 24.5 VOLT DC

CAUTION

TO AVOID DAMAGE TO AIRCRAFT EQUIPMENT ENSURE BATT NO. 1 AND BATT NO. 2 SWITCHES ARE SET TO ON (FORWARD) PRIOR TO AND DURING APPLICATION OF EXTERNAL ELECTRICAL POWER.

k. START EXTERNAL ELECTRICAL POWER SUPPLY AND ALLOW VOLTAGE AND FREQUENCY TO STABILIZE.
l. DEPRESS ON SWITCH, (AC OUTPUT NO. 1 FOR AC OUTPUT CABLE NO. 1 OR AC OUTPUT NO. 2 FOR AC OUTPUT CABLE NO. 2) ON EXTERNAL ELECTRICAL POWER SUPPLY, AND RELEASE.
m. OBSERVE AIRCRAFT LIGHTS AND INDICATORS FOR THE FOLLOWING INDICATIONS:

DC LIGHT (RED) GOES OUT
DC LIGHT (AMBER) GOES OUT
BATT VOLTMETER – APPROX 28.0 VOLT DC
NO. 1 AC POWER ON LIGHTS
A, B AND C COME ON
NO. 2 AC POWER ON LIGHTS
A, B AND C COME ON

n. DEPRESS DC RESET SWITCH AND RELEASE.

AV8A-1-(144-1)A

Figure 1-37 (Sheet 1 of 2)

2. DISCONNECTING EXTERNAL ELECTRICAL POWER.

WARNING

TO AVOID INJURY TO PERSONNEL OR DAMAGE TO AIRCRAFT EQUIPMENT ENSURE HYDRAULIC POWER IS REMOVED BEFORE DISCONNECTING EXTERNAL ELECTRICAL POWER.

a. IF EXTERNAL HYDRAULIC POWER IS USED, REMOVE EXTERNAL HYDRAULIC POWER. REFER TO NAVAIR 01-AV8A-2-5.

b. DEPRESS OFF SWITCH (AC OUTPUT NO. 1 FOR AC OUTPUT CABLE NO. 1, AC OUTPUT NO. 2 FOR AC OUTPUT CABLE NO. 2) ON EXTERNAL ELECTRICAL POWER SUPPLY, AND RELEASE.
RESULT: BATT VOLTMETER – APPROX 24.5 VOLT DC
DC LIGHT (RED) COMES ON.
DC LIGHT (AMBER) COMES ON
NO. 1 AC POWER ON LIGHTS A, B AND C GO OUT.
NO. 2 AC POWER ON LIGHTS A, B AND C GO OUT.

c. SET BATT NO. 1 AND BATT NO. 2 SWITCHES TO OFF (VERTICAL).
RESULT: DC LIGHT (RED) GOES OUT.
DC LIGHT (AMBER) GOES OUT
BATTERY VOLTMETER – POINTER FAR LEFT

d. DISCONNECT EXTERNAL ELECTRICAL SUPPLY PLUG FROM RECEPTACLE IN DOOR 57.

e. CLOSE DOOR 57. (MAINTENANCE ASSURANCE)

f. INSTALL PROTECTIVE COVERS ON REAR EQUIPMENT COMPARTMENTS AIR INTAKE AND EXHAUST. REFER TO NAVAIR 01-AV8A-2-5.

g. INSTALL FUSE 182 (NAVAIR 01-AV8A-2-3.4 WP 021 00) IF REMOVED. (MAINTENANCE ASSURANCE)

TABLE I GROUND CHECKLIST

GROUND CHECKLIST (PRIOR TO APPLYING EXTERNAL ELECTRICAL POWER)		
CONTROLS	COCKPIT LOCATION	POSITION
Cabin air switch	Switches and selector mounting bracket assembly, starboard console aft end.	OFF
Eqpt, bay cool switch	Switches and selector mounting bracket assembly, starboard console aft end.	Set Off
GTS/APU Mode selector switch	Starboard console, aft.	Off
TACAN switch	Starboard console, forward	Off
Ignition isolation Switch	Below right canopy sill.	NORM
Wing fuel jett Port and Stbd switches	Starboard glareshield.	Off (aft)
Pump port switch	Starboard side panel.	pulled
Pump stbd switch	Starboard side panel.	pulled
Flow Prop switch	Starboard side panel.	on
Guns switches	Weapons control panel. Below main instrument panel port side.	P/Off S/Off
Bombs/Rockets/ Sidewinder switch	Sidewinder control panel, below main instrument panel, port side.	Bombs/Rockets On
Arm Masters 1 and 2 switches	Sidewinder control panel, below main instrument panel, port side.	Safe
Ground Test Switch	Sidewinder control panel, below main instrument panel, port side.	Cover down
U/C emergency extend switch	Above forward end of port console.	Locked in (red band on plunger not visible)
Undercarriage Selector DOWN button	Above forward end of port console.	Depressed
Anti Skid switch	Above forward end of port console.	Skid Off NWS On
MANL FUEL switch	Left console, forward.	Off
Throttle Control Lever	Port console, denter.	H. P. COCK OFF (full aft)
L.P. FUEL shut off valve	Aft of port console.	OFF
Gun Trigger	Control column.	Stowed
Bomb/RP Safety flap	Control column.	Lowered
Gun Safety Catch	Control column.	SAFE

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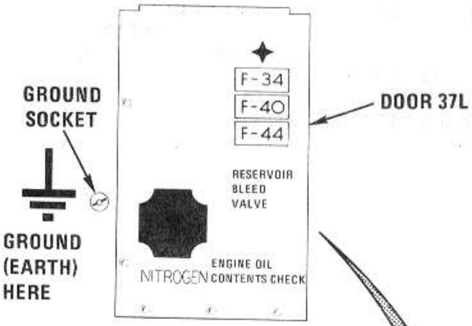
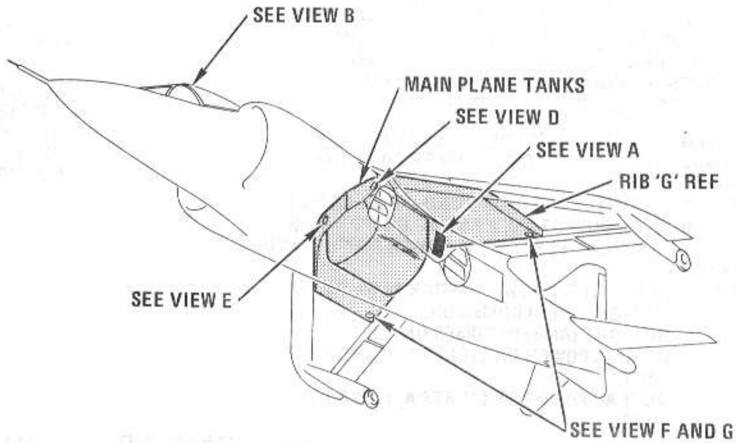
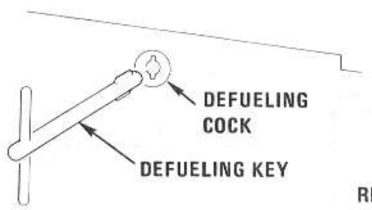
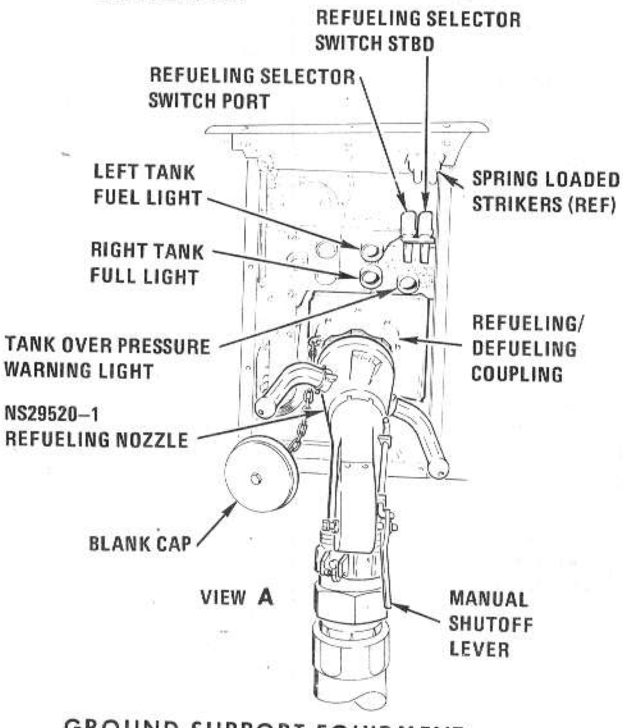
Figure 1-37 (Sheet 2 of 2)

REFUEL/DEFUEL PROCEDURES









GROUND SUPPORT EQUIPMENT

PART NO.	NOMENCLATURE
MMG2 OR NC10	POWER SOURCE, EXTERNAL ELECTRICAL EQUIPMENT, FUEL SERVICING
A24193	KEY, DEFUELING
A273190	PIPE, FUEL DRAIN

MATERIALS
LOCKWIRE

GENERAL

1. THE AIRCRAFT IS REFUELED AND DEFUELED THROUGH A STANDARD 1.5 INCH REFUELING/DEFUELING COUPLING IN DOOR 37L. THE FUEL SYSTEM IS DESIGNED TO BE PRESSURE FUELED AT 50 PSI, NOT TO EXCEED 55 PSI. EXTERNAL ELECTRICAL POWER IS NOT REQUIRED DURING REFUELING EXCEPT WHEN SETTING POUNDS REMAINING INDICATOR IN COCKPIT. ALL TANKS ARE VENTED THROUGH THE VENT (MAST) EXTENSION ON LOWER RIGHT SIDE OF FUSELAGE, JUST AFT OF NOSEWHEEL DOORS.

REFUELING

2. REFUELING PRECAUTIONS.

CAUTION

FAILURE TO COMPLY WITH THE FOLLOWING PRECAUTIONS COULD RESULT IN DAMAGE TO AIRCRAFT. SPECIFIC INSTRUCTIONS GOVERNING THE HANDLING OF FUEL ARE CONTAINED IN THE HANDBOOK ON AIRCRAFT REFUELING NAVAIR 06-5-502.

a. GROUND AIRCRAFT AND REFUELING EQUIPMENT.
b. PLACE REFUELING CART AS FAR FROM AIRCRAFT AS THE LENGTH OF THE REFUELING HOSE WILL PERMIT, TO PREVENT IGNITION OF FUEL VAPORS BY THE POWER PLANT OF THE REFUELING CART.
c. REFUELING SHOULD NOT BE CONDUCTED WITHIN 100 FEET OF AN AIRCRAFT WITH ENGINES OPERATING.
d. REFUELING SHOULD NOT BE CONDUCTED WITHIN 100 FEET OF OPERATING AIRBORNE TYPE RADIO OR RADAR EQUIPMENT OR WITHIN 300 FEET OF GROUND RADAR EQUIPMENT.
e. INSPECT FUEL SYSTEM VENT FOR OBSTRUCTIONS.
f. ENSURE THAT ONLY THE ELECTRICAL CIRCUITS ESSENTIAL FOR REFUELING ARE ON.
g. ENSURE THAT ADEQUATE FIRE FIGHTING EQUIPMENT IS AVAILABLE.

3. NORMAL REFUELING.
a. GROUND AIRCRAFT AND REFUELING EQUIPMENT.
b. ENSURE L.P. FUEL SHUTOFF HANDLE IS OFF.
c. USING DEFUELING KEY ENSURE DEFUELING COCK IS CLOSED. (VIEW A.)
d. OPEN DOOR 37L. ATTACH GROUND WIRE FROM REFUELING NOZZLE TO AIRCRAFT BONDING SOCKET (GROUNDING RECEPTACLE). SEE VIEW A.
e. REMOVE BLANK CAP FROM AIRCRAFT COUPLING.
f. INSERT REFUELING NOZZLE INTO THE AIRCRAFT REFUELING COUPLING BY PUSHING NOZZLE IN AND TURNING CLOCKWISE TO LOCKED POSITION.

AV8A-1-(142-1)

Figure 1-38 (Sheet 1 of 4)

REFUEL/DEFUEL PROCEDURES (CONTINUED)

WARNING

TO PREVENT FUEL SPILLAGE, RESULTING IN POSSIBLE FIRE AND/OR EXPLOSION, ENSURE REFUELING NOZZLE IS LOCKED INTO POSITION.

g. ENSURE REFUELING NOZZLE IS FULLY ENGAGED CLOCKWISE UNTIL NOZZLE RESISTS FURTHER TURNING. LOCK NOZZLE INTO POSITION BY PLACING THE MANUAL SHUTOFF LEVER IN FULL OPEN POSITION.
h. ENSURE REFUELING NOZZLE CANNOT BE ROTATED AND DISCONNECTED.

CAUTION

TO PREVENT POSSIBLE DAMAGE TO FUEL SYSTEM, FUEL PRESSURE FROM SERVICING EQUIPMENT SHALL NOT EXCEED 55 PSI.

i. ENSURE AIRCRAFT IS RECEIVING THE PROPER FUEL (JP-5), THEN POSITION FUEL CONTENTS, PORT AND STARBOARD REFUELING SWITCHES TO GROUND REFUEL POSITION (SWITCH TOGGLES UP) AND START REFUELING.
j. ENSURE PORT AND STBD TANK FULL LIGHTS ARE ON. (VIEW A.)
k. IF TANKS BECOME OVERPRESSURIZED DURING REFUELING, THE TANK OVER PRESS WARNING LIGHT (DOOR 37L) WILL COME ON. IF THIS OCCURS STOP REFUELING IMMEDIATELY AND INVESTIGATE CAUSE.
l. AFTER 60 TO 120 GALLONS OF FUEL HAVE ENTERED TANKS ENSURE AIR IS VENTING FROM VENT (MAST) EXTENSION ON LOWER RIGHT SIDE OF FUSELAGE, JUST AFT OF NOSEWHEEL DOORS.
m. WHEN TANKS ARE FULL EACH REFUELING VALVE WILL CLOSE AUTOMATICALLY, REFUELING CIRCUITS WILL DEENERGIZE AND PORT AND STBD TANKS LIGHTS WILL GO OUT. IF FUEL FLOW DOES NOT STOP AUTOMATICALLY, FUEL SPILLAGE FROM VENT (MAST) EXTENSION WILL RESULT AND THE FOLLOWING STEPS SHOULD BE PERFORMED IMMEDIATELY:
   (1) STOP FUEL SERVICE OPERATION IMMEDIATELY AND TURN OFF FUEL SERVICING EQUIPMENT.
   (2) DISCONNECT REFUELING NOZZLE FROM REFUELING COUPLING, THEN DISCONNECT REFUELING NOZZLE GROUND WIRE.
   (3) NOTIFY FIRE DEPARTMENT AND TAKE ACTION TO RENDER THE AREA SAFE PRIOR TO MOVING AIRCRAFT OR GROUND SUPPORT EQUIPMENT.
n. STOP REFUELING EQUIPMENT.
o. IF REFUELING FOR FIRST TIME SINCE DEFUELING PERFORM THE FOLLOWING:

NOTE

ON FIRST REFUELING SINCE DEFUELING, AIR IS TRAPPED IN PIPE BELOW DEFUELING COCK. THE FOLLOWING PROCEDURE IS TO RELEASE THIS AIR.

UNLESS EXTERNAL ELECTRICAL POWER IS ON, BATT NO. 1 AND BATT NO. 2 SHOULD ONLY BE ON FOR AS SHORT A TIME AS POSSIBLE TO MINIMIZE LOSS OF BATTERY CHARGE.

   (1) POSITION COCKPIT BATT NO. 1 AND BATT NO. 2 ON. (VIEW B)
   (2) PUSH COCKPIT PUMP PORT AND PUMP STBD SWITCHES (CIRCUIT BREAKERS) IN.
   (3) INSERT DEFUELING KEY IN FUSELAGE KEYHOLE AND TURN COUNTERCLOCKWISE THROUGH 90° TO OPEN DEFUELING COCK. THE AIR WILL THEN BE HEARD BUBBLING UP INTO THE REFUELING GALLERY PIPE.
   (4) WHEN BUBBLING STOPS, TURN KEY CLOCKWISE TO CLOSE COCK THEN REMOVE KEY.
   (5) PULL PUMP PORT AND PUMP STBD SWITCHES.
   (6) POSITION BATT NO. 1 AND BATT NO. 2 OFF.
   (7) START REFUELING EQUIPMENT AND TOP OFF TO REQUIRED FUEL QUANTITY.
p. OBSERVE FUEL QUANTITY INDICATORS FOR CORRECT FUEL CAPACITIES (VIEW A). REFER TO TABLE 1. IF FUEL CAPACITIES ARE INCORRECT, CROSS CHECK AIRCRAFT AND FUEL SERVICING EQUIPMENT FUEL GAGE READING.

NOTE

FUEL CONTENTS, PORT AND STARBOARD REFUELING SWITCHES AUTOMATICALLY RETURN TO THE FLIGHT POSITION (SWITCH TOGGLES DOWN) ON CLOSING DOOR 37L.

q. TURN OFF FUEL SERVICING EQUIPMENT.

WARNING

TO PREVENT THE POSSIBILITY OF STATIC ELECTRICITY ARCING WHICH COULD CAUSE FIRE AND/OR EXPLOSION, RESULTING IN INJURY TO PERSONNEL, DISCONNECT REFUELING NOZZLE BEFORE DISCONNECTING REFUELING NOZZLE GROUND WIRE.

r. DISCONNECT REFUELING NOZZLE FROM REFUELING ADAPTER AND INSTALL REFUELING COUPLING BLANK CAP, THEN DISCONNECT REFUELING NOZZLE GROUND WIRE.
s. CLOSE DOOR 37L. (MAINTENANCE ASSURANCE)
t. WHEN REFUELING IS COMPLETED AND A.C. POWER AVAILABLE, SET FUEL POUNDS REMAINING INDICATOR TO QUANTITY GIVEN BY FUEL QUANTITY INDICATORS. PULL AND ROTATE DATUM RESETTING KNOB, ON FRONT FACE OF INDICATOR, CLOCKWISE TO INCREASE AND COUNTERCLOCKWISE TO DECREASE READING.

4. PARTIAL REFUELING. THE AIRCRAFT CAN BE PARTIALLY REFUELED BY USING NORMAL REFUELING PROCEDURE, BUT IT IS IMPORTANT TO ENSURE THE PORT AND STARBOARD TANK GROUPS ARE CORRECTLY BALANCED ON COMPLETION OF REFUELING. THIS IS ACCOMPLISHED BY DIVIDING THE REQUIRED FUEL LOAD BY TWO AND REFUELING EACH TANK GROUP INDEPENDENTLY BY SELECTING CONTENTS, PORT OR STBD REFUELING SWITCH. USE THE FUEL QUANTITY INDICATORS TO ENSURE THE QUANTITY OF FUEL IN EACH SIDE IS THE SAME.

DEFUELING

5. DEFUELING PRECAUTIONS ARE THE SAME AS REFUELING PRECAUTIONS, EXCEPT FOR STEP F.
6. DEFUELING WITH AIR PRESSURE.
   a. GROUND AIRCRAFT, DEFUELING EQUIPMENT AND EXTERNAL POWER EQUIPMENT.
   b. CONNECT EXTERNAL ELECTRICAL POWER BUT DO NOT APPLY AT THIS TIME.
   c. ENSURE L.P. FUEL SHUTOFF HANDLE IS OFF.
   d. INSERT DEFUELING KEY IN FUSELAGE KEY HOLE AND TURN COUNTERCLOCKWISE THROUGH 90° TO OPEN DEFUELING COCK. (VIEW A)
   e. OPEN DOOR 37L. ATTACH GROUND WIRE FROM DEFUELING NOZZLE TO AIRCRAFT GROUNDING RECEPTACLE.
   f. REMOVE BLANK CAP FROM AIRCRAFT COUPLING.
   g. INSERT REFUELING NOZZLE INTO AIRCRAFT DEFUELING COUPLING BY PUSHING NOZZLE IN AND TURNING CLOCKWISE TO LOCKED POSITION.

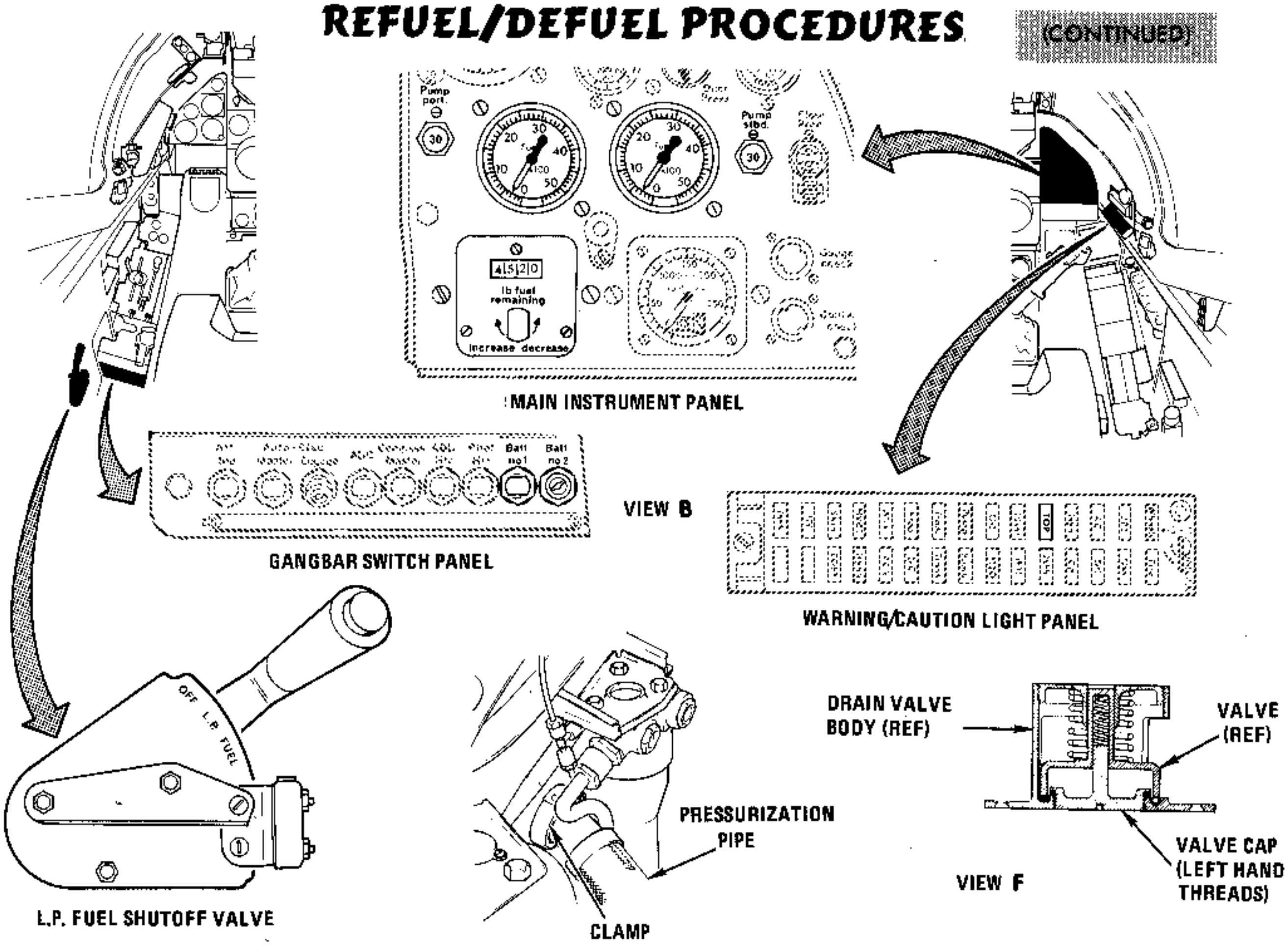
WARNING

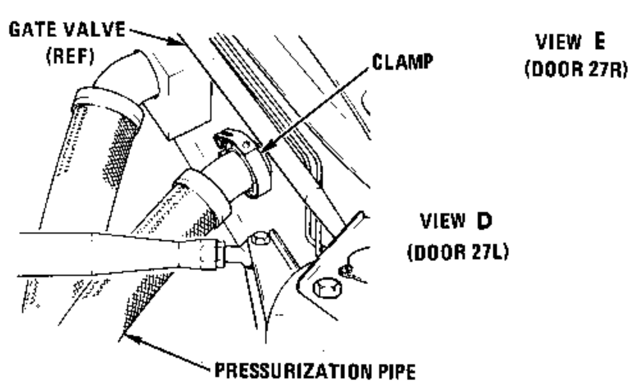
TO PREVENT FUEL SPILLAGE, RESULTING IN POSSIBLE FIRE AND/OR EXPLOSION, ENSURE REFUELING NOZZLE IS LOCKED INTO POSITION.

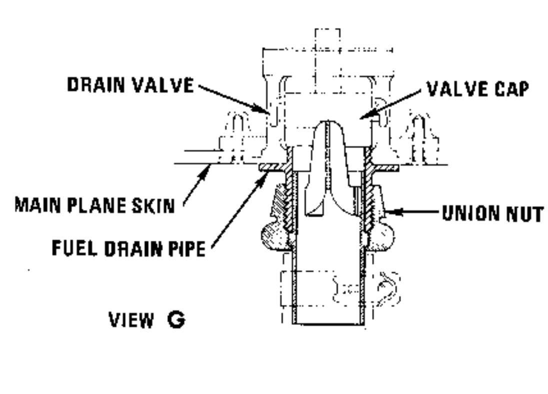
AV8A 1-(142-2)

Figure 1-38 (Sheet 2 of 4)

REFUEL/DEFUEL PROCEDURES (CONTINUED)







h. ENSURE DEFUELING NOZZLE IS FULLY ENGAGED CLOCKWISE UNTIL NOZZLE RESISTS FURTHER TURNING. LOCK NOZZLE INTO POSITION BY PLACING THE MANUAL SHUTOFF LEVER IN FULL OPEN POSITION.
i. ENSURE REFUELING NOZZLE CANNOT BE ROTATED AND DISCONNECTED.
j. OPEN DOOR 22R. REMOVE BLANKING CAP AND CONNECT EXTERNAL AIR SOURCE TO EXTERNAL AIR SUPPLY CONNECTION. (VIEW C.)
k. START FUEL SERVICING EQUIPMENT AND BEGIN DEFUELING.
l. SLOWLY APPLY 10 TO 150 PSI TO FUEL SYSTEM.
m. IF FUEL QUANTITY INDICATORS INDICATE THAT ONLY ONE TANK GROUP IS EMPTY TURN ON EXTERNAL ELECTRICAL POWER, POSITION BATT NO. 1 AND BATT NO. 2 ON AND REDUCE DEFUELING RATE TO 35 GALLONS PER MINUTE. (VIEW B.)

NOTE

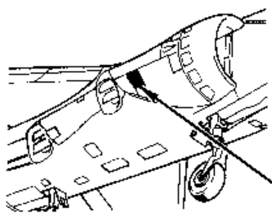
COMPLETELY EMPTY SYSTEM WILL BE INDICATED BY FUEL QUANTITY GAGES IN COCKPIT AND AUDIBLY BY AN INCREASE IN PUMP SPEED.

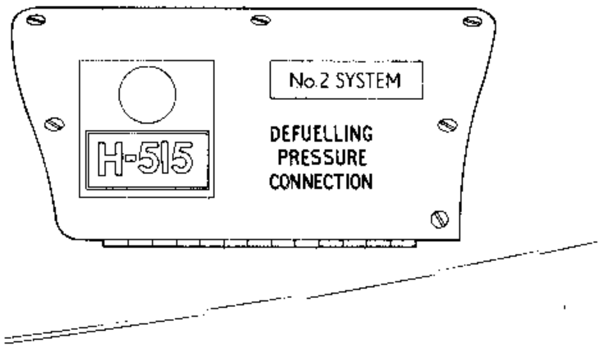
n. PUSH PUMP PORT OR PUMP STBD SWITCH (CIRCUIT BREAKER) IN (SWITCH APPLICABLE TO TANK GROUP WITH FUEL REMAINING) TO COMPLETELY EMPTY SYSTEM.
o. PULL PUMP PORT OR PUMP STBD SWITCH.
p. TURN OFF FUEL SERVICING EQUIPMENT.
q. REMOVE EXTERNAL ELECTRICAL POWER.
r. REMOVE EXTERNAL AIR SOURCE. INSTALL BLANKING CAP AND CLOSE DOOR 22R. (MAINTENANCE ASSURANCE)
s. TURN DEFUELING COCK THROUGH 90° AND REMOVE KEY. (MAINTENANCE ASSURANCE)

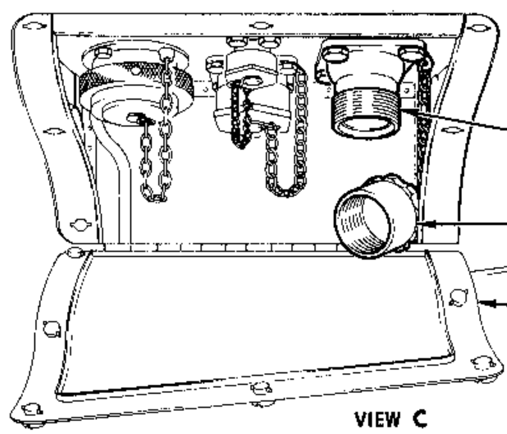
AV8A-1-(142-3)

Figure 1-38 (Sheet 3 of 4)

REFUEL/DEFUEL PROCEDURES (CONTINUED)







VIEW C

WARNING

TO PREVENT THE POSSIBILITY OF STATIC ELECTRICITY ARCHING WHICH COULD CAUSE FIRE AND/OR EXPLOSION, RESULTING IN INJURY TO PERSONNEL, DISCONNECT DEFUELING NOZZLE BEFORE DISCONNECTING DEFUELING NOZZLE GROUND WIRE.

t. REMOVE DEFUELING NOZZLE FROM DEFUELING COUPLING AND INSTALL BLANK CAP, THEN DISCONNECT DEFUELING NOZZLE GROUND WIRE.
u. CLOSE DOOR 37L. (MAINTENANCE ASSURANCE)

7. DEFUELING WITHOUT AIR PRESSURE. THE AIRCRAFT CAN BE DEFUELED AT A SLOWER RATE WITHOUT AIR PRESSURE. THE PROCEDURE IS IDENTICAL TO THAT OF DEFUELING WITH AIR PRESSURE, BUT OMIT STEPS J, L AND R.
8. DEFUELING INTERNAL WING TANKS.

CAUTION

TO PREVENT DAMAGE TO ENGINE, SPECIAL CARE MUST BE TAKEN TO AVOID FOREIGN OBJECTS FALLING INTO ENGINE BAY.

a. OPEN DOORS 27L AND 27R.
b. REMOVE CLAMPS ON LEFT AND RIGHT PRESSURIZATION PIPES. (VIEWS D AND E.)
c. LOOSEN VALVE CAP (LEFT HAND THREADS) IN MAIN PUMP UNTIL THEY ARE FREE TO MOVE UPWARDS INTO THE VALVE BODY. (VIEW F.)
d. PLACE HOSE END OF FUEL DRAIN PIPE INTO A SUITABLE CONTAINER. INSTALL OPPOSITE END IN DRAIN VALVE THEN TIGHTEN UNION NUT TO FULLY OPEN VALVE. (VIEW G.)
e. WHEN DEFUELING IS COMPLETE REMOVE FUEL DRAIN PIPE.
f. TIGHTEN VALVE CAP (LEFT HAND THREADS).
g. INSTALL PRESSURIZATION PIPES AND CLAMPS. TORQUE CLAMPS TO TORQUE STAMPED ON CLAMPS AND SAFETY CLAMP NUT WITH LOCKWIRE. (MAINTENANCE ASSURANCE)
h. CLOSE DOORS 27L AND 27R. (MAINTENANCE ASSURANCE)

TABLE 1. FUEL CAPACITY

TANKS	US GALLONS	POUNDS JP-5	IMPERIAL GALLONS	LITERS
PORT FRONT TANK	61	415	51	232
STARBOARD FRONT TANK	61	415	51	232
PORT CENTER (FEED) TANK	46	213	38	175
STARBOARD CENTER (FEED) TANK	46	213	38	175
REAR TANK	124	843	103	480
[1] PORT MAIN PLANE (INTERNAL WING) TANK	208	1322	173	790
[1] STARBOARD MAIN PLANE (INTERNAL WING) TANK	208	1322	173	790
TOTAL INTERNAL FUEL	754	4743	627	2874
PORT EXTERNAL WING TANK	120	817	100	456
STARBOARD EXTERNAL WING TANK	120	817	100	456
TOTAL INTERNAL AND EXTERNAL TANKS	994	6377	827	3786

[1] 8.6 US GALLONS ADDITIONAL FUEL PER TANK IS AVILABLE WHEN EXTERNAL TANKS ARE FITTED.

2. FUEL WEIGHTS ARE BASED ON 6.8 POUNDS (JP-5) PER GALLON AT 60°F FUEL TEMPERATURE. IF GREATER ACCURACY IS REQUIRED, THE FUEL DENSITY SHOULD BE DETERMINED.
3. ADJUSTMENTS TO THE ACCELERATION CONTROL UNIT WILL BE NECESSARY ON CHANGING TO A FUEL OF DIFFERENCE DENSITY SUCH AS JP-4. REFER TO NAVAIR 01-AV8A-2-3.4, WP 004 00.

AV8A-1-(142-4)

Figure 1-38 (Sheet 4 of 4)

OXYGEN SYSTEM SERVICING

BEFORE AFC 85

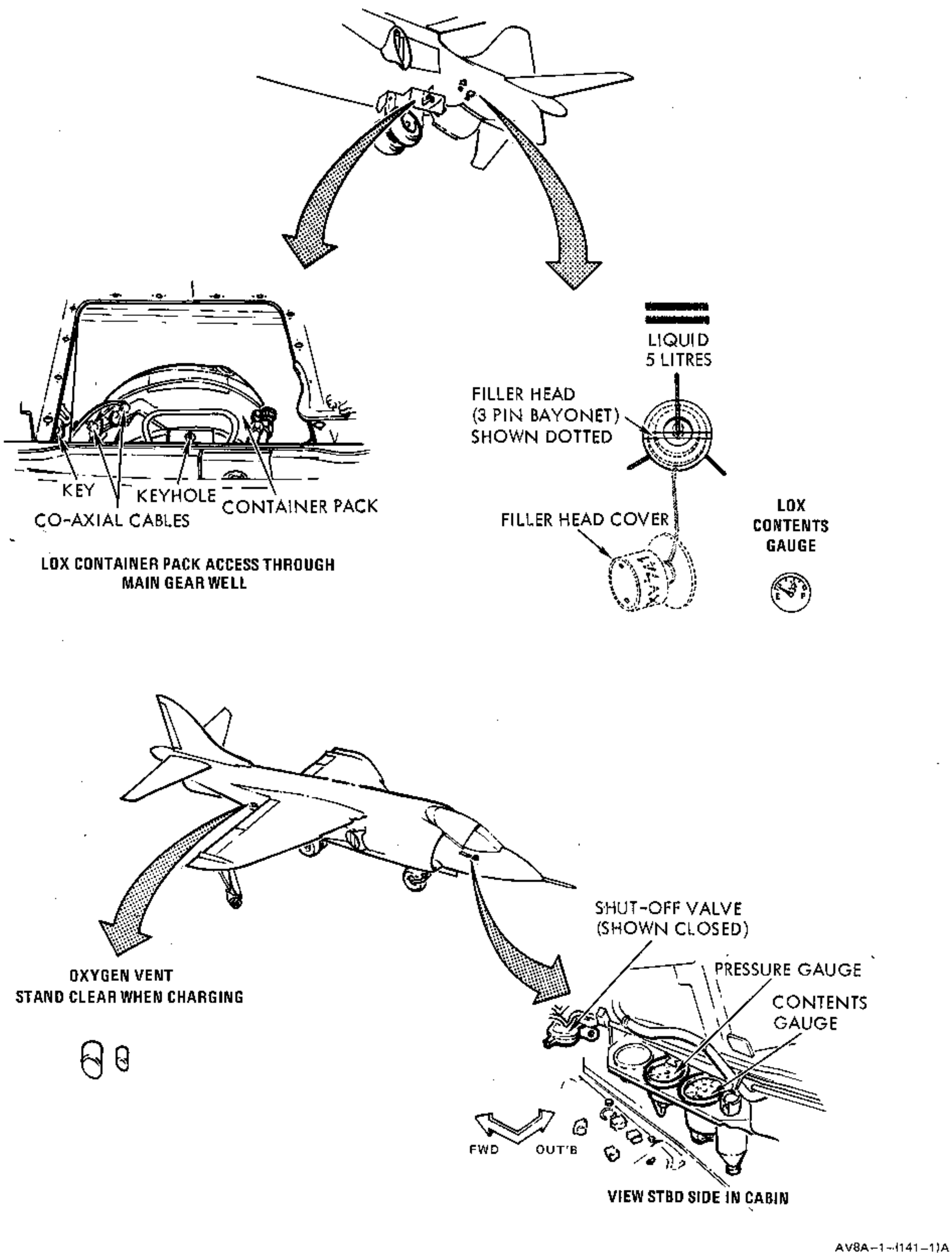


Figure 1-39 (Sheet 1 of 4)

GROUND SUPPORT EQUIPMENT REQUIRED

PART NO. TYPE DESIGNATION	NOMENCLATURE
1890-0051-52	CART, OXYGEN CHARGING

SERVICING WITH CONTAINER INSTALLED IN AIRCRAFT

OXYGEN SYSTEM..........WP00600

1. PROCEDURE

WARNING

DUE TO THE HAZARDS INVOLVED WHEN HANDLING LIQUID OXYGEN, THE FOLLOWING SAFETY PRECAUTIONS MUST BE OBSERVED DURING SERVICING OPERATION:

- THE AREA IN THE VICINITY OF THE AIRCRAFT MUST BE OPEN, WELL VENTILATED, AND FREE OF OIL, GREASE, AND OTHER HIGHLY COMBUSTIBLE LIQUIDS.
- THE AIRCRAFT MUST NOT BE REFUELED DURING LIQUID OXYGEN SERVICING.
- ELECTRICAL POWER MUST NOT BE APPLIED AND THE AIRCRAFT MUST BE WELL GROUNDED.
- SERVICING PERSONNEL MUST WEAR PROTECTIVE CLOTHING.
- ALL PERSONNEL SHOULD STAND CLEAR OF THE SYSTEM VENTS TWO THROUGH THE FUSELAGE STARBOARD SKIN BELOW THE REAR EQUIPMENT BAY DOOR AND ONE POINTING TO STARBOARD IN THE SPEED BRAKE WELL.
- A CO_2 EXTINGUISHER SHOULD BE AVAILABLE AND ANY FLAME PRODUCING ACTIVITY MUST NOT BE LESS THAN 50 FEET FROM THE SERVICING OPERATION.

a. PLACE OXYGEN CHARGING CART IN A SUITABLE LOCATION ON LEFT SIDE OF AIRCRAFT.
b. ENSURE SHUT OFF VALVE IN COCKPIT IS IN OFF POSITION.
c. REMOVE COVER FROM FILLER CONNECTION ON FILLER, BUILD-UP, VENT AND RELIEF VALVE.

CAUTION

ENSURE TRANSFER HOSE AND FILLER, BUILD-UP, VENT AND RELIEF VALVE FILLER CONNECTIONS ARE THOROUGHLY CLEAN AND DRY.

d. PURGE CHARGING CART TRANSFER HOSE.
e. CONNECT TRANSFER HOSE TO FILLER CONNECTION ON FILLER, BUILD-UP, VENT AND RELIEF VALVE AND NOTE TIME.

NOTE

GASEOUS OXYGEN WILL BE DISCHARGED FROM FILLER, BUILD-UP, VENT AND RELIEF VALVE VENT WHILE SERVICING.

f. ADJUST OXYGEN CHARGING CART PRESSURE TO 50 PSI AND CONTINUE FILLING UNTIL LIQUID OXYGEN SPILLS FROM FILLER, BUILD-UP, VENT AND RELIEF VALVE VENT. DETERMINE ELAPSED FILLING TIME. THE FILLING TIME MUST NOT EXCEED 6 MINUTES
g. CLOSE VALVE ON OXYGEN CHARGING CART AND DISCONNECT TRANSFER HOSE.
h. INSTALL COVER ON FILLER CONNECTION. NOTE TIME.
i. PLACE BATT NO. 1 AND BATT NO. 2 SWITCHES ON. ENSURE THAT CONTENTS GAUGES IN THE COCKPIT AND AT THE CHARGING POINT, INDICATE F (FULL).
j. PLACE BATT NO. 1 AND BATT NO.2 SWITCHES OFF'
k. CHECK PRESSURE BUILDUP TIME. FROM TIME OF COMPLETION OF FILLING, THE SUPPLY PRESSURE GAUGE SHALL INDICATE 50 PSI IN 4 MINUTES AND REACH THE NORMAL WORKING PRESSURE OF 70 PSI WITHIN A MAXIMUM OF 6 MINUTES.

NOTE

AFTER FILLING, A SLIGHT LEAK MAY OCCUR FROM THE CONTAINER RELIEF VALVE VENT. THIS IS NORMAL AND SHOULD CEASE IN APPROXIMATELY 10 MINUTES. AFTER FILLING, THE CONTENTS GAUGE POINTERS MAY CREEP PAST THE F (FULL) MARK. THIS IS DUE TO THE PHYSICAL PROPERTIES OF THE LIQUID AND THE CONTENTS GAUGE SYSTEM MUST NOT BE ADJUSTED.

SERVICING BY LOX CONTAINER PACKAGE REPLACEMENT.

2. PROCEDURE REMOVE EMPTY CONTAINER PACKAGE FROM AIRCRAFT AND REPLACE WITH FULLY SERVICED CONTAINER.

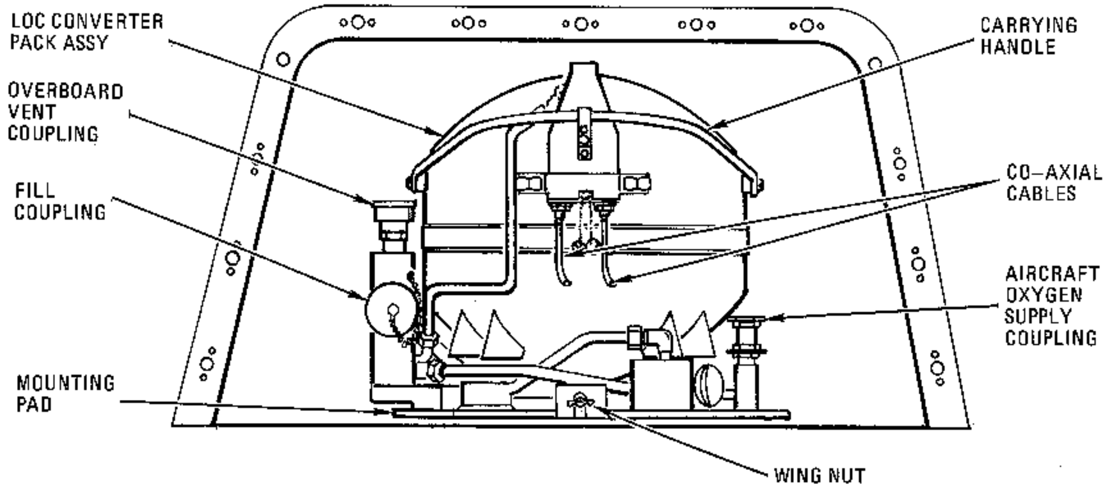
AV8A-1 (141-2)A

Figure 1-39 (Sheet 2 of 4)

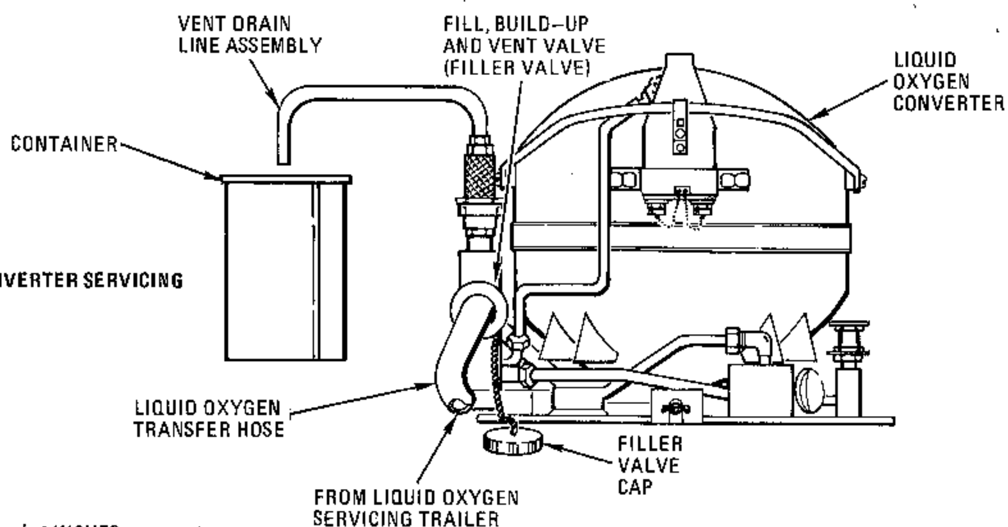
OXYGEN SYSTEM SERVICING

AFTER AFC 85

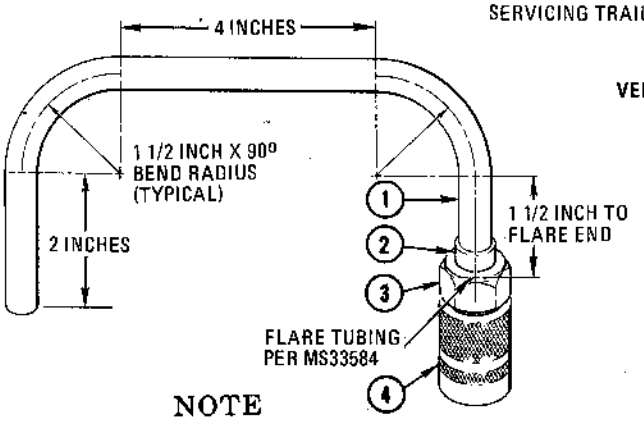
AFT END OF MAIN WHEEL WELL



LIQUID OXYGEN CONVERTER SERVICING



VENT DRAIN LINE ASSEMBLY



NOTE

PROCEDURE STANDARD PARTS SPECIFIED AS OXYGEN CLEAN. FABRICATED PARTS SHALL BE CLEANED SUITABLE FOR USE WITH LIQUID OXYGEN.

FABRICATION MATERIAL LIST

INDEX NO.	NOMENCLATURE	PART NO.
1	TUBING	1/2 INCH OD X 0.035 INCH WALL THICKNESS, 5052-0 PER MIL-STD-WW-T-787
2	SLEEVE	MS20819-8
3	COUPLING NUT	AN818-8D
4	VENT LINE QUICK DISCONNECT COUPLING	MS22068-8 (256000-1, ESSEX MFG. CO.; 1700-1, AIRBORNE RESEARCH AND DEVELOPMENT CORP.; OR EQUIVALENT)

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Figure 1-39 (Sheet 3 of 4)

GROUND SUPPORT EQUIPMENT REQUIRED

PART NO. TYPE DESIGNATION	NOMENCLATURE
1890-0051-52	CART, OXYGEN CHARGING

SERVICING WITH CONTAINER OUT OF AIRCRAFT

WARNING

DUE TO THE HAZARDS INVOLVED WHEN HANDLING LIQUID OXYGEN, THE FOLLOWING SAFETY PRECAUTIONS MUST BE OBSERVED DURING SERVICING OPERATION:

- THE AREA IN THE VICINITY OF THE SERVICING OPERATION MUST BE OPEN, WELL VENTILATED, AND FREE OF OIL, GREASE, AND OTHER HIGHLY COMBUSTIBLE LIQUIDS.
- THE AIRCRAFT MUST NOT BE REFUELED DURING LIQUID OXYGEN SERVICING.
- ELECTRICAL POWER MUST NOT BE APPLIED TO THE AIRCRAFT.
- SERVICING PERSONNEL MUST WEAR PROTECTIVE CLOTHING.
- ALL PERSONNEL SHOULD STAND CLEAR OF THE VENT DRAIN LINE.
- A CO_2 EXTINGUISHER SHOULD BE AVAILABLE AND ANY FLAME PRODUCING ACTIVITY MUST NOT BE LESS THAN 50 FEET FROM THE SERVICING OPERATION.

REMOVAL

a. PLACE BATT NO. 1 AND BATT NO. 2 SWITCHES OFF
b. ENSURE SHUTOFF VALVE IN COCKPIT IS IN OFF POSITION.
c. REMOVE ACCESS PANEL IN AFT END OF MAIN WHEEL WELL.
d. DISCONNECT TWO CO-AXIAL LEADS AND STOW.
e. DISCONNECT AIRCRAFT OXYGEN SUPPLY COUPLING.
f. DISCONNECT OVERBOARD VENT COUPLING.
g. LOOSEN WING NUT UNTIL SWIVEL BOLT CAN BE ROTATED DOWNWARD.
h. PULL CONVERTER FORWARD AND REMOVE WHILE HOLDING CARRYING HANDLE.

SERVICING

i. PLACE OXYGEN CHARGING CART AND LOX CONVERTER PACK ASSY. IN A SUITABLE LOCATION.
j. INSTALL VENT DRAIN LINE ASSY. TO OVERBOARD VENT COUPLING.
k. REMOVE COVER FROM FILLER CONNECTION ON FILLER, BUILD-UP, VENT AND RELIEF VALVE.

CAUTION

ENSURE TRANSFER HOSE AND FILLER, BUILD-UP, VENT AND RELIEF VALVE FILLER CONNECTIONS ARE THOROUGHLY CLEAN AND DRY.

l. PURGE CHARGING CART TRANSFER HOSE.
m. CONNECT TRANSFER HOSE TO FILLER CONNECTION ON FILLER, BUILD-UP, VENT AND RELIEF VALVE AND NOTE TIME.

NOTE

GASEOUS OXYGEN WILL BE DISCHARGED FROM FILLER, BUILD-UP, VENT AND RELIEF VALVE VENT WHILE SERVICING.

n. ADJUST OXYGEN CHARGING CART PRESSURE TO 50 PSI AND CONTINUE FILLING UNTIL LIQUID OXYGEN SPILLS FROM VENT DRAIN LINE. DETERMINE ELAPSED FILLING TIME. THE FILLING TIME MUST NOT EXCEED 6 MINUTES.
o. CLOSE VALVE ON OXYGEN CHARGING CART AND DISCONNECT TRANSFER HOSE.
p. INSTALL COVER ON FILLER CONNECTION. NOTE TIME. PLACE BATT NO. 1 AND BATT NO. 2 SWITCHES ON. ENSURE THAT CONTENTS GAUGES IN THE COCKPIT AND AT THE CHARGING POINT, INDICATE F (FULL).
q. PLACE BATT NO. 1 AND BATT NO. 2 SWITCHES OFF.
r. CHECK PRESSURE BUILDUP TIME. FROM TIME OF COMPLETION OF FILLING, THE SUPPLY PRESSURE GAUGE SHALL INDICATE 50 PSI IN 4 MINUTES AND REACH THE NORMAL WORKING PRESSURE OF 70 PSI WITHIN A MAXIMUM OF 6 MINUTES.

NOTE

AFTER FILLING, A SLIGHT LEAK MAY OCCUR FROM THE CONTAINER RELIEF VALVE VENT. THIS IS NORMAL AND SHOULD CEASE IN APPROXIMATELY 10 MINUTES. AFTER FILLING, THE CONTENTS GAUGE POINTERS MAY CREEP PAST THE F (FULL) MARK. THIS IS DUE TO THE PHYSICAL PROPERTIES OF THE LIQUID AND THE CONTENTS GAUGE SYSTEM MUST NOT BE ADJUSTED.

INSTALLATION

s. REVERSE PROCEDURES h THRU b.

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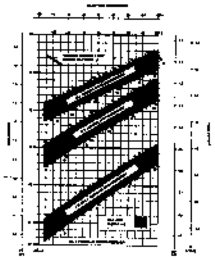
Figure 1-39 (Sheet 4 of 4)

PC-1, PC-2 RESERVOIR/ ACCUMULATOR SERVICING



GRAPH IS ON DOOR 34L

GROUND SUPPORT EQUIPMENT REQUIRED

PART NO./ TYPE DESIGNATION	NOMENCLATURE
	HOSE, 1/4 ID (APPROXIMATELY 2 FEET LENGTH)
E40-6603-1	CART, NITROGEN AND AIR SERVICING
772B-35798	ADAPTER KIT, TURNER

MATERIALS.

Lockwire
Fluid, hydraulic, MIL-H-5606A
Nitrogen or dry compressed air

NOTE

PC-1 AND PC-2 SYSTEM SERVICING IS BASICALLY THE SAME; THEREFORE, ONLY ONE PROCEDURE IS USED. DOOR NUMBERS QUOTED ARE L FOR PC-1 SYSTEM AND R FOR PC-2 SYSTEM. ANY OTHER DIFFERENCES WILL BE NOTED IN THE TEXT

RESERVOIR SERVICING

1. PROCEDURE

NOTE

GRAPHS ARE LOCATED ON 34L/R DOOR TO INDICATE RESERVOIR FULL ZONE AND RELATED NITROGEN PRESSURE FOR A RANGE OF MEAN FLUID TEMPERATURES. A THERMOMETER IS LOCATED ON REAR NOSEWHEEL DOOR. HYDRAULIC FLUID CAN BE CONSIDERED AS BEING AT AMBIENT TEMPERATURE APPROXIMATELY 1 HOUR ELAPSED TIME FROM ENGINE SHUTDOWN

a. BEFORE SERVICING HYDRAULIC SYSTEM RESERVOIR CHECK THAT ALL ACCUMULATORS ARE PROPERLY SERVICED WITH NITROGEN AND THE HYDRAULIC PRESSURE IS DISIPATED FROM THE FLIGHT CONTROLS. FOR PC-1, ALSO FOR THE FOLLOWING CONDITIONS: LANDING GEAR DOWN, FLAPS UP, SPEED BRAKE 25° OUT AND NOSEWHEEL DOORS OPEN. THE NOSEWHEEL STEERING AND WHEEL BRAKE ACCUMULATORS MAY BE IN EITHER OF THREE CONDITIONS; BOTH ACCUMULATORS PRESSURIZED, BOTH DEPRESSURIZED OR ONLY THE NOSEWHEEL STEERING DEPRESSURIZED (WHEEL BRAKE ACCUMULATOR MAY BE PRESSURIZED TO PERMIT PARKING BRAKE OPERATION).

b. OPEN 34L/R AND 37L/R DOORS, ILLUMINATE GAUGE BY PRESSING RUBBER COVER ON TOP OF FAIRING FORWARD OF ENGINE REAR NOZZLE.

NOTE

RESERVOIR GAUGE IS GRADUATED IN CUBIC INCHES x 10.

c. CHECK CONTENTS OF RESERVOIR, REFER TO GRAPH ON DOOR 34L, PLOT INTERSECTION OF FLUID CONTENT AND AMBIENT TEMPERATURE ON APPROPRIATE GRAPH. IF INTERSECTION IS WITHIN FULL ZONE OR ABOVE THE FLUID CONTENT IS SATISFACTORY. IF BELOW, NOTE QUANTITY OF FLUID REQUIRED TO BRING INTERSECTION TO MIDDLE OF FULL ZONE FOR AMBIENT TEMPERATURE.

d. IF RESERVOIR FLUID CONTENT IS SATISFACTORY CHECK RESERVOIR NITROGEN CHARGE AND OMIT STEPS e THROUGH m.

e. OPEN DOORS 22L/R AND 108L/R.

f. CONNECT 1/4 INCH I.D. HOSE TO RESERVOIR BLEED VALVE NIPPLE WITH OPEN END OF HOSE IN A SUITABLE CONTAINER, PRESS AND HOLD RESERVOIR BLEED VALVE BUTTON UNTIL AIR FREE FLUID FLOWS FROM HOSE.

g. REMOVE BYPASS COUPLING BLANKING CAP IN 22L/R DOOR.

h. PUMP HYDRAULIC OIL GUN SEVERAL STROKES TO PRIME OIL GUN OUTLET PIPE BEFORE CONNECTING TO AIRCRAFT.

CAUTION

WHEN USING HYDRAULIC OIL GUN WITH TRANSPARENT HOSE, IF A LARGE AIR BUBBLE APPEARS OR PUMP SUCKS AIR STOP PUMPING TO PREVENT AIR BEING PUMPED INTO RESERVOIR. DISCONNECT HOSE FROM AIRCRAFT AND REPLENISH HYDRAULIC FLUID SUPPLY IN GUN.

i. CONNECT HYDRAULIC OIL GUN TO BYPASS COUPLING IN 22L/R DOOR AND FILL RESERVOIR (APPROXIMATELY FIVE STROKES OF GUN WILL FILL RESERVOIR ONE MARK ON CONTENTS GAUGE).

j. IF RESERVOIR IS OVERFILLED ATTACH A HOSE TO BLEED VALVE IN 108L/R DOOR AND BLEED FLUID INTO SUITABLE CONTAINER. DO NOT REUSE FLUID THAT IS BLED OFF.

k. RECHECK RESERVOIR FLUID CONTENTS.

l. DISCONNECT HYDRAULIC OIL GUN FROM AIRCRAFT.

m. INSTALL CAP ON BYPASS COUPLING AND SECURE WITH LOCKWIRE. (MAINTENANCE ASSURANCE)

n. DETERMINE REQUIRED RESERVOIR NITROGEN CHARGE BY USING GRAPH ON 34L/R DOOR.

o. CONNECT ADAPTER AND GAUGE TO NITROGEN CHARGING VALVE IN DOOR 108L/R TO OBTAIN PRESSURE READING.

p. CONNECT NITROGEN SERVICING CART TO ADAPTER FITTING AND CHARGE RESERVOIR TO PROPER PRESSURE.

q. DISCONNECT NITROGEN CART AND REMOVE ADAPTER AND GAUGE. INSTALL CAP ON NITROGEN CHARGING VALVE AND SECURE WITH LOCKWIRE. (MAINTENANCE ASSURANCE)

r. CLOSE 22L/R, 34L/R, 108L/R AND 37L/R DOORS AS APPLICABLE. (MAINTENANCE ASSURANCE)

ACCUMULATOR

1. PROCEDURE

a. DISSIPATE HYDRAULIC PRESSURE BY OPERATING THE FLIGHT CONTROLS BEFORE CHECKING ACCUMULATOR NITROGEN CHARGE.

b. OPEN MAIN LANDING GEAR DOORS (NAVAIR 01-AV8A-2-5).

c. GAIN ACCESS TO ACCUMULATOR NITROGEN CHARGING VALVE ON LEFT (PC-1) RIGHT (PC-2) SIDE OF MAIN LANDING GEAR WELL AND REMOVE CAP FROM CHARGING VALVE.

d. CONNECT ADAPTER WITH 0 TO 1500 PSI PRESSURE GAUGE TO NITROGEN CHARGING VALVE, ACCUMULATOR PRESSURE SHOULD BE 1100 PSI.

e. WHEN PRESSURE IS BELOW 1100 PSI CONNECT NITROGEN CART TO ADAPTER AND SERVICE ACCUMULATOR TO PROPER PRESSURE.

f. DISCONNECT NITROGEN CART, ADAPTER AND PRESSURE GAUGE FROM CHARGING VALVE.

g. INSTALL CAP ON NITROGEN CHARGING VALVE AND LOCKWIRE CAP.

h. CLOSE MAIN LANDING GEAR DOORS (NAVAIR 01-AV8A-2-5).

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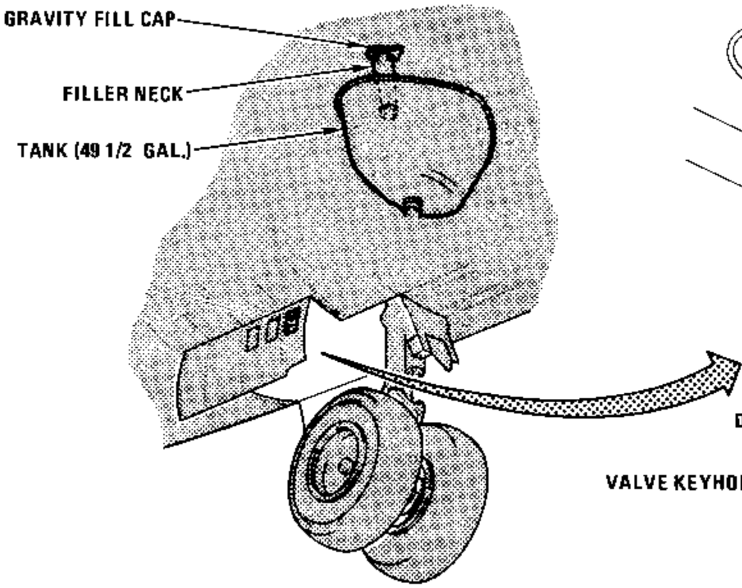
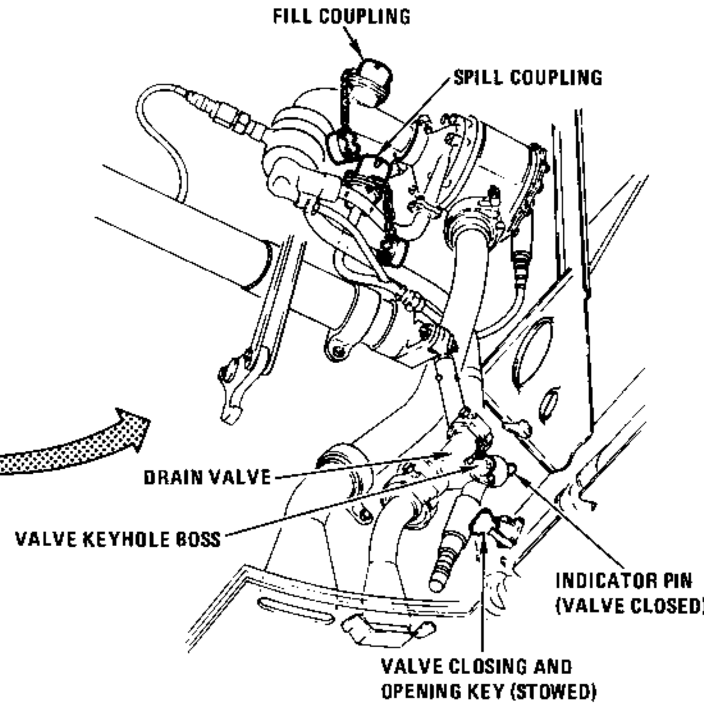
Figure 1-40

WATER INJECTION SYSTEM SERVICING





FILL AND SPILL COUPLINGS

GROUND SUPPORT EQUIPMENT

PART NO. TYPE DESIGNATION	NOMENCLATURE
26VA/6043433	UNIT, WATER SERVICING

MATERIALS
WATER, DISTILLED MS36300

1. PROCEDURE (PRESSURE FILL)

CAUTION

WHEN AIRCRAFT IS LEFT IN 0°C OR BELOW TEMPERATURE, DRAIN WATER SYSTEM BY OPENING SOLENOID/MANUAL DRAIN VALVE. FAILURE TO DRAIN SYSTEM WILL DAMAGE COMPONENTS IF FREEZING OCCURS.

a. ASSURE WATER ON–OFF–JETT SWITCH IS OFF, COCKPIT MAIN INSTRUMENT PANEL. (MAINTENANCE ASSURANCE)
b. CLOSE WATER DRAIN VALVE IN MAIN GEAR WELL BY TURNING WITH CAPTIVE KEY. INDICATOR PIN IS EXTENDED WHEN VALVE IS CLOSED. (MAINTENANCE ASSURANCE)

NOTE

FILL AND SPILL COUPLINGS ARE LOCATED ON AFT SIDE OF FRAME 29 IN MAIN GEAR WELL.

c. REMOVE CAPS FROM FILL AND SPILL COUPLINGS.

NOTE

FILL COUPLING IS UPPER COUPLING.

d. CONNECT WATER SERVICING UNIT TO FILL AND SPILL COUPLINGS. (MAINTENANCE ASSURANCE)

CAUTION

REPEATED USE OF NON DISTILLED OR DEMINERALIZED WATER WILL DETERIORATE ENGINE PERFORMANCE.

e. PUMP WATER INTO SYSTEM UNTIL WATER FLOWS FROM SPILL PIPE. (MAINTENANCE ASSURANCE)
f. MOVE NO. 1 AND NO. 2 BATT SWITCHES ON (COCKPIT CONSOLE) AND CHECK WATER TANK GAUGE (MAIN INSTRUMENT PANEL) READS 50 GALLONS. (MAINTENANCE ASSURANCE)
g. RETURN NO. 1 AND NO. 2 BATT. SWITCHES OFF.
h. DISCONNECT WATER SERVICING UNIT.
i. REPLACE FILL AND SPILL COUPLING CAPS AND ENSURE DRAIN VALVE KEY IS STOWED. (MAINTENANCE ASSURANCE)

2. PROCEDURE (GRAVITY FILL)
   a. ASSURE WATER ON–OFF–JETT SWITCH IS OFF, COCKPIT MAIN INSTRUMENT PANEL. (MAINTENANCE ASSURANCE)
   b. CLOSE WATER DRAIN VALVE IN MAIN GEAR WELL BY TURNING WITH CAPTIVE KEY. INDICATOR PIN IS EXTENDED WHEN VALVE IS CLOSED. (MAINTENANCE ASSURANCE)
   c. OPEN CAP ON TOP OF FUSELAGE MARKED WITH WATER SYMBOL.
   d. FILL TANK UNTIL WATER IS VISIBLE IN FILLER NECK. (MAINTENANCE ASSURANCE)
   e. MOVE NO. 1 AND NO. 2 BATT SWITCHES ON (COCKPIT LEFT CONSOLE) AND CHECK WATER TANK GAGE (MAIN INSTRUMENT PANEL) READS 50 GALLONS. (MAINTENANCE ASSURANCE)
   f. RETURN NO. 1 AND NO. 2 BATT SWITCHES OFF.
   g. CLOSE CAP. (MAINTENANCE ASSURANCE)

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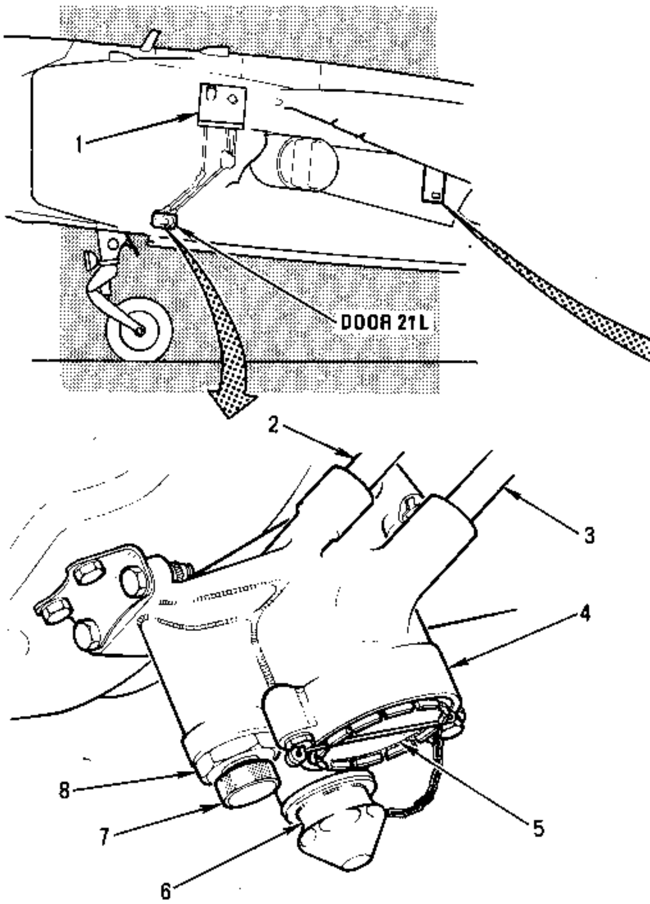
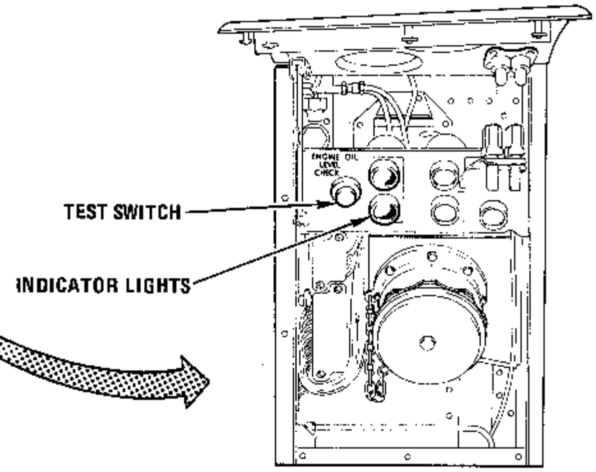
Figure 1-41

ENGINE OIL SERVICING





ENGINE OIL LEVEL TEST SWITCH
AND INDICATOR LIGHTS

1. OIL TANK
2. OVERFLOW PIPE
3. FILL AND DRAIN PIPE
4. FILTER HOUSING
5. FILTER PLUG
6. PRESSURE FILL AND DRAIN CONNECTION CAP
7. MAGNETIC DRAIN PLUG
8. OVERFLOW CONNECTION

GROUND SUPPORT EQUIPMENT

PART NO./TYPE DESIGNATION	NOMENCLATURE
580 LMT	ADAPTER
PON 6	PREOILER, PRESSURE

MATERIALS

OIL, TURBINE ENGINE, MIL-L-23699
LOCKWIRE

1. PROCEDURE

CAUTION

WHEN CHANGING TYPES OF OIL, DRAIN TANK AND SUMP BEFORE FILLING WITH ALTERNATE OIL. CHANGE OIL AGAIN WITHIN 5 OPERATING HOURS TO AVOID CONTAMINATING OIL SYSTEM. AFTER DRAINING SUMP, SERVICE OIL TANK AND PERFORM DRY MOTORING CYCLE. RESERVICE OIL TANK TO AVOID UNDERSERVICING.

a. OPEN DOOR 21L.
b. REMOVE MAGNETIC PLUG AND CHECK FOR PARTICLES. (MAINTENANCE ASSURANCE)
c. CONNECT DRAIN BOTTLE TO OVERFLOW CONNECTION USING ADAPTER.
d. REMOVE PRESSURE FILL AND DRAIN CONNECTION CAP.
e. CONNECT PON 6 HOSE TO PRESSURE FILL AND DRAIN CONNECTION USING ADAPTER.
f. FILL TANK UNTIL OIL OVERFLOW ENTERS DRAIN BOTTLE. (MAINTENANCE ASSURANCE)
g. SUBTRACT AMOUNT OF OIL IN DRAIN BOTTLE FROM OIL PUMPED FROM PON 6. THIS GIVES AMOUNT OF OIL USED BY ENGINE. RECORD ENGINE OIL CONSUMPTION. (MAINTENANCE ASSURANCE)
h. DISCONNECT DRAIN BOTTLE AND ADAPTER.
i. INSTALL DRAIN PLUG.
j. FOR FERRY FLIGHTS, ADDITIONAL OIL CAN BE ADDED.
   (1) OPEN DOOR 17L.
   (2) BREAK LOCKWIRE, REMOVE OIL TANK DIPSTICK.

   NOTE

   CORRECT OIL LEVEL IS INDICATED WHEN BOTTOM THREAD OF DIPSTICK IS RESTING ON TANK THREADS.

   (3) ADD OIL WITH PON 6 UNTIL OIL LEVEL REACHES "OIL LEVEL FOR FERRY FLIGHT" MARKED ON DIPSTICK. (MAINTENANCE ASSURANCE)
   (4) INSTALL DIPSTICK AND LOCKWIRE. (MAINTENANCE ASSURANCE)
   (5) CLOSE DOOR 17L. (MAINTENANCE ASSURANCE)
k. DISCONNECT PON 6 AND INSTALL PRESSURE FILL AND DRAIN CONNECTION CAP. (MAINTENANCE ASSURANCE)
l. CLOSE DOOR 21L. (MAINTENANCE ASSURANCE)
m. OPEN DOOR 38.
n. PRESS OIL LEVEL TEST BUTTON AND CHECK BOTH LIGHTS ARE ON. (MAINTENANCE ASSURANCE)
o. CLOSE DOOR 38. (MAINTENANCE ASSURANCE)

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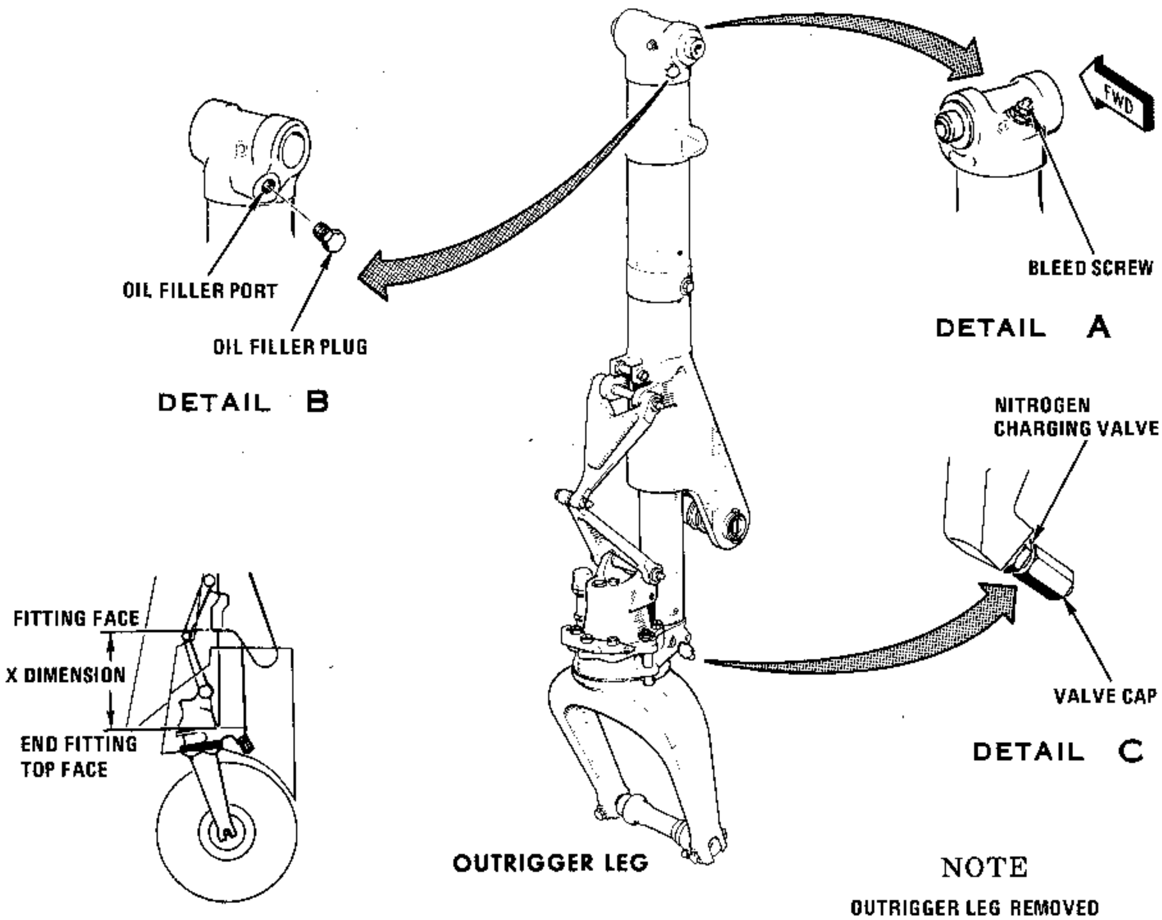
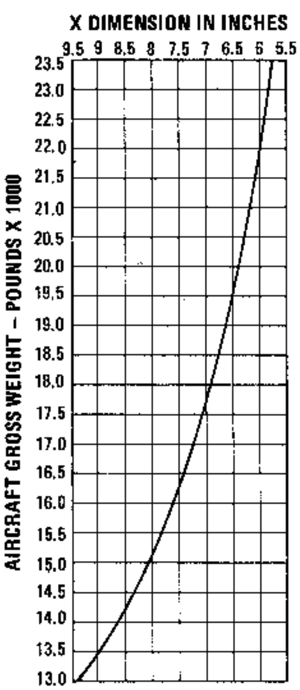
Figure 1-42

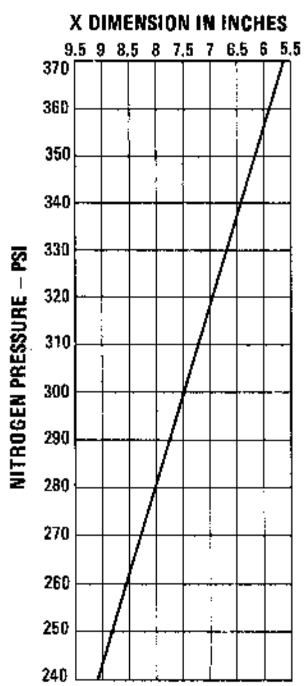
OUTRIGGER SERVICING



NOTE

OUTRIGGER LEG REMOVED FROM AIRCRAFT FOR CLARITY





GROUND SUPPORT EQUIPMENT

PART NO. TYPE DESIGNATION	NOMENCLATURE
772B/35798	ADAPTER KIT MK-6A
MIL-G-8348 CLASS A-3	PRESSURE GAGE (0 TO 400 PSI)
E40-6603-1	NITROGEN PRESSURE SOURCE
951 (RISBRIDGER/LTD)	HYDRAULIC OIL GUN
	CONTAINER (ONE GALLON CAPACITY)

MATERIALS
LOCKWIRE

AV8A–1–(136–1)

Figure 1-43 (Sheet 1 of 2)

OUTRIGGER SERVICING (CONTINUED)

OUTRIGGER STRUT SERVICING CHECK (AIRCRAFT WEIGHT ON WHEELS)

1. PROCEDURE. CHECK X DIMENSION AND COMPARE X DIMENSION TO AIRCRAFT GROSS WEIGHT OR NITROGEN PRESSURE PER X DIMENSION GRAPHS.

OUTRIGGER STRUT NITROGEN SERVICING

1. PROCEDURE.
   a. ENSURE LANDING GEAR GROUND SAFETY LOCKS ARE INSTALLED.
   b. JACK AIRCRAFT (NAVAIR 01–AV8A–2–5).
   c. REMOVE VALVE CAP FROM NITROGEN CHARGING VALVE VALVE AND CONNECT ADAPTER, PRESSURE GAGE AND NITROGEN PRESSURE SOURCE TO NITROGEN CHARGING VALVE. SEE DETAIL C.
   d. DEPRESS NITROGEN ADAPTER HAND LEVER AND CHECK PRESSURE ON PRESSURE GAGE. PRESSURE SHALL BE 230 ±10 PSI.
   e. BLEED OR ADD NITROGEN PRESSURE UNTIL STRUT PRESSURE IS 230 ±10 PSI.
   f. SHUT OFF NITROGEN PRESSURE SOURCE.
   g. LOWER AIRCRAFT AND REMOVE JACKS (NAVAIR 01–AV8A–2–5).
   h. CHECK X DIMENSION PER FIGURE 1. IF X DIMENSION IS CORRECT, PERFORM STEPS (h) AND (i). IF X DIMENSION IS CORRECT, PERFORM OUTRIGGER LEG HYDRAULIC OIL SERVICING. REFER TO PARAGRAPH TITLED OUTRIGGER LEG HYDRAULIC OIL SERVICING.
   i. REMOVE NITROGEN ADAPTER, PRESSURE GAGE AND NITROGEN PRESSURE SOURCE FROM LEG.
   j. INSTALL VALVE CAP ON NITROGEN CHARGING VALVE AND SAFETY WITH LOCKWIRE. (MAINTENANCE ASSURANCE)

OUTRIGGER STRUT HYDRAULIC SERVICING.

1. PROCEDURE.
   a. ENSURE LANDING GEAR GROUND SAFETY LOCKS ARE INSTALLED.
   b. JACK AIRCRAFT (NAVAIR 01–AV8A–2–5).
   c. REMOVE VALVE CAP FROM NITROGEN CHARGING VALVE (SEE DETAIL C) AND CONNECT ADAPTER, PRESSURE GAGE, AND NITROGEN PRESSURE SOURCE TO NITROGEN CHARGING VALVE.
   d. CONNECT HYDRAULIC OIL GUN TO ADAPTER. ENSURE HYDRAULIC OIL GUN IS FILLED WITH OM–15 HYDRAULIC OIL AND PRIME ADAPTER DELIVERY HOSE.
   e. REMOVE OIL FILLER PLUG FROM OIL FILLER PORT (SEE DETAIL B) AND CONNECT THE ADAPTER DELIVERY HOSE TO OIL FILLER PORT ON STRUT.
   f. CONNECT A BLEED HOSE TO THE BLEED SCREW (SEE DETAIL A) AND PLACE THE FREE END OF BLEED HOSE INTO A CONTAINER.

NOTE

- HYDRAULIC OIL BLED OFF FROM STRUT MUST BE DISCARDED.
- KEEP THE HYDRAULIC OIL GUN FILLED WITH HYDRAULIC OIL WHILE FILLING STRUT TO KEEP FROM INDUCING AIR INTO STRUT.

   g. OPEN BLEED SCREW. WHILE KEEPING THE NITROGEN ADAPTER HAND LEVER DEPRESSED AND THE NITROGEN ADAPTER RELEASE VALVE OPEN, PUMP HYDRAULIC OIL INTO STRUT UNTIL OIL FLOWS FROM BLEED HOSE.
   h. TIGHTEN THE BLEED SCREW AND CONTINUE PUMPING HYDRAULIC OIL INTO STRUT UNTIL STRUT IS FULLY EXTENDED AND HYDRAULIC OIL PRESSURE REACHES 200 TO 250 PSI. THE STRUT X DIMENSION IS BETWEEN 10.0 AND 10.1 INCHES WHEN STRUT IS FULLY EXTENDED.

CAUTION

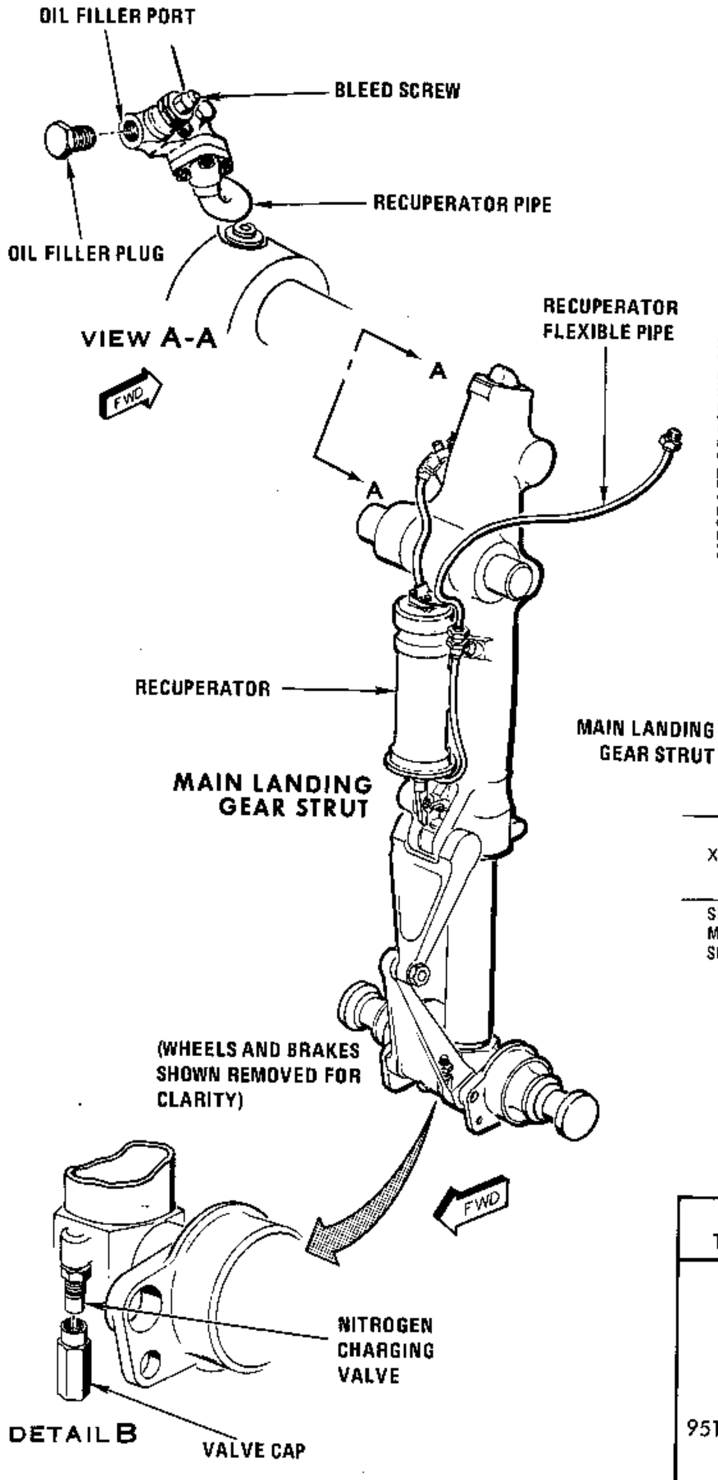
WHEN PERFORMING STEP (i), PROCEED WITH CAUTION TO PREVENT LIFTING AIRCRAFT OFF MAIN JACKS.

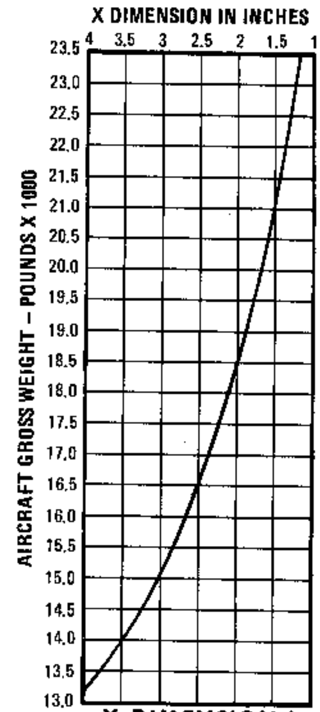
   i. WHILE SHAKING WING TO PREVENT STRUT PISTON FROM STICKING WHILE JACKING, SLOWLY OPEN BLEED SCREW AND FULLY COMPRESS STRUT BY JACKING OUTRIGGER STRUT PER (NAVAIR 01–AV8A–2–5) ALLOWING ANY AIR AND EXCESSIVE HYDRAULIC OIL TO ESCAPE, THEN TIGHTEN BLEED SCREW.
   j. REMOVE JACK FROM OUTRIGGER STRUT (NAVAIR 01–AV8A–2–5) AND MOVE CLEAR OF OUTRIGGER STRUT.
   k. CLOSE RELEASE VALVE ON NITROGEN ADAPTER AND PRESSURIZE STRUT WITH NITROGEN TO 100 PSI THRU NITROGEN CHARGING VALVE TO FULLY EXTEND STRUT. OPEN NITROGEN ADAPTER RELEASE VALVE AND RELEASE NITROGEN PRESSURE FROM STRUT.
   l. REPEAT STEPS (g) THRU (k) TO BLEED ALL AIR FROM STRUT.
   m. DEPRESS THE HAND LEVEL ON THE NITROGEN ADAPTER AND OPERATE THE HYDRAULIC OIL GUN UNTIL HYDRAULIC OIL PRESSURE REACHES 200 TO 250 PSI TO FULLY EXTEND FLOATING PISTON.
   n. SLOWLY OPEN BLEED SCREW AND REMOVE THE HYDRAULIC OIL GUN FROM STRUT HYDRAULIC OIL FILLER PORT. INSTALL AND TIGHTEN OIL FILLER PLUG IN OIL FILLER PORT.
   o. FULLY COMPRESS STRUT WITH JACK (NAVAIR 01–AV8A–2–5) AND CLOSE BLEED SCREW WHEN HYDRAULIC OIL CEASES TO FLOW.
   p. REMOVE JACK (NAVAIR 01–AV8A–2–5) AND MOVE CLEAR OF OUTRIGGER STRUT.
   q. SLOWLY PRESSURIZE STRUT WITH NITROGEN TO 230 ±10 PSI THRU NITROGEN CHARGING VALVE.
   r. LOWER AIRCRAFT AND REMOVE MAIN JACKS (NAVAIR 01–AV8A–2–5).
   s. CHECK X DIMENSION PER FIGURE 1.
   t. REMOVE ADAPTER, PRESSURE GAGE AND NITROGEN PRESSURE SOURCE FROM INSTALL VALVE CAP ON NITROGEN CHARGING VALVE AND SAFETY WITH LOCKWIRE. (MAINTENANCE ASSURANCE).
   u. TIGHTEN BLEED SCREW AND OIL FILLER PLUG AND SAFETY WITH LOCKWIRE. (MAINTENANCE ASSURANCE).

AV8A–1–(136–2)

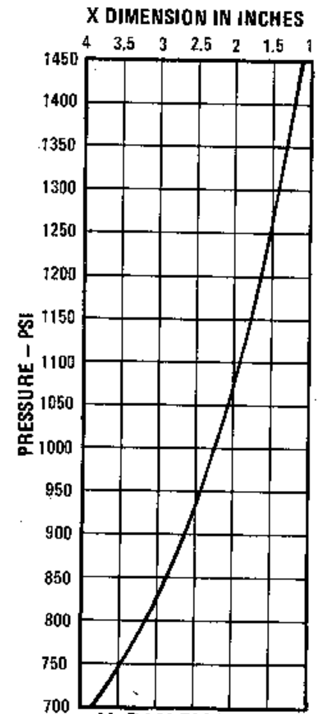
Figure 1–43 (Sheet 2 of 2)

MAIN LANDING GEAR STRUT SERVICING

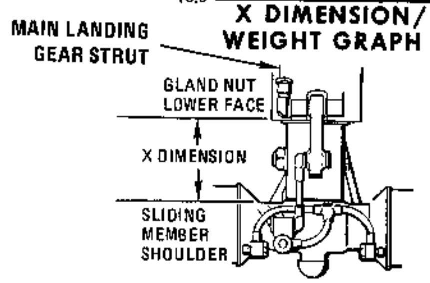


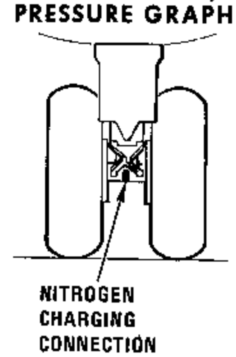


X DIMENSION/ WEIGHT GRAPH



X DIMENSION/ PRESSURE GRAPH





GROUND SUPPORT EQUIPMENT

PART NO. TYPE DESIGNATION	NOMENCLATURE
MIL-G-8348 CLASS A-2	PRESSURE GAGE (0 TO 1000 PSI)
772B/35798	ADAPTER KIT MK6A
E40-6603-1	NITROGEN PRESSURE SOURCE
951 (RISBRIDGER/LTD)	HYDRAULIC OIL GUN
	CONTAINER (ONE GALLON CAPACITY)

MATERIALS —
LOCKWIRE

AV8A-1-(137-1)

Figure 1-44 (Sheet 1 of 2)

MAIN LANDING GEAR STRUT SERVICING (CONTINUED)

MAIN LANDING GEAR STRUT SERVICING CHECK. (AIRCRAFT WEIGHT ON WHEELS.

1. PROCEDURE. CHECK X DIMENSION AND COMPAREX DIMENMENSION TO AIRCRAFT GROSS WEIGHT OR NITROGEN PRESSURE PER X DIMENSION GRAPHS.

MAIN LANDING GEAR STRUT NITROGEN SERVICING.

1. PROCEDURE.
   - a. ENSURE LANDING GEAR GROUND SAFETY LOCKS ARE INSTALLED (NAVAIR 01–AV8A–2–5).
   - b. JACK AIRCRAFT (NAVAIR 01–AV8A–2–5).
   - c. REMOVE VALVE CAP (SEE DETAIL B) FROM NITROGEN CHARGING VALVE AND CONNECT ADAPTER, PRESSURE GAGE, AND NITROGEN PRESSURE SOURCE TO NITROGEN CHARGING VALVE.
   - d. DEPRESS NITROGEN ADAPTER HAND LEVER AND CHECK PRESSURE ON PRESSURE GAGE. PRESSURE SHALL BE 520 ± 10 PSI.
   - e. BLEED OR ADD NITROGEN PRESSURE UNTIL STRUT PRESSURE IS 520 ± 10 PSI.
   - f. SHUT OFF NITROGEN SUPPLY.
   - g. LOWER AIRCRAFT AND REMOVE JACKS (NAVAIR 01–AV8A–2–5).
   - h. CHECK X DIMENSION. IF X DIMENSION IS CORRECT, PERFORM STEPS (h) AND (i). IF X DIMENSION IS INCORRECT, PERFORM MAIN LANDING GEAR STRUT HYDRAULIC OIL SERVICING.
   - i. REMOVE NITROGEN ADAPTER, PRESSURE GAGE AND NITROGEN PRESSURE SOURCE FROM STRUT.
   - j. INSTALL VALVE CAP ON NITROGEN CHARGING VALVE AND SAFETY WITH LOCKWIRE (MAINTENANCE ASSURANCE).

MAIN LANDING GEAR STRUT HYDRAULIC OIL SERVICING.

1. PROCEDURE.
   - a. ENSURE LANDING GEAR GROUND SAFETY LOCKS ARE INSTALLED.
   - b. JACK AIRCRAFT (NAVAIR 01–AV8A–2–5).
   - c. REMOVE VALVE CAP FROM NITROGEN CHARGING VALVE (SEE DETAIL B) AND CONNECT ADAPTER, GAGE, AND NITROGEN PRESSURE SOURCE TO NITROGEN CHARGING VALVE.
   - d. CONNECT HYDRAULIC OIL GUN TO ADAPTER. ENSURE HYDRAULIC OIL GUN IS FILLED WITH MIL–H–5606 HYDRAULIC OIL AND PRIM ADAPTER DELIVERY HOSE.
   - e. REMOVE OIL FILLER PLUG FROM OIL FILLER PORT (SEE VIEW A–A) AND CONNECT ADAPTER DELIVERY HOSE TO OIL FILLER PORT ON STRUT.
   - f. CONNECT A BLEED HOSE TO THE BLEED SCREW (SEE DETAIL A–A) AND PLACE THE FREE END OF BLEED HOSE INTO CONTAINER.

     NOTES

     - HYDRAULIC OIL BLEED FROM STRUT MUST BE DISCARDED.
     - KEEP HYDRAULIC OIL GUN FILLED WITH HYDRAULIC OIL WHILE FILLING STRUT TO KEEP FROM INDUCING AIR INTO STRUT.
   - g. DISCONNECT RECUPERATOR FLEXIBLE PIPE ON LEFT SIDE JUST ABOVE STRUT.
   - h. CONNECT A HIGH PRESSURE TIRE INFLATION ADAPTER AND NITROGEN PRESSURE SOURCE TO RECUPERATOR FLEXIBLE PIPE.
   - i. OPEN ADAPTER RELEASE VALVE AT NITROGEN CHARGING VALVE AND DEPRESS HAND LEVER OF ADAPTER TO RELEASE NITROGEN PRESSURE FROM STRUT.

     CAUTION

     TO PREVENT DAMAGE TO STRUT WHEN PERFORMING STEP (j) HYDRAULIC OIL PRESSURE MUST NOT EXCEED 250 PSI.
   - j. WHILE KEEPING HAND LEVER OF ADAPTER AT NITROGEN CHARGING VALVE DEPRESSED, PUMP HYDRAULIC OIL INTO STRUT UNTIL HYDRAULIC OIL PRESSURE REACHES 250 PSI INDICATING RECUPERATOR PISTON AND STRUT PISTON ARE BOTTOMED OUT. RELEASE HAND LEVER OF ADAPTER AT NITROGEN CHARGING VALVE.
   - k. OPEN BLEED SCREW TO RELEASE OIL PRESSURE AND LEAVE BLEED SCREW OPEN. (SEE VIEW A–A).
   - l. CLOSE ADAPTER RELEASE VALVE AT NITROGEN CHARGING VALVE.
   - m. SLOWLY PRESSURIZE STRUT WITH NITROGEN TO 100 PSI THRU NITROGEN CHARGING VALVE.

     CAUTION

     TO PREVENT DAMAGE TO RECUPERATOR DO NOT EXCEED 100 PSI IN STEP (n).
   - n. PRESSURIZE RECUPERATOR THRU RECUPERATOR FLEXIBLE PIPE TO 100 PSI WITH NITROGEN.
   - o. WHEN HYDRAULIC OIL CEASES TO FLOW FROM BLEED SCREW, CLOSE BLEED SCREW AND RELEASE NITROGEN PRESSURE FROM BOTH RECUPERATOR AND STRUT BY OPENING RELEASE VALVE AND DEPRESSING HAND LEVERS OF BOTH ADAPTERS.
   - p. REPEAT STEPS (j) THRU (o) TO BLEED ALL AIR FROM STRUT.
   - q. PUMP HYDRAULIC OIL INTO STRUT UNTIL HYDRAULIC OIL PRESSURE REACHES 250 PSI. DO NOT EXCEED 250 PSI.
   - r. OPEN BLEED SCREW AND REMOVE HYDRAULIC OIL GUN AND INSTALL HYDRAULIC FILLER PLUG AND TIGHTEN PLUG.

     CAUTION

     WHEN PERFORMING STEPS (s) PROCEED WITH CAUTION TO PREVENT LIFTING AIRCRAFT OFF MAIN JACKS.
   - s. FULLY COMPRESS STRUT BY JACKING STRUT (NAVAIR 01–AV8A–2–5). WHEN HYDRAULIC OIL HAS CEASED TO FLOW AND STRUT X DIMENSION IS 0.1 INCHES. CLOSE BLEED SCREW AND REMOVE STRUT COMPRESSING JACK.
   - t. CLOSE NITROGEN RELEASE VALVE AND PRESSURIZE WITH NITROGEN TO 510 TO 10 PSI THRU NITROGEN CHARGING VALVE. THE X DIMENSION SHOULD BE 5.4 TO 5.6 INCHES.
   - u. PRESSURIZE THE RECUPERATOR TO (100 PSI). DO NOT EXCEED 100 PSI. THE STRUT X DIMENSION SHOULD BE 12.4 TO 12.6 INCHES.
   - v. RELEASE THE RECUPERATOR PRESSURE AND REMOVE INFLATION ADAPTER FROM RECUPERATOR FLEXIBLE PIPE. RECONNECT RECUPERATOR FLEXIBLE PIPE.
   - w. LOWER AIRCRAFT AND REMOVE JACKS (NAVAIR 01–AV8A–2–5). CHECK THE X DIMENSION.
   - x. REMOVE NITROGEN CHARGING ADAPTER FROM NITROGEN CHARGING VALVE AND INSTALL NITROGEN CHARGING VALVE CAP.
   - y. SAFETY OIL FILLER PLUG, BLEED SCREW, NITROGEN CHARGING VALVE CAP AND RECUPERATOR LINE WITH LOCKWIRE (MAINTENANCE ASSURANCE).

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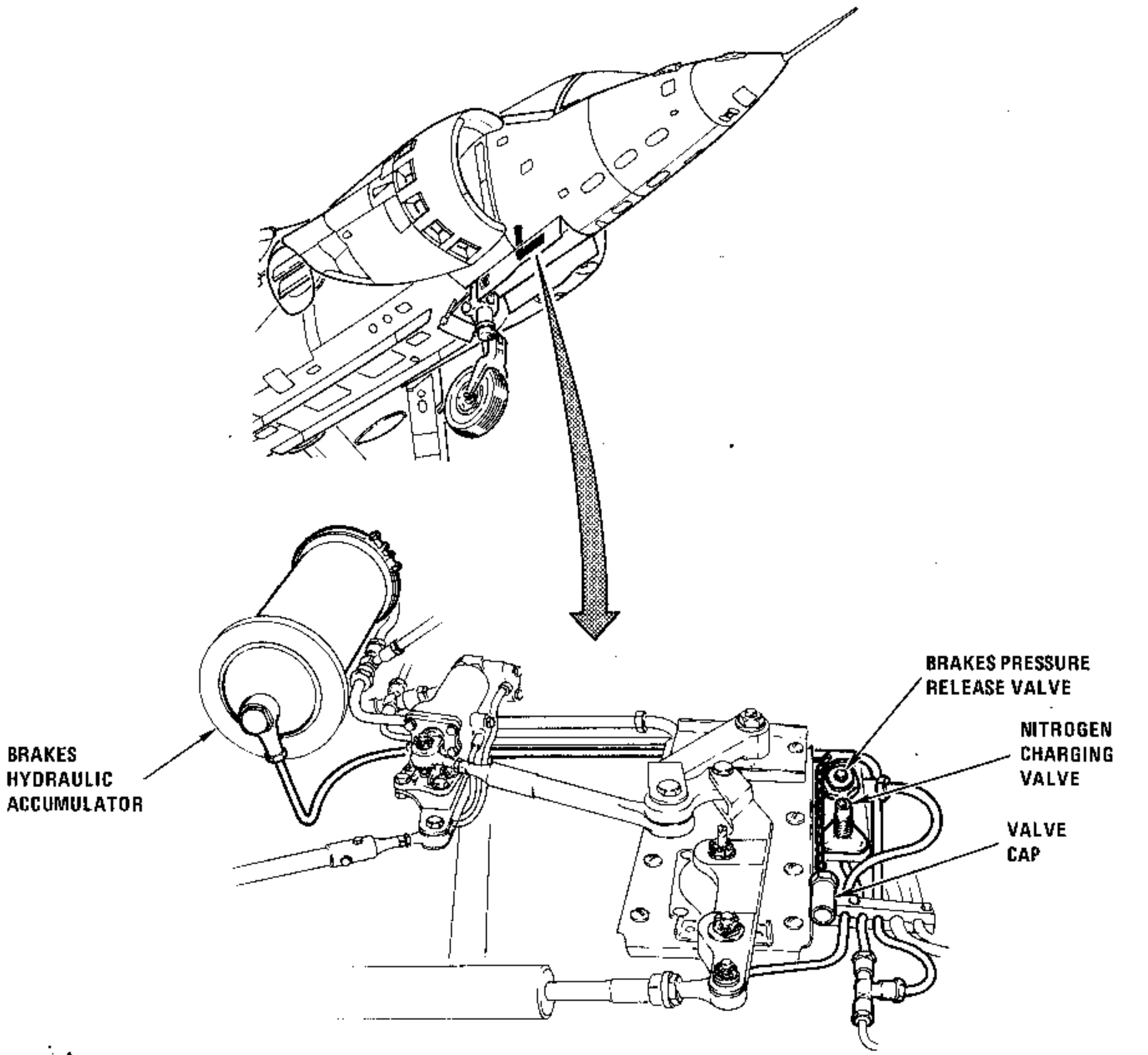
Figure 1–44 (Sheet 2 of 2)

BRAKES HYDRAULIC ACCUMULATOR SERVICING



GROUND SUPPORT EQUIPMENT REQUIRED

PART NO. TYPE DESIGNATION	NOMENCLATURE
MIL-G-8348 CLASS A-1	PRESSURE GAGE (0 TO 1500 PSI)
772B/35798	ADAPTER KIT MK-6A
E40-6603-1	NITROGEN PRESSURE SOURCE

MATERIALS

LOCKWIRE

1. PROCEDURE
   a. OPEN NOSEWHEEL DOORS. SEE NOSEWHEEL DOORS OPENING THIS SECTION.
   b. BLEED PRESSURE FROM BRAKE SYSTEM BY PUSHING BRAKES PRESSURE RELEASE VALVE.
   c. CHECK BRAKES HYDRAULIC ACCUMULATOR PRESSURE ON COCKPIT PRESSURE GAGE. PRESSURE SHOULD BE 1250 PSI. IF PRESSURE IS CORRECT, PERFORM STEP h. IF PRESSURE IS INCORRECT, PERFORM STEPS d THRU h.
   d. REMOVE VALVE CAP FROM NITROGEN CHARGING VALVE AND CONNECT ADAPTER, GAGE, AND NITROGEN PRESSURE SOURCE TO NITROGEN CHARGING VALVE.
   e. BLEED OR ADD NITROGEN PRESSURE UNTIL ACCUMULATOR NITROGEN PRESSURE IS 1250 PSI.
   f. SHUT OFF NITROGEN PRESSURE SOURCE AND REMOVE NITROGEN PRESSURE SOURCE, ADAPTER, AND GAGE FROM NITROGEN CHARGING VALVE.
   g. INSTALL VALVE CAP ON NITROGEN CHARGING VALVE AND SAFETY WITH LOCKWIRE. (MAINTENANCE ASSURANCE).
   h. CLOSE NOSEWHEEL DOORS. SEE NOSEWHEEL DOORS OPENING, THIS SECTION.

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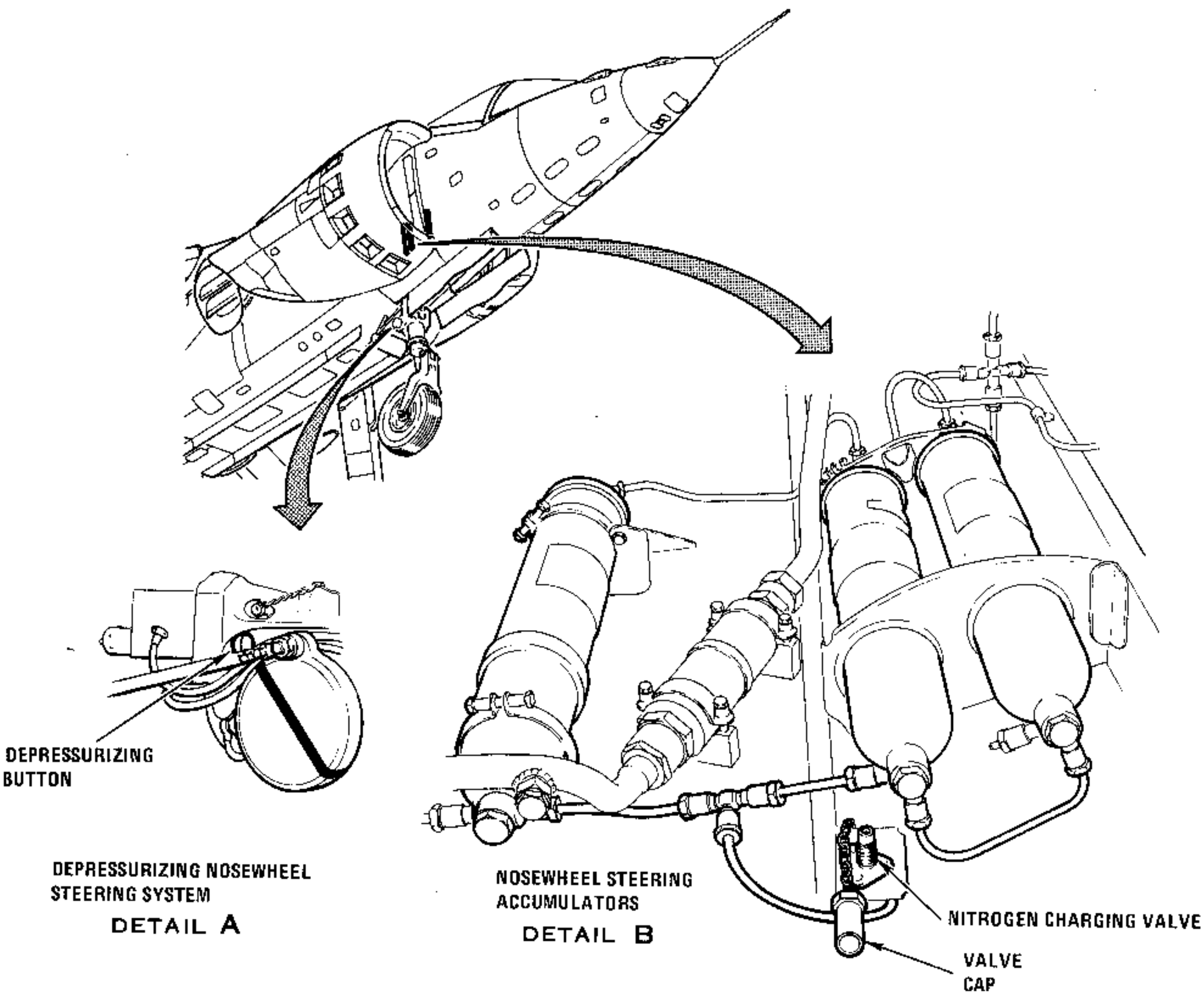
Figure 1-45

NOSEWHEEL STEERING ACCUMULATOR SERVICING



GROUND SUPPORT EQUIPMENT REQUIRED

PART NO. TYPE DESIGNATION	NOMENCLATURE
MIL-G-8348-1 CLASS A-1	PRESSURE GAGE (0 TO 1500 PSI)
772B/35798	ADAPTER KIT MK-6A
E40-6603-1	NITROGEN PRESSURE SOURCE

MATERIALS

LOCKWIRE

1. PROCEDURE
   a. OPEN NOSEWHEEL DOORS. SEE NOSEWHEEL DOORS OPENING, THIS SECTION.
   b. BLEED PRESSURE FROM NOSEWHEEL STEERING SYSTEM BY PUSHING DEPRESSURIZING BUTTON. SEE DETAIL A.
   c. CHECK NOSEWHEEL STEERING ACCUMULATOR PRESSURE ON COCKPIT PRESSURE GAGE, PRESSURE SHOULD BE 1100 PSI. IF PRESSURE IS CORRECT, PERFORM STEP h. IF PRESSURE IS INCORRECT, PERFORM STEPS d THRU g.
   d. REMOVE VALVE CAP FROM NITROGEN CHARGING VALVE (SEE DETAIL B) AND CONNECT ADAPTER, GAGE, AND NITROGEN PRESSURE SOUCE TO NITROGEN CHARGING VALVE.
   e. BLEED OR ADD NITROGEN PRESSURE UNTIL ACCUMULATOR NITROGEN PRESSURE IS 1100 PSI.
   f. SHUT OFF NITROGEN PRESSURE SOURCE AND REMOVE NITROGEN PRESSURE SOURCE, ADAPTER, AND GAGE FROM NITROGEN CHARGING VALVE.
   g. INSTALL VALVE CAP ON NITROGEN CHARGING VALVE AND SAFETY WITH LOCKWIRE. (MAINTENANCE ASSURANCE).
   h. CLOSE NOSEWHEEL DOORS. SEE NOSEWHEEL DOORS OPENING, THIS SECTION.

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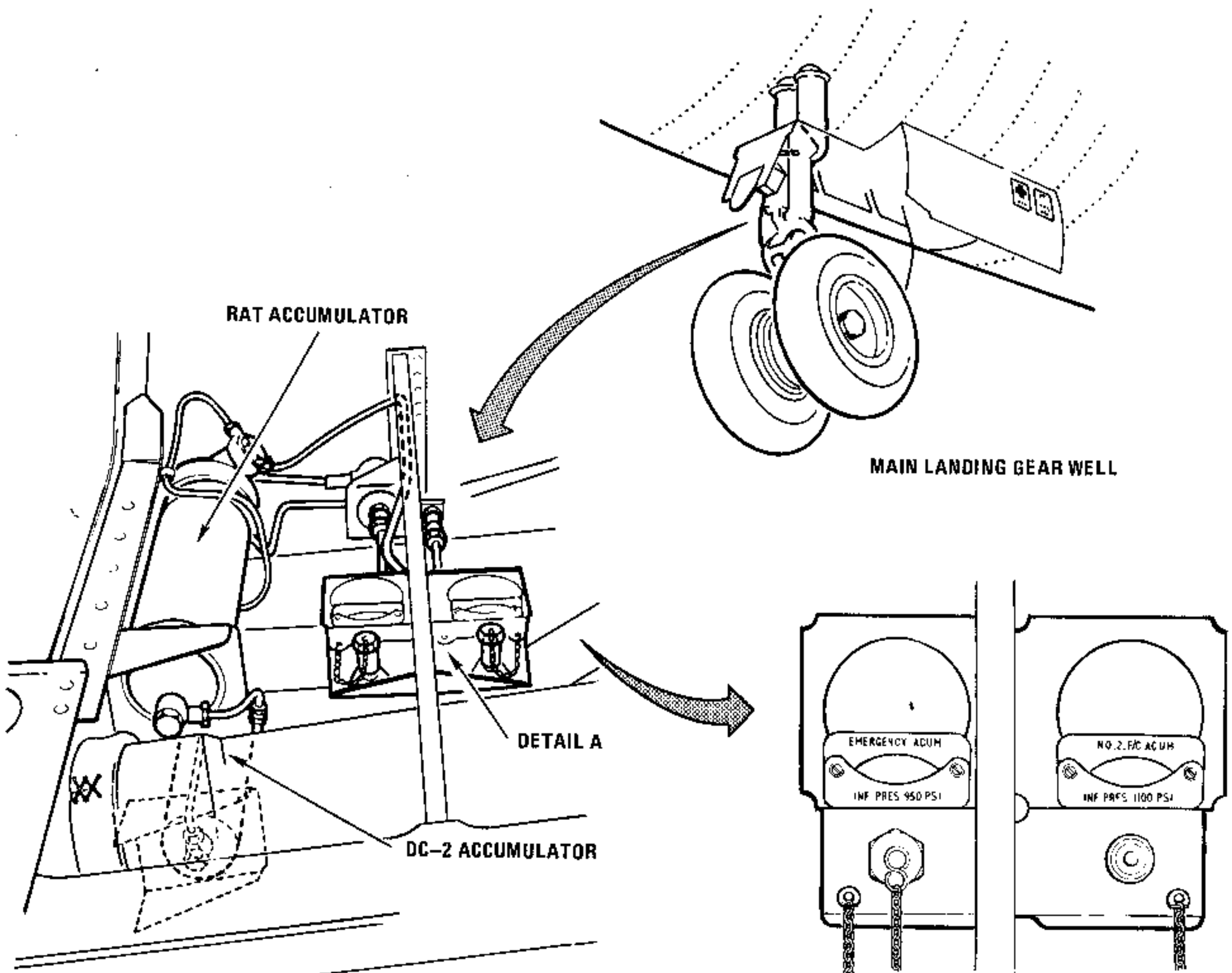
Figure 1-46

RAT ACCUMULATOR SERVICING



DETAIL A. ASSEMBLY OF GAUGES AND NITROGEN CHARGING VALVES

GROUND SUPPORT EQUIPMENT

PART NO./TYPE DESIGNATION	NOMENCLATURE
E40-6603-1	CART, NITROGEN AND AIR SERVICING
772B-35798	ADAPTER, TURNER

MATERIALS.

LOCKWIRE

1. PROCEDURE.
   a. DISSIPATE HYDRAULIC PRESSURE BY OPERATING THE FLIGHT CONTROLS BEFORE CHECKING ACCUMULATOR NITROGEN CHARGE.
   b. OPEN MAIN LANDING GEAR DOORS (NAVAIR 01-AV8A-2-2-5).
   c. GAIN ACCESS TO ACCUMULATOR NITROGEN CHARGING VALVE ON INBOARD RIGHT SIDE OF MAIN LANDING GEAR WELL AND REMOVE CAP FROM CHARGING VALVE.
   d. CONNECT ADAPTER WITH 0 TO 1500 PSI PRESSURE GAGE TO NITROGEN CHARGING VALVE, ACCUMULATOR PRESSURE SHOULD BE 950 PSI.
   e. WHEN PRESSURE IS BELOW 950 PSI CONNECT NITROGEN CART TO ADAPTER AND SERVICE ACCUMULATOR TO PROPER PRESSURE.
   f. DISCONNECT NITROGEN CART, ADAPTER AND PRESSURE GAGE FROM CHARGING VALVE.
   g. INSTALL CAP ON NITROGEN CHARGING VALVE AND LOCKWIRE CAP (MAINTENANCE ASSURANCE).
   h. CLOSE MAIN LANDING GEAR DOORS (NAVAIR 01-AV8A-2-5).

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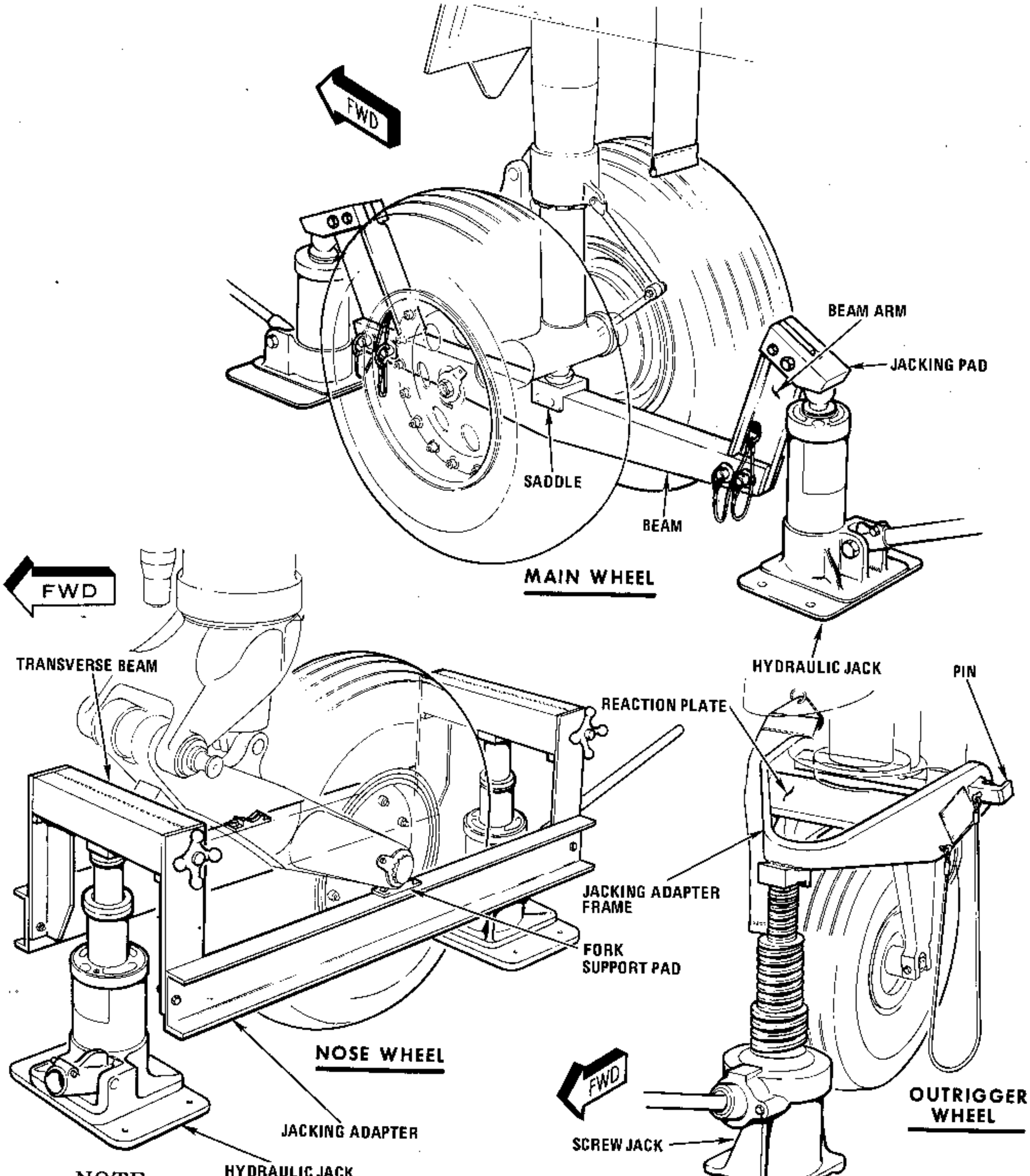
Figure 1-47

WHEEL JACKING



NOTE

WHEEL IS TURNED TO AN ANGLE OF APPROXIMATELY 45°TO CLEAR NOSE WHEEL REAR DOOR AND RECONNAISSANCE POD.

NOTE

INSTALL ADAPTER FROM FRONT OF WHEEL. INSTALL PIN ON PARALLEL SECTION OF FORK WITH THE REACTION PLATE ON THE FORK RADIUS

AV8A-1-(150)-1

Figure 1-48 (Sheet 1 of 2)

1. WHEEL JACKING

GROUND SUPPORT EQUIPMENT

PART NO./TYPE DESIGNATION	NOMENCLATURE	
	(MAIN WHEEL)	
E 295256	ADAPTER JACKING	1 REQUIRED
	JACK, HYDRAULIC PILLAR 4 TON	2 REQUIRED
	(NOSEWHEEL)	
C 276206	ADAPTER, JACKING	1 REQUIRED
	JACK, HYDRAULIC PILLAR 4 TON	2 REQUIRED
	ADAPTER, JACK HEAD MK 42	2 REQUIRED
	(OUTRIGGER WHEEL)	
C 276207	ADAPTER, JACKING	1 REQUIRED
	JACK, SCREW, 1 TON	1 REQUIRED
	CHOCKS, AIRCRAFT	4 REQUIRED

2. PREPARATION

a. CHOCK AIRCRAFT, FORWARD AND AFT, AT ONE OUTRIGGER AND AT EITHER THE MAIN OR NOSEWHEELS, DEPENDING ON WHICH WHEEL IS BEING JACKED.
b. FIT EQUIPMENT CAREFULLY TO AVOID DAMAGE TO WHEELS AND/OR AIRCRAFT STRUCTURE.

3. NOSEWHEEL JACKING.

WARNING

ENSURE HYDRAULIC PRESSURE IS NOT APPLIED DURING JACKING OPERATIONS.

a. DISENGAGE RUDDER BAR LOCK, DEPRESSURIZE NOSEWHEEL STEERING SYSTEM, AND THEN TURN WHEEL 45° OFF CENTER.
b. RELEASE ONE SIDE OF ADAPTER, FIT ADAPTER AROUND WHEEL, AND REFIT LOOSE SIDE. ENSURE ALL BOLTS AND THUMB NUTS ARE FULLY TIGHTENED.
c. LIFT ADAPTER, KEEPING SIDE BEAMS HORIZONTAL, TO FIT FORK SUPPORT PADS UNDER BOTTOM OF WHEEL FORM ARMS.
d. FIT JACKS, WITH JACK HEAD ADAPTERS, UNDER THE TRANSVERSE BEAMS CENTERS.
e. OPERATE JACKS SLOWLY TO ENGAGE THE JACKING PADS.
f. JACK UP EVENLY UNTIL WHEEL IS CLEAR OF GROUND.

4. NOSEWHEEL LOWERING.

a. LOWER AIRCRAFT EVENLY UNTIL WEIGHT IS OFF NOSEWHEEL JACKS.
b. REMOVE JACKS AND JACK HEAD ADAPTERS.

5. MAIN WHEEL JACKING.

WARNING

ENSURE HYDRAULIC PRESSURE IS NOT APPLIED DURING JACKING OPERATION.

a. REMOVE QUICK-RELEASE PINS AND INSERT BEAM BETWEEN WHEELS.
b. REFIT BEAM ARM AND SECURE QUICK-RELEASE PINS.
c. LIFT BEAM TO ENGAGE SADDLE UNDER JACKING BOSS AND POSITION A JACK UNDER EACH END.
d. OPERATE JACKS EVENLY UNTIL WHEELS ARE CLEAR OF THE GROUND.

6. MAIN WHEEL LOWERING.

a. LOWER AIRCRAFT EVENLY UNTIL WEIGHT IS OFF MAIN WHEEL JACKS.
b. REMOVE JACKS AND JACK BEAM.

7. OUTRIGGER WHEEL JACKING.

WARNING

ENSURE HYDRAULIC PRESSURE IS NOT APPLIED DURING JACKING OPERATION.

a. REMOVE PIN FROM ADAPTER, FIT ADAPTER FROM FRONT, AND FIT PIN BEHIND AND CONTACTING THE WHEEL FORK ARMS ON THEIR PARALLEL PORTION.
b. HOLD ADAPTER SO ITS REACTION PLATE IS AGAINST FRONT OF WHEEL FORK, AND PLACE JACK UNDER ADAPTER JACKING BLOCK.
c. SCREW JACK UP TO MATE WITH ADAPTER JACKING BLOCK.
d. JACK OUTRIGGER UNTIL WHEEL IS CLEAR OF GROUND.

8. OUTRIGGER WHEEL LOWERING.

a. LOWER OUTRIGGER UNTIL WEIGHT IS OFF OUTRIGGER JACK.
b. UNSCREW JACK UNTIL FREE OF ADAPTER JACKING BLOCK, AND REMOVE JACK.
c. REMOVE PIN FROM ADAPTER, AND REMOVE ADAPTER.

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Figure 1-48 (Sheet 2 of 2)

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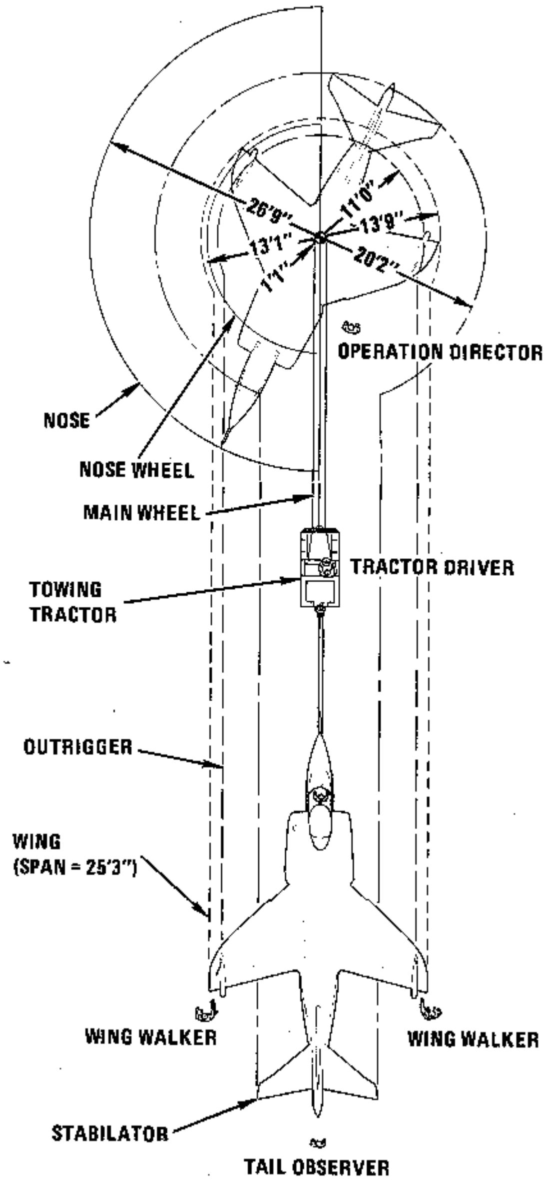
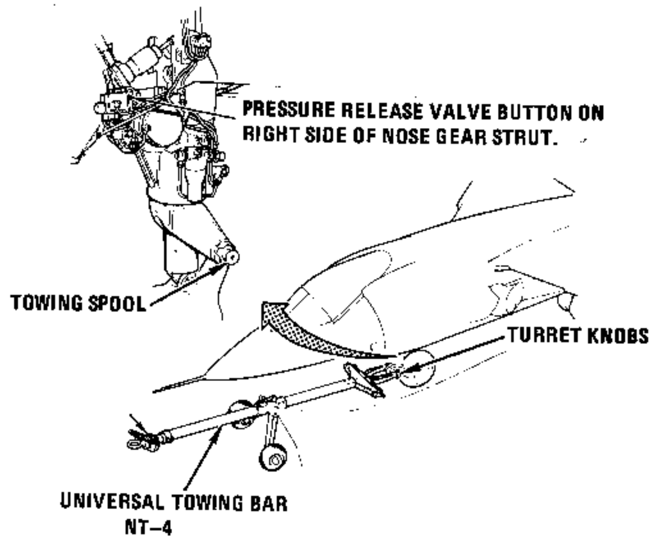
TOWING





NOTE

GIVEN DIMENSIONS ARE FOR AIRCRAFT ONLY. THE LENGTH OF THE TOW BAR AND TRACTOR HAVE NOT BEEN INCLUDED.

GROUND SUPPORT EQUIPMENT

PART NO. TYPE DESIGNATION	NOMENCLATURE	
	HYDRAULIC HAND PUMP HANDLE	1 REQUIRED
	TOWING CABLE	1 REQUIRED
	TOWING TRACTOR	1 REQUIRED
NT-4	UNIVERSAL TOW BAR	1 REQUIRED
	WHEEL CHOCKS	1 REQUIRED

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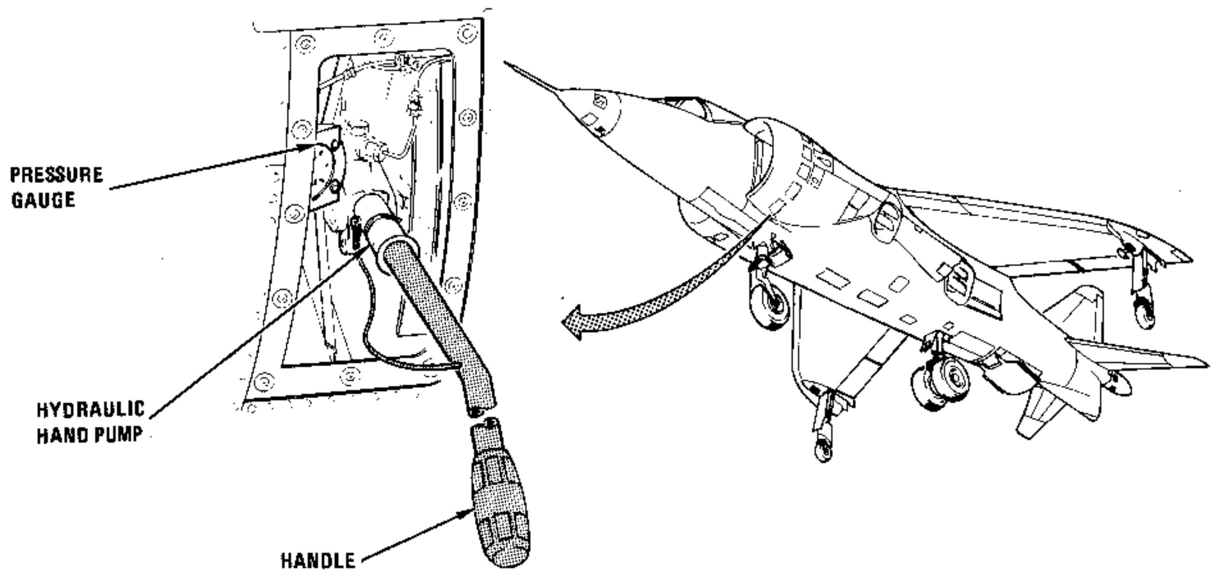
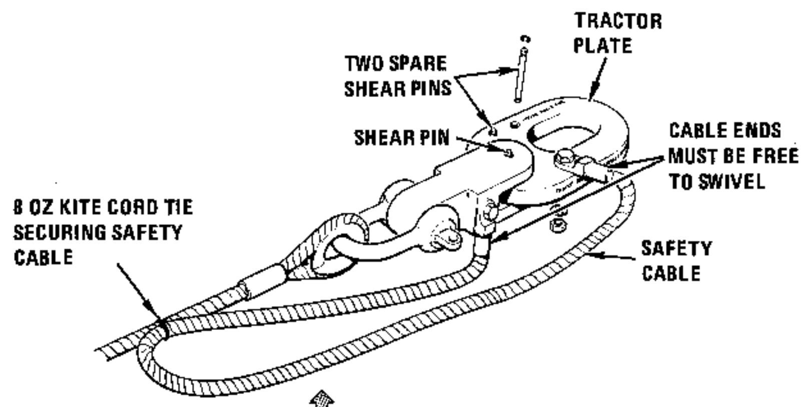
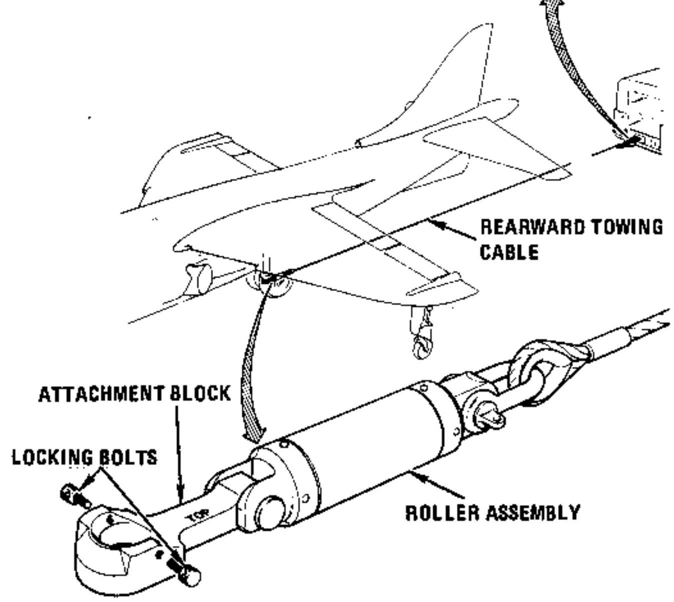
Figure 1-49 (Sheet 1 of 3)

TOWING (CONTINUED)







NOTE

TO AVOID DAMAGE TO VENTRAL FIN WHEN TOWING KEEP TOWING BRIDLE SLIGHTLY OFF CENTER.

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Figure 1-49 (Sheet 2 of 3)

TOWING (CONTINUED)

1. TOWING.
2. GENERAL.
THE AIRCRAFT SHALL NOT BE TOWED AT SPEEDS IN EXCESS OF 5 MPH WHILE TOWING IN A STRAIGHT COURSE OR 4 MPH WHILE TURNING. THE AIRCRAFT CAN BE MOVED BACKWARD FOR PARKING OR POSITIONING, INCLUDING UP SLOPES OF A MAXIMUM GRADIENT OF 1 IN 8, USING THE EQUIPMENT AND PROCEDURES FOR FORWARD TOWING. THE AIRCRAFT MAY BE TOWED FORWARD IN ALL CONFIGURATIONS AND WEIGHTS UP TO 6,500 POUNDS, AND REARWARD UP TO 8,000 POUNDS.
3. PREPARATION. BEFORE ANY TOWING OPERATION IS STARTED, ENSURE THE FOLLOWING CONDITIONS EXIST:
   a. SUFFICIENT HYDRAULIC PRESSURE IS AVAILABLE IN THE WHEEL BRAKES SYSTEM FOR THE APPLICATION OF THE WHEEL BRAKES IN AN EMERGENCY. IF THE PRESSURE IN THE SYSTEM IS INADEQUATE, CHECK BRAKE ACCUMULATOR PRESSURE, REPLENISH IF NECESSARY, THEN PRESSURIZE NO. 1 HYDRAULIC SYSTEM USING THE HYDRAULIC HAND PUMP.
   b. FULLY DISSIPATE NOSEWHEEL STEERING HYDRAULIC PRESSURE MANUALLY BY OPERATING THE PRESSURE RELEASE VALVE BUTTON, ON THE NOSE GEAR STRUT. CHECK THAT PRESSURE GAUGE IN CABIN DOES NOT REGISTER MORE THAN 1200 PSI.
   c. THE RETRACTABLE FOOTSTEP IS EITHER FULLY UP OR ONLY PARTLY DOWN ALLOWING CANOPY TO OPEN TO BRAKED POSITION.
   d. ENSURE HYDRAULIC PUMP HANDLE AND A PAIR OF WHEEL CHOCKS ARE CARRIED ON TOWING VEHICLE.
4. TOW BAR HOOKUP.
   a. POSITION BAR WITH ITS ARMS ON BOTH SIDES OF THE FRONT OF THE NOSEWHEEL.
   b. PULL OUT TURRET KNOBS ON THE ARMS AND SET THE SMALL PINS TO PICK UP WITH THE NOSE GEAR TOWING SPOOLS.
   c. LOWER TOWING EYE-END, ADJUST BAR POSITION AND OPERATE ARM ADJUST CRANK UNTIL THE TURRET KNOBS ENGAGE THE TOWING SPOOLS.
   d. ADJUST HEIGHT OF TOWING BAR UNDERCARRIAGE TO SUIT TOWING VEHICLE AND ATTACH TOWING EYE TO VEHICLE.
   e. RAISE TOWING BAR UNDERCARRIAGE TO PROVIDE NECESSARY GROUND CLEARANCE DURING TOWING.
5. FORWARD TOWING.

CAUTION

DURING TOWING, THE COCKPIT SHOULD BE OCCUPIED SO THAT IN AN EMERGENCY, THE AIRCRAFT BRAKES CAN BE APPLIED WHEN ORDERED. WHILE TOWING, ACUTE TURNS SHOULD BE AVOIDED. THE MAIN LANDING GEAR TURNING RADIUS MUST BE NOT LESS THAN 12 FEET.

   a. THE AIRCRAFT CAN BE TOWED FORWARD USING THE NT-4 UNIVERSAL TOWING BAR. THE EQUIPMENT MAY ALSO BE USED TO PUSH THE AIRCRAFT BACKWARDS FOR SHORT DISTANCES, INCLUDING UP SLOPES OF A MAXIMUM GRADIENT OF 1 IN 8. ON COMPLETION OF TOWING, CHOCK AIRCRAFT AND BEFORE REMOVING UNIVERSAL TOWING BAR, LOWER IT'S WHEELS TO TAKE THE WEIGHT PRIOR TO FREEING THE PINS FROM THE AIRCRAFT BY WINDING OUT THE ARMS.
6. REARWARD TOWING.

CAUTION

WHEN TOWING, THE CABLE MUST BE KEPT SLIGHTLY OFF-CENTER TO AVOID DAMAGE TO THE VENTRAL FIN. BEFORE TOWING, DISSIPATE THE NOSEWHEEL STEERING HYDRAULIC PRESSURE MANUALLY BY OPERATING THE PRESSURE RELEASE VALVE BUTTON ON THE NOSE GEAR STRUT.

   a. DURING REARWARD TOWING, THE COCKPIT SHOULD BE OCCUPIED SO THAT IN AN EMERGENCY THE AIRCRAFT BRAKES CAN BE APPLIED WHEN ORDERED. WHILE TOWING, ACUTE TURNS SHOULD BE AVOIDED. THE MAIN UNDERCARRIAGE TURNING RADIUS MUST BE NOT LESS THAN 12 FEET. THE AIRCRAFT CAN BE TOWED REARWARDS USING NOSEWHEEL STEERING ARM OR BAR, THE REARWARD TOWING CABLE, AND A TOWING VEHICLE.
7. REARWARD TOWING CABLE.

NOTE

IF THE TOWING CABLE END FITTING IS FOUND TO BE FOULING THE ANTI-SKID SENSOR CABLE AT THE BOTTOM OF THE MAIN UNDERCARRIAGE SHOCK ABSORBER, EASE THE SENSOR CABLE BY REPOSITIONING THE LOWEST 'P' CLIP SECURING THE SENSOR CABLE.

   a. THE REARWARD TOWING CABLE CONSISTS OF A 50 FOOT LENGTH OF FLEXIBLE STEEL CABLE WITH THIMBLED EYES AND D SHACKLES AT EACH END. A ROLLER ASSEMBLY WITH AN ATTACHMENT BLOCK IS ATTACHED TO ONE OF THE D SHACKLES, WHILE A FORK LINK AND TRACTOR PLATE ARE ATTACHED TO THE OTHER D SHACKLE. THE ATTACHMENT BLOCK FITS AROUND AND UNDER THE MAIN LANDING GEAR JACKING BOSS ON THE BOTTOM OF THE MAIN GEAR SHOCK ABSORBER. IT IS RETAINED ON THE BOSS BY MEANS OF TWO LOCKING BOLTS, ONE ON EACH SIDE, WHICH SCREW INTO THE BLOCK AND PROJECT ABOVE THE JACKING BOSS SHOULDER. THE ROLLER ASSEMBLY PREVENTS THE CABLE CHAFING THE TIRES. THE TRACTOR PLATE IS ATTACHED TO THE FORK LINK BY A SHEAR PIN, RETAINED BY CIRCLIPS, WHICH IS DESIGNED TO FAIL WHEN THE LOAD IS IN EXCESS OF 8000 LB. A SAFETY CABLE, APPROXIMATELY 6 FEET LONG, IS ATTACHED TO THE FORK LINK AND TRACTOR PLATE BY BOLTS. THE ENDS OF THE CABLE ARE FREE TO SWIVEL ON THE ATTACHING BOLTS. THIS SAFETY CABLE TAKES THE LOAD AND PREVENTS THE TOWING CABLE FROM WHIPPING IF THE SHEAR PIN FAILS. THE LOOP OF SAFETY CABLE SHOULD BE TIED TO THE TOWING CABLE WITH A SINGLE LOOP OF 8 OUNCE KITE CORD TO KEEP IT CLEAR OF THE GROUND AND TRACTOR DURING TOWING OPERATIONS. THE TRACTOR PLATE IS DRILLED TO ACCOMMODATE TWO SPARE SHEAR PINS AND IS ENGRAVED AROUND THE EDGE AS FOLLOWS: "TO AVOID DAMAGE TO VENTRAL FIN WHEN TOWING REARWARD, KEEP CABLE SLIGHTLY OFF CENTER". IT IS IMPORTANT THAT THIS INSTRUCTION BE COMPLIED WITH. ON COMPLETION OF TOWING, CHOCK AND REMOVE EQUIPMENT.

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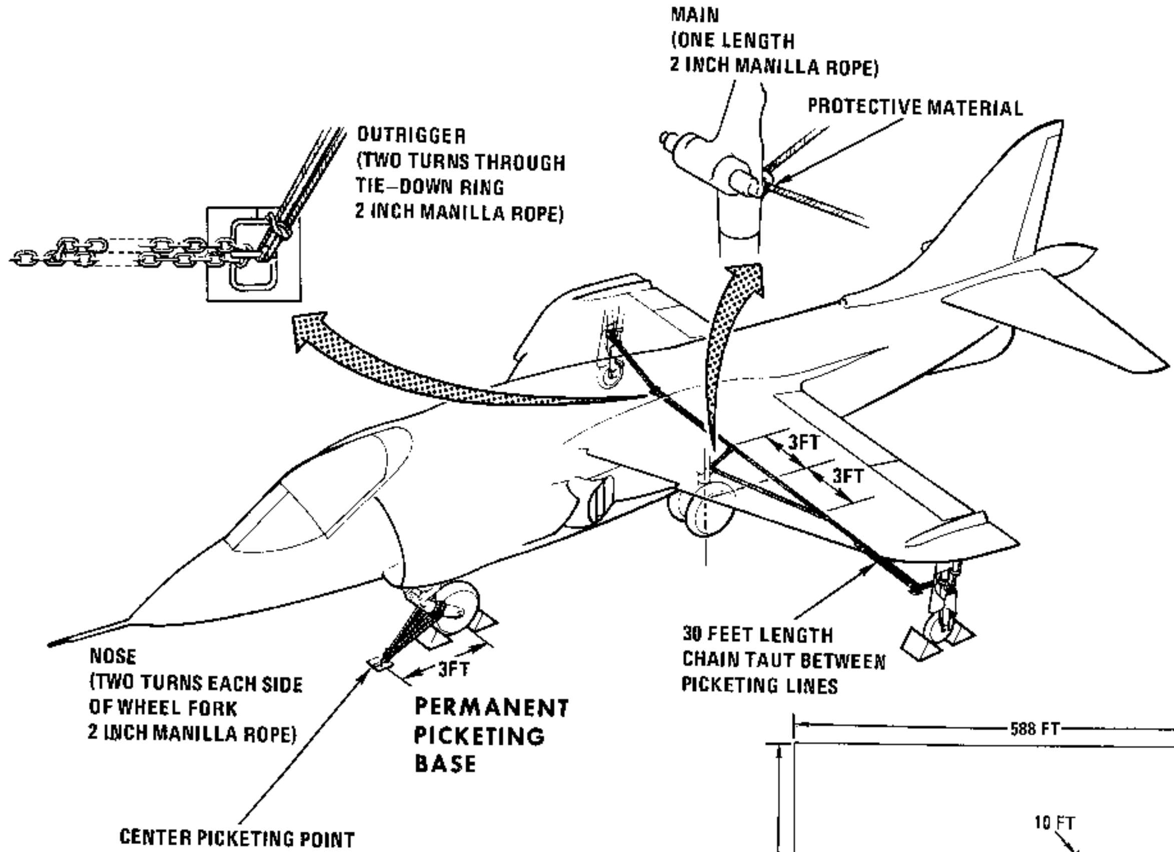
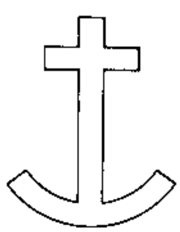
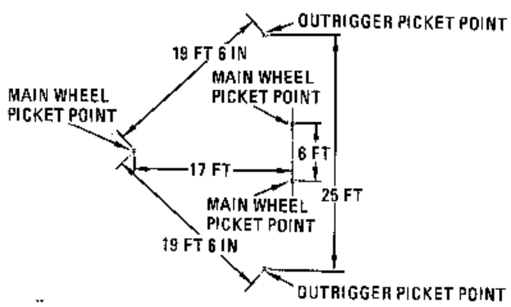
Figure 1-49 (Sheet 3 of 3)

PARKING AND MOORING

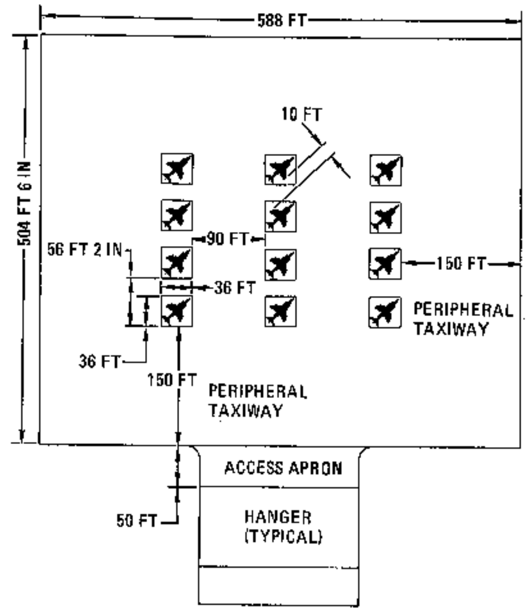




PICKETING POINT SYMBOL



GROUND PLAN FOR STANDARD PICKETS



GROUND SUPPORT EQUIPMENT

PART NO./ TYPE DESIGNATION	NOMENCLATURE
	WHEEL CHOCKS (2 SETS)
	CHAIN (30 FT LONG)
	MANILLA ROPE (2 INCH DIA)
4G/4202	METAL CHOCKS (1 SET)

1. PARKING AND MOORING.
2. GENERAL PRECAUTIONS.
   a. CHOCK NOSE LANDING GEAR WHEEL.
   b. CHOCK ONE OF THE OUTRIGGER WHEELS FORWARD AND AFT TO RESIST WEATHERCOCKING.
   c. ELECTRICALLY GROUND AIRCRAFT.
   d. INSTALL APPLICABLE PROTECTIVE COVERS AND GUARDS.
3. COLD WEATHER.
   a. WHEN DIRECTING AN AIRCRAFT BEING TAXIED ON SNOW OR ICE, ALLOW MAXIMUM CLEARANCE BETWEEN AIRCRAFT AND OBSTACLES.
   b. TO PREVENT TIRES FROM FREEZING TO GROUND OR RAMP, PLACE INSULATING MATERIAL UNDER TIRES.
   c. REMOVE ALL ACCUMULATIONS OF SLUSH OR MOISTURE FROM WHEEL WELLS AND UNDERSIDE OF WING.

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Figure 1-50 (Sheet 1 of 2)

PARKING AND MOORING (CONTINUED)

4. WET WEATHER.
   a. KEEP CANOPY CLOSED WHEN ACCESS TO COCKPIT IS NOT REQUIRED. INSTALL COCKPIT COVER WHEN COCKPIT ACCESS IS NOT REQUIRED FOR EXTENDED PERIODS. IF WATER ACCUMULATES IN COCKPIT, REMOVE BY OPENING DRAINS.

CAUTION

AFTER DRAINING COCKPIT ENSURE DRAINS ARE RESEATED OR LOSS OF CABIN PRESSURE MAY RESULT.

   b. KEEP ALL MOISTURE VENTS AND DRAINS OPEN.
5. PARKING. WHEN PRACTICABLE, THE AIRCRAFT SHOULD BE PARKED FACING INTO THE WIND. THE AIRCREW EJECTION SEAT AND CANOPY MDC SYSTEM MUST BE MADE SAFE. IF AIRCRAFT IS TO BE PARKED BETWEEN FLIGHTS, THE NOSEWHEEL SHOULD BE CHOCKED FORWARD AND AFT USING SMALL COLLAPSIBLE METAL CHOCKS; THE BRAKES, IF HOT, SHOULD BE RELEASED, THE RUDDER BAR LOCK ENGAGED, THE HUD COVER FITTED, THE CANOPY CLOSED, AND THE PRESSURE HEAD COVERED, AOA PROBE UNIT GUARD, LANDING GEAR GROUND LOCKS, AIR INTAKE BLANKS, AND ENGINE NOZZLE COVERS FITTED. AIRCRAFT PARKED FOR LONGER PERIODS SHOULD, IF POSSIBLE, BE FITTED WITH ALL PROTECTIVE COVERS.
6. NORMAL PARKING.

NOTE

- AVOID PARKING THE AIRCRAFT HEAD ON INTO STRONG WINDS (EXCEEDING 20 KNOTS) UNLESS THE ENGINE AIR INTAKE BLANKS ARE FITTED, AS THE RESULTANT WINDMILLING OF THE ENGINE WILL CAUSE OIL TO BE PUMPED INTO THE TURBINE REAR BEARING AND SUBSEQUENTLY TO ESCAPE INTO THE EXHAUSE DUCT (JET PIPE). IF PARKED WITHOUT ENGINE AIR INTAKE BLANKS FITTED, AND WINDMILLING OCCURS, CHECK THE ENGINE OIL LEVEL BEFORE TAKE OFF AND CARRY OUT A DRY MOTORING CYCLE IF NECESSARY.
- IT IS SAFE TO LEAVE THE AIRCRAFT PARKED WITH THE CANOPY CLOSED, THE NOSE WHEEL CHOCKED FOREWARD AND AFT, AND WITH THE RUDDER BAR LOCKED, IN WINDS OF 50 KNOTS FROM ANY DIRECTION. AIRCRAFT WITH FULL INTERNAL FUEL TANKS AND PARKED AS DESCRIBED, ARE SAFE IN WINDS UP TO 60 KNOTS FROM ANY DIRECTION.
- AFTER PARKING AND BEFORE CLOSING CANOPY, CHECK THAT BATTERY MASTER SWITCHES ARE OFF.
- WHEN PARKED BETWEEN FLIGHTS IN CONDITIONS OF HOT SUNSHINE, THE CANOPY SHOULD BE LEFT OPEN AND THE SUNSHADE FITTED OVER COCKPIT.
- OPERATIONAL DEPLOYMENT MAY PRECLUDE COMPLIANCE WITH SOME OF THESE REQUIREMENTS.

   a. DIRECT AIRCRAFT INTO PARKING AREA BY USING HAND SIGNALS.
   b. WHEN AIRCRAFT STOPS, ALLOW ENGINE TO SHUT DOWN. PLACE WHEEL CHOCKS IN FRONT AND BEHIND MAIN LANDING GEAR WHEELS.
   c. INSERT LANDING GEAR GROUND SAFETY PINS.
   d. ELECTRICALLY GROUND AIRCRAFT.
   e. INSTALL APPLICABLE PROTECTIVE COVERS AND GUARDS.
7. PARKING IN MAINTENANCE HANGAR.

WARNING

AIRCRAFT SHALL BE INSPECTED FOR THE PRESENCE OF ALL APPLICABLE SEAT AND ARMAMENT SAFETY PINS BEFORE BEING PLACED INSIDE HANGAR TO PREVENT INJURY OR DEATH TO PERSONNEL.

NOTE

REFER TO NAVAIR 01-AV8A-75, OP 3347 AND CG 108 FOR GROUND HANDLING OF AIRCRAFT CONTAINING AMMUNITION AND EXPLOSIVE MATERIAL.

   a. AIRCRAFT SHALL NOT BE MOVED INTO A MAINTENANCE HANGAR BEFORE INSTALLING THE COCKPIT AND EJECTION SEAT SAFETY DEVICES. IF THE FOLLOWING SAFETY PRECAUTIONS ARE OBSERVED, ARMAMENT NEED NOT BE REMOVED FROM AIRCRAFT.

WARNING

- PERFORM MAINTENANCE ON GUN SYSTEM/CIRCUITRY ONLY WHEN AMMUNITION IS NOT ON BOARD AIRCRAFT.
- DO NOT USE HEAT OR FLAME-PRODUCING DEVICES IN AREA OF GUN OR AMMUNITION. FAILURE TO COMPLY CAN RESULT IN INJURY OR DEATH TO PERSONNEL.

      (1) ENSURE AIRCRAFT IS GROUNDED.
      (2) INSTALL ARMAMENT SAFETY KEY IN AIRCRAFT.
      (3) INSTALL SAFETY PINS IN ALL STATIONS WITH STORES INSTALLED.
      (4) ENSURE AMMUNITION IS NOT IN GUNS.
      (5) ENSURE GUN FIRING CABLES ARE CONNECTED.
      (6) ENSURE ARMAMENT CONTROL SWITCHES ARE AS FOLLOWS:
         (a) ARM MASTERS NO. 1 AND NO. 2 TO OFF.
         (b) SIDEWINDER GROUND TEST SWITCH TO NORM WITH COVER DOWN.
         (c) SEAM SCAN SWITCH TO OFF.
         (d) THE BOMBS/ROCKETS/SIDEWINDER SWITCH TO BOMBS/ROCKETS.
         (e) BOTH GUN SELECTOR SWITCHES TO OFF.
         (d) ALL STATION SELECTOR SWITCHES TO OFF.
         (g) THE FUZING SELECTOR SWITCH TO OFF.
         (h) ALL PATCHING SWITCHES TO OFF.
         (i) THE AUTO/MANUAL SWITCH TO MANUAL.
         (j) THE SINGLE/DOUBLE SWITCH TO S.
         (k) ON CONTROL STICK GRIP, ENSURE BOMB/RP SAFETY FLAP IS LOWERED AND THE GUN TRIGGER IS STOWED WITH THE GUN SAFETY CATCH IN THE SAFE POSITION.

8. MOORING (PICKETING). WHEN A PERMANENT PICKETING BASE IS NOT AVAILABLE, SCREW PICKETS ARE TO BE USED. FIVE PICKETING POINTS ARE REQUIRED. ON A PERMAMENT BASE, POSITION AND PARK THE AIRCRAFT INTO THE WIND WITH THE NOSEWHEEL APPROXIMATELY 3 FEET BEHIND THE CENTRAL PICKETING POINT AND THE OUTRIGGER WHEELS APPROXIMATELY EQUIDISTANT FROM THEIR RESPECTIVE PICKETING POINTS. PRESSURIZE HYDRAULIC BRAKES ACCUMULATOR, APPLY BRAKES, SET PARKING BRAKE LOCK, AND LOCK RUDDER BAR, BEFORE FITTING THE AIRCRAFT COVERS. CHOCK NOSEWHEEL AND ONE OUTRIGGER WHEEL FORWARD AND AFT TO ASSIST THE PREVENTION OF WEATHERCOCKING.
9. PROCEDURE.
   a. FIX ONE 30 FOOT LENGTH OF CHAIN, WITH SHACKLES TAUT; BETWEEN THE OUTRIGGER PICKETING POINTS. USING LENGTHS OF 2 INCH ROPE, LASH AS FOLLOWS:
      (1) NOSEWHEEL
         (a) SECURE TWO ROPES TO PICKETING EYE.
         (b) SECURE ROPE TO WHEEL FORK WITH TWO TURNS, PASSING ROPE UP BETWEEN TIRE AND WHEEL FORK, AND BACK ON THE OUTSIDE OF FORK TO PICKETING EYE-END; FASTEN IN A KNOT.
      (2) MAIN WHEEL.
         (a) SECURE A LENGTH OF ROPE TO CHAIN APPROXIMATELY 3 FEET FROM AIRCRAFT CENTERLINE.
         (b) PASS ROPE THROUGH EYE ON REAR OF STRUT, WRAP ROPE WITH PROTECTIVE MATERIAL; E.G., PLASTIC STRIP WHERE IT PASSES THROUGH THE EYE, AND PULL TAUT.
         (c) SECURE ROPE TO CHAIN SO THAT ROPE IS EQUIDISTANT LEFT AND RIGHT.
      (3) OUTRIGGER WHEEL.
         (a) SECURE A LENGTH OF ROPE TO PICKETING POINT.
         (b) PASS TWO TURNS OF ROPE THROUGH OUTRIGGER INBOARD TIE DOWN RING AND PICKETING EYE AND SECURE.

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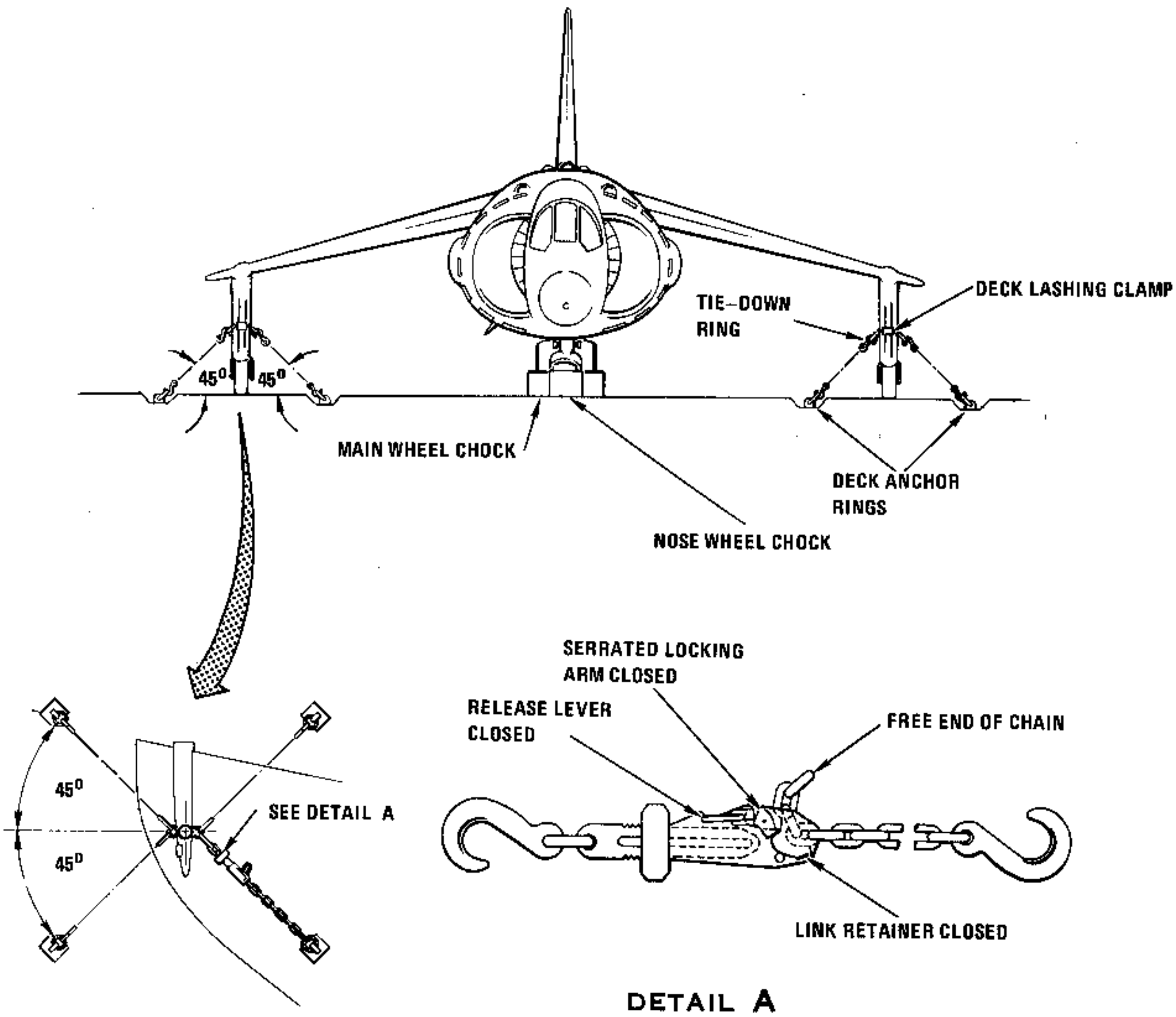
Figure 1-50 (Sheet 2 of 2)

CARRIER DECK HANDLING



DETAIL A
TD-1A TIE–DOWN ASSEMBLY

1. RAPID TIE–DOWN OF SHIPBOARD AIRCRAFT.
2. PROCEDURE.

NOTE

THIS PROCEDURE IS SAFE FOR WIND SPEEDS UP TO 40 KNOTS FROM ANY DIRECTION.

a. APPLY WHEEL BRAKES, SET PARKING BRAKE AND LOCK RUDDER BAR.
b. CHOCK NOSE AND MAIN WHEELS FORWARD AND AFT.
c. INSERT CHAIN HOOKS (POINT UP) IN DECK ANCHOR RINGS AND LOCK HOUSING HOOKS IN OUTRIGGER OUTBOARD TIE–DOWN RING. SECURE CHAIN IN LOCK HOUSING AND APPLY TENSION BY HAND AS DESCRIBED IN NAVAIR 17–1–537, SECTION 11.
d. THE PROCEDURE FOR THE OUTRIGGER INBOARD TIE–DOWN IS THE SAME AS THE OUTRIGGER OUTBOARD TIE–DOWN.

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Figure 1–51

PART 4 AIRCRAFT OPERATING LIMITATIONS

AIRCRAFT

GENERAL

All airplane/systems limitations that must be observed during normal operation are covered or referenced herein. Some limitations that are characteristic only of a specialized phase of operation (emergency procedures, flight through turbulent air, starting procedures, etc.) are not covered here; however, they are contained along with the discussion of the operation in question.

INSTRUMENT MARKINGS

The limitation markings appearing on the instrument faces are shown in figure 1-52 and noted in the applicable text.

ENGINE LIMITATIONS

JPT LIMITER

The JPTL limits the jet pipe temperature to 740° ±10°C for short lift wet, 710° ±10°C for short lift dry and 600° +10°C for maximum thrust.

RPM

The maximum permissable indicated RPM is 107.0%. Due to structural limits however, it may be further restricted by the engine's ability to handle a given mass flow of air. The mass flow limit is reached at 106.5% on a standard day. Since the amount of air drawn into the engine for any given RPM will vary with temperature the maximum allowable indicated RPM will vary according to table:

OAT°C	INDICATED RPM%	
+18	107.0	
+15	106.5	
+10	105.5	
+5	104.5	
0	103.5	= 106.5% CORRECTED RPM
−5	102.5	
−10	102.0	
−15	101.0	
−20	100.0	

RPM corrected to standard day temperature is referred to as corrected or non dimensional RPM. Above 10,000 feet, the pressure ratio limiter regulates the corrected RPM to 100.0 ±1%.

PRESSURE RATIO LIMITER (PRL)

When the PRL is turned off above 10,000 feet, the following indicated RPM vs. altitude limitations must be observed?

10,000 feet - 95%
15,000 feet - 93%
20,000 feet - 91%
25,000 feet - 89%
30,000 feet - 88%
Above 35,000 feet - 87%

LIFT RATING

Each 2½ minute period of operation in the lift rating must be separated by at least 5 minutes in or below the maximum continuous rating.

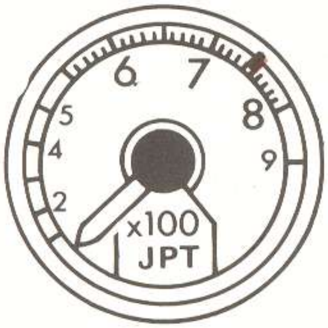
ENGINE STARTING

A starting attempt should be abandoned immediately if:

a. RPM stagnate below idling RPM.
b. JPT reaches 450°C (If JPT rises rapidly above 350°C, throttle OFF before 450°C.)
c. Light up has not occurred after 20 seconds of starter operation.

If the engine fails to light, a fuel drainage period of 1 minute must be allowed before a further starting attempt is made.

INSTRUMENT MARKINGS



JET PIPE TEMPERATURE	
745°C	MAXIMUM STEADY STATE TEMP

TACHOMETER	
107.0%	MAXIMUM RPM

PC-1, PC-2 HYDRAULICS	
3000 ±200	NOMINAL PRESSURE

NOSEWHEEL STEERING	
1100 PSI	MINIMUM PRESSURE

BRAKE ACCUMULATOR	
1250 PSI	MINIMUM PRESSURE

AV8A–1–(46)B
R–G

Figure 1–52

APU STARTING

Unless an external air supply is used to cool the electric starter motor, no more than three engine starting attempts (within a 20 minute period) may be made, with at least 1 minute between attempts.

WATER INJECTION

Distilled or demineralized water (per NAVAIR Instruction 13780.1) must be used whenever possible. Repeat use of other than distilled or demineralized water results in deterioration of engine performance. The water injection rate is 39.6 gallons per minute (nominal). Water injection is not to be used if OAT is below +5°C.

AIRSPEED LIMITATIONS

The maximum permissible airspeeds for flight in smooth or moderately turbulent air with landing gear and wing flaps retracted and with the speed brake retracted or extended is 1.2 Mach. Airspeed limitations for various systems are as follows:

a. Flaps
   Mid-Flaps - 0.8 IMN to 15,000 ft., unrestricted above 15,000 ft.
   Full-Flaps - 300 KIAS/0.8 IMN
b. Landing gear operation - 250 KIAS
c. Landing gear locked down - 350 KIAS
d. Stab aug engaged - 250 KIAS
e. Q feel disengaged - 500 KIAS
f. One hydraulic system inoperative - 0.9 IMN
g. Air refueling probe installed - 500 KIAS/0.9 IMN
h. Canopy open - 40 Knots
i. Wheels in contact with ground - 180 Kts ground speed
j. Windshield wiper - 550 KIAS

PROHIBITED MANEUVERS

ALL NOZZLE CONFIGURATIONS

1. Overriding aileron high speed stops above 250 knots, except in emergency.
2. Inverted maneuvers with high roll rate.
3. Rolls in excess of 360°.
4. Full lateral stick deflection rolls (to the high speed stop) at speeds above 450 Kt./0.9M.
5. Full lateral stick deflection rolls (to the high speed stop above 250 Kt. or full aileron travel below 250 Kt.) up to 180° below 1G or above 4G.
6. Full lateral stick deflection rolls (to the high speed stop above 250 Kt. or full aileron travel below 250 Kt.) beyond 180° and up to 360° below 1G or above 2G.
7. Hesitation rolls; stall turns.
8. Intentional spins.
9. Less than 1G in excess of 15 seconds.
10. Intentional stalls below 15,000 feet and above 30,000 feet.
11. Intentional stalls with the refueling probe installed.

NOZZLES DEFLECTED

1. Less than 10° nozzle deflection during takeoffs until wingborne.
2. Sideslip between 30 to 150 knots.
3. More than 15 units AOA above 50 knots when in landing configuration.
4. Between 30 to 90 knots, turns are not permitted; and between 90 and 150 knots, only gentle turns are permitted.
5. Rearward or sideward translations above 30 knots or into winds exceeding 30 knots.
6. Continuous use of engine bleed for more than 5 minutes in any one period. Use of engine bleed for reaction control must be followed by a cooling period of at least the same duration (nozzles aft).
7. On aircraft before PPC 19 and AYC 382, nozzle deflection above 400 knots; more than 45° nozzles above 300 knots; more than 80% RPM above 250 knots.

CG LIMITATIONS

The center of gravity must be kept between 2.9% and 15.4% of the mean aerodynamic chord (MAC) with a clean airplane configuration. The allowable aft CG with external stores is 13.7% MAC. For precise loading and CG data, refer to the handbook of weight and balance data NAVAIR 01-1B-40 for the AV-8A.

WEIGHT LIMITATIONS

There are no weight limitations on takeoff with any of the symmetrical store loads. The maximum landing gross weight (720 fpm sink rate) is 16,900 pounds except in an emergency.

ASYMMETRIC LANDING

Landing with an asymmetric load is limited as follows:

a. Vertical landing with an asymmetric load in excess of 45,000 inch-pounds is prohibited. The inboard pylons are 75.2 inches and the outboard pylons are 133.1 inches from the aircraft centerline.
b. Landing with a 1000 pound bomb on an inboard pylon is limited to a minimum approach speed of 160 knots with the nozzles deflected 20° or more and a minimum of 80% RPM. Any type rolling landing may be made with any other single asymmetric store.

ACCELERATION LIMITATIONS

The maximum permissible accelerations shown in figure 1-53 are for flight in smooth air. Moderate and heavy buffet should be avoided whenever possible. The Acceleration Limitations chart presents the maximum positive and negative G permissible for various gross weights. The envelope is based on a maximum gross

weight of 19,300 pounds, exclusive of external stores. However, the same envelope determines the maximum permissible G (positive and negative) for external stores totaling up to an additional 4,000 pounds.

FLIGHT STRENGTH DIAGRAM

The Flight Strength Diagram (figure 1-54) is a composite presentation of the airplane's operating envelope at two different gross weights. Parameters of each envelope include maximum allowable Mach number, wings-level stall speed at sea level, and the positive and negative load factor limits.

CROSSWIND LIMITATIONS

PAVED RUNWAY - DAY AND NIGHT

a. CTO and CL (day or night)
    Dry runway - 20 knots
    Wet runway - 15 knots
b. VTO and STO (day or night)
    Lift off above 120 knots - 20 knots
    Lift off 90 to 120 knots - 15 knots
    Lift off below 90 knots - 10 knots
c. VL and SL
    Day - 15 knots
    Night - 10 knots
d. RVTO and RVL
    Day - 10 knots
    Night - 5 knots

OTHER SURFACES

The maximum permissible crosswind component for takeoff and landing using other surfaces is 10 knots.

Arresting Gear Limitations

The aircraft is cleared to taxi over a supported arresting gear wire up to a maximum speed of 5 knots. Stop immediately if an outrigger is trapped by the wire. The aircraft may cross an unsupported tensioned arresting gear wire at any speed, engine RPM or nozzle angle if the wire lies flat on the runway or deck.

Maximum Performance Operation.

Operation from sites without abort capability are not permissable unless the engine meets the following criteria:

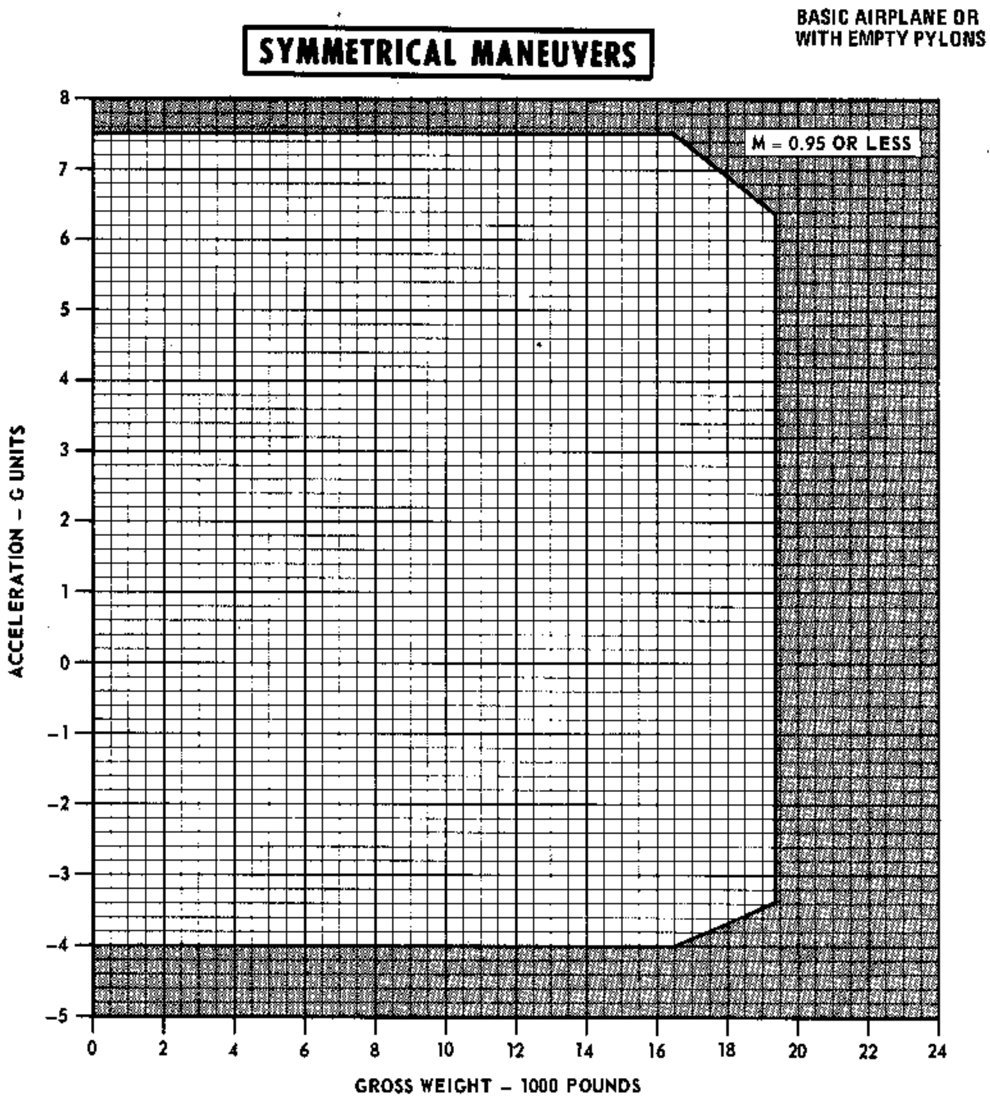
a.L.P. governor setting - 102.5%
b.Acceleration time 27% to 55% RPM - 3.5 to 4.5 seconds
c.Acceleration time 55% to 100% RPM - 2.5 to 3.0 seconds (when acceleration commences at IDLE)

EXTERNAL STORES

GENERAL

The external wing tanks may be carried to an airspeed of 595 KIAS or Mach 0.93 whichever is less. Acceleration G is the same as the basic airplane. The tanks must be jettisoned in 1G level flight between 200 and 550 KIAS (0.85 Mach) if empty, and between 200 and 250 KIAS if tanks contain fuel. Before jettisoning tanks containing fuel, allow 10 seconds of straight and level flight in order to equalize fuel in tank compartments. The operating limitations for all other external stores is contained in appendix A of the AV8A-1T Tactical Manual.

ACCELERATION LIMITATIONS



Notes

- FLIGHT LIMITS FOR EXTERNAL STORE CARRIAGE ARE SUBJECT TO ABOVE LIMITATIONS AND AS SPECIFIED IN THE EXTERNAL STORES LIMITATIONS CHART, APPENDIX A OF NAVAIR 01-AV8A-1T.
- THE FLIGHT ENVELOPE FOR UNSYMMETRICAL MANEUVERS IS FROM 0 G TO 80% OF THE SYMMETRICAL LIMIT.
- REFER TO THE FLIGHT STRENGTH DIAGRAM FOR ADDITIONAL LOAD FACTOR LIMITS ABOVE 0.95 MACH.

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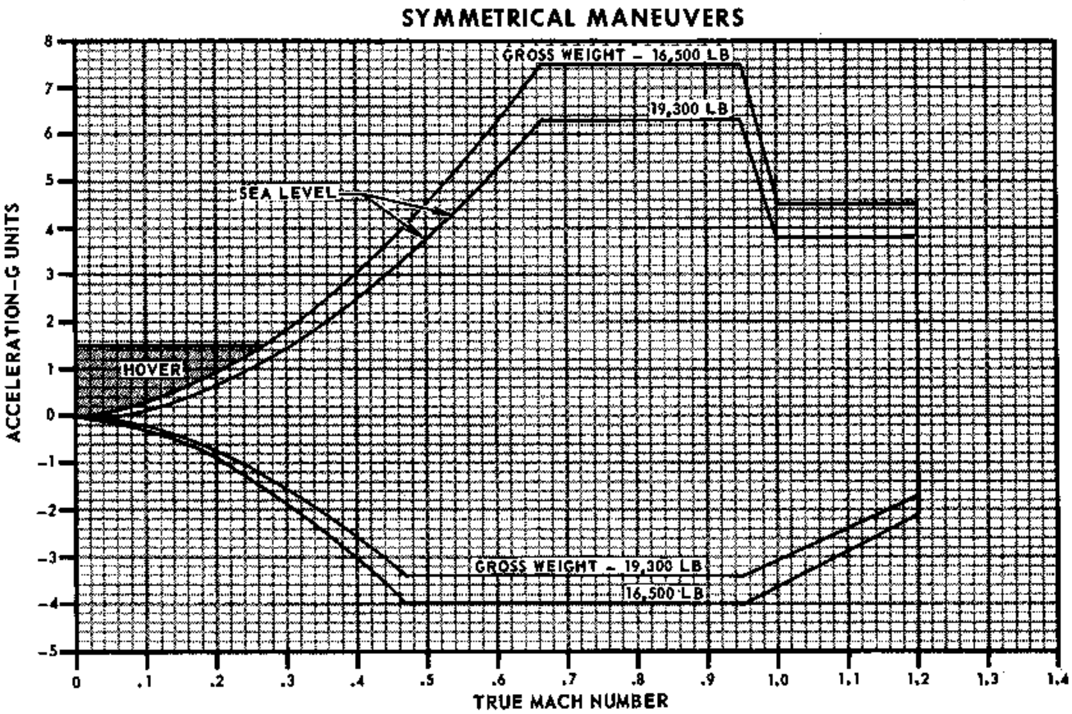
Figure 1-53

FLIGHT STRENGTH DIAGRAM

BASIC AIRPLANE OR
WITH EMPTY PYLONS



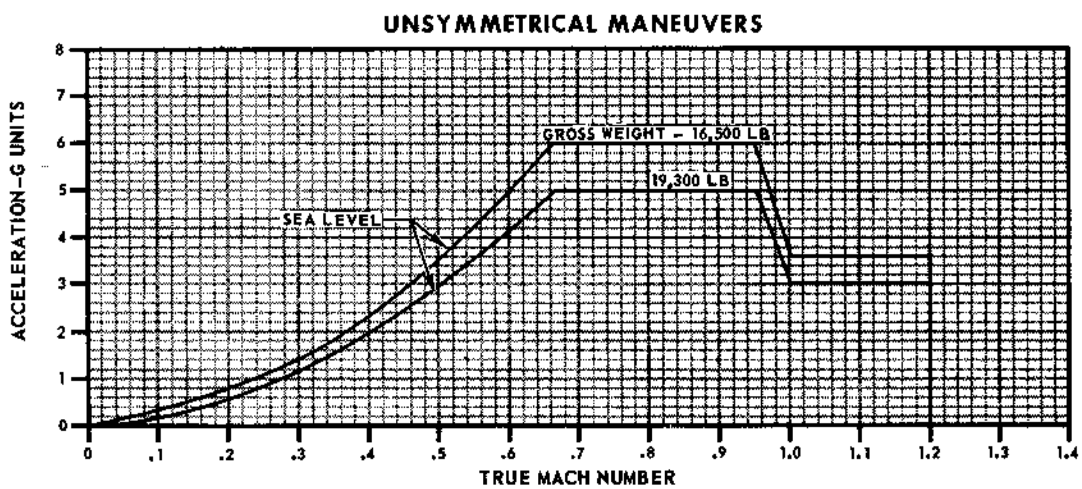


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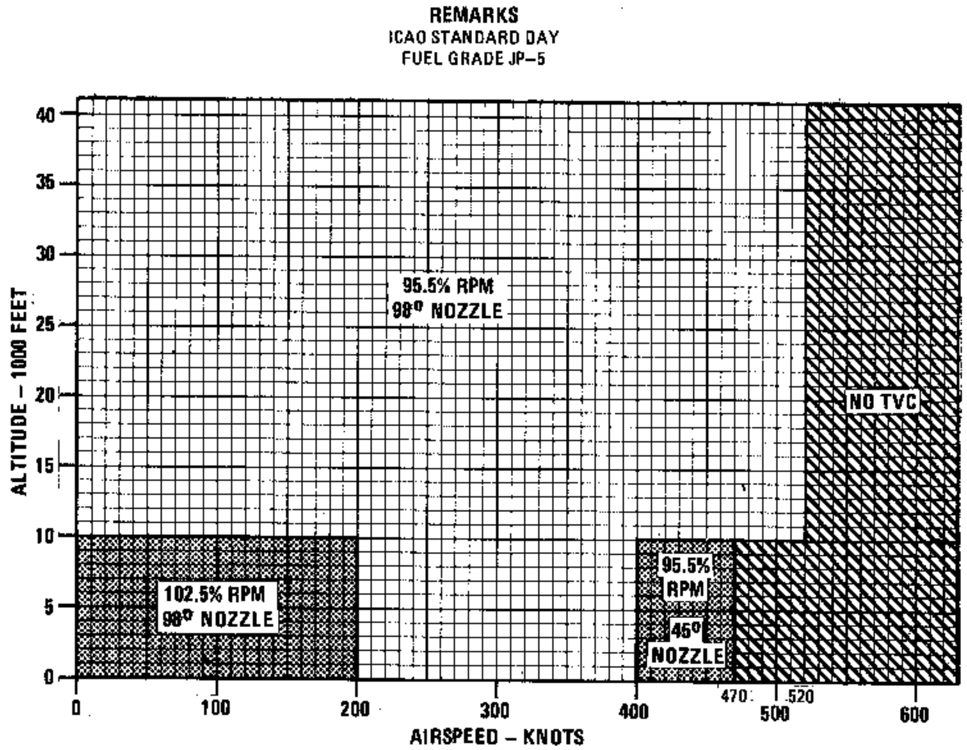
Figure 1–54

THRUST VECTOR CONTROL ENVELOPE LIMITS



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SECTION II
INDOCTRINATION

TABLE OF CONTENTS

GROUND TRAINING

MINIMUM GROUND TRAINING SYLLABUS

The overall ground training syllabus for each activity will vary according to local conditions, field facilities, requirements from higher authority, and the immediate Unit Commander's estimate of squadron readiness.

FAMILIARIZATION

Flight physiological training as appropriate

AV-8A NAMT pilot's course

Simulated Ejection

Parachute Hang

FLIGHT SUPPORT LECTURES

Cockpit

Hydraulic System and Services

Flight Controls

Fuel System

Engine and Engine Fuel System

Electrical System

Instruments (Head Down)

Pressurization and Air Conditioning

Safety Equipment

Warning and Caution Lights and COMNAV Systems

Preflight, Strapin and Checklists

VTOL Characteristics and Techniques

Transition Techniques

STOL Flight and Techniques

Conventional Flight

Engine Handling

Limitations

Emergency Procedures

Performance Computations

NATOPS Flight Manual (open and closed book)

Ejection Seat

FAMILIARIZATION LECTURES

HUD

Instrument Flight

Formation Flight

Night Flying

BASIC LECTURES

INAS

Visual and System Navigation

Weapons System Use

Close Air Support Techniques

Tactics and ACM Brief

SATS/VSTOL Procedures

FMLP/SHIPQUAL Brief

Dispersed Site Operations

Aerial Refueling

ADVANCED LECTURES

NAV Attack

Conventional Weapon Delivery

Air to Air Weapons

Air Combat Maneuvering

SATS/Ship Qualification

WAIVING OF MINIMUM GROUND TRAINING REQUIREMENTS

Where recent pilot experience in similar aircraft models warrant, Unit Commanding Officers may waive the minimum ground training requirements provided the pilot meets the following mandatory qualifications:

Has obtained a current medical clearance

He is currently qualified in flight physiology

Has satisfactorily completed the NATOPS Flight Manual open and closed book examinations

Has received adequate briefing on normal and emergency operating procedures

Has received adequate instructions on the use/operation of the ejection seat and survival kit.

FLIGHT TRAINING SYLLABUS

AIRCREW FLIGHT TRAINING SYLLABUS

Prior to flight, all pilots will have completed the Familiarization and Flight Support Lectures previously prescribed. A qualified instructor pilot will be assigned for the familiarization flights. The geographic location, local command requirements, squadron mission, and other factors will influence the actual flight training syllabus and the sequence in which it is completed.

PROFICIENCY BUILDUP

Conventional Jet

Helicopter
Familiarization

Instruments

Formation

Night Familiarization
Visual Navigation

System Navigation

Conventional Weapon Delivery

Close Air Support

Tactics

Air Combat Maneuvering

SATS/VTOL Pad

Ship Take Off and Landing

Dispersed V/STOL Site Operations

Aerial Refueling
NAV Attack Profiles

Advanced Conventional Weapons

Air to Air Weapons

Advanced ACM

Day Ship Qual

Night SATS/Ship T.O. and Landing Practice

Night Ship Qual

OPERATING CRITERIA

CEILING/VISIBILITY REQUIREMENTS

Prior to the pilot becoming instrument qualified in the airplane, field ceiling/visibility and operating area weather must be adequate for the entire flight to be conducted in a clear air mass according to Visual Flight Rules. After the pilot becomes instrument qualified, the following weather criteria apply:

Time-in-Model (hr)	Ceiling/Visibility (ft)/(mi)
0-50	500/1
50 and above	Field minimums or 200/½ whichever is higher

Where adherence to these minimums unduly hampers pilot training, Commanding Officers may waive time-in-model requirements for actual instrument flight, provided pilots meet the following criteria:

Have a minimum of 10 hours in model

Completed 2 simulated instrument sorties

Completed 2 satisfactory Tacan penetrations.

MINIMUM FLIGHT QUALIFICATIONS

Where recent pilot experience in similar aircraft models warrant, Unit Commanding Officers may waive the minimum flight training requirements for basic qualifications. Minimum flight hour requirements to maintain pilot qualificiations after initial qualification in each specific phase will be established by the Unit Commanding Officer. Pilots who have more than 50 hours in model are considered current subject to the following criteria:

Must have a NATOPS evaluation check with the grade of Conditionally Qualified, or better, within the past 12 months and must have flown 10 hours in model and made five takeoffs and landings within the last 60 days.

Must have satisfactorily completed the ground phase of the NATOPS evaluation check, and be considered qualified by the Commanding Officer of the unit having custody of the aircraft.

REQUIREMENTS FOR VARIOUS FLIGHT PHASES

NIGHT

Not less than 10 hours in model

CROSS COUNTRY

Have a minimum of 20 hours in model

Have a valid instrument card

Have satisfactorily completed an instrument check in model

Have completed the night familiarization syllabus prior to night cross country flight

SHIP QUALIFICATION

Each pilot will have a minimum of 50 hours in model for day qualification and 100 hours in model for night qualification and meet the requirements set forth in the LSO NATOPS manual.

PILOT FLIGHT EQUIPMENT

MINIMUM REQUIREMENTS

In accordance with OPNAVINST 3710.7, the flying equipment listed below will be worn by pilots on every flight. All survival equipment will be secured in such a manner that it will be easily accessible and will not be lost during ejection or landing. This equipment shall be the latest available as authorized by Aircrew Personal Protective Equipment Manual (NAVAIR 13-1-6).

Anti-buffet helmet modified in accordance with current aviation clothing and survival equipment bulletins

Oxygen mask

Anti-G suit (required on all flights where high G forces may be encountered)

Fire retardant flight suit

Steel-toed flight safety boots

Life Preserver

Harness assembly

Shroud cutter

Sheath knife

Flashlight (for all night flights)

Strobe light

Pistol with tracer ammunition, or approved flare gun

Fire retardant flight gloves

Identification tags

Anti-exposure suit in accordance with OPNAVINST 3710.7

Personal survival kit

Other survival equipment appropriate to the climate of the area

SECTION III
NORMAL PROCEDURES

TABLE OF CONTENTS

PART I BRIEFING/DEBRIEFING

BRIEFING

GENERAL

The flight leader is responsible for briefing all pilots on all aspects of the mission to be flown. A briefing guide or syllabus card, as appropriate, will be used in conducting the briefing. Each pilot will maintain a knee pad and will record all flight numbers, call signs, and all other data necessary to assume the lead and complete the assignment. However, this does not relieve the flight leader of the responsibility for briefing all pilots in the operation and conduct of the flight. The briefing guide will include the following:

ASSIGNMENTS

Aircraft assigned, call sign, and deck spot when appropriate.

Engine start, taxi, and takeoff times, type takeoff and associated nozzle, trim and airspeed setting.
Visual signals and rendezvous instructions

MISSION

Primary
Secondary
Operating area
Control agency
Time on station or over target

WEAPONS

Loading
Safety
Arming, dearming
Duds
Special routes with ordnance aboard
Minimum pull-out altitude
Jettison area

COMMUNICATIONS

Frequencies
Radio procedure and discipline
Navigational aids
Identification and ADIZ procedures

WEATHER

Local area
Local area and destination forecast
Weather at alternate
High altitude weather for the jet stream, temperature, and contrail band width

NAVIGATION AND FLIGHT PLANNING

Takeoff
Climb out
Mission route, including ground controlling agencies
Fuel/oxygen management
Marshal
Penetration
GCA or CCA
Recovery
Hover weights

EMERGENCIES

Aborts
Divert fields
Bingo and low state fuel
Waveoff pattern
Ready deck
Radio failure
Loss of visual contact with flight
SAR procedures
System failures

AIR INTELLIGENCE AND SPECIAL INSTRUCTIONS

Friendly and enemy force disposition
Current situation
Targets
Safety precautions

OPERATING AREA BRIEFINGS

Prior to air operations in and around a new area, it is mandatory that a comprehensive area briefing be given including, but not limited to, the following:

Bingo Fields

Instrument approach facilities
Runway length
Terrain and obstructions

Emergency Fields

Fields suitable for landing but without required maintenance equipment
Include information under Bingo fields

SAR Facilities

Type
Frequencies
Locations

DEBRIEFING

GENERAL

Postflight debriefing is an integral part of every flight. The flight leader should review the entire flight from takeoff to landing, including not only errors and poor techniques, but also the methods of correcting them. Also, the flight leader shall cover completely any deviations from standard operating procedures. All weapons deliveries should be reviewed using the HUD camera, voice recorder and controller information when available.

PART 2 MISSION PLANNING

GENERAL

The pilot shall be responsible for the preparation of required charts, flight logs, navigation computations including fuel planning, checking weather and NOTAMS, and for filing required flight plans. Refer to section XI, Performance Data, to determine fuel consumption, correct airspeed, power settings, and optimum altitude for the intended flight mission. Operations status board must be checked to determine assigned aircraft thrust variance from spec engine. Planning data for specialized missions will be contained in the AV-8A Tactical Manual.

FLIGHT CODES

The proper Kind of Flight classification and codes to be assigned individual flights are established by OPNAVINST 3710.7.

PART 3 SHORE-BASED PROCEDURES

PREFLIGHT

GENERAL

The yellow sheet must be checked for flight status, configuration, armament loading, and servicing prior to manning the aircraft. At least the ten previous B sections should be reviewed for discrepancies noted and the corrective action taken. Weight and Balance clearance is the responsibility of the maintenance department.

EXTERIOR INSPECTION

See figure 3-1

BEFORE ENTERING COCKPIT

1. Canopy - OPEN

WARNING

Before opening the canopy, ensure area under the retracted boarding ladder is clear.

2. Ejection seat and canopy - CHECK

WARNING

The rocket motor ignition sear is under the seat. Do not use this area for stowage. Exercise caution when performing any function in the vicinity of the rocket pack; e.g., pulling rocket motor safety pin, adjusting leg restraint lines, etc.

a. Check condition of canopy and MDC patterns.
b. Check rocket motor firing lanyard connected to inboard side of right floor bracket.
c. Check survival kit sticker clips inserted.
d. Check emergency harness release handle connected to sear.
e. Check drogue gun shear pin installed and trip rod connected.
f. Check top latch mechanism, top latch plunger flush or slightly below housing and locking indicator flush or slightly protruding from housing.
g. Check ejection gun cross rod connected to ejection gun sear.
h. Check parachute withdrawal line intact, connected, and routed through the guillotine.
i. Check time release mechanism trip rod connected.
j. Check emergency oxygen gage indicates in white sector and emergency oxygen control knob seated.
k. Check scissors shackle for drogue scissor shackle inserted in scissors jaw, pin inserted in shackle release plunger, and scissor properly tied down.

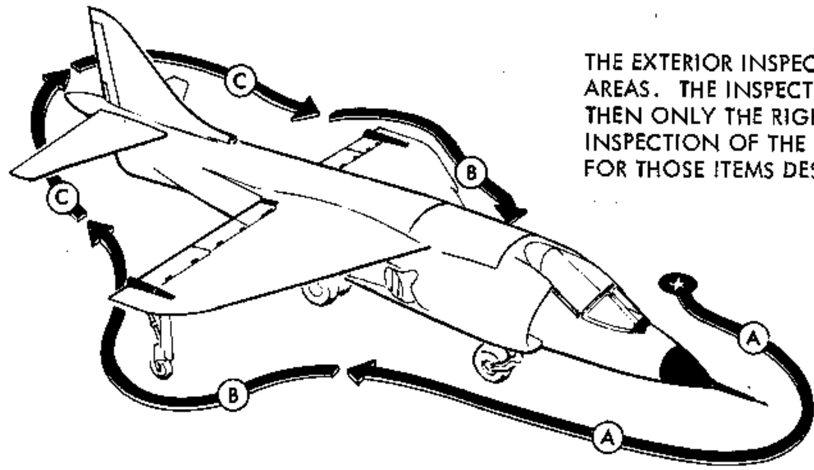
3. Rocket motor pitch control - SET
4. Seat safety pins except ejection handle and MDC firing handle safety pin - REMOVED & STOWED
   Check seat safety pins - ejection gun, guillotine, MDC detonator, and rocket motor removed and stowed. Check drogue gun safety lock (used for maintenance only) removed.
5. Landing gear selector - DOWN
6. Armament master switches - OFF
7. Weapons switches - SAFE
8. Stick grip - SAFE
   a. Trigger safety catch - ON
   b. Bomb button safety flap - OVER BOMB BUTTON
9. Patching switches - SET
10. Fuel jettison switches - OFF
11. Maintenance panel switches - LOCKED
12. Water switch - OFF

AFTER ENTERING COCKPIT

Before external electrical power -

1. Seat pan - FASTEN
   a. Connect survival kit retaining straps to integrated harness, and survival kit lowering line to life vest.
2. Leg restraint lines - ROUTE
   Pass the leg restraint lines through the garter rings (routing the lines from outboard to inboard) then through their appropriate guide rings and drop over the thighs.
3. Personal equipment connector upper (man) block - CONNECT
4. Set QRB to FASTEN and align arrows.
5. Ensure QRB and lap belt strap passes over PEC disconnect lanyard and supply hoses.
6. Place the loops of the left leg restraint line, the negative-G strap and then the right leg restraint line onto the lug of the left lap belt strap and insert the lug into the QRB.
7. Tighten lap belt straps.
   a. Shoulder harness handle - CHECK OPERATION
8. Connect parachute using Koch fittings.
9. Connect shoulder harness straps to QRB (ensure communication line is routed under right shoulder strap). Check arrowheads on QRB are still aligned.
10. Tighten negative-G strap and engage the spring clip over the buckle.
11. Helmet oxygen and communication lines - CONNECT

EXTERIOR INSPECTION



NOTE

THE EXTERIOR INSPECTION HAS BEEN DIVIDED INTO FOUR AREAS. THE INSPECTION BEGINS AT THE NOSEWHEEL AND THEN ONLY THE RIGHT SIDE OF THE AIRPLANE IS DISCUSSED. INSPECTION OF THE LEFT SIDE IS IDENTICAL EXCEPT FOR THOSE ITEMS DESIGNATED RIGHT (R) OR LEFT (L).

(A) NOSE

1. GENERAL AREA

A. PITOT-STATIC BOOM SECURE, CLEAR
B. YAW VANE SECURE

2. UNDERSIDE OF NOSE

A. NLG STRUT CONDITION, INFLATION
B. NLG TIRE CONDITION, INFLATION
C. NLG DOOR SELECTOR VALVE T-HANDLE SEATED, DOOR CLOSED.
D. PUFFER CONDITION

3. FORWARD FUSELAGE

A. AOA PROBE SECURE & FREE TO ROTATE (R)
B. INTAKE DUCT CLEAR
C. COLD NOZZLE CONDITION
D. DOORS SECURE
E. GTS INTAKE AND EXHAUST CLEAR
F. AIR MOTOR FEED PIPE AIR LEAK INDICATOR

(B) WING

A. CONDITION
B. OUTRIGGER STRUT CONDITION, INFLATION
C. OUTRIGGER TIRE CONDITION, INFLATION
D. PUFFER CONDITION
E. AILERON CONDITION
F. FLAP CONDITION

(C) AFT FUSELAGE

A. MLG STRUT CONDITION, INFLATION
B. MLG TIRES CONDITION, INFLATION
C. MLG DOORS SECURE
D. HOT NOZZLE CONDITION
E. EQUIPMENT RAM AIR INTAKE CLEAR
F. STABILATOR CONDITION
G. RUDDER CONDITION
H. PUFFER CONDITION

(D) UNDERSIDE OF FUSELAGE

A. DOORS AND PANELS SECURE
B. WHEELS CHOCKED

AV8A-1-(11)A

Figure 3-1

EJECTION SEAT AND CANOPY CHECK POINTS

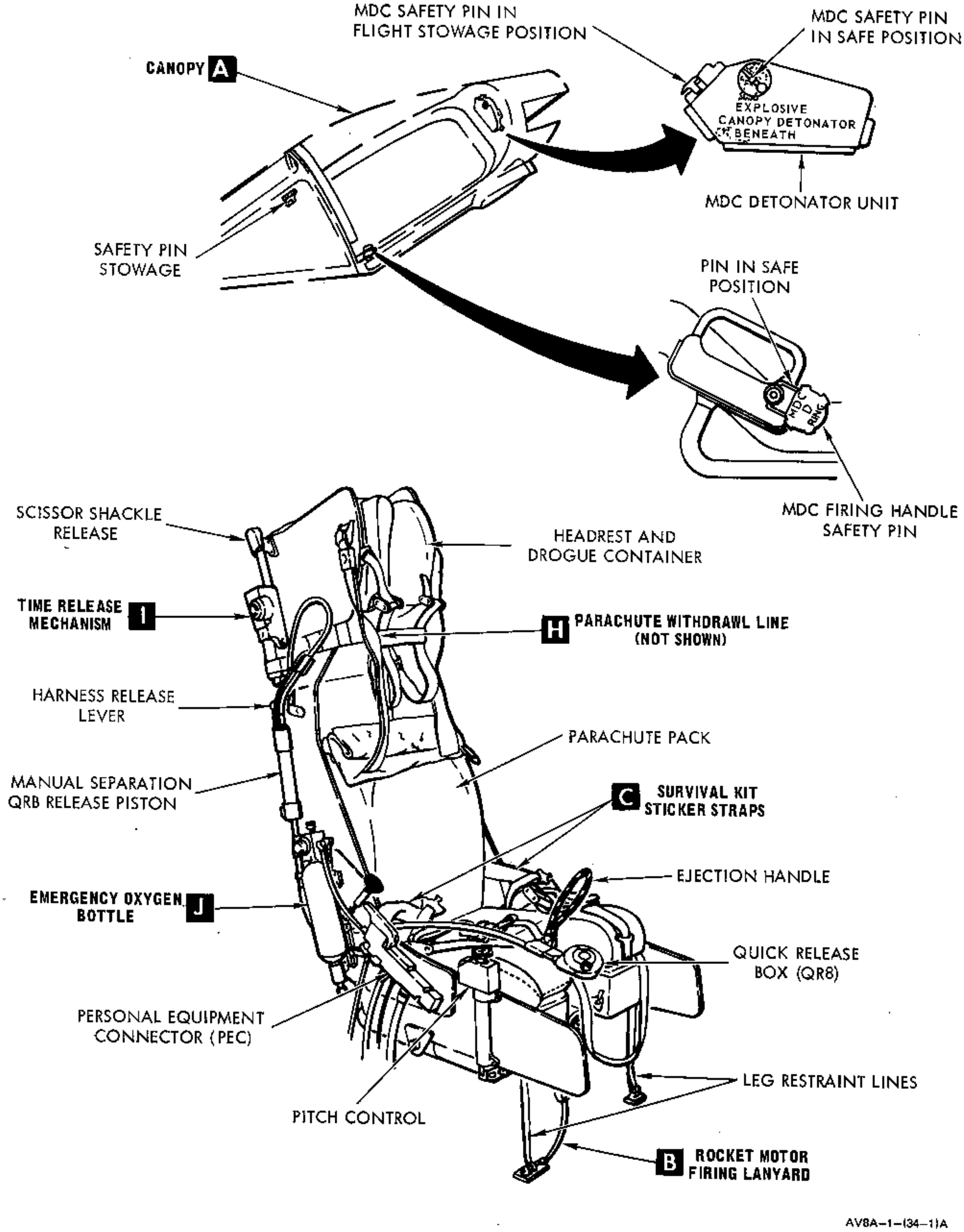


Figure 3-2 (Sheet 1 of 2)

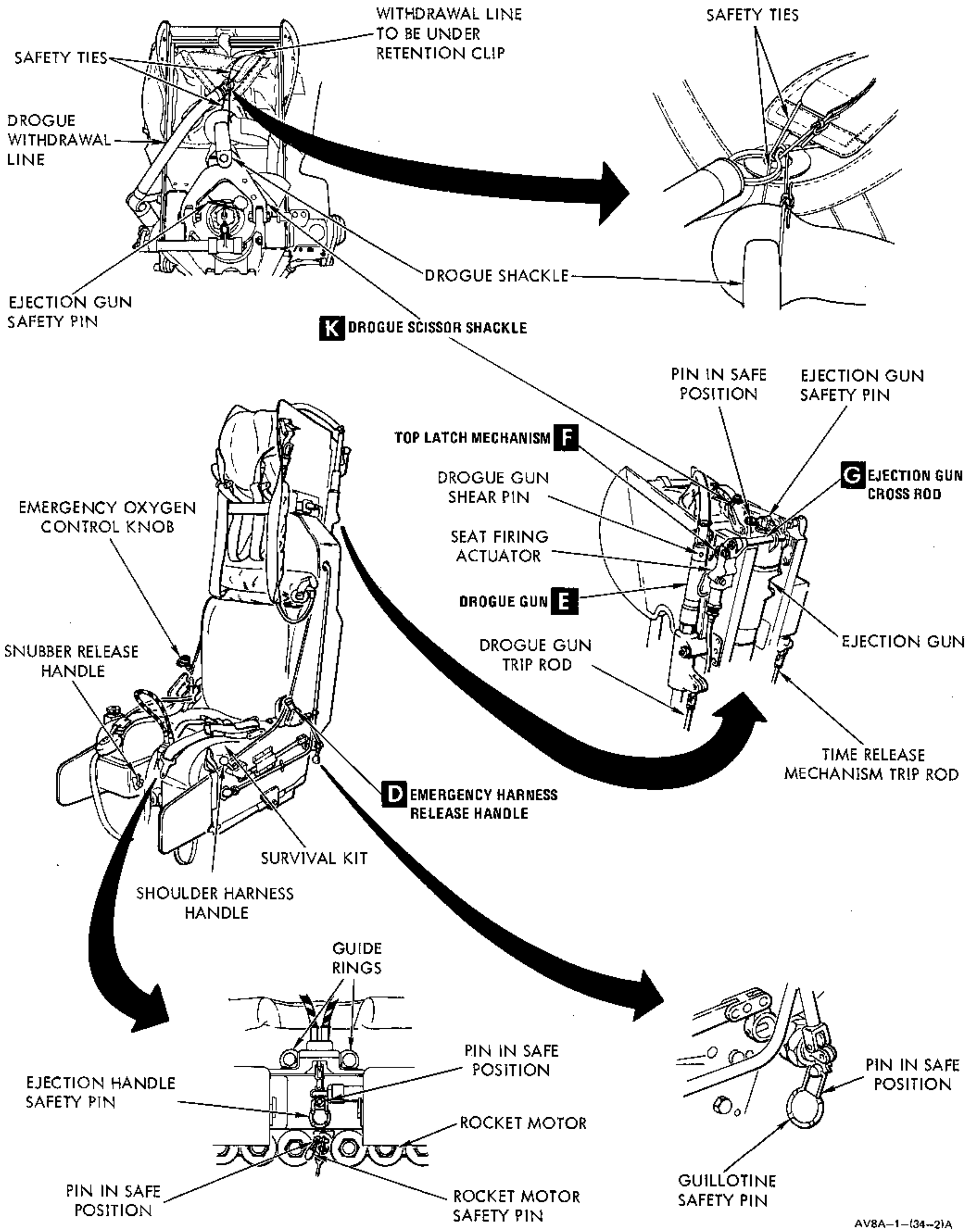


Figure 3-2 (Sheet 2 of 2)

NOTE

Connect oxygen mask to left side of helmet to prevent snagging on shoulder harness connectors. Route communications line over left shoulder.

12. Oxygen - CHECK
    Turn oxygen shut-off lever ON. Place selector knob to 100%, check normal breathing and blinker operation. Place knob to NORMAL, check normal breathing and blinker operation.
13. Navigation control panel NDC switch - OFF
14. Low pressure fuel shutoff lever - ON
15. Battery switches - ON
16. Compass master switch - ON
17. Shakers and Q-feel - ON
18. Interior lights - AS REQUIRED
19. Throttle quadrant - SET
    a. Full throttle stop - SET AS REQUIRED
    b. Friction knobs - SET
    c. Throttle - FULL; OVERRIDE LIMITERS; OFF
    d. Limiters - LIGHT ON; SWITCH ON; LIGHT OUT
    e. Nozzle stops - SET

CAUTION

Do not move nozzle lever without air supply to drive motors.

    f. Igniters - CHECK
20. Brake lock lever - ON
    a. Brake pressure gage - 1500 to 2000 psi
21. Flaps - UP
22. Manual fuel switch - OFF
23. Landing gear indicator - 4 GREEN (or downlocks installed)
24. Anti-skid - SWITCH OFF, LIGHT ON; SWITCH ON, LIGHT OUT
    Switch OFF after check aboard ship.
25. Fuel tank depressurization switch - OFF
26. Water gage - CHECK QUANTITY
27. Fuel flow proportioner switch - ON
28. Batteries - CHECK (minimum 23 volts)
    a. Battery 1 switch - OFF THEN ON
    b. Battery 2 switch - OFF THEN ON
29. Fuel gages and fuel warning lights - CHECK
30. Total fuel - CHECK
31. IFF master knob - OFF
32. Communications control panel - SET
    a. UHF switch - ON
    b. FM switch - AS REQUIRED
    c. Tacan switch - AS REQUIRED
    d. I/C switch - AS REQUIRED
    e. Standby UHF channel switch - ALT
    f. Transmitter switch - NORM
    g. Power switch - NORM
    h. I/C volume control knob - SET
    i. Function selector switch - UHF
    j. Receiver volume control knob - SET
    k. Sound recorder switch - AS DESIRED
33. UHF - OFF
34. VHF/FM - OFF
35. TACAN - OFF
36. Voice recorder - OFF
37. Temperature control - SET
38. Cabin air - ON
39. Anti G - ON AND SET
40. Oxygen pressure gage - 60 TO 120 PSI
41. Oxygen quantity gage - CHECK
42. Warning and caution lights - TEST
43. Connect ground power or APU to GROUND RUN or START

If external or APU electrical power connected -

1. External lights - AS REQUIRED
2. Anti-collision light - ON
3. C2J - SYNCH
4. ADC/HUD/INAS - CHECK (ALIGN IF DESIRED)
   Refer to section I
5. UHF control panel - SET
   a. Function switch - MAIN
   b. Channel - SET
   c. Volume knob - ADJUST
   d. Squelch switch - AS REQUIRED
6. VHF control panel - SET
   a. Function selector knob - T/R OR T/R GUARD
   b. Frequency knobs - SET FREQUENCY
   c. Audio knob - AS REQUIRED
7. Tacan control panel - SET
   a. Function selector knob - AS REQUIRED
   b. Channel selector - AS REQUIRED
   c. Volume control knob - AS REQUIRED

BEFORE STARTING ENGINE

1. External power - DISCONNECT
2. Fire bottle - MANNED
3. Intake and exhaust areas - CLEAR
4. Canopy - CLOSED

STARTING ENGINE

WARNING

- Suction at the intakes is sufficient to kill or severely injure personnel drawn into or pulled suddenly against the duct.
- Danger areas to each side and aft of the aircraft are created by high exhaust temperatures and velocities. Nozzle rotation and high power settings increase this danger.

1. Low pressure fuel shutoff handle - ON
2. Boost pump switches - ON
3. APU mode selector knob - START
4. Starter button - PRESS AND RELEASE

CAUTION

Do not hold starter button depressed as this bypasses safety features and may lead to APU turbine disintegration.

NOTE

Starter button must be actuated within 15 seconds after APU mode selector knob is placed to START.

5. Throttle - IDLE
   After 10 seconds if prestart JPT below 150°CDo not move throttle to idle until JPT is below 200°C

CAUTION

- If starting in manual fuel, ensure throttle does not move beyond idle or a hot start may occur.
- If JPT exceeds 400°C before attaining 15% RPM, or exceeds 450°C or if RPM ceases to rise below 25%, place throttle OFF and APU mode selector knob OFF.

NOTE

Do not attempt more than three starts in a 20 minute period.

6. Idle RPM - 25–28%
7. JPT - 525°C maximum
8. Fire warning lights - OUT
9. AC and DC (dual generator systems only) reset buttons - DEPRESS
10. Warning and caution lights - OUT
11. Voltmeter - 28 VDC
12. APU mode selector knob - OFF
13. Landing gear indicators - GREEN
14. Ejection handle and MDC firing handle safety pins - REMOVE AND STOW
15. Canopy - AS DESIRED

BEFORE TAXIING

1. Gang bar - FORWARD

CAUTION

Do not operate engine at stabilized RPM between 28% and 36% to avoid turbine rotor blade resonance.

2. Stab aug - SET AND CHECK
3. Hydraulic gages - CHECK
   a. Hydraulic 1 - 3000 ±200 PSI
   b. Hydraulic 2 - 3000 ±200 PSI
   c. Brake - 1400 ±50 PSI
   d. Brake accumulator - 3000 ±200 PSI
   e. Steering accumulator - 3000 ±200 PSI
4. MFC - CHECK/SET OFF
5. HUD/ADC - SET AND CHECKED AS DESIRED
   Refer to section I
6. Standby gyro - caged
7. Rudder trim - CHECK AND SET NEUTRAL
8. Stabilator trim - CHECK AND SET
9. Aileron trim - CHECK AND SET NEUTRAL
10. INAS - ALIGNED (if not previously aligned)
    a. INAS - PNPN
11. Flow proportioner - SWITCH OFF; LIGHT ON; SWITCH ON; LIGHT OFF
12. IFF - ON/STBY
13. UHF - ON
14. VHF - ON
15. Tacan - AS REQUIRED
16. Downlocks - REMOVED
17. RAT - CHECK
    Cycle controls to reduce hydraulic 2 pressure below 1500 psi. RAT should extend. Depress RESET RAT button to retract RAT.
18. Flight controls - CHECK
    Cycle full throw and check surface travel direction and amount.
    a. Ailerons
    b. Stabilator
    c. Rudder
19. Flaps - CYCLE/SET
20. Five pins - STOWED
21. Clearance to taxi - RECEIVED
22. Altimeter/HUD - SET BAROMETRIC PRESSURE

TAXIING

Nose wheel steering should be engaged at all times since there is no differential braking available and repeated engagement with rudder applied reduces the fatigue life of the system.

Idle thrust is high and will result in excessive taxi speed unless the brakes are used or nozzles deflected. The brakes are designed for the limited requirements of V/STOL operations and will overheat easier than on most conventional aircraft. The use of nozzle deflection between 45° and 60° for control of taxi speed is recommended. With nozzles deflected, it is essential that the stick be held forward or stabilator be trimmed at least 2° nose down to prevent the high velocity jet from the nose puffer blowing debris into the engine intake ducts. Should the taxi speed become too slow, the nozzles should be placed aft before increasing RPM above idle.

NOTE

RPM will drop 2 to 3% when nozzles are lowered.

CAUTION

- If the nozzle angle exceeds 60°, the danger of ingestion of debris blown by the nozzles is high and the nozzle exhaust may overheat the tires. For shipboard operations, JPT must be carefully monitored during reverse thrust operations.
- Place nozzles fully aft immediately after stopping to avoid damage to the taxiway surface.
- Do not attempt to taxi backward because of the excessive risk of FOD.

Below 15–20 knots the anti-skid is inoperative and care must be used to avoid locking the wheels, particularly at low gross weights. There is no sensation of brake locking which will result in tire skid. At low speeds, particularly when braking to a stop, pronounced brake chatter may occur. Brake pressure should be reduced below the chatter threshold (300–400 psi) to stop the chatter and associated fatigue damage to the landing gear.

Above 15–20 knots the anti-skid is operative and the characteristic tugging deceleration will be felt during heavy braking as the brake pressure oscillates between 100 and 1000 psi.

A minimum radius turn as shown in figure 3–3 can be made only at taxi speeds below 2 to 3 mph. The radius of turn will increase with speed and a full nosewheel steering angle at relatively high speeds will heavily load the outboard outrigger, cause a bank angle of 5–7° and may cause a skid as the main wheel tires lose adhesion.

The aircraft is cleared to taxi over a supported arresting gear wire up to a maximum speed of 5 knots. Stop immediately if an outrigger is trapped by the wire. The aircraft may cross an unsupported, tensioned arresting gear wire at any speed, engine RPM or nozzle angle if the wire lies flat on the runway or deck.

After clearing chocks and when clear of other aircraft:

1. Anti-skid - CHECK
2. Shakers - CHECK
3. Nose gear castoring - CHECK
   Release nose gear steering while in a turn and ensure that the nose gear does not snap back to center.
4. Engine - CLEAR

TAXIING ON UNPREPARED SURFACES

On loose surfaces or snow RPM and nozzle deflection should be kept at a minimum to reduce the danger of FOD.

The aircraft can be taxied on surfaces too soft to support its parked weight. Directional control is good even when the nosewheel digs a rut. The main wheels will sink deeper than the nosewheel. Nozzle angles up to 45° may be used to reduce sinking into soft surfaces with due regard for surface damage and FOD.

CAUTION

RPM in excess of 70% with nozzles aft or 80% with nozzles at 45° will cause excessive loads on bogged landing gear.

TAKEOFF

BEFORE TAKEOFF

1. STO stop - SET
2. Engine acceleration - CHECK
   The engine should accelerate from 27% to 55% RPM in 3.5 to 5.0 seconds.
3. Water - ON (IF REQUIRED)
   Place water switch ON with engine at idle. RPM should rise approximately 6%.
4. Inlet guide vanes - CHECK 14° to 18° (APPROXIMATE)
5. Duct pressure - CHECK
   Set nozzles 40° down. Check duct pressure approximately 55 psi. Set nozzles as required.
6. Warning and caution lights - OUT
7. Flaps - SET (CTO - MID; ALL OTHER - DOWN)
8. Stabilator trim - SET 2°ND
9. Tighten the shoulder harness length adjusters to give maximum shoulder restraint.

NOTE

During flight, if shoulder harness is unlocked, it may be necessary to slacken the shoulder straps and re-tighten to achieve maximum restraint.

10. Armament master switches - ON

TAKEOFF TECHNIQUE

Four methods of takeoff are possible with the AV-8A. These are Vertical Takeoff (VTO), Rolling Vertical Takeoff (RVTO), Short Takeoff (STO) and Conventional Takeoff (CTO). The method of takeoff is dependent upon tactical and operating conditions and must be predetermined in order to perform the necessary calculations and properly configure the aircraft. Refer to Performance Data, section XI, for takeoff calculations.

VERTICAL TAKEOFF (VTO)

CAUTION

Failure to understand engine characteristics in the lift regime can result in unexpected thrust reductions or engine overtemperatures necessitating engine overhaul. Refer to Engine Operation and Limitations, section I.

1. Trim - 2°ND
2. Brakes - ON
3. References - SELECT
4. Throttle - 55% RPM
5. Nozzle - HOVER STOP
6. Throttle - FULL (LIMITERS)

CAUTION

If airplane does not lift off within 10 seconds or JPT exceeds limits before lift-off, place throttle to IDLE.

7. Scan references, hold heading and attitude during lift-off
8. When clear of ground effect (20-25 feet), reduce power to hover or gradually deflect nozzles to transition to forward flight at 75-100 feet.

WARNING

Failure of JPT limiters will cause an immediate large thrust reduction. Be prepared to assume manual control of JPT by pushing throttle forward to trip limiters switch to OFF.

ROLLING VERTICAL TAKEOFF (RVTO)

An RVTO allows an increase in gross weight of approximately 1000 pounds over VTO weight under the same conditions. An RVTO may be desirable if the surface is marginal for a VTO. The RVTO requires approximately 100 feet of ground roll and 500 feet to clear a 50 foot obstacle. An RVTO should be made as nearly into the wind as possible.

1. Trim - 2°ND
2. Brakes - ON
3. Engine - CHECK
4. STO stop - 70°
5. RPM - 55%
6. Nozzles - 30°
7. Nosewheel steering - ENGAGE
8. Brakes - OFF
9. Throttle - FULL (LIMITERS)
10. RPM and heading - SCAN
11. Nozzles - STO STOP AS RPM PASSES 97%
12. Hold heading and attitude constant on lift-off. Monitor and adjust heading for slip during transition.

CAUTION

Do not rotate nozzles to hover stop during RVTO as this action may result in wing drop, reingestion of hot gas and performance loss.

13. Transition to forward flight holding 75-100 feet.

SHORT TAKEOFF (STO)

A STO may be made when aircraft gross weight is too high for a VTO, RVTO or CTO. With lower gross weights it may be the most desirable method for a variety of reasons such as engine stress reduction, surface conditions, etc.

Nozzle rotation angle and IAS at nozzle rotation for STO are contained in the Performance Data, section XI and on the VSTOL computer.

1. Airspeed indicator index - SET TO CALCULATED NOZZLE ROTATION SPEED
2. Flaps - CHECK FULL DOWN
3. Trim - SET (2°ND without stores, 4°ND with stores)
4. STO stop - SET TO CALCULATED NOZZLE ROTATION ANGLE
5. Engine - CHECK (55%)
6. Nosewheel steering - ENGAGE
7. Nozzles - 10°
8. Brakes - RELEASE
9. Throttle - FULL (LIMITERS)
10. At calculated IAS rotate nozzle smoothly to STO stop.
11. Maintain attitude and heading at lift-off. Adjust heading for slip after lift-off.
12. Commence transition to forward flight at 75-100 feet.

ACCELERATING TRANSITION

An accelerating transition is made, commencing at 75-100 feet, after a VTO, RVTO or STO.

1. Set full throttle.
2. Hold attitude constant while progressively easing nozzle lever forward.
   Control nozzle rotation rate to maintain constant altitude.
3. Slip - MONITOR
4. Brakes - APPLY MOMENTARILY
5. Landing gear - UP ABOVE 150 KNOTS

NOTE

With the landing gear up, the JPT limiters will throttle the engine back to the maximum thrust rating when nozzle angle is reduced below 10-15°. If operating near lift ratings, this sudden and large thrust reduction must be anticipated or the last 20° of nozzle rotation delayed until after power is reduced with the throttle.

6. Flaps - UP OR MID PRIOR TO 300 KNOTS (MINIMUM 200 KNOTS)
7. Nozzles - CHECK FULL AFT

CONVENTIONAL TAKEOFF (CTO)

The CTO is restricted to aircraft gross weights which will not cause the wheel/tire limitation speed of 180 knots to be exceeded on the takeoff roll. Refer to section XI.

1. Flaps - MID
2. Trim - 2°ND
3. Engine - CHECK (RPM 55%)
4. Nozzles - 10°
5. Nosewheel steering - ENGAGE
6. Brakes - OFF
7. Throttle - FULL
8. Fly off at 140 to 150 knots
9. Brakes - APPLY MOMENTARILY

10. Landing gear – UP
11. Flaps – UP ABOVE 190 KNOTS
12. Nozzles – AFT

FORMATION TAKEOFF

VERTICAL TAKEOFF

Formation VTO is not recommended.

ROLLING VERTICAL TAKEOFF

Formation RVTO is not recommended.

SHORT TAKEOFF

Formation STO will not be made with a crosswind component greater than 10 knots or if runway width does not permit the required lateral separation. Lateral separation is a function of computed lift–off speed and should be a minimum of 25 feet above 100 knots, 50 feet from 80 to 100 knots, 75 feet from 60 to 80 knots and 100 feet below 60 knots. Exact station keeping should be disregarded with lift–off speeds below 60 knots with the main attention directed toward flying the aircraft. The wingmen should be upwind of the leader and no further aft than the flap hinge line.

Flight leader transmits "SET (calculated value) KNOTS AND (calculated value) NOZZLES" –

1. STO stop – CHECK AT CALCULATED VALUE (WINGMEN LEAVE CLEAR)
2. Airspeed indicator bug – CHECK AT CALCULATED VALUE
3. Engine – CHECK (RPM 55%)
4. Nozzles – 10°
5. Signal thumbs up or transmit "READY"
6. Nosewheel steering – ENGAGE

Flight leader nods head –

7. Brakes – RELEASE
8. Throttle – ADVANCE TO STOP
9. Flight leader throttle back 3% to 5% RPM

At nozzle rotation speed, flight leader transmits "NOZZLES" –

10. Nozzles – STO STOP (WINGMEN AS REQUIRED)

After lift–off –

11. Initiate accelerating transition

Flight leader transmits "GEAR" –

12. Landing gear and flaps – UP

CAUTION

Flaps should be raised prior to 230 knots to avoid transient forces in pitch as the autostabilizer switches off when the flaps pass 45° or airspeed passes 250 knots.

CONVENTIONAL TAKEOFF

Line up with a minimum lateral separation of one wingspan with the wingman upwind and no further aft than the leader's flap hinge line.

When takeoff checks complete –

1. Throttle – 55% RPM
2. Nozzles – 10°
3. Signal thumbs up or transmit "READY"

Leader nods head –

4. Brakes – RELEASE
5. Throttle – FULL
   Flight leader should throttle back to 97% RPM

After liftoff, flight leader transmits "GEAR" –

6. Landing gear and flaps – UP
7. Nozzles – AFT WITHOUT SIGNAL

NOTE

Flight leader should conduct any required frequency change and check wingmen's position prior to entering IFR conditions.

AFTER TAKEOFF

1. Water injection – OFF
2. STO stop – CLEAR FULLY AFT
3. Nozzle lever – FULL FORWARD

CLIMB

Climb at 350 knots until 0.81 Mach (approximately [illegible],000 feet) and then at 0.81 Mach.

INFLIGHT

NOTE

Refer to Flight Characteristics, section IV, and Performance Data, section XI.

DESCENT

Do not exceed airframe limitations during descent. See section I, part IV. Five minutes prior to commencing descent from altitude, increase cockpit temperature to the maximum consistent with comfort and use defog heat as feasible. Refer to section XI, part 7, for recommended descent. Perform the following checks before commencing descent:

1. Attitude indicator and altimeter (head up/head down) - CROSSCHECK
2. Tacan - CHECK
3. Gang bar - FORWARD
4. Compass - SYNC
5. IFF - AS REQUIRED

LANDING

Four methods of landing, comparable to the four methods of takeoff, are available. These are Vertical Landing (VL), Rolling Vertical Landing (RVL), Short Landing (SL) and Conventional Landing (CL). A decelerating transition from normal flight is used to place the aircraft in position for a VL or RVL.

DECELERATING TRANSITION

Decelerating transitions are started from a key position approximately 3/4 to 1 nautical mile from the touchdown point at an altitude of 150—200 feet AGL. The key should be approached in level or very slightly descending flight.

Approaching key -

1. Speed brake - IN
2. Landing gear - DOWN
3. Flaps - DOWN
4. Nozzles - 40° VFR; 20° IFR
5. AOA - 8 UNITS
6. Throttle - MINIMUM 70% RPM

At key -

7. Nozzles - HOVER STOP

Departing key -

8. Maintain attitude, minimize slip and increase power as required to control rate of descent to hover height of 50-60 feet AGL.

At approximately 50 knots -

9. Select ground references, flare slightly to stop. Use nozzle braking stop as required.

THE HOVER

The hover may be entered from a decelerating transition or a VTO. It is an interim period during which the aircraft is held relatively stationary at an altitude of 50-100 feet AGL.

1. Control height with small throttle changes
2. Maintain position with ground references
3. RPM/JPT - WITHIN LIMITS

VERTICAL LANDING (VL)

The vertical landing is commenced from a 50-60 foot AGL hover. Refer to figure 3-3.

1. Brakes - CHECK OFF
2. Start slow descent with throttle
3. Monitor ground references
4. Maintain heading and attitude except for drift correction
5. Expect turbulence and random trim changes in ground effect below 20-25 feet. Maintain positive rate of descent. Avoid stopping in ground effect.

When positively down -

6. Throttle - Idle
7. Brakes - APPLY
8. Nozzles - AFT (LEVER FORWARD)
9. Trim - 2°ND
10. Taxi — CLEAR OF LANDING AREA

NOTE

Do not hover in ground effect. Avoid large pitch changes near ground to prevent hot gas reingestion and hitting the tail bumper.

ROLLING VERTICAL LANDING (RVL)

An RVL should be used instead of a VL when the landing area is subject to damage from heating or is a source of FOD due to surface condition. It is identical to the VL except that a small forward speed (30-50 knots) is maintained. A speed of 5-10 knots is sufficient to prevent heat damage to asphalt surfaces. The hover should be established short of the intended touch down point or the RVL may be entered directly from a decelerating transition.

1. Nozzles – 75°±2°
2. Control airspeed with pitch
3. Control descent with throttle
4. Brakes and nosewheel steering – CHECK OFF

Prior to entering ground effect (20-25 feet) –

5. Flare to landing attitude

When positively down –

6. Throttle – IDLE
7. Nozzles – HOVER STOP (IF REQUIRED)
8. Nosewheel steering – ENGAGE WHEN ROLLING STRAIGHT
9. Brakes – APPLY
10. Trim – 2°ND
11. Nozzles – AFT (LEVER FORWARD) OR TAXI POSITION (40°-60°)

SLOW LANDING (SL)

The SL may be used when aircraft gross weight is too high for a VL or RVL or to reduce engine stress. Performance calculations are required for heavy gross weights or short strips (less than 3000 feet). The approach speed depends upon the aircraft gross weight and the RPM used during the approach. The higher the RPM the slower the approach speed for a given gross weight. The maximum available RPM is dictated by power reserve requirements for waveoff/missed approach. The pattern (figure 3-4) is identical to that for a conventional landing to the 180° position.

Approaching 90° position –

1. Nozzles – 40°
2. AOA – 8 UNITS

At 45° position –

3. Nozzles – 70°
4. Progressively add throttle to 90 ±2% RPM to maintain 8 units AOA.
5. Control AOA with nozzles and the descent with pitch

At 30-50 feet AGL –

6. Nozzles - LEAVE AS SET
7. Control descent with throttle
8. Allow AOA to increase to 12 units at touchdown

NOTE

In a crosswind make a crabbed approach and land with yaw (nosewheel steering disengaged). If yaw is excessive, use moderate rudder to reduce yaw just prior to touchdown.

When positively down –

9. Throttle – IDLE
10. Nozzles – BRAKING STOP
11. Throttle – 60%

At 60 knots –

12. Nosewheel steering – ENGAGE WHEN STRAIGHT
13. Throttle – IDLE
14. Nozzles – HOVER STOP
15. Brakes – APPLY
16. Trim – 2°ND
17. Nozzles – LESS THAN 60° WHEN SLOW

With experience the technique may be altered to reduce ground roll by placing the nozzles to the hover stop upon entering ground effect (15-20 feet) and to the braking stop just prior to touchdown (2-3 feet) while maintaining a high RPM.

NOTE

Should the aircraft bounce, a nose up trim change may occur requiring full forward stick and a power reduction to correct.

WAVEOFF FROM VERTICAL/SLOW LANDING

A waveoff may be required due to a fouled landing area, an unsatisfactory approach or insufficient power. Power may be checked at the key by comparing IAS and RPM.

1. Throttle – FULL (LIMITERS)

If nozzles at braking stop –

2. Nozzles – HOVER STOP
3. Maintain 8-10 units AOA or hover attitude

WARNING

Do not pull nose up.

4. Initiate accelerating transition with the nozzle lever

VERTICAL LANDING

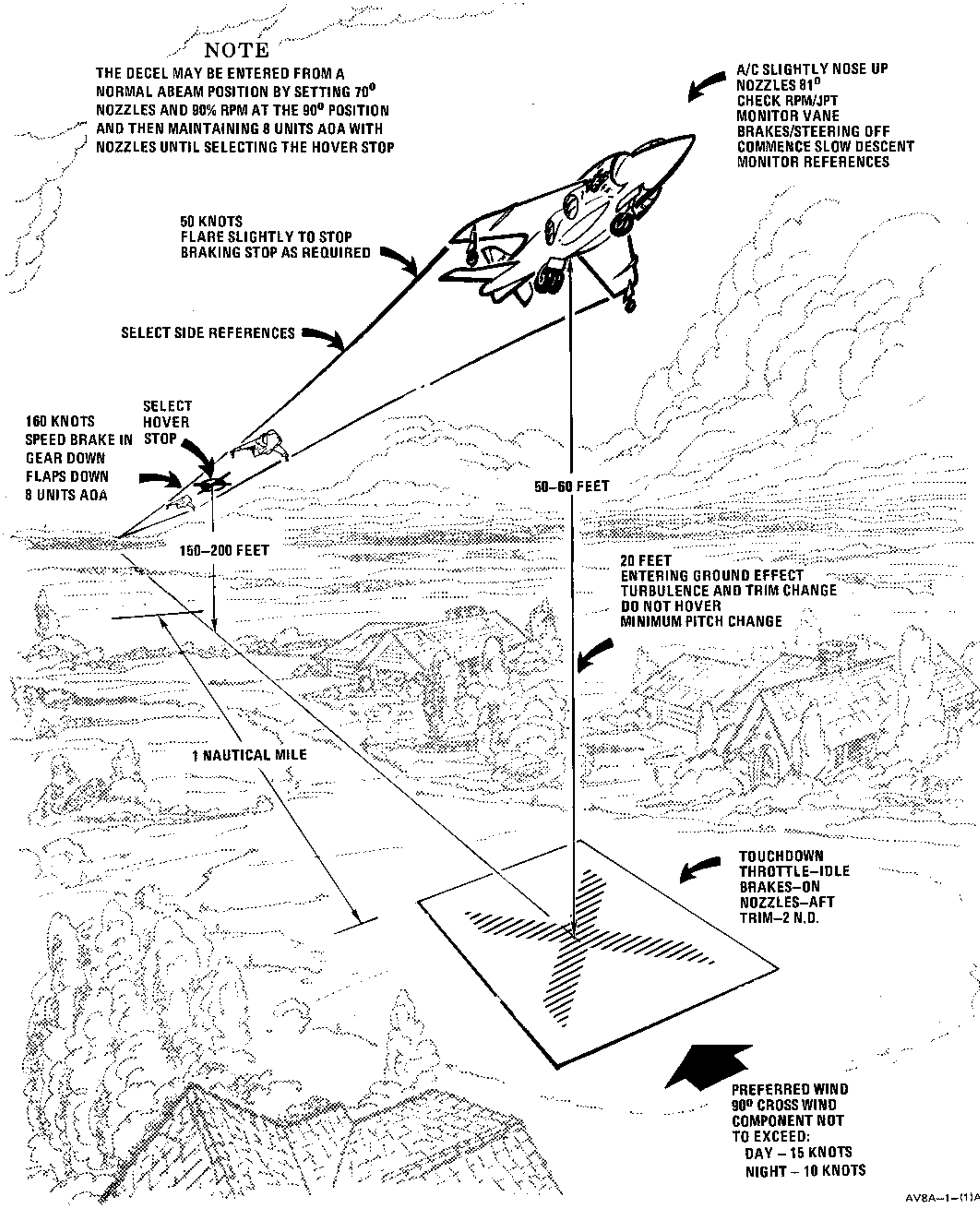


Figure 3-3

SLOW LANDING
LANDING GROSS WEIGHT-16,000 POUNDS
TYPICAL

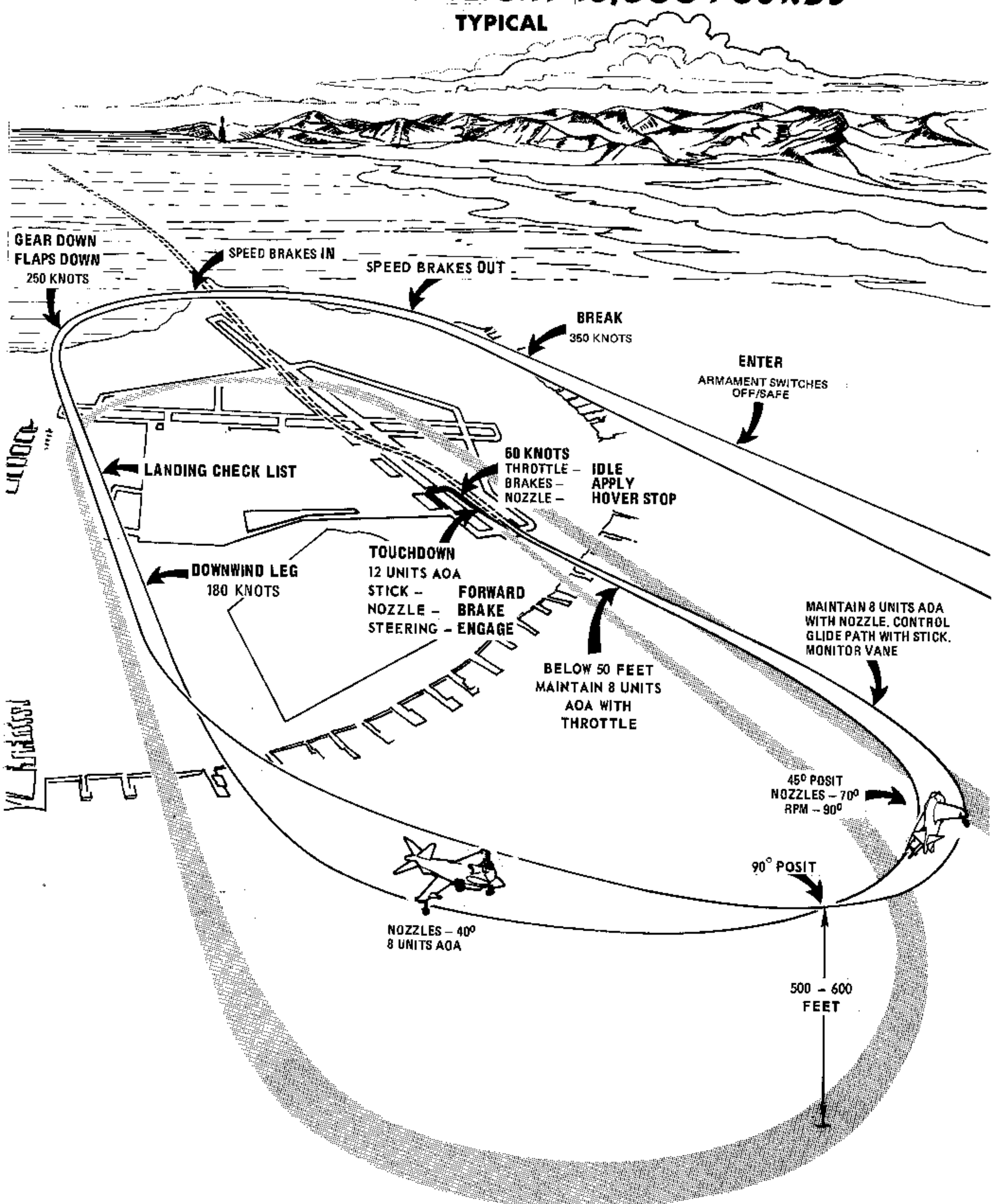


Figure 3-4

CONVENTIONAL LANDING (CL)

See figure 3-5. A CL requires a minimum of 8400 feet to stop with nozzles aft or 6000 feet with nozzle braking with no wind. The brakes are designed primarily for V/STOL and are marginal for a CL without nozzle braking.

1. Speed brake - IN
2. Landing gear - DOWN
3. Flaps - DOWN
4. Anti-skid - ON
5. Throttle stop - CLEARED
6. Nozzles — AFT

On final (maximum 2½° glide slope) -

7. AOA - 8 UNITS INCREASING TO 10 UNITS IN CLOSE
8. Flare to 10-12 units AOA at touchdown

CAUTION

Full back stick may be required for flare. A nose low touchdown will result in porpoise. Do not cut power prior to touchdown.

At touchdown -

9. Throttle - IDLE
10. Nozzles - BRAKE STOP

NOTE

Porpoising on touchdown will normally be damped out by selection of the braking stop. Do not use wheel brakes while in the braking stop.

11. Throttle - 60% RPM
12. Nosewheel steering - ENGAGE WHEN STRAIGHT

At 60 knots -

13. Throttle - IDLE
14. Nozzles - HOVER STOP
15. Brakes - APPLY
16. Trim - 2°ND

WAVEOFF FROM CONVENTIONAL LANDING

1. Throttle - FULL
2. Maintain 8 units AOA

If on runway and a CTO cannot be completed -

3. Rotate nozzles slowly until airborne and continue with an accelerating transition

POSTFLIGHT

AFTER LANDING

When clear of the active runway -

1. Brake and steering hydraulic pressures - CHECK
2. Trim - 2°ND
3. Water injection - OFF
4. IFF - OFF
5. INAS - UPDATE
6. Armament masters - OFF

When parked -

7. Flaps - UP
8. Parking brake - SET
9. Nozzle lever - FULL FORWARD
10. HUD mode knob - OFF
11. Navigation control function selector knob - OFF
12. Navigation control NDC switch - OFF
13. Throttle - OFF
    Before engine shutdown, the engine should be idled for a minimum of one minute, if possible, to allow temperatures to stabilize.
14. Fuel booster pump switches - OFF
15. Gang bar switches - OFF
16. Oxygen shutoff lever - OFF
17. Low pressure fuel shutoff lever - OFF
18. Ejection handle and MDC safety pins - INSTALLED
19. All switches and levers - OFF
20. Personal equipment - DISCONNECT
    Release harness by setting QRB to UNDO; free the straps and reset the QRB to FASTEN (arrowheads in-line). Pull the leg restraint lines free from the guide rings and the garter rings. Release the parachute Koch fasteners by lifting the safety flaps and rotating down the release bars. Disconnect the three survival kit connectors (two from the integrated harness and one from the life jacket) by pressing the plungers in each fitting. Disconnect the man portion of the PEC from the seat portion and replace dust covers on both. If hangaring the aircraft at a strange field, install all cockpit safety pins.

After leaving cockpit -

21. Inspect for FOD
22. Tires - CONDITION
23. Aircraft - LEAKS AND DAMAGE

SCRAMBLE OPERATION

The aircraft is designed to operate from forward sites in close proximity to the FEBA (forward edge of the battle area) with minimum support. Normally such sites will be dispersed, camouflaged and operated in such manner that each aircraft is an independent entity except for control through communications. With the short reaction time available due to the proximity to the FEBA and the STO capability, many formerly airborne evolutions, such as on-call close air support or CAP, will be conducted with the aircraft on the ground at a forward site. Before assuming the directed Ready Condition, the pilot should perform normal preflight, start, poststart and pretakeoff checks. Shut down the engine and set the parking brake. Dependant upon the prescribed ready condition the pilot may then be required to remain strapped in the cockpit or may unstrap and remain in close proximity to the aircraft. If unstrapped, insert the ejection handle safety pin. The battery switch position is dependant upon the radio monitoring requirement.

SCRAMBLE INTERIOR CHECK

1. Harnessing - FASTEN (IF UNFASTENED)
2. Ejection handle safety pin - REMOVE AND STOW
3. Canopy - CLOSE AND LOCK

SCRAMBLE ENGINE START

1. Low pressure fuel shutoff handle - ON
2. Battery switches - ON (IF OFF)
3. Boost pumps - ON
4. APU mode selector knob - START
5. Starter button - PRESS AND RELEASE

10 seconds after start button depressed -

6. Throttle - IDLE
7. AC and DC reset buttons - DEPRESS
8. APU mode selector knob - OFF
9. Gangbar - FORWARD
10. Warning and caution lights - OUT
11. INAS/HUD - CHECK AND SET AS DESIRED
12. Parking brake - RELEASE

SCRAMBLE TAKEOFF

Ensure ground crew and equipment are clear and perform normal VTO or STO.

NIGHT FLYING

EXTERNAL LIGHT MANAGEMENT

1. External lights - SET BRIGHT AND STEADY
2. Rotating beacon - ON

TAKEOFF

Cockpit lighting should be adjusted as dim as feasible to avoid undesirable reflections. Sufficient lighted visual cues must be available. For a VTO with limited lighted cues, the transition attitude and heading should be selected before the cues are left behind. Care should be exercised to ensure that there is no yaw component present when departing the lighted cue area.

INFLIGHT PROCEDURES

Refer to section IV of this publication.

LANDING

Night landing procedures are identical to day procedures except that there is a tendency to establish the hover at too low height. Sufficient visual cues will ease this problem. The use of the landing/hover light to increase visual cues is recommended. Decelerations and slow landings should be planned to avoid airborne use of the braking stop to reduce pilot workload. When working with an LSO, the pilot should transmit "HOVER STOP" when nozzles are so positioned.

FORMATION FLIGHT

PARADE FORMATION

The following formation description is a recommended guideline for pilots flying the aircraft in a basic parade position. This position is flown by the wingman aligning his head in line with the leader's aileron/flap hinge line and his wingtip with the bottom of the leader's fuselage. In this position, the leader's inboard pylon leading edge bottom corner should align with the bottom of his cold nozzle, and his outrigger wheel should align with his lower anti-collision light. See figure 3-6. The wingman is very slightly stepped up on the leader to avoid the aircraft's peculiar jet efflux pattern. Wingtip to wingtip clearance should be no less than 6 feet.

CAUTION

Landing gear should be UP and flaps UP or MID prior to accelerating through 230 knots in formation, particularly at night or in weather, to prevent a small G increase which occurs if the aircraft is rotating in pitch when the autostabilizer automatically switches OFF at 250 knots.

FREE CRUISE FORMATION

Free cruise formation allows for increased flight maneuverability and lookout coverage. The free cruise position is within a 60° angle astern of the leader with a minimum of one aircraft length nose to tail. The wingman should be stepped down approximately 6 feet for each aircraft length interval. In this position, the bottom of the leader's fuselage will be on the extension of the line across the top of the HUD combining glass. The wingman's power setting should remain constant while maneuvering within the assigned area. See figure 3-6.

INSTRUMENT WING FORMATION

The position for instrument wing is identical to the parade position. See figure 3-6. All turns are performed on the axis of the leader.

INSTRUMENT CHASE POSITION

This position is normally about 4 or 5 o'clock from the hooded aircraft, 500 feet away and slightly stepped up.

AIR REFUELING

NOTE

Before air refueling operations, each pilot shall be familiar with the NATOPS Air Refueling Manual.

GENERAL

An air refueling probe may be installed above the left inlet duct. When installed, the probe is connected to the center tanks refueling line. A self-sealing coupling with a check valve in the base of the probe prevents fuel loss if the probe is damaged or the nozzle valve fails. The probe nozzle has a weak link so that, if excessive strain occurs between the probe and drogue, the nozzle will separate from the probe and remain in the drogue and the emergency shut-off valve in the nozzle will close to prevent flow from the drogue. The probe may be illuminated for night refueling. Two pairs of green lights on the left glare shield indicate fuel transfer from the tanker. The lights are unmarked, however the two left lights indicate transfer to the left feed group and the two right lights indicate transfer to the right feed group. The lights are duplicated so that illumination of one of a pair only indicates failure of the other light. Each side of the refueling circuits are separate so that failure of one feed group does not prevent refueling of the other feed group. The TANK DEPRESS switch, when ON, conditions the system for air refueling.

BEFORE PLUG-IN

The air refueling checklist should be completed prior to plug-in.

1. Armament switches - OFF/SAFE
2. Tank depress switch - ON
3. Probe light - AS DESIRED

NOTE

The TRANS warning light may illuminate after tank depressurization is selected but fuel will still be available from the center tanks.

4. Flaps - MID
5. Visor - DOWN

CONVENTIONAL LANDING
LANDING GROSS WEIGHT-14,000 POUNDS
TYPICAL

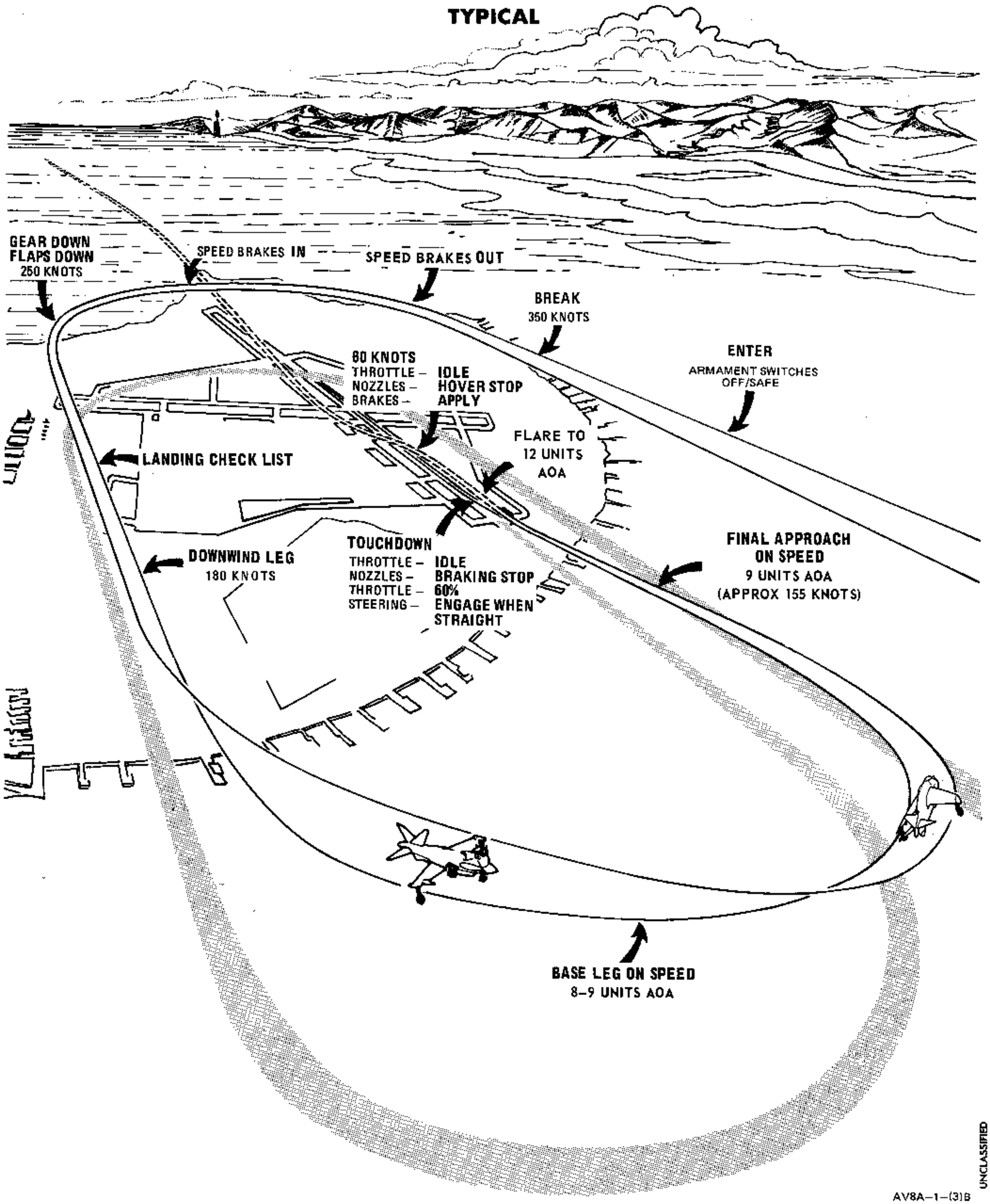
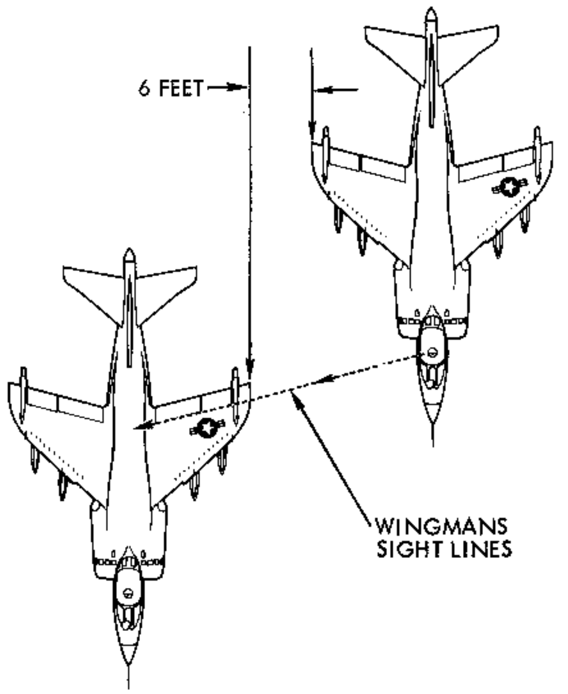
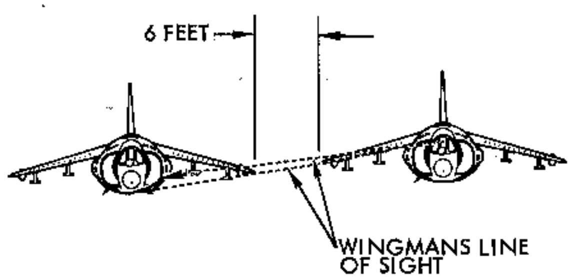


Figure 3-5

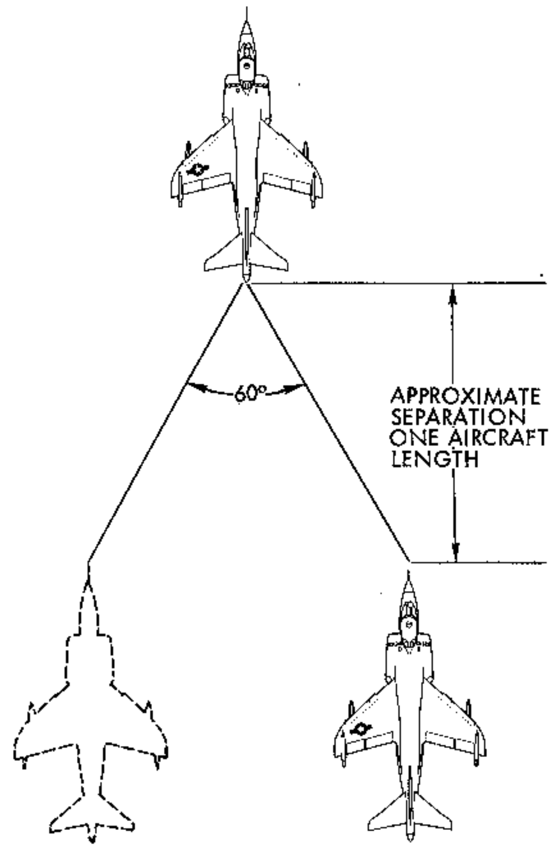
FORMATION

PARADE FORMATION





FREE CRUISE FORMATION



INSTRUMENT WING FORMATION

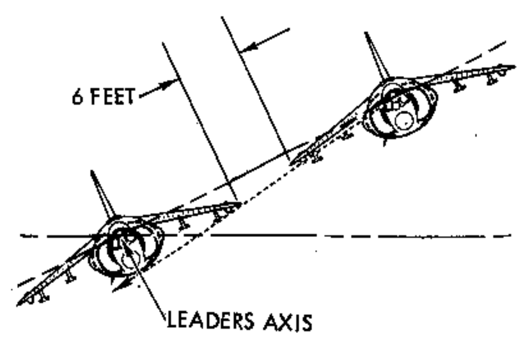


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Figure 3-6

REFUELING TECHNIQUE

NOTE

The following procedures, as applied to tanker operation, refer only to single drogue refuelers.

Refueling altitudes and airspeeds are dictated by receiver and/or tanker characteristics and operational needs, consistent with the tanker's performance and refueling capabilities. This, generally, covers a practical spectrum from the deck to 35,000 feet and 190 to 300 knots.

APPROACH

Once cleared to commence an approach, refueling checklists completed, assume a position 10 to 15 feet in trail of the drogue with the refueling probe in line in both the horizontal and vertical reference planes. Trim the aircraft in this stabilized approach position and insure that the tanker's (amber) ready light is illuminated before attempting an approach. Select a reference point on the tanker as a primary alignment guide during the approach phase; secondarily, rely on peripheral vision of the drogue and hose. Increase power to establish an optimum 3 to 5 knots closure rate on the drogue. It must be emphasized that an excessive closure rate will cause a violent hose whip following contact and/or increase the danger of structural damage to the aircraft in the event of misalignment; whereas, too slow a closure rate results in the pilot fencing with the drogue as it oscillates in close proximity to the aircraft's nose. Small corrections in the approach phase are acceptable; however, if alignment is off in the final phase, it is best to immediately retire to the initial approach position and commence another approach, compensating for previous misalignment by adjusting the reference point selected on the tanker. Small lateral corrections with a "shoulder probe" are made with the rudder, and vertical corrections with the stabilator. Avoid any corrections about the longitudinal axis since they cause probe displacement in both the lateral and vertical reference planes.

MISSED APPROACH

If the receiver probe passes forward of the drogue basket without making contact, a missed approach should be initiated immediately. Also, if the probe impinges on the canopy lined rim of the basket and tips it, a missed approach should be initiated. A missed approach is executed by reducing power and backing to the rear at an opening rate commensurate with the optimum 3 to 5 knot closure rate made on an approach. By continuing an approach past the basket, a pilot might hook his probe over the hose and/or permit the drogue to contact the receiver aircraft fuselage. Either of the two aforementioned hazards require more skill to calmly unravel the hose and drogue without causing further damage than to make another approach. If the initial approach position is well in line with the drogue, the chance of hooking the hose is diminished when last minute corrections are kept to a minimum. After executing a missed approach, analyze previous misalignment problems and apply positive corrections to preclude a hazardous tendency to blindly stab at the drogue.

CONTACT

When the receiver probe engages the basket, it will seat itself into the drogue coupling and a slight ripple will be evident in the refueling hose. The tanker's drogue and hose must be pushed forward 3 to 5 feet by the receiver probe before fuel transfer can be effected. This advanced position is evident by the tanker's (amber) ready light going out and the (green) fuel transfer light coming on. The tanker's (green) fuel transfer light will illuminate and the four cockpit fuel transfer lights will illuminate. While plugged-in, merely fly a close tail chase formation on the tanker. Although this tucked-in condition restricts the tanker's maneuverability, gradual changes involving heading, altitude and/or airspeed may be made. A sharp lookout doctrine must be maintained due to the precise flying imposed on both the tanker and receiver pilots. In this respect, the tanker can be assisted by other aircraft in the formation. When the tanks are full the refueling valves close to stop the flow.

DISENGAGEMENT

Disengagement from a successful contact is accomplished by reducing power and backing out at a 3 to 5-knot separation rate. Care should be taken to maintain the same relative alignment on the tanker as upon engagement. The probe will separate from the drogue when the hose reaches full extension. When clear of the drogue, place the tank depressurization switch OFF. At night, turn the probe floodlight off.

RESTRICTED SITE OPERATIONS

Refer to the Tactical Manual, NAVAIR 01-AV8A-IT

FIELD CARRIER LANDING PRACTICE

PATTERN ENTRY (VFR)

Call the tower for entry into the FCLP pattern. Request an 800 foot break altitude or break at the normal break altitude. When cleared and at proper altitude, roll into a 45° break. If in formation use a 12–14 second interval. Reduce power to 65% and extend the speed brake. Passing 250 knots, raise the speed brake, extend the gear and flaps and complete the landing checklist. Adjust the angle of bank to provide ¾ to 1¼ miles abeam. Descend to 600 feet AGL on downwind. Arm water if needed and clear STO stop. Call abeam with gear, fuel state, STO stop clear and water armed. Abeam, AOA should be 8 units, select 40° nozzles and commence the turn to final. Passing the 90° position, select 70° nozzles and maintain 8 units AOA. Enter the groove at 350–400 feet. Select the hover stop and add power as required. Call BALL (or CLARA) and HOVER STOP. Fly a normal VL to land on the simulated deck or other designated spot. Cross check meatball, lineup, rate of descent and airspeed. After landing, clear the runway or prepare for a STO/VTO as directed by the LSO.

SIMULATED CARRIER STO

When cleared by the tower/LSO, taxi onto the simulated deck and position the aircraft on the start line and centerline. Report to the LSO, fuel state, STO stop set and trim. STO stop and pitch trim settings will be computed by the LSO prior to launch. When cleared for takeoff and checks are completed, apply full throttle and hold the brakes until the tires begin to skid. Release brakes and maintain lineup. Check for normal engine acceleration. When the end of the pitot boom crosses the nozzle rotation line, smartly move the nozzle lever to the STO stop. When airborne and after establishing a positive rate of climb at 12 units AOA, transition to wingborne flight. At 200 knots and 800 feet, commence a turn to downwind using 30°–40° bank angle. Follow the FCLP pattern procedures when established on downwind.

NIGHT FLYING (VFR)

The night VFR pattern is identical to the day pattern. Night lighting will be; rotating beacon – ON, Navigation lights – BRIGHT AND STEADY and landing light – APPROACH.

NIGHT FLYING (IFR)

The night IFR pattern (see figure 3-9) and waveoff pattern are the same as described in section 3, part 4 with the following exceptions:

a. Do not turn exterior lights OFF on the deck.
b. Follow GCA control for turn downwind and around pattern until under positive control of the LSO.

PART 4 SHIPBOARD PROCEDURES

GENERAL

Carrier and floating platform operations differ from other VSTOL operations in the precision required, INAS management procedures and STO technique. The degree of precision required places a higher workload on the pilot and, to assist him, LSO techniques, visual aids and radar control are employed. Shipboard INAS management procedures are designed to minimize the effect of ship's motion and magnetic deviation on platform alignment. The Shipboard STO technique minimizes the number of variables to be considered by the pilot and thus reduces his workload. These factors combined with the shipboard environment require that a buildup philosophy be employed in the field and carrier qualification training program. The applicable ship NATOPS manual or NWP 42 and Aircraft Launching Bulletins shall be read by all pilots prior to shipboard operations.

EMERGENCY PROCEDURES

The emergency procedures contained in appropriate NATOPS and NWP manuals will be briefed and utilized. All aviation shipboard control agencies will be advised of the standby UHF channelization, VHF/FM capability and their availability as backup radios

PREFLIGHT

A normal preflight should be accomplished with particular attention to evidence of damage from shipboard handling. Start the engine on signal from the plane director. Tiedowns shall not be removed until brake hydraulic pressure is confirmed.

AFTER START

After completing Before Taxi checks, if EMCOM is not in effect, check in with pri-fly in order, with call sign, water weight, fuel weight and gross weight. Pri-fly will acknowledge this ripple check and transmit ships heading (true) and "steady" if cleared to commence INAS alignment. Aircraft whose heading is not parallel to the deck centerline will be given an estimated angle off centerline. INAS alignment will not be started until the "steady" call is received.

TAXIING

Double check brake and nosewheel steering accumulator pressures and the anti-skid and nosewheel steering switch at SKID OFF/NWS ON prior to chains/chock removal. External lights will remain off unless a brake or nosewheel steering failure is experienced. Set all switches and stops for takeoff. Once INAS alignment is started, do not initiate taxi until alignment is complete. Anti-skid shall not be used aboard ship. Taxiing is under control of the plane director. The plane director is entirely responsible for positioning the aircraft and his signals are to be followed explicitly. The only alternative for the pilot, if he believes compliance would be hazardous, is to stop. Any signal by the plane director above the waist is intended for the pilot. Any signal below the waist is intended for the deck handling crew. Caution must be exercised when turning the aircraft crossdeck and with the roll during heavy rolls, or turns which may cause a heavy roll, due to the high residual thrust. If the nosewheel castors out of limits and a tiller bar is needed to straighten the wheel, the following procedure must be used to avoid injury to the tiller bar operator.

1. Parking brake – SET
2. Anti-skid – ON

WARNING

Do not depress NWS paddle switch with the tiller bar installed.

When the nosewheel is straight and the tiller bar removed –

3. Anti-skid – OFF
4. Parking brake – RELEASE

NOTE

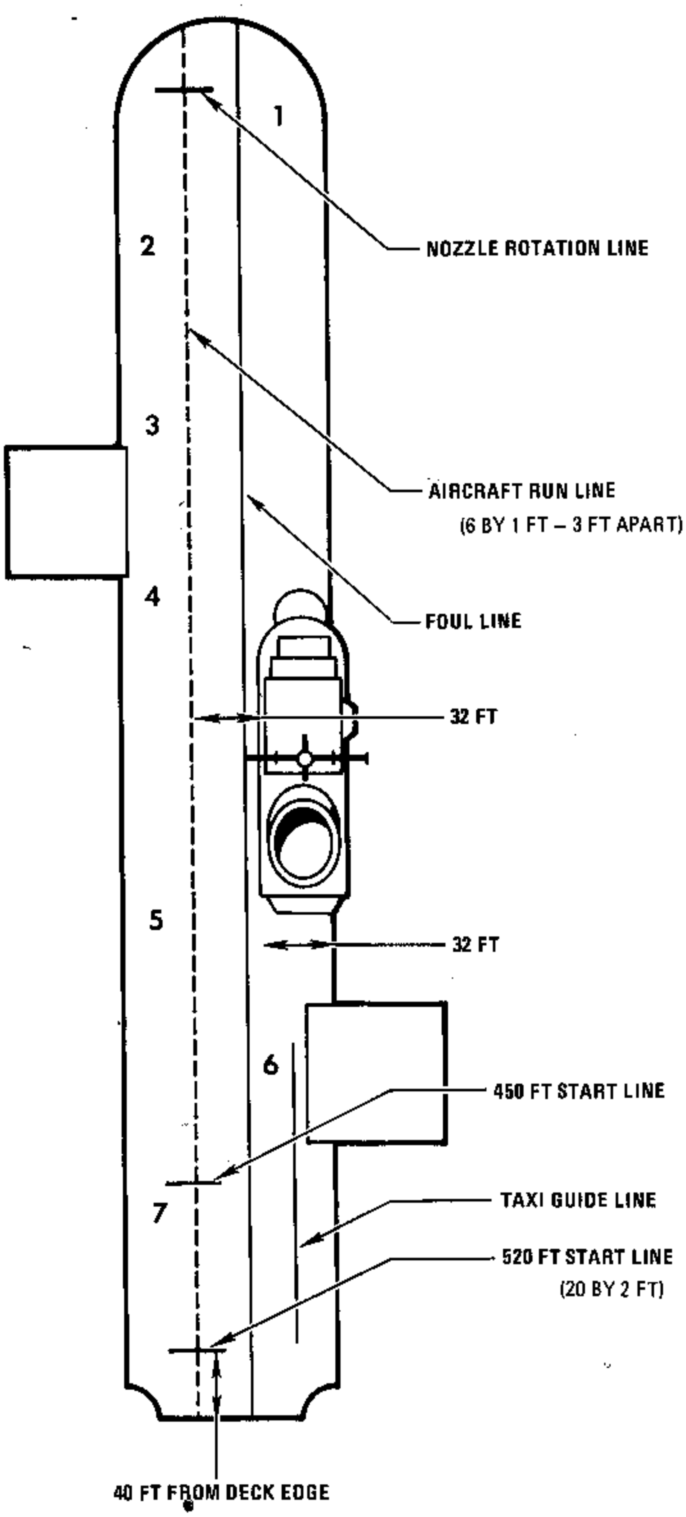
- Outrigger wheels may castor through approximately 180° if the aircraft has been pushed backward or turned sharply. Castor over 45° must be corrected prior to launch.
- See figures 3-7 and 3-7A for typical LPH/LPD deck dimensions and marking.

CAUTION

- When backing up, monitor JPT to ensure temperature remains below 525°C.
- Sudden stops while backing may result in striking the tail on the deck.

LPH DECK MARKING

RECOMMENDED



NOTES

START LINE DISTANCES ARE TO NOZZLE ROTATION LINE.

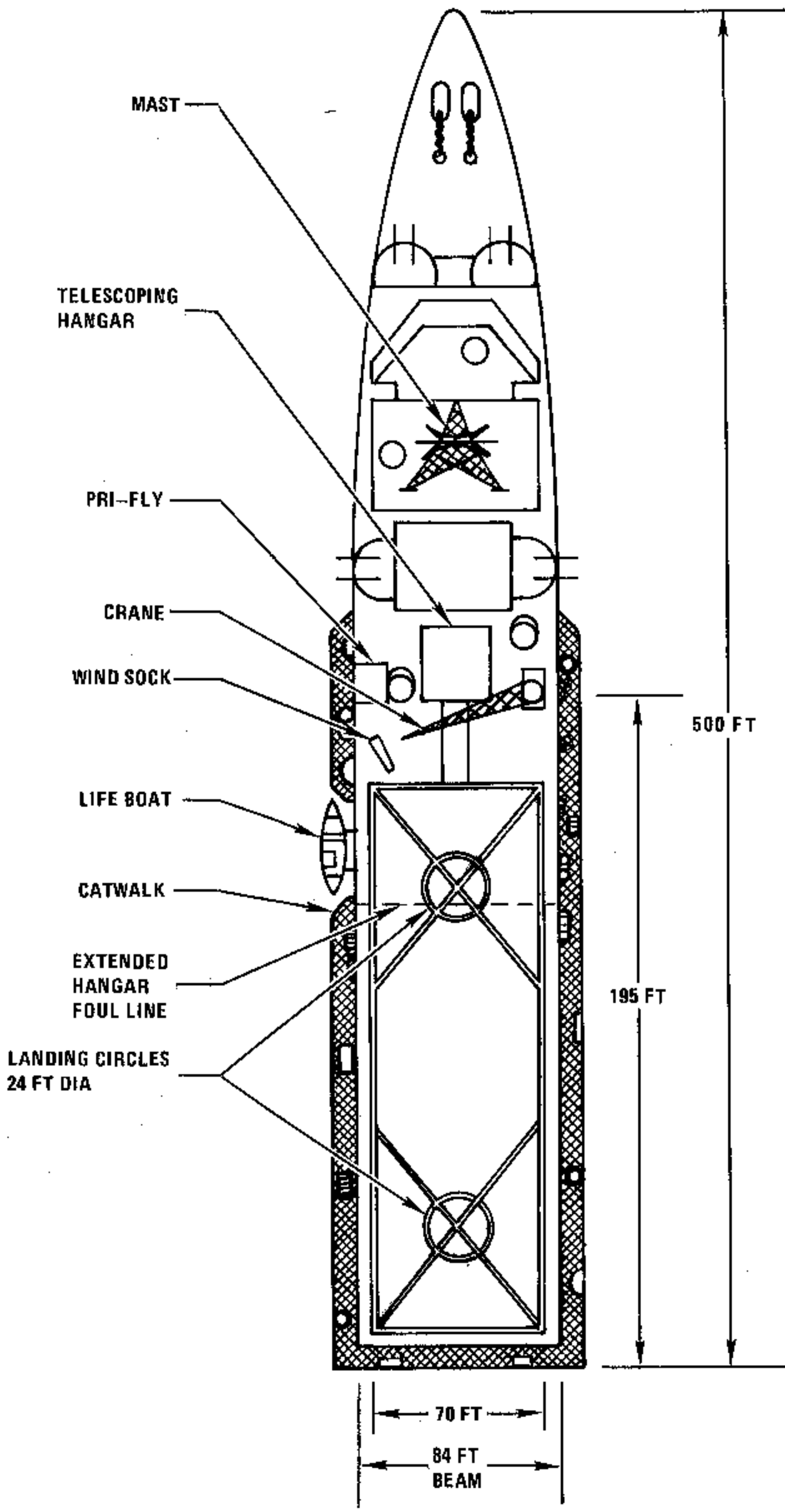
AIRCRAFT RUN LINE IS CENTER OF CLEAR DECK NOT SHIP CENTERLINE.

ALL MARKINGS SHOULD BE PAINTED WITH DAY–GLOW WHITE PAINT.

Figure 3-7

LPD DECK MARKING

RECOMMENDED



NOTES

FREEBOARD-35 FT (NORMAL)
-30 FT (FLOODED)

MARKINGS-DAY GLO WHITE

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Figure 3-7A

LAUNCH

PRELAUNCH

Prior to launch, the LSO will compute gross weight, WOD requirement, pitch trim and nozzle angle setting based upon the current launch bulletins. Upon approaching the start line or launch spot, observe and confirm the information presented on the "Tote Board" by flight deck personnel (i.e., gross weight, nozzle angle, trim and water injection requirement). If "Tote Board" information differs from prelaunch briefing, resolve the disparity prior to launch. When ready, the Flight Deck Officer will give the First Ready (one finger) turnup signal for engine and trim checks. Confirm STO stop and trim settings and conduct normal engine checks. When checking duct pressure, move the nozzle lever to the STO stop and observe the Flight Deck Officer. If configuration, trim and nozzle function are correct, the Flight Deck Officer will signal a "thumbs up" if a launch delay is expected or a Final Ready (two finger) turnup if no launch delay is expected. Arm the water (if required), note the RPM rise, and return the nozzle lever to the 10° deck run position. If a launch delay is expected the Flight Deck Officer will signal "throttle back". Throttle back to idle. For Condition I deck alert, turn water switch OFF, shut down the aircraft and ensure external power applied for alignment. Leave the standby attitude indicator, air data computer, C2J gyro compass, anti-collision light, boost pumps and communications-navigation equipment ON. Place the low pressure fuel shutoff valve OFF to prevent caution and warning panel lights burnout. When external power is applied depress and hold the DC reset button for a minimum of 3 seconds until reset observed on the voltmeter. Upon receipt of ships head and "steady" execute a rapid alignment (2 minutes VFR, 6 minutes IFR) with the C2J mode selector switch at DG to coarse align the platform. Observe vertical speed on the HUD VSTOL display and switch the INAS function selector knob to NAV as the vertical speed passes 0. Report ready status to the flight deck personnel either verbally or with a "thumbs up" when alignment is complete. Disconnect external power upon receipt of the launch order. Turn the Low Pressure Fuel Shutoff Valve ON and start the engine. As hydraulic pressure rises give a "Pull Chocks" signal to the Plane Director. Clear the INAS by cycling the NDC Mode Selector knob PNPN, turn water switch ON if required (5 finger turn up from Flight Deck Officer) and IFF turned on. For operations aboard LPD's, procedures remain the same. VTO's only are permitted and should be into the relative wind.

LAUNCH

Asymmetrical STO or VTO shall not be attempted due to the possibility of running out of lateral control authority. If wing fuel tanks are installed, the fuel quantity indicating system must be operating correctly to prevent an inadvertent asymmetrical takeoff. With external stores or at night, it is imperative that the HUD and SAS are operative. Do not accept any crosswind which is out of limits based on the launch bulletin for STO deck run due to cross control and/or yaw/sideslip buildup. When ready for launch, guard the stick lightly in the trimmed position with the right hand and salute with the left or turn exterior lights ON. The Flight Deck Officer will observe the deck and the Ready Deck light and then signal launch by touching his hand to the deck.

STO

Upon receiving the launch signal, add full power, hold the brakes until the tires start to skid, scan the water light (if used), note top RPM and concentrate on controlling the aircraft down the run line with rudder. Observe nozzle rotation line closure. When the pitot boom crosses the nozzle rotation line, move the nozzle lever smartly to the STO stop and guard the stick in the trimmed position. Resist any tendency to pull back on the stick at nozzle rotation except to maintain deck run attitude (i.e. control nose tuck) or the resulting overrotation may cause deceleration and settle. With proper trim set, the nose will dip slightly then tend to rise as the aircraft leaves the bow. Observe AOA on the HUD and stop the AOA increase at a maximum of 12 units. Do not move the nozzle lever forward until a climb is established.

VTO

Upon receiving the launch signal, use standard short based VTO procedures.

POST LAUNCH

After climb is established, initiate an accelerating transition with the nozzle lever. Do not raise the gear below 160 knots and 200 feet to prevent RPM cutback while low and slow. When wingborne, check water OFF. Exercise caution to avoid rotating the water injection switch through OFF to JETTISON inadvertently. Select flaps to MID or UP above 200 knots. Yaw/sideslip buildup must be controlled in a timely manner to prevent saturation of the lateral control system, particularly under gusty or high AOA conditions during launch and transition.

WARNING

Deviation from these launch procedures is dangerous to your health.

INFLIGHT

Refer to Flight Characteristics, section IV, and Performance Data, section XI.

LANDING

SHIP LANDING PATTERN

VFR PATTERN

See figure 3-8. The VFR pattern may be entered from the break or downwind turn after launch or wave-off. The pattern altitude is 800 feet. The break interval is 12-14 seconds. Angle of bank should be 45°. If the pattern is entered from launch or wave-off, the gear and flaps should be left down, fuel permitting, to reduce the workload. The turn to downwind should be level at 200 knots with 30-40° bank. On the downwind leg slow to 8 units AOA and perform landing checks as for shore except place the anti-skid and nosewheel steering switch to SKID OFF/NWS ON. Descend to 600 feet. Water injection, if required, will be armed as part of the landing check.

WARNING

The anti-skid and nosewheel steering switch must be in SKID OFF/NWS ON to prevent loss of directional control on the deck.

Abeam the stern or upon commencing final turn for a cross axial approach, transmit "Abeam, gear down, stops clear" and intentions (eg., landing aft). Distance abeam should be 3/4 to 1 1/4 miles. Select 40° nozzles at the 180° position and maintain 8 units AOA with throttle to arrive at the 90° position at 600 feet. Approaching the groove, select 70° nozzles and set the throttle at 90-92%. Maintain 8 units AOA with the nozzles. Continue descent to enter the groove at 350 feet. Upon entering the groove place nozzles to the hover stop and transmit "hover stop". Control sink with throttle and speed with stick.

NOTE

If use of the braking stop is required, call it and call again when returning to the hover stop for LSO information.

When the glide slope indicator is observed, transmit "Ball, state, water ON (if on)". If the ball is not observed before 1/2 mile, transmit "Clara". Airspeed should be no greater than 50-60 knots at 1000 feet astern. Cross the ramp with 25 feet minimum clearance at 5-10 knots closure. Crossing the ramp or deck edge below 25 feet may cause foreign objects to be blown out of the catwalks and strike the aircraft or be ingested into the engine. When the aircraft is stabilized over the landing area and the deck is clear, the LSO will transmit "Clear". Initiate a normal vertical landing. Resist any tendency to chase the deck. Upon touchdown, reduce power to idle, apply the brakes, select nozzles aft and follow the plane director's signals.

For operations aboard LPD's, the VFR pattern is the same until in the groove. Approaching the groove, the ship should, ideally, have the relative wind 30°-45° off either bow. The pilot will be advised of the direction of the relative wind and should plan his approach to be into the relative wind on final. No glide slope information will be available and particular attention must be paid to altitude. If landing aboard an LPD with the relative wind on the bow, plan to come to a hover abeam the landing area to avoid superstructure turbulence and enhance waveoff capability.

IFR/NIGHT PATTERN

See figure 3-9. The IFR pattern may be entered from marshall, launch, wave-off or missed approach. Approaching marshall, the flight leader shall transmit an arrival report containing position, angels, low state in the flight, line-up and any pertinent remarks (e.g., hung ordnance). The marshall holding pattern is a 6 minute pattern with left hand turns. Holding airspeed is 240-250 knots. Upon entering holding on the assigned radial, report angels. Departing marshall, select full flap, speedbrake out and maintain 250 knots, 4000-6000 feet/minute descent. Transmit a departure report containing state and altimeter setting. At platform (5000 feet), reduce rate of descent by selecting speed brakes in while maintaining 250 knots and report "platform". Departing platform, progressively reduce rate of descent so as to not exceed passing altitude in feet per minute. Level off at 800 feet. Perform landing checklist at 12 miles including water (if required) and report when completed. Descend to 400 feet at no more than 500 feet per minute commencing at 6 miles. Report commencing descent and level. At 3 miles in level flight select 40° nozzles. At 1 mile (1½ miles without stab aug) select the hover stop and increase power as necessary to maintain level flight (90-95%). Report "hover stop". Check for the ball. Report "Ball" or "Clara" (ball not in sight) and state. Do not descend below 400 feet until ball is in sight or 200 feet until deck is clearly visible. Control sink with power and airspeed with stick. Do not exceed 250 feet/minute rate of descent. Aim to be no faster than 50-60 knots 1000 feet astern and no lower than 25 feet crossing the deck edge.

SHIP LANDING PATTERN

TYPICAL VFR/CARQUAL

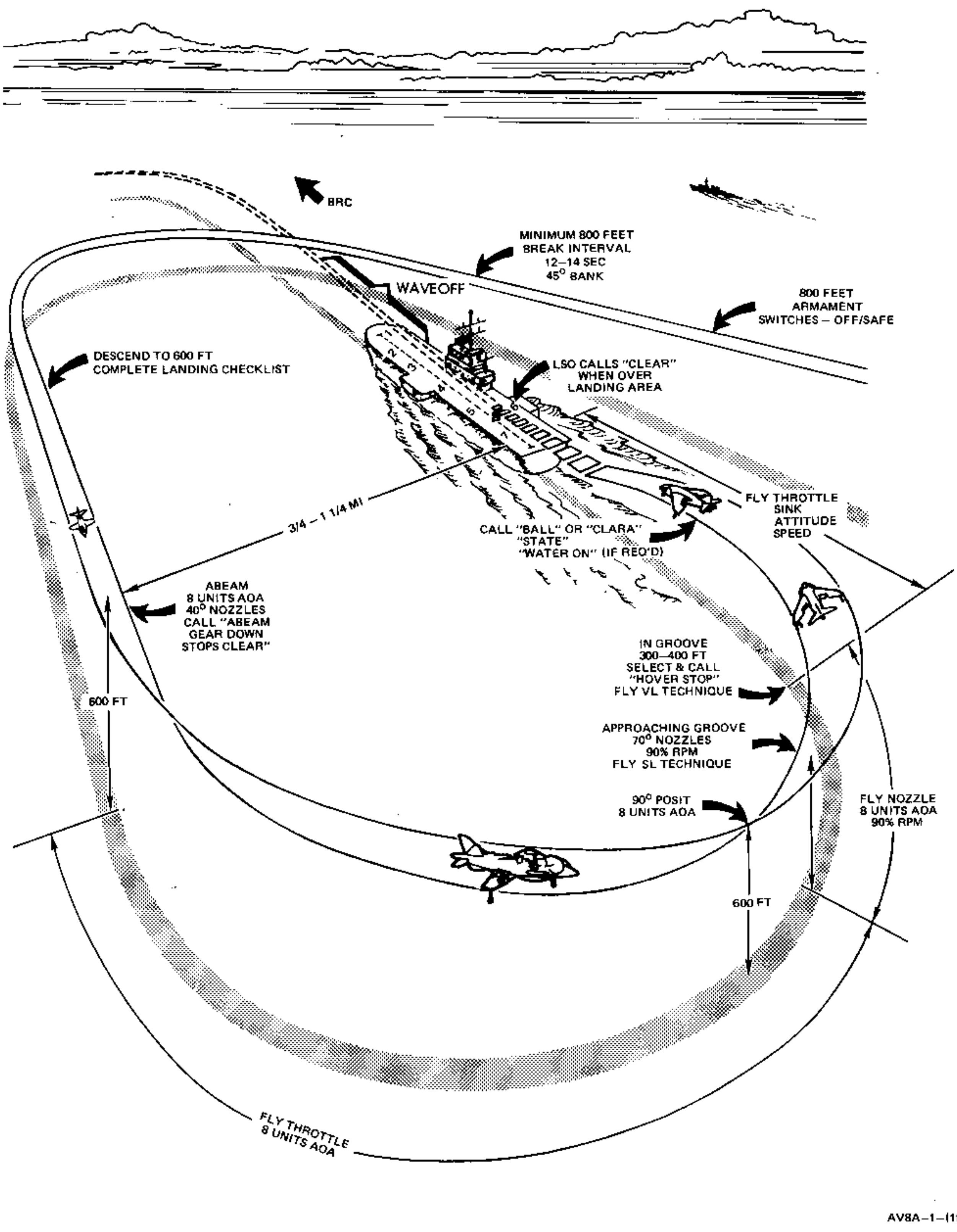


Figure 3–8

Avoid any overshoot to starboard. If a slight overshoot to port is experienced, do not descend below 200 feet until the deck is clearly visible. When over the landing area and upon receipt of "Clear" from the LSO, complete a vertical landing. Upon touchdown, reduce power to idle, apply the brakes, select nozzles aft and follow the plane director's signals. Turn exterior lights OFF as soon as possible. Cross-axial or bow-to-stern landings in IFR conditions or at night shall not be attempted due to lack of glide slope, horizon and line up information. Operations aboard LPD's are limited to day/VFR only due to the lack of visual or radar glideslope/centerline information at night or IFR.

WAVE-OFF PATTERN

The following procedures apply to wave-off, missed approach, or landing immediately following launch:

Add full power if not already selected. Ensure a positive rate of climb. Initiate a slow accelerating transition maintaining a positive rate of climb. Correct any yaw. When possible, reduce power slightly, complete the transition and level off at 800 feet. Select water injection OFF and check contents. Perform a level turn to downwind at 200 knots and 30° bank. When straight and level downwind, reduce speed to 8 units AOA (170-180 knots) and parallel BRC. Complete landing checks, arm water injection (if required) and report abeam with state.

NOTE

Leave gear and flaps down, fuel permitting.

If executing a visual approach, start the turn to the BRC abeam the stern and follow VFR procedures. If executing a low level visual approach, commence a level 8 unit AOA 25° banked turn with nozzles aft to the BRC when directed by CATCC. If communication problems are encountered, commence the turn at 6 miles TACAN range. When intercepting the extended centerline at about 6 miles (gate 2), continue the approach using the same procedures as used from marshall. If the landing gear was raised to save fuel, extend the gear at gate 2 when commencing descent to 400 feet.

SECTION CCA

Section CCA's are normally necessary if communications or navigational aids are lost. The aircraft with the difficulty will fly the starboard wing. The lead aircraft should fly 5-10 knots faster than normal on the final approach to provide the wingman some comfort and latitude in power control. Nozzles should remain aft unless radio communications are available. When the meatball or positive visual references are sighted, the leader should detach the wingman by passing the lead or, at night, flashing his exterior lights. The leader shall then use nozzles to slow to ensure the wingman lands safely or can join in event of a waveoff. When the wingman is safely on deck, the leader may then land or enter the waveoff pattern as directed by the CATCC.

NOTE

For emergency IFF codes, refer to the CVA/CVS NATOPS manual.

NIGHT FLYING

The procedures outlined here are different from, or in addition to normal day procedures.

BRIEFING

Before initial night operation, all pilots should receive a briefing from the Flight Deck Officer and the LSO. Individual briefings will place particular emphasis on weather and Bingo fuel.

PREFLIGHT

Ensure that external light switches are positioned for a poststart lighting check.

TAXI

Night deck operations are slower than day operations. If in doubt as to the meaning of the taxi director's signal, stop.

NIGHT LIGHTING

During the approach and landing, lights should be BRIGHT and STEADY, rotating beacon - ON and landing light - APPROACH. When the landing is completed, turn all lights OFF and follow the taxi director's signals.

SHIP LANDING PATTERN
TYPICAL NIGHT IFR

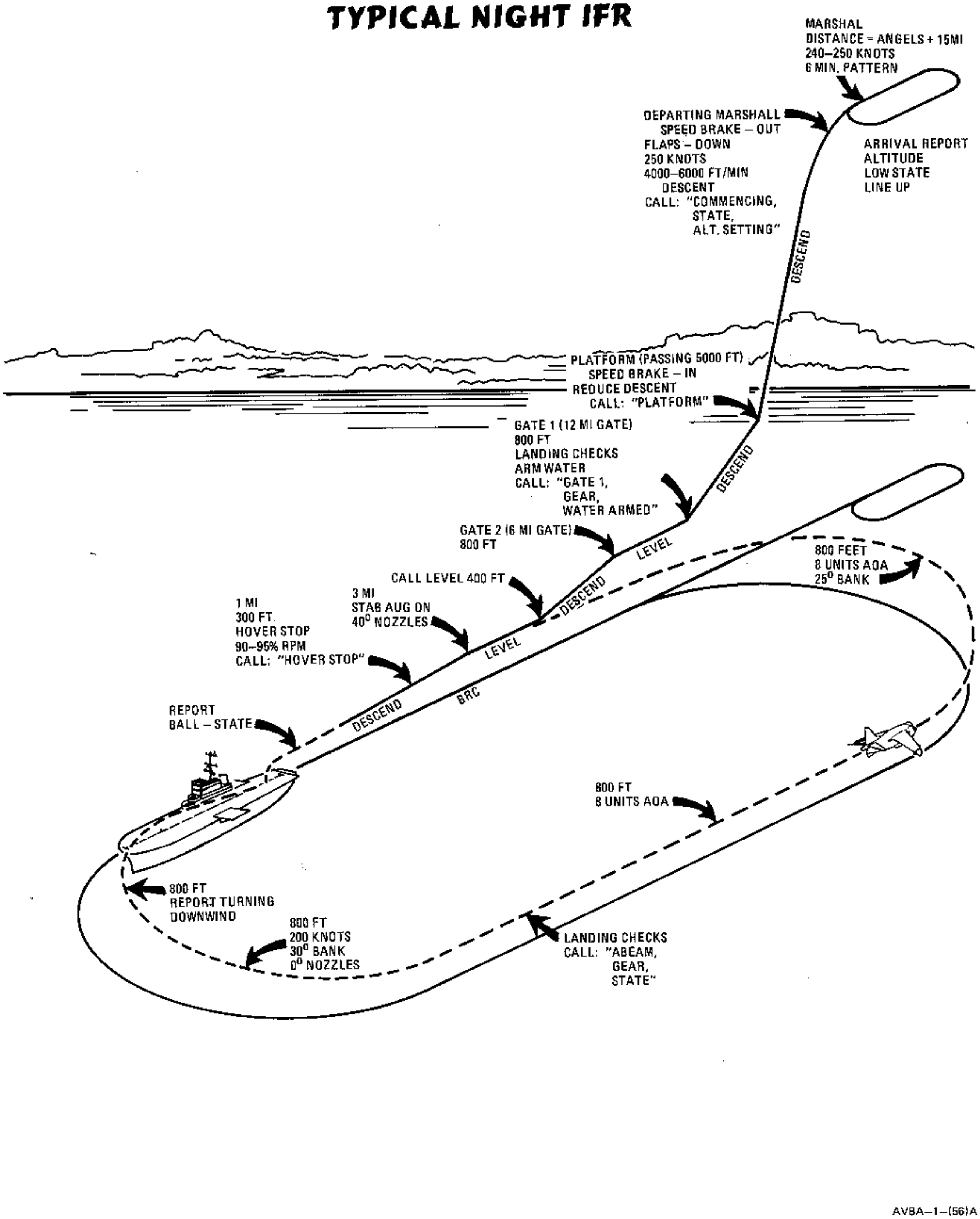


Figure 3-9

PART 5 FUNCTIONAL CHECKFLIGHT PROCEDURES

FUNCTIONAL CHECKFLIGHT REQUIREMENTS

GENERAL

The functional checkflight will be performed after the completion of the calendar maintenance requirements using the applicable Functional Checkflight Checklist. This section contains a detailed description of the checkflight requirements, sequenced in the order in which they will be performed. The checkflight personnel will familiarize themselves with these requirements prior to the flight. NATOPS procedures will apply during the entire checkflight. Only those pilots designated in writing by the Squadron Commanding Officer shall perform squadron checkflights. Checkflight procedures will be in accordance with the current edition of OPNAVINST 4790.2. For ready reference, excerpts from OPNAVINST 4790.2 are quoted below.

At the discretion of the Commanding Officer, checkflights may be flown in combination with operational flights, provided the operational portion is not conducted until the checkflight requirements have been satisfied and the results have been entered on the checkflight checklist. The general purpose code assigned to a combination check and operational flight will be the one that describes the primary purpose of the flight.

Pilots and crew members who perform checkflights are qualified in accordance with OPNAVINST 3710.7 Series and the applicable NATOPS manual, and are provided a thorough briefing by the Maintenance Officer or his designated representative (normally the QA Officer). This briefing should describe the requirements for that particular flight, the expected results, and corrective emergency action to be taken if required.

Checkflights are conducted with the minimum crew necessary to ensure proper operation of all required equipment.

Checkflights must be of sufficient duration to perform the prescribed checks and to determine whether any additional maintenance work is required.

Checkflights shall be conducted in accordance with the criteria established by OPNAVINST 3710.7 Series (NATOPS).

Checkflight forms must be properly completed and returned to the Maintenance Department.

Checkflights are required to determine whether the airframe, power plant, accessories, and items of equipment are functioning in accordance with predetermined requirements. Depending upon the maintenance performed, the functional checkflight will be either a complete or a partial checkflight. If a complete checkflight is to be flown, all the items contained in the Functional Checkflight Requirements must be accomplished. If a partial checkflight is to be flown due to engine change, flight control rigging, etc., only those items that directly relate to the equipment being checked need be accomplished. Therefore, some items contained in the Functional Checkflight Requirements are coded. This coding is intended to assist the FCF crewmembers in determining which items pertain to the various conditions requiring checkflights. Items coded (E) pertain to engine/fuel control maintenance as outlined in OPNAVINST 4790.2. Items coded (FC) pertain to flight control/rigging maintenance as outlined in OPNAVINST 4790.2. The uncoded items in conjunction with the coded items constitute a complete Functional Checkflight, requirements for which are outlined in OPNAVINST 4790.2. Coding shall appear adjacent to a paragraph title or a step. If it appears adjacent to a paragraph title, all steps following that paragraph title will apply. If the coding appears adjacent to a step, only that step and its subordinates will apply.

CHECKFLIGHT REQUIREMENTS

PREFLIGHT

1. Exterior Preflight
   The aircraft exterior preflight will be conducted in accordance with section III of this manual. Particular attention shall be made to check for loose or improperly installed panels in those areas where maintenance has been performed.
2. Interior Preflight
   Internal inspection and proper switch positions will be accomplished in accordance with section III of this manual.
3. APU/Start/Output
   Select ground run and start APU. Ensure lightoff occurs within 4 to 5 seconds and the ALT ON light illuminates after APU has reached operating rpm.
4. ADC (if not accomplished on external power)
   Check the ADC in BIT 1 and BIT 2.
5. HUD
   Check the HUD in BIT 1 and BIT 2.
6. INS
   Check INS for normal alignment.
7. Navigation Display and Computer
   Set coordinates and wind data for intended flight utilizing all stores. Check function of MAG/TAC/TRUE switch.
8. Warning Lights
   Check warning lights for proper operation.
9. Low Pressure Fuel Shutoff Lever
   Ensure low pressure fuel shutoff lever is locked in the fully open position.
10. Throttle/Limiter Trip/Ignitors/Parking Brake
    Check throttle movement including override of limiters switch then reset switch. Depress

airstart button to check ignitor plugs. Check parking brake for proper operation.

(E) STARTING ENGINE

1. Maximum JPT during engine start is 450°C.
2. At idle check the following:
   a. RPM 25 to 28%.
   b. JPT 525°C. maximum
   c. IGV 35 to 40°.
   d. Place the manual fuel switch to MAN FUEL ON and check that the rpm fluctuates and the MFC caution light illuminates. Return the switch to OFF and close the guard. Ensure rpm stabilizes and the MFC caution light goes out.

BEFORE TAXIING

1. Landing gear position lights – GREEN
2. (FC) Yaw Stab
   Perform functional check of yaw stability.
3. (FC) Pitch Stab
   Perform functional check of pitch stability.
4. (FC) Roll Stab
   Perform functional check of roll stability with the aid of the plane captain.
5. Hydraulic Pressure
   Check PC–1 and PC–2 hydraulic pressure is 3000 ±200 psi.
6. Brake Pressure
   Check brake pressure is 1300 psi minimum with brakes fully depressed.
7. RAT Pressure
   Rapidly cycle the control stick and ensure that the RAT extends when PC–2 pressure drops to approximately 1600 psi. Have ground crew ensure the RAT retracts after the RAT reset button is depressed.
8. Trim
   Set rudder, aileron and stabilator trim using both stick and emergency trim.
9. Controls
   Cycle the flight controls and check for normal feel.
10. Flaps
    Cycle the flaps and check proper operation of flaps and indicator.
11. VHF/FM
    Perform functional check of VHF/FM set.
12. UHF
    Perform functional check of primary and standby UHF. Use the emergency battery to power the standby UHF.
13. TACAN
    Perform functional check of TACAN.
14. INAS/VSI
    The vertical speed indicator pointer, on the HUD, should be at 0.

DURING TAXI

1. Anti–skid.
   While holding constant brake pressure; press and release the anti–skid test button, check that brake pressure drops to below 200 (within 1 to 3 seconds) then builds back up to 1350 psi (within 8 to 11 seconds).
2. Nosewheel Steering
   Engage nosewheel steering and move rudder pedals left and right. Ensure that the nosewheel indicator shows white with the nosewheel off center and black when centered.
3. Nosewheel Castor
   Release nosewheel steering while in a turn and ensure that it does not return to center at maximum rate.
4. (FC) Rudder Shaker
   With nosewheel steering engaged, depress the RPS/YAW TEST pushbutton and alternately deflect the rudder pedals. Ensure that the rearward rudder pedal oscillates briefly and the HUD sideforce symbol briefly indicates sideforce in the direction of the applied rudder.

BEFORE TAKEOFF

1. (E) Perform engine check
   a. Accelerate the engine from 27 to 55% rpm. The engine shall reach 55% rpm within 3.5 to 5.0 seconds.
   b. With the engine stabilized at 55% rpm check duct pressure and inlet guide vane angle.
   c. Accelerate the engine from idle to 100% rpm. The time from 55% to 100% rpm shall be 2.5 to 3.0 seconds.
2. Engine check wet
   a. With engine at idle turn water switch ON, rpm rise shall be 4.5 to 10.5%.
   b. Accelerate the engine from idle to 100% rpm. The time from 55% to 100% rpm shall be a maximum of 4.5 seconds.
   c. Turn water switch OFF.

TAKEOFF (CTO)

Perform a conventional takeoff and check the following:

1. (E) RPM – 103.5% maximum
2. (E) JPT – 710° ±10°C
3. (E) JPT cutback (600 ±10°C)

1000 FEET

1. (E) Water Injection (200 knots)
   a. Place the water switch to ON at 85% rpm. Ensure that the rpm increase 3.0 to 4.5%, the light comes on at 90 to 96% rpm, the rpm is 105 to 107% and the JPT in short lift wet rating is 740° ±10°C. Ensure that the H_2O light comes on with 7.5 gallons of water remaining.
   b. Place the water switch to OFF.
2. Jettison Water
   Jettison the remaining water
3. (FC) RAT Check
   Rapidly move the control stick to bleed off PC–2 hydraulic pressure. The RAT will extend when the pressure drops below 1600 psi. Proper RAT operation will be indicated by the PC–2 gage fluctuating between 2500 and 3000 psi. Reset

RAT.

4. (E) Full Throttle Climb
   Make a full throttle climb to 40,000 feet at 400 knots/.80 IMN and record RPM and JPT when passing through 5000, 15,000, 25,000, 30,000, 35,000 and 40,000 feet. Monitor JPT and RPM for PRL cutback. Do not exceed 103% corrected RPM.

40,000 FEET

1. (E) PRL Check
   a. RPM
   b. COAT (switch in OAT)

CAUTION

Refer to PRL chart to ensure proper operation. If PRL is not operating properly, do not perform steps 4 and 5. Do not exceed 103% corrected RPM.

2. Cabin pressure
   a. At 80% rpm, cabin pressure shall be 21,000 ±1000 feet.
   b. At idle, cabin pressure shall be 22,000 ±1000 feet.
3. (E) Idle RPM – Check
4. (E) Slam
   At 200 knots, make a slam acceleration check of the engine from idle to full throttle (3–10 seconds).
5. (E) Hot Slam
   At 200 knots and 18 units AOA, make a slam acceleration from full throttle to 80% rpm to full throttle. Rate of throttle movement must be greater than rate of rpm change. Engine may experience a compressor stall.

30,000 FEET

1. (E) PRL Check
   a. RPM
   b. COAT (switch in OAT)
2. Fuel Dump
   Place fuel dump switches to dump and ensure fuel is dumped from each side. Return switches to normal.
3. Tacan
   a. The bearing pointer must center within ±1° of known course to station. Erratic bearing pointer movement is unacceptable.
   b. Range counter accuracy is ±0.2 miles plus 0.1% of total distance from station; however, reading and flying accuracy will permit an accuracy check of no better than ±1 mile.
4. IFF
   a. Functional check of IFF to include mode C.
5. Flood Flow
   Functional check the windshield defrost system.
6. Voice Recorder
   Functional check the voice recorder.

17,000 TO 10,000 FEET

1. (FC) Clean Stall
   Perform an idle power, wings level, stall with gear and flaps up and record AOA and IAS at buffet onset and stall.
2. (FC) AOA – Buffet Onset
   Check AOA indications at buffet onset with gear and flaps up and with gear down and flaps full down. (14 ±½ units AOA).
3. (FC) With gear down, flaps full down and the engine at 65% rpm, stall the aircraft.
   a. Record AOA and IAS at buffet onset.
   b. Record AOA and IAS at stall.
4. Check wheels warning light.
5. Rudder Pedal Shaker
   Reduce speed below 165 knots, induce side slips left and right and check for proper rudder pedal shaker operation.
6. Inverted Flight
   At 85% rpm invert the aircraft for a maximum of 15 seconds. Check fuel pump warning lights do not illuminate and that the oil and bingo lights come on.

5000 FEET

1. (FC) Trim Check
   Establish 450 knots and select mid flap, check aileron and rudder trim. Trim for hands off flight must be 0 ±10% of full throw.
2. (E) (FC) V_{max}
   Accelerate the aircraft to maximum obtainable airspeed, JPT must not exceed 595°C. Thrust surging and directional oscillations are unacceptable.
3. Perform a 4 G turn. Select Q feel OFF and ON.
4. G Suit – Check
   Check normal operation of the G suit.
5. INAS/Weapons System HUD Displays
   a. Check the HUD display obtained for various weapons: Guns (air to air and air to ground), sidewinder and rockets/bombs.
   b. Select the REV sight and check both stabilized sight and fixed sight. Select the mil depression display and rotate the depression knob to observe a change in digits and movement of the aim dot.
   c. Check single point sight depression with a known reference.
6. (E) Nozzle Trim Check
   Reduce speed to 180 knots, lower gear and flaps and set the engine at 90% rpm. Select braking stop and check that the angle is within 95 to 98° and the trim change does not exceed 1 ball.
7. HUD Sideslip
   At 120 knots with gear and flaps down, the HUD sideslip symbol shall be within ¼ width when the exterior sideslip vane is centered.
8. (F) Autostab Check (200 knots dirty)
   a. Pitch – lower nozzles and note stabilator position indicator.
   b. Roll – rap the control stick and check for normal damping.
   c. Yaw – conduct rudder free turns and check for yaw input (nozzles down).
   d. Cut out – accelerate above 250 knots and check for

pitch cut out at 250 ± 10 knots.

9. INAS

   Perform a random update.

10. Map Error

    Record error in degrees and nautical miles.

LANDING

1. Check for normal handling characteristics during the slow landing paying particular attention to the reaction control.

HOVERS (FROM A VTO)

Check for normal hovering characteristics and record performance figures (2 hovers minimum).

1. Bingo Lights
   a. Lights come on steady at 750 pounds of fuel remaining.
   b. Lights begin flashing at 250 pounds of fuel remaining.
2. Conduct planned update.

ENGINE SHUTDOWN

1. After engine shutdown, check for a minimum of 25 brake applications.

SECTION IV
FLIGHT CHARACTERISTICS

TABLE OF CONTENTS

CONVENTIONAL FLIGHT CHARACTERISTICS

STABILITY AND CONTROL

PITCH

The aircraft is stable in all maneuvering flight below 15 units AOA at all gross weights with any authorized load. Light to moderate buffet will occur above 10 to 14 units AOA depending on Mach effects. With Q feel on, the stick forces vary from light at low speeds to moderate at high speeds. With Q feel off, stick forces are light over the whole speed range and, at high indicated air speeds, care must be exercised to avoid overstressing the aircraft or initiating a pilot induced oscillation (PIO). There is little trim change with speed. Typical stabilator trim is 0° to 1°. At low speed a marked nose up trim change occurs with power increase. If G is pulled while decelerating through the transonic region, a very slight G increase will occur as the aircraft becomes subsonic. Longitudinal stability increases slightly with a heavy centerline store and decreases slightly with a wing store. Extension of the flaps or speed brake causes little trim change.

YAW AND ROLL

The aircraft exhibits mild inertial cross-coupling effects resulting in adverse yaw (yaw due to roll) at high roll rates. Lateral stick forces are light and the ailerons can produce high roll rates particularly if the spring stop is overridden. If the roll limitations are exceeded, the resulting adverse yaw will induce severe side loads on the vertical stabilizer and forward fuselage. These loads can exceed the structural strength in these areas. A heavy centerline store and/or light wing stores will increase the adverse yaw. Rudder force is low at low speeds and very high at high speeds. The aircraft can be overstressed by alternating rudder in sequence with yaw oscillations. With asymmetric loads, lateral trim changes with G are large, particularly near maximum G. Roll control is sufficient with a 1000 pound store on the inboard pylon at maximum G, but control of bank angle during G variations may be erratic until experience is gained.

THRUST VECTORING

Thrust vectoring in conventional flight is used primarily to reduce airspeed, increase turn rate and, through the reaction controls, increase controllability at low airspeeds. Its use will permit pulling about ½ G more prior to stall although this will cause a rapid reduction in airspeed. It is recommended that G be limited to 3 G with the nozzles in the braking position because stick forces are very light and deceleration at maximum G is about 25/30 knots/second. Rotation of the nozzles from aft will cause a nose-up trim change. Longitudinal control is degraded during thrust vectoring.

STALLS

NORMAL STALLS

Normal (1 G) stalls are preceded by a wide band of buffet commencing at 10-14 units AOA. The buffet increases with AOA to 18-20 units AOA with full back stick where wing rock and or wing heaviness may commence combined with random yaw. Wing rock and heaviness can be controlled with ailerons. High sink rates can develop. With external stores, the characteristics are similar but more pronounced and some pitch oscillation may develop. With gear and flaps down, the characteristics are similar but a wallowing or dutch roll motion may occur. Stall recovery is immediate when the back stick is relaxed.

ACCELERATED STALLS

At low Mach numbers the accelerated stall is similar to the normal stall. As Mach increases the buffet onset AOA reduces to 7 to 8 units AOA at 0.9 Mach. A pitching oscillation may occur. External stores do not introduce new characteristics but determine whether yawing or rolling characteristics are more predominate. Outboard pylon stores increase yaw instability and inboard or centerline stores increase roll instability.

SPINS

UPRIGHT SPIN

The aircraft is reluctant to enter or maintain a spin. If it does enter a spin, the engine compressor will probably stall causing the spin to be very oscillatory in pitch and roll. Pitch oscillations of 60° to 70° with roll rates of 0° to 150°/second and a yaw rate of 70° to 100°/second are characteristic.

INVERTED SPIN

Inverted spin tests have not been conducted; however, those inverted spins which have been entered inadvertently have been relatively smooth with a yaw rate of about 120°/second. Recoveries after 2 to 3 turns have been prompt.

SPIN RECOVERY

The symptoms of compressor stall in a spin are a slight vibration possibility preceded by one or more popping noises coupled with a rising JPT and falling RPM. The symptoms can easily go unnoticed upon inadvertent spin entry and must be specifically looked for. In case of loss of control, the controls should be neutralized. If an upright or inverted spin develops, proceed as follows:

1. CONTROLS - NEUTRAL
2. NOZZLES - AFT
3. THROTTLE - IDLE

If compressor stalled -

4. THROTTLE - OFF
5. RUDDER - FULL OPPOSITE TO YAW

If spin does not stop in two turns -

6. AILERONS - FULL WITH SPIN

Upright spin -

7. STICK - FULL BACK

Inverted spin -

7. STICK - FULL FORWARD
8. EXTERNAL STORES - JETTISON

WARNING

Jettisoned stores may strike the aircraft.

If still spinning below 10,000 feet -

9. EJECT

V/STOL FLIGHT CHARACTERISTICS

GENERAL

Jet V/STOL aircraft, in wingborne flight, are similar to any other jet aircraft, but, in the V/STOL regime, they exhibit peculiar characteristics which may not be readily apparent to those familiar with conventional aircraft. Some characteristics are general to all V/STOL aircraft while others result from a particular design. The V/STOL characteristics discussed here are particularly applicable to this aircraft.

STABILITY AND CONTROL

The aircraft exhibits neutral stability in pitch and roll and is unstable in yaw in a hover above ground effect. Ground effects are discussed at length later. Controls are sensitive in roll, fairly sensitive in pitch and sluggish in yaw. The pitch, roll and yaw autostabilizers noticeably steady the aircraft and reduce pilot workload. The yaw autostabilizer may cause a low amplitude snaking motion at low AOA and high thrust settings. Figure 4-1 illustrates CG travel due to fuel consumption for typical configuration.

YAW STABILITY

Intake momentum drag which acts parallel to the relative wind and ahead of the CG is a destablizing force in yaw. See figure 4-2. This destabilizing force is much smaller than the stabilizing effect of the vertical stabilizer at normal wingborne flight speeds. It is obvious that the vertical stabilizer has no effect at zero airspeed; therefore, the intake momentum drag makes the aircraft unstable in yaw in the hover. The exact crossover point is dependent upon several factors, but the stability decreases progressively with decrease in airspeed. The aircraft is near neutral stability in yaw between 50 and 60 knots and is unstable below 50 knots. Appreciable yaw between 30 and 90 knots can lead to loss of control in roll.

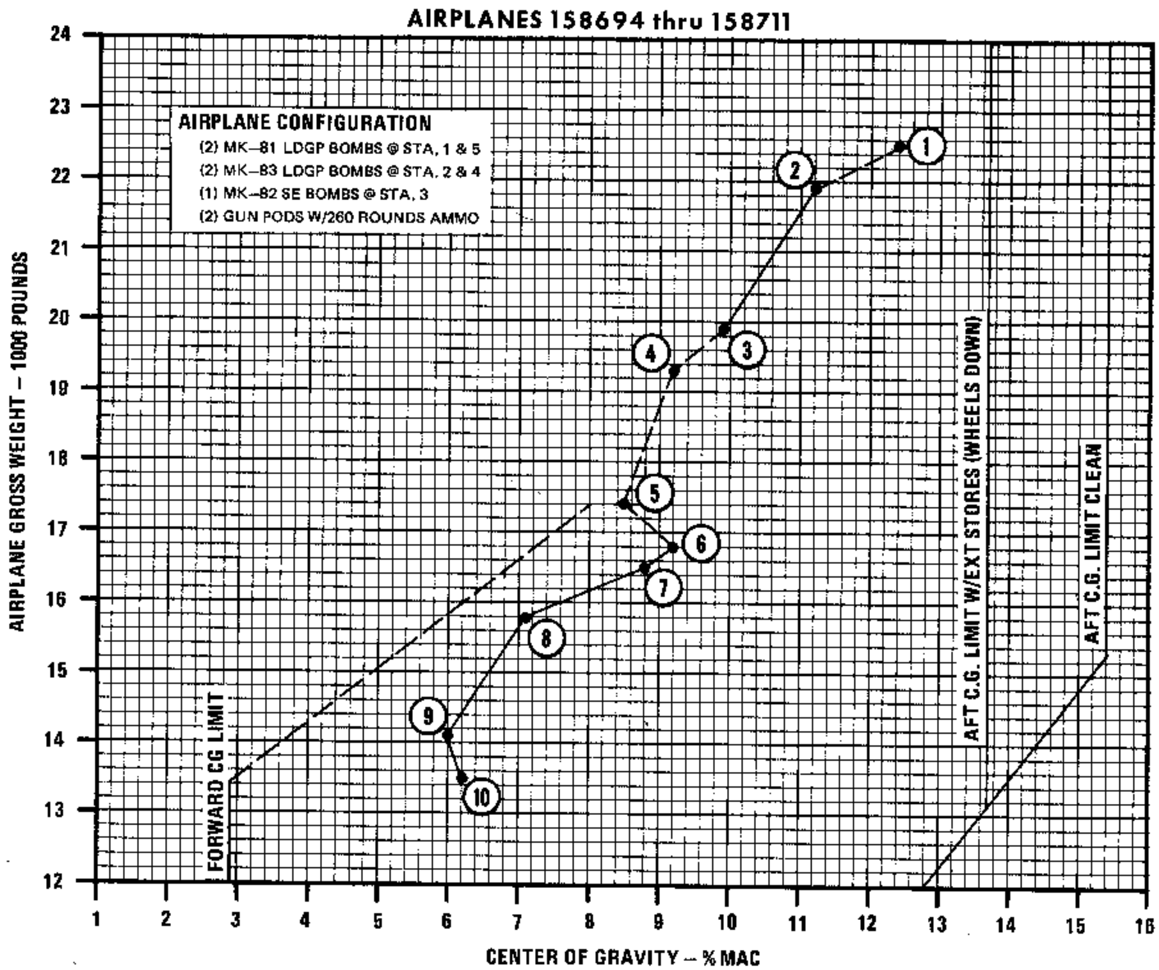
ROLL DUE TO YAW

As is true of most aircraft, this aircraft produces rolling moments as a result of and proportional to yaw. If the sideslip angle (angle between the aircraft centerline and the relative wind) becomes so large that the rolling moment exceeds that produced by the ailerons or other roll control devices, control is lost. At wingborne speeds the vertical stabilizer prevents yaw sufficient to produce loss of roll control. The rolling moment produced by yaw is proportional to the product of indicated air speed (q), AOA (α) and sideslip angle (β). If any two of the terms have a large value, it is obvious that only a small change in the third term will have a large effect on the rolling moment. Thus if IAS and AOA are high (120 knots and 15 units), a small sideslip angle will produce a large rolling moment. Likewise, a large sideslip angle (30°) and a large AOA (15 units) will produce a large rolling moment at a low IAS.

While IAS and sideslip angle can be changed fairly rapidly, it is obvious to the pilot from visual cues that this is occurring; however, AOA can increase rapidly without obvious visual or feel cues. AOA can be increased rapidly by stick application but, more dangerously because of poor visual cues, it can increase rapidly with sink rate. Most dangerous of all, the AOA will increase instantly with roll if there is a sideslip angle present. This can result in an almost instantaneous loss of control with very little or no warning. A typical loss of control sequence at low IAS involves allowing a yaw to develop which introduces a rolling moment which, if not counteracted, instantly

CG TRAVEL DUE TO FUEL CONSUMPTION

APPROXIMATE



(1) TAKEOFF GROSS WEIGHT (GEAR DOWN)
(2) WATER EXPENDED
(3) 40% FUEL EXPENDED
(4) OUTBOARD STORES DROPPED
(5) INBOARD STORES DROPPED
(6) CENTERLINE STORE DROPPED
(7) AMMO EXPENDED
(8) WING FUEL EXPENDED
(9) FWD & AFT FUSELAGE FUEL EXPENDED
(10) CENTER FUEL EXPENDED

AV8A-1-(133)

Figure 4-1

INTAKE MOMENTUM DRAG EFFECT

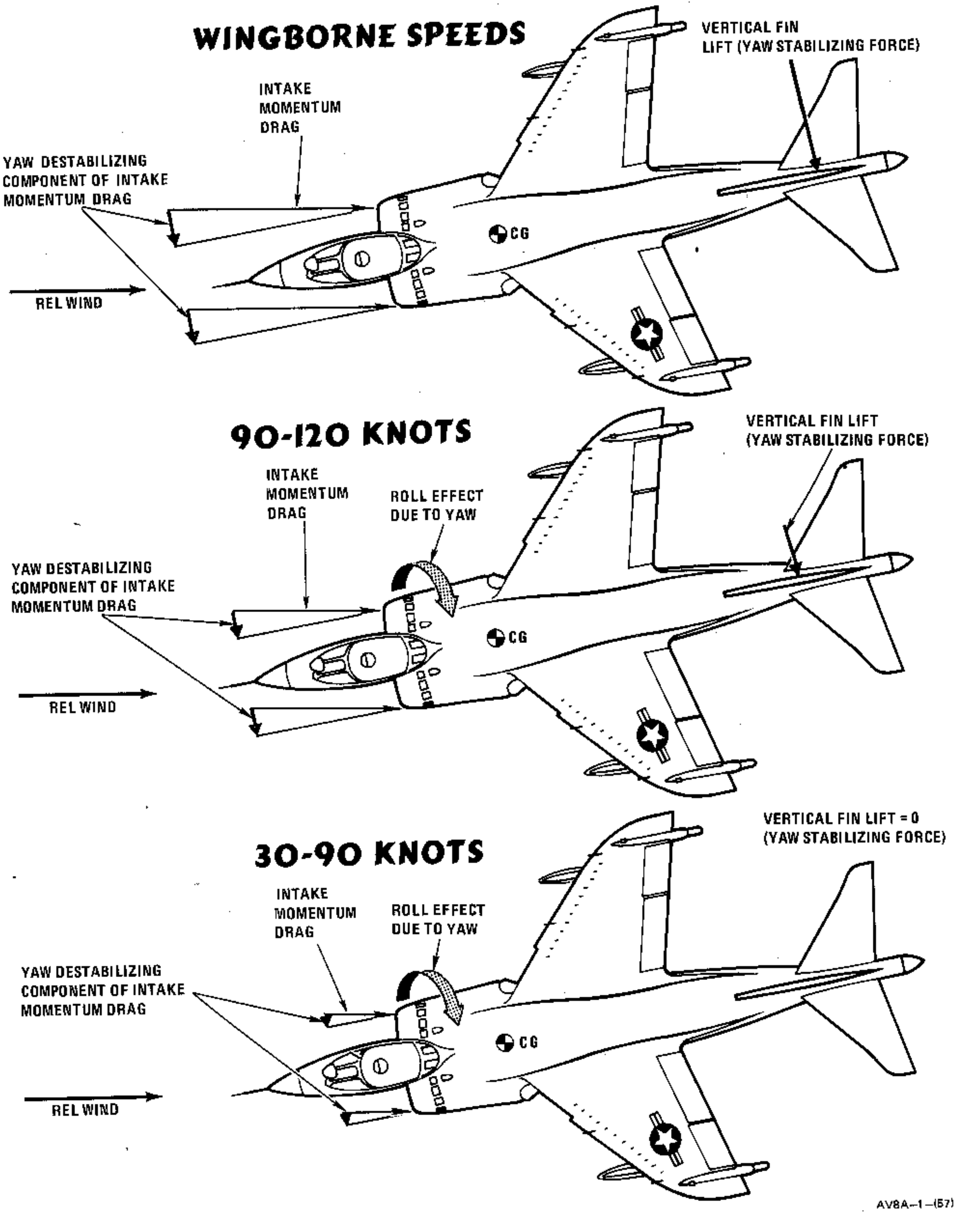


Figure 4-2

increases AOA which increases the rolling moment so that the situation becomes progressive.

OUT-OF-CONTROL ROLL AVOIDANCE

From the preceding discussion it can be seen that, if the sideslip angle is zero, no rolling moment can exist. Control of yaw is therefore the primary method of avoiding (but not recovering from) loss of control. The most reliable yaw indicator is the yaw vane. The yaw vane points into the relative wind, in the direction of nose movement to zero yaw, and in the direction of the rudder pedal to zero yaw. The HUD sideforce symbol is in the direction of the relative wind and toward the rudder required to zero yaw. The rudder pedal shaker shakes the rudder required to zero yaw (push the shaking pedal). The rudder pedal shaker is set at a relatively low sideforce so that initiation of rudder pedal shaking does not indicate a requirement for large or coarse corrective action.

OUT-OF-CONTROL ROLL RECOVERY

1. STICK - FORWARD

WARNING

In exceptional circumstances, AOA may be negative in which case the stick must be moved rearward to reduce negative AOA.

2. THROTTLE - FULL
   An increase in RPM will increase the reaction control duct pressure and thus the control available. In addition, the increased thrust will reduce AOA even without attitude change due to the flight path change.
3. STICK - FULL AGAINST ROLL
4. RUDDER - FULL AGAINST YAW

NOTE

Steps 1 thru 4 should be applied simultaneously but the priority is in the order shown.

Rudder will have a rapid effect only if sideslip angle was the last of the three terms (q, α, β) to increase. In addition, application of rudder may momentarily reduce roll control as duct pressure drops slightly due to the large reaction control flow through the yaw shutter valve. Do not interpret this momentary effect as indicating application of the wrong rudder. As sideslip angle decreases, the roll control will recover due to the reduction in roll-due-to-yaw moment.

ENERGY LEVELS IN V/STOL FLIGHT

The energy output from the four nozzles in V/STOL flight is about 30,000 horsepower. The reaction controls at full control demand have an energy output of several thousand horsepower. The front nozzles exhaust emerges at about 700 knots, 105°C (220°F) and 16 psi. The rear nozzles exhaust emerges at about 1050 knots, 645°C (1195°F) and 11 psi. The reaction control valves exhaust emerges at about 1500 knots, 400°C (750°F) and 150 psi. Although velocity, pressure, and temperature drop off with distance, the exhaust velocity at ground level in a low hover can be 300-400 knots at 4 psi. If this pressure is permitted to build up under a surface such as a landing mat or manhole cover by penetrating through holes or around unsealed edges, the lifting force becomes tremendous. A pressure of 4 psi will lift 4-foot-thick concrete or 8-inch-thick steel. The aircraft has proven to be an efficient manhole cover remover although it displays no discretion in depositing them after removal. The aircraft has raised an 11 ton mat 4 feet above the ground. Pneumatically supported mats do not soften the landing; therefore, all landing mats should be thoroughly sealed including the perimeter. The aircraft should never cross the edge of a mat in V/STOL flight at less than 30 feet.

JET EXHAUST INTERACTION

SINGLE EXHAUST PATTERN

A jet exhaust will interact with a surface upon which it impinges to form a flow pattern as shown in figure 4-3. In the V/STOL mode the predominate surface is, of course, the ground which may be considered as a plane approximately normal to the exhaust; however, the presence of other large surfaces in the immediate area, such as buildings or vehicles, may alter the flow pattern to some extent. The jet exhaust will mix with the surrounding air by jet edge shear resulting in a rapid drop in temperature and velocity but with a relatively small reduction in mass flow.

COMPLEX PATTERNS

When two jet exhausts in proximity impinge upon a plane normal to their flow, their radial flows will collide and be forced upward along a surface of symmetry where their energies are equal. If the two exhausts are initially of equal energy, this surface will be a plane normal to a line between their centers and equidistant from their centers. See figure 4-4. This upward flow may be called a jet fountain. Additional jet exhausts, unequal energies, wind, and surface irregularities will act to change the shape and direction of the jet fountain.

FOUR NOZZLE EXHAUST PATTERNS

Figure 4-5 is a pictorial representation of the interaction of the four exhaust nozzles and the ground for the aircraft in a low level hover. Interactions of the control reaction jets are not shown in order to simplify the representation and discussion. Their interaction has a considerably smaller though similar effect on the complete pattern.

Note that there are two intersecting surfaces of symmetry labeled A-A and B-B. Their point of intersection on the ground is the initiation point for a relatively focused jet fountain which angles toward the tail of the airplane. This angle is due to the higher energy of the forward nozzles in comparison with the aft nozzles due to their exhausting cooler air with a consequent higher mass flow.

INSTABILITY DUE TO GROUND EFFECT

Figure 4-6 illustrates two instability mechanisms associated with the jet fountain. As the aircraft reaches a critical altitude the jet fountain moves forward from aft of the aircraft and commences to impinge on the tail surfaces causing a nose down trim change. As the aircraft descends, the center of pressure moves forward on the aircraft and at the same time, becomes more powerful. These two actions tend to cancel each other, however, as the jet fountain moves forward, its force is expended on varying surface areas resulting in random pitch trim changes. As

JET EXHAUST AND SURFACE INTERACTION

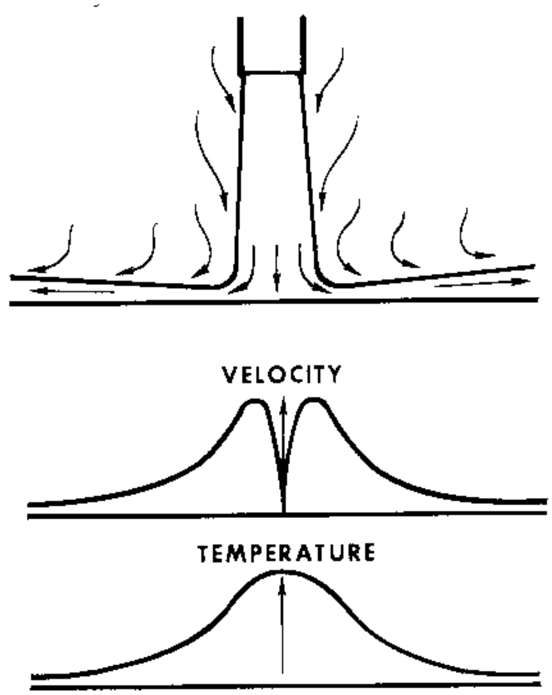


Figure 4-3

the aircraft is rolled, the jet fountain moves toward the high wing. If it then impinges upon the aircraft it will tend to increase the roll angle and may cause a pitch trim change. If it leaves the aircraft surface it will cause a nose up pitch trim change. Surface irregularities will also cause deflection of the jet fountain causing rapid trim changes or turbulence sometimes known as cobblestoning. Wing gusts will also cause random trim changes.

FOD

V/STOL aircraft are particularly adept at creating their own FOD and then ingesting it. Figure 4-7 illustrates four mechanisms for FOD ingestion:

A

Even a smooth surface is relatively bumpy to a small object such as a rock, bolt, gravel, etc. As this object is rapidly accelerated by the radial flow of perhaps 400 knots of the jet exhaust, it soon encounters a bump and bounces up, often into the engine intake flow which is also at a high velocity, and thus into the engine.

B

On an unprepared surface, the aircraft is capable of rapidly digging its own grave. As a crater is formed, the crater itself serves to direct the ejected material back toward the aircraft. Although the illustration shows the aircraft on the ground, the 8 to 10 psi of the jet exhaust in a low hover will immediately form a crater in loose soil. On a grass surface, the jet temperature will dry the soil in a few seconds and shrinkage cracks will normally appear. Clods and chunks are then blasted out of the soil. For this reason, truly vertical VTOL should never be made on an unprepared surface. If it is necessary to takeoff from or land on an unprepared surface, it should be planned so that a small forward velocity (60 knots) can be maintained throughout the maneuver.

C

If an object lies at the stagnation point between two opposing radial jet sheets, it will be subjected to a large negative pressure gradient which will give it an upward acceleration of approximately 3 G and will enter the jet fountain. Thus, the interaction of the jet exhausts form a giant vacuum cleaner effect.

D

An object may be bounced into the jet fountain in an action similar to that in A and then will be accelerated upward as in C.

TWO JET AND SURFACE INTERACTION

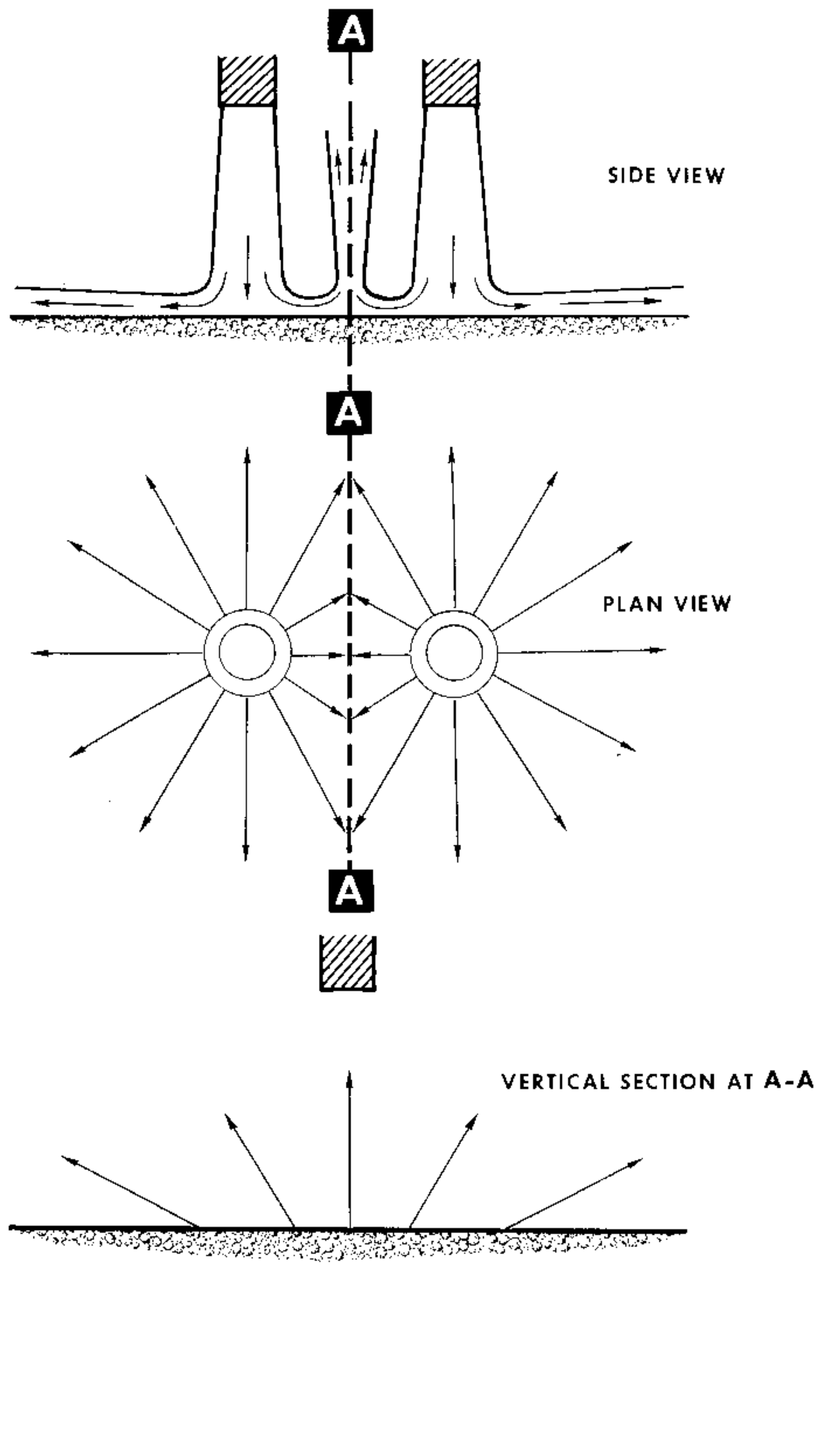


Figure 4-4

NOZZLES EXHAUST PATTERN

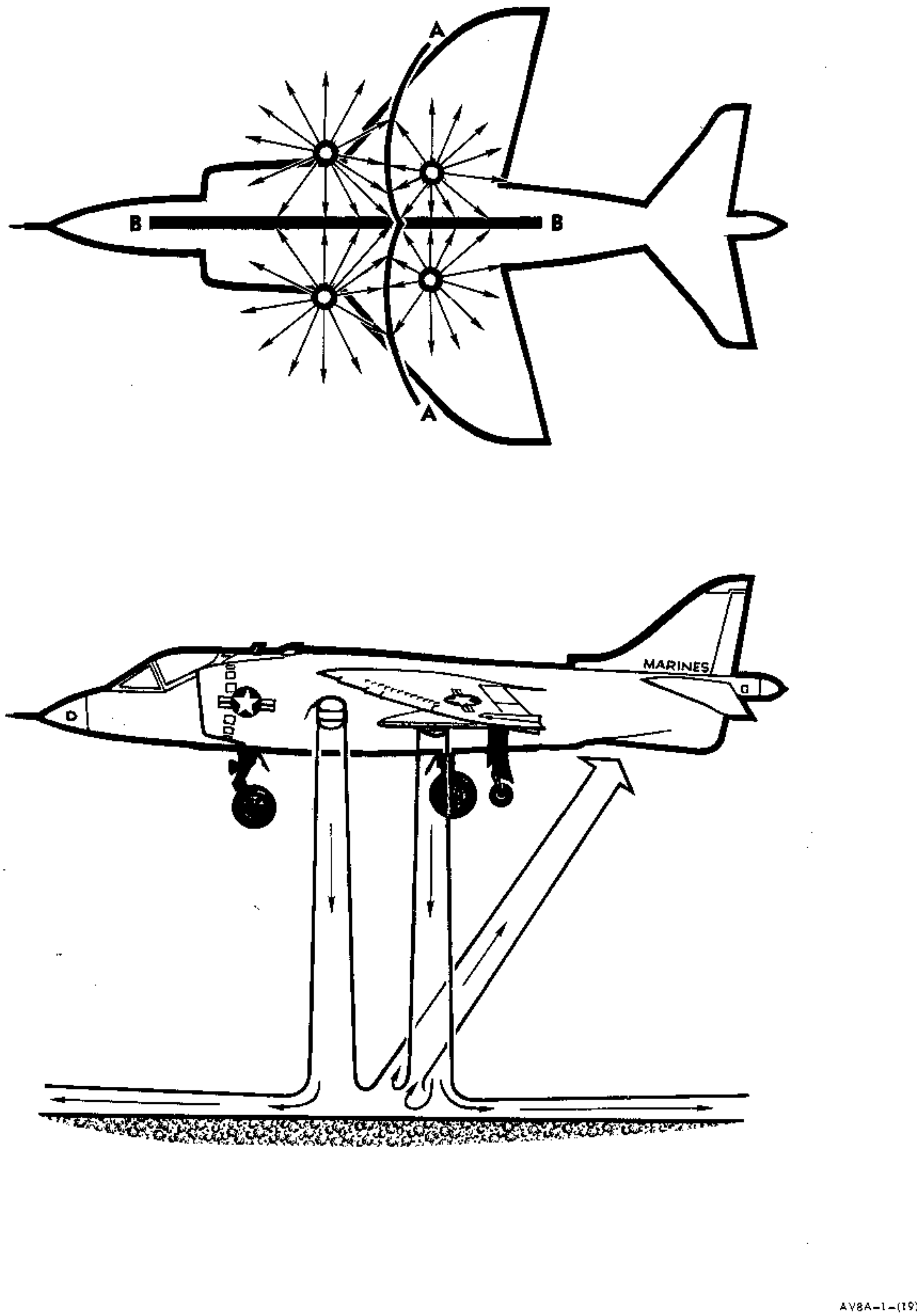


Figure 4-5

INSTABILITY DUE TO GROUND EFFECT

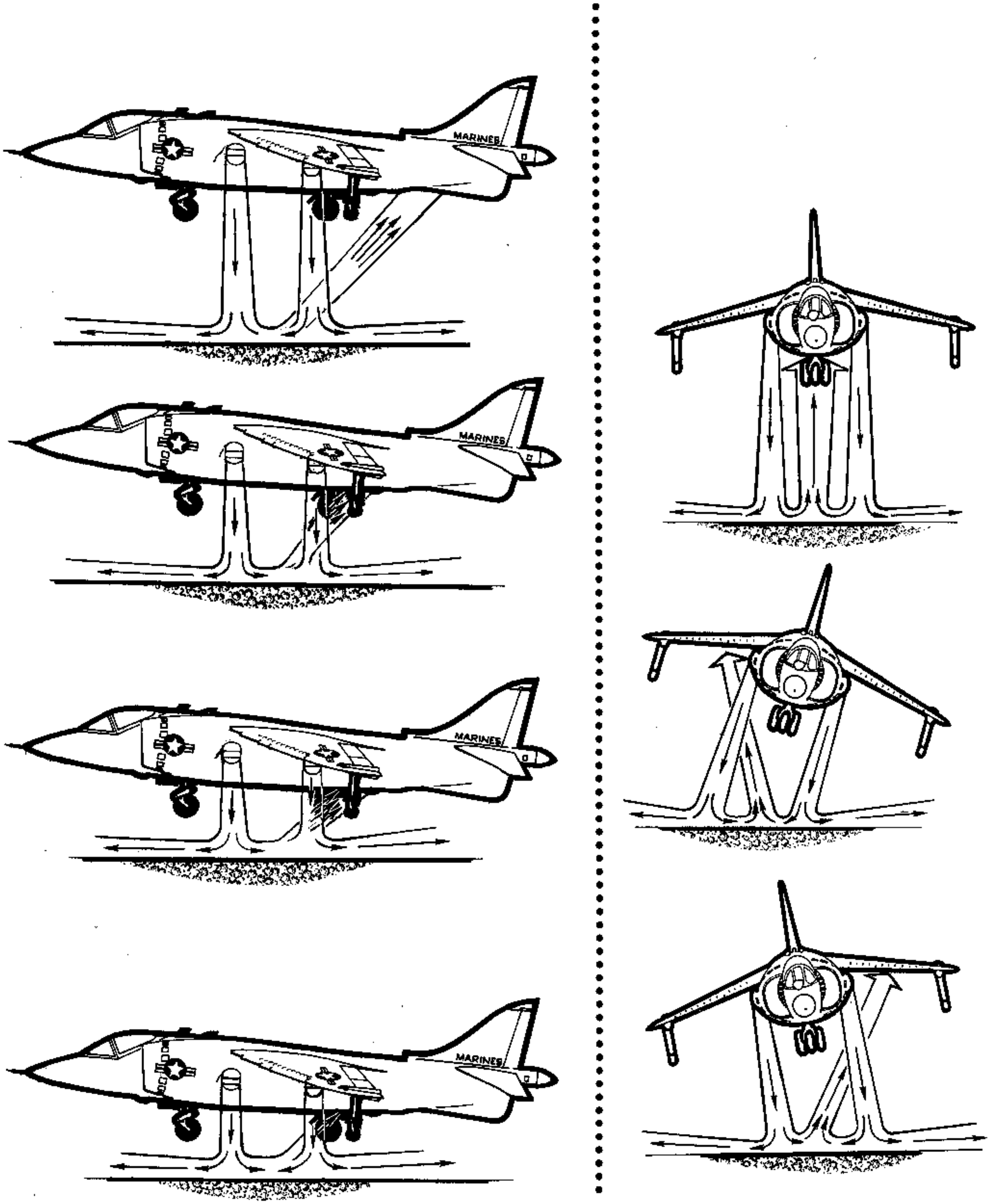


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Figure 4-6

FOD MECHANISMS

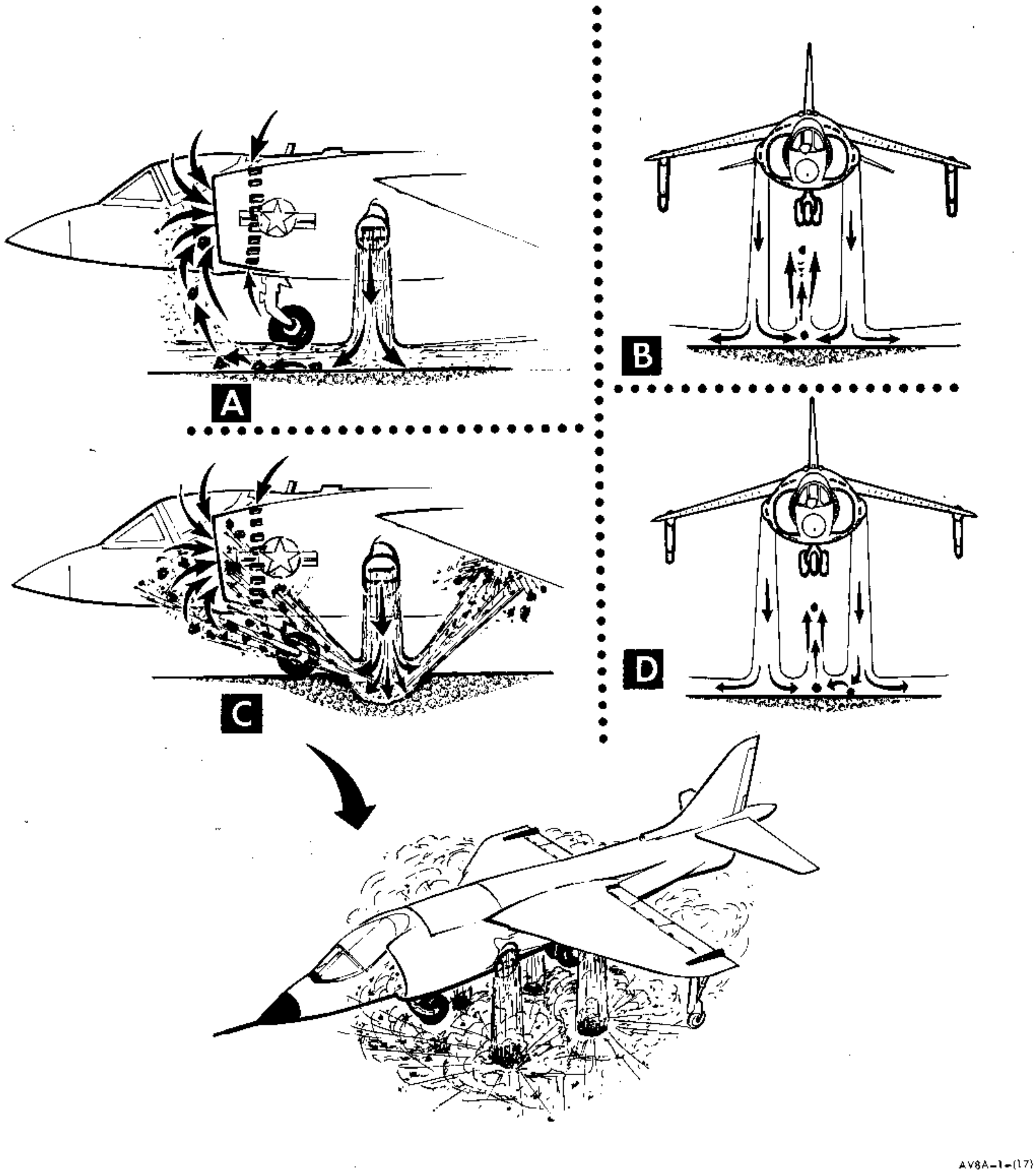

Figure 4-7

EXHAUST GAS INGESTION

In a normal hover at 50-60 feet, the jets from the nozzles merge prior to reaching the surface and there is, therefore, no interaction as at lower levels. Instead, the merged exhaust acts as a single jet and upon striking the surface, expands radially through 360°. The ground jet sheet velocity decays rapidly and, as the velocity approaches zero, the warm exhaust gases commence to rise by convection. The gases break from the surface and commence to raise at a radius of 50–100 feet dependent upon hover height, wind, surface roughness and ambient temperature. As the gases rise they are blown by the wind. The gases which are upwind will be blown toward the aircraft and will envelope it. Ingestion of this warm gas will reduce engine thrust. Figure 4-8 illustrates the best and worst case. With the aircraft pointed into the wind, the ingested gases will be predominantly from the front nozzles, thus cooler than in the case where the aircraft is pointed downwind and thus ingesting gas predominantly from the rear nozzles. At lower hovers, convection is still present but the major part of the gas is blown directly back by the exhaust reaction with the surface and reaches the aircraft much hotter than the convection gas, therefore, low hovers cannot usually be sustained and are not recommended.

Recirculation can become critical at low forward speeds on or near the ground. See figure 4-9.

EXHAUST GAS INGESTION

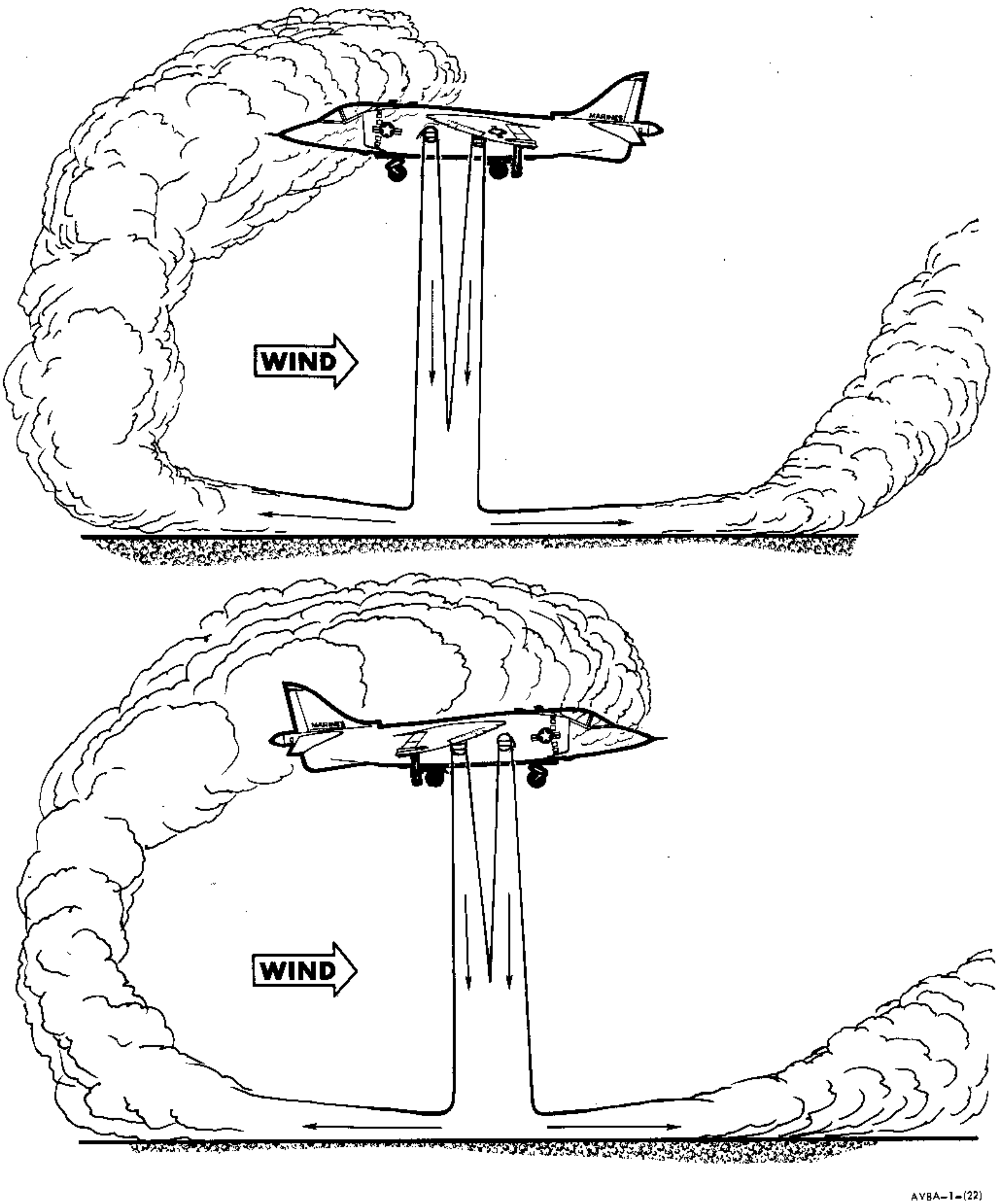

Figure 4-8

RECIRCULATION CRITICAL SPEED

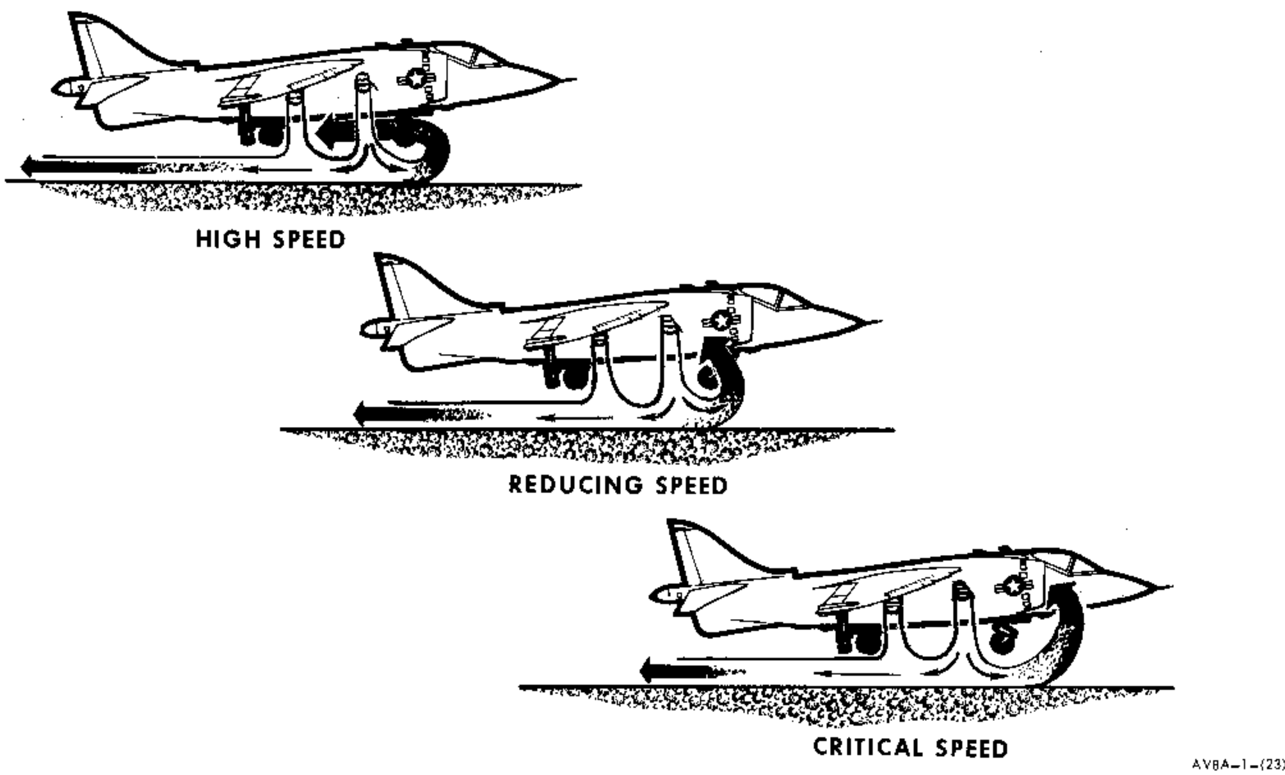

Figure 4-9

SECTION V

EMERGENCY PROCEDURES

TABLE OF CONTENTS

This section contains procedures to be followed to correct an emergency condition. These procedures will ensure maximum safety for the pilot and/or aircraft until a safe landing or other appropriate action is accomplished. Multiple emergencies, adverse weather and other peculiar conditions may require modification of these procedures. The mandatory items (ALL CAPITAL LETTERS) contained in the various emergency procedures cover the most adverse conditions. The nature and severity of the encountered emergency will dictate the necessity for complying with the mandatory items in their entirety. It is essential, therefore, that pilots determine the correct course of action by use of common sense and sound judgement. As soon as possible, the pilot should notify the flight/flight leader and tower of any existing emergency and of the intended action. When an emergency occurs, three basic rules are established which apply to airborne emergencies. They should be thoroughly understood by all pilots:

1. Maintain aircraft control.
2. Analyze the situation and take proper action.
3. Land as soon as practicable.

When an airborne emergency occurs and the flight conditions permit, the pilot should record and/or broadcast all available information such as airspeed, altitude, power settings, instrument readings and fluctuations, warning lights illuminated, loss of thrust and unusual noises. Flight leaders, wingmen, other pilots, or any ground station receiving such information should copy it and forward it as soon as possible to the cognizant activity. Wingmen should also record their observations of vapor, smoke, flames or other phenomena. Whenever possible, an effort should be made to escort an aircraft with a declared emergency until it is safely landed. This escort will observe the distressed aircraft for any external indications or symptoms of the problem, to provide assistance or advice that may be required, and to assist in a SAR effort if required.

WARNING

In the troubleshooting of a system discrepancy or in the accomplishment of an emergency procedure, the operation of a system control (such as flap, throttle, flight control, electrical switch, etc.) is usually required. Due to the nature of some failures and/or the occurrence of successive malfunctions, some control operations may occasionally result in undesirable aircraft responses, such as unexpected roll or pitch motions, smoke, unstable engine operation, etc. Often the most prudent action to take to eliminate such an undesirable response is to immediately return the operated control to its former setting. The pilot must be mentally conditioned to take that action promptly when appropriate.

AIR CONDITIONING/PRESSURIZATION

COCKPIT OVER/UNDER PRESSURE (CP WARNING LIGHT)

1. Descend to below 25,000 feet
2. Cabin air switch - OFF (overpressure)

COCKPIT OVERTEMPERATURE

1. Cabin air switch - ON
2. Cabin air temperature knob - MANUAL SECTOR
   Manually regulate temperature.

If temperature remains too high -

3. Descend to below 25,000 feet
4. Cabin air switch - OFF

COCKPIT UNDERTEMPERATURE

1. Cabin air temperature knob - MANUAL SECTOR
   Manually regulate temperature.

If temperature remains too low -

2. Cabin air switch - FLOOD

EQUIPMENT AIR CONDITIONING FAILURE (EQPT CAUTION LIGHT)

Equipment air conditioning failure is indicated by illumination of the EQUIP caution light indicating the bleed air is shut off and the system has automatically shifted to ram air cooling.

1. Equipment air switch - RESET

If equipment air does not reset -

2. Limit airspeed below 15,000 feet:
   Below 5,000 feet - 0.7 Mach
   5,000 to 10,000 feet - 0.8 Mach
   10,000 to 15,000 feet - 0.9 Mach

ANTI-G FAILURE

1. Test button - PRESS AND RELEASE

If failure still present

2. Anti-G shutoff lever - OFF

EJECTION

GENERAL

Escape from the airplane in flight and in some instances from ground level or water should be made with the ejection seat (figures 5-1 thru 5-4).

The study and analysis of escape techniques by means of the ejection seat reveals that:

a. Ejection at airspeeds ranging from stall speed to 400 knots results in relatively minor forces being exerted on the body, thus reducing injury hazard.
b. Appreciable forces are exerted on the body when ejection is performed at airspeeds of 400 to 600 knots rendering escape more hazardous.
c. At speeds above 600 knots, ejection is extremely hazardous because of excessive forces on the body.

When circumstances permit, slow the airplane prior to ejection to reduce the forces exerted on the body.

WARNING

The emergency harness release handle should never be actuated before an ejection attempt.

LOW ALTITUDE EJECTION

Low altitude ejection depends for success on the observance of the sink rate, dive angle, airspeed and altitude (AGL) limitations. See figures 5-5 and 5-6 for minimum ejection altitudes for these parameters. The pilot must make the ultimate decision as to the minimum safe altitude from which an ejection can be made in the prevailing conditions, but every effort must be made to initiate ejection before the aircraft has descended to the minimum safe altitude. Assuming that the aircraft is substantially straight and level, the ejection seat should provide safe escape as follows:

a. At zero and low airspeeds - ground level
b. At airspeeds above 400 knots - 100 feet minimum AGL

Where conditions permit, the recommended ejection conditions are 250 to 350 knots (straight and level) at a minimum altitude of 2,000 feet AGL.

WINGBORNE FLIGHT

Provided the aircraft is controllable and airspeed is not below approximately 150 knots, ejection from low altitude is facilitated by pulling the aircraft nose up and initiating a zoom maneuver before ejecting. This increases the ejection altitude AGL and adds an upward component to seat velocity, thus allowing more time for man/seat separation and main parachute development than might be available in the level flight case. At speeds below approximately 150 knots (e.g., conventional landing approach) the zoom maneuver should not be attempted, but if possible and if time permits, any rate of descent should be reduced or arrested before ejection. Ejection must not be delayed when the aircraft is in a descending attitude from which it cannot be recovered.

JETBORNE FLIGHT

During low level jetborne flight, an engine or control failure will demand immediate ejection if critical sink rate, attitude and altitude conditions are not to preclude all chance of the ejection being successful. Successful ejection can be expected within the sink rate and minimum altitude (AGL) parameters shown in figure 5-2 provided the aircraft is substantially level. Small attitude departures are acceptable, but it is emphasized that since following engine/control failures, roll rates and pitch rates will quickly develop leading rapidly to an aircraft attitude from which successful ejection cannot be made, it is vital that ejection be initiated immediately after such a failure occurs.

WARNING

When circumstances demand an immediate ejection from low level, no attempt should be made to adjust aircraft attitude at the expense of further increase in sink rate and further height loss.

EJECTION FROM GROUND LEVEL

At ground level, the ejection option exists so long as the seat harness remains properly fastened at the QRB (occupant properly strapped in), the parachute harness is connected at the Koch fasteners, the cockpit canopy remains closed and locked, and the aircraft is in a substantially upright attitude. Ejection must not be attempted unless each of these conditions is satisfied. It is stressed that following, say, a crash landing, where it is possible that damage to the canopy frame or front fuselage has occurred and where escape by ejection may be the best course, no attempt should be made to open the canopy. If such an attempt were made and resulted in the canopy jamming in a partially open position, the ejection option would be lost and manual egress from the cockpit might also be lost. On the other hand, manual use of the MDC does not invalidate the ejection option and does not prevent a subsequent manual escape. In such circumstances, the MDC must be used and the canopy must not be opened. Further, the occupant should not unstrap until it is evident that no danger is present which might inhibit his manual escape from the aircraft. In all circumstances, the pilot must make the ultimate decision as to whether ejection offers the best escape chance in the given conditions on the operating surface.

EJECTION IN WATER

NOTE

If the aircraft is ditched (which should only be attempted if the ejection seat fails to provide escape from the airborne aircraft), a manual escape from the cockpit must be made. See Ditching Chart. Consideration is given here only to escape by ejection from emergency circumstances during shipborne or water platform type operations.

BEFORE EJECTION SEQUENCE

If time and conditions permit -

- LOWER HELMET VISOR

WARNING

LOWERING THE HELMET VISOR MINIMIZES THE POSSIBILITY OF INJURY DUE TO THE MDC EXPLODING TO SHATTER THE CANOPY SHELL. UNLESS LACK OF TIME DICTATES OTHERWISE, THE HELMET VISOR SHOULD BE LOWERED.

- ADJUST ALTITUDE, AIRSPEED AND ATTITUDE.
- MAKE RADIO DISTRESS CALL

WARNING

EJECTION MUST NOT BE ATTEMPTED UNLESS THE CANOPY IS CLOSED. ANY ATTEMPT TO EJECT WHILE THE CANOPY IS PARTLY OR FULLY OPEN WILL RESULT IN THE COLLISION OF THE SEAT/OCCUPANT AND THE CANOPY ARCH.

- STOW ALL LOOSE EQUIPMENT
- CHECK HARNESS LOCKED AND TIGHTENED.

1. ASSUME PROPER EJECTION POSITION

BRACE THIGHS ON SEAT CUSHION, LEGS EXTENDED AND FEET AGAINST RUDDER PEDALS, SIT ERECT, BUTTOCKS BACK, SPINE STRAIGHT, HEAD BACK AGAINST HEADREST, AND CHIN IN.

2. EJECTION HANDLE-PULL

GRASP THE HANDLE TIGHTLY WITH BOTH HANDS, PALM AFT AND ELBOWS IN. PULL SHARPLY UP ON HANDLE (FULL TRAVEL ON HANDLE IS ABOUT TWO INCHES) RETAIN FIRM HOLD ON HANDLE DURING EJECTION SEQUENCE.

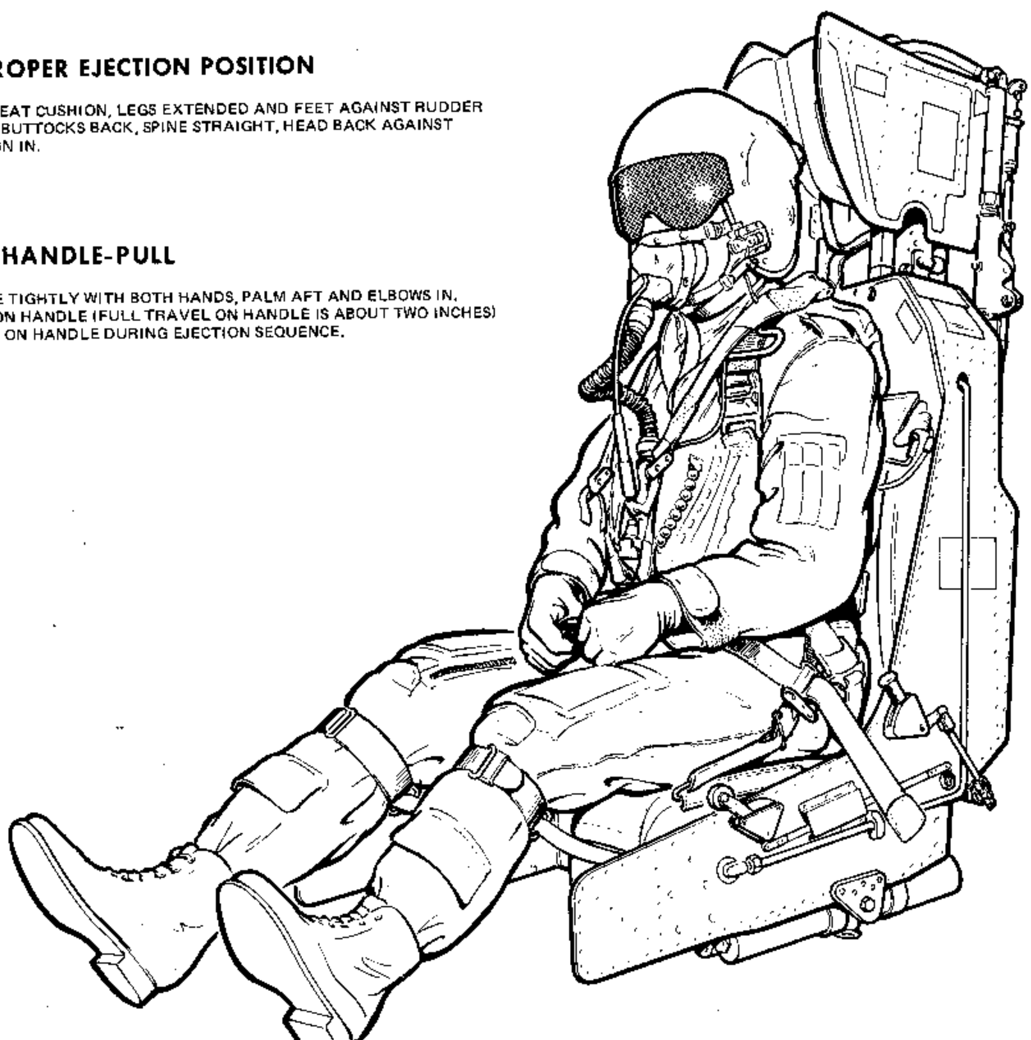

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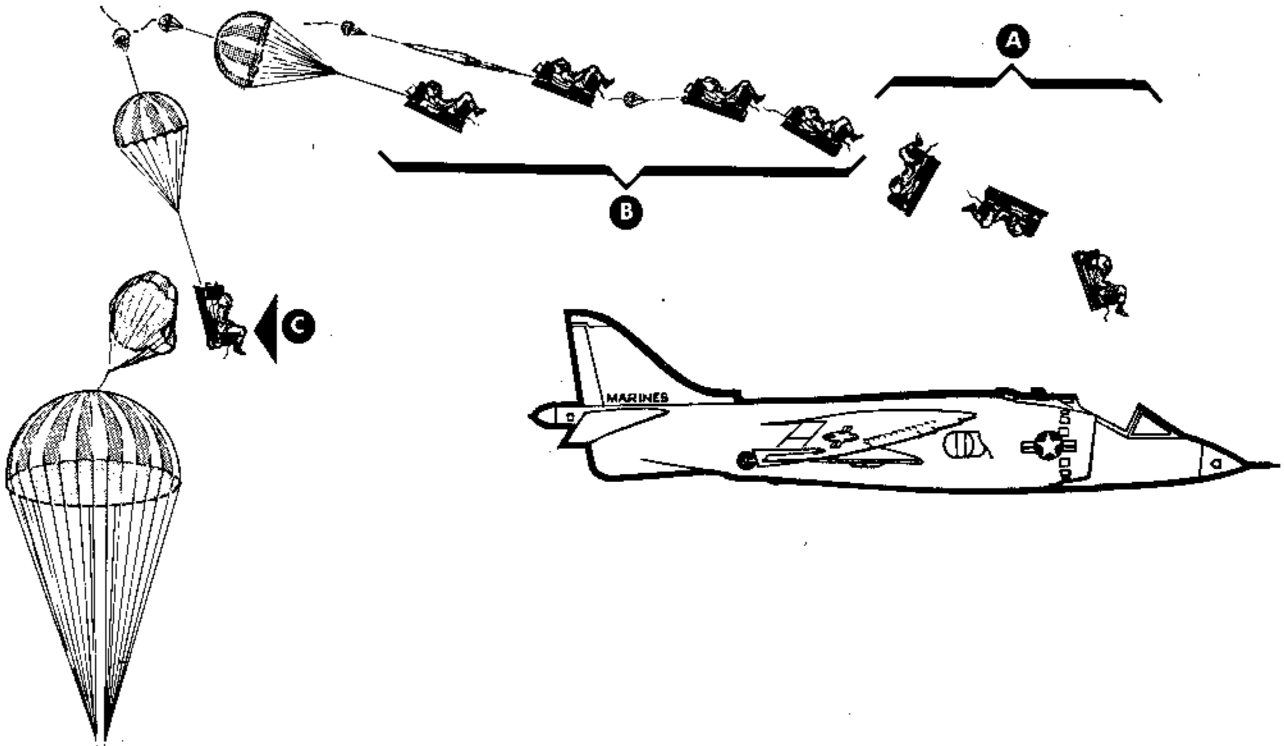
Figure 5-1

EJECTION SEQUENCE



HIGH ALTITUDE SEQUENCE

PULL SEAT FIRING HANDLE TO INITIATE THE EJECTION SEQUENCE.

A THE EJECTION GUN FIRES, THE SEAT IS PROPELLED UP GUIDE RAIL, AND THE MDC SHATTERS THE CANOPY. OCCUPANT'S LEGS ARE RESTRAINED, EMERGENCY OXYGEN IS ACTUATED, TIME RELEASE MECHANISM AND DROGUE GUN ARE TRIPPED, EMERGENCY IFF AND UHF AUTO–TONE ARE ACTUATED, AND AS THE SEAT LEAVES THE RAILS, THE SEAT ROCKET PACK FIRES.

B DROGUE GUN FIRES APPROX. .6 TO .7 SEC. AFTER EJECTION, DEPLOYS CONTROLLER DROGUE, WHICH IN TURN DEPLOYS STABILIZER DROGUE. SEAT IS STABILIZED AND DECELERATED BY DROGUE CHUTES.

C SEAT AND OCCUPANT DESCEND RAPIDLY THRU UPPER ATMOSPHERE. WHEN AN ALTITUDE OF APPROXIMATELY 10,000 FT. IS REACHED, THE BAROSTAT RELEASES THE ESCAPEMENT MECHANISM, WHICH IN TURN, ACTUATES TO RELEASE THE OCCUPANT'S HARNESSING ANG LEG RESTRAINT LINES. THE DROGUE CHUTES PULL THE LINK LINE TO DEPLOY THE MAIN PARACHUTE.

10,000 FEET...IF NECESSARY PROCEED WITH MANUAL SEPARATION

D OCCUPANT IS HELD TO SEAT BY STICKER CLIPS UNTIL OPENING SHOCK OF PARACHUTE SNAPS HIM FROM SEAT (AND DISCONNECTS MAN PORTION OF PEC) PERMITTING NORMAL DESCENT.

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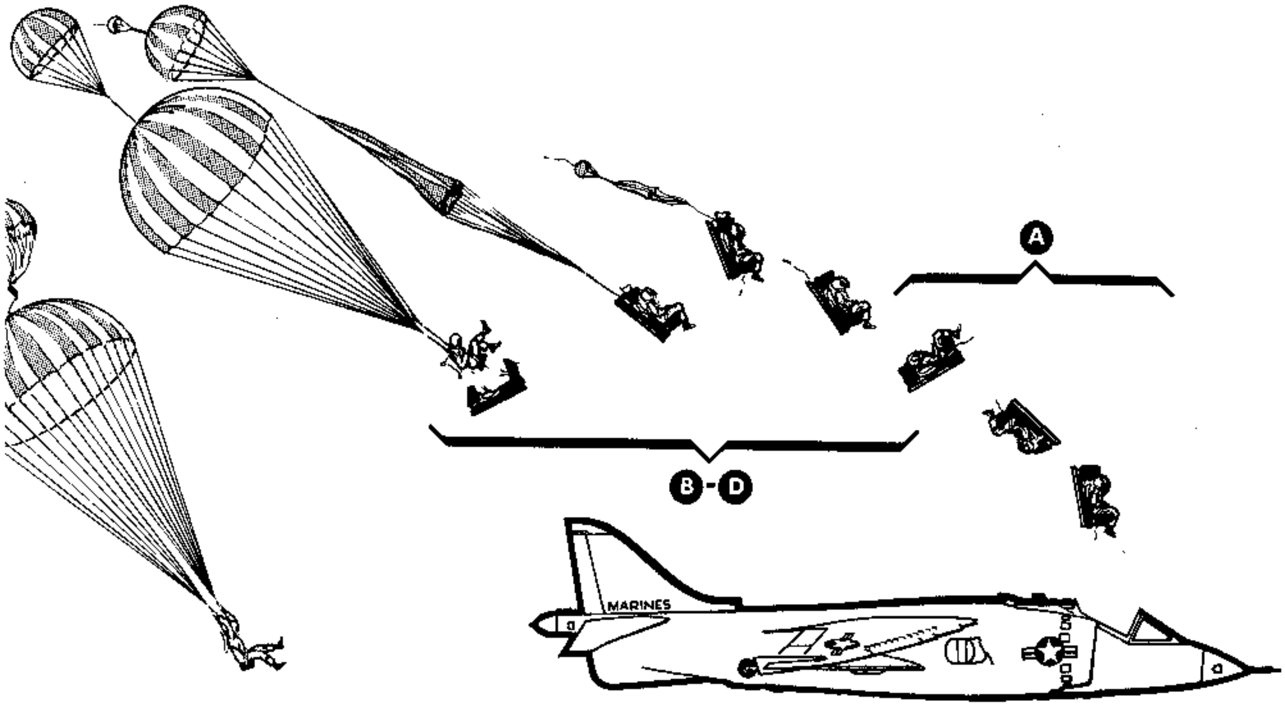
Figure 5–2 (Sheet 1 of 2)

EJECTION SEQUENCE



LOW ALTITUDE SEQUENCE

PULL SEAT FIRING HANDLE TO INITIATE THE EJECTION SEQUENCE.

A THE EJECTION GUN FIRES, THE SEAT IS PROPELLED UP GUIDE RAIL, AND THE MDC SHATTERS THE CANOPY. OCCUPANT'S LEGS ARE RESTRAINED, EMERGENCY OXYGEN IS ACTUATED, TIME RELEASE MECHANISM AND DROGUE GUN ARE TRIPPED, EMERGENCY IFF AND UHF AUTO–TONE ARE ACTUATED, AND AS THE SEAT LEAVES THE RAILS, THE SEAT ROCKET PACK FIRES.

B DROGUE GUN FIRES APPROX. .6 TO .7 SEC. AFTER EJECTION, DEPLOYS CONTROLLER DROGUE, WHICH IN TURN DEPLOYS STABILIZER DROGUE.

C APPROX. 2.25 SEC. AFT EJECTION THE ESCAPEMENT MECHANISM ACTUATES TO RELEASE THE OCCUPANT'S HARNESSING AND LEG RESTRAINT LINES. THE DROGUE CHUTES PULL THE LINK LINE TO DEPLOY THE MAIN PARACHUTE.

...IF NECESSARY PROCEED WITH MANUAL SEPARATION

D OCCUPANT IS HELD TO SEAT BY STICKER CLIPS UNTIL OPENING SHOCK OF PARACHUTE SNAPS HIM FROM SEAT (AND DISCONNECTS MAN PORTION OF PEC) PERMITTING NORMAL DESCENT.

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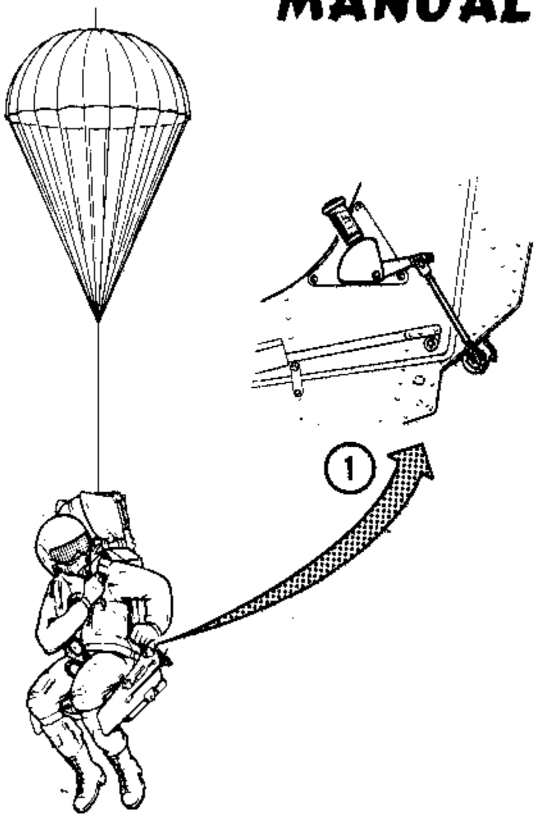
Figure 5-2 (Sheet 2 of 2)

MANUAL SEPARATION

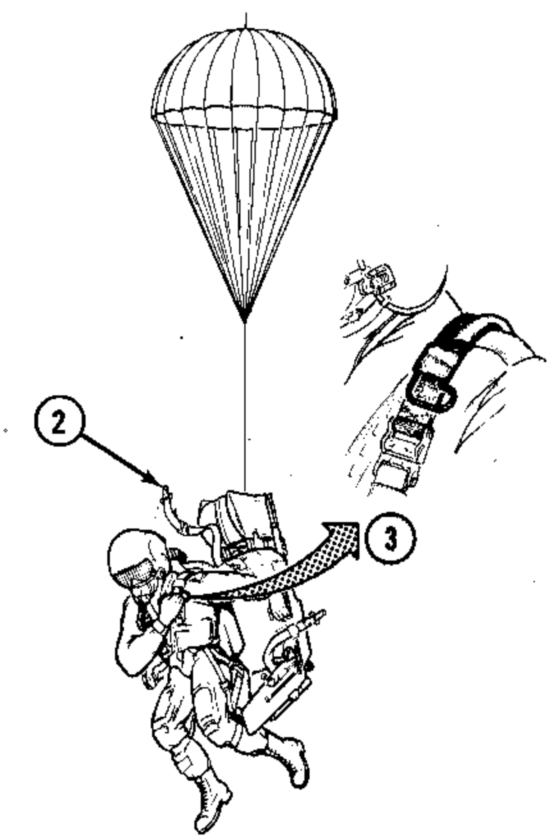


SHOULD THE TIME RELEASE MECHANISM FAIL TO OPERATE AUTOMATICALLY, THE OCCUPANT WOULD MANUALLY SEPARATE FROM THE SEAT AS FOLLOWS:

1. ACTUATE EMERGENCY HARNESS RELEASE HANDLE ON LEFT SIDE OF SEAT BY PULLING UP THEN DOWN AND FORWARD ON THE HANDLE. THIS ACTION WILL RELEASE RESTRAINT HARNESS LEG RESTRAINT LINES AND A CARTRIDGE ACTUATED GUILLOTINE WILL SEVER THE LINK LINE BETWEEN THE PERSONAL CHUTE AND DROGUE CHUTE. THE OCCUPANT IS NOW HELD IN SEAT ONLY BY STICKER CLIPS.

NOTE

THE PARACHUTE PACK AND SURVIVAL KIT ARE JOINED AT THE REAR OF THE SEAT PAN WELL. THEREFORE, THE SURVIVAL KIT WILL ACCOMPANY THE OCCUPANT.



2. PUSH FREE OF STICKER CLIPS AND CLEAR OF SEAT. THE PEC DISCONNECTS BY THE PULL OF ITS LANYARD, AND THE LEG RESTRAINT LINES RUN OUT THROUGH THE LEG GARTER RINGS.

NOTE

PARTIALLY FREE THE PARACHUTE PACK FROM ITS HOUSING BEFORE PUSHING FREE OF SEAT. THIS IS DONE BY GRASPING THE CHUTE RISERS AT THE SHOULDERS AND EXERTING A FORWARD PULL ON THE LEFT AND RIGHT VISOR IN TURN, WHILE LEANING FORWARD IN THE SEAT.

3. LOOK FOR AND PULL PARACHUTE RIP CHORD "D" RING LOCATED ON LEFT SHOULDER. WITH THE RIGHT HAND, PULL THE "D" RING SHARPLY AND FULLY DOWN ACROSS THE CHEST. FULL HANDLE TRAVEL IS APPROXIMATELY SIX INCHES.

WARNING

IF AT LOW LEVEL, LEAN FORWARD, LOOK FOR, GRASP AND PULL THE PARACHUTE "D" RING IMMEDIATELY AFTER OPERATING THE EMERGENCY HARNESS RELEASE HANDLE.

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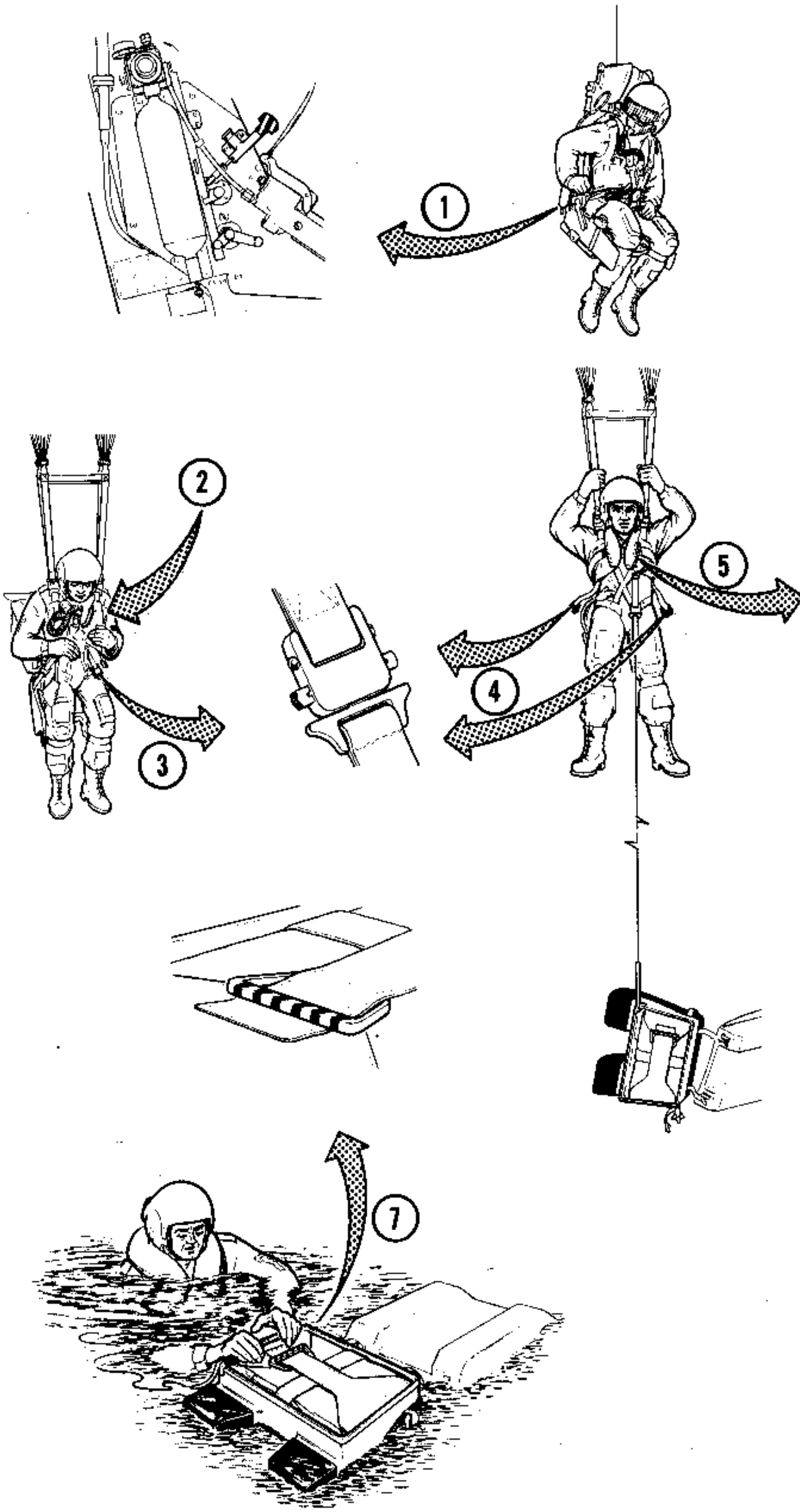
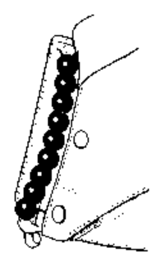
Figure 5-3

SURVIVAL EQUIPMENT DEPLOYMENT





1. EMERGENCY OXYGEN IS SUPPLIED AUTOMATICALLY UPON SEAT EJECTION. IF AUTOMATIC SELECTION FAILS, PULL THE EMERGENCY OXYGEN RELEASE KNOB ON RIGHT SIDE OF SEAT.

2. AFTER THE PERSONAL PARACHUTE HAS OPENED, OPEN FACE VISOR AND RELEASE OXYGEN MASK TO PREVENT SUFFOCATION,SINCE EMERGENCY OXYGEN IS LEFT WITHTHE SEAT.

3. DURING PARACHUTE DESCENT, CHECK THAT THE SURVIVAL KIT LOWERING LINE IS ATTACHED TO THE FRONT OF THE LIFE JACKET.

WHEN DESCENDING INTO WATER -

4. RELEASE THE SURVIVAL KIT RETAINING STRAP CONNECTORS ON THE SIDES OF THE SURVIVAL KIT. THE SURVIVAL KIT WILL DROP AND HANG BY ITS LOWERING LINE.

5. INFLATE LIFE VEST.

AFTER ENTERING WATER -

6. RELEASE PARACHUTE FASTENERS.

7. INFLATE LIFE RAFT BY GRASPING AND PULLING THE SURVIVAL KIT RELEASE HANDLE (BLACK AND YELLOW).

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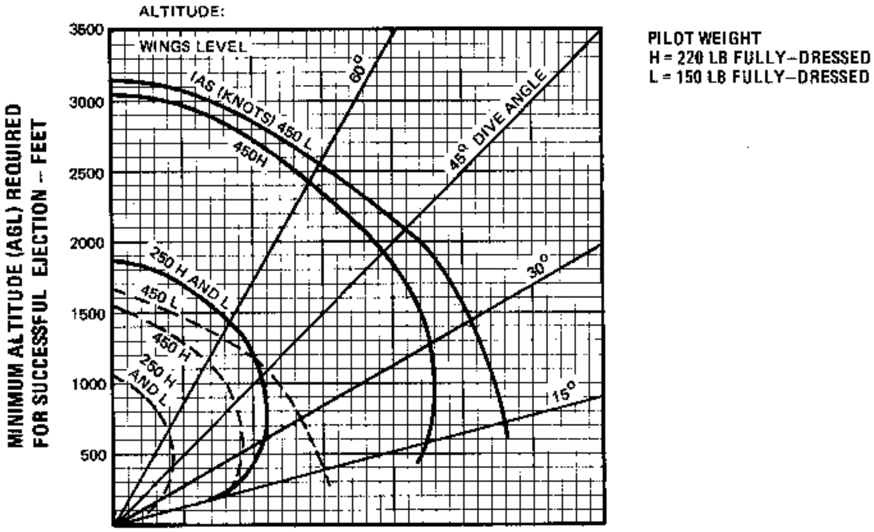
Figure 5-4

MINIMUM EJECTION ALTITUDE VS AIRSPEED AND DIVE ANGLE



Notes

- THE ALTITUDES SHOWN BY SOLID LINES ALLOW A PILOT REACTION TIME OF 2 SECONDS.
- THE ALTITUDES SHOWN BY DASHED LINES ARE BASED ON EJECTION SEAT SEQUENCE TIME ONLY, AND ARE INCLUDED FOR REFERENCE.
- NO ACCOUNT IS TAKEN OF THE TIME LAG INHERENT IN THE HUD PRESENTATION OF AIRSPEED AND BAROMETRIC HEIGHT, CAUSED BY THEIR HALF–SECOND UPDATE INTERVALS.
- THE ABOVE MINIMUM EJECTION ALTITUDES, BASE ON LEVEL FLIGHT, WILL INCREASE DUE TO THE AGGRAVATING EFFECTS OF APPLIED BANK, ROLL RATE AND EXCESSIVE PITCH.

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Figure 5–5

Escape from circumstances which result, or may result, in the aircraft entering the water should be made by ejecting. Every effort must be made to initiate the ejection before impact with the surface. If the aircraft is submerged or is on the surface before escape is initiated, ejection still provides the best method of escape. If the seat fails to operate, manual escape is the only option. See Emergency Egress procedures.

HIGH ALTITUDE EJECTION

For a high altitude ejection, the basic low level ejection procedure is applicable. Furthermore, the zoom up maneuver is still useful to slow the airplane to a safer ejection speed or provide more time and glide distance as long as an immediate ejection is not mandatory. If the aircraft is descending uncontrolled as a result of a mid–air collision, control failure, spin, or any other reason, abandon the aircraft at a minimum altitude of 10,000 feet above the terrain if possible. If it is decided to abandon the aircraft while still in controlled flight at altitude, the pilot should abandon the aircraft at a minimum altitude of 2,000 feet above the terrain.

SURVIVAL EQUIPMENT DEPLOYMENT

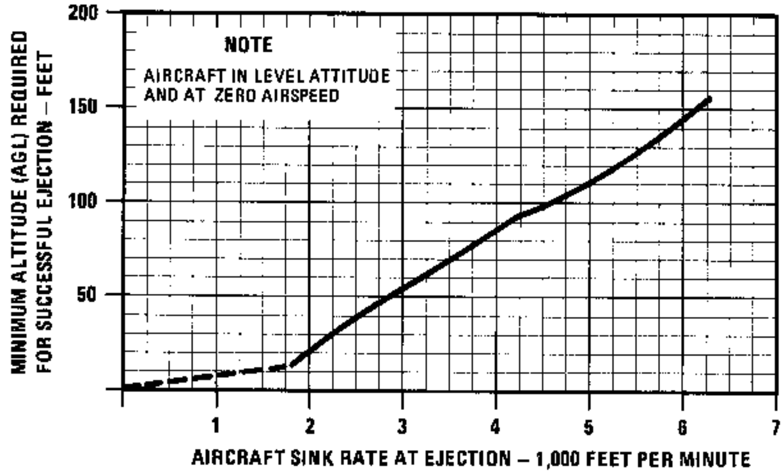
For survival equipment deployment, refer to figure 5–4.

EJECTION SEAT FAILURE (BAILOUT)

If the seat fails to eject from the airborne aircraft, pull the ejection handle again sharply while still in the correct ejection posture. If time permits, a check can be made that the seat safety pins are removed. If after repeated attempts the seat still does not operate, bailout may be attempted. Bailout is hazardous and the technique to be employed depends on the prevailing flight conditions and therefore must be decided upon by the pilot. Should a bailout be necessary, the following is suggested:

1. Reduce speed as much as possible.
2. IFF – EMERG
3. MDC firing handle – PULL
   Close eyes, place head on head rest, and time permitting, helmet visor down.
4. Emergency harness release handle – LIFT, PUSH FORWARD AND DOWN
   Lift, push forward and down on the emergency

MINIMUM EJECTION ALTITUDE VS SINK RATE AT ZERO AIRSPEED



NOTES

- THE SOLID LINE SHOWS ALTITUDE VS SINK RATE AT THE START OF THE EJECTION SEQUENCE (WHEN THE SEAT FIRES). PILOT REACTION TIME AND AIRCRAFT VERTICAL ACCELERATION ARE NOT CONSIDERED. THE DASHED LINE VALUES ARE ESTIMATES.
- NO ACCOUNT IS TAKEN OF THE TIME LAG INHERENT IN THE HUD PRESENTATION OF AIRSPEED AND BAROMETRIC HEIGHT, CAUSED BY THEIR HALF–SECOND UP DATE INTERVALS.
- THE ABOVE MINIMUM EJECTION ALTITUDES, BASED ON LEVEL FLIGHT, WILL INCREASE DUE TO THE AGGRAVATING EFFECTS OF APPLIED BANK, ROLL RATE AND EXCESSIVE PITCH.

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Figure 5–6

harness release handle on the left side of the seat bucket to disconnect pilot from the seat. This handle also fires the guillotine and severs the link line between the drogue chute and the personal parachute.

NOTE

- It may be necessary to partially free the parachute pack from its housing before the escape attempt. This is done by grasping the parachute risers at the shoulders and exerting a forward pull on the left and on the right in turn, while leaning forward away from the seat.
- Since the parachute pack and the survival kit are joined by two straps at the rear of the seat pan well, the survival kit will accompany the occupant during manual separation.

5. Full nose down trim while holding airplane level.
6. Roll inverted, push stick forward and push sharply to fall clear of the airplane.

WARNING

Attempt to avoid the engine air intakes when abandoning aircraft.

When clear of airplane and at 10,000 feet or below –

7. Parachute D ring – PULL
   When clear of the aircraft, look for and then grasp the parachute rip cord handle with the right hand. When below approximately 10,000 feet AMSL, unless terrain height dictates a higher altitude, pull the rip cord handle sharply and fully down across the chest. Full handle travel is about 6 inches.

WARNING

Pilots using the manual method of seat separation and parachute deployment should immediately check for parachute actuation and be prepared to forcibly deploy the chute by hand after rip cord actuation.

NOTE

- Emergency oxygen will not be available after man/seat separation and the face mask must be opened to prevent suffocation.
- Pilots should rigidly hold left front riser with left hand and pull rip cord D–ring with right hand to ensure full travel of the lanyard.

WARNING/CAUTION/INDICATOR LIGHTS

LIGHT	CAUSE	CORRECTIVE ACTION REMARKS
PORT GLARE SHIELD		
C	MASTER CAUTION	WARNING/CAUTION LIGHT PANEL - CHECK
(FUEL)	STEADY - PORT FUEL 750 POUNDS FLASHING - PORT FUEL 250 POUNDS	MONITOR FUEL USAGE
F	FIRE WARNING	COMPLY WITH EMERGENCY PROCEDURE
STARBOARD GLARE SHIELD		
C	MASTER CAUTION	WARNING/CAUTION LIGHT PANEL - CHECK
(FUEL)	STEADY - STARBOARD FUEL 750 POUNDS FLASHING - STARBOARD FUEL 250 POUNDS	MONITOR FUEL USAGE
M	ALL LIGHTS EXCEPT FIRE INHIBITED	INFORMATION - GROUND USE ONLY
RED WARNING LIGHTS		
WHEELS	GEAR UP & FLAPS DOWN BELOW 165 KIAS	INFORMATION
FIRE	FIRE WARNING	COMPLY WITH EMERGENCY PROCEDURE
J.P.T.	ENGINE OVERTEMP	REDUCE THROTTLE - LAND AS SOON AS PRACTICABLE
OXG	LOW OXYGEN DELIVERY PRESSURE	REDUCE COCKPIT ALTITUDE TO BELOW 10,000 FEET MONITOR CONTENTS & PRESSURE
A.C.	BOTH AC GEN OFF THE LINE-DUAL GENERATOR SYSTEMS AC GENERATOR OFF THE LINE-SINGLE GENERATOR SYSTEMS	COMPLY WITH EMERGENCY PROCEDURE
D.C.	NO. 2 28 VOLT DC BUS VOLTAGE BELOW 24.5V-DUAL GENERATOR SYSTEMS XFMR-RECTIFIER FAILURE OR MAIN 28 VOLT DC BUS VOLTAGE BELOW 24.5V-SINGLE GENERATOR SYSTEMS	COMPLY WITH EMERGENCY PROCEDURE
HYD	PC-1 & PC-2 HYDRAULIC FAILURE	CHECK HYDRAULIC GAGES
C.P.	COCKPIT ALTITUDE ABOVE 32,000 FEET	REDUCE ALTITUDE AS PRACTICABLE
TOP	WING FUEL TANK OVERPRESSURE	TANK DEPRESS - ON, TRANS LIGHT, TANK DEPRESS - OFF
MFS	MANUAL FUEL SYSTEM ACTIVATED	MONITOR ENGINE INSTRUMENTS DURING THROTTLE MOVEMENT

AV8A 1 (2) 1(3)

Figure 5-7 (Sheet 1 of 2)

WARNING/CAUTION/INDICATOR LIGHTS - CONTINUED

LIGHT	CAUSE	CORRECTIVE ACTION/REMARKS
AMBER CAUTION LIGHTS		
15 SEC.	ENGINE AT OR ABOVE SHORT LIFT RATING	REDUCE THROTTLE AS PRACTICABLE
J.P.T.L.	JPT LIMITER OFF PRL OFF	RESET LIMITER SWITCH – IF NO RESET: REDUCE POWER TO KEEP JPT IN LIMITS
OIL	OIL PRESSURE BELOW 30 PSI	MINIMUM POWER - LAND AS SOON AS PRACTICABLE
H_2O	11 SEC WATER REMAINING	INFORMATION
PUMP (2)	L OR R FUEL BOOST PUMP FAILURE (L - LEFT LIGHT)	FAILED BOOST PUMP - OFF LAND AS SOON AS PRACTICABLE
TRANS (2)	L OR R FUEL TRANSFER FAILURE (L - LEFT LIGHT)	COMPLY WITH EMERGENCY PROCEDURE
PROP	FUEL FLOW PROPORTIONER OFF OR FAILED	MONITOR TANK FUEL LEVELS
D.C.	SINGLE TRANSFORMER/RECTIFIER FAILURE (DUAL GENERATOR SYSTEMS ONLY)	RESET REDUCE #1 DC BUS BAR LOAD
A.C. 1 A.C. 2	NO. 1 AC GEN OFF THE LINE NO. 2 AC GEN OFF THE LINE (DUAL GENERATOR SYSTEMS ONLY)	RESET REDUCE #1 DC BUS BAR LOAD
HYD 1 HYD 2	NO. 1 HYD PRESSURE LOW NO. 2 HYD PRESSURE LOW	COMPLY WITH EMERGENCY PROCEDURE
SKID	ANTI-SKID OFF & GEAR DOWN	INFORMATION
EQPT.	ELECTRONIC COOLING OFF, HI TEMP OR HI PRESSURE	RESET IF NO RESET RESTRICT SPEED BELOW 15,000 FEET S.L.-0.7M, 5000-0.8M, 10,000-0.9M
I.F.F.	MOD 4 INOPERATIVE	INFORMATION
MFS	MANUAL FUEL SYSTEM ACTIVATED	MONITOR ENGINE INSTRUMENTS DURING THROTTLE MOVEMENT
MISCELLANEOUS		
AIR REFUEL (4)	FUEL TRANSFERRING	INFORMATION
(WATER)	WATER INJECTION ON	INFORMATION
REPLY	IFF RESPONDING TO MODE 4 INTERROGATION	INFORMATION

AV8A-1 (2 2)C

Figure 5-7 (Sheet 2 of 2)

EMERGENCY POWER DISTRIBUTION

Airplanes 158384 thru 158711

NO. 1 GENERATOR OUT - NO. 2 GENERATOR OPERATING

INOPERATIVE EQUIPMENT –

AC1

AIM-9

ADDITIONAL INOPERATIVE EQUIPMENT WHEN BATTERY NO. 1 DISCHARGED OR SHUT OFF –

DC (AMBER)

ANTI-COLLISION LTS
EJECTION SEAT ADJUST
LEFT & RIGHT FUEL BOOST PUMPS
NAV LIGHTS
WATER INJECTION HEAT CIRCUIT

NO. 2 GENERATOR OUT - NO. 1 GENERATOR OPERATING

INOPERATIVE EQUIPMENT WHEN BATTERY NO. 1 DISCHARGED OR SHUT OFF–

AC2

DC (AMBER)

AIM-9
ANTI-COLLISION LTS
EJECTION SEAT ADJUST
LEFT & RIGHT FUEL BOOST PUMPS
NAV LTS
WATER INJECTION HEAT CIRCUIT

NO. 1 TRANSFORMER - RECTIFIER OUT - BOTH GENERATORS AND NO. 2 TRANSFORMER - RECTIFIER OPERATING

INOPERATIVE EQUIPMENT WHEN BATTERY NO. 1 DISCHARGED OR SHUT OFF –

DC (AMBER)

AIM-9
ANTI-COLLISION LTS
EJECTION SEAT ADJUST
LEFT & RIGHT FUEL BOOST PUMPS
NAV LTS
WATER INJECTION HEAT CIRCUIT

NO. 2 TRANSFORMER - RECTIFIER OUT - BOTH GENERATORS AND NO. 1 TRANSFORMER - RECTIFIER OPERATING

INOPERATIVE EQUIPMENT –

DC (AMBER)

AIM-9
ANTI-COLLISION LTS
EJECTION SEAT ADJUST
LEFT FUEL BOOST PUMP
NAV LTS

NO. 1 AND NO. 2 TRANSFORMER - RECTIFIERS OUT - BOTH GENERATORS OPERATING

INOPERATIVE EQUIPMENT WHEN BATTERIES NO. 1 AND NO. 2 ARE DISCHARGED OR SHUT OFF –

DC (RED)

DC (AMBER)

AC & DC RESET
AILERON TRIM CONTROL
AILERON STOP
AILERON TRIM INDICATOR
AIM-9
AIR REFUEL PROBE LT
ALL JETTISON CIRCUITS
ANTI-COLLISION LTS
ANTI SKID SYSTEM
AOA
ATTITUDE INDICATOR (PRIMARY POWER)
BOMBS & ROCKETS
CANOPY SEAL
COCKPIT & EQUIPMENT AIR CONDITIONING SHUTOFF
COCKPIT LIGHTING (NORM)
COCKPIT TEMP CONTROL
ENGINE IGNITION
ENGINE LIFE RECORDER
FIRE DETECTOR & EXTINGUISHER (DISCHARGED BATTERY ONLY)
FLAPS CONTROL
FLAPS INDICATOR
FUEL FLOW INDICATOR
FUEL PROPORTIONER (DEENERGIZES ON)
FUEL REMAINING INDICATOR
FUEL TRANSFER PRESSURE VALVES
GUNS
IFF
IGV POSITION INDICATOR
INAS
JET PIPE TEMPERATURE LIMITER
LANDING GEAR CONTROL
LANDING GEAR INDICATOR
LANDING LTS
NAV LTS
NOSE CAMERA
NOSE WHEEL STEERING
NOZZLE ANGLE INDICATOR
PRESSURE RATIO LIMITER
Q FEEL CONTROL
RAT RESET
RIGHT FUEL BOOST PUMP
RUDDER PEDAL SHAKER
RUDDER TRIM CONTROL
RUDDER TRIM INDICATOR
SOUND RECORDER
SPEED BRAKES CONTROL
SPEED BRAKES INDICATOR
STAB AUG SYSTEM
STABILATOR POSITION INDICATOR (PRIMARY & STBY)
STABILATOR TRIM CONTROL
STBY UHF (NORM)
TACAN
UHF
UTILITY LIGHTS
VHF
WARNING/CAUTION LTS
WATER INJECTION CONTROL
WATER INJECTION JETTISON
WATER QUANTITY INDICATOR
WING FUEL DUMP

AV8A-1-151-11C

Figure 5-8 (Sheet 1 of 2)

EMERGENCY POWER DISTRIBUTION (CONTINUED)

DOUBLE GENERATOR FAILURE - BOTH GENERATORS AND TRANSFORMER - RECTIFIERS OUT

OPERATIVE EQUIPMENT ON BATTERIES NO. 1 AND NO. 2 BEFORE DISCHARGE –

AC | DC (RED)

AC1 | DC (AMBER)

AC2

- AC & DC RESET
- AILERON TRIM CONTROL
- AILERON STOP
- AILERON TRIM INDICATOR
- AIR REFUEL PROBE LT
- ALL JETTISON CIRCUITS
- ANTI COLLISION LTS
- AOA
- ATTITUDE INDICATOR (PRIMARY POWER)
- BOMBS & ROCKETS
- CANOPY SEAL
- COCKPIT & EQUIPMENT AIR CONDITIONING SHUTOFF
- COCKPIT LIGHTING (NORM)
- COCKPIT TEMP CONTROL
- ENGINE IGNITION
- ENGINE LIFE RECORDER
- FIRE DETECTOR & EXTINGUISHER (DISCHARGED BATTERY ONLY)
- FLAPS CONTROL
- FLAPS INDICATOR
- FUEL FLOW INDICATOR
- FUEL PROPORTIONEER (DEENERGIZES ON)
- FUEL REMAINING INDICATOR
- FUEL TRANSFER PRESSURE SHUTOFF VALVES
- GUNS
- IFF
- IGV POSITION INDICATOR
- INAS
- JET PIPE TEMPERATURE LIMITER
- LANDING GEAR CONTROL
- LANDING GEAR INDICATOR
- LANDING LTS
- NAV LTS
- NOSE CAMERA
- NOSE WHEEL STEERING
- NOZZLE ANGLE INDICATOR
- PRESSURE RATIO LIMITER
- Q FEEL CONTROL
- RAT RESET
- RIGHT FUEL BOOST PUMP
- RUDDER PEDAL SHAKER
- RUDDER TRIM CONTROL
- RUDDER TRIM INDICATOR
- SOUND RECORDER
- SPEED BRAKES CONTROL
- SPEED BRAKES INDICATOR
- STABILATOR POSITION INDICATOR (PRIMARY & STBY)
- STABILATOR TRIM CONTROL
- STBY UHF (NORM)
- UHF
- UTILITY LIGHT
- VHF
- WARNING/CAUTION LTS
- WATER INJECTION CONTROL
- WATER INJECTION JETTISON
- WATER QUANTITY INDICATOR
- WING FUEL PUMP

EMERGENCY POWER-BATTERY NO. 3

OPERATIVE EQUIPMENT WHEN SELECTED BEFORE BATTERY DISCHARGE –

AC | DC (RED)

AC1 | DC (AMBER)

AC2

- ATTITUDE INDICATOR (EMERGENCY POWER)
- COMMUNICATIONS AMPLIFIER
- EJECT AUTO–TONE GENERATOR
- EMERGENCY COCKPIT LIGHTING
- EMERGENCY LANDING GEAR LOWERING
- STBY UHF (EMERGENCY)

AV8A–1–(51–2)C

Figure 5-8 (Sheet 2 of 2)

EMERGENCY POWER DISTRIBUTION

Airplanes 158948 and up

TRANSFORMER-RECTIFIER FAILURE-GENERATOR OPERATING

OPERATIVE EQUIPMENT BEFORE BATTERIES NO. 1 AND NO. 2 ARE DISCHARGED OR SHUT OFF –

DC

AC RESET
AILERON TRIM CONTROL
AILERON STOP
AILERON TRIM INDICATOR
AIR REFUEL PROBE LT
ALL JETTISON CIRCUITS
ALTIMETER VIBRATOR
ANTI-COLLISION LTS
ANTI-SKID SYSTEM
AOA
ATTITUDE INDICATOR (PRIMARY POWER)
AUTO STABILIZER
BOMBS & ROCKETS
CANOPY SEAL
COCKPIT & EQUIPMENT AIR CONDITIONING SHUTOFF
COCKPIT LIGHTING (NORM)
COCKPIT TEMP CONTROL
COMPASS C2J
EJECTION SEAT ADJUST
ENGINE IGNITION
ENGINE LIFE RECORDER
EQUIPMENT RACK COOLING
FIRE DETECTOR & EXTINGUISHER (DISCHARGED BATTERY ONLY)
FLAPS CONTROL
FLAPS INDICATOR
FUEL FLOW METER
FUEL PROPORTIONER (DEENERGIZES ON)
FUEL REMAINING INDICATOR
FUEL TRANSFER PRESSURE SHUTOFF VALVES
GUN FIRING & VENTILATION
IFF
IGV POSITION INDICATOR
JET PIPE TEMPERATURE LIMITER
LANDING GEAR CONTROL
LANDING GEAR INDICATOR
LANDING LTS
LEFT FUEL BOOST PUMP
NAV/ATTACK
NAV LTS
NOSE CAMERA & HEATER
NOSE WHEEL STEERING
NOZZLE ANGLE INDICATOR
PRESSURE RATIO LIMITER
Q FEEL CONTROL
RAT RESET
RIGHT FUEL BOOST PUMP
RUDDER PEDAL SHAKER
RUDDER TRIM CONTROL
RUDDER TRIM INDICATOR
SIDEWINDER
SOUND RECORDER
SPEED BRAKES CONTROL
SPEED BRAKES INDICATOR
STABILATOR POSITION INDICATOR (PRIMARY & STBY)
STABILATOR TRIM CONTROL
STBY UHF (NORM)
TACAN
UHF
UTILITY LIGHT
VHF
WARNING/CAUTION LTS
WATER INJECTION CONTROL & JETT
WATER INJECTION INDICATOR
WINDSHIELD & CAMERA WINDOW DEFOG
WING FUEL DUMP

OPERATIVE EQUIPMENT AFTER BATTERIES NO. 1 AND NO. 2 ARE DISCHARGED OR SHUT OFF –

ALTIMETER VIBRATOR
FUEL FLOW METER
RADAR ALTIMETER

GENERATOR FAILURE-TRANSFORMER-RECTIFIER OUT

OPERATIVE EQUIPMENT ON BATTERIES NO. 1 AND NO. 2 BEFORE DISCHARGE

AC

DC

AC RESET
AILERON TRIM CONTROL
AILERON STOP
AILERON TRIM INDICATOR
AIR REFUEL PROBE LT
ALL JETTISON CIRCUITS
ANTI-COLLISION LTS
AOA
ATTITUDE INDICATOR (PRIMARY POWER)
BOMBS & ROCKETS
CANOPY SEAL
COCKPIT & EQUIPMENT AIR CONDITIONING SHUTOFF
COCKPIT LIGHTING (NORM)
EJECTION SEAT ADJUST
ENGINE IGNITION
ENGINE LIFE RECORDER
FIRE DETECTOR & EXTINGUISHER (DISCHARGED BATTERY ONLY)
FLAPS CONTROL
FLAPS INDICATOR
FUEL PROPORTIONER (DEENERGIZES ON)
FUEL REMAINING INDICATOR
FUEL TRANSFER PRESSURE SHUTOFF VALVES
IGV POSITION INDICATOR
JET PIPE TEMPERATURE LIMITER
LANDING GEAR CONTROL
LANDING GEAR INDICATOR
LANDING LTS
LEFT FUEL BOOST PUMP
NAV LTS
NOSE CAMERA
NOSE WHEEL STEERING
NOZZLE ANGLE INDICATOR
PRESSURE RATIO LIMITER
Q FEEL CONTROL
RAT RESET
RIGHT FUEL BOOST PUMP
RUDDER PEDAL SHAKER
RUDDER TRIM CONTROL
RUDDER TRIM INDICATOR
SOUND RECORDER
SPEED BRAKES CONTROL
SPEED BRAKES INDICATOR
STABILATOR POSITION INDICATOR (PRIMARY & STBY)
STABILATOR TRIM CONTROL
STBY UHF (NORM)
UHF
UTILITY LIGHT
UHF
WARNING/CAUTION LTS
WATER INJECTION CONTROL
WATER INJECTION JETTISON
WATER QUANTITY INDICATOR
WINDSHIELD & CAMERA WINDOW DEFOG
WING FUEL DUMP

EMERGENCY POWER-BATTERY NO. 3

OPERATIVE EQUIPMENT WHEN SELECTED BEFORE BATTERY DISCHARGE –

AC

DC

ATTITUDE INDICATOR (EMERGENCY POWER)
COMMUNICATIONS AMPLIFIER
EJECT AUTO-TONE GENERATOR
EMERGENCY COCKPIT LIGHTING
EMERGENCY LANDING GEAR LOWERING
STBY UHF (EMERGENCY)

AV8A 1 (177)A

Figure 5-8A

ELECTRICAL

GENERAL

If an electrical system failure occurs, various components of the combined aircraft systems will be inoperative. Refer to figure 5-8 for equipment that will be lost/available with one or both generators or transformer-rectifiers inoperative for dual generator systems, and refer to figure 5-8A for lost/available equipment with an inoperative generator and/or transformer-rectifier for single generator systems.

SINGLE GENERATOR AND/OR TRANSFORMER-RECTIFIER FAILURE - DUAL GENERATOR (AC1, AC2, OR DC CAUTION LIGHT)

If the AC1, AC2 and/or DC caution light(s) illuminates -

1. Appropriate button(s) (AC and/or DC) - RESET (AC FIRST)

If light(s) remains illuminated -

2. Navigation lights - OFF
3. Anti-collision lights - OFF
4. Camera - OFF
5. Left and right booster pumps - OFF (ON FOR LANDING)
6. Return to base and land as soon as practicable.

DOUBLE TRANSFORMER-RECTIFIER FAILURE - DUAL GENERATOR (DC WARNING LIGHT)

If the DC warning and caution lights illuminate -

1. DC button - RESET

If DC warning light remains illuminated -

2. HUD mode selector knob - OFF
3. V/UHF - OFF (IF PRACTICABLE)
4. Comm control function selector switch - UHF STBY
5. Tacan - OFF
6. Voice recorder - OFF
7. IFF - OFF
8. Left and right booster pumps - OFF (ON FOR LANDING)
9. Land as soon as practicable before voltmeter indicates 21 volts.

When voltmeter indicates 21 volts -

10. Artificial horizon switch - RIGHT POSITION (if AC2 not available)
11. Standby UHF power selector switch - EMERG

The following are considerations when operating with both transformer-rectifiers inoperative:

Batteries discharge slowly to 21 volts and then quickly decay.
Flight controls and engines operate satisfactorily without electrical power.
Put down landing gear early if practicable.
Nosewheel steering is automatically engaged.
The emergency battery (No. 3) lasts 30 minutes and supplies:
- Emergency landing gear lowering
- Attitude indicator emergency supply
- Emergency cockpit lighting
- Standby UHF
- Eject auto-tone generator
- Communications amplifier

TRANSFORMER-RECTIFIER FAILURE - SINGLE GENERATOR (DC WARNING LIGHT)

If DC warning light illuminates and remains illuminated -

1. HUD mode selector knob - OFF
2. V/UHF - OFF (IF PRACTICABLE)
3. Comm control function selector switch - UHF STBY
4. Tacan - OFF
5. Voice recorder - OFF

6. IFF – OFF
7. Left and right booster pumps – OFF (ON FOR LANDING)
8. Land as soon as practicable before voltmeter indicates 21 volts.

When voltmeter indicates 21 volts –

9. Artificial horizon switch – RIGHT POSITION
10. Standby UHF power selector switch – EMERG

The following are considerations when operating with both transformer–rectifiers inoperative:

Batteries discharge slowly to 21 volts and then quickly decay.
Flight controls and engines operate satisfactorily without electrical power.
Put down landing gear early if practicable.
Nosewheel steering is automatically engaged.
The emergency battery (No. 3) lasts 30 minutes and supplies:
Emergency landing gear lowering
Attitude indicator emergency supply
Emergency cockpit lighting
Standby UHF
Eject auto–tone generator
Communications amplifier

DOUBLE GENERATOR FAILURE – DUAL GENERATOR (AC WARNING LIGHT)

If AC (and DC) warning lights illuminate –

1. AC button – RESET

If AC warning light goes out –

2. DC button – RESET

If AC warning light remains illuminated –

3. HUD mode selector knob – OFF
4. V/UHF – OFF (IF PRACTICABLE)
5. Comm control function selector switch – UHF STBY
6. Tacan – OFF
7. Voice recorder – OFF
8. IFF – OFF
9. Left and right booster pumps – OFF (ON FOR LANDING)
10. Land as soon as practicable before voltmeter indicates 21 volts.

When voltmeter indicates 21 volts –

11. Artificial horizon switch – RIGHT POSITION
12. Stanbdy UHF power selector switch – EMERG

In addition to the equipment lost with a DC failure, the following equipment will be lost:

C2J compass
Autostabilizers
Cockpit temperature control
Fuel flowmeter

GENERATOR FAILURE – SINGLE GENERATOR (AC WARNING LIGHT)

If AC (and DC) warning lights illuminate –

1. AC button – RESET

If AC warning light remains illuminated –

2. HUD mode selector knob – OFF
3. V/UHF – OFF (IF PRACTICABLE)
4. Comm control function selector switch – UHF STBY
5. Tacan – OFF
6. Voice recorder – OFF
7. IFF – OFF
8. Left and right booster pumps – OFF (ON FOR LANDING)
9. Land as soon as practicable before voltmeter indicates 21 volts.

When voltmeter indicates 21 volts –

10. Artificial horizon switch – RIGHT POSITION
11. Standby UHF power selector switch – EMERG

In addition to the equipment lost with a DC failure, the following equipment will be lost:

C2J compass
Autostabilizers
Cockpit temperature control
Fuel flowmeter
Radar altimeter
ADC

ENGINE

SUDDEN RPM LOSS

IN V/STOL FLIGHT

1. THROTTLE – FULL
2. LIMITERS – OFF
3. RELIGHT BUTTON – PRESS

If RPM does not recover and conditions permit –

4. MANUAL FUEL SWITCH – ON

If RPM still does not recover –

5. EJECT

If RPM recovers –

6. Land as soon as practicable

IN CONVENTIONAL FLIGHT

1. Throttle – 1/2
2. Limiters – OFF
3. Throttle – ADVANCE SLOWLY

If RPM does not recover –

4. Throttle – 1/2
5. Manual fuel switch – ON
6. Throttle – ADVANCE SLOWLY

If RPM still does not recover –

7. Initiate airstart

COMPRESSOR STALL

1. Throttle – IDLE
2. AOA – DECREASE IF FEASIBLE

If JPT continues to rise; before 590°C –

3. Throttle – OFF
4. Initiate air start when in envelope

ENGINE FAILURE IN FLIGHT

MECHANICAL FAILURE

1. EJECT

NON-MECHANICAL FAILURE

1. Initiate airstart

IMMEDIATE AIRSTART

1. Throttle – IDLE
2. Relight button – PRESS (10 SECONDS MAXIMUM)
3. JPT – 450°C MAXIMUM

If RPM does not stabilize at idle –

4. Throttle – OFF
5. Initiate airstart

AIRSTART

Above 25,000 feet –

1. Throttle – OFF
2. Flaps – MID
3. AOA – 9 UNITS

Below 25,000 feet –

1. Airspeed – 200–350 knots
2. Relight button – PRESS AND HOLD (30 SECONDS MAXIMUM)
3. Throttle – ADVANCE TO IDLE
4. JPT – 450°C MAXIMUM

At idle –

5. AC/DC reset buttons – PRESS

If no start -

6. Throttle - OFF
7. Manual fuel switch - ON
8. Repeat airstart attempts (20,000 feet maximum)

WARNING

Do not continue airstart attempts below safe ejection altitude.

CAUTION

- If the airstart is made using manual fuel control, do not deselect manual fuel control.
- Climbs in manual fuel control at a constant throttle setting will result in approximately 1% RPM increase per 1000 feet of altitude and require continuous throttle reduction to prevent exceeding engine limits.

ENGINE FAILS TO ACCELERATE

1. Throttle - IDLE
2. Manual fuel switch - ON
3. Throttle - ADVANCE SLOWLY

OIL SYSTEM FAILURE (OIL CAUTION LIGHT)

1. Use minimum power
2. Land conventionally as soon as practicable
3. Throttle - OFF AS SOON AS PRACTICABLE AFTER TOUCHDOWN

IGV FAILURE

Sticking at high angle -

1. Use minimum power
2. Land conventionally as soon as practicable

Sticking at low angle -

1. Maintain maximum feasible power
2. Perform fixed throttle slow landing as soon as practicable
3. Throttle - OFF AFTER TOUCHDOWN

JPT OUT-OF-LIMITS (JPT WARNING LIGHT)

If JPT exceeds 774°C (dry)/784°C (wet) (JPT light) -

1. Land as soon as practicable
2. Use minimum power

If conventional landing not practicable -

3. Jettison fuel and stores to reduce weight if feasible

NOZZLE CONTROL FAILURE

Exact technique to be used in event of nozzle control failure is dependant upon the position at which the nozzles are failed and the phase of flight in which they fail. The following procedures provide a general guide which may require some modification due to the particular circumstances of a specific failure. In all cases, lighten the aircraft to hover weight prior to landing.

DURING STO

If insufficient runway remains for either abort or conventional takeoff -

1. EJECT

DURING TRANSITION

With low nozzle angle -

1. Accelerate to and maintain 300 knots minimum and proceed to runway where slow/conventional landing is practicable.

With high nozzle angle -

1. Make rolling vertical landing
2. Throttle - OFF AT TOUCHDOWN

With nozzle in braking position -

1. Accelerate to 50 knots
2. Flare to hover attitude
3. Touchdown before airspeed falls to zero
4. Throttle - OFF AT TOUCHDOWN

DURING CONVENTIONAL FLIGHT

1. Accelerate and maintain 300 knots minimum until hover weight is reached.

RUNAWAY ENGINE

WARNING

If throttle linkage fails, the fuel control can assume any position from OFF to FULL and may not remain stable at any power setting.

If sufficient power is available –

NOTE

Switching to manual fuel control will increase the engine RPM approximately 1% per 1000 feet of altitude at any fixed throttle angle and can be used to increase power.

CAUTION

If the manual fuel control is used to increase power on a runaway engine, the RPM will decrease approximately 1% per 1000 feet of descent and may not be sufficient to complete a safe landing.

1. Make a conventional or slow landing as dictated by power available.
2. Use nozzle angle to control airspeed

CAUTION

Due regard for the 5 minute limit on use of reaction controls is recommended.

After touchdown –

3. Fuel shut-off lever – OFF

FIRE (FIRE WARNING LIGHT)

GENERAL

The pilot's first indication of fire is, normally, illumination of the fire warning and fire extinguisher light. A momentary illumination of these lights should not be ignored as it may indicate that the circuitry has been burned through. If the fire warning lights illuminate momentarily, the circuitry should be tested by pressing the warning/caution light test button.

ENGINE FIRE DURING START

1. THROTTLE – OFF
2. FUEL SHUTOFF LEVER – OFF
3. CONTINUE TO CRANK ENGINE
4. FIRE EXTINGUISHER BUTTON – PRESS

If fire persists –

5. BATTERY SWITCHES – OFF
6. ABANDON AIRCRAFT

ENGINE FIRE DURING V/STO

1. FIRE EXTINGUISHER BUTTON – PRESS
2. ABORT OR LAND IMMEDIATELY
3. THROTTLE – OFF
4. FUEL SHUTOFF LEVER – OFF
5. BATTERY SWITCHES – OFF
6. ABANDON AIRCRAFT

ENGINE FIRE DURING TRANSITION

1. FIRE EXTINGUISHER BUTTON – PRESS
2. ACCELERATE AS RAPIDLY AS POSSIBLE
   With nozzles aft, the reaction control air (a possible ignition source) is shut off.

If fire persists –

3. EJECT

If fire ceases –

3. Make conventional landing as soon as practicable

ENGINE FIRE DURING CTO

1. ABORT
2. FIRE EXTINGUISHER BUTTON – PRESS
3. THROTTLE – OFF

If abort is not feasible –

1. FIRE EXTINGUISHER BUTTON – PRESS
2. NOZZLES – AFT

If fire persists –

3. EJECT

If fire ceases –

3. Make conventional landing as soon as practicable

ENGINE FIRE IN FLIGHT

1. Throttle – IDLE
2. Fire extinguisher button – PRESS
3. Check for confirmatory signs of fire

If fire warning persists but no other signs of fire –

4. Use minimum power and land as soon as practicable

If fire warning light goes out –

4. Warning/caution light test button – PRESS AND CHECK SYSTEMS STILL OPERABLE
   Use minimum power and land as soon as possible

If fire confirmed –

5. Throttle – OFF

If fire ceases –

6. Glide to optimum ejection conditions and eject

If fire does not cease –

6. Eject immediately

ENGINE FIRE DURING SHUTDOWN

1. FUEL SHUTOFF LEVER – OFF
2. FIRE EXTINGUISHER BUTTON – PRESS
3. BATTERY SWITCHES – OFF
4. ABANDON AIRCRAFT

ELECTRICAL FIRE

1. Battery switches – OFF
2. All electrical switches – OFF

If fire persists –

3. Throttle – OFF
4. Battery 2 switch – ON
5. Airstart

If fire ceases –

6. AC/DC reset buttons – DO NOT PRESS
7. Land as soon as practicable

ELIMINATION OF SMOKE AND FUMES

1. Descend to below 25,000 feet
2. Oxygen – 100%
3. Cabin air switch – OFF

If smoke and fumes persist –

3. MDC D-ring – PULL (EYES CLOSED AND VISOR DOWN)

FUEL

SINGLE BOOST PUMP FAILURE (PUMP CAUTION LIGHT)

1. Boost pump switch (failed pump) – OFF

DOUBLE BOOST PUMP FAILURE

1. Boost pump switches – OFF
2. Land as soon as practicable

FLOW PROPORTIONER FAILURE (PROP CAUTION LIGHT)

1. Flow proportioner switch – OFF
2. Monitor fuel quantity indicators
3. Balance fuel by switching lowest feed group boost pump switch OFF until balanced

TANK OVERPRESSURE (TOP WARNING LIGHT)

During inflight refueling –

1. BREAKAWAY

In normal flight –

1. Tank depressurization switch – ON

If TOP warning light remains on and one TRANS caution light comes on –

2. Wing fuel jettison switch (opposite side from TRANS light) – ON
3. Land as soon as practicable

If TOP warning light goes out and both TRANS caution lights come on –

2. Tank depressurization switch – OFF
3. Repeat steps as necessary to keep TOP light out

NOTE

If required, inflight refueling may be resumed when TRANS caution lights come on.

FUEL TRANSFER FAILURE (TRANS CAUTION LIGHT)

SINGLE FEED GROUP

1. Use minimum fuel flow flight profile
2. Do not exceed 5000 feet/minute sustained descent
3. Avoid violent maneuvers

If fuel low level warning light flashes –

4. Boost pump switch (failed side) – OFF
5. Flow proportioner switch – OFF

WARNING

The engine will not run with one feed tank dry (allow 150 pounds unusable fuel) and the flow proportioner ON.

6. Land as soon as practicable

NOTE

- If range is critical, jettison failed side drop tank.
- If fuel out-of-balance exceeds 500 pounds, make a conventional or slow (120 knot minimum) landing.

BOTH FEED GROUPS

If one or both feed groups remain constant at 300 pounds –

1. Follow single feed group failure procedure

If both Fuel Low Level warning lights flash –

2. Drop tanks – JETTISON
3. Flow proportioner switch – OFF

WARNING

The engine will not run with one feed tank dry (allow 150 pounds unusable fuel) and the flow proportioner ON.

If warning lights continue to flash –

4. Land immediately

FUEL LOW LEVEL (FUEL LOW LEVEL LIGHT(S) FLASHING)

1. Apply negative and then positive G

If light continues to flash –

2. Boost pump switch (failed side) – OFF
3. Flow proportioner switch – OFF
4. Gauge check button – PRESS
5. If only one light flashes, consider the warning probably spurious.

If both lights flash and fuel critical –

6. Boost pump switch (failed side) – ON
7. When PUMP caution light comes on, boost pump switch – OFF
8. Repeat steps 6 and 7 each 10 minutes.

NOTE

If fuel out-of-balance exceeds 500 pounds make a conventional or slow (120 knot minimum) landing.

FLIGHT CONTROLS

REACTION CONTROL FAILURE

Reaction control failure will most often be accompanied by low duct pressure and/or an excessive nose-up trim change as the nozzles are lowered. The proper corrective action is to fly the aircraft out of the reaction control regime as fast as possible, either by landing or transitioning to conventional flight. The choice of method depends on which is faster in the situation.

1. Land or transition to conventional flight immediately

STABILATOR TRIM FAILURE

1. Use standby trim switch

If standby trim inoperative –

2. Q feel switch – OFF

NOTE

Out-of-trim forces will be reduced above 250 knots with Q feel off. Do not exceed 500 knots.

RUDDER TRIM FAILURE

Failed in neutral –

1. No action required

Failed hardover

1. Reduce speed below 250 knots (if practicable)
2. Flaps – MID (IF PRACTICABLE)

Q FEEL FAILURE

1. Q feel switch – OFF

CAUTION

Do not exceed 500 knots.

AUTOSTABILIZER FAILURE

1. Autostabilizer engage switch – OFF

HYDRAULIC

PC–1 FAILURE (HYD 1 CAUTION LIGHT)

1. Do not exceed 500 knots/.90 IMN
2. Land as soon as practicable

The following services will be lost:

Normal landing gear extension
Flaps
Fuel flow proportioner
Speed brakes
Pitch and yaw autostabilizers
Q feel
Windshield wiper

3. Landing gear – BLOW DOWN WHEN READY FOR LANDING

After touchdown –

NOTE

Land at 130 knots if possible to stay within RAT operating envelope.

4. Use intermittent nose wheel steering actuation as required.
5. Use steady brake pressure below anti–skid threshold.
6. Shutdown after stop

PC–2 FAILURE (HYD 2 CAUTION LIGHT)

1. RAT reset button – PUSH
   If RAT resets, failure was transient.

If RAT does not reset –

2. PC–2 hydraulic pressure – CHECK
   If no PC–2 pressure there will be no roll stab aug.
3. Land as soon as practicable (minimum 130 knots)

PC–1 AND PC–2 FAILURE (HYD WARNING LIGHT)

1. PC–2 hydraulic pressure – CHECK

If no PC–2 hydraulic pressure control of the aircraft will be lost –

2. EJECT

If PC–2 gage indicates pressure –

2. RAT reset button – PUSH
   If RAT resets, PC–2 failure was transient.

If RAT does not reset –

3. Maintain airspeed between 130 knots and 500 knots
4. Land as soon as practicable
5. Landing gear – BLOW DOWN WHEN READY FOR LANDING

After touchdown –

6. Use intermittant nosewheel steering actuation as required.
7. Use steady brake pressure below anti–skid threshold.
8. Shutdown after stop.

NOSEWHEEL STEERING FAILURE

1. If possible, land vertically.
2. Shutdown after stop.

NOTE

In an emergency, use reaction controls for steering.

LANDING GEAR UNSAFE INDICATION

An unsafe gear indication does not necessarily constitute an emergency. The unsafe indication could be the result of a malfunctioning indicating system or incorrect gear lowering procedure. If gear indicates unsafe, proceed as follows:

1. Airspeed below 250 knots
2. If PC–1 hydraulic pressure normal, cycle gear.
3. Landing gear position indicators – CHECK

If unsafe condition still exists –

4. Landing gear – UP
5. Apply negative G to aircraft
6. While under negative G, landing gear – DOWN

If unsafe condition still exists –

7. Use Landing Gear Emergency Lowering procedure.

LANDING GEAR EMERGENCY LOWERING

1. Airspeed below 250 knots.
2. Emergency extension T–handle – PUSH BUTTON AND PULL
3. Landing gear position indicator – CHECK

NOTE

- The landing gear cannot be retracted after emergency extension.
- The speed brake is not available after emergency extension of the landing gear.

LANDING EMERGENCIES

LANDING GEAR MALFUNCTION

Refer to Landing Gear Emergency Lowering, this section.

LANDING GEAR UNSAFE

With any gear unsafe –

1. Reduce gross weight to minimum practicable
2. Perform vertical landing
   If vertical landing not feasible, land as slow as possible.
3. Throttle – OFF AT TOUCHDOWN

With outrigger(s) unsafe –

With one outrigger unsafe, land with any crosswind from the bad outrigger side. If not making vertical landing, make a curved roll–out into the bad outrigger if feasible. If both outriggers unsafe, reduce crosswind to a minimum.

BLOWN TIRE

1. Perform vertical landing

If vertical landing not feasible or tire blows during landing roll –

2. Anti–skid – OFF (IF MAIN TIRE BLOWN)
3. Use maximum nozzle braking.
4. Use nosewheel steering and reaction controls to maintain directional control.

DAMAGED AIRCRAFT

During any inflight emergency, when structural damage or any other failure is known or suspected that may adversely affect aircraft handling characteristics, a controllability check should be performed as follows:

1. Reduce gross weight to minimum practicable.
2. Proceed to a safe altitude.
3. Perform controllability check required by the type of emergency.
4. Check reaction controls at 40° nozzles.

If aircraft has structural damage –

5. Perform controllability check in the gear–down, flap–up configuration.
6. Investigate approach and landing characteristics at 10 units AOA.
7. If adequate control available, maintain configuration and make straight–in approach to slow landing.

NO–FLAPS LANDING

A no–flaps landing is basically the same as a normal landing. For a conventional landing, the roll–out will increase due to the increased airspeed at the landing AOA. The pattern should be expanded slightly. If possible, perform a slow or vertical landing.

ASYMMETRIC STORES

If an asymmetric condition in excess of 45,000 inch–pounds exists –

1. Stores – JETTISON

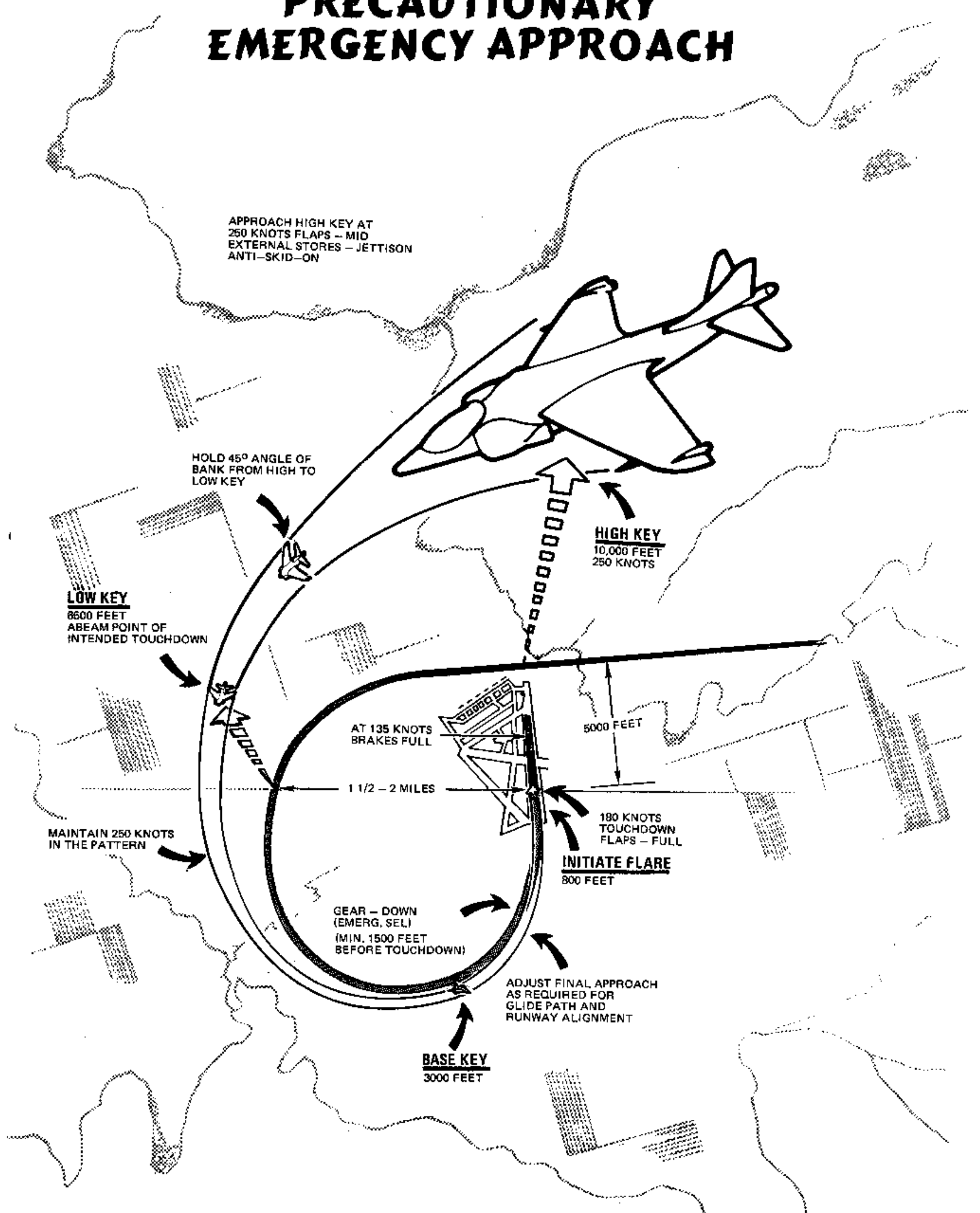
If unable to jettison –

1. Autostab engage switch – OFF
2. Nozzles – 20°
3. Maintain 160 knots minimum for approach and touchdown
4. Do not allow aircraft to float after flare

HOT BRAKE PROCEDURE

Hot brake procedures are contained in BUAER/BUWEPS INST 13420.1. Do not set parking brake. In view of the varied climatic conditions, field conditions, and safety devices available, specific procedures must be covered in local squadron/field SOP.

PRECAUTIONARY EMERGENCY APPROACH



NOTE: ROLLOUT WILL REQUIRE APPROXIMATELY 8000 FEET

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Figure 5-9

LANDING WITH ENGINE INOPERATIVE

Landing with the engine inoperative shall not be attempted.

Best range glide is at 9 units AOA with mid flaps. Range is approximately 1 nautical mile per 1000 feet of altitude.

PRECAUTIONARY EMERGENCY APPROACH

The standard precautionary emergency approach is a straight-in GCA type approach to a conventional or slow landing, modified as aircraft configuration and power available dictates. The precautionary emergency approach depicted in figure 5-9 will be used only if ejection is not feasible.

FORCED LANDING

WARNING

All forced landings on land shall be made with the landing gear extended regardless of terrain. A greater injury hazard is present when emergency landings are made with the landing gear retracted. Increased airspeed or nose high impact during emergency landings is common and with the landing gear retracted contributes greatly to aircraft damage and pilot injury. The nose high attitude causes the aircraft to slap down on impact causing possible spinal injury to the pilot. Less airplane damage and injurious forces will result with the landing gear down.

It is recommended that a landing on unprepared terrain not be attempted with this aircraft unless a vertical or very slow rolling vertical landing is feasible. The crew should eject if these conditions cannot be met. If a forced landing is feasible or unavoidable, proceed as follows:

1. If time and conditions permit, dump or burn excess fuel.
2. Armament - JETTISON
3. Make normal VL or RVL (slow RVL preferred if terrain permits)

If VL or RVL not possible -

4. Landing gear - DOWN
5. Flaps - DOWN
6. Shoulder harness - LOCKED AND TIGHT
7. External tanks - RETAIN IF EMPTY AND UNPRESSURIZED
   Empty tanks should be retained for shock absorbtion.

NOTE

External tanks may be depressurized by selecting tank depressurization switch to TANK DEPRESS.

8. Make normal approach.
9. Throttle - OFF AS SOON AS PRACTICABLE
10. Battery switches - OFF
11. When stopped - EVACUATE AIRCRAFT

EMERGENCY EGRESS

Due to forced landing, ditching, runway overrun or other landing emergency, rapid egress is essential. The most rapid method of egress is by divestment of both the seat survival kit and the parachute. On land, if the aircraft is burning, the extra time to egress retaining the seat kit could cause serious injury or death. After safely egressing, if conditions permit, return to the aircraft and retrieve the survival kit.

To evacuate cockpit without survival kit and parachute -

1. Canopy - OPEN
   a. Normal

WARNING

If there is any reason to believe the canopy will jam in attempting to open it by normal means, operate the MDC firing handle and exit aircraft through canopy frame.

   b. Pull MDC firing handle (eyes closed and visor down).

NOTE

If circumstances dictate, open canopy after remaining steps are performed.

2. Quick release box - UNLOCK
3. Parachute riser release fittings - RELEASE
4. Leg restrainers - WITHDRAW
5. Survival kit fittings - RELEASE
6. Personal equipment connector - RELEASE

NOTE

To evacuate cockpit after ditching, refer to ditching chart, this section.

DITCHING

Ditching the aircraft should be the pilots last choice. However, if the situation demands ditching, the procedures set forth on the ditching chart (figure 5-10) should be observed.

NOTE

In the event of ditching and sinking when immediate escape is impossible, it is possible to survive underwater with oxygen equipment until escape can be made. The oxygen regulator is a suitable underwater breathing device if 100% oxygen is selected. It is essential that the mask be strapped tightly in place.

OPERATIONAL EMERGENCIES

DOWNED PLANE PROCEDURES

DECLARATION OF AN EMERGENCY

When flying without a wingman or section leader, it is critically important that the pilot advise someone of his trouble and location. Even a deferred emergency can develop into a first rate emergency. The initial radio contact should be preceded with the word PAN when the situation requires urgent action, but is not an actual distress; the word MAYDAY should be used when threatened by serious or imminent danger and immediate assistance is required. If a serious emergency has arisen, shift immediately to EMERGENCY IFF; set up SIF Mode 3, Code 77; place UHF to GUARD; and broadcast MAYDAY. The following information should be relayed to a ground station immediately:

1. PAN or MAYDAY (depending upon situation)
2. Identification
3. Model aircraft
4. Position
5. Situation
6. Intentions

DITCHING CHART

WARNING

THE AIRCRAFT SHOULD BE DITCHED ONLY WHEN ALL OTHER ATTEMPTS OF EGRESS HAVE FAILED.

DUTIES BEFORE IMPACT	POSITION	DUTIES AFTER IMPACT	EQUIPMENT	EXIT
1. MAKE RADIO DISTRESS CALL 2. IFF EMERGENCY 3. EXTERNAL STORES – JETTISON 4. LANDING GEAR UP 5. WING FLAPS - DOWN 6. OXYGEN – 100% 7. THREE SURVIVAL KIT CONNECTORS DISCONNECT 8. FACE MASK – TIGHTEN 9. HELMET VISOR – DOWN 10. SHOULDER HARNESS – LOCK AND TIGHTEN 11. IF AIRBORNE, FLY PARALLEL TO SWELL PATTERN. IF JETBORNE, HEAD INTO WIND. 12. WHEN AIRCRAFT CONTACTS WATER – SHUT DOWN ENGINE	1. IN SEAT. 2. FEET ON RUDDER PEDALS, KNEES FLEXED.	1. QRB – UNLOCK 2. PARACHUTE RISER RELEASE FITTINGS – RELEASE 3. LEG RESTRAINERS - WITHDRAW 4. PEC DISCONNECT 5. CLOSE EYES AND PULL MDC FIRING HANDLE 6. ABANDON AIRCRAFT **WARNING** EXERCISE CARE NOT TO PULL THE SEAT FIRING HANDLE. IF AIRCRAFT IS ABANDONED UNDER WATER, EXHALE WHILE ASCENDING TO THE SURFACE TO PREVENT BURSTING OF LUNGS DUE TO PRESSURE DIFFERENTIAL BETWEEN LUNGS AND OUTSIDE OF BODY. **Note** IF CIRCUMSTANCES PERMIT, RETRIEVE SURVIVAL KIT BEFORE LEAVING AIRCRAFT. 7. INFLATE LIFE VEST 8. IF CIRCUMSTANCES DICTATE, DEPLOY SURVIVAL KIT.	1. ONE MAN RAFT & EMERG. EQUIP. 2. LIFE VEST 3. FLASHLIGHT	OVER CANOPY FRAME

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Figure 5-10

Single Aircraft

If the situation permits, prior to ejection or crash landing:

1. Switch IFF to EMERGENCY.
2. Transmit MAYDAY over guard channel.

Conditions existing following the ejection or crash landing will dictate whether to remain near the scene of the crash or attempt to find assistance.

Section

If one member of a section goes down, the other member should:

1. Establish contact with a ground station, preferably a GCI site or RADAR control agency. Switch IFF to EMERGENCY and UHF to GUARD.
2. Make every effort to follow the other aircraft or crew during descent. It is of primary importance to keep the crew in sight at all times, while on the ground or in the water. Note as accurately as possible, bearings, distances from known prominent landmarks or navigational aids, in order to direct rescue planes or boats to the scene.
3. Establish a RESCAP.
4. Maintain sufficient altitude to assure radio contact with the rescue facility.
5. Leave the area with sufficient fuel to POSITIVELY ensure return to base or alternate field.

Division

Everything mentioned earlier holds true if there are more than two members to the flight. Some additional procedures can be followed which will ensure a greater likelihood of a successful rescue. The other member of the section in which the downed crew has been flying, should:

1. Follow the aircraft/crew and circle them at low altitude, making every effort to keep the downed crew in sight.

Other members of the flight:

1. Remain at altitude.
2. Alert appropriate facilities.
3. Relay communications.
4. Conserve fuel.

NAV–COMM EMERGENCY PROCEDURES

These procedures deal with communication emergencies. Other types of emergencies where navigation and communication aids are available should be handled according to the individual circumstances under which they arise and as the factors involved indicate. An aircraft with running lights flashing usually indicates that an emergency condition exists.

LOST AIRCRAFT (WITHOUT NAVIGATION AIDS)

The pilot will have navigated to best position by dead reckoning. The following procedures will apply.

With Radio Receiver

1. Fly a minimum of two triangular patterns to the right with 1–minute legs. Repeat pattern at 20–minute intervals.
2. Conserve fuel and maintain altitude.
3. Squawk appropriate Mode and be alert for aircraft vectored to join.

Without Radio Receiver

1. Fly a minimum of two triangular patterns to the left with 1–minute legs. Repeat pattern at 20–minute intervals.
2. Conserve fuel and facilitate radar pickup by maintaining highest feasible altitude consistent with situation.
3. Squawk appropriate Mode and be alert for aircraft vectored to join.
4. After joining, inform healthy aircraft of all emergency conditions by appropriate hand signals in order to prevent separation during penetration/letdown.

NO RADIO AIRCRAFT (WITH NAVIGATION AIDS)

1. Proceed to alternate marshal.
2. Energize I/P function at least once each minute.
3. Commence penetration/letdown at EAC as briefed.
4. Be alert for aircraft vectored to join.
5. If immediate assistance is required, energize emergency IFF.

PENETRATION/LETDOWN NAV–COMM EMERGENCIES

Even though communication aids have failed, if navigation equipment is still available:

1. Continue approach.
2. If no contact has been made after 2 minutes past individual expected ramp time, conduct lost aircraft (without navigation aids, and without radio receiver) procedures.

If all communication and navigation equipment is lost, and last known weather at the ship was 800 feet with two miles visibility or better:

1. Continue approach by dead reckoning.
2. Maintain dead reckoning until 2 minutes past individual expected ramp time.
3. Conduct lost aircraft (without navigation aids, and without radio receiver) procedures.

If last known weather at ship was below 800 feet or 2 miles visibility:

1. Level off.
2. Conserve fuel.
3. Execute a one–half standard rate timed turn to a heading of 90 degrees to the right of previous penetration heading.
4. Maintain new heading for 2 minutes.
5. Conduct lost aircraft (without navigation aids, and without radio receiver) procedures.

LANDING WITHOUT UHF COMM (ESCORTING WINGMAN)

Exact procedures to be followed in the event one aircraft in a flight experiences communications failures must be covered in detail on every pre-flight brief. In general, the following procedures are recommended for the approach and landing:

1. Escorting aircraft determine the escorted (no radio) aircrafts fuel state through hand signals.
2. Escorting aircraft determine escorted aircrafts, VHF/FM, UHF guard and standby receiver status.
3. Escorting aircraft establishes flight for a straight-in approach, lowers gear and flaps through hand signals, and passes the lead to the escorted aircraft after clearance to land is received.
4. Passing of the lead should ideally be done at about one mile from touchdown. At this time the flight should be lined up with the runway with the proper rate of descent established.

SECTION SHIP CONTROLLED APPROACH

Should a section approach become necessary because of radio or instrument failure:

1. Place wingman on right side prior to commencing descent.
2. Complete decelerating transition.
3. Indicate ship to wingman (blink external lights at night ship in sight).
4. Wingman will continue approach and land.
5. Leader will make definite turn to port and parallel final bearing in order to be in position should wingman waveoff.
6. Following the wingman landing/waveoff, the leader will execute the normal waveoff procedure and be vectored in for an additional section approach or final landing.

SHIP EMERGENCY NAV-COMM SIGNALS

Refer to the appropriate ship NATOPS Manual.

TAKEOFF EMERGENCIES

NO LIFTOFF ON VTO

If no liftoff in 10 seconds -

1. Throttle - IDLE
2. Nozzles - AFT
3. Taxi clear and investigate.

NO LIFTOFF ON STO

1. Nozzles - AFT
2. Increase speed 20 knots.
3. Nozzles - STO STOP

ABORT (CTO OR STO)

1. Stick - FORWARD
2. Nozzles - BRAKING STOP
3. Throttle - 80%

at 60 knots -

4. Throttle - IDLE
5. Nozzles - HOVER STOP
6. Brakes - FULL

BLOWN TIRE ON TAKEOFF

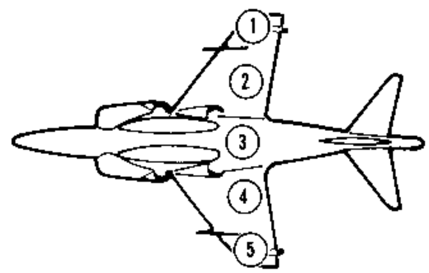
If decision to stop is made -

1. ABORT

If takeoff is continued -

1. Throttle - FULL (LIMITERS)
2. Nozzles - 50° AT 120 KNOTS
3. Leave flaps and gear down.
4. Plan vertical/rolling vertical landing.

EXTERNAL STORES JETTISON CHART



EXTERNAL STATION(S) (STORE LOADED)	INTERLOCKS	METHODS
1 THRU 5 (ANY EXCEPT SIDEWINDERS)	THE ARMAMENT SAFETY BREAK SWITCHES MUST BE CLOSED (ARMAMENT SAFETY KEY REMOVED PRIOR TO FLIGHT) AND THE WEIGHT-ON-WHEELS SWITCH MUST BE CLOSED (AIRCRAFT AIRBORNE).	NO. 1 OR NO. 2 ARM MASTERS SWITCH–ON CLEAR A/C BAR–PUSH (3 SEC. MAX.)
1, 2, 3, 4 OR 5 (ANY EXCEPT SIDEWINDERS)		NO. 1 OR NO. 2 ARM MASTERS SWITCH –ON APPROPRIATE JETTISON BUTTON–PUSH (3 SEC. MAX.)
1 AND 5 (SIDEWINDERS)		NO. 2 ARM MASTER SWITCH–ON BOMBS/ROCKET SIDEWINDER SELECT SWITCH–SIDEWINDER ON SIDEWINDER JETTISON BUTTON–PUSH. (SIDEWINDER FIRES UNGUIDED)

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Figure 5-11

SECTION VI

ALL WEATHER OPERATION

TABLE OF CONTENTS

SIMULATED INSTRUMENT PROCEDURES

GENERAL

Instrument flight is primarily a problem of time and distance navigation wherein all, or part, of the flight is conducted under instrument conditions. To complete a successful instrument flight, pilots must be properly prepared and have conducted the necessary planning. All pilots will be current in latest instrument flight rules and regulations published by higher authority and, when operating aircraft under instrument flight conditions, will be guided by the current OPNAV INSTRUCTION 3710.7 (General Flight and Operating Instructions for Naval Aircraft) and Federal Air Regulations.

SAFETY PRECAUTIONS

It is the responsibility of the chase pilot to ensure that the flight is clear of other aircraft at all times.

The instrument pilot will not go hooded on departure until reaching a minimum of 2000 feet above the terrain.

At a minimum of 500 feet above terrain, the instrument pilot will go contact on any hooded penetration or ground controlled approach.

The chase pilot will conduct communications checks with the instrument pilot and receive an acknowledgement at 1-minute intervals below FL 240 and at 3-minute intervals above FL 240, if not under positive control.

If loss of radio contact occurs, the instrument pilot will immediately go contact and remain VFR until radio contact is re-established. If necessary, the chase pilot will pass to the right and pull ahead/in front to attract the instrument pilot's attention to go contact.

Radio contact will be positively established immediately before and after any channel or frequency change.

Unless under positive control, the instrument pilot will call the indicated altitude at each 5000-foot interval during descent and at level-off.

CHASE PLANE PROCEDURES

The chase pilot's duties on instrument flights are to act as lookout and to be a flight monitor. The best position for this is a loose tactical wing position where airspeed, attitude, and altitude may be monitored while maintaining a good lookout. During GCA approaches, the chase will fly a position as directed by GCA. This position is normally about four or five o'clock from the GCA aircraft, 500 feet away, and slightly stepped up.

CHASE PLANE RADIO PROCEDURES

The chase pilot will set up his radios with the frequency in use on the UHF and GUARD on the VHF. The instrument pilot will monitor UHF and VHF guard. The chase pilot will normally transmit on UHF. If the chase pilot suspects radio failure or cannot "burn through" transmissions by GCA or other controlling agencies he can switch the function selector switch to BOTH and transmit on both the assigned frequency and VHF GUARD.

ACTUAL INSTRUMENT PROCEDURES

INSTRUMENT FLIGHT

The primary instruments for instrument flight are all contained in the HUD presentation. Instruments on the main instrument panel provide a back-up and should be cross-checked with the HUD. The ability of the aircraft to fly at slow speeds and to hover dictates some modification of standard instrument procedures.

INSTRUMENT FLIGHT PLANNING

On instrument flights, delays in departure and descent and low climb rates to altitude are often required in high density control areas. These factors make fuel consumption and flight endurance critical. All instrument flights should be carefully planned and consideration given to the additional time and fuel which may be required. A complete weather briefing for all pilots on the flights will be obtained and the appropriate flight plan will be filed.

BEFORE STARTING ENGINE

When practical, an ATC clearance should be obtained before starting the engine.

BEFORE TAKEOFF

It is essential that the instrument and navigation equipment be thoroughly checked prior to takeoff. If a climb through precipitation or clouds is anticipated, the pitot-static heater switch and the AOA probe heater switch should be placed ON. The compass should be aligned with the runway. Autostabilization should be ON. Head up and head down displays should be cross checked.

INSTRUMENT TAKEOFF

Same as normal Takeoff.

INSTRUMENT CLIMB

The simplified climb technique described in part 3 of section III can be used with minimum sacrifice in fuel consumption and climb rates. Turns should be kept to a minimum during climb. Follow the clearance exactly as given. If unable to comply with the clearance, it is mandatory that ATC be advised immediately.

PENETRATION PROCEDURES

Three to five minutes prior to making a descent, the cabin temperature control should be set at the maximum comfortable level and the cabin air switch should be set to FLOOD. Contact approach control 10 minutes prior to ETA or as directed by ARTC, and conform to the provision of section 2, Flight Planning Document. Three minutes prior to entering holding, adjust power to arrive at the holding fix with maximum endurance airspeed (265 KIAS maximum). Prior to descent, the pilot will check missed approach procedures and will obtain the latest weather information at the destination and at the alternate if required. Refer to Descent/Instrument Penetration procedures, section III. Instrument descent settings are 300 knots, MID flaps, speed brakes OUT and minimum 65% RPM.

RADAR CONTROLLED PENETRATION

The approaches are basically the same as previously described with the following additions. The controlling activity will normally ask for turns or specific IFF squawks for positive identification. The controlling activity will advise turns or headings which will produce the desired flight path. They will also advise as to distance from the destination and direct a descent to lower minimum altitudes as traffic and terrain permit.

GCA Approaches

The GCA is flown with a normal pattern except that, after visual contact is established, the aircraft may be transitioned for a short, rolling vertical, or vertical landing.

TURBULENT AIR AND THUNDERSTORM OPERATION

Intentional flight through thunderstorms should be avoided, unless the urgency of the mission precludes a deviation from course, because of the high probability of damage to the airframe by impact ice, hail, and lightning and possible compressor stall due to negative AOA encountered in turbulence. The airplane is capable of climbing over the top of small and moderately developed thunderstorms.

PENETRATION

If necessary to penetrate, the basic structure of the airplane is capable of withstanding the accelerations and gust loadings associated with the largest thunderstorms. The airplane is stable and comparatively easy to control in the severe turbulence; however, the effects of turbulence becomes noticeably more abrupt and uncomfortable at airspeeds above optimum cruise and below 35,000 feet. The airplane is not displaced significantly from the intended flight path and desired heading. Altitude, airspeed, and attitude can be maintained with reasonable accuracy.

Penetration Airspeeds

The optimum thunderstorm penetration speeds, based on pilot comfort, controllability, and engine considerations are between optimum cruise and 280 knots below 35,000 feet, and no less than 300 knots above 35,000 feet. Engine RPM should be maintained below 85% to reduce compressor stall susceptibility.

APPROACHING THE STORM

Adjust power to establish the recommended penetration speed (less than 85%). Place the pitot-static heater and the AOA probe heater switches ON. Do not try to top thunderstorms at the sacrifice of maintaining penetration speed. Flight through a thunderstorm at the proper airspeed and attitude is much more advantageous than floundering into the storm at a dangerously slow airspeed while attempting to reach the top. All cockpit lighting should be on at maximum brightness.

IN THE STORM

Maintain a normal instrument scan with added emphasis on the horizon bar. Attempt to maintain a constant pitch attitude and, if necessary, accept moderate altitude and airspeed fluctuations. In heavy precipitation, a reduction in engine rpm may be necessary due to the increased thrust resulting from water ingestion. If compressor stalls or engine stagnation develops, attempt to regain normal engine operation by momentarily retarding the throttle to IDLE then advance to the operating range. If the stall persists, shut down the engine and attempt a relight.

Angle-of-Attack System Failure

The angle-of-attack system may become temporarily inaccurate due to probe icing, or it may permanently fail due to structural damage of the probe from ice or hail. Icing of the probe is usually characterized by a zero angle of attack indication which will return to normal in clear air. Structural damage may cause erroneous readings or fail the system completely.

ICE AND RAIN

The possibility of engine and/or airframe icing is always present when the airplane is operating under instrument conditions. Icing is most likely to occur when takeoffs must be made into low clouds with temperature at or near freezing. Normal flight operations are carried on above the serious icing levels, and the airplane's high performance capabilities will usually enable the pilot to move out of the dangerous areas quickly. When an icing condition is encountered, immediate action should be taken to avoid further accumulation by changing altitude and/or course and increasing the rate of climb or airspeed. When icing conditions are anticipated turn the pitot-static and AOA probe heaters ON.

HYDROPLANING

Operations on wet or flooded runways may produce three conditions under which tire traction may be reduced to an insignificant value.

1. Dynamic hydroplaning
2. Viscous hydroplaning
3. Reverted rubber skids

Hydroplaning will not present a significant problem unless a conventional landing must be made. Nozzle braking is effective regardless of runway condition.

DYNAMIC HYDROPLANING

As the tire velocity is increased, the hydrodynamic pressure acting on the leading portion of the tire footprint will increase to a value sufficient to support the vertical load acting on the tire. The speed at which this occurs is called total hydroplaning speed. This speed (in knots) can be computed by multiplying 9 times the square root of the tire pressure. Any increase in ground speed above this critical value lifts the tire completely off the pavement, leaving it supported by the fluid alone. Since the fluid cushion is incapable of sustaining any appreciable shear forces, braking and sideforce coefficients become almost non-existent.

VISCOUS HYDROPLANING

Viscous hydroplaning occurs due to the inability of the tire to penetrate the very thin fluid film found under damp runway conditions. This condition is aggravated when more viscous fluids such as oil, or road dust and water mixed are present, and is improved in the presence of a coarse textured runway surface. Viscous hydroplaning occurs at medium to high speed with rolling or skidding tires, and the speed at which it occurs is not dependent on tire pressure.

REVERTED RUBBER SKIDS

Reverted rubber skids occur after a locked-wheel skid has started on a wet runway. Enough heat may be produced to turn the entrapped water to steam. The steam in turn melts the rubber. The molten rubber forms a seal preventing the escape of water and steam. Thus the tire rides on a cushion of steam which greatly reduces the friction coefficient and may continue to do so to very low speeds.

EXTREME WEATHER PROCEDURES

COLD WEATHER OPERATION

PREFLIGHT

Check that the airplane is free of frost, snow, and ice. These accumulations present a major flight hazard resulting in loss of lift and increased stall speeds. Do not allow ice to be chipped or scraped from the airplane; damage to the airframe may result. Shock struts, actuating cylinders, pitot-static sources, and fuel vents should be inspected for ice and dirt accumulation.

INTERIOR CHECK

In temperatures below 0°F, difficulty may be experienced when connecting the oxygen mask hose to the connector, due to a stiff O-ring in the connector. Application of a small amount of heat to the connector will alleviate this problem. Also, if the oxygen mask is not fastened, keep it well clear of the face to prevent freezing of the inhalation valves.

ENGINE START

If any abnormal sounds or noises are present during starting, discontinue starting and apply intake duct preheating for 10 to 15 minutes.

TAXIING

Avoid taxiing in deep or rutted snow; frozen brakes will probably result. Increase the interval between taxiing airplanes to insure a safe stopping distance and to prevent icing of the airplane surfaces by the snow and ice melted by the jet blast of the preceding airplane. Trim 2° ND to keep nose puffer duct closed.

BEFORE TAKEOFF CHECK

During the engine runups, an ice-free area should be selected if possible. The engine thrust is noticeably greater at low temperatures and the probability of skidding the airplane is likely. Determine the maximum indicated RPM to remain within corrected RPM limits.

LANDING

Perform a slow or vertical landing, if feasible, to reduce rollout distance.

CAUTION

Check nose gear steering operation prior to landing to ensure it is not frozen.

BEFORE LEAVING AIRPLANE

Weather permitting, leave the canopy partially open to allow for air circulation. This will help prevent canopy cracking from differential cooling and decreases the possibility of windshield and canopy frosting.

HOT WEATHER OPERATION

TAXIING

While taxiing in hot weather, the canopy may be opened, if necessary, to augment pilot comfort. Do not operate the engine in a sand or dust storm if avoidable. Park the airplane crosswind and shut down the engine to minimize damage from sand or dust.

TAKEOFF

The required takeoff distances are increased by a temperature increase. Check the applicable Takeoff Distance charts, section XI.

SECTION VII
COMMUNICATIONS PROCEDURES

TABLE OF CONTENTS

GENERAL

Because of the nature of jet operations, voice radio is normally used for communications between aircraft. Occasionally, however, conditions of radio silence are prescribed for certain operations. Proficiency in the use of visual signals must therefore be maintained by all pilots.

Information and additional references concerning the following categories of radio/electronic communications are contained in Chapter VI of NWP 41(D) and appendix B of the CVA/CVS NATOPS manual.

a Communications procedures and terminology.
b Operational use of voice radio.
c Standard fleet weather reporting procedures.
d Contact reports.
e Aircraft identification procedures.
f IFF procedures.

RADIO COMMUNICATIONS

Good operating procedures must be practiced by each pilot if radio communication is to be effective. Compliance with the basic, common-sense guidelines of correct radio operation which follow, will eliminate the most frequent breaches of good radio discipline.

a Use proper R/T voice procedure and terminology.
b Do not cut in on other transmissions.
c Make only necessary transmissions and then be as brief as possible.
d Use complete call signs to avoid confusion.
e Mentally phrase a message before keying the mike.
f Delay the transmission about 1 second after keying the mike to avoid loss of the first syllable.
g Transmit on the guard channel only in an emergency.
h Leave the UHF selector switch on T/R & G position unless guard channel traffic or noise renders the selected channel unusable.
i Take pride in a silent flight if it can be accomplished safely and effectively.
j Do not switch radio frequency or IFF code below 2500 feet under night or instrument conditions, except for urgent military necessity. If this necessity arises, the aircraft should be in stabilized level flight before changing frequencies or codes.

VISUAL COMMUNICATIONS

Aircraft visual communications include those made with the hands or other parts of the body, aircraft maneuver, code transmission, or lights. Ground-to-air signals also include panel signals or other displays.

Information and additional references concerning the following categories of visual communications are contained in Chapter VI of NWP 41(D).

a Air station control tower light signals.
b Signals between ground and aircraft for use by downed pilots. These include: body signals, international ground-air emergency codes and aircraft replies, panel signals, pyrotechnics, miscellaneous, ground search-party signals, and RESCAP rescue signals.

Visual signals should be used between aircraft whenever practicable, provided no loss in operational efficiency results. Those signals with which the pilot is primarily concerned are shown in figures 7-1 and 7-2.

NIGHT TACTICAL SIGNALS

Night tactical signals are usually given on voice radio, but they may be transmitted by the use of external lights or by a maneuver using the appropriate signal as shown. Maneuvers at night should be kept to a minimum consistent with the effective performance of the assigned task.

SIGNALING DISTRESS BETWEEN AIRCRAFT AND SURFACE SHIPS

If an aircraft which is not in radio communication with a ship wishes to attract attention to survivors or to an aircraft in distress, a standard procedure is used. The aircraft first circles the ship closely at low altitude. This circle is made at least once. The pilot then flies across the bow of the ship at low altitude, changing power setting and rocking the wings. After this, he heads in the direction of the distress incident. Flight across the bow and in the direction of the incident is repeated until the ship acknowledges by following the aircraft.

The ship should either follow the aircraft or indicate by the visual signal NOVEMBER that this is impossible. The action taken must be reported to the OTC. Surface ships may use signals from the one-letter code given below when assisting a distressed aircraft.

SURFACE SHIP ONE-LETTER CODE

A one-letter aircraft code is available to surface ships for the controlling of aircraft. The code is peculiar to aircraft operations and is limited to that use. The signals are made only by flashing-light or deck panels. Letters and their meanings are as follows:

Code

B – Make passes.

C – Land aboard.

D – Delay; re–form; remain within signal distance until further notice. (When the delay in recovery will be for more than five minutes, the number of minutes, in tens, may be flashed after the letter "D". Example: A 20–minute delay would be indicated by flashing the signal "D2".)

F – Flaps are not down.

G – Jettison droppable fuel tank(s).

K – Your (my) plane is damaged (unless otherwise directed, plane should land aboard ship last).

M – Proceed to base or ship in accordance with doctrine or orders. (Unless otherwise briefed, this signal will mean to proceed to the designated bingo field, or, if not designated, to the nearest suitable field.)

Q – Jettison bombs.

R – Radio failure. (By aircraft, utilizing the external lights or white fuselage lights.)

S – Flight Commander fly alongside and read signals.

U – Turn off (on) running lights.

W – Lower landing gear.

X – Previous landing order cancelled.

Z – Do not land aboard; land aircraft in water or eject.

VISUAL COMMUNICATIONS

GENERAL SIGNALS

SIGNAL		MEANING	RESPONSE
DAY	NIGHT		
Thumbs up, or nod of head	Flashlight moved vertically up-and-down repeatedly.	Affirmative. ("Yes," or, "I" understand.")	
Thumbs down, or turn of head from side to side	Flashlight moved horizontally back--and--forth repeatedly	Negative. ("No," or, "I do not understand.")	
Hand cupped behind ear as if listening	Question. Used in conjunction with another signal, this gesture indicates that the signal is interrogatory		As appropriate.
Hand held up, with palm outward.	Wait.		
Hand waved back and forth in an erasing motion in front of face, with palm turned forward.	Letter N is code, given	Ignore my last signal.	
Hand held up, with thumb and forefinger forming an O and remaining fingers extended.		Perfect, well done.	
Employ fingers held vertically to indicate desired numerals 1 through 5. With fingers horizontal, indicate number which added to 5 gives desired number from 6 to 9. A clenched fist indicates 0. (Hold hand near canopy when signalling.)		Numerals as indicated.	A nod of the head ("I understand"). To verify numerals, addressee repeats. If originator nods, interpretation is correct. If originator repeats numerals, addressee should continue to verify them until they are understood.

CONFIGURATION CHANGES

SIGNAL		MEANING	RESPONSE
DAY	NIGHT		
Rotary movement of clenched fist in cockpit as if cranking wheels, followed by head nod.	Letter W in code, given by external lights or rotary motion of flashlight.	Lower or raise landing gear and flaps, as appropriate.	Repeat signal. Execute when leader changes configuration.
Forearm held vertically while nodding, clenched fist followed by extending number of fingers for each 10^0 of nozzle rotation.		Rotate nozzles.	Repeat signal. Execute when leader changes configuration.
Open and close four fingers and thumb		Extend or retract flaps, as appropriate.	Repeat signal. Execute upon head-nod from leader or when leader's flaps extend/retract.
Rapid opening and closing four fingers and thumb.		Extend or retract speed brake as appropriate.	Repeat signal. Execute upon head-nod from leader or when leader's speedbrake extends/retracts.

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Figure 7-1 (Sheet 1 of 7)

VISUAL COMMUNICATIONS (CONTINUED)

FUEL AND ARMAMENT

SIGNAL		MEANING	RESPONSE
DAY	NIGHT		
Raised fist with thumb extended in drinking position		How much fuel have you?	Repeat signal, then indicate fuel fuel in hundreds of pounds by finger—numbers.
1. Pistol—cocking motion with either hand. 2. Followed by question—signal. 3. Followed by thumbs—down signal.		1. Ready or safety guns. 2. How much ammo do you have? 3. I am unable to fire.	1. Repeat signal and execute. 2. Thumbs up—"over half"; thumbs down—" less than half." 3. Nod head ("I understand').
1. Shaking fist. 2. Followed by question—signal. 3. Followed by thumbs—down signal.		1. Arm or safety bombs, as applicable. 2. How many bombs do I have? 3. I am unable to drop.	1. Repeat signal and execute. 2. Indicate with appropriate finger—numerals. 3. Nod head ("I understand").
1. Shaking hand, with fingers extended downward. 2. Followed by question—signal. 3. Followed by thumbs—down signal.		1. Arm or safety missile/rockets as applicable. 2. How many missiles/rockets do I have? 3. I am unable to fire.	1. Repeat signal and execute. 2. Indicate with appropriate finger—numerals. 3. Nod head ("I understand").
Pistol cocking motion with either hand, followed by fore and aft pulling motion with a clenched fist.		Jettison external stores.	Repeat signal and execute.
	1. Rotating beacon ON and OFF by lead aircraft. 2. Rotating beacon turned ON for second time (allow time for setting up switches).	1. Set up your switches for jettison 2. You are cleared to drop	1. Set up jettison/ordnance switches. 2. Execute.

MALFUNCTIONING EQUIPMENT (HEFOE. CODE)

SIGNAL		MEANING	RESPONSE
DAY	NIGHT		
Weeping signal and then indicating by finger — numbers 1 to 5 the affected system.	Flashlight held close to top of canopy, pointed toward wingman, followed by 1 to 5 dashes to indicate system affected.	Number of fingers or dashes means: 1. Hydraulic system. 2. Electric system. 3. Fuel system. 4. Oxygen system. 5. Engine	Day: nod, or thumbs up ("I understand.") Night: Vertical movement of flashlight. Pass lead to disabled plane or assume lead, if indicated.

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Figure 7-1 (Sheet 2 of 7)

VISUAL COMMUNICATIONS (CONTINUED)

ELECTRONIC COMMUNICATIONS AND NAVIGATION

SIGNAL		MEANING	RESPONSE
DAY	NIGHT		
Tap earphones, followed by patting of head, and point to other aircraft.		Take over communications.	Repeat signals, pointing to self, and assume communications lead.
Tap earphones, followed by patting of head.		I have taken over communications.	Nod ("I understand").
Tap earphones and indicate by finger–numerals, number of channel to which shifting.		Shift to radio frequency indicated by numerals.	Repeat signal and execute.
Tap earphones, extend forearm vertically, and rotate fingers, formed as if holding a grapefruit, followed by four numbers.		Manual set up radio on frequency indicated.	Repeat signal and execute.
1. Open hand held up, fingers together, moved in fore–and–aft chopping motion (by leader). 2. Followed by question signal. 3. Followed by three–finger numerals.		1. Course to be steered is present compass heading. 2. What is your compass heading? 3. My compass heading is as indicated by finger–numerals.	1. Nod of head ("I understand"). 2. Repeat signal and give compass heading in finger–numerals. 3. Nod of clarify, as appropriate.
Tap oxygen mask (or earphones) and give thumbs down.	Turn wing and tail lights BRT/FLASH.	I have UHF transmitter (or receiver) failure.	Execute no–radio procedure as briefed. Attempt contact on guard if necessary.
Tap earphones, followed by question signal.		What channel (or frequency) are you on?	Indicate channel (or frequency) by finger–numerals.
Tap earphones and point to aircraft being called, followed by finger– numerals indicating frequency.		You are being called by radio on channel indicated by finger numerals.	Repeat numerals. Check receiving frequency and switch to channel indicated by originator. Dial in manually, if necessary.
Tap O_2 mask followed by numbers 1, 2 or 3.		1. I am Tx on UHF 2. I am Tx on STBY UHF 3. I am Tx on VHF/FM	Nod head (understand) followed by thumbs up (I am switching to indicated radio and it is operable) or thumbs down (Indicated radio not operable).
Tap O_2 mask followed by question		What radio are you on?	Tap O_2 mask followed by number 1. UHF 2. STBY UHF 3. VHF/FM
Vertical hand, with fingers pointed ahead and moved in a horizontal sweeping motion, with four fingers extended and separated.		What is bearing and distance to the TACAN station?	Wait signal, or give magnetic bearing and distance with finger–numerals. The first three numerals indicate magnetic bearing and the last two or three, distance.
Vertical hand, with four fingers extended and separated, pointed ahead in a fore–and–aft chopping motion, followed by a question signal.		What is bearing to TACAN station?	Repeat signal and give bearing in three digits.
Arm and vertical hand, with four fingers extended and separated, moved ahead in a fore–and–aft circular motion, followed by question signal.		What is distance to TACAN station?	Repeat signal and give distance in two or three digits.

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Figure 7-1 (Sheet 3 of 7)

VISUAL COMMUNICATIONS (CONTINUED)

ELECTRONIC COMMUNICATIONS AND NAVIGATION (CONTINUED)

SIGNAL		MEANING	RESPONSE
DAY	NIGHT		
Tacan bearing or distance sgianl, followed by thumbs up or down.		TACAN bearing or distance, up or down.	Thumbs up or nod ("I understand").
TACAN bearing signal, followed by finger-numerals.	•	Switch to TACAN station indicated.	Repeat and execute.
Hand held up. First and fourth fingers extended, moved in fore-and-aft chopping motion, followed by: 1. Four numbers. 2. Question signal. 3. Up or down signal.		1. Set up UHF/ADF on frequency indicated. 2. What is UHF/ADF bearing? 3. My UHF/ADF is up or down.	1. Repeat signal and execute. 2. Repeat chopping motion, followed by wait, or three numerals indicating magnetic bearing. 3. Thumbs up or nod ("I understand").
Two fingers pointed toward eyes (meaning IFF/SIF signals), followed by: 1. "CUT". 2. 3-digit numerals.		1. Turn IFF/SIF to "STANDBY". 2. Set mode and code indicated: first numeral-mode, second and third numerals - code.	Repeat, then execute.

FORMATION

SIGNAL		MEANING	RESPONSE
DAY	NIGHT		
Open hand held vertically and moved forward or backward, palm in direction of movement.		Adjust wing position forward or aft.	Wingman moves in direction indicated.
Open hand held horizontally and moved slowly up or down, palm in direction of movement.		Adjust wing position up or down.	Wingman moves up or down as indicated.
Open hand used as if beckoning inboard of pushing outboard		Adjust wing position laterally toward or away from leader.	Wingman moves in direction indicated.
Hand opened flat and palm down, simulating dive or climb.		I am going to dive or climb.	Prepare to execute.
Hand moved horizontally above glareshield, palm down.		Leveling off.	Prepare to execute.
Head moved backward.		Slow down.	Execute.
Head moved forward.		Speed up.	Execute.

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Figure 7-1 (Sheet 4 of 7)

VISUAL COMMUNICATIONS (CONTINUED)

FORMATION (CONTINUED)

SIGNAL		MEANING	RESPONSE
DAY	NIGHT		
Head nodded right or left.		I am turning right or left.	Prepare to execute.
Thumbs waved backward over shoulder.	Series of 00's in code, given by external lights.	Take cruising formation or open up.	Execute.
1. Holds up right (or left) forearm vertically, with clenched fist or single wing-dip.	1. Single letter R (or K) in code, given by external lights.	1. Wingman cross under to right (or left) echelon or in direction of wing-dips.	1. Execute.
2. Same as above, except with pumping motion or double wing-dip.	2. Series of RR's (or KK's) in code, given by external lights.	2. Section cross under to right (or left) echelon or in direction of wing-dips.	2. Execute.
Triple wing-dip		Division cross under.	Execute.
	Series of VV's in code, given by external lights.	Form a Vee or balanced formation.	Execute.
Series of zooms.	Series of XX's in code, given by external lights.	Close up or joinup; join up on me.	Execute.
Rocking of wings by leader.		Prepare to attack.	Execute preparation to attack.
Rocking of wings by any other member of flight.		We are being, or are about to be, attacked.	Stand by for and execute defensive maneuvers.
Lead plane swiches tail		All aircraft in this formation form step-down column in tactical order behind column leader.	Execute. Leader speeds up slightly to facilitate formation of column.
Shaking of ailerons.	Long dash, given with external lights.	Execute signal; used as required in conjunction with another signal.	Execute last signal given.

TAKEOFF, CHANGING LEAD, LEAVING FORMATION, BREAKUP, LANDING

SIGNAL		MEANING	RESPONSE
DAY	NIGHT		
1. Section takeoff– leader gives thumbs up.		1. I have completed my takeoff checklist and am ready for takeoff.	1. Stands by for reply from wingman.
2. Wingman gives thumbs up.		2. I have completed my takeoff checklist and am ready for takeoff.	2. Wingman stands by for immediate takeoff.
3. Leader nods head.		3. Takeoff path is clear, I am commencing takeoff.	3. Execute section takeoff.

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Figure 7-1 (Sheet 5 of 7)

VISUAL COMMUNICATIONS (CONTINUED)

TAKEOFF, CHANGING LEAD, LEAVING FORMATION, BREAKUP, LANDING (CONTINUED)

SIGNAL		MEANING	RESPONSE
DAY	NIGHT		
1. Leader pats self on the head, points to wing-	1. Lead aircraft switches lights to BRT/FLASH. 2. If external lights are inoperative, leader shines flashlight on hard—hat, then shines light on wingman.	Leader shifting lead to wingman.	1. Wingman pats head and assumes lead. 2. Wingman places lights on DIM/STDY and assumes lead. 3. Wingman shines flashlight at leader, then on his hard hat and assumes lead.
Leader pats self on head and holds up two or more fingers.		Leader shifting lead to division designated by numerals.	Wingman relays signal; division leader designated assumes lead.
Pilot blows kiss to leader.		I am leaving formation.	Leader nods ("I understand") or waves goodby.
Leader blows kiss and points to aircraft.		Aircraft pointed out leave formation.	Wingman indicated blows kiss and executes.
Leader points to wingman, then points to eye, then to vessel or object.		Directs plane to investigate object or vessel.	Wingman indicated blows kiss and executes.
Division leader holds up and rotates two fingers in horizontal circle, preparatory to breaking off.		Section break off.	Wingman relays signal to section leader. Section leader nods ("I understand") or waves goodby and executes.
Leader describes horizontal circle with forefinger.	Series of "I's" in code, given by external lights.	Breakup (and rendezvous).	Wingman take lead, pass signal after leader breaks, and follow.
Landing motion with open hand: 1. Followed by patting head. 2. Followed by pointing to another aircraft.		Refers to landing of aircraft, generally used in conjunction with another signal. 1. I am landing. 2. Directs indicated aircraft to land.	1. Nods. ("I understand") or waves goodby. 2. Aircraft indicated repeats signal, blows a kiss and executes.

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Figure 7-1 (Sheet 6 of 7)

VISUAL COMMUNICATIONS (CONTINUED)

ARMING AND DEARMING SIGNALS DEARMING

SIGNAL		MEANING	RESPONSE
DAY	NIGHT		
1. Arming supervisor: Hands over head.	Same	Pilot: Check all armament switches OFF and SAFE.	Pilot: Execute. Raise both hands to view of arming supervisor after checking switch positions. (Hands remain in view during check and hook-up.)
2. Arming supervisor points at crew member (used if applicable).	Same	Crew: Perform stray voltage checks.	Arming crew: Execute. Give arming supervisor THUMBS UP if no stray voltage exists.
3. Arming supervisor: raises fist, thumb extended upward, to meet horizontal palm of other hand.	Same	Arming crew: (as applicable). Hook up rocket pigtails and/or arm 20 MM's.	Arming crew: Execute. Give arming supervisor THUMBS UP when arming completed and clear immediate area.
4. Arming supervisor gives pilot:	Same		
a. Thumbs up		a. Aircraft is armed and all personnel and equipment clear of area.	a. Hold until arming crew clear of arming.
b. Thumbs down		b. Aircraft is down.	b. Return to line.

DEARMING

SIGNAL		MEANING	RESPONSE
DAY	NIGHT		
5. Dearming supervisor: Hands over head.	Same	Pilot: Check all armament switches OFF or SAFE.	Pilot: Execute. Raise both hands to view of dearming supervisor after checking switch positions. (Hands remain in view during dearming.)
6. Dearming supervisor points at crew member.	Same	Crew: Disconnect rocket pigtail and/or disconnect feed mech air supply hose, clear rounds from feed mech throat. (If jammed, also disconnect electrical lead to feed mech to disable firing circuit). Comply with appropriate local and technical instructions for the type armament concerned.	Crew: Execute.
7. Dearming supervisor give pilot: Thumbs-up.	Same	Pilot: Aircraft is dearmed and crew and equipment clear of aircraft.	Pilot: Hold until arming crew clear of arming area then return to line.

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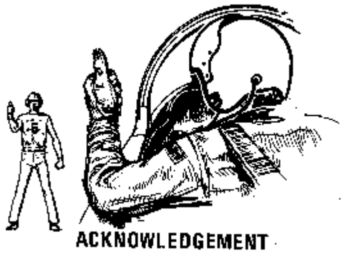
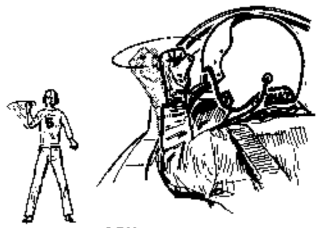
Figure 7-1 (Sheet 7 of 7)

DECK GROUND HANDLING SIGNALS



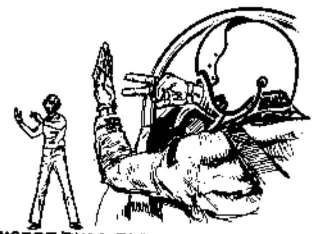
ACKNOWLEDGEMENT

A CLENCHED FIST WITH THUMB POINTING STRAIGHT UP INDICATES SATISFACTORY COMPLETION OF A CHECK ITEM. A CLENCHED FIST WITH THUMB POINTING STRAIGHT DOWN INDICATES UNSATISFACTORY COMPLETION AND/OR DO NOT CONTINUE.



APU RUN UP

PILOT MOVES CLENCHED FIST IN CIRCULAR MOTION IN VIEW OF SIGNALMAN.

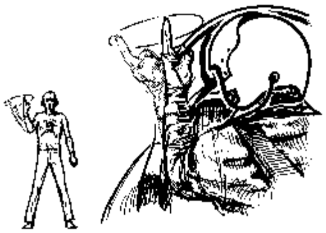


INSERT/PULL ELECTRICAL POWER

PILOT INSERTS/PULLS INDEX AND MIDDLE FINGER TO/FROM OPEN PALM. SIGNALMAN RESPONDS WITH SAME SIGNAL.

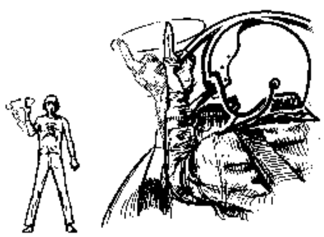
GROUND INTERCOM

CUP HANDS OVER EARS OR POINT WANDS TO EARS.



START ENGINE

IF ALL CLEAR, SIGNALMAN RESPONDS WITH SIMILAR GESTURE.



ENGINE RUN–UP

PILOT MOVES INDEX FINGER IN CIRCULAR MOTION INDICATING HE IS READY TO RUN UP ENGINE. SIGNALMAN RESPONDS WITH SIMILAR SIGNAL WHEN ALL CLEAR.

FINAL READY

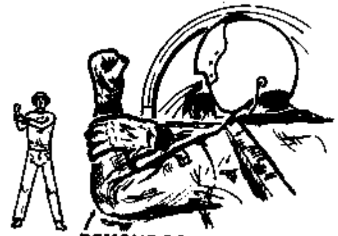
TWO FINGERS IN CIRCULAR MOTION

CUT ENGINE

HAND DRAWN ACROSS NECK IN "THROAT CUTTING" MOTION.

PULL CHOCKS

PILOT MAKES SWEEPING MOTION OF FISTS WITH THUMBS EXTENDED OUTWARD. SIGNALMAN SWEEPS FISTS APART AT HIP LEVEL WITH THUMBS EXTENDED OUTWARD.



REMOVE DOWNLOCKS

RIGHT HAND CLASPING LEFT WRIST

AM I CLEAR UNDERNEATH

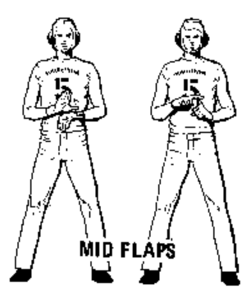
WITH LEFT HAND OPEN, PALM OUT, PILOT MAKES SWEEPING MOTION ACROSS COCKPIT FROM RIGHT TO LEFT.

ROTATE NOZZLES

FOREARM HELD VERTICALLY WHILE NODDING CLENCHED FIST FOLLOWED BY EXTENDING NUMBER OF FINGERS CORRESPONDING TO EACH 10° OF ROTATION.

LOWER WING FLAPS

HANDS FLAT TOGETHER, THEN OPENED WIDE FROM WRISTS. ARM IN CLOSE TO BODY.



MID FLAPS

LOWER MID FLAPS

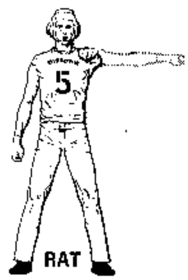
RAISE WING FLAPS

HANDS, OPENED WIDE FROM WRIST, SUDDENLY CLOSED, ARMS IN CLOSE TO BODY.

AV8A–1–(60–1)B

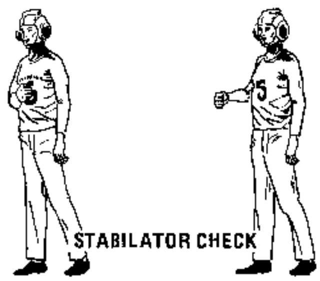
Figure 7–2 (Sheet 1 of 3)

DECK GROUND HANDLING SIGNALS (CONTINUED)



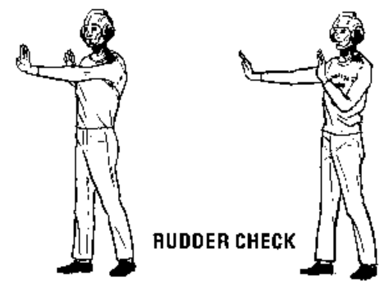
RIGHT ARM STRAIGHT AHEAD, FIST CLENCHED; SWINGS ARM 90° TO SIDE. REVERSE THE PROCEDURE FOR RETRACT.

EXTEND ARMS AT WAIST WITH PALMS TOGETHER. KEEP WRISTS TOGETHER AND OPEN PALMS.



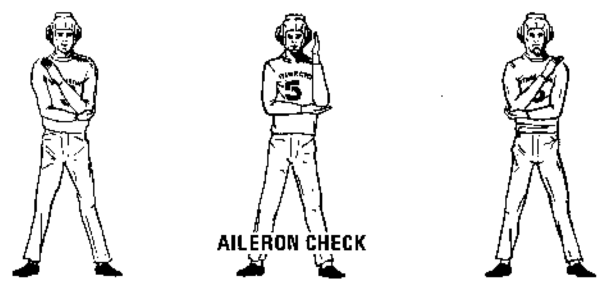
STICK AFT
LEADING EDGE DOWN

STICK FWD
LEADING EDGE UP



LEFT RUDDER IN
RUDDER SWINGS LEFT

RIGHT RUDDER IN
RUDDER SWINGS RIGHT



LEFT STICK
RIGHT AILERON DOWN

NEUTRAL STICK
AILERON UP

RIGHT STICK
LEFT AILERON DOWN

HOLD THE INDEX AND MIDDLE FINGER IN A "V" SIGNAL POINTING TOWARDS THE EYES.

HOLD HAND WITH INDEX FINGER EXTENDED AND POINT TOWARDS HEAD AND WITHDRAW FINGER.

RIGHT INDEX FINGER POINTING TO RIGHT SIDE OF NOSE FOR RIGHT TURN AND VICE VERSA FOR LEFT TURN; OPPOSITE HAND POINTING TO NOSE GEAR.

AV8A-1-(50-2)

Figure 7-2 (Sheet 2 of 3)

DECK GROUND HANDLING SIGNALS (CONTINUED)

COME AHEAD

HANDS AT EYE LEVEL. EXECUTE MOTION; RATE OF MOTIONS INDICATES DESIRED SPEED OF AIRCRAFT. FOR NIGHT OPERATION, WAVE WANDS SIDE TO SIDE.

RIGHT TURN

PULL DESIRED WING AROUND WITH REGULAR "COME AHEAD". POINT AT OPPOSITE BRAKE.

LEFT TURN

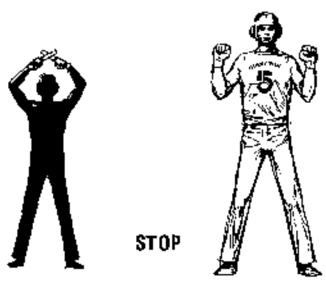
PULL DESIRE WING AROUND WITH REGULAR "COME AHEAD". POINT AT OPPOSITE BRAKE.

TURNOVER OF COMMAND

BOTH HANDS POINTED AT NEXT SUCCEEDING TAXI SIGNALMAN

SLOW DOWN

DOWNWARD PATTING MOTION, HANDS OUT AT WAIST LEVEL



STOP

ARMS UPRAISED, FISTS CLENCHED AND HELD IN SIMPLE "POLICEMAN'S STOP".

EMERGENCY STOP

ARMS CROSSED ABOVE HEAD FISTS CLENCHED

REVERSE THRUST TAXI

PALMS FACING AIRCRAFT AT EYE LEVEL WITH A PUSHBACK MOTION. FOR TURNS, THE DIRECTOR POINTS IN DIRECTION TAIL IS TO MOVE.

HOT BRAKES

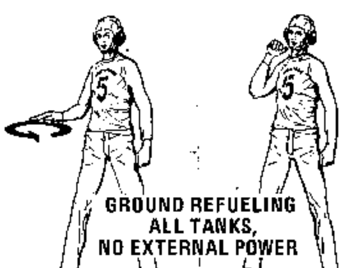
MAKE RAPID FANNING MOTION WITH ONE HAND IN FRONT OF FACE, POINT TO WHEEL WITH OTHER HAND.

ARM WATER

FIVE FINGER TURN-UP

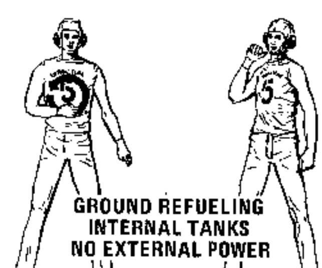
ENGINE FIRE

DESCRIBE A LARGE FIGURE EIGHT WITH ONE HAND AND POINT TO THE FIRE AREA WITH THE OTHER HAND.



GROUND REFUELING ALL TANKS, NO EXTERNAL POWER

CIRCULAR MOTION PARALLEL TO THE HORIZON WITH ONE HAND EXTENDED FOLLOWED BY A DRINKING MOTION (THUMB TO MOUTH).



GROUND REFUELING INTERNAL TANKS NO EXTERNAL POWER

CIRCULAR MOTION WITH THE PALM OF HAND TOWARD STOMACH (AS RUBBING STOMACH) FOLLOWED BY A DRINKING MOTION (THUMB TO MOUTH).

NIGHT SIGNALS

NIGHT SIGNALS ARE THE SAME AS DAY SIGNALS EXCEPT AS NOTED. FLASHLIGHTS OR WANDS WILL SUBSTITUTE FOR HAND AND FINGER MOVEMENTS DURING NIGHT OPERATIONS.

DECK PERSONNEL COLOR CODING

REFER TO CVA/CVS NATOPS MANUAL

AV8A-1-(50-3)B

Figure 7-2 (Sheet 3 of 3)

SECTION VIII

WEAPON SYSTEMS

TABLE OF CONTENTS

BOMB RELEASE SYSTEM

DESCRIPTION

The bomb release system consists of weapon controls in the cockpit, suspension equipment required for carrying the bombs/rockets, and control circuits for releasing/firing the weapons. The primary weapon release controls are on the weapon control panel, the Sidewinder control panel, and the control stick. These controls enable the pilot to select and arm a specific weapon, establish a release sequence, and release/fire the selected weapon. Suspension equipment for carrying weapons may be installed on five non-jettisonable pylons. Refer to the Tactical Manual (NAVAIR 01-AV8A-1T) for detailed description of the weapon release controls, suspension equipment, and procedures for releasing/firing the weapons.

GUN FIRING SYSTEM

DESCRIPTION

Two non-jettisonable 30 mm gun pods may be installed on the lower sides of the aircraft fuselage. Each gun pod may be loaded with 130 rounds of ammunition and utilized for air-to-ground or air-to-air gunnery. Gun aiming symbols are presented on the head-up display combining glass. Controls required for operating the guns consist of the gun selector switches on the weapon control panel and the gun trigger and safety catch on the control stick. Additional controls provided for selecting head-up display aiming symbols and performing target ranging include the phase change trigger on the hand controller, the wingspan setting knob on the head-up display control panel, and the throttle twist grip. Refer to the Tactical Manual (NAVAIR 01-AV8A-1T) for detailed description of the gun pods, controls, and procedures for employing the guns in an air-to-ground or air-to-air role.

HEAD-UP DISPLAY SYSTEM

DESCRIPTION

The head-up display (HUD) system obtains information from various inertial navigation and attack system (INAS) units and projects the information onto a combining glass in front of the pilot. The data projected onto the combining glass includes navigational information and aiming symbols for weapon delivery. Primary controls for the HUD are on the HUD control panel. Additional controls are provided on the reversionary sight/nose camera control panel. Refer to Navigation Equipment in section I for navigational functions of the HUD and for operating procedures. Refer to the Tactical Manual (NAVAIR 01-AV8A-1T) for detailed description of the HUD, controls, HUD symbols, and procedures for utilizing the HUD in the weapon aiming phases of operation.

INAS WEAPON AIMING

DESCRIPTION

INAS weapon aiming provides the pilot with information required for accurate weapon delivery. Weapon aiming is accomplished through the use of a weapon aiming computer, ballistic plugs, and a hand controller. The weapon aiming computer solves the weapon aiming problems based on ballistic plug inputs and information received from associated inertial navigation and attack system (INAS) units. The weapon aiming computer also provides release pulses for automatic weapon release. Associated INAS equipment utilized to provide data for the weapon aiming computations include the inertial platform, present position computer, navigation and display computer, air data computer, C2J gyro-magnetic compass, navigator control, and hand controller. Weapon aiming symbols are presented to the pilot on the HUD combining glass. Refer to the Tactical Manual (NAVAIR 01-AV8A-1T) for detailed description of the weapon aiming system and procedures for weapon delivery.

MISSILE SYSTEM

DESCRIPTION

Two AIM-9 Sidewinder missiles may be carried on the outboard pylons to provide an additional air-to-air attack capability. Operating controls and indicators for the AIM-9 missiles are on the Sidewinder control panel, the left glare shield, and the control stick. Aiming symbols for missile firing are presented to the pilot on the HUD combining glass. Refer to the Tactical Manual (NAVAIR 01-AV8A-1T) for detailed description of the AIM-9 missiles and controls, employment considerations, and missile firing procedures.

RECORDING SYSTEMS

NOSE CAMERA

A side looking camera is installed in the nose of the aircraft, and enables low altitude photographic reconnaissance. Controls and indicators for the nose camera are on the reversionary sight/camera control panel and the control stick. Refer to the Tactical Manual (NAVAIR 01-AV8A-1T) for detailed description of the nose camera, nose camera controls, and camera operating procedures.

HUD CAMERA

The HUD camera clips onto a mounting plate at the rear end of the HUD unit, and records the field of view visible through the HUD combining glass. Refer to the Tactical Manual (NAVAIR 01-AV8A-1T) for detailed description of the HUD camera, controls, and operating procedures.

SINGLE-POINT SIGHT

DESCRIPTION

The single-point sight is installed on the left side of the HUD combining glass. The single-point sight is a manually adjustable sight with an aiming dot. The sight does not require any aircraft power. Refer to the Tactical Manual (NAVAIR 01-AV8A-1T) for detailed description of the single-point sight and for operational applications.

SECTION IX
FLIGHT CREW COORDINATION

This section is not applicable.

SECTION X
NATOPS EVALUATION

TABLE OF CONTENTS

NATOPS EVALUATION PROGRAM

CONCEPT

The standard operating procedures prescribed in this manual represent the optimum method of operating the AV–8A aircraft. The NATOPS Evluation is intended to evaluate compliance with NATOPS procedures by observing and grading individuals and units. This evaluation is tailored for compatability with various operational commitments and missions of both Navy and Marine Corps units. The prime objective of the NATOPS Evaluation program is to assist the unit commanding officer in improving unit readiness and safety through constructive comment. Maximum benefit from the NATOPS Program is achieved only through the vigorous support of the program by commanding officers as well as pilots.

IMPLEMENTATION

The NATOPS Evaluation program shall be carried out in every unit operating naval aircraft. Pilots desiring to attain/retain qualification in the AV–8A shall be evaluated initially in accordance with OPNAV Instruction 3510.9 series, and at least once during the twelve months following initial and subsequent evaluations. Individual and unit NATOPS Evaluations will be conducted annually; however, instruction in and observation of adherence to NATOPS procedures must be on a daily basis within each unit to obtain maximum benefits from the program. The NATOPS Coordinators, Evaluators, and Instructors shall administer the program as outlined in OPNAVINST 3510.9 series. Evaluees who receive a grade of Unqualified on a ground or flight evaluation shall be allowed 30 days in which to complete a re–evaluation. A maximum of 60 days may elapse between the date the initial ground evaluation was commenced and the date the flight evaluation is satisfactorily completed.

DEFINITIONS

The following terms, used throughout this section, are defined as to their specific meaning within the NATOPS program.

NATOPS EVALUATION

A periodic evaluation of individual pilot standardization consisting of an open book examination, a closed book examination, an oral examination, and a flight evaluation.

NATOPS RE–EVALUATION

A partial NATOPS Evaluation administered to a pilot who has been placed in an Unqualified status by receiving an Unqualified grade for any of his ground examinations or the flight evaluations. Only those areas in which an unsatisfactory level was noted need be observed during a re–evaluation.

QUALIFIED

Well standardized; evaluee demonstrated highly professional knowledge of and compliance with NATOPS standards and procedures; momentary deviations from or minor omission in non–critical areas are permitted if prompt and timely remedial action is initiated by the evaluee.

CONDITIONALLY QUALIFIED

Satisfactorily standardized; one or more significant deviations from NATOPS standards and procedures, but no errors in critical areas and no errors jeopardizing mission accomplishment or flight safety.

UNQUALIFIED

Not acceptably standardized; evaluee fails to meet minimum standards regarding knowledge of and/or ability to apply NATOPS procedures, one or more significant deviations from NATOPS standards and procedures which could jeopardize mission accomplishment or flight safety.

AREA

A routine of preflight, flight, or postflight.

SUB-AREA

A performance sub-division within an area, which is observed and evaluated during an evaluation flight.

CRITICAL AREA/SUB-AREA

Any area or sub-area which covers items of significant importance to the overall mission requirements, the marginal performance of which would jeopardize safe conduct of the flight.

EMERGENCY

An aircraft component, system failure, or condition which requires instantaneous recognition, analysis, and proper action.

MALFUNCTION

An aircraft component or system failure or condition which requires recognition and analysis, but which permits more deliberate action than that required for an emergency.

GROUND EVALUATION

GENERAL

Prior to commencing the flight evaluation, an evaluee must achieve a minimum grade of Qualified on the open book and closed book examinations. The oral examination is also part of the ground evaluation but may be conducted as part of the flight evaluation. To assure a degree of standardization between units, the NATOPS instructors may use the bank of questions contained in this section in preparing portions of the written examinations.

OPEN BOOK EXAMINATION

The open book examination shall consist of, but not be limited to, the question bank. The purpose of the open book examination portion of the written examination is to evaluate the pilot's knowledge of appropriate publications and the aircraft.

CLOSED BOOK EXAMINATION

The closed book examination may be taken from, but not limited to, the question bank and shall include questions concerning normal/emergency procedures and aircraft limitations. Questions designated critical will be so marked.

ORAL EXAMINATION

The questions may be taken from this manual and drawn from the experience of the Instructor/Evaluator. Such questions should be direct and positive and should in no way be opinionated.

COT/WST PROCEDURES EVALUATION

A COT may be used to assist in measuring the pilot's efficiency in the execution of normal operating procedures and his reaction to emergencies and malfunctions. In areas not served by the COT facilities, this may be done by placing the pilot in an aircraft and administering appropriate questions.

NAMT SYSTEMS CHECK

If desired by the individual squadron, Naval Air Maintenance Trainer facilities may be utilized to evaluate pilot knowledge of aircraft systems and normal and emergency procedures.

GRADING INSTRUCTIONS

Examination grades shall be computed on a 4.0 scale and converted to an adjective grade of Qualified or Unqualified.

Open Book Examination

To obtain a grade of Qualified, an evaluee must obtain a minimum score of 3.5.

Closed Book Examination

To obtain a grade of Qualified, an evaluee must obtain a minimum score of 3.3.

Oral Examination and OFT Procedure Check (If Conducted)

A grade of Qualified or Unqualified shall be assigned by the Instructor/Evaluator.

FLIGHT EVALUATION

GENERAL

The flight evaluation may be conducted on any routine syllabus flight with the exception of flights launched for SCTLP/SHIPQUAL training. Emergencies will not be simulated.

NOTE

The number of flights required to complete the flight evaluation should be kept to a minimum; normally one flight. The areas and sub-areas to be observed and graded on a flight evaluation are outlined in the grading criteria with critical areas marked by an asterisk (*). Sub-area grades will be assigned in accordance with the grading criteria. These sub-areas shall be combined to arrive at the overall grade for the flight. Area grades, if desired, shall also be determined in this manner. At the discretion of the squadron or unit commander, the evaluation may be conducted in a WST, OFT, or COT.

FLIGHT EVALUATION

The areas and sub-areas in which pilots may be observed and graded for adherence to standarized operating procedures are outlined in the following paragraphs.

NOTE

- If desired, units with training missions may expand the flight evaluation to include evaluation of standarized training methods and techniques.
- The IFR portions of the Flight Evaluation shall be in accordance with the procedures outlined in the NATOPS Instrument Flight Manual.

MISSION PLANNING/BRIEFING

a. Flight Planning.
b. Briefing.
c. Personal Flying Equipment (*)

PREFLIGHT/LINE OPERATIONS

Inasmuch as preflight/line operations procedures are graded in detail during the ground evaluation, only those areas observed on the flight check will be graded.

a. Aircraft Acceptance
b. Start
c. Before Taxiing Procedures

TAXI/RUN UP

TAKEOFF/TRANSITION (*)

a. ATC Clearance
b. Takeoff
c. Transition

CLIMB/CRUISE

a. Departure
b. Climb and Level-Off
c. Procedures Enroute

APPROACH/LANDING (*)

a. Radar, ADF
b. Recovery

COMMUNICATIONS

a. R/T Procedures
b. Visual Signals
c. IFF Procedures

EMERGENCY/MALFUNCTION PROCEDURES (*)

In this area, the Pilot will be evaluated only in the case of actual emergencies, unless evaluation is conducted in the COT/WST.

POST FLIGHT PROCEDURES

a. Taxi-in
b. Shutdown
c. Inspection and Records
d. Flight Debriefing

MISSION EVALUATION

This area includes missions covered in the NATOPS Flight Manual, AV-8A Tactical Manual, and NWP NWIP's for which standardized procedures/techniques have been deployed.

APPLICABLE PUBLICATIONS

The NATOPS Flight Manual contains the standard operations criteria for AV-8A aircraft. Publications relating to environmental procedures peculiar to shorebased and shipboard operations and tactical missions are AV-8A Tactical Manual, NWP's, NWIP's, ATC/CATCC Manual, Local Air Operations Manual, and Ship Air Operations Manual.

FLIGHT EVALUATION GRADING CRITERIA

Only those sub-areas provided or required will be graded. The grades assigned for a sub-area shall be determined by comparing the degree of adherence to standard operating procedures with adjectival ratings listed below. Momentary deviations from standard operating procedures should not be considered as unqualifying provided such deviations do not jeopardize flight safety and the evaluee applies prompt corrective action.

FLIGHT EVALUATION GRADE DETERMINATION

The following procedure shall be used in determining the flight evaluation grade: A grade of Unqualified in any critical area/sub-area will result in an overall grade of Unqualified for the flight. Otherwise, flight evaluation (or area) grades shall be determined by assigning the following numerical equivalents to the adjective grade for each sub-area. Only the numerals 0, 2 or 4 will be assigned in sub-area. No interpolation is allowed.

Unqualified	0.0
Conditionally qualified	2.0
Qualified	4.0

To determine the numerical grade for each area and the overall grade for the flight, add all the points assigned to the sub-areas and divide this sum by the number of sub-areas graded. The adjective grade shall then be determined on the basis of the following scale.

0.0 to 2.19 – Unqualified
2.2 to 2.99 – Conditionally Qualified
3.0 to 4.0 – Qualified

EXAMPLE: (Add Sub-area numerical equivalents)

$(4+2+4+2+4) \div 5 = 3.20$ Qualified

FINAL GRADE DETERMINATION

The final NATOPS Evaluation grade shall be the same as the grade assigned to the flight evaluation. An evaluee who receives an Unqualified on any ground examination or the flight evaluation shall be placed in an Unqualified status until he achieves a grade of Conditionally Qualified or Qualified on a re-evaluation.

RECORDS AND REPORTS

A NATOPS Evaluation Report (OPNAV Form 3510-8) shall be completed for each evaluation and forwarded to the evaluee's commanding officer only. This report shall be filed in the individual flight training record and retained therein for 18 months. In addition, an entry shall be made in the pilot flight log book under "Qualifications and Achievements"

CRITIQUE

The critique is the terminal point in the NATOPS evaluation and will be given by the Evaluator/Instructor administering the check. Preparation for the critique involves processing, reconstructing data collected, and oral presentation of the NATOPS Evaluation Report. Deviations from standard operating procedures will be covered in detail using all collected data and worksheets as a guide. Upon completion of the critique, the pilot will receive the completed copy of the NATOPS Evaluation Report for certification and signature. The completed NATOPS Evaluation Report will then be presented to the Unit Commanding Officer.

NATOPS EVALUATION QUESTION BANK

The following bank of questions is intended to assist the unit NATOPS Instructor/Evaluator in the preparation of ground examinations and to provide an abbreviated study guide. The questions from the bank may be combined with locally originated questions in the preparation of ground examinations. The closed book exam will consist of no less than 50 questions. The time limit for the closed book exam is 1 hour and 30 minutes. The requirements for the open book exam are the same as those for the closed book exam, except there is no time limit.

AV-8A NATOPS QUESTION BANK

GENERAL KNOWLEDGE

1. The full nozzle braking position is ____ degrees forward of the hover stop.

   a. 81 1/2
   b. 17 1/2
   c. 98 1/2
   d. None of the above

2. The nozzles are driven by the;

   a. Fan
   b. Compressor
   c. Air motors driven by fan compressor air
   d. Air motors driven by compressor air

3. The approximate aircraft operating weight is ____ pounds.

   a. 12,000
   b. 12,155
   c. 12,455
   d. None of the above

4. The RAT can provide hydraulic power for conventional flight through either system should both PC-1. and PC-2 fail. T/F

5. Reaction control valves use air from the ____ to give control during slow speed and hovering flight.

   a. Compressor
   b. Combustion Chamber
   c. Fan
   d. Compressor and/or fan depending on demand

6. The effective range of the UHF standby radio at 10,000 feet is;

   a. 50 NM
   b. 75 NM
   c. 100 NM
   d. Depends on the radio

7. The Warning/Caution/Indicator lights are inoperative when the LP fuel shutoff is off. T/F

8. The red OXY warning light on the warning and caution light panel comes on when;

   a. The oxygen level drops below 2 liters
   b. The PEC is not selected and the engine is started
   c. The oxygen pressure drops below 50 psi
   d. The demand regulator has a broken diaphragm

9. What does an OXY warning light indicate?

10. Breathing will be possible with NORM selected on the mask regulator and the oxygen supply depleted. T/F

11. With emergency oxygen selected manually, are any other oxygen system management procedures required?

12. The oxygen contents gauge is;

    a. Electrically operated
    b. Pressure operated
    c. Operates only if the OXY shut-off valve is open
    d. None of the above

13. How can "Flood Flow" be manually selected and when is it automatically selected?

14. Besides cockpit environmental services, what other items are served by the air conditioning system?

15. You get an EQUIP caution light - what should you do to cancel it and if unsuccessful what further action is required?

16. At what fuel state do the bingo lights illuminate? Flash?

17. What happens if you push the long term cancel?

18. The IFF caution light is inoperative unless MODE 4 is incorporated. T/F

19. What switch settings are required to use the standby UHF on guard frequency powered by the emergency (No. 3) battery?

20. What provides the heading reference when "HDGM" is selected on the lookup counters in the NDC?

21. What pressure must be set on the HUD control panel before conducting the ADC check?

22. What HUD mode should be used for take-off and landings?

23. The standby gyro can be erected in flight. T/F

24. If the power to the ADD fails what will the instrument read?

25. The aircraft is parked with two 120 gallon drop tanks fitted -

    a. How can these tanks be made safe regardless of cockpit switches?

    b. With all external devices removed, what switch selections are required to drop the tanks?

26. The operating weight of the AV-8A (clean) is _______ lb.

27. Hover weight should always be computed prior to flight. T/F

28. Briefly explain how intake momentum drag contributes to instability during V/STOL flight.

29. In what approximate speed range is the aircraft directionally unstable? Above what nozzle angle does the aircraft exhibit dynamic longitudinal instability?

30. Due to the normal dihedral effect sideslip will cause rolling moments. What other conditions will aggrevate this?

31. If the airplane is sideslipping right i.e. vane pointing right/right RPS, what will happen if a left bank is initiated?

32. Give two symptoms of slideslip build-up?

33. Give two guides as to which rudder to apply in an undesirable sideslipping condition.

34. Each rudder pedal shaker has its own motor therefore it is possible to have only one shaker operative. T/F

35. Rudder shakers cut in at ____ knots.

36. The HUD sideslip indicator, the rudder shaker and the yaw stab system all get inputs from the same lateral accelerometer. T/F

EJECTION

37. How many pins should you remove from the seat prior to flight and replace after flight?

38. Auto separation is set at 10,000 feet on the ejection seat. T/F

39. After an aborted take-off, you find yourself in an upright flaming wreck. Should you open the canopy manually or use the MDC? Why?

40. The manual separation handle is on the starboard side of the seat. T/F

41. What are the recommended controlled ejection conditions?

42. You wish to clear the seat and aircraft due to a fire on start. What do you do? (Essential actions).

43. Due to battle damage you notice your rocket firing line has been sheared. At 5000 feet you are forced to abandon. Can you eject?

ELECTRICAL SYSTEM (DUAL GENERATOR SYSTEM)

44. If either generator fails the ____ is automatically taken over by the remaining generator.

    a. No. 2 system
    b. The system with the priority load
    c. No. 1 system
    d. Standing loads

45. The XFMR-RECT supply ____ to the two electrical sub-systems.

    a. 24V DC
    b. 24V AC
    c. 28V DC
    d. Whatever DC is required at the time

46. If either XMFR-RECT fails the ____ is supplied by the remaining XMFR-RECT.

    a. No. 2 bus-bar DC
    b. No. 2 bus-bar AC
    c. Both of the above
    d. No. 1 bus-bar AC

47. The emergency DC bus is supplied by a;

    a. 24V, 2.5 amp/hr battery
    b. 24V, 4 amp/hr battery
    c. The No. 2 XFMR-RECT
    d. a and c above

48. The APU can charge the batteries by running the No. 1 AC generator. T/F

49. The warning and caution light panel is inoperative when external power is connected. T/F

50. What equipment should be turned off if only a DC caution light appears?

    a. ____________
    b. ____________
    c. ____________

51. When the AC warning light illuminates, the standby gyro is of no further use. T/F

52. What supplies power to the DC buses?

53. What caution lights will immediately illuminate with an AC-1 failure?

54. What caution lights will immediately illuminate with an AC-2 failure?

55. Electrical power is not required for emergency operation of the landing gear. T/F

56. Name three services powered by the emergency battery through separate switches.

57. What actions are required if the DC warning light illuminates?

58. All radios will be inoperative if both the DC warning and caution lights are illuminated. T/F

59. What vital two parts of the secondary instruments are affected by an AC failure?

60. The master armament switches are "hot" with the batteries off? T/F

61. What are the possible power sources for the artificial horizon?

ENGINE

62. The IGV position is controlled by____

a. Fuel pressure and intake air temperature
b. Intake temperature and compressor RPM
c. Fan RPM and ICAO conditions
d. By the throttle below 80% rpm and fuel pressure above 80%

63. RPM will increase approximately 1% per 1000 feet during a climb when in manual fuel control. T/F

64. The intake suction doors operate only above 250 knots and are spring loaded closed during hovering and slow flight. T/F

65. When selecting manual fuel the throttle should be in the idle detent. T/F

66. The HP fuel pump helps determine engine RPM by the amount of fuel it delivers. T/F

67. The fan mechanical governor controls engine speed during steady running in excess of 85% RPM at sea level conditions. T/F

68. The primary function(s) of the PRL is to;

a. Limit surge at high RPM
b. Limit surge at low temperatures
c. To reduce RPM as intake temp falls
d. All of the above
e. None of the above

69. After the throttle is pushed hard against the limiter switch the limiters;

a. Automatically reset when the throttle is withdrawn
b. Can only be reset on the ground
c. Can be reset manually by resetting the switch
d. Can be reset only after the PRL is reset by pushing the relight button

70. The LP mechanical governor maintains engine speed during steady running in excess of 85% RPM at sea level conditions. T/F

71. Max thrust JPT limit is

a. 625°
b. 615° ±10°
c. 610°

72. The airstart button must be held down to keep the ignitors on the line. T/F

73. After initiating a penetration descent with 65% the RPM will drop with a fixed throttle. T/F

74. What limiter systems are installed to protect the engine?

75. Which limiter compensates for altitude effects for surge?

76. What actions can cause automatic fuel system datum cut-back?

77. What cockpit indication is provided for water injection water flow?

78. What does the action of arming the water injection switch result in?

79. An oil warning light coming on indicates?

a. Low oil pressure
b. Low oil quantity
c. Either a or b

80. What is the primary instrument to be monitored during and after experiencing a compressor stall?

81. You are flying IFR conditions at high altitude and experience a compressor stall. After retarding the throttle to idle you note your JPT stabilized at 600° and your RPM at 34%. The correct procedure to follow would be to leave everything as is until descending to VFR conditions (if possible) since you are not exceeding any JPT limits and your INAS system is still on the line. Once VFR, shut the engine down and perform an airstart when in envelope. T/F

82. Approximately what duct pressure should you read with the nozzles at 20° and 55% RPM (Trim 0, 0, 2 ND)?

83. What will happen if the PRL is inoperative and RPM limits are ignored? What is the maximum RPM above 35,000 ft with the PRL inoperative?

84. Below what OAT must the pilot manually control max RPM in the takeoff and landing pattern?

a. WET (°C)
b. DRY (°C)

85. After bringing the throttle around the horn during an airstart it is noted that the fuel flow indicator reads zero. Further attempts at airstarts are futile and pilot attention should be directed to looking for a safe ejection area. T/F

86. If you are flying at high speed below 10,000 feet and open the throttle the RPM will govern initially at 96%. T/F

87. The engine can not be relit once the fire extinguisher button has been depressed. T/F

88. If you are doing a STO using short lift dry power and you raise the gear and move the nozzle lever fully forward, what will happen?

89. Give two effects which result in JPT rise in V/STOL.

90. Why is the use of water injection limited to +5°C minimum?

91. What could happen if you did not reduce RPM during a pushover entry into a steep dive at 40,000 feet while cruising at .97 IMN?

92. What immediate action would you take with a high altitude surge? If this does not correct a JPT rise what further action is required?

93. What is the greatest engine hazard during V/STOL operations from unprepared sites? Why should the stabilator angle be greater than +2° (nose down) to reduce this?

94. What do you do if you suspect a limiter malfunction?

a. In V/STOL flight?
b. In conventional flight?

95. What is the airstart procedure?

96. During a decelerating transition with the power set at 96% RPM you select water injection on. What indications will you have of governor shift and water flowing?

97. During start JPT rise is slow and progressive to ____ degrees and idling stabilizes at ____ RPM in ____ seconds.

a. 300-400; 25%; 60
b. 300-400; 25-27%; 60
c. 400-450; 25-27%; 60
d. 300-400; 25-28%; 40-50

98. If a locked surge condition is encountered, the engine must be shut down immediately to avoid turbine failure. T/F

99. When water injection is selected ON, an RPM rise of 3-4% will occur. T/F

100. To avoid overheating the APU, not more than ____ attempts must be made in any ____ minute period.

a. 3 in 20 min
b. No limit if JPT is below 200°C
c. 3 attempts no time limit
d. No limit at ICAO conditions

101. If main engine start has not been estabilished within 15 seconds the APU will automatically shut down. (Switch on start). T/F

102. After an unsuccessful starting attempt (either main engine or APU ground run) the APU mode selector must be set to ____ before attempting another start.

a. Start
b. Ground Run
c. Reset
d. Off
e. Restart before another start attempt is made

103. Normal lift rating is available for ____ minutes in addition to short lift rating of ____ seconds.

a. 2 1/2; 15
b. 2; 30
c. 2 1/4; 30
d. 2 1/4; 15

104. If the water tank empties during "wet" lift the JPTL automatically resets to dry datum with a resultant loss of thrust. T/F

105. The three datums of the JPTL are; (1) max thrust rating 610° (conv flight), (2) short lift dry rating (15 sec), 715°C, (3) short lift wet rating (15 sec), 745°C. T/F

106. The JPTL is automatically reset to wet left (short lift) if;

a. The water tank is full enough to allow 15 sec at the wet rating
b. The water switch is turned on
c. Water pressure is 240 psi and the water injection switch is on

107. The JPTL is automatically changed to short lift datum as the nozzles pass 16° down from the horizontal. T/F

108. The STO stop on the nozzle control lever can be overridden by lifting the nozzle lever over the stop. T/F

109. The JPTL max thrust datum is 735°C/96.5% RPM. T/F

110. The methyl-bromide fire extinguisher is inoperative if the No. 2 battery is not on. T/F

FLIGHT CONTROLS

111. The ADC removes power to the autostabs at 250 ±10 knots. T/F

112. Above 250 knots with the main stabilator trimmer inoperative out-of-trim forces can be reduced by;

    a. Increasing speed to above 250 knots and use the autostab
    b. Switching to Q feel OFF
    c. Lowering the speedbrake if a nose-down trim is encountered
    d. Lower the nozzles to 16° to increase the duct pressure

113. If the nozzles are lowered with a low duct pressure an excessive nose-down trim change occurs. T/F

114. What two methods can be used to activate the nose wheel steering?

115. The selection of permanent NWS causes the loss of anti-skid. T/F

116. The anti-skid system will be lost with a PC-1 failure. T/F

117. What is the minimum operating speed for the anti-skid system?

118. All AV-8A aerodynamic control surfaces are hydraulically powered and irreversible. T/F

119. At what trim setting is the front reaction control duct closed?

120. During a decelerating transition, an excessive nose up trim change is noted when the nozzles are lowered. What gauge should be immediately checked?

121. The yaw stab is checked by pressing the yaw test button and insuring that the rudder trim needle moves in the same direction as the lateral displacement of the stick. T/F

122. Lowering of full flaps below 250 knots will engage the yaw system regardless of landing gear position. T/F

123. What action(s) automatically cut-out the auto-stabs?

124. What action pressurizes the reaction control system?

125. What are the minimum operating pressures for the nosewheel steering and wheel brakes (accumulator)?

FUEL SYSTEM

126. Fuel capacity of a clean airplane (JP5) is;

    a. 5560
    b. 5650
    c. 5150
    d. None of the above

127. Negative-G maneuvers should not be done at fuel states of less than;

    a. 150 lb per side
    b. 100 lb a side in level flight
    c. 500 lb total
    d. 300 lb a side

128. Unuseable fuel should be normally be considered as;

    a. 250 lb a side
    b. 300 lb total
    c. 150 lb a side
    d. 100 lb a side

129. The booster pumps are located in the;

a. Center tanks
b. Wing tanks
c. Compressor accessory drive
d. Rear tanks
e. Front tanks

130. If the PC-2 hydraulic system fails the RAT will continue to power the fuel proportioner if the failure is not due to a leak and/or loss of fluid. T/F

131. The AC operated fuel flow transmitter is completely accurate up to ICAO +15°C, but at higher temperature fuel expansion must be taken into consideration to acquire an accurate reading. T/F

132. The APU fuel is:

a. Self contained
b. Taken from the port aircraft supply therefore the port booster pump must be on when starting
c. Taken from the starboard aircraft supply
d. From the port rear tank

133. The green air-to-air refueling lights indicate when;

a. The TANK DEPRESS switch is selected
b. The tanks have actually depressurized
c. The fuel transfer from the tanker is complete (aircraft is actually full)
d. Fuel is flowing into the aircraft

134. The fuel low level lights (bingo) come on at ____ lb a side and flash at ____ lb a side.

a. 650:250
b. 750:300
c. 750:250
d. 650:300

135. If the fuel proportioner fails or is off, you must;

a. Land immediately
b. Leave both booster pumps on
c. Extend the RAT and see if the PROP light goes out
d. Leave at least one booster pump on
e. None of the above

136. If a center tank is in danger of running dry, what precautions should be taken and why?

137. What switch if inadvertently turned on has the same effect as a double transfer failure?

138. You decide to dump some fuel. Will this show on the fuel remaining counter and or the gauges?

139. How do you balance fuel?

140. During inflight refueling you get a TOP warning light. What has happened? What action is required?

141. What will happen if you run a center fuel tank dry with the fuel proportioner on?

142. What are the indications and what do you do if you have a double transfer failure?

143. What indications will be observed in proper sequence if wing fuel fails to transfer?

144. During refueling what do the refueling lights indicate when they are steady? When they go out?

145. Down to what fuel state can you dump fuel?

LIMITATIONS

146. Above 10,000 feet the RPM is controlled by the PRL to;

a. Short lift rating
b. 99-101% $N/\sqrt{\theta}$
c. 97%
d. PRL controls it below 10,000 feet, not above

147. Water injection should not be used at temperatures below ____ C.

a. 10°
b. 5°
c. 15°
d. -5°

148. The minimum ground idling speed is (cold);

a. 30%
b. 25-27%
c. 25%
d. 23%

149. Rapid rolling is not permitted above ____ knots/IMN?

150. What is the maximum number of degrees you can roll?

151. Maximum gross weight for landing is:

a. Prepared field?
b. Unprepared field?

152. If you can not remember the optimum jettison speed for the stores you are carrying, what one speed will allow you to jettison most AV-8A stores safely?

a. 175 knots
b. 250 knots
c. 350 knots
d. 450 knots

153. What are the crosswind limits for a VTO? VL? STO?

154. What is the maximum speed with the canopy open? Why should the canopy be kept closed for starting and when the engine is running?

155. What is the maximum AOA to be used during STOL flight?

156. What is the maximum speed with the Q feel OFF? Why?

157. What limitations are associated with the windshield wiper?

158. How many consecutive starting attempts can be made? What are the associated time limits?

159. If the JPT rises rapidly during start, set the ____ off by ____ degrees C.

a. LP lever; 590
b. Throttle; 400
c. LP lever; 300-400
d. Throttle; 450

160. The maximum landing weight (SL) with 12'/sec sink is;

a. 16,900 lb prepared surface
b. 14,700 lb unprepared surface
c. a and b
d. None of the above

161. Taxiing speed with the canopy open should be limited to;

a. No limit
b. 25 knots
c. 40 knots
d. 50 knots

162. During sustained engine operation under all except low temperatures the limiting ____ is reached on the engine before the limiting

a. RPM; JPT
b. JPT: RPM
c. Can't really tell which will come first
d. None of the above

163. What are the limitations associated with inflight nozzle vectoring?

164. What are maximum AS/IMN limits for:

a. Flap
b. Gear
c. Clean A/C
d. Full power dives

165. What are the "G" limits without stores:

a. Below .95 IMN?
b. Above .95 IMN?

EMERGENCY PROCEDURES

166. Max recommended height for engine airstart is ____ feet.

a. 40,000
b. 25,000
c. 27,000
d. 16,000

167. The best gliding speed for range is ____ .

a. 9 units AOA
b. 280 knots
c. 240 knots
d. 12 units AOA

168. The airstart button;

a. Must be held down as long as ignition is desired
b. Provides ignition for 30 sec after being pressed
c. Provides ignition for 15 sec after being pressed
d. Does not work above 40,000 feet

169. Flap position for glide is;

a. Mid-flap
b. Full-flap
c. No flap
d. Depends on aircraft gross weight

170. If max range is not essential you should glide at ____ and use ____ degree of bank to maneuver and maintain airspeed.

a. 250 knots; 45
b. 9 units AOA; 45
c. 12 units AOA; 45
d. 9 units AOA; 30

171. What three immediate actions should you take if the aircraft started an uncontrolled roll?

172. What is the spin recovery procedure?

173. During an emergency such as "fire on start" the APU can be shut down prematurely by;

a. Pressing the fire extinguisher button
b. LP lever off
c. Selector (APU) off
d. Throttle off; LP lever off

174. On the final approach of the precautionary approach keep speed above _____ knots until the flare.

a. 200
b. 160
c. 9 units AOA
d. 240

175. With a PC-2 failure and a functioning RAT the threshold speed should be a minimum of _____ knots to insure adequate PC-2 pressure.

a. 160
b. 150
c. 130
d. 190

176. With a loss of duct pressure only conventional flight is recommended. T/F

177. During ditching the canopy release should not be pulled until the aircraft has stopped moving. T/F

178. Fuel flow information will not be available during an airstart. T/F

179. Electrical power is required to activate the emergency gear extension. T/F

180. A vertical landing is preferred if any landing gear malfunction is suspected. T/F

181. The AV-8A should not be taxied after landing with a PC-1 failure. T/F

MISCELLANEOUS

182. Whenever the nozzles are deflected the stick should be trimmed forward of _____ stabilator trim.

a. 2°ND
b. 2°NU
c. None of the above

183. At low speed, directional control on the ground is solely dependent on

a. Nosewheel steering
b. The rudder
c. Nosewheel steering and reaction jets if nozzles are lowered
d. a and b above

184. The anti-skid does not work below 15 knots because at a slow speed the pilot can tell if he has locked the brakes. T/F

SECTION XI PERFORMANCE DATA

PART 1	DRAG NUMBERS, ALTIMETER POSITION ERROR CORRECTIONS, AND STANDARD USAGE CHARTS.	PART 1 INTRODUCTION
PART 2	ENGINE DATA FOR HOVER OPERATIONS.	PART 2 HOVER
PART 3	TAKEOFF CAPABILITIES: VERTICAL; ROLLING; SHORT; AND CONVENTIONAL TAKEOFF.	PART 3 TAKEOFF
PART 4	CLIMB SPEEDS, TIMES, FUEL, AND DISTANCES.	PART 4 CLIMB
PART 5	CRUISE SPEEDS, ALTITUDES, AND MACH NUMBERS.	PART 5 RANGE
PART 6	ENDURANCE TIMES, SPEEDS, AND ALTITUDES.	PART 6 ENDURANCE
PART 7	DESCENT SPEEDS, TIMES, RATES, AND DISTANCES.	PART 7 DESCENT
PART 8	LANDING SPEEDS AND DISTANCES FOR SHORT AND CONVENTIONAL LANDING. VERTICAL LANDING CAPABILITY.	PART 8 LANDING
PART 9	COMBAT POWER FUEL FLOW RATES AND NAUTICAL MILES PER POUND, DIVE RECOVERY, MAXIMUM PERFORMANCE ENVELOPES AND ACCELERATION.	PART 9 COMBAT PERFORMANCE

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PART 1
INTRODUCTION

Charts

This section is divided into parts (1 through 9) to present performance data in proper sequence for preflight planning. Two concepts of data presentation are utilized to show drag effects on aircraft performance; i.e., specific configuration charts and drag index charts. The drag index concept presents climb data, nautical miles per pound for cruise/endurance, and descents. All other data are presented as a specific-configuration per chart. All performance data is based on flight tests or the contractor's estimate, ICAO standard day conditions and/or provisions to correct for nonstandard temperatures, and the F402-RR-401 engine using JP-5 fuel.

NOTE

The indication of the fuel quantity indicators presents the readings of useable fuel weight. Fuel system sequencing and operation is automatic any time the engine is running and the tank depressurization switch is off. If transfer pressure fails, or is not available, the indicator(s) will display feed tank(s) fuel quantity only.

STATION LOADING

The Station Loading chart (figure 11-1) lists the individual weight, drag number, stations location and incremental center-of-gravity shift, of the various pylons, adapters, racks and external stores. It also lists the average operating weight with its corresponding center-of-gravity and the basic takeoff gross weight with its corresponding center-of-gravity for the airplane. The chart does not intend to list the quantity and total gross weight of the external stores that can be carried on each station. However, the takeoff gross weight and approximate takeoff center-of-gravity can be computed by referring to the Armament Attachment Association data (figure 11-1) and determining the various attachments necessary to carry the particular stores that are to be loaded. Next refer to the Station Loading chart to find the individual weights and incremental center-of-gravity shifts of the selected stores and attachments. Once the individual weights have been noted, multiply the individual weights by the quantity to be carried (this figure will be the total external store weight). The external store weight, added to the airplane basic takeoff weight will result in a close approximation of the takeoff gross weight. The takeoff center-of-gravity can be computed by adding the incremental center-of-gravity values for each station that the various pylons, adapters, racks and external stores are intended to be carried on. The summation of the center-of-gravity values, added or subtracted as necessary from the center-of-gravity corresponding to the basic takeoff weight will result in a close approximation of the actual takeoff center-of-gravity.

INCREMENTAL CG SHIFT

Sample Problem

Configuration: 2 - MK 81 LDGP bombs on aircraft stations 1 & 5
2 - MK 83 LDGP bombs on aircraft stations 2 & 4
1 - MK 82 Snakeye bomb on aircraft station 3

Estimated CG of 11.72% MAC (estimated operating weight plus weight of full internal fuel, guns, ammo, and full water with gear down).

A.	MK-82 LDGP (stations 1 & 5)	(+.27 x 2) = +0.54
B.	Suspension equipment (stations 1 & 5) O/B Pylons	(+.14 x 2) = +0.28
C.	MK-83 LDGP (stations 2 & 4)	(+.21 x 2) = +0.42
D.	Suspension equipment (stations 2 & 4) I/B Pylons	(+.07 x 2) = +0.14
E.	MK-82 Snakeye (station 3)	(-.67 x 1) = -0.67
F.	Suspension equipment (station 3) ℄ Pylon	(-.05 x 1) = -0.05
G.	Incremental CG shift	+0.60
H.	Estimated takeoff CG	(11.72% +0.66) = 12.38% M.A.C.

DRAG INDEX SYSTEM

Most of the charts utilize the drag index system to effectively present the many combinations of weight/drag effects on performance. The Station Loading chart (figure 11-1) contains the drag number and weight of each externally carried store and its associated suspension equipment. The drag index for a specific configuration may be found by multiplying the number of stores carried by its drag number, and adding the drag number of the applicable suspension equipment. The total drag index may then be used to enter the planning data charts. Charts applicable for all loads and configurations are labeled ALL DRAG

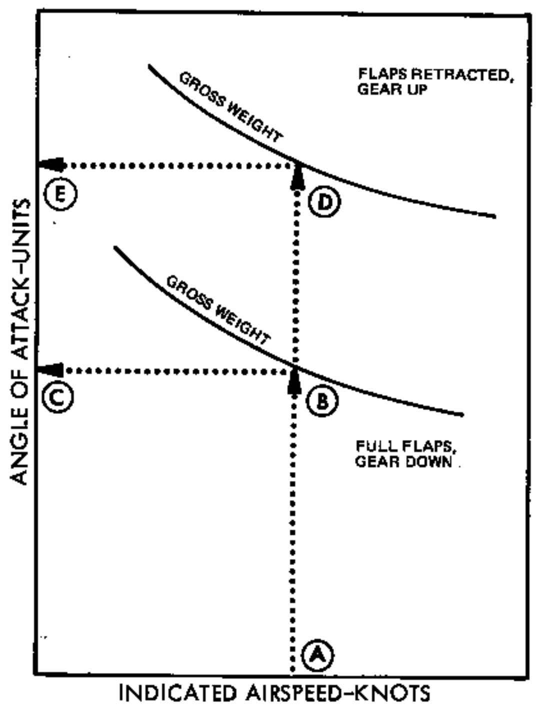
INDEXES. Charts labeled INDIVIDUAL DRAG INDEXES contain data for a range of drag numbers; i.e., individual curves/columns for a specific drag number.

Sample Problem

Configuration: 2 - Gun pods on fuselage
2 - 120 gallon fuel tanks on stations 2 & 4
2 - AIM-9 Missile on stations 1 & 5

A.	120-gal. tank drag number	2.6 x 2 =	5.20
B.	Inboard pylon drag number	1.25 x 2 =	2.50
C.	AIM-9 missile drag number	1.7 x 2 =	3.40
D.	Outboard pylon drag number	1.75 x 2 =	3.50
E.	Total drag index		14.60

SAMPLE ANGLE OF ATTACK CONVERSION



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ANGLE OF ATTACK CONVERSIONS

This chart (figure 11-4) presents the corresponding indicated angle of attack for various combinations of airspeed and gross weight. The data is based on stabilized 1 G level flight conditions with separate plots provided for the two different flap and landing gear settings.

USE

Enter applicable plot at the airspeed scale and project vertically to intersect the aircraft gross weight curve. From this point, project horizontally to the left to find the corresponding indicated angle of attack for the specified flight condition/configuration.

Sample Problem

Configuration: Flaps up, gear up, nozzles aft.

A.	Indicated airspeed	218 Kt.
B.	Gross weight	18,000 Lb.
C.	Indicated Angle of Attack	10.0 UNITS

AIRSPEED CONVERSION

The Airspeed Conversion chart (figure 11-5) provides a means of converting calibrated airspeed to true Mach number and true airspeed.

INDICATED AIRSPEED

Indicated airspeed (IAS) is the uncorrected airspeed read directly from the indicator.

CALIBRATED AIRSPEED

Calibrated airspeed (CAS) is indicated airspeed corrected for static source error.

TRUE AIRSPEED

True airspeed (TAS) is equivalent airspeed corrected for density altitude. Refer to the Airspeed Conversion chart (figure 11-5).

WIND COMPONENTS-CROSSWIND LIMITS CHART

A Wind Components - Crosswind Limits chart (figure 11-7) is included. It is used primarily for breaking a forecast wind down into crosswind and headwind components for takeoff computations. The crosswind component is compared with the crosswind limits for the type takeoff or landing planned.

USE

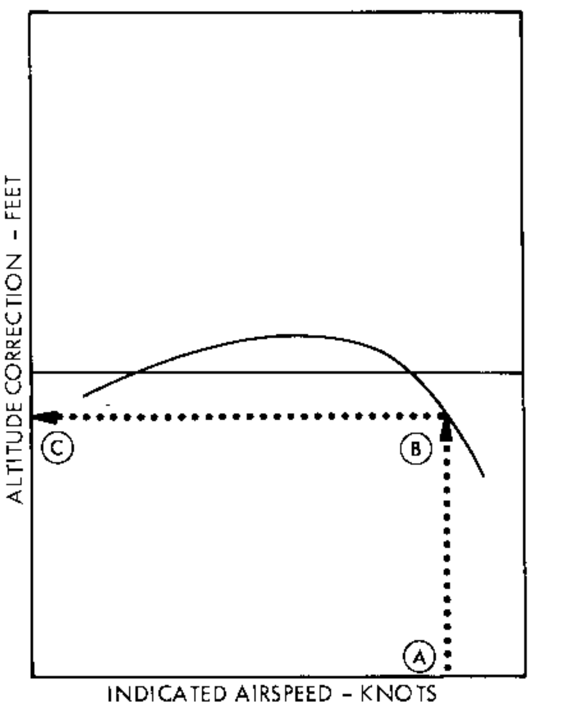
Determine the effective wind velocity by adding one-half the gust velocity (incremental wind factor) to the steady state velocity; e.g., reported wind 050/20 G30, effective wind is 050/25. Reduce the reported wind direction to a relative bearing by determining the wind direction and runway heading. Enter the chart with the relative bearing. Move along the relative bearing to intercept the effective wind speed arc. From this point, project horizontally to the left to read headwind component. From the intersection of the bearing and wind speed, descend vertically downward to read the crosswind component. Continue this line down and compare the forecast crosswind component with the recommended limit for the type takeoff or landing planned.

Sample Problem

Reported wind 050/35, runway heading 030.

A.	Relative bearing	20°
B.	Intersect windspeed arc	35 Kt.
C.	Headwind component	33 Kt.
D.	Crosswind component	12 Kt.
E.	Crosswind component within limits	YES

SAMPLE ALTIMETER POSITION ERROR CORRECTION



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ALLOWABLE TOLERANCE ON P.R.L. SETTING

This chart (figure 11-8) presents the band of allowable RPM to verify operation of the engine pressure ratio limiter. Outside air temperature is the only variable considered in the chart.

USE

A check of PRL operation can be made any time when flying above 10,000 feet at constant altitude and airspeed. Switch the C.O.A.T. gauge to the O.A.T. mode and read the C.O.A.T. gauge reading. The chart depicts the band of allowable RPM band of the engine at these operating conditions.

AIRSPEED POSITION ERROR CORRECTION

The design and location of the pitot-static sensors provides airspeed data which requires no pressure error correction. Therefore calibrated airspeed and true mach number may be read from the respective indicators.

ALTIMETER POSITION ERROR CORRECTION

The design and location of the static ports provide a static source with a small position error. The altimeter can be corrected for static source error by using the Altimeter Position Error Correction chart (figure 11-6). This chart supplies " H" (incremental change) corrections for sea level, 15,000 feet and 30,000 feet altitude. A separate plot is provided for a landing configuration.

USE

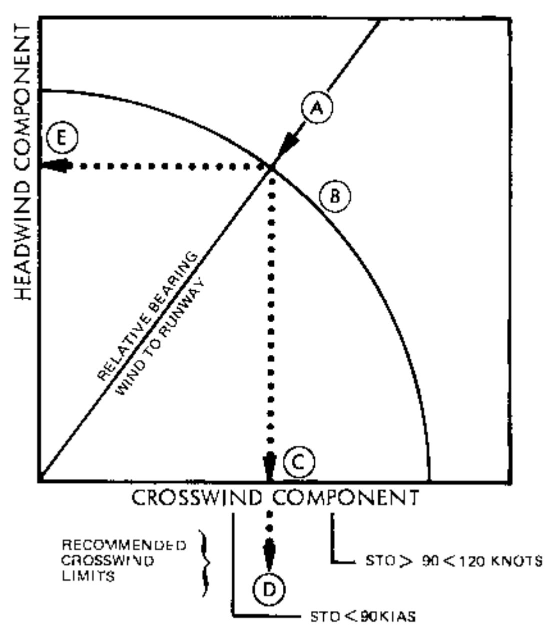
Enter the chart with the indicated airspeed. Proceed vertically upward to the applicable assigned altitude curve and then horizontally to the left to read " H". Add " H" algebraically to the assigned altitude to obtain indicated altitude. Fly indicated altitude.

Sample Problem

Flaps Retracted, Gear up

A.	Indicated airspeed	240 Kt.
B.	Assigned altitude	30,000 Ft.
C.	" H" correction	-20 Ft.
D.	Indicated altitude necessary to maintain 40,000 feet (B - C)	29,080 Ft.

SAMPLE WIND COMPONENTS-CROSSWIND LIMITS



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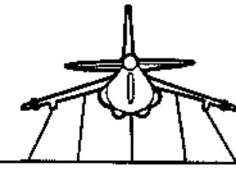
WARNING

For precise external store and attachment information, refer to charts C and E of the Weight and Balance Data Handbook (AN-01-1B-40) for your airplane.

STATION LOADING



STORES		MAXIMUM UNIT WT (LB)	UNIT DRAG	STATION LOCATION AND INCREMENTAL CG SHIFT FOR INDIVIDUAL UNIT				
GENERAL PURPOSE BOMBS				1	2	3	4	5
MK 81 LDGP CONICAL FIN		270	0.8	+.27	+.08	–.35	+.08	+.27
MK 81 SNAKEYE		300	1.2	+.30	+.09	–.39	+.09	+.30
MK 82 LDGP CONICAL FIN (Mech. or MK 36 DST fuzing)		531	1.0	+.53	+.16	–.68	+.16	+.53
MK 82 SNAKEYE (Mech. or MK 36 DST fuzing)		570	1.8	+.62	+.23	–.67	+.23	+.62
MK 83 LDGP CONICAL FIN (Mech. or MK 40 DST fuzing)		985	1.3	—	+.21	—	+.21	—
PRACTICE BOMBS								
MK 76		24	0.35	+.03	+.01	—	+.01	+.03
MK 86 CONICAL FIN (WET SAND FILLED)		200	0.8	+.19	+.06	–.26	+.06	+.19
MK 87 CONICAL FIN (WET SAND FILLED)		330	1.0	+.32	+.09	–.43	+.09	+.32
MK 88 CONICAL FIN (WET SAND FILLED)		784	1.3	—	+.23	—	+.23	—
MK 106		5	NE	.00	.00	—	.00	.00
MK 124 SNAKEYE FIN (cement filled)		565	NE	+.55	+.16	–.67	+.16	+.55
PMBR WITH (6) MK 76		229	6.0/3.9	+.32	+.17	—	+.17	+.32
PMBR WITH (6) MK 106		116	6.0/3.9	+.20	+.12	—	+.12	+.20
CLUSTER BOMBS								
APAM		760	3.0	—	NE	NE	NE	—
CBU-24/29/49		835	4.2	—	+.21	–1.10	+.21	—
ROCKEYE II MODS 2/3		490	3.0	+.50	+.16	–.44	+.16	+.50
FIRE BOMBS								
MK 77 (MOD 2/4)		520	4.1	+.52	+.16	–.67	+.16	+.52
FLARE DISPENSERS								
SUU-40/A, -44/A	EMPTY	132	NE	+.11	+.03	—	+.03	+.11
	FULL (MK 24 FLARES)	351	NE	+.59	+.35	—	+.35	+.59
	FULL (MK 45 FLARES)	359	NE	+.60	+.36	—	+.36	+.60
MISSILES								
AIM-9B SIDEWINDER		157	1.7	+.18	—	—	—	+.18
AIM-9D/G/H		187	1.7	+.22	—	—	—	+.22
MISCELLANEOUS								
120 GALLON EXT. TANK	EMPTY	105	2.6	—	+.04	—	+.04	—
	FULL	930	2.6	—	+.27	—	+.27	—
ADU-299A/A ADAPTER		24	[2]	+.03	—	—	—	+.03
LAU-7A LAUNCHER [1]		87	1.0 [2]	+.12	—	—	—	+.12
A/A 37B-3 PRACTICE MULTIPLE BOMB RACK (PMBR)		87	3.9	+.18	+.12	—	+.12	+.18
INFLIGHT REFUELING PROBE		69	2.5	–.42				

AV8A-1-(117-1)A

Figure 11-1 (Sheet 1 of 3)

STATION LOADING (CONTINUED)

WARNING

For precise external store and attachment information, refer to charts C and E of the Weight and Balance Data Handbook (AN-01-1B-40) for your airplane.

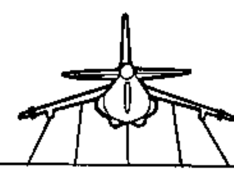
UNIT DRAG — ROCKET LAUNCHERS

LAUNCHERS	LAU-10 SERIES	LAU-60, 61/A, 69/A	LAU-68/A
CONFIGURATION:	UNIT DRAG	UNIT DRAG	UNIT DRAG
Nose & Tail Cones ON	2.6	3.2	1.7
Nose Cone OFF, Tail Cone ON	9.2	11.5	5.3
Nose & Tail Cones OFF (full)	10.2	12.5	5.8
Nose & Tail Cones OFF (empty)	9.0	11.0	5.2

UNIT WEIGHT (LBS) AND INCREMENTAL CG SHIFT

2.75-INCH ROCKETS		LAU-60/A LAUNCHER			LAU-61/A LAUNCHER			LAU-68/A LAUNCHER			LAU-69/A LAUNCHER		
2.75-INCH WARHEADS:	Warhead Weight Group (lbs)	WT (lbs)	OB	IB	WT (lbs)	OB	IB	WT (lbs)	OB	IB	WT (lbs)	OB	IB
MK 1, MK 5, MK 61, MK 67	5.2 to 6.6	421	+.41	+.13	474	+.47	+.14	193	+.21	+.08	440	+.48	+.18
M151, M156, MK 64, WDU-4A/A, WTU-1/B	9.4	474	+.47	+.14	527	+.52	+.16	213	+.24	+.09	493	+.54	+.20
M229	16.8	615	NE	NE	668	NE	NE	264	NE	NE	634	NE	NE
Empty Launcher		79	+.09	+.04	132	+.18	+.08	67	+.08	+.03	98	+.12	+.05
Weight of one 2.75-INCH MK 4 FFAR less warhead: 11.40 pounds													

5.0-INCH ROCKETS (LAU-10 SERIES) ZUNI MOTORS:		MK 16 MOTOR			MK 71 Mod 0 MOTOR			MK 71 Mod 1 MOTOR		
5.0-INCH WARHEADS:	Warhead Weight Group (lbs)	WT (lbs)	OB	IB	WT (lbs)	OB	IB	WT (lbs)	OB	IB
MK 6, MK 32, MK 33, MK 62	45 to 48	559	+.54	+.15	571	+.55	+.16	611	+.59	+.17
MK 24, MK 34	50 to 52	575	+.55	+.16	587	+.57	+.16	627	+.60	+.17
MK 63	55	587	+.56	+.16	599	+.58	+.16	639	+.61	+.17
Empty LAU-10 Launcher		112	+.17	+.09	112	+.17	+.09	112	+.17	+.09
Weight of one motor less warhead (lbs)		63.69			66.85			76.85		



TO APPROXIMATE CG EFFECTS OF ADDING GUNS, AMMO, WATER OR PYLONS ON A CLEAN AIRCRAFT, USE THIS TABLE WHICH IS BASED ON AIRPLANE WEIGHT OF 17,620 POUNDS AND CG OF 10.45% MAC.	MAXIMUM UNIT WT (LB)	UNIT DRAG	STATION LOCATION AND INCREMENTAL CG SHIFT FOR INDIVIDUAL UNIT				
			1	2	3	4	5
INBOARD PYLON	77	1.25		+.07		+.07	
OUTBOARD PYLON	72	1.75	+.14				+.14
CENTERLINE PYLON	55	1.01			-.05		
GUNPOD (EMPTY)	126	1.25			-.03		
GUNPOD & GUN (EMPTY)	323	1.25			-.20		
GUNPOD & GUN & 130 ROUNDS AMMO	463	1.25			-.01		
WATER	495	0.0			+1.35		

AV8A-1-(177-2)A

Figure 11-1 (Sheet 2 of 3)

STATION LOADING

(CONTINUED)

ARMAMENT ATTACHMENT ASSOCIATION

STORES TO BE CARRIED	SUSPENSION EQUIPMENT	STATION						
		1	2	FUS	3	FUS	4	5
120-GAL EXT. TANK OR MK 83 GP BOMB	INBOARD PYLON		X				X	
MK 76 OR MK 106 PRACTICE BOMB	INBOARD PYLON AND A/A 37B-3 PMBR		X				X	
	OUTBOARD PYLON AND A/A 37B-3 PMBR	X						X
MK 81, MK 81 SNAKEYE, MK 82, MK 82 SNAKEYE, MK 86, MK 87, OR MK 88 GP BOMBS, MK 124 RETARD PRACTICE BOMB, MK 77 FIRE BOMB, OR MK 20 ROCKEYE CLUSTER BOMB	CENTERLINE PYLON				X			
	INBOARD PYLON		X				X	
	OUTBOARD PYLON	X						X
CBU-24, -29, -49 OR APAM	CENTERLINE PYLON				X			
	INBOARD PYLON		X				X	
SUU-40 OR -44 FLARE DISPENSER	OUTBOARD PYLON	X						X
AIM-9 MISSILE	OUTBOARD PYLON, ADU-299 A/A ADAPTER AND LAU-7A LAUNCHER	X						X
30MM ADEN GUN POD	FUSELAGE MOUNT			X		X		
LAU-10, -60, -61, -68, -69 ROCKETS	INBOARD PYLON		X				X	
	OUTBOARD PYLON	X						X

CAUTION

JETTISON CONFIGURATION IS ZERO TO MID FLAPS, LANDING GEAR UP AND NOZZLES AFT. ALL EMPTY STORES CAN BE JETTISONED AT 250 KNOTS WITH THE EXCEPTION OF THE LAU-10/A ROCKET PODS WHICH MUST BE JETTISONED AT 350-450 KNOTS.

NOTES

- ALL EXTERNAL STORE INCREMENTAL CG SHIFT VALUES WERE DERIVED FROM AN AIRPLANE CONFIGURED AS FOLLOWS: GUNS, 260 ROUNDS OF AMMO, 495 LB. OF WATER, PILOT, FULL INTERNAL FUEL AND (5) PYLONS. THIS AIRPLANE WEIGHED 19,375 POUNDS @ 12.09% MAC. (GEAR DOWN)
- THE INCREMENTAL CG SHIFT EFFECTS ARE IN TERMS OF % MAC (PLUS SIGN = AFT CG SHIFT) AND (MINUS SIGN = FWD CG SHIFT).
- THE INCREMENTAL CG SHIFT VALUES ARE APPROXIMATIONS ONLY, AND WILL VARY DEPENDING ON THE INDIVIDUAL AIRPLANE GROSS WEIGHT AND CG.
- INDIVIDUAL STORE DRAG X NUMBER OF STORES TO BE CARRIED + SUSPENSION EQUIPMENT DRAG (IF NOT INCLUDED) = DRAG INDEX
- THE DRAG INDEX OF THE CLEAN AIRPLANE IS ZERO.

  NE = NOT ESTABLISHED WT = WEIGHT OF FULL LAUNCHER
  NA = NOT APPLICABLE OB = OUTBOARD (UNIT CG SHIFT FOR EITHER STATION 1 OR 5)
  E = EMPTY, F = FULL IB = INBOARD (UNIT CG SHIFT FOR EITHER STATION 2 OR 4)
- ESTIMATED OPERATING WEIGHT (BASIC AIRPLANE PLUS THE WEIGHT OF OIL, UNUSABLE FUEL AND PILOT)

  AIRPLANES: 158384 THRU 158395 .... 12,330 LB. 6.36% MAC
  158694 THRU 158711 .... 12,460 LB. 5.9% MAC
  158948 THRU 158977 .... 12,315 LB. 4.88% MAC
- ESTIMATED TAKEOFF GROSS WEIGHT (ESTIMATED OPERATING WEIGHT PLUS WEIGHT OF FULL INTERNAL FUEL)

  AIRPLANES: 158384 THRU 158395 .... 17,490 LB. 10.8% MAC
  158694 THRU 158711 .... 17,620 LB. 10.45% MAC
  158948 THRU 158977 .... 17,475 LB. 9.77% MAC

[1] ADAPTOR ADU-299A/A IS REQUIRED.
[2] LAUNCHER DRAG INDEX INCLUDES ALLOWANCE FOR ADAPTOR.

AV8A-1-(117-3)A

Figure 11-1 (Sheet 3 of 3)

STANDARD ATMOSPHERE TABLE

Standard Sea Level Air:
T = 15°C.
P = 29.921 in. of Hg.

W = .07651 lb/cu. ft. ρ_0 = .002378 slugs/cu. ft.
1" of Hg. = 70.732 lb/sq. ft. = 0.4912 lb/sq. in.
a = 1116 ft./sec.

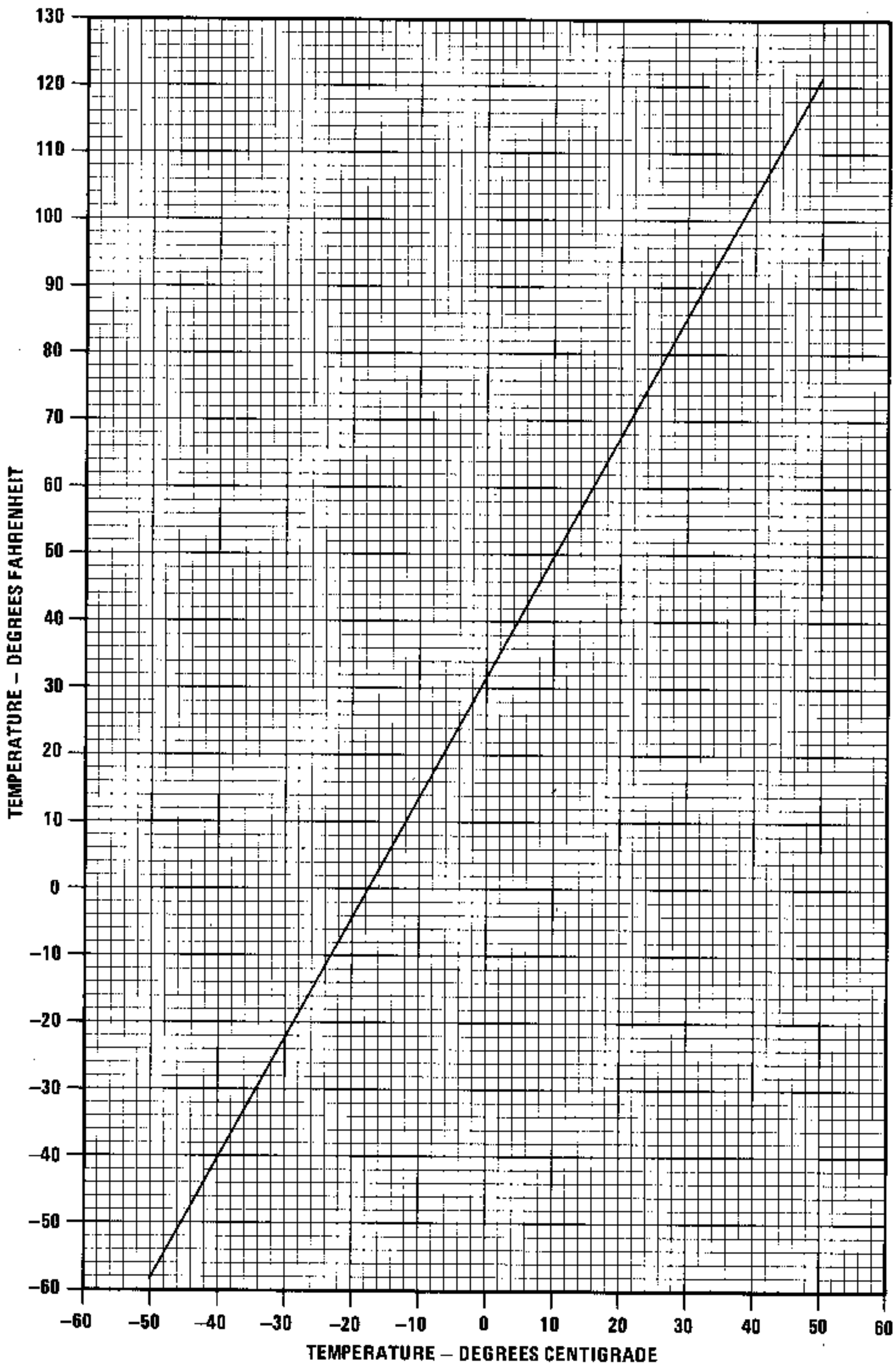
This table is based on NACA Technical Report No. 218

ALTITUDE FEET	DENSITY RATIO ρ/ρ_0	$\frac{1}{\sqrt{\sigma}}$	TEMPERATURE		SPEED OF SOUND RATIO a/ao	PRESSURE	
			DEG. C	DEG. F		IN. OF Hg	RATIO P/PO
0	1.0000	1.0000	15.000	59.000	1.000	29.92	1.0000
1000	.9710	1.0148	13.019	55.434	.997	28.86	.9644
2000	.9428	1.0299	11.038	51.868	.993	27.82	.9298
3000	.9151	1.0454	9.056	48.301	.990	26.81	.8962
4000	.8881	1.0611	7.075	44.735	.986	25.84	.8636
5000	.8616	1.0773	5.094	41.169	.983	24.89	.8320
6000	.8358	1.0938	3.113	37.603	.979	23.98	.8013
7000	.8106	1.1107	1.132	34.037	.976	23.09	.7716
8000	.7859	1.1280	−0.850	30.471	.972	22.22	.7427
9000	.7619	1.1456	−2.831	26.904	.968	21.38	.7147
10,000	.7384	1.1637	−4.812	23.338	.965	20.58	.6876
11,000	.7154	1.1822	−6.793	19.772	.962	19.79	.6614
12,000	.6931	1.2012	−8.774	16.206	.958	19.03	.6359
13,000	.6712	1.2206	−10.756	12.640	.954	18.29	.6112
14,000	.6499	1.2404	−12.737	9.074	.950	17.57	.5873
15,000	.6291	1.2608	−14.718	5.507	.947	16.88	.5642
16,000	.6088	1.2816	−16.699	1.941	.943	16.21	.5418
17,000	.5891	1.3029	−18.680	−1.625	.940	15.56	.5202
18,000	.5698	1.3247	−20.662	−5.191	.936	14.94	.4992
19,000	.5509	1.3473	−22.643	−8.757	.932	14.33	.4790
20,000	.5327	1.3701	−24.624	−12.323	.929	13.75	.4594
21,000	.5148	1.3937	−26.605	−15.890	.925	13.18	.4405
22,000	.4974	1.4179	−28.586	−19.456	.922	12.63	.4222
23,000	.4805	1.4426	−30.568	−23.022	.917	12.10	.4045
24,000	.4640	1.4681	−32.549	−26.558	.914	11.59	.3874
25,000	.4480	1.4940	−34.530	−30.154	.910	11.10	.3709
26,000	.4323	1.5209	−36.511	−33.720	.906	10.62	.3550
27,000	.4171	1.5484	−38.493	−37.287	.903	10.16	.3397
28,000	.4023	1.5768	−40.474	−40.853	.899	9.720	.3248
29,000	.3879	1.6056	−42.455	−44.419	.895	9.293	.3106
30,000	.3740	1.6352	−44.436	−47.985	.891	8.880	.2968
31,000	.3603	1.6659	−46.417	−51.551	.887	8.483	.2834
32,000	.3472	1.6971	−48.399	−55.117	.883	8.101	.2707
33,000	.3343	1.7295	−50.379	−58.684	.879	7.732	.2583
34,000	.3218	1.7628	−52.361	−62.250	.875	7.377	.2465
35,000	.3098	1.7966	−54.342	−65.816	.871	7.036	.2352
36,000	.2962	1.8374	−55.000	−67.000	.870	6.708	.2242
37,000	.2824	1.8818	−55.000	−67.000	.870	6.395	.2137
38,000	.2692	1.9273	−55.000	−67.000	.870	6.096	.2037
39,000	.2566	1.9738	−55.000	−67.000	.870	5.812	.1943
40,000	.2447	2.0215	−55.000	−67.000	.870	5.541	.1852
41,000	.2332	2.0707	−55.000	−67.000	.870	5.283	.1765
42,000	.2224	2.1207	−55.000	−67.000	.870	5.036	.1683
43,000	.2120	2.1719	−55.000	−67.000	.870	4.802	.1605
44,000	.2021	2.2244	−55.000	−67.000	.870	4.578	.1530
45,000	.1926	2.2785	−55.000	−67.000	.870	4.364	.1458
46,000	.1837	2.3332	−55.000	−67.000	.870	4.160	.1391
47,000	.1751	2.3893	−55.000	−67.000	.870	3.966	.1325
48,000	.1669	2.4478	−55.000	−67.000	.870	3.781	.1264
49,000	.1591	2.5071	−55.000	−67.000	.870	3.604	.1205
50,000	.1517	2.5675	−55.000	−67.000	.870	3.436	.1149

AV8A-1-(65)

Figure 11-2

TEMPERATURE CONVERSION



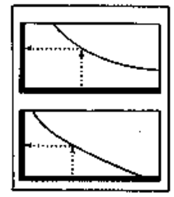
AV8A-1-(92)

Figure 11-3

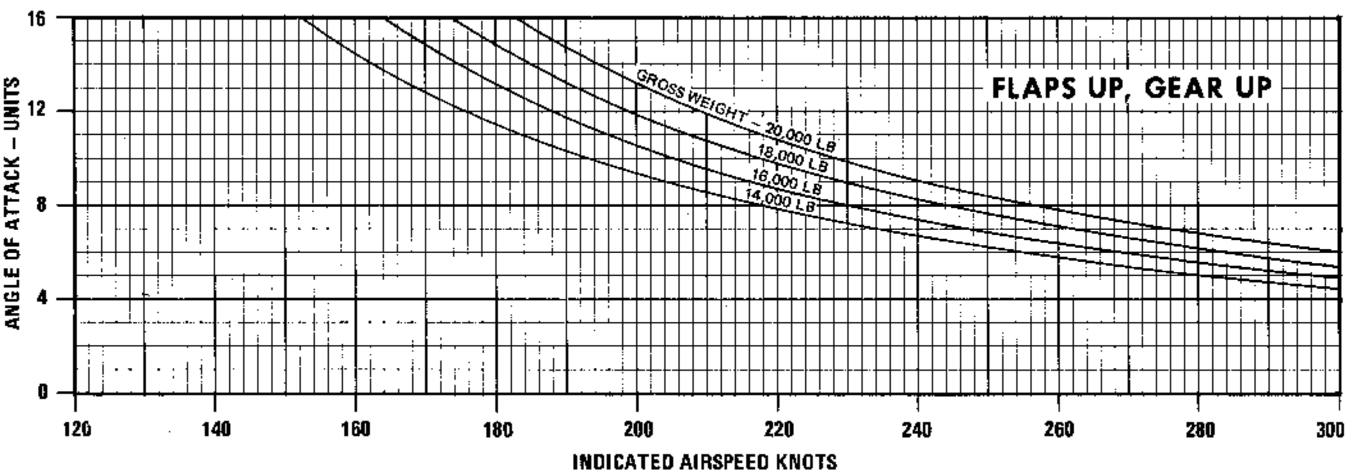
ANGLE OF ATTACK CONVERSIONS
IG LEVEL FLIGHT-NOZZLES AFT

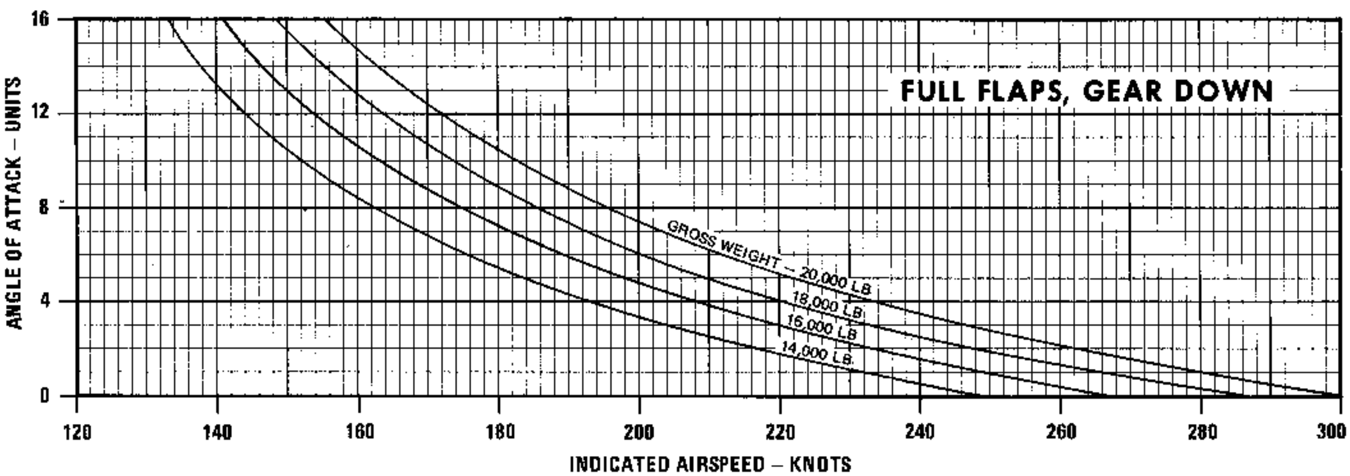
AIRPLANE CONFIGURATION
GEAR AND FLAPS
AS NOTED

REMARKS
ENGINE: F402-RR-401
ICAO STANDARD DAY
10,000 FEET AND BELOW



DATE: 1 DECEMBER 1972
DATA BASIS: ESTIMATED (BASED ON FLIGHT TEST)

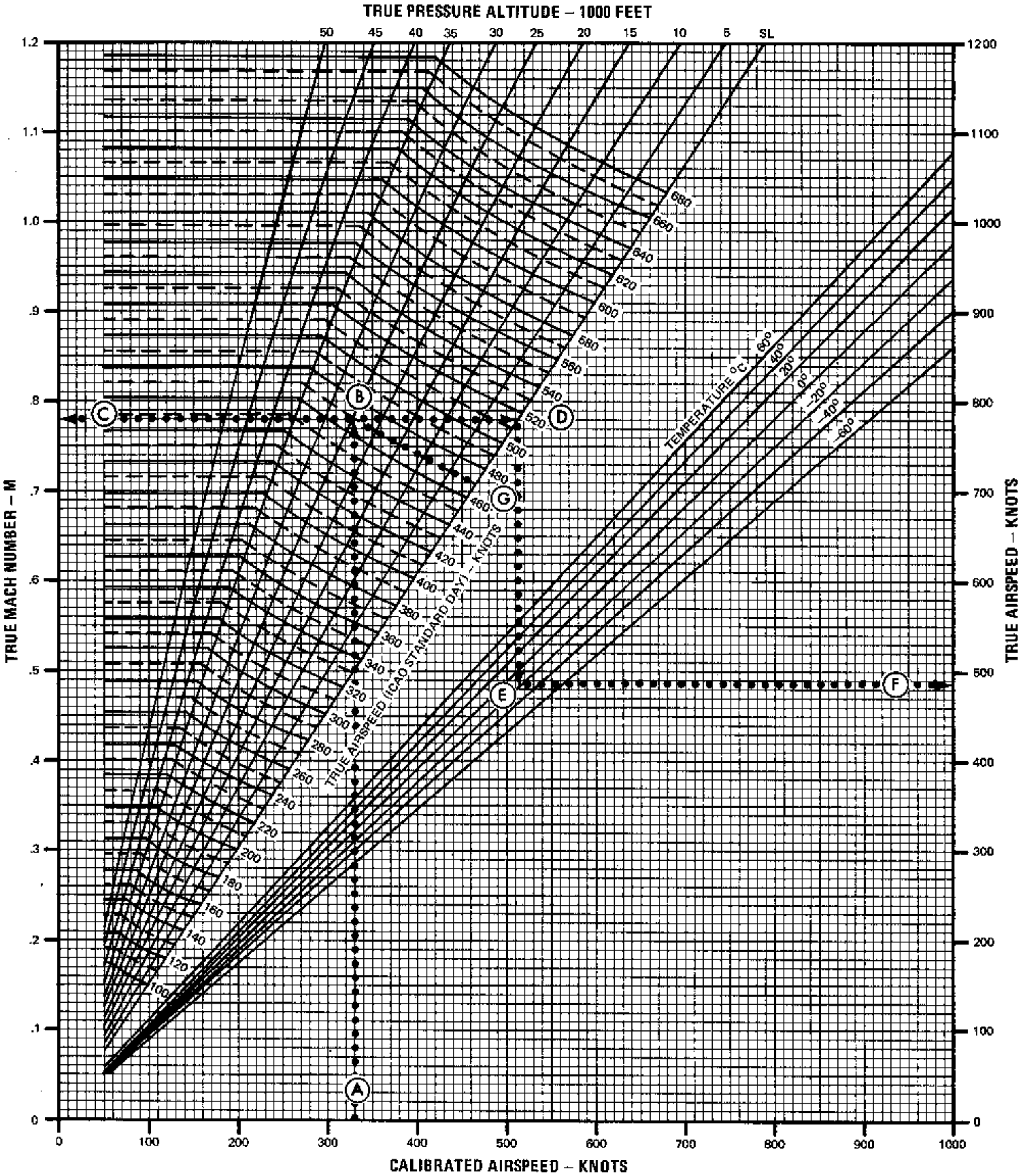




AV8A–1–(91)

Figure 11-4

AIRSPEED CONVERSION



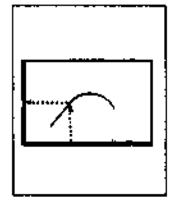
EXAMPLE

A = CAS = 330 KNOTS
B = ALTITUDE = 25,000 FEET
C = MACH = .782
D = SEA LEVEL LINE
E = TEMPERATURE –20°C
F = TAS = 486 KNOTS
G = TAS (STANDARD DAY) = 472 KNOTS

AV8A–1–(115)

Figure 11-5

ALTIMETER POSITION ERROR CORRECTION



AIRPLANE CONFIGURATION
ALL DRAG INDEXES
FLAPS AND GEAR AS NOTED

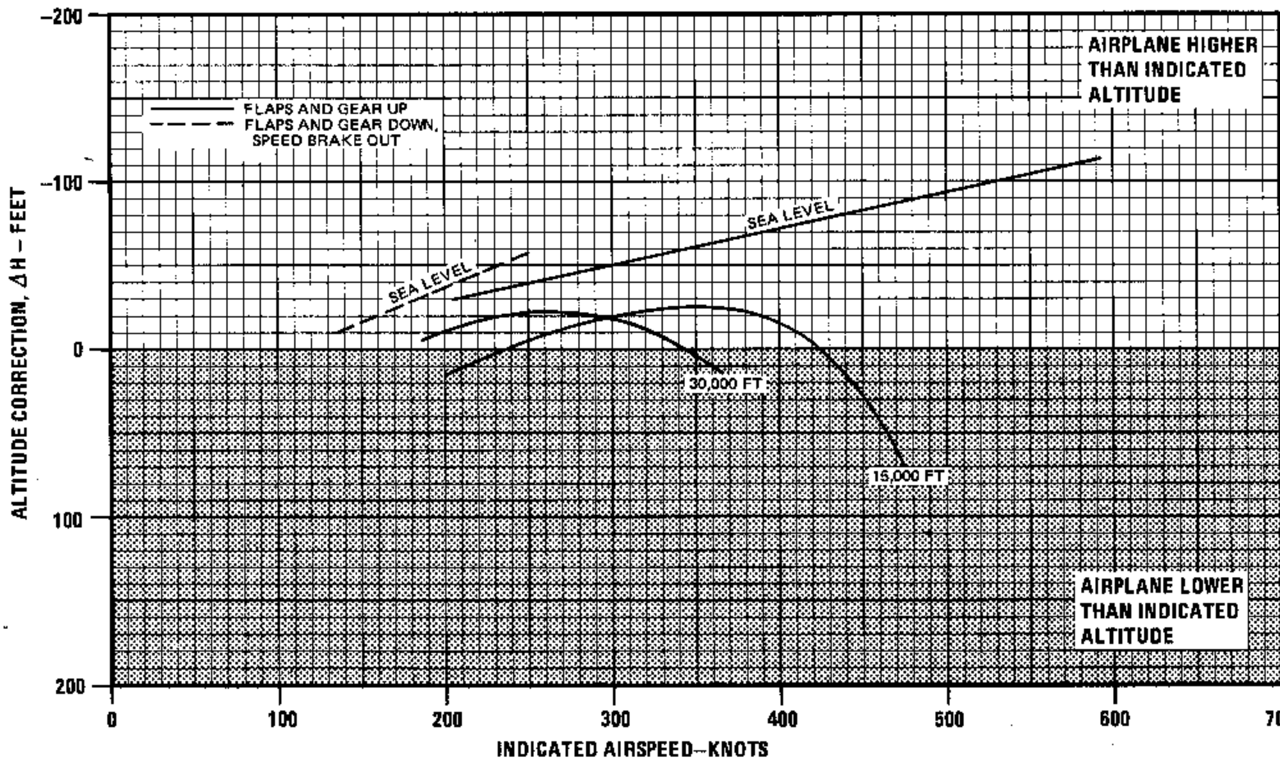
REMARKS
ENGINE: F402-RR-401
ICAO STANDARD DAY

DATE: 1 APRIL 1971
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

NOTE

ASSIGNED ALTITUDE + ΔH = INDICATED ALTITUDE. FLY INDICATED ALTITUDE.



AV8A-1-(89)

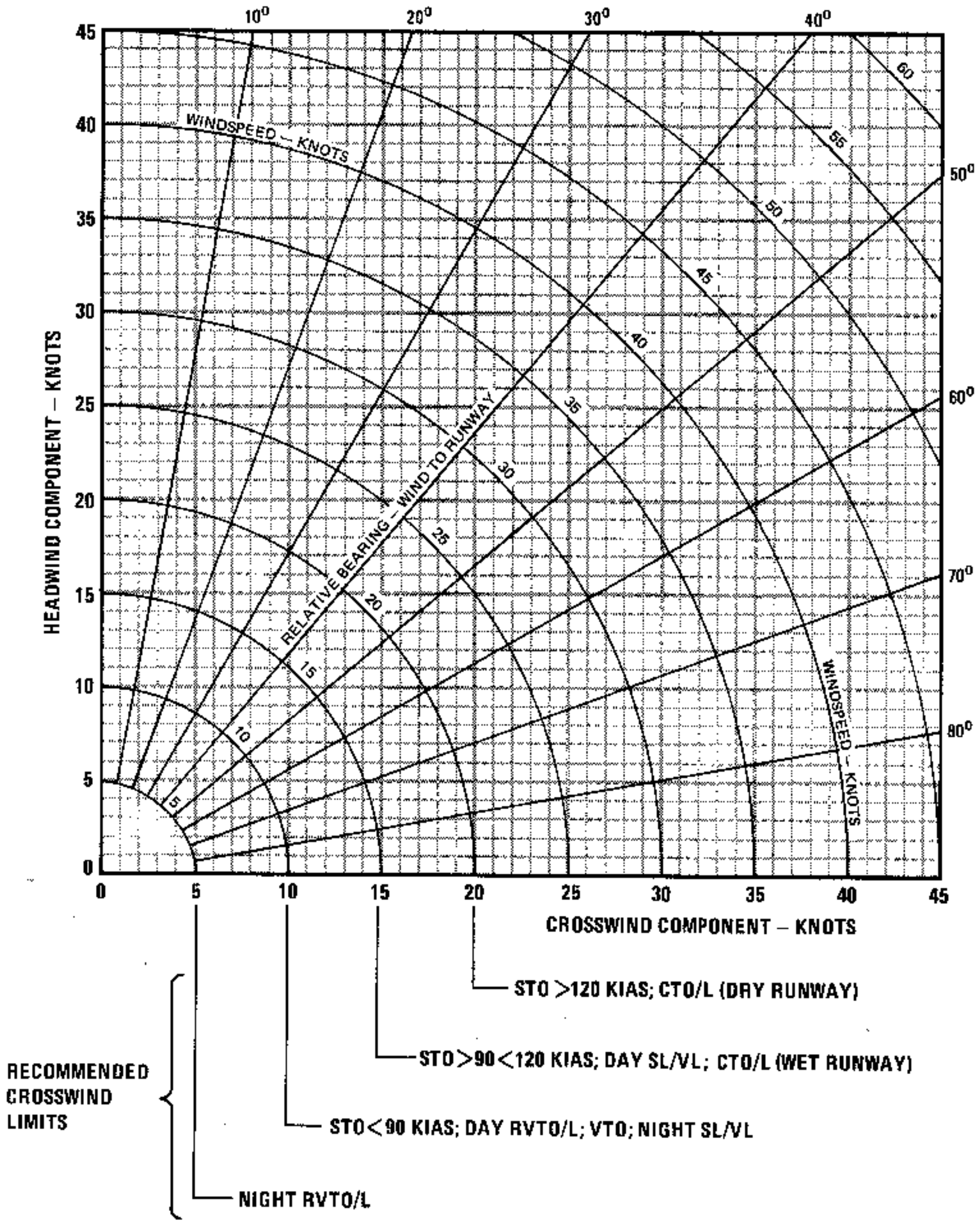
Figure 11-6

WIND COMPONENTS-CROSSWIND LIMITS

AIRPLANE CONFIGURATION
ALL DRAG INDEXES

NOTE

LIMITS SPECIFIED ARE FOR PREPARED SURFACES. FOR UNPREPARED SURFACES, THE MAXIMUM PERMISSIBLE CROSSWIND COMPONENT FOR TAKEOFF AND LANDING IS 10 KNOTS.



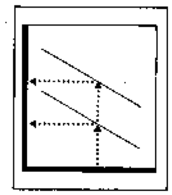
AV8A-1-(90)

Figure 11-7

ALLOWABLE TOLERANCE ON P.R.L. SETTING

AIRPLANE CONFIGURATION
ALL DRAG INDEXES
ALL GROSS WEIGHTS

REMARKS
ENGINE: F402-RR-401
ICAO STANDARD DAY



NOTE

PERFORM P.R.L. CHECK ABOVE 10,000 FEET WHEN ENGINE GOVERNED BY P.R.L. WHILE FLYING AT CONSTANT ALTITUDE AND AIRSPEED WITH C.O.A.T. GAUGE IN P.R.L. CHECK MODE.

DATE: 1 JANUARY 1972
DATA BASIS: H. S. AVIATION DWG. 310178
AV8A FLIGHT TEST SCHEDULE

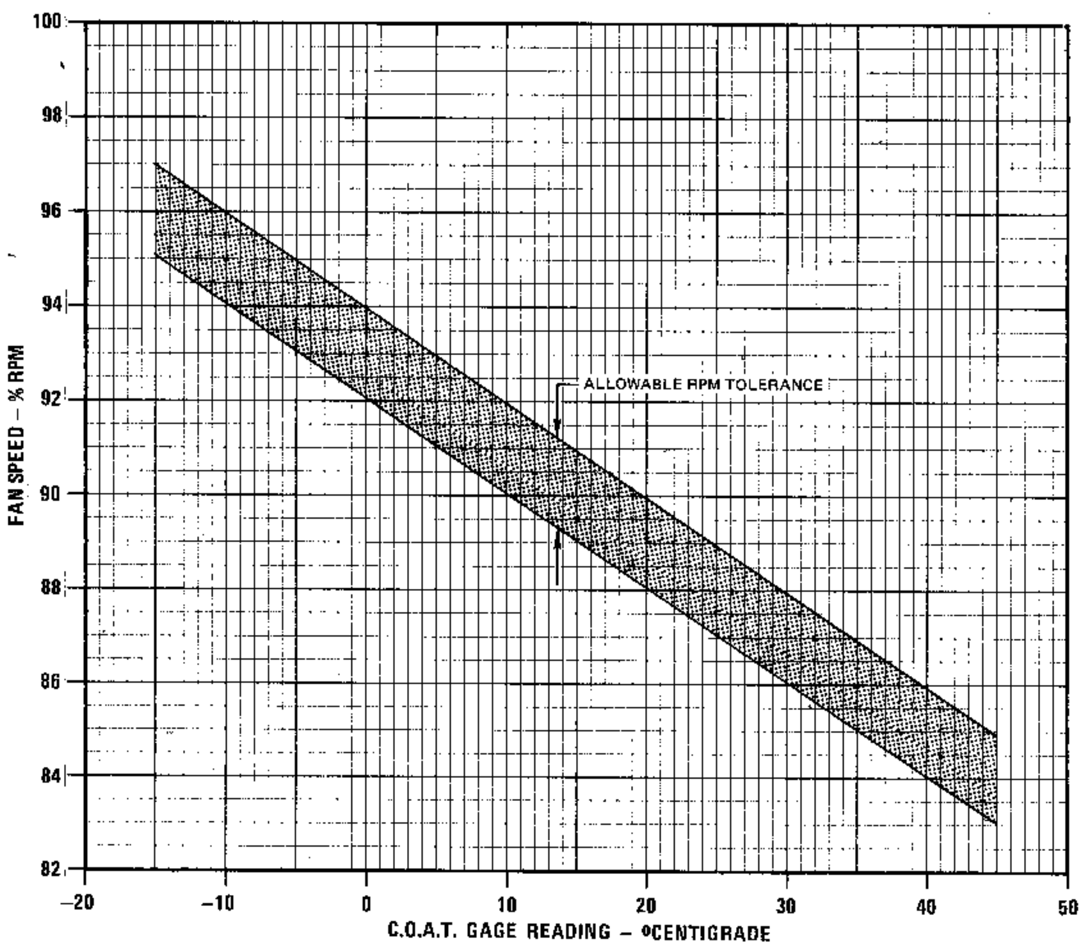


Figure 11-8

PART 2
HOVER

Charts

DEFINITION OF TERMS USED

MAXIMUM CONTINUOUS THRUST

Maximum continuous thrust is an engine rating and JPT limit in use when the landing gear is raised, the nozzles are rotated up through 16° from full aft, and the JPT is less than 525°C. This is a wingborne rating with no time limit and no automatic JPT control.

MAXIMUM THRUST

Maximum thrust is an engine rating and JPTL datum in use when the nozzles are positioned less than 16° from full aft. Fan speed and JPT limits at this rating are 95.5% RPM and 610°C. This is a wingborne rating limited to 15 minutes duration and the JPT is limiter controlled.

SHORT LIFT DRY

Short lift dry is an engine rating and JPTL datum in use at full throttle. The limitations at this rating are 103.5% RPM fan speed and 715°C JPT which are limiter controlled. A 15 second time limit JPTL light is illuminated while operating at this rating to alert the pilot that high count rates are being approached on the engine life recorder.

SHORT LIFT WET

Short lift wet is an engine rating and JPTL datum in use when water injection is used at full throttle settings. The limitations at this rating are 107.0% RPM fan speed and 745°C JPT which are limiter controlled. The JPTL light is on at this rating to alert the pilot of high engine life count rates if this power setting is maintained beyond a 15 second period.

JPTL

The Jet Pipe Temperature Limiter ensures automatic control of JPT while operating at short lift and maximum thrust ratings.

MAXIMUM ALLOWABLE RPM

This chart (figure 11-9) provides maximum RPM values for wet or dry engine operation as a function of air temperature.

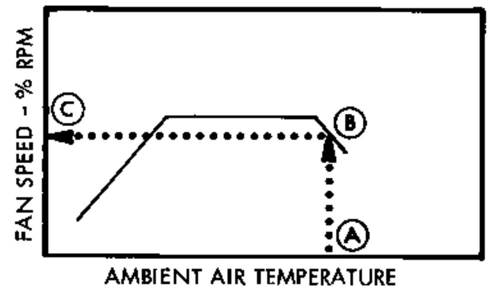
USE

Enter the chart with ambient air temperature and proceed vertically to the engine rating for the planned operation. From this point proceed horizontally to the left to read the maximum allowable engine fan speed.

Sample Problem

A.	Temperature	40°C
B.	Nominal Dry	
C.	Engine fan speed	103% RPM

SAMPLE MAXIMUM ALLOWABLE RPM



AV8A-1-(153)

ENGINE RPM REQUIRED TO HOVER

This chart (figure 11-10) presents the corresponding engine RPM required to hover for all gross weights and considers the variables of ambient pressure and temperature also.

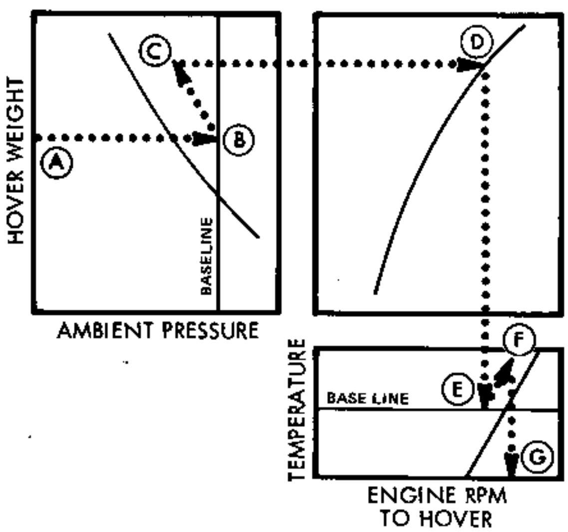
USE

Enter the chart with the planned (aircraft weight and proceed horizontally to the right to the pressure base line. From this point parallel the pressure guide lines to intercept the appropriate ambient pressure or pressure altitude line. From this intersection proceed horizontally to the right to the reflector line and then project vertically down to the ambient temperature base line. From this point parallel the temperature guide lines to the appropriate temperature line and then project vertically down to read the engine RPM required to hover. Check Maximum Allowable RPM (figure 11-9), to ensure operation within engine RPM limits.

Sample Problem

A.	Aircraft weight	16,000 Lb.
B.	Pressure base line	
C.	Ambient pressure	29.50 In. Hg.
D.	Reflector curve	
E.	Temperature base line	
F.	Temperature	25°C
G.	Engine RPM required to hover	98.7% RPM

SAMPLE ENGINE RPM REQUIRED TO HOVER



AV8A-1-(155)

JPT IN HOVER

This chart (figure 11-11) provides approximate engine jet pipe temperatures during hover operations for conditions of aircraft weight, ambient pressure and temperature.

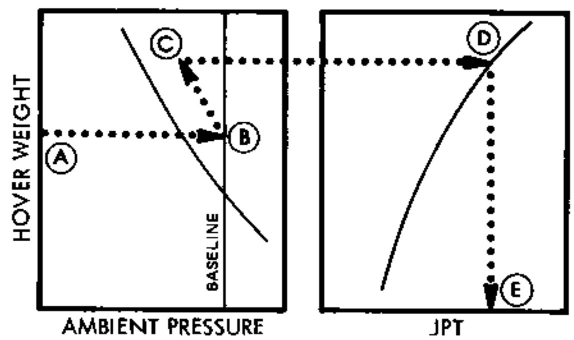
USE

Enter the chart with the planned aircraft weight and proceed horizontally to the right to the pressure base line. From this point parallel the pressure guide lines to intercept the appropriate ambient pressure line. From this intersection project horizontally to the right to intercept the appropriate temperature. From this point project vertically down to read the JPT in hover. Check at this point to determine if the planned hover falls within the planned short lift rating temperature limits depicted on the chart. Note that JPT shown is for dry operation. During wet operation JPT will be reduced approximately 40°C.

Sample Problem

A.	Aircraft weight	16,000 Lb.
B.	Pressure base line	
C.	Ambient pressure	29.50 In. Hg.
D.	Temperature	20°C
E.	JPT (dry)	654°C

SAMPLE JPT IN HOVER



AV8A-1-(157)

MAXIMUM ALLOWABLE RPM

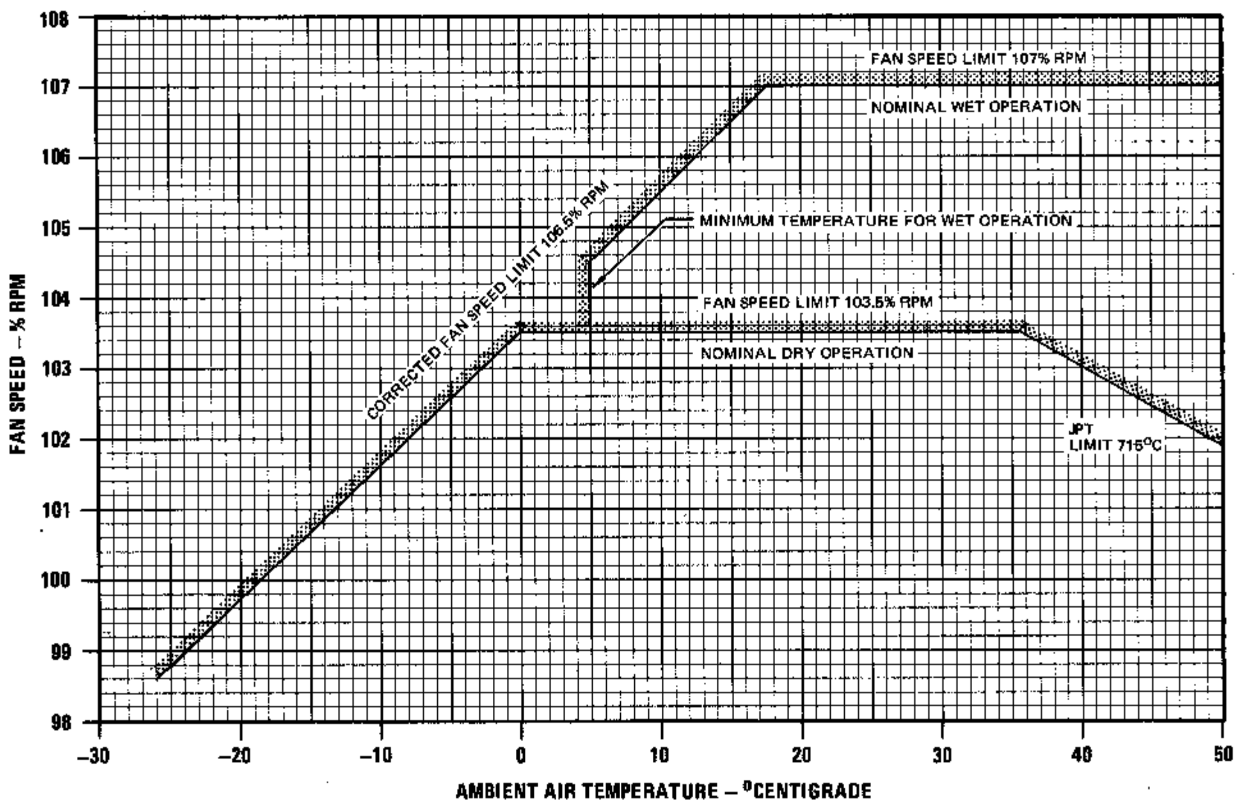
AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE: F402-RR-401
ICAO STANDARD DAY

GUIDE

DATA: 1 DECEMBER 1972
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



AV8A-1-(87)

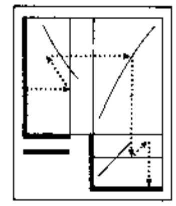
Figure 11-9

ENGINE RPM REQUIRED TO HOVER
NOZZLES IN HOVER STOP WET OR DRY ENGINE OPERATION

AIRPLANE CONFIGURATION
ALL DRAG INDEXES
FULL FLAPS, GEAR DOWN

REMARKS
ENGINE: F402-RR-401

GUIDE



DATE: 1 JANUARY 1973
DATA BASIS: ESTIMATED

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

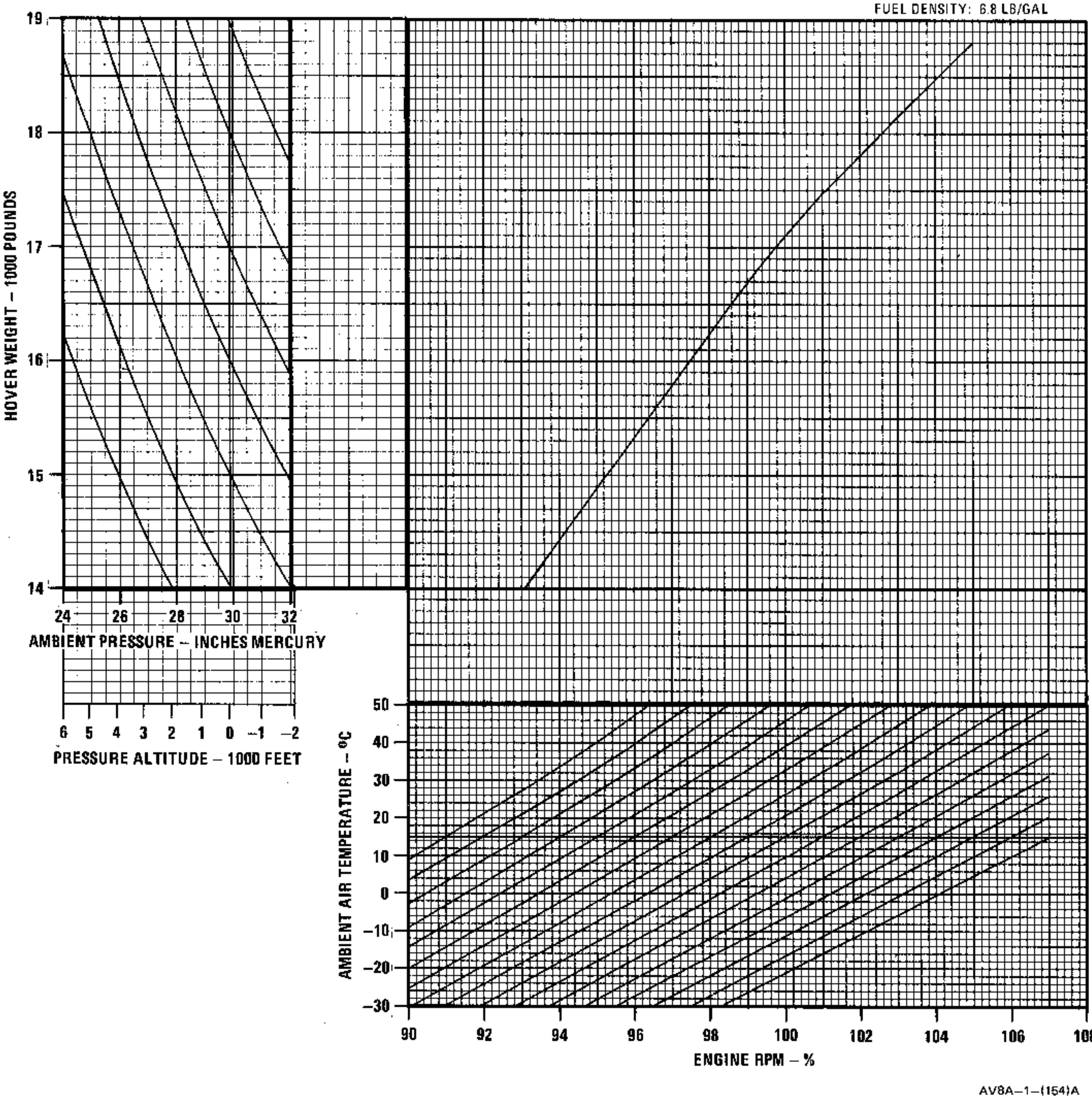


Figure 11-10

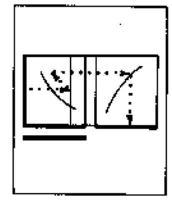
JPT IN HOVER

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES
FULL FLAPS, GEAR DOWN

REMARKS
ENGINE: F402-RR-401
ICAO STANDARD DAY

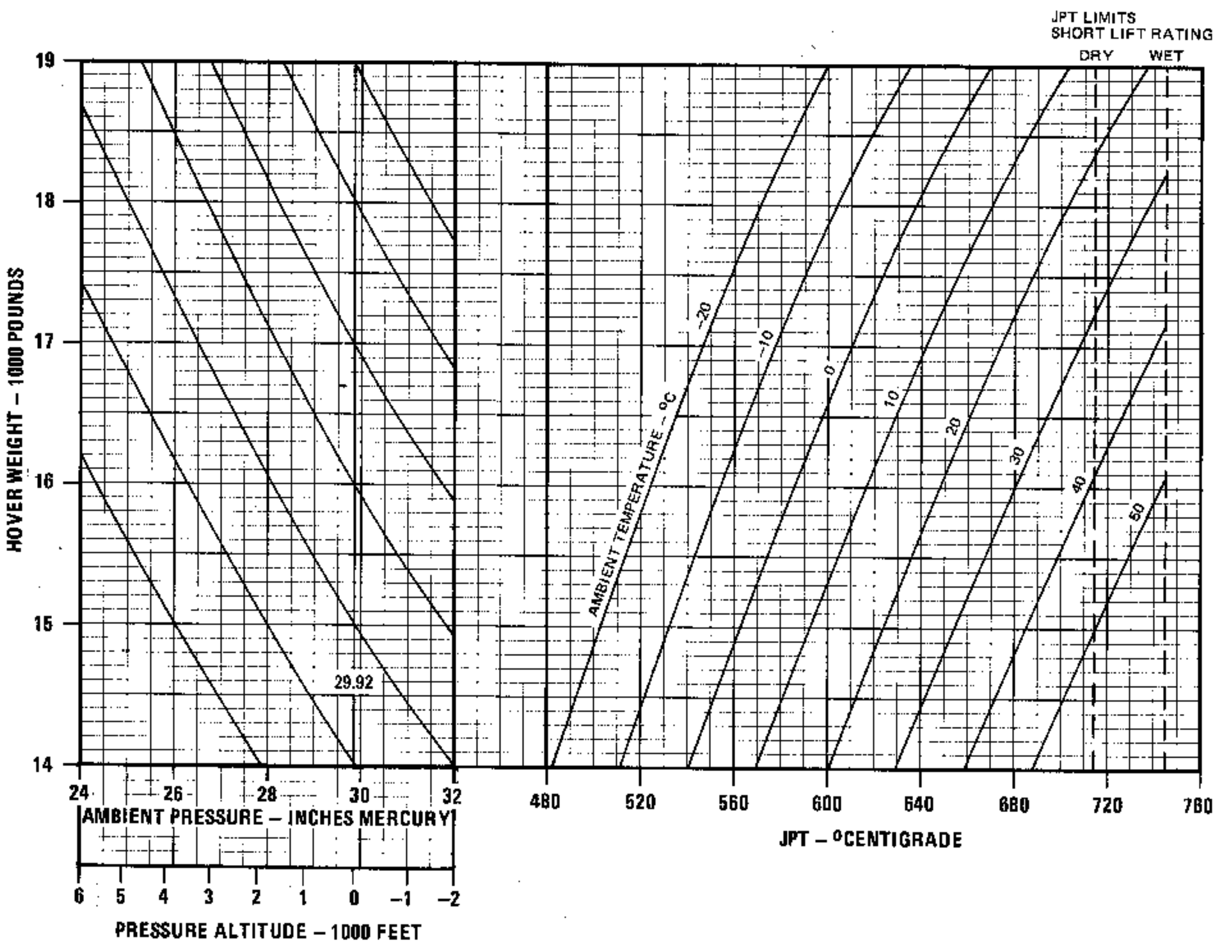
NOTE
JPT SHOWN IS FOR DRY OPERATION; WITH WATER FLOWING JPT IS REDUCED APPROXIMATELY 40° C.

GUIDE



DATE: 1 JANUARY 1973
DATA BASIS: **ESTIMATED**

FUEL GRADE: JP-5
FUEL DENSITY: 6.5 LB/GAL



AV8A-1-(156)A

Figure 11-11

PART 3
TAKEOFF

Charts

VERTICAL TAKEOFF CAPABILITY

This chart (figure 11-12) provides the vertical takeoff weight capability at wet and dry short lift ratings and accounts for the variables of ambient pressure and temperature.

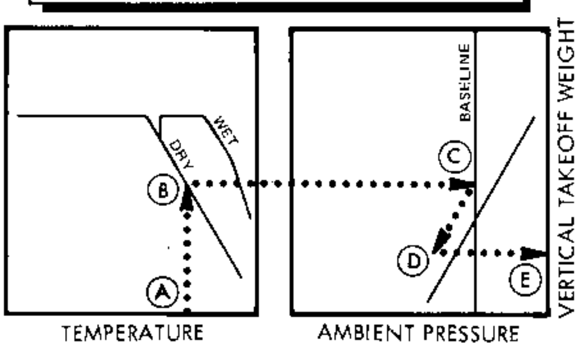
USE

Enter the chart at the ambient temperature and proceed vertically upward to the planned short lift rating curve. From this point project horizontally to the right to the pressure base line. From this point parallel the pressure guide lines to the appropriate ambient pressure line. From this intersection project horizontally to the right to read vertical takeoff weight.

Sample Problem

A.	Ambient temperature	20°C
B.	Short lift dry curve	
C.	Pressure base line	
D.	Ambient pressure	29.50 In. Hg.
E.	Vertical takeoff weight	16,300 Lb.

SAMPLE VERTICAL TAKEOFF CAPABILITY



AV8A-1-(159)

ROLLING VERTICAL TAKEOFF CAPABILITY

This chart (figure 11-13) provides the total distance traveled to clear a 50 foot obstacle during a rolling vertical takeoff. The variables considered in these calculations are wet and dry short lift ratings, takeoff gross weight, ambient pressure and temperature.

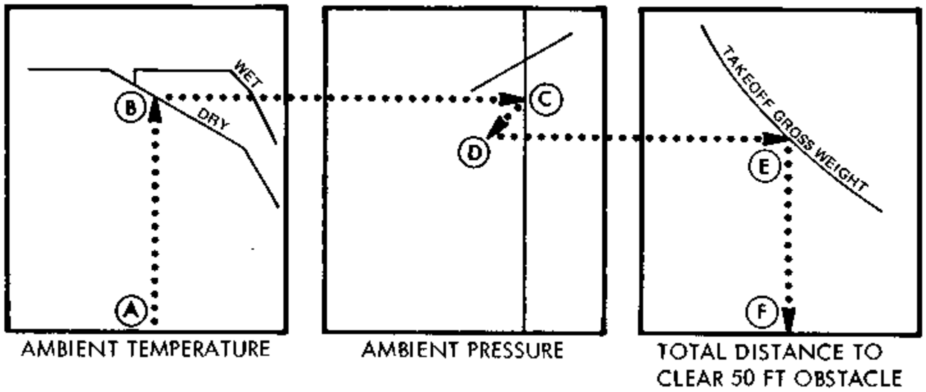
USE

Enter the chart with the ambient air temperature and proceed vertically upward to the planned short lift rating curve. From this point project horizontally to the right to the pressure base line. From this point parallel the pressure guide lines to the appropriate ambient pressure line. From this intersection project horizontally to the right to appropriate takeoff gross weight. From this point project vertically down to read the total distance to clear a 50 foot obstacle.

Sample Problem

A.	Temperature	20°C
B.	Short lift dry curve	
C.	Pressure base line	
D.	Ambient pressure	29.50 In. Hg.
E.	Takeoff gross weight	17,000 Lb.
F.	Total distance to clear 50 Ft. obstacle	380 Ft.

SAMPLE ROLLING VERTICAL TAKEOFF CAPABILITY



AV8A-1-(160)

SHORT TAKEOFF ROTATION SPEED AND NOZZLE ANGLE

This chart (figure 11-14) provides the short takeoff rotation speed and nozzle angle for both short lift ratings and the variables of ambient pressure and temperature.

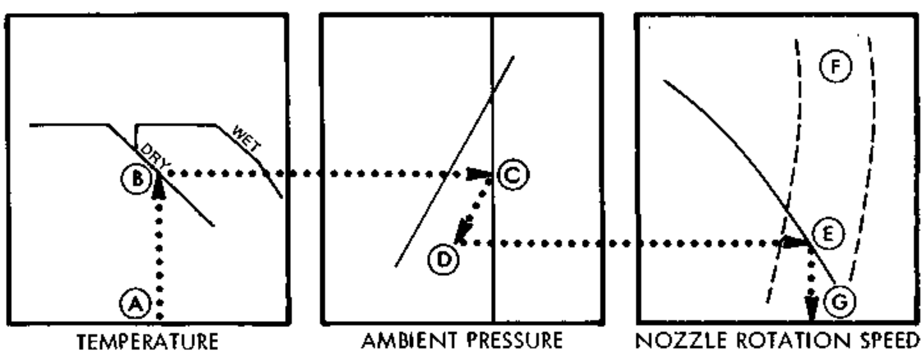
USE

Enter the chart with the ambient temperature and proceed vertically up to the planned short lift rating curve. From this point project horizontally to the right to the pressure base line. From this point parallel the pressure guide lines to the appropriate ambient pressure line. From this intersection project horizontally to the right to aircraft takeoff gross weight. At this point read the nozzle angle to select for takeoff. Then project vertically down to read the nozzle rotation speed.

Sample Problem

A.	Temperature	20°C
B.	Short lift dry curve	
C.	Pressure base line	
D.	Ambient pressure	29.50 In. Hg.
E.	Gross weight	20,000 Lb.
F.	Nozzle angle	60°
G.	Nozzle rotation speed	98 Kt.

SAMPLE SHORT TAKEOFF-ROTATION SPEED AND NOZZLE ANGLE



AV8A-1-(164)

SHORT TAKEOFF DISTANCE

This chart (figure 11-15) provides the ground roll distance and total distance traveled to clear a 50-foot obstacle during a short takeoff with wind effects applied.

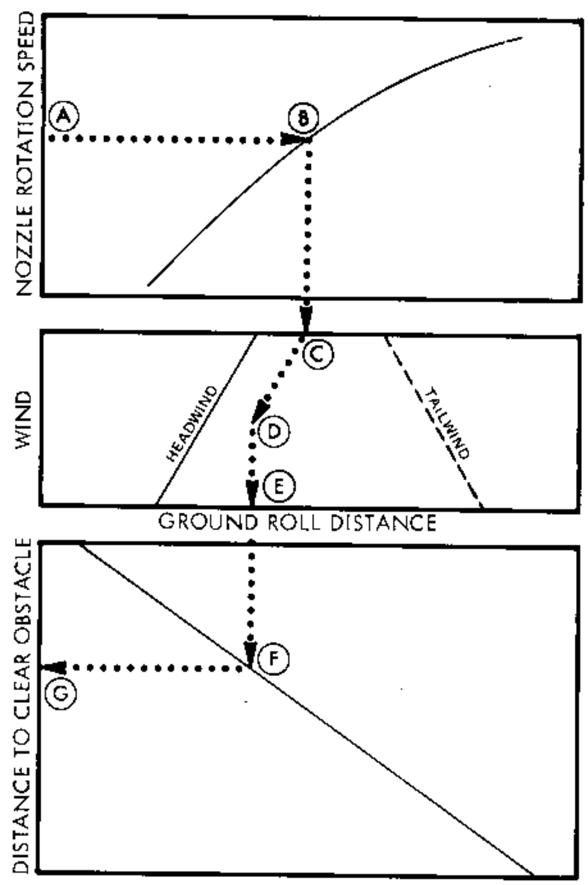
USE

Enter the chart with the previously determined nozzle rotation speed and project horizontally to the right and intersect the reflector curve. From this point, descend vertically to the wind base line and parallel the wind guidelines to the effective wind velocity (headwind or tailwind). From this point, project vertically down to read ground roll distance. Continue vertically to intersect the reflector line. From this point project horizontally to the left to read the total distance from start of takeoff roll to clear a 50-foot obstacle.

Sample Problem

A.	Nozzle rotation speed	98 Kt.
B.	Reflector curve	
C.	Wind base line	
D.	Headwind	20 Kt.
E.	Ground roll distance	720 Ft.
F.	Reflector line	
G.	Total distance to clear 50-foot obstacle	1500 Ft.

SAMPLE SHORT TAKEOFF DISTANCE



AV8A 1-(166)

CONVENTIONAL TAKEOFF DISTANCE

These charts (figure 11-16) are used to determine the tire limited takeoff gross weight, ground roll, and airborne distance to clear a 50-foot obstacle during a conventional takeoff. Effective wind velocities (headwind or tailwind), ambient pressure and temperature are all considered in determining the tire limited takeoff gross weight. These factors and the wet and dry short lift ratings are all considered in the takeoff distance determination.

USE

Enter the top charts on sheet 1 with the effective wind velocity and project vertically to the appropriate line (headwind or tailwind). From this point, project horizontally to the right to the pressure base line. Parallel the pressure guide lines to the appropriate ambient pressure. From this intersection, project horizontally right to the temperature base line. Parallel the temperature guide lines to the appropriate temperature. From this intersection, project horizontally right to read the tire limited takeoff gross weight.

Enter the bottom chart with the temperature and proceed vertically upward to the planned short lift rating (wet or dry). From this point project horizontally right to the ambient pressure base line. From this point, parallel the pressure guide lines to the appropriate pressure. From this intersection project horizontally to the right and read the reference number. Enter the chart on sheet 2 with this reference number and continue horizontally right to intercept both takeoff gross weight curves. From the first gross weight intersected read the lift off speed and then project vertically down to the wind base line. Parallel the wind guidelines to the effective wind (headwind or tailwind). From this intersection descend to read the ground roll. Repeat these steps from the second gross weight intersected to obtain the airborne distance to clear a 50-foot obstacle. These two distances must be added to provide the total distance from start of takeoff roll to clear a 50-foot obstacle.

Sample Problem

Tire limited gross weight -

A.	Wind	12 Kt.
B.	Headwind	
C.	Pressure baseline	
D.	Ambient pressure	29.50 In. Hg.
E.	Temperature baseline	
F.	Temperature	20°C
G.	Tire limited gross weight	17,800 Lb.

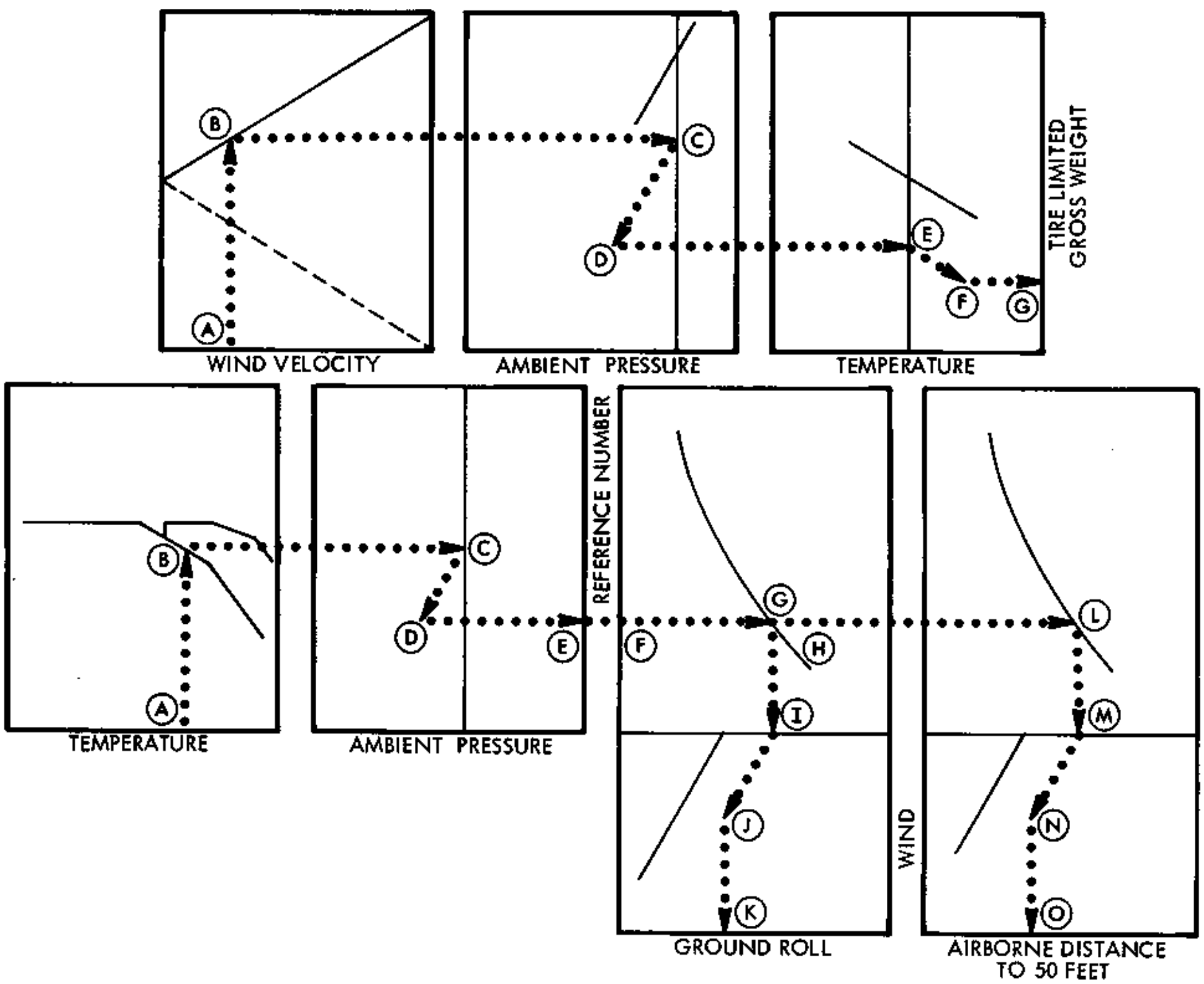
Takeoff ground roll distance -

A.	Temperature	20°C
B.	Short lift dry curve	
C.	Pressure baseline	
D.	Ambient pressure	29.50 In. Hg.
E.	Reference number	5.5
F.	Reference number	5.5
G.	Gross weight	17,600 Lb.
H.	Liftoff speed	166 Kt.
I.	Wind baseline	
J.	Effective headwind	12 Kt.
K.	Ground roll	1840 Ft.

Airborne distance -

L.	Gross weight	17,600 Lb.
M.	Wind baseline	
N.	Effective headwind	12 Kt.
O.	Airborne distance	730 Ft.
P.	Total distance to clear 50-foot obstacle	2570 Ft.

SAMPLE CONVENTIONAL TAKEOFF DISTANCE



AV8A-1-(172)

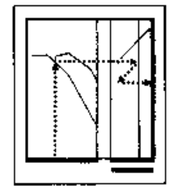
VERTICAL TAKEOFF CAPABILITY

SHORT LIFT RATING ZERO WIND-81° NOZZLES

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES
FULL FLAPS, GEAR DOWN

REMARKS
ENGINE: F402-RR-401
ICAO STANDARD DAY

GUIDE

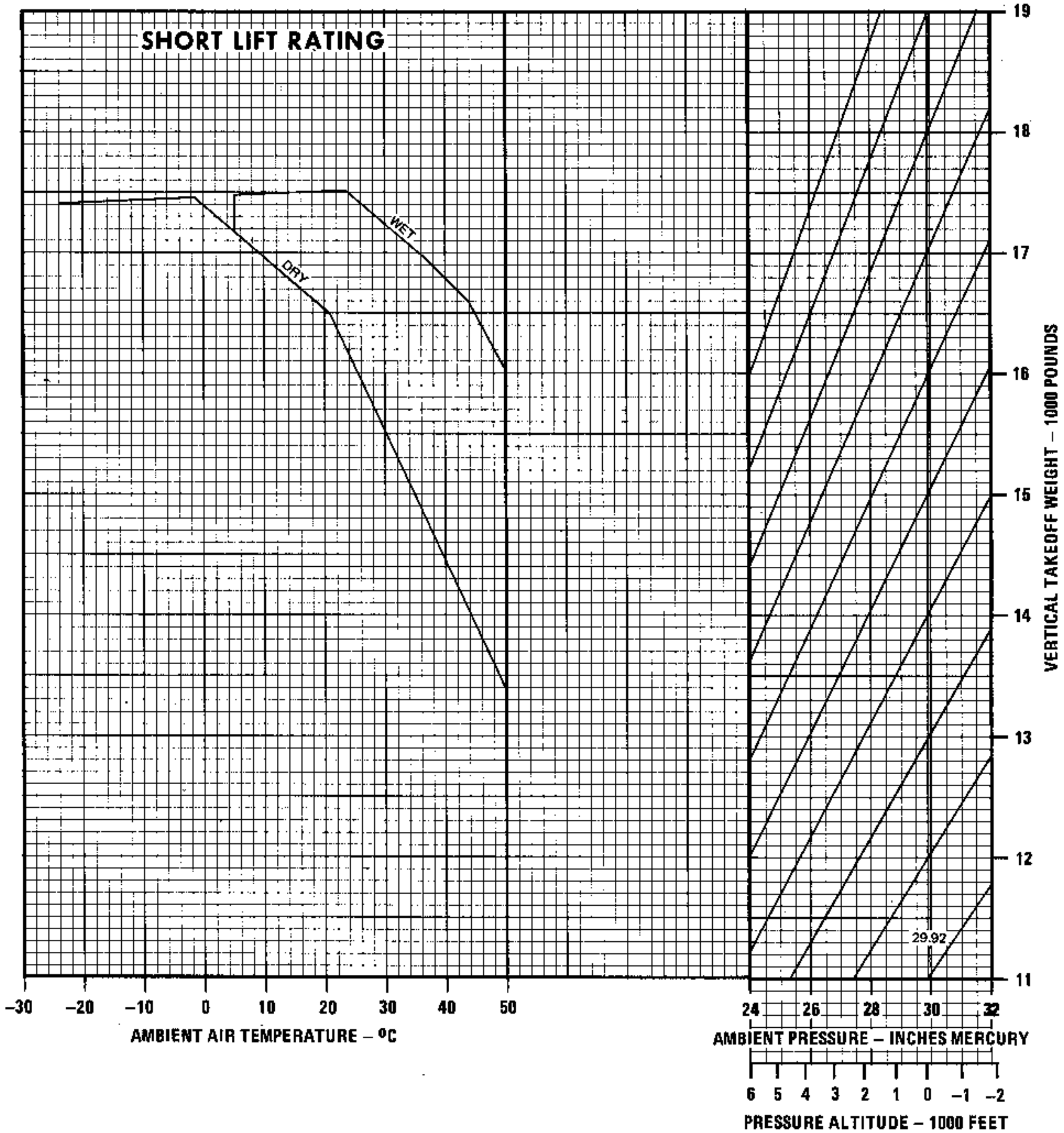


NOTE

WITH FUSELAGE MOUNTED STORES OR GUN PODS, VTO PERFORMANCE MAY BE DEGRADED UP TO 700 POUNDS.

DATE: 1 MAY 1973
DATA BASIS: ESTIMATED

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



AV8A-1-(158)B

Figure 11-12

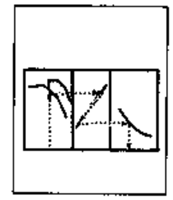
ROLLING VERTICAL TAKEOFF
SHORT LIFT RATING

AIRPLANE CONFIGURATION
FULL FLAPS, GEAR DOWN

REMARKS
ENGINE: F402-RR-401

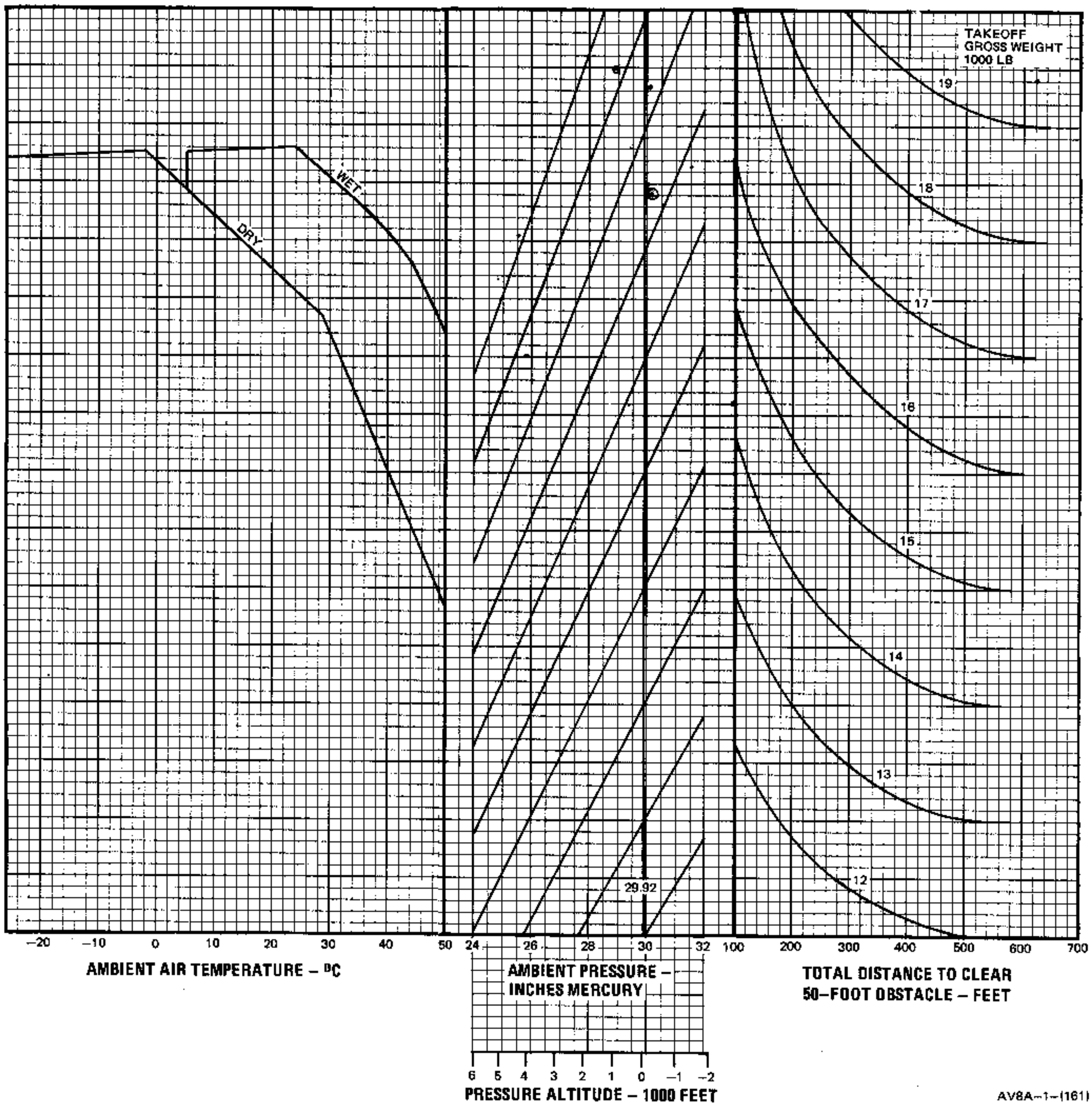
NOTE
SHORT LIFT RATING
TECHNIQUE: AS PER SECTION III
NOZZLES AT 30°, POWER 55%
THROTTLE TO FULL
AS RPM PASSES THROUGH 100%
ROTATE NOZZLES TO 70°

GUIDE



DATE: 1 JANUARY 1973
DATA BASIS: **ESTIMATED**

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.



AV8A-1-(161)

Figure 11-13

SHORT TAKEOFF
ROTATION SPEED AND NOZZLE ANGLES

AIRPLANE CONFIGURATION
ALL DRAG INDEXES
FULL FLAPS, GEAR DOWN

REMARKS
ENGINE: F402-RR-401
ICAO STANDARD DAY

NOTE
SHORT LIFT RATING
10° NOZZLES IN GROUND RUN

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

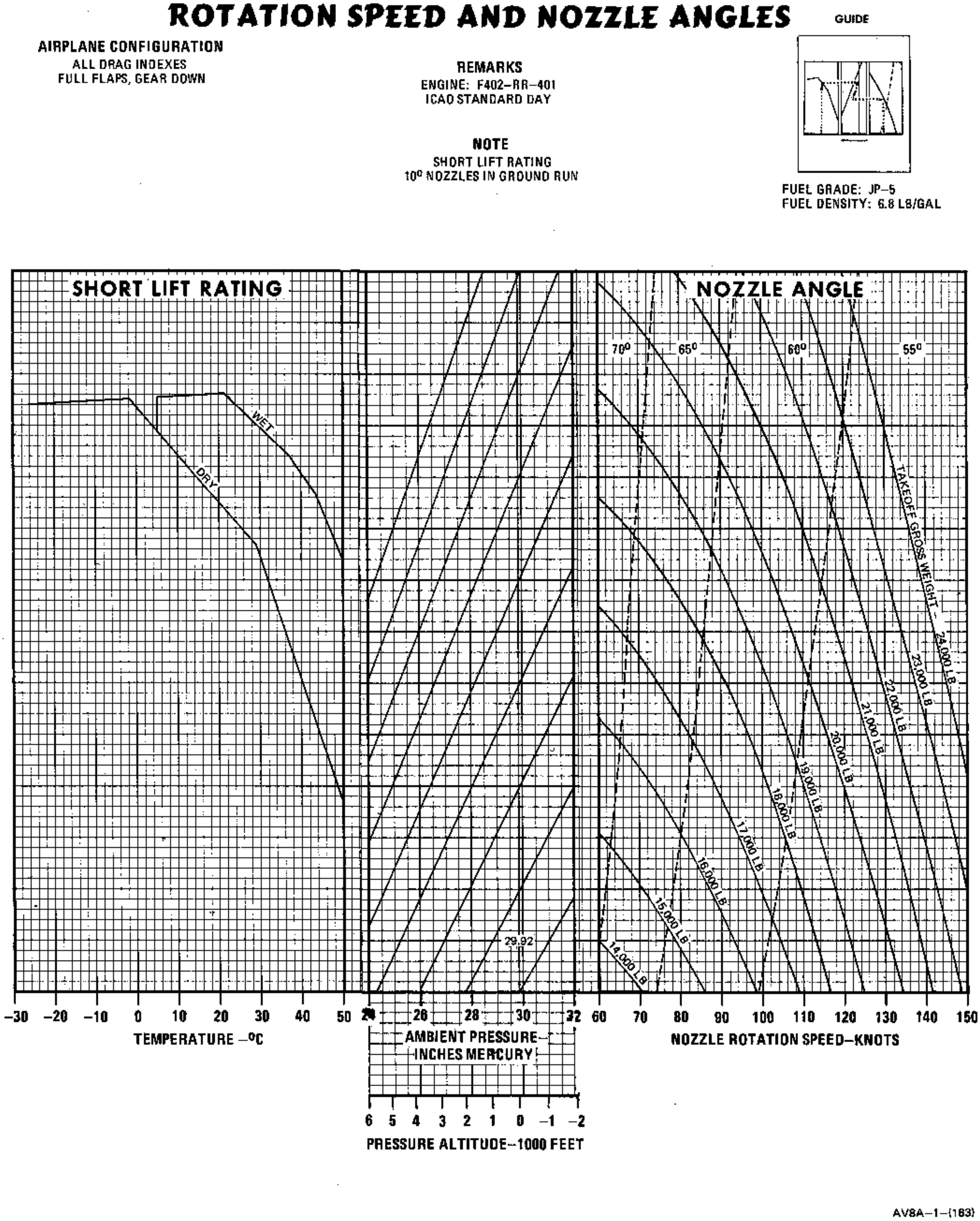


Figure 11-14

SHORT TAKEOFF DISTANCE

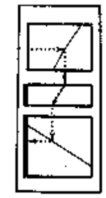
SHORT LIFT RATING
10° NOZZLES IN GROUND ROLL

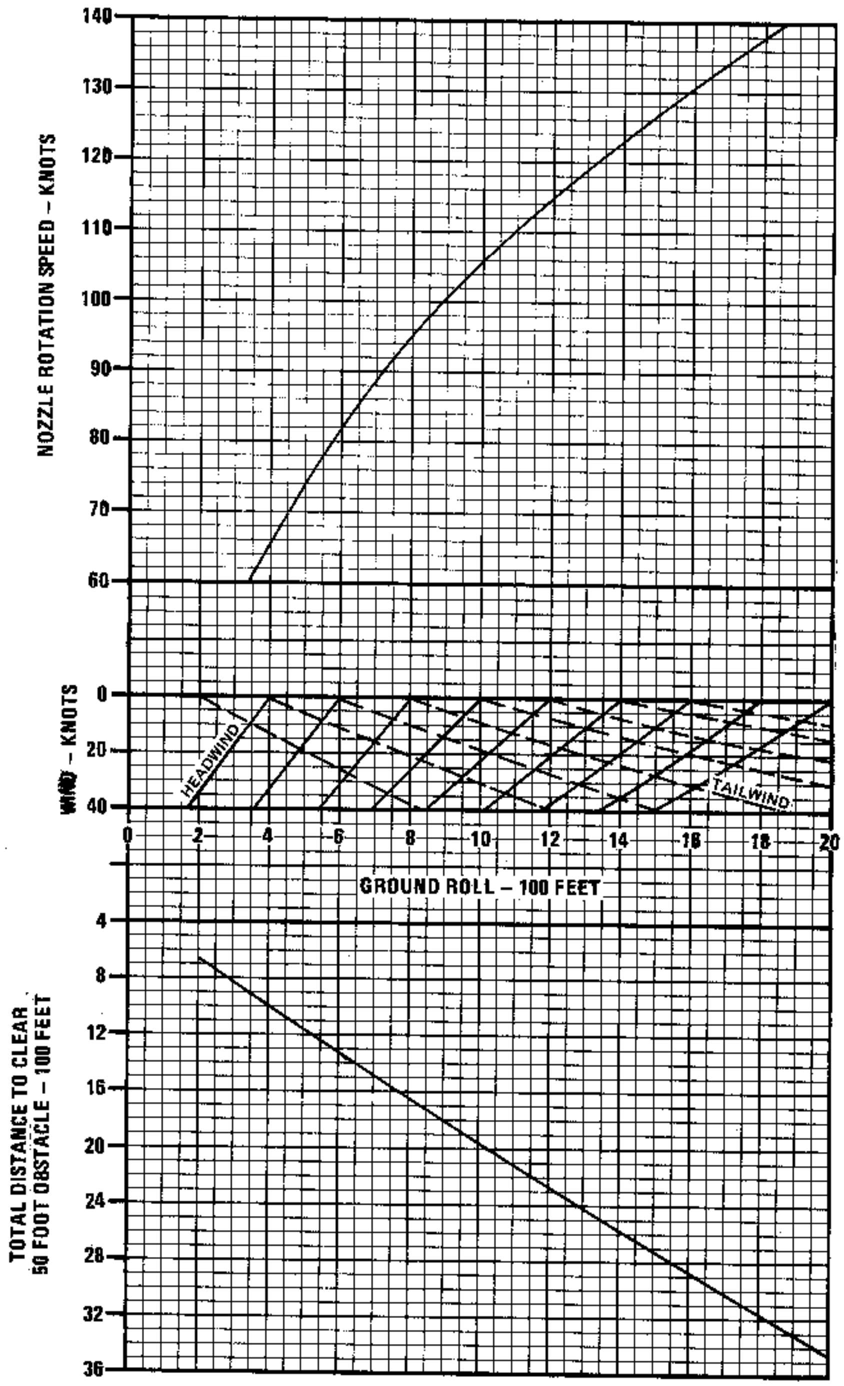
AIRPLANE CONFIGURATION
ALL DRAG INDEXES
FULL FLAPS, GEAR DOWN

REMARKS
ENGINE: F402-RR-401

DATE: 1 JANUARY 1973
DATA BASIS: ESTIMATED

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



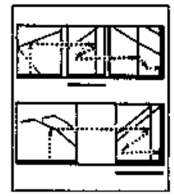


AV8A-1-(165)

Figure 11-15

CONVENTIONAL TAKEOFF DISTANCE
SHORT LIFT RATING-NOZZLES 10 DEGREES

GUIDE



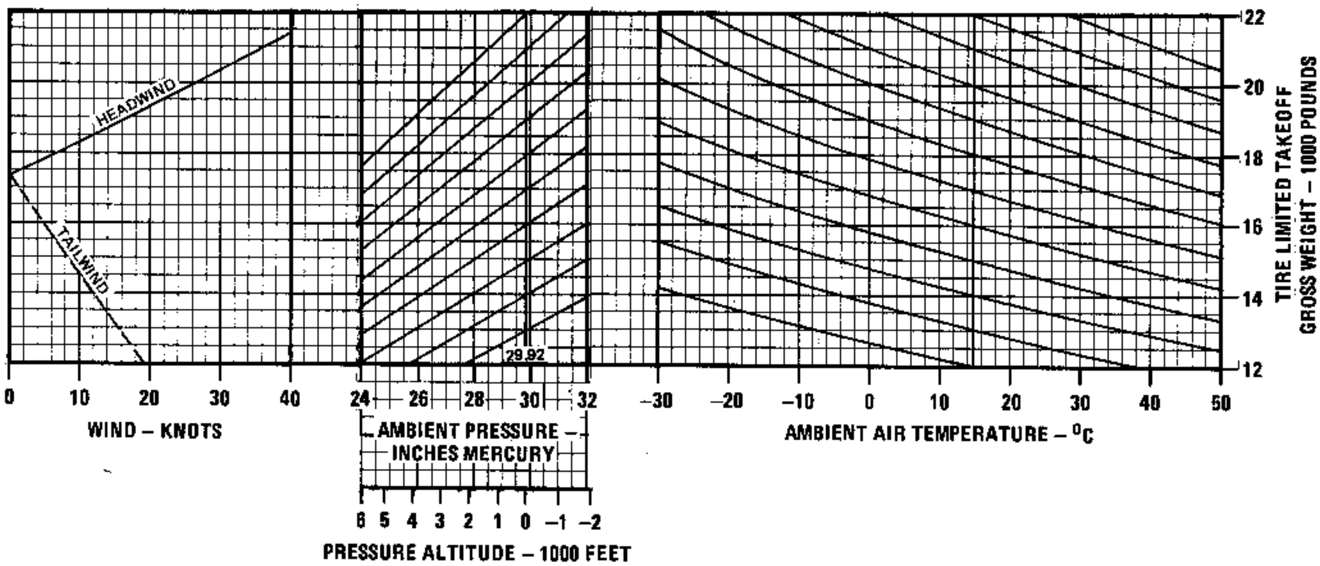
AIRPLANE CONFIGURATION
ALL DRAG INDEXES
MID-FLAPS, GEAR DOWN

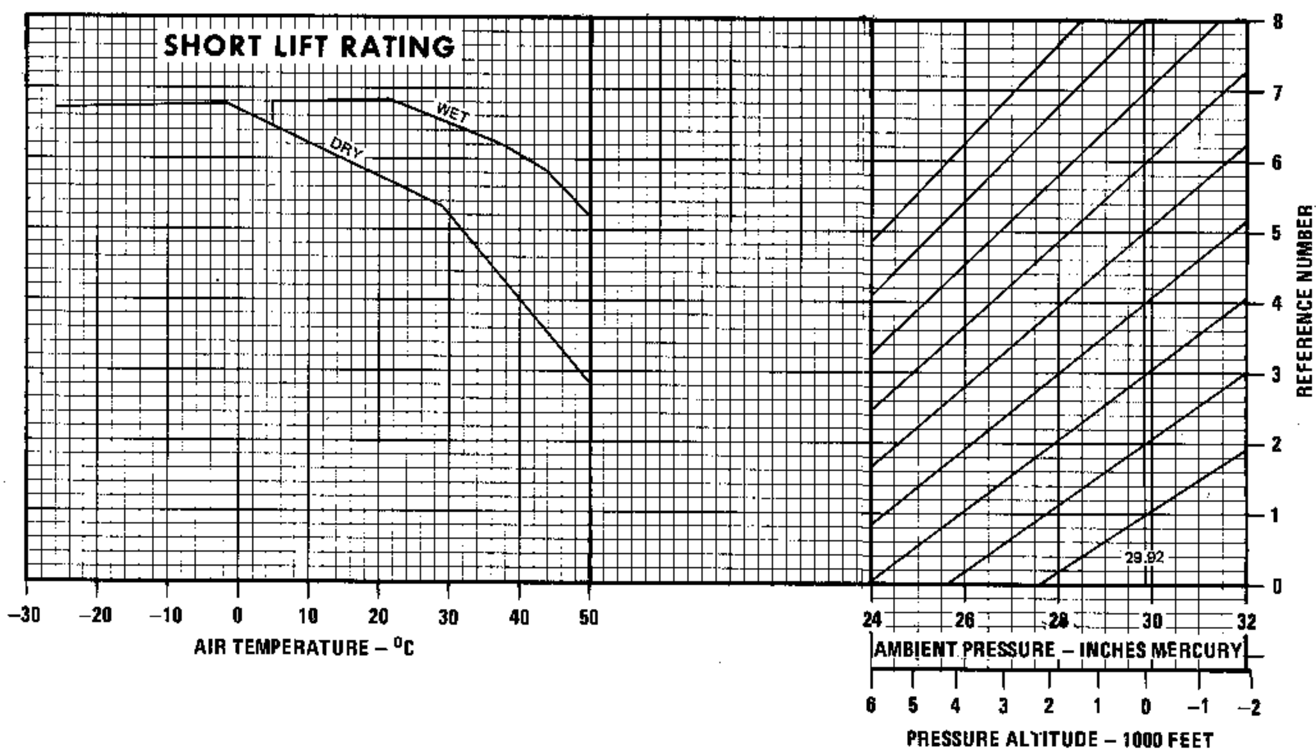
REMARKS
ENGINE: F402-RR-401
ICAO STANDARD DAY

NOTE
INITIALLY CHECK GROSS WEIGHT FOR TIRE LIMITATIONS.

DATE: 1 JANUARY 1973
DATA BASIS: ESTIMATED

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL





AV8A-1-(173-1)

Figure 11-16 (Sheet 1 of 2)

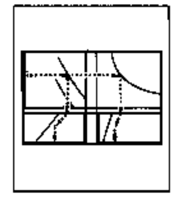
CONVENTIONAL TAKEOFF DISTANCE
SHORT LIFT RATING-NOZZLES 10 DEGREES

AIRPLANE CONFIGURATION
ALL DRAG INDEXES
MID-FLAPS, GEAR DOWN

REMARKS
ENGINE: F402-RR-401
ICAO STANDARD DAY

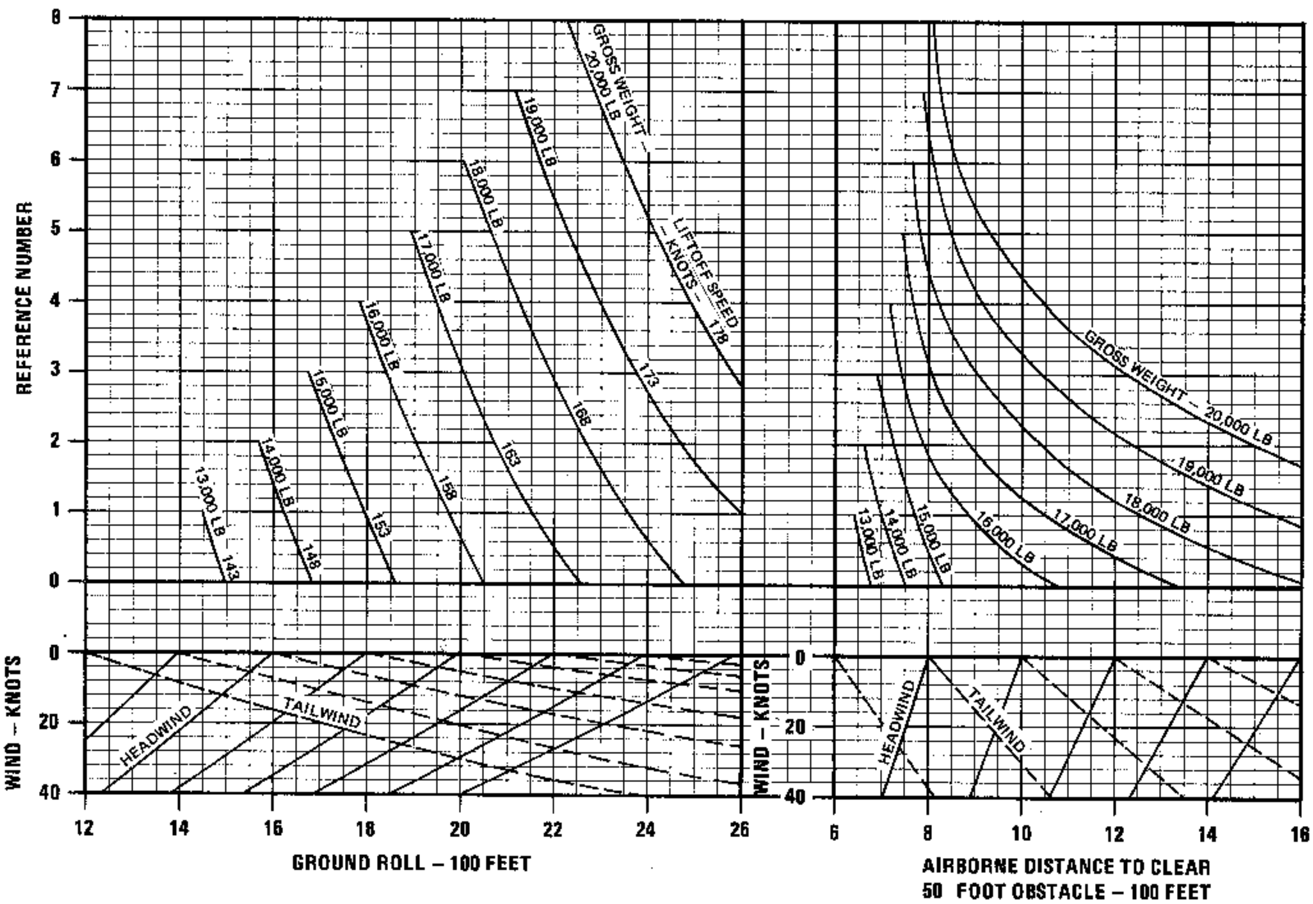
NOTE
INITIALLY CHECK GROSS WEIGHT FOR TIRE LIMITATIONS ON SHEET 1.

GUIDE



DATE: 1 JANUARY 1973
DATA BASIS: ESTIMATED

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



AV8A-1-(173-2)

Figure 11-16 (Sheet 2 of 2)

PART 4
CLIMB

Charts

NOTE

All climb charts are based on a flaps up, gear up, nozzles aft configuration.

CLIMB CHARTS

Two series of charts are presented, one for maximum and one for maximum continuous thrust climb schedules (figures 11-17 thru 11-19). Each series includes charts for determining time, distance covered and fuel used while in the climb. The charts are based on a simplified climb schedule of 350 KIAS until interception of 0.81 Mach and then a constant mach climb to cruise altitude. The charts may be used to obtain climb data from start of climb to cruise altitude or incrementally between altitudes.

USE

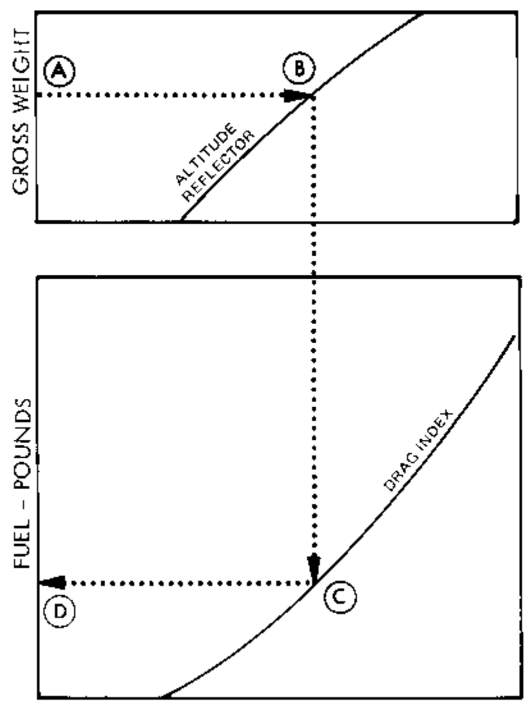
The method of presenting data on the time, distance, and fuel charts is identical, and the use of one chart will be undertaken here. Enter the charts with the initial climb gross weight. Project horizontally to the right and intersect the assigned cruise altitude, or the optimum cruise altitude for the computed drag index. Project vertically downward to intersect the applicable drag index line, then project horizontally to the left to read the planning data.

Sample Problem

Fuel Required - Maximum Continuous Thrust

A.	Gross weight	21,000 Lb.
B.	Cruise altitude	30,000 Ft.
C.	Computed drag index	20
D.	Fuel required to climb	760 Lb.

SAMPLE CLIMB



AV8A-1 (70)

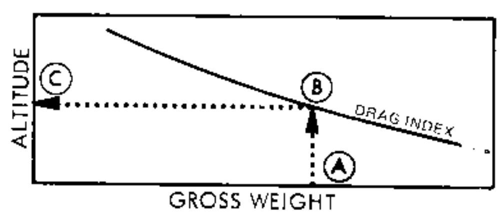
COMBAT CEILING CHART

This chart (figure 11-19) presents the maximum thrust combat ceiling for normal operation. The variables of gross weight and drag index are taken into consideration.

USE

Enter the applicable graph with estimated gross weight at end of climb. Project vertically upward to intersect applicable drag index, then horizontally to the left to read combat ceiling.

SAMPLE COMBAT CEILING



AV8A-1-(71)

Sample Problem

Combat Ceiling - Maximum Thrust

A.	Gross weight at end of climb	20,000 Lb.
B.	Drag index	20
C.	Combat ceiling	39,200 Ft.

TIME TO CLIMB
MAXIMUM THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

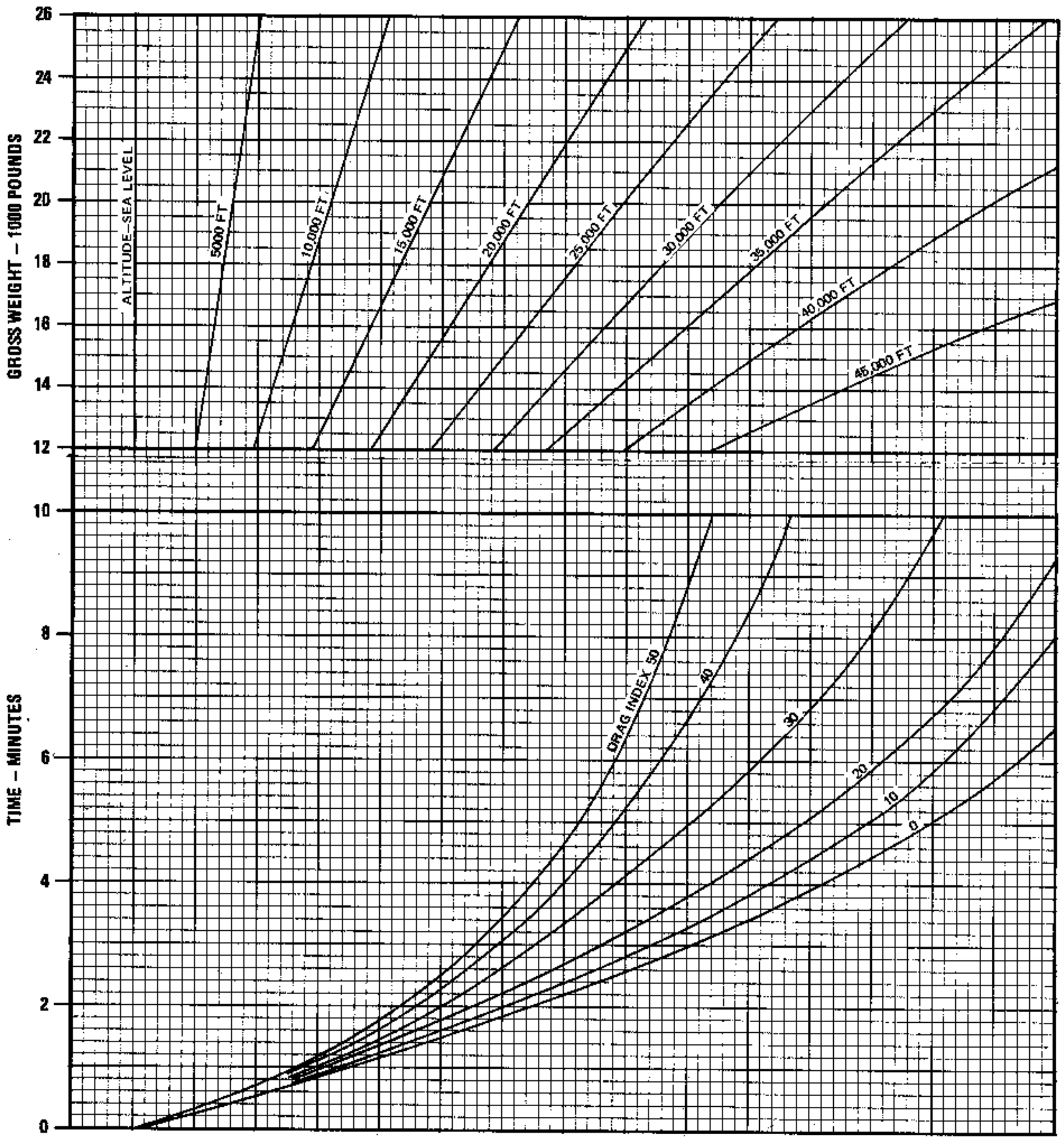
REMARKS
ENGINE: F402-RR-401
ICAO STANDARD DAY

NOTE
DATA BASED ON 350-KNOT CLIMB UNTIL INTERCEPTION OF .81 MACH THEN MAINTAIN .81 MACH TO CRUISE ALTITUDE. REFER TO PART 4 TO OBTAIN OPTIMUM CRUISE ALTITUDE

GUIDE

DATE: 1 DECEMBER 1972
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



AV8A-1-(84-1)

Figure 11-17 (Sheet 1 of 3)

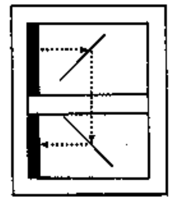
FUEL REQUIRED TO CLIMB
MAXIMUM THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE: F402–RR–401
ICAO STANDARD DAY

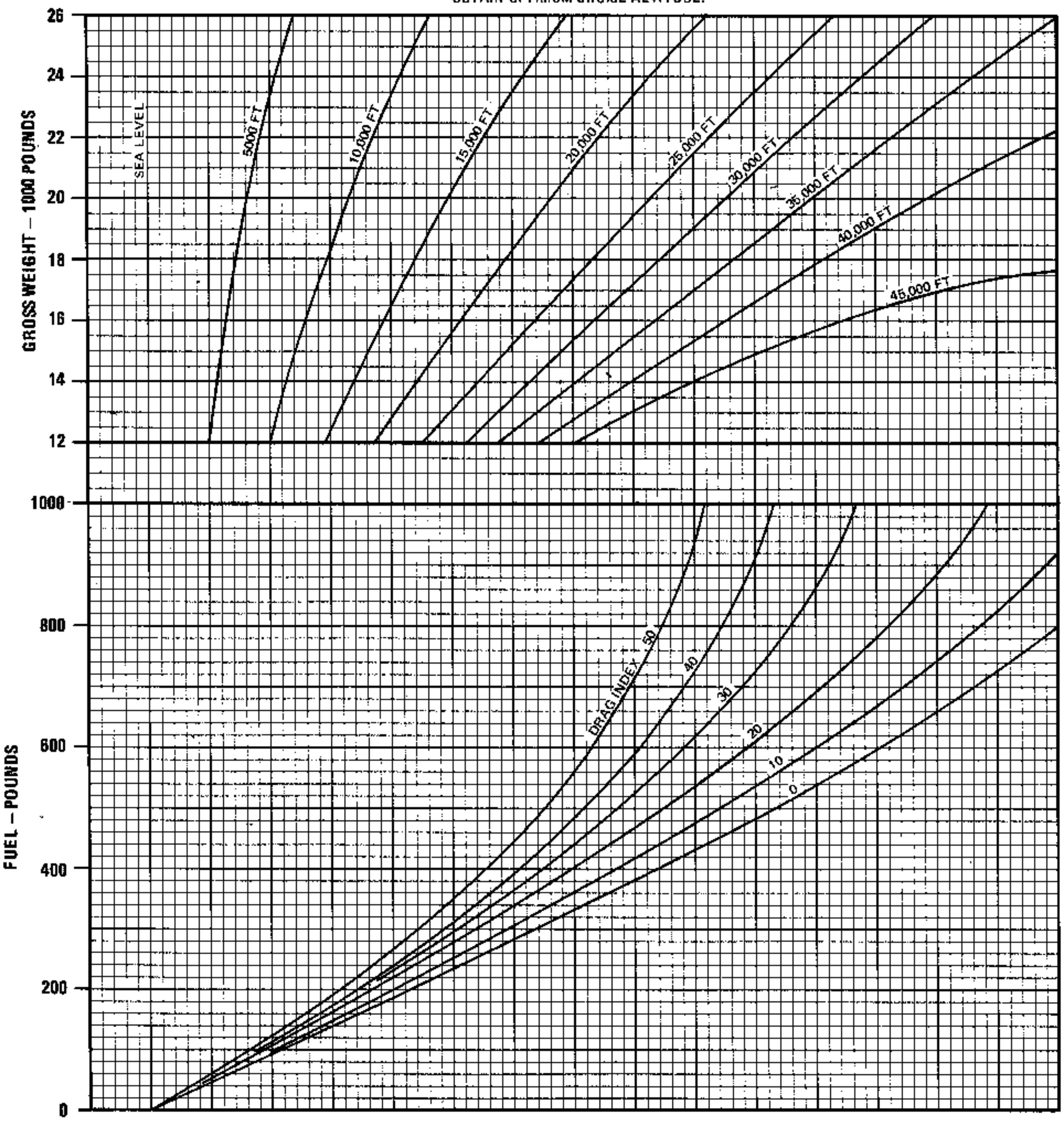
NOTE
DATA BASED ON 350–KNOT CLIMB UNTIL INTERCEPTION OF .81 MACH, THEN MAINTAIN .81 MACH TO CRUISE ALTITUDE. REFER TO PART 4 TO OBTAIN OPTIMUM CRUISE ALTITUDE.

GUIDE



DATE: 1 DECEMBER 1972
DATA BASIS: ESTIMATED (BASED ON FLIGHT TEST)

FUEL GRADE: JP–5
FUEL DENSITY: 6.8 LB/GAL



AV8A–1–(84–2)

Figure 11–17 (Sheet 2 of 3)

DISTANCE REQUIRED TO CLIMB

MAXIMUM THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

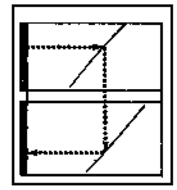
REMARKS
ENGINE: F402-RR-401
ICAO STANDARD DAY

NOTE

DATA BASED ON 350-KNOT CLIMB UNTIL INTERCEPTION OF .81 MACH, THEN MAINTAIN .81 MACH TO CRUISE ALTITUDE. REFER TO PART 4 TO OBTAIN OPTIMUM CRUISE ALTITUDE

DATE: 1 DECEMBER 1972
DATA BASIS: ESTIMATED (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



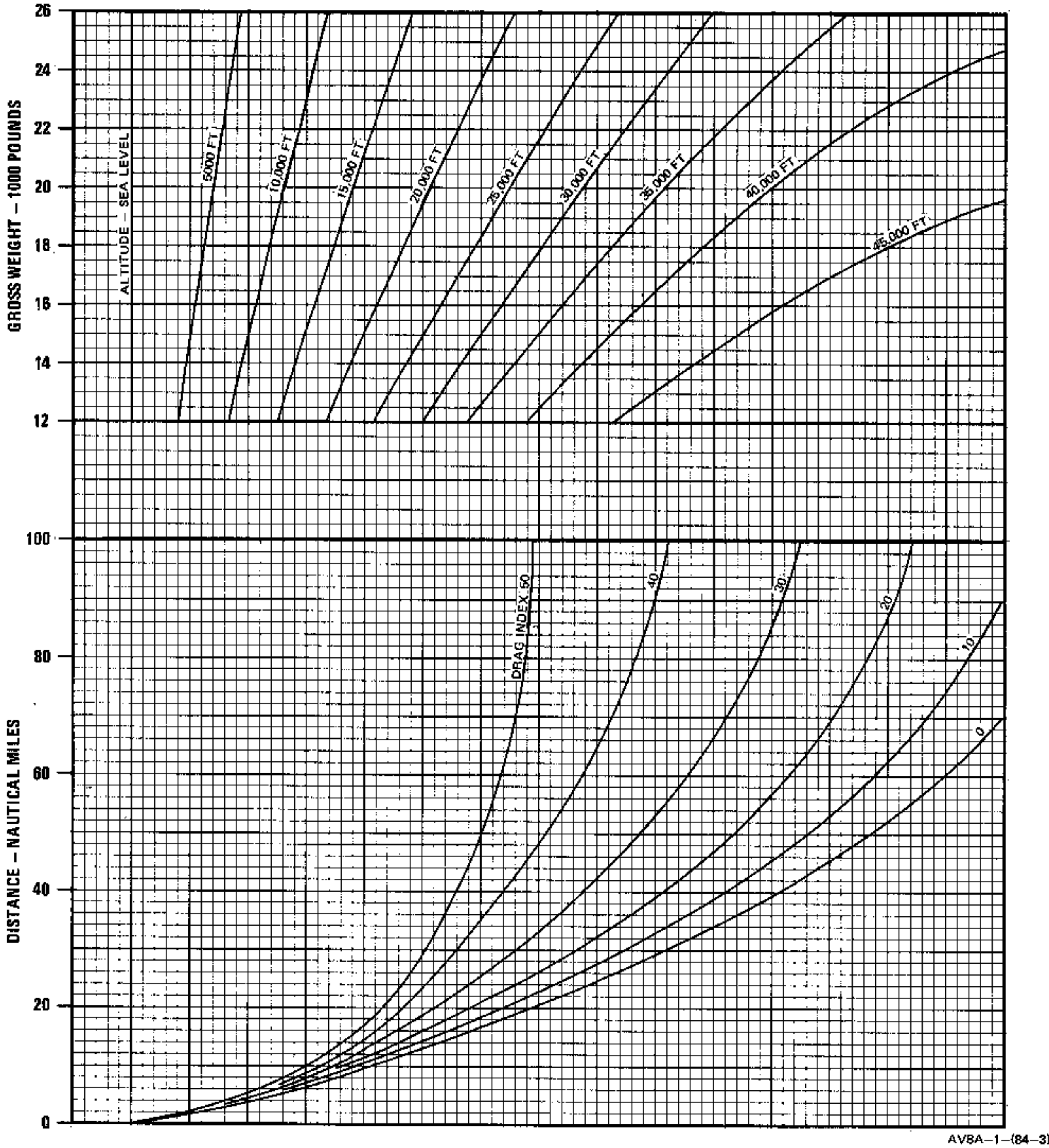


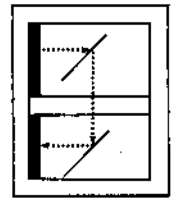
Figure 11-17 (Sheet 3 of 3)

TIME TO CLIMB
MAXIMUM CONTINUOUS THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE: F402-RR-401
ICAO STANDARD DAY

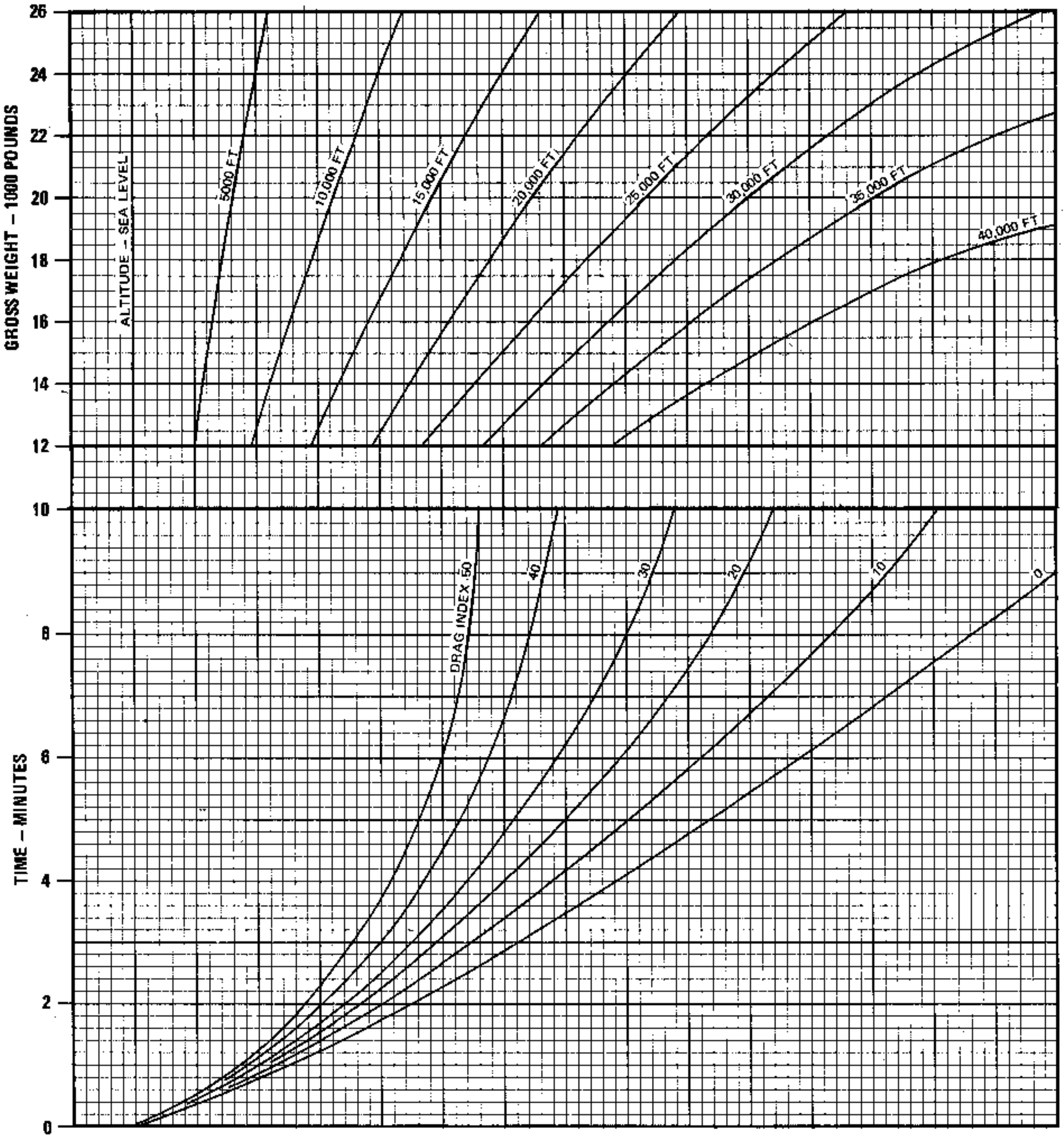
GUIDE



NOTE
DATA BASED ON 350-KNOT CLIMB UNTIL INTERCEPTION OF .81 MACH, THEN MAINTAIN .81 MACH TO CRUISE ALTITUDE. REFER TO PART 4 TO OBTAIN OPTIMUM CRUISE ALTITUDE.

DATE: 1 DECEMBER 1972
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



AV8A-1-(81-1)

Figure 11-18 (Sheet 1 of 3)

FUEL REQUIRED TO CLIMB
MAXIMUM CONTINUOUS THRUST

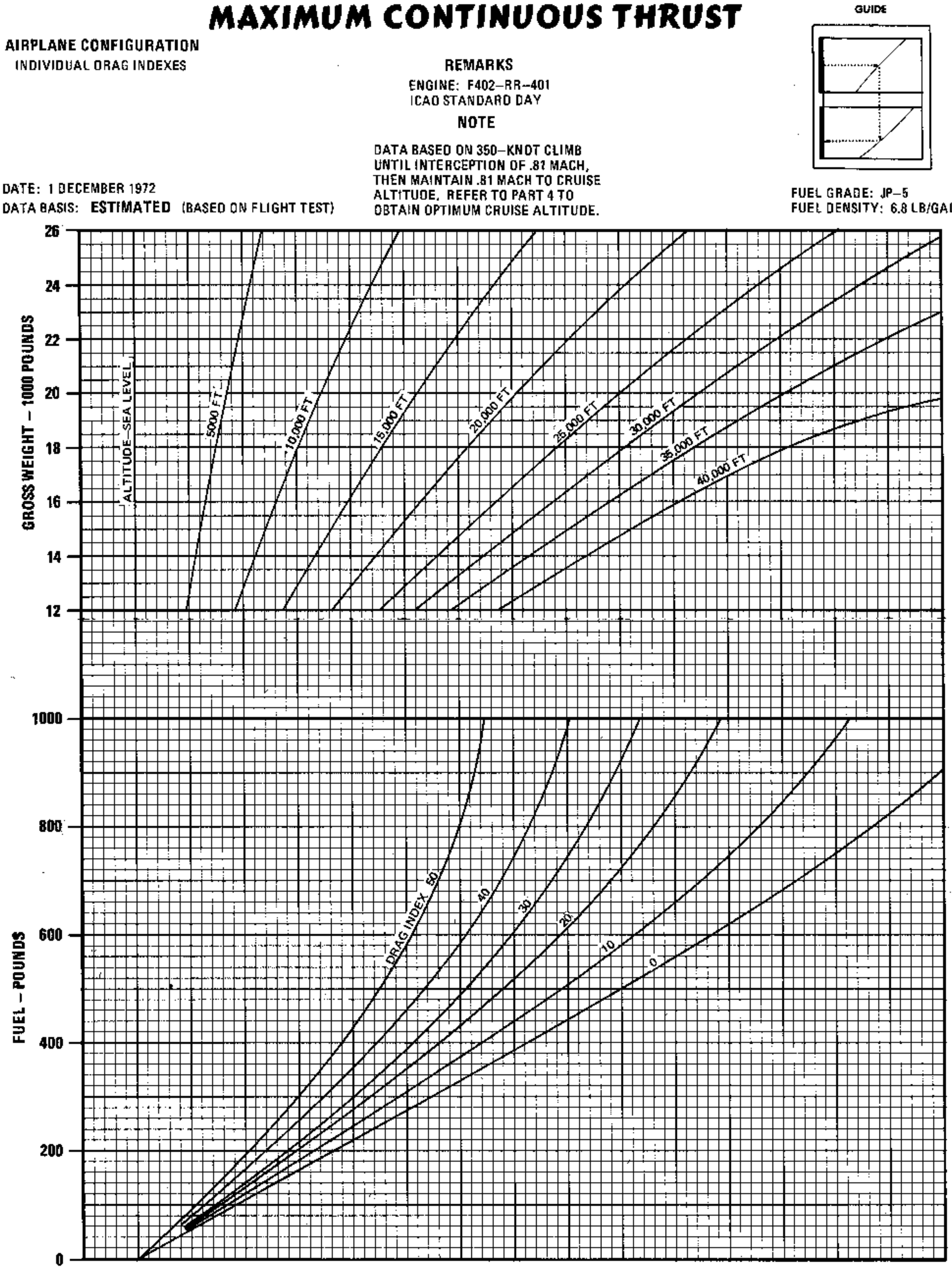
AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE: F402-RR-401
ICAO STANDARD DAY

NOTE
DATA BASED ON 350-KNOT CLIMB UNTIL INTERCEPTION OF .81 MACH, THEN MAINTAIN .81 MACH TO CRUISE ALTITUDE. REFER TO PART 4 TO OBTAIN OPTIMUM CRUISE ALTITUDE.

DATE: 1 DECEMBER 1972
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



AV8A-1-(81-2)

Figure 11-18 (Sheet 2 of 3)

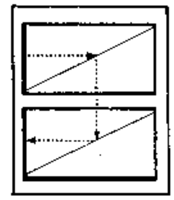
DISTANCE REQUIRED TO CLIMB
MAXIMUM CONTINUOUS THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE: F402-RR-401
ICAO STANDARD DAY

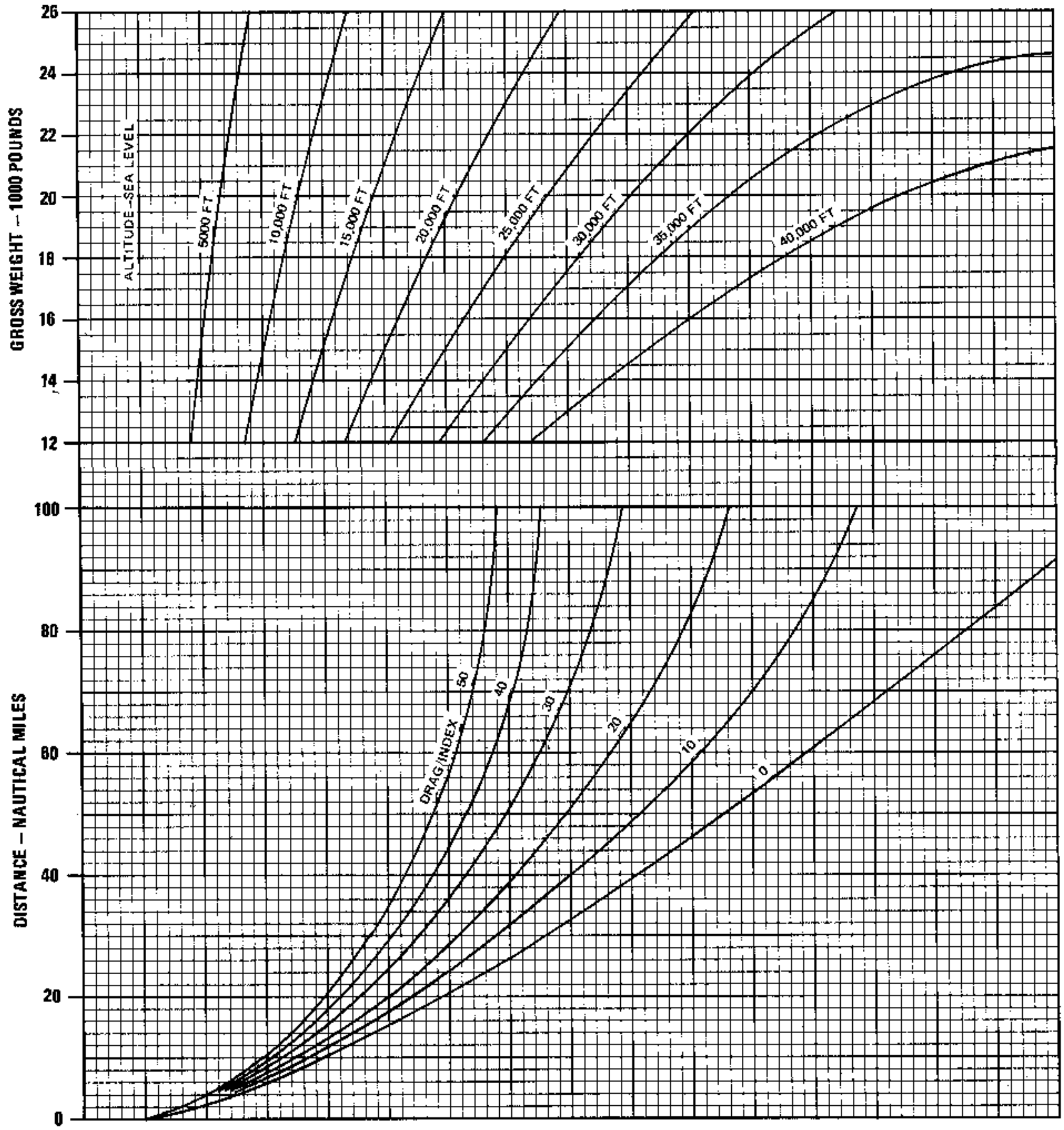
NOTE
DATA BASED ON 350-KNOT CLIMB UNTIL INTERCEPTION OF .81 MACH THEN MAINTAIN .81 MACH TO CRUISE ALTITUDE. REFER TO PART 4 TO OBTAIN OPTIMUM CRUISE ALTITUDE

GUIDE



DATA: 1 DECEMBER 1972
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



AV8A-1-(81-3)

Figure 11-18 (Sheet 3 of 3)

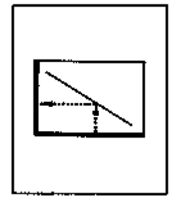
COMBAT CEILING
MAXIMUM THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE: F402-RR-401
ICAO STANDARD DAY

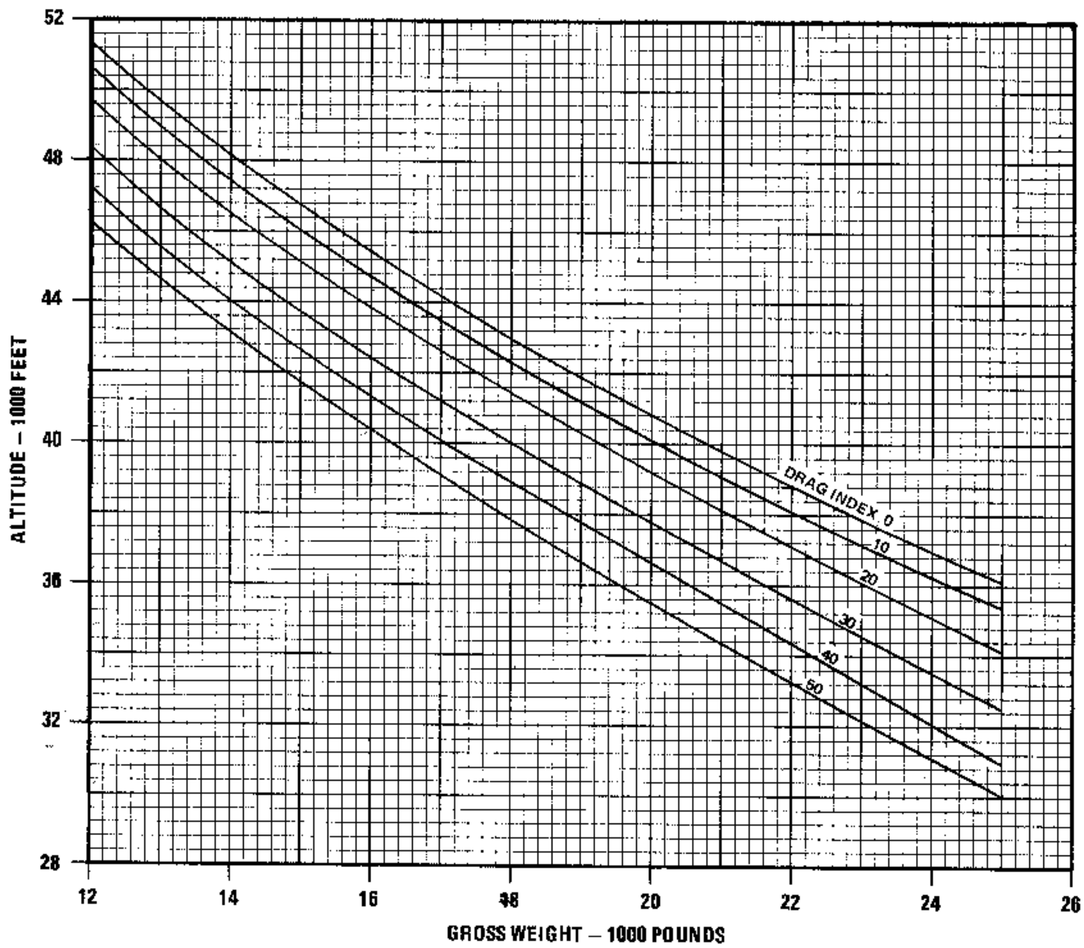
NOTE
COMBAT CEILING IS PRESSURE ALTITUDE AT WHICH AIRCRAFT CAN CLIMB AT MAXIMUM RATE OF 500 FEET PER MINUTE.

GUIDE



DATE: 1 DECEMBER 1972
DATA BASIS: ESTIMATED (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



AV8A-1-(80)

Figure 11-19

PART 5
RANGE

Charts

NOTE

All cruise charts are based on a flaps up, gear up, nozzles aft configurations.

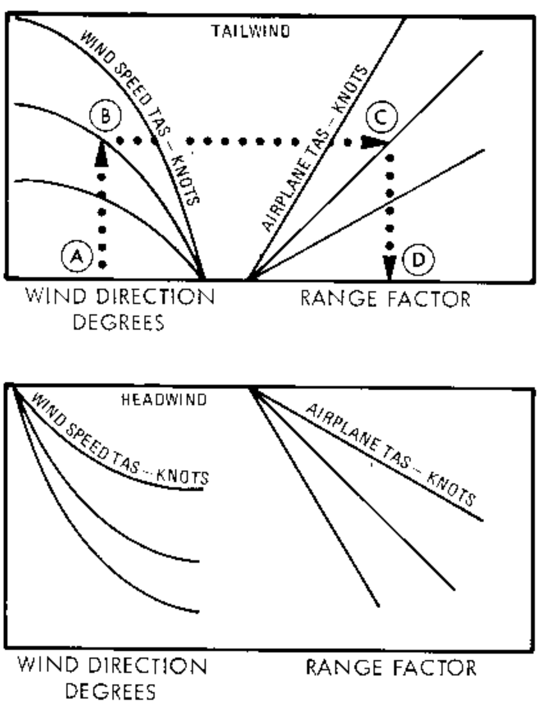
RANGEWIND CORRECTION CHART

This chart (figure 11-20) provides a means of correcting computed range (specific or total) for existing wind effects. The presented range factors consider wind speeds up to 150 knots from any relative wind direction for airplane speeds of 200 to 800 knots (TAS).

USE

Determine the relative wind direction by substracting the aircraft heading from the forecast wind direction. If the aircraft heading is greater than forecast wind direction, add 360° to the wind direction and then perform the subtraction. Enter the chart with relative wind direction and proceed vertically to the interpolated wind speed. From this point, project horizontally to intersect the airplane true airspeed and reflect to the lower scale to read the range factor. Multiply computed range by this range factor to find range as affected by wind.

SAMPLE RANGEWIND CORRECTION



AVBA-1-(93)

Sample Problem

A.	Relative wind direction	150°
B.	Wind speed	125 Kt
C.	Airplane speed (TAS)	400 Kt
D.	Range factor	1.25

OPTIMUM AND FAST CRUISE FLIGHT CONDITIONS

This chart (figure 11-21) presents optimum and fast cruise Mach numbers and optimum altitude at various combinations of gross weight and drag index.

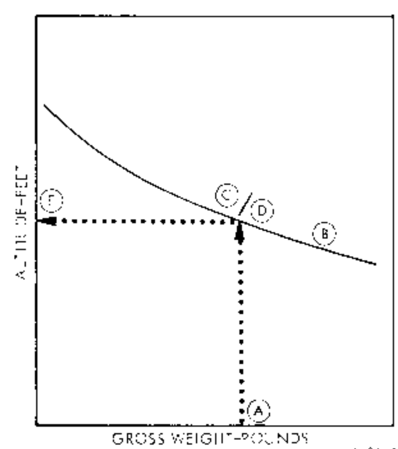
USE

Enter the chart with the estimated gross weight at end of climb. Project vertically upward to intersect applicable drag index to read optimum and fast cruise Mach numbers. From this point project horizontally to the left to read optimum cruise altitude.

Sample Problem

A.	Gross weight	20,000 Lb
B.	Drag index	20.0
C.	Optimum cruise Mach number	.78
D.	Fast cruise Mach number	.80
E.	Optimum altitude	34,500 Ft

SAMPLE OPTIMUM AND FAST CRUISE FLIGHT CONDITIONS



LOW ALTITUDE CRUISE

These charts (figures 11-22 thru 11-25) present total fuel flow values for various combinations of airspeed and drag index at altitudes of Sea Level, 4000, 8000, and 12,000 feet. Separate charts are provided for several gross weights. Also included for each altitude are the total fuel flow values and resultant V_{max} (maximum indicated airspeed-knots) for a maximum thrust setting. Fuel flow values are tabulated for ICAO Standard Day.

USE

After selecting the applicable chart for gross weight and altitudes, enter with the desired airspeed and project horizontally to the applicable drag index column. Read total fuel flow for a standard day.

CONSTANT MACH/ALTITUDE CRUISE

These charts (figures 11-26 thru 11-29) present nautical miles per pound and total fuel flow for various combinations of Mach number, gross weight, altitude and drag index. This data is based on cruise at a constant Mach number and a constant altitude.

USE

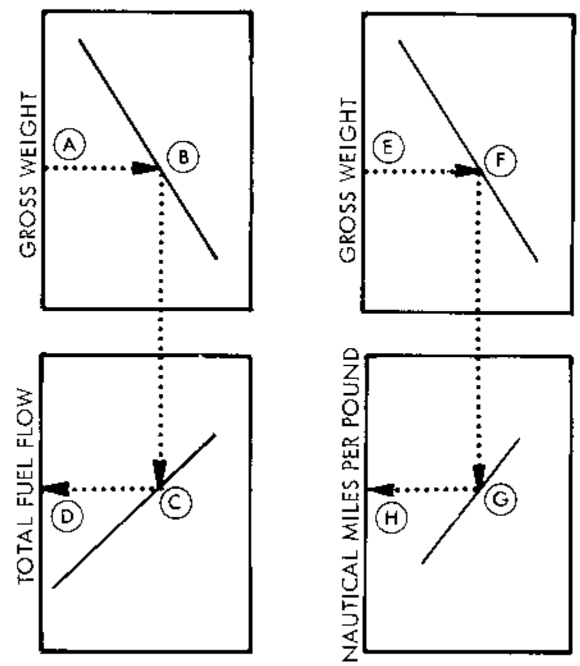
After selecting the desired cruise Mach, enter the top left chart with the estimated gross weight at end of climb. Project horizontally to the right to intersect the desired cruise altitude, then vertically downward to intersect the applicable drag index. From this point, project horizontally to the left and read total fuel flow. Repeat these steps with the right hand charts to derive specific range (nautical miles per pound). These values are computed for standard day temperatures.

Sample Problem

Cruise Mach number 0.70

A.	Gross weight	20,000 Lb.
B.	Altitude	35,000 Ft.
C.	Drag index	10
D.	Total fuel flow	53 PPM
E.	Gross weight	20,000 Lb.
F.	Altitude	35,000 Ft.
G.	Drag index	10
H.	Specific range	0.13NMPP

SAMPLE CONSTANT MACH/ ALTITUDE CRUISE



AV8A-1-109

OPTIMUM CRUISE AT CONSTANT ALTITUDE

These charts (figure 11-30, sheets 1 and 2) present the necessary planning data to set up optimum cruise schedules at a constant altitude. The recommended procedure is to use an average gross weight for a given leg of the mission. One way to find the average gross weight is to divide the mission into weight segments. With this method, readjust the cruise schedule each time a given amount of fuel is used. Subtract one-half of the fuel weight alloted for the first leg from the initial cruise gross weight. The remainder is the average gross weight for the leg. It is possible to obtain instantaneous data if desired.

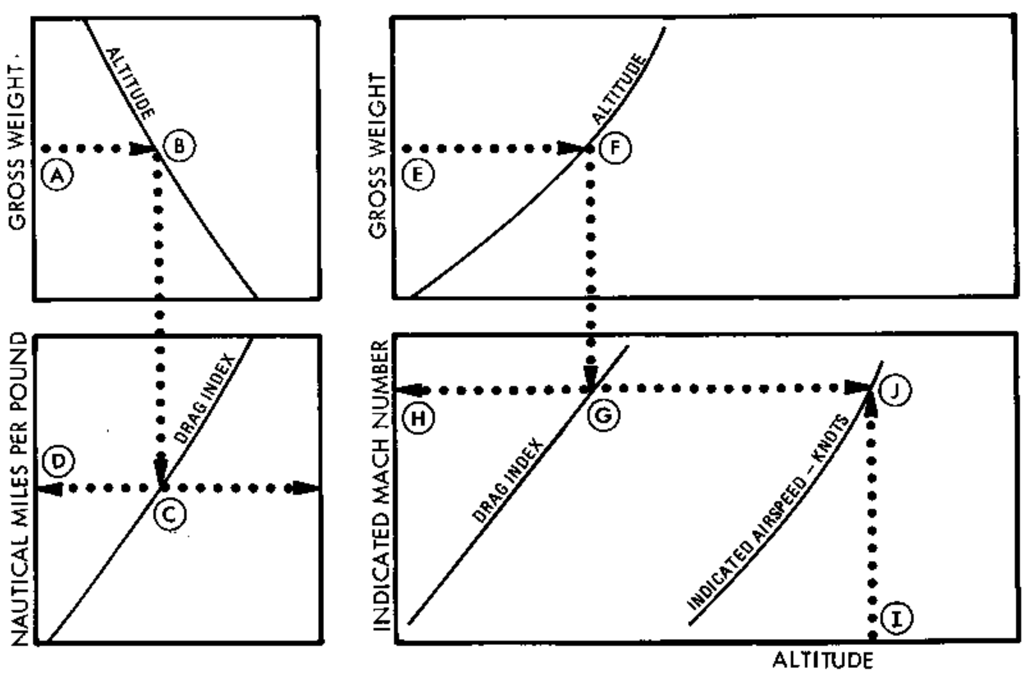
USE

Enter the left side of sheet 1 with the average gross weight. Project horizontally to the right to intersect desired cruise altitude, vertically downward to the computed drag index, then horizontally to the left to obtain specific range (nautical miles per pound). Enter sheet 2 with the average gross weight. Project horizontally to the right to intersect the desired cruise altitude, then vertically downward to the computed drag index. From this intersection project horizontally left and right. At the left projection obtain the indicated mach number. Enter the bottom of the lower chart with the cruise altitude and project vertically upward to intersect the right extension of the drag index projection. This intersection provides the indicated airspeed for optimum cruise.

Sample Problem

A.	Average gross weight for first leg	20,000 Lb
B.	Cruise altitude	20,000 Ft
C.	Computed drag index	10.0
D.	Specific range	.114MPP
E.	Gross weight	20,000 Lb
F.	Altitude	20,000 Ft
G.	Drag index	10.0
H.	Indicated mach number	0.66
I.	Altitude	20,000 Ft
J.	Indicated airspeed	300 Kt.

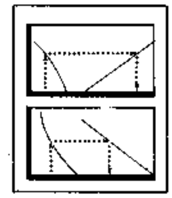
SAMPLE OPTIMUM CRUISE AT CONSTANT ALTITUDE



AV8A-1-(94)

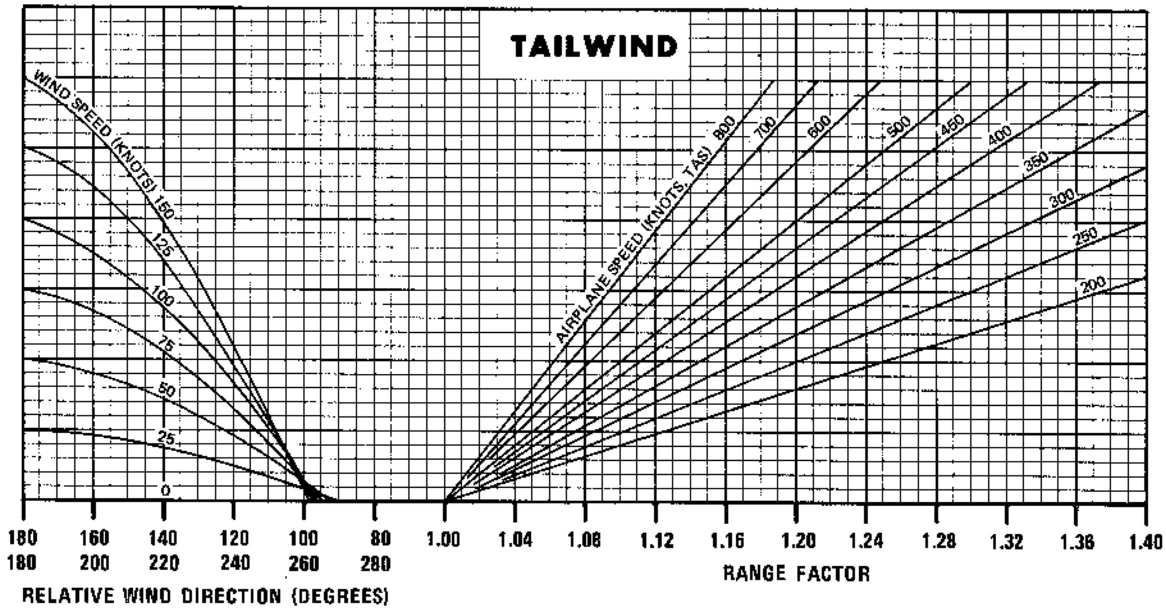
RANGEWIND CORRECTION

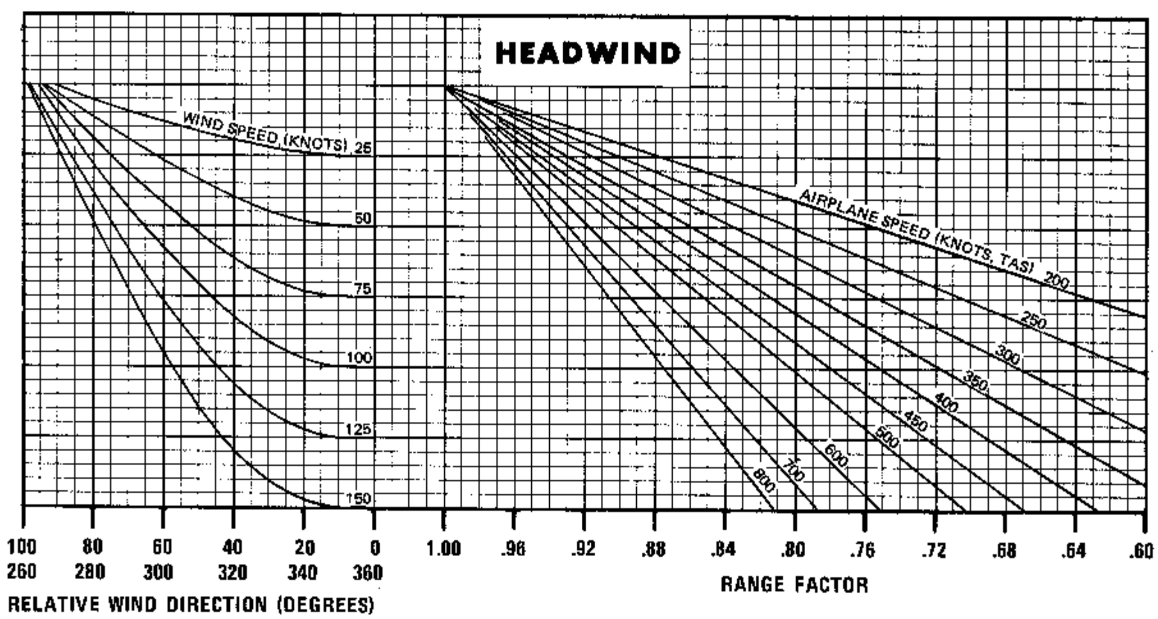
AIRPLANE CONFIGURATION
ALL DRAG INDEXES



RELATIVE WIND DIRECTION

NOTE: RELATIVE WIND DIRECTION = ANGULAR DIFFERENCE MEASURED CLOCKWISE, BETWEEN AIRPLANE HEADING AND TRUE WIND DIRECTION





AV8A-1-(79)

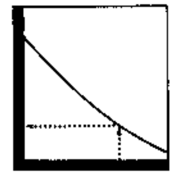
Figure 11-20

OPTIMUM AND FAST CRUISE FLIGHT CONDITIONS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

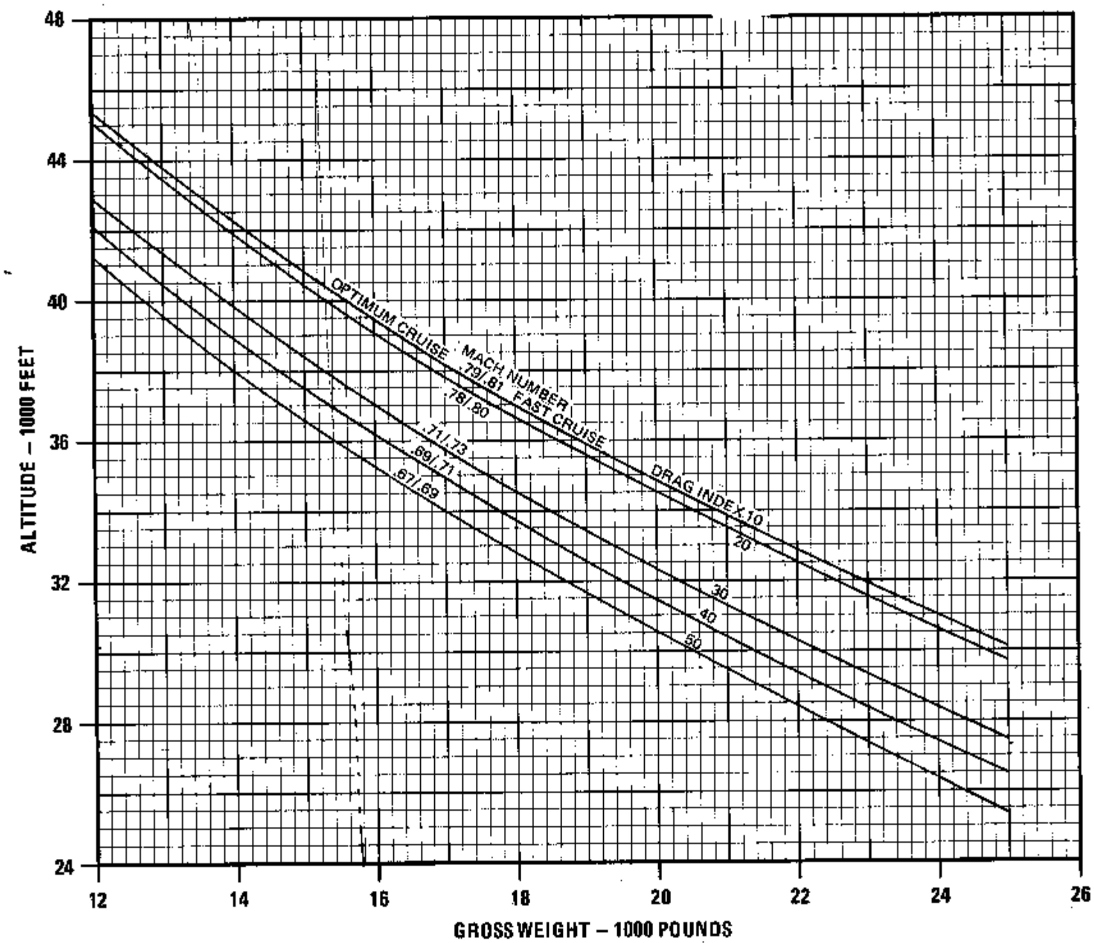
REMARKS
ENGINE: F402-RR-401
ICAO STANDARD DAY

GUIDE



DATE: 1 DECEMBER 1972
DATA BASIS: ESTIMATED (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



AV8A-1-(78)B

Figure 11-21

LOW ALTITUDE CRUISE

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

GROSS WEIGHT – 15,000 POUNDS
REMARKS
ENGINE: F402-RR-401
ICAO STANDARD DAY

DATE: 1 DECEMBER 1972
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

	KTAS	DRAG INDEX 0	10	20	30	40	50
		TOTAL FUEL FLOW – LB/MIN					
SEA LEVEL	300	59.0	63.3	67.7	72.0	76.5	81.0
	330	65.6	70.8	76.4	81.7	87.7	93.0
	360	73.4	79.8	86.6	93.0	100.4	106.6
	390	82.6	90.5	98.2	106.1	114.5	122.3
	420	92.7	102.4	111.1	121.9	132.0	143.2
	450	104.2	115.9	127.2	140.8	154.6	173.4
	480	116.9	131.5	146.0	164.4	185.5	208.1
	510	131.7	151.4	171.5	199.4		
	540	148.8	176.7	210.5			
	MAX	233	230	227	225	221	219
	V_{MAX}	594	570	552	531	507	490
4,000 FEET	300	56.1	60.5	64.7	69.5	74.0	78.5
	330	62.7	68.0	73.5	79.0	84.5	89.8
	360	70.6	77.2	84.1	90.5	97.1	103.4
	390	79.1	87.3	95.6	103.8	112.5	121.5
	420	89.7	99.7	110.0	121.1	133.2	145.5
	450	100.9	113.1	125.2	140.5	155.8	176.4
	480	113.7	130.7	145.2	171.0	196.0	
	510	123.2	151.0	178.5			
	MAX	214	211	209	206	204	201
	V_{MAX}	564	545	528	505	486	469
8,000 FEET	300	53.5	57.7	62.2	66.7	70.9	75.1
	330	59.8	65.1	70.4	75.9	81.2	86.2
	360	67.7	74.2	80.5	87.3	94.2	101.5
	390	76.7	84.7	92.4	101.8	111.3	121.8
	420	87.0	97.2	107.8	120.9	135.5	149.9
	450	98.0	112.4	127.3	150.4	169.1	
	480	111.4	132.0	152.8			
	MAX	196	193	191	188	186	184
	V_{MAX}	534	518	501	479	464	446
12,000 FEET	300	51.1	55.5	59.8	64.0	68.0	72.2
	330	57.5	62.7	67.9	73.3	78.6	84.6
	360	65.3	72.0	78.5	86.0	93.8	102.6
	390	74.0	83.0	92.2	102.9	113.6	126.0
	420	83.7	96.3	108.7	128.6	144.6	161.0
	450	98.3	115.8	133.2	165.3		
	MAX	178	176	174	171	169	167
	V_{MAX}	505	492	475	454	438	424

AV8A-1-(77)

Figure 11-22

LOW ALTITUDE CRUISE

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

GROSS WEIGHT – 17,500 POUNDS
REMARKS
ENGINE: F402-RR-401
ICAO STANDARD DAY

DATE: 1 DECEMBER 1972
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

	KTAS	DRAG INDEX	TOTAL FUEL FLOW – LB/MIN				
		0	10	20	30	40	50
SEA LEVEL	300	61.9	66.2	70.8	75.5	79.8	84.2
	330	68.1	73.7	79.3	84.8	90.3	95.8
	360	75.5	82.4	89.1	95.8	102.6	108.9
	390	84.3	92.1	100.2	108.1	116.1	123.9
	420	94.1	103.4	113.1	123.0	132.9	143.1
	450	105.9	117.0	128.7	142.4	154.4	170.7
	480	118.5	132.9	147.4	166.0	181.8	206.5
	510	132.7	152.3	177.8	201.0		
	540	148.3	179.0	211.6			
	MAX	233	230	227	225	221	219
	VMAX	594	570	552	530	507	489
4,000 FEET	300	58.8	63.3	67.7	72.2	76.5	80.9
	330	64.9	70.4	76.1	81.5	86.8	92.0
	360	72.3	79.0	85.5	92.2	98.9	105.2
	390	81.4	89.0	96.9	105.6	112.8	121.7
	420	91.5	101.3	111.0	122.6	133.3	150.0
	450	102.1	114.8	128.0	143.1	161.3	177.7
	480	115.2	132.2	154.7	175.5	196.0	
	510	129.4	154.0	185.4			
	MAX	214	211	209	206	204	201
	VMAX	564	544	527	505	485	468
8,000 FEET	300	56.2	60.6	65.0	69.3	73.4	77.8
	330	62.2	67.3	72.5	77.8	82.9	88.7
	360	69.5	76.0	82.3	89.4	95.7	102.7
	390	78.0	86.5	94.5	103.8	113.1	124.2
	420	88.0	99.1	109.3	123.8	138.5	153.9
	450	99.4	114.3	128.5	152.0	171.0	
	480	111.8	131.3	156.8			
	MAX	196	193	191	188	186	184
	VMAX	534	517	500	478	463	445
12,000 FEET	300	54.3	58.7	62.7	67.0	71.0	75.4
	330	60.1	65.5	70.7	76.2	81.7	87.0
	360	67.3	73.9	80.5	88.3	95.8	103.5
	390	75.9	84.7	93.8	105.3	117.2	129.6
	420	85.5	97.7	110.0	130.2	145.9	162.5
	450	99.1	117.3	136.7			
	MAX	178	176	174	171	169	167
	VMAX	504	491	474	453	437	423

AV8A-1-(76)

Figure 11-23

LOW ALTITUDE CRUISE

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

GROSS WEIGHT – 20,000 POUNDS
REMARKS
ENGINE: F402-RR-401
ICAO STANDARD DAY

DATE: 1 DECEMBER 1972
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

	KTAS	TOTAL FUEL FLOW – LB/MIN					
	DRAG INDEX	0	10	20	30	40	50
SEA LEVEL	300	64.8	69.2	73.8	77.8	82.5	86.9
	330	70.6	76.3	81.9	87.4	92.9	98.4
	360	77.5	84.3	91.2	97.7	104.6	111.3
	390	86.0	94.1	101.8	109.8	117.5	125.6
	420	95.9	105.5	114.9	125.0	134.6	145.0
	450	107.4	118.7	130.6	144.6	157.8	174.0
	480	120.0	134.2	149.5	166.8	189.5	208.8
	510	134.0	153.2	179.7	200.4		
	540	150.3	178.5	214.0			
	MAX	233	230	227	225	221	219
	VMAX	593	570	551	530	506	488
4,000 FEET	300	62.2	66.5	70.9	75.2	79.5	84.0
	330	67.8	72.9	78.3	83.8	89.2	94.8
	360	74.7	81.2	87.5	94.2	101.0	107.5
	390	83.0	90.9	98.3	106.6	115.2	123.7
	420	93.1	102.8	112.6	123.8	135.2	147.5
	450	104.0	115.8	129.3	145.8	162.3	179.5
	480	116.6	133.5	154.9	178.4	199.7	
	510	131.5	154.6	188.0			
	MAX	214	211	209	206	204	201
	VMAX	563	543	526	504	484	467
8,000 FEET	300	59.6	64.0	68.5	72.6	77.2	81.1
	330	65.0	70.3	75.7	80.9	86.5	91.5
	360	71.6	78.0	84.8	91.6	98.4	105.6
	390	79.9	87.8	96.6	116.0	114.9	129.1
	420	89.8	100.4	110.9	123.9	137.6	155.7
	450	101.0	115.7	130.4	151.8	170.0	
	480	115.1	134.8	156.3			
	MAX	196	193	191	188	186	184
	VMAX	533	516	499	477	462	443
12,000 FEET	300	57.1	61.6	65.9	70.2	74.5	78.4
	330	62.4	67.8	73.0	78.5	84.0	89.3
	360	69.4	76.0	82.8	90.0	98.0	106.0
	390	77.7	86.6	95.8	106.9	117.5	130.9
	420	87.3	99.6	112.0	127.5	146.5	164.0
	450	100.4	117.5	136.5	168.8		
	MAX	178	176	174	171	169	167
	VMAX	503	489	472	452	436	421

AV8A-1-(75)

Figure 11-24

LOW ALTITUDE CRUISE

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

GROSS WEIGHT – 22,500 POUNDS
REMARKS
ENGINE: F402-RR-401
ICAO STANDARD DAY

DATE: 1 DECEMBER 1972
DATA BASIS: ESTIMATED (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

	KTAS	TOTAL FUEL FLOW – LB/MIN					
		DRAG INDEX 0	10	20	30	40	50
SEA LEVEL	300	68.3	72.6	77.3	81.6	85.9	90.2
	330	73.4	79.0	84.5	90.1	95.3	100.5
	360	80.1	86.6	93.4	100.0	106.5	113.1
	390	88.3	96.2	103.9	111.9	119.5	122.5
	420	97.7	107.4	116.5	126.1	135.7	147.5
	450	109.0	120.5	131.6	145.0	160.0	179.0
	480	121.6	136.0	151.5	170.1	191.5	213.5
	510	135.4	155.1	180.0	203.2		
	540	150.5	177.5	214.0			
	MAX	233	230	227	225	221	219
	VMAX	593	570	550	529	505	487
4,000 FEET	300	65.6	70.0	74.4	78.8	83.2	87.6
	330	70.7	76.2	81.4	86.8	92.5	98.1
	360	77.0	83.6	90.2	97.1	103.8	110.5
	390	85.0	92.9	101.0	109.1	116.9	125.5
	420	94.7	104.5	114.4	125.7	136.4	149.0
	450	105.5	118.2	130.6	146.2	163.5	181.6
	480	118.4	135.5	155.0	178.7	201.0	
	510	131.6	155.3	188.0			
	MAX	214	211	209	206	204	201
	VMAX	563	542	525	503	483	466
8,000 FEET	300	63.2	67.5	71.9	76.0	80.3	84.7
	330	68.1	73.2	78.6	83.9	89.2	94.3
	360	74.3	80.5	82.3	94.5	101.3	107.8
	390	82.0	90.0	98.4	108.3	118.0	130.4
	420	91.9	102.5	112.9	127.2	140.0	159.8
	450	103.0	117.6	134.5	154.5	174.0	
	480	117.0	137.1	166.0			
	MAX	196	193	191	188	186	184
	VMAX	532	514	498	476	460	442
12,000 FEET	300	60.8	65.0	69.4	74.1	78.1	82.3
	330	65.8	71.0	76.5	82.0	87.3	92.6
	360	72.3	78.7	85.6	93.0	100.8	108.5
	390	80.2	89.0	98.2	109.9	121.3	134.7
	420	89.2	101.3	114.0	134.4	149.6	
	450	101.2	118.7	138.0	169.8		
	MAX	178	176	174	171	169	167
	VMAX	502	487	471	451	435	419

AV8A-1-(74)

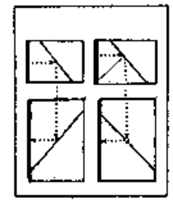
Figure 11-25

CONSTANT MACH/ALTITUDE CRUISE

AIRPLANE CONFIGURATION
INDIVIDUAL

REMARKS
ENGINE: F402-RR-401
ICAO STANDARD DAY

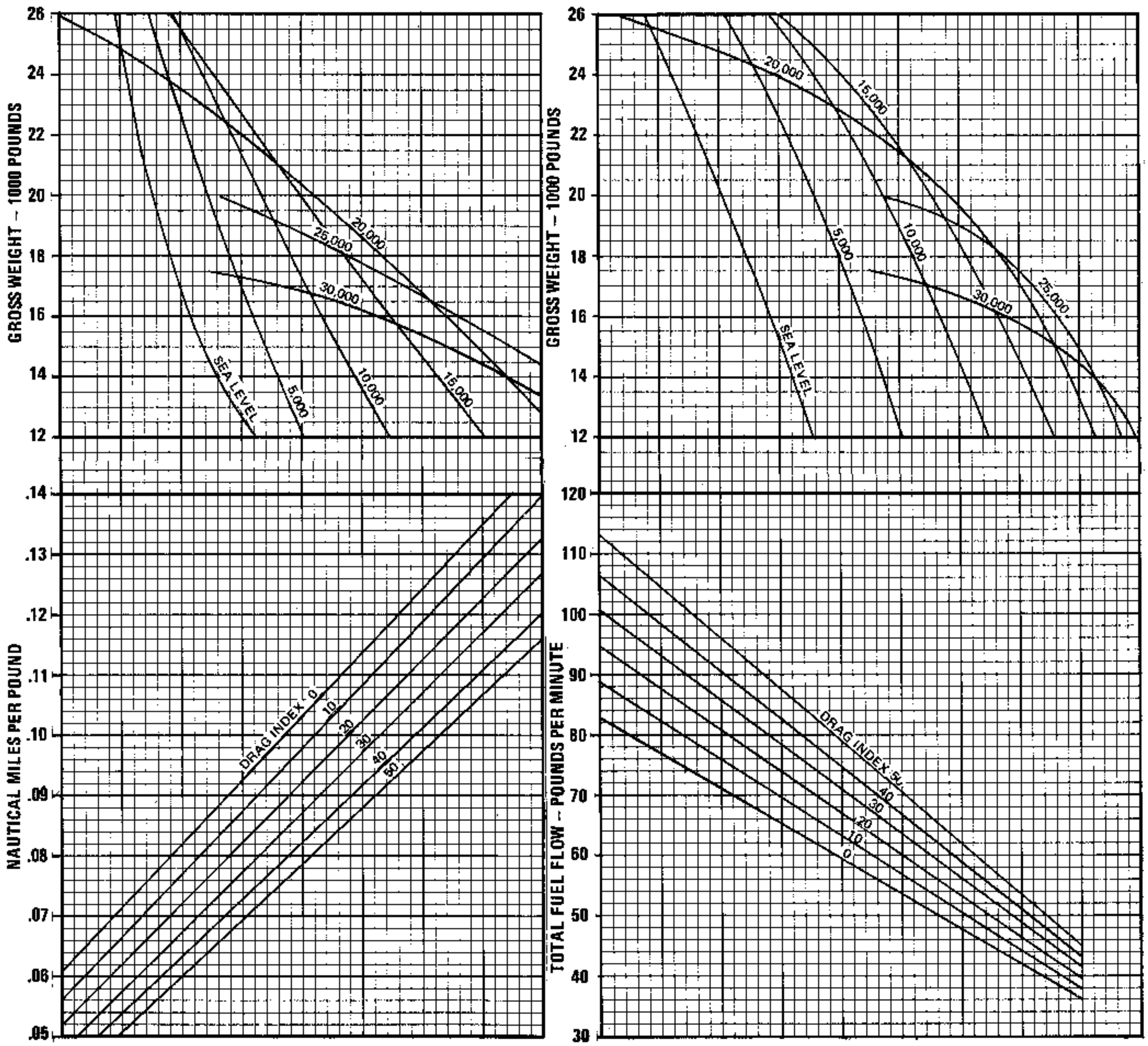
GUIDE



0.50 MACH CRUISE

DATE: 1 DECEMBER 1972
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



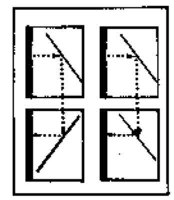
AV8A-1-(73)

Figure 11-26

CONSTANT MACH/ALTITUDE CRUISE

AIRPLANE CONFIGURATION
INDIVIDUAL

GUIDE

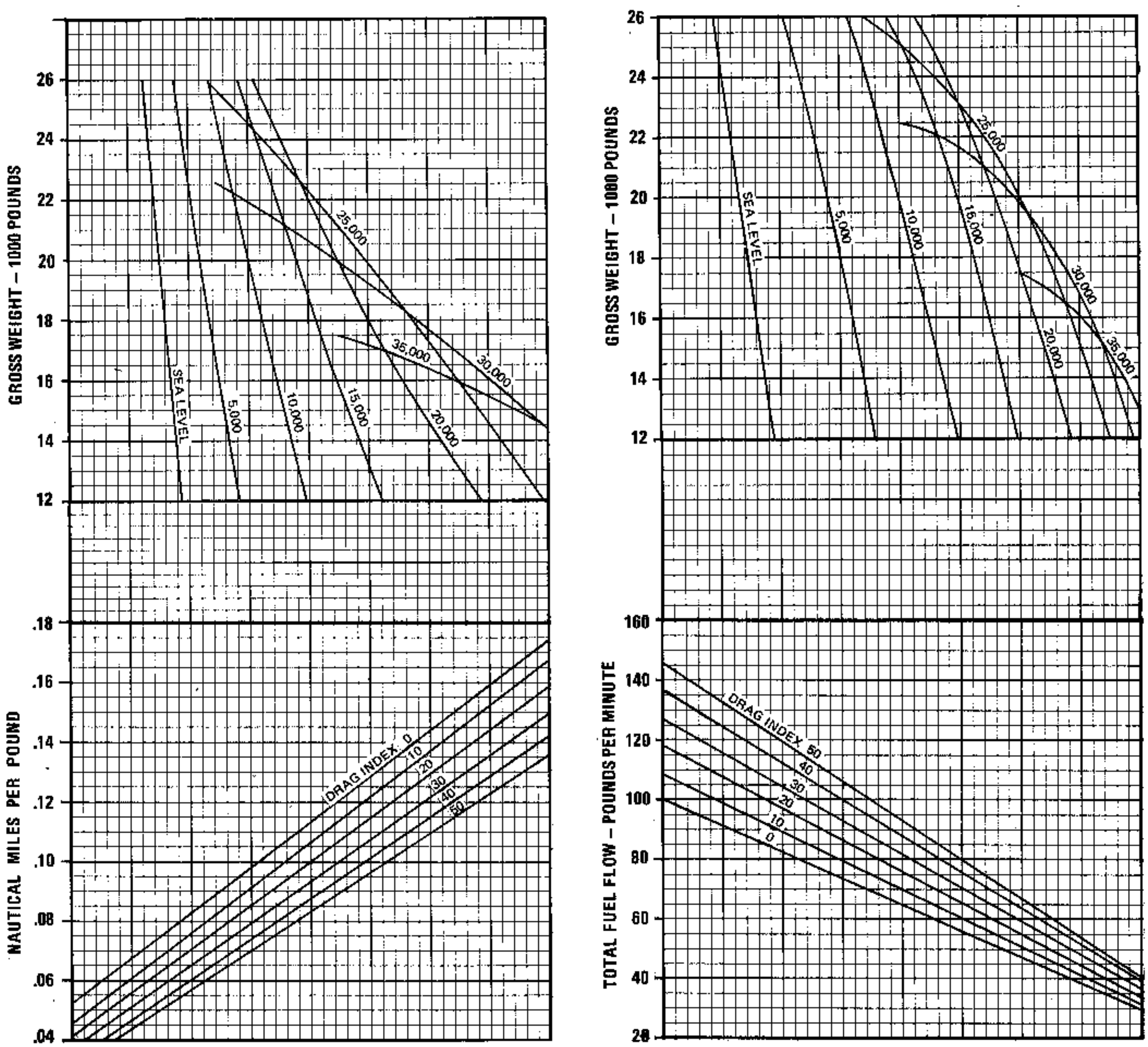


REMARKS
ENGINE: F402-RR-401
ICAO STANDARD DAY

DATE: 1 DECEMBER 1972
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

0.60 MACH CRUISE

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



AV8A-1-(113)

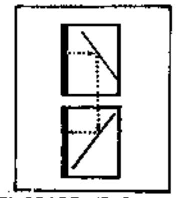
Figure 11-27

CONSTANT MACH/ALTITUDE CRUISE

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE: F402-RR-401
ICAO STANDARD DAY

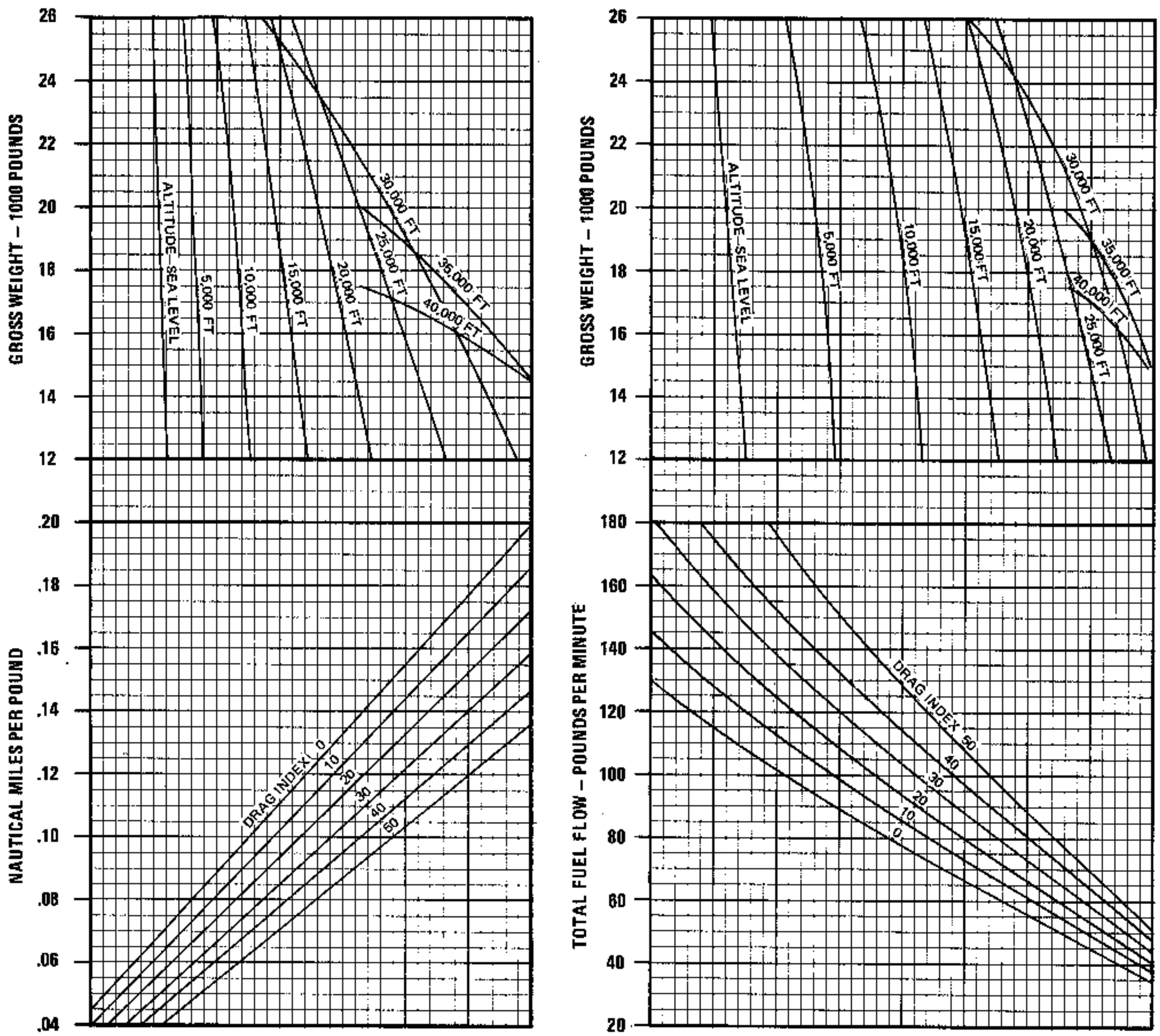
GUIDE



DATE: 1 DECEMBER 1972
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

0.70 MACH CRUISE



AV8A-1-(72)

Figure 11-28

CONSTANT MACH/ALTITUDE CRUISE

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE : F402-RR-401
ICAO STANDARD DAY

GUIDE

DATE: 1 DECEMBER 1972
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

0.80 MACH CRUISE

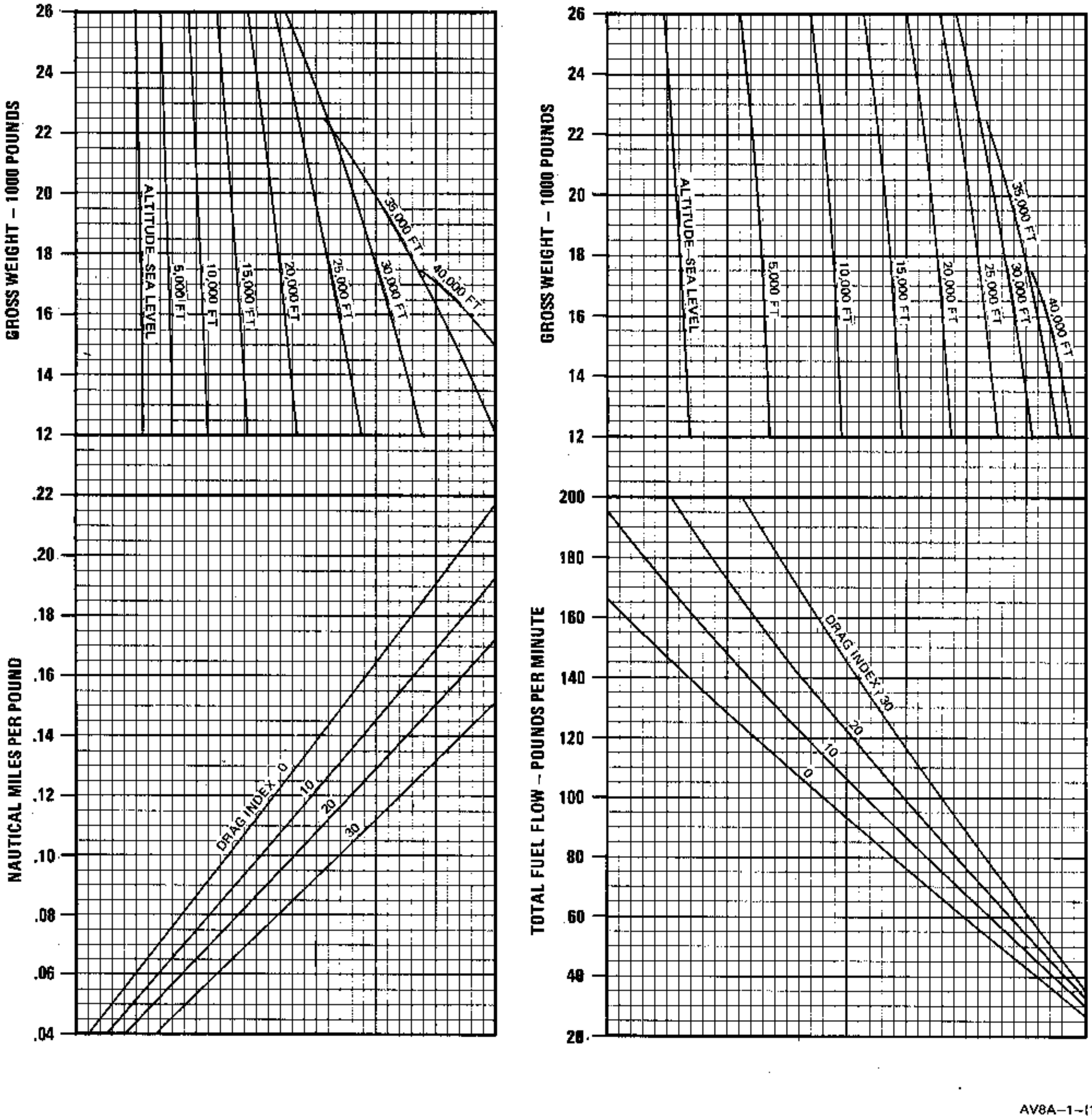
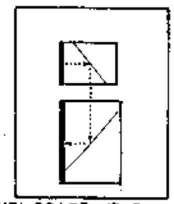


Figure 11-29

OPTIMUM CRUISE AT CONSTANT ALTITUDE
NAUTICAL MILES PER POUND

GUIDE

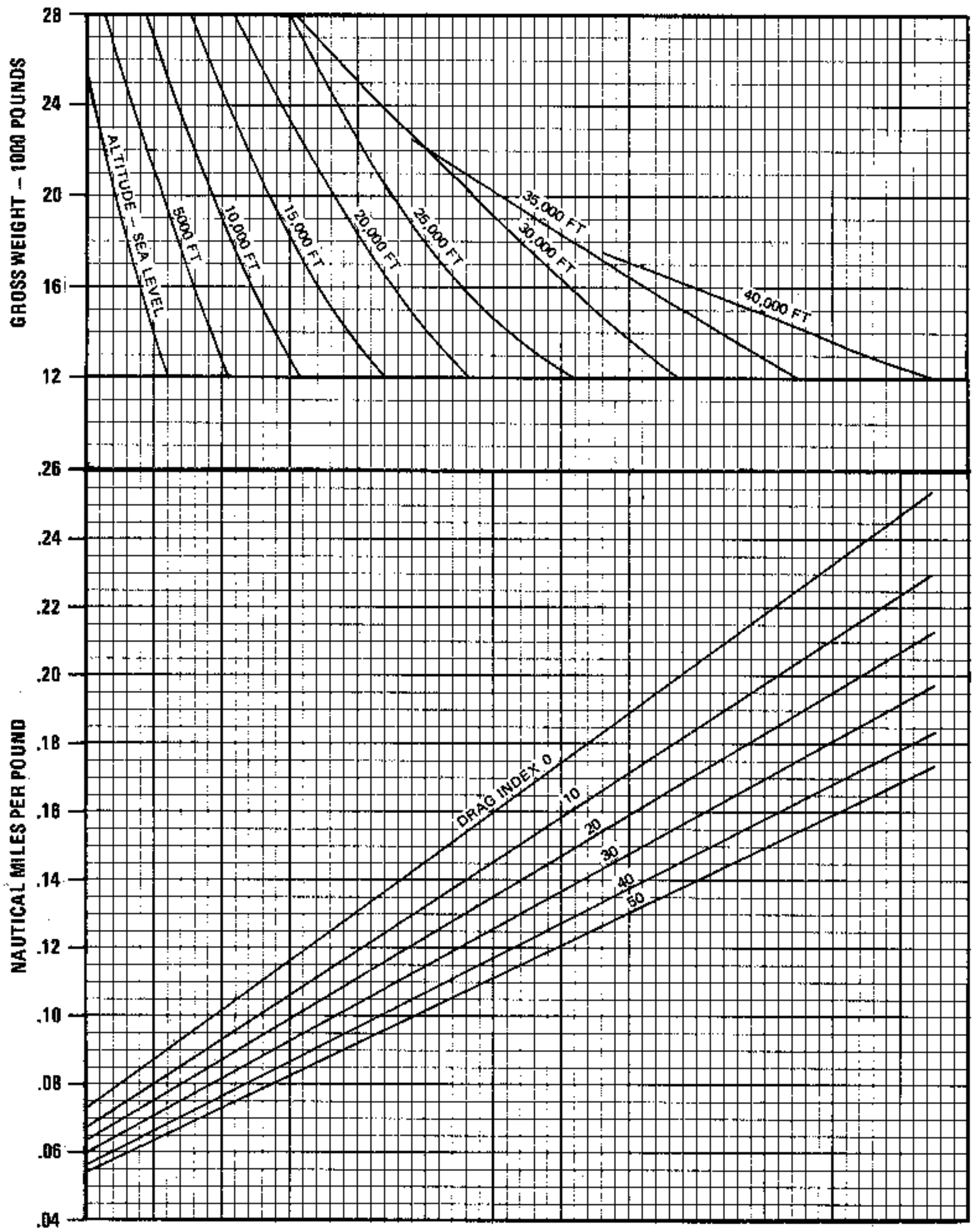


AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE: F402-RR-401
ICAO STANDARD DAY

DATA: 1 DECEMBER 1972
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



AV8A-1-(96-1)

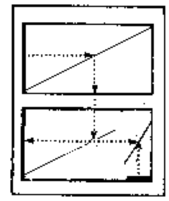
Figure 11-30 (Sheet 1 of 2)

OPTIMUM CRUISE AT CONSTANT ALTITUDE
MACH NUMBER AND AIRSPEED

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

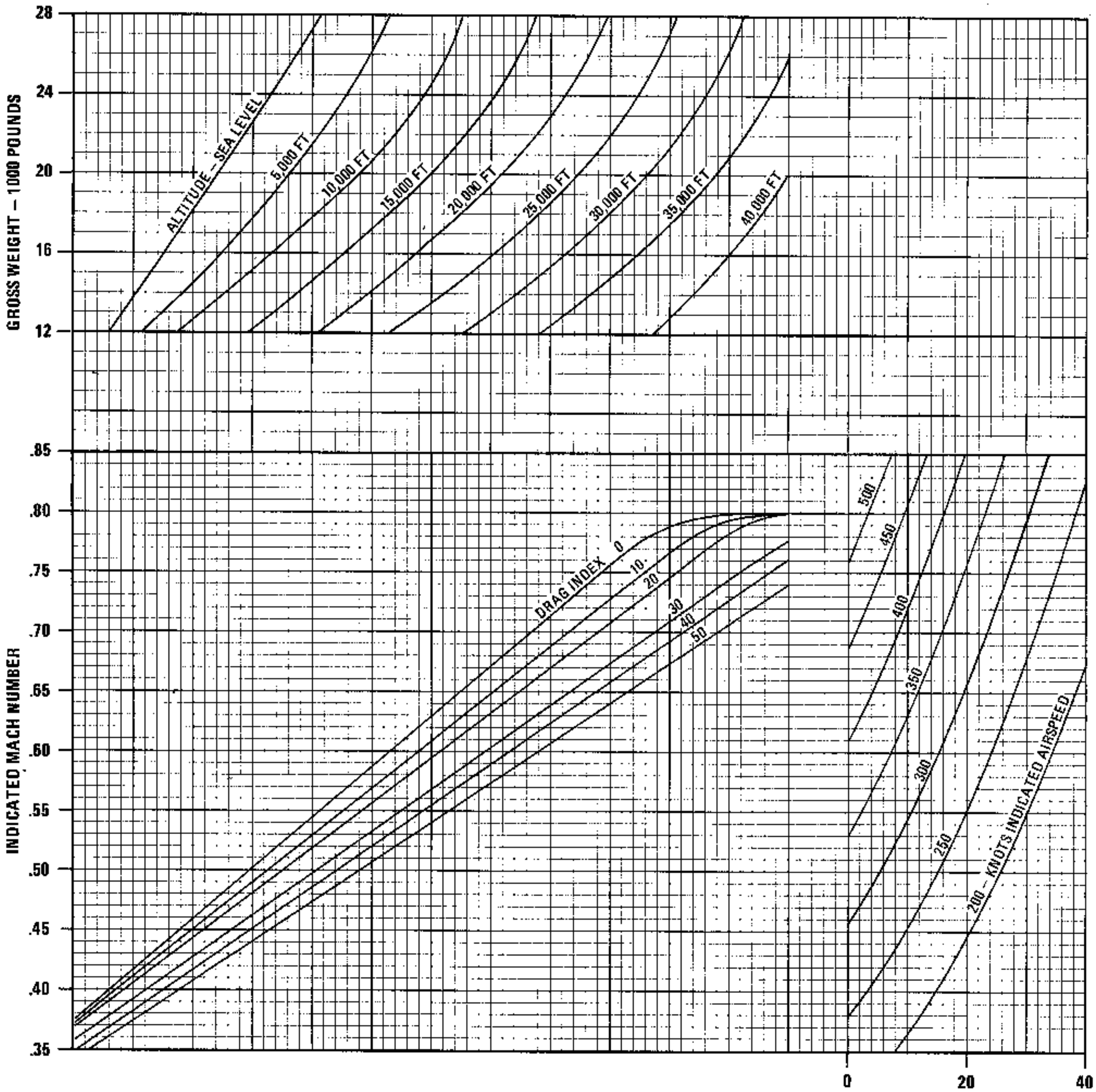
REMARKS
ENGINE: F402-RR-401
ICAO STANDARD DAY

GUIDE



DATE: 1 MAY 1973
DATA BASIS: ESTIMATED (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



AV8A-1-(95-2) A

Figure 11-30 (Sheet 2 of 2)

PART 6
ENDURANCE

MAXIMUM ENDURANCE CHARTS

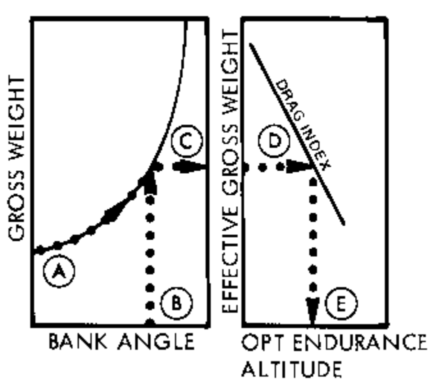
These charts (figures 11-31 thru 11-33) present optimum endurance altitude and maximum endurance specifics (fuel flow and Mach number) for all combinations of effective gross weight and altitude.

USE

Enter the Altitude and Bank Angle chart with the average gross weight. If bank angles are to be considered, follow the gross weight curve until it intersects the bank angle to be used; then horizontally to the right to obtain effective gross weight. (If bank angles are not to be considered, enter the chart at the effective gross weight scale.) From this point proceed horizontally to the right and intersect the computed drag index. Reflect downward and read the optimum endurance altitude. Enter the mach number plots with the effective gross weight, and proceed horizontally to intersect the optimum endurance altitude. Then descend downward and intersect the computed drag index and horizontally left and right to read the indicated mach number and indicated airspeed respectively. Enter the Fuel Flow plots with the effective gross weight, proceed horizontally to intersect the optimum endurance altitude. Reflect downward to the computed drag index, and then horizontally to read total fuel flow.

SAMPLE MAXIMUM ENDURANCE

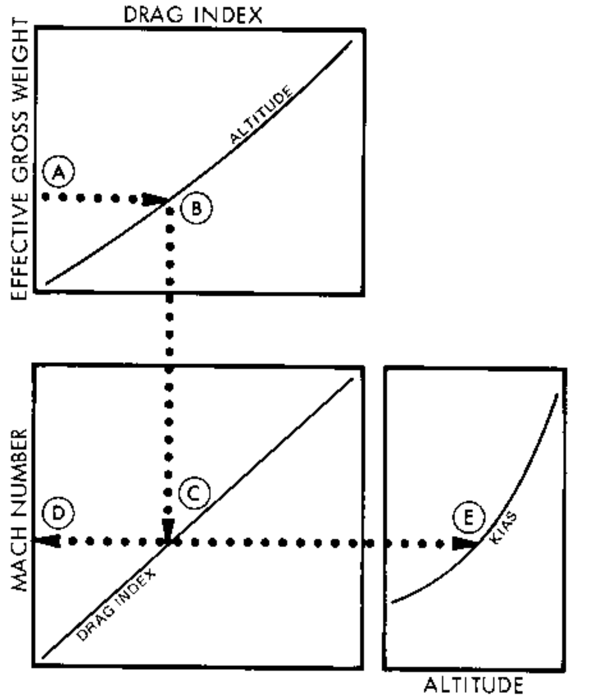
ALTITUDE AND BANK ANGLE



AV8A-1-(103)

SAMPLE MAXIMUM ENDURANCE

MACH NUMBER



AV8A-1-(102)

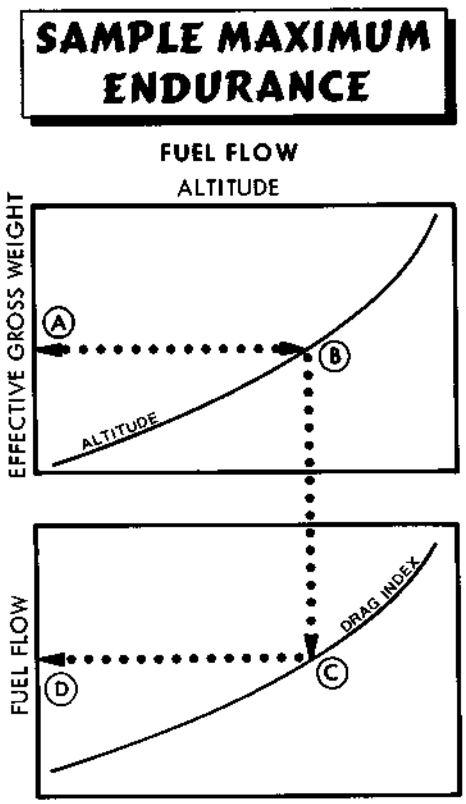
Sample Problem

Altitude and Bank Angle

A.	Gross weight	16,000 Lb.
B.	Bank angle	30
C.	Effective gross weight	18,600 Lb.
D.	Drag index	20
E.	Optimum endurance altitude	30,000 Ft.

Mach Number

A.	Effective gross weight	18,600 Lb.
B.	Endurance altitude	30,000 Ft.
C.	Drag index	20
D.	Mach number	0.62
E.	Airspeed (IAS)	235 Kt.



AV8A-1-(101)

Fuel Flow

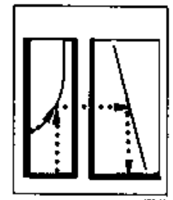
A.	Effective gross weight	18,600 Lb.
B.	Endurance altitude	30,000 Ft.
C.	Drag index	20
D.	Total fuel flow	45 PPM

MAXIMUM ENDURANCE
ALTITUDE & BANK ANGLE

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

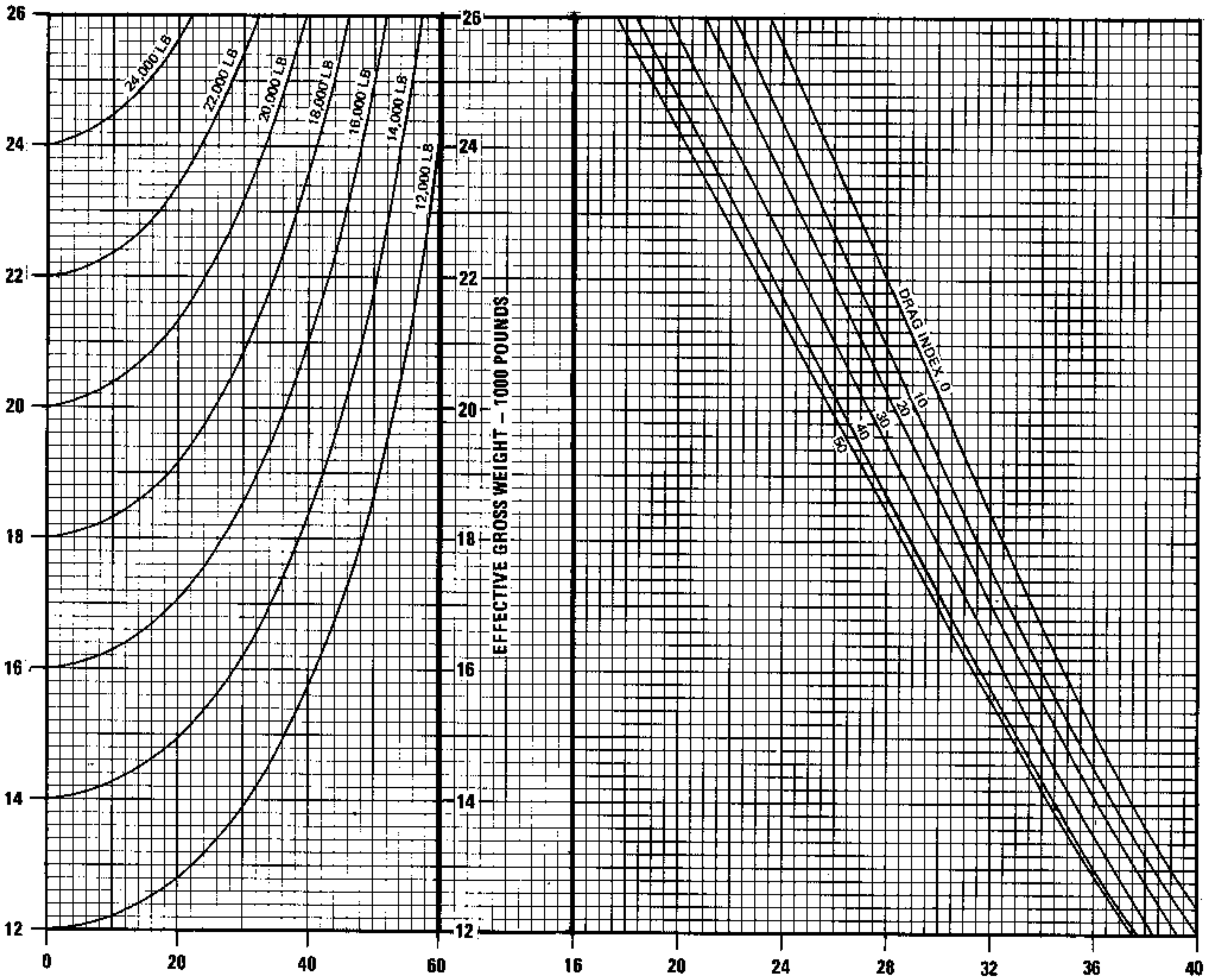
REMARKS
ENGINE: F402-RR-401
ICAO STANDARD DAY

GUIDE



DATE: 1 DECEMBER 1972
DATA BASIS: ESTIMATED (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



AV8A-1-(100)

Figure 11-31

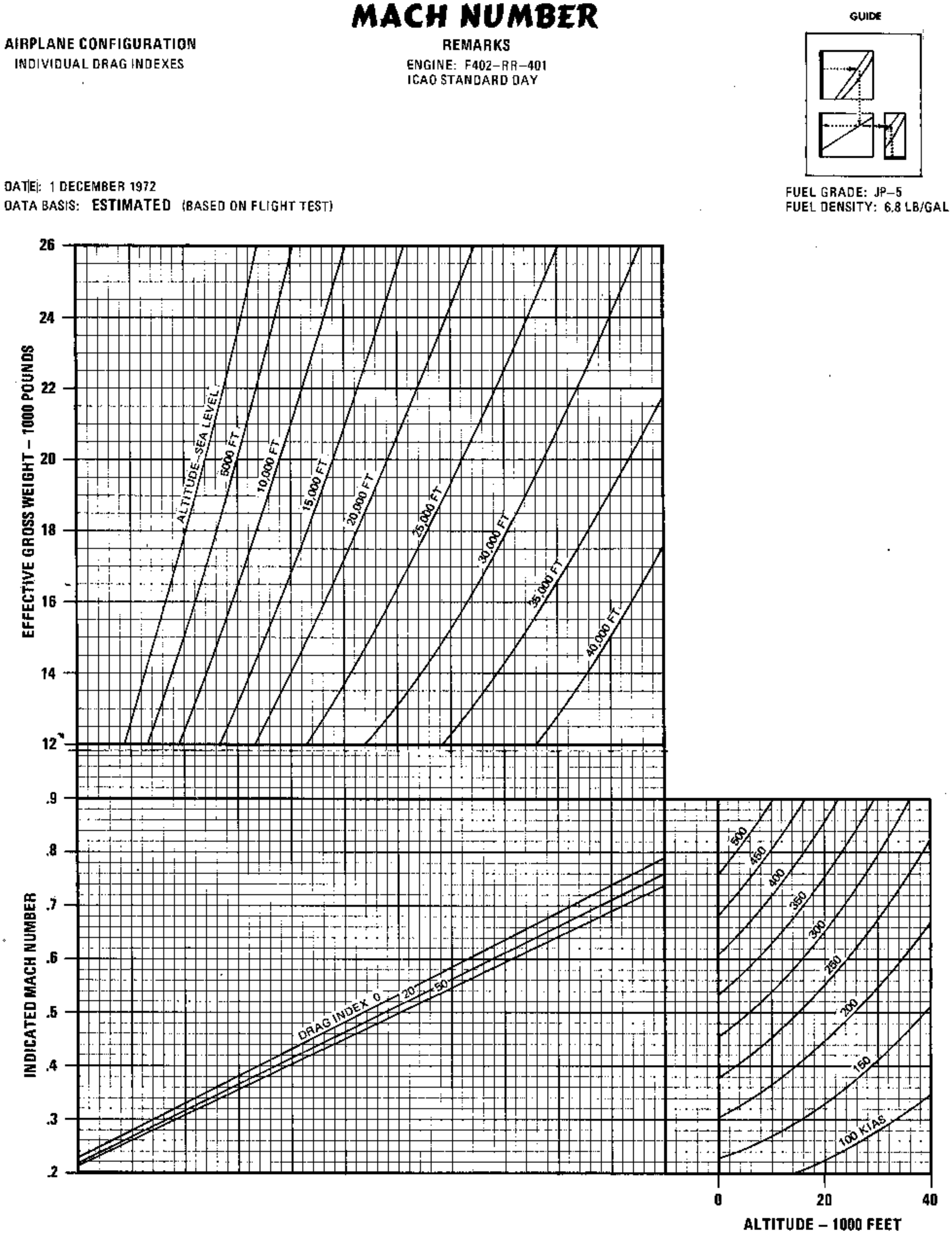
MAXIMUM ENDURANCE
MACH NUMBER

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE: F402-RR-401
ICAO STANDARD DAY

DATE: 1 DECEMBER 1972
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



AV8A-1-(99)

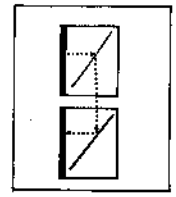
Figure 11-32

MAXIMUM ENDURANCE
FUEL FLOW

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

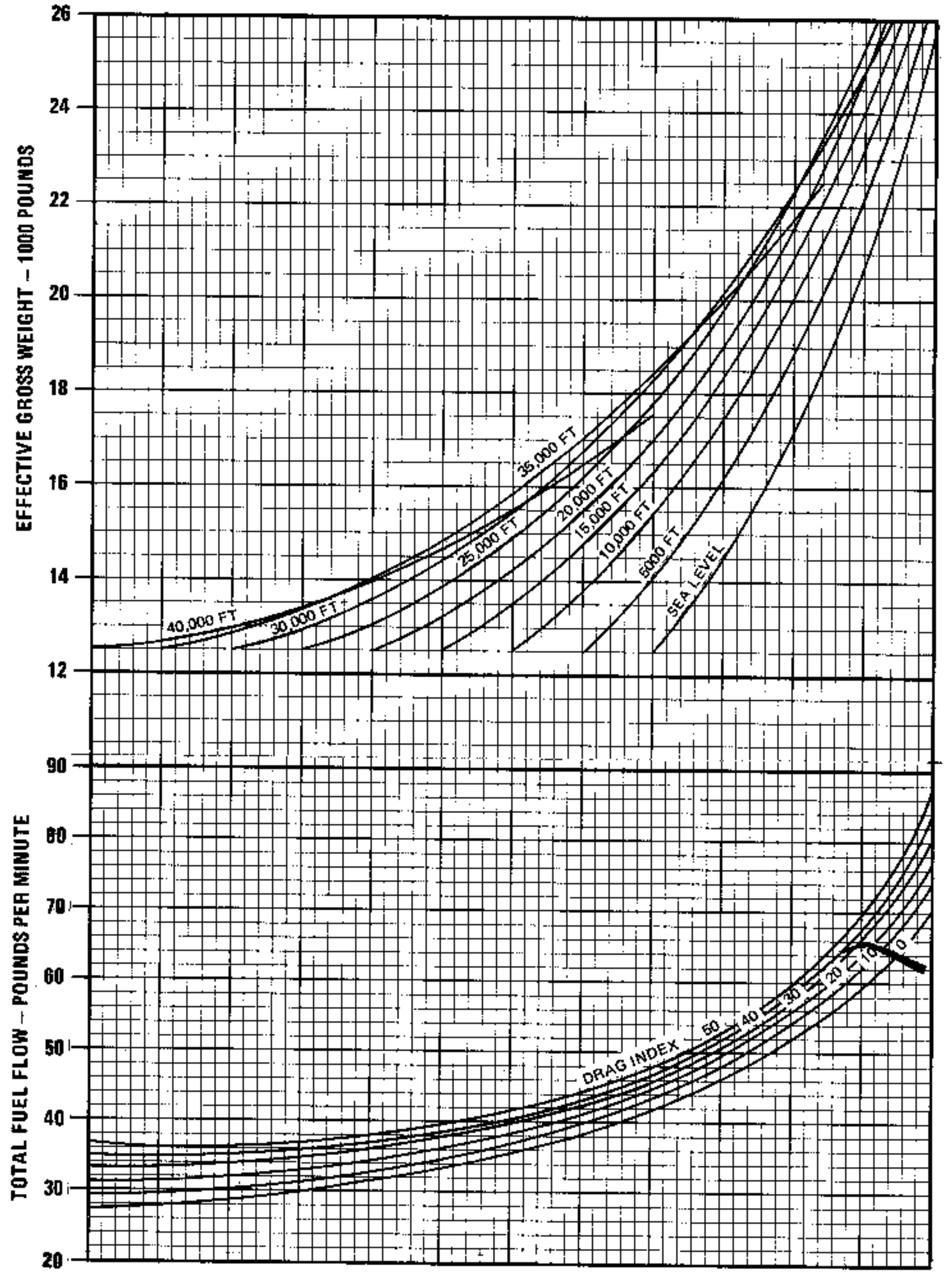
REMARKS
ENGINE: F402-RR-401
ICAO STANDARD DAY

GUIDE



DATA: 1 DECEMBER 1972
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



AV8A-1-(98)

Figure 11-33

PART 7
DESCENT

DESCENT

The Descent charts (figures 11-34 thru 11-36) present distance, time and fuel used in the descent. Incremental data may be obtained for distance, time, and fuel by subtracting data corresponding to level-off altitude from the data for the original cruising altitude.

USE

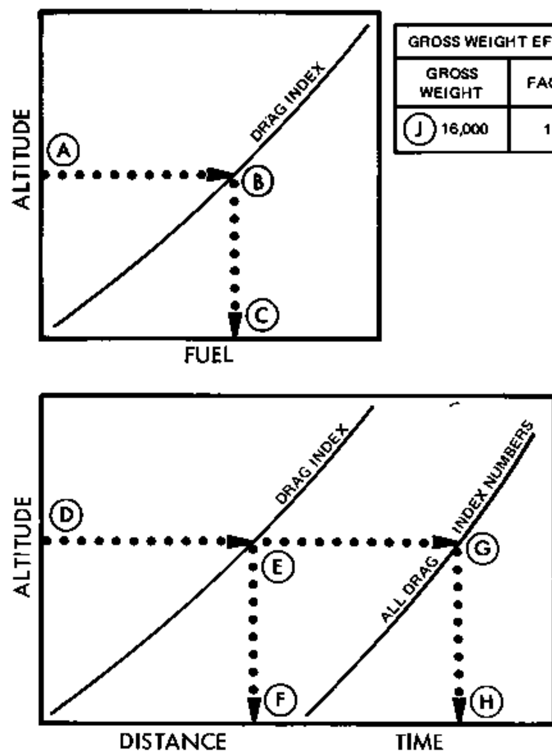
Enter the upper plot of the appropriate charts at the cruising flight level, project horizontally to the right to intersect the drag reflector at the applicable computed drag index. From this intersection, project vertically downward to intersect and read the fuel. Enter the lower plot with the cruising altitude and proceed horizontally to the right to intersect the drag reflector at the applicable computed drag index on the distance graph. Continue horizontally to the right to intersect the single drag reflector on the time graph. From the intersection on the distance graph, project vertically downward to read distance required. From the intersection at the single drag reflector on the time graph, project vertically downward to read time to descend.

Sample Problem

Descent (instrument penetration): 300 KIAS, 65% RPM, mid-flaps and speedbrake extended.

A.	Altitude	30,000 Ft.
B.	Computed drag index	20
C.	Fuel required	202 Lb.
D.	Altitude	30,000 Ft.
E.	Computed drag index	20
F.	Distance	26.5 Miles
G.	Drag index reflector	
H.	Time required	4.4 Min.
I.	Gross weight effects (16,000 Lb.)	1.04
J.	Corrected values:	
	Fuel	210 Lb.
	Distance	27.6 Miles
	Time	4.6 Min.

SAMPLE DESCENT



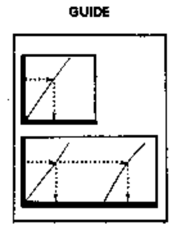
GROSS WEIGHT EFFECTS	
GROSS WEIGHT	FACTOR
(J) 16,000	1.04

AV8A-1-(97)

DESCENT-INSTRUMENT PENETRATION

300 KIAS-65% RPM

MID FLAPS-SPEED BRAKES EXTENDED

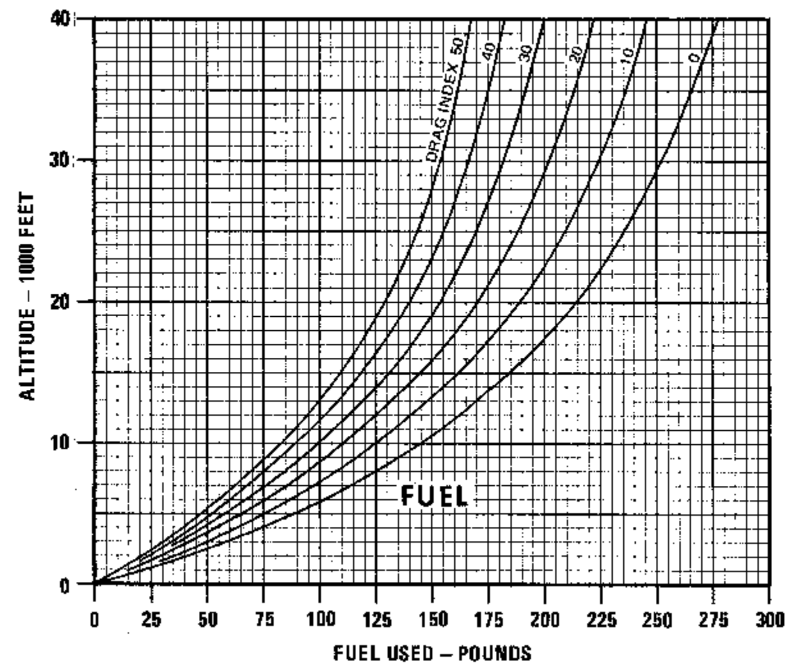


AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE: F402–RR–401
15,000 POUNDS GROSS WEIGHT
ICAO STANDARD DAY

DATE: 1 DECEMBER 1972
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

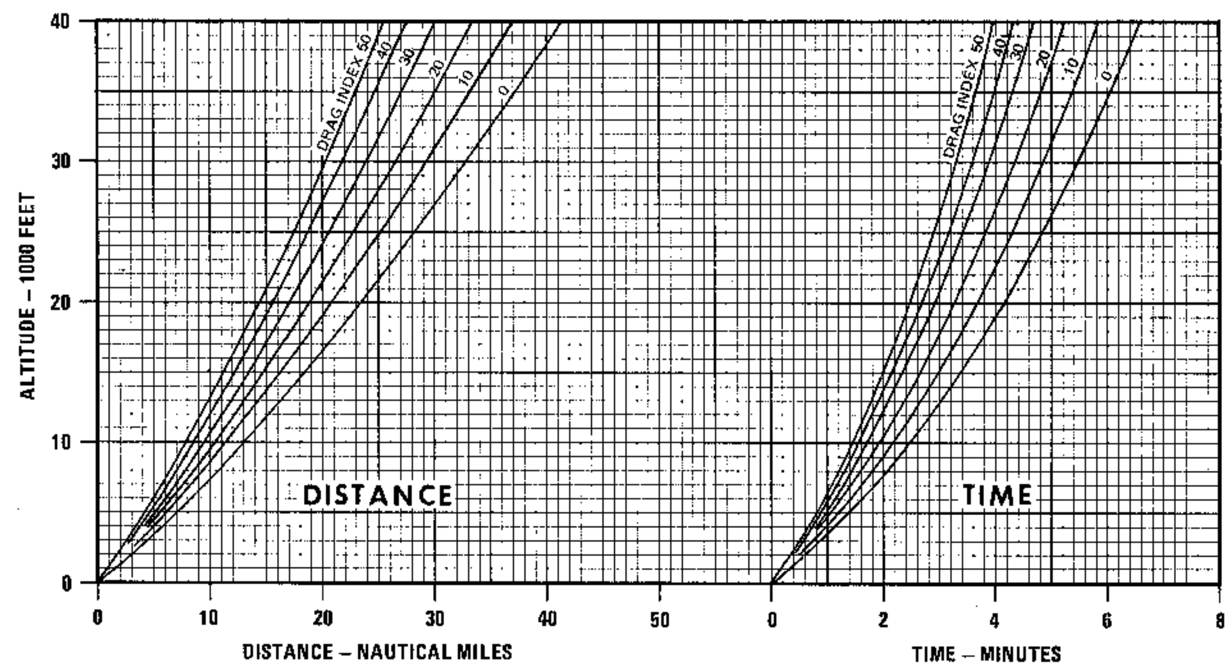
FUEL GRADE: JP–5
FUEL DENSITY: 6.8 LB/GAL



GROSS WEIGHT EFFECTS

NOTE
FACTOR TO BE APPLIED TO DISTANCE, TIME AND FUEL.

GROSS WEIGHT	FACTOR
13,000 LB	.92
14,000 LB	.96
15,000 LB	1.0
16,000 LB	1.04
17,000 LB	1.08
18,000 LB	1.12
19,000 LB	1.17
20,000 LB	1.22

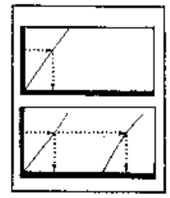


AV8A–1–(108)

Figure 11–34

MAXIMUM RANGE DESCENT
230 KIAS-IDLE THRUST
FLAPS UP-SPEED BRAKES RETRACTED

GUIDE

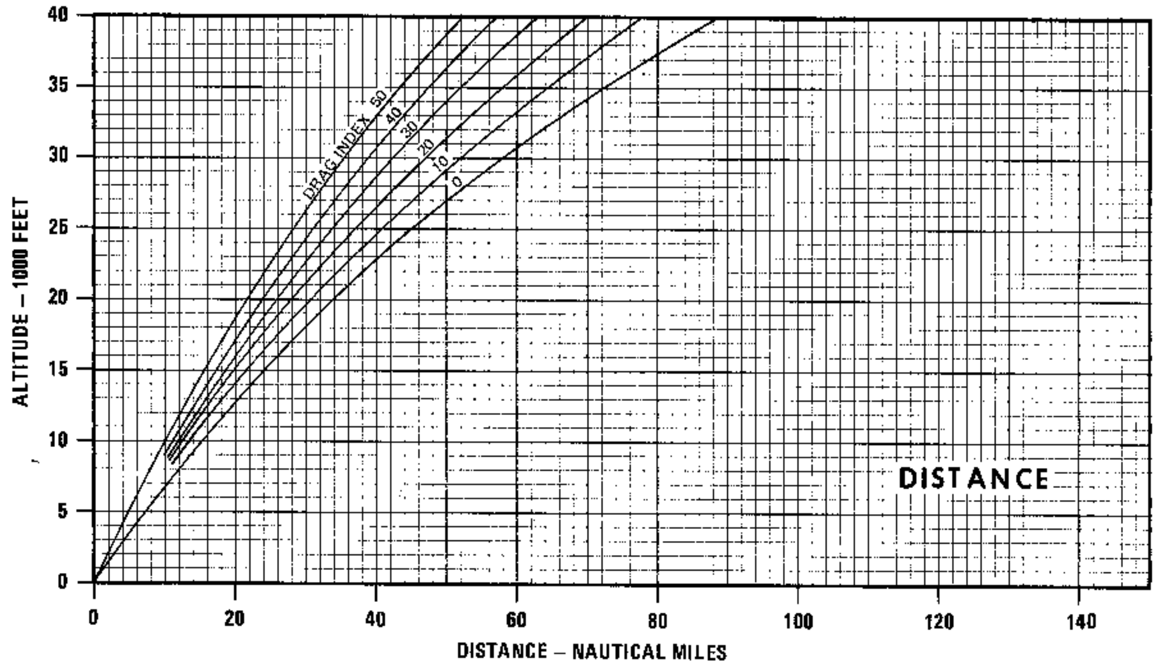


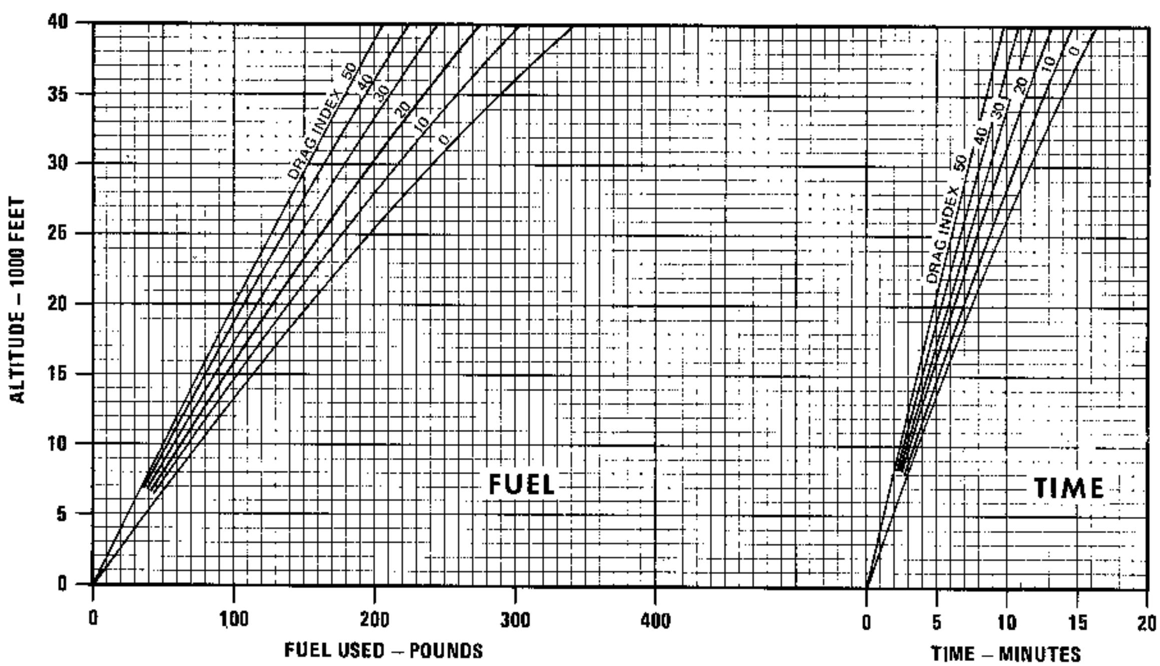
AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE: F402-RR-401
ALL GROSS WEIGHTS
ICAO STANDARD DAY

DATA: 1 DECEMBER 1972
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

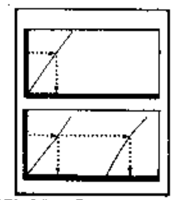




AV8A-1-(110)

Figure 11-35

MAXIMUM RANGE DESCENT
230 KIAS - 30PPM FUEL FLOW
FLAPS UP - SPEED BRAKES RETRACTED

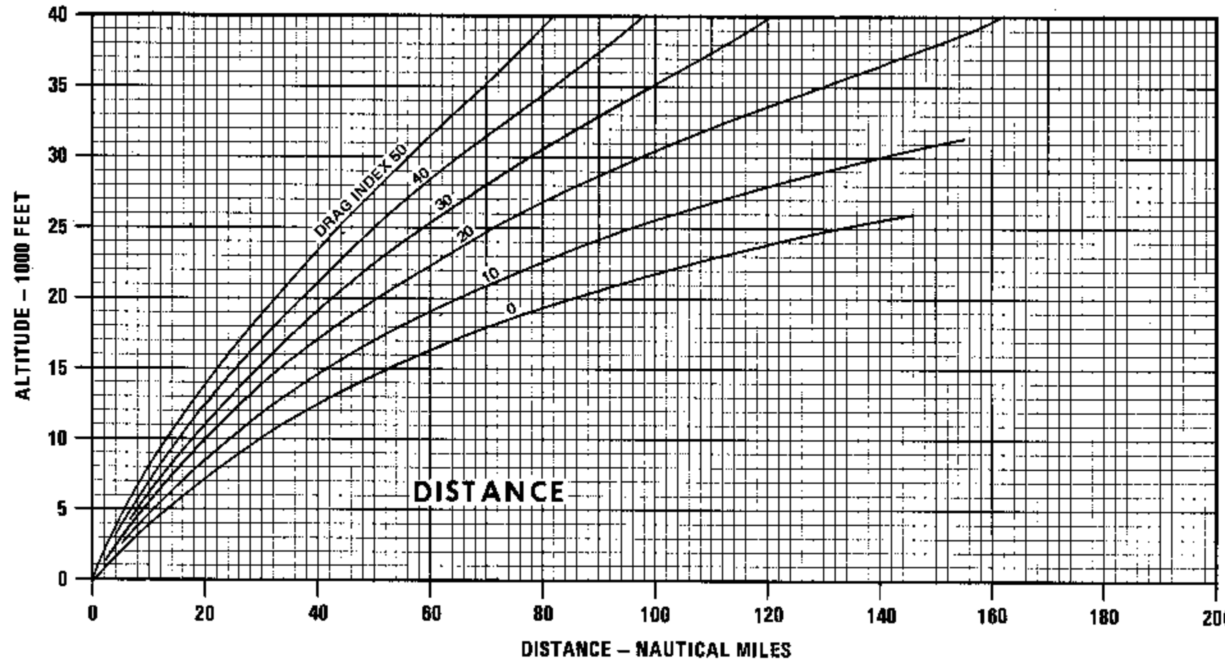


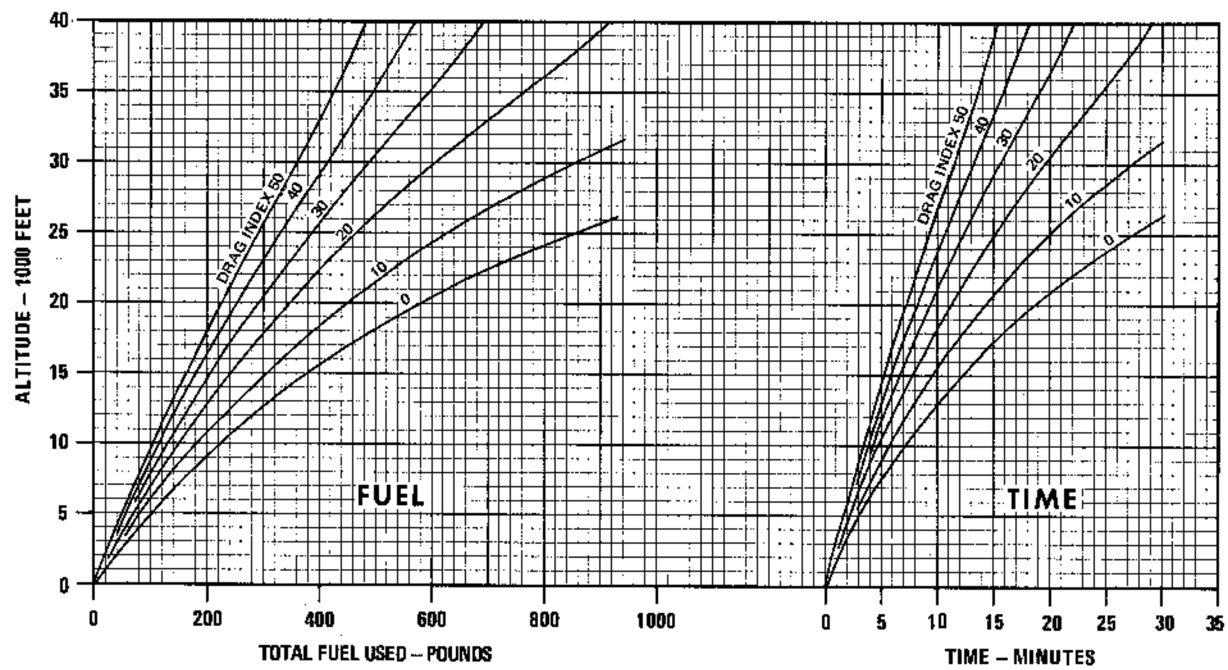
AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE: F402-RR-401
14,000 POUNDS GROSS WEIGHT
ICAO STANDARD DAY

DATE: 1 DECEMBER 1972
DATA BASIS: ESTIMATED (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL





AV8A-1-(96-1)

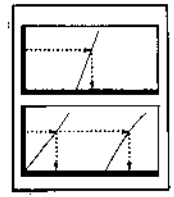
Figure 11-36 (Sheet 1 of 3)

MAXIMUM RANGE DESCENT

230 KIAS - 30PPM FUEL FLOW

FLAPS UP - SPEED BRAKES RETRACTED

GUIDE

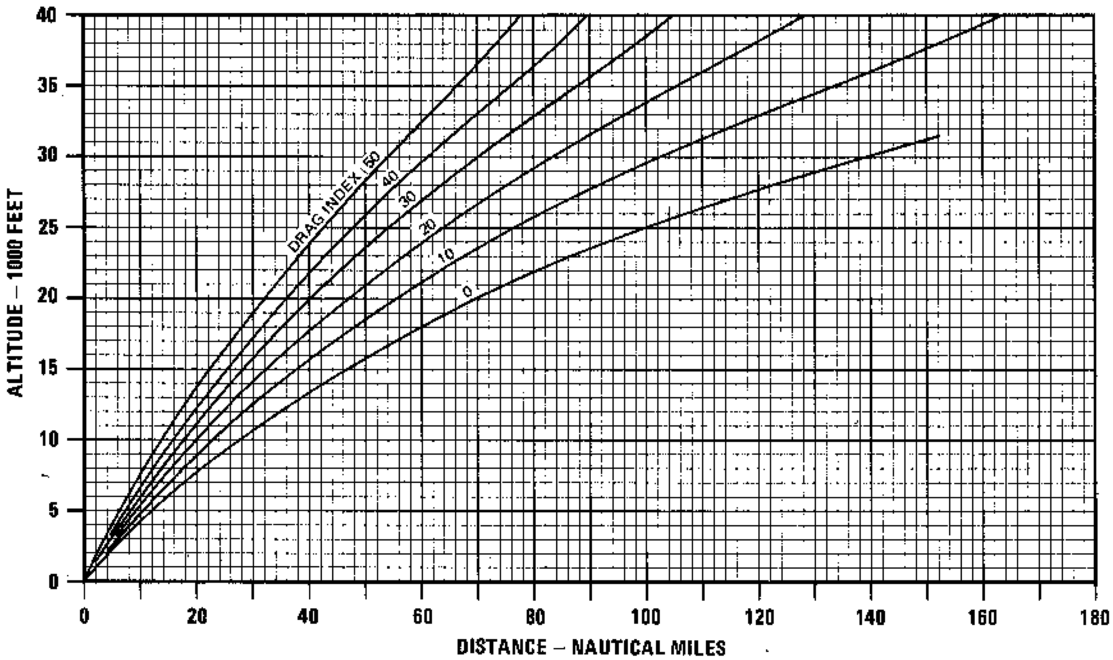


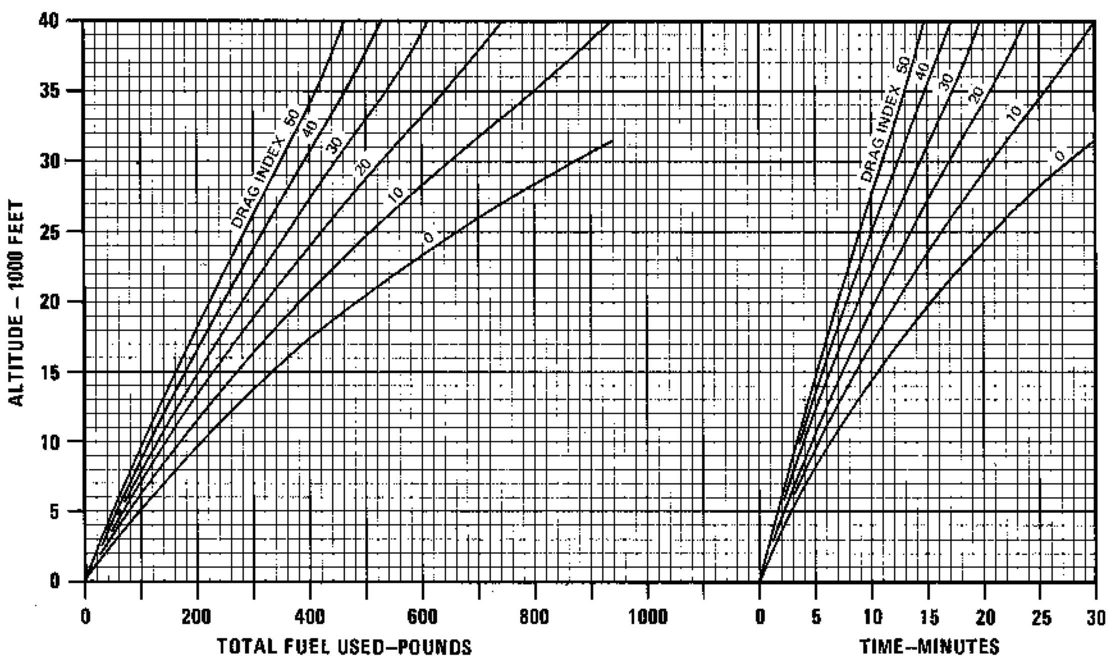
AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE: F402-RR-401
16,000 POUNDS GROSS WEIGHT
ICAO STANDARD DAY

DATA: 1 DECEMBER 1972
DATA BASIS: ESTIMATED (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



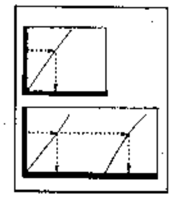


AV8A-1-(96-2)

Figure 11-36 (Sheet 2 of 3)

MAXIMUM RANGE DESCENT
230 KIAS-30 PPM FUEL FLOW
FLAPS UP-SPEED BRAKES RETRACTED

GUIDE

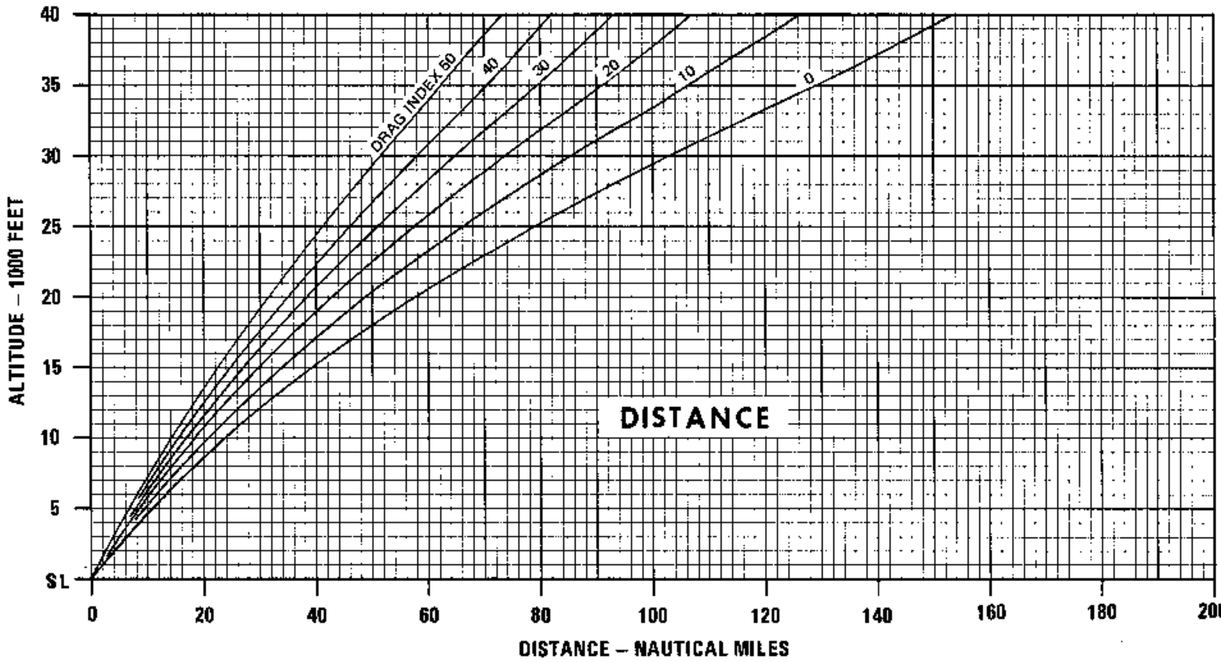


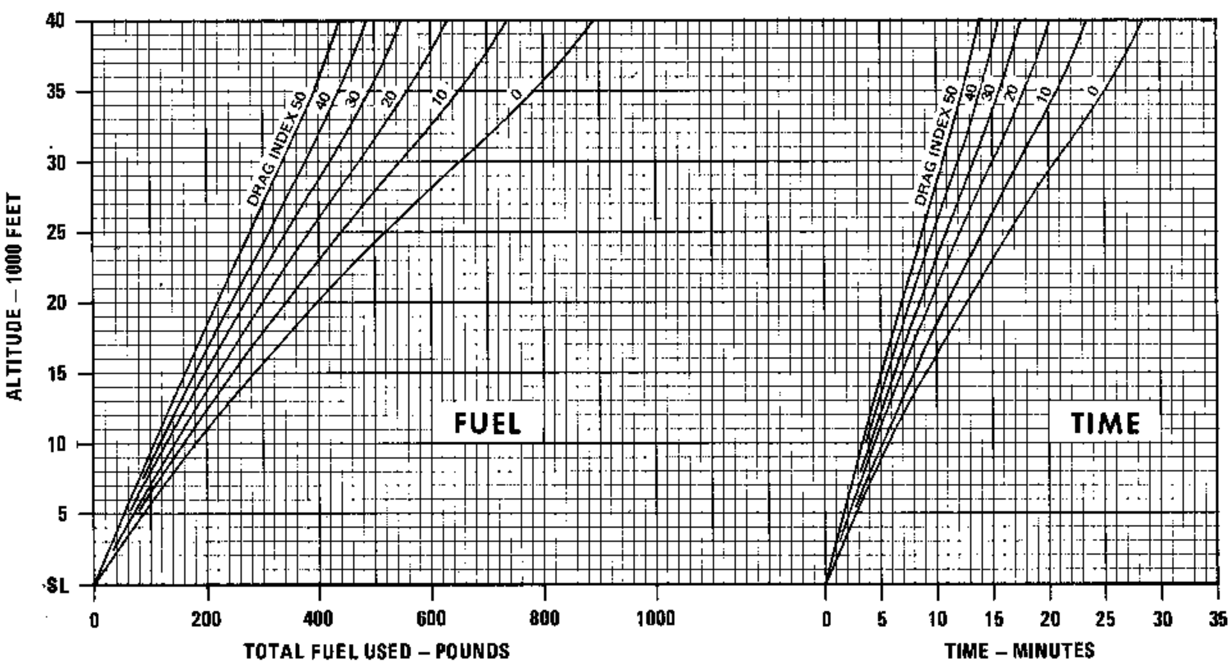
AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE, F402-RR-401
18,000 POUNDS GROSS WEIGHT
ICAO STANDARD DAY

DATE: 1 DECEMBER 1972
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL





AV8A-1-(96-3)

Figure 11-36 (Sheet 3 of 3)

PART 8
LANDING

Charts

VERTICAL LANDING CAPABILITY

This chart (figure 11-37) provides vertical landing capability for wet and dry lift ratings. The variables of temperature and ambient pressure are taken into consideration.

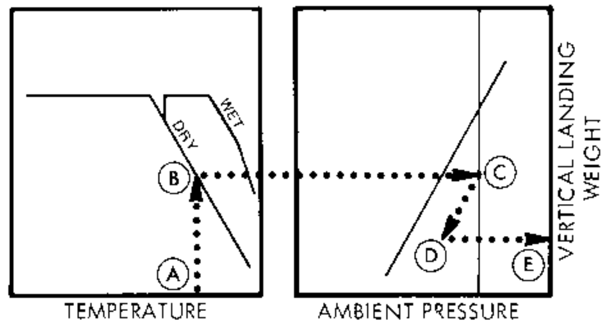
USE

Enter the chart with the ambient temperature and project vertically up to the planned short lift rating. From this point, project horizontally to the right to the pressure base line. Parallel the pressure guidelines to the correct ambient pressure. From this intersection project horizontally to the right to read the vertical landing weight capability.

Sample Problem

A.	Temperature	10 °C
B.	Short lift dry curve	
C.	Pressure base line	
D.	Ambient pressure	29.50 In. Hg.
E.	Vertical landing weight	16,700 Lb.

SAMPLE VERTICAL LANDING CAPABILITY

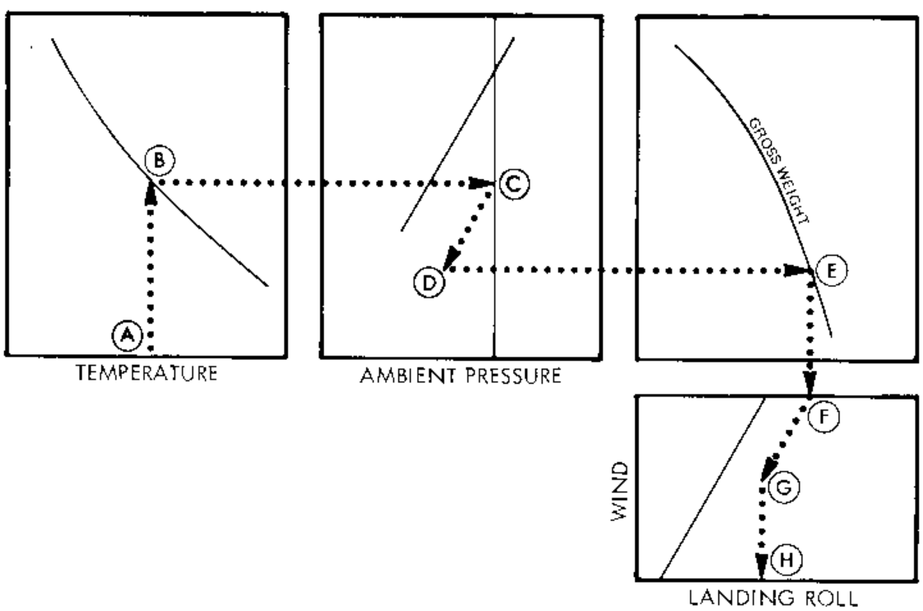


AV8A-1-(168)

SHORT LANDING DISTANCE CHART

This chart (figure 11-38) provides landing speed and ground roll distance information. The variables of gross weight, temperature, ambient pressure, and effective wind are considered.

SAMPLE SHORT LANDING DISTANCE



AV8A-1 (170)

USE

Enter the chart with the temperature and project vertically to the reflector curve. From this point, project horizontally to the right to the pressure base line. Parallel the pressure guidelines to the appropriate ambient pressure. From this intersection project horizontally right to the landing gross weight. From this point, project vertically downward to the wind base line. Parallel the wind guidlines (headwind or tailwind) to the effective wind velocity. From this point descend vertically and read the landing ground roll distance.

Sample Problem

A.	Temperature	15°C
B.	Reflector curve	
C.	Pressure base line	
D.	Ambient pressure	29.50 In. Hg.
E.	Gross weight	15,000 Lb.
F.	Wind base line	
G.	Headwind	8 Kt.
H.	Landing distance	1050 Ft.

CONVENTIONAL LANDING DISTANCE CHART

This chart (figure 11-39) provides landing distance information for various gross weights. Separate charts provide the landing ground roll distance and the airborne distance from a 50-foot obstacle to the touchdown point. The ground roll charts allow for landing with or without nozzle braking. The variables of temperature, ambient pressure, and effective landing wind are considered.

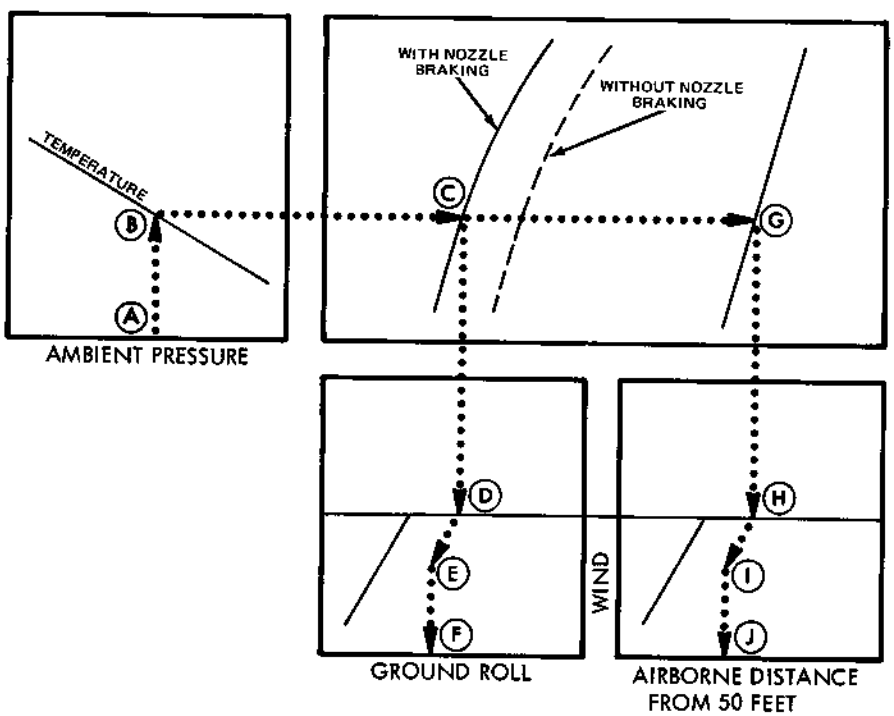
USE

Enter the chart with the ambient pressure or pressure altitude and proceed vertically to the appropriate temperature. From this point, project horizontally to the right to intersect three landing gross weight plots. From the first two plots intersected, select the appropriate weight (with or without nozzle braking) and descend to the wind base line. Parallel the wind guidelines (headwind or tailwind) to the effective wind velocity. From this intersection proceed vertically down to read the landing ground roll distance. Repeat these steps from the third gross weight plot intersection to obtain the airborne distance from a 50-foot obstacle to the landing touchdown point.

Sample Problem

A.	Ambient pressure	29.50 In. Hg.
B.	Temperature	20°C
C.	Gross weight (with nozzle braking)	14,000 Lb.
D.	Wind base line	
E.	Headwind	8 Kt.
F.	Landing roll distance	4000 Ft.
G.	Gross weight	14,000 Lb.
H.	Wind base line	
I.	Headwind	8 Kt.
J.	Airborne distance from 50 feet	2270 Ft.
K.	Total distance from 50 foot obstacle	6270 Ft.

SAMPLE CONVENTIONAL LANDING DISTANCE

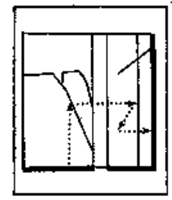


AV8A-1-(162)

VERTICAL LANDING CAPABILITY
81° NOZZLES

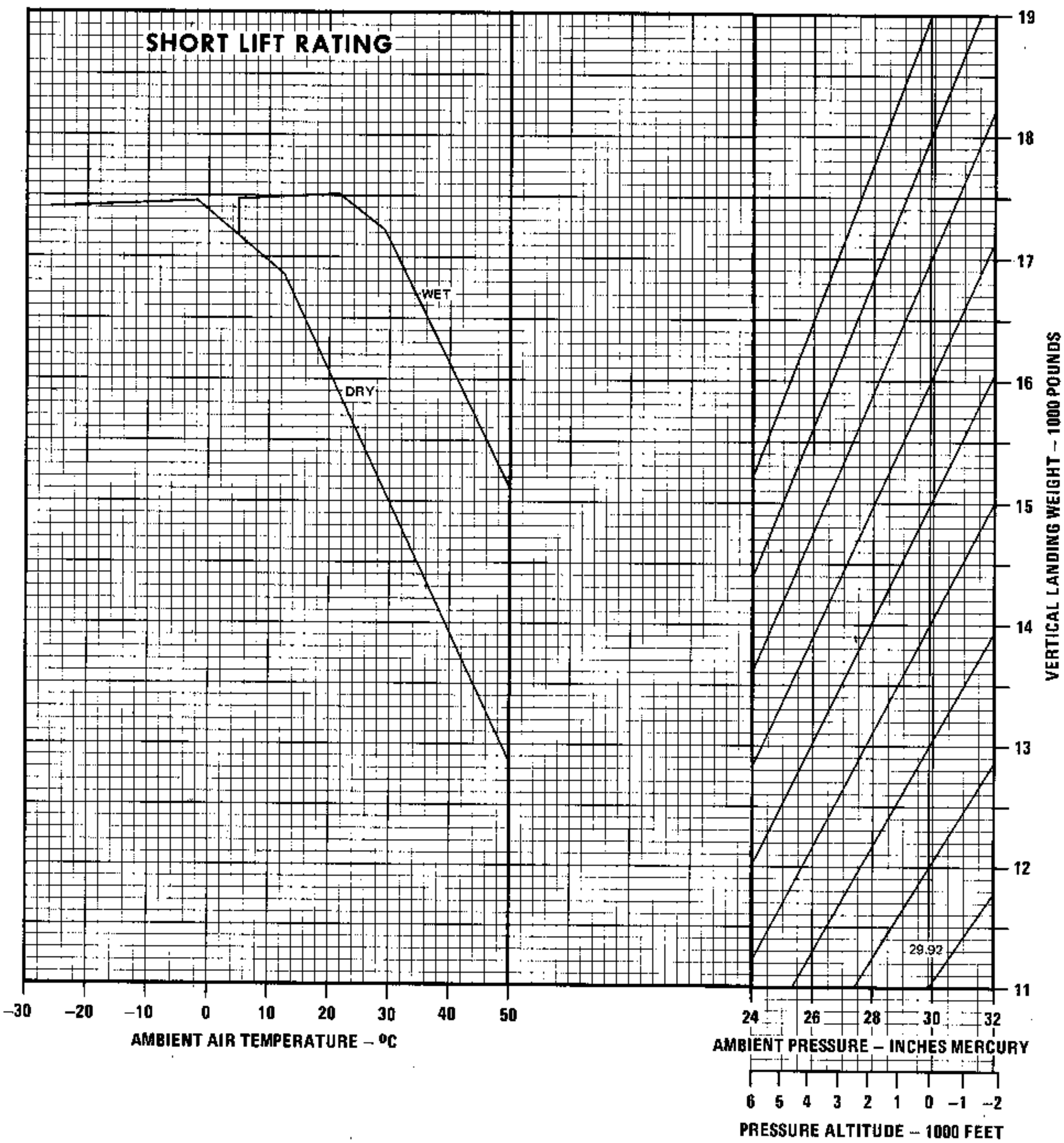
AIRPLANE CONFIGURATION
ALL DRAG INDEXES
FULL FLAPS, GEAR DOWN

REMARKS
ENGINE: F402-RR-401



DATE: 1 JANUARY 1973
DATA BASIS: ESTIMATED

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



AV8A-1-(167)

Figure 11-37

SHORT LANDING DISTANCE

DRY RUNWAY

AIRPLANE CONFIGURATION
ALL DRAG INDEXES
FULL FLAPS, GEAR DOWN

REMARKS
ENGINE: F402-RR-301

NOTES

1. TECHNIQUE: AS PER SECTION III. TOUCHDOWN AT 12 UNITS AOA; POWERED-NOZZLE BRAKING FROM TOUCHDOWN TO 60 KNOTS; THEN MAXIMUM WHEEL BRAKING, ENGINE AT IDLE WITH NOZZLES AT HOVER STOP; NOZZLES AFT AT 15 KNOTS.
2. AIRBORNE DISTANCE FROM 50-FOOT OBSTACLE IS APPROXIMATELY 1350 FEET FOR A 3-DEGREE GLIDE SLOPE.

DATE: 1 JANUARY 1973
DATA BASIS: **ESTIMATED**

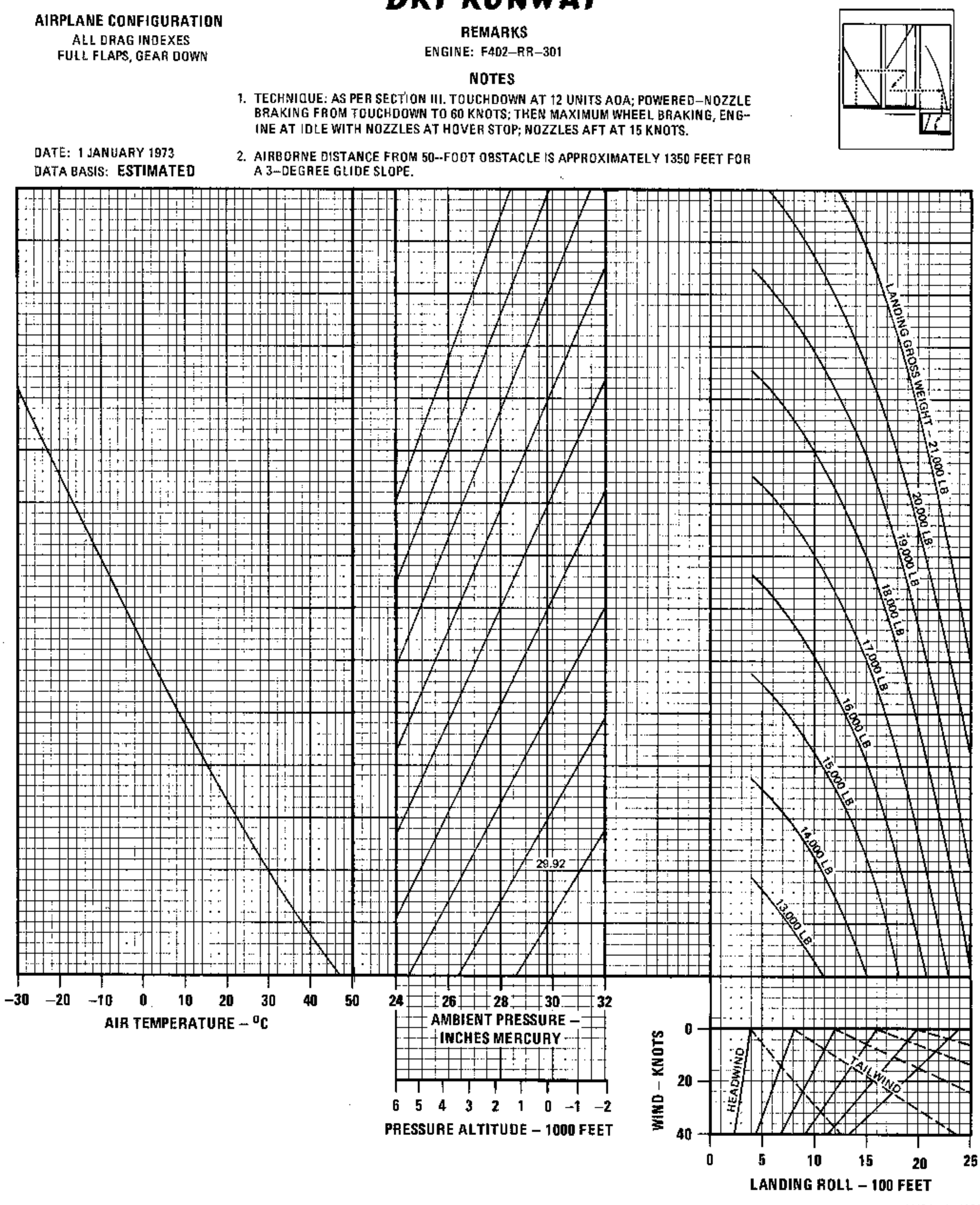


Figure 11-38

CONVENTIONAL LANDING DISTANCE
DRY RUNWAY

AIRPLANE CONFIGURATION
ALL DRAG INDEXES
FULL FLAPS, GEAR DOWN

DATE: 1 JANUARY 1973
DATA BASIS: **ESTIMATED**

REMARKS
ENGINE: F402-RR-401

NOTE

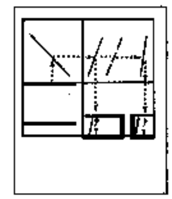
TECHNIQUE: AS PER SECTION III.
TOUCHDOWN AT 12 UNITS AOA

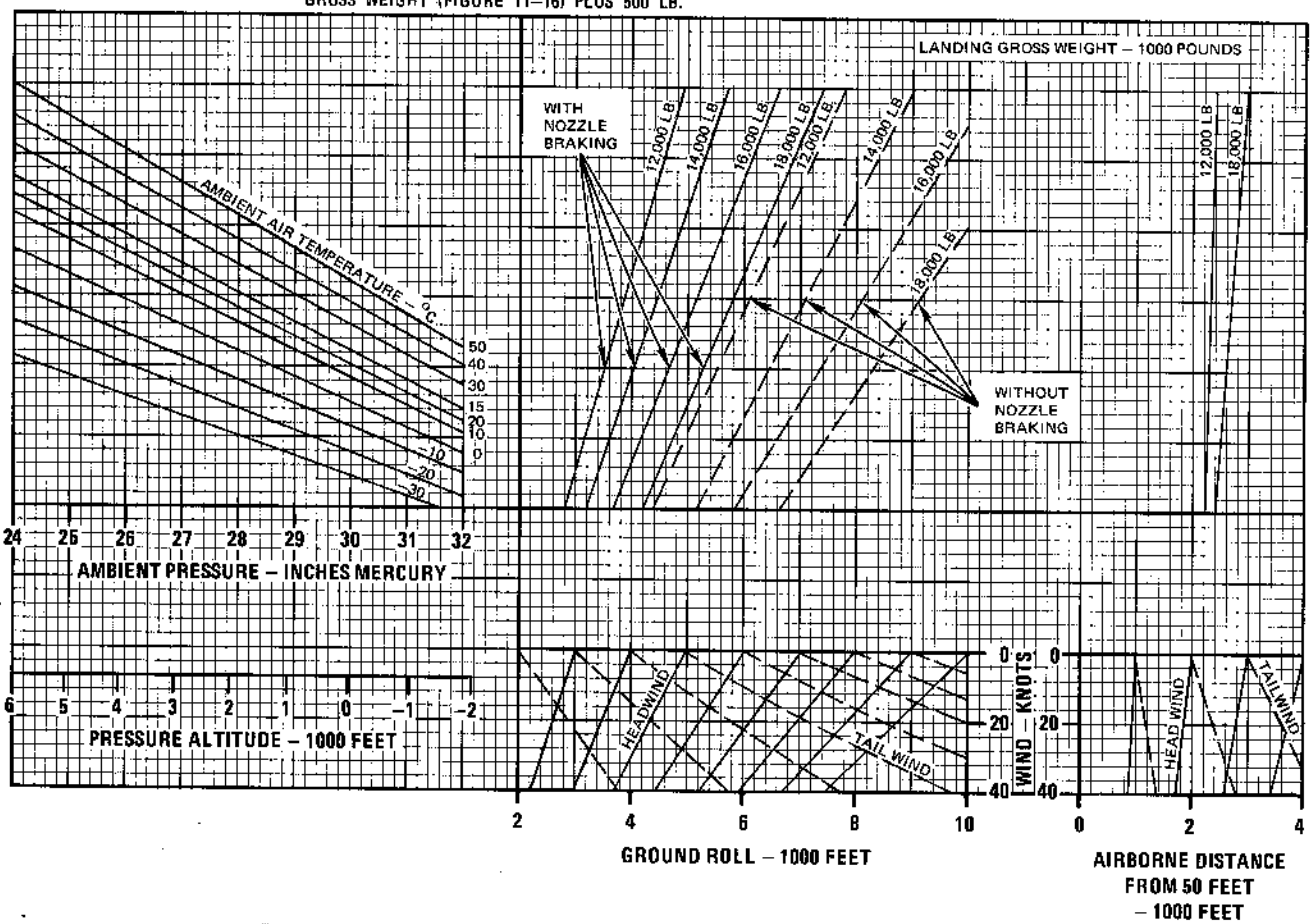
(1) WITH NOZZLE BRAKING: POWERED-NOZZLE BRAKING FROM TOUCHDOWN TO 60 KNOTS; THEN MAXIMUM WHEEL BRAKING, ENGINE AT IDLE WITH NOZZLES AT HOVER STOP; NOZZLES AFT AT 15 KNOTS.

(2) WITHOUT NOZZLE BRAKING: NOZZLES AFT; MAXIMUM WHEEL BRAKING AND ENGINE AT IDLE FROM TOUCHDOWN.

(3) TIRE LIMITED CONVENTIONAL LANDING WEIGHT IS THE TIRE LIMITED CTO GROSS WEIGHT (FIGURE 11-16) PLUS 500 LB.

GUIDE





AV8A-1-(171)

Figure 11-39

PART 9
COMBAT PERFORMANCE

Charts

LEVEL FLIGHT ENVELOPE

This chart (figure 11-40) presents the aircraft level flight speed envelope for various configurations and average combat gross weights. Parameters of the envelopes extend from maximum useable lift coefficient to V_{max} throughout the altitude range.

WARNING

Refer to appendix A of NAVAIR 01-AV8A-1T for external stores operating limitations.

USE

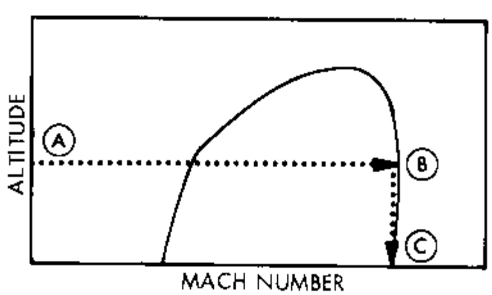
Enter the appropriate chart with the desired combat altitude. Proceed horizontally to intersect the applicable configuration - power curve. From this point, proceed vertically downward to read the maximum attainable Mach number in level flight.

Sample Problem

Configuration: CLEAN

A.	Combat altitude	36,000 Ft.
B.	Airplane complete load	(2) AIM 9, (2) Gun Pods, and (1) ℄ RACK
C.	Maximum attainable Mach number	0.91

SAMPLE LEVEL FLIGHT ENVELOPE



AV8A-1-(107)

SYMMETRICAL FLIGHT V-N DIAGRAM

The Symmetrical Flight V-N diagram (figure 11-41) is a graphical presentation of airspeed versus acceleration with lines of indicated angle of attack superimposed. The data is supplied for a single configuration at sea level altitude. The chart may be used to determine the allowable maximum symmetrical maneuvering capability of the airplane as well as the indicated angle of attack for any desired G.

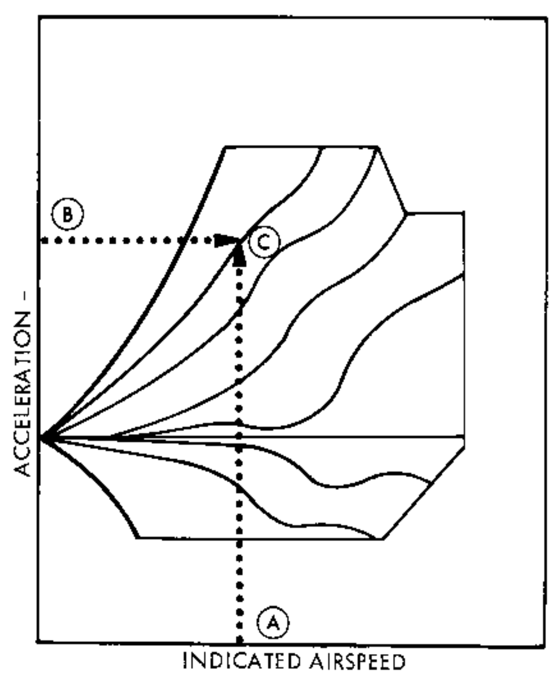
USE

To find the allowable maximum symmetrical performance capability, enter the chart with the indicated airspeed and proceed vertically to the stall boundary (positive or negative G) or the maximum allowable acceleration (upper and lower) as applicable. From these intersections, project horizontally to the left to read the positive and negative G obtainable in the case of the stall boundaries, or the upper and lower maximum allowable G for the selected gross weight. To find the angle of attack for a given condition of G and airspeed, enter the chart with these parameters. Project horizontally to the right from the load factor and vertically upward from the airspeed. At the intersection of these two projections, read the indicated angle of attack.

Sample Problem

A.	Indicated airspeed	550 Kt.
B.	Load factor	3G
C.	Angle of attack	3.8 units

SAMPLE SYMMETRICAL FLIGHT V-N DIAGRAM



AV8A-1-(106)

TURN CAPABILITIES

This chart (figure 11-42) presents the radius of turn and the rate of turn for a constant altitude, constant speed turn. Turn data is available for various speeds and bank angles. Load factor is also included for each bank angle.

USE

Enter the radius of turn plot with the true airspeed. Proceed horizontally to the right to the desired bank angle. Note the load factor, then proceed vertically downward and read the radius of turn. Enter the rate of turn plot with the true airspeed. Proceed horizontally to the right to the bank angle, note the load factor and then proceed vertically downward to read the rate of turn.

Sample Problem

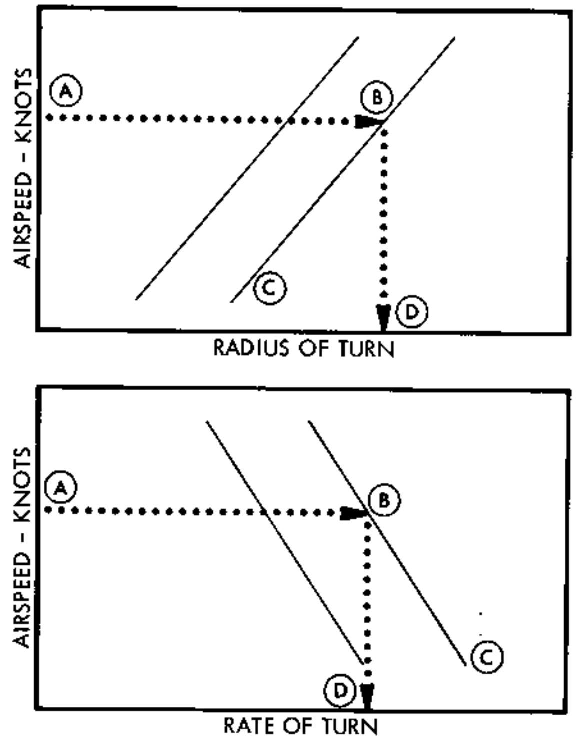
Radius of Turn

A.	True airspeed	420 Kt
B.	Bank angle	60°
C.	Load factor	2.0 G
D.	Radius of turn	9000 Ft

Rate of Turn

A.	True airspeed	420 Kt
B.	Bank angle	60°
C.	Load factor	2.0 G
D.	Rate of turn	4.5°/sec

SAMPLE TURN CAPABILITIES



AV8A-1-(179)

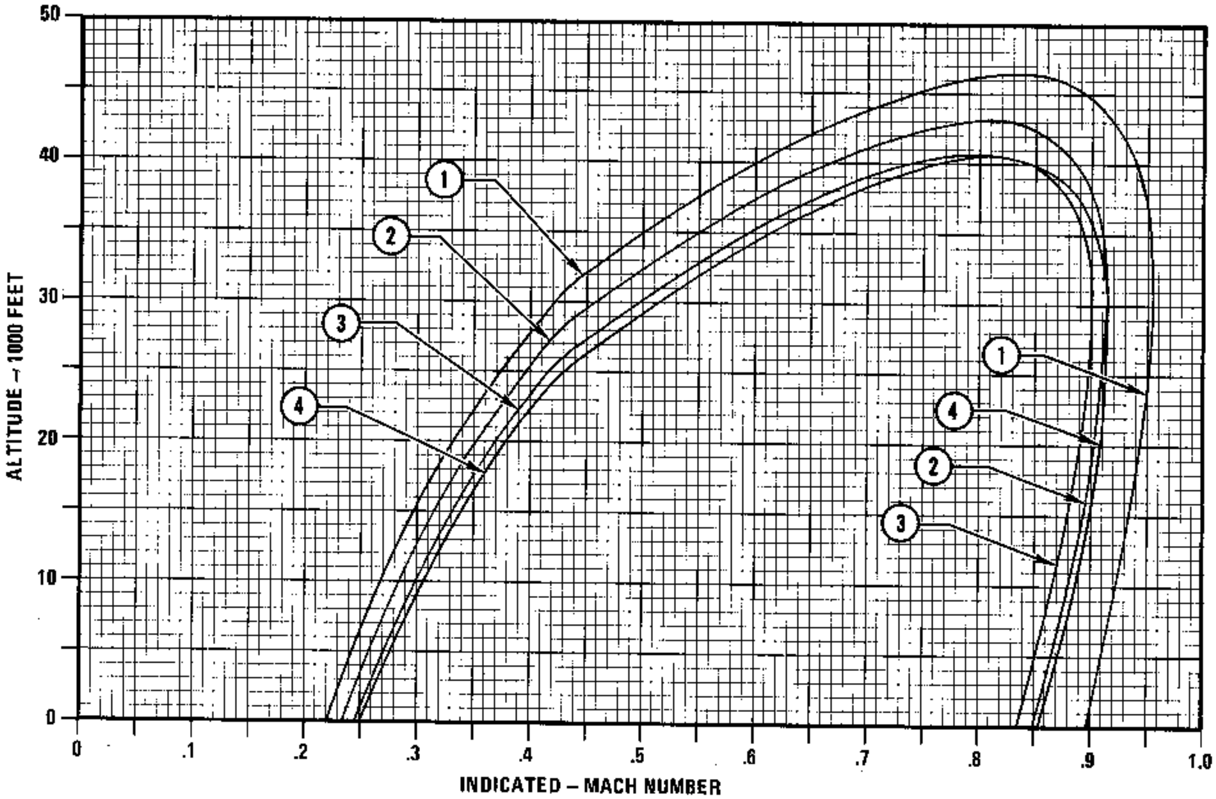
LEVEL FLIGHT ENVELOPE

CONFIGURATION: SEE NOTES BELOW

REMARKS
ENGINE: F402-RR-401
ICAO STANDARD DAY

DATA: 1 DECEMBER 1972
DATA BASIS: ESTIMATED (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



CURVE NO.	CONFIGURATION	GROSS WEIGHT	DRAG INDEX
1	CLEAN	15,424 LB.	0
2	(2) AIM-9, (2) GUN PODS AND ℄ RACK	17,214 LB.	14.9
3	(2) 120 GAL WING TANKS, (2) LAU-10A LAUNCHERS, AND (2) GUN PODS	18,873 LB.	18.9
4	(2) MK-82 SNAKEYE AND (2) MK-83 LDGP	19,714 LB.	12.0

AV8A-1-(105)

Figure 11-40

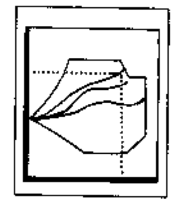
SYMMETRICAL FLIGHT V-N DIAGRAM

ALTITUDE SEA LEVEL
GROSS WEIGHT 17,214 POUNDS

AIRPLANE CONFIGURATION
(2) AIM-9G AND (2) GUN PODS

REMARKS
ENGINE: F402-RR-401
ICAO STANDARD DAY
NOZZLES AFT

GUIDE



DATE: 1 DECEMBER 1972
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

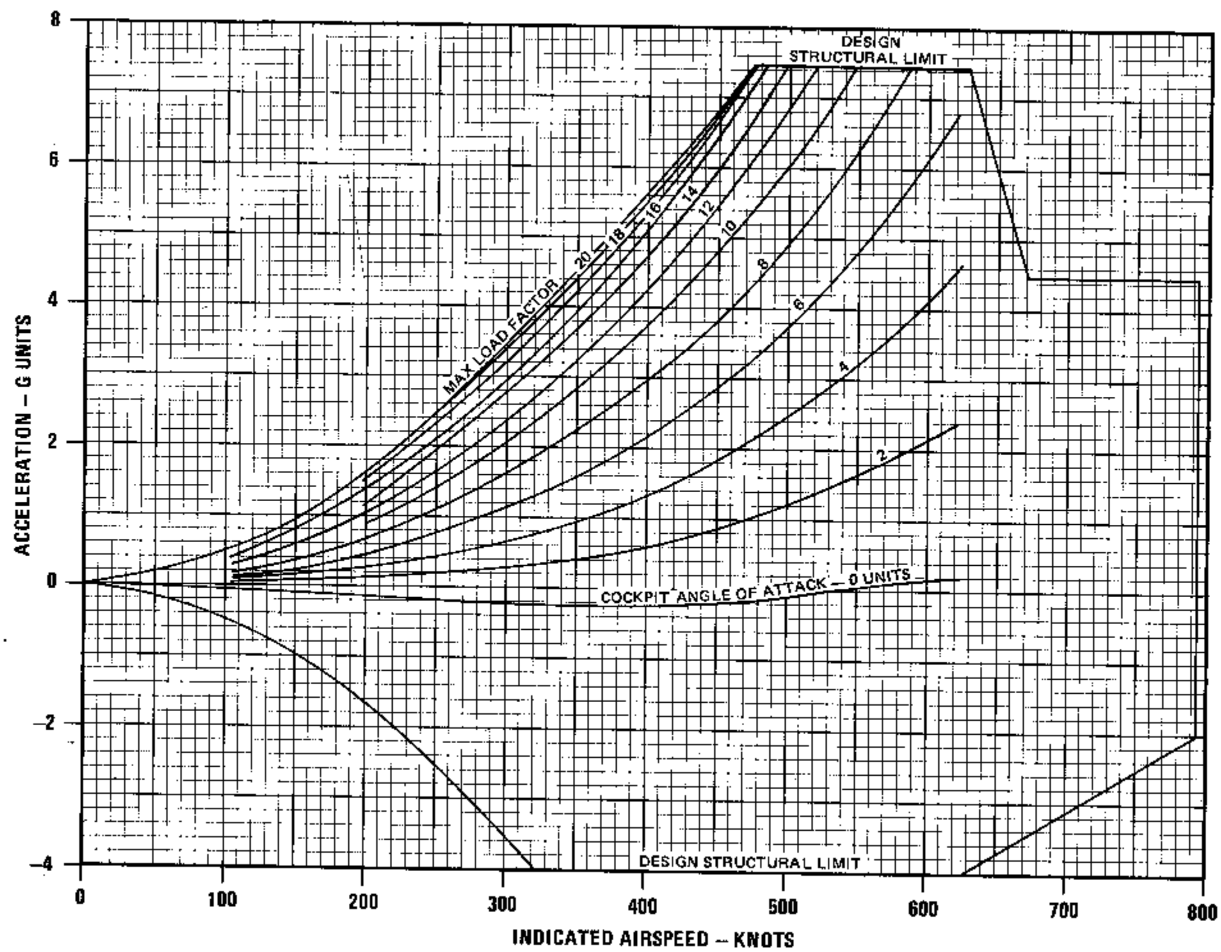


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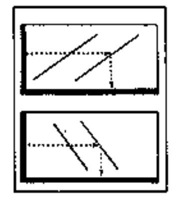
Figure 11-41

TURN CAPABILITIES
CONSTANT SPEED AND ALTITUDE

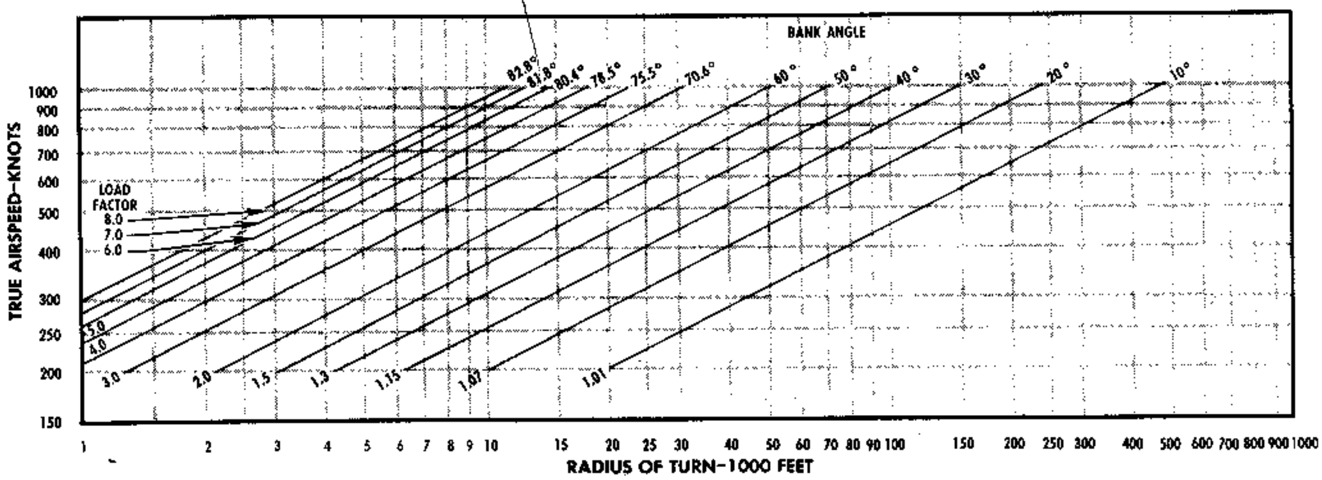


REMARKS
ENGINE: F402-RR-401
ICAO STANDARD DAY

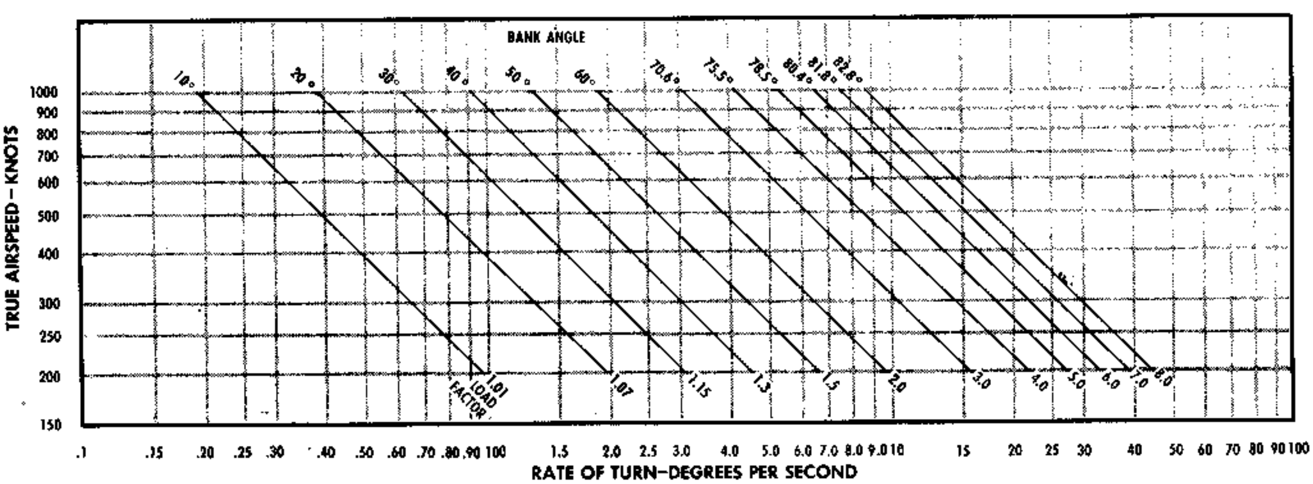
DATE: 1 OCTOBER 1973

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

RADIUS OF TURN



RATE OF TURN



AV8A-1-(180)

Figure 11-42

APPENDIX A

FOLDOUT ILLUSTRATIONS

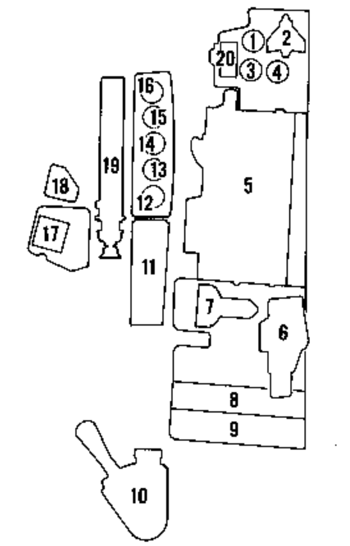
TABLE OF CONTENTS

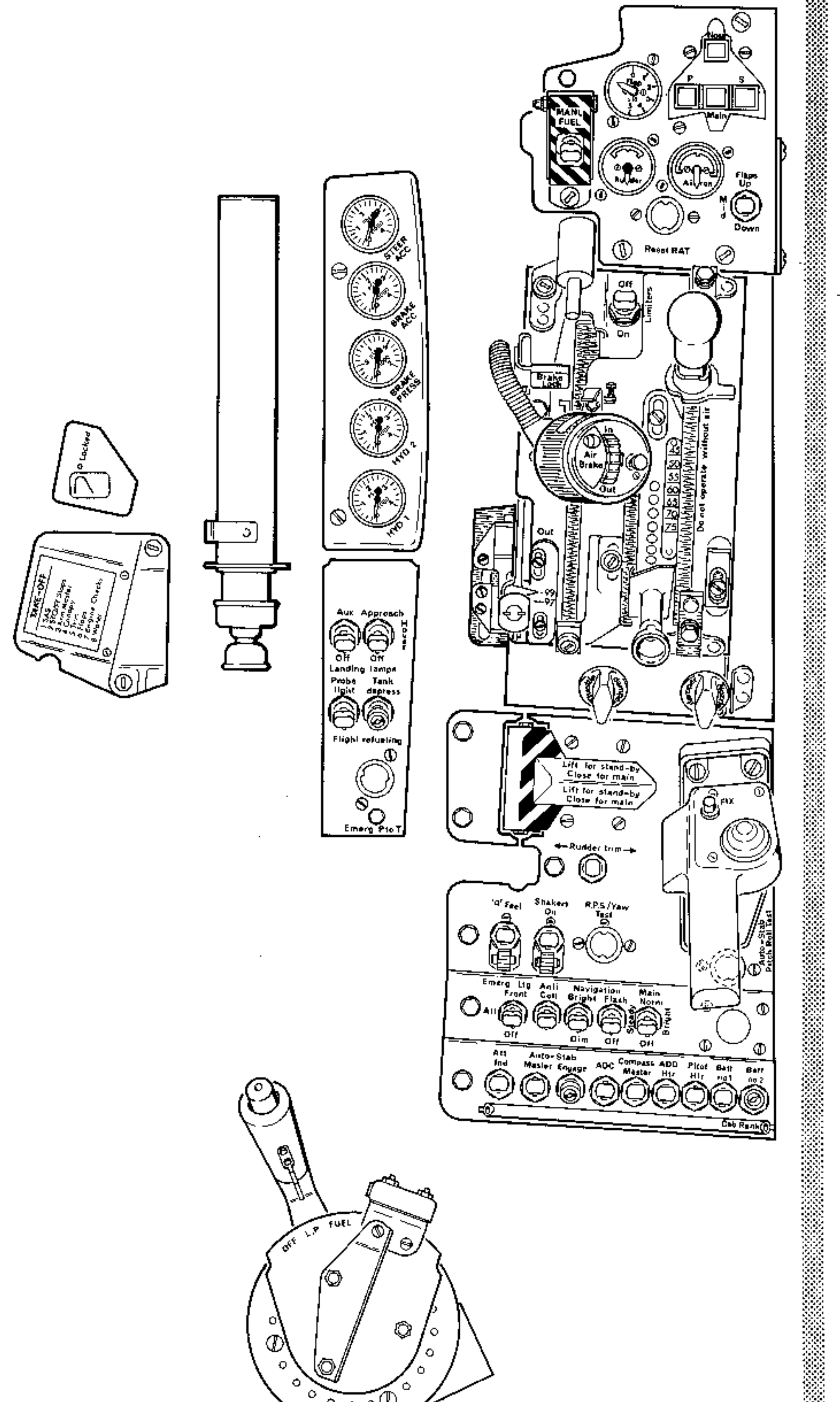
COCKPIT

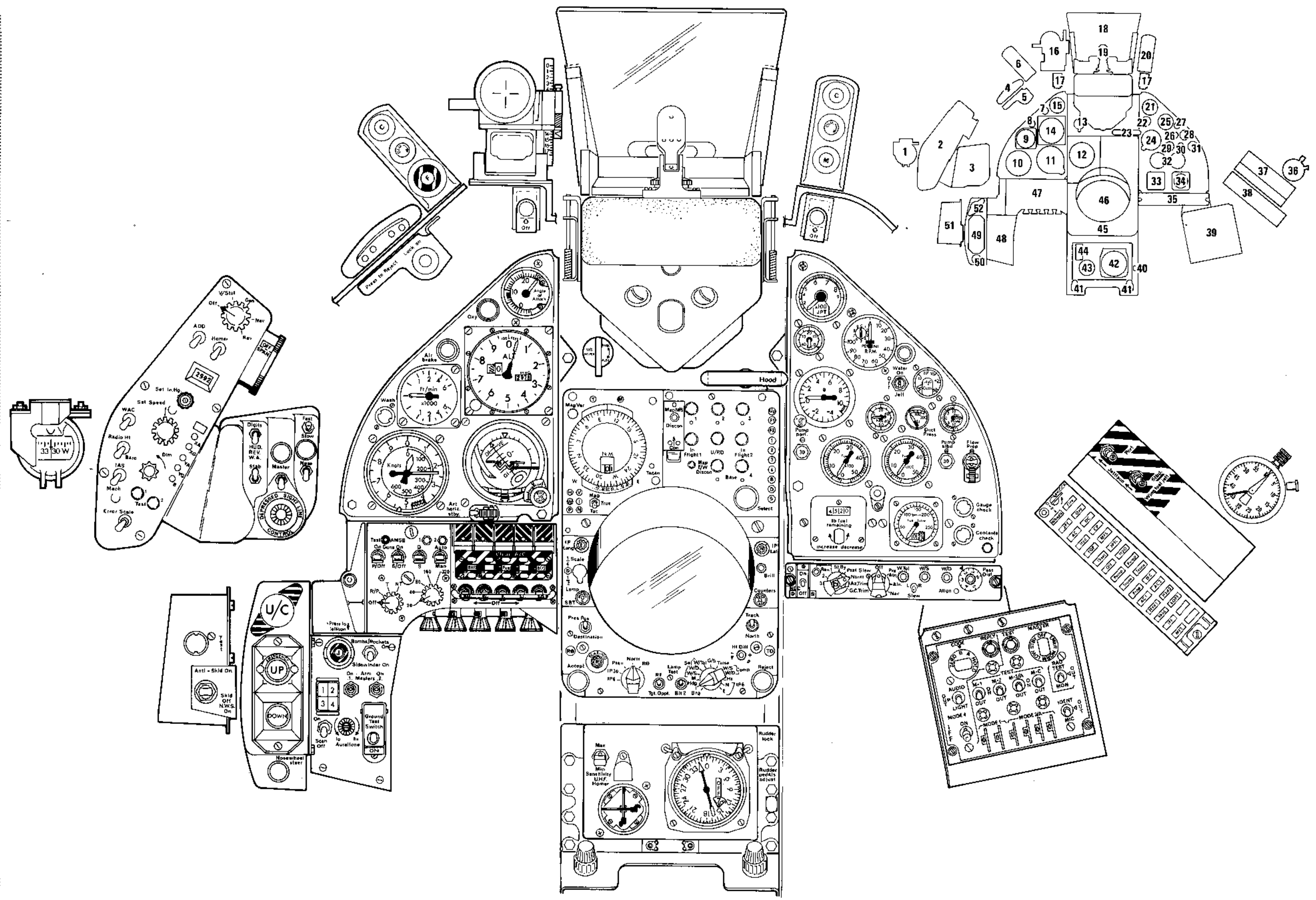
TYPICAL BASELINE

LEFT CONSOLE AREA

1. FLAP POSITION INDICATOR
2. LANDING GEAR POSITION INDICATORS
3. RUDDER TRIM TAB INDICATOR
4. AILERON TRIM POSITION INDICATOR
5. THROTTLE/NOZZLE CONTROL QUADRANT
6. HAND CONTROLLER
7. STABILATOR STANDBY TRIM CONTROL
8. LIGHTS CONTROL PANEL
9. GANG BAR SWITCH PANEL
   - BATT NO. 1 & 2
   - PITOT HEAT
   - ADD HEAT (AOA)
   - MASTER COMPASS
   - ADC
   - AUTO-STAB
   - ATTITUDE INDICATOR
   - GANG BAR
10. LOW PRESSURE FUEL SHUTOFF VALVE
11. LANDING/PROBE LIGHT SWITCHES & TANK DEPRESS SWITCH
12. HYD 1 PRESSURE INDICATOR
13. HYD 2 PRESSURE INDICATOR
14. BRAKE PRESSURE INDICATOR
15. BRAKE ACCUMULATOR PRESSURE INDICATOR
16. NOSEWHEEL STEERING ACCUMULATOR PRESSURE INDICATOR
17. TAKEOFF CHECKLIST
18. CANOPY LOCK INDICATOR
19. UTILITY LIGHT
20. MANUAL FUEL SWITCH





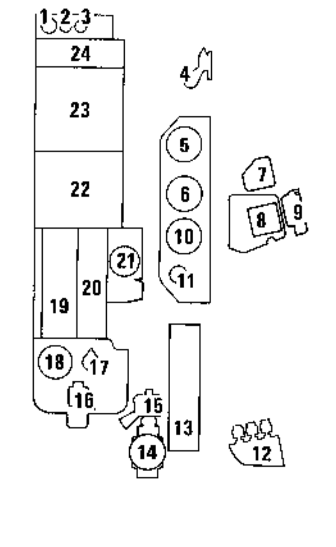


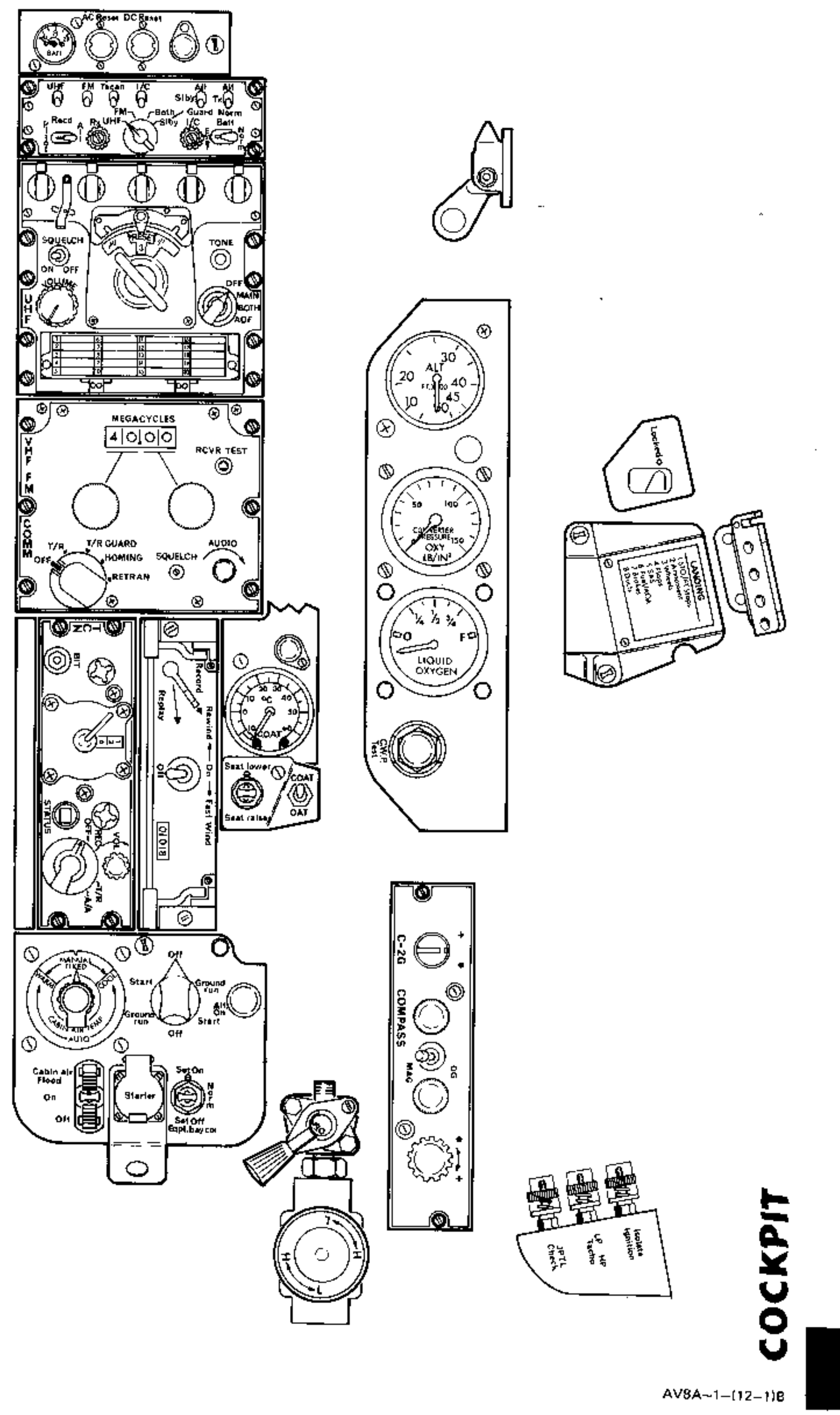
MAIN PANEL AREA

1. STANDBY MAGNETIC COMPASS
2. HUD CONTROL PANEL
3. REV SIGHT/NOSE CAMERA CONTROL PANEL
4. AIR REFUELING LIGHTS
5. MISSILE LOCK ON LIGHT/REJECT SWITCH
6. WARNING LIGHTS (FROM TOP TO BOTTOM)
   - MASTER CAUTION LIGHT & SHORT TERM CANCEL BUTTON
   - FUEL LOW LEVEL WARNING LIGHT (LEFT)
   - FIRE EXTINGUISHER WARNING LIGHT & PUSH BUTTON
7. OXYGEN FLOW INDICATOR
8. SPEED BRAKE INDICATOR
9. VERTICAL VELOCITY INDICATOR
10. AIRSPEED INDICATOR
11. ATTITUDE INDICATOR
12. RANGE & BEARING INDICATOR (NDC)
13. WINDSHIELD WIPER CONTROL KNOB
14. ALTIMETER
15. ANGLE OF ATTACK INDICATOR
16. SINGLE POINT SIGHT
17. FRESH AIR OUTLETS
18. HUD COMBINING GLASS
19. HUD CAMERA
20. WARNING LIGHTS (FROM TOP TO BOTTOM)
   - MASTER CAUTION LIGHTS & LONG TERM CANCEL BUTTON
   - FUEL LOW LEVEL WARNING LIGHT (RIGHT)
   - MUTE LIGHT & BUTTON
21. JET PIPE TEMPERATURE INDICATOR
22. IGV POSITION INDICATOR
23. INTERNAL CANOPY RELEASE HANDLE
24. ACCELEROMETER
25. TACHOMETER
26. WATER INJECTION SWITCH
27. WATER INJECTION INDICATOR LIGHT
28. WATER QUANTITY INDICATOR
29. WARNING/CAUTION PANEL
30. FUEL JETTISON SWITCHES
31. ELAPSED TIME INDICATOR
32. STABILATOR POSITION INDICATOR
33. REACTION CONTROLS DUCT PRESSURE INDICATOR
34. NOZZLE ANGLE INDICATOR
35. RIGHT & LEFT FUEL QUANTITY INDICATORS
36. FUEL REMAINING INDICATOR
37. FUEL FLOW INDICATOR
38. NAVIGATION CONTROL PANEL
39. IFF CONTROL PANEL
40. RUDDER PEDALS ADJUST KNOB
41. COCKPIT LIGHTING DIMMER KNOBS
42. TACAN INDICATOR
43. UHF HOMING INDICATOR
44. HOMING INDICATOR SENSITIVITY SWITCH
45. NAVIGATION DISPLAY & COMPUTER (NDC)
46. MOVING MAP DISPLAY
47. WEAPON CONTROL PANEL
48. SIDEWINDER CONTROL PANEL
49. LANDING GEAR SELECTOR
50. NOSEWHEEL CENTERED INDICATOR
51. ANTI-SKID & NOSEWHEEL STEERING SWITCH
52. LANDING GEAR EMERGENCY LOWERING T-HANDLE

RIGHT CONSOLE AREA

1. DC VOLTMETER
2. AC RESET BUTTON
3. DC RESET BUTTON
4. OXYGEN SHUTOFF VALVE
5. COCKPIT ALTIMETER
6. OXYGEN SUPPLY PRESSURE INDICATOR
7. CANOPY LOCK INDICATOR
8. LANDING CHECKLIST
9. SAFETY PIN STOWAGE BRACKET
10. OXYGEN QUANTITY INDICATOR
11. WARNING/CAUTION LIGHTS TEST BUTTON
12. MAINTENANCE TEST PANEL
13. C2G COMPASS CONTROL PANEL
14. ANTI-G CONTROL VALVE
15. ANTI-G SHUTOFF VALVE
16. ENGINE START BUTTON
17. APU MODE SELECTOR
18. COCKPIT TEMPERATURE CONTROL
19. TACAN CONTROL PANEL
20. VOICE RECORDER
21. COAT INDICATOR
22. VHF CONTROL PANEL
23. UHF CONTROL PANEL
24. COMMUNICATIONS CONTROL PANEL





AV8A-1-(12-1)B

Figure A-1 (Sheet 1 of 2)

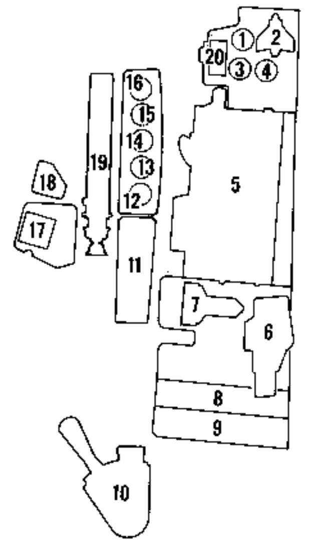
Figure A-1

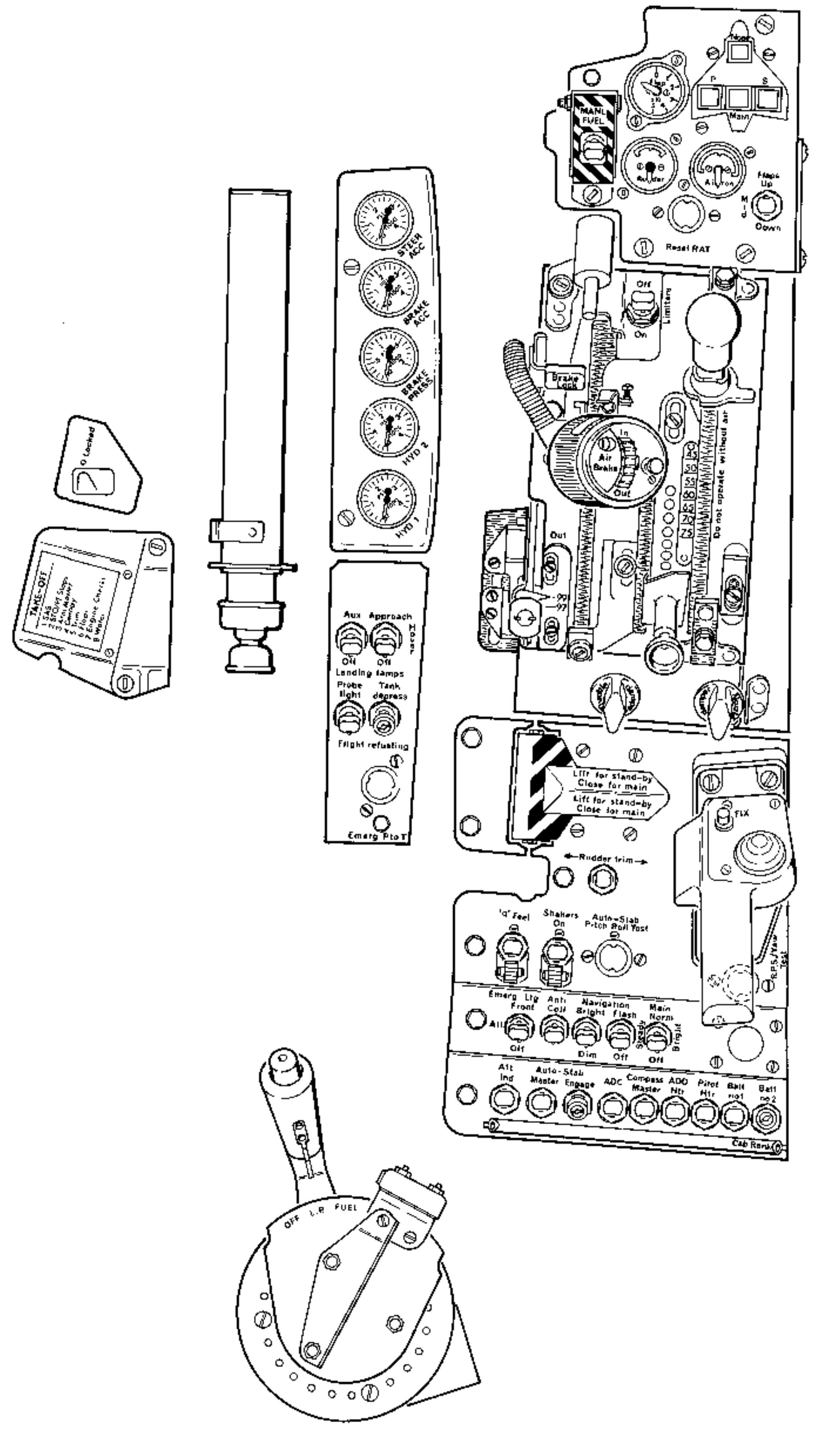
COCKPIT

TYPICAL WITH VARIOUS AFC'S ADDED

LEFT CONSOLE AREA

1. FLAP POSITION INDICATOR
2. LANDING GEAR POSITION INDICATORS
3. RUDDER TRIM TAB INDICATOR
4. AILERON TRIM POSITION INDICATOR
5. THROTTLE/NOZZLE CONTROL QUADRANT
6. HAND CONTROLLER
7. STABILATOR STANDBY TRIM CONTROL
8. LIGHTS CONTROL PANEL
9. GANG BAR SWITCH PANEL
   - BATT NO. 1 & 2
   - PITOT HEAT
   - ADD HEAT (AOA)
   - MASTER COMPASS
   - ADC
   - AUTO–STAB
   - ATTITUDE INDICATOR
   - GANG BAR
10. LOW PRESSURE FUEL SHUTOFF VALVE
11. LANDING/PROBE LIGHT SWITCHES & TANK DEPRESS SWITCH
12. HYD 1 PRESSURE INDICATOR
13. HYD 2 PRESSURE INDICATOR
14. BRAKE PRESSURE INDICATOR
15. BRAKE ACCUMULATOR PRESSURE INDICATOR
16. NOSEWHEEL STEERING ACCUMULATOR PRESSURE INDICATOR
17. TAKEOFF CHECKLIST
18. CANOPY LOCK INDICATOR
19. UTILITY LIGHT
20. MANUAL FUEL SWITCH





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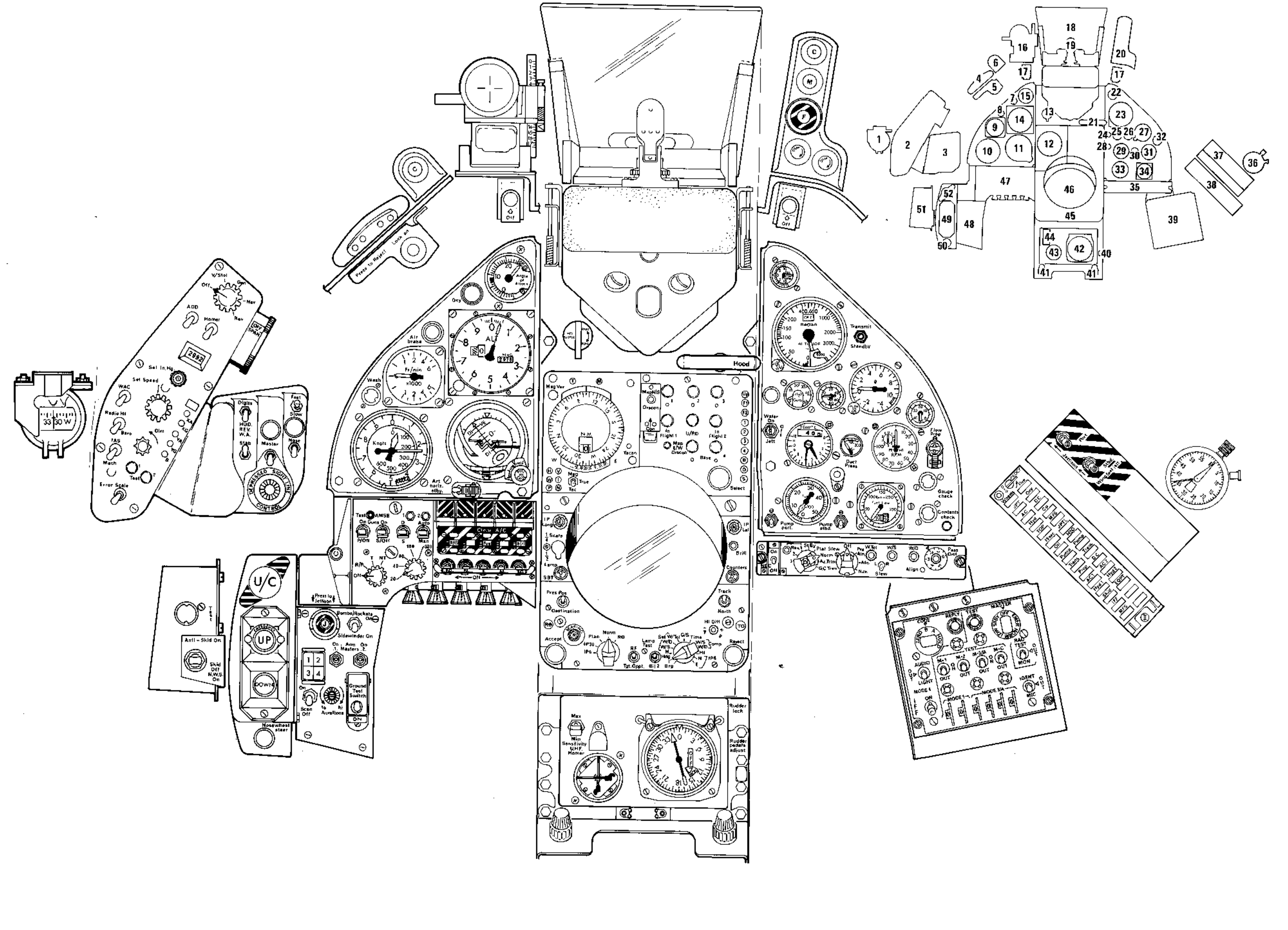
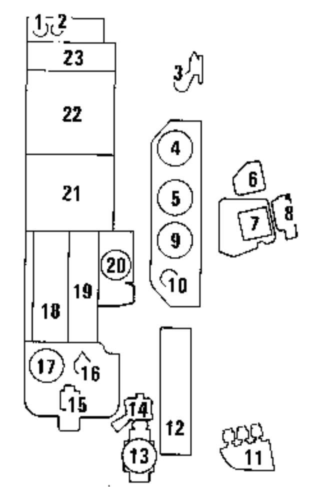


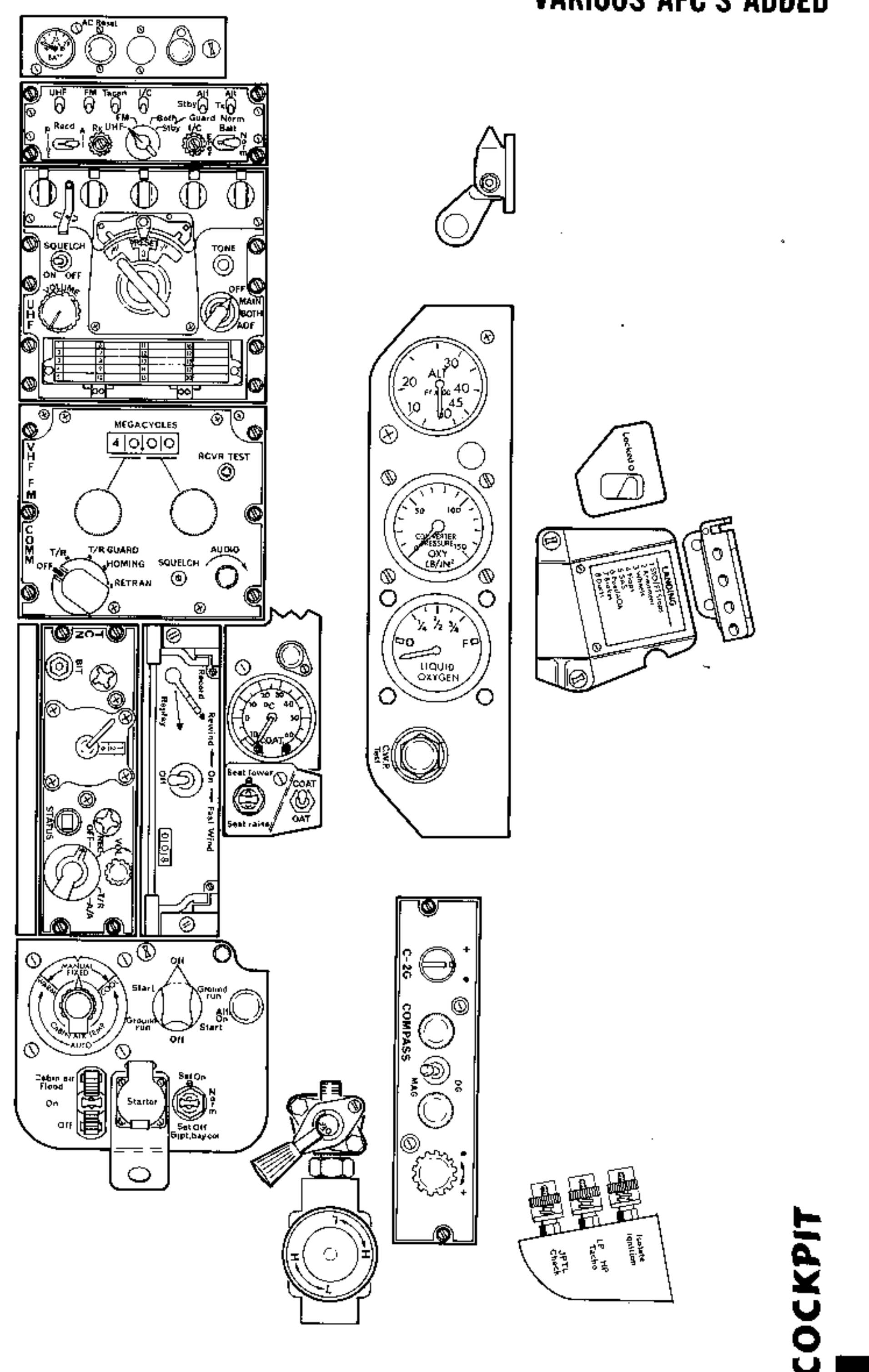
MAIN PANEL AREA

1. STANDBY MAGNETIC COMPASS
2. HUD CONTROL PANEL
3. REV SIGHT/NOSE CAMERA CONTROL PANEL
4. AIR REFUELING LIGHTS
5. MISSILE LOCK ON LIGHT/REJECT SWITCH
6. WARNING LIGHT
   - MASTER CAUTION LIGHT & SHORT TERM CANCEL BUTTON
7. OXYGEN FLOW INDICATOR
8. SPEED BRAKE INDICATOR
9. VERTICAL VELOCITY INDICATOR
10. AIRSPEED INDICATOR
11. ATTITUDE INDICATOR
12. RANGE & BEARING INDICATOR (NDC)
13. WINDSHIELD WIPER CONTROL KNOB
14. ALTIMETER
15. ANGLE OF ATTACK INDICATOR
16. SINGLE POINT SIGHT
17. FRESH AIR OUTLET
18. HUD COMBINING GLASS
19. HUD CAMERA
20. WARNING LIGHTS (FROM TOP TO BOTTOM)
   - MASTER CAUTION LIGHT & LONG TERM CANCEL BUTTON
   - MUTE LIGHT & BUTTON
   - FIRE EXTINGUISHER WARNING LIGHT & PUSH BUTTON
   - FUEL LOW LEVEL WARNING LIGHTS (LEFT & RIGHT)
21. INTERNAL CANOPY RELEASE HANDLE
22. STABILATOR POSITION INDICATOR
23. RADAR ALTIMETER
24. WATER INJECTION INDICATOR LIGHT
25. WATER QUANTITY INDICATOR
26. NOZZLE ANGLE INDICATOR
27. ACCELEROMETER
28. WATER INJECTION SWITCH
29. JET PIPE TEMPERATURE INDICATOR
30. REACTION CONTROLS DUCT PRESSURE INDICATOR
31. TACHOMETER
32. IGV POSITION INDICATOR
33. FUEL QUANTITY INDICATOR (DUAL NEEDLES)
34. FUEL FLOW INDICATOR
35. NAVIGATION CONTROL PANEL
36. ELAPSED TIME INDICATOR
37. FUEL JETTISON SWITCHES
38. WARNING/CAUTION PANEL
39. IFF CONTROL PANEL
40. RUDDER PEDALS ADJUST KNOB
41. COCKPIT LIGHTING DIMMER KNOBS
42. TACAN INDICATOR
43. UHF HOMING INDICATOR
44. HOMING INDICATOR SENSITIVITY SWITCH
45. NAVIGATION DISPLAY & COMPUTER (NDC)
46. MOVING MAP DISPLAY
47. WEAPON CONTROL PANEL
48. SIDEWINDER CONTROL PANEL
49. LANDING GEAR SELECTOR
50. NOSEWHEEL CENTERED INDICATOR
51. ANTI–SKID & NOSEWHEEL STEERING SWITCH
52. LANDING GEAR EMERGENCY LOWERING T–HANDLE

RIGHT CONSOLE AREA

1. DC VOLTMETER
2. AC RESET BUTTON
3. OXYGEN SHUTOFF VALVE
4. COCKPIT ALTIMETER
5. OXYGEN SUPPLY PRESSURE INDICATOR
6. CANOPY LOCK INDICATOR
7. LANDING CHECKLIST
8. SAFETY PIN STOWAGE BRACKET
9. OXYGEN QUANTITY INDICATOR
10. WARNING/CAUTION LIGHTS TEST BUTTON
11. MAINTENANCE TEST PANEL
12. C2G COMPASS CONTROL PANEL
13. ANTI–G CONTROL VALVE
14. ANTI–G SHUTOFF VALVE
15. ENGINE START BUTTON
16. APU MODE SELECTOR
17. COCKPIT TEMPERATURE CONTROL
18. TACAN CONTROL PANEL
19. VOICE RECORDER
20. COAT INDICATOR
21. VHF CONTROL PANEL
22. UHF CONTROL PANEL
23. COMMUNICATIONS CONTROL PANEL





COCKPIT

AV8A–1–(12–2)

Figure A-1

ELECTRICAL SYSTEM

EXTERNAL POWER CONNECTED

Airplanes 158384 thru 158711

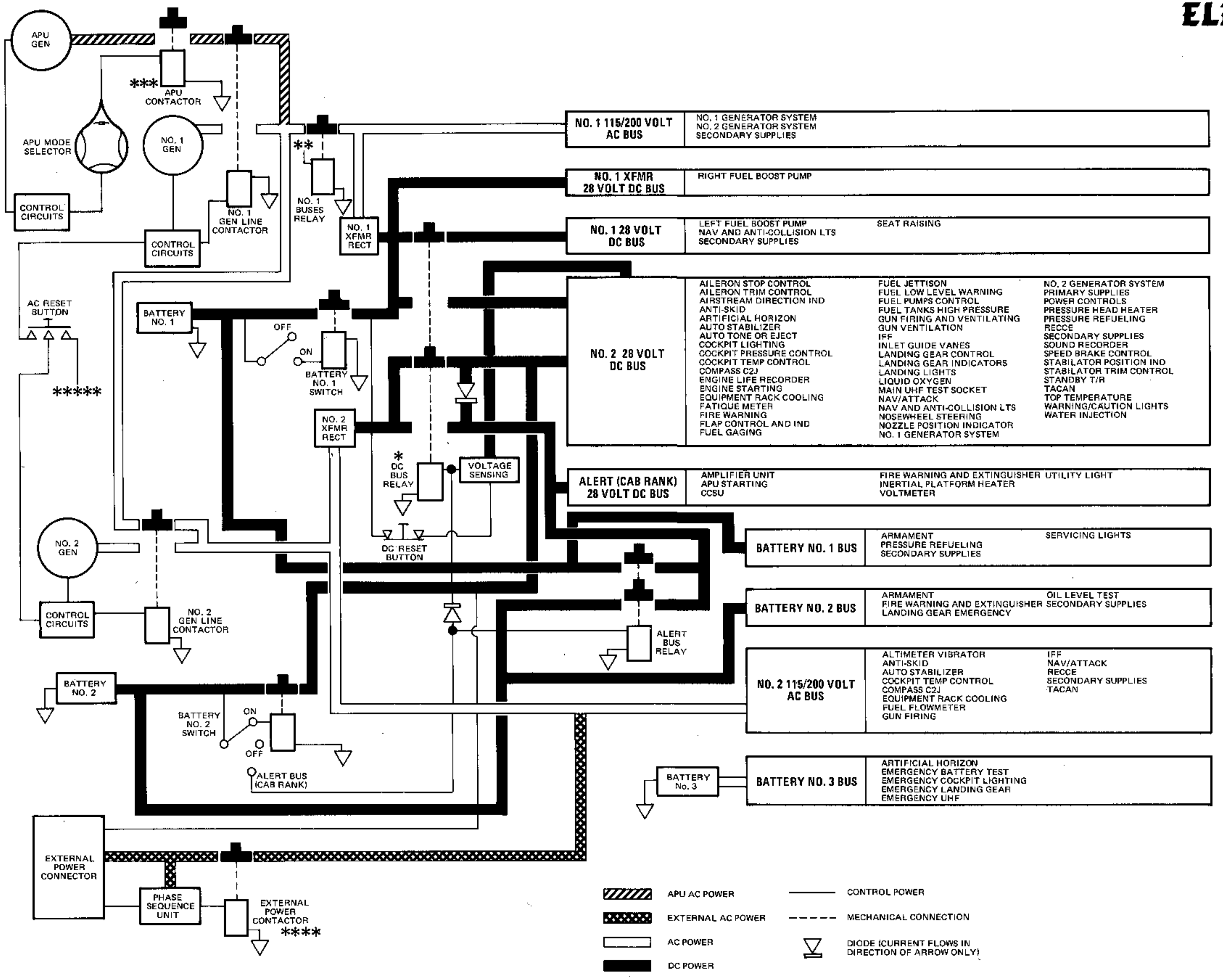


Figure A-2

* UNDER NORMAL CONDITIONS, DC BUS RELAY IS DE-ENERGIZED. WITH LOW VOLTAGE CONDITION ON NO. 2 DC BUS OR WITH NO. 2 BATTERY SWITCH IN ALERT BUS, RELAY ENERGIZES.

** NO. 1 BUSES RELAY CLOSES WHEN NO. 2 GENERATOR LINE CONTACTOR IS ENERGIZED, THE EXTERNAL POWER CONTACTOR IS ENERGIZED, OR WHEN THE EXTERNAL POWER CONTACTOR IS DE-ENERGIZED AND GROUND RUN IS SELECTED ON APU MODE SELECTOR. NO. 1 BUSES RELAY IS OPEN WHEN NO. 2 GENERATOR LINE CONTACTOR AND EXTERNAL POWER CONTACTOR ARE DE-ENERGIZED AND THE APU MODE SELECTOR IS NOT IN GROUND RUNNING, OR WHEN ALERT BUS IS SELECTED.

*** APU CONTACTOR CLOSES WHEN GROUND RUN IS SELECTED ON APU MODE SELECTOR AND THE EXTERNAL POWER CONTACTOR IS DE-ENERGIZED. RELAY OPENS WHEN OFF OR START IS SELECTED ON APU MODE SELECTOR OR EXTERNAL POWER CONTACTOR IS CLOSED.

**** EXTERNAL POWER CONTACTOR CLOSES WITH PLUG CONNECTED WHEN NO. 1 AND NO. 2 GENERATOR LINE AND APU CONTACTORS ARE OPEN, NO. 2 BATTERY SWITCH IS ON AND EXTERNAL POWER PHASE SEQUENCE IS CORRECT. CONTACTOR OPENS WHEN PLUG IS WITHDRAWN OR NO. 1 OR NO. 2 GENERATOR LINE CONTACTORS CLOSE.

***** AC RESET BUTTON RECEIVES POWER FROM NO. 2 28 VOLT DC BUS.

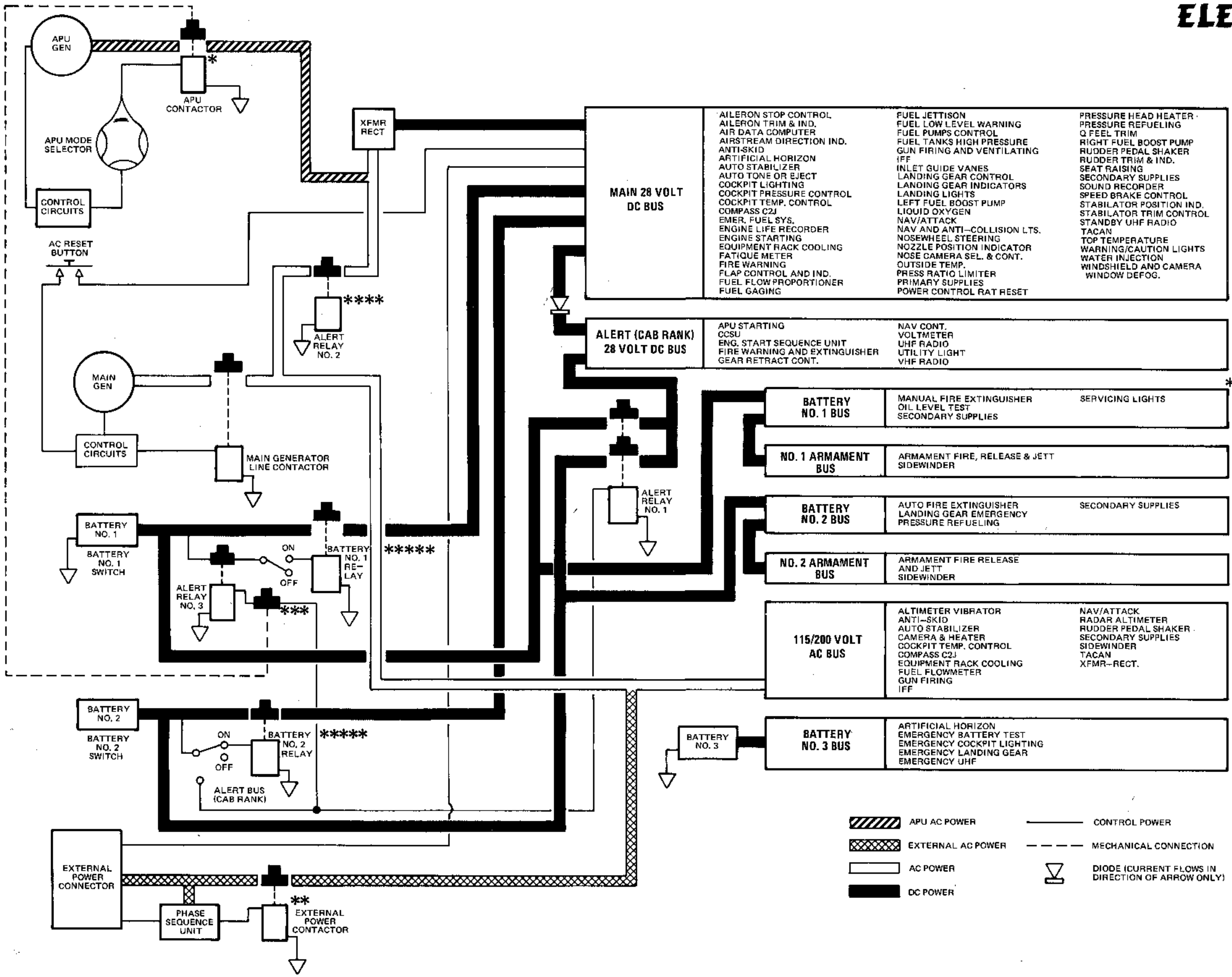
AV8A-1-(43) C

Figure A-2

ELECTRICAL SYSTEM

EXTERNAL POWER
CONNECTED

AIRPLANES 158948 AND UP.



* APU CONTACTOR CLOSES WHEN GROUND RUN IS SELECTED ON APU MODE SELECTOR AND EXTERNAL POWER AND MAIN GENERATOR LINE CONTACTORS ARE DE-ENERGIZED. CONTACTOR OPENS WHEN APU MODE SELECTOR IS PLACED TO OFF OR START, OR EITHER EXTERNAL POWER OR MAIN GENERATOR LINE CONTACTORS IS ENERGIZED.

** EXTERNAL POWER CONTACTOR CLOSES WITH PLUG CONNECTED, MAIN GENERATOR LINE CONTACTOR OPEN, EITHER OR BOTH BATTERY SWITCHES ON, AND EXTERNAL POWER PHASE SEQUENCE CORRECT. CONTACTOR OPENS WHEN MAIN GENERATOR COMES ON LINE.

*** APU CONTACTOR CONTACT AND RELAY COMBINATION PREVENT CONNECTION OF THE NO. 1 BATTERY TO THE MAIN 28 VOLT DC BUS WHEN THE NO. 2 BATTERY SWITCH IS IN THE ALERT BUS POSITION AND THE APU IS NOT OPERATING. THIS PREVENTS NO. 1 BATTERY DRAIN BY EQUIPMENT ON MAIN 28 VOLT DC BUS.

**** RELAY CONTACT CLOSES WHEN THE BATTERY NO. 2 SWITCH IS NOT IN ALERT BUS, AND EITHER OF THE FOLLOWING CONTACTORS ARE ENERGIZED: MAIN GENERATOR, EXTERNAL POWER OR APU. RELAY CONTACT OPENS WITH BATTERY NO. 2 SWITCH IN ALERT BUS OR ALL OF THE ABOVE CONTACTORS DE-ENERGIZED.

***** BATTERY NO. 1 AND NO. 2 RELAYS ENERGIZE AUTOMATICALLY WITH APU CONTACTOR CLOSED AND BATTERY SWITCH NO. 2 IN ALERT BUS.

AV8A-1-(176)

Figure A-2A

AIRPLANE AND ENGINE FUEL SYSTEM

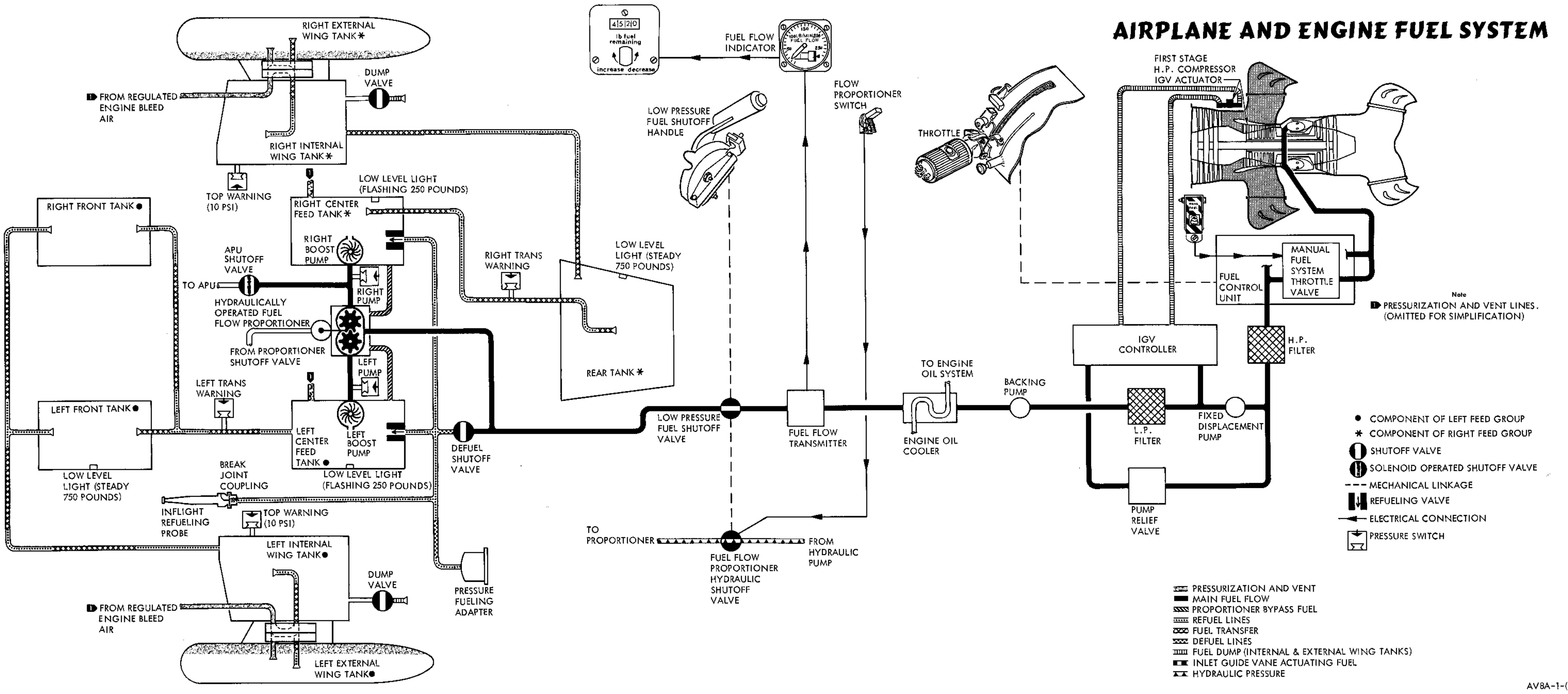


Figure A-3

AIRPLANE AND ENGINE FUEL SYSTEM

UNCLASSIFIED

Figure A-3

HYDRAULIC SYSTEM

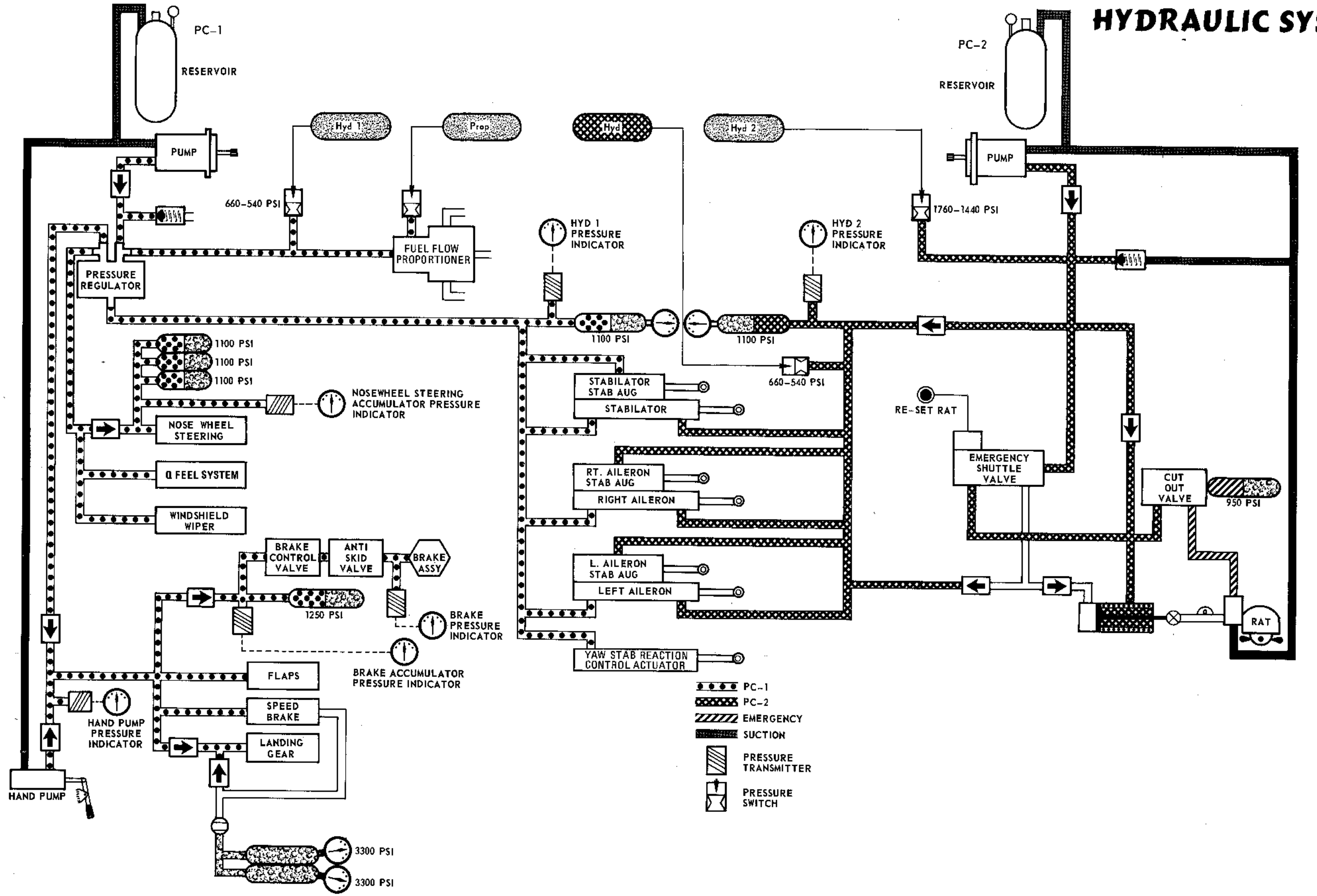


Figure A-4

AV8A-1-(31)B

HYDRAULIC SYSTEM

Figure A-4

ALPHABETICAL INDEX

☆ U.S. GOVERNMENT PRINTING OFFICE: 1974—768-176/4118