NAVWEPS 01-245FDC-1

NATOPS Flight Manual

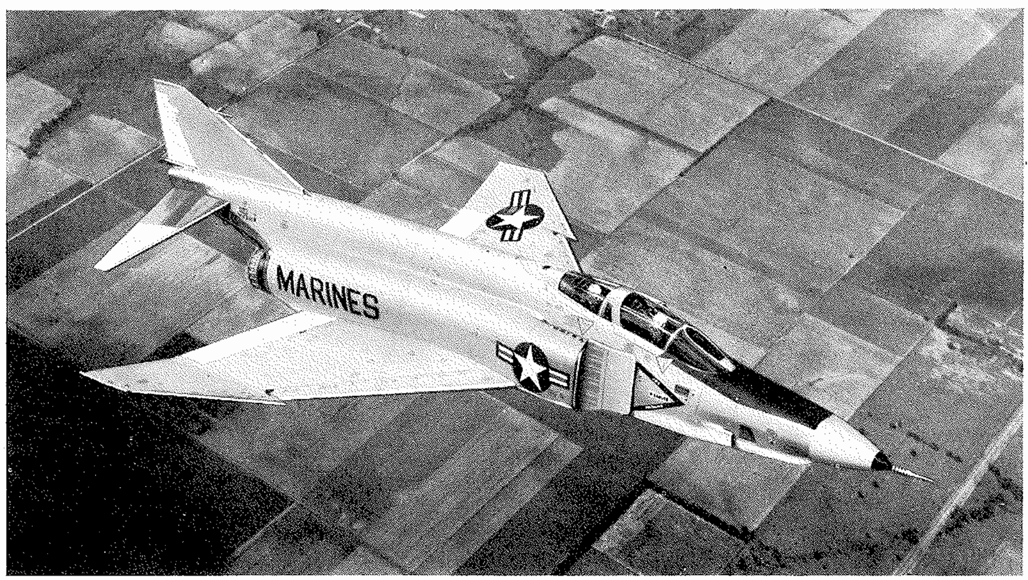
NAVY MODEL

RF-4B

AIRCRAFT

THIS PUBLICATION IS INCOMPLETE WITHOUT CLASSIFIED SUPPLEMENT, NAVWEPS 01-245FDC-1A

THIS PUBLICATION SUPERSEDES NAVWEPS 01-245FDC-1 DATED 15 APRIL 1965, CHANGED 15 JULY 1965.



ISSUED BY THE AUTHORITY OF THE CHIEF OF NAVAL OPERATIONS AND UNDER THE DIRECTION OF THE CHIEF OF THE BUREAU OF NAVAL WEAPONS.

15 December 1965

LIST OF CHANGED PAGES ISSUED

INSERT LATEST CHANGED PAGES. DESTROY SUPERSEDED PAGES.

NOTE: The portion of the text affected by the current change is indicated by a vertical line in the outer margins of the page.

Page No.	*Date of Latest Change*	*Page No.*	*Date of Latest Change*	*Page No.*	*Date of Latest Change*

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BUWEPS

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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 towards 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, it will aid the Commanding Officer in increasing his unit's combat potential without reducing his command prestige or responsibility.

2. This Manual is published for the purpose of standardizing ground and flight procedures, and does not include tactical doctrine. Compliance with the stipulated manual procedure is mandatory. However, to remain effective this manual must be dynamic. It must stimulate rather than stifle individual thinking. Since aviation is a continuing progressive profession, it is both desirable and necessary that new ideas and new techniques be expeditiously formulated and incorporated. It is a user's publication, prepared by and for users, 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. Check lists 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.

Paul H. Ramsey
PAUL H. RAMSEY
Vice Admiral, USN
Deputy Chief of Naval Operations (Air)

INTERIM CHANGE RECORD

The following list contains: the previously cancelled or incorporated Interim Changes; the outstanding Interim Changes, if any; and the Interim Changes incorporated in this issue. In addition, space is provided to list those Interim Changes received since the latest issue.

INTERIM CHANGE NUMBER	SUBJECT OR DISPOSITION
1	Canopy shear pin failure. Section V
2	Inspection of bleed air check valve. Section III, Part 3
3	Air refueling of fuselage tanks only. Section V
4	Variable area inlet ramp failure. Section I, Part 2 and Section V
5	Retraction of RAT after extension. Section I, Part 2 and Section V

TECHNICAL DIRECTIVES SUMMARY

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

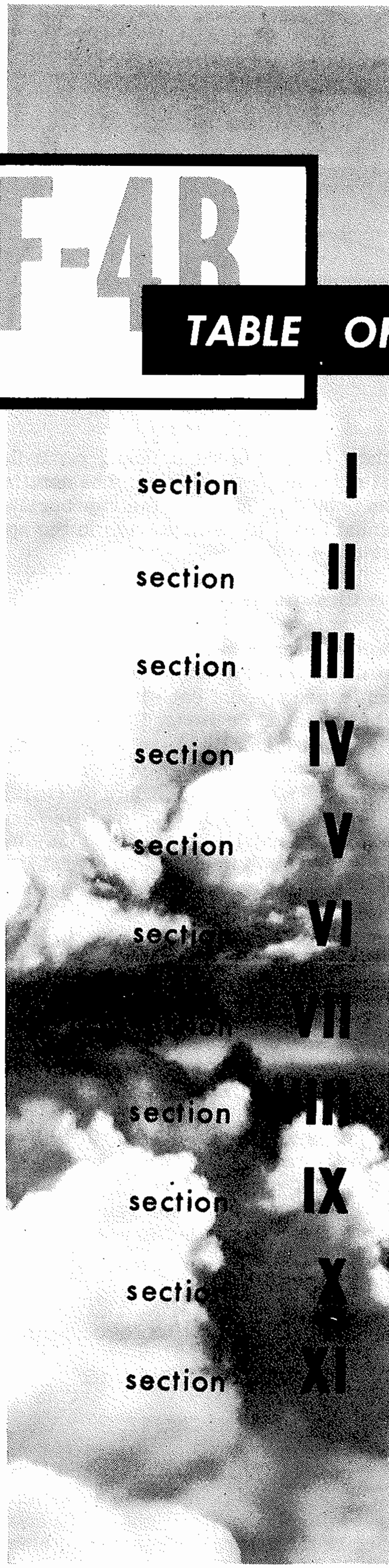
Airframe Change (AFC) or Airframe Bulletin (AFB)
Power Plant Change (PPC) or Bulletin (PPB)
Aviation Armament Change (AAC) or Bulletin (AAB)
Avionics Change (AVC) or Bulletin (AVB)
Accessory Change (AYC) or Bulletin (AYB)
Support Equipment Change (SEC) or Bulletin (SEB)
Photographic Change (PHC) or Bulletin (PHB)
Propeller Change (PRC) or Bulletin (PRB)
Air Crew System Change (ACC) or Bulletin (ACB)
Air Launched Missile Change (AMC) or Bulletin (AMB)
Target Control System Change (TCC) or Bulletin (TCB)

The following Technical Directives are of direct interest to the crew, and are noted throughout the manual:

DIRECTIVE AND NO.	EFFECT
ACC 19	Adds visual indication of ejection seat security.
AFC 203	Provides individual axis stab aug engagement.
AFC 220	Removes hydraulic pump from RAT.
AFC 267	Adds canopy alignment tape.

PUBLICATION INDEX
MAINTENANCE INSTRUCTION MANUALS

ITEM NO.	PUBLICATION TITLE	PUBLICATION NO.
1	General Information and Servicing	NAVWEPS 01-245FDB-2-1.1
2	Corrosion Control and Decontamination	NAVWEPS 01-245FDB-2-1.2
3	Safety and Survival Equipment	NAVWEPS 01-245FDB-2-2.1
4	Structure and Surface Controls	NAVWEPS 01-245FDB-2-2.2
5	Landing Gear and Related Systems	NAVWEPS 01-245FDB-2-2.3
6	Hydraulic, Pneumatic and Utility Systems	NAVWEPS 01-245FDB-2-2.4
7	J-79GE-8 Power Plant	NAVWEPS 01-245FDB-2-3.1
8	Air Induction System	NAVWEPS 01-245FDB-2-3.2
9	Fuel System	NAVWEPS 01-245FDB-2-3.3
10	Power Plant Control Systems	NAVWEPS 01-245FDB-2-3.4
11	Instrument Systems	NAVWEPS 01-245FDB-2-4.1
12	Air Data Computer Set	NAVWEPS 01-245FDB-2-4.2
13	Electrical Power Supply System	NAVWEPS 01-245FDB-2-5.1
14	Lighting Systems	NAVWEPS 01-245FDB-2-5.2
15	Integrated Electronic Central AN/ASQ-19	NAVWEPS 01-245FDB-2-6.1
16	Miscellaneous Electronic, Navigation and Recording System	NAVWEPS 01-245FDB-2-6.2
17	Flight Control Group AN/ASA-32 and Related Systems	NAVWEPS 01-245FDB-2-6.3
18	Integrated Electronic Central AN/ASQ-88	NAVWEPS 01-245FDB-2-6.6
19	Forward Looking Radar and Electronic Altimeter Systems	NAVWEPS 01-245FDB-2-6.7
20	Radar Mapping System	NAVWEPS 01-245FDB-2-6.8
21	Sensor Control Optical Viewfinder and Data Display Systems	NAVWEPS 01-245FDB-2-6.9
22	Infrared Detecting System	NAVWEPS 01-245FDB-2-6.10
23	H.F. Radio and Sound Recorder System	NAVWEPS 01-245FDB-2-6.11
24	Inertial Navigation System	NAVWEPS 01-245FDB-2-6.12
25	Armament and Loft Bomb Release Equipment	NAVWEPS 01-245FDB-2-7
26	System Integration	NAVWEPS 01-245FDB-2-9.1
27	Wiring Data Diagrams	NAVWEPS 01-245FDB-2-10.3
28	Wiring Data Repair	NAVWEPS 01-245FDB-2-10.4
29	Photographic Reconnaissance Systems	NAVWEPS 01-245FDB-2-11



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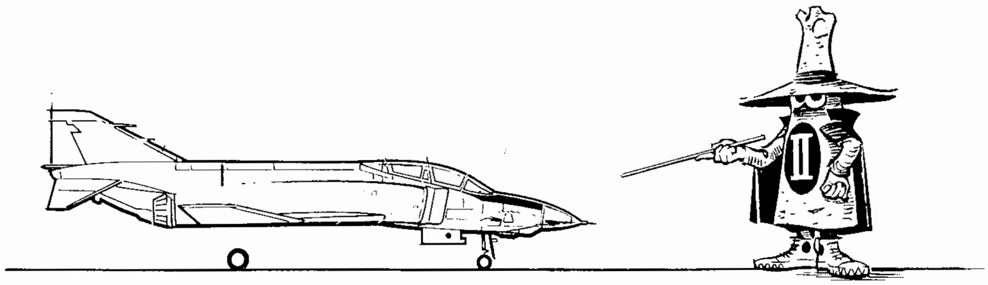


SCOPE

As outlined in the Letter of Promulgation, the RF-4B NATOPS Flight Manual is authorized by the Chief of Naval Operations and is issued in conjunction with the Naval Air Training and Operating Procedures Standardization (NATOPS) Program. Prepared under Contract NOw (A) 65-0044-f, this manual contains the mandatory operating procedures necessary for the safe and efficient operation of RF-4B aircraft. Every effort has been made to provide adequate data for the support of all missions within the assigned parameters of the aircraft.

KEEPING THE MANUAL CURRENT

The RF-4B NATOPS Flight Manual will be constantly up-dated through an extremely active revision program. This program includes the publication of Revisions, Changes, and Interim Changes.

Revisions and Changes

Revisions and changes are prepared and distributed on a fairly routine basis. A revision (formerly called "re-issue") is a completely reprinted manual and is normally issued annually. A change consists of formal printed changed and/or additional pages to be incorporated into your existing manual. The publication date on the title page represents the contractor's source-data cutoff date and, therefore, currency of the manual. Revisions and changes are the more formal method of up-dating your manual to include: production/retrofit changes to the equipment; outstanding interim changes; correction of significant errors; more recent or revised data; corrections and/or improvements generated through reviews and comments by the user and appropriate Navy monitoring agencies.

Interim Changes

Interim changes are issued to forward vital operating procedures or limitations between routine changes or revisions. These changes are recommended, approved, and disseminated in accordance with OPNAVINST 3510.9. Interim changes are issued to the individual publication (i.e., separately for the -1, the -1A, etc.) and are numbered consecutively throughout the life of the manual, regardless of subsequent changes or revisions. The details of these changes should be noted on the appropriate page(s) of the manual and a log-entry made in the applicable Interim Change Record.

Interim Change Record

The interim change record is provided for the purpose of maintaining a complete record of all interim changes issued against each manual. Each time the manual is changed or revised, the interim change record will be formally up-dated to indicate disposition and/or incorporation of previously issued interim changes. When a regular change or revision is received, the applicable interim change record should be checked to ascertain that all outstanding interim changes have been formally incorporated. Those changes that were not incorporated should be renoted as applicable.

USER COMMENTS

The airframe contractor, NATOPS evaluator/instructors, and several Navy agencies are all actively engaged in up-dating and improving this manual. However, overall optimization of this type publication is directly proportional to user input ("...prepared by and for users..."--remember?). If this going to be your operational "bible", it behooves you to get in your "two-bits worth". Consult your squadron NATOPS Instructor any time you have a comment, question, or recommended improvement.

Commanding Officer
VMCJ-3
Marine Corp. Air Station
El Toro, California 92709
Attn: RF4B NATOPS Evaluator

NATOPS POCKET CHECKLIST

A pocket checklist has been prepared under Contract NOw(A) 65-0044-f to provide, in abbreviated form, essential information for flight crews engaged in the operation of the aircraft. The pocket checklist (NAVWEPS 01-245FDC-1B) is not distributed automatically with the NATOPS Flight Manual and, therefore, should be ordered as a separate publication.

The checklist is printed on cardboard stock and is designed to be fastened to the pilot's knee pad. The cover page contains locator-bars for the side-tabbed individual emergency procedures and performance data. A divider for each of the remaining sections (normal procedures, special procedures, and reference data) is tabbed at the top and is indexed from corresponding locator-bars on the cover page.

WARNINGS, CAUTIONS, AND NOTES

The following definitions apply to the "Warnings", "Cautions", and "Notes" found throughout the manual:

WARNING

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

CAUTION

Operating conditions, practices, etc., which if not strictly observed will result in damage to equipment.

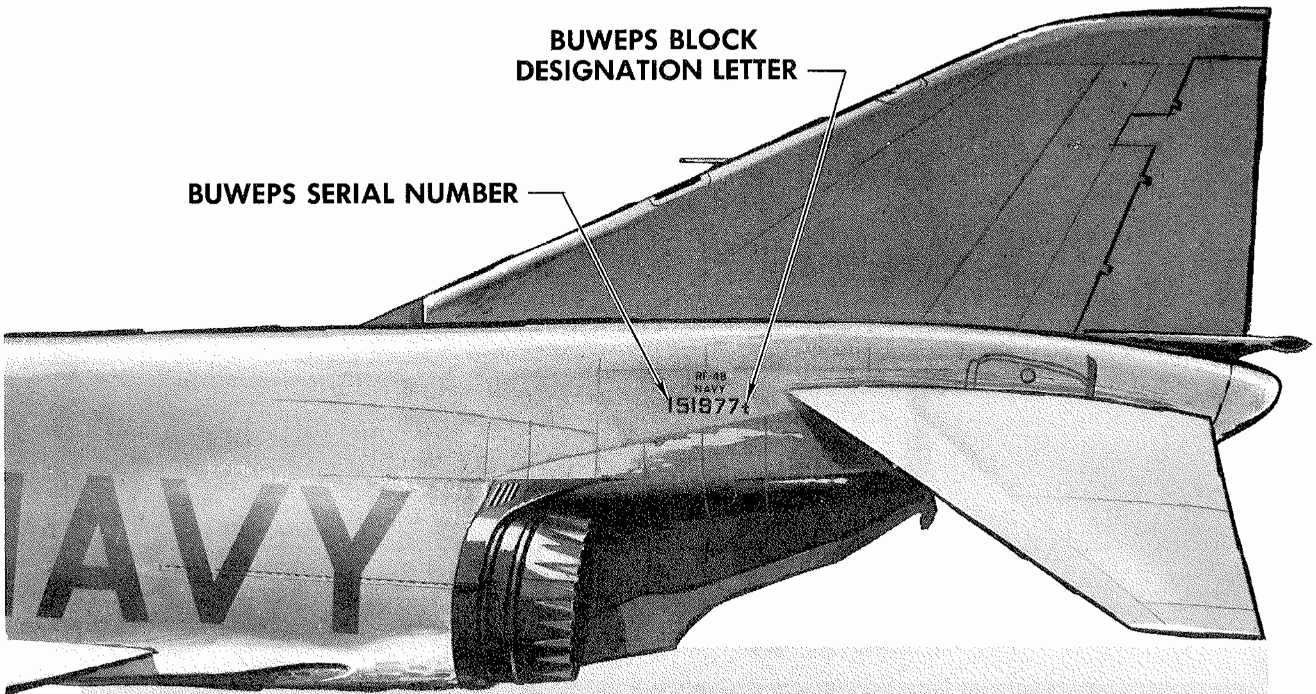
Note

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

NEW TEXT SYMBOL

The lines of text that were revised or added during the current revision will be identified by a symbol in the outboard margin of the effected column. The symbol (illustrated with this paragraph) is in the form of a black vertical line with the word(s) "new" superimposed and is extended to pinpoint only those lines of text effected.

Block Numbers



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151982w thru 151983w

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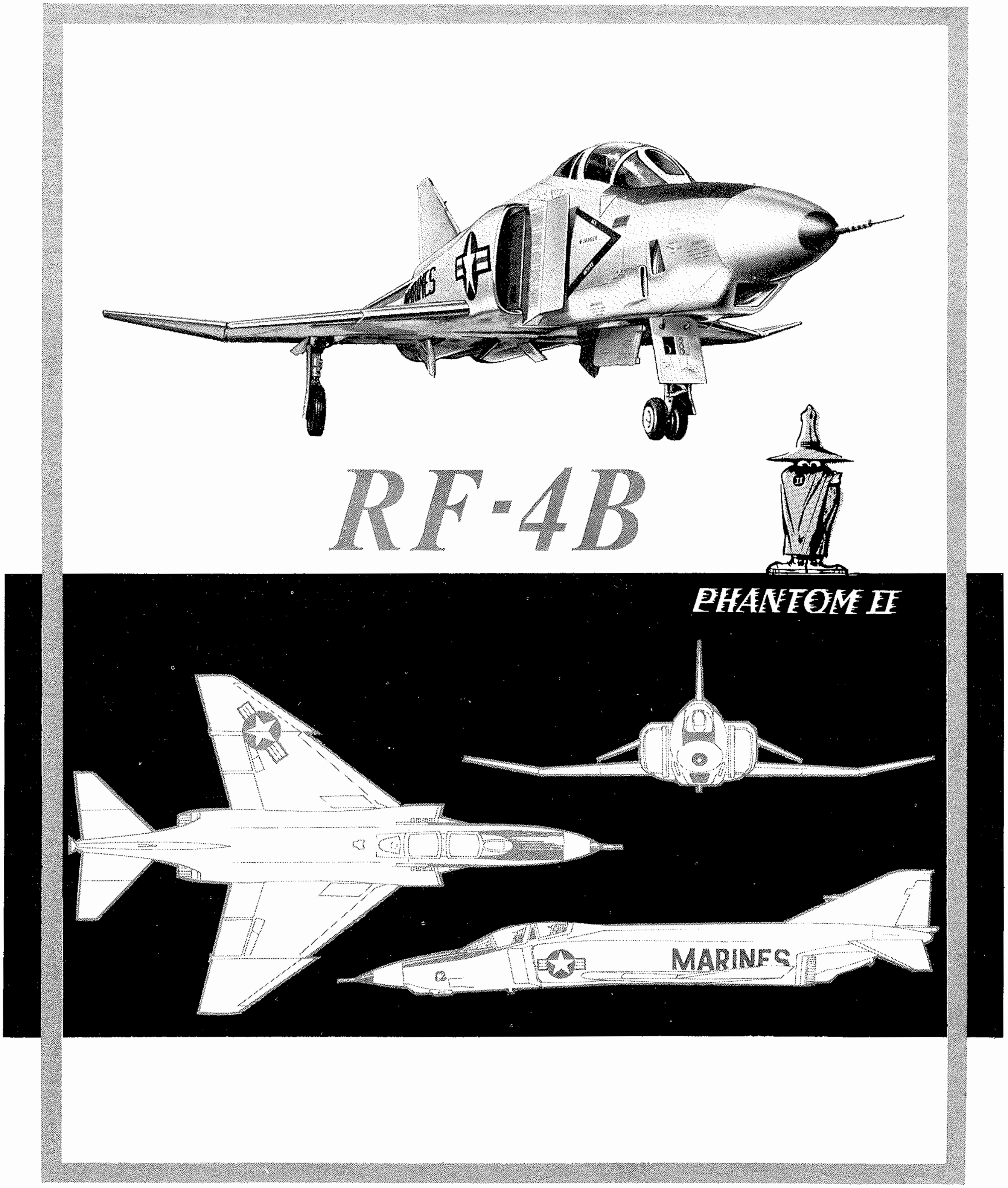

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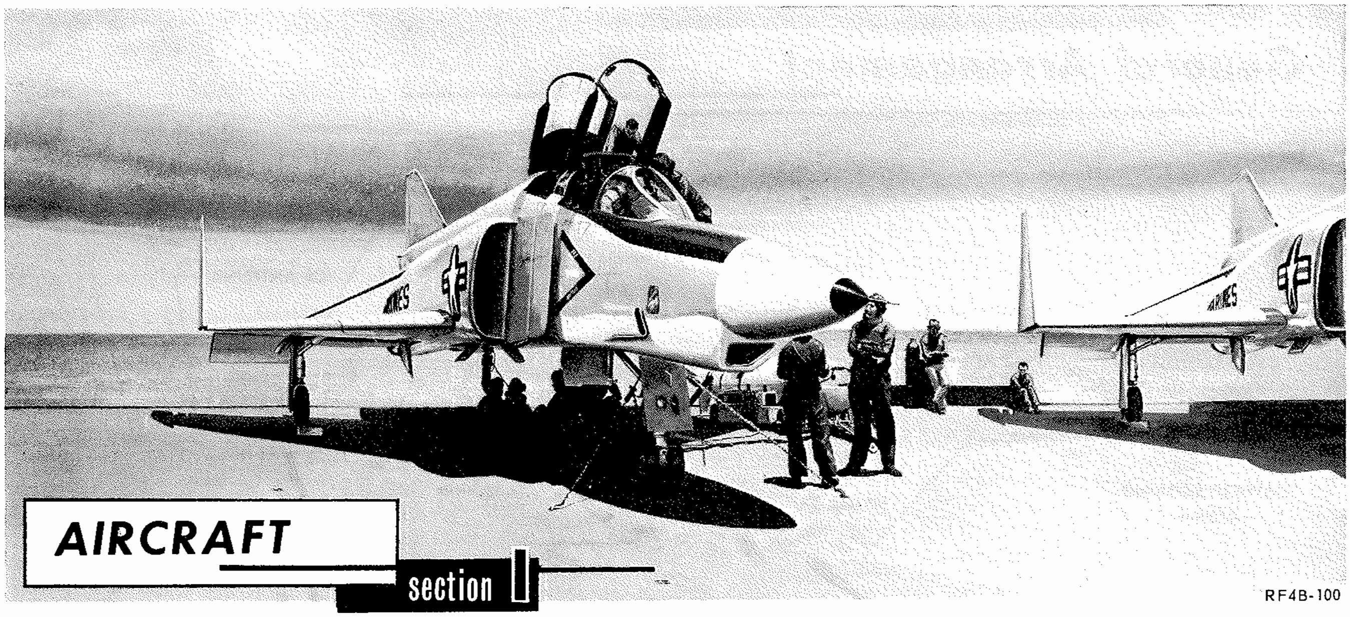

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PART 1 GENERAL DESCRIPTION

AIRCRAFT

DESCRIPTION

The RF-4B is a supersonic, two place, carrier based, twin turbojet tactical reconnaissance airplane built by McDonnell Aircraft. The airplane is designed for all-weather, high-low, day-night selective reconnassiance operations. Propulsion is provided by two J79-GE-8 axial flow turbojet engines. Airplane appearance is characterized by a low mounted swept back wing with obvious anhedral at the wing tips, and a one piece stabilator with obvious cathedral, mounted low on the aft fuselage. The wings are fitted with hydraulically operated leading and trailing edge flaps, ailerons, spoilers, speed brakes and wing fold system. All control surfaces are positioned by irreversible hydraulic power cylinders to provide desired control effectiveness throughout the entire flight envelope. The two pressurized cockpits are enclosed by individual pneumatically operated clamshell canopies. The crew consists of the pilot and reconnaissance systems officer.

General Arrangement

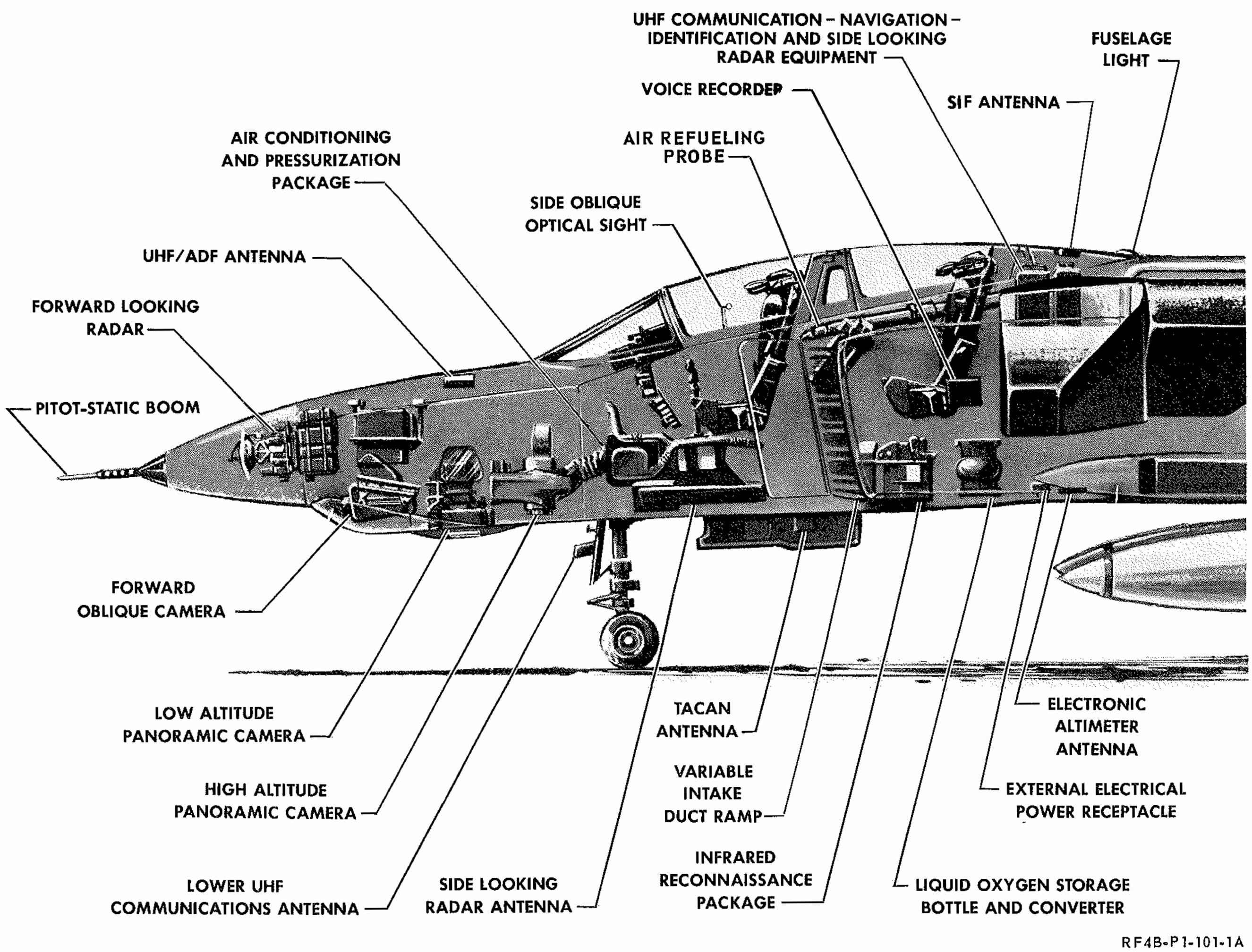


Figure 1-1 (Sheet 1)

AIRCRAFT DIMENSIONS

The approximate dimensions of the aircraft are as follows:

Wing Span (Wings Spread)	38 feet, 5 inches
(Wings Folded)	27 feet, 6-1/2 inches
Length	62 feet, 11 inches
Height (To Top of Fin)	16 feet, 3 inches

AIRPLANE 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 airplane 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 Display

1. Special stores may not be carried or displayed.
2. External tanks may be carried.
3. The radome must be secured.
4. The photographic equipment compartment must be secured.
5. The front canopy must be secured.
6. The rear canopy, with blackout curtain in place, must be secured.
7. The pneumatic system must be bled to prevent the canopies from being opened.
8. No smoking rules must be enforced.

RON at Civilian Fields

1. Make necessary security guard arrangements.
2. Secure radome.
3. Secure photographic equipment compartment.
4. Secure front canopy.

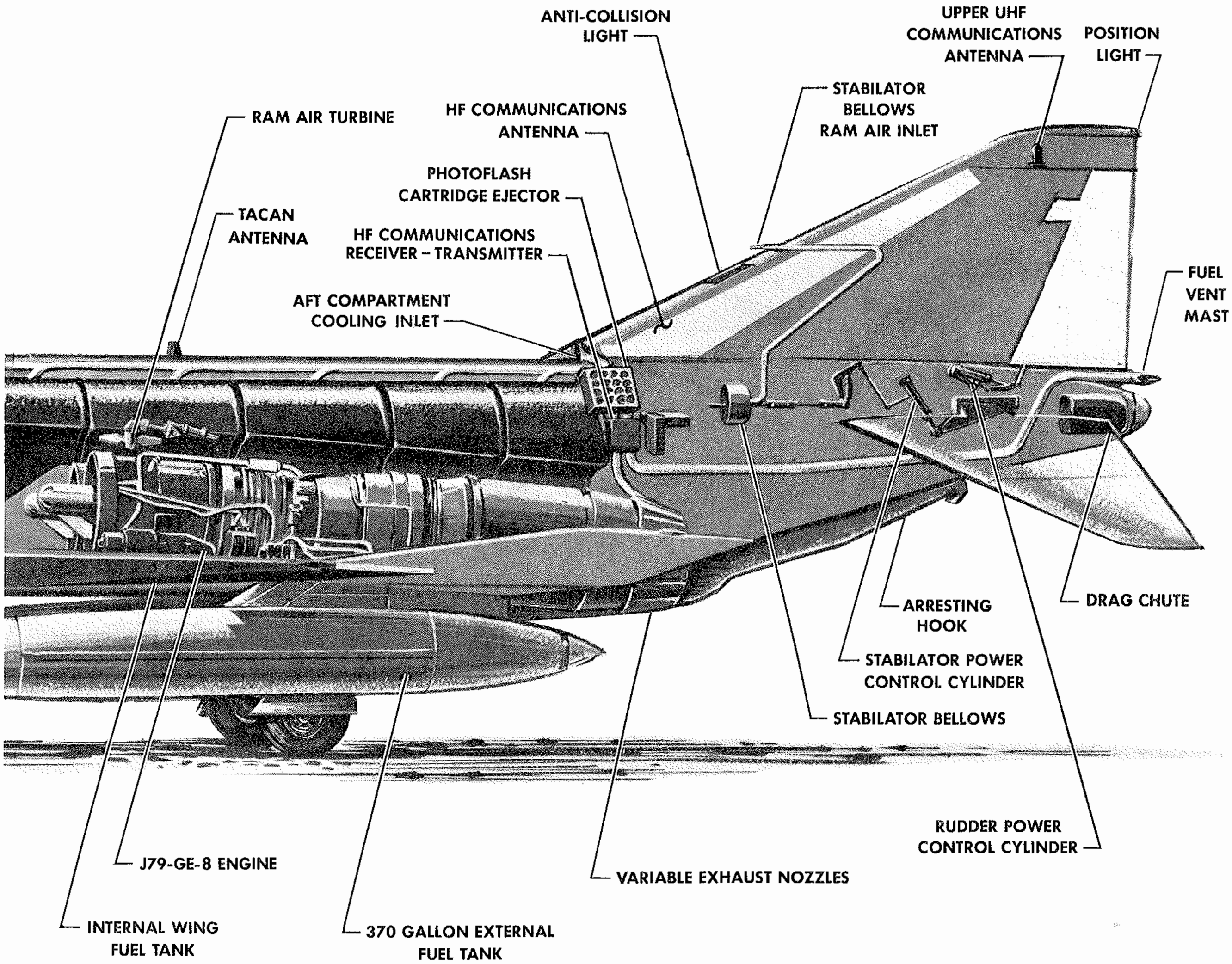


Figure 1-1 (Sheet 2)

5. Secure aft canopy with blackout curtain in place.
6. Bleed off pneumatic systems to prevent opening of the canopies.

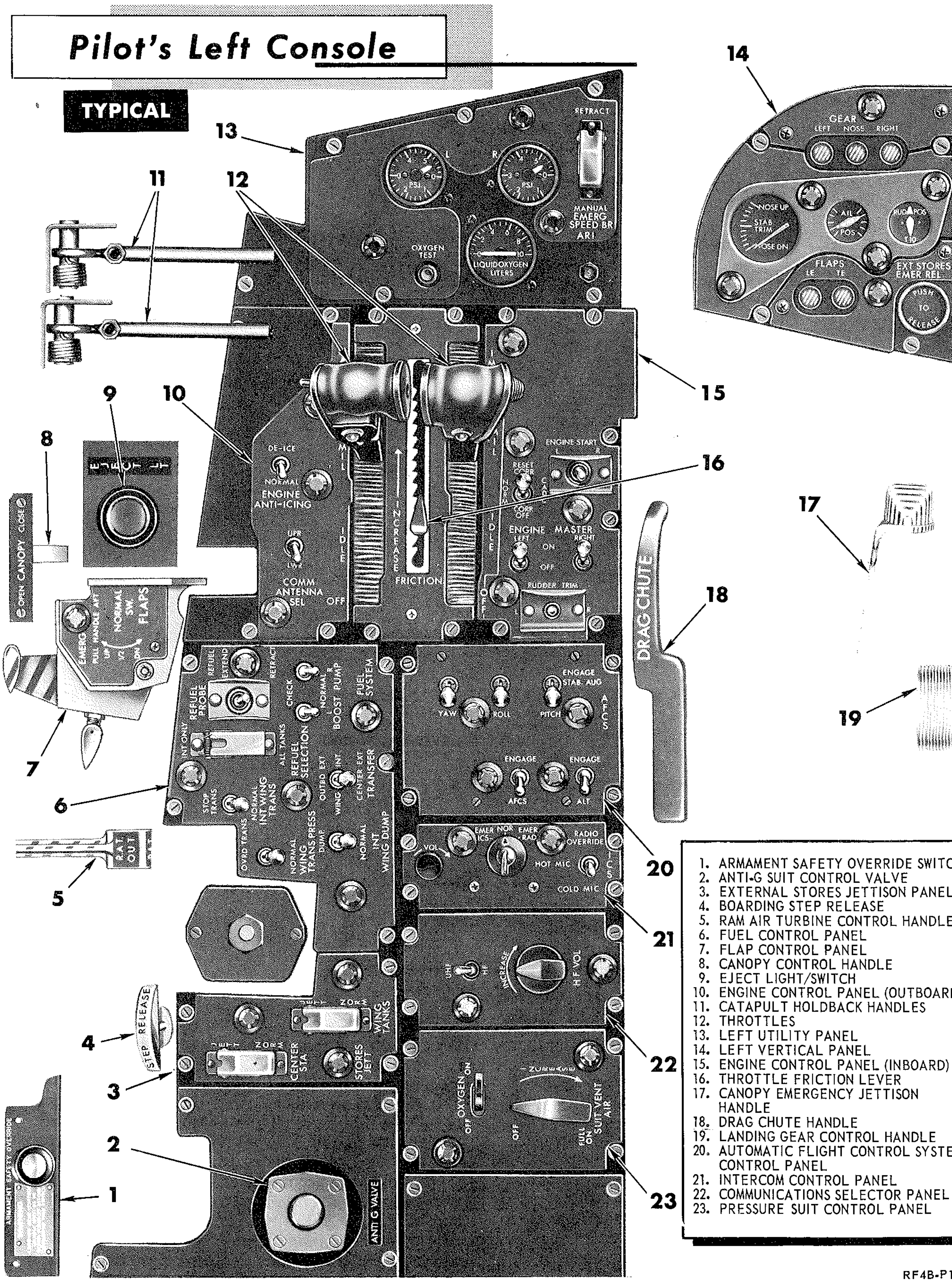
COCKPITS

INTERIOR ARRANGEMENT

Although the cockpits are enclosed with individual canopies, they are not separated internally and, therefore, the air-conditioning and pressurization environment is commonly shared by both crewmembers. Each cockpit incorporates an ejection seat that is adjustable in the vertical plane for comfort. The forward cockpit instrument panel contains the flight and engine instruments, radar scope and optical viewfinder. Engine controls, autopilot and fuel management panels are located on the left console. Communication, navigation, heating and lighting controls are on the right console. Left and right vertical panels, forward of the consoles, contain the flight control trim position indicators and the telelight panels. The aft cockpit instrument panel contains the necessary instruments for navigation, plus miscellaneous switches and indicator lights. Radar equipment is located below the instrument panel. The right side of the cockpit contains the reconnaissance sensor and cockpit lighting controls. The left console contains the communication, navigation, oxygen, and pressure suit controls. The main circuit breaker panel is located in the rear cockpit along the left side, under the canopy sill. There are no flight controls in the rear cockpit. Refer to figures 1-2 thru 1-8 for instrument panels, consoles, and circuit breakers.

Pilot's Left Console

TYPICAL



1. ARMAMENT SAFETY OVERRIDE SWITCH
2. ANTI-G SUIT CONTROL VALVE
3. EXTERNAL STORES JETTISON PANEL
4. BOARDING STEP RELEASE
5. RAM AIR TURBINE CONTROL HANDLE
6. FUEL CONTROL PANEL
7. FLAP CONTROL PANEL
8. CANOPY CONTROL HANDLE
9. EJECT LIGHT/SWITCH
10. ENGINE CONTROL PANEL (OUTBOARD)
11. CATAPULT HOLDBACK HANDLES
12. THROTTLES
13. LEFT UTILITY PANEL
14. LEFT VERTICAL PANEL
15. ENGINE CONTROL PANEL (INBOARD)
16. THROTTLE FRICTION LEVER
17. CANOPY EMERGENCY JETTISON HANDLE
18. DRAG CHUTE HANDLE
19. LANDING GEAR CONTROL HANDLE
20. AUTOMATIC FLIGHT CONTROL SYSTEM CONTROL PANEL
21. INTERCOM CONTROL PANEL
22. COMMUNICATIONS SELECTOR PANEL
23. PRESSURE SUIT CONTROL PANEL

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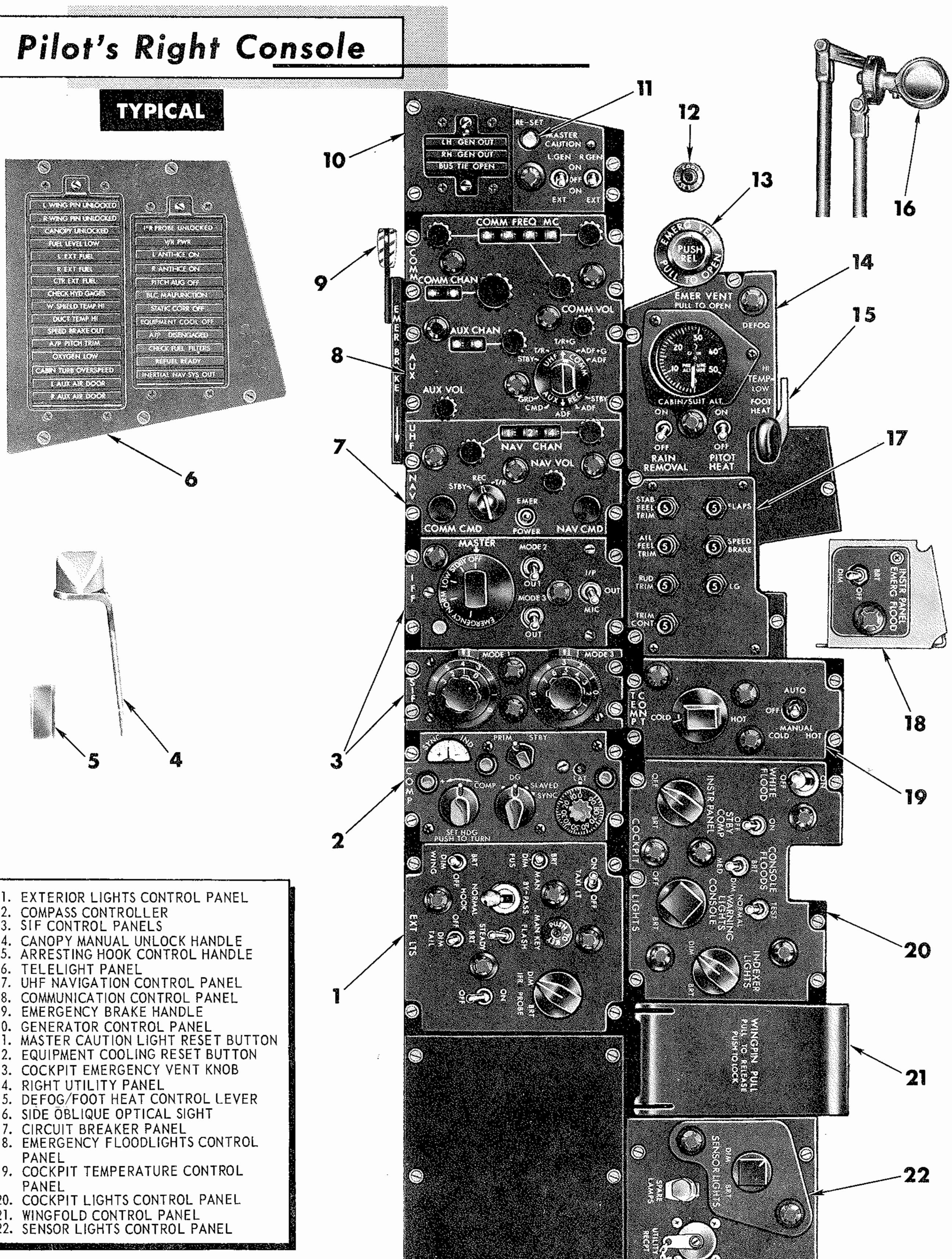
Figure 1-2

Pilot's Right Console

TYPICAL



1. EXTERIOR LIGHTS CONTROL PANEL
2. COMPASS CONTROLLER
3. SIF CONTROL PANELS
4. CANOPY MANUAL UNLOCK HANDLE
5. ARRESTING HOOK CONTROL HANDLE
6. TELELIGHT PANEL
7. UHF NAVIGATION CONTROL PANEL
8. COMMUNICATION CONTROL PANEL
9. EMERGENCY BRAKE HANDLE
10. GENERATOR CONTROL PANEL
11. MASTER CAUTION LIGHT RESET BUTTON
12. EQUIPMENT COOLING RESET BUTTON
13. COCKPIT EMERGENCY VENT KNOB
14. RIGHT UTILITY PANEL
15. DEFOG/FOOT HEAT CONTROL LEVER
16. SIDE OBLIQUE OPTICAL SIGHT
17. CIRCUIT BREAKER PANEL
18. EMERGENCY FLOODLIGHTS CONTROL PANEL
19. COCKPIT TEMPERATURE CONTROL PANEL
20. COCKPIT LIGHTS CONTROL PANEL
21. WINGFOLD CONTROL PANEL
22. SENSOR LIGHTS CONTROL PANEL

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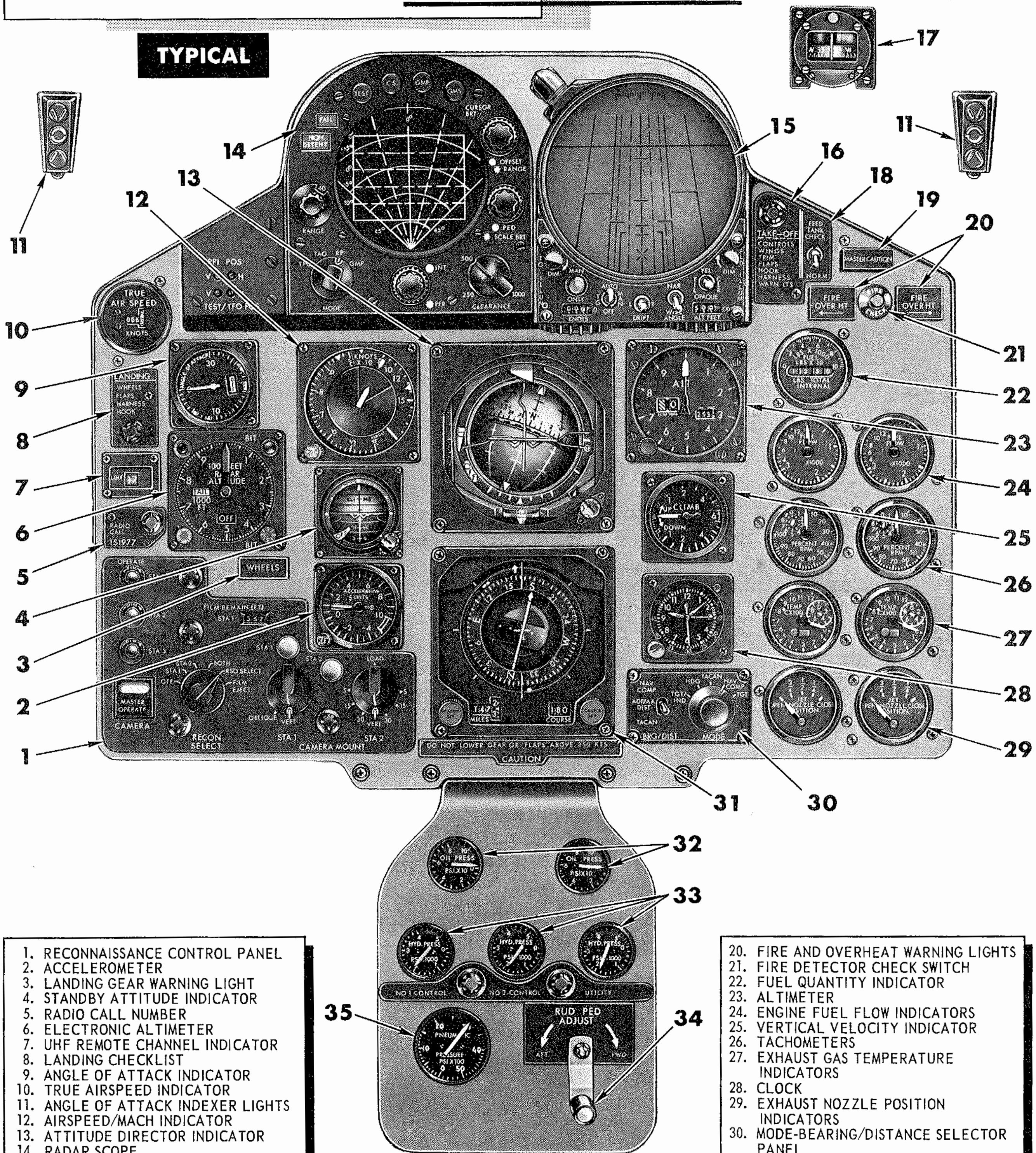
Figure 1-3

Pilot's Instrument Panel

TYPICAL



1. RECONNAISSANCE CONTROL PANEL
2. ACCELEROMETER
3. LANDING GEAR WARNING LIGHT
4. STANDBY ATTITUDE INDICATOR
5. RADIO CALL NUMBER
6. ELECTRONIC ALTIMETER
7. UHF REMOTE CHANNEL INDICATOR
8. LANDING CHECKLIST
9. ANGLE OF ATTACK INDICATOR
10. TRUE AIRSPEED INDICATOR
11. ANGLE OF ATTACK INDEXER LIGHTS
12. AIRSPEED/MACH INDICATOR
13. ATTITUDE DIRECTOR INDICATOR
14. RADAR SCOPE
15. OPTICAL VIEWFINDER
16. TAKEOFF CHECKLIST
17. MAGNETIC COMPASS
18. FEED TANK CHECK SWITCH
19. MASTER CAUTION LIGHT
20. FIRE AND OVERHEAT WARNING LIGHTS
21. FIRE DETECTOR CHECK SWITCH
22. FUEL QUANTITY INDICATOR
23. ALTIMETER
24. ENGINE FUEL FLOW INDICATORS
25. VERTICAL VELOCITY INDICATOR
26. TACHOMETERS
27. EXHAUST GAS TEMPERATURE INDICATORS
28. CLOCK
29. EXHAUST NOZZLE POSITION INDICATORS
30. MODE-BEARING/DISTANCE SELECTOR PANEL
31. HORIZONTAL SITUATION INDICATOR
32. ENGINE OIL PRESSURE INDICATORS
33. HYDRAULIC PRESSURE INDICATORS
34. RUDDER PEDAL ADJUSTING CRANK
35. PNEUMATIC PRESSURE INDICATOR

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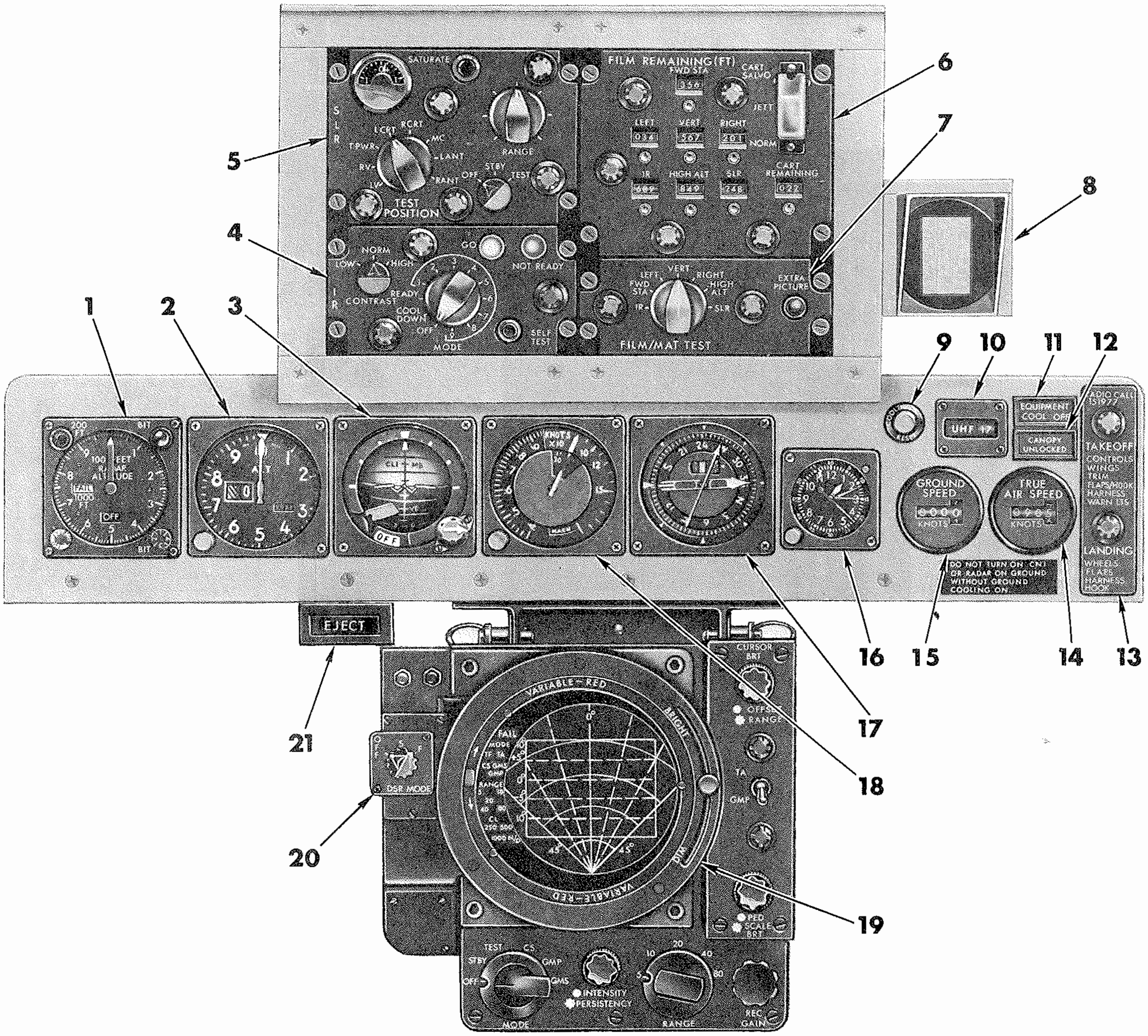
Figure 1-4

RSO'S Instrument Panel

TYPICAL



1. ELECTRONIC ALTIMETER
2. ALTIMETER
3. ATTITUDE INDICATOR
4. IR SENSOR CONTROL PANEL
5. SLR SENSOR CONTROL PANEL
6. FILM/CART REMAINING PANEL
7. FILM/MAT TEST PANEL
8. DIGITAL DISPLAY INDICATOR
9. EQUIPMENT COOLING RESET BUTTON
10. UHF RADIO REMOTE CHANNEL INDICATOR
11. EQUIPMENT COOLING OFF INDICATOR LIGHT
12. CANOPY UNLOCKED WARNING LIGHT
13. TAKEOFF/LANDING CHECKLIST
14. TRUE AIRSPEED INDICATOR
15. GROUND SPEED INDICATOR
16. CLOCK
17. BEARING-DISTANCE-HEADING INDICATOR
18. AIRSPEED/MACH INDICATOR
19. RADAR SCOPE
20. DATA RECORDING CAMERA SET
21. EJECT LIGHT

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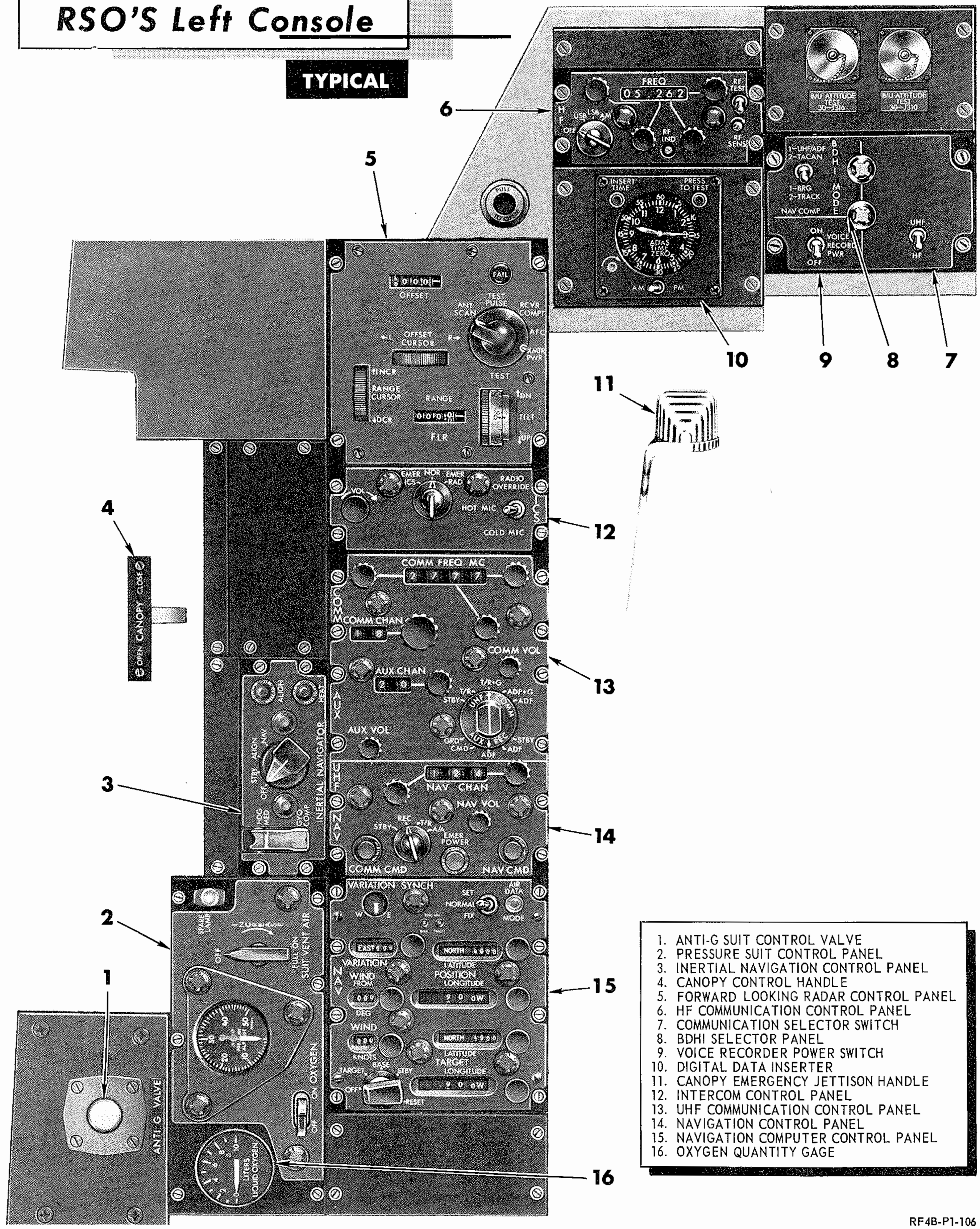
Figure 1-5

RSO'S Left Console

TYPICAL



1. ANTI-G SUIT CONTROL VALVE
2. PRESSURE SUIT CONTROL PANEL
3. INERTIAL NAVIGATION CONTROL PANEL
4. CANOPY CONTROL HANDLE
5. FORWARD LOOKING RADAR CONTROL PANEL
6. HF COMMUNICATION CONTROL PANEL
7. COMMUNICATION SELECTOR SWITCH
8. BDHI SELECTOR PANEL
9. VOICE RECORDER POWER SWITCH
10. DIGITAL DATA INSERTER
11. CANOPY EMERGENCY JETTISON HANDLE
12. INTERCOM CONTROL PANEL
13. UHF COMMUNICATION CONTROL PANEL
14. NAVIGATION CONTROL PANEL
15. NAVIGATION COMPUTER CONTROL PANEL
16. OXYGEN QUANTITY GAGE

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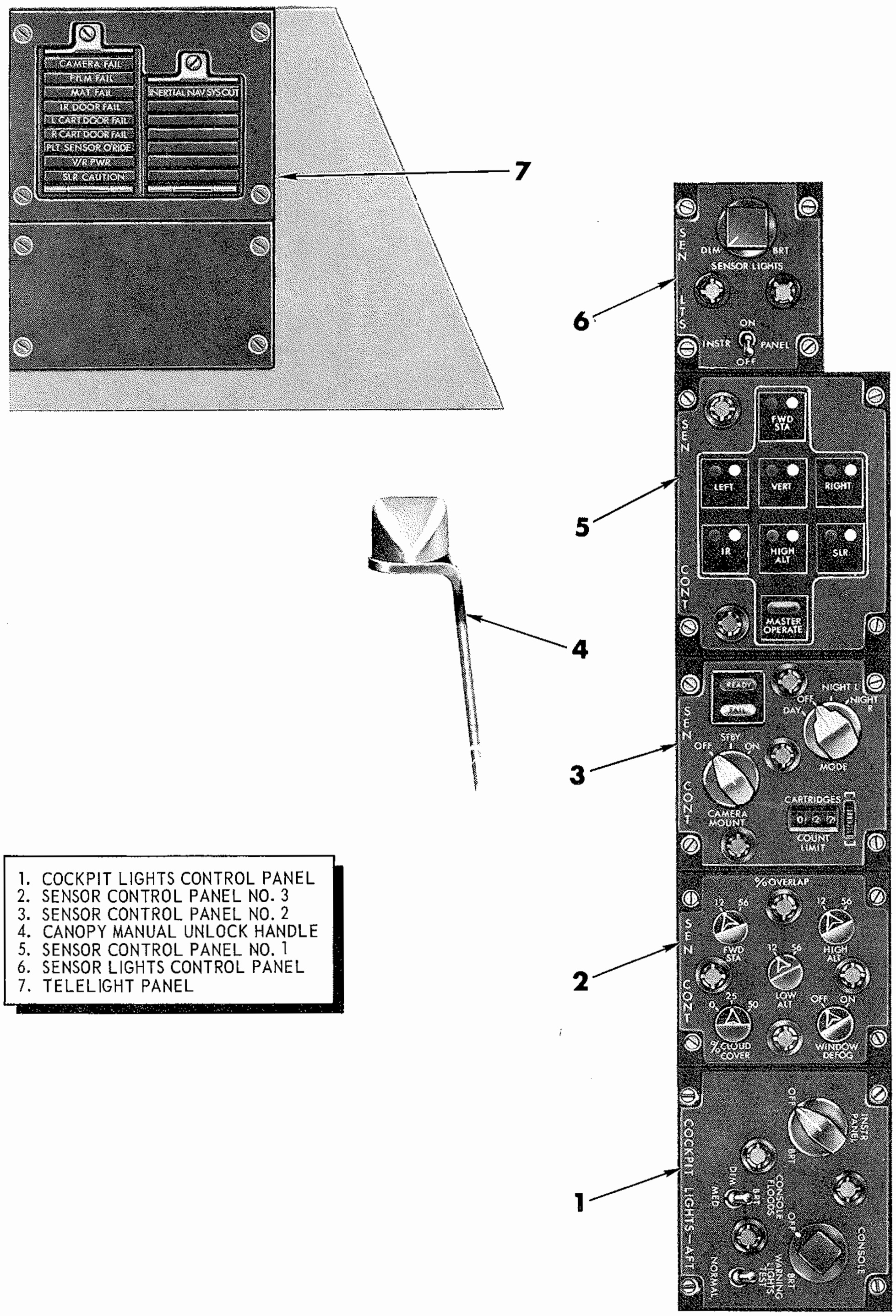
Figure 1-6

RSO'S Right Console

TYPICAL



1. COCKPIT LIGHTS CONTROL PANEL
2. SENSOR CONTROL PANEL NO. 3
3. SENSOR CONTROL PANEL NO. 2
4. CANOPY MANUAL UNLOCK HANDLE
5. SENSOR CONTROL PANEL NO. 1
6. SENSOR LIGHTS CONTROL PANEL
7. TELELIGHT PANEL

Figure 1-7

Circuit Breakers

TYPICAL

REAR COCKPIT
CIRCUIT BREAKER
PANEL NO.1

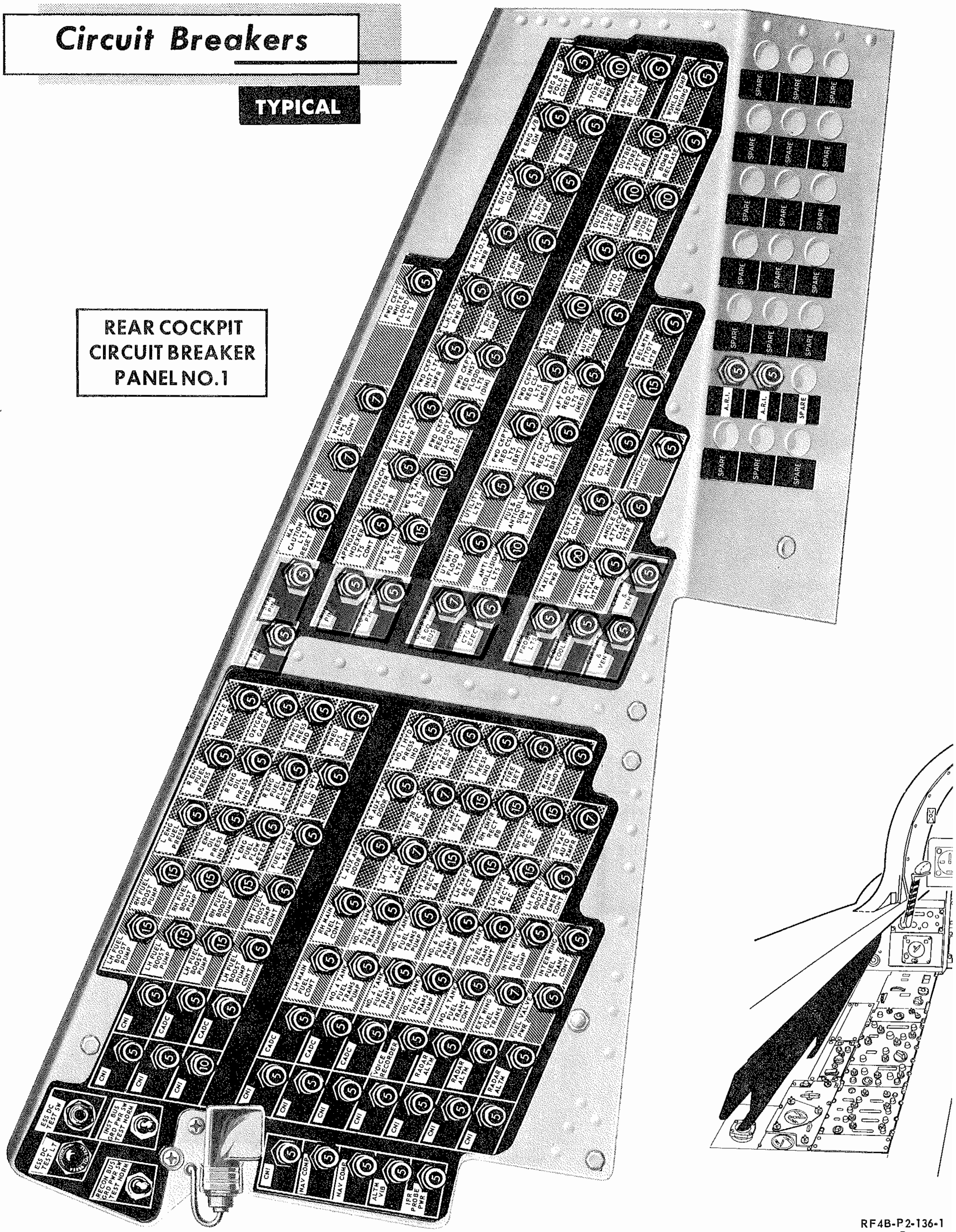


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Figure 1-8 (Sheet 1)

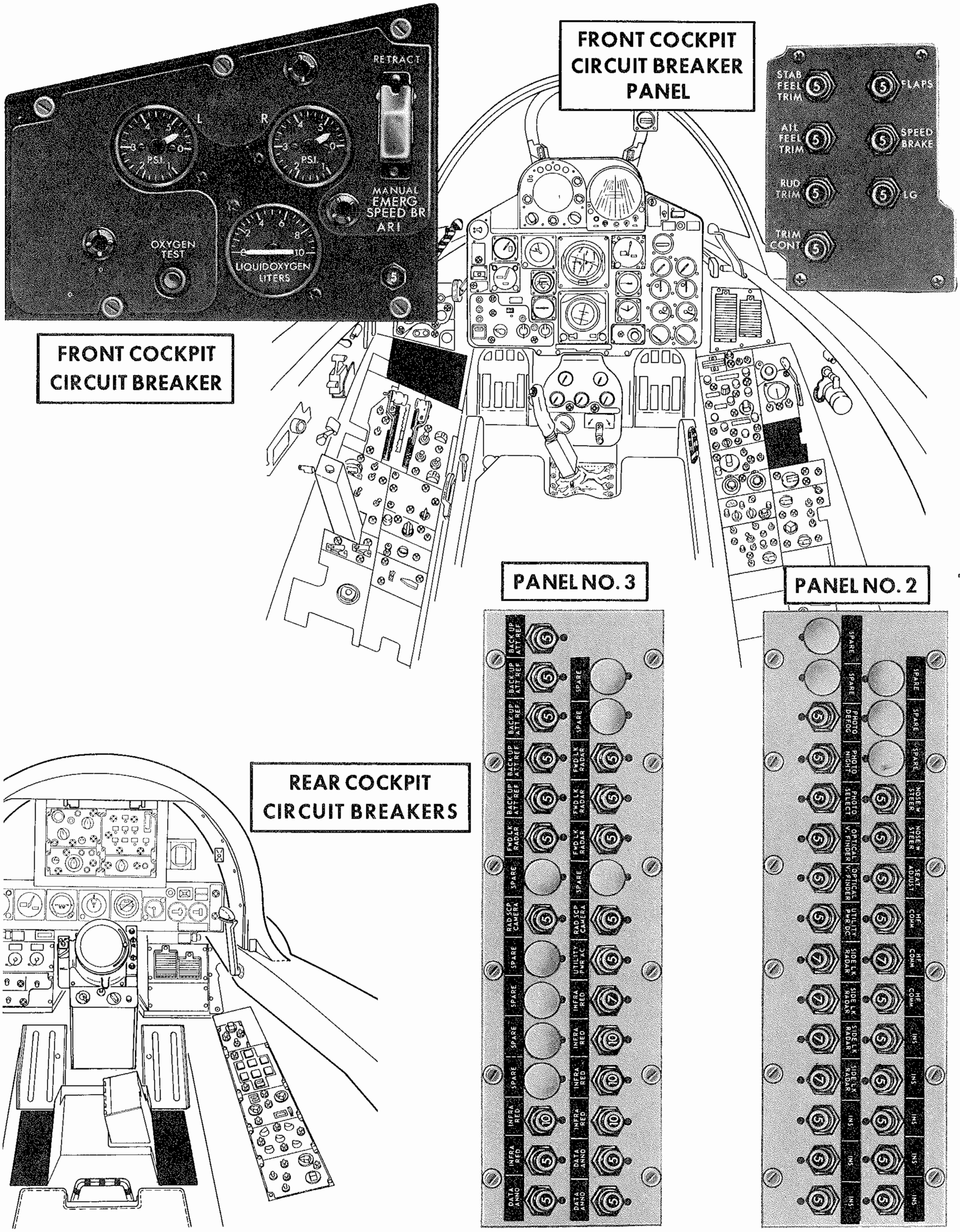

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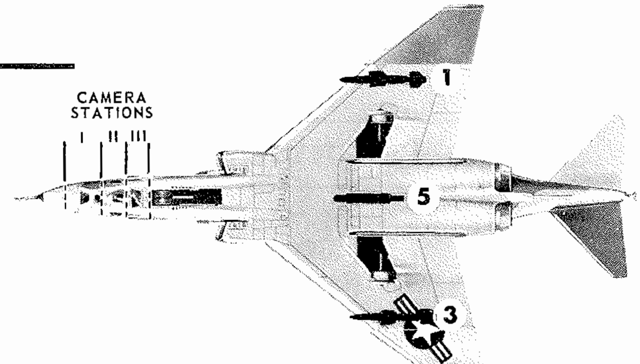
Figure 1-8 (Sheet 2)

STATION LOADING

DESCRIPTION

The Station Loading chart (figure 1-9) lists the individual weight and station location of the authorized external store racks and pylons. In addition, the chart lists the individual weight and location of the various cameras, camera mounts, photoflash cartridges and ejectors. The chart also lists the average basic weight of the airplane and corresponding center-of-gravity, and the average takeoff gross weight (with basic camera configuration) and corresponding center-of-gravity.

Station Loading



WARNING

For precise store loading information refer to charts C and E of the Weight and Balance Data Handbook (AN-01-1B-40) for your airplane.

COMPONENTS		INDIVIDUAL WEIGHT	CAMERA I	CAMERA II	CAMERA III	EXTERNAL STORES 1	2	3	4	5	6	7	8	9
EXT WING TANK PYLON		92 Lbs.				X								X
EXT WING TANK & UNUSABLE FUEL (4 GAL.)		248 Lbs.				X								X
EXT WING TANK USABLE FUEL (370 GAL.)		2516 Lbs.				X								X
AERO 27A EJECTOR RACK		51 Lbs.								X				
EXT ℄ TANK & UNUSABLE FUEL (2 GAL.)		249 Lbs.								X				
EXT ℄ TANK USABLE FUEL (600 GAL.)		4080 Lbs.								X				
RCPP-105 STARTER POD		2015 Lbs.								X				
KS-72 CAMERA, 3" or 6" LENS	LOADED UNLOADED	73 Lbs. 64 Lbs	X	X	X									
KS-72 CAMERA, 12" or 18" LENS	LOADED UNLOADED	84 Lbs 75 Lbs		X	X									
KS-72 3" or 6" INFLIGHT ROTATABLE MOUNT		23 Lbs.	X											
KS-72 3" or 6" FIXED MOUNT		13 Lbs.	X											
KS-72 18" INFLIGHT ROTATABLE MOUNT		63 Lbs.		X										
KS-72 3" or 6" SIDE OBLIQUE MOUNT		29 Lbs.		X										
KS-72 3" or 6" VERTICAL MOUNT		6 Lbs.		X										
KS-72 12" or 18" SIDE OBLIQUE MOUNT		31 Lbs.		X										
KS-72 6" or 18" SPLIT VERTICAL MOUNT		20 Lbs.			X									
KS-72 18" ADAPTER AND STABILIZED MOUNT (LS-58A)		146 Lbs.			X									
KA-56 CAMERA, EJECTABLE CASSETTES	LOADED UNLOADED	97 Lbs 89 Lbs		X										
KA-56 CAMERA, NON-EJECTABLE CASSETTES	LOADED UNLOADED	91 Lbs 73 Lbs		X										
KA-56 BASIC MOUNT		2 Lbs.		X										
KA-55 CAMERA	LOADED UNLOADED	110 Lbs 93 Lbs			X									
KA-55 STABILIZED MOUNT (LS-58A)		137 Lbs.			X									
M-112 PHOTOFLASH CARTRIDGES (104)	LOADED (EACH) SPENT (EACH)	1 Lbs .75 Lbs												
9A PHOTOFLASH EJECTORS (4)		106 Lbs												
M-123 PHOTOFLASH CARTRIDGES (40)	LOADED (EACH) SPENT (EACH)	4.3 Lbs 1.1 Lbs.												
9B PHOTOFLASH EJECTORS (4)		102 Lbs.												

AVERAGE BASIC WEIGHT (Empty airplane weight plus unusable fuel, oil parachutes, survival kit, oxygen equipment, and reconnaissance equipment (less cameras, mounts and photoflash equipment.) .... 28,981 Lbs-29 %MAC

AVERAGE TAKEOFF GROSS WEIGHT, WITH BASIC CAMERA CONFIGURATION (Average basic weight plus full internal fuel, oil, crew, and basic camera configuration) 43,103 Lbs-33.7%MAC

RF4B-P1-109

Figure 1-9

PART 2 SYSTEMS

AIR CONDITIONING AND PRESSURIZATION SYSTEM

DESCRIPTION

Air conditioning in the airplane is divided into two major systems, one for the cockpit and one for the electronic equipment. Both cockpits and the pressure suits for both crewmen are pressurized, and supplied with conditioned air from the cockpit air conditioning unit. The same air that pressurizes and heats the cockpit also is used to keep the windshield free of fog, frost and rain. The equipment air conditioning unit provides cooling air for the main radar package and communication-navigation-identification equipment. Both air conditioning units utilize high temperature, high pressure, engine compressor bleed air from either or both engines. The cockpit/pressure suit air conditioning system (figure 1-10) consists of two air-to-air heat exchangers, an expansion turbine, shutoff, pressure regulating and mixing valves, and temperature controls necessary to select cockpit temperatures, pressure suit temperatures, defogging, rain removal and ram air operations. Separate temperature ranges and control systems for the pressure suit and cockpit are provided. High temperature/high pressure engine compressor bleed air passes through the primary and secondary heat exchanger and is expanded through the cooling turbine. After being mixed with hot compressor bleed air (as required by pilot's temperature selection) it enters the cockpits through several manifolds, one near the RSO's feet, one near the pilot's feet, one along the lower surface of each windshield side panel and one at the base of the flat optical panel of the windshield. Two "eyeball" type air nozzles are located just below the canopy sill on the right and left side of the RSO's cockpit. Air is also routed into the aft cockpit via an open tube duct located behind the circuit breaker panels.

COCKPIT/PRESSURE SUIT AIR CONDITIONING

The cockpit air conditioning system operation can best be explained and understood by referring to the cockpit/pressure suit temperature schedule (figure 1-11). The low temperature range, which refers to the curve labeled Foot Heat, produces temperatures from -20°F to 100°F. These temperatures refer to inlet air, and not cockpit temperature - so cockpit temperature will be determined by a combination of inlet air and environmental conditions. The low temperature curve is the governing schedule for all air entering the cockpit while in automatic temperature control with the defog-foot heat lever in the LOW range. A little air is always entering through the defog port and this air increases (while foot heat air decreases) as the defog-foot heat lever is moved forward. But until a switch is made at the HI/LOW position, both defog and foot heat air enter on the low temperature schedule. Thus, full range of the temperature control knob (from 8 o'clock to 4 o'clock positions) will only produce -20°F to 100°F air - unless the defog-foot heat lever is moved into the HI range. When the HI/LOW switch is made, the temperature schedule of all entering air, switches to the high temperature curve. Thus, if the temperature control knob was positioned toward HOT (about 3:00 o'clock), 87°F would be the temperature of incoming air in the low temperature range, but when the switch to HI is made, the temperature would change to 137°F. As the defog-foot heat lever is moved forward through full travel, the foot heat butterfly valves - for both front and rear cockpits - are closing as the defog valve opens. Thus the defog air volume increases on a rather steep slope, and when the lever is closed to full defog position (full forward), the temperature of the air entering the cockpit is quite warm.

Manual Override-Cockpit Temperature Mixing Valve

If the automatic temperature control system malfunctions, the manual position of the temp control auto-manual switch can be used to select a full range of temperatures up to 230°F. The HI/LOW switch on the defog-foot heat lever is bypassed. Thus the entire temperature range for both foot heat and defog air is scheduled directly by the mixing valve position, which in turn is moved only when the temperature control switch is held to either HOT or COLD. The switch is spring-loaded to OFF and in the OFF position the mixing valve is held stationary.

Cockpit Ambient Fog

It is possible, through selection of cold temperature settings, particularly on humid days, for the air conditioning system to deliver air at temperatures well below the dew-point, with resultant cockpit fogging. This fog can be rapidly dissipated by selecting a slightly warmer temperature. When operating in high humidity conditions, it is recommended that warmer than normal temperatures be selected prior to starting the takeoff run, to preclude the possibility of cockpit fogging as thrust is increased.

Pressure Suit Operation

When the pressure suit mixing valve becomes active (vent air turned on), both pressure suit and cockpit air schedules are followed while in automatic temperature control; that is, with the defog-foot heat lever in the LOW range, vent air will be provided to the pressure suit at its schedule while simultaneously foot heat and defog air will enter on the low temperature schedule. Moving the defog lever into the HI range again switches foot heat and defog air to the high temperature schedule, but the pressure suit schedule remains unchanged.

Cockpit Air Conditioning & Pressurization System

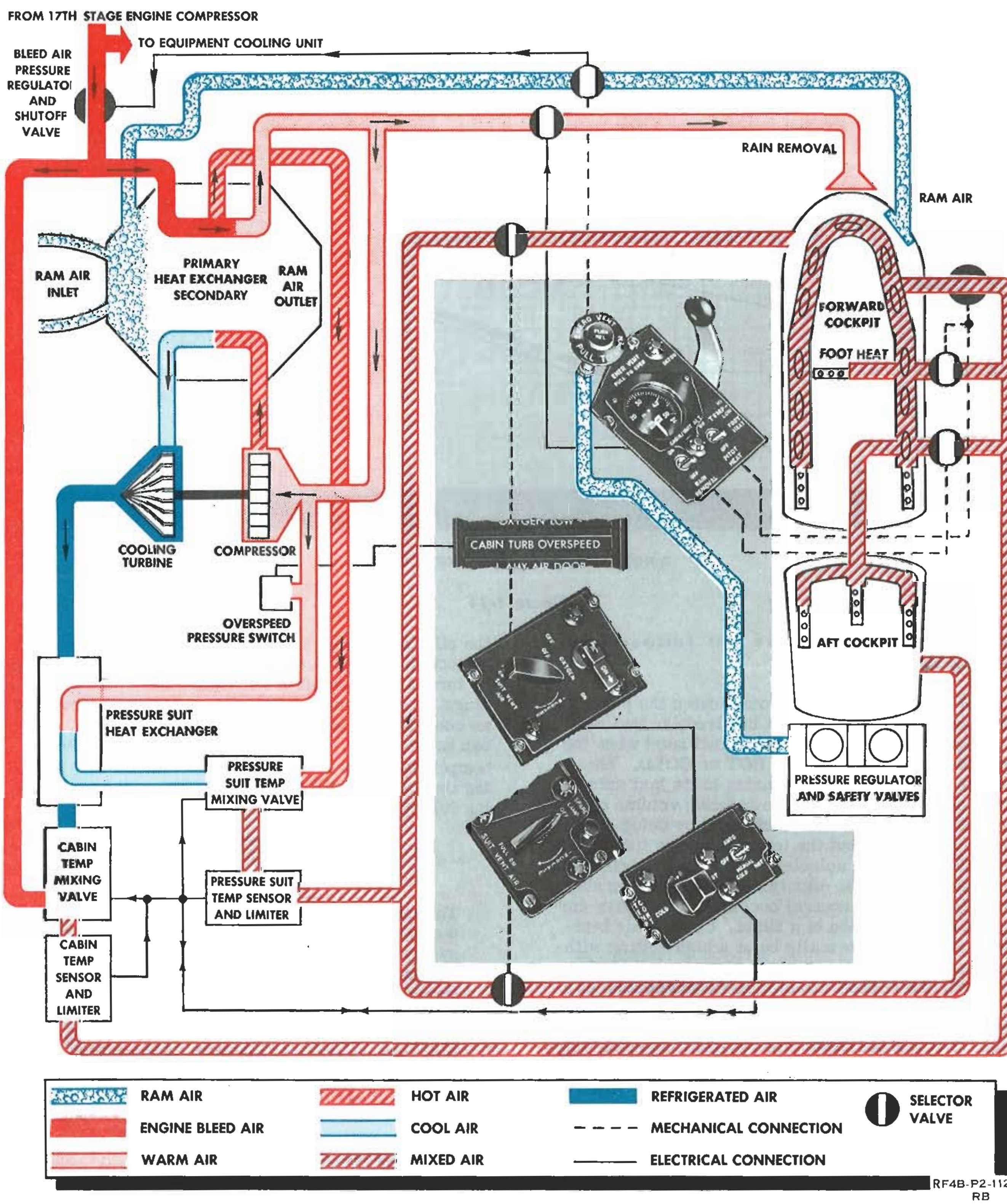


Figure 1-10

Cockpit/Pressure Suit Temperature Schedule

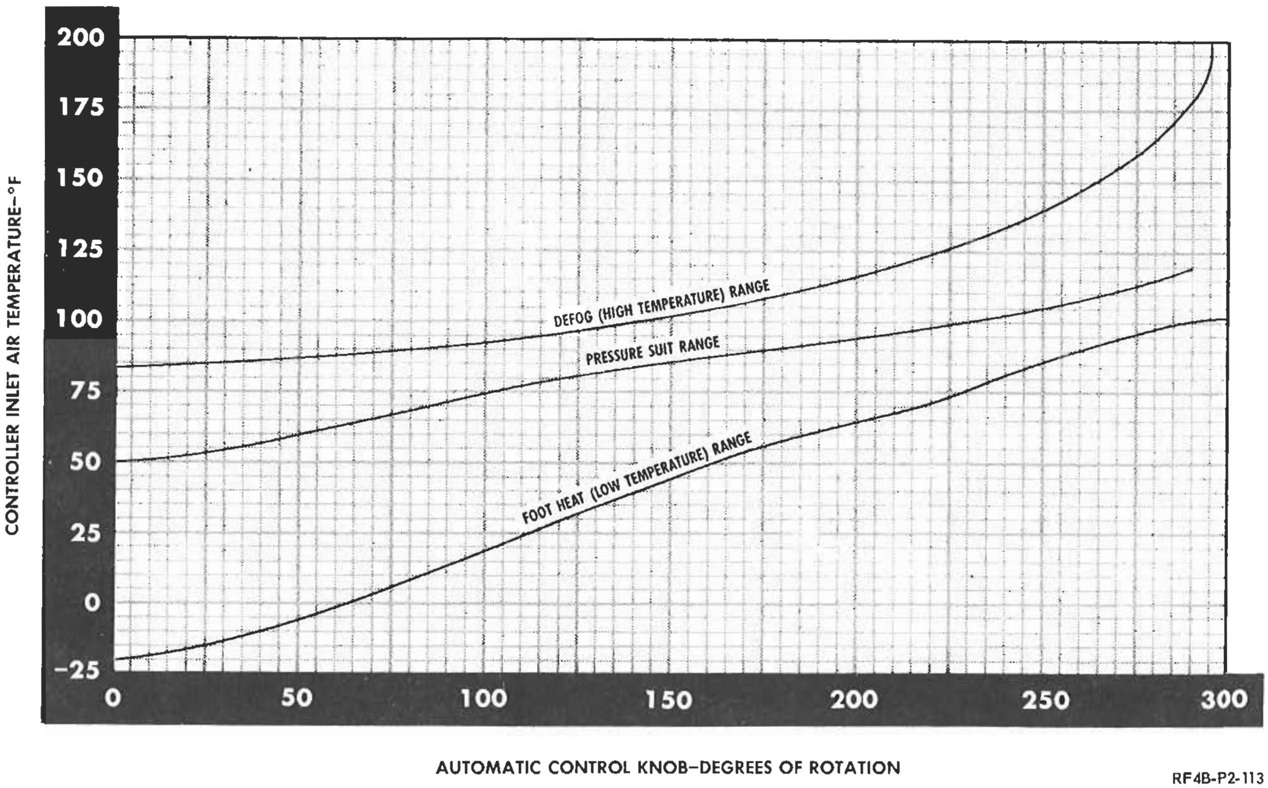


Figure 1-11

Manual Override-Pressure Suit Temperature Mixing Valve

Manual override operation complicates the picture a bit when the pressure suit is involved, in that only the pressure suit mixing valve is actuated when the override switch is moved to HOT or COLD. The cockpit air mixing valve remains in its last automatic selected position. The relative volume of defog and foot heat air can be changed by defog-foot heat lever action, but the temperature is fixed when manual override is selected. This characteristic can cause an undesirable situation in the event the automatic temperature control becomes inoperative during the cruise portion of a flight. Cockpit air temperature will not normally be at a high setting with the pressure suit on, so when manual override is selected, the cockpit air mixing valve remains at a fixed, moderate temperature position. Therefore, when higher temperature defog air is desired for letdown, it is not available since manual override only controls suit vent air. However, when the pilot's suit vent air lever is turned off, the suit mixing valve becomes stationary at the cold position and the cockpit mixing valve again is operative. Since suit vent air would not be absolutely necessary during letdown into fog producing altitudes, this method to control cockpit air temperatures is plausible. However, it must be remembered when operating in manual override, the pilot's suit vent air must be off if manual control of cockpit temperatures is desired. Suit vent air can be turned on again after increasing defog air temperature. It also must be remembered that the RSO has no control over pressure suit air temperature. He can control flow, but must accept the pilot selected temperature. So if the pilot turns vent air off, driving the mixing valve to cold, the RSO will be receiving full cold air, unless he elects to turn it off.

CAUTION

The manual override should be used only in the event of an automatic temperature control system malfunction. To increase the temperature in this mode, the manual control switch should be held toward the HOT position for no more than one-half second at a time between pauses of at least three seconds until the desired temperature is reached. Actuating the switch for more extended periods does not allow the temperature limiter adequate time to function, and may result in an overheat condition. Detection of smoke in the cockpit after use of manual control is evidence of improper use of the switch and requires the selection of a colder valve position to avoid overheating of the cockpit distribution ducting.

Windshield Defogging

Fogging of the windshield is prevented by heating the inside surface with incoming cabin air that is diverted into the defogging manifolds located along the lower surfaces of the side and center panels. The defog lever (figure 1-3), located on the pilot's right console, is provided to select windshield defogging. The lever proportions the cabin airflow between the foot heaters and windshield defogging tubes such that in the full aft (FOOT HEAT) position approximately 90% of the total cockpit airflow is delivered to the pilot's and RSO's air distribution manifolds and 10% through the windshield defog manifold. At the full forward (DEFOG) position approximately 20% of the total airflow is delivered through the foot heat manifolds and 80% through the windshield defog manifold. Obtaining adequate defog air is achieved only after the defog-foot heat lever has been moved to the HI range. The pilot should attempt to anticipate fogging conditions so that, through proper management of temperature and airflow, it will not become necessary to subject the windshield and crew to the high temperatures and defog airflows which are required to clear an already fogged windshield.

Windshield Rain Removal

Windshield rain removal is controlled by a rain removal switch (figure 1-3) located on the right utility panel, front cockpit. Placing the switch in the ON position will open a valve causing warm air to flow through a nozzle directed up the outer surface of the windshield center panel. This air breaks up the rain drops into small particles and diverts the majority of them over the windshield. A "W Shield Temp Hi" light on the telelight panel will illuminate in the event the windshield material approaches a temperature which will cause optical deterioration. If the light illuminates, the system should be turned off immediately. If the windshield temperature sensors have not been calibrated properly, the light may illuminate as a result of aerodynamic heating (occurs only near level flight maximum speed with maximum afterburning). In this event, the overheat signal may be disregarded.

CAUTION

- For a static ground check, the system is limited to operation with leading edge flaps in the full down position and engines running at or below 88 percent rpm.
- Do not operate the rain removal system in flight with a dry windshield or above Mach 1.0.

Note

- In the event the windshield rain removal system cannot be shut down, pull up on the cockpit emergency vent handle. Engine bleed air will be shut off prior to entering the rain removal ducts.
- Prior to flight, a rain repellent should be applied to the windshield.

COCKPIT PRESSURIZATION

With the canopy closed and the cockpit refrigeration system in operation, the cockpit will automatically become pressurized at an altitude of 8,000 feet and above (figure 1-12). The pressure in the cockpit is maintained by the cockpit pressure regulator (located on the cockpit floor aft of the RSO's seat), which controls the outflow of air from the cockpit. Below 8,000 feet, the regulator relieves cockpit air at a rate to keep the cockpit unpressurized. Above 8,000 feet, the regulator relieves cockpit air as necessary to follow a definite cockpit pressure schedule. Operation of the pressure regulator is completely automatic. The cockpit safety (and dump) valve is used to prevent the cockpit pressure differential from exceeding the limit positive or negative differential pressure in case of malfunctioning of the cockpit pressure regulator, and to provide an emergency means of dumping the cockpit air. The dump feature of the safety valve is pneumatically connected to a dump feature on the cockpit pressure regulator. Both valves, which are operated pneumatically from a single control, have sufficient capacity to permit the cockpit differential pressure to be reduced from 5.5 psi to 0.05 psi within 5 seconds or less.

Cockpit Pressure Altimeters

The pressure altitude of the cockpit is indicated on a pressure altimeter. The pilot's cabin altimeter (figure 1-3) is located on the right console. The RSO's cabin altimeter (figure 1-6) is located in a panel on the left side of the aft cockpit. The cabin altimeters are vented directly to cockpit pressure.

Cockpit Turbine Overspeed Indicator Light

The cockpit turbine overspeed indicator light (figure 1-3) is located on the pilot's telelight panel. The indicator light will illuminate when the cooling turbine in the cockpit/pressure suit refrigeration unit is being subjected to pressures and temperatures in excess of normal operation. If possible, the airplane speed and engine power should be reduced until the light goes out. If the light fails to go out, the pilot should then select ram air by pulling UP on the emergency vent knob, which will divert ram air into the cockpit and at the same time shut off bleed air to the refrigeration unit, thereby stopping the cooling turbine.

PRESSURE SUIT PRESSURIZATION SYSTEM

The cockpit air conditioning system is designed to deliver up to 10 cfm of air per suit at any temperature selected by the pilot. This air is provided at a pressure of 3.0 ± 0.2 psi above cockpit pressure to insure proper flow of ventialting air through the suit. For operation when the cockpit altitude exceeds 35,000 feet, the air is provided at a pressure of 6.5 ± 0.2 psi. In the event the pilot selects ram air for the cockpit, thereby shutting off the flow of conditioned air, the flow of air from the refrigeration unit to the pressure suit will also be stopped. If the pilot should select ram air above 35,000 feet, suit pressurization will be automatically and instantly provided by the airplane's oxygen system.

Cockpit Pressure Schedule

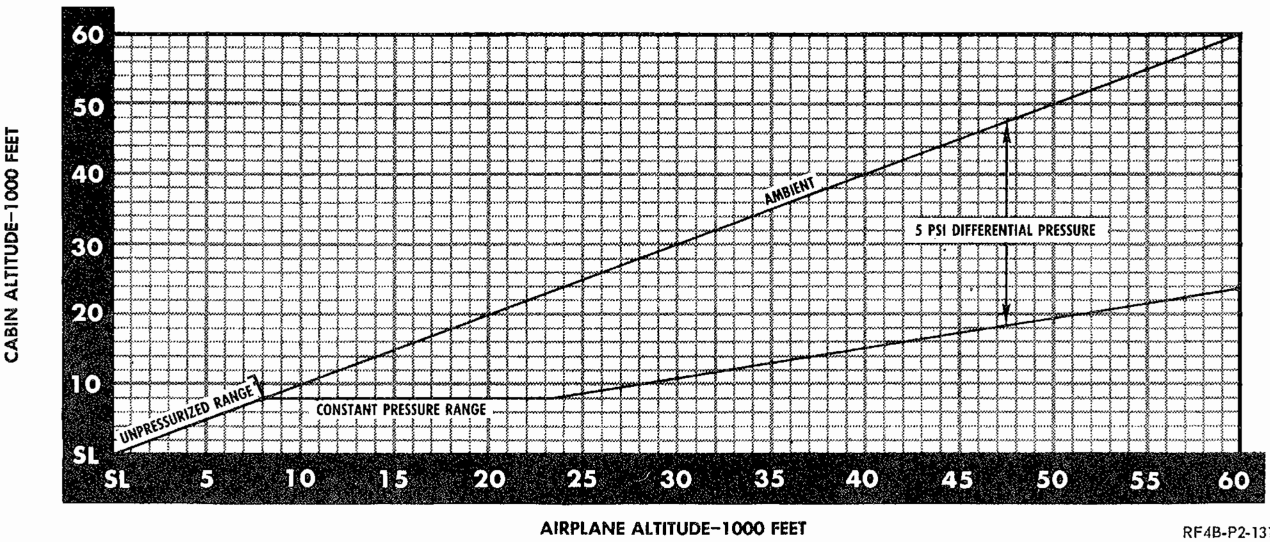


Figure 1-12

Note

> The RSO can control flow through his pressure suit by means of a manual flow control and shutoff valve located on the left side of the cockpit. The RSO has no control over cockpit or pressure suit temperatures.

MK IV PRESSURE SUIT

The full pressure suit consists of a two-layer garment. The inner garment is an air tight, ozone resistant, neoprene rubber layer, the only interruption being at the entrance which is sealed by a pressure sealing entrance slide fastener. The outer restraining garment is of nylon and is equipped with the necessary straps, tie-down, slide fasteners and adjustments to enable donning and fitting of the suit. The neck ring on the suit is the attachment point for the helmet and is also a pivot for the head and neck. On the left side of the suit there are two ports, one for ventilating air attachment and one for the "g" suit attachment. On the right side of the suit is an exhaust port. The helmet incorporates the breathing regulator and communication equipment. Suit ventilating air is supplied from the aircraft's conditioned and regulated supply via the composite disconnect to the ventilating air hose and suit inlet port. From the suit inlet port, air flows through ventilation tubes built into the pressure suit body and exists at the wrists, ankles, and the back of the neck. It then flows into the body of the suit, out through the exhaust port and through a hose to the suit controller which is located in the survival kit. In normal flight, air is allowed to pass through the suit controller and is expelled through its exhaust port, underneath the right forward corner of the survival kit. After incorporation of Clothing and Survival Equipment Change No. 14, the suit controller is installed in the pressure suit exhaust port. With this modification and Clothing and Survival Equipment Change No. 15 incorporated, the pressure suit exhaust hose need no longer be plugged into the survival kit. There is no need for the suit to be pressurized when safe cockpit pressure prevails. Any slight pressurization that occurs is due to some suit resistance to ventilation airflow. However, the pressure suit system is devised so that the suit will be instantly pressurized if the ambient (cockpit) pressure falls below 35,000 feet pressure altitude. The full pressure suit system is designed to respond to and function under several distinct conditions that might be encountered in flight, namely:

a. In normal flight with adequate cabin pressurization, the suit is pressurized only to a very slight extent due to the suit resistance to airflow.

b. When cockpit pressure falls below 3.4 psi, the suit will become pressurized by the ventilating air.

c. If ventilation air supply is lost, the airplane's oxygen supply will pressurize the suit as well as supply breathing oxygen. With Clothing and Survival Equipment Changes No. 14 and No. 15 incorporated, the air present in the suit at ventilation pressure loss will become trapped (with cockpit pressure above 35,000 feet) to maintain 3.4 psi in the pressure suit. In the event of minor suit leakage for this condition, the suit pressure loss will be made up by exhaled air and the oxygen supply system.

d. If the airplane oxygen supply fails, or in the event of bailout, the bailout oxygen should be used to pressurize the suit as well as supply breathing oxygen.

Helmet

The helmet is equipped with an oxygen regulator (Model GR 90), face visor, visor seal, face seal, helmet liner adjusting mechanism, sun visor and a dynamic (AIC-10) lip mike and headset. The oxygen regulator is provided to control the flow of oxygen to the facial area. The regulator is divided into two compartments separated by a diaphragm. One compartment has an opening leading directly to the facial area, while the other compartment has an opening directly to the area behind the face seal. The second opening senses the suit pressure, and will keep the oxygen to the facial area at slightly higher pressure than that of the suit, so that the suit air will never flow into the facial area. When the demand valve is opened by the negative pressure of inhalation, oxygen is emitted to the facial area via the perforated visor defogging tube. During exhalation, a positive pressure of 0.072 psi will force the exhaled gases to pass from the facial area of the pressure suit body via exhalation valves located in the area below the chin. These valves permit flow in one direction only and, therefore, will prevent gases from the suit area from flowing into the facial area. The face visor is sealed when closed by means of a tube which is inflated by oxygen when the supply switch on the regulator is switched to ON. On current issued helmets, the face visor seal is deflated by merely turning the supply switch OFF and inhaling. If the oxygen is turned on when the visor is in the up position, oxygen will flow freely to atmosphere from the visor defogging tube. Oxygen is prevented from flowing directly into the rear of the helmet and into the body section of the suit by a face seal. The face seal forms the closure that separates the 100% oxygen in the face compartment from the gases of the suit. This seal is shaped to form a continuous line over the occupant's forehead, down along his checks and across his chin. To gain this seal, contact with the subject's face should be as complete as possible. This requires that the seal be properly fitted and shaped when donning the helmet. A badly fitted face seal will be noted by a continuous flow of oxygen from the regulator. The helmet liner adjusting mechanism consists of an external knob and internal straps wrapped around a tightening mechanism. Turning the knob in either direction will tighten the helmet liner on the head and also force the head forward into the faceseal. The face seal, when formed properly, and the helmet liner, when adjusted properly, will provide the occupant with the best possible degree of comfort while wearing the helmet. The crash protection provided by the full pressure suit helmet is equivalent to that provided by the standard Navy helmet. Due to the nature of its attachment to the suit body, however, the pressure suit helmet has superior retention qualities.

Suit Controller

The suit controller, located in the survival kit, is the heart of the pressure suit system. After incorporation of Clothing and Survival Equipment Change No. 14, the suit controller is located in the pressure suit exhaust port. It is completely automatic and requires no adjustment or control by the suit occupant. All exhaust air must pass through the suit controller prior to being exhausted. Through restriction of the exhaust flow of vent air, the controller prevents the suit pressure from dropping below a pressure equal to 35,000 feet. As the cockpit altitude rises above 35,000 feet, the controller will begin to restrict the exhaust flow causing a pressure build-up in the suit. This pressure will be maintained at an absolute pressure equal to 35,000 feet pressure altitude. The differential suit pressure will be the difference between 35,000 feet equivalent and the cockpit pressure. The suit controller operates on a balance pressure being kept between the suit and the internal altitude reference chamber of the controller. The internal altitude reference chamber of the controller is continuously fed with a metered flow of the airplane's oxygen at approximately 100 to 150 cc/min. The outlet flow of this oxygen from the reference chamber is controlled by an aneroid operated valve which senses cockpit pressure and regulates the outlet flow to maintain a pressure equal to 35,000 feet within the suit controller. In the event of ventilation air loss to the pressure suit, the pressure in the suit controller will drop, causing the suit controller exhaust valve to close. At the same time, a tilt valve will open allowing oxygen to flow through the suit controller and exhaust hose to the suit. After incorporation of Clothing and Survival Equipment Change No. 15, the tilt valve is located in the pressure suit helmet. The suit will then be pressurized by oxygen. The suit controller will continue to maintain suit pressures in the same way as it did when the suit was using ventilation inlet for pressurization. A check valve in the ventilation inlet line will prevent any oxygen in the suit from escaping. There will be no ventilation air flow when the suit is being pressurized by oxygen. Upon ejection above 35,000 feet, the suit controller will still maintain a no greater than 35,000 feet pressure altitude in the suit. The only difference being that the oxygen supply for controller operation and suit pressurization will come from the occupant's bailout oxygen supply which will be triggered upon ejection.

Composite Disconnect

The composite disconnect is designed to be used in conjunction with the suit controller and the suit control system of which it is a part. The composite disconnect assembly consists of a lower block, an intermediate block, and an upper block. The intermediate block is fastened to the upper part of the survival kit and contains the tie-in between the crewman and the emergency oxygen supply. The disconnect is so designed that the aircrewman, during normal aircraft entrance or departure, is capable of quickly attaching or detaching all hoses and electrical lines leading from the aircraft to the survival kit and man. The lower block contains check valves in the ventilating air, anti-"g" and oxygen ports, that are open when the three sections of the disconnect are plugged in, and closed when either the upper or lower blocks are disconnected from the intermediate block. The check valves prevent gas leakage in the normal direction of flow when the valves are closed. The lower block is provided with a lanyard operating locking device, the free ends of the lanyard being attached to the airplane structure. As the seat is ejected, tension in the lanyard unlocks the device and separates the lower block from the intermediate block. The intermediate block serves as the connecting link between upper and lower blocks and by means of a "Tee" in the oxygen line, connects the emergency oxygen to the system. The upper block provides the means for attaching all service lines corresponding to those leading to the lower block. It also contains a manual disconnect device that permits the aircrewman to free himself from all kit connections during normal aircraft departure by a single pull on the manual disconnect handle. This action simultaneously unlocks the upper block from the intermediate block and the vent exhaust hose from the kit.

WARNING

Replacement O-ring seals for composite disconnect must be cleaned with solvent MIL-T-7003 prior to installation to preclude the possibility of an oxygen oil explosion occurring upon composite disconnect inertion or in flight.

Note

Prior to each flight, lubricate the exposed seals of the composite disconnect upper block with lubricant MIL-C-21567.

EQUIPMENT AIR CONDITIONING SYSTEM

The equipment air conditioning system, located on the left side of the forward fuselage, supplies cooled air for reconnaissance and electronic equipment cooling. It also supplies partially cooled air to the equipment auxiliary air system. The equipment air conditioning system utilizes a cooling (expansion) turbine and a compressor, mounted at opposite ends of a common shaft. High pressure, high temperature 17th stage engine compressor bleed air is directed to the periphery of the cooling turbine after passing through an air-to-air heat exchanger. As the air passes through the turbine, it causes the turbine to rotate (and thus the compressor) while at the same time undergoing rapid expansion, with a resulting temperature and pressure drop. This air is then directed through the various equipment cooling circuits. Ram air enters the airplane at the forward left fuselage air scoop and splits into two parts. One part is directed through the compressor and the other through the air-to-air heat exchanger where it acts as a cooling media and thence to the ram air exit duct. The compressor performs two functions. It serves as the balance load for the turbine, while its exhaust is discharged through an ejector assembly located in the ram air exit duct. The purpose of the ejector is to insure airflow through the ram air duct (and thus the air-to-air heat exchanger) during periods of low ram air pressure. Control of the system is entirely automatic. The temperature in the equipment cooling air circuit is controlled at approximately 85°F from sea level to 25,000 feet and 40°F from 25,000 feet up. The temperature in the camera compartment cooling circuit is controlled so as to maintain a compartment discharge temperature of 95°F. The temperature in the infrared reconnaissance sensor cooling circuit is controlled so as to maintain a compartment discharge temperature of 75°F. All three cooling circuits employ overtemperature sensors placed in the compartment distribution ducts. Should an overtemperature condition occur in any one of the cooling circuits, the air conditioning system will be shut down automatically the "Equipment Cool Off" indicator lights will be illuminated, and emergency ram air cooling will be provided. Reset buttons one for each cockpit (figure 1-3 and figure 1-5), serve to reset the temperature limiter and to restart the air conditioning system. There are two situations where the "Equipment Cool Off" light may be illuminated by external conditions rather than an internal malfunction. The first may occur during the landing phase when touch-and-go landings are being made, or during a waveoff. When power is applied, the sudden increase in 17th stage bleed air temperature may cause the unit to sense an overtemperature condition and illuminate the indicator light. In this case, wait approximately 15 seconds and/or until a power reduction is made before depressing the reset button. If the light remains illuminated, no further attempt should be made to restart the system. The second situation may occur during high speed flight. In this situation, the unit may sense an overtemperature condition as a result of the temperature increase caused by aerodynamic heating. If the indicator light should illuminate under these circumstances, reduce airspeed below the speed at which the light illuminated, wait at least 15 seconds and then depress the reset button. If the light remains illuminated, no further attempt should be made to restart the air conditioning system.

CAUTION

Avoid operation for prolonged periods with the "Equipment Cool Off" light illuminated unless operational necessity dictates otherwise. If maximum allowable cooling temperatures are exceeded, equipment life and/or reliability may be adversely affected.

Note

Illumination of the "Equipment Cool Off" light shall be logged on the yellow sheet (OPNAV FORM 3760-2).

EQUIPMENT AUXILIARY AIR SYSTEM

The equipment auxiliary air system utilizes partially cooled air from the equipment air conditioning system. The air is 17th stage engine compressor bleed air which is bled off the equipment air conditioning system after it has passed through the air-to-air heat exchanger. The partially cooled air is distributed to the anti-g suits, front and rear canopy seals, air data computer, radar transmitter, radar wave guide, radio receivers-transmitters, amplifier modulator, SLR wave guide, SLR wave guide antenna, fuel system pressurization, and the pneumtaic system air compressor.

EMERGENCY VENT KNOB

The cockpits may be cleared of undesired smoke or fumes and the cabin/pressure suit air conditioning unit may be shut off by pulling up on the emergency ventilating handle (figure 1-3). Push button on top of knob and then pull up on the knob. The handle may be placed in an intermediate position to obtain desired amount of emergency ventilation. When pulled up, three actions occur simultaneously:

a. All air conditioning and pressurization air from the cabin/pressure suit air conditioning unit to the cockpits and pressure suits is shut off.
b. The cabin/pressure regulator and safety (dump) valve is opened and the cockpit becomes completely depressurized.
c. A ram air shutoff valve is opened and the atmospheric air is allowed to enter the cockpit through a port located just forward of the pilot's feet.

Note

Operation of the emergency ventilating control knob is the only method of shutting off the cabin/pressure suit air conditioning unit when the engine is operating.

NORMAL OPERATION

Optimum cockpit environment can best be achieved by placing the override selector switch on the temperature control panel in the AUTO position, and adjusting the temperature control knob for the desired cockpit temperature. Adjust the defog control lever on the right utility panel for personal comfort and effective windshield defogging. If the automatic temperature control system fails, or if you desire a cooler or hotter temperature within the pressure suit, a temporary adjustment may be obtained by "bumping" the override selector switch to the HOT or COLD position. To prevent windshield defogging during letdown into a hot humid atmosphere, place the override selector switch in the AUTO position, and have the defog lever positioned about 3/4 of the way forward. Five minutes prior to letdown, select the full defog position and adjust the temperature control knob to the 2 o'clock (200 degrees of clockwise rotation) position, and maintain these settings throughout the letdown. If fogging persists and will not clear up, retract flaps if extended, or increase power (use speed brakes as necessary to maintain airspeed) to provide more engine bleed air to the mixing valves. In the event cockpit and pressure suit temperatures become too high at low altitudes and cannot be lowered, some degree of comfort can be achieved by opening the face plate, removing the gloves, and unzipping the pressure suit.

PRESSURE SUIT OPERATION

After donning the suit, vent air should be applied if it is available, especially if any delay is anticipated before going out to the aircraft. It doesn't take long to become dehydrated in warm weather. To avoid visor fogging, coat the visor with recommended anti-fog compound. On the way to the airplane, a portable pressure suit ventilating unit should be used. After arriving at the airplane, vent air is available from the auxiliary power unit (RCPP-105) either in the cockpit or standing outside the airplane. Before entering the cockpit, the vent air hose, anti-g hose, and exhaust hose connections to the suit should be checked secure. The first two things to do after climbing in the cockpit are to connect the composite disconnect to the upper block and connect the exhaust hose. The exhaust hose cannot be connected until the composite disconnect is locked. After these two connections are made, the vent air may be turned on before finishing the job of getting strapped in. If the exhaust hose is not connected, above normal ballooning of suit will occur and ballooning will be slow to dissipate even after vent air has been turned off. After the helmet and gloves have been donned and the assistant has plugged in the communications and oxygen line to the helmet, the oxygen system should be checked by closing the visor, turning on the oxygen and checking the visor seal. If the system checks out satisfactorily, remain on oxygen. Normal flight procedures are then followed until takeoff position is reached, where the vent air should be turned down to prevent suit ballooning as power is advanced on the takeoff roll. As soon as the airplane is cleaned up after takeoff, the vent air should be adjusted to a comfortable level. Vent air temperature is adjustable by use of the cockpit temperature control. To monitor suit altitude, a suit altimeter is installed on the left leg of the suit. Pressure suit operation can be checked during flight by pulling the emergency vent knob (between 12,000 and 20,000 feet), climbing to 40,000 feet, and checking that suit inflates and holds an absolute pressure equal to 35,000 feet.

WARNING

Do not turn pressure suit vent air more than 1/4 ON when the BLC is operating. When the flaps are raised, the additional engine bleed air to the air conditioning and pressurization system can cause the pressure suit to "balloon". If the pressure suit controller should malfunction, the increased suit pressure could become high enough to cause immobilization.

CAUTION

Prior to making an inflight pressure suit check, turn radar equipment off to prevent possible arcing of the pilot's radar scope.

EMERGENCY OPERATION

Although there are no provisions made for emergency operation of the cockpit/pressure suit air conditioning system, emergency ventilating air is available. The cockpits may be cleared of undesired smoke or fumes and the cockpit/pressure suit air conditioning unit may be shut off by depressing the button and pulling up on the emergency ventilating knob. The handle may be placed in an intermediate position to obtain the desired amount of emergency ventilation.

LIMITATIONS

There are no specific limitations pertaining to the operation of the air conditioning and pressurization system.

REFERENCE PUBLICATIONS

If more detailed system information is required, refer to Item No. 6, on Maintenance Instruction Manuals Publication Index (flyleaf 3, this publication).

ANGLE OF ATTACK SYSTEM

DESCRIPTION

The angle of attack system consists of a probe, transmitter, indicator, indexer lights, approach lights, and a stall warning vibrator. The system provides the pilot with a visual indication of the instantaneous angle of attack, and a physical indication of impending stall through a stall warning vibrator on the left rudder pedal. The angle-of-attack probe is mounted forward of the front cockpit on the right side of the fuselage. The airstream strikes two parallel slots in the probe. As the angle of attack changes, pressure becomes greater in one slot, causing the probe assembly to rotate, aligning the probe slots with the airstream. The amount of probe rotation is transmitted to the indicator, where it is displayed in angle-of-attack units. The probe is equipped with a heater for de-icing purposes, which is energized any time the weight is off the landing gear. The angle of attack for a given flight condition (stall, landing approach, cruise, etc.) is unaffected by gross weight, bank angle, load factor, airspeed, density altitude or airplane configuration. Therefore, by flying the recommended angle of attack for various flight conditions, the pilot will realize optimum performance from the aircraft.

ANGLE-OF-ATTACK INDICATOR

The angle-of-attack indicator (figure 1-13) displays the angle of attack in relative units. The indicator is calibrated from 0 to 30 units, which corresponds to -10 to +40 degrees of rotation of the probe. A reference "bug" is provided for approach ("on speed") angle of attack and is set at 19.2 units. Additional "bugs" are provided and can be set at any desired angle of attack. The suggested values for the "bug" settings are as follows:

Climb (400 KCAS) - 5.5 units
Max Endurance - 8.5 units
Stall Warning - 22.3 units

The indicator also incorporates switches which operate the indexer lights, approach lights, and stall warning vibrator. When the indicator is inoperative, the word OFF shows in a small window on the face of the dial. Refer to Airspeed Indicator Failure illustration, Section V, to obtain angle of attack ranges for various drag indices and flight conditions. The angle-of-attack indicator power is supplied from the right main 28 volt d-c bus.

ANGLE-OF-ATTACK INDEXER

An angle-of-attack indexer is located on the left and right side of the windshield in the front cockpit. The indexer presents landing approach angle-of-attack information by illuminating symbolic cutouts. The cutouts are energized through switches in the angle-of-attack indicator when the landing gear is down. At fast airspeeds (low angle of attack), the lower symbol is illuminated. At slightly fast airspeeds, the lower symbol and center circular symbol will be illuminated. At optimum approach speeds, only the center circular symbol will illuminate. For slightly slow airspeeds, the center symbol and upper symbol will illuminate. For slow airspeeds (high angle of attack), only the upper symbol will be illuminated. When the gear and flaps are down and the arresting hook is up, the indexer lights will pulsate at the same frequency that the approach lights flash. When the indexer light intensity is turned up, they will appear to flash. The lights will illuminate steady when the gear, flaps, and arresting hook are down. The lights may be made to illuminate steady during a normal field landing by moving the hook bypass switch to the BYPASS position.

Indexer Lights Control Knob

An indexer lights control knob is located on the front cockpit right console (figure 1-2). The lights are automatically illuminated when the landing gear is lowered; however, their intensity is increased or decreased by the indexer lights control knob.

STALL WARNING VIBRATOR

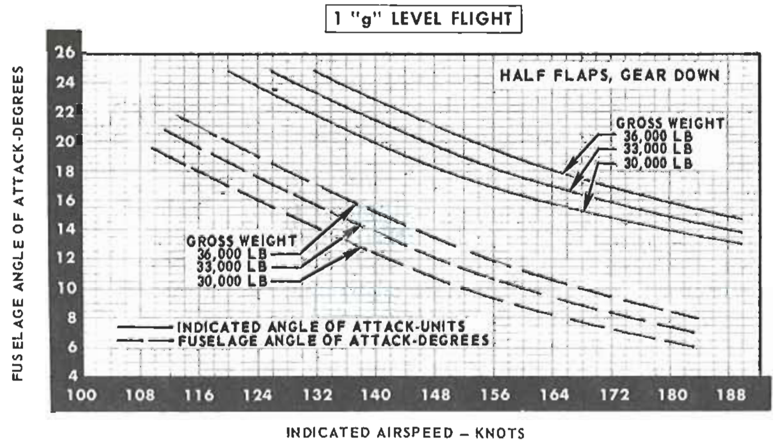
A stall warning vibrator is mounted on the left rudder pedal and provides a means of warning the pilot of an impending stall. The vibrator is an electric motor driven eccentric weight. Rotation of the weight causes the left rudder pedal to vibrate. A sufficient airspeed margin exists to allow the pilot to return to the proper flight attitude by normal reaction to the warning. The vibrator is electrically connected to a switch in the angle-of-attack indicator, which is set at 22.3 units. The stall warning vibrator motor is powered from the right main 28 volt d-c bus through the angle-of-attack heater circuit breaker. The circuit breaker is located in the rear cockpit on the number one circuit breaker panel. In the event of a malfunction in which the vibrator runs continuously, it may be rendered inoperative by pulling this circuit breaker.

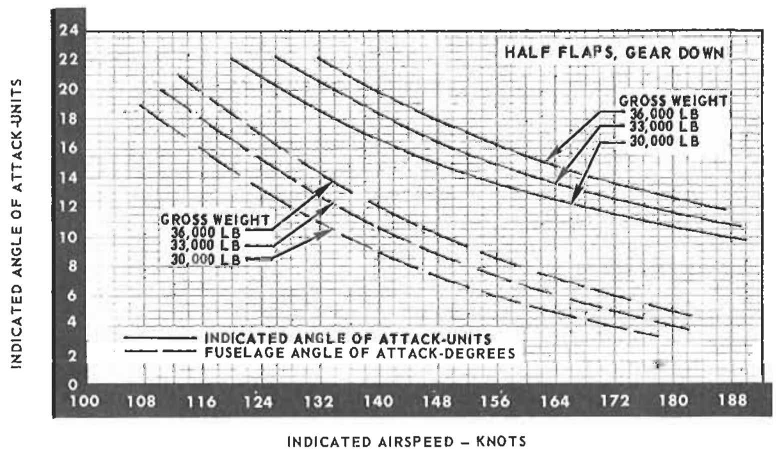
Angle of Attack Conversion And Displays

APPROACH LIGHT	INDICATOR	INDEXER	ANGLE OF ATTACK UNIT	AIRSPEED
			20.3-30	VERY SLOW
			19.7-20.3	SLIGHTLY SLOW
			18.7-19.7	ON SPEED
			18.1-18.7	SLIGHTLY FAST
			0-18.1	VERY FAST

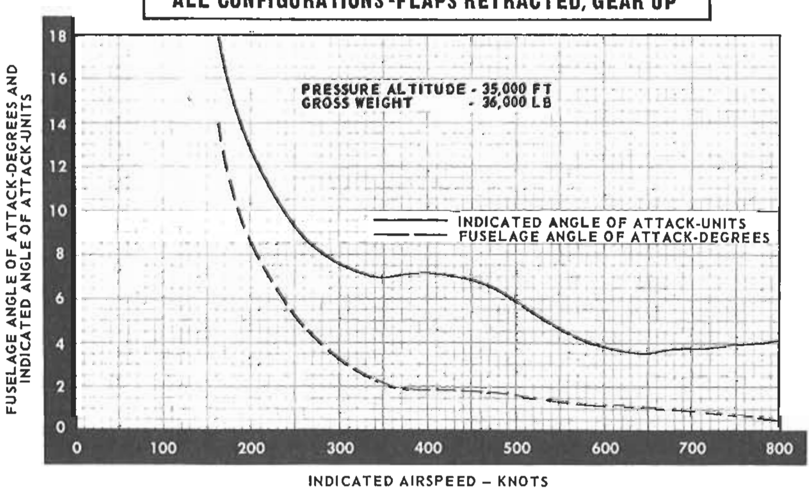
ALL CONFIGURATIONS-FLAPS AS NOTED, GEAR DOWN

1 "g" LEVEL FLIGHT





ALL CONFIGURATIONS-FLAPS RETRACTED, GEAR UP



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RGA

Figure 1-13

APPROACH LIGHTS

An approach light system, with red, amber and green indicator lights, is used to show the LSO symbolic airplane angle-of-attack during landing approaches. Two switches within the angle-of-attack indicator determine which of the three lights will be illuminated. The lights are energized through switches in the landing gear, wing flaps, and arresting gear systems. A hook bypass switch, located on the exterior lights control panel, is used to bypass the wing flap and arresting gear switches. When the hook bypass switch is in NORMAL, the landing gear is down and locked and the arresting hook is down, the applicable approach light will glow steady. With the hook bypass switch in NORMAL, the landing gear down, the wing flaps 1/2 or full down and the arresting hook up, the approach light will flash. When the hook bypass switch is in BYPASS and the landing gear is down, the approach light will glow steady regardless of the position of the arresting hook and wing flaps. A green approach light indicates a high angle of attack, low airspeed; and amber light indicates optimum angle of attack; and a red approach light indicates a low angle of attack, high airspeed.

NORMAL OPERATION

There are no controls pertaining to the angle of attack system other than the indexer lights control knob.

EMERGENCY OPERATION

There are no alternate or emergency provisions pertaining to the angle of attack system. However, in the event the angle-of-attack indexer lights and approach lights are not illuminated during a landing approach, it may mean that the nose gear catapult extension is still pressurized. To preclude the possibility of exploding the nose gear strut upon touchdown, relieve the catapult extension pressure by cycling the landing gear.

NEW NEW

LIMITATIONS

There are no limitations pertaining to the angle of attack system.

REFERENCE PUBLICATIONS

If more detailed system information is required, refer to Item No. 11 & 12, on Maintenance Instruction Manuals Publication Index (flyleaf 3, this publication).

ARRESTING HOOK SYSTEM

DESCRIPTION

The arresting hook system consists of an arresting hook, a combination hydraulic actuator and dashpot, a mechanical uplatch, and a control handle. The forward end of the arresting hook is pivoted in a manner which not only permits up and down movement, but left and right motion as well. Coil springs keep the hook centered for retraction. It is retracted up and aft by a hydraulic actuating cylinder, and is caught and held there by a mechanical uplatch. It is extended by the pneumatic action of the dashpot and its own weight. The arresting hook is controlled by a handle located on the right side of the front cockpit instrument panel. The handle and the uplatch mechanism are joined by a control cable. In the event of a cable failure, the arresting hook will extend.

ARRESTING HOOK CONTROL HANDLE

The arresting hook is controlled by a handle (figure 1-4) located to the right of the instrument panel in the forward cockpit. When the control handle is pushed down, the uplatch is released and the arresting hook is extended. Placing the handle in the up position energizes a solenoid valve which directs utility hydraulic pressure to the cylinder. A red warning light inside the control handle will come on any time the hook is not fully extended or retracted.

NORMAL OPERATION

Normal operation of the arresting hook system consists of placing the arresting hook control handle down, and observing the warning light to assure the arresting hook is fully extended. To retract the arresting hook, place the handle up and observe the warning light to assure the arresting hook is fully retracted.

EMERGENCY OPERATION

In the event the arresting hook control handle feels "spongy" when placed in the down position, the hook-up limit switch has failed to de-energize the solenoid operated selector valve. As a result, the hook will not extend. To de-energize the solenoid selector valve, cycle the arresting hook control handle and hold in its full down position. Hydraulic fluid will then bleed from the up side of the arresting hook actuator cylinder and the hook will extend. There are no provisions for arresting hook retraction in the event of a utility hydraulic failure or double generator failure.

LIMITATIONS

There are no practical arresting hook limitations for field arrestment; however, there are airspeed/gross weight limitations for shipboard recovery. Refer to applicable Recovery Bulletins.

REFERENCE PUBLICATIONS

If more detailed system information is required, refer to Item No. 5, on Maintenance Instruction Manuals Publication Index (flyleaf 3, this publication).

AUTOMATIC FLIGHT CONTROL SYSTEM (AN/ASA-32)

DESCRIPTION

The automatic flight control system (AFCS) is an electro-hydraulic system designed to provide stable, accurate, and coordinated flight maneuvers without interferring with manual control. The automatic flight control system is capable of performing two modes of operation, stability augmentation and AFCS. Stability augmentation improves airplane stability in pitch, roll, and yaw; it opposes any change of altitude but will not return the airplane to a given attitude or ground track. This mode of operation may be used while the aircraft is under manual control. On airplanes 153095y and up and all others after incorporation of AFC 203, stability augmentation can be engaged individually or in any combination for pitch, roll, or yaw axis. However, all three channels must be engaged before complete AFCS operation can be engaged. The AFCS mode of operation will maintain any aircraft ground track and/or attitude selected within the AFCS limits and will correct for any deviation from the selected ground track or attitude of the aircraft within the AFCS limits. On airplanes prior to 153095y without AFC 203 incorporated, two additional operating features are available while in the AFCS mode of operation. They are altitude hold and Mach hold. The altitude hold mode of operation will hold any altitude selected while in the AFCS mode, and the Mach hold mode of operation will hold any indicated Mach number selected while in the AFCS mode. On airplanes 153095y and up and all others after incorporation of AFC 203, the Mach hold mode is removed and only the altitude hold mode is used. The inertial navigation system provides the vertical and ground track reference for the AFCS.

STABILITY AUGMENTATION MODE

In the stability augmentation mode of operation, the system senses motion about the longitudinal, lateral, and directional axes and acceleration along the lateral axis, by means of rate gyro and accelerometer sensors, respectively. All attitude changes will cause these sensing devices to transmit signals representing the changing motion about or along their respective axis. These signals are sent to longitudinal, lateral, and directional servo valves in the control surface actuators. Therefore, any output signals from the rate gyro or accelerometer (indicating yawing, rolling, pitching or lateral acceleration motions) causes the automatic flight control system to position the appropriate control surface to oppose that motion. This action decreases any tendency of the airplane to oscillate in roll, yaw, or pitch, or to develop lateral forces which cause airplane slip or skid. In the stability augmentation mode, the rate gyros or lateral accelerometer will send signals to the surface controls to oppose any deviation from selected flight attitudes but will not return the airplane to its original ground track or attitude. On airplanes prior to 153095y without AFC 203 incorporated, the stability augmentation mode is in operation whenever the stab aug switch is in the ENGAGE position. On airplanes 153095y and up and all others after incorporation of AFC 203, stability augmentation can be obtained individually or in any combination for pitch, roll, or yaw axis by placing the pitch, roll, and yaw stab aug switches to the ENGAGE position.

AFCS MODE

In the AFCS mode of operation, the inertial navigation set signals are used, in addition to the rate gyro sensor signals, to maintain the airplane in a desired attitude with maximum pitch, roll, and yaw stability. The AFCS system can be engaged and hold maneuvers and attitudes within a range of ± 70° pitch, 70° in bank and 360° in azimuth, providing the "g" limits are not being exceeded. The components used by the AFCS are the control amplifier, the inertial navigation set, the central air data computer, force transducer, accelerometers, lateral series servos, longitudinal parallel servos, and rate gyro sensors.

Control Amplifier

The control amplifier comprises the control center for the entire automatic flight control system. It receives the signals from the various sensing elements in the system and supplies power to the flight control components.

Central Air Data Computer

The central air data computer peforms three functions for the autopilot. First, it provides all required gain changes. This is necessary to maintain constant maneuvering rates regardless of changes in airspeed and altitude. Second, the CADC contains a clutched synchro which supplies the autopilot with a signal proportional to the deviation from the barometric altitude which existed when the altitude/Mach switch was placed in the ALTITUDE position. This signal is used by the autopilot to move the stabilator as necessary to maintain constant barometric altitude. The third function of the CADC is to provide clutched synchro output proportional to the deviation from the Mach number that existed at the time that the altitude/Mach switch was placed in the MACH position. This signal is used by the autopilot to move the stabilator as necessary to decrease or increase the airplane's airspeed in order to hold a constant Mach number. On airplanes 153095y and up and all others after incorporation of AFC 203, the Mach hold mode of the AFCS is removed and this input from the central air data computer is not used.

Force Transducer

The force transducer is a unit which senses the force applied by the pilot to the control stick. This unit actually comprises the visible portion of the control stick with the stick grip mounted on top. The force transducer contains pressure sensitive switches which react to lonitudinal and lateral stick forces. A lateral stick force of 2.25 ± 0.25 pounds or more closes a switch that will, in effect, disengage the autopilot in roll. The autopilot will stay disengaged as long as the 2.25 ± 0.25 pound force remains on the stick. When the stick forces are released, the autopilot will be re-engaged and hold the new roll attitude. Fore and aft stick forces close a switch to operate certain autopilot components and also cause a force sensing device to send a signal proportional to the applied stick force to the servo amplifier and stabilator actuator, thus causing the desired pitch attitude change. During this operation, the pilot controls stabilator position through the autopilot, while the ailerons and spoilers are being manually controlled by the pilot. When the stick forces are released, the autopilot will hold the new pitch attitude. This feature is commonly known as control stick steering (CSS). In the event the pitch or roll limits of the autopilot are exceeded (± 70°), the autopilot, in effect, will be disengaged, although the autopilot switch will remain ON. Therefore, when the airplane returns to within the limits of the autopilot, the autopilot will once again take over.

Accelerometers

During autopilot operation, three accelerometers are being utilized to insure proper functioning of the autopilot system. Two of the accelerometers are of the G-limiting type which prevent "g" loads from occurring as a result of autopilot operation. The other accelerometer which is used to perform coordinated maneuvers while in stab aug and autopilot operation.

G-LIMIT ACCELEROMETER. The normal load factor interlock ("g" - disengage) feature of the AFCS is designed to inhibit the system from commanding excessive load factors on the airplane. The system will revert automatically from whatever mode is engaged to the stab aug mode in the event that plus 4 or minus 1 "g" absolute is sensed by the "g" - disengage accelerometer switch. This switch is mounted forward on the radar bulkhead so that if the airplane is rotated rapidly into a maneuver, disengagement will occur at lower values of normal load factor due to the "anticipation" resulting from the forward location sensing a component of pitching acceleration, If, in addition to the "g" switch being operated, the stab aug servo is hard over in a direction that would tend to increase the magnitude of the existing load factor, the stab aug mode will also disengage. It is possible to check out the proper functioning of this feature in flight by engaging the stab aug and AFCS modes and gradually increasing load factor to approximately plus 4 or minus 1 "g". AFCS modes should disengage, stab aug should not. The "g" disengage feature is inoperative outside the ± 70° limits of the autopilot.

TRIM CUTOUT ACCELEROMETER. This unit cuts off power to the automatic pitch trim circuit when acceleration forces along the vertical axis of the airplane reach or exceed the limits of 0 "g" or +3 "g's". This circuit prevents the airplane from being trimmed automatically into a high "g" maneuver.

LATERAL ACCELEROMETER. This accelerometer detects airplane skids or slips and produces error signals proportional to the lateral forces developed. These error signals cause the autopilot to take corrective action with the rudder to coordinate the maneuver being performed.

Control Servos

The automatic flight control system utilizes lateral series servos, a directional series servo, a longitudinal series servo, and a longitudinal parallel servo to convert autopilot signals into control surface deflections. The lateral series servos provide deflection commands to the spoilers and ailerons during stab aug and AFCS operation. The directional series servo commands rudder deflection during stab aug and AFCS operation. The longitudinal series servo provides stabilator command during stab aug operation and the longitudinal parallel servo provides the stabilator command during AFCS operation.

Rate Gyro Sensors

Refer to Stability Augmentation Mode, previously discussed in this section.

AFCS CONTROLS

The automatic flight control system control panel (hereafter referred to as the AFCS panel) (figure 1-2) is located on the pilot's left console. This panel contains all the controls for the normal operation of the automatic flight control system.

Stab Aug Switch (Prior to 153095y Without AFC 203)

NEW

The stab aug switch is a two-position toggle switch located on the AFCS panel. The switch positions are STAB AUG and ENGAGE. Placing the switch in the ENGAGE position will establish the stab aug mode of operation.

Stab Aug Switches (153095y and Up; All Others With AFC203)

NEW

The three stab aug switches for pitch, roll, and yaw are two-position toggle switches located on the AFCS panel. Placing any one of these switches in the ENGAGE position will establish the stability augmentation mode for the axis selected. These switches can be engaged individually or in any combination for stability augmentation in pitch, roll, or yaw.

NEW NEW

AFCS Switch

The AFCS switch is a two-position toggle switch located on the AFCS panel. The switch positions are AFCS and ENGAGE. On airplanes prior to 153095y without AFC 203 incorporated, this switch can become energized only if the stab aug switch is energized. Placing the switch in the ENGAGE position will energize the AFCS mode and the system will become fully effective, holding the attitude and ground track selected. On airplanes 153095y and up and all others after incorporation of AFC 203, the switch

NEW NEW

can become energized if only the pitch stab aug switch is energized, only the roll and yaw stab aug switches are energized, or if all three stab aug switches are energized. However, for the AFCS mode to be fully effective, holding attitude and ground track selected, all three stab aug switches must be energized. An additional feature will prevent the pitch channel of the AFCS from being energized (even though the AFCS switch is engaged) if a malfunction or out of synchronization condition occurs in the pitch channel. This feature can cause a hazardous flight control condition if the proper engagement sequence is not followed. Should a malfunction exist in the pitch AFCS channel which precludes pitch attitude or stabilator follow-up synchronization, the pitch channel of the AFCS will be unreliable and hazardous. Selecting full AFCS mode of operation (pitch, roll, and yaw) will result in an apparently satisfactory AFCS. However, the pitch channel of the AFCS will not engage until the aircraft attitude matches the pitch attitude synchronizer. When this occurs, the AFCS will be locked in this pitch attitude. Pitch control stick steering is inoperative and if aircraft pitch attitude is changed by overpowering the AFCS, the aircraft will return to the pitch engagement attitude when stick force is released. This potentially hazardous control condition can be identified by attempting to engage the altitude hold mode immediately after inflight engagement of the AFCS. If the altitude hold switch will not hold in the ENGAGE position, do not use the AFCS. This malfunction will in no way affect the stab aug modes.

Altitude/Mach Hold Switch (Prior to 153095y Without AFC 203)

The altitude/Mach hold switch is a three-position rotary switch located on the AFCS panel. The switch positions are ALT, OFF and MACH. This switch will function only if the autopilot is engaged. Placing the switch in the ALT position energizes an altitude sensor in the CADC which is controlled by barometric altitude. As the altitude varies, an error signal is produced and fed to the pitch servo amplifier. The amplifier will then send a signal to the stabilator actuator which will deflect the stabilator as necessary to return the airplane to its "hold" altitude. The altitude sensor will hold the airplane within an altitude of ± 50 feet or ± 0.3 percent of the reference altitude at speeds up to 0.9 Mach and at speeds greater than 1.0 Mach. Altimeter fluctuations while accelerating through the transonic range (0.9 to 1.0 Mach) will produce transient fluctuations which, although not violent, may cause the reference altitude to slip. When altimeter fluctuations have ceased, normal altitude hold operation should again be apparent. Engaging the altitude hold mode in climbs of greater than 1,000 feet per minute may result in a reference altitude other than the engage altitude. Placing the switch to the MACH position energizes a Mach sensor in the CADC which will cause the autopilot to maintain a constant Mach number within ± 0.03 Mach. As the Mach number varies, an error signal is produced and fed to the pitch servo amplifier. The amplifier will then send a signal to the stabilator actuator which will deflect the stabilator to put the airplane in a shallow dive to pick up Mach number or it will deflect the stabilator to put the airplane in a gradual climb to decrease Mach number. In Mach hold AFCS operation, the airplane will hold a selected ground track, roll, and yaw attitude but its pitch attitude may vary. Due to the fact that the stabilator is the primary control factor in both altitude and Mach hold, it can readily be seen why the two modes of operation cannot be used together. Placing the altitude/Mach hold switch to OFF or applying stick force in excess of 3.75 ± 0.25 pounds forward or 2.55 ± 0.25 pounds aft for at least 0.5 seconds, will disengage altitude or Mach hold.

Altitude Hold Switch (153095y and Up; All Others With AFC 203)

The altitude hold switch is a two-position toggle switch located on the AFCS panel. The switch positions are ALT and ENGAGE. The altitude hold feature will function only if AFCS is engaged. Placing the switch to the ENGAGE position energizes an altitude sensor in the CADC which is controlled by barometric altitude. As the altitude varies, an error signal is produced and fed to the pitch servo amplifier. The amplifier will then send a signal to the stabilator actuator which will deflect the stabilator as necessary to return the aircraft to its "hold" altitude. The altitude sensor will hold the aircraft within ± 50 feet or ± 0.3 percent of the reference altitude at speeds up to 0.9 Mach and at speeds greater than 1.0 Mach. Altimeter fluctuations while accelerating through the transonic range (0.9 to 1.0 Mach) will produce transient fluctuations which, although not violent, may cause the reference altitude to slip. Engaging the altitude hold mode in climbs greater than 1000 feet per minute may result in a reference altitude other than the engage altitude.

Ground Track Hold Cutout

When operating in the AFCS mode, roll attitudes must be larger than 5° angle of bank in order to disengage the ground track hold. Depressing the nose gear steering button provides the means of disengaging the ground track to allow turns at an angle-of-bank of 5° or less. Ground track hold may be reestablished by again depressing the nose gear steering button.

AFCS/ARI Emergency Disengage Lever

A spring-loaded emergency disengage lever is located on each control stick. On airplanes prior to 153095y without AFC 203 incorporated, depressing the lever will cause all the switches on the AFCS panel to return to OFF, and will also disengage the aileron rudder interconnect system as long as the lever is held depressed. When the lever is released, the ARI system will again be in operation, but the AFCS and stability augmentation will no longer be engaged. On airplanes 153095y and up and all others after incorporation of AFC 203, the lever will only cause the AFCS and altitude hold switch to return to OFF. The stability augmentation mode and ARI will be disengaged as long as the lever is held depressed. When the lever is released, the stability augmentation and ARI will again be in operation, but the AFCS will no longer be engaged. To permanently disengage the stability augmentation mode, the pitch, roll, and yaw stab aug switches must be placed OFF. To permanently disengage the ARI, the yaw stab aug switch must be OFF and the ARI circuit breaker, on the front cockpit left sub panel, must be pulled.

Autopilot Pitch Trim

An automatic pitch trim feature is included in the autopilot system which attempts to keep the airplane longitudinally trimmed to the flight conditions experienced while in AFCS mode. Thus, an out-of-trim condition (which would not be sensed while in autopilot mode) will be prevented, insuring against an excessive pitch transient when disengaging the autopilot. The auto-pitch trim operates at approximately 40% the speed of the normal trim system, resulting in a slight delay after changing flight conditions before the basic airplane is properly trimmed. During CSS maneuvering and beyond the 0 to +3 "g" trim cutout limits, the auto-pitch trim is inoperative. Auto-pitch trim operation can be observed on the pitch trim indicator after changing flight conditions in the AFCS mode.

Auto-Pitch Trim Light

An "A/P Pitch Trim" light (figure 1-3) is located on the telelight panel. This light will illuminate during AFCS operation if the automatic pitch trim is inoperative or lagging sufficiently behind airplane maneuvering to cause an out-of-trim condition in the basic airplane. Since: (1) auto-pitch trim rate is only 40% of normal trim rate, (2) auto-pitch trim is inoperative anytime the stick grip transducer switches are made (i.e., during CSS maneuvering), and (3) auto-pitch trim is inoperative outside of the trim cutout acceleration limits (+3, -0 "g"), it is possible to develop an out-of-trim condition while maneuvering in the AFCS mode. However, this out-of-trim condition must exist for approximately 10 seconds before the "A/P Pitch Trim" warning light illuminates, thus eliminating constant light flickering. Momentary illumination of the light does not necessarily indicate a malfunction; however, if the light remains on and it is apparent from the pitch trim indication that the trim is not working, the pilot should realize that a pitch transient may be experienced when the AFCS mode is disengaged. Airspeed/pitch trim indicator relationship should provide an indication of the severity of the transient. If an out-of-trim condition is realized by the steady illumination of the "A/P Pitch Trim" light, grasp the stick firmly before disengaging the AFCS mode in anticipation of a pitch "bump". However, before disengaging the AFCS following an automatic pitch trim malfunction, the pilot may elect to alleviate the out-of-trim condition by operating the manual trim button and observing the pitch trim indicator. If the out-of-trim condition is thus reduced to within five pounds of trim, the "A/P Pitch Trim" light will be extinguished. Illumination of the "A/P Pitch Trim" light will also illuminate the "Master Caution" light. Depressing the master caution reset button will only extinguish the "Master Caution" light, leaving the "A/P Pitch Trim" light illuminated.

Autopilot Disengaged Indicator Light

The "A/P Disengaged" light (figure 1-3) is located on the telelight panel. After initial engagement of the AFCS mode of operation, the "A/P Disengaged" light and "Master Caution" light will illuminate when the AFCS mode is disengaged by any means. Both lights will be extinguished by pressing the master caution reset button. The lights will remain extinguished until the AFCS is again disengaged.

Note

> If PC-I hydraulic pressure is lost or drops below 500 psi, stab aug and AFCS will be inoperative; however, the "A/P Disengaged", "Stab Aug Off", or "Pitch Aug Off" indicator lights will not illuminate.

Stab Aug Off Indicator Light (Prior to 153095y Without AFC203)

A "Stab Aug Off" indicator light is located on the telelight panel. The "Stab Aug Off" light and "Master Caution" light will illuminate any time power is on the airplane and the stab aug switch is disengaged. Depressing the master caution reset button will clear the "Master Caution" light; however, the "Stab Aug Off" light will remain illuminated until the stab aug switch is engaged.

Pitch Aug Off Light (153095y and Up; All Others After AFC 203)

The "Pitch Aug Off" indicator light (figure 1-3) is located on the telelight panel. The "Pitch Aug Off" and "Master Caution" lights will illuminate when power is on the airplane and the pitch stab aug switch is not engaged. Depressing the master caution reset button will extinguish the "Master Caution" light; however, the "Pitch Aug Off" light will remain illuminated until the pitch stab aug is engaged.

NORMAL OPERATION

Note

> The AFCS cannot be engaged unless the reference system selector knob on the compass controller is in PRIM and the power control knob on the inertial navigation control panel is in NAV.

Prior to engaging the AFCS, the following conditions must exist:

1. On airplanes prior to 153095y without AFC 203 incorporated, the stab aug switch must be engaged. On airplanes 153095y and up and all others after incorporation of AFC 203, the stability augmentation mode can be selected individually or in any combination for pitch, roll, and yaw axis. However, all three switches must be engaged for complete AFCS operation.
2. The airplane should be in trim.

3. An attitude within the AFCS limits must be established.
4. AFCS operation can then be achieved by engaging the AFCS switch.
5. On airplanes 153095y and up and all others with AFC 203 incorporated, engage the altitude hold switch immediately after inflight engagement of the AFCS.

WARNING

If the altitude hold switch will not remain engaged, a malfunction or out of synchronization condition exists in the pitch channel of the AFCS. If a pitch AFCS malfunction is indicated do not use the AFCS. This malfunction will not effect stability augmentation operation.

On airplanes prior to 153095y without AFC 203, if altitude or Mach hold is desired, establish a Mach number or altitude and engage the preferred mode. It should be remembered that Mach or altitude hold can only be selected after the AFCS is engaged and the desired Mach number or altitude has been established. Fore and aft stick movement will disengage the Mach or altitude hold modes. On airplanes 153095y and up and all others after incorporation of AFC 203, the Mach hold mode is removed. Manual trim during AFCS operation should not be used unless roll reversal is encountered, and then, only a small amount of trim should be used to counteract the roll. Autopilot disengagement can be accomplished by placing the AFCS switch OFF; the airplane will still be in the stab aug mode. On airplanes prior to 153095y without AFC 203 incorporated, the AFCS and stab aug modes can both be disengaged by depressing the emergency disengage lever on the control stick. On airplanes 153095y and up and all others after incorporation of AFC 203, the AFCS will be disengaged when the emergency disengage lever is depressed. The stab aug will be disengaged as long as the lever is held depressed but will return to normal operation when the lever is released. To permanently disengage stab aug, the pitch, roll, and yaw stab aug switches must be turned OFF.

OPERATIONAL PRECAUTIONS

Generator Switching

Power to the autopilot, central air data computer, and the INS may be momentarily interrupted during the starting and stopping of the airplane engines or generators. When the right engine or generator is started with the left generator already on the line, the connection between the right and left main buses is momentarily opened to allow the right generator to come on the line. This momentary interruption will allow the solenoid held switches on the AFCS panel to disengage. The AFCS and central air data computer will not be effected by starting or stopping the left engine or generator with the right generator on the line.

Note

If failure of the right generator occurs, place the right generator switch to OFF, then disengage the stab-aug prior to cycling the right generator switch back ON to prevent the possible occurrence of control surface transients. Stab aug may be engaged after the right generator has been cycled to ON or may be engaged with the right generator OFF.

Roll Reversal

There is a possibility of a condition called roll reversal occurring when operating the AFCS in the autopilot mode. This condition will occur infrequently and is apparent only when attempting small changes in bank angle. Roll reversal is associated with a small out-of-trim condition in the lateral control system and is apparent as a slow rolling of the aircraft in the opposite direction of the low lateral force. If, for instance, the airplane is out of trim laterally to the left when the autopilot mode is engaged, roll reversal may occur when low right stick forces are applied. A roll reversal situation may also be caused by operating the lateral trim button while in the autopilot mode, followed by low lateral stick forces being applied opposite to the direction of the trim. There is also a possibility of roll reversal occuring even if the airplane has been trimmed prior to engaging the autopilot mode, and the manual trim button had not been touched. This condition is brought about by changes in aircraft trim accompanying changed flight conditions.

Pitch Oscillations (Altitude Hold Mode)

When using the AFCS altitude hold mode, the aircraft may experience pitch oscillations in the transonic regions due to fluctuations in the CADC static pressure system. The nature of these oscillations vary from "stick pumping" to divergent pitch oscillations. It is recommended that in the event pitch oscillations occur, the altitude hold switch be turned OFF. Divergent pitch oscillations should not be allowed to develop. If any divergent pitch activity is noted, corrective action should be taken immediately.

Pitch Oscillations (Mach Hold Mode; Prior to 153095y Without AFC 203)

When using the AFCS with Mach hold mode engaged, a divergent oscillation may result if thrust is added and light forward stick force is applied as the nose rises to correct the Mach error caused by the thrust change. At 300 knots IAS, the "g" forces can reach +0.5 to +2.0 "g" with two to three inches of stick travel. Mach hold may disengage. The oscillation can be stopped by disengaging the AFCS. Pitch oscillations may become severe if thrust is added (while in Mach hold) at high airspeeds. Generally, thrust should not be added with Mach hold engaged.

EMERGENCY OPERATION

There are no provisions for emergency operation of the Automatic Flight Control System.

LIMITATIONS

Autopilot operation will be interrupted when ± 70° pitch or bank is exceeded. However, the AFCS engage switch will remain engaged and the autopilot will resume normal operation when the airplane is returned to within the ± 70° limits. If a load factor of +4 "g's" or -1 "g" is sensed by the G-limit accelerometer, the autopilot will revert to the stab aug mode and the AFCS engage switch must be re-engaged for AFCS operation

REFERENCE PUBLICATIONS

If more detailed system information is required, refer to Item No. 17, on Maintenance Instruction Manuals Publication Index (flyleaf 3, this publication).

BRAKE SYSTEM

DESCRIPTION

Each main landing gear is equipped with a multi-disc, multi-piston, hydraulic/pneumatic wheel brake assembly. Normal brakes are applied hydraulically, emergency brakes are applied pneumatically. The hydraulic and pneumatic brake systems are completely independent of each other, utilizing separate controls, lines, and actuating pistons. The normal brake system is controlled through toe action on the rudder pedals. The pedals are mechanically linked to two hydraulic power control units, one for each side, which serve to multiply pilot brake pedal effort and supply pressure to actuate the brakes. The fluid supply comes directly from the utility hydraulic system. The hydraulic brake system incorporates a 25 cubic inch accumulator which should supply sufficient pressure for a limited number of brake applications in the event the utility hydraulic system fails.

Note

In the event of a utility hydraulic system failure, the pilot should anticipate no more than three maximum effort brake applications from the accumulator.

In addition, the brake power control valves will act as conventional brake master cylinders in the event utility system pressure is lost, thus allowing the pilot to use manual braking. Manual braking should be sufficient to stop the airplane in deck rolls up to 8 degrees. Differential braking is available with normal, accumulator, or manual brakes. Each main wheel is equipped with three fuse plugs which melt and allow air to escape from the tire when tire/wheel overheating occurs with excessive braking.

EMERGENCY BRAKE SYSTEM

In the event of hydraulic pressure failure, an emergency air system is provided to accomplish maximum braking. Emergency pressure is provided by a 100 cubic inch air bottle charged to 3000 psi. Up to ten maximum effort applications may be made by means of the emergency brake handle (figure 1-3) located just inboard of the right console. It is hand operated, and is spring-loaded to the off or brake released position. It is a power brake valve of conventional design and meters air pressure to completely independent pneumatic brake cylinders in proportion to applied effort. The emergency pneumatic brake system does not provide differential wheel brake pressure. However, by applying the manual portion of the hydraulic brakes in conjunction with the emergency air brakes, differential braking can be accomplished.

NORMAL OPERATION

The brakes are conventionally operated by toe action on the rudder pedals. This action meters utility hydraulic pressure to force the brake disks together. Pedal pressure felt by the pilot is proportionate to braking force applied. The pilot is capable of locking the brakes by both normal and emergency braking systems. Caution must be exercised in overbraking, since a fully locked wheel offers less retardation than very light normal braking. If one wheel is locked during application of the brakes, there is a very definite tendency for the airplane to turn away from that wheel and further application of brake pressure will offer no corrective action. This produces a rapidly decreasing coefficient of friction between the skidding tire and the runway, while the coefficient of friction between the other tire and the runway remains near optimum for braking effectiveness. It is, therefore, apparent that a wheel, once locked, will never free itself until brake pressure to that wheel is reduced sufficiently to permit the wheel to rotate. It has been found that optimum braking occurs when the wheel is in a slight skid. The wheel continues to rotate but at a speed of approximately 80 to 85 percent of its normal free rolling rotational speed. Increasing the rolling skid above approximately 15 to 20 percent will only decrease the braking effectiveness. Recognition of maximum braking force is strictly a matter of pilot sensitivity. As with other examples of operating "on the limit", the only sure way of determining maximum braking effort is to exceed it. Since this is seldom a desirable technique, the pilot should attempt to mentally catalogue his body response to normal braking, in order to more readily recognize the maximum if an emergency should require it. For all conditions, normal and emergency, the most desirable braking technique is a single smooth application of the brakes with a constantly increasing pedal pressure (to just below the skid point) as the airplane decelerates. In the event of a reduction in retardation being felt while exercising maximum braking, pedal force must be fully released in order to allow the skidding wheel to regain full rolling speed before further application of brakes.

Note

Rough runways will tend to emphasize the skip or bounce characteristics of the airplane which are caused by relatively stiff struts. In order to preclude the possibility of locking a wheel while momentarily off the ground, use light braking until the airplane is solidly on the ground and all skipping has ceased.

WARNING

If it is suspected that the brakes have been used excessively and are in a heated condition, the airplane should not be taxied into a crowded parking area. Peak temperatures occur in the wheel brake assembly from 5 to 15 minutes after maximum braking. To prevent brake fire and possible tire explosion, the specified procedures for cooling brakes should be followed. it is recommended that a minimum of 15 minutes elapse between landings where the landing gear remains extended in the airstream, and a minimum of 30 minutes between landings where the landing gear has been retracted to allow sufficient time for cooling. Additional time should be allowed for cooling if brakes are used for steering, crosswind taxiing operation, or a series of landings.

EMERGENCY OPERATION

In the event of a utility hydraulic system failure, the airplane can still be stopped by utilizing accumulator brake pressure. This can be accomplished by depressing the brakes and applying a constantly increasing brake pressure. Do not pump the brakes as this will rapidly deplete the accumulator pressure. If accumulator brake pressure fails to stop the airplane, utilize the emergency air brake system. It should be remembered that there will be a slight time lag between pulling the emergency brake handle and braking action; that the system meters air in proportion to pilot effort; and that the system does not provide differential braking. In most cases, asymmetrical braking will be prevalent when utilizing the air brakes due to runway crown, crosswinds, and unequal brake torque. However, since there is some fluid trapped between the brake valves and the brakes, the manual hydraulic brakes are still capable of furnishing pressure to accomplish differential braking.

LIMITATIONS

There are no specific limitations pertaining to the brake system.

REFERENCE PUBLICATIONS

If more detailed system information is required, refer to Item No. 5 on Maintenance Instruction Manuals Publication Index (flyleaf 3, this publication).

CANOPY SYSTEM

DESCRIPTION

Each cockpit area is enclosed by a separate, transparent, acrylic plastic, clam shell type canopy. The canopies are hinged aft of each cockpit enclosure and open approximately 53 degrees. Canopy operation, both normal and emergency, is accomplished pneumatically. Clean dry air at 3000 psi is supplied by the pneumatic system and is reduced by a pressure regulator to 1000 +100, -0 psi for use in the normal canopy system. Individual manual controls are provided for each cockpit. In addition, external operation is provided for each cockpit by means of individual push buttons on the exterior of the fuselage. In normal operation, the canopy operating time is set at 5 seconds, and is controlled by pneumatic restrictors incorporated in the system. Each cockpit employs an inflatable canopy seal for cockpit pressurization. The canopy seals are automatically inflated and deflated upon opening and closing of the canopies. The emergency canopy system utilizes clean dry air at 3000 psi supplied from the pneumatic system. After leaving the air bottles, the pressure is reduced to 1375 ± 100 psi in order to minimize structural damage upon emergency opening of the canopy. Each canopy has individual manual control valves. These operate independently of each other to direct the flow of air to the actuating cylinders in each cockpit. The valves can be operated by pulling on the face curtain handles, alternate ejection handles, or by actuating the emergency canopy release lever. In addition, one emergency control is provided on the fuselage to open both canopies simultaneously for ground crew rescue purposes. The canopy emergency system also actuates the forward and aft cockpit flooding doors in order to reduce the time required to equalize the cockpit pressure under water in the event the airplane ditches. Design time for deck operation or testing of canopy emergency system is 2 seconds. Inflight operation of the canopy emergency system takes 1 second. Design time for under-water pressure equalization of the cockpit is 7 seconds.

Note

The canopy is designed to remain in the full open position up to 60 knots and to separate from the airplane at approximately 100 knots.

EXTERNAL CANOPY CONTROLS

External Canopy Buttons

The forward cockpit external canopy control buttons are located on the left side of the airplane just forward of the engine air intake duct. The aft cockpit external canopy control buttons are located on the left side of the airplane just above the engine air intake ducts between the forward and aft canopies. The forward and aft canopy push buttons operate independently of each other but their functions are the same. Push OPEN button to open the canopy; push CLOSE button to close the canopy. The push buttons operate the same valves as the internal canopy controls.

External Manual Unlock Handles

The forward canopy external manual unlock handle is located on the left side of the fuselage below the aft end of the canopy. The aft canopy external manual unlock handle is located in the same position below the aft canopy. Each handle operates independently, but their functions are the same. Operating a push-type latch causes the handle to pop out about 1-3/4 inches. A 63-degree counterclockwise rotation of the handle unlocks the canopy down-lock mechanism and permits the canopy to be lifted open manually. The aft canopy manual unlock handle operates the same as that of the forward canopy except that the handle rotation is clockwise.

INTERNAL CANOPY CONTROLS

Canopy Control Handle

The forward cockpit canopy control handle is located on the left side of the cockpit above the flap control panel and just below the canopy sill. The aft cockpit canopy control handle is located in the same position in the aft cockpit. Each canopy control operates independently, but their functions are the same. Pull control handle aft to open the canopy; push forward to close the canopy. Returning the control handle to the neutral position when opening or closing the canopy allows the canopy to be stopped at an intermediate position.

Manual Canopy Unlock Handles

The forward cockpit manual canopy unlock handle is located on the right side of the cockpit above the arresting hook control handle. The aft cockpit manual canopy unlock handle is located in the same position in the aft cockpit. Each cockpit manual canopy unlock handle operates independently, but their functions are the same. The handle, when pulled aft, releases the canopy down-lock linkage so the canopy may be pushed open to permit exit from the cockpit. Before manual unlocking of the canopy, the normal control lever must be placed in the open position. The manual unlock handle is used in the event that the airplane pneumatic system is depleted.

Note

When the canopy has been opened manually, it should be held open while entering or leaving the cockpit, since, without pressure the actuator may not hold the canopy in the open position.

Canopy Unlocked Indicator Light

An amber "Canopy Unlocked" light (figures 1-3 and 1-7), located in the forward and aft cockpits, is used to notify the crew that a canopy is unlocked. The pilot's "Canopy Unlocked" light will illuminate when either canopy is unlocked. The RSO's light will illuminate only when the aft canopy is unlocked.

EXTERNAL EMERGENCY CANOPY CONTROL

Emergency Jettison Lanyard

The external emergency canopy jettison lanyard is located on the left lower side of the fuselage, just forward of the nose wheel door. Pulling the handle operates the emergency canopy air valve. As the jettison lanyard is pulled, the forward canopy will be jettisoned. After the forward canopy has cleared the aft cockpit enclosure, the aft canopy will be jettisoned. This jettison sequence precludes the possibility of the forward canopy landing is an unprotected aft cockpit enclosure. The external canopy jettison lanyard is intended for use by the ground crew for rescue purposes.

INTERNAL EMERGENCY CANOPY CONTROLS

Emergency Canopy Release Handle

The forward cockpit emergency canopy release handle (figure 1-2) is located on the left side of the cockpit above the landing gear control. The handle is painted with black and yellow stripes for ease of identification. The aft cockpit emergency canopy release handle is located in the same position and is painted the same as the forward cockpit lever. Each canopy emergency release handle operates independently of the other but their functions are the same. The handle, when pulled aft, operates the emergency canopy valve which directs 1375 ± 100 psi to the canopy actuator and cockpit flooding doors actuators. When the aft emergency canopy release handle is pulled aft, the action is identical to that in the forward cockpit. The emergency canopy release handle is primarily used for ditching.

Emergency Canopy Release (Ejection Seat)

The seat ejection handles are used to jettison the canopy prior to ejection. A downward pull on the face curtain handle, or an upward pull on the alternate ejection handle will jettison the canopy. Refer to Ejection Seats, this section.

NORMAL OPERATION

Normal operation of the canopies is accomplished through the use of push buttons on the exterior of the

Central Air Data Computer

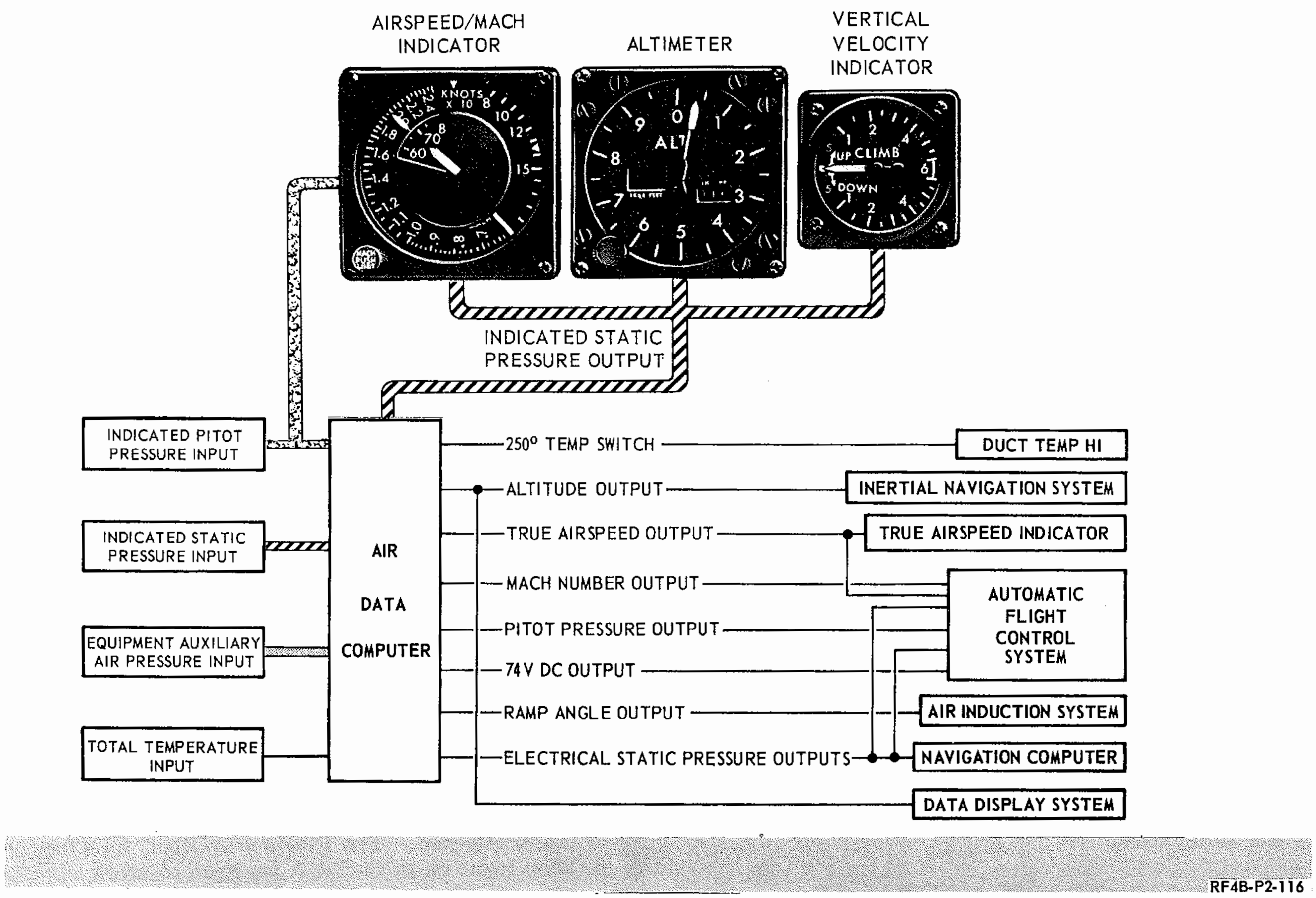


Figure 1-14

aircraft and a lever in the cockpit. Refer to applicable canopy control, Canopy Systems.

EMERGENCY OPERATION

Emergency operation of the canopies is accomplished through the use of an emergency jettison lanyard on the exterior of the airplane and an emergency canopy release handle in each cockpit. Refer to applicable emergency canopy control, Canopy Systems.

LIMITATIONS

With the canopy open, taxi speeds should be kept below 60 knots.

REFERENCE PUBLICATIONS

If more detailed system information is required, refer to Item No. 3, on Maintenance Instruction Manuals Publication Index (flyleaf 3, this publication).

CENTRAL AIR DATA COMPUTER SYSTEM (CADC)

DESCRIPTION

The central air data computer, located in the rear cockpit, utilizes inputs of indicated pitot pressure, indicated static pressure, equipment auxiliary air pressure, and total temperature. The total temperature sensor is located on the nose wheel door. When taxiing close behind an operating jet engine, the sensor will pick up the sudden temperature change. This may result in the extension of the variable duct ramps. The computer (figure 1-14) provides electrical outputs to meet the requirements of the "Duct Temp Hi" indicator light, inertial navigation system, true airspeed indicator, automatic flight control system, air induction system, and navigation computer. A static pressure compensator is installed aboard the aircraft. The design and location of the pitot-static probe provides a static source with a very small position error. The compensator, therefore, is not used and the static pressure compensator switch, located on the inboard engine control panel (figure 1-2), is inoperative. A "Static Corr Off" light is located on the right vertical panel in the forward cockpit. The light is inoperative. The static pressure compensator is retained aboard the aircraft for future use. If calibrated airspeed or altitude correction is required, refer to Air Speed Position Error Correction and Altimeter Position Error Correction charts, Section XI.

NORMAL OPERATION

With the static pressure compensator switch inoperative, there are no normal procedures pertaining to the central air data computer system.

EMERGENCY OPERATION

There are no emergency operation procedures pertaining to the central air data computer system.

LIMITATIONS

There are no specific limitations pertaining to the central air data computer system.

REFERENCE PUBLICATIONS

If more detailed system information is required, refer to Item No. 12, on Maintenance Instructions Manuals Publication Index (flyleaf 3, this publication).

COMMUNICATION-NAVIGATION-IDENTIFICATION (CNI) EQUIPMENT

DESCRIPTION

The integrated electronic central, AN/ASQ-88, provides communication, navigation and identification functions for the aircraft. Communication functions are provided by subsystems which include a UHF transmitter-receiver, an auxiliary UHF receiver, an HF transmitter-receiver, an intercommunication system and a voice recorder. Navigation functions are provided by subsystems which include a TACAN receiver-transmitter and the ADF feature of the UHF receivers. Identification functions are provided by an SIF subsystem.

EXTERNAL GROUND POWER OPERATION

With external ground power connected to the airplane and neither of the two generators connected to the line, the integrated electronic central will not operate unless the CNI-GND PWR switch is placed to the ON position. The CNI GND PWR switch, located in the left wheel well, applies external power to the integrated electronic central for ground operation. The switch is manually operated and electrically held, and must be reset after each interruption of external power.

INTERCOM SYSTEM

Intercommunications between pilot and RSO, or pilot, RSO and ground crew are provided by the intercom system. Each cockpit is provided with a primary and secondary amplifier. During normal operations, the primary amplifiers are used to amplify microphone output while the secondary amplifiers are used to amplify all audio signals, both internal and external, before feeding them to the headsets. For example, when the pilot talks on intercom, his microphone output goes to the front cockpit primary amplifier. This amplifier then directs the signal to both front and rear cockpit secondary amplifiers. The secondary amplifiers feed the signal to the headsets in their respective cockpits. Should any intercom amplifier become inoperative, communications may be restored by bypassing the faulty amplifier with the amplifier selector knob. An external intercom receptacle is installed in the left wheel well to provide communications between ground and aircrews.

Note

> The external intercom receptacle is wired to the RSO's microphone line and earphone. As a result, the ground crewman and the RSO can block each other during simultaneous transmissions. The RSO's amplifier selector knob must be in the NOR position to allow ground crew-pilot communications.

The intercom system is controlled by means of the intercom control panels (figures 1-2 and 1-6) located in each cockpit.

INTERCOM CONTROLS

The intercom controls consist of volume controls, function selector switches, emergency amplifier selector switches, intercom switches and microphone buttons.

Volume Control

The intercom volume control knob is located at the left side of the intercom panels. The input level of the intercom signals to the headsets is increased by rotating the volume control knob in a clockwise direction. Signals received from other radio receivers are not affected by the intercom volume control knob.

Function Selector Switch

A three-position toggle switch, with positions marked RADIO OVERRIDE, HOT MIC and COLD MIC, is located on the right side of the intercom control panel. The RATIO OVERRIDE position of the switch is momentary, while the HOT MIC and COLD MIC positions are fixed. The HOT MIC position allows continuous intercom transmission. The COLD MIC position requires the intercom button, on the inboard throttle, to be depressed to allow transmission. The RADIO OVERRIDE position is identical to HOT MIC, except that all other radio volume is reduced; communications between cockpits then overrides other radio reception. In order to select COLD MIC operation, the function selector switches in both cockpits must be in COLD MIC. If either crewmember selects HOT MIC or RADIO OVERRIDE, the system will correspond to that function.

Intercom Microphone Button (Pilot's)

An intercom microphone button is installed on the pilot's inboard throttle grip. The intercom microphone button is utilized for inter-cockpit and cockpit-to-ground communication when both function selector switches on the intercom control panels are in COLD MIC.

Intercom Foot Switch (RSO)

A foot operated switch is installed on the left foot ramp in the RSO cockpit. This switch is wired in parallel with the pilot's intercom switch. By depressing his foot switch, the RSO may override any of the positions selected on the radio override switch. This permits intercom transmissions without the necessity of releasing other manual controls.

Amplifier Selector Knob

NEW

The amplifier selector knob is a three-position rotary-type switch located on the intercom control panel. This knob provides a means of bypassing a failed amplifier to select an operational amplifier. There are three settings for the control, NOR, EMER RAD, and EMER ICS. The NOR position is used when all amplifiers are operating properly. The EMER RAD position will bypass the secondary amplifier and utilize the primary amplifier for all operations, while the EMER ICS position will bypass the primary amplifier and utilize the secondary amplifier for all operations.

Note

> In the event both amplifier selector knobs are in an emergency position (EMER RAD and/or EMER ICS), and both intercom volume control knobs are above 75% of their volume range, a loud squeal will be heard in both headsets. To eliminate the squeal, turn either volume control knob to a position below 75% of its volume range.

Microphone Button

The microphone buttons are used to connect microphone outputs to the UHF or HF transmitter. The pilot's microphone button is located on the inboard throttle grip, the RSO's microphone button is a foot-operated switch on the right foot ramp. When either crewmember wishes to transmit, he selects either UHF or HF on the radio selector switch and depresses the microphone button, and the output from the microphone is fed into the transmitter. The positioning of other controls in no way affects the transmitting operation from either cockpit.

MAIN RECEIVER-TRANSMITTER (UHF)

The main receiver-transmitter is designed to broadcast and receive UHF frequencies in a range of 225.0 to 399.9 mc for air-to-air or air-to-ground communications. Complete control over the operation of the main radio receiver-transmitter can be maintained by either the pilot or the RSO through the Comm-Nav group control panels (figures 1-3 and 1-6), located in each cockpit. The pilot's Comm-Nav group control panel is located on the right console, the RSO's panel is located below the instrument panel, to the left of the radar scope. The Comm-Nav group control panel provides control for operation of the main receiver-transmitter on any one of the 1750 channels available, on 18 preset channels, a guard receiver, or for ADF operation with associated direction finder equipment.

MAIN RECEIVER-TRANSMITTER CONTROLS

The controls for the operation of the main receiver-transmitter are located in the middle of each Comm-Nav group control panel (figures 1-3 and 1-6). The controls consist of manual communication frequency controls, communication channel selector knob, function switch and volume control knob.

Communication Frequency Controls (Comm Freq MC)

Three control knobs, at the top of the Comm-Nav group control panel, are used to manually adjust the operating frequency of the radio receiver-transmitter when the communication channel control knob is in the M position. When the communication channel control knob is not in the M position, the communication frequency control knobs do not affect the operating frequency.

Communication Channel Control (Comm Chan)

The communication channel control knob is located at the upper left on the Comm-Nav group control panel. This knob, when rotated, will select 18 preset channels of operation that will be shown in the UHF remote channel indicator window. There is also an M position which permits the operator to select manually the operating frequency, and a G position which permits operation on the guard frequency of 243.0 mc.

UHF Remote Channel Indicator

A remote channel indicator is located on each instrument panel (figures 1-4 and 1-5). This enables the crewmember to dial a channel with the communication channel control knob without shifting his vision from the instrument panel.

Function Switch

The function switch is located in the right center of the Comm-Nav group control panel. The switch is labeled UHF Comm and Aux Rec. Only the UHF Comm portion of the switch shall be discussed at this time. The switch consists of five positions described below:

STBY	- The standby position indicates that only filament power is applied to the radio receiver-transmitter to warm-up the set.
T/R	- In this position, the radio receiver-transmitter is activated for transmitting and receiving operations. The set will normally be on receive until the microphone button is depressed.
T/R+G	- In this position the radio receiver-transmitter will operate on transmit or receive within the 225.0 to 399.9 mc range; in addition, the guard receiver is turned on.
ADF+G	- In this position, the radio receiver-transmitter operates with the receiver-ADF-power supply unit and the antenna unit in an automatic direction finder system. This position will also furnish guard channel reception.
ADF	- In this position, the radio receiver-transmitter operates with the receiver-ADF-power supply unit and the antenna unit in an automatic direction finder system.

AUXILIARY RECEIVER

An auxiliary receiver works in conjunction with the main radio receiver-transmitter under normal conditions, and operates as an emergency receiver in the event of power failure to the main radio receiver-transmitter. The auxiliary receiver can be used as a conventional radio receiver for reception of AM radio signals in the frequency range of 265.0 to 284.9 mc on 20 preset frequency channels. It can also be used as an ADF receiver for any of the signals on the 20 preset frequency channels when the function switch is in the ADF position. The auxiliary receiver contains a guard receiver which receives signals on 243.0 mc when the function switch is in the guard (GRD) position. The auxiliary receiver can be placed in either function by operation of the controls on either Comm-Nav group control panel. Channel selection is also accomplished by operation of the aux chan control on one of the Comm-Nav group control panels. The function switch controls the functions of the auxiliary receiver equipment and provides for either the auxiliary receiver or the main radio receiver-transmitter to be operating as an ADF receiver while the other equipment is operating as a voice receiver. The direction finder group of the auxiliary receiver provides the pilot with continuous indications of the direction of radio frequency signals intercepted by either the radio receiver-transmitter or the auxiliary receiver which is used in conjunction with the ADF system. These receivers function to receive amplitude modulated and unmodulated signals in the frequency range of 225 through 400 mc and 265 through 284.9 mc, depending on which receiver is used. Continuous indication of the bearing of the intercepted signals relative to the airplane heading is presented on the horizontal situation indicator. Necessary primary power, 115 volt a-c, is applied to the auxiliary receiver when the electrical system is energized.

AUXILIARY RECEIVER CONTROLS

The controls for the operation of the auxiliary receiver are located in the middle of each Comm-Nav group control panel. The controls consist of a channel control knob, volume control, and function switch.

Channel Control

The operating channels for the auxiliary receiver are selected by operation of the auxiliary channel control knob located on the left side of each Comm-Nav group control panel. The channel, selected by rotating the control, is shown in the window directly to the right of the auxiliary channel control knob.

Volume Control

The auxiliary receiver volume control knob is located directly below the auxiliary channel window on the Comm-Nav group controls. Operating this control varies the audio input level to the intercom loop.

Function Switch

The function switch, labeled UHF Comm-Aux Rec, is located at the right side of the group controls. This control provides facilities for selection of the various modes of operation of the auxiliary receiver and the main radio receiver-transmitter. As the control is rotated, different modes of operation are selected for the radio receivers. There are five possible control settings for each receiver. One control position for one receiver corresponds to a control position for the other. The auxiliary receiver functions are selected from the positions at the bottom of the dial. These positions are GRD, CMD, ADF, ADF and STBY.

GRD	- When the function switch is positioned so that the auxiliary receiver setting is at the GRD position, the main receiver is in the ADF position. This allows the operator to monitor the guard channel frequency and maintain ADF operation at the same time.
CMD	- When the auxiliary receiver is set for CMD position, a command antenna is connected to the auxiliary receiver. The main receiver is positioned in the ADF+G position.
ADF	- The auxiliary receiver is placed in ADF operation at either of two positions. At one of these switch settings, the ADF antenna is connected to the auxiliary receiver and the radio receiver-transmitter is set at the T/R+G position for receiving, transmitting and monitoring the guard channel frequency.

ADF - When the auxiliary receiver function switch is placed in the other ADF position, the main receiver will be positioned at the T/R position. This setting will connect the ADF antenna to the auxiliary receiver and at the same time the main receiver will be set for receiving and transmitting operations.

STBY - When the auxiliary receiver is set for standby, the main receiver will also be positioned at standby.

COMM COMMAND CONTROL

A communication command push button control marked Comm Cmd is located in the lower left corner of each Comm-Nav group control panel. Operation of this push button allows the operator to take or relinquish command of the communication system. A green light in the center of the push button lights up when the operator has control of the radio receiver-transmitter, the auxiliary receiver and ADF functions. When one of the operators has command of the communication functions, depressing the communication command button on the Comm-Nav group control panel will transfer the communication functions to the other operator. If one of the operators does not have control of the communication functions, depressing the communication command button will take control away from the other operator. The volume controls on each Comm-Nav group control panel are independent of each other, and are not affected by the take command functions.

Note

Do not switch UHF channel when other operator is utilizing the UHF communications transmitter. The nature of the system is such that there is a possibility of an inadvertent change of channels on the users set.

ANTENNA SELECTOR SWITCH

A two position antenna selection switch, (figure 1-2) located in the front cockpit and labeled UPPER and LOWER, enables the pilot to select either the upper or lower UHF blade antenna for UHF radio operation.

Radio Selector Switch

A two position radio selector switch (figures 1-2 and 1-5), located in each cockpit and labeled HF-UHF enables the crewmembers to select the radio set to be used for voice communications.

HF RADIO SET AN/ARC-105

The High Frequency radio set provides long range voice communication capabilities within the frequency range of 2.000 megacycles to 29.999 megacycles. The set's 28,000 channels, spaced 1 kilocycle apart, combined with three modes of operation; upper side band, lower side band and amplitude modulation equivalent, make it a highly effective and reliable communication system. The components of the set are a single side band, remote controlled transmitter receiver, a radio set control unit and antenna tuning and coupling devices. The antenna arrangement is unique in that the skin of the aircraft serves as the antenna, with the feed point being at the base of the forward spar in the vertical stabilizer.

CAUTION

Do not operate the HF transmitter when personnel are working about the airplane, particularly in the area of the vertical stabilizer, as r-f burn injuries could result.

HF RADIO CONTROLS

The radio set control unit, located in the rear cockpit, enables the RSO to turn the set on and off, select the mode of operation, change frequencies, control the master volume of the system, and perform the HF BIT (Built In Test) checks. The control unit includes the function selector knob, four operating frequency selector knobs, the RF sensitivity knob, the RF test switch, the RF indicator light and the operating frequency indicator.

Function Selector Knob

The function selector knob, with positions of OFF, USB (upper side band), LSB (lower side band) and AM (amplitude modulation) is used to turn the set ON and OFF, and to select the three operating modes.

Operating Frequency Selectors

The operating frequency selectors are used to set the desired frequency in the operating frequency indicator. There are four selectors in all, the first of which controls the megacycle digits, while the remaining three control the 100, 10, and 1 kilocycle digits of the frequency selected.

Operating Frequency Indicator

The operating frequency indicator furnishes digital readout of the frequency presently set in the radio. The indicator is lighted internally and the light intensity may be controlled with the instrument panel lights control knob (figure 1-5).

Radio Frequency Sensitivity Control

The RF SENS knob is used to achieve the best compromise between received signals and atmospheric noise.

Radio Frequency Test Switch

The "RF" test switch is used in conjunction with the "RF IND" light in performing the BIT Checks.

Radio Frequency Indicator Light

The "RF Ind" light, used in conjunction with the RF test switch, furnishes the operator with a go no-go indication of system operation.

Radio Selector Switch

A two position radio selector switch (figures 1-2 and 1-5), located in each cockpit and labeled HF - UHF, enables the crewmembers to select the radio set to be used for voice communications.

HF Volume Control

The HF volume control knob is located on the pilot's left console. The knob controls volume of the HF radio system in the pilot's cockpit only.

TACAN (TACTICAL AIR NAVIGATION) SYSTEM

The TACAN navigation system functions to give precise air-to-ground bearing and distance information at ranges up to 196 miles (depending on airplane attitude and altitude) from an associated ground or shipboard transmitting station. It also determines the identity of the transmitting station and indicates the dependability of the transmitting station signal. It will provide deviation indication from a selected course. The TACAN navigation system employs UHF radio frequencies, the propagation of which is virtually limited to line of sight distances. The maximum distances from the beacon at which reliable TACAN signals can be obtained depends on the altitude of the airplane and the height of the transmitting antenna. The TACAN navigation system will also provide air-to-air TACAN capability for airplane rendezvous, station keeping and collision avoidance. In this mode (also called bilateral ranging) both ends of the air-to-air link will simultaneously give a continuous display of the link distance. It is possible for five airplanes (all equipped for bilateral ranging) to simultaneously obtain and display on their BDHI and/or HSI the distance from a sixth similarly equipped airplane, with the sixth airplane displaying the distance to one of the other five. The bearing circuits of the TACAN will be disabled during air-to-air ranging. Air-to-air bearing information is supplied by the ADF function of the UHF radio. TACAN information is presented on the HSI, and ADI in the pilot's cockpit (refer to Navigation Equipment, this Section), and on the No. 2 needle of the BDHI in the RIO's cockpit. The BDHI is a conventional RMI display with the additional feature of displaying distance to a TACAN station. The No. 2 bearing pointer of the BDHI is the TACAN needle and indicates magnetic heading to the TACAN station. The No. 1 pointer, provides magnetic heading to the selected UHF station. The BDHI indicator is also capable of displaying distance information to a TACAN station. When a usable signal is not being received, the red warning flag partly obscures the distance indicators from view and the word "OFF" in black letters will appear in the window. The units digit indicator dial is divided into 1/2 mile increments. The BDHI is controlled strictly from the aft cockpit by a BDHI MODE switch located on the aft left subpanel. Switch positions selected on the mode-bearing/distance selector panel in the pilot's cockpit will have no effect on BDHI operation.

TACAN CONTROLS

All operating controls for the TACAN system are located on the lower third of the Comm-Nav group (figures 1-3 and 1-6) control panels. The controls and their functions are as follows:

Function Selector Knob

The TACAN function selector knob is a four-position rotary switch whose positions are marked STBY, REC, T/R and A/A.

STBY - When the TACAN function selector knob is in the STBY position, only filament and blower power are being supplied to the receiver and transmitter.

REC - The REC position places only the receiver portion of the system in operation. When the TACAN function selector knob is in this position, only bearing information is furnished to the horizontal situation indicator and bearing-distance-heading indicator.

T/R - When the TACAN function selector knob is in the transmit-receiver position, the airplane transmitter sends a signal to the transmitting station and receives a signal which is used to determine the airplane distance from the transmitting station. Both bearing and range information are furnished to the HSI and BDHI.

A/A - When the TACAN function selector knob is in the air-to-air position, range to the transmitting airplane is displayed on the BDHI and/or HSI. To obtain ADF bearing information on the HSI, the bearing distance selector switch must be placed to the ADF/AA DIST position.

Navigation Channel Control Knobs

Two nav chan control knobs, one to the right and one to the left of the nav chan window permit channel selection. The left knob selects the tens and hundreds digits of the operating channel. The right knob selects the units digits of the operating channel. The dial system is numbered 0 to 129; each number from 1 to 126 represents a specific pair (transmitting and receiving) of frequencies. Numbers 0, 127, 128 and 129 on the channel dial are not usable. In both air-to-air and air-to-ground TACAN operation, the transmitter frequency range for channels 1 through 126 is 1025 mc through 1150 mc. The air-to-ground TACAN receiver frequency ranges are 962 mc to 1024 mc and 1151 mc to 1213 mc. In air-to-ground TACAN operation, the low-band receiving frequencies for channels 1 through 63 are 63 mc below the transmitting frequency. The high-band receiving frequencies for channels 64 through 126 are 63 mc above the transmitting frequency. In the air-to-air ranging mode, when the transmitter is operating between 1025 mc and 1087 mc (channels 1 through 63) the receiver is operating 63 mc above the transmitter frequency, or between 1088 mc and 1150 mc. When the transmitter (air-to-air) is operating between 1088 mc to 1150 mc (channels 64 through 126) the receiver is operating 63 mc below the transmitter frequency, or between 1025 mc and 1087 mc. As a result, during A/A operation, the transmitter and receiver are operating within the transmitter band of frequencies only. Consequently, there are 63 pairs of air-to-air ranging channels available. Low-band channel 1 pairs with high-band channel 64, channel 2 with 65, etc., for bilateral TACAN operation.

Navigation Volume Control Knob

The nav vol control knob is used to adjust the volume of an audio identification signal received from the transmitting station. The identification signal consists of a two - or three-letter tone signal in international morse code. The identification signal is normally transmitted every 30 seconds.

Navigation Command Button

The nav CMD button transfers control of the TACAN functions from one cockpit to the other. When the green light in the center of the nav CMD button in one cockpit illuminates, command of the TACAN functions has been obtained in that cockpit. Then, the channel controls and function knob in that cockpit only are effective. The nav vol control knob is effective in both cockpits regardless of the take-command situation.

RADAR IDENTIFICATION

SIF (Selective Identification Feature)

The aircraft incorporates a transistorized SIF coder which provides automatic selective identification of the airplane in which it is installed when properly challenged by surface or airborne radar sets. Supplementary purposes are to provide momentary identification of position upon request and to transmit a specially coded response to indicate an emergency. In operation, the radar identification system receives coded interrogation signals and transmits coded responsive signals to the source of the challenge, where the response is displayed together with associated radar information (target, etc.) on the radar scope. Proper reply indicates the target is friendly. Three modes of operation are provided for response to interrogation signals. These are known as Mode 1, Mode 2, and Mode 3, which are used for security identification, personal identification and traffic identification, respectively. The radar identification system utilizes 115 volt a-c and 28 volt d-c electrical power.

Note

- The radar identification system has the capability of being coded in Mode 2 on the ground.
- The radar identification system does not have Mark X IFF capability.

Radar Identification Control Panels

Two SIF control panels (figure 1-3) are located on the pilot's right console. No SIF control panels are located in the rear cockpit. The control panels contain the system master control knob, two mode selector switches, two code selector switches and an I/P switch. The five-position master control knob is marked OFF, STBY, LOW, NORM and EMERGENCY. In the STBY position the system is inoperative but ready for instant use. In the LOW position the system operates in partial sensitivity and replies only in the presence of strong interrogations. In the NORM position the system operates in full sensitivity which provides maximum performance. In the EMERGENCY position, the coder will respond to interrogations with an emergency (code) response, regardless of mode or code selection on the control panels. The emergency SIF will also be tripped upon ejection of either or both crewmembers. Emergency signals, however, will not be transmitted until the airplane is interrogated by a ground station. The mode 2 selector switch, placarded MODE 2 and OUT, is used for personal identification. The mode 3 selector switch, placarded MODE 3 and OUT, is used for traffic identification. The identification of position (I/P) switch, placarded I/P, OUT and MIC, is utilized upon request, to provide momentary identification of position when held in the spring-loaded I/P position. When placed in the MIC position, the identification of position signals are transmitted while the microphone button is held depressed. Two rotary code selector switches are used to select the specified code signals to be used in Mode 1 and Mode 3 operation. The specified coded signals to be used in Mode 2 are preset on the ground and cannot be changed in flight.

VOICE RECORDER (RO-254/ASQ)

The voice recorder is used to record selected HF-UHF and intercom (ICS) transmissions. The voice recorder is a transistorized unit requiring no warm-up time. The voice recorder, located aft of the RSO's left console, has a removable tape magazine. The magazine contains 1/4-inch magnetic tape for maximum recording time of 60 minutes. The recording time remaining is displayed on an indicator, located on top of the magazine, in 10-minute increments. When the voice record power switch, located on the RSO's left subpanel, is placed to ON, the voice recorder is placed in a standby condition and the V/R PWR light on both telelight panels is illuminated. Operation of the voice recorder is initiated by actuating the mic button in either cockpit. The voice record power switch should be placed OFF when the 60-minute recording time has elapsed. To play-back the tape on a standard tape recorder, the tape must be removed from the reel on which it has been stored twisted 180°, and rewound onto a standard tape reel.

NORMAL OPERATION

NORMAL OPERATION OF INTERCOM SYSTEM

The intercom system will become operative when the airplane 28 volt d-c essential bus is energized. Set the function selector switch to the HOT MIC position and the amplifier selector knob to the NOR position. Set the volume control as desired.

To check the intercom system prior to flight:

1. Function selector switch - HOT MIC

2. Amplifier selector knob - NOR
3. Volume control knob - ROTATE CLOCKWISE

With the intercom controls positioned as stated, check the duplex operation of the system by talking into the microphones. Rotate the volume control knobs to insure that they are operating properly. Place the amplifier selector knob to EMER RAD and EMER ICS to insure that their amplifiers are operating properly. Place the function selector switch to COLD MIC and check the operation of the intercom microphone button and intercom foot switch. Individually place the function selector switches to RADIO OVERRIDE and check for reduction of UHF communication and/or TACAN volume. The RADIO OVERRIDE positions should be checked individually since reduction in volume for the radio receivers is accomplished in both headsets when only one switch is actuated.

NORMAL OPERATION OF COMMUNICATIONS TRANSMITTER AND RECEIVERS (UHF)

With aircraft power activated, the main UHF radio receiver-transmitter, and the auxiliary UHF receiver will be placed into operation by moving the function selector switch out of the STBY position. The desired frequencies for the functions selected can be obtained by utilizing the Aux Chan, Comm Chan and Comm Freq controls. A quick check to prove the main UHF equipment is operating at an adequate power level should be made by performing a receiver-transmit check with the base control tower on several frequencies. The auxiliary receiver should be checked by selecting the CMD position and rotating the aux volume control fully clockwise. A live sound should be heard on the headsets. A further check may be made by receiving from the control tower if deemed necessary. The ADF loop should be preflight checked with each of the two receivers utilized in the system, the main radio receiver-transmitter, and the auxiliary receiver. Place the function switch on either Comm-Nav group control panel to the main receiver ADF or the main receiver ADF+G position. Tune the main radio receiver transmitter to the frequency of a station of known geographical location by use of the main channel frequency selector control knobs, and adjust the main volume control knob to obtain a comfortable listening level in the headset. Select the 1 UHF ADF - 2 TACAN position on the BDHI mode switch in the rear cockpit and the ADF/AA DIST position on the mode bearing/distance selector panel in the front cockpit. Observe the bearing pointer on the HSI and the No. 1 needle on the BDHI, and note that they indicate the approximate direction of the signal relative to the airplane heading. Place the function switch in the auxiliary receiver ADF position and tune the auxiliary receiver to a station of known geographical location by use of the auxiliary channel control knob. Note that the needle on the indicator indicates the approximate direction of the signal relative to the airplace heading. Adjust the auxiliary volume control to obtain a comfortable listening level. (A 100 cycle buzz should be heard in the headset while the antenna is searching.) A preflight check may also be accomplished by utilizing the transmitting facilities in the control tower if the aircraft is taxied to a remote point of the airstrip.

Note

- When in the gear down configuration, the ADF antenna pattern is distorted due to the close proximity of the nose landing gear door to the antenna. Therefore, the UHF ADF system should not be relied upon as a primary navigational aid in the gear down configuration.
- When used on the ground, bearing error in the system will likely exceed 30° and therefore no accuracy tolerances are established for this condition.

Due to ADF pattern distortion at the higher frequencies of the UHF band, sizable bearing inaccuracies can be expected at frequencies above 310 mcs. Precise navigational operation should be limited to assigned ADF frequencies (265 to 284.9 MCS) when using the auxiliary receiver, and to frequencies lower than 310 mcs when using the main receiver.

NORMAL OPERATION OF HF RADIO

With aircraft power activated, the HF radio will be placed into operation by placing the function selector knob to the desired operating mode. After a one minute warm-up period place the operating frequency selectors to the desired frequency. Note that when the receiver-transmitter is changing frequency, the receiver audio output is muted. Place the UHF/HF switch to the HF position. Adjust the RF sensitivity control for a comfortable listening level. Depress and release the microphone button. Momentarily depressing the microphone button will initiate the antenna coupler tuning cycle. During the tuning cycle, a 1000 cps audio tone will be present in the headsets. When the audio tone stops, the radio is ready for transmit operation.

BIT CHECKS (HF RADIO)

The built-in-test (BIT) feature of the radio set allows the operator to quickly determine the area of trouble, should it develop, so that alternate frequency/mode selection may be made to establish communications. The feature also allows the operator to effectively check out the equipment prior to landing to shorten aircraft turn around time. The procedure is as follows:

1. Set up radio for normal operation.
2. RF test switch - DEPRESS
   a. "RF Ind" light - ILLUMINATED
      The "RF Ind" light may blink for approximately 5 seconds and then light continuously. The 1000 cps tone will be present in the earphones. This indicates that the system is operational and ready for use.
   b. "RF" light - NOT ILLUMINATED
      If the 1000 cps tone is present, indications are that the transmitter is not putting out sufficient power to tune the coupler system. Set up a new frequency and repeat the check. If no sidetone is present, indications are that the transmitter is not putting out any power and the set is not operational.

c. "RF Ind" light - BLINKS CONTINUOUSLY
If the 1000 cps tone is present, indications are that the coupler has lost pressure. Set up a new frequency and repeat the check. If the same results are obtained, use the transmitter only as operational necessity dictates and then only for short periods of time.

Note

Coupler pressure is equal to atmospheric pressure at 5000 feet, and therefore a "lost pressure" indication will never show up below this altitude.

If no 1000 cps tone is present, indications are that the coupler system has failed to tune or that the radio-transmitter has lost pressure. Release the RF test switch and speak into the microphone. If voice is present in sidetone, select a new frequency and repeat the check. If the light blinks longer than 25 seconds, the coupler system will not tune. If voice is not present in sidetone, the radio-transmitter has lost pressure. In either case, the set is not usable.

If "RF Ind" light blinks without RF test switch being operated:

3. Select a different frequency momentarily, then key the microphone button.
If the antenna coupler does not complete its tuning cycle within 30 seconds after it starts, the "RF Ind" light will flash automatically without the RF test switch being operated. If this occurs, select a different frequency momentarily, then key the microphone button to initiate retuning action in the antenna coupler. If the "RF Ind" light starts to blink during radio transmissions, the reflected power has exceeded limits and the radio should be retuned.

If trouble persists:

4. Attempt operation on a different frequency, a different operating mode, or both.

NORMAL OPERATION OF TACAN

Starting and stopping of the TACAN system is controlled by the function switch. When this switch is in the STBY position, only the equipment filament and blower power are on. When the switch is in either REC or T/R position, the equipment is ready to operate. To operate the TACAN receiver and transmitter, set the function switch to REC if only bearing information is desired, or to T/R position if both bearing and distance information is desired. Allow a warm-up period of approximately 90 seconds. Turn the navigation selector dials to the channels of a TACAN station within operating range. Place the bearing/distance selector switch on the pilot's instrument panel in the TACAN position, and the BDHI mode switch in the aft cockpit in the TACAN position. Bearing and distance to the TACAN station will be displayed on the HSI and BDHI. The identification signal for the selected TACAN station should be heard in the headphones.

WARNING

The TACAN system may occasionally be subject to a false lock-on, which will result in an erroneous bearing indication. Due to an inherent characteristic of the system, the error will occur in multiples of 40 degrees. Therefore, when using the TACAN, cross check for false lock-on with ground radar, airborne radar, dead reckoning, or other available means. These cross checks are especially important when switching channels. If a false lock-on is suspected, switch to another channel, check it for correct bearing, and then switch back to the desired channel. If a false lock-on still persists, utilize other equipment or aids available.

Two airplanes operating in the A/A mode, tuned 63 channels apart, supply distance information to each other since each would be operating as interrogator and transponder. When three or more airplanes (maximum of six) are using the A/A mode, a lead airplane is designated to operate as transponder. The lead airplane is tuned exactly 63 channels away from the interrogating airplanes which are all tuned to the same channel. The lead airplane supplies distance reply pulses to each of the interrogating airplanes which are decoded and supplied to the BDHI and/or HSI distance counters. The lead airplane interrogates, locks-on and displays distance to one of the interrogating airplanes, although it cannot determine to which one.

NORMAL OPERATION OF RADAR IDENTIFICATION SYSTEM

To maintain the equipment inoperative but ready for instant use, rotate the master control knob to STBY. To place the equipment in operation, rotate the master control knob to NORM.

Note

- The LOW position of the master control knob should not be used except upon proper authorization.
- Mode 1, the selective identification feature, is in operation when the master control knob is in NORM.

After turning on the equipment, set up the operating mode as directed. For emergency operation, press dial stop and rotate master control knob to EMERGENCY so that the set will automatically transmit a special coded distress signal in response to interrogation. To turn off set, rotate master control knob to OFF.

EMERGENCY OPERATION

EMERGENCY OPERATION OF INTERCOM SYSTEM

If the intercom system is operating in duplex (either or both of the function switches in HOT MIC), and one of the amplifying stages fails, the fault may be corrected by placing one or both of the amplifier selector knobs to EMER RAD or EMER ICS. If there is no audio present in the headset, the crewmember should switch to the EMER RAD position. If audio is present but no sidetone, the crewmember should switch to the EMER ICS position.

EMERGENCY OPERATION OF COMMUNICATIONS TRANSMITTER AND RECEIVERS (UHF)

Warning lights labeled "Emergency Power" are situated at the bottom of each Comm Nav group control panel. The light will illuminate whenever a malfunction occurs in one or both of the +430 volt and +130 volt d-c rectifiers in the power supply of the integrated electronic central. Should the voltage of the +430 volt d-c rectifier drop below a certain value, the "Emer Power" light will illuminate and the following equipment operating status will result: the TACAN is inoperative; the intercom, the main UHF receiver, the auxiliary UHF receiver, the ADF, and the IFF/SIF operate normally, and the main UHF transmitter operates at reduced power. Should the voltage of the +130 volt d-c rectifier drop below a certain value, the "Emer Power" light will illuminate and the following equipment operating status will result: the TACAN is inoperative; the IFF/SIF, the intercom, the main UHF receiver, the ADF, the auxiliary UHF receiver operate normally; and the main UHF transmitter operates at reduced power. Should a malfunction occur in a third d-c rectifier in the power supply, the +275 volt d-c rectifier, the "Emer Power" light will not illuminate and the following equipment operating status will result: the TACAN is inoperative; the IFF/SIF, the intercom, main UHF receiver, main UHF transmitter, auxiliary UHF receiver, and ADF will function normally. Should there be a malfunction in the electrical system causing the ram air turbine to be extended, the "Emer Power" light will not illuminate and the following equipment operating status will result: the ADF, the auxiliary UHF receiver, and the TACAN are inoperative; the intercom, the main UHF receiver and IFF/SIF operate normally, and the main UHF transmitter operates at reduced power. Transition from normal to emergency operation is completely automatic and is brought about by a malfunction in one of the major power sources, except for the case when the ram air turbine is extended manually. The type of failure which is experienced will determine what portions of the equipment that is still operative. The "Emergency Power" light will only inform the crewmember that a failure has occurred, but will not identify the type of failure. In the event the light illuminates, the crewmember by observation and operation should determine what equipment is still available.

LIMITATIONS

When the CNI equipment is operating on external power, they are limited to 10 minutes of accumulated operation in a one hour span. This limitation applies to all CNI equipment except the intercom. The maximum permissible altitude with CNI equipment ON is 60,000 feet. Flight above 60,000 feet with CNI equipment ON may result in damage to the equipment due to arcing.

REFERENCE PUBLICATIONS

If more detailed system information is required, refer to Items No. 15, 18 and 23 on Maintenance Instruction Manuals Publication Index (flyleaf 3 this publication).

DATA RECORDING CAMERA SYSTEM KS-74

DESCRIPTION

The data recording camera set KS-74 is attached to the RSO's radar scope. The camera set is an automatic photo-optical camera system used for recording radar video presentations and mode, range and clearance legends from the forward looking radar system. It also records aircraft flight information, which is presented in binary form, from the data display system. The displays, which the camera photographs, are used for ground evaluation of target areas, which were mapped by the forward looking radar during flight. The forward looking radar display is recorded on five successive film frames and on the sixth frame, a binary coded display from the data display system is photographed. The camera is a shutterless type which uses a standard Kodak type U (or equivalent) film magazine with a 50 foot capacity.

MODE SELECTOR KNOB

The mode selector knob has three positions: OFF, S (SLOW), and F(FAST). Power is applied to the camera system when the mode selector knob is in the S or F position; however, no display will be recorded unless the forward looking radar is also operating. When the mode selector knob is in the S (SLOW) position, the camera photographs one radar display every fifth radar scan. In the F (FAST) position, one radar display will be photographed for each radar scan. The camera will photograph the binary display from the data display system after each five pictures, regardless of the mode selected.

INDICATOR LIGHTS

Two lights (green and amber) are located on the data recording camera. The green light denotes the camera is capable of taking pictures when the forward looking radar is operating. The amber light denotes a preselected (15 feet or less) amount of film remains to be exposed before film reloading is necessary.

BRIGHTNESS CONTROL

The brightness control is the outer control on the camera periscope. It is a screw-lock knob which is used to adjust the brightness of the radar display being viewed by the RSO. The knob travels in a track which limits the range from transparent to almost opaque. The desired brightness of the radar display may be obtained by loosening the knob and rotating the viewing lens. Adjustment of the control does not affect the intensity of the display reaching the camera and thus has no effect on film exposure. The screw-lock knob should be tightened after adjustment to prevent any change in brightness setting when the variable red lens is used.

VARIABLE RED LENS CONTROL

The variable red lens is the inner control on the camera periscope. It is used to vary the red color of the radar display for night time use. It is operated by rotating the viewing lens, using the finger tab on the inner ring, until the desired color is obtained.

NORMAL OPERATION

To operate the data recording camera, place the mode selector to S or F as desired, and check that the green (operate) light is illuminated and the amber (film remaining) light is out. The camera will operate automatically when the forward looking radar is turned on. With the forward looking radar operating, adjust the brightness and red lens controls on the camera periscope for the desired presentation.

Note

Do not adjust the intensity or persistence control on the radar scope. Overexposure or underexposure of the film may result.

When the amber light comes on, approximately five minutes film supply remains if operating in the F (FAST) mode; or approximately 30 minutes film supply in the S (SLOW) mode.

FILM MAGAZINE REPLACEMENT

1. Open the camera door by grasping the latch handles with the thumb and finger.
2. Slide the magazine of exposed film out of the magazine clamps.
3. Hold new magazine in same position as the previously removed magazine, and insert the new magazine into the magazine clamps.
4. Allow the camera door to fall closed, then push the door to insure it is latched.

Note

Do not open the door except for film magazine removal after the camera door has been closed and the film has been partially advanced. Opening the door causes the counter assembly to reset, and closing the door after the film has been advanced will cause a false low film indication.

EMERGENCY OPERATION

There are no provisions for emergency operation of the data recording camera system.

LIMITATIONS

There are no specific limitations pertaining to the data recording camera system.

REFERENCE PUBLICATIONS

If more detailed system information is required, refer to Item 19, Maintenance Instruction Manuals Publication Index (flyleaf 3, this publication).

DRAG CHUTE SYSTEM

DESCRIPTION

The airplane is equipped with a 16 foot, ring slot type parachute which is deployed after touchdown to aid in reducing landing roll distances. The drag chute may also be utilized for spin recovery. The chute is carried in a compartment within the empennage at the base of the vertical stabilizer, and is pulled into the airstream by a pilot chute when the spring-loaded compartment door is opened. The design of the attaching mechanism is such that should the compartment door open, without operating the cockpit control handle, the chute will be released and fall free of the airplane. The drag chute is retained to the airplane structure upon normal deployment. There is no "breakaway" fitting within the attaching mechanism.

DRAG CHUTE HANDLE

The drag chute is deployed by means of a control handle (figure 1-2) located along side of the left console. A cable joins the handle, the release and jettison mechanism, and the door latch mechanism. Rotating the handle aft without depressing the button on the handle releases the door latch mechanism. The spring-loaded actuator then opens the drag chute door, and at the same time the hook lock is positioned over the drag chute attach ring. The spring-loaded pilot chute pops out, opens, and pulls out the drag chute. The drag chute is jettisoned by pulling aft on the handle to clear the detent, depressing the thumb button and lowering the handle. The release and jettison mechanism then returns to the normal position, permitting the drag chute to pull free.

NORMAL OPERATION

Normal operation of the drag chute system consists of deploying and jettisoning the drag chute. The drag chute is deployed by grasping the drag chute handle and rotating the handle aft. To jettison the drag chute, rotate handle further aft to clear detent, depress the thumb button and then rotate handle full forward.

EMERGENCY OPERATION

There are no specific emergency operations pertaining to the drag chute system.

LIMITATIONS

Maximum airspeed for drag chute deployment is 200 knots IAS.

REFERENCE PUBLICATIONS

If more detailed system information is required, refer to Item No. 5 on Maintenance Instruction Manuals Publication Index (flyleaf 3 this publication).

EJECTION SEAT

DESCRIPTION

The ejection seat system (figure 1-16) 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 personnel parachute at a predetermined altitude or deceleration "g" force which is within a safe limit for the occupant. 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 two separate firing controls which are used to fire the seat during the ejection sequence. These two controls are the face curtain and alternate ejection handle. The face curtain, located above the head, provides the normal means of firing the seat and also provides head protection and promotes proper ejection posture during the ejection sequence. The alternate ejection handle, located between the occupant's knees on the seat bucket, provides an alternate method if firing the seat. Either control will jettison the canopy and fire the catapult gun. The top of the seat provides a mounting for the drogue chutes, face curtain, drogue chute restraining scissors and canopy interlock mechanism. 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 upper 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 interlock mechanism to prevent accidental ejection through the canopy plexiglas. Ejection through the plexiglas is not possible due to the high strength qualities of the plexiglas used on the canopy. The interlock mechanism is located on the top aft portion of the seat and contains torque tubes and levers which are connected by mechanical linkage to the face curtain and alternate ejection handle. The interlock mechanism is linked to the canopy by a cable. The drogue chutes, which are located on the top of the seat, stabilize the seat after ejection and deploy the personnel parachute. Three handles are incorporated on the seat bucket, which are the emergency harness release, the shoulder harness handle, and the leg restraint manual release handle. Two finger rings, located adjacent to the leg restraint snubber units, provide a means of releasing the snubbers on the leg restraint cords. The emergency harness release handle permits manual release of the harness during manual separation procedures, the shoulder harness handle provides a means of controlling the upper harness movement, and the leg restraint manual release handle provides a method of releasing the leg restraint cords. A seat position switch, located on the forward right side of the seat bucket, controls the seat adjusting motor.

MAIN BEAM ASSEMBLY

The main beam assembly is a strong, lightweight structure built to withstand high "g" loads. This assembly is the main frame of the seat and supports the seat pan, drogue chute container, drogue shackle scissors, drogue gun time release mechanism, and personnel parachute. It is composed of two vertical beams bridged by three cross-members. Each vertical beam has three slippers located on the inner side. Upon ejection, these slippers slide in the guide rails of the cylinder barrel which is secured to the airplane structure. On the lower outboard side of each vertical beam are two seat bucket guide tracks. The seat bucket assembly rides in these tracks during seat height adjustment. The top latch mechanism is attached to the top of the left vertical beam and is used to secure the seat structure to the cylinder barrel.

CANOPY INTERLOCK MECHANISM

The canopy interlock mechanism is mounted across the top of the aft corners of the main beam on the seat. This mechanism is used to provide proper sequencing between the canopy and ejection seat during the ejection sequence and also transmits the force of the face curtain handle or alternate ejection handle to the canopy initiator and catapult firing mechanism. The interlock block of the mechanism is connected to the canopy by a cable and is pulled from the interlock mechanism by the canopy during the ejection sequence. This block and various lever arrangements within the interlock mechanism preven firing of the ejection seat before the canopy has been jettisoned from the aircraft.

CATAPULT GUN

The catpult gun is located on the ejection seat between the main beams and 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.

DROGUE GUN

The drogue gun is mounted on the left side of the ejection seat headrest and is used to extract the controller drogue chute from its container 1 second after ejection. Upon ejection, a trip rod fixed to the airplane structure pulls a sear from the drogue gun to initiate the 1 second time delay. After the time delay has elapsed, a cartridge is fired and the resultant gas pressures propel a piston but 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.

DROGUE CHUTE RESTRAINING SCISSORS

The drogue chute restraining scissors are located 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 scissor 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 personnel parachute when actuation of the time release mechanism occurs.

TIME RELEASE MECHANISM

The time release mechanism is located on the right side of the ejection seat headrest. Its function is to delay deployment of the personnel parachute and seat separation until the occupant has descended from the upper atmoshpere, and/or has slowed enough to prevent excessive opening shock of the personnel parachute. The time release mechanism is armed upon ejection by a trip rod secured to the airplane. Initiation of the timing sequence follows immediately, providing the altitude is below 10,000 feet and the deceleration rate of the seat is less than 4.5 "g's". Initiation is delayed until these conditions are met. One and three quarters seconds after initation, the time release mechanism releases the drogue chutes from the restraining scissors allowing the personnel parachute to be pulled from its container. At the same time, it unlocks the harness and leg restraint lines to allow the occupant to be pulled from the seat when the personnel parachute deploys.

STICKER CLIPS

The sticker clips are located one on each side of the inner seat bucket. Each clip is made of spring steel with a detent point to hold the harness sticker strap lugs. The sticker clips clamp on the harness sticker strap lugs and retain the occupant in the seat until

Pressure Suit & Harnessing

TYPICAL

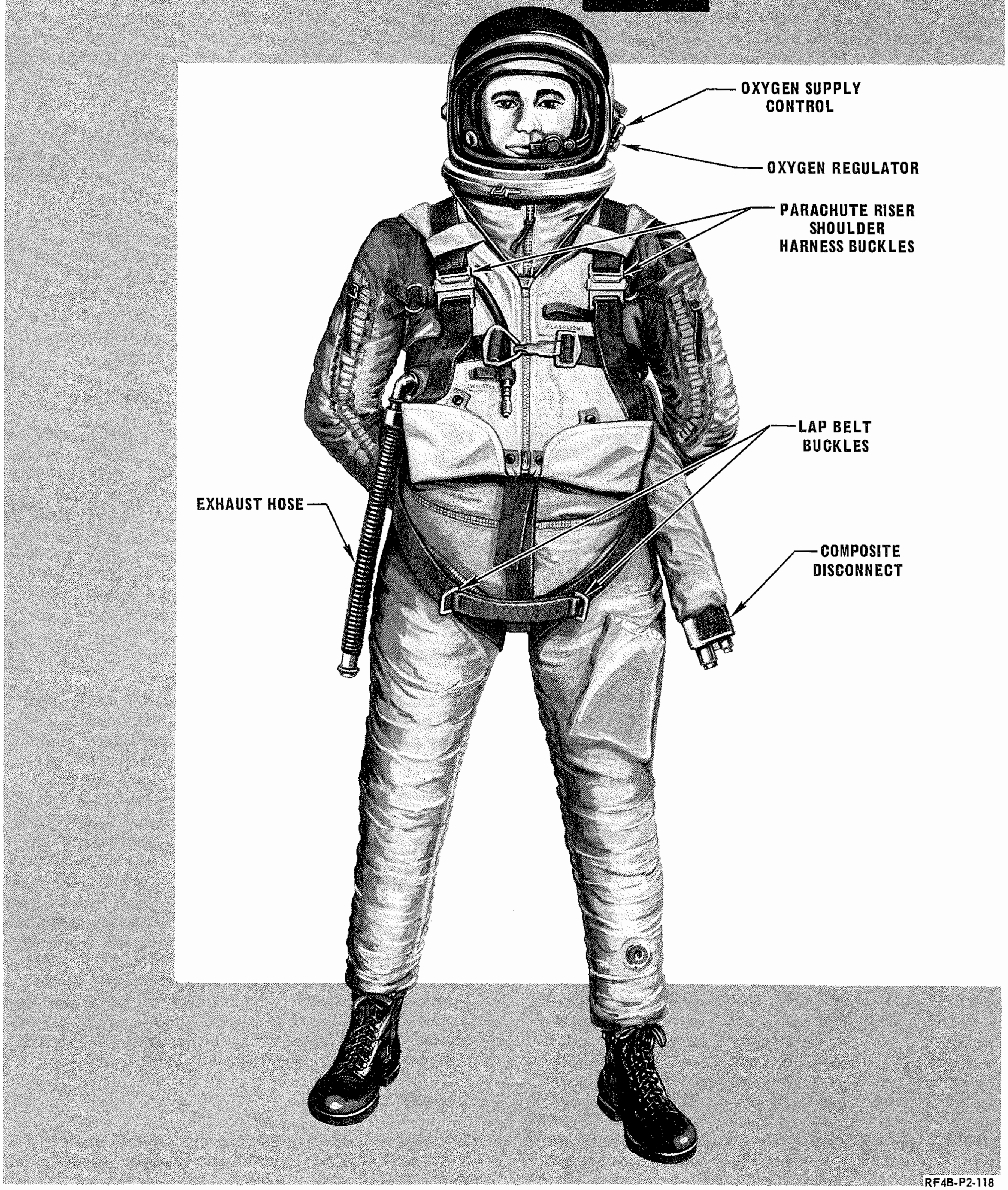


Figure 1-15

Ejection Seat

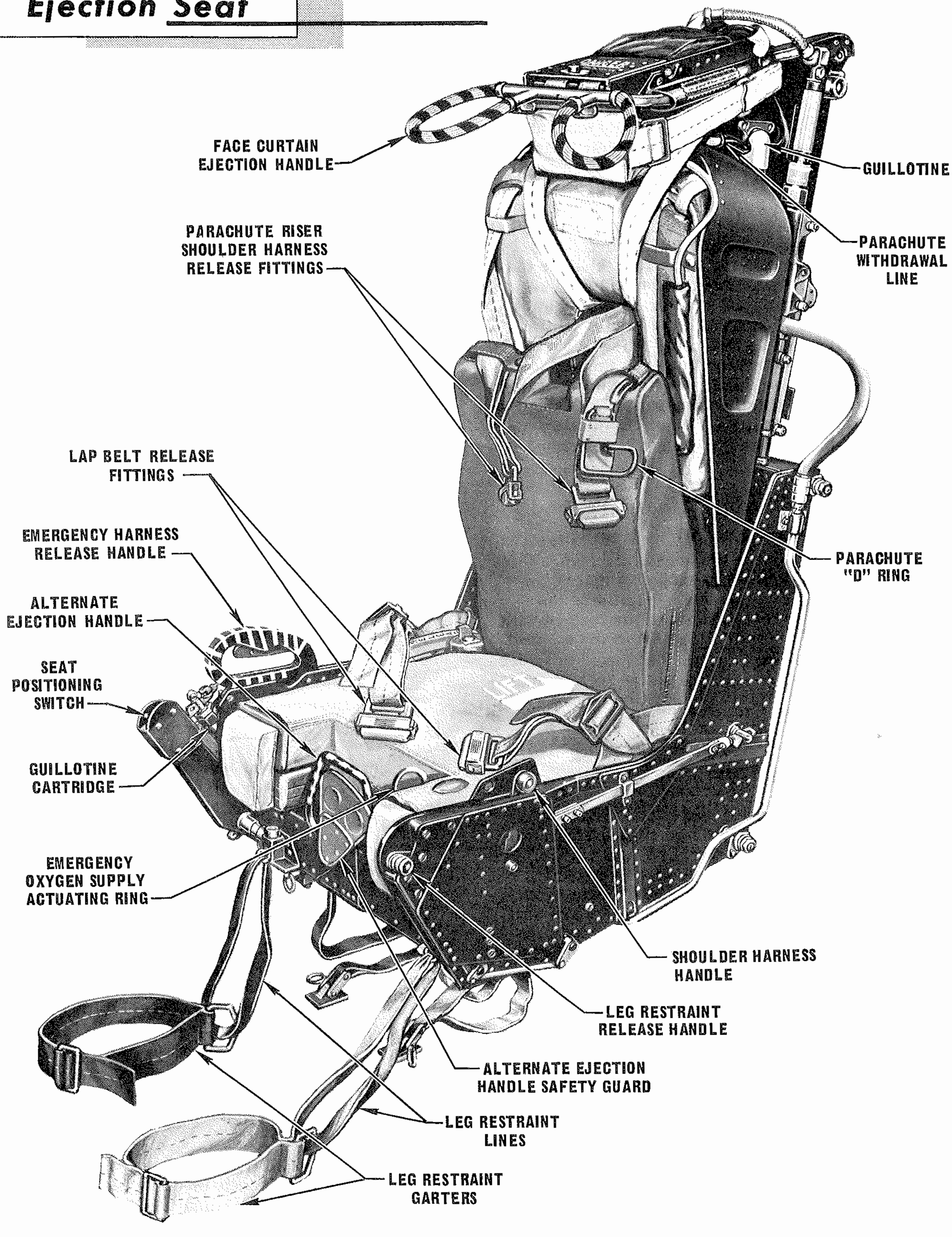


Figure 1-16

the personnel parachute blossoms and pulls the occupant clear of the seat. This prevents a collision between seat and occupant.

FACE CURTAIN EJECTION HANDLE

A face curtain ejection handle (figure 1-16) is provided for normal seat ejection. The ejection handle, located at the top of the seat, projects forward and provides a gripping surface for the crewmember. When ejection is desired, a forward and downward pull on the handle will fire an initiator. The expanding gases from the initiator operate the emergency canopy valve which directs 1375 ± 100 psi to the canopy actuator and cockpit flooding doors actuators. The canopy will open and air loads will separate the canopy from the cockpit. The canopy will then remove the interlock from the seat firing mechanism. After the canopy has jettisoned, the handle can be pulled until full travel is reached. This pulls the face curtain over the face and removes the wedge-shaped sear from the ejection gun firing head, firing the main charge and ejecting the seat. The canopy interlock in the firing mechanism of both seats prevents seat ejection before the canopy is jettisoned.

ALTERNATE EJECTION HANDLE

The alternate ejection handle (figure 1-16) is located on the seat bucket between the occupant's legs. This handle is connected to a cable assembly that is routed under and behind the seat. It initiates the same jettison and firing functions as the face curtain. The alternate ejection handle is guarded (by a plate) to prevent inadvertent actuation. The guard provides a mechanical stop to prevent the handle from moving, and must be rotated to the down position before ejection.

SEAT POSITIONING SWITCH

The ejection seats may be adjusted vertically only. Fore and aft seat positioning is compensated for by adjusting the rudder pedals (front cockpit only). Vertical seat positioning is accomplished by actuating a momentary contact switch (figure 1-16) located on the right forward side of the seat bucket. Each seat can be adjusted up or down through a total distance of six inches. It is not necessary to adjust the seat height before ejection; however, the seat should be low enough to afford adequate clearance between the helmet and face curtain ejection handle.

SHOULDER HARNESS LOCKING MECHANISM

The shoulder harness locking mechanism is part of the seat center cross-member and is approximately at shoulder level. It is used to hold the occupant's upper torso against the seat back during all flight conditions and ejection. The mechanism consists of a strap wound on a spring-loaded retraction reel, a snubbing unit and an upper harness release pin. The strap wound on the retraction reel passes through a snubbing unit and then through the occupant's upper harness roller fitting. The eye of the strap then returns to the seat and through the rings to the two straps securing the personnel parachute to the seat. It is anchored by the upper harness release pin. The snubbing unit prevents any forward movement of the strap unless the unit is unlocked. During ejection, upon actuation of the time release mechanism, the upper harness release pin releases the eye fitting, thereby freeing the occupant's upper harness and the parachute securing straps.

Shoulder Harness Handle

The shoulder harness handle is mechanically linked to a two-position cam and must be mechanically moved to the unlocked (aft) position or the locked (forward) position. After placing the handle in the unlock position, the handle will automatically return to an unlocked neutral position. In this position, the shoulder harness will automatically lock when the seat senses approximately 2.5 "g's" in the vertical plane or approximately 4.0 "g's" in the horizontal plane.

WARNING

The shoulder harness does not automatically lock when the harness movement exceeds a predetermined rate (such as an inertial reel system). The ejection seat must sense approximately 2.5 "g's" vertically or approximately 4.0 "g's" horizontally to automatically lock the shoulder harness.

LEG RESTRAINERS

A leg restraint assembly is provided on the seat to hold the occupant's legs in place and to prevent them from failing during ejection. The leg restraint assembly consists of garters worn by the crewmember, leg restraint lines with lock pins, snubber unit, and shear fitting secured to the floor. The garters are strapped on to the leg just below the knee. The leg lines running from the shear fitting beneath the seat, pass through the snubber unit, through the garter, to the lock pin on the leg lines, and finally plug into the leg lock mechanism on the front of the seat pan. When the seat is ejected, the slack in the leg restraint line is taken up by the upward travel of the seat, pulling the occupant's legs to the front face of the seat pan. When all the slack has been removed in the leg restraint lines, the tension of the line will cause the shear fitting to fail. The occupant's legs will be firmly held against the seat pan by the snubbing unit until the hanress is released and the occupant is separated from the seat. Leg restraint disengage rings (figure 1-16) located on the face of the seat pan are provided to adjust the amount of slack in the leg restraint lines. This slack may be adjusted by the occupant by pulling out on the appropriate finger ring. This allows more restraint line to be pulled out to provide sufficient slack. To take in excess slack, the occupant need only reach under the seat bucket and pull in the excess restraint line through the snubber unit.

WARNING

Remove excessive slack from the leg restraint lines to prevent entanglement during rapid egress.

Leg Restraint Release Handle

The leg restraint release handle (figure 1-16) is located on the left forward side of the seat bucket. When the handle is moved to the aft (unlocked) position, the lock pins on the leg lines are released from the leg lock mechanism. This allows the occupant to thread the leg lines back through the garter, enabling him to leave the seat without removing the garters.

GUILLOTINE ASSEMBLY

Components of the guillotine assembly (figure 1-16) are located on the right side of the seat bucket and on the left side of the main beam assembly near the drogue gun. The guillotine is a pyrotechnically operated device that is manually actuated and is used to sever the personnel parachute withdrawal line during manual separation from the seat during the ejection sequence. The assembly consists of a firing mechanism, gas line, and a guillotine blade assembly. The personnel parachute withdrawal line passes through a spring-loaded gate on the guillotine blade housing. Under normal ejection conditions, the parachute withdrawal line withdraws from the guillotine gate as the drogue chutes deploy the personnel parachute. During manual separation from the seat, guillotine actuation is accomplished when the emergency harness release handle is pulled. The action of the emergency harness release handle fires the guillotine cartridge which supplies gas pressure to the guillotine blade assembly. The pressure forces the blade assembly upward, which severs the withdrawal line and thereby releases the personnel parachute from the drogue chutes.

INTEGRATED HARNESS

The integrated harness (figure 1-15) is a vest-like garment or a series of web straps worn by the crewmember. The harness, when used with the C/MBEU/615/PA integrated type parachute, takes the place of a lap belt and shoulder harness. Both of the harness configurations have four buckles for attaching the parachute of the crewmember. The lower two buckles, when connected to the lap belt release fittings, which in turn is fastened to the seat, serve as the lap belt. The upper two buckles, when connected to the parachute riser-shoulder harness release fittings, which in turn is fastened to the locking reel assembly, serve as the shoulder harness. The integrated harness eliminates the need for the crewmember to wear his parachute to and from the airplane, and it eliminates a separate lap belt and shoulder harness.

Emergency Harness Release Handle

The emergency harness release handle (figure 1-16) is located on the right side of the seat bucket. The handle is used by the occupant to manually separate from the seat in the event the automatic time release mechanism fails or in the event of ditching. Pulling aft on the handle operates a system of linkages which pulls the pins retaining the lap belt harnessing, pulls the pin from the shoulder harness, and releases the leg restraint lines. This handle performs the same functions as the time release mechanism. To actuate the handle, squeeze the trigger and pull up and aft. The handle is protected by a trigger that must be squeezed before the handle may be pulled. When the handle is pulled the lap belt harnessing, shoulder harness and leg restraint lines will be released. In addition, a cartridge is fired and the gas pressures are piped to a guillotine which severs the line which connects the drogue chute to the personnel parachute. The guillotine is located on the upper left side of the seat back. The emergency harness release handle should not be pulled in flight for the following reasons:

1. Actuating the emergency harness release handle creates a hazard to survival during uncontrollable flight, since negative "g" forces may prevent the occupant from assuming the correct ejection position.
2. 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. Once the emergency harness release handle has been pulled, the lap belt and shoulder harness cannot be refastened in flight.
3. 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.

SURVIVAL KIT

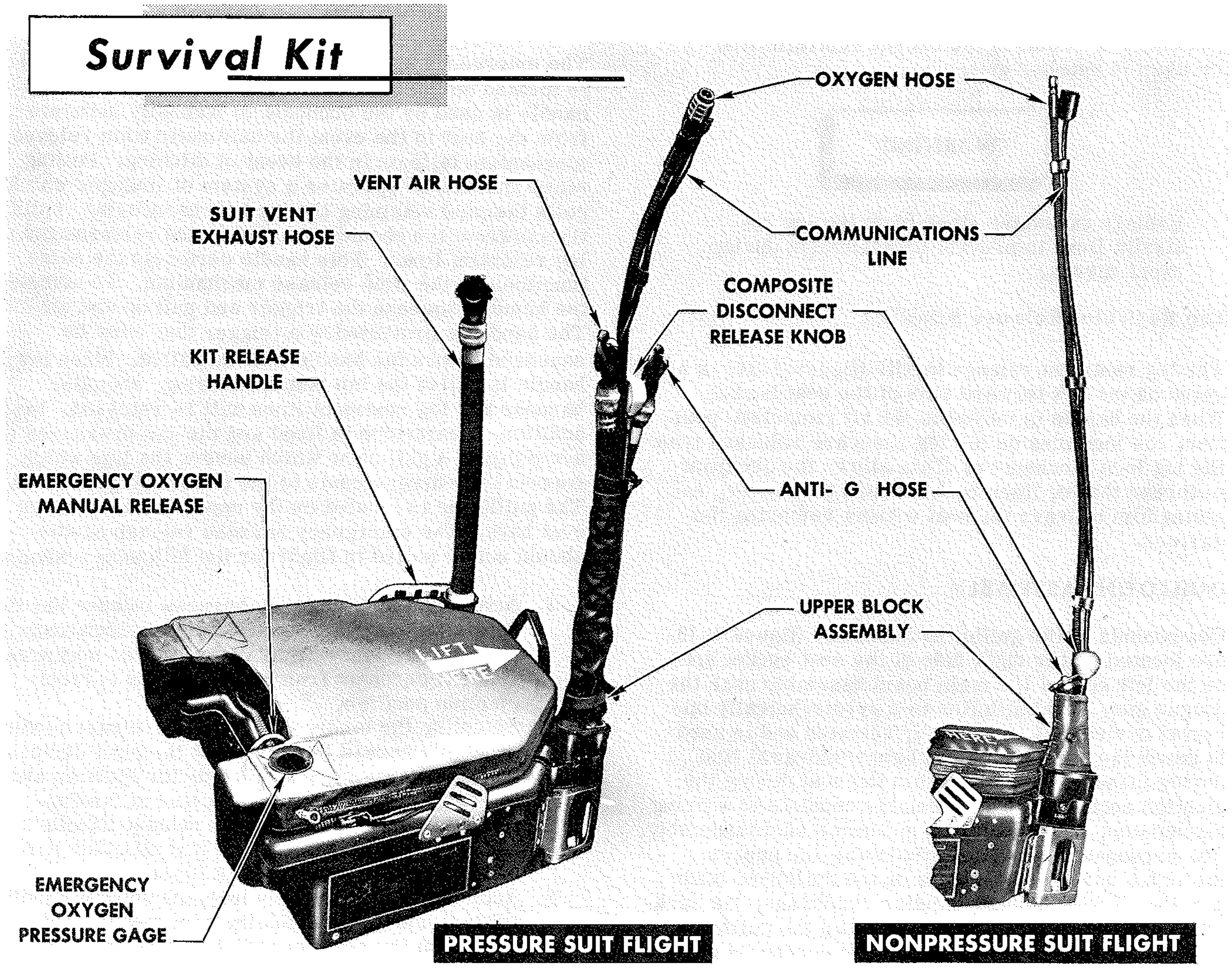
A modified PK-2 survival kit is packed within a two piece fiberglas container (figure 1-17) which, in turn, is attached to the occupant by strap-harnessing. The content of the survival kit is the same as for a normal issue PK-2, but the packing arrangement has been changed to suit the requirements of the container. The following is a list of contents of this kit:

Note

The emergency provisions included in the PK-2 survival kit are subjected to local option and may be altered at the discretion of the area commander.

Pararaft with inflation bottle, sleeve type sea anchor and lanyard
Metallic radar reflector assembly (disassembled)
Solar distillation unit
De-salter kit (tablets)
Water storage bag
Signal mirror
Bailing sponge

Survival Kit



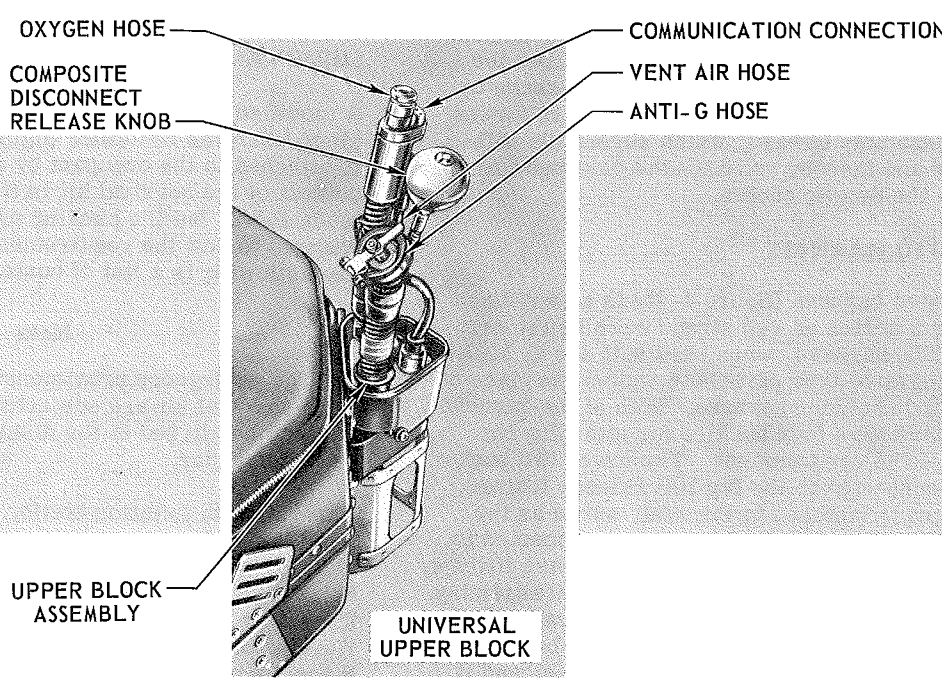


Figure 1-17

RF4B-P2-120

50 feet of nylon line
2 packs dye marker
Poncho with reflective surface
Canned rations
Can of sunburn ointment
Emergency code instruction sheets

All items except the pararaft and its associated gear are packed in a zipper enclosed bag which is attached to the pararaft by a lanyard. Both the pararaft and bag are packed into the survival kit container and the pararaft is attached by a lanyard to the upper half of the container. Aside from the PK-2 equipment packed in the lower half of the container, the upper half contains the emergency oxygen and pressure suit controller. A receptacle for plugging in the composite disconnect is located in the left rear corner of the survival kit container and a kit release handle is located on the right rear side of the survival kit container. Pulling up on the kit release handle unlocks the container and actuates the pararaft inflation bottle. The inflating pararaft separates the container; the upper half of the container with emergency oxygen and suit controller remains with the crewmember, and the lower half of the container with pararaft and survival equipment floats free on the end of the lanyard that is attached to the upper half of the container. In the event of an ejection, the pararaft should be inflated prior to entering the water since the kit release handle is accessible while still in the parachute harnessing, and all survival equipment is secured to the crewmember.

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 either the face curtain or alternate ejection handle causes the canopy to jettison and the catapult gun to fire. It 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, manual release of the leg restraint cords, and leg restraint cord adjustment with the finger rings. 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 pyrotechnically energized catapult gun. The ejection sequence is initiated by pulling the face curtain handle or the alternate ejection handle. Actuation of either handle fires the canopy initiator which subsequently jettisons the canopy from the aircraft. When the canopy separates from the aircraft, the canopy interlock block, which is attached to the canopy, is pulled from the seat. Continued pull of the face curtain handle fires the primary cartridge of the catapult gun. 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. During upward travel of the seat, the sears of the drogue gun and time release mechanism are pulled by trip rods. The auxiliary cartridges are fired during upward travel also when they become exposed to the hot propellant gases within the gun. Gas pressure generated by the auxiliary cartridges adds additional force to the gun during upward travel. Separation of the inner tube from the gun occurs when the inner and intermediate tubes are fully extended in the outer tube. Upward seat travel after separation from catapult gun continues by the momentum of the seat mass. Staggered firing of the catapult gun cartridges furnishes even pressure within the gun during the power stroke, eliminating high acceleration forces during ejection. Approximately one second after ejection the drogue gun fires, deploying the controller drogue which subsequently deploys the stabilizer drogue. The seat is stabilized and decelerated by the drogue chutes and the seat and occupant descend rapidly through the upper atmosphere. When an altitude of approximately 10,000 feet is reached or approximately 1-3/4 seconds after ejection below 10,000 feet, a barostat releases the escapement mechanism. This action releases the occupant's harnessing, leg restraint lines, and chute restraint straps. The drogue chute pulls a link line to deploy the personnel parachute. The occupant is held to the seat by sticker clips until the opening shock of the parachute snaps him out of the seat. If the time release mechanism fails to operate automatically after descending through 10,000 feet, actuate the emergency harness release handle on the right side of the seat to its full aft position. Reach over your shoulders and pull the parachute off of the horseshoe fitting, push free of the seat, and pull the parachute rip cord.

EMERGENCY OPERATIONS

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

The minimum ejection altitude is ground level, providing the airspeed is at least 130 knots CAS and the airplane has no sink rate. Ejection seat integrity will be maintained up to airspeeds of 350 knots IAS below 100 feet, and up to 550 knots IAS above 100 feet.

REFERENCE PUBLICATIONS

If more detailed system information is required, refer to Item No. 3, on Maintenance Instruction Manuals Publication Index (flyleaf 3 this publication).

ELECTRICAL POWER SUPPLY SYSTEM

DESCRIPTION

The airplane electrical power supply system consists of two engine driven a-c generators, two d-c transformer-rectifiers, an emergency a-c generator, and a power distribution (bus) system. The generators supply a-c power to the right main 115/200 volts a-c bus, the essential 115/200 volt a-c bus, the left main 115/200 volt a-c bus, the instrument 115/200 volt a-c bus, the reconnaissance 115/200 volt a-c bus, the left main 28/14 volt a-c bus, the right main 28/14 volt a-c bus, the instrument 28 volt a-c bus, the ignition 115 volt a-c bus, the warning lights 14/28 volt a-c bus, and the transformer-rectifiers. The transformer-rectifiers convert 115/200 volt a-c power to d-c power, which is supplied to the essential 28 volt d-c bus, the right main 28 volt d-c bus, the left main 28 volt d-c bus and the reconnaissance 28 volt d-c bus. Refer to Electrical System, figure 1-18 for individual bus loading. The bus callouts are circuit breakers.

A-C ELECTRICAL POWER

Two 400 cycle, three phase, 115/200 volt a-c generators are the primary source of all electrical power. Each generator (one on each engine) is capable of supplying the system with 20,000 volt-amperes of electrical power. On aircraft 153089x and up, each generator is rated at 30,000 volt-amperes. The generators are driven by constant speed drive units, which utilize engine oil as a coolant and as the hydraulic media to regulate the generators at a constant speed of 8000 rpm. The CSD units are of two types. One type incorporates a mechanical shaft disconnect feature which disconnects the CSD from the engine oil supply should a malfunction occur in the CSD to cause it to lose oil. The gear box of the disconnect type unit is painted white and is readily visible through the auxiliary air doors. A placard is also installed in the front cockpit immediately below the generator warning lights with the following words as appropriate: "Port and/or Stbd CSD Disconnect". It is possible to have a pair of identical type units or a combination of the types. The pilot should acquaint himself with the CSD configuration before flight. The left engine generator supplies power directly to the instrument 115/200 volt a-c bus, the left main 115/200 volt a-c bus, the reconnaissance 115/200 volt a-c bus, and the left transformer-rectifier. The right engine generator supplies power to the essential 115/200 volt a-c bus, the right main 115/200 volt a-c bus, the ignition 115 volt a-c bus, and the right transformer-rectifier. Either generator is capable of supplying electrical power to the entire bus system through an auto-parallel controlled bus tie relay. When the generators are in phase, and are operating at approximately the same frequency, the auto-parallel control closes the bus tie relay, thereby connecting the left and right bus systems. In the event one of the generators becomes out of phase or frequency with respect to the other, the auto-parallel will open the bus tie relay, and each generator will be supplying power to its own bus system. Should one generator fail, the bus tie relay will close, or remain closed, allowing the good generator to power the entire system. Each generator may be manually disconnected from the bus system by placing its generator control switch to OFF. Under maximum generator loads, a generator will drop off the line at an engine rpm of approximately 53%. At less than maximum generator loads, a generator will drop off the line at a lower engine rpm than for maximum generator loads. An emergency a-c generator, when operating, supplies power to the essential 115/200 volt a-c bus, the instrument 115/200 volt a-c bus, the instrument 28 volt a-c bus, and the right transformer-rectifier. Auto-transformers reduce 115/200 volt a-c power to 28 volt and 14 volt a-c power, and transformer-rectifiers convert 115/200 volt a-c power to 28 volt d-c power.

EMERGENCY GENERATOR

An emergency 400 cycle, three phase, 200/115 volt a-c generator is provided as a source of electrical power in the event both engine driven generators go off the line. The emergency generator is capable of supplying the essential a-c and d-c buses with 3000 volt-amperes of electrical power. The generator is powered by a ram air turbine which is extended into the airstream pneumatically. When the emergency generator reaches its rated voltage, it energizes an a-c relay which connects generator output to the essential 115/200 volt a-c bus, the essential 28 volt d-c bus, the instrument 115/200 volt a-c bus, and the instrument 28 volt a-c bus. The ignition 115 volt a-c bus becomes energized by phase B of the emergency generator and remains energized while the generator is operating. The emergency generator a-c relay will not become energized unless both engine driven generators are off the line, and the airplane airspeed is above approximately 195 knots IAS. If either engine driven generator is restored, or the aircraft airspeed drops below approximately 195 knots IAS, the emergency generator a-c relay will deenergize and disconnect the emergency generator from the bus system. On aircraft 153095y and up, and all others upon incorporation of AFC 220, the emergency generator does not deenergize until airspeed is reduced to approximately 90 knots IAS. To extend the ram air turbine, place the ram air turbine control handle to RAT OUT (push down). In the event the engine driven generators are restored, the ram air turbine may be retracted by placing the ram air turbine control handle to RAT IN (pull up). Based on NATC tests, the emergency generator will deliver fully rated power for a minimum continuous period of three hours.

Note

- Emergency generator operational time shall be logged on the yellow sheet (OPNAV FORM 3760-2).

- A pressure switch in the emergency generator circuit will disconnect the emergency generator from the essential buses when the aircraft's airspeed drops below 195 knots IAS. This will result in complete loss of electrical power (except engine ignition) and will allow all of the ram air turbine's power to be utilized in driving the emergency hydraulic pumps in order to maintain control of the aircraft. On aircraft 153095y and up, and all others upon incorporation of AFC 220, the pressure switch and hydraulic pump are removed and emergency electrical power is maintained until airspeed is reduced to approximately 90 knots CAS.

D-C ELECTRICAL POWER

Two 100 ampere transformer-rectifiers receive 400 cycle, three phase, 115/200 volt a-c power, and supply 28 volt d-c power. The left transformer-rectifier supplies power directly to the left main 28 volt d-c bus, and the reconnaissance 28 volt d-c bus. The right transformer-rectifier supplies power directly to the essential 28 volt d-c bus, and through an essential d-c line relay to the right main 28 volt d-c bus. The output of both transformer-rectifiers is connected in parallel through a 60 ampere bus tie current limiter. In the event one of the transformer-rectifiers fails, the remaining transformer-rectifier will supply power to the entire d-c bus system. The emergency a-c generator will supply power through the right transformer-rectifier to the essential 28 volt d-c bus.

EXTERNAL ELECTRICAL POWER RECEPTACLE

To provide adequate power for ground operation of electrical equipment, an external power receptacle (figure 1-18) is located on the bottom of the left air duct. The external power required is three-phase, 400 cycle, 115/200 volt a-c. With external electrical power applied, and both generator control switches in EXT ON, the bus system, with the exception of the instrument and reconnaissance buses, will be energized. To energize the instrument and reconnaissance buses, the instrument ground power switch and the reconnaissance ground power switch on the No. 1 circuit breaker panel must be actuated. As long as the external power is applied, the instrument and reconnaissance busses will remain energized even though the generator control switches are moved to OFF. External electrical power is distributed through the bus system in the same manner as generator output.

GENERATOR CONTROL SWITCHES

Two generator control switches, one for each generator, are located on the generator control panel (figure 1-3). The switches, labeled R GEN - ON, OFF, ON - EXT and L GEN - ON, OFF, ON - EXT, are utilized to select the source of electrical power for the airplane bus system. With external electrical power applied, and with both generator control switches in EXT ON, electrical power will be supplied to the entire bus system. When either engine driven generator is operating, its output may be connected to the entire bus system by placing its control switch to GEN ON.

Note

If either generator indicator light illuminates as a result of a temporary generator malfunction, the generator may be reset. It is however, necessary to wait approximately 45 seconds to enable the generator control relays to reset. To reset the generator, place the generator control switch to OFF, wait 45 seconds and reposition it to GEN ON.

CIRCUIT BREAKER

Circuit breakers distribute power from the aircraft buses to each electrical and electronic system in the aircraft. The left utility panel and a panel on the right console in the pilot's cockpit contain circuit breakers for the aircraft control and landing gear systems. Three circuit breaker panels are located in the aft cockpit. The number 1 circuit breaker panel is mounted on the left side of the cockpit, the number 2 circuit breaker panel is mounted on the floor of the cockpit aft of the right foot rest, and the number 3 circuit breaker panel is mounted on the floor of the cockpit aft of the left foot rest. The photo system control circuit breaker panel is located on the photo system power control and ADAS distribution panel in the nose equipment compartment.

GENERATOR INDICATOR LIGHTS

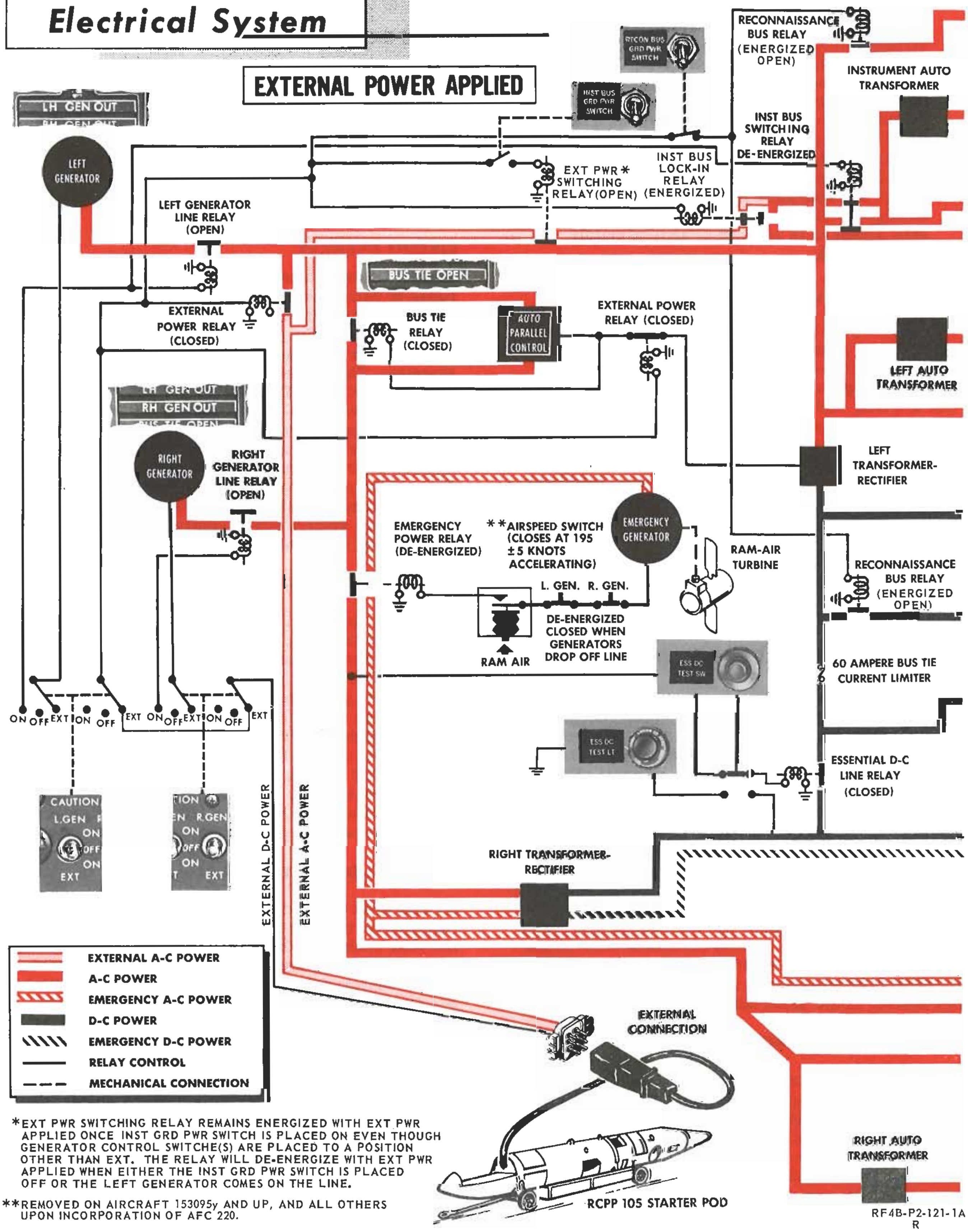
The "L.H. Gen Out", and "R.H. Gen Out" indicator lights, and the "Bus Tie Open" light are located on the generator control panel (figure 1-3) in the front cockpit. One of the generator lights will illuminate any time its generator is not on the line. The pilot may attempt to reset the generator by placing generator switch to OFF and then placing it back to ON. In the event of a double generator failure, both generator lights will be illuminated as long as the generators are turning. The "Bus Tie Open" indicator light will illuminate when the left and right generator bus system are not paralleled.

ESSENTIAL D-C TEST BUTTON

An essential d-c test button and indicator light are installed on the number 1 circuit breaker panel in the rear cockpit. When the essential d-c test button is depressed, the essential d-c line relay is deenergized. Power will then be supplied to the essential d-c test light by the right (essential) transformer-rectifier. If the light illuminates bright, the right transformer-rectifier is receiving three phase 115/200 volt a-c power and is supplying 28 volt d-c power. If the light illuminates dim, it can be assumed that one phase of the 115/200 volt a-c power supply has failed. If the light does not illuminate, the transformer-rectifier has failed, or the a-c power supply has failed. With the essential d-c test button depressed, the left transformer-rectifier can be checked by actuating the warning lights test switch. If the warning and indicator lights illuminate, the left transformer-rectifier and the d-c current limiter are operating properly.

Electrical System

EXTERNAL POWER APPLIED



*EXT PWR SWITCHING RELAY REMAINS ENERGIZED WITH EXT PWR APPLIED ONCE INST GRD PWR SWITCH IS PLACED ON EVEN THOUGH GENERATOR CONTROL SWITCHE(S) ARE PLACED TO A POSITION OTHER THAN EXT. THE RELAY WILL DE-ENERGIZE WITH EXT PWR APPLIED WHEN EITHER THE INST GRD PWR SWITCH IS PLACED OFF OR THE LEFT GENERATOR COMES ON THE LINE.

**REMOVED ON AIRCRAFT 153095y AND UP, AND ALL OTHERS UPON INCORPORATION OF AFC 220.

Figure 1-18 (Sheet 1)

Bus			
RECONNAISSANCE 115/200 VOLT A-C BUS	DATA ANNOTATOR DEHYDRATOR DEFOG BLOWER FORWARD CAMERA FORWARD MOUNT	HIGH ALTITUDE CAMERA INFRARED LEFT CAMERA PHOTOGRAPH CONTROL UNIT STABILIZED MOUNT	RIGHT CAMERA SIDE LOOKING RADAR VERTICAL CAMERA
INSTRUMENT 28 VOLT A-C BUS	AILERON POSITION INDICATOR CENTRAL AIR DATA COMPUTER CNI DATA ANNOTATOR FORWARD COCKPIT RED CONSOLE LIGHTS (BRT) INERTIAL NAVIGATION SYSTEM LEFT ENGINE FUEL FLOW METER	LEFT ENGINE FUEL PRESSURE LEFT ENGINE OIL PRESSURE INDICATOR NO. 1 HYDRAULIC PRESSURE INDICATOR NO. 2 HYDRAULIC PRESSURE INDICATOR	PNEUMATIC PRESSURE INDICATOR RADAR ALTIMETER RIGHT ENGINE FUEL FLOW METER RIGHT ENGINE FUEL PRESSURE RIGHT ENGINE OIL PRESSURE INDICATOR RUDDER POSITION INDICATOR
INSTRUMENT 115/200 VOLT A-C BUS	AFT COCKPIT RED CONSOLE LIGHTS (BRT) CNI	INERTIAL NAVIGATION SYSTEM INSTRUMENT 28V A-C AUTO-TRANSFORMER	NAVIGATION COMPUTER STANDBY AND REMOTE ATTITUDE REFERENCE INDICATORS
WARNING LIGHTS 14/28 VOLT A-C BUS	CAMERA WARNING AND GO BUS	WARNING LIGHTS POWER	
LEFT MAIN 28/14 VOLT A-C BUS	FUSELAGE AND ANTI-COLLISION LIGHTS	TAXI LIGHTS POWER	WING AND TAIL LIGHTS (DIM)
LEFT MAIN 115/200 VOLT A-C BUS	ANTI-ICE FORWARD COCKPIT CONSOLE LIGHTS X-FORMER FORWARD LOOKING RADAR HF COMM INERTIAL NAVIGATION SYSTEM INFRARED	LEFT ENGINE AFTERBURNER IGNITION LEFT TRANSFORMER RECTIFIER LEFT 14/26V A-C X-FORMER NOSE WHEEL STEERING NO. 4 TANK FUEL TRANSFER PUMP OPTICAL VIEW FINDER	RADAR SCOPE CAMERA RIGHT ENGINE AFTERBURNER IGNITION RIGHT FUEL BOOST PUMP SEAT ADJUST UTILITY A-C POWER
LEFT MAIN 28 VOLT D-C BUS	AILERON RUDDER INTERCONNECT APPROACH AND INDEXER LIGHTS CONTROL ARRESTING GEAR AND WING FOLD CONTROL BOMB RELEASE FORWARD LOOKING RADAR	LEFT AUXILIARY AIR DOOR NAVIGATION COMPUTER NOSE WHEEL STEERING NO. 4 TANK FUEL TRANSFER CONTROL OPTICAL VIEW FINDER OUTBOARD STORE JETTISON (PRI)	PNEUMATIC SYSTEM CONTROL RADAR SCOPE CAMERA RAIN REMOVAL RIGHT AUXILIARY AIR DOOR RIGHT FUEL BOOST PUMP STABILATOR POSITION INDICATOR UTILITY POWER D-C
RECONNAISSANCE 28 VOLT D-C BUS	FORWARD CAMERA HIGH ALTITUDE CAMERA INFRARED LEFT CAMERA	PHOTOGRAPH CONTROL UNIT STABILIZED MOUNT PHOTO DEFOG PHOTO NIGHT	PHOTO SELECT RIGHT CAMERA SIDE LOOKING RADAR VERTICAL CAMERA
RIGHT MAIN 28 VOLT D-C BUS	AUTOPILOT CNI COCKPIT HEAT AND VENT EQUIPMENT COOLING EXTERIOR LIGHTS CONTROL FLAPS	FORWARD COCKPIT WHITE FLOOD LIGHTS INTERNAL WING FUEL DUMP LANDING GEAR LEFT FUEL BOOST PUMP	NO. 6 FUEL TRANSFER CONTROL RADAR ALTIMETER RUDDER TRIM SPEED BRAKE WARNING LIGHTS CONTROL
ESSENTIAL 28 VOLT D-C BUS	ANGLE OF ATTACK HEATER ARMAMENT POWER RELAY CONTROL BACKUP ATTITUDE REFERENCE CENTERLINE STORES RELEASE POWER CENTRAL AIR DATA COMPUTER CNI EXTERNAL WING FUEL TRANSFER FORWARD COCKPIT RED INSTRUMENT FLOOD LIGHTS (BRT) FUEL LEVEL LOW WARNING LIGHT	FUEL VALVE POWER INBOARD STORES JETTISON INERTIAL NAVIGATION SYSTEM INFLIGHT REFUELING PROBE POWER INTERNAL WING FUEL TRANSFER CONTROL LANDING GEAR AND FLAPS POSITION INDICATOR LEFT FUEL BOOST PUMP EMERGENCY CONTROL	LEFT MAIN FUEL CONTROL MASTER CAUTION LIGHTS RESET NOZZLE POSITION INDICATOR OUTBOARD STORES JETTISON (SEC) PHOTO CARTRIDGE EJECTION RIGHT MAIN FUEL CONTROL STABILATOR FEEL TRIM TRIM CONTROL UTILITY WHITE FLOOD LIGHTS (EQUIPMENT BAYS)
**IGNITION BUS	LEFT ENGINE IGNITION	RIGHT ENGINE IGNITION	
ESSENTIAL 115/200 VOLT A-C BUS	AFT COCKPIT INSTRUMENT LIGHTS X-FORMER BACK UP ATTITUDE REFERENCE CENTRAL AIR DATA COMPUTER CNI FIRE DETECTOR	FORWARD COCKPIT INSTRUMENT LIGHTS X-FORMER FUEL QUANTITY INDICATOR 1 LEFT ENGINE IGNITION LEFT FUEL BOOST PUMP LEFT TURBINE OUTLET TEMP. POWER	1 RIGHT ENGINE IGNITION RIGHT TRANSFORMER RECTIFIER RIGHT TURBINE OUTLET TEMPERATURE POWER WINDSHIELD TEMPERATURE SENSING
RIGHT MAIN 115/200 VOLT A-C BUS	AILERON FEEL TRIM AILERON RUDDER INTERCONNECT AIRSPEED PITOT HEATER ALTIMETER VIBRATOR ANGLE OF ATTACK CASE HEATER AUTOPILOT	BELLMOUTH PITOT HEATER CNI COCKPIT HEAT AND VENT INFLIGHT REFUELING PROBE LIGHTS LEFT ENGINE RAMP NO. 6 TANK FUEL TRANSFER PUMP	OXYGEN GAGE RADAR ALTIMETER RIGHT ENGINE RAMP RIGHT 28V A-C X-FORMER VOICE RECORDER
RIGHT MAIN 28/14 VOLT A-C BUS	AFT COCKPIT RED CONSOLE LIGHTS (MED) AILERON RUDDER INTERCONNECT ANTI-COLLISION LIGHTS APPROACH & INDEXER LIGHTS PWR	FORWARD COCKPIT RED CONSOLE LIGHTS (MED) FORWARD COCKPIT RED INSTRUMENT FLOOD LIGHTS (DIM) INERTIAL NAVIGATION SYSTEM	UTILITY HYDRAULIC PRESSURE INDICATOR UTILITY LIGHTS WING AND TAIL LIGHTS (BRT)

DIMMING RELAY

**IGNITION BUS RELAY DE-ENERGIZED

1 AIRCRAFT 153095y AND UP, AND ALL OTHERS UPON INCORPORATION OF AFC 220.

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Figure 1-18 (Sheet 2)

INSTRUMENT GROUND POWER SWITCH

The instrument 115/200 volt a-c bus and the instrument 28 volt a-c bus will not be energized by external electrical power until the instrument ground power switch, on the rear cockpit number 1 circuit breaker panel, is actuated. This arrangement is provided to reduce operating time of many of the airplane instruments during ground repair and system testing. The switch is solenoid operated, and will remain engaged, regardless of the position of the generator control switches, as long as external electrical power is applied. This feature prevents a power interruption to the instrument buses when switching from external electrical power to airplane generated power. The instrument buses may be de-energized, when operating on external electrical power, by placing the instrument ground power switch to OFF (NORM position).

RECONNAISSANCE GROUND POWER SWITCH

The reconnaissance 115/200 volt a-c bus and the reconnaissance 28 volt d-c bus will not be energized with external power applied and the generator control switches in the EXT position until the reconnaissance ground power switch on the rear cockpit number 1 circuit breaker panel is actuated. This arrangement is provided to reduce operating time on the multiple reconnaissance sensor equipment during ground repair and system testing. The switch is solenoid operated and will remain engaged as long as external power is applied and both generator control switches are in the EXT position. The reconnaissance buses may be de-energized, when operating on external power, by placing the reconnaissance ground power switch off (NORM position).

NORMAL OPERATION

Normal operation of the electrical system commences when external power is applied to the aircraft and the generator switches are in the EXT ON positions, or when the engines are running and the generator control switches are in the GEN ON positions.

EMERGENCY OPERATION

SINGLE GENERATOR FAILURE

Failure of one generator will be noted by illumination of either the "L.H. or R.H. Gen Out" light. The light will determine which generator has failed. One generator in normal operation is sufficient to support the entire electrical demand or load. In the event of generator failure, cycle the generator control switches from ON to OFF, wait 45 seconds, and back to ON. If the generator fault has been corrected, the generator will be brought back on the line and the light will go out. If the light remains illuminated, monitor engine oil pressure and variable nozzle operation. If oil starvation is indicated, secure the affected engine if practicable.

CAUTION

Upon illumination of a generator indicator light, immediately check the corresponding oil pressure gage. The generator failure could have been caused by oil starvation which will also affect the engine oil system.

DOUBLE GENERATOR FAILURE

Although a double generator failure is highly remote, the possibility of a double failure is still present. It is more likely that one generator will fail, followed by the failure of the other generator. As previously stated in the paragraph on single generator failures, one generator out light will be illuminated when one of the generators fail. When the other generator fails, both generator out lights will be illuminated. Although a double generator failure results in a complete electrical power failure, the permanent magnet generators (provided for field excitation and generator warning lights) will continue to function while the generators are turning. Upon the loss of both generators, extend the ram air turbine and turn off all electrical equipment not necessary to maintain flight. Attempt to return the generators to the line by cycling the generator control switches to OFF, wait 45 seconds, then back to ON. If the fault has been corrected, the generator lights will be extinguished. With the loss of all electrical power in flight, the emergency pneumatic system should be utilized to extend the landing gear and flaps. If the gear has been lowered prior to loss of electrical power, the pneumatic system should still be utilized. Blowing the gear down will assist the integral locks in keeping the gear down and locked since, with the loss of electrical power, the landing gear selector valve will revert to a neutral position. In the neutral position, both sides of the actuating cylinder will be routed to utility return, resulting in no hydraulic pressure on the down side of the landing gear actuator. Therefore, by blowing the gear down, 3000 psi pneumatic pressure will be exerted on the down side of the landing gear actuator to keep the gear down and locked. If all electrical power is lost while taxiing, the emergency pneumatic system should be actuated to assure that the gear remains locked. If the flaps had been lowered prior to electrical failure, air loads will return the flaps to a low drag position.

BUS TIE OPEN

Due to the design of the airplane's electrical system, it is possible to lose the essential buses as a result of a short in the right generator system. A short on the right generator bus will be noted by the illumination of the "Bus Tie Open" light followed in 5 seconds by the illumination of the "R.H. Gen Out" light. The "Bus Tie Open" light will then be extinguished. If the "Bus Tie Open" light remains extinguised, the short will present no problem since the left generator will supply the power to the right buses. However, if the "Bus Tie Open" light illuminates again within 2 seconds, all the buses supplied by the right generator will be lost since the illumination of the "Bus Tie Open" light indicates that the bus tie relay has opened. Because the bus tie relay parallels the output of the two generators it can be seen that an open relay and an inoperative right generator will automatically deprive the airplane the use of the right main a-c and essential airplane buses. An attempt should be made to regain the right generator by placing the right generator control switch OFF, waiting 45 seconds, and placing the switch back to ON. If the right generator comes on the line, the short is no longer present. The generators will parallel and normal operation will be resumed. If the right generator light does not go out when the right generator switch is placed on, the short remains and the emergency generator must be used. The essential buses may be regained but this necessitates the loss of the left generator system, since the emergency generator will not come on the line as long as either main generator is in service. Extension of the ram air turbine must be followed by switching off the left generator in this circumstance. A short in the left generator or in any of the left generator system buses is not of such a serious nature due to the fact that the right main and essential buses will still be in operation. Refer to Emergency Procedures for action to be taken upon illumination of the "Bus Tie Open" light.

ELECTRICAL FIRE

In the event of an electrical fire, turn the generator control switches and all electrical switches OFF. When the fire subsides, place the generator control switches ON. If the fire still persists after turning the generator control switches ON; extend the ram air turbine and turn the generator control switches OFF. Operate essential equipment only, and land as soon as practicable. If no fire is apparent when the generator control switches are placed ON, individually reposition the electrical equipment switches to ON, beginning with the most essential equipment first. If the malfunctioning piece of equipment is found, turn that equipment OFF, and pull the applicable circuit breaker.

Note

Ram air turbine operating time shall be logged on the yellow sheet (OPNAV Form 3760-2).

LIMITATIONS

Based on NATC tests, the emergency generator will deliver fully rated power for a minimum continuous period of three hours.

REFERENCE PUBLICATIONS

If more detailed system information is required, refer to Item No. 13, on Maintenance Instruction Manuals Publication Index (flyleaf 3 this publication).

EMERGENCY EQUIPMENT

DESCRIPTION

The airplane emergency equipment consists of a pneumatically extended and retracted ram air turbine, and a comprehensive set of warning and indicator lights.

RAM AIR TURBINE

A ram air turbine, located in the upper left side of the fuselage, is provided as a power source for an emergency a-c generator. The turbine assembly consists of a housing that contains two variable pitch turbine blades, a governing unit that controls the pitch of the blades, and the gearing to transfer blade rotation to a vertical drive shaft. The gear box then drives the generator. On aircraft 153094x and prior, before incorporation of AFC 220, the gear box also drives an emergency hydraulic pump. When the ram air turbine is extended into the airstream, the turbine blades are at a maximum angle of attack. This results in a rapid acceleration of the turbine blades and governing unit. As the regulating speed of the governing unit is approached, the turbine blades decrease their angle of attack. Turbine blade angle of attack (as directed by the governing mechanism) then varies with respect to the velocity of the airstream in order to maintain a constant 12,000 rpm. In effect, the ram air turbine functions as a constant speed drive unit for the emergency generator and emergency hydraulic pump, providing the airspeed is above 195 ± 7 knots. When the airspeed drops to 195 ± 7 knots, an airspeed pressure switch disconnects the emergency generator in order to provide maximum hydraulic pump output for landing approaches. As the airspeed drops below approximately 180 knots, the velocity of the airstream across the turbine blades is not sufficient to maintain 12,000 rpm, and as a result, hydraulic pump output will decrease in proportion to the decrease in rpm of the turbine. On aircraft 153095y and up, and all others upon incorporation of AFC 220, the emergency hydraulic pump and airspeed cut-out switch is removed. This allows the emergency generator to function down to speeds of approximately 90 knots and assures emergency electrical power during landing. Refer to Electrical System and Hydraulic Systems, this section, for the operation of the emergency a-c generator and the emergency hydraulic pump.

WARNING AND INDICATOR LIGHTS

Warning and indicator lights have been incorporated throughout the cockpits to reduce instrument surveillance to a minimum. The majority of the lights are located in the front cockpit, with most of them being grouped on the telelight panel.

Telelight Panels

Telelight panels, located on the front cockpit right vertical panel and the generator control panel (figure 1-3), contain the telelight bars. When a condition exists that requires corrective action, or is worthy of note, a telelight bar corresponding to the condition will illuminate. Most of the lights on the telelight panels will illuminate in conjunction with the "Master Caution" light. Indicator lights that do not illuminate in conjunction with the "Master Caution" light are: "Speed Brake Out", "L Ext Fuel", "Ctr Ext Fuel", "R Ext Fuel" and "Refuel Ready", The light(s) will be extinguished when the condition that caused the light(s) to illuminate is corrected. Amplification of conditions that exist upon illumination of a telelight, and its corrective action, can be found in Warning Indicator Light Analysis, Section V.

Master Caution Light

A "Master Caution" light operates in conjunction with lights on the telelight panel. It is only necessary to monitor the "Master Caution" light for an indication of a condition requiring attention, and then referring to the telelight panel for the specific condition.

Warning Light Test and Dimmer Circuit

The warning light test and dimmer circuit provides a means of testing the operation of the bulbs in the warning and indicator lights. All warning and indicator lights are included in the test and dimmer circuit. The circuit does not provide an operational check of any warning or indicator system, it merely checks the light bulbs. The warning and indicator lights may be illuminated by actuating the warning lights test switches on the interior lights control panels.

Eject Light

This system provides for a positive visual ejection command from the pilot to the RSO. The lights can be actuated only from the front cockpit. The pilot's switch and monitor light are incorporated into a single unit, mounted under the left canopy sill just forward of the flap switch (figure 1-2). The switch is a "push ON, push OFF" type, with the push button being the lens of the light. The lens is recessed sufficiently to preclude an accidental actuation. The light in the rear cockpit is a rectangular "press to test" unit mounted at the bottom left of the instrument panel (figure 1-5). The lights both incorporate red lenses with black lettering. Power for the system is supplied by a separate dry cell battery mounted in the front cockpit.

NORMAL OPERATION

RAM AIR TURBINE

The ram air turbine is extended and retracted penumatically by a ram air turbine handle (figure 1-2) located in the forward cockpit. Pushing down on the handle extends the turbine, pulling up on the handle retracts the turbine.

CAUTION

When retracting the ram air turbine, insure that 2000 psi pneumatic pressure is available. If the ram air turbine is retracted when the pressure is less than that recommended, the ram air turbine doors will close prematurely, resulting in damage to the doors.

MASTER CAUTION RESET

The "Master Caution" light may be extinguished by depressing the master caution reset button, located on the generator control panel. The illuminated lights on the telelight panel will not be extinguished by the master caution reset button, with the exception of the "A/P Disengage" light, until their respective faults have been cleared. After the "Master Caution" light is cleared, and an additional condition exists that requires attention, the "Master Caution" light will again illuminate.

EJECT LIGHT

When the switch in the front cockpit "Eject" light is depressed, both "Eject" lights will illuminate. Depressing the switch again will extinguish both lights. Pressing the lens on the rear light will test the rear light bulb and circuitry only.

EMERGENCY OPERATION

There are no provisions for emergency operation of the emergency equipment.

LIMITATIONS

The maximum airspeed for operation of the ram air turbine is 515 knots IAS or Mach 1.1, whichever is less.

REFERENCE PUBLICATIONS

If more detailed information is required, refer to Item No. 6, 13 and 14, on Maintenance Instruction Manuals Publications Index (flyleaf 3, this publication).

ENGINES

DESCRIPTION

The airplane is powered by two modified General Electric J79-GE-8 engines. The modifications consist of a nose dome anti-icing capability, designated J79-GE-8A, and a production installed approach power compensator, designated J79-GE-8B. The modifications do not alter the operation or performance of the basic engine, and therefore, to avoid confusion, only the basic J79-GE-8 engine will be called out when it is necessary to specify engine model in this manual. Any of the engines may be used interchangeably. At Military power the engine developes 10,900 pounds thrust and with complete afterburner, total thrust is 17,000 pounds. The engine features a variable stator (first six stages), a 17-stage compressor, 10 annular combustion chambers, a three-stage turbine, a variable area exhaust nozzle and a variable thrust afterburner. An impingement type starter, supplied with air from an external auxiliary power unit, is used to "crank" the engine during starting. During operation, air enters the inlet of the engine and is directed into the compressor rotor by the variable inlet guide vanes. As it is compressed, the air is forced through the compressor rear frame into the combustion chambers. Fuel nozzles, projecting into the combustion chambers, eject a fuel spray which mixes with the compressed air. Ignition is provided by a spark plug located in the number 4 combustion chamber, the remaining nine combustion chambers are ignited through cross fire tubes. The gases resulting from combustion flow from the combustion chambers into the turbine. The three turbine wheels move as a unit on a common shaft which is directly splined to the compressor rotor. After passing through the turbine section, the exhaust gases flow into the afterburner where their flow is stabilized and then ejected through the variable exhaust nozzle. Additional fuel may be injected into the hot exhaust gases for afterburner combustion, producing considerable thrust augmentation. The engine oil system is a dry sump type completely contained on the engine. The compressor inlet guide vanes and the stators in the first six compressor stages are variable, and are controlled by the variable stator system. The compressor blades are small fixed airfoils whose theory of operation is essentially that of a wing. It is highly advantageous to control the angle of attack of the early stage compressor blades, and this is accomplished in effect, by controlling the airflow to blade impingement angle through the variable stator system. The impingement angle is controlled within acceptable limits for low airflow (low speed and/or rpm) conditions and to permit high airflow with a minimum of restriction. Controlling the impingement angle reduces compressor stall problems at critical engine-airplane speeds, particularly during burst acceleration and deceleration. The variable stators and inlet guide vanes are interconnected externally and are positioned by two actuators which utilize high pressure engine fuel as the hydraulic medium. The variable nozzle system is hydromechanically controlled and schedules nozzle area by positioning the nozzle opening to obtain optimum thrust with respect to altitude and airspeed conditions. The purpose of the variable exhaust nozzles is to control the operating temperature of the engine as governed by the engine amplifier during Military and Maximum engine operation. Air bled from the 17th stage of each engine compressor is used by the equipment cooling system, the boundary layer control system, the central air data computer system, the cockpit air conditioning and pressurization system, the engine anti-icing system, the fuel tank pressurization system, the pneumatic system (air source) and the windshield rain removal system. A one-way check valve is located in the bleed air manifold of each engine. The purpose of the valve is to prevent the bleed air of one engine from entering the other during differential power settings.

ENGINE FUEL CONTROL SYSTEM

The fuel control system (figure 1-19) for each engine is complete in itself and the two systems are identical. For simplicity of discussion, only one system or engine shall be discussed. The engine fuel control system transports fuel from the engine fuel inlet to the combustion chambers. This fuel is discharged in the proper state of atomization for complete burning. Varying engine power settings and conditions demand changes in fuel flow; therefore, the engine fuel control system must also control fuel flow to obtain maximum engine efficiency within the design limits of the engine. Only the engine fuel system is discussed in the following paragraphs. The afterburner fuel system is discussed separately in this section.

Fuel Pump Unit

The engine fuel pump unit consists of a low pressure impeller-type pumping element, a high pressure gear-type main pumping element, a low pressure fuel filter, a fuel filter by-pass, and an output pressure relief valve. The centrifugal impeller performs a pressure boost function which assures pump operation at low inlet fuel pressures. Airplane boosted fuel from the main fuel manifold passes through the impeller-pump. The impeller boosted fuel then passes through the fuel filter to the main gear-pump, which delivers it to the main engine fuel control at approximately 1000 psi. In the event the fuel pressure differential across the fuel filter exceeds approximately 33 psi, the fuel filter bypass opens, and a "Check Fuel Filters" light, on the pilot's right vertical panel will illuminate. If the discharge pressure of the gear-pump exceeds approximately 1125 psi, the output pressure relief valve will open to maintain safe fuel pressures. The output pressure relief valve will reseat when discharge pressures reduce to approximately 1025 psi.

Engine Fuel System

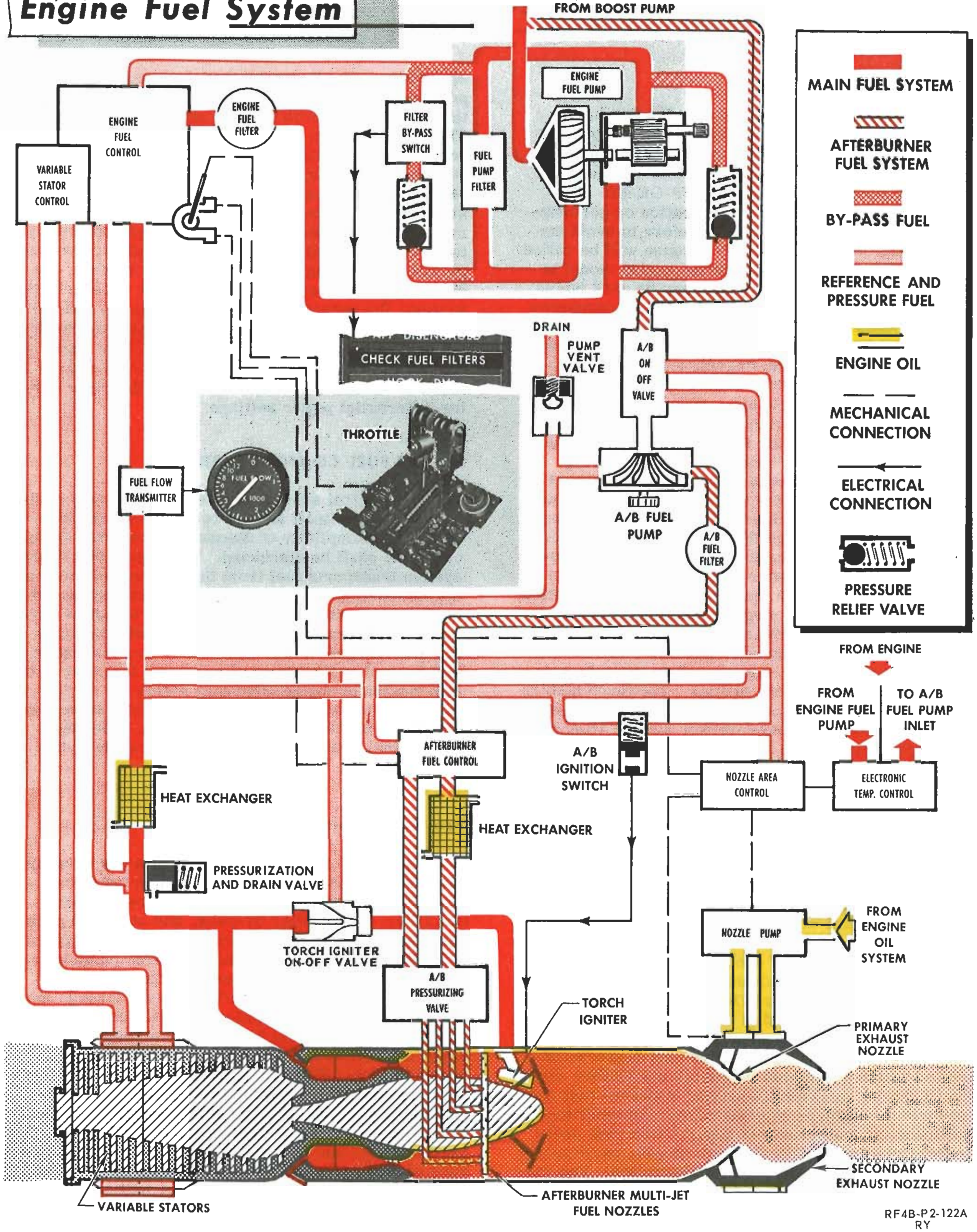

Figure 1-19

Engine Fuel Control

The main fuel control is a hydromechanical computer which uses engine fuel as the hydraulic controlling medium. The control performs the following functions: provides engine speed control by regulating main fuel flow; provides fuel surge protection; limits turbine inlet temperature to a safe value; provides a positive fuel shutoff; schedules variable stator vane angle to control airflow into the engine; and provides a hydraulic signal to initiate afterburning operation. High pressure fuel from the pump is delivered to the bypass valve and the metering valve in the main fuel control. The bypass valve senses the pressure differential across the metering valve. It maintains this pressure differential at a predetermined value by bypassing varying amounts of fuel back to the main fuel pump inlet. The metering valve is positioned by various operating signals and meters fuel to the engine as a result of these integrated signals. From the metering valve, fuel flows through the main fuel control cutoff valve. The cutoff valve cuts off fuel flow at engine shutdown. Fuel passing through the open cutoff valve flows through a fuel-oil radiator which effects a transfer of heat from the scavenge oil to the fuel. From the fuel-oil radiator, the fuel flows into the pressurizing and drain valve. This valve maintains the fuel pressure at the minimum acceptable for all operations and also drains the fuel manifold at engine shutdown. Fuel flows from the pressurizing and drain valve into the fuel manifold. High pressure metered fuel is fed from the manifold into the 10 flow-divider type fuel nozzles. The fuel nozzles discharge an atomized fuel spray into the combustion chambers. Here the fuel is mixed with air and burned to produce engine thrust.

Fuel Oil Heat Exchanger

Fuel metered from the main fuel control passes through the coolant tubes of the fuel-oil heat exchanger and then to the fuel nozzles. The fuel serves as the coolant for the scavenge oil which flows around the heat exchanger tubes. The heat exchanger incorporates a bypass valve to regulate the flow of oil which, in turn, controls the temperature of the oil and fuel. There are two fuel-oil heat exchangers incorporated on the engine, one utilizes normal engine fuel as a coolant while the other uses afterburner fuel. Both fuel-oil heat exchangers serve the same purpose and their operation is the same.

Fuel Pressurization and Drain Valve

The fuel pressurization and drain valve prevents fuel flow to the engine until sufficient fuel pressure is attained in the main fuel control to operate the servo assemblies, which are used to compute the fuel flow schedules. It also drains the fuel manifold at engine shutdown to prevent post shutdown fires, but keeps the upstream portion of the system primed to permit faster starts. When the fuel pressure differential across the pressurizing valve drops below 80 psi, the pressurizing valve closes, cutting off fuel flow to the engine and the drain valve opens to drain the fuel manifold.

Fuel Nozzles

A flow-divider type fuel nozzle in each inner combustion chamber liner delivers metered fuel into the compressor discharge air entering the combustion chamber. The nozzles produce a uniformly distributed, cone shaped, hollow fuel spray. High velocity compressor air is directed around the nozzle by an air shroud to provide a cooling action around the nozzle orifice and to reduce carbon deposits.

OIL SYSTEM

Each engine is equipped with a completely self contained, dry sump, full pressure oil system. Oil is stored in a 5.3 gallon, pressurized reservoir, located at the one o'clock position on the engine compressor front casing. The oil pump is a positive displacement, dual element, rotary vane type unit. The lubrication element is capable of delivering 11.8 gpm at 40 to 60 psi, while the hydraulic element is capable of delivering 4.1 gpm at 70 to 110 psi. Each element contains a filter, through which the oil is pumped before distribution. Engine oil is used for lubrication, variable nozzle positioning and constant speed drive unit operation. The standpipes which supply the three systems utilizing engine oil are located in the reservoir such that the pipe for the constant speed drive unit is the highest, the one for the nozzle control is the next highest, and the lubricating system pipe is the lowest. Therefore, a leak in the constant speed drive unit would probable cause a failure of the system only, while a leak in the nozzle control system may cause failure of that system and the constant speed drive unit. A leak in the lubricating or the scavenging system will cause failure of the constant speed drive unit and the nozzle control system, and ultimately, engine bearing failure will result. After distribution to various points throughout the engine, the oil is picked up by three scavenge pumps, routed through a scavenge filter, through an air-oil heat exchanger and two fuel-oil heat exchangers and finally back to the tank. A pressurizing system maintains the proper relationship between ambient air pressure and air pressure in the bearing sumps, gear boxes, damper bearing and reservoir to ensure effective oil seal operation, and to prevent damage to the reservoir and sumps due to high speed ascents or descents. Oil is also supplied directly from the reservoir to the constant speed drive unit, where it is used as both the control and final drive medium for controlling generator speed. Refer to this section for oil servicing specifications.

Lubrication

The lubrication element of the oil pump supplies oil to cool and lubricate bearings, gears and other rubbing or moving parts in the engine. Lubricating oil is also circulated through the engine driven generator for cooling purposes. Oil is drawn from the lowest standpipe in the reservoir by the constant displacement, rotary vane type lubrication element of the oil pump, which is capable of delivering the oil at 10.5 gpm and 80 psi. By supplying the lubrication element from the lowest standpipe, oil will be available for lubrication, should leakage occur in the nozzle control or constant speed drive unit. Lubricating oil is routed from the lubricating element, through the filter to three branch lines. The first branch distributes oil forward to the transfer gear box, intermediate damper bearing, number 1 bearing, fron gear box and the afterburner fuel pump. The second branch distributes to the number 2 and 3 bearings and the rear gear box. The third branch distributes to the pressure transmitter and the pressure relief valve. The pressure relief valve protects the system and is set to relieve at approximately 95 psi. The oil is picked up from the bearing sumps by the scavenge pumps, which pump the oil through the scavenge filter, the air/oil cooler, the two fuel/oil heat exchangers and returns it to the tank. Oil temperature is maintained by temperature regulators on the two fuel/oil heat exchangers. A check valve, located in the lubrication element outlet, prevents gravity flow of oil from the oil tank when the engine is not running.

Variable Nozzle Control

Engine oil is used as the hydraulic medium for positioning the variable nozzle flaps. During normal flight attitudes, oil flows through a gravity valve and into an accumulation compartment in the reservoir. During inverted flight, the gravity valve will close and oil for nozzle positioning is available for approximately 30 seconds. From this compartment, oil is drawn through a weighted, flexible standpipe, which stays submerged regardless of flight attitude, to the hydraulic element of the oil pump. This element is of the rotary vane type, and is capable of delivering 3.5 gpm at 60 psi. A relief valve in the pump protects the system by opening at approximately 70 psi. Oil is routed from the pump, through the hydraulic element filter to the nozzle pump. From here, it may return directly to the scavenge system, or be boosted and directed to the nozzle actuators on command from the nozzle area control. From the actuators, oil is routed back to the nozzle pump and into the scavenge system. The scavenge system is the same as described in the preceding paragraph.

ENGINE AIR INDUCTION

NEW There are two independent but identical air induction systems, one for each engine. The components making up the primary air system are the fixed and variable duct ramps. The secondary air system is made up of the variable bypass bellmouth and the auxiliary air door. NEW

Variable Duct Ramp

The variable duct ramp system is utilized to provide primary air at optimum subsonic airflow to the compressor face throughout the wide range of aircraft speeds. The ramp assembly consists of a fixed forward ramp and two variable ramps. The forward variable ramp is perforated to allow boundary layer air to be bled off and exhausted overboard. The aft variable ramp is solid. Movement of the aft ramp positions the forward variable ramp through mechanical linkage. The central air data computer supplies a total temperature input to the ramp control amplifier, which in turn sends a signal to a utility hydraulic system servo unit. This unit positions the ramps for optimum airflow at Mach number of 1.5 and above. The airplanes have a fixed forward ramp angle of 10° and a variable ramp angle of 0° to 14° relative to the fixed forward ramp.

Duct Temp Hi Indicator Light

The duct temperature high indicator light, marked "Duct Temp Hi", is located on the telelight panel (figure 1-3). The light, when illuminated, indicates that the temperature within the engine intake duct (compressor inlet) is beyond allowable limits for steady state engine operation. The maximum steady state operation of the engine is limited to 121° Centigrade (250°F) compressor inlet temperature. Operating the engine at high altitudes, with the compressor inlet temperature above the prescribed limit, will cause the life of the gears, bearings, and carbon seals to be reduced because the lubricating oil will exceed its design temperature. Exceeding the temperature will also cause structural components of the engine (compressor rear frame and combustion casings) to exceed their design limit because of high temperatures and pressures.

Variable Bypass Bellmouth

The variable bypass bellmouth is an automatic unit which allows excess induction air from the compressor face to flow into the engine compartment. Air diverted in this fashion is referrred to as secondary air. The variable bypass bellmouth is a perforated ring located between the airplane duct structure and the engine compressor inlet. Between .4 to .98 Mach, the bypass bellmouth is closed; however, a limited amount of bypass air flows into the engine compartment through the perforations in the bypass bellmouth and the engine air-oil cooler bleed. Above .98 Mach the bypass bellmouth controller senses the optimum airflow (based on duct air velocity) for induction into the engine. When this airflow is exceeded, (rapid throttle retardation) the controller signals a utility system hydraulic actuator which opens the bypass until the optimum airflow to the engine is established.

Auxiliary Air Door

Two auxiliary air doors, one for each engine compartment, are located on the center underside of the fuselage. They are normally controlled by the landing gear handle and actuated open or closed by utility hydraulic pressure. When the landing gear handle is placed in the down position, the doors open, making additional air available to the engine compartments for cooling purposes. When the landing gear handle is placed in the up position, the doors close. The closing force applied to each door by its hydraulic actuator is equivalent to the area of the door times 13.3 psi. If the engine compartment pressures exceed the ambient pressure by approximately 13.3 psi, the door will be forced open by an amount proportional to the overpressure. As soon as the overpressure is relieved, the actuator will pull the door closed.

CAUTION

Engine compartment pressures in excess of 13.3 psi are not normal. Therefore, in the event either auxiliary air door indicator light illuminates (other than momentary), corrective action should be taken as soon as possible. Refer to Auxiliary Air Door Malfunction, Section V.

Auxiliary Air Door Indicator Lights

The auxiliary air door indicator lights, located on the telelight panel (figure 1-3) and marked "L Aux Door" and "R Aux Door" respectively, will illuminate any time the auxiliary air doors operate out of phase with the landing gear handle. The lights will illuminate momentarily when engine compartment overpressures are relieved. Illumination of the auxiliary air door indicator lights will cause the "Master Caution " light to illuminate. Refer to Section V for operating instructions during auxiliary air door malfunctions.

VARIABLE AREA EXHAUST NOZZLE

Two sets of cylindrical nozzles, operating together, make up the variable area exhaust nozzle system. The primary nozzle, hinged to the aft end of the tail pipe, controls the convergent portion of the nozzle. The secondary nozzle, hinged to a support ring, controls the divergent portion of the nozzle. The two sets of nozzles are linked together and maintain a scheduled area and spacing ratio which is infinitely variable between full open and full closed. The nozzles are regulated by the nozzle area control. Movement of the nozzles is accomplished automatically by four synchronized hydraulic actuators. The exhaust gases leave the primary flaps at sonic velocity and are accelerated to supersonic velocity by the controlled expansion of the gases. Control of this expansion is provided by the cushioning effect of the secondary airflow through the annular passage between the two sets of nozzles.

Exhaust Nozzle Control Unit

Throttle position, nozzle position feedback, and exhaust gas temperature are the parameters utilized to schedule the correct nozzle area. During engine operation in the sub-military region, nozzle area is primarily a function of throttle angle and nozzle position feedback. The nozzle is scheduled full open at "idle" and the area is decreased as the throttle is advanced toward the military position. During a rapid throttle burst from below 79% rpm to 98% rpm, a control alternator supplies engine speed information to the temperature amplifier which in turn schedules engine "off speed" inputs as a function of temperature limiting. This signal prevents the primary nozzle from closing down past a preset position, permitting a rapid increase in engine rpm. During engine operation in the Military and afterburner region, it becomes necessary to limit the nozzle schedule as established by the throttle angle and nozzle feedback to prohibit exhaust gas temperature from exceeding the design limits. Exhaust gas temperature is sensed by 12 thermocouple loops and the resulting millivoltage is transmitted to the magnetic temperature amplifier. The amplifier, which receives its power supply from the control alternator, compares the thermocouple signal to a preset reference voltage representing desired engine temperature. The difference is amplified and transmitted to the nozzle area control. The nozzle area control output signal directs the operation of the variable pressure, variable displacement nozzle pump.

Note

Spasmodic exhaust nozzle operation shall be logged on the yellow sheet (OPNAV Form 3760-2).

AFTERBURNER SYSTEM

The engine is equipped with an afterburner, where additional fuel may be injected into the hot exhaust gases for afterburner combustion, producing considerable thrust augmentation. The main components of the afterburner system are the afterburner fuel pump, afterburner fuel control, afterburner fuel manifold and spray bars, and the torch igniter.

Afterburner Fuel System

The afterburner fuel system (figure 1-19) provides the fuel for augmentation of the thrust produced by the engine. A separate fuel control meters afterburner fuel. Ignition is by a separate A/B ignition system. In operation, the airplane boost pumps supply fuel to the inlet of the afterburner fuel pump. The inlet valve is opened by a fuel pressure signal from the main fuel control when engine speed is above 91 percent rpm and throttle angle is above 76.5 degrees (in minimum A/B range). Fuel passing through the check valve continues to the afterburner fuel control. It is metered and separated into core and annulus flows, and directed to the afterburner pressurizing valve. The core fuel passes through the afterburner fuel/oil heat exchanger on the way to the control and pressurizing valve. The core and annulus flows are further sub-divided into primary and secondary flows by the pressurizing valve. The flow sequence as the throttle is advanced in the afterburner range is to the primary core, secondary core, primary annulus and secondary annulus.

Afterburner Fuel Pump

The afterburner fuel pump is an engine-driven centrifugal pump. It operates continuously, but discharges fuel to the afterburner fuel system only when the inlet valve on the pump is open. To open the inlet valve to the afterburner fuel pump, the pilot must move the throttle into the afterburner modulation range and engine speed must be sufficiently high (above 91% rpm) to support combustion.

Afterburner Fuel Control

The afterburner fuel control is linked mechanically to the main fuel control through the use of teleflex cabling. Any movement of the throttle moves the main fuel control teleflex and also moves the teleflex to the afterburner fuel control. Fuel entering the afterburner fuel control is metered and separated into core and annulus flows in response to throttle movement and changes in compressor discharge pressure. The control varies fuel flow between the minimum necessary for afterburner combustion for any flight condition and the maximum fuel flow allowable at the flight condition. The afterburner fuel control is designed to hold a constant pressure drop across an orifice while the area of that orifice is varied in accordance with throttle position and compressor discharge pressure.

Afterburner Fuel Distribution

Four afterburner fuel pressurizing valves (primary annulus, primary core, secondary annulus, and secondary core) deliver fuel to four separate fuel manifolds. The fuel is distributed by the manifolds to 21 multi-jet afterburner fuel nozzles which are equally spaced around the perimeter of the afterburner section. Each multi-jet nozzle contains 4 tubes, one for each manifold, and holes in the sides of the tubes spray the fuel into the exhaust gases. When the throttle is first placed in the afterburner position, the core pressurizing valve opens and fuel is delivered to the primary core tube in the fuel nozzles. Further advancement will activate the secondary core valves which will deliver fuel to the secondary core tubes in the fuel nozzles and join the primary core in delivering fuel for afterburner operation. When the throttle is advanced still further, the annulus pressurizing valve opens and the primary annulus valves also deliver fuel to the nozzles. As the throttle is advanced to the maximum afterburner position the secondary annulus valves join the three other manifolds in delivering fuel to the nozzle; this is full afterburner operation. The afterburner fuel manifolds and multi-jet nozzle system gives a smooth afterburner operation, with hardly any recognizable acceleration surge between full military and minimum afterburner, or between minimum afterburner and maximum afterburner.

IGNITION SYSTEM

The ignition system consists of an ignition button (figure 1-2) on each throttle, a low voltage, high energy ignition unit on the engine, a spark plug in No. 4 combustion chamber and the necessary wiring. The main ignition system ignites the atomized fuel-air mixture in the No. 4 combustion can . The remaining nine combustion cans are ignited through the cross fire tubes. The afterburner ignition system includes the torch igniter, an afterburner ignition switch, and a torch igniter fuel metering valve. The torch igniter, which includes an afterburner spark plug and a fuel nozzle, is continuously supplied with fuel during afterburner operation. The fuel is ignited when the throttle is first moved into the afterburner detent. When the throttle is moved into the afterburner detent, fuel from the main engine fuel control is directed to the pressure actuated afterburner ignition switch. Electrical power from the left main 115/200 volt a-c bus is then supplied to the afterburner spark plug which emits a continuous arc to ignite the fuel-air mixture in the torch igniter. Once ignited, the torch igniter flame is self sustaining; however, continuous ignition is provided as long as the throttle is in the afterburner detent. The torch igniter produces an intense flame which, in turn, ignites the afterburner fuel.

Ignition Buttons

The ignition buttons are spring-loaded push button type switches located on each throttle directly below the throttle grips. The switches control the ignition system. Depressing the ignition button causes the spark plug to discharge, igniting the fuel-air mixture. The spark plug will fire only while the ignition button is depressed. The ignition duty cycle is 2 min. on, 3 min. off, 2 min. on, and 23 min. off. The ignition circuits are completed anytime aircraft power is on, and the ignition button is depressed.

STARTING SYSTEM

The impingement starting system consists of an assembly of ducting and valves which are airframe mounted, and a manifold assembly which is mounted on the turbine frame of the engine. The single receptacle for connecting the air supply line is located on the bottom left side of the fuselage aft of the main gear wheel well. Air from the external source is directed to the left or right selector valve which will distribute the air to either the left or right engine, depending on cockpit selection. The engine manifold assembly distributes the starting air to seven (7) impingement nozzles, which direct the air against the second stage turbine blades of the turbine wheel.

Engine Start Switch

The engine starting switch (figure 1-2) is located on the left console in the pilot's cockpit just inboard of the throttles. The starter switch is a three-position switch and is marked L, OFF, and R. With APU air connected, actuating the starter switch to L energizes the left engine selector valve and permits air to flow to the left engine impingement nozzles. Selecting R energizes the right engine selector valve and permits air to flow to the right engine impingement nozzles. The OFF position closes both selector valves and stops airflow to the engines. For impingement starting, a 5.5:1 pressure ratio gas turbine starting unit is desired.

ENGINE CONTROLS

Engine Master Switches

The toggle lock type two-position engine master switches (figure 1-2) are located on the left console in the pilot's cockpit on the inboard engine control panel. Placing the switch in the ON position will direct power to the fuel boost pumps and fuel transfer pumps. The circuits for the fuel shutoff valves, which are normally operated by the throttles, are such that either valve will be closed when its respective engine master switch is placed OFF regardless of the throttle position.

Throttles

A standard lever type throttle (figure 1-2) for each engine is located on the left console of the forward cockpit. Mechanical linkage and teleflex cables transmit mechanical motion from the throttle to those accessories requiring coordination to obtain the degree of thrust desired. Movement of the throttle is transmitted by mechanical linkage to the main fuel control. The main fuel control unit incorporates a throttle booster which reduces the amount of effort needed to move the throttles. The boost power is supplied by fuel from the engine driven fuel pump. Teleflex cables from the main fuel control link the nozzle area control and afterburner fuel control to throttle movement so that fuel flow and nozzle area are compatible throughout the full range of engine operation. A friction adjusting lever is mounted between the throttles which permits adjustment of throttle friction to suit individual requirements. Included on the throttles are the ignition buttons (one for each engine on the applicable throttle), speed brake switch and microphone button on the right throttle, and master lights control switch on the outboard side of the left throttle. Limit switches which control the main fuel shutoff valves are built into the throttle quadrant. Advancing the throttle from OFF to IDLE (with the engine master switch ON) will actuate electrical switches which will open the main fuel shutoff valve corresponding with the throttle moved. With further advancement of the throttle from IDLE to MIL, engine thrust will increase proportionally. At the MIL position of the throttles, the engine should be delivering its rated Military power. Afterburner light-off can be initiated anywhere within the afterburner modulation range by shifting the throttles outboard and moving forward toward the MAX position. Movement of the throttles from IDLE to OFF will actuate a switch which will close the main fuel shutoff stopping fuel flow to the engine. Throttle movement through the cutouts is as follows: To move throttles from OFF to IDLE, push forward and then shift throttles inboard. To move from MIL to MAX shift throttles outboard, throttles can now be moved forward in the afterburner range.

Catapult Hold-Back Handles

Handles secured to the pilot's cockpit structure and located above the MIL throttle detent and MAX throttle detent may be hinged upward to line up with the throttle grips at the MIL and MAX throttle positions. The grips and handle may then be held together to prevent involuntarily closing the throttles during catapult accelerations. The handles are automatically stowed when released.

NEW

ENGINE INSTRUMENTS

Engine Fuel Flow Indicators

The engine fuel flow indicators (figure 1-4) are mounted on the right side of the pilot's instrument panel. The fuel flow indicating system indicates the amount of fuel, in pounds per hour, the engines are using at a particular power setting. The rate of fuel flow is shown in 1000 pounds per hour by a pointer moving over a scale calibrated from 0 to 12. The flow is measured by transmitters mounted on the engines which receiver power from the instrument 28 volt a-c bus. Afterburner fuel flow bypasses the fuel flow transmitters and therefore is not shown on the indicators.

Tachometers

The electric tachometer system is composed of two tachometer indicators (figure 1-4) mounted on the pilot's instrument panel and one engine-driven tachometer generator mounted on each engine. The system is completed self-contained in that it requires no external source of power. The tachometer generator develops a poly-phase alternating current which is used to indicate percentage of maximum engine rpm. The indicator dials are calibrated from 0 to 110. Each indicator includes two pointers, a large one operating on the 0 to 100 scale and a small one operating on a separate scale calibrated from 0 to 10.

Exhaust Gas Temperature Indicators

The exhaust gas temperature indicators (figure 1-4) are mounted on the pilot's instrument panel. The scale range on the indicators is 0 to 11 with the reading multiplied by 100 degrees centigrade. The system indicates the temperature of the exhaust gas as it leaves the turbine unit during engine operation. Twelve dual loop thermocouples are installed on each engine and are connected in parallel. The millivoltages produced by one of the sets of dual loop thermocouples is directed to an amplifier for temperature limiting. The millivoltages produced by the other set of 12 thermocouples is directed to the cockpit indicator. The indicator is a null-seeking potentiometer type. It balances a thermocouple voltage against a constant voltage source with a small servo simultaneously balancing a bridge circuit and operating the indicator pointers.

Exhaust Nozzle Position Indicators

Exhaust nozzle position indicators (figure 1-4) which show the exit area of the exhaust nozzles, are located on the pilot's instrument panel. The instruments are placarded Jet Nozzle Position and are calibrated from CLOSE to OPEN in 1/4 increments. The nozzle position indicators enable the pilot to make a comparison of nozzle position between engines, and is also used to establish a relationship between nozzle position and exhaust gas temperature and nozzle position and throttle settings.

Oil Pressure Indicators

The oil pressure indicators (figure 1-4) are located on the pedestal panel. The scale range on the indicators is 0 to 10 with reading multiplied by 10. The oil pressure indication system senses oil pressure downstream of the main lube pump in the main lube discharge line.

ENGINE ANTI-ICING SYSTEM

The engine anti-icing system is a compressor discharge air bleed type system, controlled by a shutoff/pressure regulating valve. Air for anti-icing purposes is supplied from the 17th stage of the engine compressor at pressures up to 275 psi, and temperatures up to 593°C. A regulator incorporated in the anti-icing valve reduces the incoming air to a pressure of appoximately 14-20 psi. Air from the anti-icing valve is distributed through the first stage stator vanes, the compressor front frame struts, and the inlet guide vanes. Engine anti-ice air is also delivered to a port in the front gear box for engine nose dome anti-icing.

Note

During subsonic flight, the anti-icing system should only be used when icing conditions are anticipated.

CAUTION

During supersonic flight, the anti-icing system should only be used when actual aircraft icing is noted.

Engine Anti-Icing Switch

A two-position engine anti-icing switch (figure 1-2) is located on the outboard engine control panel. The switch is marked engine anti-icing and the switch positions are DE-ICE and NORMAL. Placing the switch in the DE-ICE position opens the regulator valve which starts anti-icing air flow. With the switch in the NORMAL position, anti-icing air is shut off.

Engine Anti-Ice Lights

Engine anti-ice lights are included on the telelight panel. The lights, marked "L Anti-Ice On" and "R Anti-Ice On", operate from a pressure sensitive switch which is actuated by the pressure of engine bleed air when the system is turned on. During flight in the high Mach number region, a pressure build-up, caused by high dynamic pressures, may occur in the anti-icing system. This may cause the anti-icing lights to illuminate even though the anti-icing switch is in the NORMAL position, resulting in an erroneous indication. If the lights illuminate under these conditions, reduce speed. If the lights go out, high Mach flight may be continued. If the lights illuminate during low speed flight and the engine anti-icing switch is in NORMAL, check for proper system operation by placing the anti-ice switch to DE-ICE and observe a 10° rise (approximately) in exhaust gas temperature.

CAUTION

In the event the "Master Caution" light and the "L Anti-Ice On" and/or "R Anti-Ice On" lights illuminate during high Mach flight and a speed reduction will not extinguish them, remain at a reduced speed. Continued operation in the high Mach range may cause engine damage.

ENGINE FIRE AND OVERHEAT DETECTOR SYSTEM

Fire/Overheat Warning Lights

Two combination "Fire" and "Overheat" warning lights (figure 1-4), one for each fire warning system, are located on the upper right portion of the main instrument panel. Along with the lights, each system consists of a control unit, and a series of continuous type sensing elements. The fire warning system sensing elements are routed throughout the engine compartments. The lights are energized when a temperature of approximately 765°F occurs in the engine compartment. This excessive temperature causes the sensing element to ground out and unbalance a bridge network in the detector control unit. The unbalancing of this bridge circuit energizes the fire warning light for the engine which is in an over-temperature condition. The aft fuselage over-heat warning systems are separate (but similar) to the fire warning systems. The sensing elements are routed vertically in recesses provided in the skin fairing of the keel. These recesses are located opposite the aft end of the secondary engine nozzle fingers. The energizing temperature for the overheat warning systems is approximately 1050°F. Illumination of the 'Fire" or "Overheat" warning lights warns the pilot to initiate emergency procedures. Afterburners must never be used if the "Overheat" warning light illuminates. The indication means a safety of flight condition exists, such as an open engine compartment door or a damaged engine nozzle. Either of these conditions can lead to the loss of flight control if afterburners are used.

Note

Illumination of the "Fire" or "Overheat" warning lights shall be logged on the yellow sheet (OPNAV FORM 3760-2).

Fire Detector Check Switch

The "Fire" and "Overheat" warning light system may be tested by momentarily placing the warning lights test switch (figure 1-3), on the left console, to the TEST position. This action, however, will only check the condition of the light bulbs. By depressing the fire detector check switch (figure 1-4), on the front cockpit instrument panel, the fire warning circuit from the light bulbs to their sensing elements is checked.

NORMAL OPERATION

STARTING ENGINES

The following procedures contain only the steps that are necessary to start the engines. Many checks that are performed on other systems during the engine start have been omitted. Therefore, the procedures contained herein should be used only for familiarization with the actual steps necessary to start the engines.

Note

With flaps extended, the BLC ducts are open and the loss of engine bleed air, while attempting to start the engines, may result in a hot or false (no-ignition) start.

1. Throttles - OFF
2. External compressed air source - CONNECTED
3. Engine master switches - ON
4. Engine start switch - RIGHT

CAUTION

If there is no indication of engine rpm within 15 seconds, or no indication of oil pressure within 30 seconds after start cycle begins, shutdown immediately and investigate.

5. At 10% rpm, right engine ignition button - DEPRESS
   At approximately 10% rpm, depress right engine ignition button and simultaneously advance the throttle half way up throttle quadrant and immediately return to idle.

Note

Sustained combustion usually occurs at approximately 10 to 16% rpm with a fuel flow of 500 to 800 pph.

CAUTION

If the engine does not light off by the time fuel flow reaches 500-800 pph or within 15 seconds after fuel flow or pressure is indicated, chop throttle to full OFF position, release ignition button and investigate.

6. Release ignition button when light-off is indicated by a sudden increase in EGT.

CAUTION

If engine does not continue to accelerate after light-off, discontinue start.

7. Start switch - NEUTRAL
   When the engine is operating at a self-sustaining rpm (usually about 45%) move the starter switch to the neutral position.
8. Exhaust temperature gage - CHECK WITHIN LIMITS (982°C MAX, 3 sec.)

CAUTION

At no time should EGT exceed 1000°C nor should the starting temperature exceed maximum starting limits.

Note

After the engine reaches idle rpm and stabilizes, the EGT will recede to a temperature of approximately 320° to 400°C.

9. Fuel flow indicator - CHECK
   Fuel flow will indicate 500 to 800 lbs. per hour during starting and 800 to 1400 lbs. per hour at idle rpm.

Note

Fuel consumed while starting engines is approximately 65 pounds.

CAUTION

If fuel flow is appreciably less than 500 lbs. per hour, a false (no-ignition) start will likely result. If fuel flow is in excess of 700 lbs, per hour, a hot start will likely result.

10. Oil pressure gage - CHECK
    Check oil pressure 12 psi minimum at idle rpm.

Note

In the event the throttles cannot be returned OFF, the engine may be shut down from any throttle setting by placing the respective master switch in the OFF position. This will close the corresponding fuel shutoff valve, thus depriving the engine of fuel. The engine will flameout in approximately 15 seconds in Idle power, and in approximately 2 seconds from Mil power.

After any wet start or false (no-ignition) start, allow one minute or longer for the combustion system to drain before starting the engine.

11. Generator control switches from EXT to GEN ON.
12. Start the left engine as per items 1 thru 10.

Note

Non-start or abnormal starts shall be logged on the yellow sheet (OPNAV FORM 3760-2).

Fuel consumption at idle rpm is approximately 42 ppm.

EMERGENCY OPERATIONS

ENGINE FAILURE

Jet engine failures in most cases will be caused by improper fuel scheduling, due to a 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 stops. If engine failure is due to a malfunction of the fuel control system or improper operating technique, an air start can usually be accomplished, providing time and altitude permit. If engine failure can be attributed to some obvious mechanical failure within the engine proper, do not attempt to restart the engine.

RUNAWAY ENGINE

There is no provision made on the main fuel control for stabilized engine rpm in the event the throttle linkage becomes disconnected from the control. 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 with the engine master switch. If a runaway engine occurs in flight, shut it down before commencing the approach, or sooner if necessary.

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. Depending on airspeed and altitude, the engines will start at various low rpm indications. Above 12 percent rpm, however, is considered optimum. An airstart is accomplished by depressing the ignition button with the throttle at any position beyond IDLE. A start is indicated by a rapid increase in EGT followed by an increase in rpm. In the event light-off does not occur within 30 seconds after ignition; the engine does not continue to accelerate after light-off; the EGT exceeds maximum limitations; or the oil pressure does not attain 12 psi minimum at idle, retard the throttle to OFF. Wait 30 seconds before initiating a restart.

Note

If one or both engines flame out, do not delay the airstart. If a non-mechanical failure is immediately evident, depress and hold the ignition button(s) to restart the engine(s) before an excessive loss of rpm occurs.

OIL SYSTEM FAILURE

The standpipes which supply the three systems utilizing engine oil are located in the reservoir such that the pipe for the constant speed drive unit is the highest, the one for the nozzle control is the next highest, and the lubricating system pipe is the lowest. Therefore, a leak in the constant speed drive unit would probably cause a failure of that system only, while a leak in the nozzle control system may cause failure of that system and the constant speed drive unit. A leak in the lubricating or the scavenging system will cause failure of the constant speed drive unit and the nozzle control system, and ultimately, engine bearing failure will result. A "Gen Out" light illumination, followed by sluggish exhaust nozzle action, is an early indication of impending engine oil starvation. The engine oil pressure gage should be monitored closely subsequent to a generator failure. In general, it is advisable to shut the engine down as early as possible after a loss of oil supply is indicated to minimize the possibility of damage to the engine and the constant speed drive unit. The engine will operate satisfactorily at military power for a period of one minute with an interrupted oil supply. Continuous operation at any engine speed with the oil supply interrupted, will result in bearing failure and eventual engine seizure. The rate at which a bearing will fail, measured from the moment the oil supply is interrupted, cannot be accurately predicted. Such rate depends upon the condition of the bearing before oil starvation, temperature of the bearing and loads on the bearing. Malfunctions of the oil system are indicated by a shift (high or low) from normal operating pressure, sometimes followed by a rapid increase in vibration. A slow pressure increase may be caused by partial clogging of one or more oil jets; while a rapid increase may be caused by complete blockage of an oil line. Conversely a slow pressure decrease may be caused by an oil leak; while a sudden decrease is probably caused by a ruptured oil line, or a sheared oil or scavenge pump shaft. Vibration may increase progressively until it is moderate to severe before the pilot notices it. At this time, complete bearing failure and engine seizure is imminent. Limited experience has shown that the engine may operate for 4-5 minutes at 80-90 rpm before a complete failure occurs. In the event of a drop in oil pressure or a complete loss of pressure, shut the affected engine down if power is not required or, set the engine speed at 86-89% rpm if partial power is required. If partial power is required on the affected engine, avoid abrupt maneuvers causing high "g" forces and avoid unnecessary or large throttle bursts.

Engine Speeds

CONDITION	STATIC	INFLIGHT
NORMAL OPERATION	100 ± 0.5% RPM	100 ± 0.5% RPM
ALLOWABLE OVERSPEED NON TIME LIMITED	103% RPM	102% RPM
ALLOWABLE OVERSPEED TIME LIMITED	103-105% RPM For 3 Minutes	102-103.6% RPM For 1 Minute

Note

ANY RPM IN EXCESS OF THE ABOVE LIMITATIONS SHALL BE LOGGED ON THE YELLOW SHEET (OPNAV FORM 3760-2)

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Figure 1-20

LIMITATIONS

RPM DROP

When entering afterburner from throttle settings less than military, the allowable rpm drop is 14%. When entering afterburner from stabilized military power, the allowable rpm drop is 10%. All exceeded engine speed limitations must be recorded on the flight forms (yellow sheets).

T_2 RESET

During high compressor inlet temperature operation (high speed flight), engine idle speed is rescheduled upward to maintain sufficient airflow to prevent compressor stall. As compressor inlet temperature increases from 57° to 108°C, engine idle speed is raised from normal idle (65 percent) to 100 percent regardless of the throttle position. To reduce engine idle speed once reset has occurred, compressor inlet temperature must be reduced. This is effected by retarding the throttles out of afterburner to reduce thrust. Thrust can be further reduced by retarding the throttles below the military position so that the exhaust nozzles open, lowering exhaust gas velocity and temperature. As thrust decreases, compressor inlet temperature decreases as a result of lower airspeed, and engine speed control is returned to the throttle.

T_2 CUTBACK

When the compressor inlet temperature (T_2) falls below +4°C, the maximum engine rpm is limited to prevent excessive mass air flow through the engine. The maximum rpm reduction starts at +4°C and is reduced until at -54°C the maximum rpm is approximately 91.5 percent.

T_5 RESET

When compressor inlet temperature falls below +4°C, T_5 reset comes into operation if the engines are operating at military power or above. The T_5 reset occurs at the same point as T_2 cutback and reduces EGT at the same time T_2 cutback is reducing rpm. T_5 reset is accomplished by rescheduling the nozzles to operate with a larger area for a given power setting. This effectively reduces EGT, net thrust and fuel consumption.

Engine Exhaust Temperature Limitations

CONDITION	TEMP	TIME
Steady state temperature for continuous operation in military or maximum range	625±10°C	NO LIMIT
Starting time from light-off	982°C 788°C 752°C 649°C	3 sec 6 sec 8 sec 1 min 40 sec
During all engine operations other than starting	749°C 660°C 635°C	3 sec 30 sec NO LIMIT

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Figure 1-21

ENGINE TEMPERATURE LIMITATIONS

Engine temperatures are limited by degree and time as shown on figures 1-21 and 1-22.

THROTTLE BURST LIMITATIONS

When operating with maximum engine compressor bleed air (flaps down and cockpit pressurized) in outside air temperatures of -37°C and below, rapid throttle bursts may result in an rpm hang-up. If a throttle burst into maximum afterburner is made, cyclic engine operation may result. When rapid throttle bursting is necessary under these conditions, it is recommended that the throttle be advanced to minimum afterburner first and the engine rpm be allowed to stabilize before advancing further into the afterburner range.

WINDMILLING LIMITATIONS

Except for emergency shutdown, do not allow the engine to windmill below 7% rpm below 40,000 feet for periods greater than 10 minutes. Extended windmilling may result in engine damage from inadequate lubrication or oil depletion, and may cause internal engine conditions that are conducive to sump fires when relighting. Prior to shutdown (non-emergency) the engine should be decelerated to the coolest operating point (lowest EGT), and this speed maintained long enough to stabilize EGT. The number of 10 minute intervals below 7% rpm is not limited, providing the engine is operated above 7% rpm for a minimum of 10 minutes between intervals.

POWER LIMITATIONS

Maximum Power

Maximum power is obtained with full afterburning thrust and is time limited to 30 minutes below 35,000 feet, and 2 hours above 35,000 feet.

Military Power

Military power is obtained with full non-afterburning thrust and has the same limits as Maximum power; i.e., 30 minutes below 35,000 feet, and 2 hours above 35,000 feet.

ENGINE IGNITION LIMITATIONS

The engine ignition duty cycle is as follows:

2 minutes ON - 3 minutes OFF
2 minutes ON - 23 minutes OFF

Note

In an emergency, use the ignition system as required. Exceeded limits must be entered in the flight forms (yellow sheets).

Engine Inlet Temperature Limitations

CONDITION	TEMP	TIME
"Duct Temp Hi" Warning Light Illumination	121°C	Prohibited operation with light illuminated below 30,000 FT.
Transient Temperature Operation	121°C-193°C (max. temperature occurs approximately .4 Mach above illumination of "Duct Temp Hi" warning light.)	5 min. per hour (noncumulative) above 30,000 FT.

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Figure 1-22

GRADUAL AFTERBURNER SHUTDOWN

Gradual afterburner shutdown is required in certain areas of the airplane flight envelope, and is intended to allow the airplane to decelerate to a lower Mach number before the engineexhaust nozzles close. This will prevent the nozzles from becoming overpressurized due to peak transient pressures between Max and Mil power.

ENGINE G LIMITATIONS

Due to limited oil distribution to all systems utilizing engine oil for lubrication or operation during negative "g" or zero "g" flight, the airplane is limited to the following:

1. 30 seconds of negative "g" flight.
2. 10 seconds of zero "g" flight.

EMERGENCY FUEL LIMITATIONS

The engines may be operated on MIL-G-5572B 115/145 AVGAS if JP-4 or JP-5 is not available. When AVGAS is used the aircraft is restricted to one flight of no more than 5 hours duration at subsonic speeds. AVGAS has a specific gravity range between 0.730-0.685. The fuel control should be set to correspond to these values.

CAUTION

One adjustment lower than 0.720 is permitted on the fuel control. Do not attempt to reduce the setting further as the specific gravity cam rises back to the maximum value of 0.850.

The engine top speed should be adjusted as necessary. If the fuel control adjustments cannot be made, the aircraft may be flown; however, the pilot should be aware that the following degradations in engine performance will occur.

1. Longer time to start and accelerate, with possible missed-starts or start-stalls.
2. Maximum engine RPM and EGT may not be attained.
3. Slow acceleration throughout the operating range.
4. Lower than normal afterburner thrust.
5. Reduced aircraft range.

REFERENCE PUBLICATIONS

If more detailed system information is required, refer to Item No. 7, 8, 9, 10 & 11, on Maintenance Instruction Manuals Publication Index (flyleaf 3 this publication).

FLAPS

DESCRIPTION

Two-position leading edge flaps and three-position trailing edge flaps that utilize basic utility hydraulic system pressure are incorporated on the airplane. The leading edge flaps are mounted on the inboard, center and outer wing panels. Trailing edge flaps are mounted on the inboard portion of the wing adjacent to the fuselage. Each flap has its own hydraulic actuator. The leading edge flaps are locked in the retracted position by overcenter linkages. Trailing edge flaps are locked in the retracted position by internal locks in the cylinders. A check valve is provided as an integral part of the selector valve to prevent unlocking of overcenter mechanisms and internal locks by back pressure in the return lines. A flow divider is provided to synchronize the trailing edge flaps. There is no synchronization between leading edge flaps or between leading and trailing edge flaps.

WING FLAP SWITCH

The leading and trailing edge flap switch (figure 1-2) is located on the wing flap control panel which is mounted above the left console outboard of the throttles. The three-position toggle switch is marked UP, 1/2, and DN and is shaped like an airfoil for ease of identification. Selecting the 1/2 position will move the center and outboard leading edge flaps to the full down position (60°); it will move the inboard leading edge flaps to the full down position which is 30°; and it will move the trailing edge flaps 1/2 (30°) down.

Selection of the DN position will move the trailing edge flaps to the fully extended position (60°). Selecting the 1/2 position after the flaps have been fully extended will raise the trailing edge flaps to the 1/2 (30°) position. Placing the flap switch in the UP position will simultaneously return all the flaps to the fully retracted position. There is no individual selecting of flaps.

Emergency Flap Extension

Emergency extension of the wing flaps is accomplished pneumatically. High pressure air (approximately 3000 psi), stored in a 300 cubic inch air bottle, may be released to extend the flaps by pulling AFT on the Emergency Flap Extension handle (figure 1-2). Actuation of the emergency flap extension system will extend the flaps to the one-half down position. The emergency flap extension handle is airfoil shaped and is painted in alternating black and yellow stripes for ease of identification. The air bottle contains sufficient air for one flap extension. The flaps, when extended pneumatically, will not be retracted on actuation of the flap blow-up switch.

Flap Position Indicator

The leading edge and trailing edge flap indicators (figure 1-2) are located on the left vertical panel in the pilot's cockpit. The indicators work in conjunction with position switches on the leading and trailing edge flaps. The position of the flaps is indicated by drum dials viewed through cutouts in the instrument panel. With flaps up, the word UP will appear on the indicators; flaps in transit will be indicated by a barber pole; half flaps will be indicated by the fraction 1/2 appearing on the drum dial for the trailing edge flaps only; with flaps down, the letters DWN will appear on the indicators.

Landing Gear Warning Light

The landing gear warning light, marked WHEELS, is located on the upper left corner of the main instrument panel. The light will flash any time the flaps are down and the landing gear handle is in the UP position. An additional light is located in the landing gear handle and is illuminated any time the gear is unlocked.

BOUNDARY LAYER CONTROL SYSTEM

The boundary layer control system utilizes bleed air from the 17th stage of the engine compressor. This air passes through ducts attached to the rigid part of the wing between leading edge flaps and the spar and between the trailing edge flap and the flap closure beam. Slots along the ducts behind the outboard and center panel leading edge flaps, and in front of the trailing edge flaps, direct laminar air over the wing and flaps when the flaps have deflected sufficiently to expose the slots. The high temperature and high velocity laminar air directed over the wings and flaps will delay flow separators over the airfoil, hence reducing turbulence and drag. This results in a lower stall speed and therefore a reduction of landing speed.

Leading edge BLC is operative in the 1/2 or full flap position. Trailing edge BLC is operative only when the flaps are in the full down position.

BLC Malfunction Indicator Light

A "BLC Malfunction" light (figure 1-3) is located on the telelight panel. The purpose of the light is to indicate a BLC valve malfunction in the flaps up condition. When any one of the four BLC valves is not fully closed and the flaps are up, the "BLC Malfunction" light will illuminate. It must be remembered that the illumination of the "BLC Malfunction" light only indicates that a BLC valve has failed to close when the flaps are up. No indication is provided for a completely inoperative system, nor is there an indication provided for a BLC valve failing to open when the flaps are down.

NORMAL OPERATION

The leading edge flaps are operated by the use of a manifold-mounted selector valve and single-acting actuators. The trailing edge flaps employ the same manifold-mounted selector valve, a wing-mounted selector valve, and dual-acting actuators. Placing the flap switch in the 1/2 position energizes the manifold mounted selector valve allowing utility hydraulic pressure to extend the leading edge flaps to full down. Further movement of the switch to the DN position energizes the wing-mounted selector valve, resulting in complete extension of the trailing edge flaps. Immediate movement of the switch from the UP position to the DN position causes both selector valves to become energized simultaneously, thereby completely extending both the leading and trailing edge flaps. The limit switches, provided on each flap, are all connected in parallel to deenergize the electrical circuits to the selector valves after all flaps are retracted. The electrical circuits are continuously energized to maintain hydraulic pressure on the actuators when the flaps are down. Should the cockpit switch inadverently be left in the down position, the flaps will retract when the airplane reaches an airspeed of 230 ± 7 knots. This is accomplished through an airspeed pressure switch which operates the manifold solenoid selector valve. Should the cockpit switch continue to remain in the down position, the flaps will extend when the airplane reaches an airspeed of 15 ± 7 knots less than the speed at which they retracted. Flap extension will be accomplished in approximately 8 seconds and retraction in approximately 6 seconds.

EMERGENCY OPERATION

If normal wing flap operation fails, the flaps can be extended by pulling the flap circuit breaker and pulling full aft and down on the emergency wing flap extension handle. The flap circuit breaker must be pulled prior to lowering the flaps by the emergency system. This will cause the flap hydraulic selector valve to return to its full trail position, blocking hydraulic pressure to the flap actuators and insuring that hydraulic fluid will not be forced into the actuators on top of the pnuematic pressure. Should this occur, system "hammering" may result, with possible eventual rupture and loss of system integrity. Once the emergency wing flap extension handle has been pulled, it should be left in the full aft position. Returning the handle to its normal position allows the compressed air from the flap down side of the actuating cylinder to be vented overboard, and the flaps will be blown up by the airstream. If the flaps are inadvertently extended in flight by emergency pneumatic pressure, they must be left in the extended position until post-flight servicing. If retraction in flight is attempted, rupture of the utility reservoir will probably occur with subsequent loss of the utility hydraulic system.

Note

Any penumatic extension of the wing flaps shall be logged on the yellow sheet (OPNAV FORM 3760-2).

LIMITATIONS

Do not attempt to lower flaps above 250 knots IAS.

REFERENCE PUBLICATIONS

If more detailed system information is required, refer to Item No. 4, on Maintenance Instruction Manuals Publication Index (flyleaf 3 this publication).

FLIGHT CONTROLS

DESCRIPTION

The airplane primary flight controls consist of the stabilator, rudder, ailerons, and spoilers. The stabilator, ailerons and spoilers are actuated by irreversible, dual power cylinders. The rudder is actuated by a conventional, irreversible power cylinder. Artificial feet systems provide simulated aerodynamic control stick and rudder pedal forces due to the lack of aerodynamic "feedback" forces from the power control cylinders. The feel systems have trim actuators which, through the power cylinders, move the entire control surface. Secondary controls are leading edge flaps, trailing edge flaps, and wing mounted speed brakes. Refer to figure 1-24.

LATERAL CONTROL SYSTEM

The lateral control system is a unique aileron-spoiler combination. It basically consists of the control stick; left and right push-pull rod systems; left and right walking beam bellcranks; aileron dual power cylinders with integrated control valves; spoiler dual control valves; left and right autopilot series servos; and left and right lateral feel trim actuators. The ailerons travel downward 30 degrees from a full trail position. Upward travel is limited to 1 degree. The spoilers travel upward, 45 degrees from a flush contour position in the upper wing surface. Lateral movement of the control stick is transmitted mechanically by the push-pull rods through the walking beam bellcranks to the spoiler and aileron control valves. The control valves meter hydraulic fluid to their respective dual power cylinders in proportion to the mechanical displacement. An override spring cartridge is incorporated into the left and right push-pull rod systems. In the event one side becomes jammed, the override spring will deflect, under force, allowing operation of the other lateral control surfaces. The walking beam bellcranks receive control surface movement inputs from three sources: the control stick, the lateral trim system, and the autopilot series servos. A self-serviced hydraulic damper, attached to the aileron backup structure, is utilized as an uplock for the aileron as well as a flutter damper. The control system uses dual power cylinders to allow simultaneous use of both power control hydraulic systems. In the event of a single power control hydraulic system failure, the remaining system will supply adequate power for control.

Aileron Control

The ailerons are controlled by dual, irreversible power cylinders that receive metered hydraulic fluid from dual integrated control valves. The control valves are controlled by the push-pull rods, through the walking beam bellcranks, and control stick. Each power cylinder contains four parallel inner cylinders with rods and pistons. The piston rods are joined at one end by a yoke that is attached to the airplane structure. The cylinder portion of the power cylinder is attached to the aileron. The two outer cylinders receive hydraulic fluid from PC-2, and the two inner cylinders receive hydraulic fluid from PC-1. This arrangement provides symmetrical loading of the yoke should one of the power control systems fail.

Spoiler Control

Each wing contains two spoiler surfaces, spoiler power cylinders, and a dual spoiler control valve. Each surface has a dual, irreversible power cylinder with a feedback linkage to a dual spoiler control valve. The spoiler control valve divides each power control system input into equal parts which is then distributed to each spoiler dual power cylinder. One portion of each power cylinder receives hydraulic pressure from PC-1 and the other portion receives hydraulic pressure from PC-2. In the event one of the power control hydraulic systems fail, the other will supply adequate pressure for spoiler control.

Lateral Control Feel and Trim System

The lateral trim system consists of the trim switch (figure 1-24), a rotary power unit, two flexible drive shafts and two screwjack actuators. When the trim switch is energized, the rotary power unit and flexible drive shafts position the screwjack actuators. The screwjack actuators are connected to the airplane structure on one end, and the walking beam bellcranks on the other end. As the screwjack actuators extend and retract, the lateral controls are repositioned and the control stick follows the trim movements. Lateral control artificial feel is provided by double-action spring cartridges connected in tandem with the screwjack actuators. When the control stick is moved from neutral, the springs are compressed. The farther the control stick is moved from neutral, the greater the force required to compress the springs. The spring cartridges return the control stick to neutral when the force on the control stick is removed.

Aileron Position Indicator

An aileron position indicator (figure 1-2) is located on the left vertical panel in the front cockpit. A transmitter is mechanically connected to the lateral control linkage in the left wing. As the control linkage moves, the mechanical input is converted into electrical impulses which are sent to the position indicator. The indicator, marked in units of percent of system travel, represents actual control surface position. A wings level indication is zero trim, and a full down left or right indication is maximum trim travel. The maximum lateral trim available is 33%.

STABILATOR CONTROL SYSTEM

Longitudinal control is provided by a single unit horizontal tail surface (stabilator), that is actuated by an irreversible, dual power cylinder. System components include the control stick; push-pull rods; cables; bellcranks; integrated control valve; and an irreversible dual power cylinder. Additional components include a ram air bellows for system artificial feel, a trim actuator, and an AFCS servo that is integral with the control valve. When the control stick is moved longitudinally, the motion is transmitted by push-pull rods to a bellcrank. It is then transmitted by a cable assembly to another push-pull rod set. The second push-pull rod set actuates the control valve which meters hydraulic fluid to the dual power cylinder. Hydraulic pressure to the stabilator power cylinder is supplied by both power control hydraulic systems. In the event one of the power control hydraulic systems should fail, the remaining system will provide adequate control response. A hydraulic AFCS servo is integrated into the stabilator dual servo valve. It positions the dual servo valve in the same manner as control stick inputs. As a result, when the autopilot signals for a pitch attitude change, the control stick will follow the movement. A bob weight is included in the control linkage to increase stick forces in proportion to an increase in "g" forces.

Stabilator Control Feel and Trim System

Artificial feel is provided by a dynamic (ram air) pressure bellows acting through a variable bellcrank on the stabilator trim actuator and a 5 pound/g bob weight. When the airplane is in trim, the ram air force on the bellows is balanced by a spring assembly. As the airplane increases or decreases in airspeed, the pressure on the bellows changes causing the bellows-spring assembly to become off balance. The off balance condition is then transmitted through the trim actuator, control cables and push-pull rods back to the control sticks. Actuating the trim switch causes the stabilator trim actuator to move, balancing the forces between the bellows and spring assembly, and threeby eliminating force on the control sticks. A viscous damper, attached to the trim actuator, prevents abrupt control surface movements by increasing control stick forces with rapid stick movements. An override spring cartridge allows the feel and trim portion of the stabilator control system to be bypassed in the event of a trim malfunction (runaway trim and/or bellows diaphragm failure). A heater is installed in the bellows ram air inlet probe and venturi to prevent freezing of moisture which causes restriction of the airflow in these units. The heaters are controlled by the pitot switch located on the right console (figure 1-3).

Stabilator Trim Position Indicator

The stabilator trim indicator (figure 1-2) is located on the left vertical panel in the front cockpit. It is directly controlled by a transmitter which is integral with the stabilator feel trim actuator. The indicator, marked in units of percent of trim, represents trim actuator position.

CONTROL STICK

The control stick, which consists of a stick grip and motional pickup transducer, is mounted in a yoke to permit left, right, fore and aft movement. The control stick grip contains five controls: a four-way lateral and longitudinal trim switch, a bomb release

Control Stick Grip

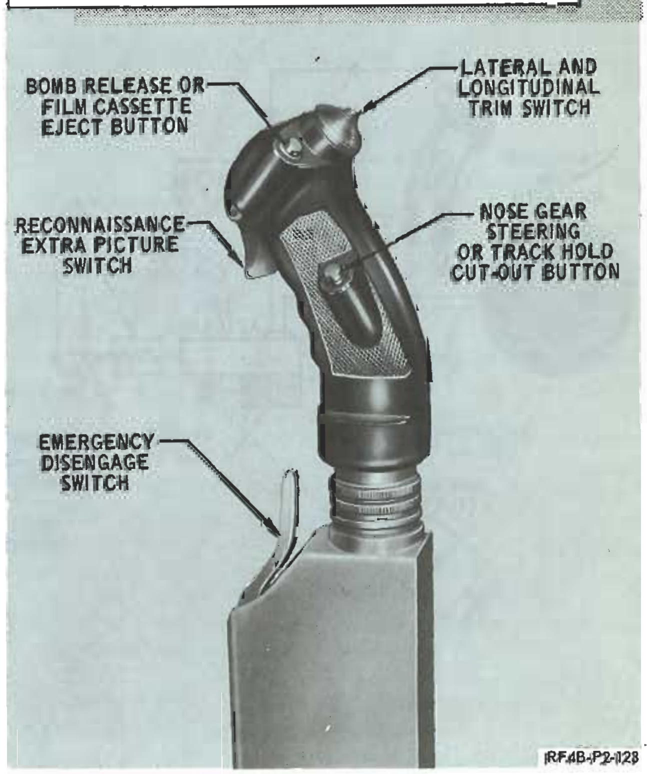

Figure 1-23

Flight Controls

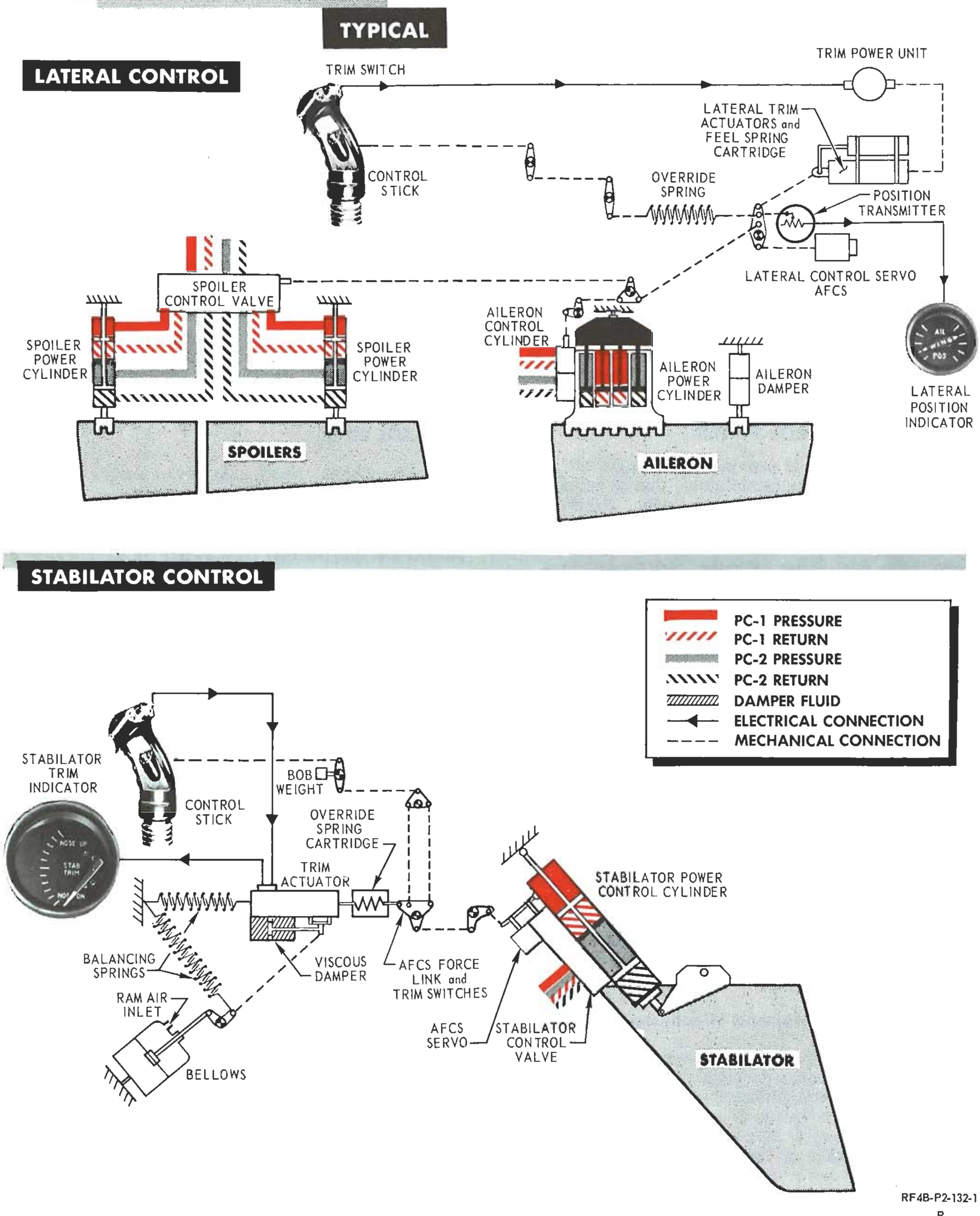

Figure 1-24 (Sheet 1)

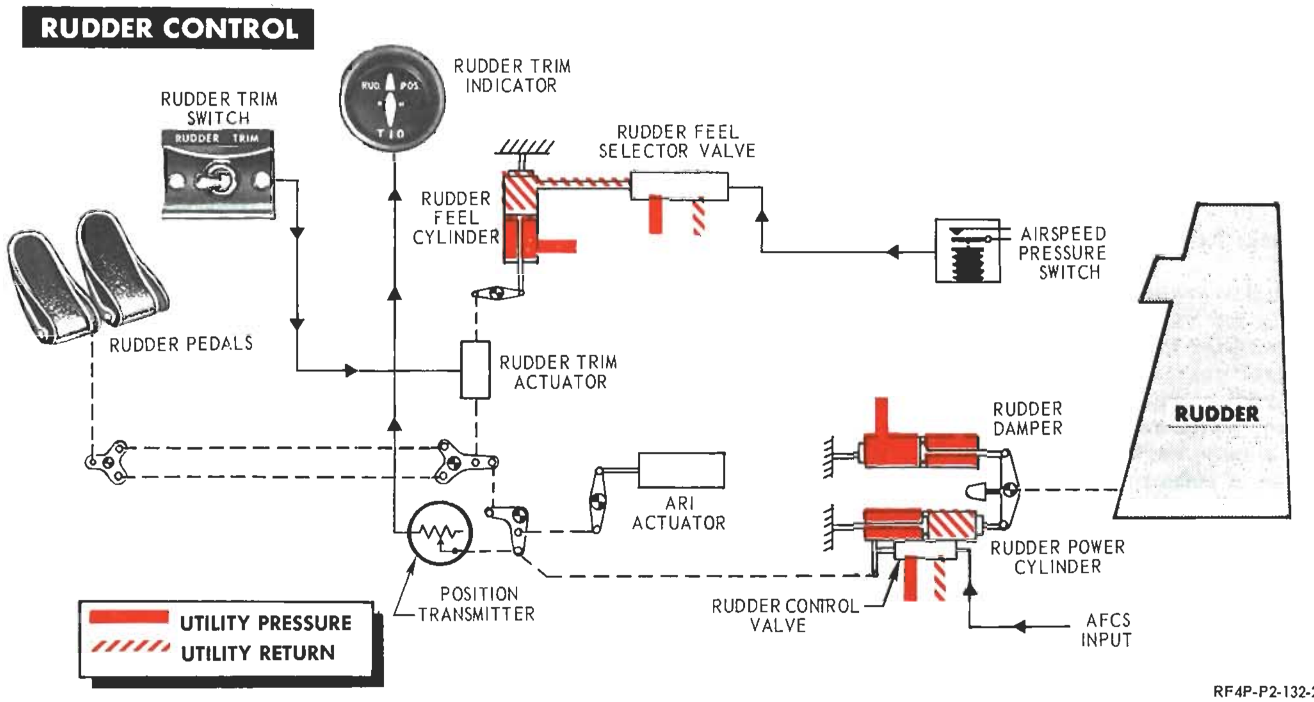

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Figure 1-24 (Sheet 2)

or film cassette eject button, a nose gear steering or ground track hold cut-out button, a reconnaissance extra picture switch, and an emergency disengage switch. The motional pickup transducer is utilized in conjunction with the automatic flight control system.to provide control stick steering. The nose gear steering button also functions as a ground track hold cut-out button for the automatic flight control system. Refer to figure 1-23 for the location of the control stick grip controls.

RUDDER CONTROL SYSTEM

The rudder control system consists of the rudder pedals, push-pull rods, cable assemblies, bellcranks, a rudder feel trim system, an aileron-rudder interconnect actuator, a rudder damper, and an irreversible power cylinder with integral control valve. When the rudder pedals are moved, the motion is transmitted by the push-pull rods, bellcranks and cable assemblies to the control valve of the power cylinder. The control valve meters utility system hydraulic fluid to the power cylinder which positions the rudder. It is possible to have limited mechanical authority over the rudder in the event of a utility hydraulic system failure; however, under all speed conditions it requires a considerable amount of pilot effort to manually deflect the rudder. A bypass valve in the power cylinder opens when system pressure is lost, allowing fluid to pass from one side of the cylinder to the other. Total amount of rudder deflection available is then a function of air loads on the rudder. A hydraulic servo for yaw damping and AFCS operation is incorporated into the control valve of the power cylinder. Operation of the AFCS, however, does not move the rudder pedals.

Rudder Feel Trim System

Artificial feel is supplied to the rudder pedals by an artificial feel trim system. A hydraulic cylinder, with utility system hydraulic pressure on both sides of a differential area piston, provides a pedal force of approximately 2.6 pounds per degree of rudder deflection below 235 ± 10 knots during acceleration and below 220 ± 7 knots during deceleration. Above approximately 235 knots, a pressure switch in the pitot static system cuts off hydraulic pressure to the low area side of the piston and the pedal force becomes approximately 11.5 pounds per degree of rudder deflection. Rudder forces may be trimmed out through use of the rudder trim switch. A rudder trim position indicator shows rudder displacement. Normal trim range is 7.5 ± 1 degree of rudder deflection left and right.

CAUTION

In the event of a loss of the right main 28 volt d-c bus, while above approximately 235 knots IAS, the rudder feel force of 11.5 pounds per degree of rudder deflection will automatically revert to 2.6 pounds per degree of rudder deflection. As a result, rudder pedal forces at high airspeeds becomes extremely sensitive, and excessive structural loads can be imposed on the airplane if full rudder deflection is commanded.

Rudder Trim Switch

The rudder trim switch (figure 1-2) is located in the front cockpit on the inboard engine control panel. This switch controls the trim actuator in the rudder feel and trim system to trim the airplane directionally.

Rudder Position Indicator

A rudder position indicator (figure 1-2) is located on the left vertical panel in the front cockpit. A transmitter is mechanically connected to the rudder control linkage. As the control linkage moves, the mechanical input is converted into electrical impulses which are sent to the indicator. The indicator is only marked for takeoff trim, which is zero degrees of rudder deflection.

Rudder Pedals

The rudder pedals are conventional type suspended units which are coupled to the rudder push-pull rod system by individual screwjacks. The screwjacks provide adjustment of the rudder pedals for comfort and are adjusted simultaneously by turning a crank on the pedestal panel. The pedals are also coupled to the power brake valves so that toe pressure on the pedal will apply the brakes. The rudder pedals are also used to control the nose gear steering unit when the nose gear steering button on the control stick grip is depressed.

Stall Warning Vibrator

A stall warning vibrator is mounted on the front cockpit left rudder pedal to warn of approaching stall conditions. The vibrator consists of an electric motor which drives an eccentric weight. Rotation of the weight causes the rudder pedals to vibrate, warning of an impending stall. A sufficient margin exists to return to the proper flight attitude by normal reaction to the warning. The vibrator is electrically connected to a switch in the angle-of-attack indicator. The switch to activate the rudder pedal vibrator is set at 22.3 units angle of attack.

AILERON RUDDER INTERCONNECT (ARI)

The aileron-rudder interconnect system causes rudder displacement proportional to aileron displacement which provides coordinated turns at low airspeeds. The limits of the system are 15° of rudder displacement when the automatic flight control system is in the stability augmentation or autopilot mode, and 10° rudder displacement when the Stab Aug switch is disengaged. Components of the system include the control amplifier, the 10° servo actuator, acting through a walking beam, an airspeed pressure switch and two aileron transducers. The ARI circuit is completed through the flap blow-up airspeed pressure switch. When the flap switch is down, and airspeed is below 230 ± 7 knots, 28 volts d-c is applied to the engage relay solenoids of the ARI system. This allows the hydraulic 10° servo actuator to move the control linkage (if aileron displacement is present) and cause rudder displacement. The system can be disengaged by depressing the emergency disengage switch on the control stick; this will disengage the ARI only as long as it is held depressed. To permanently disengage the system, the circuit breaker on the left utility panel must be pulled, and the Stab Aug switch must be disengaged. Pulling the circuit breaker only, and keeping Stab Aug engaged will still provide 5° of ARI rudder authority.

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 FEEL TRIM FAILURE

Partial Bellows Failure

Partial bellows failure is recognized by a mild nose down stick force proportional to the airspeed, unless the failure occurs during maneuvering flight, at which time it may not be noticeable. Reduction of stick centering and pitch stability will result. Should this failure occur, reduce airspeed to 250-300 knots IAS; retrim the airplane; avoid abrupt fore and aft stick movements; and land as soon as practicable.

Complete Bellows Failure

A complete bellows failure is recognized by a heavy nose down feel force at the control stick. The maximum amount that this stick force can attain is 30 pounds dependent on the trim position. This force can be reduced to 5 pounds by applying full NOSE UP trim. Should a complete bellows failure occur, reduce airspeed to 250-300 knots IAS; apply full nose up stabilator trim; avoid abrupt fore and aft stick movements; and land as soon as practicable.

Ice/Water Blockage of Ram Air Line

The ram air bellows line is equipped with a heater which operates in conjunction with the pitot heat switch. With this arrangement, bellows line icing should not be encountered. If, however, the bellows line is allowed to ice up, the pilot will experience a situation similar to a complete bellows failure. If ice or water blockage is suspected, insure that the pitot heat switch is in the ON position, and do not apply longitudinal trim to relieve control stick forces. The intermittent nature of this condition and the suddenness of return to normal can cause violent pitch transients. When the ram airline is blocked, no stick force gradient will be felt by the pilot should a change in stick position be required. In the event of suspected ice or water blockage of the ram air line, reduce airspeed to 250-300 knots IAS; maintain attitude by pilot effort; and if practicable descend to air that is above freezing. If the condition persists, land as soon as practicable.

Runaway Stabilator Trim

Runaway stabilator trim can be alleviated by engaging the autopilot, providing, the stab trim circuit breaker has been pulled immediately upon detection of runaway trim; runaway trim is in the nose up direction; nose down runaway trim has not exceeded 2-1/2 units; and airspeed is reduced to 300 knots IAS or less. If the above conditions are met, engage the autopilot. When the autopilot is used to alleviate a runaway trim condition, and excessive out of trim forces are present (full nose down runaway trim), the autopilot will alternately disengage and re-engage. If this occurs, discontinue use of the autopilot and plan to land as soon as practicable. If the autopilot is still engaged when in the landing configuration (gear and flaps extended), grasp the control stick firmly and disengage the autopilot at 180 to 190 knots IAS. Depending upon the severity of the malfunction, the airplane may or may not be in trim; if out of trim the forces should not be too high and the airplane can be landed with the out of trim condition, or the autopilot can be re-engaged, and the landing made with control stick steering. If the landing is made with autopilot engaged, disengage the autopilot immediately after touchdown to prevent damage to autopilot components.

ARI SYSTEM DISENGAGEMENT

The ARI system can be temporarily disengaged by depressing the AFCS/ARI emergency disengage switch. This will disengage the ARI only as long as it is held depressed. To permanently disengage the ARI system, the circuit breaker on the left utility panel must be pulled and the stab aug switch must be disengaged. Pulling the circuit breaker only, and keeping the stab aug engaged will still provide 5° of ARI rudder authority.

LIMITATIONS

There are no specific limitations pertaining to the flight controls.

REFERENCE PUBLICATIONS

If more detailed system information is required, refer to Item No. 4, on Maintenance Instruction Manuals Publication Index (flyleaf 3 this publication).

FORWARD LOOKING RADAR SYSTEM

DESCRIPTION

The forward looking radar set AN/APQ-99 (FLR) is designed to provide navigation information concerning terrain clearance and ground map. The system utilizes inputs from the inertial navigation set which represents roll, pitch, drift angle, and climb angle. These signals are used for antenna stabilization. The electronic altimeter set supplies an altitude over terrain signal to the radar set. The system uses the pitch steering bar on the attitude director indicator to provide climb and dive signals to the pilot during terrain following. The pitch steering bar is held out of view when it is not used. Each member of the aircrew has operating controls for the system. The RSO is the prime operator but the pilot has the capability to override the selection of the RSO as flight conditions dictate. The system provides five modes of operation; three modes for terrain clearance navigation and two modes for ground mapping purposes. The terrain clearance modes are: terrain following override (TFO), terrain avoidance override (TAO), and cross scan (CS). The terrain following mode utilizes a radar beam with monopulse resolution improvement in pitch. Monopulse resolution improvement video is provided by circuitry in the radar receiver which is able to determine whether target returns are above or below boresight. In the terrain following mode, the beam is scanned 10 degrees below boresight to gather information about the terrain relative to the horizontal. During the pitch scan, a zero command template is generated as a function of angular position of the antenna. The mechanization of the template allows for the aircraft performance and pilot reaction time. This template is displayed on both radar scopes as a curved line. This type of scope display is referred to as an E^2 display. If terrain video is received prior to the generation of the template, the video will be within the template and a climb command indication will be displayed by the pitch steering bar on the attitude director indicator. This video will be displayed above the template on the radar scopes. If the terrain video is received after the template has been generated, the video will be displayed below the template on the radar scopes and a dive command will be displayed by the pitch steering bar. When video is received at the same time, the template is generated, neither a climb or dive command is given, indicating the pilot is flying the computed flight path. The actual pitch steering bar position, as seen by the pilot, will be the most positive command generated during any one vertical sweep of the antenna, and will be held constant during the sweep and sample time of the terrain following computer. The climb and dive commands from the forward looking radar are compared with an altimeter override signal that is proportional to the difference between the desired altitude and actual (absolute) altitude from the electronic altimeter. The signal commanding the greatest climb (or the least dive) is selected. When flying over water or terrain with low radar reflectivity, the absence of radar video would result in a dive command. In this situation, the altimeter override signal will initiate commands to keep the aircraft at the desired altitude. In the terrain avoidance mode, the radar beam is scanned ± 45 degrees in azimuth and is referenced to the aircraft water line. The monopulse resolution improvement, which is introduced in the receiver, provides the system with terrain video that protrudes above the plane described by the antenna scan and radar boresight. This video is displayed on the radar scopes, thereby enabling the pilot to avoid terrain that is in or above the radar boresight. The cross scan mode is a time shared terrain avoidance and terrain following mode. The antenna scan is time shared to provide ± 20 degrees of azimuth scan and +10 degrees to -15 degrees of elevation scan. During the azimuth scan, a terrain avoidance display is presented on the radar scopes. This display provides the pilot with an indication of terrain that protrudes above and within ± 20 degrees of the horizontal. The terrain following portion of the cross scan mode is accomplished during the elevation scan period. Terrain video that is received before or after the zero command template is generated will be displayed in the form of climb and dive signals on the attitude director indicator. No terrain following information is displayed on the radar scopes during the elevation scan period. The ground map modes are: ground map pencil (GMP) and ground map spoiled (GMS). These modes provide the aircrew with a map of the terrain ahead of the aircraft flight path. The antenna scans in a ±45 degree azimuth scan, producing a ±45 degree sector PPI display. The scan rate of the antenna will depend on range selection. The antenna will scan one cycle per second in 5 and 10-mile range and one-half cycle per second in 20, 40, and 80-mile ranges. Either a pencil or spoiled radar beam can be selected for ground mapping. The pencil beam illuminates terrain that falls only within the narrow pencil beam and therefore, depending on altitude and antenna tilt position, a portion of the terrain will be displayed on the scopes. The spoiled beam provides the aircrew with a map display covering the entire range sweep on the radar scopes.

PILOT'S RADAR SCOPE

The pilot's radar scope (figure 1-4) provides the pilot a visual indication for ground mapping, terrain avoidance and terrain following. The PPI sector and E^2 displays are presented on a storage tube which permits viewing the target return for a longer period per sweep. Either ground range or slant range may be selected for PPI displays. Electronic cursors are presented on the PPI displays dependent on mode and range selection. An offset cursor provides azimuth information to a selected target and is displayed on all PPI displays except terrain clearance modes at 20-mile range selection. A range cursor provides range information to a selected target during ground range PPI displays. No cursors are displayed during cross scan mode. Presentation and operating controls are also located on the radar scope.

Range Selector Knob

The range selector knob, located on the left side of the pilot's radar scope, provides range selections of 5, 10, 20, 40, and 80 miles. Any of these ranges can be selected in the ground map modes. In the cross scan mode, only 5, 10, or 20-mile ranges can be selected. A 10-mile range is automatically selected for terrain following and terrain avoidance modes, and the range selector knob will have no effect.

Mode Selector Knob

The mode selector knob, located on the lower left corner of the pilot's radar scope, has positions of TFO, TAO, RP, and GMP. The TFO (terrain following override) position will override any mode selection made by the RSO and select terrain following mode. The TAO (terrain avoidance override) position will also override modes selected by the RSO and select terrain avoidance mode. The RP position gives mode selection control to the RSO. The GMP position selects ground map pencil video with ground range indications on both radar scopes when the RSO has the CS mode selected. If the RSO has a ground map mode selected, the GMP position on the pilot's scope functions the same as the RP position.

Intensity Control Knob

The intensity control knob is the large outer knob located in the lower center of the pilot's radar scope. This knob is used to regulate the brightness of the displayed video.

Persistance Control Knob

The persistence control knob is the small inner knob in the lower center of the pilot's radar scope. This knob is used to set the memory time of the direct view storage tube thus permitting the viewer control of the video display time.

Clearance Set Knob

The clearance set knob, located in the lower right corner of the pilot's radar scope, is continuously variable from 200 to 1000 feet and has three detent positions of 250, 500, and 1000 feet. The knob is used to set the position of the zero command template for terrain following.

Pedestal Control Knob

The pedestal control knob, located on the right side of the pilot's radar scope, is used to regulate the intensity of the indicator display with the exception of the offset cursor. Adjusting the pedestal sets the background level for the scope.

Cursor Brightness Knobs

The cursor brightness knobs are located on the upper right side of the pilot's radar scope. The knobs are used to adjust the intensity of the offset and range cursors.

Scale Brightness Knob

The scale brightness knob is the small inner knob on the right side of the pilot's radar scope and is used to vary the brightness of the scale lights in the scope.

Signal Lights

The four mode lights, located on the top of the pilot's radar scope, are "Test", "CS", "GMP", and "GMS". These lights will illuminate when their respective mode is selected to give the pilot an indication of which mode the RSO has selected. The "Fail" light, on the left side of the scope, will illuminate when a forward looking radar failure occurs. The "Non Detent" light will illuminate when in the terrain following or cross scan mode and the clearance set knob is not in one of its detent positions.

RSO'S RADAR SCOPE

The RSO's radar scope (figure 1-5) will display the same type displays as the pilot's scope. The presentation controls are the same as on the pilot's radar scope. The persistence and intensity control knob on the RSO's radar scope should not be varied when the recording camera is being used. The operating controls, located on the RSO's radar scope, provide mode and range selection, type of PPI video to be displayed in terrain clearance modes, and receiver gain control in ground mapping modes. The data recording camera is mounted on the face of this scope.

Mode Selector Knob

The mode selector knob, located on the lower left corner of the RSO's radar scope, provides selections of OFF, STBY, TEST, CS, GMP, and GMS. When the knob is in the OFF position, no power will be supplied to the system. The STBY position places the system in a standby mode. In STBY, the antenna will be positioned to boresight and there will be no presentation on the radar scopes. The TEST position provides an E^2 display on both scopes with terrain following information and allows the RSO to perform BIT checks. The CS position places the system in the cross scan. The GMP position selects ground map mode with a pencil beam rf radiation pattern. The GMS position also selects ground map mode but the rf will be radiated in a spoiled beam. The TFO and TAO positions on the pilot's radar scope will override all positions of this knob except OFF and STBY.

Range Selector Knob

The range selector knob, located on the lower right side of the RSO's radar scope, provides range selections of 5, 10 or 20-mile range selection for cross scan or terrain avoidance mode and 5, 10, 20 or 80-mile range for ground map modes. When terrain following mode is selected, the system will automatically select a 10-mile range and the range selector knob will have no effect. The range displayed on the radar scopes is slant range for terrain clearance modes and ground range for ground map modes. When 20, 40, or 80-mile range is selected for ground mapping the antenna scan rate will be halved.

Receiver Gain Control Knob

The receiver gain control knob, located in the lower right corner of the RSO's radar scope, is used to adjust the video and background noise level on the scopes by changing the gain of the receiver. This control is operable only in the ground map modes.

Video Select Switch

The video select switch, located on the right side of the RSO's radar scope, is a two-position toggle switch with positions of TA and GMP. This switch is used in conjunction with cross scan and terrain avoidance overrides modes to select either terrain avoidance video with slant range indications or ground map pencil video with ground range indications.

RSO's Signal Lights

The signal lights, on the left side of the RSO's radar scope, consist of a "Fail" light, five mode lights, five range lights and four clearance lights. The "Fail" light will illuminate when a system failure occurs. The "Mode" light will illuminate when any operating mode is selected and will give the RSO a visual indication of the mode selected. The range light will indicate the range being displayed on the scope. The clearance light will indicate the position of the clearance control knob on the pilot's radar scope.

RADAR SET CONTROL

The radar set control (figure 1-6), located on the aft cockpit left console, contains controls to perform system self test and manually control range and offset cursors and set the tilt angle of the antenna.

Range Cursor Control

The range cursor control wheel, located in the lower left corner of the radar set control, is used to position the range cursor on the radar scopes. Placing the range cursor over a target return, enables the RSO to read the ground range of the target on the range counter. The range counter, located in the center of the radar set control, indicates ground range in 0.1-mile increments from 0 to 20 miles. The range cursor will only be displayed on ground map and TAO 5 and 10-mile displays. NEW

Offset Cursor Control

The offset cursor control wheel, located on the left side of the radar set control, is used to position the offset cursor on the radar scopes. By tuning this wheel until the offset cursor is over a target on the radar scope, the RSO can read the range of the target from the aircraft's flight path on the offset counter. The offset counter, located in the center of the radar set control, will indicate azimuth range in 0.1-mile increments from 0 to 20 miles. Left or right indications are displayed as L or R on the counter, depending on the azimuth direction of the target.

Test Function Selector Knob

The test function selector knob, on the right side of the radar set control, is used to select the portion of the system to be tested. The knob can be positioned to check the antenna drive circuits (ANT SCAN); the test pulse used for checking the receiver (TEST PULSE); receiver and computer functions (RCVR COMPT); the automatic frequency control circuits (AFC); and the transmitter power output (XMTR PWR). This control is operable only when the mode selector knob on the RSO's radar scope is in the TEST position. The operational condition of these circuits will be reflected by the test light, located above the test function selector knob. The test light will illuminate indicating "Fail" if the circuit being tested has malfunctioned.

Tilt Control Wheel

The tilt control wheel, in the lower right corner of the radar set control, provides manual control of the antenna elevation angle in the ground map modes. The antenna can be positioned from 5 degrees up to 15 degrees down. This control will have no effect on antenna position unless a ground map mode is selected.

NORMAL OPERATION

The following procedure is used in describing the sequence of operation. The operating modes controlled by the RSO are described first, then the operating modes controlled by the pilot are described. It must be remembered that the pilot can override the RSO selection in any mode except STBY and OFF. There is a 3-minute time delay after initiation of power-on until the system is ready for operation. The Mode Selection Chart (figure 1-25) shows the functions and displays available to the aircrew. To use the chart: Enter the chart at the applicable mode selector knob (pilot or RSO) and proceed across the chart to the desired mode selector knob position; descend vertically from the desired mode to intersect the dots; proceed horizontally from the dots to read the function or display available.

Note

The pilot's mode selector knob must be in RP or GMP position for the RSO to have mode selection control. If left in an operating mode position, the pilot has control of the system.

To place the system in standby for the 3-minute warm-up, place the mode selector knob on the RSO's scope to STBY. In the STBY position, the system is placed in a ready condition. The antenna will be positioned at boresight, both scopes will be blank, and the transmitter will be disabled.

BIT CHECKS

The "Fail" lights on the radar scopes and on the radar set control provide automatic fail-safe monitoring of the system in the TFO, TAO, CS, and TEST modes. In TAO mode, only transmitter power and afc are monitored. The "Fail" lights will be illuminated when the system is OFF. To check the self test functions of the radar, place the mode selector knob on the pilot's scope to RP and the mode selector knob on the RSO's scope to TEST. Position the test function selector knob to the five positions and monitor the "Fail" lights. The "Fail" lights will illuminate if the function selected has failed.

CROSS SCAN

The cross scan (CS) mode of operation combines the terrain following feature of the TFO mode with either the terrain avoidance feature of the TAO mode or the ground mapping feature of the GMP mode. The pilot is provided elevation commands by the pitch steering bar on the ADI at all times in the CS mode; however, the E^2 display is not available. All available displays are ± 20-degree PPI type and may present either terrain avoidance or ground mapping information. Manual control of the antenna tilt is not available in this mode.

WARNING

If the "Fail" light illuminates and/or the horizontal warning flag on the ADI is displayed during CS operation, pitch steering bar commands (except climb) and the terrain avoidance display on the radar scopes are unreliable.

To select the cross scan mode (figure 1-26), place the mode selector knob on the pilot's radar scope to RP or GMP and the mode selector knob on the RSO's radar scope to CS. The following indications and displays will be presented.

Pilot's Indications:

1. "CS" light illuminated.
2. "Non-detent" light will illuminate if clearance knob is out of a detent position.

Pilot's Displays:

1. Pitch steering bar on ADI will indicate climb or dive commands during elevation cycle of antenna. Zero reference for pitch steering bar determined by position of clearance control knob.
2. Terrain avoidance type sector PPI ± 20° scan when mode selector knob is in RP position.
3. Ground map pencil type video with ground range indications when the mode selector knob is in GMP position.
4. 5, 10, or 20-mile display range selected by the range selector knob.

Forward Looking Radar Mode Selection

PILOT	MODE SELECTOR KNOB	TFO	TAO	TAO	RP	RP	GMP	RP	RP	RP
	RANGE SELECTOR KNOB	*	*	*	*	*	5, 10, 20	5, 10 20	5, 10, 20, 40, 80	5, 10, 20, 40, 80
RECON SYSTEMS OFFICER	MODE SELECTOR KNOB	**	**	**	STBY	TEST	CS	CS	GMP	GMS
	RANGE SELECTOR KNOB	*	5, 10, 20	5, 10, 20	*	*	5, 10, 20	5, 10, 20	5, 10, 20, 40, 80	5, 10, 20, 40, 80
	VIDEO SWITCH	*	TA	GMP	*	*	*	TA	*	*
ANTENNA SCAN	ELEVATION +10°-15°	●				●	●	●		
	AZIMUTH ±45°		●	●					●	●
	AZIMUTH ±20°						●	●		
MANUAL GAIN									●	●
MANUAL TILT									●	●
FAIL LIGHT INDICATION	TRANSMITTER POWER	●	●	●		●	●	●		
	AFC	●	●	●		●	●	●		
	RECEIVER-COMPUTER	●				●	●	●		
	TEST PULSE	●				●	●	●		
	ANTENNA SCAN	●				●	●	●		
PITCH STEERING BAR COMMAND		●				●	●	●		
PILOT'S RADAR SCOPE	PPI DISPLAY		●	●			●	●	●	●
	E2 DISPLAY	●				●				
	RANGE CURSOR		◈	◈					●	●
	OFFSET CURSOR		◈	◈					●	●
	GROUND RANGE						●		●	●
	SLANT RANGE	●	●	●		●		●		
	RANGE 5						●	●	●	●
	RANGE 10	●	●	●		●	●	●	●	●
	RANGE 20						●	●	●	●
	RANGE 40								●	●
	RANGE 80								●	●
RSO'S RADAR SCOPE	PPI DISPLAY		●	●			●	●	●	●
	E2 DISPLAY	●				●				
	RANGE CURSOR		◈	◈					●	●
	OFFSET CURSOR		◈	◈					●	●
	GROUND RANGE			●					●	●
	SLANT RANGE	●	●			●		●		
	RANGE 5		●	●			●	●	●	●
	RANGE 10	●	●	●		●	●	●	●	●
	RANGE 20		●	●			●	●	●	●
	RANGE 40								●	●
	RANGE 80								●	●

* CAN BE IN ANY POSITION

** ANY POSITION BUT OFF OR STBY

◈ WILL NOT BE DISPLAYED IN 20 MILE RANGE

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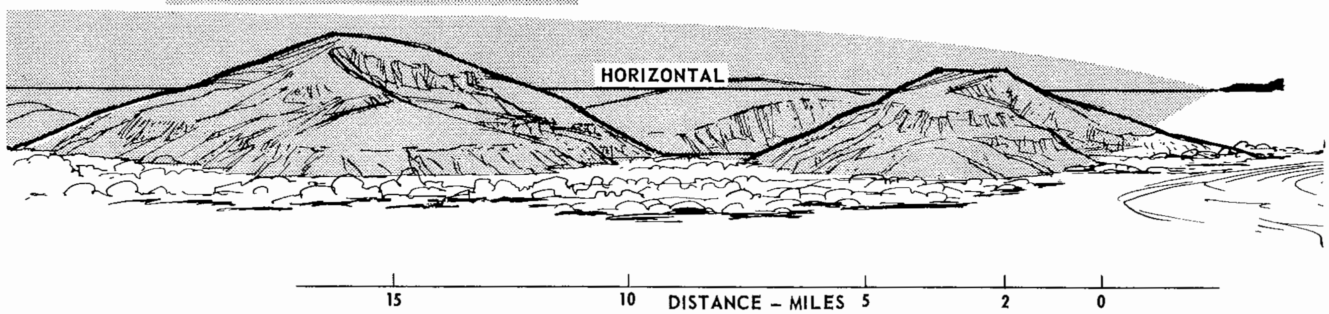
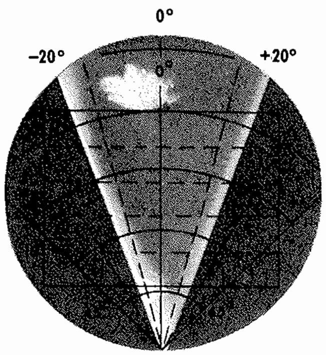
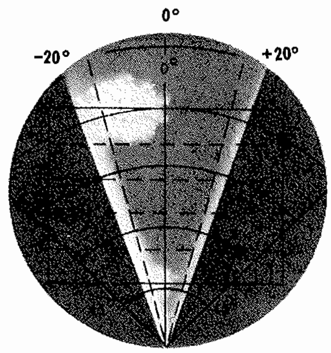
Figure 1-25

Cross Scan Mode





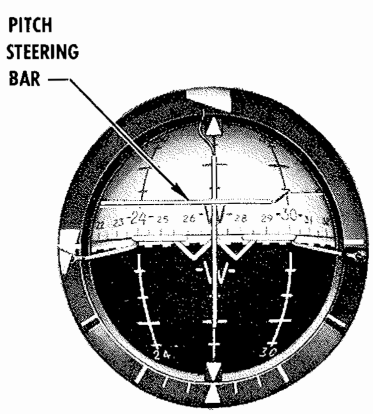
(TA) SECTOR PPI
(Pilot and RSO)



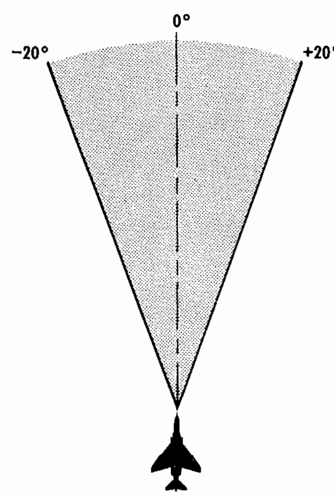
(GMP) SECTOR PPI
(Pilot and RSO)

Note

20 MILE RANGE SELECTED



ATTITUDE DIRECTOR



ANTENNA SCAN
COVERAGE
±20° AZ
(+10°−15°) EL

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Figure 1-26

RSO's Indications:

1. "Mode" light illuminated.
2. "CS" light illuminated.
3. "CL" light illuminated.
4. 250, 500, 1000, or "ND" light illuminated, depending on position of the clearance control knob.
5. "Range" light illuminated.
6. "5", "10", or "20" light illuminated, depending on range selected.

RSO's Displays:

1. Terrain avoidance type ± 20° azimuth sector PPI scan when the video switch is in the TA position and pilot's mode selector knob is in RP.
2. Ground map pencil type ± 20° sector PPI scan when the video switch is in the GMP position, or when pilot's mode selector knob is in GMP.
3. 5, 10, or 20-mile display range selected by the range selector knob.

GROUND MAP PENCIL

To select the ground map pencil mode (figure 1-27) place the mode selector knob on the pilot's radar scope to RP or GMP and the mode selector knob on the RSO's radar scope to GMP. The GMP mode provides ground mapping of a small area of terrain at low altitudes. The following indications and displays will be presented.

Pilot's Indications:

1. "GMP" light illuminated.

Pilot's Displays:

1. Ground map pencil type ± 45° sector PPI scan.
2. 5, 10, 20, 40, or 80-mile display range, selected by the range selector knob.
3. Offset and range cursors present on the radar scope.

RSO's Indications:

1. "Mode" light illuminated.
2. "GMP" light illuminated.
3. "Range" light illuminated.
4. "5", "10", "20", "40", or "80" light illuminated, depending on range selector knob setting.
5. Digital readout on range counter indicates position of range cursor.
6. Digital readout on offset cursor counter indicates position of offset cursor.

RSO's Displays:

1. Ground map pencil type ± 45° sector PPI scan.
2. 5, 10, 20, 40, or 80-mile display range, depending on the range selector knob setting.
3. Offset and range cursors present on the scope.

RSO Auxiliary Controls:

1. Tilt control wheel positions the elevation zero degree reference of the antenna beam, angular displacement is from -15° to +5°.
2. Manual receiver gain adjustment.

GROUND MAP SPOILED

To select the ground map spoiled mode (figure 1-27), place the mode selector knob on the pilot's scope to RP and the mode selector knob on the RSO's scope to GMS. The displays and indications presented to the aircrew are the same as in ground map pencil except that more of the terrain will be viewed on the radar scopes due to the spoiled beam radiation pattern. The GMS mode provides ground mapping of a large area of terrain at higher altitudes.

TERRAIN FOLLOWING OVERRIDE

To select the terrain following override mode (figure 1-28), place the mode selector knob on the pilot's radar scope to TFO. This position will override any selection on the RSO's mode selector knob except OFF or STBY. The TFO mode provides information for the pilot to fly a course with elevation maneuvers to maintain a preselected altitude above the terrain. The following displays and indications will be presented.

WARNING

If the "Fail" light illuminates and/or the horizontal warning flag on the ADI is displayed during TFO operation, pitch steering bar commands, other than climb, are unreliable.

Pilot's Indications:

1. "ND" light illuminated when clearance control knob is in a non-detent position.

Pilot's Displays:

1. Pitch steering bar on ADI will indicate climb or dive command signals. Zero reference for pitch steering bar determined by position of the clearance control knob.
2. E^2 type scope presentation.
3. 10-mile display range regardless of range selector knob position.
4. Template which governs command steering presented by the pitch steering bar when video is present on the scope.

RSO's Indications:

1. "Mode" light illuminated.
2. "TF" light illuminated.
3. "Range" light illuminated.
4. "10" light illuminated.
5. "CL" light illuminated.
6. "250", "500", "1000", or "ND" light illuminated, depending on clearance control knob setting.

Ground Map Mode

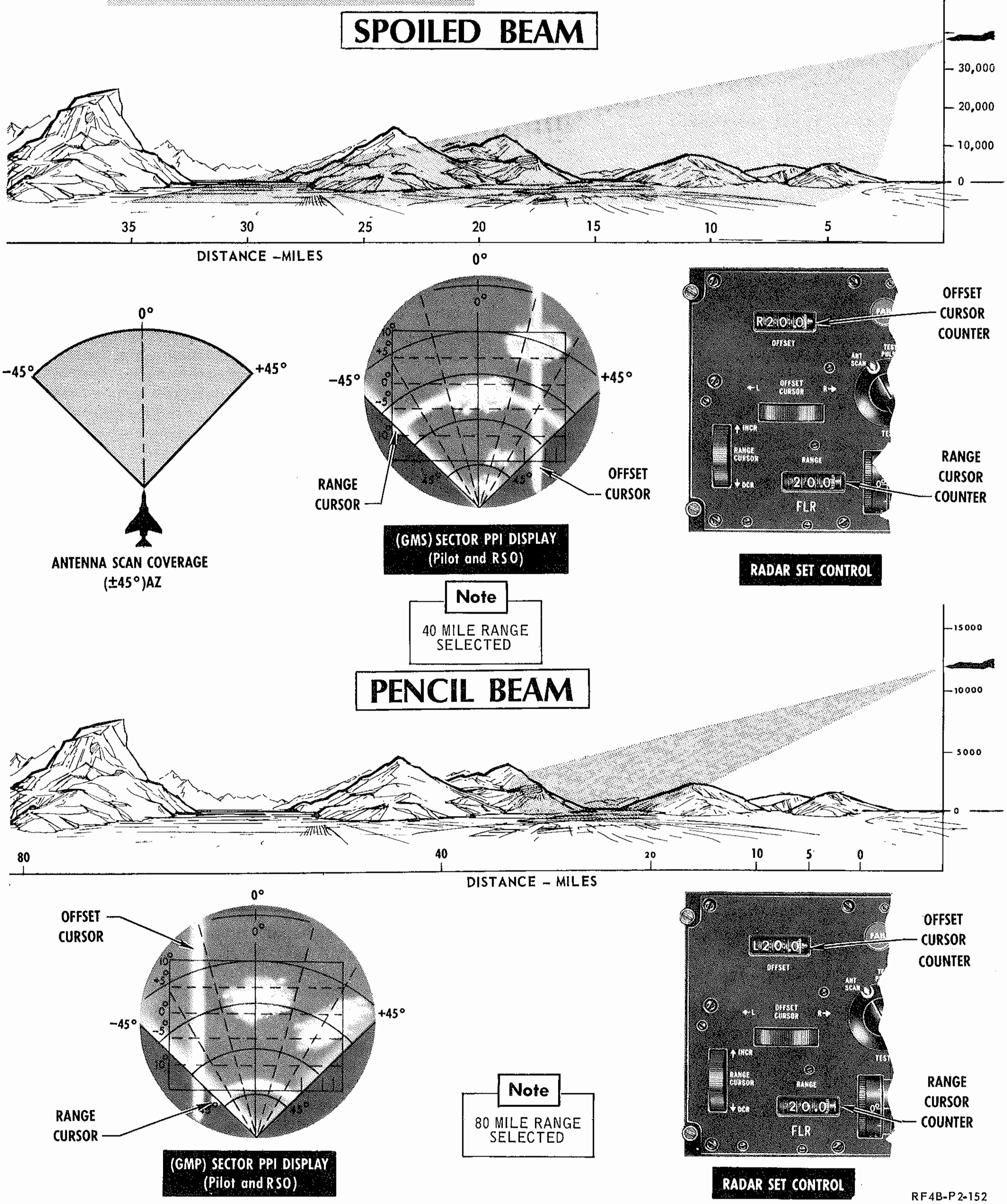
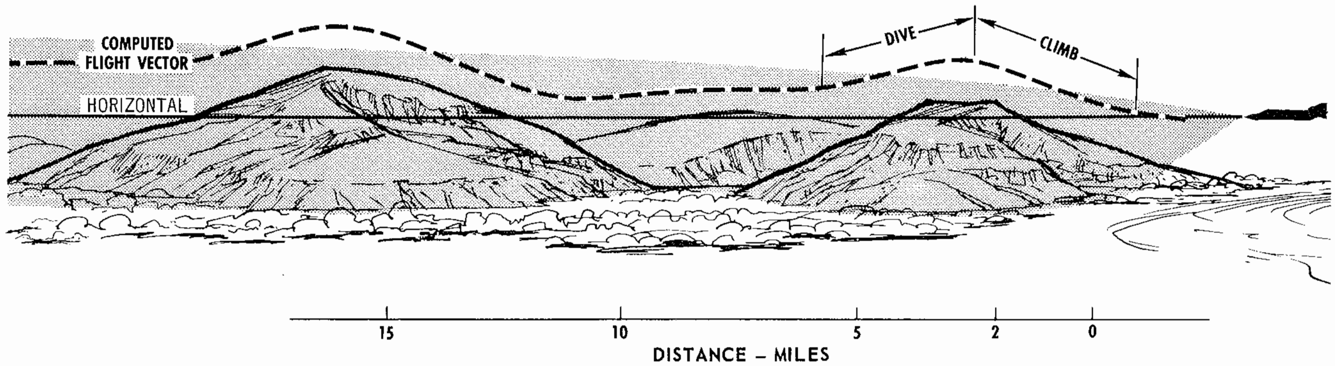
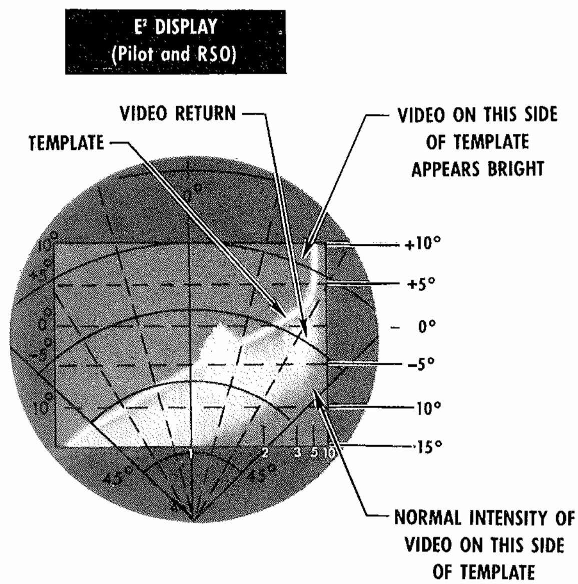
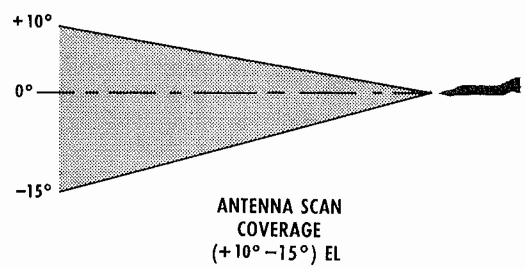


Figure 1-27

Terrain Following Override Mode







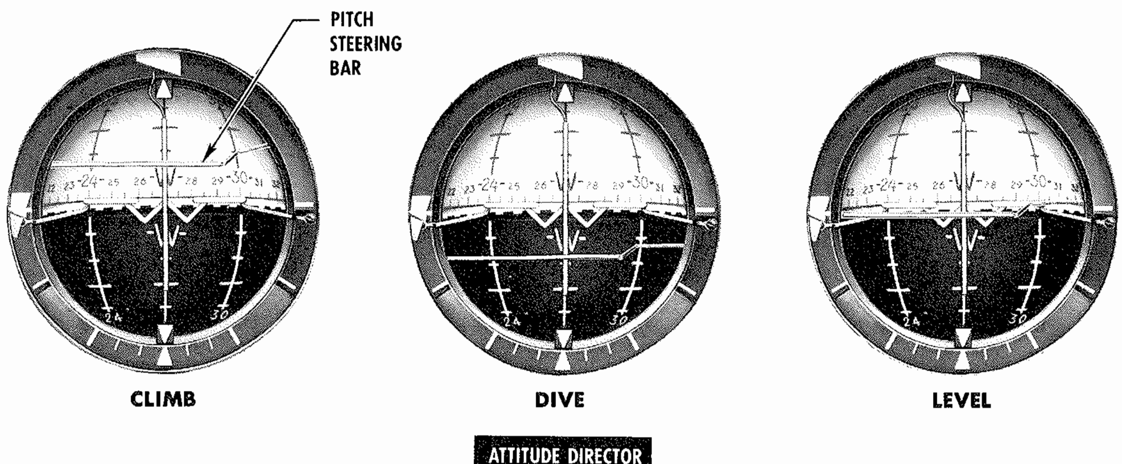


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Figure 1-28

RSO's Displays:

1. E^2 type presentation on scope.
2. 10-mile display range regardless of range selector knob setting.
3. Template which governs command steering presented by the pitch steering bar when video is present on the scope.

Auxiliary Controls:

1. Intensity, persistence, and pedestal controls on both radar scopes will adjust the intensity of the video return below the template. Video received above the template will be bright and cannot be controlled.

Note

When operating in the TFO mode, precipitation in the form of rain or water saturated clouds will cause the system to react in a similar manner as it does against solid ground return within the template. Weather return, other than very light return, will normally be visible in the E^2 display provided a high pedestal setting has been selected. Rain will appear as vertical streamers and clouds as more concentrated return on the scope. Both returns will produce large upward deflections on the pitch steering bar until the template envelope is clear. Operational commitments and/or terrain characteristics will dictate whether terrain following will be momentarily continued by manually flying the E^2 display until clear of the precipitation area. TAO mode, with its wide azimuth coverage, can also be utilized to define areas of heavy precipitation and to aid in circumnavigation if penetration is not deemed feasible.

TERRAIN AVOIDANCE OVERRIDE

To select the terrain avoidance override mode (figure 2-29), place the mode selector knob on the pilot's radar scope to TAO. This position will override any selection on the RSO's mode selector knob except OFF and STBY. The TAO mode is an alternate terrain clearance mode which can be used if the stabilization input from the INS is inoperative. Only terrain in or above the radar boresight is displayed on the radar scope. The displayed information allows the pilot to steer the aircraft around or over terrain above the radar boresight. Since the radar boresight line is fixed and referenced to the aircraft waterline, it will not compensate for changes in angle of attack. Therefore, the TAO mode should not be used below 400 knots IAS. The following displays and indications will be presented.

Pilot's Indications:

1. None.

Pilot's Displays:

1. Terrain avoidance type ± 45° sector PPI scan.
2. 10-mile display range regardless of range selector knob setting.
3. Offset and range cursors present on scope display if RSO has 5 or 10-mile range selected.

RSO's Indications:

1. "Mode" light illuminated.
2. "TA" light illuminated.
3. "Range" light illuminated.
4. "5", "10", or "20" light illuminated, depending on range selector knob setting.
5. Digital readout on offset and range cursor counters indicates position of cursors when 5 or 10-mile range is selected.

Note

The range and offset cursors will not be displayed in the 20-mile range.

RSO's Displays:

1. Terrain avoidance type ± 45° sector PPI scan when video switch is in TA position.
2. Ground map pencil type ± 45° sector PPI scan when video switch is in GMP position.
3. Offset and range cursor present on scope in 5 and 10-mile range.
4. 5, 10, or 20-mile display range depending on the range selector knob setting.

EMERGENCY OPERATION

There are no provisions for emergency operation of the forward looking radar set.

LIMITATIONS

There are no specific limitations pertaining to the forward looking radar set.

REFERENCE PUBLICATIONS

If more detailed system information is required, refer to Item 19, on Maintenance Instruction Manuals Publication Index (flyleaf 3, this publication).

Terrain Avoidance Override Mode

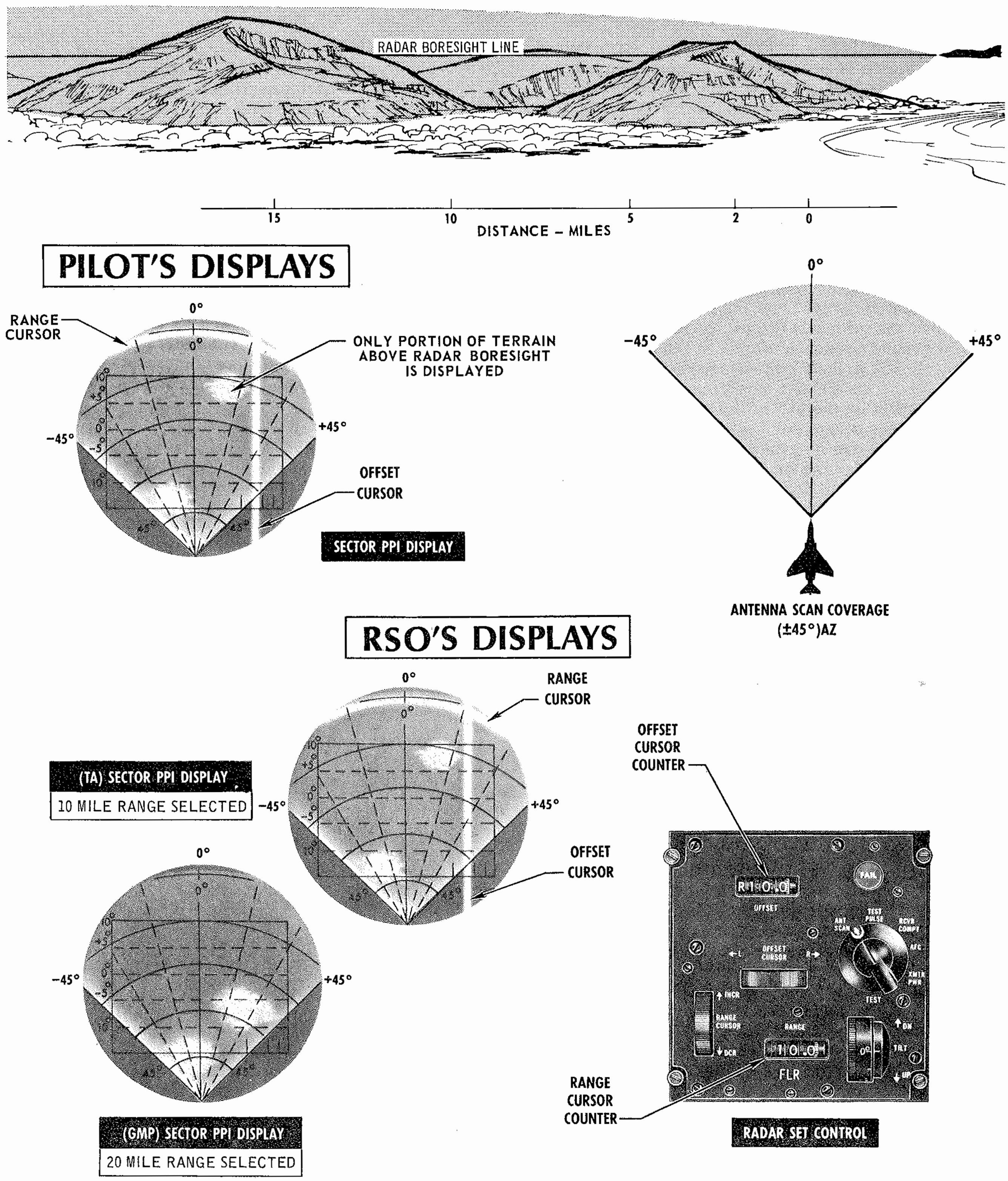

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Figure 1-29

FUEL SYSTEM

DESCRIPTION

The fuel system (figure 1-30) consists of six interconnected fuel cells in the fuselage, and two integral "wet wing" cells located in the wing torque boxes. Provisions are made for two externally mounted droppable wing tanks and a droppable fuselage centerline external tank. Provisions are also made for air refueling. The function of fuselage cells 2, 3, 4, 5 and 6 is to keep cell number 1 supplied with fuel. See figure 1-31, Fuel Quantity Data Table for fuel specifications and quantities. An air pressure fuel transfer system is provided to transfer wing and external tank fuel to the fuselage cells. Hydraulic and electric transfer pumps plus gravity feed are utilized to transfer fuel from the fuselage cells to number one cell which is the engine feed tank. Single point ground pressure fueling at the rate of approximately 250 gallons per minute may be accomplished. Two point ground refueling can be accomplished by utilizing the air refueling probe in conjunction with the single point ground refueling receptacle. There are no gravity fueling or defueling provisions made for the internal or external fuel systems. All internal fuel cells incorporate capacitance type fuel gaging units. These units continuously indicate the total fuel quantity in pounds in all internal cells. The fuel system is equipped with refueling level control valves which are float type valves that shut off the pressure fueling when predetermined fuel levels are reached. All internal and external fuel tanks are pressurized in flight by regulated engine bleed air which is also utilized to transfer wing or external fuel to the fuselage cells or to dump wing fuel. The internal cells and external centerline tank are vented to a common manifold which dumps overboard from the fuel vent mast located immediately below the rudder. The external wing tanks are vented to the wing cell dump lines.

FUEL BOOST SYSTEM

Fuel is supplied to the engine during all flight attitudes by two submerged electric motor-driven centrifugal type boost pumps. The left pump is a two-speed unit. During normal operation, both pumps operate at high speed. In the event of a complete electrical failure or double engine failure, extending the ram air turbine automatically switches the left pump from high to low speed; thereby reducing the amperage load and conserving electrical power; and at the same time maintaining positive fuel pressure at the engine inlet. The boost pumps are located in the engine feed (No. 1) tank. Both pumps are mounted on the bottom of the cell. Due to internal tank baffling and check valves, which trap approximately 133 gallons of fuel in the lower third of the tank during inverted flight, the boost pumps will always remain submerged and provide a continuous fuel flow to the engines. The two boost pumps will operate when either engine master switch is ON, provided a-c power is supplied to the system.

Note

> In the event of a double engine failure and loss of electrical power, extending the ram air turbine will automatically switch the left boost pump to low speed. The low speed boost pump plus gravity feed will supply enough fuel pressure to the engine driven fuel pumps to enable the engines to be started.

Boost Pump Pressure Indicators

The boost pump pressure indicators (figure 1-2) are mounted on the left console in the front cockpit. The gage dials are calibrated from 1 to 10 with readings multiplied by 10. Pressure transmitters mounted on the airplane keel in the engine compartment measure pressure in the aircraft fuel system as it enters the engine fuel pump.

Fuel Boost Pump Check

Two momentary type check switches (figure 1-2) are located on the fuel control panel to check the operation of the fuel boost pumps. This check can be conducted only with external power applied and the engine master switches OFF since either engine master switch in the ON position will operate both boost pumps. Placing either switch in the CHECK position operates the corresponding boost pump and opens the corresponding left or right engine shutoff valve allowing a pressure transmitter to pick up engine inlet pressure. This pressure is indicated on the applicable pressure gage for that pump. The pressure gages are located on the forward end of the pilot's left console. A discharge pressure reading below 30 ± 2 psi while a pump is being checked indicates a malfunction. On the deck, when the fuselage tanks are pressurized, the tank pressure will be additive to the pump pressure and indicated on the gages. The fuselage tank pressure will normally be as high as 4 psi; therefore, the gages could indicate as high as 36 psi when the fuselage tanks are pressurized. Pressures in excess of 38 psi, after an acceptable boost pump preflight pressure check, are indicative of a malfunction in the fuselage tank pressurization system. The boost pump pressure check limits are 32 ± 2 psi under no-flow conditions.

FUEL TRANSFER SYSTEM

With electrical power supplied, the electric transfer pumps located in fuselage cells 4 and 6 will commence transferring fuel to the engine feed tank and cell 2 with the selection of the ON position of either engine master switch. With hydraulic and electrical power supplied and an engine master switch on, the hydraulic transfer pumps in cells 4 and 6 will also be operating to deliver fuel to cell 1 and cell 2. Level control valves open to allow fuel from the transfer pumps to enter cells 1 and 2 when the fuel level in these cells drops below a preset level. Cell No. 2 transfers to cell No. 1 by gravity only; cell 3 gravity feeds cell 4; and cell 5 gravity feeds cell 6. All internal and external tanks and cells are pressurized when the landing gear handle is in the gear up position (or the wing transfer pressure switch is in the emergency position) and an engine is running. NEW The internal and external tanks are transferred by regulated air pressure. Wing fuel is transferred to fuselage cells 1 and 3 only. It will not normally enter cell 1 unless the fuel level in the cell drops low enough to permit the transfer level control valve to open. Wing fuel is transferred to fuselage cell 3 as soon as the internal wing tanks are pressurized, NEW providing the internal wing transfer switch is in the NORMAL position and the level control valve in cell three is open. Internal wing fuel is not transferred to cell 5 in order to prevent an aft c.g. condition. With an engine running, fuel from the external tanks will commence transferring upon selection of the desired position (OUTB'D or CENTER) on the external transfer switch (figure 1-2), providing the landing gear is in the gear up position or the wing transfer pressure switch is in the emergency position. When operating on the emergency generator, internal wing and external fuel can be transferred normally.

Internal Wing Transfer Switch

The internal wing transfer switch (figure 1-2) is a two-position toggle switch located in the fuel control panel. The switch positions are marked NORMAL and STOP TRANS. In the NORMALposition, internal wing fuel is transferred to fuselage cell 3 as soon as the internal wing tanks are pressurized, and the refueling level control valve in cell 3 opens. Selecting the STOP TRANS position of the switch closes the internal wings fuel transfer valves thus preventing further internal wing fuel transfer to the fuselage tanks and cells.

Wing Transfer Pressure Switch

The wing transfer pressure switch (figure 1-2) is a two-position switch located in the fuel control panel. The switch positions are marked NORMAL and OVRD TRANS. When the landing gear handle is in the UP position and the wing transfer switch is in the NORMAL position, all internal and external tanks become pressurized. At this time the pressure regulator valves are deenergized open and the pressure relief valves are energized closed. This maintains 15 ± 0.5 psi air pressure in the wing and external tanks and 2 ± 0.5 psi in the fuselage tanks. Placing the switch in the OVRD TRANS position performs the same functions as did the landing gear handle; all pressure regulators open and all pressure relief valves close; the tanks are thereby pressurized and ready to transfer.

CAUTION

To prevent external tank collapse during high altitude descent with wheels down, place wing transfer pressure switch to OVRD TRANS position before lowering the landing gear. If the tanks have been de-pressurized in level flight, place wing transfer pressure switch to OVRD TRANS and continue in level flight for approximately 30 seconds to insure adequate re-pressurization before commencing descent. Place wing transfer pressure switch to NORMAL prior to landing.

External Transfer Switch

The external transfer switch (figure 1-2) is a three-position toggle switch located in the fuel control panel. The switch positions are marked CENTER EXT, WING INT, and OUTB'D EXT. Upon the selection of the CENTER EXT position, the internal wing tank shutoff valves close, the centerline tank fuel shutoff and refuel shutoff valves are energized open, and fuel commences to transfer. Placing the switch in the OUTB'D EXT position closes the centerline shutoff valves, opens the external wing tanks shutoff valves and fuel transfers to cell 3. External fuel will transfer to fuselage cells 3 and 5.

CAUTION

- Catapult launching acceleration can force fuel out of the external tanks through the transfer lines to the fuselage cells at a rate beyond tank venting capability, thus creating a partial vacuum in the external tanks. Therefore, to prevent external tank collapse during a catapult launch, insure that the external transfer switch is in the WING INT position prior to launch.
- If external tanks are being carried, internal wing fuel will not transfer if the external transfer switch is in any position other than WING INT.

EMERGENCY FUEL TRANSFER

There are no provisions for an emergency fuel transfer system on this airplane. With hydraulic and electric fuselage transfer pumps working simultaneously, and the utilization of air pressure for wing and external tanks transfer, the possibility of a complete fuel transfer system failure is highly improbable.

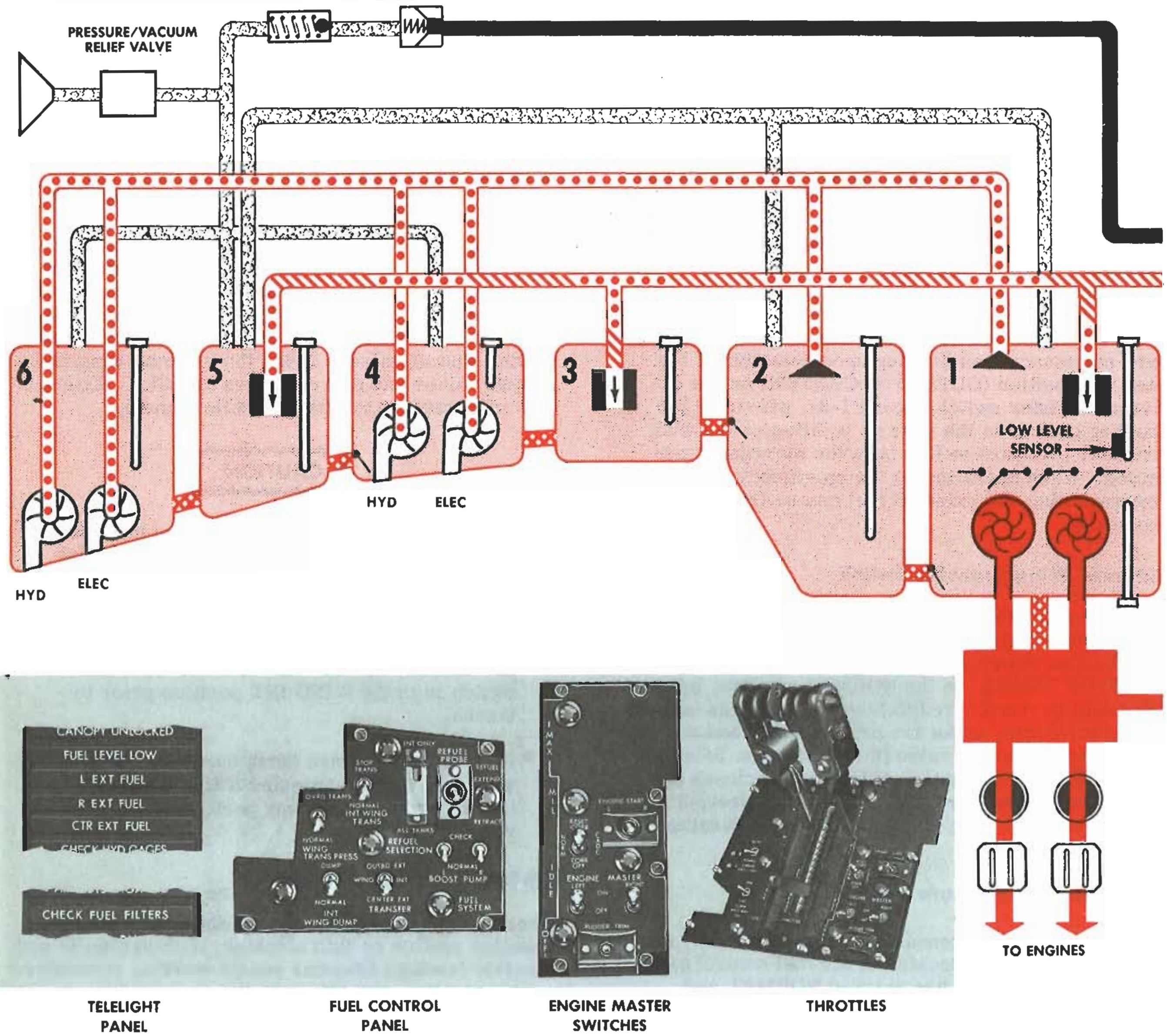
PRESSURIZATION AND VENT SYSTEM

The pressurization and vent system provides regulated engine bleed air pressure to all internal, and external tanks for pressurization, fuel transfer, and wing dump. The system also provides for venting of external tanks to prevent collapse during fast descents.

Wing Tank Pressurization and Vent

The wing cells and external tanks pressurization system utilizes pressure regulators and pressure relief valves which are set respectively at 15 ± 0.5 psi and 17.5 ± 0.5 psi. The wing cell pressure relief valves, which provide fuel tank pressure and vacuum relief,

Airplane Fuel System



Note

CENTERLINE TANK SHOWN, FUEL SYSTEM COMPATIBLE WITH AN INFLIGHT REFUELING STORE.

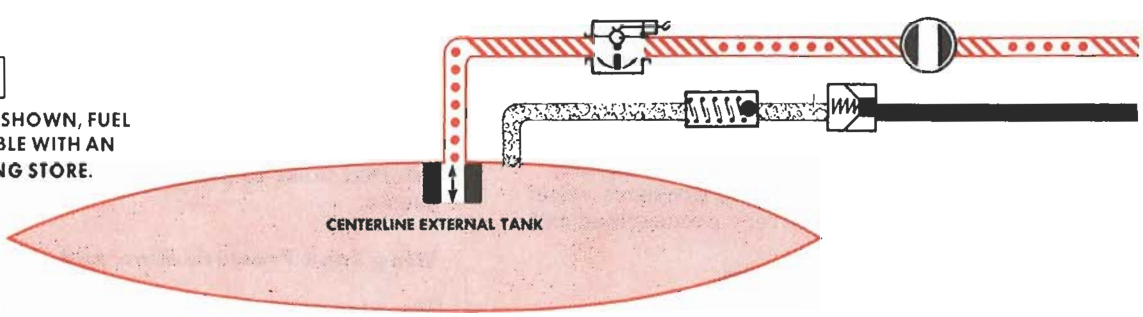


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Figure 1-30 (Sheet 1)

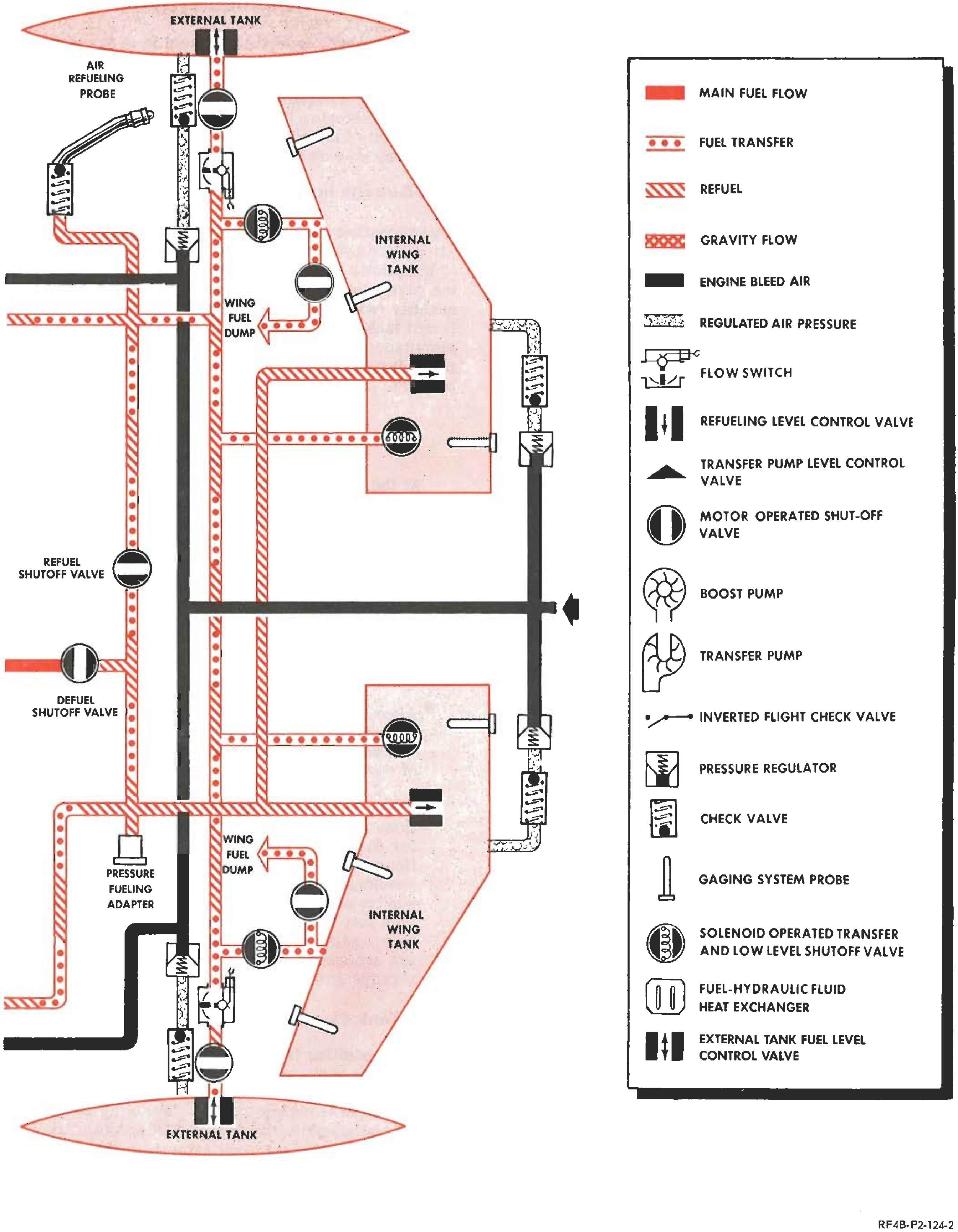


Figure 1-30 (Sheet 2)

dump into a common manifold which is vented overboard under the rudder. The external wing tanks are vented through their pressure relief valves to the wing cell dump lines. The wing cells and external wing tanks are vented to the atmosphere when the landing gear is extended.

Fuselage Tank Pressurization and Vent

The fuselage tank pressure regulator, in conjunction with the flow limiter and pressure relief vent valve will maintain regulated air pressure at 2 ± 0.5 psi and provide pressure relief at 3.5 ± 0.5 psi. The fuselage cells and the Buddy Tank or centerline external tank are vented to the common fuel vent manifold and then dumped overboard through the fuselage pressure relief valve. When the airplane is on the ground, all pressure relief valves are open, venting all tanks to the atmosphere.

WING FUEL DUMP

Wing fuel may be dumped in flight at any time, regardless of any other transfer position, by selecting the DUMP position on the internal wing dump switch (figure 1-2). The two-position toggle switch marked NORMAL and DUMP is located on the fuel control panel on the left console of the pilot's cockpit. Selecting the DUMP position opens the left and right wing dump shutoff valves and closes the wing transfer and vent valves. The wing air pressure regulator will open, allowing the wing tank to remain pressurized and force fuel out the dump lines at the wing fold trailing edge. Air pressure will continue to bleed out the dump line until the internal wing dump switch is placed in the NORM position to close the dump valves.

CAUTION

- Due to the fact that the internal wing dump switch will function with the engine master switch ON or OFF, and the landing gear UP or DOWN, wing fuel will be dumped ON THE DECK when the internal wing dump switch is placed in the DUMP position and external power is applied to the airplane.
- To prevent external tank collapse during descent with wheels down while dumping fuel, place wing transfer pressure switch in the OVRD TRANS position before lowering the gear. If the tanks have been depressurized in level flight, place the wing transfer pressure switch to OVRD TRANS and continue in level flight for approximately 30 seconds to insure adequate repressurization before commencing descent. Place wing transfer pressure switch to NORMAL prior to landing.

Note

Power settings in excess of 85% rpm may be required in order to initiate and ensure wing fuel dumping.

FUEL QUANITY INDICATING SYSTEM

The fuel quantity indicating system is of the capacitance type and provides a reading in pounds of total internal fuel. The system components include the fuel quantity indicator, fuel check switch and a fuel level low indicator light. There are thirteen fuel gaging units located throughout the internal tanks which register on the one cockpit fuel quantity gage.

Fuel Quanity Indicator

A combination (counter-sector) fuel quantity indicator (figure 1-4) is located in the upper right corner of the pilot's instrument panel. The counter unit of the gage continuously indicates the total usable fuel quantity (with readings multiplied by 10) in all internal tanks. The sector portion of the indicator simultaneously indicates the total usable fuel quantity in the fuselage tanks only with readings multiplied by 1000.

WARNING

At the low end of the fuel scale, the counter portion of the fuel quantity gage has a tolerance of ± 150 pounds, and the sector portion has a tolerance of ± 100 pounds. Therefore, in the event the "Fuel Level Low" light illuminates above an indicated 1960 pounds, the warning light should be used as the primary indication of a low fuel state, and continued flight operations should be judiciously considered.

Note

- After all wing fuel has transferred, the counter and sector portions of the fuel quantity gage should read within 300 pounds of each other.
- There is a possibility that fuel quantity variations will be noted on the fuel quantity indicator during aircraft accelerations and decelerations. Transient increases in fuel quantity readings may be noted during deceleration, and transient decreases in fuel quantity readings may be noted during acceleration. Therefore, optimum fuel quantity gage indications are achieved with the aircraft in sustained, straight and level, constant speed flight.

Feed Tank Check Switch

The two-position feed tank check switch (figure 1-4), with switch positions of CHECK and NORMAL, gives the pilot the opportunity of checking the fuel quantity in the engine feed tank (cell 1). When the switch is placed in the spring-loaded CHECK position, the sector portion and the counter portion of the fuel quantity gage will both read engine feed tank fuel quantity. Aside from the fact that the feed tank check switch affords an opportunity of checking feed tank fuel quantity, it is also an indication that there is power to the fuel quantity circuits and that the gage is functioning properly.

Fuel Level Low Indicator Light

The "Fuel Level Low" indicator light located on the telelight panel illuminates when the combined usable fuel in the engine feed tank and tank No. 2 is reduced to approximately 1960 ± 200 lb. (288 ± 29 gal. for JP-5 or 320 ± 31 gallons for JP-4). The "Fuel Level Low" light will illuminate at the above fuel quantities only if the airplane is in a perfectly level attitude and moderate stabilized power settings are being used. However, due to the various attitudes and power settings required during a normal flight the illumination of the "Fuel Level Low" indicator light is not an accurate indication of the amount of fuel remaining in the No. 1 and No. 2 cells. The illuminated light will only serve notice to the pilot that his fuel is low. In this system the unit which operates the low level indicator light is a thermistor sensor which is located on the engine feed tank fuel quantity probe. When the fuel level in No. 1 and No. 2 cells is above the sensor, the resistance of the reference thermistor (which is enclosed in an air filled capsule) is much less than the resistance of the sensing thermistor, causing an unbalance in the bridge circuit. The relay is energized and the "Fuel Level Low" indicator light is out. When the fuel level drops below the sensor, the thermistors are both exposed to air, and resistances of the reference and sensing thermistors are equal, balancing the bridge circuit. The relay then becomes deenergized and allows current flow to the "Fuel Level Low" indicator light.

Left and Right External Tank Fuel Lights

The "L. Ext Fuel" or "R. Ext Fuel" indicator lights located on the telelight panel are provided to indicate an empty left or right outboard external tank with the OUTB'D EXT position selected on the external transfer switch. One or the other external fuel indicator lights will illuminate simultaneously when fuel flow from one of the external wing tanks ceases. This will notify the pilot that the tank indicated is empty or flow is interrupted. Since external fuel transfer is intermittent rather than continuous the "L. Ext Fuel", and the "R. Ext Fuel" indicator lights will come on during a temporary halt of fuel flow. Intermittent external fuel transfer is desired since this means the transfer rate is greater than engine consumption and fuselage fuel is being maintained at its highest possible volume. The "L. Ext Fuel" or "R. Ext Fuel" indicator lights will also illuminate when the tanks are full during refueling operation.

Note

> When selecting the OUTB'D EXT position on the external transfer switch, or the REFUEL position on refuel probe switch, the "L. EXT FUEL" or "R. EXT FUEL" lights will illuminate any time fuel flow is less than 5 gpm.

Centerline External Tank Fuel Light

The "Ctr Ext Fuel" indicator light is provided to indicate an empty centerline tank with CENTER EXT position selected on the external transfer switch. The "Ctr Ext Fuel" indicator light will illuminate when fuel flow ceases. The "Ctr Ext Fuel" indicator light will also illuminate when the tank is full during a refueling operation.

Note

> When selecting the CENTER EXT position on the external transfer switch, or the REFUEL position on the refuel probe switch, the "Ctr Ext Fuel" light will illuminate any time fuel flow is less than 5 gpm.

IFR PROBE UNLOCK INDICATOR LIGHT

The "IFR Probe Unlock" indicator light is located on the telelight panel, and will be illuminated when the air refueling probe is not fully retracted. The illumination of the "IFR Probe Unlock" warning light will also energize the "Master Caution" light. The indicator light circuit is completed through a limit switch located within the air refueling probe latching actuator.

CHECK FUEL FILTER INDICATOR LIGHT

The "Check Fuel Filters" indicator light is located on the telelight panel. The "Check Fuel Filters" indicator light, and "Master Caution" light will be illuminated when the fuel filter on either engine is being bypassed. The light circuit is completed through a pressure differential switch which senses filter inlet and filter outlet pressure. In the case of a partially clogged fuel filter, the "Check Fuel Filters" indicator light may be extinguished by reducing power on both engines. Check each engine individually by adding power to see if the light will illuminate. In this manner, it can be determined if one or both engines are affected.

EXTERNAL TANK JETTISON SYSTEM

External Tank Jettison Switch

The external wing tanks can be jettisoned by simply selecting the JETT position on the external stores jettison panel (figure 1-2) located on the left console in the pilot's cockpit. The tanks can be jettisoned before or after the flow indicating light illuminates. Illumination of the flow light indicates flow has ceased and external tanks are empty. If the external transfer switch has been inadvertently left in either the OUTB'D EXT or CENTER EXT position and external tanks are not installed on the airplane, or the tanks have been jettisoned, the external wing tanks fuel shutoff valve will close and the switch will be ineffective, allowing wing fuel to transfer in its normal manner.

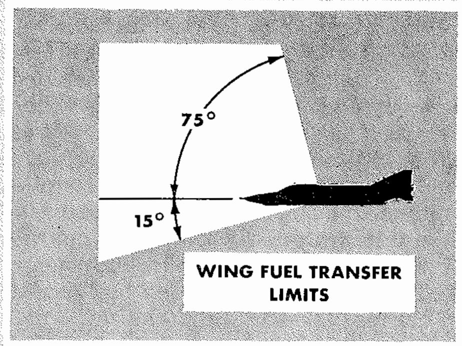
CAUTION

> The external wing tanks can be jettisoned by the external wing tank jettison switch any time power is on the airplane and the external tanks safety pins are removed. This circuit is not wired through the landing gear handle.

Fuel Quantity Data Table

TANK	FULLY SERVICED		USABLE FUEL	
	GALLONS	POUNDS	GALLONS	POUNDS
FUSELAGE CELL 1	—	—	231	1571
CELL 2	—	—	221	1503
CELL 3	—	—	164	1115
CELL 4	—	—	221	1503
CELL 5	—	—	201	1367
CELL 6	—	—	235	1598
TOTAL FUSELAGE FUEL	1302	8854	1273	8657*
INTERNAL WING TANKS	634	4311	630	4284
TOTAL INTERNAL FUEL	1936	13,165	1903	12,941*
EXTERNAL WING TANKS	744	5059	740	5032
INTERNAL FUEL PLUS EXTERNAL WING TANKS	2680	18,224	2643	17,973
EXTERNAL CENTER TANK	602	4094	600	4080
INTERNAL FUEL PLUS EXTERNAL CENTER TANK	2538	17,259	2503	17,021
MAXIMUM FUEL LOAD TOTAL INTERNAL PLUS ALL EXTERNAL TANKS	3282	22,318	3243	22,053

*GAGEABLE FUEL



Note

FUEL WEIGHTS ARE BASED ON JP-5 AVERAGE OF 6.8 POUNDS PER GALLON AT STANDARD DAY TEMPERATURE.
JP-5 DENSITY VARIES FROM 6.68 TO 7.0 LB/GAL.

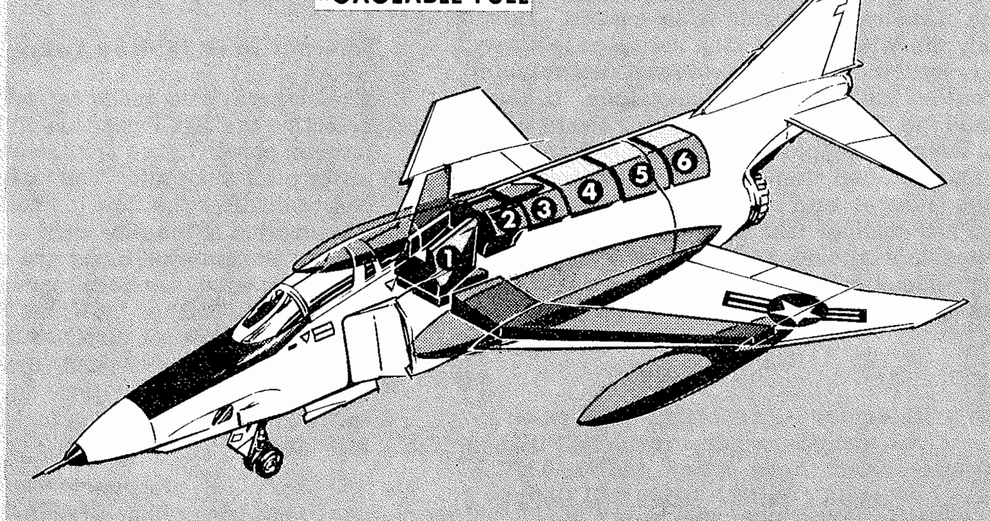


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Figure 1-31

External Stores Emergency Release Button

The external stores emergency release button (figure 1-2) is located on the left vertical panel. This button, when depressed, will jettison all external stores with gear either up or down (providing weight is off the gear). The external tanks can be jettisoned before or after the flow indicating light illuminates. Illumination of the flow light indicates flow has ceased and external tanks are empty. If the external transfer switch is in the CENTER position at time of jettison, the centerline tanks fuel shutoff valve will close and the switch will be ineffective, allowing wing fuel to transfer in its normal manner.

AIR REFUELING SYSTEM

The air refueling probe is located on the starboard side of the fuselage above the engine air inlet duct. The probe is equipped with an MA-2 refueling nozzle which is capable of receiving fuel from any drogue type refueling system. The refueling operation is actuated by the refuel probe switch which is located on the fuel control panel. The refuel probe switch has three positions: REFUEL, EXTEND and RETRACT. The REFUEL position conditions the airplane fuel system for inflight refueling and extends the inflight refueling probe. The EXTEND position retains the probe in the extended position, but returns the airplane fuel system to normal operation. This position is used when normal fuel transfer is desired with the probe extended or in the event the probe is damaged and cannot be retracted. The RETRACT position returns the fuel system to normal transfer operation and retracts the probe. Effective airplane 152303w and up, and all others upon incorporation of AFC 213; when the refuel probe switch is placed in the REFUEL position, a "Refuel Ready" light, located on the telelight panel, will illuminate if the fuselage pressurization and vacuum relief valve opened properly. This will assure that the fuselage tanks are properly vented for refueling. The refuel selection switch is located on the fuel control panel. This is a two-position guarded switch with ALL TANKS and INT. ONLY positions. The ALL TANKS position opens the external tank fuel shutoff valves when refueling. The INT. ONLY position closes the external tank fuel shutoff valves and allows only the internal tanks to be refueled during air refueling.

Air Refueling Probe Light

An air refueling probe light is installed on the right side of the fuselage forward of the air refueling probe. The light is used during night air refueling operations to illuminate the refueling probe and the drogue from the refueling airplane. The light is controlled by the IFR switch and variable intensity control knob, both of which are located on the exterior lights control panel.

GROUND REFUELING SYSTEM

The airplane is capable of either single point or two point pressure refueling. The single point refueling receptacle is located on the right underside of the fuselage in the area below the aft cockpit. Single point pressure fueling at the rate of approximately 250 gallons per minute may be accomplished. Two point pressure fueling at the rate of approximately 480 gallons per minute may be accomplished by utilizing the air refueling probe with a special fitting attached. The system also allows a controlled partial refueling capability. If desired, fuel is locked out of the left and right wing tanks, and number 5 and 6 fuselage cells. This allows the airplane to be partially refueled to an amount of 902 gallons (approximately 5,683 pounds JP-4) without creating an undesirable c.g. condition.

Cockpit Switch Positions

The switches on the fuel control panel, located on the left console in the pilot's cockpit, should be in the following positions before single point pressure fueling: external transfer switch, WING INT; wing transfer pressure switch, NORMAL; refuel selection switch, ALL TANKS; refuel probe switch, RETRACT. Refueling of the internal tanks only, with any or all external tanks installed may be accomplished by selecting INT ONLY on the refuel selection switch. The landing gear control handle must be in the gear down position and master switches and throttles should be in the OFF position. The generator control switches should be in the EXT ON position. If two-point pressure refueling is desired, the refueling probe switch should be placed in the REFUEL position.

REFUELING OPERATION

Apply external a-c power to the airplane and place the generator control switches to EXT ON. Open filler door and attach fueling nozzle to service inlet valve. Set ground fueling switch located in the right wheel well to REFUEL position. (The ground fueling switch is only effective with the engine master switches OFF and ground electrical power applied.) With the REFUEL position selected on the ground fueling switch, all valves in the fuel system will be closed with the following exceptions. The fuselage air pressure regulators will be open, all internal tank vent valves will be open, all external tank vent valves will be open if their respective tanks are installed and the refuel selection switch is in the ALL TANKS position. All fuel level control valves are open to receive fuel until their respective tanks are filled, at which time floats rise in the valves to shut off fuel. Outboard and centerline external tanks motor operating shutoff valves will be open, allowing fuel to fill the external tanks installed. A fuel flow transmitter in each refueling line to any external tank, energizes a caution indicator light in the cockpit corresponding to the tank not accepting fuel. Partial refueling is accomplished by actuating and holding the left and right wing tank and No. 5 fuselage tank fuel level control valve switches.

Functional Precheck of Electric Transfer Pumps

Individual, momentary-type check switches for each electrically operated transfer pump and a pressure indicator light, are located on a panel in the left wheel well to provide a functional check for each electric transfer pump. When either switch is placed in the CHECK position, the primary circuit shuts off both fuselage fuel level control valves in fuselage cells No. 1 and No. 2, energizes the pressure transmitter switch and operates the transfer pumps in cells No. 4 and No. 6. The pressure transmitter switch energizes the green indicator light if the discharge pressure of the selected pump is normal. No light, while the pump is being checked, indicates a malfunction in the pump.

Functional Precheck of Hydraulic Transfer Pumps

A momentary type check switch is provided on a panel in the left wheel well to check the operation of the hydraulic transfer pumps. The switch works in conjunction with two indicator lights. The check switch, when placed in the CHECK position, closes transfer pump level control valves in fuselage cells No. 1 and No. 2, opens the hydraulic shutoff valve to allow both pumps to operate and energize each pressure transmitter switch. Each pressure transmitter switch illuminates the green indicator light for each pump if their discharge pressure is normal. No light, with the switch in the CHECK position, indicates a malfunction of that pump. Hydraulic and electrical ground power must be connected to the airplane to conduct the above check.

Note

> During the precheck of the electric and hydraulic transfer pumps, if the indicator light does not illuminate immediately, continue holding check switches for at least one minute, since the No. 1 fuel cell must be full before the level control valve closes.

Functional Precheck of Refueling Level Control Valves

A double throw, momentary-type master check switch and seven individual momentary-type check switches are located in a panel in the right wheel well. The master switch has positions of CHECK NO. 1 and CHECK NO. 2. With fuel flow started from the fueling source, hold the master check switch to the CHECK NO. 1 position. This position closes the motor operated shutoff valves of any external tank installed, and energizes a solenoid in the primary float unit of the refueling level control valves, causing the primary floats to rise and shut off fuel flow to all internal tanks. Placing the master check switch in the CHECK NO. 2 position closes the motor operated shutoff valves of any external tank installed, and energizes a solenoid in the secondary float unit of the refueling level control valves which causes the secondary floats to rise and shut off fuel flow to all internal tanks. Continuation of fuel flow with the master switch in the CHECK NO. 1 or CHECK NO. 2 position indicates a malfunction of one or more of the refueling level control valves and/or motor operated shutoff valves. When a malfunction occurs in the primary or secondary system, that respective position on the master switch shall be held. Malfunction of any refueling level control valve can then be isolated by operating the individual momentary type check switches, one at a time to their respective position, until fuel flow is stopped. The respective position of the individual switches energizes the solenoid in the circuit of each valve opposite to the circuit checked on the master switch. The individual switch that stops fuel flow, indicates a malfunction of that valve in the primary or secondary unit corresponding to the circuit checked. In the event the refueling level control valve check does not stop fuel flow with an external tank installed, this indicates a malfunction of a motor operated shutoff valve corresponding to the tank or tanks installed.

NORMAL OPERATION

Operation of the fuel system is controlled through the fuel control panel. With no external tanks aboard, all switches on the fuel control panel should be in the inboard position, with the exception of the external transfer switch which should be in the WING INT position. With this switch arrangement, the fuel system will be set up for automatic fuel transfer and no further switching will be required. If only external tanks are carried, switch positions are the same as with no external tanks except that the external transfer switch is placed in an appropriate external tank position. In this case, it will be necessary to switch to another external tank position, or place the external transfer switch in the WING INT position when the fuel in the selected tank(s) is depleted. After all external fuel is expended and the external transfer switch is in the WING INT position, internal wing fuel will transfer automatically and no further switching will be required. The "L. Ext Fuel", "R. Ext Fuel" and "Ctr Fuel" warning lights will illuminate when flow from the selected tank is interrupted; therefore, the only indication of completed external fuel transfer is the illumination of the external fuel warning lights, accompanied by a decrease in internal fuel. Upon depletion of external tank fuel, the fuselage cells will continue to supply fuel to the engine feed tank; however, internal wing fuel will not commence transferring until the external transfer switch is in the WING INT position. During carrier operation, manage internal wing fuel so as to arrive at the carrier with the maximum trap weight.

EMERGENCY OPERATION

FUEL BOOST PUMPS

If fuel boost pumps fail, fuel will still be supplied to the engines by gravity feed. If both boost pumps fail above 20,000 feet and/or at a high power setting, flameout or an unstable rpm indication on one or both engines may occur. During gravity feed, high fuel flow rates required by afterburner operation cannot be met. A boost pump pressure indication of 0 psi indicates that both boost pumps are inoperative. If both engines have flamed out, reduce airspeed to 515 knots CAS or Mach 1.1 whichever is less and extend the ram air turbine. Extending the ram air turbine will operate the left fuel boost pump at low speed. This will supply enough fuel to either engine to accomplish an airstart. If an airstart has been accomplished or the engines have not flamed out, reduce power and/or descend until stable engine operation can be maintained. Since the boost pumps feed into a common manifold before branching off to the engines and boost pump pressure transmitters, an inoperative pump will be noted on both boost pump indicators. Therefore, a boost pump pressure reading below normal (30 ± 2 psi) will be a good indication that one of the boost pumps is inoperative. The power settings on each engine should be reduced as necessary until a boost pump pressure reading of 5 psi or greater is obtained.

INTERNAL TANKS TRANSFER SYSTEM

Transfer system failure in this airplane can usually be attributed to failure of the fuel system to become pressurized. Failure of the fuselage cells transfer pumps is not likely, since two hydraulic and two electric transfer pumps operate simultaneously and either set of pumps (electric or hydraulic) is capable of transferring all fuselage fuel. If the fuel system fails to become pressurized, place the wing transfer pressure switch in the EMERG position. This performs the same functions as did the landing gear handle switch; all pressure regulators open and all pressure relief valves close.

LIMITATIONS

WING FUEL TRANSFER

Internal wing fuel will not transfer above 75° nose up attitude, or below 15° nose down attitude.

REFERENCE PUBLICATIONS

If more detailed system information is required, refer to Item No. 9, on Maintenance Instruction Manuals Publications Index (flyleaf 3 this publication).

HYDRAULIC POWER SUPPLY SYSTEM

DESCRIPTION

Hydraulic power is supplied to components of the airplane that require application of heavy force by three, completely independent, closed center hydraulic systems. They are Power Control System One (PC-1), Power Control System Two (PC-2), and Utility System. The systems have operating pressures of approximately 3000 psi, and are pressurized any time the engines are running. The power control systems supply hydraulic pressure to the dual power control cylinders of the ailerons, spoilers, and stabilator. The utility system supplies hydraulic pressure to the power control cylinder of the rudder, and to all other hydraulically operated systems. Each system can be pressurized by an external hydraulic power source.

POWER CONTROL SYSTEM ONE (PC-1)

PC-1 (figure 1-32) is pressurized to 3000 ± 250 psi, by a variable volume (18 to 26 gpm), constant pressure hydraulic pump mounted on the left engine. This system supplies hydraulic pressure to one side of the dual power control cylinders of the ailerons, spoilers, and stabilator. Fluid is supplied to the pump by an airless, pressure loaded, piston-type hydraulic reservoir that has a usable capacity of 0.83 gallons. The reservoir insures positive hydraulic pressure and fluid supply to the pump suction port, regardless of airplane altitude or flight attitude. A 25 cubic inch accumulator, precharged to 2000 psi, supplies supplemental fluid and pressure to the reservoir during periods of peak system demands. A 50 inch accumulator, precharged to 1000 psi, is utilized as a pump surge suppressor, and as a limited source of hydraulic fluid and pressure when system demands exceed pump output. A pressure relief valve protects the system from pressure surges, and limits pressure build-up by dumping pressures in excess of 3850 psi to return. A pressure transmitter for the PC-1 hydraulic pressure indicator (figure 1-4), is located in a main pressure line. In the event of a loss of system pressure, a "Check Hyd Gages" indicator light and "Master Caution" light will illuminate. The hydraulic fluid is maintained at a usable temperature by a fuel-hydraulic fluid heat exchanger. In the event of a failure of the engine driven hydraulic pump, the system may be pressurized to 1400 ± 100 psi, by an emergency hydraulic pump that is driven by a ram air turbine on aircraft 153094x and prior, before incorporation of AFC 220.

NEW

POWER CONTROL SYSTEM TWO (PC-2)

PC-2 (figure 1-32), is pressurized to 3000 ± 250 psi, by a variable volume (18 to 26 gpm), constant pressure hydraulic pump mounted on the right engine. This system supplies hydraulic pressure to one side of the dual power control cylinders of the aileron, spoilers, and stabilator. Fluid is supplied to the pump by an airless, pressure loaded, piston type hydraulic reservoir that has a usable capacity of 0.83 gallons. The reservoir insures positive hydraulic pressure and fluid supply at the pump suction port, regardless of airplane altitude or flight attitude. A 50 cubic inch accumulator, precharged to 1000 psi, is utilized as a pump surge suppressor, and as a limited source of hydraulic fluid and pressure when system demands exceed pump output. A pressure relief valve protects the system from pump surges, and limits pressure build-up by dumping pressures in excess of 3850 psi to return. A pressure transmitter for the PC-2 hydraulic pressure

Power Control Hydraulic System

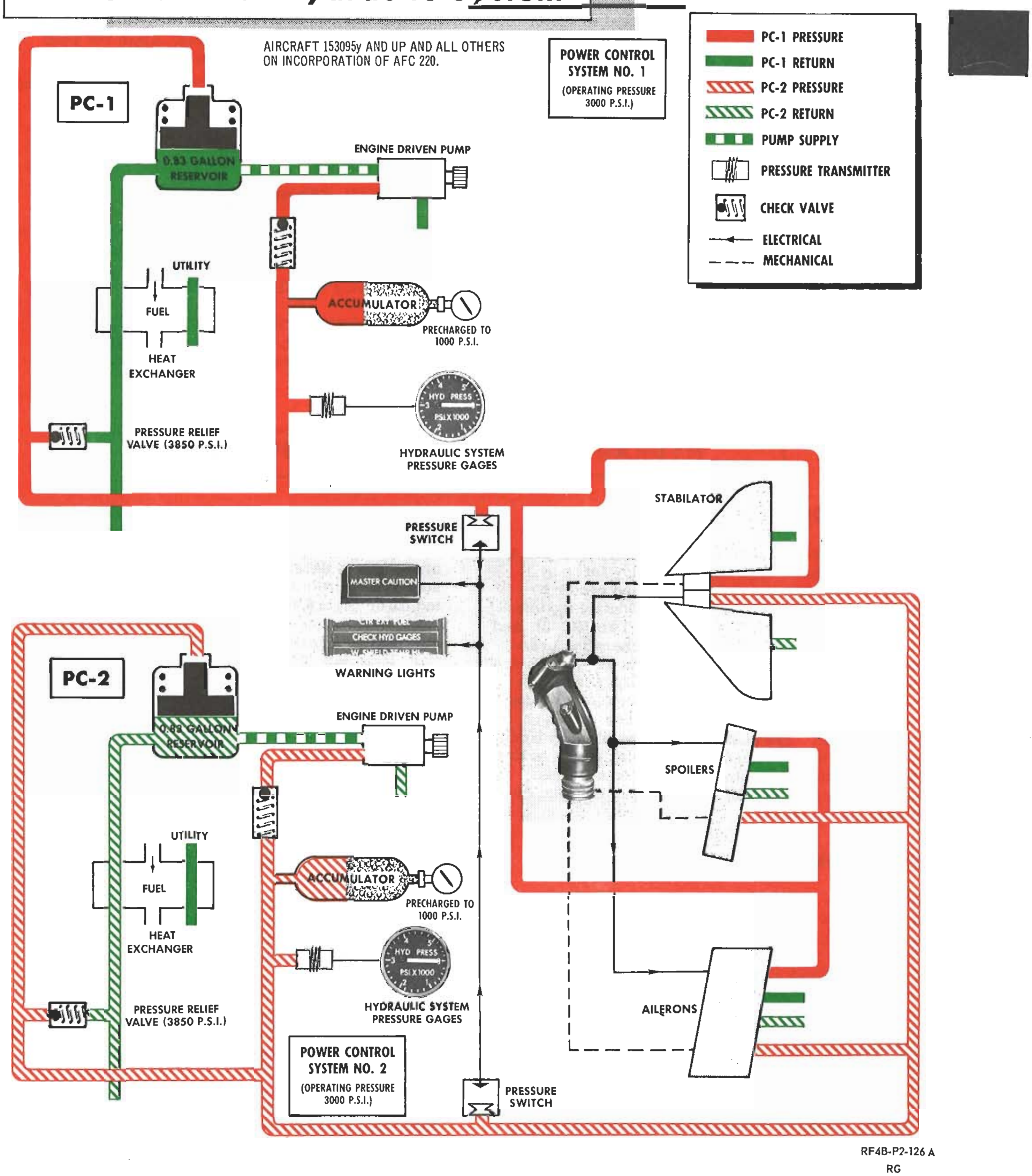


Figure 1-32

indicator (figure 1-4), is located in a main pressure line. In the event of a loss of system pressure, a "Check Hyd Gages" indicator light and "Master Caution" light will illuminate. The hydraulic fluid is maintained at a usable temperature by a fuel-hydraulic fluid heat exchanger. There are no emergency hydraulic pump provisions associated with the PC-2 hydraulic system.

Note

PC-1 and PC-2 are completely independent of each other. Therefore, one system will function as a back-up for the other.

UTILITY SYSTEM

The utility hydraulic system (figure 1-33), is pressurized to 3000 ± 250 psi by two variable volume (22 to 30 gpm combined), constant pressure hydraulic pumps, one on each engine. To prevent the utility hydraulic pumps from resonating, check valves with different cracking pressures are installed on the pump output lines. As a result, the right engine utility hydraulic pump will deliver approximately 2800 psi at idle rpm, while the left engine utility hydraulic pump will deliver approximately 3000 psi at idle rpm. Fluid is supplied to the pumps by an airless, pressure loaded, piston-type hydraulic reservoir that has a usable capacity of 1.84 gallons. The reservoir insures positive hydraulic pressure and fluid supply at the suction ports of the pumps regardless of airplane altitude or flight attitude. A 50 cubic inch accumulator, precharged to 1000 psi, is utilized as a pump surge suppressor, and as a limited source of hydraulic fluid and pressure when system demands exceed the output of the pumps. A pressure relief valve protects the system from pump surges, and limits pressure build-up by dumping pressures in excess of 3850 psi to return. A pressure transmitter for the utility hydraulic pressure indicator is located in a main pressure line. In the event either pump fails, a "Check Hyd Gages" indicator light and "Master Caution" light will illuminate. The hydraulic fluid is maintained at a usable temperature by two fuel-hydraulic fluid heat exchangers. The utility hydraulic system supplies hydraulic pressure to the:

Aileron-Dampers
Aileron-Rudder Interconnect
Air Refueling Probe
Arresting Hook (retraction)
Auxiliary Air Doors
Flaps (leading and trailing edge)
Fuel Transfer Pumps (hydraulic)
Landing Gear
Lateral Control Servo (autopilot)
Nose Gear Steering
Pneumatic System Air Compressor
SLR Antenna Drive
Rudder Damper
Rudder Power Control Cylinder
Speed Brakes
Variable Engine Bellmouth
Variable Engine Intake Duct Ramps
Wheel Brakes
Wing Fold

EMERGENCY HYDRAULIC PUMP

On aircraft prior to 153094x without AFC 220 incorporated, an emergency hydraulic pump is located in the upper left side of the fuselage, behind the aft cockpit. It is a multiple piston, constant delivery pump, and is driven by a ram air turbine. Hydraulic pressure and flow is governed by a flow sensitive pressure regulator. The pump is capable of delivering 11 gpm at 1400 ± 100 psi. Fluid is supplied from the PC-1 reservoir, to the pump, and then through the flow sensitive pressure regulator into the plumbing of PC-1. The emergency hydraulic pump will deliver approximately 1400 psi down to 195 knots IAS, and 650 psi at 115 knots IAS. Control response is provided with airspeeds as low as 100 knots IAS.

Note

- The emergency hydraulic pump may be activated by extending the ram air turbine. The ram air turbine is extended by placing the ram air turbine control handle (figure 1-2) to RAT OUT (push down on the handle).
- In the event there is a failure in one system, the other system will remain in operation and continue to supply power to the dual power control cylinders. This will not affect control stick movement or control response; however, it will limit full travel of the control surfaces at high airspeeds.

HYDRAULIC PRESSURE INDICATORS

Three hydraulic pressure indicators (figure 1-4), are mounted on the pedestal panel in the front cockpit. Pressure transmitters, one for each system, convert pressure impulses into electrical signals which are supplied to the indicators. The indicators are identical, and cover a pressure range of 0 to 5000 psi and are marked from 0 to 5 with readings multiplied by 1000.

HYDRAULIC SYSTEM INDICATOR LIGHT

An amber "Check Hyd Gages" indicator light is located on the telelight panel (figure 1-3). This single light is utilized by both the power control systems and the utility system to indicate loss of hydraulic system pressure and direct the pilot's attention to the hydraulic pressure indicators. Illumination of the "Check Hyd Gages" indicator light is controlled by the hydraulic systems pressure switches. The "Check Hyd Gages" light will illuminate when the pressure in any one system drops below 1500 ± 100 psi and/or when one of the utility hydraulic pumps fail. In all cases, a loss of system pressure will be noted on the applicable hydraulic pressure indicator, but a failed utility hydraulic pump may not register a significant pressure drop on the utility pressure indicator. It can be generally concluded, however, that an illuminated "Check Hyd Gages" light with no noted pressure drop on any of the hydraulic pressure indicators signifies that the right utility hydraulic pump has failed. An illuminated "Check Hyd Gages" light in conjunction with a utility hydraulic pressure

Utility Hydraulic System

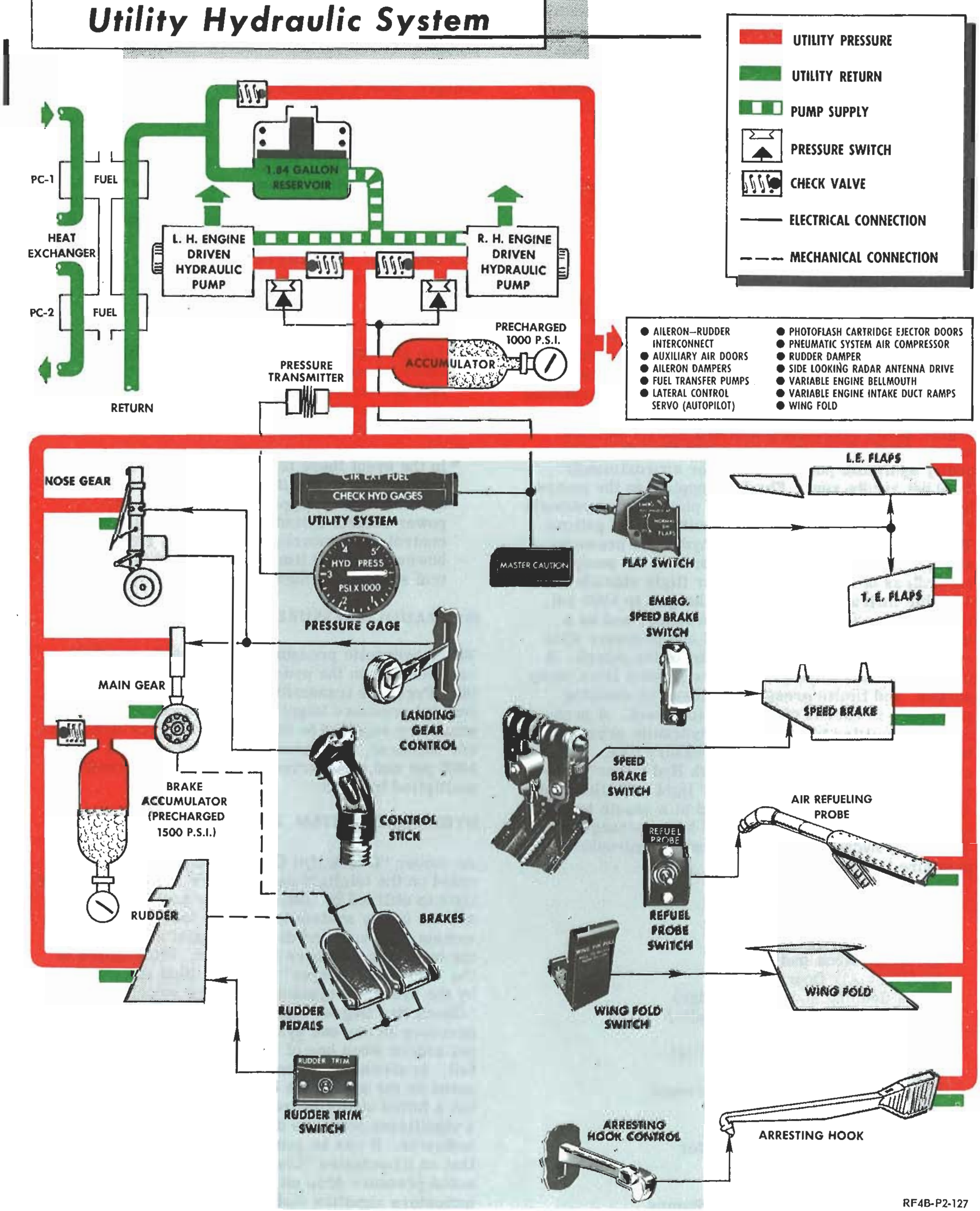


Figure 1-33

drop of 200 psi signifies that the left utility pump has failed. The "Master Caution" light will illuminate in conjunction with the "Check Hyd Gages" indicator light. The "Master Caution" light may be extinguished by depressing the reset button. The "Check Hyd Gages" light will remain illuminated until the pressure in the faulty system increases beyond 1750 psi. Should a failure occur in one of the remaining hydraulic systems while the "Check Hyd Gages" light is already illuminated, the "Master Caution" light will not illuminate again and the pilot will not be alerted to the second failure.

Note

The "Master Caution" light, "Aux Air Door" light, and "Check Hyd Gages" light may illuminate momentarily when the landing gear is being lowered due to high system demands.

NORMAL OPERATION

Normal operation of the hydraulic system commences with engine operation. Hydraulic pressure indicators are located on the pilot's pedestal panel.

EMERGENCY OPERATION

The loss of a hydraulic pump in either power control system, or in the utility hydraulic system, will be noted by the illumination of the "Check Hyd Gages" light. This single light serves all three systems, and the pilot should check the hydraulic gages to determine which system has malfunctioned. A hydraulic pump failure in PC-1 presents no serious problem due to the fact that an emergency hydraulic pump can feed the system if the need arises, and PC-2 is capable of assuming the full demand of the flight control dual cylinders. If a failure should occur in either PC system, the remaining system will supply sufficient pressure for flight control operation.

COMPLETE POWER CONTROL SYSTEM FAILURE

The pilot should, upon initial detection of hydraulic power loss, note the trend of failure, i.e., whether the gages show a definite steady drop, or gage fluctuations. With a steady drop indication, hydraulic power will probably not recover. In the event of complete power control hydraulic failure, the aircraft will become uncontrollable. Before this occurs, extend the ram air turbine on aircraft prior to 153094x without AFC 220 incorporated. On aircraft 153095y and up and all others upon incorporation of AFC 220, if a dual PC failure occurs, there is no course of action but to eject.

UTILITY HYDRAULIC SYSTEM FAILURE

Failure of the utility system will prevent the hydraulic operation of the following essential items:

a. Air refueling probe
b. Auxiliary air doors
c. Arresting hook (retraction)
d. Flaps
e. Fuel transfer pumps
f. Landing gear
g. Nose gear steering
h. Pneumatic system air compressor
i. Rudder
j. Speed brakes
k. Variable bypass bellmouth
m. Variable engine intake ramps
n. Wheel brakes
o. Wing fold

Of the above items, emergency pneumatic operation is provided for the following:

a. Landing gear
b. Wheel brakes
c. Wing flaps

In addition to emergency (pneumatic) operation of the landing gear, wheel brakes, and wing flaps, backup or alternate operation is provided for the rudder, fuel transfer pumps, and speed brakes. The rudder can be manually operated; however, deflection will be entirely dependent upon air loads on the rudder surface. The electric fuel transfer pumps act as a back-up for the hydraulic transfer pumps. The speed brakes can be retracted to a low drag trail position by placing the emergency speed brake switch to RETRACT.

LIMITATIONS

The maximum airspeed for extending the ram air turbine is 515 knots IAS or Mach 1.1 whichever is less.

REFERENCE PUBLICATIONS

If more detailed system information is required, refer to Item No. 6, on Maintenance Instruction Manuals Publication Index (flyleaf 3 this publication).

INSTRUMENTS

DESCRIPTION

Most of the instruments are electrically operated by power from the electrical system, see figure 1-18. Some instruments, such as the accelerometer, are self-contained and do not require external power. Only the instruments which are not covered under another system are discussed herein.

TRUE AIRSPEED INDICATOR

A true airspeed indicator (figure 1-4) is located on the pilot's and RSO's instrument panels. The airspeed is indicated by a small counter which rotates to show a row of numbers through a window on the indicator face. The airspeed indicator is read directly in knots TAS; the range of the instrument is from 0 to 1500 knots to the nearest knot. The system calibrated range is 150 to 1500 knots. Therefore, true airspeed readings below 150 knots are not reliable. The true airspeed indicator may indicate between 108 and 150 knots while the airplane is motionless on the ground. The true airspeed outputs are produced from the signal from the total temperature sensor of the CADC by routing this signal through a potentiometer driven by one of the Mach function cams. Thus, Mach number is translated into true airspeed.

GROUND SPEED INDICATOR

A ground speed indicator is located on the RSO's instrument panel (figure 1-5). The instrument displays a digital readout of ground speed with a total range of 0 to 1999 knots. The indicator receives its inputs from the inertial navigation set AN/ASM-56, when it is operating, through the navigation computer set, AN/ASN-46. When the inertial navigation set is off, the indicator receives inputs from the navigation computer set (air data mode) only. The calibrated range of the instrument in the INS mode is 0 to 1500 knots, and 20 to 1777 knots in the air data mode. While operating on the ground in the INS mode, the indicator will display actual ground speed, and show a zero indication when the airplane is stopped. When operating on the ground in the air data mode, the indicator may display anything from 0 to 20 knots. The indicator obtains power from the instrument 115/200 volt a-c bus. The ground speed indicator will function automatically anytime the input data is supplied. There are no operating controls.

ALTIMETER

An altimeter (figure 1-4), located on the pilot's and RSO's instrument panel, is designed to indicate the altitude of the airplane above sea level. This unit is of the counter pointer type, which displays the whole thousands numbers in a counter window and indicates the increments of the whole number with a pointer which rotates on the face of the instrument. The pointer scale is graduated in 50 foot units with major 100 foot scale divisions from 1 to 10. The range of the altimeter is 0 to 80,000 feet. An adjustable barometric scale is provided so that the altimeter may be set to a sea level pressure. This scale range is from 28.10 to 31.00 inches mercury. The altimeters utilize static pressure supplied directly by the nose boom. The altimeter position error is so small as to be considered negligible, as may be seen by referring to the Altimeter Position Error Correction chart in Section XI.

Note

> Although the altimeter position error is small throughout the entire flight regime, a fluctuation will be noticed when passing through the transonic region.

AIRSPEED AND MACH NUMBER INDICATOR

The combination airspeed and Mach number indicator (figure 1-4) shows airspeed readings at low speeds and includes Mach number readings at high speeds. Both readings are provided by a single pointer moving over a fixed airspeed scale, graduated from 80 to 850 knots, and a rotatable Mach number scale graduated from Mach .4 to Mach 2.5. A movable "bug" is included as a landing speed reference and can be positioned by the knob on the face of the instrument. The same knob can position another "bug" on the Mach number scale for maximum indicated airspeed reference. The airspeed indicator pointer and the Mach number scale are synchronized so that a proper relationship between the two is assured throughout all altitude changes. Thus, at sea level and under standard conditions, the pointer will indicate Mach 1 at approximately 660 knots. Under the same conditions, but at 50,000 feet, if the same true airspeed is maintained, the pointer will indicate approximately 292 knots and a Mach number of 1.15. The airspeed and Mach number indicator utilize pitot and static pressure from the nose boom. The airspeed position error is so small as to be considered negligible, as may be seen by referring to the Airspeed Position Error Correction chart in Section XI. The speeds that the pilot will read are indicated airspeed and Mach number (IAS and IMN).

VERTICAL VELOCITY INDICATOR

A vertical velocity indicator (figure 1-4) is located on the pilot's instrument panel. The indicator shows the rate of ascent or descent of the airplane, and is so sensitive that it can register a rate of gain or loss of altitude which would be too small to cause a noticeable change in the altimeter reading. The upper half of the indicator face is graduated in 500 foot units from 0 to 6,000 feet with 100 foot scale divisions from 0 to 1,000 feet. The upper half of the instrument indicates rate of climb in thousands of feet per minute. The lower half of the indicator face is identical to the upper half except that it would indicate rate of descent in thousands of feet per minute. The vertical velocity indicator is connected to the nose boom static pressure system and measures the change in atmospheric pressure as the airplane climbs or descends.

TURN-AND-SLIP INDICATOR

A slip inclinometer and rate of turn needle is incorporated into the attitude director indicator (figure 1-4), on the front cockpit instrument panel. The indicator displays turn rate about the vertical axis of the airplane, and as a result, does not provide an accurate indication of actual airplane rate of turn. When the airplane bank angle is increased, the rate of turn needle will show increased turn rate up to a point, beyond which the rate of turn around the vertical axis of the airplane will decrease. This characteristic will normally preclude obtaining a full needle width deflection at high altitudes and/or high airspeeds. Therefore, the indicator should not be used as a primary turn rate instrument. At low airspeeds, however, a single needle width deflection will be approximately equivalent to a "two minute turn". The turn needle is deflected electronically, and therefore, an electrical failure will render the needle immediately inoperative, despite the fact that the gyro is still spinning. Power for the turn and slip indicator is supplied by the instrument 28 volt a-c and the essential 115 volt a-c buses.

ACCELEROMETER

An accelerometer, to measure and record positive and negative acceleration ("g") loads, is mounted on the front cockpit instrument panel (figure 1-4). The indicator has three movable pointers. One pointer moves in the direction of the "g" load being applied, while the other two (one for positive "g", and one for negative "g") follow the indicator pointer to its maximum travel. These recording points remain at their respective maximum travel position of the "g" load being applied. Depressing a PUSH TO SET button, in the lower left corner of the instrument, will allow the recording pointers to return to the one "g" position.

Note

The accelerometer may read as much as 1/2 "g" low; possibly lower if the pull-in rate is high.

STANDBY ATTITUDE INDICATOR

A small (two inch diameter approximately) standby attitude indicator is installed on the pilot's main instrument panel (figure 1-4). The instrument supplies back-up attitude information, taken from the roll and pitch displacement gyro in the attitude heading reference system, AN/ASN-55. An OFF flag is displayed in the face of the instrument when power is interrupted.

REMOTE ATTITUDE INDICATOR

A remote attitude indicator is installed on the RSO's main instrument panel (figure 1-5). The instrument supplies attitude information, taken from the roll and pitch displacement gyro in the attitude heading reference system, AN/ASN-55. An OFF flag is displayed in the face of the instrument when power is interrupted.

STANDBY COMPASS

A conventional magnetic compass mounted on the cockpit windshield frame is provided for navigation in event of instrument or electrical malfunction. Compass cards are located above the canopy sill on the right side of the cockpit.

ELECTRONIC ALTIMETER SET (AN/APN-159)

The electronic altimeter set is designed to provide the flight crew with accurate terrain clearance information within ± 8 feet, or ± 1% of the indicated altitude, whichever is greater. The set will function normally from 0° to 15° bank and/or pitch, and between 200 feet and 70,000 feet altitude. The set also provides altitude information to the radar set, APQ-99, data display set, side looking radar, AN/APQ-102, inertial navigation set and aircraft camera parameter control. The main components of the set include a transmitter-receiver, individual transmitting and receiving antennas, power supply, and a height indicator for each cockpit (figures 1-4 and 1-5). The set contains an automatic calibration (auto-cal) feature which verifies the timing function of the set and readjusts it, should it be out of calibration. An auto-cal cycle operates continuously while the electronic altimeter is in operation. The auto-cal cycle consists of a three minute no calibration period followed by a one second period spent verifying and calibrating the set's timing function.

NEW

NEW

Height Indicator

The height indicators, located in each cockpit, are identical in appearance. The indicator in the pilot's cockpit is a repeater only, and none of the controls are operational. The RSO has command of the set through the use of the controls on his indicator. In the face of the height indicators there is incorporated a fixed dial scale, an altitude pointer, a mode indicator flag and a digital 1000 foot altitude counter. A fail flag will cover the digital counter any time the set is off, power is lost, or the received signal is too low to provide reliable operation. The mode indicator flag will read OFF, STBY and ON, corresponding to the first three positions of the function Selector Knob. When the knob is moved to the BIT position, the flag will read ON also. Surrounding the face of the indicator is a "Low Altitude Warning" light, a "BIT" check indicator light, a function selector knob and a BIT check selector knob.

Function Selector Knob

The function selector knob, with positions of OFF, STBY, ON and BIT, allows the RSO to turn the set ON and OFF, and, in conjunction with the BIT selector knob, perform the BIT checks. The STBY position will disable the transmitter so that r-f energy will not be transmitted.

BIT Selector Knob

The BIT selector knob, in conjunction with the BIT position of the function selector knob, enables the RSO to perform the BIT checks on the set.

BIT Check Indicator Light

The green "BIT" check indicator light provides a visual indication of the results of BIT checks 1, 2 and 3 only, on a go no-go basis. That is, a steady green light for a BIT Check selection would indicate that system of the set is "go".

Low Altitude Warning Light

The red "Low Altitude" warning light will illuminate when the terrain clearance is reduced to 200^{+32}_{-0} feet. There is no provision for selecting low altitude limits. The warning light has a "twist to dim" feature.

NORMAL OPERATION

ELECTRONIC ALTIMETER

Preflight Check

1. Function selector knob - STBY
   Mode indicator reads STBY. Observe 90 second warm-up period.
2. Function selector knob - ON
   Mode indicator reads ON. Allow 3 minutes for an auto-cal cycle.
3. Function selector knob - BIT
4. BIT selector knob - 2
   a. BIT check indicator light - ILLUMINATED
      The green light will confirm the proper transmitter frequency.
5. BIT selector knob - 3
   a. BIT check indicator light - ILLUMINATED
      The green light will confirm the proper power output.
6. BIT selector knob - 4
   a. Altitude pointer - CHECK
      Note that pointer stabilizes at 5000 ± 100 feet. If indicator does not read 5000 ± 100 feet, switch the function selector knob to ON, allow 3 minutes for an additional auto-cal cycle, and then repeat BIT check 4.

Note

Operations of the FAIL flag and BIT 1 check are unreliable on the ground due to reflections and mutual interference. The FAIL flag becomes reliable above 200 feet and the BIT 1 check becomes reliable above 7500 feet.

7. Function selector knob - ON
8. BIT selector knob - 1
   Set is now ready for inflight use.

Inflight

Note

- High frequency radar waves can penetrate snow and ice fields. When operating in areas covered with ice and snow, the radar altimeter may indicate a greater terrain clearance than actually exists.
- Altitude indications are unreliable when the AN/APN-159 is operating in close proximity to another airplane with an AN/APN-159 installed and operating.
- The indicator needle stops moving for one second during the auto-cal cycle. This may be noted at times during aircraft changes in altitude and a BIT 4 check.

WARNING

When in a descent, the "Low Altitude" warning light will illuminate when an altitude of 200^{+32}_{-0} feet is reached. After the lamp is illuminated, the altimeter should no longer be used until ascending above 200 feet. Due to system windup, caused by ground interference, it is possible for the "Low Altitude" warning light to extinguish although the aircraft is still at an altitude below 200 feet.

BIT Checks (Inflight)

1. Function selector knob - BIT
2. BIT selector knob - 1
   a. BIT check indicator light - ILLUMINATED STEADY
      If the green indicator light illuminates steady, the set is functioning properly above 7500 feet.
3. BIT selector knob - 2
   a. BIT check indicator light - ILLUMINATED
      The green light will confirm the proper transmitter frequency.
4. BIT selector knob - 3
   a. BIT check indicator light - ILLUMINATED
      The green light will confirm the proper transmitter power output.
5. BIT selector knob - 4
   a. Altitude pointer - CHECK
      Note that the pointer stabilizes at 5000 ± 100 feet.

EMERGENCY OPERATIONS

There are no specific emergency operating instructions for the instruments.

LIMITATIONS

RADAR ALTIMETER

The radar altimeter is reliable from 200 feet to 70,000 within pitch and/or bank angles of 0° to 15°.

REFERENCE PUBLICATIONS

If more detailed information is required, refer to Item No. 11, on Maintenance Instruction Manuals Publication Index (flyleaf 3 this publication).

LANDING GEAR SYSTEM

DESCRIPTION

The airplane is equipped with fully retractable tricycle landing gear which are completely covered by flush doors when retracted. The gear is electrically controlled and hydraulically actuated by the utility hydraulic system. The airplane is not equipped with a tail skid. Accidental retraction of the landing gear when the airplane is on the ground is prevented by safety switches on the main gear torque scissors, and ground safety locks.

MAIN GEAR

Each main gear is hydraulically retracted and extended. As the main gear retracts, the struts are mechanically compressed. They automatically return to the normally extended position when the gear is extended. The gear is locked down by an internal finger-type latch in the side brace actuator. The main gear retracts inboard and is enclosed by fairing doors that are flush with the underside of the wing. The gear is locked up by a hydraulically actuated mechanism. All main gear doors remain open when the gear is extended.

NOSE GEAR

The nose gear is hydraulically retracted and extended. The gear is locked in the down position by an integral down lock mechanism within the gear actuating cylinder. A hydraulically operated nose gear uplock cylinder is located in the nose gear wheel well, and is employed in the system as part of the nose gear up latch mechanism. The nose gear retracts aft into the fuselage and is covered by mechanically operated doors that close flush with the underside of the fuselage. The forward door is attached to the nose gear strut, and closes with retraction; the aft door is operated and latched closed by the gear uplatch mechanism. The nose gear is equipped with dual nose wheels, a combination shimmy damper steering actuator and a self-centering mechanism. The nose gear can be steered by differential braking of the main gear wheels in the event nose wheel steering is not utilized.

LANDING GEAR CONTROL HANDLE

Operation of the landing gear is controlled by a handle (figure 1-2) at the left side of the main instrument panel. The handle has a wheel shaped knob for ease of identification. Placing the handle in the UP or DOWN position energizes a solenoid valve to connect utility hydraulic system pressure to the landing gear. Placing the handle in the gear UP position will energize switches in the fuel tank vent, pressurization, and jettison circuits. A red warning light is located in the landing gear control handle knob. This light comes on whenever the control handle is moved to retract or extend the gear and it will remain on until the gear completes its cycle and locks.

EMERGENCY LANDING GEAR CONTROL

Two 100 cubic inch air bottles provide sufficient compressed air to extend the gear pneumatically in the event of a hydraulic system failure. Pulling the landing gear control handle full AFT operates an air valve which directs 3000 psi compressed air to open all gear doors, release the uplocks, and extend all gear.

LANDING GEAR POSITION INDICATORS

The landing gear position indicators (figure 1-2) are located on the left vertical panel in the front cockpit. The indicators operate in conjunction with position switches on the landing gear. The position of the landing gear wheels is indicated by drum dials viewed through cutouts in the instrument panel. With gear up, the word UP will appear on the three indicators; gear in transient will be indicated by a barber pole; and with gear down, a picture of a wheel will be seen through the cutouts.

NOSE GEAR STRUT EXTENSION

The nose gear strut extension system is utilized to increase the airplane angle of attack for catapult launches. A nose gear extension switch in the left main gear wheel well operates a solenoid valve that ports high pressure air into a chamber above the nose gear shock strut piston. The shock strut piston is then forced down to extend the nose gear. The high pressure air will be dumped when the left main gear strut extends after launching, or when the landing gear handle is moved to the UP position. The nose gear strut extension chamber may also be deflated by momentarily placing both generator control switches to OFF.

CAUTION

In the event the angle of attack indexer lights and approach lights are not illuminated during a landing approach, it may mean that the nose gear catapult extension is still pressurized. To preclude the possibility of exploding the nose gear strut upon touchdown, relieve the catapult extension pressure by cycling the landing gear.

WARNING

- During normal operations, the airplanes pneumatic system must be fully charged (2750 psi minimum) before extending the nose gear strut. Insufficient pneumatic pressure may allow the strut to bottom out causing damage to the strut or fuselage structure. It also results in an improper airplane attitude for catapulting.

WARNING

- Do not allow the pneumatic system pressure to exceed 2300 psi with the nose gear strut extended. If the pneumatic pressure starts to build up above this value, actuate the emergency air brakes as necessary to maintain the pressure below 2300 psi. Allowing the pneumatic system pressure to exceed 2300 psi will subject the nose strut to excessive loads during catapulting.

NOSE WHEEL STEERING

An electrically controlled, hydraulically operated nose wheel steering system is installed in the aircraft. The steering actuator is located on the nose wheel strut and is geared to the strut torque collar. It performs the work of both steering and shimmy damping. A bypass valve in the steering-damper manifold directs hydraulic fluid to a vane type rotary actuator which can be pressurized on either side as directed. For the damping mode, the bypass valve traps the fluid in the rotary actuator and channels it through damping orifices which absorb energy. When the stick grip nose steering button (figure 1-23) is held down with the main gear strut compressed and the nose gear down and locked, the system is energized and steering is affected by rudder pedal movement. The limit of the nose wheel steering system is 70° on each side of center.

CAUTION

To prevent the landing gear struts from being subjected to abnormal side loads, do not use nose wheel steering and individual braking simultaneously while turning.

NORMAL OPERATION

Operation of the landing gear is controlled by the wheel shaped landing gear control handle. To lower the landing gear, push the handle down. A red warning light in the control handle knob will illuminate and stay illuminated until the gear is fully extended and locked. To raise the gear, pull up on the landing gear handle; the warning light will again illuminate until the landing gear is up and locked.

FLIGHT WITHOUT MAIN LANDING GEAR DOORS

If maintenance or operational considerations require flight without main landing gear doors, the airplane is limited as follows:

1. Below 20,000 feet - 250 knots IAS.
2. Between 20,000 and 35,000 feet - Mach 0.85.
3. Above 35,000 feet - 250 knots IAS or Mach 0.85, whichever is greater.
4. Descent - 250 knots IAS or onset of any buffet.

Note

After each flight, wheel wells should be inspected for evidence of cracks or malformed lines and fittings.

EMERGENCY OPERATION

If normal gear operation fails, the gear can be lowered by pushing the landing gear handle down, pulling the landing gear circuit breaker out and then pulling aft on the landing gear handle. The landing gear circuit breaker must be pulled prior to lowering the gear by the emergency system. This will cause the landing gear hydraulic selector valve to return to its full trail position, blocking hydraulic pressure to the landing gear and insuring that hydraulic fluid will not be forced into the actuators on top of the pneumatic pressure. Should this occur, system "hammering" may result, with possible eventual rupture and loss of system integrity. Hold the handle aft until the gear indicates down and locked. Do not retract the landing gear following an emergency extension. If the landing gear is inadvertently extended in flight by emergency pneumatic pressure, they must be left in the extended position until post-flight servicing. If retraction in flight is attempted, rupture of the utility reservoir will probably occur with subsequent loss of the utility hydraulic system.

CAUTION

- Hold handle in full aft position until gear indicates down and locked, and then leave the landing gear handle in the full aft position. Returning the handle to its normal position allows the compressed air from the gear down side of the actuating cylinder to be vented overboard. In this condition the main landing gear side brace integral mechanical latch will be the only device preventing the landing gear from collapsing upon landing.
- Pull the landing gear circuit breaker prior to extending the landing gear by the emergency system.

Note

Any pneumatic extension of the landing gear shall be logged on the Yellow sheet (OPNAV form 3760-2).

LIMITATIONS

Maximum permissible airspeed for lowering the landing gear is 250 knots IAS.

REFERENCE PUBLICATIONS

If more detailed system information is required, refer to Item No. 5, on Maintenance Instruction Manuals Publication Index (flyleaf 3 this publication).

LIGHTING EQUIPMENT

DESCRIPTION

EXTERIOR LIGHTING

The exterior lights consist of the position lights (wing and tail), join-up lights (wing only) fuselage lights, anti-collision light, angle-of-roll light, approach lights, air refueling probe light, taxi light, and utility white flood lights. An exterior lights master switch, located on the outboard side of the left throttle grip is utilized during night catapult launches. The exterior lights control panel contains all of the manual controls, with the exception of the master switch, for the exterior lights.

Exterior Lights Master Switch

The exterior lights master switch is located on the outboard side of the left engine throttle grip. The switch has three positions, ON, OFF and SIGNALS. Movement of the switch to the ON position will energize the exterior lights. Placing the switch in the SIGNAL position will cause the exterior lights to flash, providing the wing and tail light switches located on the exterior lights control panel are ON. This can be used as a "ready" signal to the catapult officer.

Position and Join Up Lights

The position lights include the wing tip position lights and the tail lights. The join-up light consists of a red or green light on the trailing edge of the applicable wing tip. The wing lights and join-up lights are controlled by the same three position OFF, DIM, BRT toggle switch. The tail light is controlled by a separate three position OFF, DIM, BRT toggle switch. Both switches are located on the exterior lights control panel. The wing and tail switches are two separate switches, but their function is the same. With the switch in the OFF position the lights are deenergized and are not illuminated. When the switch is put in the BRT position the lights will illuminate at full brilliance. Place the switch in the DIM position and the lights will reduce in brilliance. The dim circuit of the position and join-up lights is powered by the left main 28/14 volt a-c bus. The bright lights circuit is powered by the right main 28 volt a-c bus.

Fuselage and Anti-Collision Lights

Three semi-flush white lights are installed on the fuselage, one above the number two fuel cell and one below each of the engine air inlet ducts. In addition to the fuselage lights, one red anti-collision light is installed in the leading edge of the vertical stabilizer. The fuselage switch on the exterior lights control panel illuminates the three fuselage lights and the anti-collision light. The switch has three positions, DIM, BRT, and MAN. The anti-collision light will be on only when the fuselage switch is in BRT position and the exterior lights flasher switch is in the FLASH position. The MAN position of the switch allows the fuselage lights to be energized by the manual key button.

Exterior Lights Flasher Switch

The exterior lights flasher switch, located on the exterior lights control panel, will operate the flasher until causing the fuselage lights and tail light to glow steady or flash. The anti-collision light will only operate when the switch is in the FLASH position.

Manual Key Button

The manual key button, located on the exterior lights control panel, is used to energize the fuselage lights when the fuselage lights switch is in the MAN position and the exterior lights flasher switch is in the STEADY position. An indicator light on the exterior lights panel will glow when the manual key button is depressed.

Angle of Roll Light

The low, swept wing design of the airplane prevents the landing signal officer from observing the right wing tip light during a normal carrier approach until the airplane is almost on final; therefore, a green angle-of-roll light is installed in the left engine air intake duct just above the trailing edge of the wing. This light is illuminated during carrier approaches and field mirror landing practice only and is designed to serve as a roll reference for the landing signal officer until such time that the right wing tip is visible. The angle-of-roll light is automatically energized in flight when the arresting gear is down and locked. The angle-of-roll light can be made to illuminate steady without the arresting gear being extended by placing the hook bypass switch in the BYPASS position.

Hook Bypass Switch

The hook bypass switch is located on the exterior lights control panel. The switch has two positions, NORMAL and BYPASS. This is the only operating control in the cockpit for the approach light and angle-of-roll system. The switch, when placed in the BYPASS position, completes a circuit which causes the approach lights to illuminate steady without having the arresting gear extended. With the switch in the NORMAL position, the approach lights will flash unless the arresting hook is down. With the arresting hook down, the approach lights will illuminate steady.

Approach Lights

Refer to Angle-of-Attack System, this section.

Air Refueling Probe Light

An inflight refueling probe light is installed on the right side of the fuselage forward of the air refueling probe. The light is used during night air refueling operations to illuminate the refueling probe, and the drogue from the refueling airplane. The light is controlled by the IFR switch and variable intensity control knob, both of which are located on the exterior lights control panel.

Taxi Light

The taxi light is located adjacent to the approach light assembly on the nose gear door. The light is controlled by the taxi light switch on the exterior light control panel.

Utility White Flood Lights

There are two utility white flood lights, one located in the camera equipment compartment with access through access doors 502 and 503 and the other located beneath the side looking radar package with access through access door 507L.

INTERIOR LIGHTING

Interior lighting in the airplane is powered by the a-c electrical system, either from the engine driven generators or by the emergency generator.

PILOT'S COCKPIT LIGHTING

Most of the lighting controls in the pilot's cockpit are located on the cockpit lights control panel (figure 1-3). A utility light is mounted under the right canopy sill and has its own on, off, and intensity control. An instrument panel emergency red floodlight switch is mounted above the cockpit lights control panel on the right console. A sensor lights control knob is located on the aft outboard area of the right console.

Instrument Lights

The instruments are illuminated by integral instrument lights. Variations in instrument lighting intensity on all airplanes is controlled by the instrument panel lights control knob located on the forward inboard corner of the cockpit lights control panel. The control knob varies the brilliance of the instrument lights from OFF to BRT. Also, as the control is rotated from OFF to BRT, a switch within the control knob will energize the warning lights dimming relay, reducing the brilliance of the forward cockpit warning lights and the "Equipment Cool Off", "Canopy Unlocked", and "Inertial Nav Sys Out" warning lights in the aft cockpit. Secondary instrument lighting is provided by red floodlights on the instrument panel glare shield. The control for the floodlights is mounted above the forward portion of the right console and is labeled instrument panel emergency flood. The three-position switch has positions of OFF, DIM and BRT. The instrument lights are powered from the essential 115 volt a-c bus. The emergency floods are powered by the instrument 28 volt a-c bus in the bright position and by the right main 28/14 volt a-c bus in the dim position.

Console Lights

Console lighting is designed for combination edge, and floodlighting. Variation in edge lighting intensity is controlled by the console lights control knob located on the cockpit lights control panel. This knob controls all edge lighting on the left and right console and the pedestal panel. The console control knob varies the brilliance of the console edge lights from OFF to BRT. Also, as the control is rotated from OFF to BRT, a switch within the control knob will energize the console floods switch thus providing console floodlight illumination along with the edge-lighting. The console floods switch located above the console control knob selects BRT, DIM or MED brilliance for the red console floodlights. The console floodlights will be off only when the console floods switch is in the DIM position and the console control knob is rotated to the OFF position. The console edge lights and the dim circuit of the console floodlights receive power from the left main 115 volt a-c bus. The instrument 28 volt a-c bus supplies power for the bright circuit and the right main 28/14 volt a-c bus provides medium operation.

White Floods Switch

One white floodlight is provided above each console under the canopy sill. Control is by the white flood switch located in the forward outboard corner of the cockpit lights control panel. This switch is of the lever-lock type to prevent inadvertent operation. No intensity variation is provided on these lights.

Standby Compass Switch

The standby compass switch located on the cockpit lights control panel is used to turn the magnetic compass light on and off. The console lights control knob must be turned from the OFF position to energize the standby compass switch.

Warning Lights Switch

The warning lights test switch is a two position switch located on the cockpit lights control panel. The switch positions are NORMAL and TEST. The switch is spring-loaded to the NORMAL position. When placed in the TEST position, the warning lights will be illuminated.

Utility Light

A utility light is mounted under the right canopy sill. The light has its own on, off, and intensity control. This light may be changed from red to white by depressing the latch button and rotating the lens housing. An additional plug-in socket for the utility light is provided on the right windshield sill aft of the instrument panel.

Sensor Lights Control Knob

The sensor lights control knob is located on the sensor lights panel on the aft outboard area of the right console. The sensor lights control knob varies the intensity of the "Master Operate" light on the reconnaissance control panel when the instrument panel lights control knob is not in the OFF position. With the instrument panel lights control knob in the OFF position, the "Master Operate" light illuminates bright. In both positions of the instrument panel lights control knob, power is provided to the "Master Operate" light by the instrument 28 volt a-c bus.

Spare Edge Lamps

Spare edge lamps are located in a spring-loaded cylindrical container on the wingfold control panel on the right console:

Indexer Lights Control Knob

The control panel is located aft of the cockpit lights control panel (figure 1-3). The indexer lights control is a rheostat type switch which allows the pilot to vary index light intensity from BRIGHT to DIM.

RSO'S COCKPIT LIGHTING

All the controls for the RSO's cockpit lights are located on two panels on the RSO's right console (figure 1-7), the cockpit lights panel and the sensor lights panel. The controls on the cockpit lights panel are the instrument lights control knob, the console lights control knob, the console floodlights switch, and the warning lights switch. The controls on the sensor lights panel are the sensor lights control knob and the instrument panel switch.

Instrument Lights

The instrument and panels associated with the instrument panel are illuminated by a combination of integral, edge, and floodlighting. Intensity of instrument integral lighting and panel edge lighting is controlled by the instrument panel control knob located on the forward outboard corner of the cockpit lights panel. The control knob varies the brilliance of the instrument and panel lights from OFF to BRT. Also, as the control is rotated from OFF to BRT, a switch within the control knob will energize the warning lights dimming relay, reducing the brilliance of the aft cockpit warning lights with the exception of the "Equipment Cool Off", "Canopy Unlocked", and "Inertial Nav Sys Off" lights.

Console Lights

Console lighting provides edge lighting for the panels on the aft right and left consoles, and provides floodlighting for the instrument panels and the consoles. It also provides integral lighting for the oxygen quantity repeater indicator on the left rear console and the BIT meter on the SLR control panel above the instrument panel. Variation of edge lighting and integral lighting is controlled by the console lights control knob. The console lights control knob varies the brilliance of the edge lighting and the integral lighting from OFF to BRT. Also, as the control is rotated from OFF to BRT, a switch within the control knob will energize the console floods switch thus providing console floodlight illumination along with the edge lighting. The console floods switch selects BRT, DIM, or MED brilliance for the instrument panel and console floodlights. The floodlights will be off only when the console floods switch is in the DIM position and the console lights control knob is rotated to the OFF position. The console edge lights and integral lights, and the dim floodlight circuit receive power from the essential 115 volts a-c bus. The instrument 28 volt a-c bus supplies power for the bright circuit and the right main 14 volt a-c bus provides medium operation.

Sensor Lights Controls

The sensor lights control panel contains two controls which are used to control power to various lights associated with the sensor control panels. The panel is located on the forward area of the right console and contains the instrument panel switch and the sensor lights control knob. With the instrument panel switch in the ON position, circuits are completed to make power available from various sources to the following lights: the edge lights on the SLR sensor control panel, IR sensor control panel, the film/cart remaining panel, and the film/mat test panel; the integral light of the BIT meter on the SLR control panel; and the two floodlights above the SLR control panel and the film remaining panel. With the instrument panel switch ON, the edge lights of the SLR sensor control panel, the IR sensor control panel, the film/cart remaining panel, and the film/mat test panel are controlled by the INSTR control knob on the cockpit lights panel. The integral lighting of the BIT meter on the SLR sensor control panel is controlled by the console lights control knob on the cockpit lights panel, provided the instrument panel switch is on. With the instrument panel switch on, the two red floodlights above the SLR sensor control panel and the film/cart remaining panel are controlled by the console floods switch and the console lights control knob in the same manner as the remaining twelve floodlights in the rear cockpit. The sensor lights control knob controls the intensity of various warning lights associated with the sensor panels when the instrument panel control knob on the aft cockpit lights panel is not in the OFF position. The lights controlled by the sensor lights control knob are the seven green lights and the "Master Operate" light on sensor control panel number 1, and the "Ready" light on sensor control panel number 2. With the instrument panel control knob in the OFF position, instrument 28 volt a-c power is directed to the above lights for their illumination.

Cockpit Floods Switch

The cockpit floods switch is a three position switch, with positions of OFF, DIM and BRT. The switch is used to select operation and intensity of the five red floodlights located in the RSO's cockpit.

Warning Lights Switch

The warning lights switch is a two-position switch located on the cockpit lights panel inboard of the console lights control knob. The switch positions are OFF and TEST, with the switch spring-loaded to the OFF position. When placed to the TEST position, the warning lights illuminate.

Utility Light

The utility light is mounted above and to the left of the RSO's instrument panel. An additional plug-in socket for the light is provided on the upper structure aft of the instrument panel to provide an alternate location to illuminate the chartboard when it is being used. This light may be changed from red to white by rotating the lens housing. The light has an integral on, off, and intensity control.

Spare Edge Lamps

Spare edge lamps are located in a spring-loaded cylindrical container on the utility panel which is located in the left forward section of the cockpit.

NORMAL OPERATION

Normal operation of the exterior lights and pilot's and RSO's interior lights are controlled by the various switches located on their control panels.

EMERGENCY OPERATION

There are no provisions for emergency operation of the exterior or interior lighting. However, the pilot's instrument panel and consoles, and the RSO's cockpit floodlights can be illuminated when the ram air turbine is extended, by placing the respective floodlight switches in the BRT position. The taxi lights, pilot's and RSO's instrument panel lights and the warning lights will also operate on RAT power. However, the warning lights cannot be dimmed.

LIMITATIONS

There are no limitations pertaining to the lighting equipment.

REFERENCE PUBLICATIONS

If more detailed system information is required, refer to Item No. 14, Maintenance Instruction Manuals Publication Index (flyleaf 3 this publication).

NAVIGATION EQUIPMENT

DESCRIPTION

The main navigation systems in the airplane consist of the inertial navigation set, AN/ASN-56, the attitude heading reference system (AHRS) AN/ASN-55, the navigation computer set, AN/ASN-46 and the flight director group (HSI and ADI).

INERTIAL NAVIGATION SET AN/ASN-56

The inertial navigation set is a self contained fully automatic unit which utilizes a gyro stabilized (inertial) platform upon which are mounted three sensitive accelerometers. The sensitive axes of the accelerometers are aligned by the stabilized platform, one is aligned to the north-south axis, one is aligned to the east west axis, and one is aligned to the local vertical axis (defined as an imaginary line connecting the aircraft with the center of the earth). When in the align mode, the accelerometers, when sensing the local vertical (gravitational pull), cause the stabilized platform to be precessed to a position perpendicular to the local vertical (parallel to the surface of the earth). The gyros of the stabilized platform, once erected, will be oriented in space without reference to the surface of the earth. The earth, however, rotates with an angular velocity of approximately 15° per hour. It now becomes obvious that without supplying some correction, the stabilized platform will not stay aligned with the local vertical. The accelerometers sense the gravitational pull (which is in the same direction as the local vertical axis) and cause the stabilized platform to be precessed to maintain a position perpendicular to the local vertical. The direction of precession of the platform to maintain the local vertical axis is from west to east (the same direction as thr rotation of the earth). The platform is then oriented 90° to the direction of this precession, thus providing a true north reference. When the platform is stabilized in pitch and roll, and oriented to north, the north-south and east-west accelerometers can sense acceleration in any horizontal direction which can then be integrated by a computer to produce velocity (ground speed), course, and distance for the navigation computer. The inertial navigation set receives a barometric altitude input from the central air data computer and an absolute altitude input from the electronic altimeter set. It operates in conjunction with the navigation computer to furnish the aircraft with a complete inertial navigation system. Inertial navigation output signals are supplied to the attitude heading reference set, forward looking radar, side looking radar, infrared reconnaissance set, flight control group, and stabilized camera mount electronic package.

Inertial Navigation Control Panel

The inertial navigation control panel (figure 1-6) provides the means by which the inertial navigation set is aligned and placed in operation. The controls include a power control knob with positions of OFF, STBY, ALIGN and NAV, and an align mode switch with positions of HDG MEM and GYRO COMP. The power control knob controls sytem operation. The STBY position applies power to bring the inertial platform up to operating temperature as indicated by the illumination of the amber "Heat" light. The "Heat" light will go out when the unit reaches operating temperature. The ALIGN position is selected for stabilization of the platform and alignment to true north. The sequence of alignment is indicated by the green"Align" light. The NAV position is selected after the align phase is completed (as noted by the green "Align" light flashing) and is the normal operating position for the inertial navigation set. The align mode switch determines the method of alignment. The HDG MEM position is used to maintain a heading memory from a previous gyro compass alignment by locking the inertial platform to the aligned heading prior to turning the system off and to maintain the heading prior to alignment when placing the inertial navigation set in operation. The GYRO COMP position is used for alignment when no heading memory information is available. This method takes longer, but is the most accurate means of alignment.

Inertial Navigation System Out Lights

The "Inertial Nav Sys Out" lights, located on both cockpit telelight panels will illuminate when the set is in OFF, STBY or ALIGN, or when a malfunction has occurred. The light will go out when the power control knob on the inertial navigation control panel is placed to the NAV position.

Note

If the "Inertial Nav Sys Out" lights remain illuminated when going from ALIGN to NAV, a malfunction has occurred. The system should be cycled to STBY and back to ALIGN. If the malfunction persists, the power control knob should be moved to the OFF position.

ATTITUDE-HEADING REFERENCE SYSTEM (AHRS) -AN/ASN-55

The AHRS is a two-gyro all-attitude reference system which supplies standby attitude and azimuth information to the attitude director indicator, horizontal situation indicator, and the bearing distance heading indicator in the rear cockpit. The remote attitude indicator, in the rear cockpit, receives attitude information from the AHRS regardless of the position of the reference system selector knob. The autopilot receives attitude and ground track information from the inertial navigation set only, and cannot be engaged when the standby reference system is selected. In the normal primary mode of operation the attitude director indicator, horizontal situation indicator, and the bearing distance heading indicator receive attitude and azimuth information from the inertial navigation set.

Note

NEW

Attitude and heading information from the AHRS will be unreliable when aircraft roll or pitch attitude exceeds ± 85 degrees.

NEW

Spring-loaded stops on the displacement gyro gimbal cause the gyro to precess to an erroneous heading or attitude. To correct this situation, the aircraft must be flown straight and level (rate of turn less than 15 degrees per minute) while placing the compass controller mode switch to SYNC until the heading and attitude read correctly.

Compass Controller

The compass controller (figure 1-3), located on the front cockpit right console, provides the necessary controls and indication to select the reference system and operate the gyro-magnetic compass system. The reference system selector knob selects the gyro reference system to be used. The PRIM position selects the following inputs from the inertial navigation set:

a. Azimuth and attitude information to the attitude director indicator.
b. Azimuth information to the horizontal situation indicator.
c. Azimuth information to the bearing distance heading indicator (rear cockpit).

Note

Primary (inertial navigation) information will not be available unless the power control knob on the inertial navigation panel is in the NAV position.

The following inputs are supplied by the AHRS in the STBY position:

a. Azimuth and attitude information to the attitude director indicator.
b. Azimuth information to the horizontal situation indicator.
c. Azimuth information to the bearing distance heading indicator (rear cockpit).

Note

- The AFCS cannot be engaged when the reference system selector knob is in the STBY position.
- The remote attitude indicator, in the rear cockpit, will receive attitude information from the AHRS when the reference system selector knob is in either PRIM or STBY position.

When switching from STBY to PRIM or vice versa, attitude information will appear almost immediately. Accurate heading information may not be immediately available when switching between PRIM and STBY if the aircraft is in a turn having a rate of turn of more than 15° per minute. In this condition, the fast synchronization feature of the compass is cut out. This is done to prevent heading errors from being generated in the flux gate compass. Switching between PRIM and STBY under the preceding conditions can result in random erroneous heading information. To correct his situation, the airplane must be flown straight and level (rate of turn less than 15° per min) for approximately 20 seconds and then manually synchronized by placing the mode selector knob to the SYNC position. The mode selector knob is a four position rotary knob with positions of COMP, DG, SLAVED and SYNC. The COMP position is considered an emergency position. When the directional gyro is unusable due to malfunctions, the COMP position provides a source of magnetic heading information to the aircraft systems. The DG position is used in north and south latitudes greater than 70 degrees and in areas where the earth's magnetic field is appreciably distorted. When the DG mode is initially selected, the magnetic heading of the aircraft must be set into the system with the set Hdg control knob. The system will then use this reference for subsequent heading indications. Apparent and real drift compensating voltages are inserted by use of the hemisphere switch (N-S) and the latitude control knob. The SLAVED position is the mode ordinarily used under normal conditions. In this mode, the azimuth system is primarily controlled by signals from the flux valve. The momentary SYNC position is used for manual synchronization to eliminate heading reference differences which may occur due to aircraft maneuvers while the system is in the slaved mode. The vertical gyro in the AHRS will automatically receive a fast erect voltage for 60 seconds when the mode selector knob is placed to the SYNC position.

NAVIGATION COMPUTER SET AN/ASN-46

The navigation computer is a great circle computer and consists of a control panel and an amplifier-computer. The navigation computer receives inputs from either the inertial navigation set or the central air data computer. When operating from information supplied from the inertial navigation set, course and ground speed is supplied and the geographic position is indicated by the navigation computer. When operating from information supplied from the central air data computer, magnetic heading and true airspeed are supplied. In this mode, wind direction, wind speed, and magnetic variation must be manually set on the computer control panel to obtain dead reckoning navigation information. The air data mode of the navigation computer will be indicated by the illumination of the "Air Data Mode" light on the computer control panel. The navigation computer furnishes the following information during flight:

a. The airplane's present position latitude and longitude based on dead reckoning computations (air data mode) or inertial navigation from an initial fix.
b. The continuous great circle magnetic bearing and distance to either of two preset targets. This is an instantaneous spherical trigonometry solution based on true north.
c. Airplane ground speed from navigation computer (air data mode) or from INS.

In the air data mode, the dead reckoning computations are only as accurate as the wind velocity and magnetic variation references furnished the system by the RSO. Inputs of magnetic heading and true airspeed are automatically supplied by the attitude heading reference system and the CADC. In the inertial navigation mode, east-west and north-south velocities, which have wind speed and wind direction included, are supplied to the navigation computer and these values do not have to be manually set. True heading is also supplied by the INS. For purposes of discussion, the navigation computer can be divided into two functional sections. The first is the present position computer section which performs the basic dead reckoning computations. The second is a course and distance computer section which provides great circle course and distance to a target (or base). In the air data mode all inputs are manual except true airspeed and magnetic heading. In the inertial mode, all inputs are manual except true heading, east-west velocity, north-south velocity, and a change in present position information which are all derived from the INS.

Present Position Computer (Air Data Mode)

The present position computer is a group of servomechanisms contained in the computer control panel with their amplifiers located in the amplifier-computer. In the air data mode, the present position computer receives magnetic heading from the AHRS and true airspeed from the CADC. Magnetic variation, wind speed, wind direction, and the latitude and longitude of the starting position, the base, and destination are set manually by means of control knobs on the computer control panel. The present position computer resolves true airspeed and wind velocity to their north-south and east-west components and adds them algebraically to derive the components of aircraft ground speed. Ground speed is integrated with respect to time to attain distance which is then converted to a change of latitude and longitude. The north-south mileage covered is converted directly into degrees and minutes of latitude by the position latitude counter on the computer control panel, since one nautical mile is always equal to one minute of latitude. In the longitude channel an additional step is necessary since a direct conversion can only be made at the equator. At other latitudes, the east-west mileage covered is multiplied by the secant of the latitude at which the aircraft is traveling. The modified east-west mileage is then converted directly to degrees and minutes longitude by the position longitude counter on the computer control panel. The present position computer continuously computes the change in latitude and longitude from the aircraft's starting position (initial fix). These coordinate changes are applied to the corresponding position counters, both of which have been manually set to the coordinates of the starting position. Since the position counters add the change in coordinates to the starting coordinates, they will provide continuous indication of the aircraft's present position.

Present Position Computer (Inertial Mode)

In the inertial mode, the present position computer functions only to provide a readout of position latitude and longitude from the INS. The INS inputs are inertial change in latitude and inertial change in longitude. These signals replace the east-west and north-south mileage inputs from the present position computer to the present position counters during the inertial mode.

Course and Distance Computer

The basis of course and distance computation is the solution of the spherical triangle (each side of which is a segment of a great circle) formed on the earth's surface by the geographic north pole (true north), the present position, and the preselected target or base. The latitude and longitude of the base and the target are manually inserted into the system by means of the position and target counters on the computer control panel. The base coordinates are retained by memory circuits of the position counters. Since this information is known within the system, as is present position of the aircraft which is available continuously from the present position computer or INS, two sides of the spherical triangle and the angle between them are known. This makes it possible to solve for the third side and angle using the information available. The third side represents the great circle distance and the angle represents the great circle bearing or course angle.

NAVIGATION COMPUTER CONTROL PANEL

The navigation computer control panel (figure 1-6) contains the operating controls and counters which provide a readout of inserted information. The position counters also provide a continuous readout of present position during flight.

Function Selector Knob

The function selector knob is a five-position rotary switch with positions of OFF, TARGET, BASE, STBY, and RESET. The OFF position removes all power from the navigation computer. The TARGET position provides outputs of target range, true ground track relative to true heading (drift angle), and true bearing relative to true heading (relative bearing) to the preselected target coordinates set on the target counters. The BASE position selects the same output displays as the TARGET position but will be referenced to the preselected base or alternate target coordinates which are retained in the memory circuits of the position counters. The STBY position supplies filament power to the amplifier-computer and the latitude and longitude integrator channels of the system are inoperative. The RESET position is used to set base, alternate target, or return point coordinates in the memory circuits of the position counters. Placing the knob to the RESET position will cause the original memorized coordinates to be lost. A restriction on the knob prevents accidental switching to the RESET position. The knob must be pulled outward slightly to override the restriction when switching to the OFF or RESET positions.

Wind Control Knobs

The wind control knobs consist of the wind speed control knob and the wind from control knob. The wind speed control knob is used to manually insert the wind speed affecting flight into the system and is displayed on the wind speed counter. The wind from control knob is used to manually insert the true wind direction. The true wind direction is expressed as an angle measured clockwise from true north and is presented in degrees on the wind from counter.

Magnetic Variation Control Knob

The magnetic variation control knob is used to manually insert the magnetic variation angle into the system. The magnetic variation is the angular difference between true north and magnetic north.

Position Control Knob

The position control knobs are initially used to insert the base, alternate target, or return point latitude and longitude into the system. To insert these coordinates the function selector knob must be in the RESET position. With the function knob in any position but RESET, the position control knobs are used to manually insert present position latitude and longitude to establish an initial fix for the dead reckoning function of the navigation computer or as a reference for INS alignment. The base, alternate target, or return point latitude and longitude are not displayed anywhere during flight; a memory of these coordinates is retained by the system so long as the function switch is not placed to the RESET position. The position latitude and longitude counters continuously indicate the aircraft present position in degrees and minutes during flight.

Target Control Knobs

The target control knobs are used to manually insert the target latitude and longitude into the system. These coordinates are displayed on the target latitude and longitude counters. The system will provide output displays to fly to these coordinates when the function selector knob is placed to TARGET.

Position Update Switch

The position update switch is used to update the position latitude and longitude during flight. The switch positions are SET, NORMAL, and FIX. The aircraft's present position (represented by the position latitude and longitude counters) may be updated in the inertial mode as follows:

a. A few minutes prior to reaching the point of known coordinates, pull outward on the position update switch and place it to the SET position. This disengages the position latitude and longitude counters.

b. Rotate the position latitude and longitude control knobs until the coordinates of the approaching point appear in the position latitude and longitude counters.

c. Place the position update switch to the FIX position and hold in this position.

d. When exactly over the known point, release the switch; it is spring-loaded and will return to the NORMAL position, completing the updating procedure.

The inertial navigation set updates at a rate of approximately three minutes of latitude and three minutes of longitude per second. Thus, for example, if the latitude was changed by 5 minutes and the longitude was changed by 15 minutes, the longitude change would determine the amount of time the position update switch must be held in the FIX position. In this example, the position update switch must be held in the FIX position for a minimum time of 5 seconds prior to reaching the known point, otherwise the INS will be only partially updated. When the position update switch is moved from the SET position to the FIX position, it must pass through the NORMAL position. A time delay circuit in the computer control panel prevents the position counters from going to normal operation for about one-half second. Therefore, the switch movement from SET to FIX position must be a smooth continuous movement in order to prevent an unwanted interval of NORMAL operation. The aircraft's present position may be updated in the air data mode by either of two methods. One method of updating is to rotate the position latitude and longitude control knobs until the coordinates of the aircraft's actual present position appear in the position latitude and longitude counters. This may be accomplished with the function selector knob in any position except RESET or OFF. The other method utilizes the position update switch and has the advantage that the navigation computer may be instantaneously updated when the aircraft is over the point of known coordinates. When updating the navigation computer utilizing this method, perform the following:

a. A few minutes prior to reaching the point of known coordinates, place the position update switch to the SET position. This disengages the position latitude and longitude counters.
b. Rotate the position latitude and longitude control knobs until the coordinates of the approaching point appear in the position counters.
c. When exactly over the known point, place the switch to the NORMAL position, completing the updating procedure.

Variation Synch Meter

The variation synch meter indicates the error in the manual magnetic variation setting during the inertial mode. Rotating the variation control knob in the appropriate direction will center the vertical bar in the variation synch meter, indicating that the correct magnetic variation is set on the variation counter. Rotation of the variation control knob in the air data mode will have no affect on the meter.

OUTPUT DISPLAYS

The navigation computer display information in the front cockpit is shown in figure 1-36. The navigation computer also supplies the true ground track information displayed in the true ground track indicated and true ground track modes. Refer to figure 1-35. To display navigation computer information on the BDHI in the rear cockpit, select the NAV COMP position on the navigation selector switch. The displayed information on the BDHI is as follows:

1. Magnetic bearing to target or base displayed on the number 1 needle when read against the compass card. A relative bearing to the target or base can also be read by noting the number of degrees from the index clockwise to the number 1 needle.
2. Magnetic ground track displayed on the number 2 needle when read against the compass card. Left or right drift angle can also be read by noting the number of degrees left or right from the index.
3. Distance to the target or base displayed on the range counter.

To travel the great circle route to the target or base, the aircraft should be flown on a course that will cause the two needles to be coincident. However, it is not necessary to fly the course shown by the coincidental needles. Departure from the route may be made, as a part of evasive maneuvers or to fly a search pattern, without affecting the operation of the system. Since computations are being made continuously, the current position of the airplane is shown at all times on the position counters regardless of the path flown. As the target (or base) is approached, the distance on the range counter will decrease. When the target is reached, uncertainty will be exhibited by the number 1 needle which will turn 180° as the target is passed in order to indicate bearing to target. At any time during flight, the present position may be compared with a known check point or a fix obtained from radar, TACAN, or GCI and the position counters changed accordingly. This will correct errors in computation that have previously occurred but will not disturb the memory of the base or target position.

FLIGHT DIRECTOR GROUP

The purpose of the flight director group is to provide an integrated display of the navigation situation of the airplane. The flight director group consists of a flight director computer, the horizontal situation indicator (HSI), and a selector panel. Although the attitude director indicator (ADI) is not a component of the flight director group, it does receive some signals from the flight director computer and shall be discussed along with the flight director group.

Flight Director Computer

The flight director computer provides navigation information to the HSI, and steering information to the ADI. Except for the bearing and distance display on the HSI, all signals for the HSI, and signals for portions of the ADI pass through or originate in the computer. The flight director computer has no control over the 3 axis sphere portion of the ADI. Steering signals are computed to provide the pilot with flight direction information when flying either manually or remotely set headings, and manually selected TACAN radials. These computed signals, together with the required flag signals and off scale signals, are supplied by the computer to the ADI. The steering signals are limited to insure safe operation without affecting the inherent performance capabilities of the airplane.

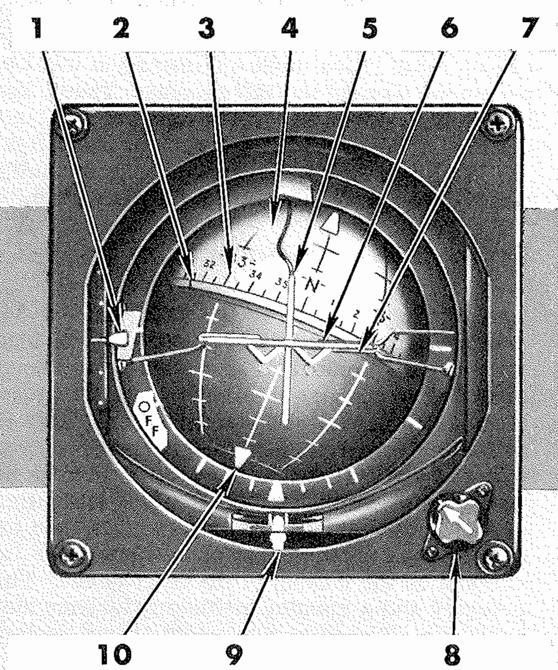
Horizontal Situation Indicator

The HSI (figure 1-34) provides the horizontal or plan view of the aircraft with respect to the navigation situation. That is, the HSI is a platform picture of the aircraft's present situation, as seen from above the airplane. The aircraft symbol, in the center of the HSI, is the airplane superimposed on a compass rose. The compass card rotates so the aircraft's magnetic heading is always under the lubber line. Index marks are provided every 45 degrees around the perimeter of the compass card, which can be used in holding patterns, procedure turns, etc. The bearing pointerprovides magnetic bearing to a selected TACAN or navigation computer station, depending on which is selected on the bearing distance selector switch. When ADF is selected on the bearing distance selector switch, the bearing pointer will indicate relative bearing to the UHF station. The heading marker is controlled by the heading set knob, except when navigation computer steering is desired at which time it is automatically set. The needle which reflects the steering asked for by the heading marker is the bank steering bar on the ADI. The heading marker will be centered under the lubber line when TGT/IND (true ground track indicated) or TGT (true ground track) is selected on the mode selector knob, but will indicate a command heading for the bank steering bar to steer to in any other mode. The course arrow indicates the selected TACAN track, present magnetic ground track, selected true ground track, or present true ground track. For TACAN steering, the course arrow must be set (using the course set knob) to coincide with the desired TACAN track. The course selector window will always agree with the course arrow when used for TACAN. Just as the heading marker provides steering information to the bank steering bar on the ADI, the course arrow provides the course deviation indicator on the HSI with displacement information in the TACAN mode. When the navigation computer is being used for steering information, the course arrow automatically indicates the magnetic ground track presently being flown. When in the TGT/IND mode, the course arrow will indicate the present true ground track being flown. In the TGT mode, the course arrow can be set (using the course set knob) to a desired true ground track. In this mode, the pilot can fly a preselected ground track by centering the bank steering bar and the ADI. The course selector window will agree with the course arrow in TGT/IND and TGT modes. The to-from indicator indicates whether the aircraft will be approaching or going away from the TACAN station on the course selected. It doesn't indicate whether the aircraft is actually heading toward the selected station. If the to-from indicator points toward the head of the course arrow (equivalent to a TO indication), it indicates the TACAN course selected will steer the aircraft toward the station and not away from it. The to-from indicator only operates when TACAN mode is selected. The course deviation indicator operates in conjunction with the course arrow and is only operative when in the TACAN mode. The course deviation indicator represents the selected TACAN radial. The relationship between the aircraft symbol and the course deviation indicator is the same as an actual plan view of the selected TACAN radial and the aircraft. The course deviation indicator will indicate direction and angular relationship to the TACAN radial. In addition, angular error from the TACAN radial can be read up to 5 degrees. The two dots, on each side of center, each indicate 2.5 degrees of angular error from the selected TACAN radial. Once the course deviation indicator is fully deflected, angular error cannot be read directly, but up to 5 degrees on either side of the selected TACAN radial can be read. Five mode-of-operation word messages are shown around the HSI display. These lights are illuminated internally to indicate the selected operating mode, provided the instrument panel lights control knob is in the ON position. The intensity of the mode lights is also controlled by this knob.

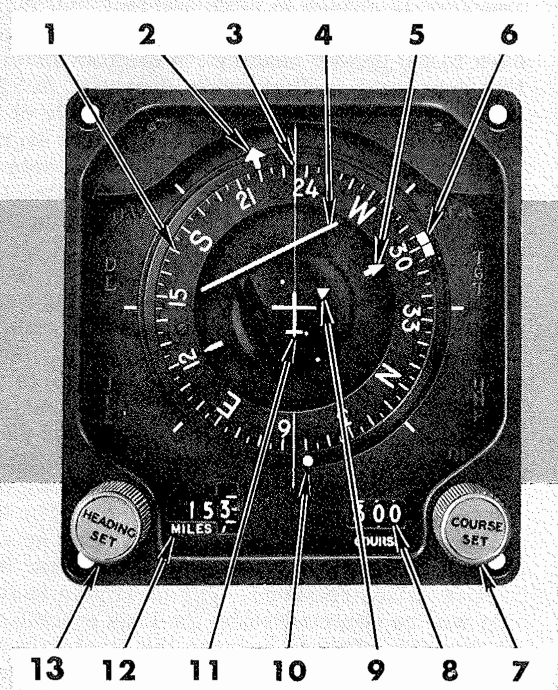
Attitude Director Indicator

The primary function of the ADI (figure 1-34) is to provide aircraft attitude reference. The black and gray sphere is movable and stabilized through all attitudes so that the miniature aircraft wings, against the moving horizon line on the sphere, give the pilot attitude reference. Pitch angle increments of 10 degrees are marked on the sphere and can be set using the pitch trim knob. Heading indications are also provided around the sphere's horizon line. Ten degree bank increments, up to 30 degrees, are marked on the bottom of the instrument. There is a primary and a standby attitude reference system available. The pilot can select either system by placing the reference system selector knob, located on the compass controller, in the desired position. When the reference system selector knob is rotated from PRIM to STBY or vice-versa, it is normal for the ADI to react in one of two ways. It may show no appreciable change in pitch and roll, but may move off to some random point in azimuth and synchronize back to the proper heading. A similar sphere gyration may occur in flight when operating in STBY during maneuvers in which the pitch attitude of the airplane passes through 90 degrees or 270 degrees. These reactions are normal. The bank steering bar is the only bar used in conjunction with the flight director group. The bank steering bar indicates corrective action necessary to intercept the selected ground track, heading, TACAN radial or navigation computer destination. The bank steering bar receives its bank information from the heading marker or course arrow on the HSI, through the flight director computer. When the heading marker is positioned either manually or automatically, the bank steering bar will deflect right or left to direct the pilot to the new heading. When the course arrow is manually set in the TGT mode the bank steering bar will direct the pilot to the selected ground track. The bank steering bar does not indicate direction or displacement from the desired heading, but rather the corrective action required. The maximum bank angle that will be commanded by the bank steering bar is 30 degrees. This is because the maximum heading error the computer will command is 90 degrees. If the heading marker or course arrow on the HSI is set at 90 degrees or more from the present position, the bank steering bar will indicate a maximum bank of 30 degrees. Any heading error of less than 90

Horizontal Situation Indicator and Attitude Director Indicator



1. VERTICAL DISPLACEMENT POINTER
2. HORIZON BAR
3. HEADING REFERENCE SCALE
4. 3-AXIS SPHERE
5. BANK STEERING BAR
6. PITCH STEERING BAR
7. MINIATURE AIRCRAFT
8. PITCH TRIM KNOB
9. TURN AND SLIP INDICATOR
10. BANK POINTER



1. COMPASS CARD
2. BEARING POINTER
3. LUBBER LINE
4. COURSE DEVIATION INDICATOR
5. COURSE ARROW
6. HEADING MARKER
7. COURSE SET KNOB
8. COURSE SELECTOR WINDOW
9. TO-FROM INDICATOR
10. RECIPROCAL BEARING POINTER
11. AIRCRAFT SYMBOL
12. RANGE INDICATOR
13. HEADING SET KNOB

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Figure 1-34

degrees will produce a bank angle indication of something less than 30 degrees. Obviously, there will be times when more than 30 degrees of bank is desired to intercept the new heading or TACAN radial and in these cases, the bank steering bar must be disregarded. The bank steering bar information will only be reliable for TACAN steering if the selected TACAN track is within ± 60 degrees of the present heading. The course deviation indicator on the HSI will be reliable regardless of the TACAN track selected. The ± 60 degree limitation applies only to the bank steering bar. If, when on the selected TACAN radial, it becomes necessary to establish a a crab angle due to wind drift (aircraft heading different from selected radial) the bank steering bar will indicate a heading error. To eliminate this apparent heading error, the heading marker on the HSI should be manually set to correspond to the new heading. Do not expect the bank steering bar to automatically correct for wind drift. The pitch steering bar is used in conjunction with the forward looking radar (AN/APQ-99).

NAVIGATION FUNCTION SELECTOR PANEL

The navigation function selector panel is located on the front cockpit instrument panel (figure 1-4). The panel contains a mode selector knob and a bearing distance selector switch.

Mode Selector Knob

The mode selector knob is a rotary type switch with positions of TGT/IND, HDG, TACAN, NAV COMP, and TGT. The switch is used to select the source of information to be displayed on the HSI and ADI. The ADI and HSI indications for the five positions of this knob are shown in figures 1-35 thru 1-37.

Bearing/Distance Selector Switch

The bearing/distance selector switch is a three-position toggle switch with switch positions of NAV COMP, ADF/TAC and TACAN. The bearing/distance selector switch only controls the bearing pointer, range indicator, and the mode word that indicates the mode selected on the HSI. The bearing/distance selector switch and mode selector knob do not have to be set up as a pair. The positions function as described in figure 1-38.

NORMAL OPERATION

INS ALIGNMENT PROCEDURES

During the align sequence of the inertial navigation set, the compass system is automatically in the compass mode and the horizontal situation indicator and bearing distance heading indicator compass cards will read magnetic heading directly from the flux valve. ADI azimuth information is not usable. If the wings are folded, the flux valve reading will not be accurate and a greater magnetic variation will be required to realize a variation synchronization on the navigation computer control panel. The reason for this is that in the wings folded position condition, the flux valve, which is located in the left wing, is oriented about 60 degrees from its proper position. If the magentic variation of the local area is used, gyro compassing will take longer to complete. Before aligning the inertial navigation set, place the controls on the navigation computer control panel as follows:

1. Function selector knob - STBY
2. Position update switch - NORMAL
3. Variation counter - LOCAL MAGNETIC VARIATION
4. Position counter - LOCAL LATITUDE AND LONGITUDE

Note

The navigation computer control panel must be set up as indicated for proper alignment of the INS.

Place the controls on the compass control panel as follows:

5. Reference system selector knob - STBY
6. Mode selector knob - SLAVED

Gyro Compass Alignment

The gyro compass mode of alignment is the most accurate means of alignment, but takes a longer period of time than the other modes. To align by this method, the align mode switch is placed to the GYRO COMP position. The power control knob is placed to the STBY position which applies power to bring the platform up to normal operating temperature. The "Heat" light is illuminated in the STBY position, and goes out when the system reaches operating temperature. The time required for the platform to reach operating temperature will depend on the ambient temperature. The platform must be at 160 degrees F for the "Heat" light to go out, and the platform will warm up at a rate of 20 degrees per minute. When the "Heat" light goes out, place the power control knob to ALIGN. The green "Align" light will illuminate after approximately two and one-half minutes, which indicates that the system is gyro compassing. After approximately five minutes the "Align" light will start to flash, indicating that gyro compassing is completed. The power control knob is then switched to NAV, the "Align" light goes out and the system is ready for operation.

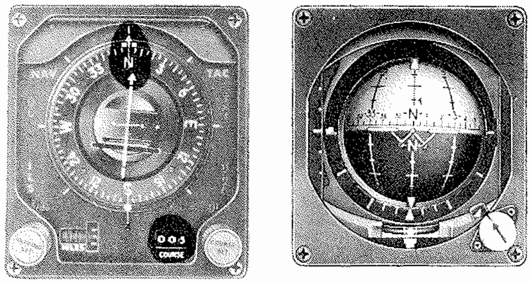
Heading Memory Alignment

Heading memory alignment is used when minimum alignment time is required. Accuracy will be somewhat degraded. Prior to heading memory alignment, a complete gyro compass alignment must have been performed through the flashing of the "Align" light indicating that the system is aligned. The align mode switch is placed to the HDG MEM position and the power control knob is then placed to OFF. From this time until the completion of the heading memory alignment, the aircraft must not be moved. When the unit is turned OFF in the heading memory mode, the platform retains the true north information obtained from the above procedure. To align the unit by the

True Ground Track and Heading Displays

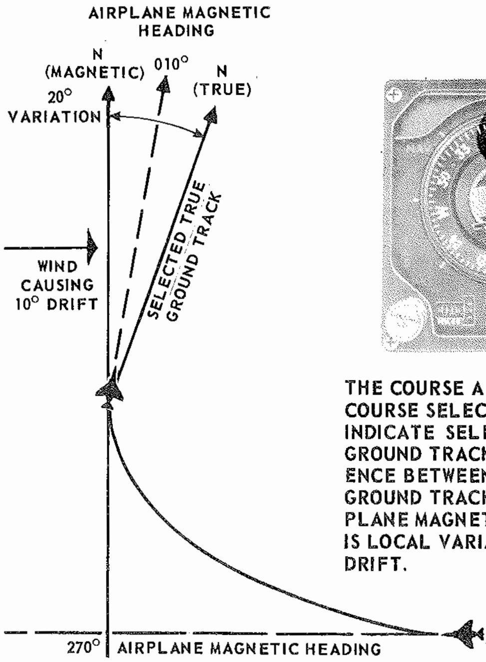
TGT/IND (True Ground Track Indicated)

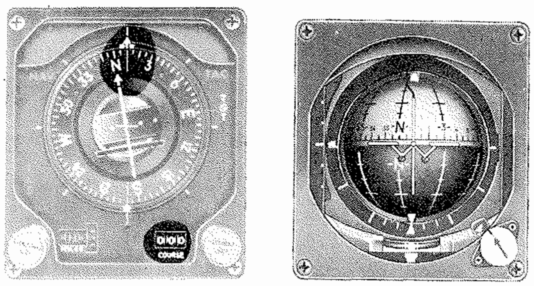
THE COURSE ARROW AND COURSE SELECTOR WINDOW INDICATE PRESENT TRUE GROUND TRACK. THE DIFFERENCE BETWEEN PRESENT TRUE GROUND TRACK AND MAGNETIC HEADING UNDER THE LUBBER LINE IS LOCAL VARIATION AND DRIFT. THE HEADING MARKER IS SLAVED TO THE MAGNETIC HEADING OF THE AIRPLANE. THE POSITION OF THE BEARING POINTER WILL BE DETERMINED BY THE POSITION OF THE BEARING DISTANCE SWITCH.



ALL STEERING BARS ARE DEFLECTED OUT OF VIEW. ONLY ATTITUDE AND AZIMUTH INFORMATION IS DISPLAYED.

TGT (True Ground Track)





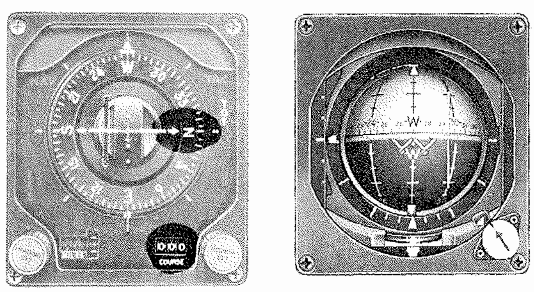
THE COURSE ARROW AND COURSE SELECTOR WINDOW INDICATE SELECTED TRUE GROUND TRACK. THE DIFFERENCE BETWEEN THE TRUE GROUND TRACK AND AIRPLANE MAGNETIC HEADING IS LOCAL VARIATION AND DRIFT.

WHEN ON THE SELECTED TRUE GROUND TRACK, THE BANK STEERING BAR WILL BE CENTERED WITH THE WINGS LEVEL.

Note

THE COURSE ARROW AND COURSE SELECTOR WINDOW ON THE HSI WILL NOT COMPENSATE FOR VARIATION AND DRIFT TO INDICATE THE MAGNETIC HEADING REQUIRED TO MAINTAIN THE SELECTED TRUE GROUND TRACK. CENTERING OF THE BANK STEERING BAR ON THE ADI IS THE ONLY INDICATION THAT THE AIRPLANE IS ON THE SELECTED TRUE GROUND TRACK.

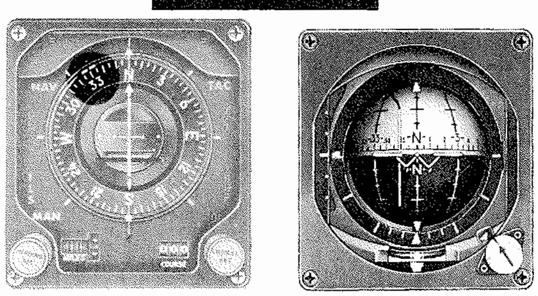
THE COURSE ARROW AND COURSE SELECTOR WINDOW CAN BE SET (USING THE COURSE SET KNOB) TO THE DESIRED TRUE GROUND TRACK. THE HEADING MARKER IS SLAVED TO THE AIRPLANE MAGNETIC HEADING. THE POSITION OF THE BEARING POINTER WILL BE DETERMINED BY THE BEARING DISTANCE SWITCH. THE TGT MODE LIGHT IS ILLUMINATED.



THE BANK STEERING BAR DEFLECTS RIGHT TO INDICATE BANK ANGLE STEERING TO THE SELECTED TRUE GROUND TRACK.

HDG (Heading)

THE HEADING MARKER IS POSITIONED BY THE HEADING SET KNOB TO PROVIDE THE ADI BANK STEERING BAR WITH BANK AND AZIMUTH INFORMATION IN ORDER TO TURN TO THE SELECTED HEADING. THE MAN MODE LIGHT IS ILLUMINATED.



THE BANK STEERING BAR INDICATES BANK ANGLE STEERING UP TO 30° OF BANK TO APPROACH THE HEADING SELECTED BY THE HEADING SET KNOB ON THE HSI.

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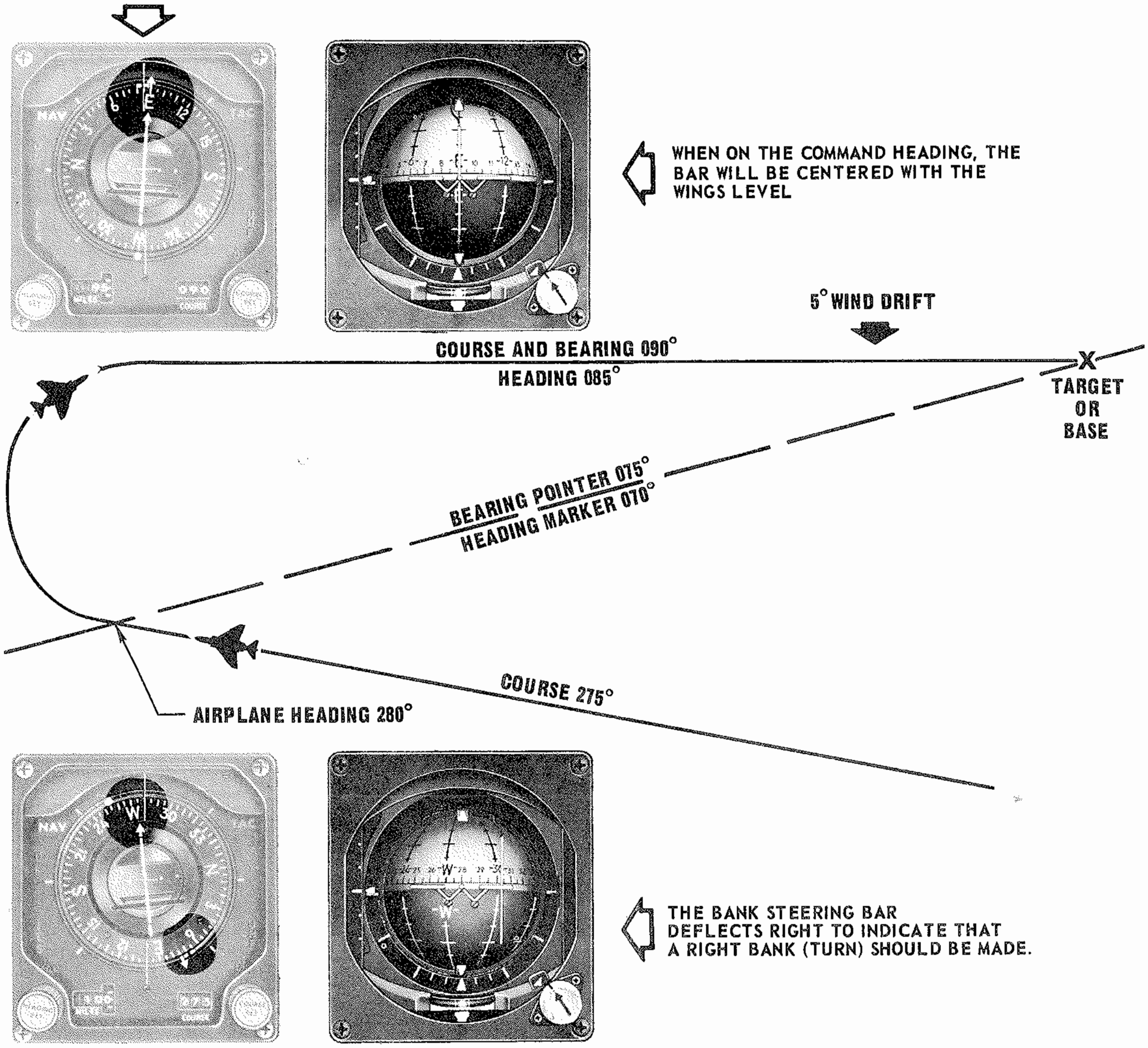
Figure 1-35

Navigation Computer Displays

WHEN ON THE COMMAND HEADING, THE HEADING MARKER WILL BE UNDER THE LUBBER LINE. THE COURSE ARROW AND BEARING POINTER WILL BE ALIGNED (BUT NOT NECESSARILY UNDER THE LUBBER LINE).



THE HEADING MARKER INDICATES THE MAGNETIC HEADING THAT MUST BE FLOWN TO MAKE GOOD A COURSE DIRECT FROM THE PRESENT POSITION OF THE AIRCRAFT TO THE DESTINATION (TARGET OR BASE) SELECTED ON THE NAV COMPUTER. WHETHER THE HEADING IS CORRECT OR NOT IS DEPENDENT UPON THE ACCURACY OF THE WIND DIRECTION AND VELOCITY, THE VARIATION, AND THE ACCURACY OF THE PRESENT POSITION. THE COURSE ARROW INDICATES THE TRACK THAT IS CURRENTLY BEING MADE GOOD, ALSO DEPENDENT UPON THE ACCURACY OF THE NAV COMPUTER SETTINGS. THE COURSE DEVIATION INDICATOR IS SLAVED TO THE COURSE ARROW. THE COURSE SELECTOR WINDOW WILL INDICATE THE SAME TRACK AS THE COURSE ARROW. THE BEARING POINTER INDICATES MAGNETIC BEARING TO DESTINATION. IN ORDER TO OBTAIN NAV COMPUTER INFORMATION FROM THE BEARING POINTER AND THE RANGE INDICATOR, THE BRG/DIST SWITCH MUST BE IN THE NAV COMP POSITION.

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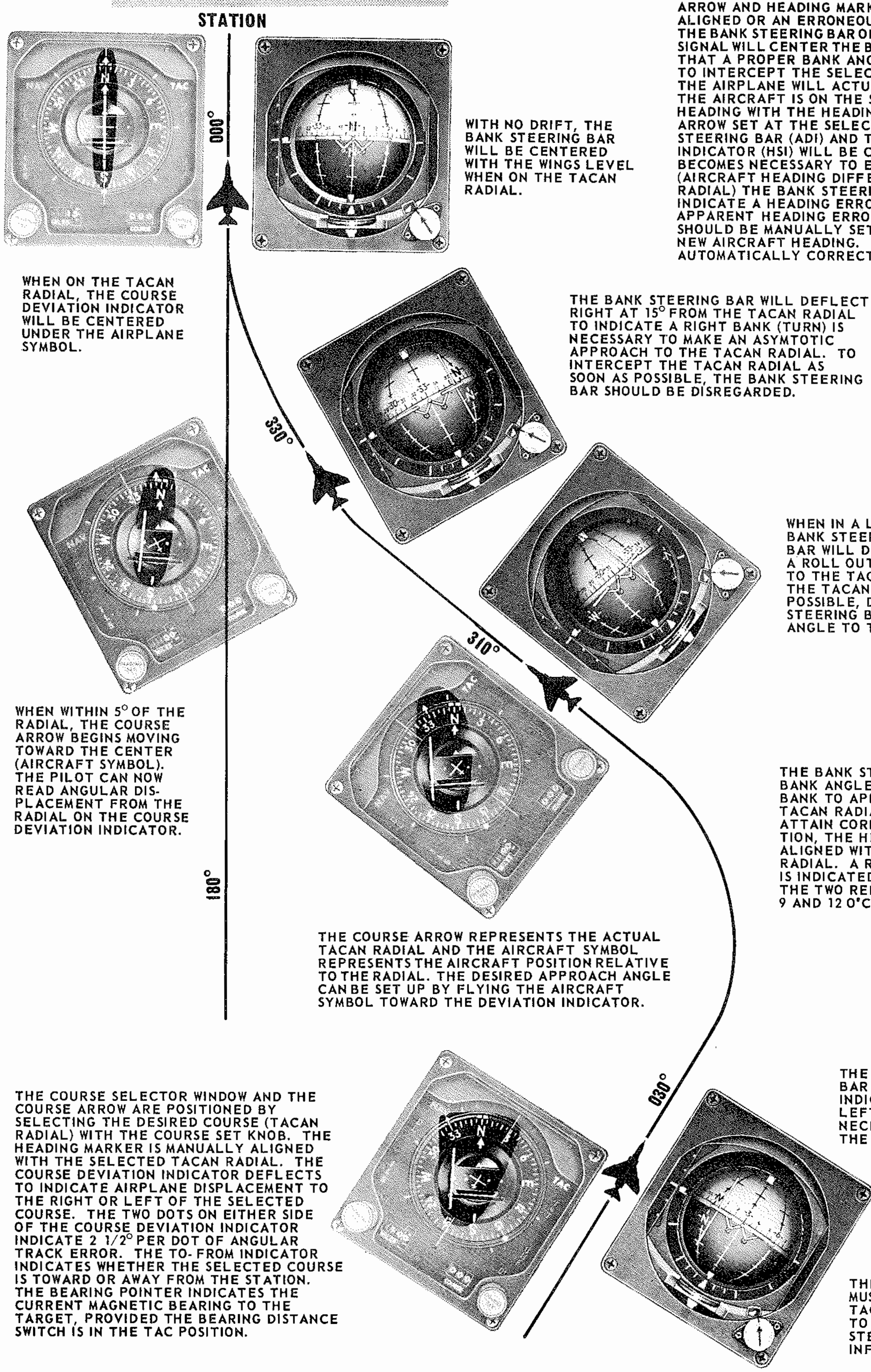
Figure 1-36

Tacan Displays

Note

WHEN OPERATING IN THE TACAN MODE, THE COURSE ARROW AND HEADING MARKER ON THE HSI MUST BE ALIGNED OR AN ERRONEOUS SIGNAL WILL BE SENT TO THE BANK STEERING BAR OF THE ADI. THIS ERRONEOUS SIGNAL WILL CENTER THE BANK STEERING BAR INDICATING THAT A PROPER BANK ANGLE HAS BEEN ESTABLISHED TO INTERCEPT THE SELECTED RADIAL, AND IN REALITY THE AIRPLANE WILL ACTUALLY BE OFF COURSE. WHEN THE AIRCRAFT IS ON THE SELECTED TACAN RADIAL AND HEADING WITH THE HEADING MARKER AND COURSE ARROW SET AT THE SELECTED COURSE, BOTH THE BANK STEERING BAR (ADI) AND THE COURSE DEVIATION INDICATOR (HSI) WILL BE CENTERED. IF IT THEN BECOMES NECESSARY TO ESTABLISH A CRAB ANGLE (AIRCRAFT HEADING DIFFERENT FROM THE SELECTED RADIAL) THE BANK STEERING BAR ON THE ADI WILL INDICATE A HEADING ERROR. TO ELIMINATE THIS APPARENT HEADING ERROR, THE HEADING MARKER SHOULD BE MANUALLY SET TO CORRESPOND TO THE NEW AIRCRAFT HEADING. DO NOT EXPECT THE ADI TO AUTOMATICALLY CORRECT FOR WIND DRIFT.



WITH NO DRIFT, THE BANK STEERING BAR WILL BE CENTERED WITH THE WINGS LEVEL WHEN ON THE TACAN RADIAL.

WHEN ON THE TACAN RADIAL, THE COURSE DEVIATION INDICATOR WILL BE CENTERED UNDER THE AIRPLANE SYMBOL.

THE BANK STEERING BAR WILL DEFLECT RIGHT AT 15° FROM THE TACAN RADIAL TO INDICATE A RIGHT BANK (TURN) IS NECESSARY TO MAKE AN ASYMTOTIC APPROACH TO THE TACAN RADIAL. TO INTERCEPT THE TACAN RADIAL AS SOON AS POSSIBLE, THE BANK STEERING BAR SHOULD BE DISREGARDED.

WHEN IN A LEFT BANK (TURN) WITH THE BANK STEERING BAR CENTERED, THE BAR WILL DEFLECT RIGHT TO INDICATE A ROLL OUT ON A 50° ANGLE APPROACH TO THE TACAN RADIAL. TO INTERCEPT THE TACAN RADIAL AS SOON AS POSSIBLE, DISREGARD THE BANK STEERING BAR AND INCREASE APPROACH ANGLE TO THE RADIAL.

WHEN WITHIN 5° OF THE RADIAL, THE COURSE ARROW BEGINS MOVING TOWARD THE CENTER (AIRCRAFT SYMBOL). THE PILOT CAN NOW READ ANGULAR DISPLACEMENT FROM THE RADIAL ON THE COURSE DEVIATION INDICATOR.

THE BANK STEERING BAR INDICATES BANK ANGLE STEERING UP TO 30° OF BANK TO APPROACH THE SELECTED TACAN RADIAL, HOWEVER, IN ORDER TO ATTAIN CORRECT STEERING INFORMATION, THE HEADING MARKER MUST BE ALIGNED WITH THE SELECTED TACAN RADIAL. A RELIABLE TACAN SIGNAL IS INDICATED BY THE RETRACTION OF THE TWO RED FLAGS LOCATED AT THE 9 AND 12 O'CLOCK POSITION.

THE COURSE ARROW REPRESENTS THE ACTUAL TACAN RADIAL AND THE AIRCRAFT SYMBOL REPRESENTS THE AIRCRAFT POSITION RELATIVE TO THE RADIAL. THE DESIRED APPROACH ANGLE CAN BE SET UP BY FLYING THE AIRCRAFT SYMBOL TOWARD THE DEVIATION INDICATOR.

THE COURSE SELECTOR WINDOW AND THE COURSE ARROW ARE POSITIONED BY SELECTING THE DESIRED COURSE (TACAN RADIAL) WITH THE COURSE SET KNOB. THE HEADING MARKER IS MANUALLY ALIGNED WITH THE SELECTED TACAN RADIAL. THE COURSE DEVIATION INDICATOR DEFLECTS TO INDICATE AIRPLANE DISPLACEMENT TO THE RIGHT OR LEFT OF THE SELECTED COURSE. THE TWO DOTS ON EITHER SIDE OF THE COURSE DEVIATION INDICATOR INDICATE 2 1/2° PER DOT OF ANGULAR TRACK ERROR. THE TO-FROM INDICATOR INDICATES WHETHER THE SELECTED COURSE IS TOWARD OR AWAY FROM THE STATION. THE BEARING POINTER INDICATES THE CURRENT MAGNETIC BEARING TO THE TARGET, PROVIDED THE BEARING DISTANCE SWITCH IS IN THE TAC POSITION.

THE BANK STEERING BAR DEFLECTS LEFT INDICATING THAT A LEFT BANK (TURN) IS NECESSARY TO CENTER THE POINTER.

Notes

THE AIRCRAFT HEADING MUST BE WITHIN 60° OF THE TACAN RADIAL IN ORDER TO OBTAIN RELIABLE BANK STEERING BAR STEERING INFORMATION.

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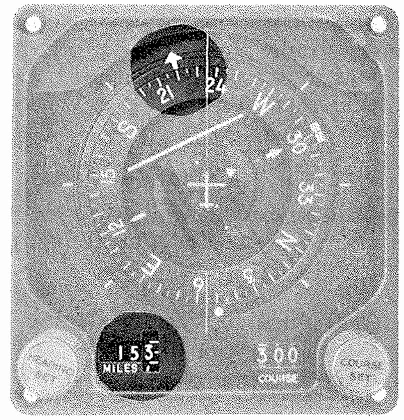
Figure 1-37

Horizontal Situation Indicator Bearing and Distance Displays

THE BRG/DIST SWITCH CONTROLS ONLY THE INDICATIONS DISPLAYED BY THE BEARING POINTER AND RANGE INDICATOR OF THE HSI.



BEARING DISTANCE SWITCH

NAV COMP (Navigation Computer)

THE BEARING POINTER INDICATES MAGNETIC BEARING TO THE DESTINATION SELECTED ON THE NAV COMPUTER. THE RANGE INDICATOR INDICATES THE NAUTICAL MILES TO THE DESTINATION SELECTED ON THE NAV COMPUTER (TARGET OR BASE). THE NAV LIGHT WILL BE ILLUMINATED.

BEARING DISTANCE SWITCH

ADF/TAC (Automatic Direction Finder/TACAN)

THE BEARING POINTER INDICATES MAGNETIC BEARING TO THE UHF STATION SELECTED ON THE COMMUNICATION CONTROL PANEL (EITHER COMM OR AUX RECEIVER MUST BE IN ADF POSITION). THE RANGE INDICATOR WILL INDICATE TACAN RANGE WHEN TACAN IS IN THE A/A OR T/R MODE. THE UHF AND TAC LIGHT WILL BE ILLUMINATED.

BEARING DISTANCE SWITCH

TACAN

THE BEARING POINTER INDICATES MAGNETIC BEARING TO THE SELECTED TACAN STATION. THE RANGE INDICATOR INDICATES THE SLANT RANGE NAUTICAL MILES TO THE TACAN STATION (FOR DISTANCE INDICATIONS, THE TACAN SELECTOR SWITCH MUST BE IN THE T/R POSITION). THE TAC LIGHT WILL BE ILLUMINATED.

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Figure 1-38

heading memory method the align mode switch is in the HDG MEM position and the power control knob is placed to the STBY position. When the "Heat" light goes out, place the power control knob to the ALIGN position. When the "Align" light comes on flashing, switch to the NAV position; the green "Align" light goes out and the system is ready for operation.

Note

The autopilot cannot be engaged until the inertial navigation set is aligned and in the NAV mode.

Inflight Alignment

In the event the inertial navigation set platform is tumbled during flight, all autopilot and primary attitude reference will be lost. Under these conditions, it might be possible to regain autopilot and primary attitude reference by performing an inflight alignment of the inertial navigation set. Do not attempt to use the AFCS position of the autopilot while the platform is tumbled. To align the inertial navigation set, the aircraft must be flown straight and level, holding a constant heading, while the power control knob is placed to STBY, then to ALIGN for 40 seconds and back to NAV.

Note

- The length of time the inertial navigation set attitude will be usable after an inflight alignment is not predictable. However, subsequent alignments can be attempted as needed.
- If AFCS is desired after an inflight alignment, AFCS can be engaged but ground track hold mode will be unreliable. If ground track information from the inertial navigation set is unstable after inflight alignment, do not attempt to use the ground track hold mode.

NAVIGATION COMPUTER

All control knobs required to operate the navigational computer are located on the computer control panel. To simplify the procedure, it should be understood, that where a counter setting is specified, the control knob associated with the particular counter will be rotated to set the counter. In the case of the position latitude and position longitude counters, the associated control knobs must be pressed in to engage them with their respective counters before they can be rotated effectively.

Note

The flight plan may be set into the navigational computer prior to applying electrical power if desired.

a. Set magnetic variation counter to local magnetic variation.
b. Set wind from counter and wind speed counter to wind direction and wind speed that will affect the flight.

Note

Weather stations may provide the magnetic wind direction which must be corrected for variation to obtain the true wind direction.

c. If memory base information is desired, place function selector knob to RESET and set latitude and longitude of alternate target, base, or return point on position counters.
d. Place function selector knob to any position but RESET and set local latitude and longitude in position counters.
e. Set latitude and longitude of the target or destination on the target counters.
f. When aircraft leaves starting point, place function selector knob to desired operating mode (TARGET or BASE).

Note

The position counters should be checked for accuracy and updated if necessary during flight.

Updating Methods

The position counters should be checked and updated at each opportunity by one of the following methods:

a. Visual reference to a geographical position.
While in one of the operating modes or temporarily in STBY, adjust the position latitude and longitude to agree with the latitude and longitude of the visual fix. This latitude and longitude may be obtained from maps, charts, or publications.

b. Radar reference to a geographical position.
Use radar mapping to obtain a bearing and distance to a known geographic position. Set the latitude and longitude of this position in the target counters or in base memory. Adjust the position counters so that the number 1 needle and the range counter on the BDHI agree with the radar bearing and distance.

c. TACAN fix.
Set the latitude and longitude of the acquired TACAN station in the target counters or in base memory. Adjust the present position counters so that the number 1 needle and the range counter on the BDHI agree with the TACAN readout.

d. GCI or radar monitored fix.
Set the latitude and longitude of the controlling agency in the target counters or in base memory. Adjust the position counters so that the number 1 needle and range counter on the BDHI agree with the bearing and distance provided by the controller.

Wind Finding Techniques

a. True wind utilizing a TACAN fix.
This solution assumes that a constant altitude will be maintained while the wind is being found. The wind speed counter is set to zero; the latitude and longitude of the reference TACAN station are set on the target counters; and the position latitude and longitude counters are set so that the TACAN range and bearing and the computer range and bearing on the BDHI are identical. After a convenient time interval has elapsed, the TACAN range and bearing and the computer range and bearing should be plotted either on a chart, a grid such as that on an MB-4 computer, or pictured on the face of the BDHI itself. The difference between these two plotted positions gives the wind vector for the elapsed time interval. Applying variation, the direction of the wind vector is from the computer DR fix to the TACAN fix. Multiply the distance by the factor necessary for an hourly rate to produce an accurate wind speed setting.

ATTITUDE HEADING REFERENCE SYSTEM

The AHRS serves as a backup system for the inertial navigation system and may be used, when necessary, as follows:

1. Reference system selector knob - STBY.
2. Mode selector knob - SLAVED.
3. Synchronization switch - SYNC (momentary)

If operating above 70° north or south latitude:

2. Mode selector knob - DG.
3. Aircraft magnetic heading - SET
Set the aircraft magnetic heading by using the set hdg control knob.
4. Set the hemisphere switch to the local hemisphere.
5. Set the latitude control knob to the local latitude.

Note

A heading error will be induced in the system when the primary attitude reference system (inertial navigation set) is used and the latitude control knob is set to the present latitude. Therefore, the latitude control knob must be set at zero when the reference system selector knob is in the PRIM position.

EMERGENCY OPERATION

There are no provisions for emergency operation of the navigation equipment with the exception of the AHRS. When the directional gyro is unusable due to some malfunction, magnetic heading information may be obtained on the HSI by placing the reference system selector knob to the STBY position, and the mode selector knob to the COMP position. The azimuth indications on the ADI should be disregarded in this case.

LIMITATIONS

There are no specific limitations pertaining to the operation of the navigation equipment with the exception of the navigation computer. Beyond 72°N or 72°S latitude, the system will continue to operate but with a progressive loss in accuracy as either geographic pole is approached.

REFERENCE PUBLICATIONS

If more detailed system information is required, refer to Item No. 16 and 24, on Maintenance Instruction Manuals Publication Index (flyleaf 3 of this publication).

OXYGEN SYSTEM

DESCRIPTION

The liquid oxygen (LOX) system consists of a ten liter capacity, vacuum insulated container, build-up coils, check valves, vent valves and quantity gages. The system is designed to deliver gaseous oxygen to the crew at a continuous rate of up to 120 liters per minute at 60 to 90 psi. From the container, the liquid oxygen flows to the build-up coils which are predetermined lengths of tubing wrapped around the outside bottom of the container. When the liquid flows through the build-up coil is absorbs heat from the surrounding area and becomes gaseous. The gaseous oxygen is then increased in pressure to assure 40 to 90 psi to the regulators. From the build-up coils, the oxygen flows into the warm-up plate located in the rear cockpit aft of the ejection seat. The warm-up coils warm it to a temperature no colder than 20°F under the cockpit temperature. From the warm-up plate the oxygen is now ready for crew consumption. A system relief valve set at 110 psi vents excessive pressures that may occur due to the boil-off of the LOX when the system is not being used. A blow out patch in the oxygen container provides added safety if a relief valve should fail. An electrical capacitance type indicator provides the pilot and RSO with an accurate means of determining the amount of LOX remaining at any time. An "Oxygen Low" indicator light operated by the indicator circuit and located on the telelight panel alerts the pilot when the liquid oxygen supply is reduced to one liter.

OXYGEN SUPPLY LEVERS

A two-position ON-OFF oxygen supply lever is located on a panel in each cockpit. The pilot's supply lever (figure 1-2) is located on the aft end of the left console. The RSO's supply lever (figure 1-6) is mounted on the utility panel which is located in the left forward section of the cockpit.

OXYGEN QUANTITY GAGE

An oxygen quantity gage is located in each cockpit (figure 1-2 and 1-6). The range of the gage is from 0 to 10 liters. The gages may give erroneous indications during HF radio transmissions; however, they will return to their normal indications when the transmitter is not in use.

WARNING

Do not rely on oxygen quantity indications during HF radio transmissions.

OXYGEN REGULATOR

The oxygen breathing regulator is personnel mounted and is used both in the inflight and bailout or emergency conditions. The regulator is so designed that with an inlet pressure of 40 to 90 psi, it will deliver 100% oxygen automatically to the user, between the altitudes of 0 to 50,000 feet. In addition, the regulator incorporates automatic safety pressure build-up to a maximum of 2 inches of water below 35,000 feet and automatic pressure breathing for altitudes above 35,000 feet and is designed to integrate with the A13/A oxygen breathing mask.

OXYGEN CONNECTION (STANDARD FLIGHT SUIT)

There are two types of oxygen connection equipment presently in use. The first type requires that the crewmember carry the upper block with his personal gear since the oxygen supply line is not detachable. With this type equipment, the personal leads are routed from the upper block, under the left arm and up to the oxygen regulator and communications connector.. The second type ("over the shoulder") utilizes a universal upper block which remains in the airplane. The oxygen-communication lead is an integrated single line. It is fastened to the back of the torso harness at the left waist and center shoulder areas with velcro fasteners. The line is then routed forward over the left shoulder and fastened permanently to the oxygen regulator. The line is clipped to the left side of the helmet. An earphone plug is attached to the line where it is clipped to the helmet, The universal composite upper block features a locking indicator in the release handle. When securely locked, the indicator is flush with the handle.

Oxygen Duration Chart

OXYGEN DURATION-HOURS

Cabin Pressure Altitude Feet	Gage Quantity-Liters						
	10	8	6	4	2	1	Below 1
40,000 and Above	60.6	48.5	36.4	24.2	12.0	6.0	-EMERGENCY- DESCEND TO ALTITUDE NOT REQUIRING OXYGEN
35,000	37.0	29.6	22.2	14.8	7.4	3.6	
30,000	27.2	21.8	16.4	10.8	5.4	2.8	
25,000	20.4	16.4	12.4	8.2	4.0	2.0	
20,000	16.0	12.8	9.6	6.4	3.2	1.6	
15,000	12.8	10.2	7.6	5.2	2.6	1.2	
10,000	10.0	8.0	6.0	4.0	2.0	1.0	
5,000	8.4	6.6	5.0	3.2	1.6	0.8	
SEA LEVEL	7.0	5.6	4.2	2.8	1.4	0.6	

● DURATION TIME IS HALVED WHEN TWO CREW MEMBERS ARE USING OXYGEN

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Figure 1-39

OXYGEN CONNECTION (FULL PRESSURE SUIT)

There are two types of pressure suit oxygen connection equipment presently in use. The first type requires that the upper block be carried with the crewmember's personal gear since the personal leads are permanently attached to it. With this type connecting equipment the personal leads are routed up the back of the life vest, and end in quick disconnects just below the helmet. When the helmet is in place the leads are hooked up to two corresponding helmet leads. The second type equipment utilizes a universal upper block which remains in the airplane. The personal lead is an integrated oxygen-communication line which is permanently attached to the left side of the helmet. After thehelmet is in place, the personal lead is routed back over the left shoulder and attached to the center shoulder area of the life vest with a velcro fastener. It is then routed through a nylon channel sewn to the life vest pad along the lower left side. The line is then connected to the universal upper block. The vent air supply and anti-g hose routings and connections are similar for both types of equipment. The suit vent exhaust on this type equipment does not plug into the survival kit. The exhaust regulator is contained within the exhaust nose.

NEW

EMERGENCY OXYGEN

Emergency oxygen is stored in a cylinder located in the survival kit container. The emergency oxygen cylinder is a coil assembly constructed of steel tubing closed at both ends with a volume of 100 cubic inches. The cylinder is normally charged to 1800 psi and supplies gaseous oxygen in emergencies for breathing and suit pressurization. The flow of oxygen from this coil is controlled and regulated by the pressure reducer manifold which is actuated either manually or automatically. The pressure reducer manifold is located within the survival kit. It is used to reduce the oxygen pressure within the emergency oxygen cylinder to 65 ± 15 psi with a flow up to 140 lpm. Components of the manifold include a toggle arm, pressure gauge, relief valve, filler valve, and safety plug. When the toggle arm of the manifold is in the cocked position, flow of oxygen from the emergency oxygen cylinder is prevented by action of the pressure reducer valve within the manifold. When the toggle is tripped, emergency oxygen flows through the manifold at a reduced pressure to the suit controller and intermediate block for suit pressurization and breathing. The relief valve, attached to the manifold, prevents excessive pressure build-up in the system when manifold pressure regulation fails, The emergency oxygen filler valve is accessible through a hold in the upper half of the container which permits ease of servicing. The safety plug of the manifold prevents excessive pressure within the emergency oxygen cylinder due to over-servicing or thermal expansion. A pressure gauge attached to the pressure reducer manifold provides pressure indication for the cylinder and is visible through a hole in the kit cushion.

Emergency Oxygen Manual Release Ring

The emergency oxygen manual release ring (figure 1-17) is located on the left forward end of the survival kit container. The ring is colored green and is in the ready position during all normal flight conditions. When emergency oxygen is needed for breathing, the release ring is pulled from the kit to actuate the emergency oxygen. The ring, when pulled, separates from the kit after the emergency oxygen has actuated.

NORMAL OPERATION

Operation of the oxygen system consists of turning the oxygen sypply lever from OFF to ON.

EMERGENCY OPERATION

Emergency oxygen is obtained by pulling up on the emergency oxygen manual release ring until the ring separates from the seat.

LIMITATIONS

There are no limitations pertaining to the operation of the oxygen system.

REFERENCE PUBLICATIONS

If more detailed system information is required, refer to Item No. 3, on Maintenance Instruction Manuals Publication Index (flyleaf 3 this publication).

PITOT-STATIC SYSTEM

DESCRIPTION

The pitot-static system supplies impact (pitot) and atmospheric (static) pressures to various flight instruments and airspeed switches. The system is composed of two separate systems that receive inputs from a single pitot-static boom located on the nose of the airplane. Both pressures may be utilized by the same instruments, but at no time do the pressures intermingle. A heating element in the pitot-static boom is actuated by the pitot heat switch located on the front cockpit right console. Both pitot and static pressures are supplied to airspeed pressure switches, that retract the flaps, actuate the rudder feel trim system, disconnect the emergency generator (if operating) on aircraft 153094x and prior before incorporation of AFC 220; and engage the aileron-rudder interconnect providing the wing flap switch is DN or 1/2. The pitot and static pressures are also directed to the airspeed/Mach indicator, altimeters, and vertical velocity indicator as applicable. Refer to figure 1-14. A pitot heat switch, with positions of ON and OFF, is located on the right utility panel (figure 1-3), front cockpit. The switch is used to energize an electrical heating element in the pitot-static boom and an electrical heating element in the stabilator feel and trim bellows air inlet.

NORMAL OPERATION

Operation of the pitot-static system consists of turning the pitot heat switch ON and OFF as necessary.

EMERGENCY OPERATION

There are no emergency operations pertaining to the pitot-static system.

LIMITATIONS

There are no limitations pertaining to the pitot-static system.

REFERENCE PUBLICATIONS

If more detailed system information is required, refer to Item No. 11, on Maintenance Instruction Manuals Publication Index (flyleaf 3 this publication).

Pneumatic System

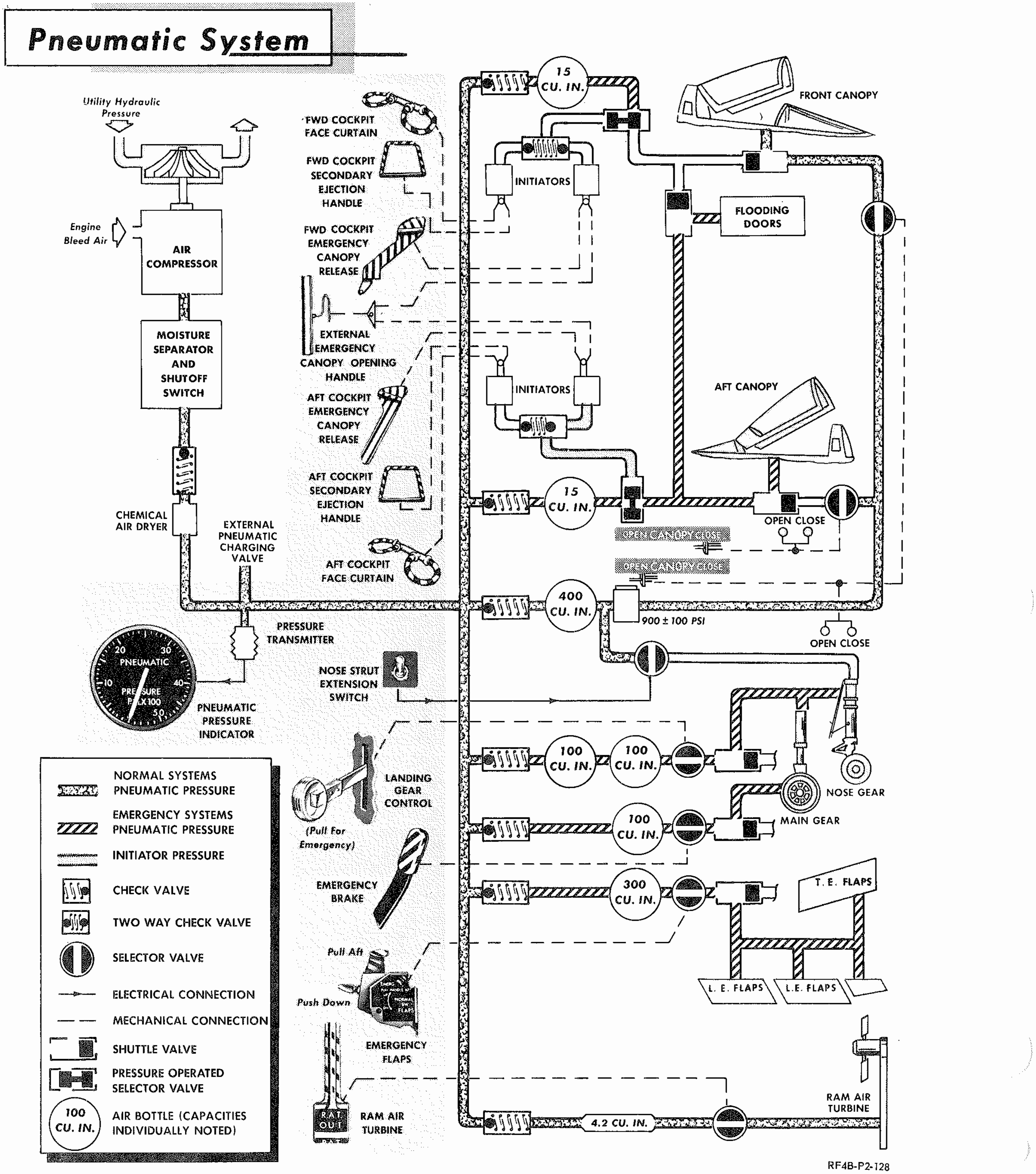


Figure 1-40

PNEUMATIC SYSTEM

DESCRIPTION

The pneumatic system (figure 1-40), provides high pressure air for normal and/or emergency operation of various accessories on the aircraft. The pneumatic system supplies pressure for operation of both the normal and emergency canopy systems. It supplies pressure for normal operation of the ram air turbine (extension and retraction) and the nose gear strut extension. It also supplies pressure for emergency extension of the landing gear, wing flaps and cockpit flooding doors, and emergency operation of the wheel brakes. Air from the pneumatic system is drawn from the engine bleed air supply, via the electronic equipment air conditioning system. It is compressed to approximately 3000 psi by a hydraulic, motor driven air compressor. A pneumatic pressure sensor, in the system moisture separator, opens a hydraulic shutoff valve to activate the air compressor when the system pressure falls below approximately 2750 psi. When the pneumatic system pressure builds to approximately 3100 psi, the pneumatic pressure sensor closes the hydraulic shutoff valve which de-activates the air compressor. The air compressor discharges through a moisture separator and chemical air dryer to the pneumatic system air bottles. Check valves prevent the air bottles from discharging back to the air compressor. Shutoff valves isolate the air bottles from their component systems until they are manually discharged. A pressure transmitter, for the pneumatic pressure indicator, is installed in a main pressure line.

PNEUMATIC PRESSURE INDICATOR

The pneumatic pressure indicator (figure 1-4) is mounted on the pedestal panel and operates in conjunction with the pneumatic pressure transmitter. The indicator has a range of 0 to 5000 pounds with calibrations of 0 to 50 and readings multiplied by 100. Normal system pressures range from 2650-3300 psi due to pressure transmitter and pressure gage tolerances.

NORMAL OPERATION

Normal operation of the pneumatic system is accomplished automatically when the engines are running or by the application of external pneumatic power. A check of the pneumatic system cockpit pressure indicator or the basic system pressure gage will show only the pressure in the supply line. Operating pressures for the emergency subsystems are indicated by their individual pressure gages. To de-activate the air compressor, pull out the pneumatic system control circuit breaker on the number 1 circuit breaker panel.

EMERGENCY OPERATION

There is no emergency operation of the pneumatic system air compressor. However, all the normal and emergency systems have air storage bottles that assure adequate air pressure to the individual penumatic subsystems. Operation of the normal and emergency subsystems is discussed under the applicable individual systems.

LIMITATIONS

The normal pneumatic system pressure as read on the cockpit indicator is 2650 to 3300 psi.

REFERENCE PUBLICATIONS

If more detailed system information is required, refer to Item No. 6, on Maintenance Instruction Manuals Publication Index (flyleaf 3 this publication).

RECONNAISSANCE SYSTEM

DESCRIPTION

The multiple sensor reconnaissance system (figure 1-41) consists of three types of sensors. They are optical (cameras), radar, and infrared. The optical sensor has day and night photographic capabilities, inflight processing, and the means to eject a film cassette. The radar sensor consists of the side looking radar which has the capability of detecting and recording both fixed and moving targets. The infrared sensor has the capability of detecting very small heat differentials and presenting them as a pictorial display. The sensor control panels in both cockpits permit selection and operation of the optical sensor. Radar and infrared sensors are operated from the aft cockpit only.

OPTICAL SENSORS

CAMERA CONFIGURATIONS

The basic and alternate configurations of the cameras are illustrated in figure 1-42. This illustration associates the camera station selector buttons on sensor control panel No. 1 with the camera installed in each camera station. The area coverage of the basic and alternate configurations is shown in figure 1-46.

Forward Camera Station (Station 1)

The forward camera station contains the KS-72 framing camera with a 6-inch lens cone mounted on an inflight rotatable mount which is controlled from the

Sensor Equipment Location

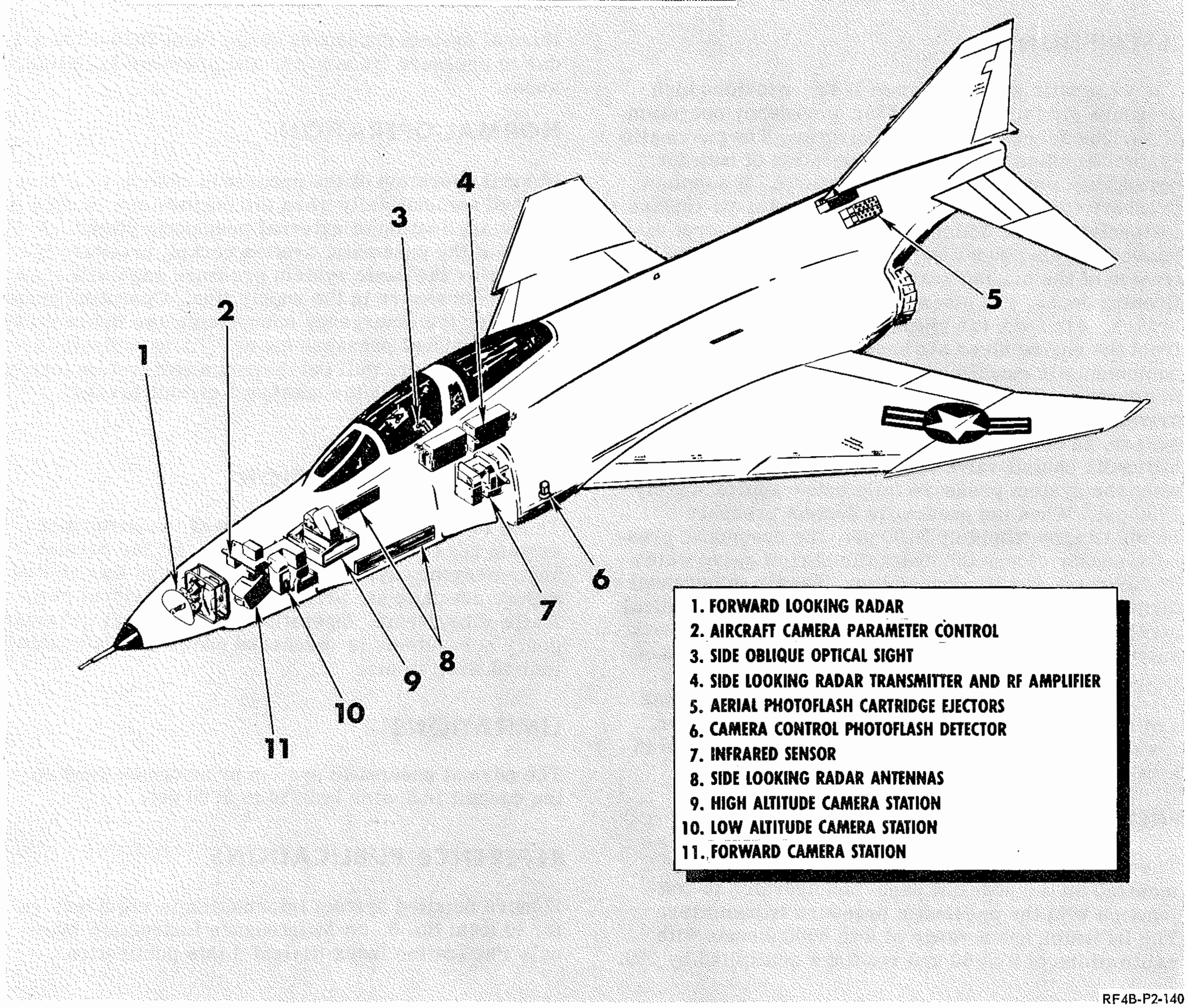


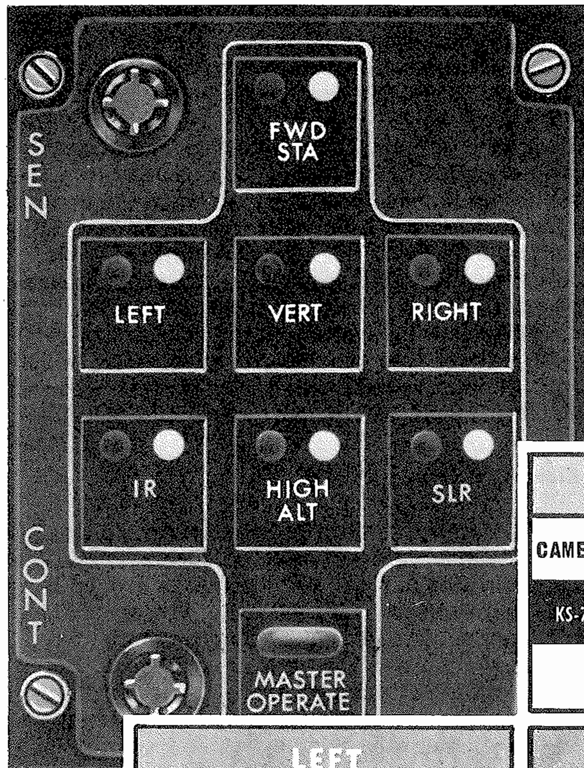
Figure 1-41

front cockpit. The camera can be rotated to a 23.5 degree forward oblique position for day photography or to the vertical position for day or night photography.

Low Altitude Station (Station 2)

The basic configuration for the low altitude station is the installation of the KA-56 low altitude panoramic camera for day photography only. The alternate configuration consists of three KS-72 framing cameras in a tri-camera array, one KS-72 framing camera in either a left or right side oblique installation, or one KS-72 framing camera mounted in an inflight rotatable mount. The KS-72 framing cameras in a tri-camera array permit joint vertical and oblique day photographic capabilities. The vertical camera of the tri-camera array provides the low altitude night photographic capabilities of the low altitude station. The KS-72 framing camera (with 12 or 18-inch lens cone) in either the right or left side oblique position, provides oblique day photographic capabilities. The KS-72 framing camera, mounted in the inflight rotatable mount, may be rotated in flight to a left or right oblique position, or to a vertical position. The depression angles available for left and right oblique photography are shown in figure 1-42. An optical sight can be mounted on either side of the forward cockpit canopy to show the terrain area being photographed by the left or right side oblique cameras.

Camera Configurations



BASIC CAMERA CONFIGURATION

* ONLY ONE KS-72 WITH THE 12-INCH OR THE 18-INCH CONE CAN OCCUPY THE LOW ALTITUDE STATION.

FWD STA

CAMERA	FOCAL LENGTH	ATTITUDE
KS-72	6"	SELECTIVE 23.5° FWD OBLIQUE OR VERTICAL

LEFT (LOW ALTITUDE STA)

CAMERA	FOCAL LENGTH	ATTITUDE
KS-72	6"	37.5° OBLIQUE
*KS-72	12" 18"	5°,15°,30° OBLIQUE
KS-72	3"	30° OBLIQUE
KS-72	18"	SELECTIVE 5°, 15°, 30° LEFT OR RIGHT OBLIQUE OR VERTICAL

VERT

CAMERA	FOCAL LENGTH	ATTITUDE
KA-56	3"	VERTICAL PANORAMIC
KS-72	3"	VERTICAL
KS-72	3"	VERTICAL

RIGHT

CAMERA	FOCAL LENGTH	ATTITUDE
KS-72	6"	37.5° OBLIQUE
*KS-72	12" 18"	5°,15°,30° OBLIQUE
KS-72	3"	30° OBLIQUE

HIGH ALT

CAMERA	FOCAL LENGTH	ATTITUDE
KA-55	12"	VERTICAL PANORAMIC
KS-72	18"	VERTICAL
(2)KS-72	6" 18"	SPLIT VERTICAL

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Figure 1-42

High Altitude Station (Station 3)

The basic configuration of the high altitude station is the KA-55 high altitude panoramic camera, mounted vertically in the aircraft camera mount set LS-58A (stabilized mount), and is used for high altitude day photography. The alternate configuration consists of two split vertical cameras or a high altitude vertical camera. The KS-72 framing camera, with an 18-inch focal length lens cone, is mounted vertically in the stabilized mount for high altitude day photography. Two KS-72 framing cameras, with either 18-inch lens cones or 6-inch lens cones, are mounted in the split vertical configuration. The two 18-inch lens cone cameras are used for high altitude day photography while the two 6-inch lens cone cameras are used for low altitude day or night photography. The split vertical cameras are installed in a specially designed mount which replaces the stabilized mount. The depression angles for the split verticals are: 71.6° for the 6-inch lens cone and 83.7° for the 18-inch lens cone.

Still Picture (High Altitude) Camera KA-55

The KA-55 high altitude panoramic camera scans 90 degrees laterally to produce a panoramic photograph of the area beneath the airplane. The camera is mounted in a vertically stabilized camera mounted in the high altitude camera station. The panoramic action is achieved by an optical (stove pipe) scanner lens that moves through 90 degrees at a constant angular velocity. The camera contains an automatic exposure sensor which controls a movable shutter in the optical scanner for each exposure. The advantage of the high altitude panoramic camera is that wide lateral coverage is obtained when using a long focal length narrow angle lens. IMC is accomplished by translating the lens in the direction of flight at a rate from 0.2 to 2.0 inches per second. The angle of view provided by the 12 inch focal length lens is approximately 21° longitudinally beneath the airplane; the area of coverage increases as the scanner lens a approaches 45 degrees. The format size of the photograph is 4.5 inches by 18 7/8 inches. The film capacity of the take-up and processing cassette with or without inflight film processing is 500 feet. The operational altitude is from 30,000 feet to 50,000 feet. The aircraft camera parameter control provides the pulses and voltage signals that establish the 12% or 56% overlap and image motion compensation in the camera.

Still Picture (Low Altitude) Camera KS-56

The KA-56 low altitude panoramic camera produces a horizon-to-horizon photograph (180 degrees scan) perpendicular to the airplane heading (figure 1-44). Panoramic photography is accomplished by continuously rotating a double dove prism in front of the lens on an axis parallel to the flight direction, and simultaneously advancing the film perpendicular to the flight direction, across a narrow slit at the focal plane. The film advance is synchronized with the prism rotation so that the terrain image is "painted" on the film as the prism scans from horizon to horizon. Variable image motion compensation (IMC) is required in panoramic photography to compensate for the relatively slight image movement at the horizon and the greater image motion beneath the airplane. To achieve this graded image motion compensation, the camera lens is moved in the direction of flight at an increasing rate as the prism rotates from horizon to vertical and at a decreasing rate from vertical to horizon. The parameter control provides IMC command voltage for image motion compensation from 0 to 11.88 inches/second. A 56% overlap is fixed within the camera. The format size is 4.5 inches by 9.4 inches for terrain photography. The format size increases to 4.5 inches by 10.8 inches when the data block from the data display set is photographed. The camera features automatic exposure control, a 3-inch focal length lens, a large capacity supply magazine and a film take-up and processing cassette. The film capacity with the non-ejectable cassette is 1000 feet; with inflight film processing the capacity is 500 feet. Film may be ejected from this camera when the associated film cassette ejector system is installed.

NEW

Still Picture Camera KS-72

The KS-72 framing camera is capable of high and low altitude, day and night, high-speed photography. The operating altitude is from 200 feet above ground level (AGL) to approximately 50,000 feet. However, the camera framing rate (6 cycles/second) can be exceeded at low altitudes and high ground speed. Refer to figure 1-43 for altitude vs ground speed framing rate limits. The film capacity is 500 feet, and the size of each photograph is approximately 4.5 by 4.5 inches. This camera will take up and process 250 feet of film, storing the mat-film combination of 500 feet in the take-up and processign cassette. The camera has an intra-lens shutter for night photography. A focal plane shutter, for day photography, operates in conjunction with the self contained automatic exposure control unit. Four focal length lens cones are available for day photography; 3-inch, 6-inch, 12-inch and 18-inch. Only the 3-inch and 6-inch lens cones are equipped with an intra-lens shutter, required for night photography. The aircraft camera parameter control establishes a pulse rate to provide 12% or 56% overlap and KVg/H signal for image motion compensation (IMC) from 0.1 to 12 inches per second. IMC is not provided to the forward station when the camera is in the forward oblique position.

RECON CONTROL PANEL

The recon control panel (figure 1-4), located on the main instrument panel in the front cockpit, provides the pilot with limited sensor selection and direct control to initiate camera operation. The three operate lights for stations 1, 2, and 3 will flash when the applicable camera(s) are operating. The camera mount knobs are used for inflight positioning of the cameras in stations 1 and 2 when the rotatable mount is installed. The lights located above the camera mount knobs indicate operation of the rotatable mount. The light for the applicable station will illuminate if the mount is not in the same position as that selected on the knob. The film remaining counter provides a digital display of the amount of film remaining in the forward station (station 1) camera.

KS-72 Camera Framing Rate Limits

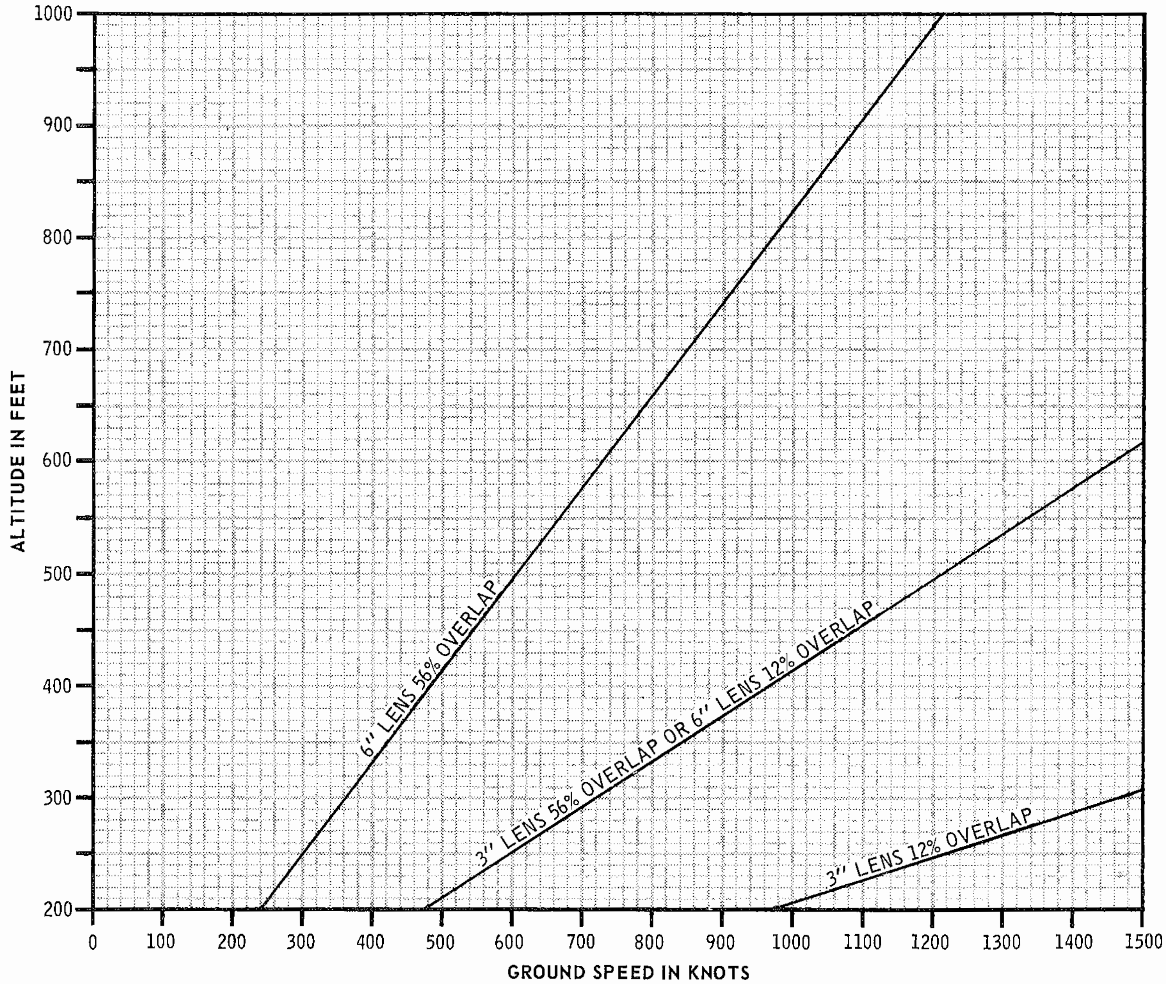

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Figure 1-43

Recon Selector Knob

The recon selector knob is a six position knob with positions of OFF, STA 1, STA 2, BOTH, RSO SELECT, and FILM EJECT. The OFF position precludes pilot operation of the cameras. When STA 1, STA 2, or BOTH is selected, the pilot can operate the cameras in either station 1, station 2, or both stations for day photography by depressing the camera master operate button to ON. The STA 1, STA 2, and BOTH positions will not operate the cameras unless the RSO has selected DAY on the sensor control panel No. 2. The RSO SELECT position will permit the pilot to operate camera stations selected by the RSO on the sensor control panel No. 1. The FILM EJECT position is used for film cassette ejection.

Camera Master Operate Button

The pilot's camera master operate button enables the pilot to initiate camera operation. When the button is actuated ON, a green light will illuminate within the button.

VIEWFINDER

The Model VF-57 viewfinder (figure 1-4) provides the pilot with a view of the terrain beneath and ahead of the aircraft for locating photographic targets and to aid in navigation. Light enters through a window installed in the lower fuselage skin and enters the viewfinder window. The ground is viewed through the eye lens which is located above the pilot's instrument panel. The viewfinder incorporates a wide angle and a narrow angle optical system. The wide angle system provides a 60 degree field-of-view, extending from 35 degrees below the horizon to 5 degrees aft of nadir (plumb point). The 30 degree narrow system field-of-view extends from 10 degrees below the horizon to 40 degrees below the horizon, refer to figure 1-45. The optical axes of both the wide and narrow optical systems are tilted forward of nadir and upward

Panoramic Area Coverage

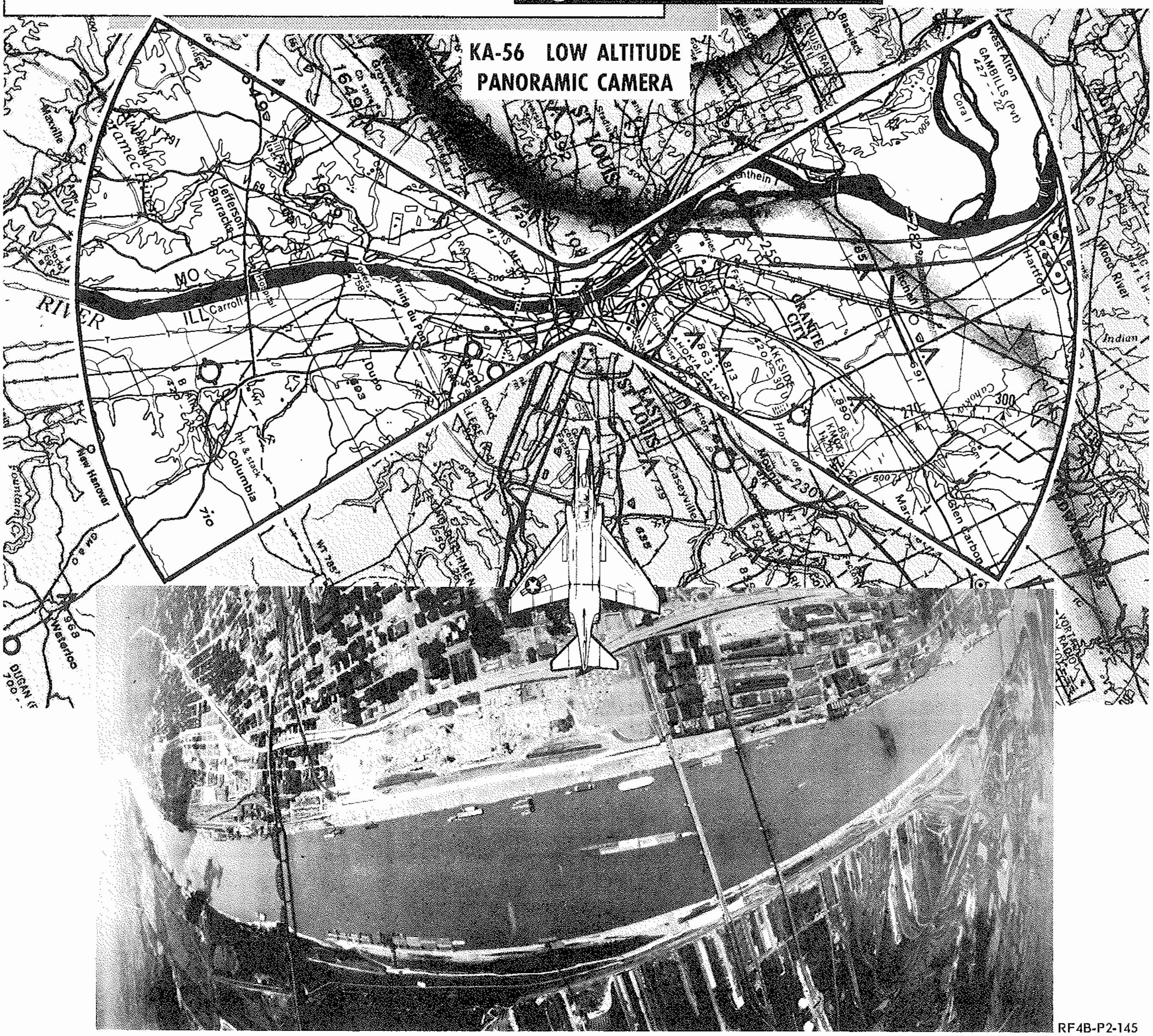


Figure 1-44

in the horizontal plane during normal flight attitude. The wide and narrow optical systems provide terrain images which are magnified approximately 1/6 and 1/3 respectively. The wide angle reticle (figure 1-45) consists of a drift scale, a track line, offset track lines representing 10 percent displacement from the side limits of camera coverage, a nadir point, and format marks for the vertically mounted 18, 12, 6, and 3-inch focal length KS-72 framing cameras. An X on the track line locates the nadir point directly below the aircraft. The narrow angle reticle contains a drift scale, a track line, and indicates the optical axis for the 3, 6, and 12-inch forward oblique KS-72 framing cameras at depression angles of 12 1/2, 23 1/2, and 36 degrees. Although the narrow reticle contains the optical axis for the 12-inch forward oblique KS-72 framing camera at a depression angle of 12 1/2 degrees, this configuration cannot be installed in the forward camera station. The drift scale indicates the drift angle of the aircraft up to 10 degrees to either side. When the wide angle field-of-view is selected, a traveling grid is superimposed on the image, appearing as a series of lines moving vertically downward at right angles to the track line. Synchronization of the lines with terrain objects verifies the accuracy of the automatic V/H signal from the INS and electronic altimeter set, or the manual V/H signal generated by the viewfinder.

Traveling Grid Illumination Control Knob

The traveling grid illumination control knob controls the intensity of the traveling grid. With the control fully clockwise, the grid lines are opaque.

Manual Only Light

The "MAN Only" light illuminates when the viewfinder is operating in the manual mode and supplying the V/H signal to the aircraft camera parameter control.

Traveling Grid Mode Switch

The traveling grid mode switch is a three-position toggle switch with positions of AUTO, MAN, and OFF. The AUTO position is used to select automatic V/H signal from the INS and electronic altimeter set. The accuracy of this V/H signal can be checked by observing that the traveling grid line movement is coincident with movement of objects on the terrain. If the automatic V/H signal is lost or becomes unreliable, the viewfinder will automatically switch to the manual mode and the "MAN Only" light will illuminate. The MAN position selects the manual V/H signal supplied by the viewfinder. The manual V/H signal is controlled by the knots (ground speed) and altitude control knobs located below the front of the viewfinder. The proper V/H signal is maintained by synchronizing the traveling grid with fixed objects on the ground through use of the knots and altitude control knobs. The OFF position removes the traveling grid presentation.

Drift Switch

The drift switch is a three-position, spring-loaded toggle switch. The switch has positions of L and R and is spring-loaded to the center OFF position. Holding the switch in either the L or R position, will move the reticle in the direction the switch is held. The function of the switch is to align the reticle track line parallel to movement of passing ground images. With the reticle track line and true line of flight paralleled, the drift can be read on the drift index, refer to figure 1-45.

Angle Switch

The angle switch is a two-position toggle switch with positions of NAR and WIDE. This switch is used to select the narrow or wide angle optical system and the corresponding reticle.

Filter Select Switch

The filter select switch is a three-position toggle switch with positions of YEL, CLR, and OPAQUE. The YEL position selects a yellow filter in the upper housing of the viewfinder for improving visibility when the ambient atmosphere is hazy. The CLR position selects a clear filter to allow the terrain to be viewed directly. The OPAQUE position inserts an opaque filter in the viewfinder housing to cut off the optical display entirely.

Field Illumination Control Knob

The field illumination control knob controls the intensity of the reticle. The reticle is dimmed by turning the knob clockwise.

Altitude and Knots Control Knob

The altitude and knots control knobs are used to control the manual V/H signal to the aircraft camera parameter control. The altitude and ground speed which are supplied can be read on the altitude and knots indicators located directly above the knobs.

SENSOR CONTROL PANEL NO. 1

The sensor control panel No. 1 (figure 1-7), located on the aft cockpit right console, is used to select and operate the optical, infrared and side looking radar sensors. The sensor select buttons contain a green select light and an amber fail light. The green select light will illuminate to indicate the sensor selected. The amber fail light will illuminate when a failure occurs in either the camera, film, or processing mat. The fail light in the vertical low altitude station will illuminate when the processing mat is not installed. The fail light on the IR select button will also illuminate if a failure occurs in scan, sweep, threshold, IR door, or dark slide function. These malfunctions can be isolated by performing IR BIT checks. The master operate button, located at the bottom of the panel, routes power through the sensor select buttons to the sensors selected. A green operate light, located on the button, will illuminate when the button is depressed ON.

SENSOR CONTROL PANEL NO. 2

The sensor control panel No. 2 (figure 1-7), located on the aft cockpit right console, provides selection of camera modes of operation, stabilized camera mount operation, and selection of the number of photoflash cartridges to be ejected during a photo run.

Camera Mode Selector Knob

The camera mode selector knob is a four-position knob with positions of DAY, OFF, NIGHT L, and NIGHT R. The knob is positioned to DAY for day photography missions. The NIGHT L position is used for night photography when the left cartridge ejector is to be used. The NIGHT R posotion will eject cartridges from the right cartridge ejector for night photography. Placing the knob in the NIGHT L or NIGHT R position will open all cartridge ejector doors. The cartridges will be ejected from the applicable ejector when the master operate button is depressed ON. The "L and R Cart Door Fail" lights on the rear cockpit telelight panel will illuminate when the knob is positioned to NIGHT L or NIGHT R and will extinguish when the ejector doors are fully open. The lights will not illuminate when the ejector doors are closing.

Viewfinder Reticle Images

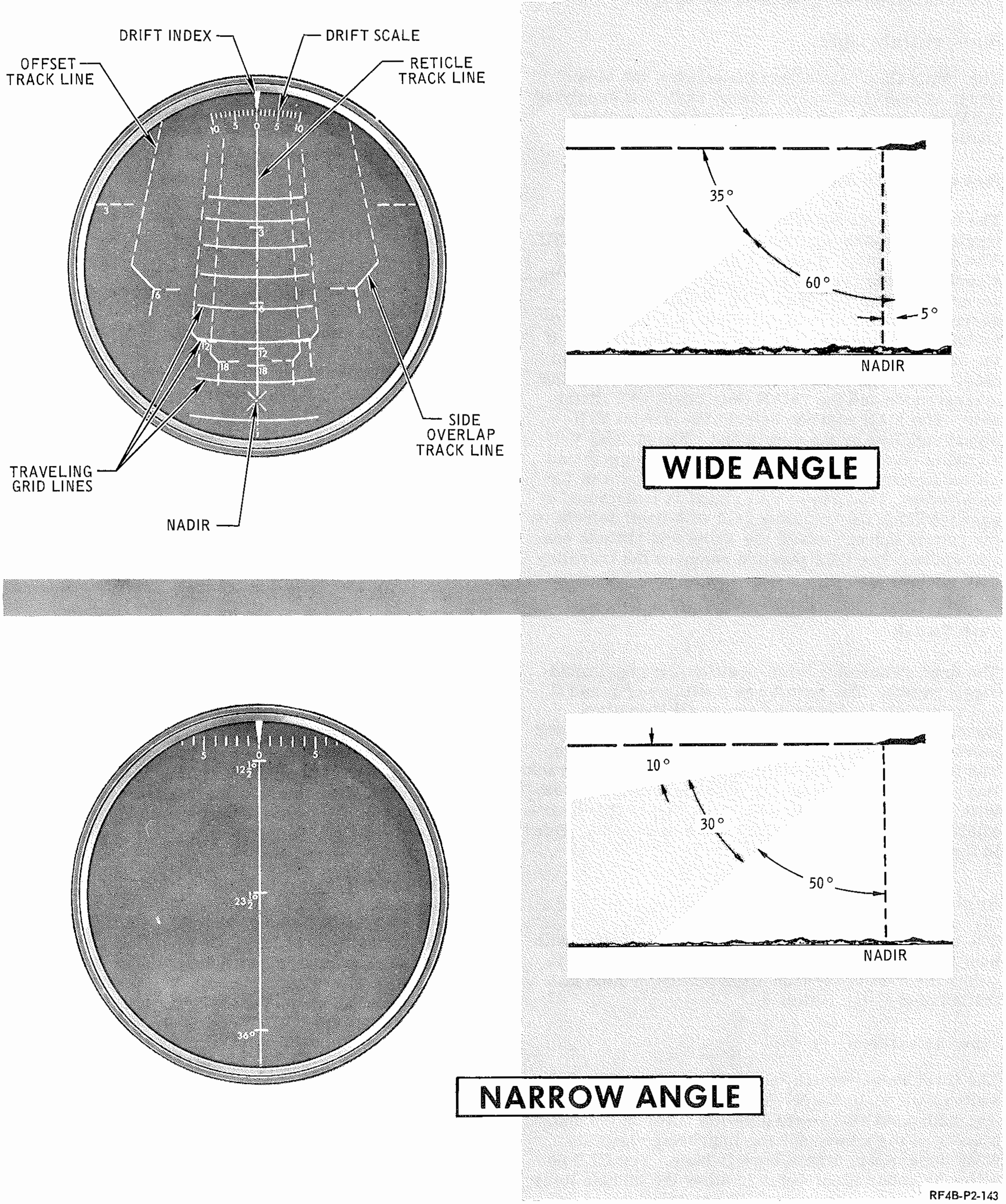


Figure 1-45

Camera Mount Knob

The camera mount knob is a three position knob with positions of OFF, STBY and ON. The "Ready" and "Fail" lights, located above the knob, are the stabilized camera mount monitor lights. For operation of the stabilized camera mount refer to Aircraft Camera Mount Set, this section.

Cartridges Count Limit Control

The count limit indicator displays a three digit figure which is set by the RSO with the thumb wheel to the right of the window. The number set in will establish the number of photoflash cartridges ejected during a single photo run.

SENSOR CONTROL PANEL NO. 3

The sensor control panel No. 3 (figure 1-7) is located on the aft cockpit right console.

Percent Overlap Knobs

Three % overlap knobs are provided to control the pulse rate to each camera station: FWD STA (forward camera station), LOW ALT (low altitude camera station), and HIGH ALT (high altitude camera station). Each knob has positions of 12% and 56%. When the knob is positioned to 12%, a signal is supplied to reduce the pulse rate to produce a 12% overlap of each photograph. When 56% is selected, no signal is applied and the cameras will operate at the normal pulse rate to produce a 56% overlap of each photograph. The percent overlap knob will not change the percent of overlap on the KA-56 low altitude panoramic camera. The camera has a fixed 56% overlap. When NIGHT mode is selected and the percent of overlap is set on 56%, the photoflash cartridges will be ejected at a rate sufficient to provide 56 percent overlap of each photograph.

Percent of Cloud Cover Knob

The % cloud cover knob has positions of 0, 25, and 50 to describe the approximate percent of cloud cover existing below the airplane. The function of this switch is to send a correction factor to the cameras by overriding the automatic exposure function, thereby compensating for high reflectivity of the clouds.

Window Defog Knob

The window defog knob has positions of ON and OFF. Placing the knob to the ON position activates a window defog blower in the camera compartment which circulates warm compartment air through a manifold system across the camera windows. The RSO should attempt to anticipate window fogging and frosting by turning the window defog knob ON at least 15 minutes prior to operation of any camera. The window defog should be left on at least 10 minutes after a descent for a low level reconnaissance run. The window defog need not be turned off during a photo run since the blower will automatically shutdown any time the camera compartment temperature exceeds 110°F.

FILM/CARTRIDGE REMAINING PANEL

The film/cartridge remaining panel (figure 1-5), located on the aft cockpit instrument panel, provides a digital display of the amount of film remaining in feet, within the following sensors: FWD STA (forward camera station), LEFT (left oblique camera), VERT (vertical camera), RIGHT (right oblique camera), IR (infrared sensor), HIGH ALT (high altitude camera station), and SLR (side looking radar sensor). The total number of photoflash cartridges remaining in the cartridge ejector units is displayed in the window marked CART REMAINING. The digital numbers will count down with each foot of film used, or cartridge fired. The total film footage and number of cartridges are set during camera loading by the camera loading crew.

Cartridge Salvo Switch

The cartridge salvo switch is a cover-guarded toggle switch with positions of JETT and NORM. The function of the switch is to provide an emergency means to salvo all remaining photoflash cartridges. Utility hydraulic power and electrical power from the essential bus is used to open the ejector doors and ripple-fire the photoflash cartridges when the cartridge salvo switch is placed to JETT. The weight must be off the landing gear or the gear handle must be up to permit cartridge salvo. The cartridges will not fire if the ejector doors remain closed.

FILM/MAT TEST PANEL

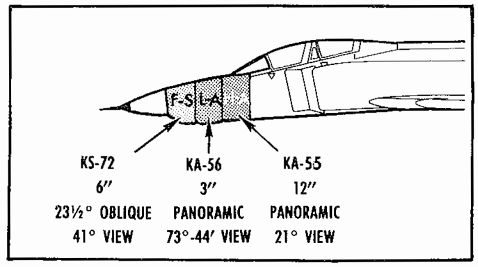
The film/mat test panel (figure 1-5), located on the aft cockpit instrument panel, provides a means to determine the nature of a sensor malfunction indication. The panel contains a sensor selector knob with positions of IR (infrared sensor), FWD STA (forward camera station), LEFT (left oblique camera), VERT (low altitude vertical camera), RIGHT (right oblique camera), HIGH ALT (high altitude camera station), and SLR (side looking radar sensor). When an amber fail light illuminates on the sensor control panel No. 1, rotate the sensor selector knob to the position that agrees with the failed sensor. The telelight panel will now indicate the cause of the sensor failure by illumination of one or more of the following lights: "Camera Fail", "Film Fail", "Mat Fail". If the amber fail light on the IR select button illuminates and none of the lights on the telelight panel illuminate when the sensor selector knob is placed to IR, the failure is within the IR system. Perform IR BIT checks to isolate the failure. The film/mat test panel also contains the RSO's extra picture switch. The function of this switch is described under Extra Picture switch, this section.

TELELIGHT PANEL

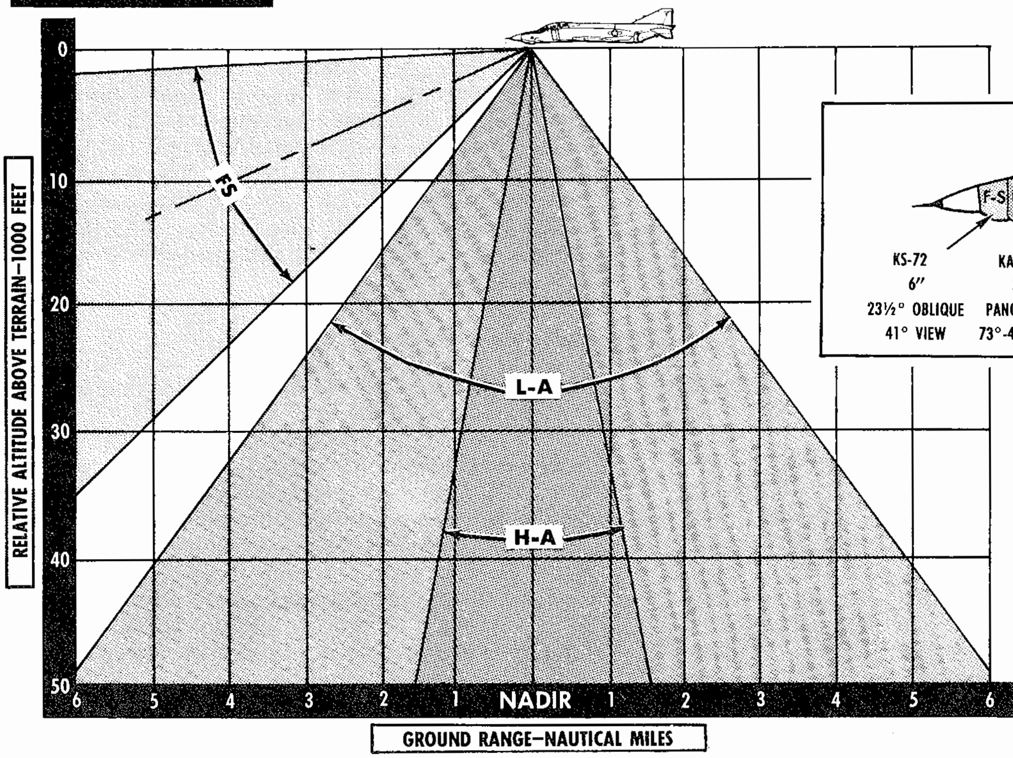
The telelight panel (figure 1-7), located on the aft cockpit right sub panel, provides a method of identifying the source of failure occurring in the reconnaissance sensors. The "Camera Fail", "Film Fail", and "Mat Fail" lights operate in conjunction with the sensor selector knob, on the film/mat test panel, to determine the failed portion of the selected sensor.

Camera Area Coverage

STATION	
FS	FORWARD
L-A	LOW ALTITUDE
H-A	HIGH ALTITUDE



BASIC CONFIGURATION



BASIC CONFIGURATION

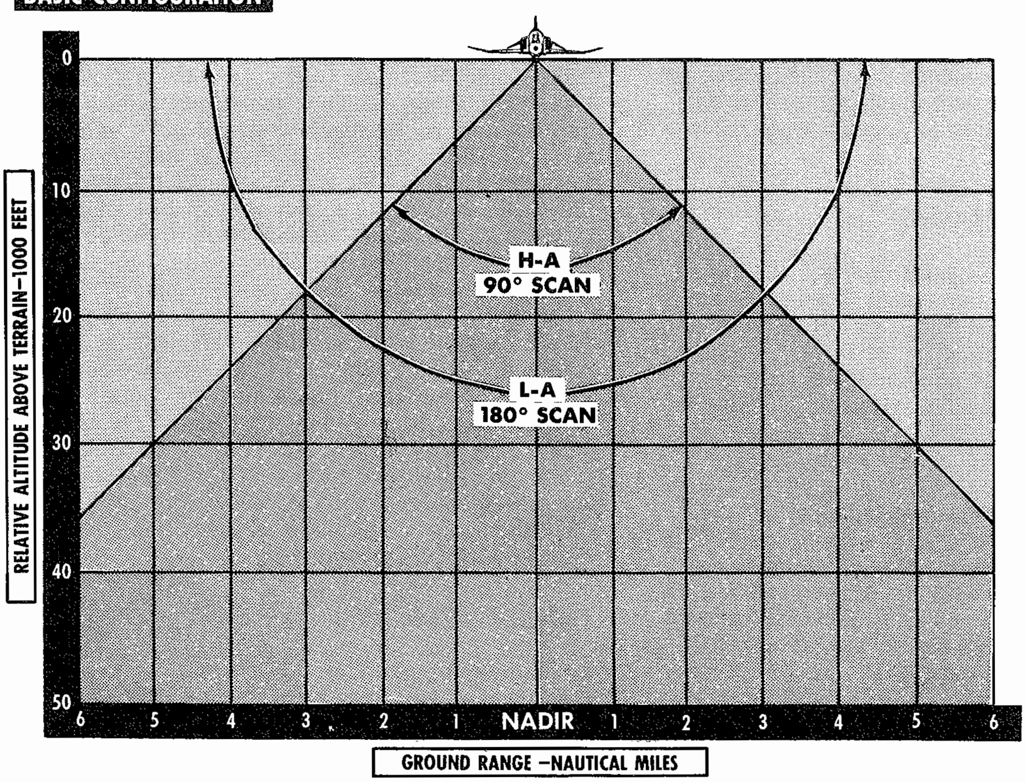


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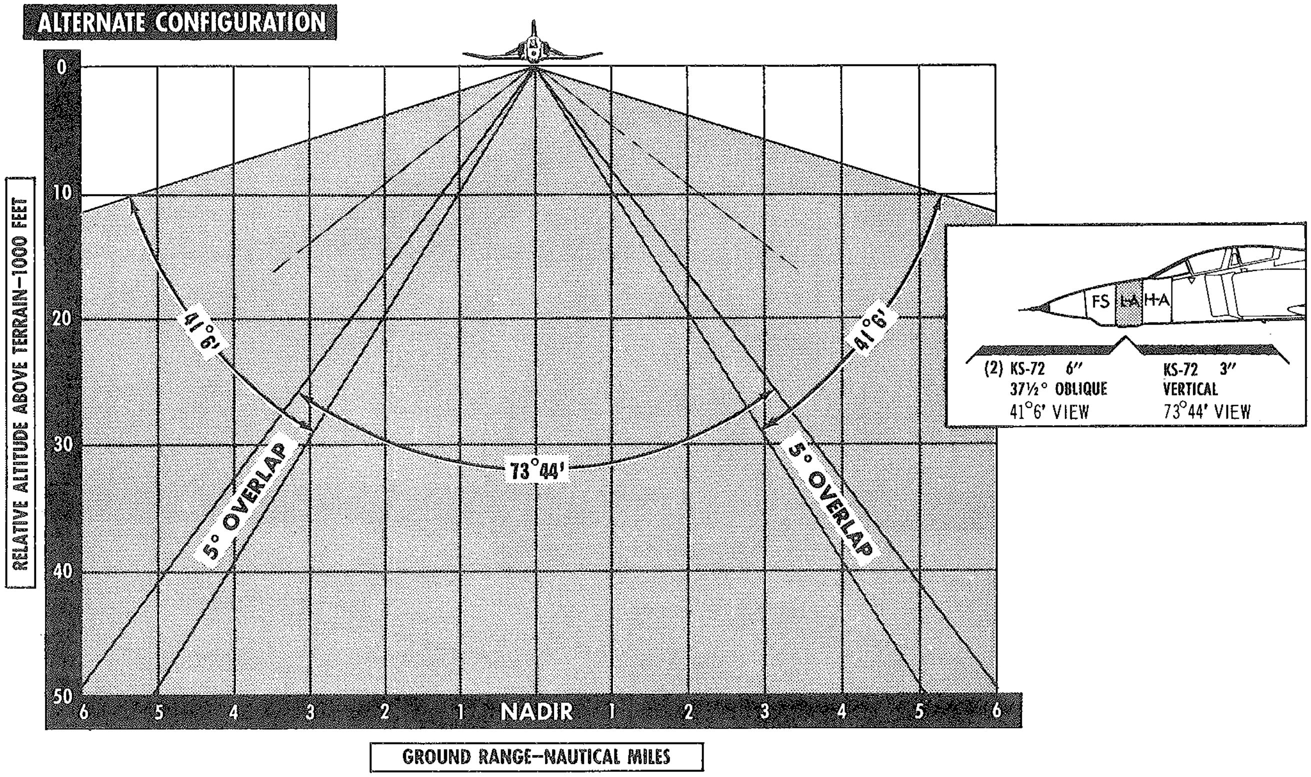
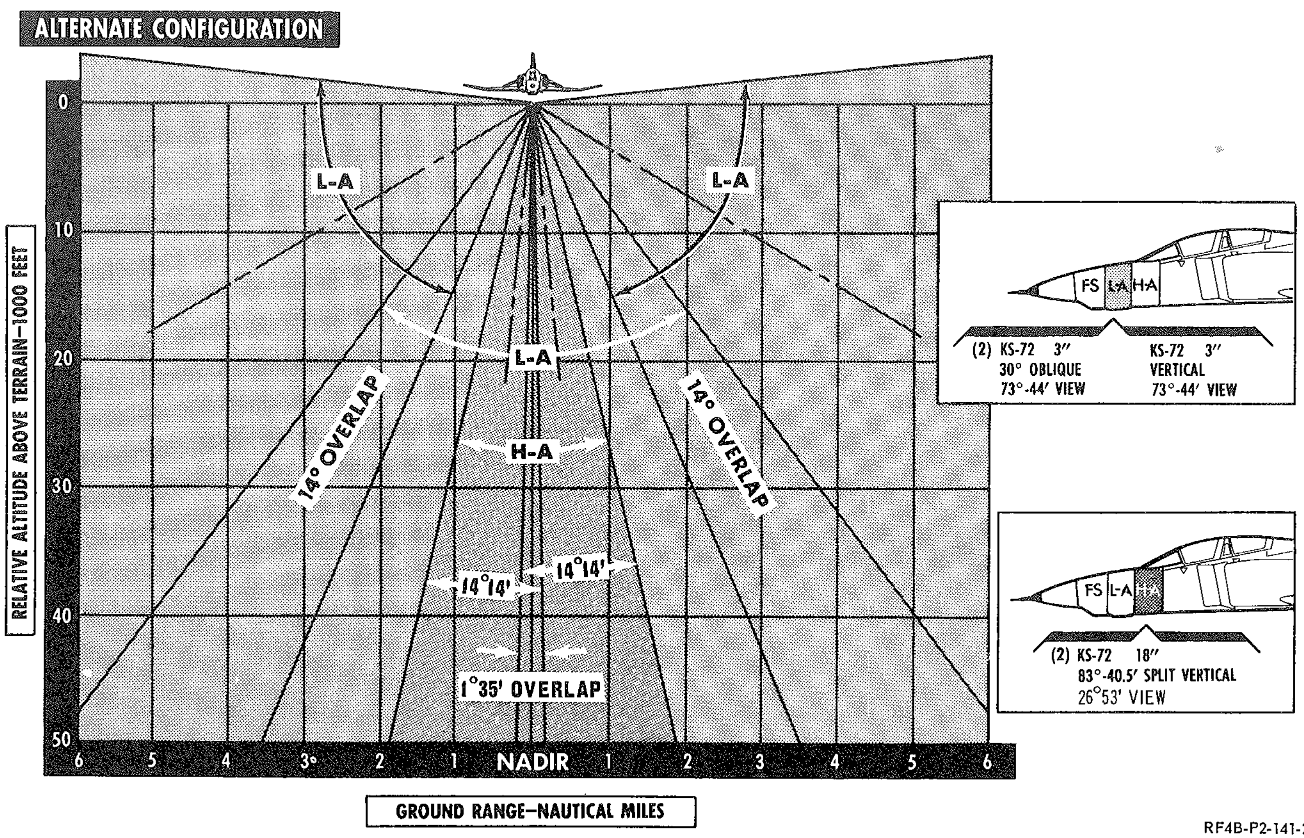
Figure 1-46 (Sheet 1)

Camera Area Coverage





UNCLASSIFIED

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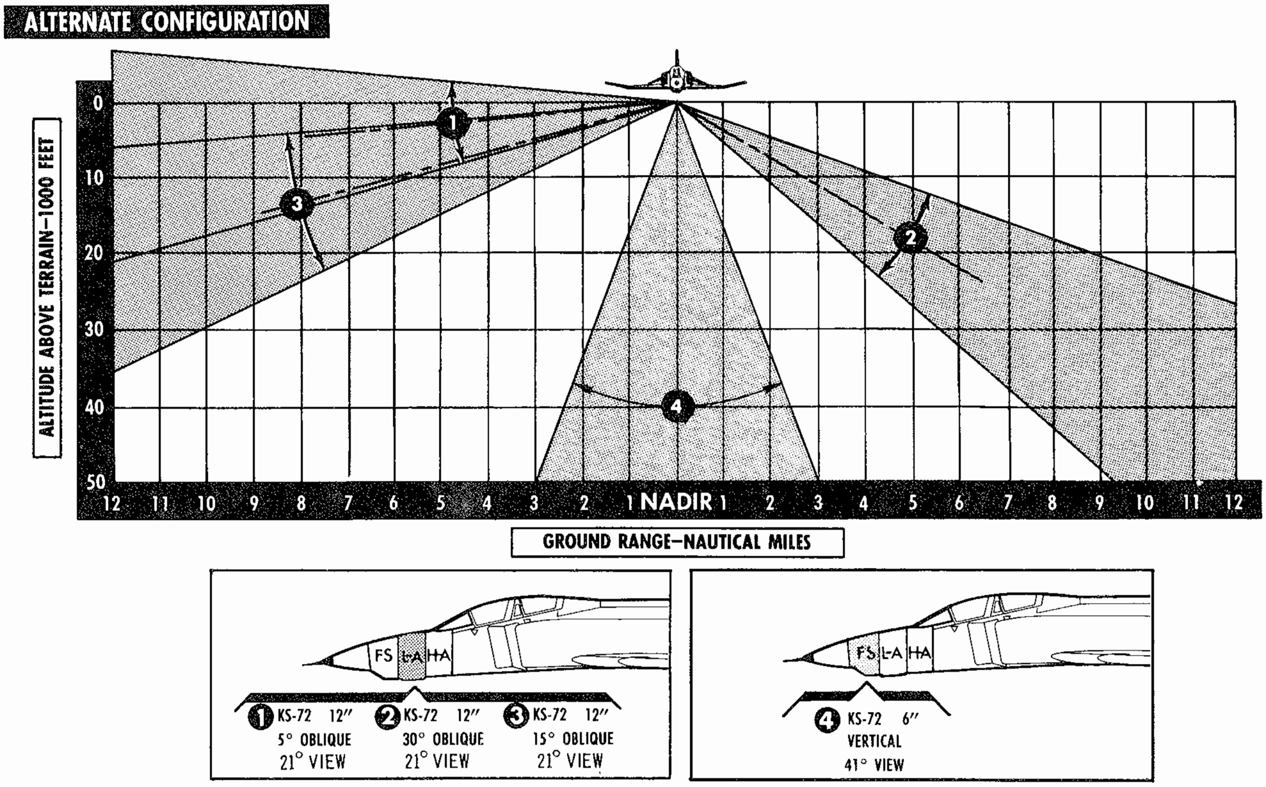
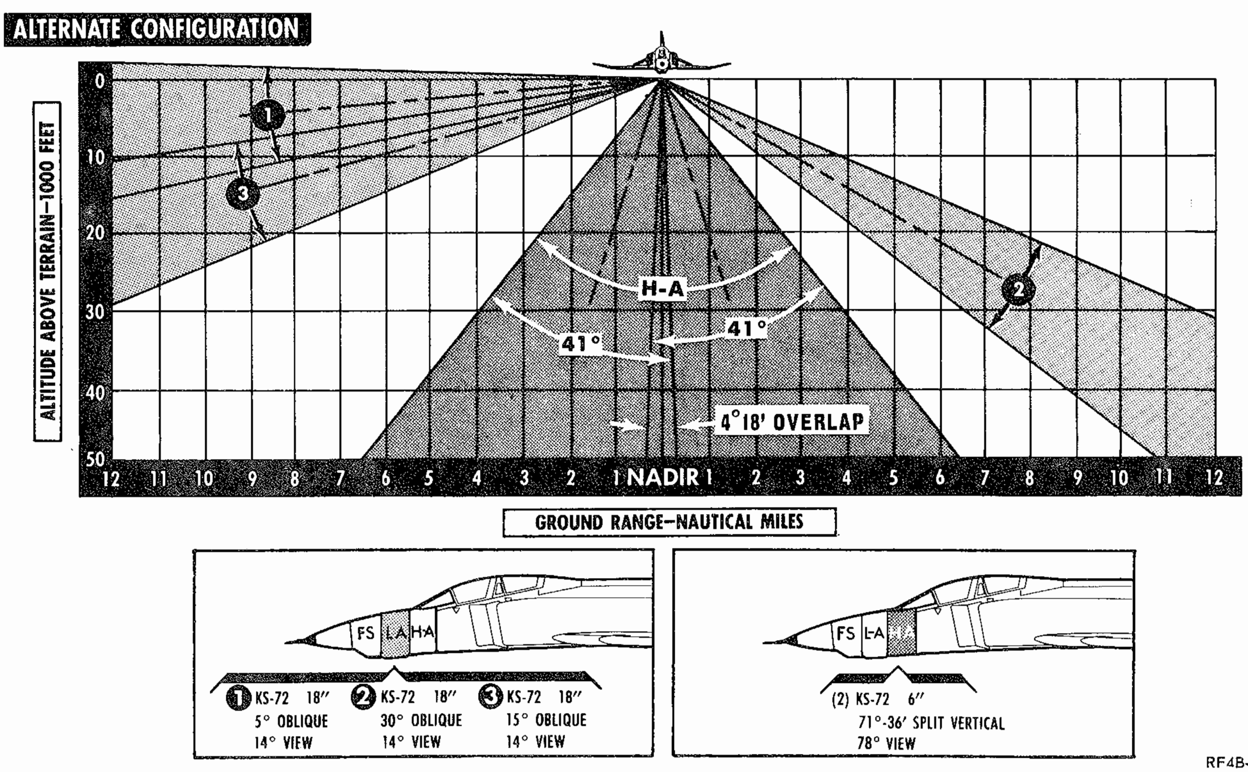
Figure 1-46 (Sheet 2)

Camera Area Coverage





UNCLASSIFIED

RF4B-P2-141-3

Figure 1-46 (Sheet 3)

The "IR Door Fail" light, on the telelight panel, and the amber fail light, on the sensor control panel No. 1, will illuminate when the IR doors remain closed after IR sensor selection. The "SLR Caution" light will illuminate to identify a high temperature or low pressure condition within the side looking radar. The "Plt Sensor O'ride" (pilot sensor override) light will illuminate when the pilot has depressed the camera master operate button on the recon control panel. The "V/R Pwr" (voice recorder power) light will illuminate when power is applied to the recorder by placing the voice record power switch to ON. The "L Cart Door Fail" and "R Cart Door Fail" (left and right cartridge ejector door fail) lights will illuminate until the cartridge ejector doors are fully open when night mode is selected. These lights will not illuminate when the cartridge ejector doors are closing.

AUXILIARY CAMERA EQUIPMENT

Aircraft Camera Parameter Control (ACPC)

The aircraft camera parameter control (LA-311) consists of one unit, located between the forward and the low altitude camera station (figure 1-41), and operates from 28 volts d-c and 115/200 volt 400 cycle a-c power. The ACPC receives 28 volt d-c signals from the sensor control panel No. 1 to indicate the particular camera station and/or sensors selected for operation. V/H (ground speed/airplane altitude above ground level) input data is received from the inertial navigation set and the electronic altimeter set when in the automatic mode and from the viewfinder when in the manual mode. A Vg (ground speed) input signal is received from the inertial navigation set and is used to generate fiducial pulses. The ACPC produces a pulse signal to initiate the shutter tripping cycle, advance the cartridge remaining counter, and eject the photoflash cartridges. It also provides a d-c signal that causes the film to move, during exposure, at a speed proportional to the relative movement of the object being photographed. This is referred to as IMC (image motion compensation). Another d-c signal is generated which is 10 times the V/H input and is routed to the high and low altitude panoramic cameras and the infrared detecting set. This signal is utilized by the low altitude panoramic camera to determine exposure cycle rate and IMC. The high altitude panoramic camera utilizes it only to determine IMC while the infrared detecting set utilizes it to determine magazine film speed and which one of two fields of view is used. Finally, the ACPC provides a pulse to the infrared detecting set and the side looking radar to produce five-mile fiducial marks as a function of Vg. This signal is also supplied to the data display set for data block insertion. Camera parameters of focal length, depression angle, and format, which affect pulse rate, are manually set on the ACPC during camera installation.

Aerial Photoflash Cartridge Ejector

The photoflash unit (figure 1-41) provides illumination for night photographic reconnaissance. There are four photoflash ejectors mounted in pairs in compartments located on both sides of the upper aft fuselage. The two hydraulically actuated doors, when closed, are flush with the aircraft fuselage. The doors are actuated open by pulling out the camera mode knob on the sensor control panel No. 2 and rotating to NIGHT L or NIGHT R. Two caution lights on the rear cockpit telelight panel will illuminate if the doors are not fully open. The photoflash unit is set up to fire by placing the camera mode switch to NIGHT L or NIGHT R. The camera select button(s) must be depressed and the count limiter set for the number of photoflash cartridges to be fired. When starting the run, the master operate button is depressed and the cartridges will fire in sequence until the number of cartridges selected have been fired. The firing sequence can be stopped at any time by depressing the master operate button. If the left ejector racks are selected, the firing sequence will fire the left racks first, then automatically step over and fire the right racks, limited by the number of cartridges selected on the count limit indicator. If the right racks are selected, the firing sequence will stop when all the right cartridges are fired. The ejector doors are closed by placing the camera mode switch in OFF or DAY. Selection of the JETT position on the film remaining panel will fire all remaining cartridges in a ripple firing sequence. Two types of ejectors may be used dependent upon which type of photoflash cartridges are used. One ejector holds twenty-six M112 photoflash cartridges. The other ejector holes 10 of the larger M123 cartridges. The left and right ejector compartments may be loaded with any combination of the two types of ejector racks.

Photoflash Camera Control Detector (LA-285A)

As each photoflash cartridge illuminates, the rate of change of light intensity is measured by the photoflash detector (figure 1-41). When a pre-determined light intensity is reached, a signal from this unit will trip the shutter of the KS-72 vertical framing camera.

Photoflash Cartridges

Two types of cartridge ejectors may be installed. One contains M112 cartridges and the other contains M123 cartridges. The M112 cartridges produce an average peak illumination of 110-million candlepower. These cartridges are used for low altitude night photography at altitudes from 500 feet to 4000 feet. The M123 cartridge is considerably larger and produces an average peak illumination of 260-million candlepower. These cartridges can be used for night photography for altitudes up to 8500 feet. There are three time delays for each of the cartridges from ejection to burst. However, only the one-second delay on the M112 and the two-second delay on the M123 will be used. The cartridge cases are marked to indicate the time delay of the cartridge.

Aircraft Camera Mount Set (LS-58A)

The purpose of the vertical stabilized mount is to stabilize the camera in a vertical attitude and align the camera with the airplane ground track. The stabilized camera mount is installed in the high altitude station and used with the KA-55 high altitude panoramic camera or the KS-72 camera mounted vertically. The stabilized camera mount is operated and controlled by the camera mount knob located on the sensor control panel No. 2 and monitored by the "Ready/Fail" light located above the knob. The camera mount knob must be in STBY for approximately 10 minutes prior to placing the knob to ON. During this warmup period, the gyro is erecting while the mount remains caged, and the mount "Ready" light illuminates. After initial warmup, the mount may be switched at anytime from ON to STBY, remain in STBY indefinitely, then be switched back to ON with full operationaly capabilities in 3.5 seconds. The mount "Ready" light will go off (and the "Fail" light will come on) if the airplane attitude exceeds ± 8 degrees in pitch or roll. The inertial navigation set supplies a voltage which automatically aligns the stabilized mount in azimuth (10 degrees left or right) to correct for drift angle.

Aerial Photographic Film Ejector Assembly

The ejectable film cassette, when installed with the low altitude panoramic camera, can be ejected when the recon selector knob is on FILM EJECT (pull knob to rotate switch to film eject), the landing gear handle is in the UP position, and the cassette eject button is momentarily depressed. When the cassette eject button is depressed, power is routed to an electrical relay which energizes a pneumatic actuator system causing the ejector door to open downward. Within 1.5 seconds, the door is fully open. At this point, a limit switch fires a gas generator cartridge which initiates: (1) cutting the film and mat, (2) retracting the film and mat into the cassette, (3) sealing the cassette, (4) retracting the film spool drive spindle, and (5) ejects the cassette. The parachute will deploy 2 seconds after ejection. The transmitter signal is initiated at parachute deployment and will transmit for two hours. After the cassette is ejected, the door must be closed by turning the recon selector knob away from the FILM EJECT position. The cassette may be ejected above an altitude AGL of 500 feet and below 10,000 feet.

Extra Picture Switch

The extra picture switch is the trigger switch located on the stick grip in the forward cockpit and is located on the film/mat test panel in the aft cockpit. The pilot can take an extra picture when the recon selector knob is in STA 1, STA2, or BOTH by momentarily depressing the trigger switch, providing the camera mode selector knob on the sensor control panel No. 2 is in DAY. This applies a 28 volt d-c pulse to the selected camera. The trigger switch must be actuated each time an extra picture is desired. When the cameras have been selected by the RSO, the pilot may insert an extra picture whenever he desires by rotating the recon selector knob to RSO SELECT and depressing the trigger switch. The RSO can take an extra picture with any camera (except the low altitude panoramic) that is operating by momentarily depressing the extra picture switch on the film/mat test panel. Unlike the pilot, the RSO cannot take an extra picture unless the camera is operating.

Side Oblique Optical Sight

The side oblique optical sight (figure 1-41) is a device used to aid the pilot in locating the optical centerline of the left and right side oblique cameras. The sight is adjustable to various camera depression angles and is stowed along the canopy sill. The lens element of the sight contains a series of concentric circles. The pilot is sighting down the camera optical centerline when the circles appear to the equidistant or centered.

SIDE LOOKING RADAR

For description of the side looking radar sensor, and figures 1-47 thru 1-49, refer to Classified Supplement NAVWEPS 01-245FDC-1A.

INFRARED DETECTING SET

For description of the infrared detecting set, and figures 1-50 and 1-51, refer to Classified Supplement NAVWEPS 01-245FDC-1A.

DATA DISPLAY SET AN/ASQ-90

The data display set provides a means of recording data concerning the aircraft's mission on the film of various cameras and system recorders. The recorded data includes time, latitude, longitude, radar altitude, barometric altitude, heading, drift, roll pitch, date, squadron and detachment, sortie number, and radar mode. This data is displayed on one-inch cathode ray tubes (one for each camera or recorder) and projected onto the film by optics with the camera or recorder. The format of the display is a rectangular array of dots which express the data in a binary coded digital form.

DIGITAL DATA INSERTER

The digital data inserter (figure 1-6) is located on the aft cockpit left sub panel. It provides a means to reset the real time source and to energize the digital display indicator which provides a visual readout of various flight information. Time is set on the standard clock face on the panel and is set into the data recording set by pressing the time insertion button. To visually check the data on the digital display indicator, press the press-to-test button on the upper right corner of the panel. A two position switch labeled AM/PM will add 12 hours to the zero time reference shown on the face of the clock when placed to the PM position.

DIGITAL DISPLAY INDICATOR

The digital display indicator (figure 1-5) is located on the right side of the main instrument panel in the aft cockpit. This unit is connected electrically parallel with the various other system digital display indicators. It will provide a visual readout of the flight information being recorded by the reconnaissance sensors when the press-to-test button on the digital data inserter is depressed.

NORMAL OPERATION

OPTICAL SENSORS

Viewfinder Preflight

With electrical power supplied and viewfinder circuit breaker in:

1. Remove the eye lens cover and clean the eye lens.
2. Turn the traveling grid and field illumination knobs clockwise to the extreme DIM position.
3. Traveling grid switch - OFF
4. Check eye lens for clear unfogged image.
5. Angle switch - NAR
6. Filter switch - CLR
7. Turn the field illumination knob counterclockwise until the narrow angle reticle lines are clearly visible.
8. Hold the drift switch alternately in L and R positions. Observe that the reticle rotates to the 10 degrees left and right limits.
9. Angle switch - WIDE
   Check for visible illumination of the reticle lines and adjust the field illumination control knob if necessary.
10. Hold drift switch alternately in L and R position and observe that the reticle rotates to the 10 degrees left and right limits.
11. Position the reticle to the 0 position.
12. Traveling grip switch - MAN
    The "MAN Only" light should illuminate.
13. Turn the traveling grid illumination control knob counterclockwise until the traveling grid lines are clearly visible.
14. Set the knots and altitude control knobs each to 100. Observe that the traveling grid lines are moving downward on the reticle track line at a steady rate.
15. Filter switch - YEL
    Check insertion of yellow filter.
16. Filter switch - OPAQUE
    Check all light is blocked from eye lens.

Day Photography

1. Circuit breakers - IN
2. Camera mode selector knob - DAY
3. Camera mount knob - STBY
   If the stabilized camera mount is used, place the camera mount knob to STBY 10 minutes prior to the photo run. After 10-minutes warm up time, the camera mount knob may be placed to ON.
4. Percent cloud cover - SET
   Set the percent cloud cover knob on the estimated percent of cloud cover below the aircraft.
5. Set percent overlap knob to percent of overlap desired.
6. Window defog knob - SET AS REQUIRED
7. Have the pilot set and check viewfinder operation:
   a. Filter switch - CLR or YEL (as desired)
   b. Angle switch - WIDE
   c. Hold drift switch L or R as required to align the reticle track line parallel to movement of passing ground images.
   d. Read drift correction from the drift scale.
   e. Traveling grid switch - AUTO
   f. Check "MAN Only" light out.
   g. The traveling grid lines should synchronize with the movement of terrain objects.

   Note

   If failure occurs in the automatic V/H data signal, the manual mode of the viewfinder is automatically energized and the "MAN Only" light will illuminate. Erroneous V/H data will be supplied to the ACPC until the proper altitude and ground speed is set on the altitude and knots control knobs. Therefore, the pilot should set the mission altitude and ground speed on the altitude and knots control knobs before flight and keep these settings current.

   h. Angle switch - AS DESIRED
   i. Select the "L" shaped marks on the wide angle reticle corresponding to the focal length of the installed vertical cameras. When they enclose the selected target, operate the desired camera.
   j. The 23 1/2 and 36 degree lines on the narrow angle reticle indicate the optical centerline of the forward camera in the oblique position and indicate when the camera should be operated.
8. Camera mount knob - AS REQUIRED
   If stabilized mount is used, the camera mount knob can be placed ON after 10 minutes warm-up time.
9. Have pilot place recon selector knob to RSO SELECT and position rotatable mounts to desired position.
10. Select the cameras to be operated by depressing the applicable select button on the sensor control panel No. 1. The green indicator lights on the buttons of the selected cameras should illuminate.
11. Master operate button - PUSH ON
    When over the photo target, either the pilot or RSO can operate the selected cameras by depressing their respective master operate button. The green indicator light on the master operate button should illuminate.
12. Monitor the film remaining indicators and the operate lights on the recon control panel to confirm operation of the cameras.

If pilot initiates forward or low altitude station cameras:

13. Recon selector knob - STA 1, STA 2, or BOTH
14. When over the photo target, depress the camera master operate button on the recon control panel. The green indicator light on the master operate button should illuminate and the operate lights for the applicable station should flash. The "Plt Sensor O'ride" light on the aft cockpit telelight panel will illuminate when the pilot operates the cameras.

Night Photography

1. Circuit breakers - IN
2. Percent overlap - SET AS DESIRED
3. Cartridge count limit - SET
   Set the number of photoflash cartridges to be fired on a single photo run in the count limit window.
4. Window defog knob - AS REQUIRED
5. Have pilot set viewfinder controls as follows:

   a. Traveling grid switch - AUTO
   b. Set mission altitude and ground speed on altitude and knots control knobs.

Note

Since the viewfinder will not provide a view of the terrain during night operation, the altitude and ground speed should be set on the altitude and knots control knobs so that the correct manual V/H signal will be supplied to the ACPC should the automatic V/H signal fail.

6. Camera mode selector knob - NIGHT L or NIGHT R
   When the camera mode selector knob is placed to either left or right night mode, both cartridge ejector doors will open. The "L and R Cart Door Fail" lights on the aft cockpit telelight panel will illuminate while the doors are opening, and go off when the doors are fully open.
7. Select the camera station to be operated by depressing the applicable select button on sensor control panel No. 1. The green indicator light on the applicable select button will illuminate.
8. Master operate button - PUSH ON
   When over the photo target, either the pilot or RSO can operate the selected cameras provided the pilot has the RSO SELECT position selected on the recon selector knob. The green indicator light on the master operate button will illuminate and the photoflash cartridges will begin to fire in sequence.
9. Monitor the cartridge remaining counter. After the number of cartridges set in the count limit window has been fired, the ejector pulse is automatically removed and the green indicator light on the camera select button will extinguish.

Camera Shutdown

1. Master operate button - PUSH OFF
   The green indicator light on the button will extinguish.
2. During day operation, camera station selector button - PUSH OFF
   The green indicator light on the button will extinguish when the button is depressed. During night operation, the button need not be depressed since selection of the cameras will be automatically discontinued when the preset number of photoflash cartridges are fired.
3. Camera mount knob - STBY
   Pause for one to three seconds with the knob in STBY to ensure the camera mount is caged prior to placing the knob to OFF.
4. Camera mode selector knob - OFF
   During night operation, the cartridge ejector doors will close when the knob is placed to OFF.
5. Window defog knob - AS REQUIRED

Cassette Ejection

1. Landing gear handle - UP
2. Recon selector knob - FILM EJECT
3. Cassette eject button - DEPRESS
   When over the drop area, depress the cassette eject button on the stick grip.
4. Recon selector knob - OFF (as required)
   After cassette ejection, place the recon selector knob to any position from FILM EJECT. This action will close the cassette ejector doors.

SIDE LOOKING RADAR

For SLR operating procedures, refer to Classified Supplement, NAVWEPS 01-245FDC-1A.

INFRARED DETECTING SET

For IR operating procedures, refer to Classified Supplement, NAVWEPS 01-245FDC-1A.

DATA DISPLAY SET

The data display set has no on-off switch; therefore, when aircraft electrical power is supplied, the data display set operates automatically. The sequence of operation for the data display set is completely automatic with the exception of inserting actual time. This is accomplished as follows:

1. Manually set the time on the face of the digital data inserter.
2. Place the AM/PM switch to AM if it is prior to noon or PM if afternoon.
3. Press the time insertion button and hold depressed for a minimum period of one second.
4. If monitoring of the system is desired, depress the press-to-test button on the digital data inserter for a display to appear on the digital display indicator.

EMERGENCY OPERATION

CARTRIDGE SALVO

Prior to an emergency landing, the photoflash cartridges should be salvoed to remove possible danger to the firefighting crew. Intense heat could cause the photoflash cartridges to fire through a closed ejector door. To salvo the photoflash cartridges, proceed as follows:

1. Landing gear handle - UP

2. Cartridge salvo switch - JETT
Placing the cartridge salvo switch to the jettison position will open both cartridge ejector doors and ripple fire the cartridges from the left and right ejectors respectively.

LIMITATIONS

Cassette ejection airspeed is limited to 0.7 Mach maximum and 200 knots IAS minimum. Cassette ejection altitude is limited to 10,000 feet maximum and 500 feet minimum.

REFERENCE PUBLICATIONS

If more detailed system information is required, refer to Items No. 21 and No. 29, on Maintenance Instruction Manuals Publication Index (flyleaf 3, this publication).

SPEED BRAKES

DESCRIPTION

Two hydraulically operated speed brakes are mounted on the underside of the airplane at the inboard wing panels. They are hinged on the forward side, permitting the brakes to open downward. The speed brakes are controlled from a switch on the throttle grip and may be positioned to any point in their travel. Due to the construction of the selector valve, the speed brakes will not close following a hydraulic pressure failure. When the emergency speed brake switch, located on the left console is placed in the RETRACT position, the speed brakes are hydraulically closed. The emergency speed brake switch is only useful in the event of a failure of the throttle mounted speed brake switch. The utility hydraulic system is used to operate the speed brakes.

SPEED BRAKE SWITCH

The speed brake switch (figure 1-2) on the throttle grip has three positions: IN, STOP and OUT. The STOP position is the normal position of the switch. Only the OUT position of the switch is momentary. Placing the switch in the OUT position will operate the speed brakes toward the extend position. When the switch is released, it will return to the STOP position. The STOP position deenergizes the selector valve and blocks all ports, forming a hydraulic lock which holds the speed brakes in any desired position. Selecting the IN position of the switch will close the speed brakes flush with the wing. The speed brakes will take 2-3 seconds to fully open and 2-3 seconds to fully close.

Note

The STOP position of the speed brake switch may not hold the speed brakes completely closed. This will be noted by the illumination of the "Speed Brake Out" light. If this occurs, position the speed brake switch to IN and leave in that position.

SPEED BRAKE OUT LIGHT

An amber "Speed Brake Out" light (figure 1-3), located on the telelight panel, will illuminate when either or both of the speed brakes are not fully closed.

Note

"Speed Brake Out" light does not light the "Master Caution" light.

NORMAL OPERATION

Normal operation of the speed brakes is accomplished through the three position throttle mounted speed brake switch. The IN position retracts the speed brakes, the OUT position extends the speed brakes, and the STOP position holds the speed brakes in any intermediate position. A "Speed Brake Out" light on the telelight panel will be illuminated any time the speed brakes are not closed.

EMERGENCY OPERATION

The speed brakes will automatically close in the event of an electrical failure. However, in the event of a hydraulic failure, the speed brakes will remain open until the throttle mounted speed brake switch is placed in the IN position. Air loads will then close the speed brakes to a low drag trail position. If a failure occurs in the throttle mounted speed brake switch, the speed brakes can be closed by placing the emergency speed brake switch in the RETRACT position.

LIMITATIONS

There are no specific limitations pertaining to the operation of the speed brakes.

REFERENCE PUBLICATIONS

If more detailed system information is required, refer to Item No. 4, on Maintenance Instruction Manuals Publication Index (flyleaf 3 this publication).

WING FOLD SYSTEM

DESCRIPTION

Each outer wing panel is folded upward and inboard by a conventional hydraulic actuator that receives hydraulic pressure from the utility hydraulic system. A mechanical locking system is installed in the airplane to lock wing pins in hinge fittings when wings are spread. A flush mounted control lever (figure 1-3), located on the right console in the pilot's cockpit, is connected by push rods and push-pull cables to a pin locking device in the wing fold area. Pulling UP on the lever unlocks wing pins, extends warning flags on the upper wing surfaces, illuminates the amber "L. Wing Pin Unlock" and "R. Wing Pin Unlock" lights in the front cockpit and energizes the wing fold. Wing fold is actually accomplished by a two-position toggle switch that is located underneath the wing pin release lever and is exposed when the lever is raised. The switch is marked FOLD and SPREAD. As an added safety precaution, the wing fold hydraulic circuit receives its hydraulic pressure from the landing gear down pressure line. This will prevent pressurizing the wing fold circuit when the landing gear is UP. When folding or spreading the outer panels, observe the following precautions:

a. Jury struts removed.
b. Do not fold or spread wings broadside of the blast of an aircraft's engines.
c. Do not fold or spread wings in winds over 60 knots.

NORMAL OPERATION

Normal operations consist of folding and spreading the wings, and is accomplished through the wing fold panel located on the right console. To fold the wings, pull UP on the wing lock lever, and place the wing fold switch in the FOLD position. To spread the wings, remove the jury struts, and place wing fold switch in the SPREAD position. After the panels have spread and pins have extended, push DOWN on the wing pin lock lever. Red warning flags, which are attached to the wing pin locks, will be flush with the wing skin if the wing pin locks are fully inserted. The warning flags will extend above the wing surface, inboard of the wing fold line, when the wing pin locks are not inserted. When the wing pin locks are fully inserted the "L. Wing Pin Unlock" and "R. Wing Pin Unlock" warning light will be extinguished.

EMERGENCY OPERATION

There is no emergency operation pertaining to the wing fold system.

LIMITATIONS

Whenever the aircraft is parked or towed with wings folded, jury struts will be installed. Taxiing with wings folded and jury struts not installed will be held to a minimum. Aboard ship, jury struts will be inserted any time wings are folded.

REFERENCE PUBLICATIONS

If more detailed system information is required, refer to Item No. 4 on Maintenance Instruction Manuals Publication Index (flyleaf 3 this publication).

PART 3 SERVICING

GENERAL INFORMATION

DESCRIPTION

The servicing data contained in this Part is provided to lend assistance to the crewmembers in the event the airplane lands at a strange field and/or the maintenance crews are unfamiliar with the aircraft.

AUTHORIZED AGE

The following is a list of authorized AGE peculiar to servicing and ground handling.

1. CP-5 (RCPP-105, RCPT-105 and MD-3) starting unit. This unit has a pressure ratio of 5.5:1 and delivers 178 lb/min at 74.5 psig on a standard day.

   a. Substitute starting units
   - MA-1A
   - MA-2
   - MA-3
   - 502 (502-7D)
   - NSL SOLAR
   - GTC-85

The starting air requirements for the aircraft are as follows:

Ambient Temp.	Airflow	Air Press.	Air Temp.
-65°F	250 lb/min	74.3 PSIG	352°F
60°F	178 lb/min	60.5 PSIG	474°F
100°F	138 lb/min	54.3 PSIG	513°F

Some of the substitute starting units listed may not meet these requirements individually, and will have to be used in pairs. Consult the specification tag on the unit to be used.

Note

Refer to ABC Air Standardization Agreement, 11/11A, 11/13A and 17/22A for specifications of British and Canadian starting units.

2. Fuselage jack (20 ton capacity) Part No. 3917
3. Wing and jack pad assembly, Part No. MDE3206-301
4. Hydraulic axle jack (15 ton capacity) Part No. MDE32899-1
5. Hydraulic axle jack (5 ton capacity) Part No. 983S
6. Mobile electric power unit (MC-7B)
7. Air conditioning unit (NRI)
8. Portable aircraft hydraulic system test stand (AHT-58)
9. Pre-oiler 36-100 or PON-5
10. Liquid oxygen servicing trailer, LOX 50-3
11. Nitrogen or air servicing trailer, 900593

CONSUMABLE MATERIAL

The following is a list of consumable materials peculiar to servicing.

1. MIL-J-5624JP-5 Ashore/Afloat
2. MIL-J-5624JP-4 Ashore
3. MIL-G-5572B AVGAS 115/145 Emergency
4. MIL-H-5606 Hydraulic Fluid
5. MIL-L-23699 Engine Lubricating Oil
6. MIL-L-7808 Engine Lubricating Oil (Alternate)
7. MIL-L-6085 Lubricating Oil
8. MIL-O-27210A Liquid Oxygen (Type II, Grade B)
9. BB-N-411a Type I, Class I, Grade A Nitrogen (gaseous)
10. BBN-411a, Type II, Grade A Nitrogen (Liquid)

CAPACITIES

The following is a list of tank/reservoir capacities.

Fuel

INTERNAL - 1936 Gallons; 13,165 Pounds
MAXIMUM - 3282 Gallons; 22,318 Pounds

Hydraulic Systems Reservoirs (Zero Pressure)

PC-1 - 0.83 Gallons
PC-2 - 0.83 Gallons
Utility - 1.84 Gallons

Engine Lubrication System

5.3 Gallons (each)

Oxygen Supply

10.0 Liters

PRESSURES

The following is a list of pressures peculiar to servicing.

Tires

Dry nitrogen should be used for tire inflation, since it is inert and therefore will not support combustion. Clean dry air may be used in an emergency situation, but should be removed and replaced with nitrogen at the first opportunity.

	Ashore	Afloat
Nose		
(under 42,000 pounds)	100 psi	300 psi
(42,000 to 49,500 pounds)	125 psi	
(over 49,500 pounds)	150 psi	
Main		
(under 42,000 pounds)	300 psi	475 psi
(42,000 to 49,500 pounds)	365 psi	
(49,500 to 52,000 pounds)	400 psi	
(over 52,000 pounds)	425 psi	

Pneumatic System

3,000 ± 100 psi

Landing Gear Struts

Refer to strut pressure vs. extension chart located on the individual struts.

Arresting Gear Cylinder

Refer to the temperature vs. pressure placard located on the cylinder.

STARTING UNIT CONNECTIONS

RCPP-105

a. Open access door 120 and connect air supply hose to airplane.
b. Open access door 26L and connect a-c electrical power cable to airplane.
c. Start Unit.
d. Place unit control transfer switch to PILOT position.
e. Place unit a-c and d-c power switches to ON position.
f. Place output air selector switch to the 5:1 position.
g. Place both airplane generator switches to the EXT position.
h. Execute the starting procedure.

Substitute Units

Note

The alternate units must be hooked up in pairs to supply sufficient air to start the engines and will require a CP-5 connector or Douglas K4449271 wye connector.

STARTING

If substitute units are employed, and starting rpm seems to be handing up, proceed as follows:

Note

When attempting an engine start, there is a possibility that the starter air valve will not open when the start switch is actuated. This does not mean that the solenoid operated valve is completely inoperative, it may be that the valve is only sticking in the closed position. In the event the valve will not open, have the air shut off at the starter cart, and then actuate the start switch. The stuck valve, unopposed by air pressure, may open.

At any rpm over 5%.

1. Ignition button - DEPRESS, THROTTLE IDLE
2. Exhaust gas temperature - MONITOR
3. If EGT starts to move up rapidly as it passes 650°C - DISCONTINUE START, THROTTLE OFF
4. Let engine coast until EGT drops to 250°C - DEPRESS IGNITION BUTTON, THROTTLE IDLE

At 250°C the engine rpm should be approximately 12% rpm, so the second relight should be successful. If it is not successful, repeat the procedure, cutting the engine when it starts to overtemp and relighting when it cools to 250°C. A little rpm will be gained each time.

COCKPIT PROCEDURES

It may be necessary to use the following substitute procedures due to operational expediency.

REFUELING

Engines Operating

1. Refuel probe switch - REFUEL
2. Attach fueling nozzle.

Engines Off Without Electrical Power-

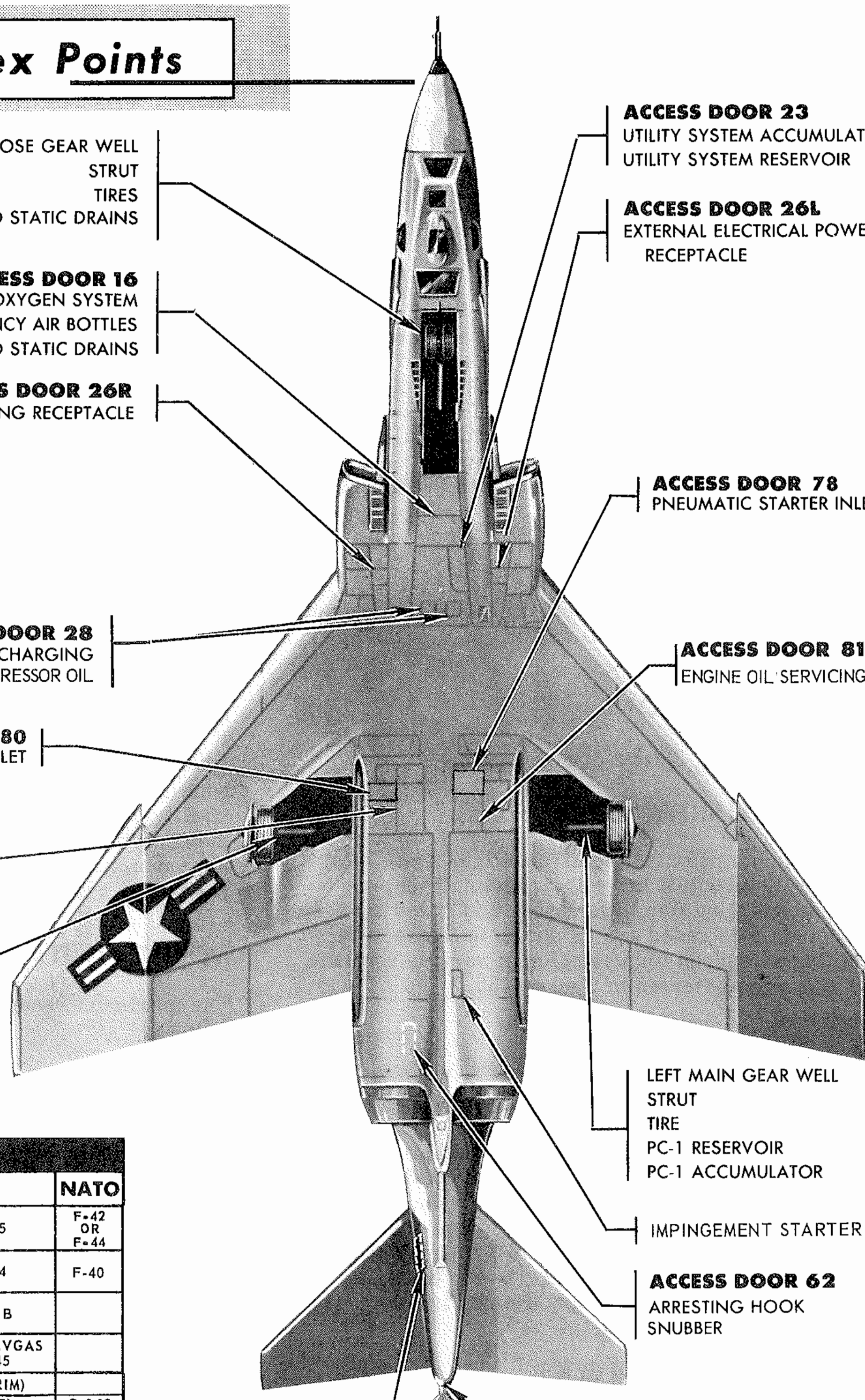
(Prior to Shutdown)

1. Refuel probe switch - REFUEL
2. Throttles - OFF

(After Shutdown)

3. When generators drop off the line, place engine master switches - OFF
   (This prevents the motor operated fuel level shutoff valves from closing.)
4. Refuel probe switch - RETRACT
5. Attach fueling nozzle.

Servicing/Index Points



SPECIFICATIONS

				NATO
FUEL	PRIMARY	ASHORE OR AFLOAT	MIL-J-5624, JP-5	F-42 OR F-44
		ASHORE	MIL-J-5624, JP-4	F-40
	COMMERCIAL		JET A-1 or JET B	
	EMERGENCY		MIL-G-5572 B, AVGAS GRADE 115/145	
OIL	TURBINE ENGINE		MIL-L-23699 (PRIM)	
			MIL-L-7808 (ALT)	O-148
HYDRAULIC FLUID			MIL-H-5606	H-515
OXYGEN	LIQUID		MIL-O-27210A, TYPE II, GRADE B	
NITROGEN	GASEOUS		BBN-411A, TYPE I, CLASS I, GRADE A	
	LIQUID		BBN-411A, TYPE II, GRADE A	

Note

THE BASIC AND AFTERBURNER FUEL CONTROLS MUST BE ADJUSTED FOR SPECIFIC DENSITY OF THE FUEL BEING USED.

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Figure 1-52

PART 4 OPERATING LIMITATIONS

AIRCRAFT

GENERAL

All airplane/systems limitations that must be observed during normal operation are covered or referencedherein. Some limitations that are characteristic only of a specialized phase of operation, i.e., 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 1-53 and noted in the applicable text.

ENGINE LIMITATIONS

Refer to Engines, Part 2 of this section.

AIRSPEED LIMITATIONS

The maximum permissible airspeeds in smooth or moderately turbulent air with arresting hook, landing gear and wing flaps retracted, and speed brakes retracted or extended are as shown in figure 1-54. Limiting airspeeds for operation of various airplane systems are presented in figure 1-55.

CAUTION

When flying at airspeeds in excess of 350 knots IAS below 10,000 feet with C.G. location aft of 32.0 percent MAC, avoid abrupt control motions. C.G. locations aft of 32.0 percent MAC will normally occur whenever full internal fuel is maintained in conjunction with external stores. Refer to Handbook of Weight and Balance, AN-01-1B-40, to determine C.G. locations of specific configurations prior to takeoff.

PROHIBITED MANEUVERS

1. Full-deflection aileron rolls in excess of 360°.
2. Intentional spins.
3. Abrupt control movements when carrying the 600-gallon external fuel tank.
4. Lateral control deflections in excess of 1/2 of total stick travel when carrying the 600-gallon external fuel tank or the 370-gallon external wing tanks.
5. With the AFCS engaged, intentional manuevers that exceed the automatic disengagement limits of the AFCS.
6. Lateral control deflections in excess of 1/3 of total stick travel when carrying the RCPP-105 starter pod.
7. Negative "g's" in excess of 30 seconds.
8. Zero "g's" in excess of 10 seconds.

ACCELERATION LIMITATIONS

The maximum accelerations permitted for flight in smooth air are shown in figure 1-56 except that moderate and heavy buffeting shall be avoided. When flying faster than 2.0 Mach, the maximum acceleration for symmetrical flight shall not exceed -1.0 "g" or +3.0 "g's". In conditions of moderate turbulence, it is essential that accelerations resulting from deliberate maneuvers be reduced 2.0 "g's" below that shown in figure 1-56. This is to minimize the possibility of overstressing the airplane as a result of the combined effects of gust and maneuvering loads. Maximum accelerations for inflight operation of various airplane systems are shown in figure 1-55.

WEIGHT LIMITATIONS

The maximum recommended gross weights are as follows:

Field takeoff	54,800 pounds
Field landing (flared)	38,000 pounds
Catapulting	54,800 pounds
Arrested landing, touch-and-go, and FMLP	34,000 pounds
Barricade engagement	34,000 pounds

C.G. LIMITATIONS

The center of gravity for all currently permissible gross weights and configurations must be kept between 27.0% and 36.0% of Mean Aerodynamic Cord (MAC). For precise loading and C.G. data, refer to the Weight and Balance Data Handbook (AN-01-1B-40) for the specific airplane.

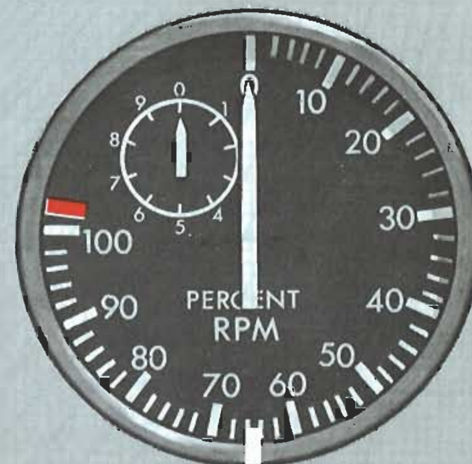
CARRIER OPERATIONS

For carrier approach and arrestment limitations, refer to the applicable recovery bulletin.

Instrument Range Markings

BASED ON JP-5 FUEL

	EXHAUST GAS TEMPERATURE
635°C	MAXIMUM STEADY STATE TEMP.



	TACHOMETER
102%	MAXIMUM

MIL-L-7808 OIL		MIL-L-23699 OIL
60 PSI	MAXIMUM	70 PSI
35 PSI	MINIMUM AT MILITARY RPM STEADY-STATE GROUND OPERATION	45 PSI
12 PSI	MINIMUM AT IDLE POWER	12 PSI
30-60 PSI	INFLIGHT NORMAL OPERATION AT MIL POWER AND ABOVE	40-70 PSI

Notes

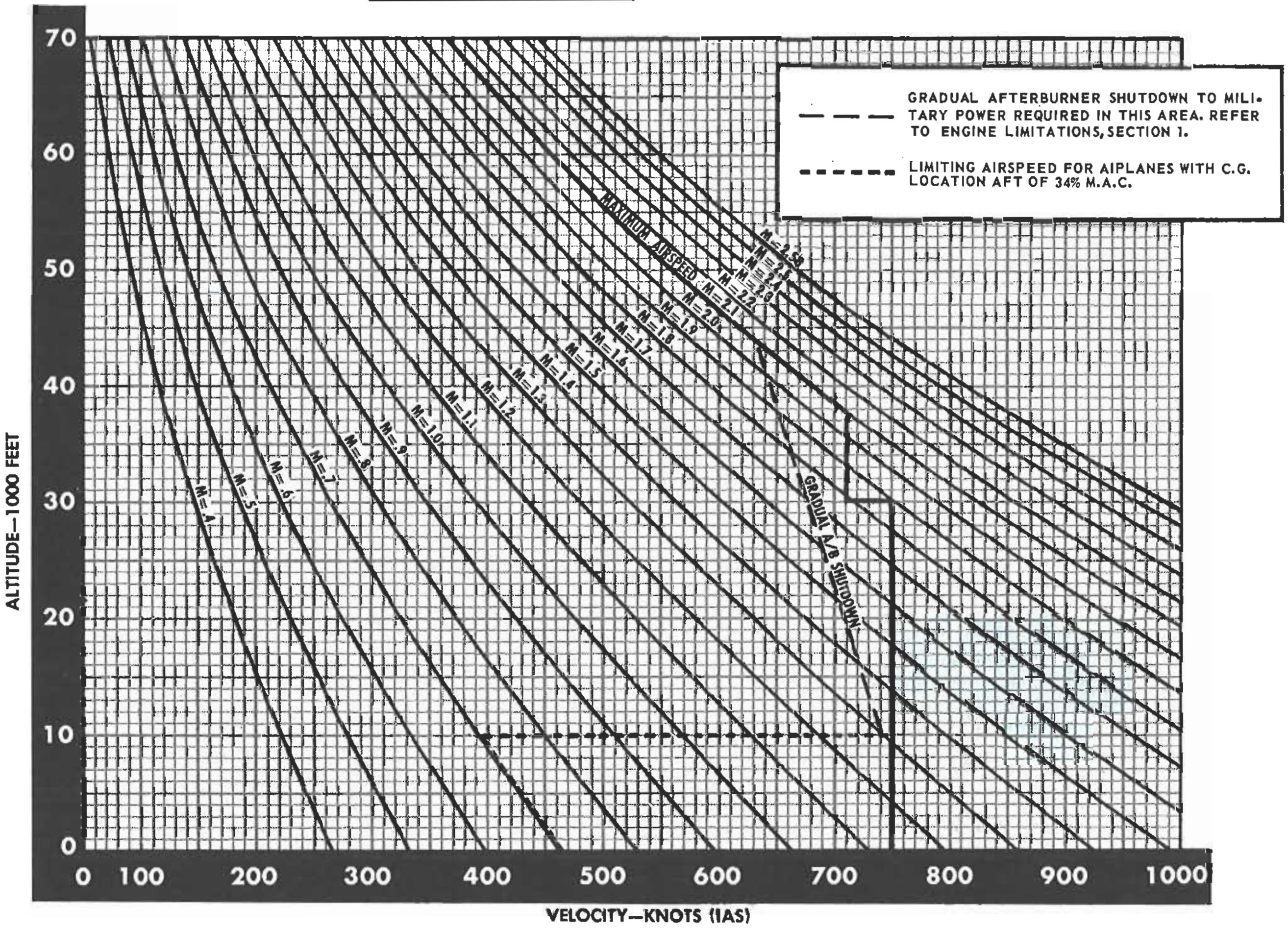
- FROM FLIGHT TO FLIGHT, INDICATED PRESSURE AT 100 PERCENT RPM MUST REPEAT WITHIN 5 PSI OF THE KNOWN NORMAL INDICATED PRESSURE OF A PARTICULAR AIRPLANE ENGINE COMBINATION.
- ANY STEADY-STATE OPERATION ERRATIC PRESSURE CHANGE WHICH EXCEEDS 5 PSI FOR MORE THAN 1 SECOND MUST BE INVESTIGATED.
- DURING T_2 CUTBACK AND OTHER ENGINE SPEED REDUCTIONS, INDICATED PRESSURE WILL DECREASE APPROXIMATELY 1 PSI PER 1 PERCENT REDUCTION IN RPM.

RF4B-P4-108
R

Figure 1-53

Airplane Speed Restrictions

BASIC AIRPLANE



NOTE: UNDER SOME CONDITIONS, MAXIMUM AIRSPEEDS ARE DETERMINED BY INLET TEMPERATURE LIMITATIONS. REFER TO INLET TEMPERATURE LIMITATIONS CHART, PART 2 OF SECTION 1 IN NAVWEPS 01-245FDC-1.

FOR AIRSPEED RESTRICTIONS CONCERNING OTHER CONFIGURATIONS, REFER TO EXTERNAL STORE LIMITATIONS CHART IN THIS SECTION.

RF4BS-P4-101F

Figure 1-54

Systems Operation Limitations

CONDITION		AIRSPEED or MACH Whichever is Less	LOAD FACTOR
LANDING GEAR EXTENDED		250 KNOTS IAS	0 TO + 2.0 "g's"
WING FLAPS FULLY OR PARTIALLY EXTENDED		250 KNOTS IAS	0 TO + 2.0 "g's"
RAM AIR TURBINE	INFLIGHT OPERATION	515 KNOTS IAS OR 1.1 MACH	0 TO + 3.0 "g's"
	EXTENDED	515 KNOTS IAS OR 1.1 MACH	−1.0 TO + 5.2 "g's"
AIR REFUELING PROBE	INFLIGHT OPERATION	300 KNOTS IAS OR 0.9 MACH	SAME AS BASIC AIRPLANE
	EXTENDED	400 KNOTS IAS OR 0.9 MACH	
CANOPY OPEN, GROUND OPERATION		60 KNOTS IAS	NOT APPLICABLE
CANOPY JETTISON, INFLIGHT		SAME AS BASIC AIRPLANE	SAME AS BASIC AIRPLANE
DRAG CHUTE DEPLOYMENT		200 KNOTS IAS	NOT APPLICABLE
OPERATION OF CASSETTE EJECTOR DOOR		MAXIMUM - 0.7 MACH MINIMUM - 200 KIAS (BELOW 10,000 FEET)	SAME AS BASIC AIRPLANE
OPERATION OF PHOTOFLASH CARTRIDGE EJECTOR DOORS		SAME AS BASIC AIRPLANE	SAME AS BASIC AIRPLANE

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Figure 1-55

EXTERNAL STORES

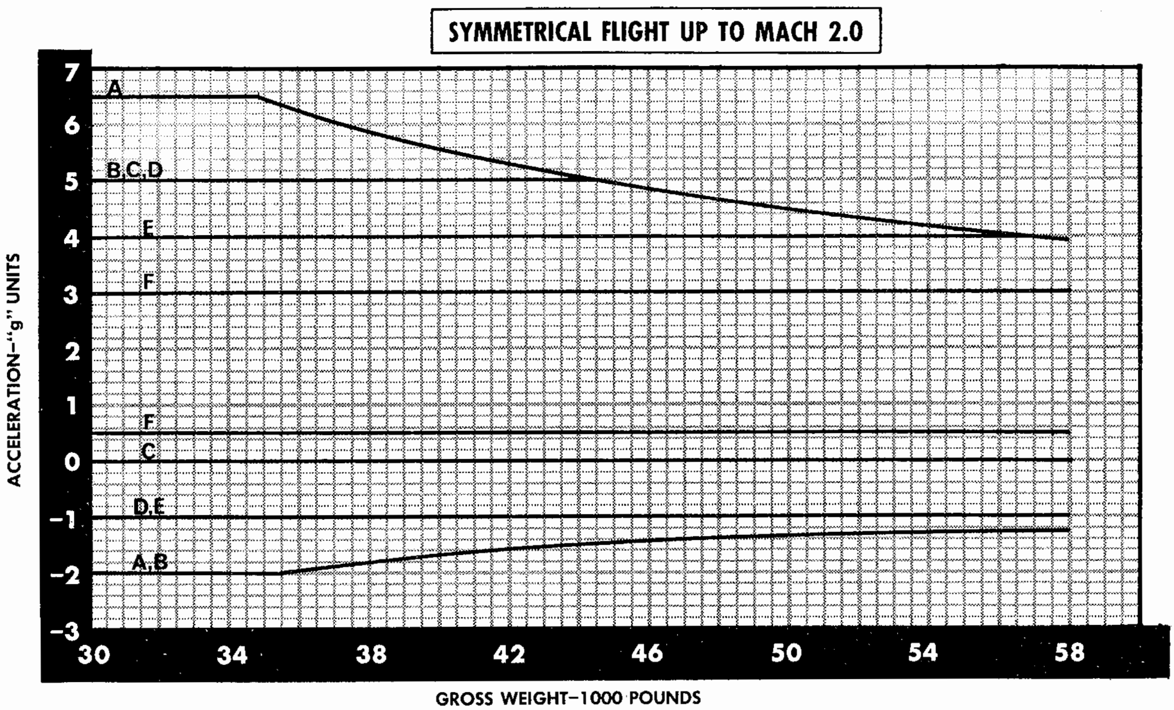
GENERAL

Only the external stores listed in figure 1-57 may be carried and released, singularly or in combination, by the aircraft. Operating limitations for flight, catapulting, and arrested landings with external stores are noted in figures 1-56 and 1-57.

CARRIER OPERATIONS

Carrier operations are not permitted with asymmetric external store landings in excess of 60,000 inch-pounds of static moment.

Acceleration Limitations



CONFIGURATIONS:

A. BASIC AIRPLANE
B. EMPTY TO ¾ FULL 370-GALLON EXTERNAL TANKS.
C. EMPTY TO ¾ FULL 600-GALLON EXTERNAL TANK.
D. RCPP-105 STARTER POD ON CENTERLINE STATION 5.
E. FULL 370-GALLON EXTERNAL TANKS.
F. FULL 600-GALLON EXTERNAL TANK.

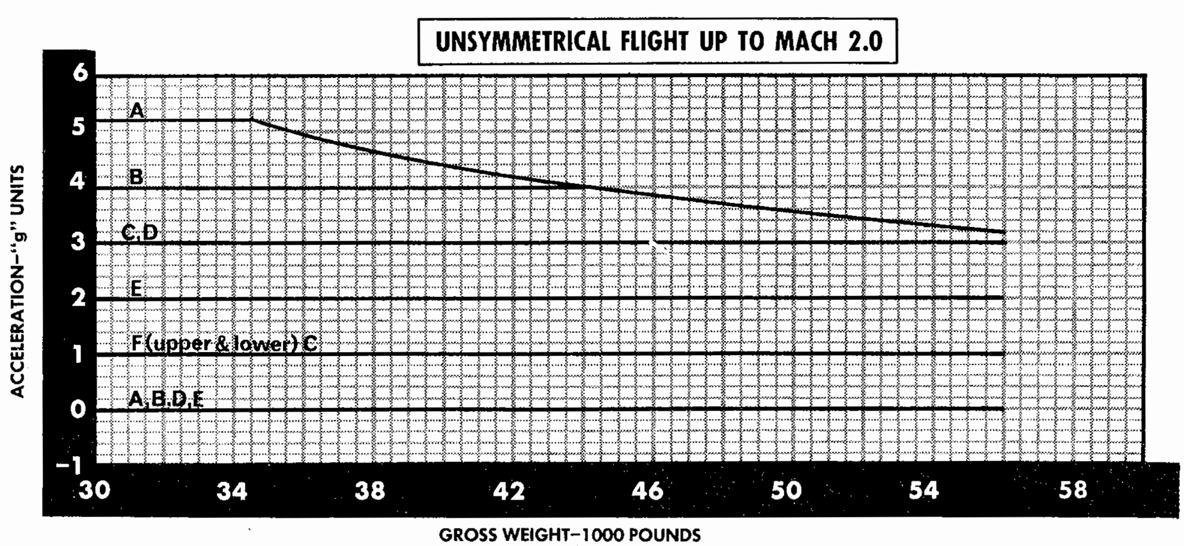


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Figure 1-56

External Stores Limitations

STORES	MAXIMUM AIRSPEED OR MACH, WHICHEVER IS LESS		REMARKS
	CARRYING	RELEASE	
370 GAL. EXT WING TANK	550 KIAS OR 1.6 MACH	420 KIAS BELOW 35,000 FT 475 KIAS ABOVE 35,000 FT	Arrested landing, both shipboard and shorebased, are permitted only with empty external tanks. Only gradual coordinated turns are permitted with 600-gal. tanks. Jettison tanks full or empty in level flight. Catapulting with partially full 600 gallon tank is not permitted.
600 GAL EXT ℄ TANK	600 KIAS OR 1.8 MACH	375 KIAS BELOW 35,000 FT 420 KIAS ABOVE 35,000 FT	
RCPP-105 STARTER POD	550 KIAS OR 0.9 MACH	300 KIAS OR 0.9 MACH	Jettison in level flight only.

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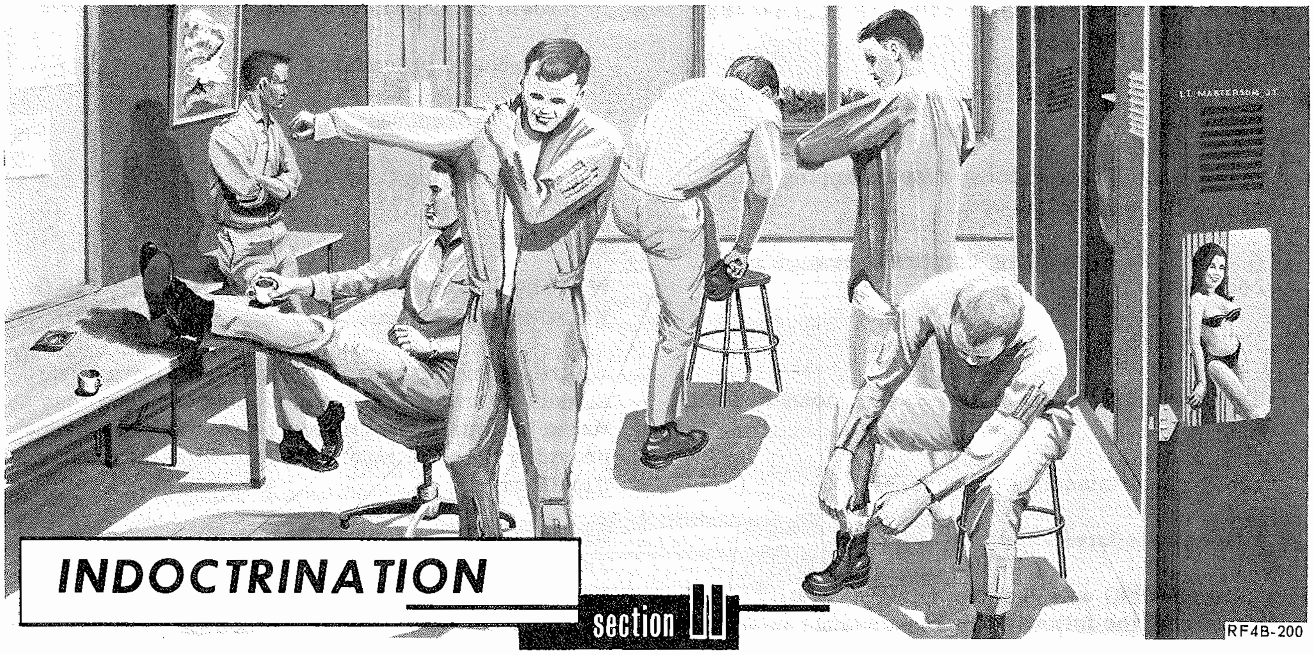
Figure 1-57



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INDOCTRINATION

section II

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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. The minimum ground training syllabus (pilot/RSO) for each phase is set forth below:

FAMILIARIZATION, TACTICS AND INSTRUMENTS

Flight physiological training as appropriate

RF-4B NAMT pilot's course

RF-4B NAMT Reconnaissance Systems course

RF-4B COT/WST.

FLIGHT SUPPORT LECTURES AND/OR BRIEFINGS

J79 engine

RF-4B air induction system

Flight controls, flaps, BLC, and AFCS

Aircraft systems and emergency procedures

Aircraft operating limitations

Flight characteristics

Preflight inspection and line operating procedures

Cockpit/Pressure suit air conditioning and MK IV pressure suit

Ejection seat and survival kit

Cockpit procedures/checklists

BIT checks (RSO only)

Climb, loiter, and cruise performance

Fuel mangement/mission planning

Single - engine performance

RF-4B CNI equipment

NATOPS Flight Manual (open and closed book), stressing normal and emergency procedures and aircraft/engine limitations.

RECONNAISSANCE FLIGHT SUPPORT LECTURES AND/OR BRIEFINGS

AN/APQ-99 forward looking radar operation procedures.

AN/APQ-102 side looking radar mapping camera operation procedures.

AN/AAS-18 IR mapping camera operation procedures.

NTDS/ATDS operating procedures

Tactical employment of the RF-4B reconnaissance system

Basic reconnaissance procedures

Voice procedures

The pilot and RSO will receive detailed briefings prior to flying the following reconnaissance missions:

High altitude reconnaissance flights

Low altitude reconnaissance flights

Air control techniques and procedures-broadcast control

FMLP/CARQUAL FLIGHT SUPPORT LECTURES

Mirror and Fresnel's lens optical landing system

Day landing pattern and procedures

Night landing pattern and procedures

Shipboard procedures and landing patterns

CCA procedures

Air refueling (Day/Night)

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 flight manual examination

Has completed at least one emergency procedures period in the COT/WST (if available)

Has received adequate briefing on normal and emergency operating procedures

Has received adequate instructions in the use/operation of the ejection seat and survival kit.

FLIGHT TRAINING SYLLABUS

AIRCREW FLIGHT TRAINING SYLLABUS

Prior to the familiarization phase, all pilots will have completed the Ground Training Syllabus previously prescribed. A qualified instructor pilot will be assigned for the first familiarization flight. The instructor pilot will occupy the rear seat. 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. The number of flight hours allocated to each subject is the command perogative. The specific phases of training are:

FAMILIARIZATION

Military and afterburner power takeoffs

Buffet boundary investigation

Rate of roll

Approach to stalls

Slow flight

Acceleration run to Mach 2.0

Subsonic and supersonic maneuvering

Investigate all features of the AFCS

Formation flight

Landings with and without drag chute

Simulated single-engine

PERFORMANCE

Acceleration runs at 25,000 feet, 35,000 feet, and 45,000 feet

Pressure suit flights to combat ceilings

Zoom climb characteristics

High altitude-high Mach maneuvering

INSTRUMENTS

Basic instrument work

Tacan penetrations and GCA's

Local area round robin (day and night) flights

TACTICS

Forward looking radar familiarization

Low level navigation

Terrain avoidance maneuvering

Terrain following maneuvering

Air refueling (Day/Night)

FIELD MIRROR LANDING PRACTICE AND CARRIER QUALIFICATION

Slow flight

Field mirror landing practice

Carrier qualification flights

OPERATING CRITERIA

CEILING/VISIBILITY REQUIREMENTS

In general, the following ceiling/visibility minimums for time-in-type apply:

Time-in-Type (hr)	Ceiling/Visibility (ft) (mi)
0-10	No ceiling/VFR
10-20	800/2; 900/1-1/2; 1,000/1
20-45	700/1; 600/2; 500/3
45 and above	Field minimums

Where adherence to these minimums unduly hampers pilot training, Commanding Officers may waive time-in-type 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 and RSO qualifications (after initial qualification) in each specific phase will be established by the Unit Commanding Officer. Crewmembers currently assigned to non-operational billets will be subject to the following criteria:

Must have a standardization check with the grade of "Conditionally Qualified", or better, within the past 12 months and must have flown 10 hours in model within the last 6 months.

Must have satisfactorily completed the ground phase of the standardization check, including COT/WST emergency procedures check (if available), 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 15 hours in model

Have a valid instrument card

Have completed at least one night familiarization flight

CARRIER QUALIFICATION

Day Qualification

Have completed 10 FMLP periods and/or be considered qualified by the LSO; and have a minimum of 50 hours in model

Night Qualification

Have completed day build-ups as specified by the Type Commander, and have made a minimum of two satisfactory arrested landings and one catapult launch during the daylight hours preceding night qualification landings.

MINIMUM CREW REQUIREMENTS

The pilot and RSO (or two pilots) consitute the minimum crew for all flights except those special flights directly concerned with research, development, evaluation, and ferry. Unit Commanders may authorize rear seat flights for personnel other than pilots and RSO's provided such personnel have received thorough indoctrination in the use of the ejection seat and oxygen equipment, and in the execution of rear seat checklists and emergency procedures.

FERRY SQUADRONS

Training requirements, check-out procedures, evaluation procedures, and weather minima for ferry squadrons are governed by the provisions contained in OPNAVINST 3710.6.

PERSONAL FLIGHT EQUIPMENT

MINIMUM REQUIREMENTS

In accordance with OPNAVINST 3710.7, the flying equipment listed below will be worn by crewmembers on every flight.

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

MK 3C or MK 4 life vest

Integrated torso harness or MA-2P harness assembly

Sheath knife

Flashlight (for all night flights)

Pistol with tracer ammunition, or approved flare gun

Flight gloves

Identification tags

An exposure suit (or full pressure suit) on all over water flights when the water temperature is 59°F or below, or OAT is 32°F or below, or the combined air/water temperature is 120°F or below

Approved personal survival kit

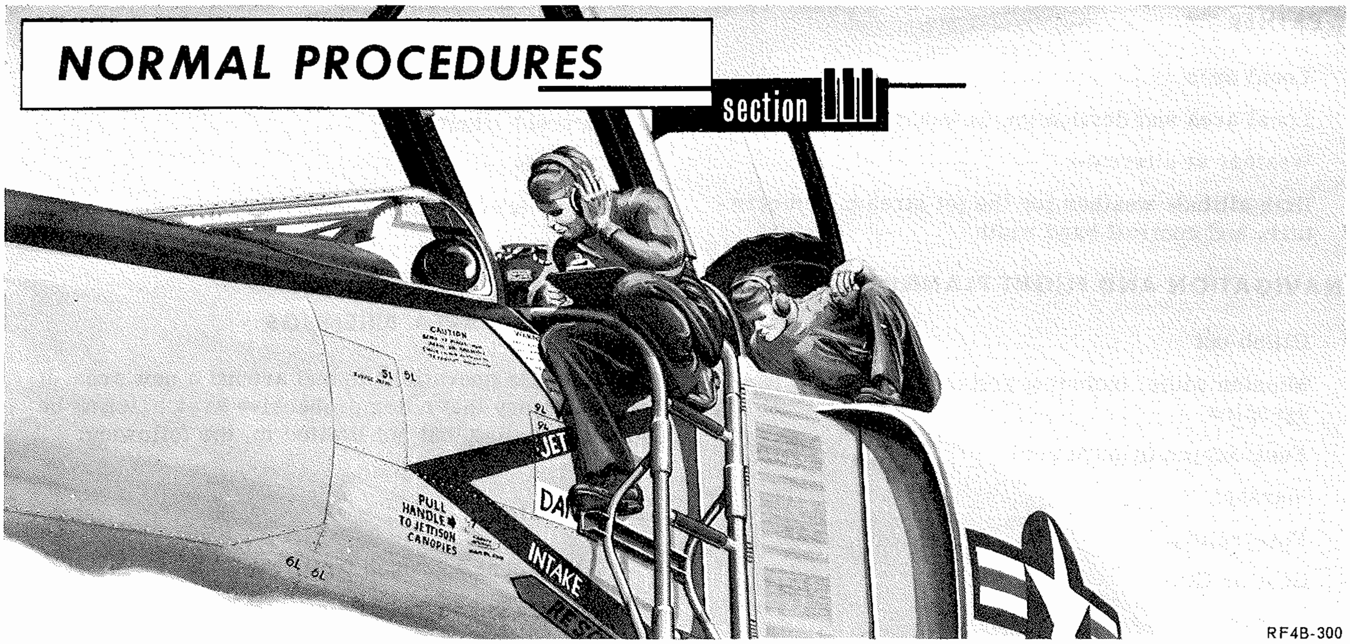
Other survival equipment appropriate to the climate of the area

Full pressure suit on all flights above 50,000 feet MSL

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.

NORMAL PROCEDURES

section III



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PART 1 BRIEFING/DEBRIEFING

BRIEFING

GENERAL

A briefing guide or syllabus card, as appropriate, will be used in conducting the briefing. Each crewmember will maintain a kneepad 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 crews 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

Visual signals and rendezvous instructions

MISSION

Primary

Secondary

Operating area

Control agency

Time on station or over target

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

Climb out

Mission route, including ground controlling agencies

Fuel/oxygen management

Marshal

Penetration

GCA or CCA

Recovery

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

ECM and ECCM

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 and arresting gear

Terrain and obstructions

Emergency Fields

Fields suitable for landing but without required support equipment

Include information under Bingo fields

SAR Facilities

Type

Frequencies

Location

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 reconnaissance missions should be reviewed using scope camera and controller information when available.

PART 2 MISSION PLANNING

Refer to Section XI, Performance Data, to determine fuel consumption, correct airspeed, power settings, and optimum altitude for the intended flight mission.

PART 3 SHORE-BASED PROCEDURES

NORMAL OPERATION

LINE OPERATIONS

The yellow sheet must be checked for flight status, aircraft configuration, camera configuration, 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.

AFT COCKPIT INTERIOR CHECK FOR SOLO FLIGHT

1. Canopy initiator safety pin (bulkhead mounted) REMOVED
   With the initiator safety pin installed, the front canopy cannot be jettisoned by means of the canopy jettison lanyard.
2. Seat safety pins - INSTALLED
3. Circuit breakers - IN

Note

Two circuit breaker panels are located on the starboard side of the cockpit. These circuit breakers control much of the electrical equipment that is essential to flight and are inaccessible to the pilot while in flight.

4. Pressure suit vent air valve - OFF
5. Oxygen supply lever - OFF
6. Cockpit light switches - OFF
7. Seat harness - STOWED
8. All loose gear - STOWED

With External Power Connected

9. Instrument ground power switch - ACTUATE
   Actuate the instrument ground power switch to energize the instrument 115/200 volt a-c bus, and the instrument 28 volt a-c bus.
10. Reconnaissance ground power switch - ACTUATE
    Actuate the reconnaissance ground power switch to energize the reconnaissance 115/200 volt a-c bus, and the reconnaissance 28 volt a-c bus.
11. Essential d-c test button - DEPRESS
    Depress the essential d-c test button, and observe that the essential d-c test light illuminates. If the essential d-c test light illuminates bright, the right (essential) transformer-rectifier is receiving three phase a-c power. If the light illuminates dim, the transformer-rectifier is only receiving two phase a-c power. If the light does not illuminate, the transformer-rectifier is not receiving a-c power, or it has failed.
12. Inertial navigation set - ALIGN
    Align the inertial navigation set in accordance with steps 11 thru 13 of the RSO Interior Check.

Note

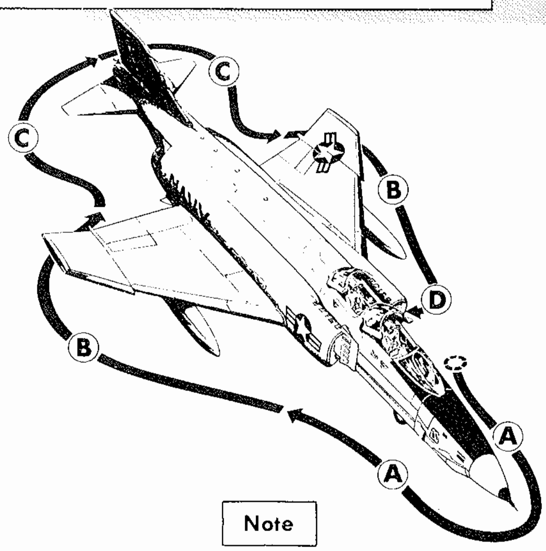
If available, have ground crew place the power control knob on the inertial navigation set to NAV after the engines are started and the "Bus Tie" light is out. If ground crew is not available, the power control knob can be placed to NAV prior to starting engines; however, this may result in slightly erroneous heading information from the inertial navigation set.

13. HF radio control panel - SET (if desired)
    a. Mode selector knob - AS ASSIGNED
    b. Frequency selector knobs - AS ASSIGNED
14. Radar altimeter - CHECK
    Check the radar altimeter in accordance with step 3 of the RSO Before Taxiing check.
15. Canopy - CLOSED

BEFORE ENTERING COCKPIT

1. Landing gear handle - DOWN
2. Ejection seat and canopy rigging - CHECK
   a. Time release mechanism trip rod - Check time release mechanism trip rod secured to anchor beam and engaged in time release mechanism. In aircraft with locking indicator type top latch plunger, check that the red color band on the trip rods is not visible.
   b. Canopy initiator firing link - Check canopy initiator firing link installed.
   c. Banana link - Check banana links pin engaged in firing mechanism sear.
   d. Canopy-seat interlock block - Check canopy-seat interlock block in place, and interlock block cable secure to the canopy. The ejection seat will not fire if the interlock block is not removed by the canopy during the ejection sequence.
   e. Scissor shackle tie-down - Check that the scissor shackle tie-down passes under the flap securing pin, around the wire loop, then aft under the shroud line loop, through the drogue shackle, over the top of the shroud line, and then forward and tie to the other end of the cord.

Exterior Inspection



Note

THE EXTERIOR INSPECTION HAS BEEN DIVIDED INTO FOUR AREAS AS SHOWN FOR SIMPLICITY, THE INSPECTION BEGINS AT THE COCKPIT LADDER INCLUDING THE LEFT FORWARD NOSE AREA AND THEN ONLY THE RIGHT SIDE OF THE AIRPLANE IS DISCUSSED. INSPECTION OF THE LEFT SIDE IS ALMOST IDENTICAL TO THE RIGHT SIDE EXCEPT FOR ITEMS SPECIFICALLY CALLED OUT AS LEFT SIDE (L) OR RIGHT SIDE (R).

(A) NOSE

1. GENERAL AREA

A. REFRIGERATION UNIT INTAKE CLEAR
B. RADOME SECURE
C. PITOT COVER REMOVED
D. CAMERA AND VIEWFINDER WINDOW COVERS REMOVED, WINDOW CLEAN AND UNMARRED

2. NOSE GEAR

A. TIRE CONDITION, INFLATION, NOSE WHEEL NUTS SECURE
B. STRUT CONDITION, PROPER INFLATION, JACK PAD SECURE
C. GROUND LOCK REMOVED
D. GEAR DOORS SECURE, ROLLER FOR FREEDOM
E. APPROACH LIGHTS SECURE
F. WHEEL WELL CONDITION
G. PITOT STATIC VENT
H. EMERGENCY FLAP PRESSURE GAGE–2750 PSI TO 3100 PSI
I. RAT PRESSURE GAGE–2750 PSI TO 3100 PSI
J. EMERGENCY LANDING GEAR PRESSURE GAGE–2750 PSI TO 3100 PSI
K. EMERGENCY BRAKE AIR PRESSURE GAGE–2750 PSI TO 3100 PSI
L. WHEEL BRAKE ACCUMULATOR PRESSURE GAGE 1500 ± 50 PSI

3. FORWARD FUSELAGE

A. ANGLE OF ATTACK PROBE COVER REMOVED
B. PROBE SECURE AND FREE TO ROTATE
C. ACCESS DOORS SECURE
D. INTAKE DUCT CONDITION, RAMPS SECURE
E. SIDE LOOKING RADAR ANTENNA COVERS, FREE FROM DAMAGE
F. IR CAMERA DOOR CLOSED

(B) CENTER FUSELAGE AND WING

1. GENERAL AREA

A. CONDITION OF WING AND CENTER FUSELAGE
B. ACCESS DOORS SECURE

2. WING

A. WING FLAPS AND CONTROL SURFACES CHECK
B. EXTERNAL TANKS SECURE (VISUALLY CHECK LOCKED ON PYLON)
C. WING FOLD JURY STRUT REMOVED
D. NAVIGATION AND JOIN UP LIGHTS SECURE
E. AIR TURBINE DOOR SECURE L (TOP)

(C) AFT FUSELAGE

1. GENERAL AREA

A. GENERAL CONDITION
B. ACCESS DOORS SECURE
C. COLLISION LIGHT SECURE
D. AUX. AIR DOORS-CHECK THROTTLE LINKAGE SECURE AND TYPE CSD INSTALLED
E. ENGINE ACCESS DOORS (96 L&R) SECURE
F. NOZZLE CONDITION ,A/B SPRAY BAR CONDITION
G. ARRESTING HOOK UPLOCK REMOVED
H. ARRESTING HOOK CONDITION, SECURE
I. STABILATOR AND RUDDER CHECK
J. NAVIGATION LIGHT SECURE
K. DRAG CHUTE DOOR SECURE
L. FUEL CAVITY DRAINS–DRY

(D) UNDERSIDE OF FUSELAGE

1. GENERAL AREA

A. GENERAL CONDITION
B. ACCESS DOORS SECURE
C. EXTERNAL STORES SECURE
D. FUEL CAVITY DRAINS–DRY
E. PC HYDRAULIC RESERVOIRS–FULL (76 L & R)

2. MAIN GEAR AND GEAR WELL

A. WHEELS CHOCKED
B. TIRE CONDITION, INFLATION
C. STRUT CONDITION, PROPER INFLATION, JACK PAD SECURE, SHRINK ROD STRAIGHT AND FASTENED
D. GROUND LOCK REMOVED
E. GEAR DOORS SECURE
F. GROUND FUELING SWITCH OFF (R)
G. #2 P.C.S. ACCUMULATOR PRESSURE GAGE– 1000 ± 50 PSI(R)
H. #1 P.C.S. ACCUMULATOR PRESSURE GAGE– 1000 ± 50 PSI (L)
I. #1 P.C.S. RESERVOIR ACCUMULATOR PRESSURE GAGE– 2000 ± 50 PSI (L)
J. SPEED BRAKES CONDITION, GROUND LOCKS REMOVED

RF4B-P3-301A

Figure 3-1

BEFORE ENTERING COCKPIT CONTINUED

f. Drogue withdrawal line - Check drogue withdrawal line (in wire braid sleeve) passes over and lays on top of all other lines.
g. Top latch mechanism - On airplanes with knurled nut type of top latch mechanism, check that top latch is lockwired and lead sealed. On airplanes with locking indicator type top latch plunger, check that top latch plunger is flush with the end of the top mechanism housing. The locking indicator must be flush with the end of the top latch plunger.

WARNING

If the top latch mechanism check does not meet the outlined requirements, an inadvertent ejection could result.

h. Parachute withdrawal line - Check that the parachute withdrawal line passes through the guillotine and is routed underneath the parachute restraint strap. In addition, check the withdrawal line quick disconnect for proper connection and swivel action.
i. Seat wedge pack (headrest) - Check seat wedge pack has approximately one-inch side play.
j. Canopy initiator (bulkhead mounted) firing link - Check that bulkhead mounted canopy initiator firing link is installed.
k. Drogue gun trip rod - Check drogue gun trip rod secured to anchor beam and engaged in drogue gun. In aircraft with locking indicator type top latch plunger, check that the red color band on the trip rods is not visible.
l. Harness assembly - Check if shoulder harness retaining pin is installed at the retraction reel. Check that the pins securing the lap belt and survival kit to the seat are in place.
m. Composite disconnect block - Check that lower block locking indicator (yellow metal flag) is tight. Check that the oxygen check valve pipe, in the intermediate block, is extended.
n. Survival kit oxygen gage - Check survival kit oxygen gage for at least 1800 psi pressure.
o. Alternate ejection handle guard - Check alternate ejection handle guard is in the up (vertical) position.
p. Emergency harness release handle - Check emergency harness release handle down, and firing sear installed in guillotine initiator.

3. Seat safety pins, except face curtain pin - REMOVE
   Check seat safety pins - ejection gun, guillotine, canopy initiator (seat mounted) drogue gun, canopy initiator (bulkhead mounted) - and both dust covers removed.

INTERIOR CHECK

PILOT

1. Composite disconnect - INSERTED and LOCKED
   Check upper block properly inserted and locked into intermediate block by exerting an upward pull on block assembly after composite disconnect release knob is locked to cable housing.

Note

The composite disconnect should be carefully inserted with a downward force parallel to the seat ejection plane. After the composite disconnect is fully inserted, push down on composite disconnect release knob to lock knob to cable housing and prevent the release knob from laying over and dangling.

2. Pressure suit lines - CONNECTED

WARNING

When the pressure suit is being worn without an anti-G garment, the anti-G line must not be connected and the corresponding port on the pressure suit must be capped. Explosive decompression will result upon ejection if the anti-G hose is connected. In the event of ejection over water or ditching, the water tight integrity of the pressure suit will be nullified.

3. Pressure suit vent air valve - ON AS DESIRED
4. Oxygen - CHECK
   Turn oxygen selector on, check normal flow with mask held away from face. Put mask on, check normal breathing. Turn oxygen off, check no breathing.

WARNING

Do not pull emergency oxygen manual release prior to actual use. If the emergency oxygen manual release is actuated prior to intended use, the pressure reducer manifold may not prevent emergency oxygen from flowing to the suit controller and/or oxygen regulator. In the event this happens, the crewmember has no way of knowing how much, or if any, emergency oxygen remains and has no way of replenishing the depleted supply.

Ejection Seat and Canopy Check Points

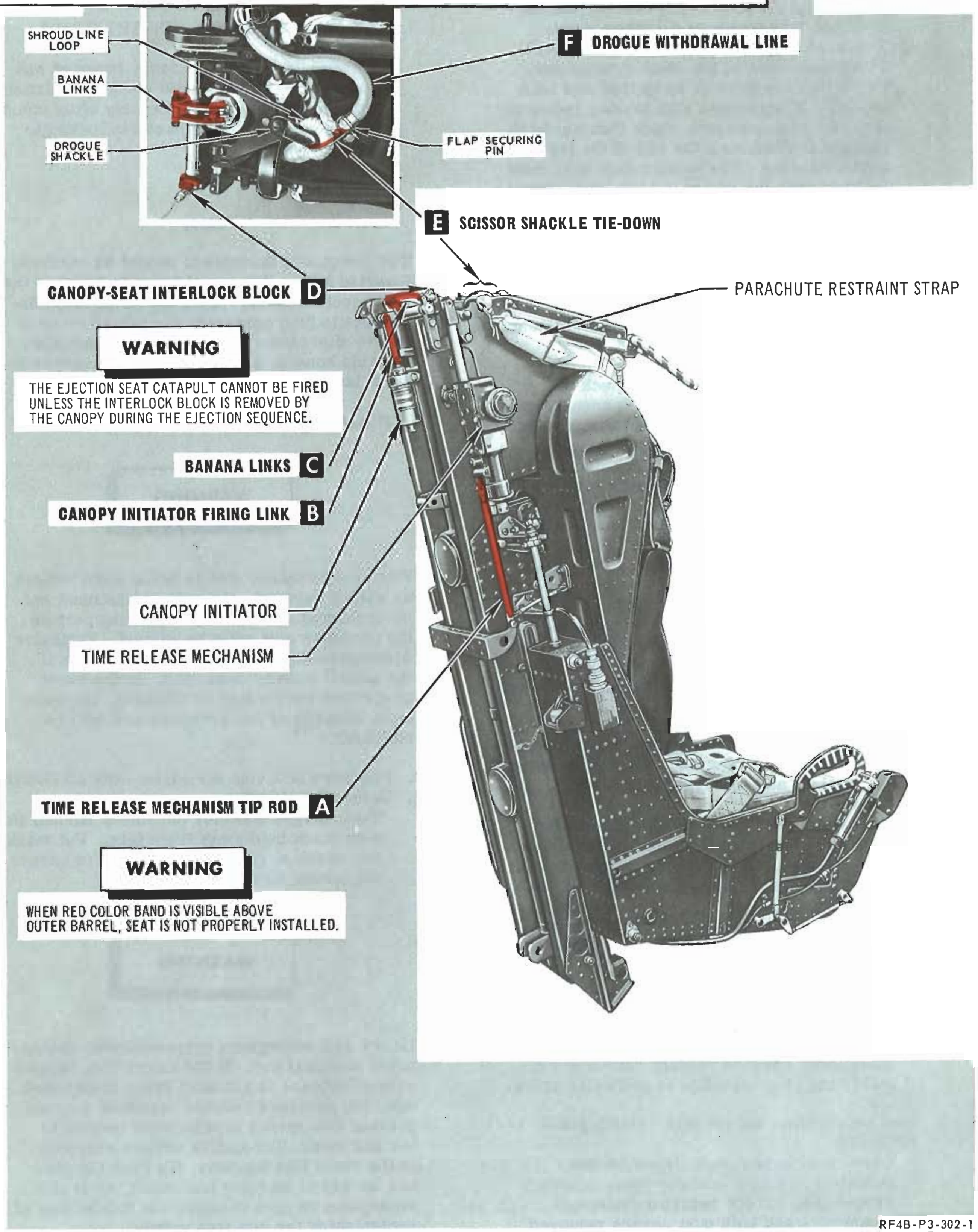


Figure 3-2 (Sheet 1)

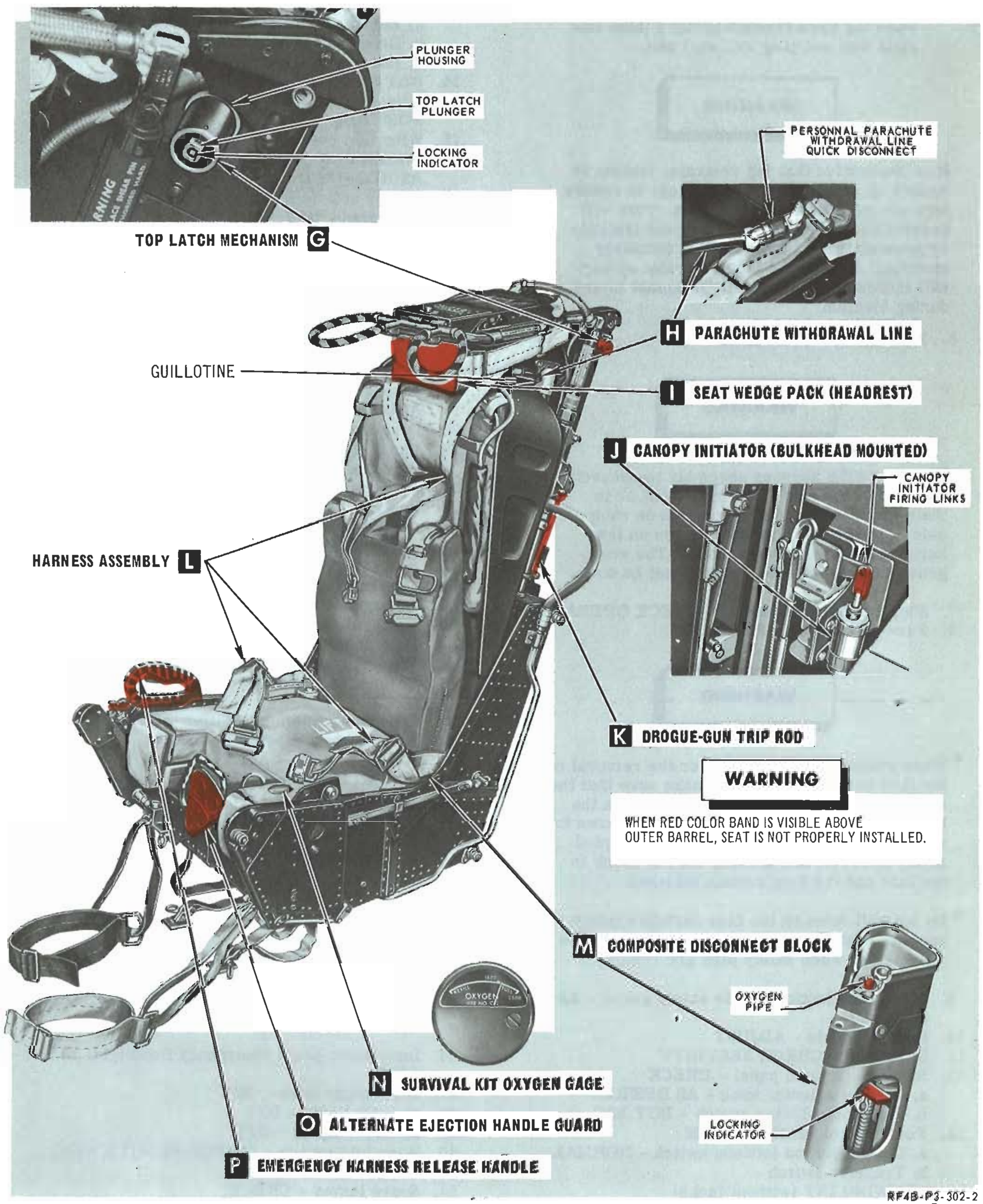


Figure 3-2 (Sheet 2)

INTERIOR CHECK CONTINUED

PILOT

5. Leg restraint lines - CONNECTED
   Pass leg lines through garters (blue line right leg) and plug into seat pan.

WARNING

It is imperative that leg restraint system be hooked up at all times during flight to ensure legs are pulled aft upon ejection. This will prevent leg injury and enhance seat stability by preventing legs from flailing following ejection. An unhooked leg restraint system will increase the possibility of spinal injury during ejection.

6. Harnessing - FASTENED

WARNING

Make sure the harness assembly is securely fastened to the seat. The pins must be in their proper receptacles, one pin on each side of the bucket seat and one pin on the harness locking reel assembly. The emergency harness release handle must be down.

7. Shoulder harness handle - CHECK OPERATION
8. Face curtain pin - PULL

WARNING

- When removing or checking for the removal of the face curtain safety pin, make sure that the safety pin shank has been removed from the hole. The safety pin collar has been known to separate from the pin shank upon attempted safety pin removal, leaving the pin shank in the hole and the face curtain safetied.
- Do not pull down on the face curtain ejection handle. Seat and canopy ejection systems are fully armed when safety pins are removed.

9. Alternate ejection handle safety guard - AS DESIRED
10. Rudder pedals - ADJUST
11. Stick grip - CHECK SECURITY
12. Intercom control panel - CHECK
    a. Volume selector knob - AS DESIRED
    b. Function selector switch - HOT MIC
13. Fuel control panel - CHECK
    a. Center station jettison switch - NORMAL
    b. Transfer switch -
       WING INT (without tanks)
       CENTER EXT or OUTBD EXT (with external tanks)
    c. Wing tanks jettison switch - NORMAL
    d. Internal wing dump switch - NORMAL
    e. Wing transfer pressure switch - NORMAL
    f. Internal wing transfer switch - NORMAL
    g. Refuel selection switch - ALL TANKS
    h. Refuel probe switch - RETRACT
    i. Boost pump switches - NORMAL
14. RAT handle - IN PLACE AND SECURE
15. Wing flap switch - COINCIDES WITH FLAP POSITION
16. Wing flap emergency pull handle - UP
17. Communication antenna selector switch - SET AS REQUIRED
18. Engine anti-icing switch - NORMAL
19. Throttles - OFF
20. Master lights switch - OFF
21. Speed brake switch - STOP (NEUTRAL)
22. Throttle friction lever - SET AS DESIRED
23. Engine master switches - OFF
24. Engine start switch - NEUTRAL
25. ARI circuit breaker - IN
26. Emergency speed brake switch - GUARD DOWN
27. Emergency canopy release lever - IN PLACE AND SECURE
28. Drag chute handle - IN PLACE AND SECURE
29. Landing gear handle - DOWN
30. Recon select knob - OFF
31. Accelerometer - SET
32. Vertical velocity indicator - CHECK
33. Clock - WIND and SET
34. Mode bearing/distance selector panel - SET
35. Arresting hook control handle - UP
36. Generator control switches - OFF
37. Emergency vent knob - IN
38. Defog/footheat handle - AS REQUIRED
39. Rain removal switch - OFF
40. Pitot heat switch - OFF
41. Communications function selector switch - STBY
42. Compass system controller - SET
    a. Latitude compensator - SET
    b. Mode switch - SLAVE
43. TACAN function selector switch - STBY
44. Circuit breakers - IN
45. Cockpit temperature control panel - CHECK
    a. Heat knob - SET AS DESIRED
    b. Temperature control switch - AUTO

Note

The MAN position of the temperature control switch should not be used except as a back-up in the event of a failure in the automatic system.

46. Instrument panel emergency floodlights switch - OFF
47. SIF master knob - OFF
48. Cockpit lights - OFF
49. Exterior lights - OFF
50. Wing fold switch - COINCIDES WITH WING POSITION
51. Spare lamps - CHECK
52. Flashlight, charts and reference material - CHECK

INTERIOR CHECK CONTINUED

RSO

1. Composite disconnect - INSERTED and LOCKED
   Check upper block properly inserted and locked into intermediate block by exerting an upward pull on block assembly after composite disconnect release knob is locked to cable housing.
2. Pressure suit lines - CONNECTED
3. Pressure suit air valve - AS DESIRED
4. Oxygen - CHECK
   Turn oxygen selector on, check normal flow with mask held away from face. Put mask on, check normal breathing. Turn oxygen off, check no breathing.
5. Leg restraint lines - CONNECTED
   Pass leg lines through garters (blue line right leg) and plug into seat pan.
6. Harnessing - FASTENED
7. Shoulder harness handle - CHECK OPERATION
8. Blackout curtain - CHECK
   Check blackout curtain does not interfere with face curtain ejection handle.
9. Face curtain pin - PULL
10. Alternate ejection handle safety guard - AS DESIRED
11. Intercom function selector switch - NOR
12. Voice recorder power switch - OFF
13. BDHI mode switch - CNI
14. Digital data inserter - WIND and SET
15. Infrared control panel - SET
    a. Contrast control knob - NORM
    b. Mode selector knob - OFF
16. Side looking radar control panel - SET
    a. Function selector knob - OFF
    b. Range selector knob - AS DESIRED
    c. Power control knob - OFF
17. Cartridge salvo switch - NORM
18. Clock - WIND and SET
19. Forward looking radar mode switch - OFF
20. Sensor control panel - SET
    a. Mode selector knob - OFF
    b. Camera mount control knob - OFF
    c. Window defog selector knob - OFF
21. Circuit breakers - CHECK

WITH EXTERNAL POWER CONNECTED

PILOT

CAUTION

Do not place generator control switch to the EXT position until external power has been connected and has had time to reach rated voltage and frequency.

1. Generator control switches - EXT ON
2. Cockpit lights - AS DESIRED
3. Seat - ADJUST
4. Interphone system - CHECK
5. Eject light system - CHECK
   Depress the light switch and check that both front and rear cockpit "Eject" lights illuminate. Depress the switch again and check that both lights extinguish.
6. Master lights switch - AS REQUIRED
7. Boost pumps and engine fuel shutoff valve - CHECK
   Observe boost pump pressure indicators while actuating boost pump check switches one at a time. Normal pressure (30 ± 2 psi) on side being checked indicates engine fuel shutoff valve open and boost pump running. Concurrent pressure on other indicator indicates other valve faulty (not properly closed). Lack of pressure on side being checked indicates faulty valve (not properly open) or pump inoperative.

CAUTION

Allow a minimum of 3 seconds between release of one fuel boost pump test switch and actuation of the other. Failure to do so could result in burning of the switch contacts and subsequent engine flameout.

8. Liquid oxygen gage - CHECK
9. Flap position indicator - UP
   Check flap position indicator corresponds with flap position
10. Landing gear indicator - CHECK
    Check landing gear position indicators indicate gear down.
11. Viewfinder - CHECK
    Refer to Section I for viewfinder preflight check.
12. Fire warning light - CHECK
    Depress the fire check button and note "Fire/Overht" warning lights illuminated.
13. Fuel quantity gage - CHECK
    Actuate feed tank check switch and check fuel gage reads feed tank fuel (approx. 1,571 lbs).
14. Fuel quantity - CHECK
    Check fuel quantity indicators against known fuel quantity.
15. Warning lights - CHECK
    Depress warning light test switch and note master caution light, warning lights panel, radar scope warning lights, arresting hook warning light and landing gear warning lights are illuminated. Check warning lights dimming circuit by holding warning lights test button depressed and rotating instrument panel lights control knob from OFF to BRIGHT. Warning lights should dim and revert to bright when knob is returned to OFF.
16. Radio equipment - CHECK
    Check communication and navigation equipment for command indication, frequency and/or channel selection.
17. Flight instruments - CHECK
18. ADI pitch indicator knob - SET FOR TAKEOFF
19. SIF master selector switch - STBY
20. Exterior lights - AS REQUIRED
    Check navigation, join-up anti-collision, and fuselage lights in the BRIGHT, DIM, STEADY, and FLASH positions.
21. Check availability and operation of flashlight (if required)

WITH EXTERNAL POWER CONNECTED CONTINUED

RSO

1. Seat - ADJUST
2. Oxygen - ON
3. Oxygen quantity gage - CHECK
4. Cockpit lights - CHECK and SET
5. Communication antenna - AS REQUIRED
6. Intercom system - CHECK
7. Warning lights - CHECK and REPORT
8. Instrument ground power switch - ACTUATE
   Actuate the instrument ground power switch to energize the instrument 115/200 volt a-c bus, and the instrument 28 volt a-c bus.
9. Reconnaissance ground power switch - ACTUATE
   Actuate the reconnaissance ground power switch to energize the reconnaissance 115/200 volt a-c bus, and the reconnaissance 28 volt a-c bus.
10. Essential d-c test button - DEPRESS
    Depress the essential d-c test button, and observe that the essential d-c test light illuminates. If the essential d-c test light illuminates bright, the right (essential) transformer-rectifier is receiving three phase a-c power. If the light illuminates dim, the transformer-rectifier is only receiving two phase a-c power. If the light does not illuminate, the transformer-rectifier is not receiving a-c power, or it has failed.
11. Navigation computer - SET
    a. Function selector knob - RESET
    b. Position update switch - NORMAL
    c. Set the point of return coordinates on the position counters and the destination coordinates on the target counters.
    d. Set the local magnetic variation of the variation counter.
    e. Set wind direction and speed on the wind counters.
    f. Function selector knob - STBY
       The function selector knob must be placed to STBY prior to turning on the inertial navigation set.
    g. If point of return is different than present position, set present position coordinates on the position counters.

Note

Before aligning the inertial navigation set, the wings must be spread.

12. Inertial navigation set gyro compass alignment - AS DESIRED
    a. Align mode switch - GYRO COMP
    b. Power control knob - STBY
    c. When the "Heat" light is extinguished, power control knob - ALIGN
       The power control knob should be left in ALIGN until after the engines are started and the "Bus Tie" light is out.

Note

The inertial navigation alignment will be erroneous if the aircraft is moved while in the ALIGN mode.

13. Inertial navigation set heading memory alignment - AS DESIRED

Note

Prior to heading memory alignment, a complete gyro compass alignment must have been performed through the flashing of the "Align" light. From this time until completion of the heading memory alignment, the airplane must not be moved.

    a. Align mode switch - HDG MEM
    b. Power control knob - STBY
    c. When the "Heat" light is extinguished, power control knob - ALIGN
       The power control knob should be left in ALIGN until after the engines are started and the "Bus Tie" light is out.
14. Communication-navigation control panel - SET and CHECK
15. HF radio control panel - SET
    a. Mode selector knob - AS ASSIGNED
    b. Frequency selector knobs - AS ASSIGNED
16. Check availability and operation of flashlight (if required)
17. Notify pilot - PRE-START CHECK COMPLETE

BEFORE STARTING ENGINES

PILOT

1. Wheels - CHOCKED
2. Fire bottle - MANNED
3. Intake and exhaust areas - CLEAR
4. Boarding steps - UP
5. External air supply - CONNECTED AND PRESSURE UP
6. Rudder - CHECK MOVEMENT
7. Canopies - CLOSE and CHECK
   Have RIO close his canopy first, ascertain aft "Canopy Unlocked" light out, forward "Canopy Unlocked" light on. Close forward canopy, check "Canopy Unlocked" light out. On airplanes 153098y and up, and on all other airplanes upon incorporation of AFC 267, check that alignment tape on canopy lock push rod aligns with the alignment mark on the bracket hanging from the left canopy sill. If canopy alignment tape (AFC 267) is not incorporated, assure rollers have engaged canopy hooks by observing approximately one-inch aft travel of canopy push rod mechanism.

WARNING

- In the event of a canopy malfunction during the closing cycle or in the event that either the front or aft "Canopy Unlock" light remains on after attempted closure, the affected crewmember will not actuate the normal canopy control selector, raise or lower the ejection seat, or allow external canopy control buttons to be operated. For additional instructions, refer to Canopy Malfunction, Section V.

- To ensure maximum canopy retention capability during flight, the canopy control handle must be retained in the closed (full forward detent) position.

RSO

1. Canopy - CLOSE and CHECK
   Close aft canopy first, check aft "Canopy Unlocked" light out.

STARTING ENGINES

Whenever practicable, start and run up engines on paved surface to minimize the possibility of foreign objects being drawn into the compressor with resultant engine damage. Start the engine with the nose into or at right angles to the wind as exhaust temperatures may be aggravated by tail wind.

WARNING

- Suction at the intake is sufficient to kill or severely injure personnel drawn into or pulled suddenly against the duct.
- Danger areas aft of the airplane are created by high exhaust temperature and velocities. The danger increases with afterburner operation.

PILOT

Note

The following engine start procedure establishes the right engine as being started first. This procedure was adopted in order to ascertain that both utility hydraulic system pumps are operating. The right engine pump delivers approximately 2800 psi at idle rpm, and the left engine pump delivers approximately 3,000 psi at idle rpm. Therefore, the single-needle utility hydraulic pressure indicator cannot be used to determine pump operation unless the right engine is started first.

CAUTION

With flaps extended, the BLC ducts are open and the loss of engine bleed air while attempting to start the engines may result in a hot or false (no-ignition) start. If it is imperative that a start be made with flaps down, the starting procedure recommended for starts when Employing Substituted Starting Units should be utilized with the exception that the start should be initiated at normal starting rpm. Refer to Section I, Part 3.

1. Throttles - OFF
2. External compressed air source - CONNECTED
3. Engine master switches - ON
4. Engine start switch - BRIGHT

Note

When attempting an engine start, there is a possibility that the starter air valve will not open when the start switch is actuated. This does not mean that the solenoid operated valve is completely inoperative, it may be that the valve is only sticking in the closed position. In the event the valve will not open, have the air shut off at the starter cart and then actuate the start switch. The stuck valve, unopposed by air pressure, may open.

CAUTION

If there is no indication of engine rpm within 15 seconds, or no indication of oil pressure within 30 seconds after start cycle begins, shut down immediately and investigate.

5. At 10% rpm, right engine ignition button - DEPRESS
   At approximately 10% rpm, depress right engine ignition button and simultaneously advance the throttle half way up the quadrant and immediately return to IDLE.

CAUTION

Do not attempt to start the engine before reaching 10% rpm. If the starting procedure is initiated at a lower rpm, additional heat distress of the engine hot section is anticipated. Overtemperature of the turbine will generally occur during a low rpm start if starter air is inadvertently interrupted during the start cycle. However, starting below 10% rpm may be helpful with a hard to start engine in an emergency situation.

Note

The engine usually fires at approximately 10 to 16% rpm with a fuel flow of 500 to 800 pph.

CAUTION

If the engine does not light off by the time fuel flow reaches 500-800 pph or within 15 seconds after fuel flow or pressure is indicated, chop throttle to full OFF position, release ignition button.

6. Release ignition button when light-off is indicated by a sudden increase in EGT.

CAUTION

If engine does not continue to accelerate after light-off, discontinue start.

STARTING ENGINES CONTINUED

PILOT

7. Start switch - NEUTRAL
   When the engine is operating at a self-sustaining rmp (usually about 45%), move the starter switch to the neutral position.
8. Exhaust temperature gage - CHECK WITHIN LIMITS (982°C max for 3 sec.)

CAUTION

- At no time should EGT exceed 1000°C nor should the starting temperature exceed maximum starting limits.
- With only one engine in operation, do not move control stick (surface controls) excessively. If the stick is moved rapidly with hydraulic pressure on only one side of the tandem power cylinders, the fluid that is in the other side of the cylinder is forced back through the return line to the reservoir, filling the reservoir, and either rupturing the reservoir or forcing the excess fluid overboard. The seals within the tandem power cylinders may also be damaged due to the ingesting and expelling of air and lack of lubrication. The power control hydraulic systems must be reserviced and checked.

Note

After the engine reaches idle rpm and stabilizes, the EGT will recede to a temperature of approximately 320° to 400°C.

9. Fuel flow indicator - CHECK
   Fuel flow should indicate 500 to 800 pph at light-off, up to 2400 pph during the transition to idle, and 1100 to 1400 pph at IDLE.

Note

Fuel consumed while starting engines is approximately 65 pounds.

CAUTION

If fuel flow is appreciably less than 500 pph, a false (no ignition) start will likely result. If fuel flow is in excess of 800 pph, a hot start will likely result.

10. Oil pressure gage - CHECK
    Check oil pressure 12 psi minimum at idle rpm.

Note

- With the right engine started, the PC-2 and utility hydraulic pressure indicators should read within normal. The "Check Hyd Gages" warning light will remain illuminated until the other engine is started and all four hydraulic pumps (PC-1, PC-2 and utility) are operating properly.
- In the event the throttles cannot be returned to OFF, the engine may be shut down from any throttle setting by placing the respective engine master switch in the OFF position. This will close the corresponding fuel shutoff valve, thus depriving the engine of fuel. The engine(s) will flame out in approximately 15 seconds from idle power, and in approximately 2 seconds from Mil power.

CAUTION

After any wet start or false (no-ignition) start, allow one minute or longer for the combustion system to drain before starting the engine.

11. Generator control switches - GEN ON
    The left generator warning light is illuminated and the bus tie warning light is out.
12. Start the left engine as per items 1 thru 10.
13. Cycle the right generator control switch to OFF and back to GEN ON.
    a. Check that the right generator warning light illuminates and the bue tie warning light remains out.
    b. With both generators in the GEN ON position, the generator warning lights and the bus tie light go out within 5 seconds.

WARNING

If both generator switches are placed to the OFF position with the engines running, the auxiliary air doors and speed brakes will close violently.

Note

- Non-start or abnormal starts shall be logged on the yellow sheet (OPNAV FORM 3760-2).
- Fuel consumption at idle rpm is approximately 42 ppm.
- After satisfactory starts are accomplished, the engines do not require any warm-up time prior to placing throttles in any position.

RSO

1. Notify pilot of any emergency signals noted from ground crew.

BEFORE TAXIING

PILOT

1. External power sources - DISCONNECT
2. Altimeter - SET and CHECK
   Set altimeter pointer to field elevation. Obtain field barometric pressure setting from tower. Note and record the difference between the tower barometric pressure and the reading in the Kollsman window of the altimeter. Check the differences between the front and rear cockpit.

BEFORE TAXIING CONTINUED

PILOT

Perform items 3 thru 7 upon signal from plane captain:

3. Wings - SPREAD AND LOCKED
4. Speed brakes - CYCLE
   Ascertain from ground crew that speed brakes are fully closed and warning light is out.
5. Flap switch - CYCLE and CHECK
   Actuate the flaps to the 1/2 and full down positions. Check that the BLC system is operating. Actuate the flaps to up and monitor the "BLC Malfunction" light for a valve malfunction.
6. Arresting hook - CYCLE (avoid abrupt movement).
7. Probe and RAT - CYCLE, (if practicable). CHECK IFR PROBE UNLOCKED LIGHT OUT
   Prior to cycling probe, close canopy to preclude fuel being sprayed into the cockpits in the event the air refueling probe leaks.
8. Flight control surfaces and power control systems - CHECK TRAVEL, NOTE PRESSURE DROP

Note

When making the above check, pull stick full aft and release gently, stick should return to its forward position. Initiate stick aft movement and release, the stick should stop and return to its forward position. There should be no tendency for the stick to motor, which means, that the stick continues to move in the direction initiated without further application of pilot effort.

9. Reference system selector knob - PRIM
   Place reference system selector knob in PRIM position in order to check AFCS.
10. AFCS - CHECK
    a. Stab aug switches - ENGAGE
    b. AFCS switch - ENGAGE
    c. AFCS/ARI disengage switch - DEPRESS
       Check that all switches on the AFCS panel return to OFF.

Note

In airplanes 153095y and up, and in all other airplanes upon incorporation of AFC 203, only the AFCS switch will move to off when the AFCS/ARI emergency disengage switch is depressed. The stab aug switches must be individually disengaged.

    d. Stab aug switches - DISENGAGE (if engaged)
11. Trim switches - CHECK AND SET FOR TAKE-OFF
    Check operation of trim switches and set rudder and aileron trim to neutral. Set stabilator trim to 1 unit nose down.
12. Compass mode control knob - SYNC

Note

The wings must be spread and locked prior to compass sync to prevent false bearing information.

RSO

1. Ascertain from the pilot that the generator control switches are ON and the bus tie and genertor warning lights are out.
2. Vent air - AS DESIRED
3. Radar altimeter - CHECK
   a. Function selector knob - STBY
      Allow 90 second warm-up period. Check that mode indicator flag reads STBY and that FAIL flag is in view.
   b. Function selector knob - ON
      Allow three minute warm-up period. Check that mode indicator flag reads ON.
   c. Function selector knob - BIT
   d. BIT selector knob - 1 (system check)
      Check that BIT check indicator light does not illuminate.
   e. BIT selector knob - 2 (xmtr freq)
      Check that BIT indicator light illuminates.
   f. BIT selector knob - 3 (xmtr pwr)
      Check that BIT check indicator light illuminates.
   g. BIT selector knob - 4
      Check that fail flag moves out of view and altitude pointer stabilizes at 5000 ± 100 feet.

Note

- While conducting this ground bit check, it is possible for system windup to occur while operating in the proximity of large metal objects, such as hangars, or another aircraft operating the radar altimeter. This does not necessarily indicate a system malfunction.
- Leave the BIT selector knob at position 4 until after take-off.

4. Pressure altimeter - SET and CHECK
5. Infrared detecting set - CHECK
   Refer to Section I, Classified Supplement for IR detecting set preflight check.
6. Side looking radar - CHECK
   Refer to Section I, Classified Supplement for SLR preflight check.
7. Inertial navigation set - ALIGNED
   Check the inertial navigation heading alignment completed and the power control knob on the inertial navigation control panel is in the NAV position.
8. Navigation computer function selector knob-BASE or TARGET
9. Report - BEFORE TAXI CHECKS COMPLETE

TAXIING

PILOT

High takeoff gross weight combined with the small wheels and tires dictate that a positive technique be used while taxiing this aircraft. After the chocks have been pulled, add power as required on both engines and engage nose gear steering. After the aircraft has started rolling, check the brakes and reduce power. Taxi at the lowest practicable rpm and use nose gear steering for directional control where possible to minimize brake heating. Do not ride or pump the brakes, use a steady pressure when needed. Keep the taxi speed slow and make as few stops as possible. Slow the aircraft before entering a turn in order to reduce side loads while in the turn. Make turns as wide as practicable, 75 foot radius if possible, at 12 to 13 knots. See figure 3-3 for minimum turning radius and ground clearance.

RSO

Complete Before Taxiing checks if not previously completed.

PRE-TAKEOFF

When in the run-up area, allow the aircraft to roll straight ahead to align the nose wheel. Apply the brakes with a firm, steady pressure and assure the flaps are up. Note the idle RPM, EGT and fuel flow of both engines. Check the engines individually at Mil power and observe that the RPM, EGT, exhaust nozzle, fuel flow, oil pressure and hydraulic pressure are within their normal operating ranges on the engine being checked; also check that the RPM, EGT and fuel flow on the idling engine remain stable.

CAUTION

During run-up, a rise in RPM above 67.5%, a drop in EGT of more than 20°, or a drop of more than 50 pph in fuel flow on the idling engine indicates a defective bleed air check valve on that engine and constitutes a downing gripe.

To guard against possible engine flameout during throttle chops at a low altitude, check the throttle rigging and fuel control behavior by abruptly retarding each throttle from MIL power to IDLE. Monitor the fuel flow indicator. The momentary minimum acceptable fuel flow during this check is 400 pph. Observe that engine rpm returns to its originally noted value.

WARNING

- If fuel flow drops below 400 pph but the engine recovers to original rpm, proceed with the flight. However, do not snap decelerate these engines below 10,000 feet.
- If engine rpm fails to recover to the original idle rpm value, regardless of fuel flow reading, the flight should be aborted.

Note

It is mandatory that an entry be made in OPNAV Form 3760-2 (Yellow Sheet) on all engines which drop below 400 pph on snap decelerations and/or fail to recover to the original idle rpm.

Do not attempt to check the engine in the MAX power range and do not operate the engine at MIL power with the flaps down for a period longer than one minute. When the engine checks are completed, complete the remainder of the takeoff checklist.

WARNING

If canopy closure is attempted with engines running, the engines should not be operating above a stabilized idle rpm. Attempted canopy closure with engine rpm above idle may result in canopy not fully locking due to back pressure caused by the aircraft pressurization system.

FLAP POSITIONS

Three flap positions are available for takeoff; half-flaps, full-flaps, and no-flaps. However, the half-flap configuration is recommended for all takeoffs. Full-flaps is not an acceptable takeoff configuration for field operations since it affords no advantages, and many disadvantages (increased drag, reduced thrust, reduced stabilator effectiveness and large trim change during transition to climb) over any other flap configuration. No-flaps is an acceptable configuration for a clean airplane only. The no-flap configuration results in a takeoff distance equal to half-flaps; however, the takeoff speed will be higher, but not high enough to achieve the same takeoff attitudes as with half-flaps. If a no-flap takeoff is attempted in a heavy or draggy aircraft in the same distance as a half-flap takeoff, the attitude of the aircraft at liftoff will result in the airplane flying closer to the stall margin and aircraft control will be more critical. In order to achieve the same takeoff attitude as that obtained with half-flaps, the airplane takeoff speed must be further increased. By increasing the takeoff speed, the takeoff distance and the airplane's kinetic energy is also increased proportionally, thereby making an abort more difficult. In addition, the increased takeoff speed begins to approach the rotational speed limitations of the tires, making the possibility of tire failure more probable.

Turning Radius and Ground Clearance

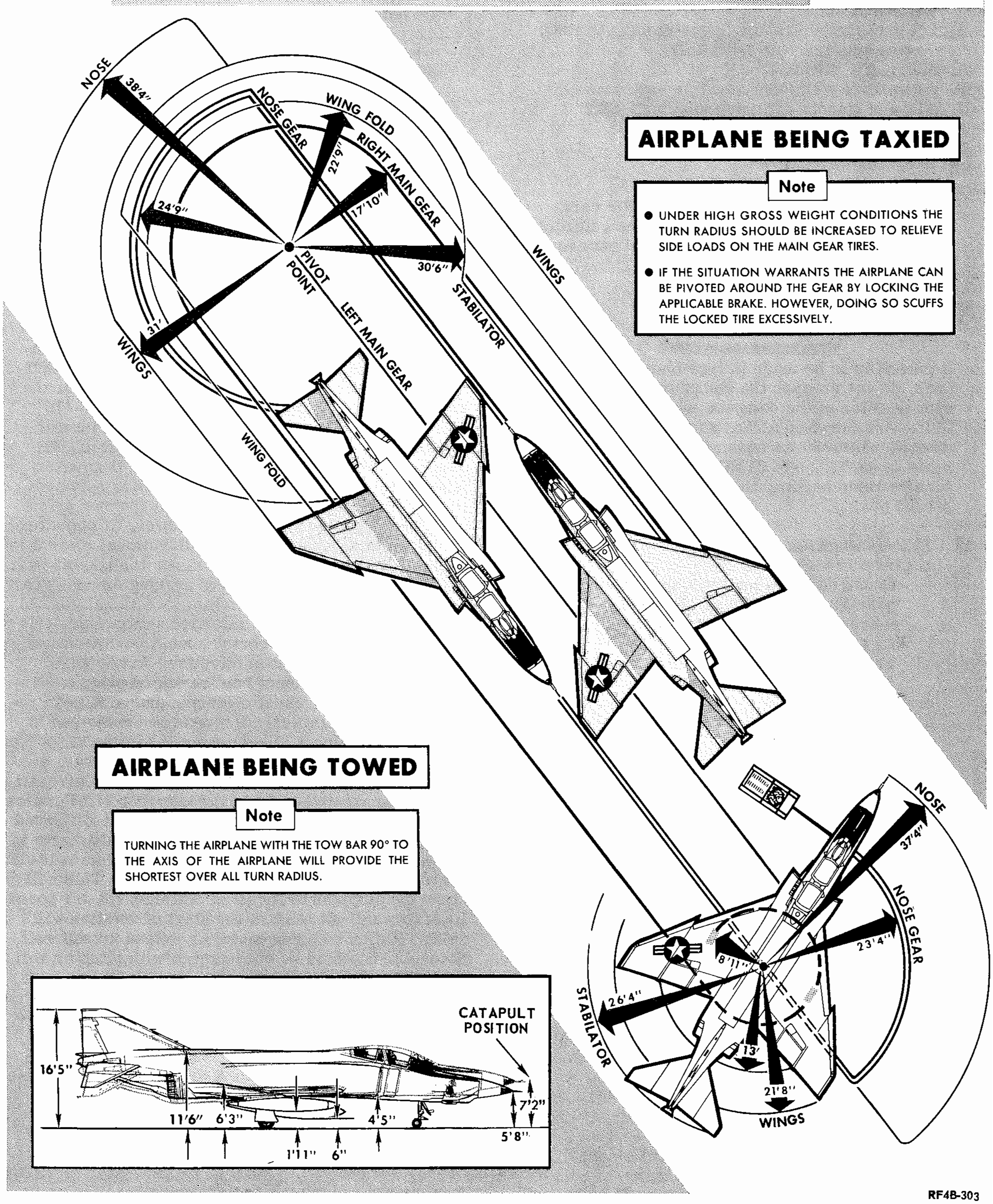


Figure 3-3

PILOT

1. Engines - RUN UP (one at a time)
2. Variable area inlet ramp - CHECK FULLY RETRACTED
3. Oil pressure - CHECK (relay reading to RSO)
4. Engine anti-ice - AS DESIRED
5. Stab aug - ENGAGE
6. Altimeters - CHECK
7. ADI and standby attitude indicator - SET
8. Defog/footheat handle - AS DESIRED.
9. Pitot heat - AS DESIRED
10. Rain removal - OFF
11. Compass heading - CHECK
    If significant error exists on the HSI card, re-sync the compass by placing the reference system selector knob to STBY and back to PRIM.

WARNING

If takeoff is to be made in less than 60 seconds, do not re-sync the compass with the sync position of the compass mode control knob. Acceleration force, such as during takeoff, within 60 seconds after placing the mode control knob to SYNC position will cause a rapid heading change after the 60 second period.

12. Takeoff checklist - COMPLETE
    a. Controls - Checked
        Check controls for freedom of movement, normal pressure drop, and direction of movement.
    b. Wings - Locked
        Check wing pin unlock handle down, and "Wing Pin Unlock" lights out.
    c. Trim - Set
    d. Flaps - As required
    e. Hook - Up
    f. Harness - Locked and tight
    g. Warning lights - Out
13. Seat pins - PULLED

RSO

1. Suit vent air - LESS THAN 1/4 ON
2. Altimeters - CHECK
3. Compass sync - CHECK
4. Remote attitude indicator - CHECK
5. Circuit breakers - CHECK
6. Takeoff checklist - COMPLETE
    a. Controls - Check
    b. Wings - Locked
        Check wing lock pins down, and "Wing Pin Unlock" lights out.
    c. Trim - Check setting
    d. Flaps/Hook - Check
    e. Harness - Locked and tight
    f. Warning lights - out
7. Seat pins - PULLED
8. Report ready for takeoff
9. Radar altimeter - ON (during takeoff roll)
10. Nav computer - TGT or BASE (at lift-off)

WARNING

Do not turn pressure suit vent air knob on in excess of 1/4 turn when BLC is operating. When the flaps are raised, the additional engine bleed air to the air conditioning and pressurization system can cause the full pressure suit to "balloon". If the pressure suit controller should malfunction, the increased suit pressure could become high enough to cause immobilization.

TAKEOFF TECHNIQUE

For individual takeoff, the centerline of the runway should be used as a directional guide. When in position, roll forward slightly to align the nose wheel. If nose gear steering is desired, engagement must be made prior to commencing takeoff roll. Do not engage after the takeoff roll has started. The takeoff roll may be started with the engines in IDLE or the brakes can be applied until 80% rpm and 450-470° EGT is reached on each engine. After the takeoff roll has begun, the throttles are advanced to MIL power and EGT and RPM are checked. If an afterburner takeoff is desired, afterburner is selected by moving both throttles into the afterburner detent and advancing smoothly to MAX power. If one afterburner fails to light, sufficient directional control is available with the rudder to continue the takeoff with asymmetric power. Very light braking or nose gear steering can be used to maintain directional control until the rudder becomes effective at approximately 70 knots. Nose gear steering should be disengaged when the rudder becomes effective. In any case, nose gear steering must be disengaged prior to lift-off to ensure nose wheel centering and nose gear retraction. Optimum lift-off speeds are contained in the NATOPS Pocket Checklist and in Section XI, of this publication. Location of the main landing gear, a good bit aft of the normal c.g., prevents this aircraft from being rotated early in the takeoff roll. Rotation should be started about 30 knots below takeoff speed by applying full back stick. As the aircraft starts to rotate, the stick should be adjusted to maintain 10-12 degree pitch attitude for aircraft fly-off. This will allow the airplane to fly off at optimum lift-off speed. Less than full aft stick at the start of rotation will delay rotation and unnecessarily extend takeoff roll. No problem should be encountered with pitch or roll sensitivity during lift-off, and transition to a clean configuration will require little stick force or attitude change. The "Aux. Air Door", "BLC Malfunction", and "Master Caution" lights may illuminate momentarily as the landing gear and flaps controls are actuated. This is normal and should be no cause for alarm.

MINIMUM RUN TAKEOFF

A minimum run takeoff in this airplane is the same as a normal afterburner takeoff.

CROSSWIND TAKEOFF

If nose gear steering is to be used, it must be engaged before commencing takeoff roll. Release brakes evenly, do not ride or keep pressure on the brakes during the initial part of the roll. The brakes should be used sparingly to prevent overheating. Excessive braking will increase the takeoff roll. The rudder will become effective at approximately 70 knots. Hold the nose wheel down until flying speed is reached. Fly the airplane off the runway at optimum lift-off speed. Do not assume an immediate wing low attitude in order to counteract for wind drift; the pilot cannot properly judge the wing tip ground clearance on a swept wing airplane.

FORMATION TAKEOFF

For formation takeoffs the leader will take position on the downwind side of the runway with other aircraft in tactical order abeam. Lateral separation must be insured to prevent difficulties should one aircraft blow a tire or abort for any reason. When in position, engines should be run up to 80% on signal from the flight leader. Engine instruments are checked and brakes are released on signal from the flight leader. Throttles are advanced to full Military and engine temperature and rpm are checked immediately after brake release. Directional control is maintained with either brakes or nose gear steering until the rudder becomes effective. Afterburner, if desired, is selected on signal from the flight leader. All other procedures are the same as for the individual takeoff except that turns will not be made into the wingman at altitudes less than 500 feet above the terrain. Flap settings, power settings, and signals must be pre-briefed by the flight leader. The first section must be airborne before the second section commences the takeoff roll. Visual communication procedures are covered in Section VII, Communication Procedures.

NEW

SCRAMBLE INTERIOR CHECK

PILOT

1. ICS - HOT MIC
2. Fuel switches - SET FOR NORMAL OPERATION
3. Flap switch - UP
4. Speed brake switch - STOP (NEUTRAL)
5. Engine master switches - ON
6. Engine start switch - RIGHT
7. Anti-ice switch - AS REQUIRED
8. Radar altimeter - ON & SET
9. Pressure altimeter - SET
10. Generator control switches - OFF
11. Radio - ON (TR + G)
12. Tacan - ON (TR)
13. SIF - NORMAL
14. Pitot heat switch - AS REQUIRED
15. Light switches - AS REQUIRED

RSO

1. Radio - ON (TR + G)
2. Tacan - ON (TR)
3. ICS - NORMAL
4. Light switches - AS REQUIRED
5. Black out curtain - AS DESIRED

SCRAMBLE ENGINE START

PILOT

1. Starting unit up to power - EXTERNAL POWER CONNECTED
2. Generator control switches - EXT ON (after engine is windmilling)
3. Signal plane captain to turn CNI ground power switch - ON
4. At 10% rpm, right ignition button - DEPRESS WHILE ADVANCING THROTTLE TO IDLE
5. At 35% on right engine, engine start switch-LEFT
6. At 53% on right engine, generator control switches - GEN ON
7. Signal to disconnect external a-c
8. Stab Aug - ENGAGE
9. At 10% on left engine, left ignition button - DEPRESS WHILE ADVANCING THROTTLE TO IDLE.
10. At 35% on left engine, engine start switch - NEUTRAL.
11. Complete T.O. checklist.

Note

During entire start sequence, the pilot and RSO are individually strapped in. Curtain pins are pulled by pilot and RSO upon entering the cockpit.

RSO

1. Navigation computer function selector knob - STBY
2. Inertial navigation set - ALIGN
   a. Power control knob - ALIGN
   b. Power control knob - NAV

Note

Course alignment is complete after approximately 60 seconds. Heading memory alignment is complete when the "ALIGN" light flashes.

3. Reference system selector knob - PRIM
4. Navigation computer function selector knob - TARGET or BASE (at lift-off)

SCRAMBLE TAKEOFF

Aircraft scrambles invariably take place under various conditions of radio silence (refer to NWP-41A, Chapter 2). The following procedures will be followed for an alert which will probably result in the actual launching of the airplane. Normal preflight, start, and poststart checks will be conducted in accordance with the NATOPS Flight Manual and the NATOPS Pocket Checklist. Shut down the engines, but leave the airplane as prepared as possible for takeoff. Remove all seat pins except the face curtain pin. If awaiting the scramble order requires the use of the aircraft radio, observe ground operating limitations. The ground equipment will be positioned to provide rapid removal after starting. When the scramble order is received, start the engines, establish radio communications, determine that all ground locks and safety pins are removed, and that the ground crew and equipment are clear before taxiing. Taxi safely but expeditiously and energize all necessary electrical/electronic equipment. Complete the scramble checklist prior to scramble.

TRANSITION TO CLIMB

When the airplane is definitely airborne, tap the wheel brakes and raise the landing gear. Raise the flaps at 300 feet or 200 knots IAS while maintaining a 10° to 12° nose-up attitude.

CLIMB

A simplified MIL power climb at normal gross weights can be made by maintaining a 10° to 12° nose-up attitude until reaching 400 knots IAS. Vary the pitch attitude as necessary to maintain 400 knots IAS until reaching final cruise Mach. Then vary the pitch attitude as necessary to maintain cruise Mach until reaching cruise altitude. A simplified MAX power climb at normal gross weights can be made by maintaining a 10° to 12° nose-up attitude until reaching 250 knots IAS. At 250 knots IAS, smoothly rotate to a 20° to 25° nose-up attitude and hold until reaching Mach 0.9. Vary the pitch attitude as necessary to maintain Mach 0.9 until reaching cruise altitude. For optimum climb performance, refer to Section XI, Part 3.

WARNING

The probability exists that engine flame-outs may occur while flying at altitudes above 35,000 feet in cirrus clouds. Such incidents have occured, and are generally believed to have been caused by excessive ingestion of ice crystals. Under such conditions, ice built-up on the duct lips or other parts of the aircraft are not likely to occur and flame-outs can, therefore, occur without warning. However, in all known incidents of this type, re-lights have been accomplished and maintained at lower altitudes. Therefore, if flame-out occurs at high altitudes in clouds, it is recommended that re-light attempts be deferred until descent to a lower altitude and, if possible, to a less dense part of the cloud.

INFLIGHT PROCEDURES

PILOT

Note

For flight Procedures, refer to Section IV of this publication.

RSO

1. Radar altimeter - ON and CHECK
   After passing through 200 feet, place the radar altimeter function selector knob ON, and perform inflight BIT checks. Refer to Section I, Part 2 for inflight BIT checks.

DESCENT/INSTRUMENT PENETRATION

PILOT

In all descents, care will be taken not to exceed any airframe limitations. See Section I, Part 4. Five minutes prior to any descent from altitude, select the desired DEFOG position on the defog lever and place the temperature control at the 2 o'clock (200 degree of clockwise rotation) position. Since rapid descents cannot always be anticipated, the maximum comfortable always be anticipated, the maximum comfortable interior temperature should be maintained. This will aid in defrosting the windshield. Refer to Section XI, Part 7 for recommended descent. Before starting descent, perform the following:

1. Engine anti-ice - AS DESIRED
2. Altimeters - SET and CHECK
3. Tacan and UHF homer - CROSS CHECK
4. Defog/Footheat handle - DEFOG
5. Pitot heat - AS DESIRED
6. Rain removal - AS DESIRED
7. Cabin heat - SET
8. Compass - SYNC (check against standby)
9. Set SIF as directed by Approach Control.

Note

If it becomes necessary to dump fuel during a descent, thrust settings in excess of 85% rpm may be required to insure rapid inflight dumping.

RSO

1. Altimeter - SET
2. Flight instruments - CHECK
3. Challenge pilot as required for cabin heat, pitot heat, engine de-icing and compass sync.
4. SLR power selector knob - OFF
5. IR mode selector knob - COOL DOWN or OFF
   The IR should be in COOL DOWN or OFF in order to close the IR doors so the IR detector does not get damaged during landing.

PATTERN ENTRY

Enter the traffic pattern at the altitude and airspeed prescribed by the local course rules. Whenever possible, pattern entry will be made in accordance with figure 3-4.

Field Landing Pattern

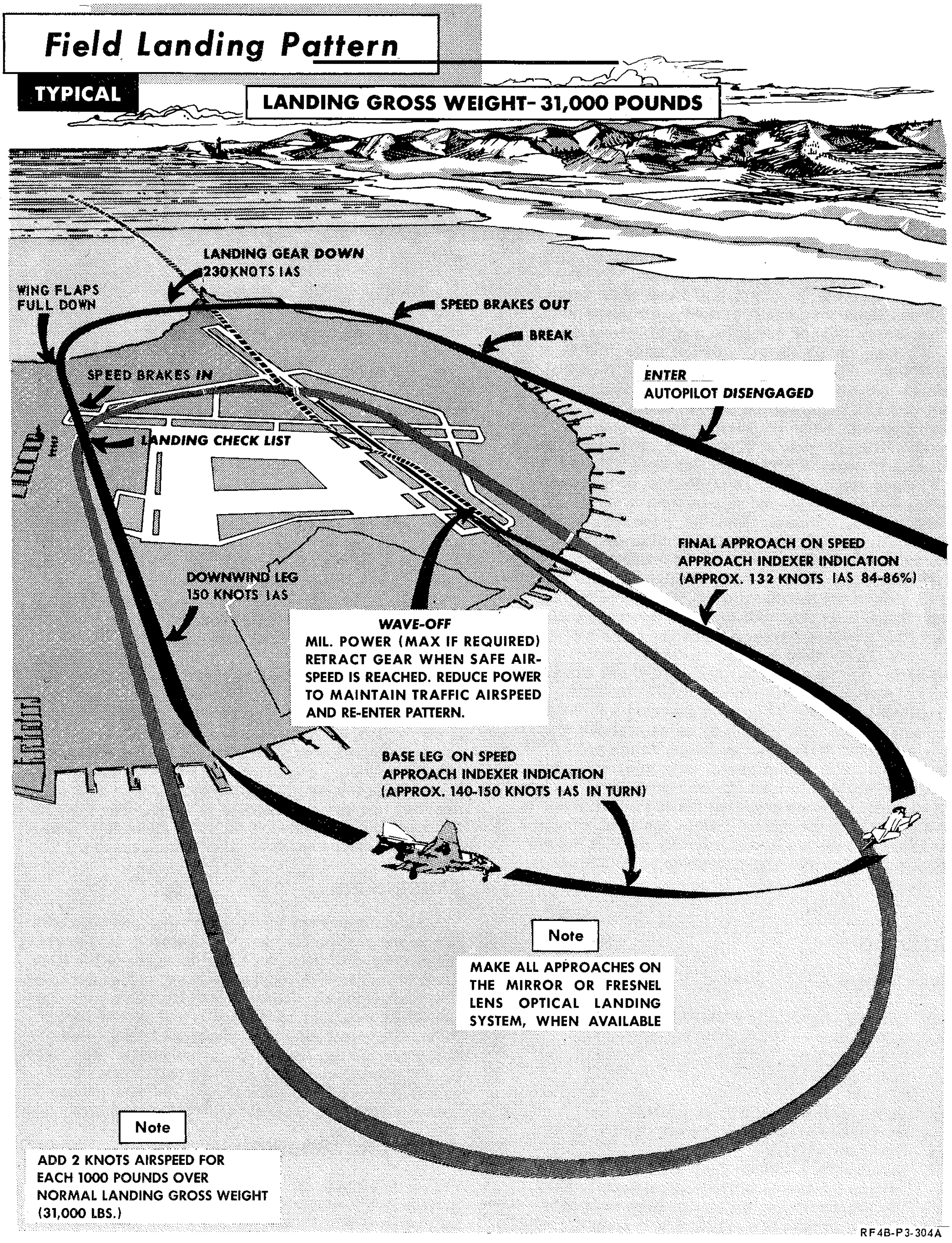


Figure 3-4

LANDING TECHNIQUE

For a normal field landing with a gross weight of approximately 31,000 pounds, fly the pattern as illustrated in figure 3-4. Enter the pattern as local course rules dictate, utilizing the throttles and speed brakes, as necessary, to maintain pattern altitude and airspeed. At the break, reduce thrust and extend the speed brakes (if required). As the airspeed decreases through 250 knots IAS, lower the landing gear and extend the wing flaps. Retract the speed brakes to decrease buffet, however, some buffet and noise will come from the nose wheel well as the landing gear extends. This noise and buffet will disappear as approach speeds are reached. Continue to decelerate to, and maintain, 150 knots IAS. After the gear and flaps have been checked and reported, roll into the base leg and establish a mild rate of descent, maintaining an "on speed" angle of attack indexer light (140 to 150 knots IAS). Use the angle-of-attack indexer and maintain the "on speed" indication except that 125 knots will be the minimum final approach speed. When on final approach, utilize a power setting of 84 to 86% rpm. This will provide an "on speed" angle of attack indexer light with a 2 1/2° to 3° glide slope and a rate of descent of approximately 700 fpm. Attempt to land within the first 1000 feet of runway whenever possible, however, do not chop power prior to crossing the end of the runway. The sudden loss of boundary layer control air will cause the airplane to settle immediately. At touchdown, retard the throttles to IDLE and deploy the drag chute. The nose will drop almost immediately due to the airplane center-of-gravity and stabilator location. When the nose gear is on the runway, hold full back stick to increase drag, and utilize the rudder and wheel brakes, as necessary to maintain directional control. Nose gear steering will not be engaged upon landing except as an emergency method of maintaining directional control. At the end of the landing roll, and at taxi speed, nose gear steering should be utilized to turn off the runway, and for low speed taxiing. When engaging the nose gear steering, be sure to have the rudder pedals centered, otherwise the nose gear will immediately cock in the direction and in proportion to rudder pedal displacement.

LANDING

PILOT

1. Landing checklist - COMPLETE
   a. Wheels
   b. Flaps
   c. Harness
   d. Hook
2. Upon touchdown, throttles - IDLE
3. Drag chute - DEPLOY (as required)
4. Brakes - APPLY
5. Temperature control knob - FULL HOT
   Place the temperature control knob to HOT to evaporate any water that may have collected in the air conditioning system during descent.
6. Drag chute - RELEASE IN DESIGNATED AREA

WARNING

Do not turn on pressure suit vent air knob in excess of 1/4 turn when BLC is operating. When the flaps are raised, the additional engine bleed air to the air conditioning and pressurization system can cause the pressure suit to "balloon". If the pressure suit controller should malfunction, the increased suit pressure could become high enough to cause immobilization.

RSO

1. Pilot's checklist - MONITOR
2. Harness - LOCKED
3. Report - READY FOR LANDING

DRAG CHUTE PROCEDURES

The drag chute will normally be employed on all landings except for specified no-drag chute landings during the familiarization phase, or landings made with a known crosswind component equal to or greater than 20 knots. All landings should be planned and flown as no-drag chute landings. In case of drag chute non-deployment, a waveoff shall be initiated if conditions are not ideal to stop the aircraft. If a waveoff is initiated the drag chute handle should be stowed immediately to preclude inadvertent chute deployment/jettison in the landing pattern. If committed for a no-drag chute landing, the pilot must be prepared to drop the hook and engage the arresting gear if there is any possibility that speed or runway condition will preclude stopping the aircraft on the runway. Caution must be exercised while taxiing with the drag chute deployed to insure that the drag chute does not become entangled in the taxi lights, other aircraft, or other obstructions. The drag chute will be released on signal from the taxi-signalman in an area where the possibility of interference with other aircraft turning up or taxiing is least. The pilot must advise tower personnel if the drag chute is released elsewhere on the field.

LANDING ROLL

The airplane is very clean on landing and even with fairly low residual thrust it will want to roll down the runway with little deceleration. Leave the flaps down to increase aerodynamic drag, and to decrease residual thrust by utilizing BLC air. Exercise caution while using the brakes until you get the feel of them. They are fully powered rather than boosted and there is very little feel at the pedals. The tire pressures are very high and they will break loose and skid with heavy applications. Refer to Brake System, Section I, Part II for braking technique.

CROSSWIND LANDING

Carefully compensate for crosswinds in the traffic pattern to guard against undershooting or overshooting the final turn. On final approach, use wing low or crab method to maintain course. Maintain normal approach speed aligning airplane with the runway.

The pilot should be prepared for aircraft weather-cocking into the wind upon drag chute deployment. Weathercocking must be corrected by rudder and spoiler control, until the rudder and spoilers are no longer effective. Nose gear steering and brakes will then be the only methods available for directional control. Before engaging nose gear steering, the pilot must insure that the rudders are centered to preclude a hard-over signal to the nose gear in direction of rudder displacement. When landing on a wet runway with a crosswind component in excess of 20 knots, it may become necessary to jettison the drag chute after initial deceleration to maintain directional control.

HEAVY GROSS WEIGHT LANDING

As landing gross weight increases, the landing pattern should be expanded and approach and touchdown speeds should be increased accordingly. Follow procedures outlined in Landing Pattern Diagram, figure 3-4. To maintain an "on speed" approach indexer indication, the airspeed is increased approximately 2 knots for each 1000 pounds over normal landing gross weight.

WET RUNWAY LANDING

If possible a wet runway landing should be made at a normal landing gross weight of 31,000 pounds (approximately 2,000 pounds of fuel remaining). Fly a normal approach with an "on speed" or "slightly slow" indexer indication. Plan to touchdown on centerline with a maximum amount of runway remaining for deceleration. The drag chute should be deployed on touchdown and the flaps should be left in the down position in order to bleed off residual engine thrust by utilizing the BLC system. Light braking can be initiated at 100 knots IAS providing a smooth easy application is used. It should be remembered that nose gear steering is available should directional control become a problem. Be prepared to engage the arresting gear if the aircraft is not slowing down properly. The arresting gear should be engaged with feet off the brakes, flaps full down, and control stick full aft.

SECTION LANDING

The leader should transition to optimum approach speed when the runway is sighted, touching down 500-1000 feet down the runway on his side. The wingman should avoid getting "sucked" and maintain a normal wing position except that as he approaches the runway, he moves out to give additional wingtip clearances at touchdown. The wingman will call "Good Chute" or "No Chute" as the case may be.

MOREST LANDING

The techniques for engaging MOREST are essentially the same as for other types of arresting equipment as are as follows:

1. Notify control tower as soon as possible, of intention of engaging MOREST, and transmit estimated gross weight for touchdown.
2. At the 180° position, receive clearance for a MOREST landing.
3. Approach on mirror.
4. Touchdown on centerline of runway and deploy drag chute as required.
5. Lower arresting hook 1,000 feet in front of MOREST gear.
6. Engage wire with feet off the brakes, stick aft.

WARNING

Maximum engagement for M-1 MOREST gear is 103 knots IAS for gross weights under 33,000 pounds. Consult current BuWeps Aircraft Recovery Bulletins if other type MOREST gear is to be utilized.

WAVEOFF

The descision to take a waveoff should be made as early as possible. Advance the throttles to MIL or MAX as required to stop the sink rate. The landing gear should be raised only after the sink rate has been stopped and there is no possibility of the airplane contacting the ground. A a safe airspeed and altitude, raise the flaps.

POSTFLIGHT PROCEDURES

Prior to engine shutdown, it is recommended (but not required) that the engines be operated at IDLE power for 3 to 5 minutes in order to allow engine temperatures to stabilize. Landing roll and taxi time may be included. Carrier landings may require that the engines be shut down almost immediately after touchdown from high power settings. If the engines are shutdown prior to the recommended idle time, a notation should be made on the yellow sheet. To shut down an engine, move the throttle to OFF, the engine master switch to OFF and the generator control switch to OFF. With only one engine operating, do not move the control stick excessively. Excessive stick movement with hydraulic pressure on only one side of the tandem power control cylinders will cause the hydraulic fluid that is in the unpressurized side of the cylinder to be forced back through the pressure lines to the reservoir, filling the reservoir, and causing the excess fluid to be dumped overboard. The seals within the power cylinders may also be damaged by air ingestion and lack of lubrication. If the above situation occurs, the power control hydraulic systems must be reserviced and checked. Perform the postflight checks as listed in the NATOPS Pocket Checklist, with the exception that during operations where the temperature is below freezing or expected to drop below freezing, the aircraft may be parked with wings spread and flaps in the full down position.

POST LANDING

PILOT

1. Flaps - RETRACT (when clear of landing runway)
2. Radar altimeter - OFF

3. Alternate ejection handle guard - UP.
4. Stab aug - OFF
5. Temperature control knob - 12 O'CLOCK POSITION
6. Station 1 camera mount selector knob - OBLIQUE
7. Station 2 camera mount selector knob - LOAD

Note

Prior to engine shutdown, ascertain from RSO that INS checks are complete.

RSO

1. Alternate ejection handle guard - UP
2. FLR mode switch - OFF
3. CNI - STBY
4. Inertial navigation power control knob - ALIGN
   If heading memory alignment is desired for the next flight, the power control knob should be left in the ALIGN position until the "ALIGN" light is flashing.
5. Inertial navigation align mode switch - HDG MEM
6. Inertial navigation power control knob - OFF
7. Navigation computer function selector knob - OFF

NEW

SHUTDOWN

PILOT

1. Throttles - OFF
2. Engine master switches - OFF
3. Generator control switches - OFF
4. Seat pins - INSTALLED
5. All switches, levers and personal equipment - OFF or DISCONNECTED

NEW

NEW

RSO

1. Seat pins - INSTALLED
2. All switches, levers, and personal equipment- OFF or DISCONNECTED.

NIGHT FLYING

EXTERNAL LIGHT MANAGEMENT

During night operations, the external lights should be set as follows:

1. On the line - BRIGHT and STEADY.
2. When ready for taxiing - BRIGHT and FLASH
3. In flight
   a. Single aircraft - BRIGHT and FLASH (or as weather conditions dictate)
   b. Formations - AS REQUESTED BY WING-MAN
      The last aircraft in formation flight should have his external lights on BRIGHT and FLASH unless tactical situation demands otherwise (actual penetrations etc.)

TAXIING

Night operation demands extra caution while taxiing. It is difficult to judge actual ground speed at night. Pilots can best judge their speed by frequently observing the runway or taxiway close to their aircraft as illuminated by the bottom fuselage light. Taxi slowly for it is possible that unlighted aircraft, vehicles, and/or obstructions are on the taxiways.

TAKEOFF

A night takeoff is accomplished in exactly the same manner as one outlined for daylight operations with the following additions:

Be prepared to transition to complete instrument flight immediately upon leaving the runway.

INFLIGHT PROCEDURES

See Section IV of this publication.

LANDING

Night landing procedures are identical to day procedures with the following exceptions:

There is often a tendency to be fast. Be positive about checking angle of attack and airspeed. Determination of altitude and sink rate are difficult at night. This necessitates reference to the vertical velocity indicator. Rates of descent up to 750 feet per minute are acceptable, use mirror when available.

FIELD MIRROR LANDING PRACTICE

PREFLIGHT INSPECTION

A normal preflight inspection will be conducted with specific attention being given to tire condition, nose strut extension, angle of attack probe conditions, and windshield cleanliness. Check that the hook bypass switch is in the BYPASS position.

TAKEOFF

The takeoff will be individual using either MIL or MAX power depending on fuel weight, mission, etc.

RADIO PROCEDURES AND PATTERN ENTRY

It is advisable to call Paddles prior to pattern entry to confirm Charlie Time. Approaches to the field for break will be controlled by the tower and then switched to Paddle for FMLP pattern control. At no time will an aircraft remain in the pattern without a UHF receiver. On each succeeding pass, the following voice report will be made at normal meatball acquisition positions:

NEW

Side Number
Meatball or Clara (no meatball)
Type aircraft
Fuel state (nearest 100 lbs.)

PATTERN

The pattern will be race track pattern with the 180 approximately 1 1/4 miles abeam at 500 feet above field elevation. The length of the groove should be adjusted to give a wings-level descent on the glide slope of 20-25 seconds (approximately one mile). For maximum gross weight at touchdown, refer to Section I, Part 4. For a 34,000 pound airplane, an optimum "on speed" indexer indication will result in an airspeed of 138 knots IAS. The turn to downwind leg should be 30° angle of bank and 140-150 knots IAS, climbing to 500 feet above field elevation. Recommended airspeed at the 180° position is 140 to 150 knots IAS. Power will be added to effect a level turn onto final. Form the 180° to the 90° position, the airspeed should be corrected for the optimum angle of attack. At approximately the 45° position, the meatball will appear on the mirror. A common error is to begin the descent upon first seeing the meatball. Maintain altitude until the meatball is centered on the mirror, then adjust power and angle of attack as necessary to start a rate of descent that will keep the meatball centered. When a Fresnel lens is used, care must be taken to avoid commencing descent until the airplane is aligned with the centerline, since an idiocyncracy of this lens is to display a false meatball indication when viewed from the approach turn.

INTERVAL

The downwind turn should be commenced when the aircraft on the downwind leg is approximately in the 8 o'clock position. The turn should be made with a 30° angle of bank and 140-150 knots IAS, climbing to 500 feet above field elevation.

GLIDE SLOPE

A 2 1/4 ° to 3° glide slope will be used dependent upon wind conditions. This slope is chosen in order to give the same approximate rate of descent that would be used on the ship.

WAVEOFF TECHNIQUE

Any time the meatball is lost close-in, in the groove, the pilot will initiate his own waveoff. Either MIL or MAX power will be used to effect all waveoffs. Normally, waveoffs will be taken straight ahead, especially when close-in.

BINGO FUEL

No FMLP approach will be commenced with 1500 or less pounds of fuel.

NIGHT FMLP

All provisions which apply to day FMLP also apply to night FMLP plus the following items:

External lights steady - BRIGHT

Hook bypass switch in the BYPASS position

When comfortably situated in the pattern, simulated instruments should be flown as much as possible up to the 45° position.

WARNING

Internal wing fuel will not transfer with landing gear handle down unless the wing transfer pressure switch is in the EMERG position.

PART 4 CARRIER-BASED PROCEDURES

NORMAL OPERATION

PREFLIGHT

Pilots will man aircraft when directed by Air Operations, normally thirty minutes prior to launch time. A normal preflight inspection should be accomplished with particular attention given the landing gear, tires, hook, and underside of the fuselage for possible launching pendant or arresting cable damage. Tie-downs will be left installed until the aircraft is started, if there is not at least 1500 psi pneumatic pressure available on the emergency brake air pressure gage. Be prepared to hold brakes when tie-downs are removed. In the cockpit, particular attention should be given to the pilot's radar scope to insure that the retaining bolts have been installed.

FLIGHT DECK OPERATIONS

PREFLIGHT TAXI

Any signal from the plane director above the waist is intended for the pilot. Any signal below the waist is intended for deck handling personnel. Taxiing aboard ship is much the same as on land with the exception of additional power requirements. Nose gear steering is excellent and requires use of minimum power while taxiing. Taxi speed should be kept under control at all times especially on wet decks and approaching the catapult area. Be prepared to use the emergency air brake should normal braking fail.

POSTFLIGHT TAXI

Taxi as directed and keep the engines running until the CUT signal is given by the plane director. After the engines are cut, use the pneumatic brake. Do not leave cockpit until tie-downs have been installed, the number of which will be dictated by the ship.

HANGAR DECK OPERATIONS

PREFLIGHT

Unless the airplane is already on the elevator, it will be towed or pushed for access to the flight deck. A whistle blast is the signal to stop an airplane being moved by any means other than its own power. Any whistle blast signifies an immediate stop. The plane director must be kept in sight at all times. Prior to start, it will be necessary to use the pneumatic brake. The aircraft will be raised to flight deck level and respotted or started on the elevator.

POSTFLIGHT

The aircraft may be parked on the flight deck or the hangar deck, or it may be taxied from the elevator to the hangar bay. When clear of the elevator, the pilot will be given the CUT signal at which time the canopy will be opened and the helmet removed. The speed will be kept under control and the pneumatic brake will be used at any time that there is doubt of normal braking action. Always be alert for the director's whistle signal.

LAUNCH OPERATIONS

GENERAL

Current applicable BUWEPS Launch Bulletins will be used to augment standard operating procedures. These bulletins will be followed implicitly. No deviations are authorized.

PRIOR TO HOOK-UP

Prior to taxi onto the catapult, pilot's and RSO'S will insure through verbal check-off that the takeoff checklists are complete, and HSI is in the DG mode. Errors are introduced into the SLAVED mode of the HSI due to the magnetic influence of the ship. Refer to applicable Launch Bulletin for temperature, gross weight, flap position, and trim setting considerations. Directional and lateral trim should be set at neutral in all cases, regardless of gross weight, flap position, or power settings.

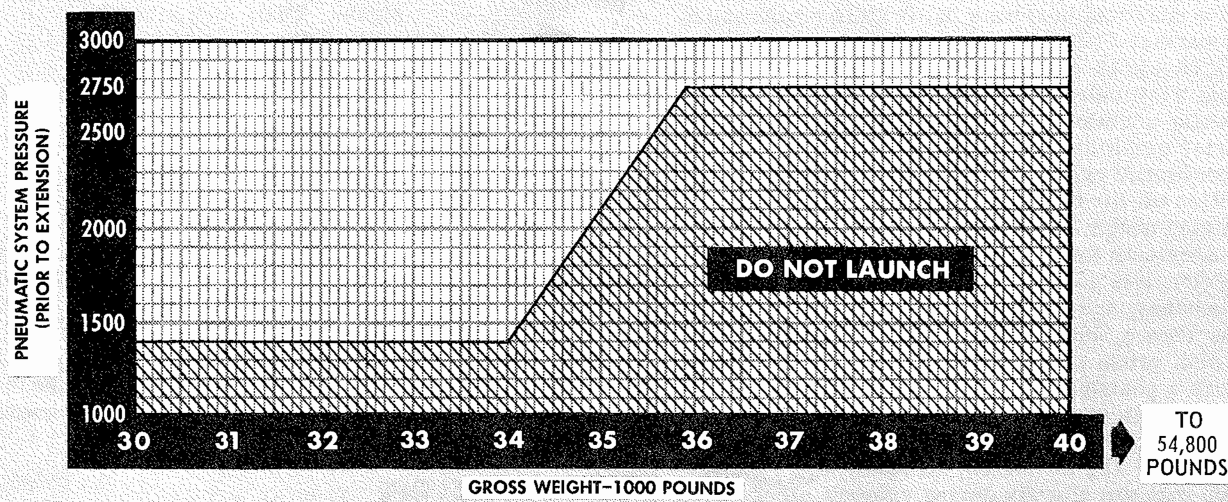
CAUTION

Catapult launching acceleration can force fuel out of the external tanks through the transfer lines to the fuselage cells at a rate beyond tank venting capability, thus creating a partial vacuum in the external tanks. Therefore, to prevent external tank collapse during a catapult launch, insure that the external transfer switch is in the OFF position prior to launch.

CATAPULT HOOK-UP

Proper positioning on the catapult is easily accomplished if the entry is made with only enough power to maintain forward motion and the plane director's signals are followed explicitly. All functional checks will be performed prior to taxiing onto the catapult, if practicable. The best technique for positioning is

Nose Strut Extension Pressure Minimums



Note

DURING CARRIER QUALIFICATIONS, THE REPEATED NOSE STRUT EXTENSIONS PLACE SUCH A HEAVY LOAD ON THE PNEUMATIC SYSTEM THAT SYSTEM PRESSURE CAN NOT BE BUILT BACK UP TO NORMAL. ALTHOUGH 2750 PSI IS THE NORMAL MINIMUM PRESSURE FOR NOSE STRUT EXTENSION, THIS MINIMUM MAY BE LOWERED AS GROSS WEIGHT DECREASES FOR CARRIER QUALIFICATION PURPOSES. THIS CURVE SPECIFIES THE MINIMUM PNEUMATIC SYSTEM PRESSURE FOR A SPECIFIC GROSS WEIGHT. SATISFACTORY NOSE STRUT EXTENSIONS CAN BE OBTAINED AT THESE MINIMUMS, HOWEVER THERE IS A DECREASE IN ANGLE OF ATTACK ON TAKE OFF.

RF4B-P3-305A

Figure 3-5

to approach the catapult track at a minimum amount of power utilizing nose gear steering. The pilot should sight down the catapult track, acquire the plane director and follow his signals very closely. The pilot should anticipate an initial hold after the nose wheel drops over the shuttle. After crossing the shuttle, prior to catapult tension the nose strut will be extended (see figure 3-5 for nose strut extension pressure minimums). On signal of catapult tensioning, release brakes and advance power slowly to about 80% and anticipate a hand-off signal to the Catapult Officer. After catapult tension, recheck ADI and standby attitude indicator for desired pitch indications.

CAUTION

Do not allow the pneumatic system pressure to exceed 2300 psi with the nose gear extended. If the pneumatic pressure starts to build up above this value, actuate the emergency air brakes as necessary to maintain the pressure below 2300 psi. Allowing the pneumatic system pressure to exceed 2300 psi will subject the nose strut to excessive loads during catapulting.

WARNING

Once the nose strut is extended, any interruption of electrical power, such as cycling both generator switches simultaneously, will cause deflation of the nose strut from the catapult extension condition.

CATAPULT LAUNCH (MIL POWER)

Upon receipt of a two finger turn-up signal from the Catapult Officer, advance throttles to MIL power, check engine instruments and trim settings. Ensure that the head is positioned firmly against the head rest. Use MIL power catapult hand grips or move throttles outboard into the afterburner detent and use as a throttle stop. When satisfied the aircraft is ready, give an exaggerated salute to the Catapult Officer. Place control stick aft. Control stick positioning during catapult launch is a function of aircraft gross weight and stabilator effectiveness. An increase in gross weight results in an aft c.g. shift with a resultant decrease in aft stick requirement. For normal-to-heavy gross weights, the control stick should be placed in the full aft position for initial positioning and then moved forward slightly reducing aft stick approximately one quarter. For carrier qualification weights, the control stick should be positioned full aft and held in this position until rotation off the bow. Although the aircraft has no trimmed neutral stick position that will meet the requirements for all gross weight launches, pilot experience is gained rapidly with a minimum number of launches, and stick positioning poses no problem. After launch, establish a 10° to 12° pitch angle on the ADI, cross checking the pressure instruments to ensure a positive rate of climb. If the ADI fails or is unreliable during launch, the standby attitude indicator and radar horizon are available for attitude reference. The altimeter, airspeed, and rate of climb may dip slightly during catapult stroke but will recover shortly after shuttle release.

Note

> Holding the control stick fully aft during a high gross weight launch will impart a higher than desired airplane rotation rate. Although this overrotation may be stopped with forward stick, it creates an undesirable and unnatural control movement, especially during night or IFR conditions.

CATAPULT LAUNCH (MAX POWER)

When a MAX power launch is scheduled, the following signals will be used:

Two finger turn-up, advance power to MIL.

Catapult Officer responds with 5 fingers (open hand held toward pilot)

Pilot selects MAX power, checks instruments and positions himself, then gives an exaggerated salute to the Catapult Officer. An optional method of selecting the afterburner may be used by advancing the throttles to minimum A/B and assuring an afterburner light-off by noting that the nozzles open slightly. After the catapult fires, advance the throttles to the MAX position.

CATAPULT LAUNCH ABORT PROCEDURE

If, after turn-up on the catapult (Day Launch), the pilot determines that the aircraft is down, he so indicates by shaking his head from side to side at the Catapult Officer. Never raise the hand into view to give a "thumbs down" or make any motion that might be construed as a salute. After the Catapult Officer observes the "no-go" signal, he will then cross his forearms over his face. This signal will be followed by the standard release-tension signal. When the bridle has dropped, the Catapult Officer will then step in front of the wing of the aircraft and give the throttle-back signal. Then, and only then, will the power be reduced. If the aircraft is down after the "go" signal is given, transmit the words "Suspend", "Suspend". This should cause all catapults to be immediately deactivated.

CARRIER LANDING PATTERN

The carrier pattern (figure 3-6) starts with the break at 600 feet, 250-300 knots IAS maximum on the starboard bow of the ship. The break interval will be one-half of the desired ramp interval time. Radio procedures will be in accordance with ship procedures. Fly the pattern at 600 feet above mean sea level. The 180° turn is commenced when abeam the LSO platform. On rollout to final, slightly overshoot the ships wake.

GLIDE SLOPE

The technique of flying the glide slope is the same as FMLP except that more power may be required and line-up will be much harder to maintain. With rough seas and subsequent pitching decks, some erratic meatball movements may be encountered. If this is the case, average out the "bouncing ball" to maintain a smooth and safe rate of descent. In no case overcorrect if the ball moves to a high indication.

ARRESTMENT OPERATIONS

Note

> In the event of a blown tire on landing, do not raise the flaps until the flap area has been inspected.

ARRESTED LANDING AND EXIT FROM LANDING AREA

As the aircraft touches down, advance throttles to MIL. Upon completion of landing rollout, reduce power to IDLE, raise the hook and allow the aircraft to roll aft. Apply brakes on signal. Fold wings and have the RSO report wing fold position. Taxi forward on the "come ahead". If, at anytime during this phase of operations, one or both brakes fail, utilize the emergency pneumatic brakes and call the tower and/or signal for chocks to be installed.

Note

> After each arrested landing, inspect the stabilator leading edge for damage from arresting cable.

Carrier Landing Pattern

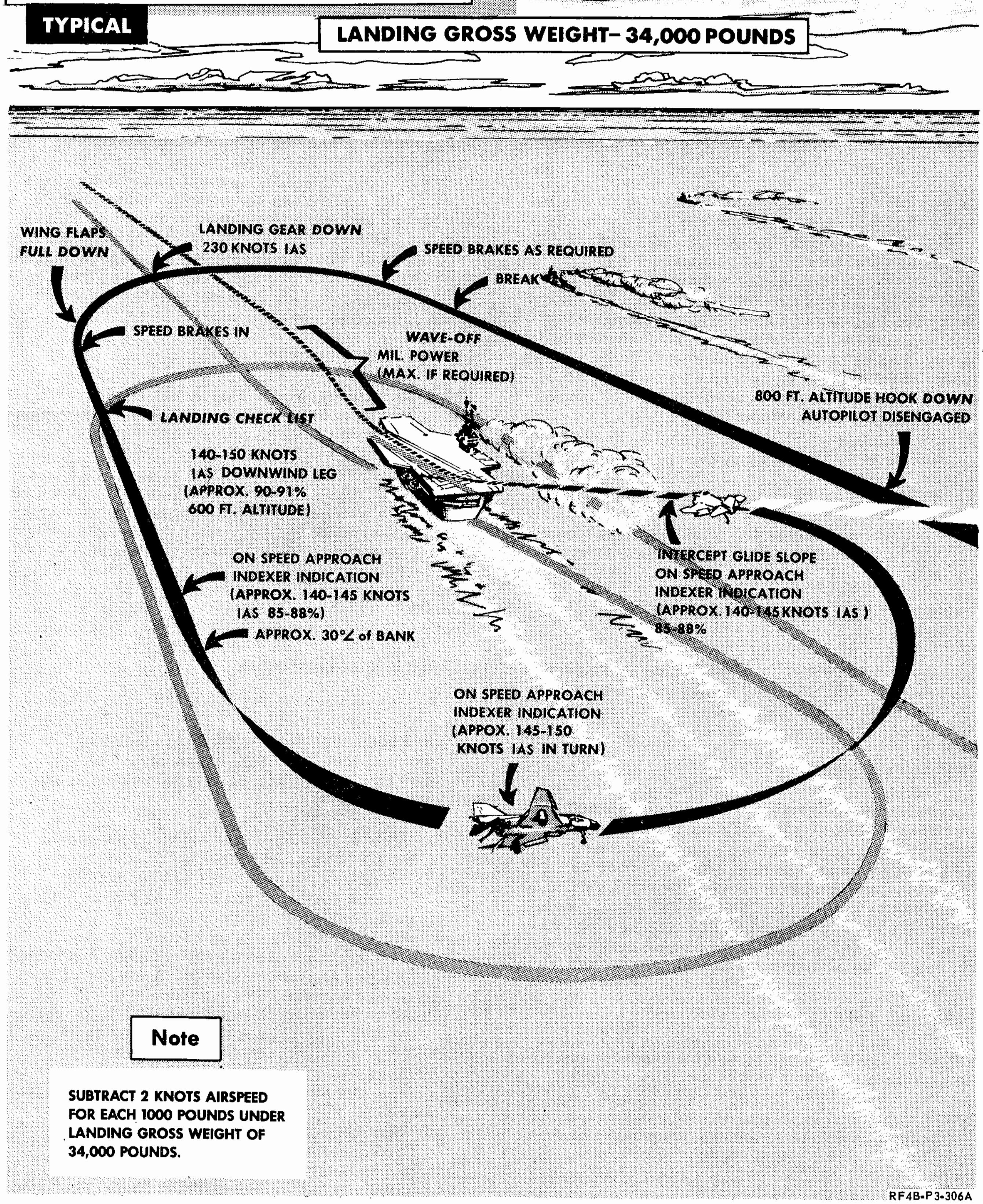


Figure 3-6

CARRIER CONTROLLED APPROACHES

GENERAL

Note

The procedures and chart in this section are for a typical operation and specifics may vary from ship to ship.

Carrier all-weather approach, or carrier controlled approach (CCA) may be used at any time at the discretion of the Commanding Officer. Normally, CCA approaches will be made individually. Formation penetrations, other than emergencies, will not be made through an aloft overcast more than 10,000 feet thick when the base of the overcast is 3,000 feet or less. Aircraft will be under positive control at all times. The succeeding articles deal with the various phases of jet carrier controlled approach. Carrier all-weather approach or CCA will be used when any of the following weather conditions exist:

Ceiling of 1,500 feet or less

Forward flight visibility of three miles or less

All flight operations during any periods one-half hour after sunset and one-half hour before sunrise

During mandatory let-down in thrunderstorm areas

In any other situation where supervisory personnel can anticipate weather phenomena that might cause pilots difficulty.

ENROUTE PHASE

Normally, CAP aircraft will contact Approach Control when directed by the CAP controller. Inbound aircraft that are not under the control of another agency will be expected to Contact Approach Control when entering the 50-mile control area. This area is defined as the circular 50-mile radius airspace around the ship and extending upward from the surface to unlimited altitude. The control area is under the cognizance of Approach/Departure Control.

ARRIVAL PHASE

Normally, the time when aircraft will arrive at Marshal point for recovery will be a minimum of 20 minutes before the scheduled recovery time. Approach Control will confirm aircraft Marshal, altimeter setting, EAC, final control frequency, expected FOXTROT CORPEN, time check, ship's weather, and the bearing and distance to Bingo Field when used. Rather than making repetitious broadcasts to individual aircraft, items that are of general interest to all pilots may be broadcast blind every few minutes by Approach Control. Inbound/final bearings may be given at this time.

HOLDING PHASE

Five minutes prior to penetration, defogging will be actuated and maximum comfortable interior temperature will be maintained to prevent possible fogging or icing on the windscreen and canopy. Pilots will manage fuel so that the aircraft will be at proper landing weight upon arrival at the ramp. The holding pattern is a left-hand, six-minute, race-track pattern with inbound heading passing through the assigned fix. Each pilot will plan his flight pattern to depart Marshal Point at his approved EAC.

LET-DOWN PHASE

The CCA let-down (figure 3-7) is based on the carrier being into the wind and effectively generating approximately 30 knots of headwind before the first aircraft commences its descent. If the carrier is not on the wind-line, there will be difficulty in making all descent check points. A speed of 250 knots IAS must be maintained to ensure proper interval unless a speed change is directed by CCA. Adjust altitude with power and configuration--not airspeed. (A maximum of 300 knots CAS and minimum of 200 knots IAS will be used during the descent when speed changes are directed by CCA.) Radar and barometric altimeters will be cross checked continuously when below 10,000 feet.

LET-DOWN PROCEDURES

Note

If it becomes necessary to dump fuel during a descent, thrust settings in excess of 85% rpm may be required to insure rapid inflight dumping.

1. Prior to descent, check shoulder harness handle locked, set lights as dictated by existing weather, and lower arresting hook.
2. Turn on pitot heat and select engine anti-icing system as appropriate.
3. Accomplish final changes to radio and IFF upon departing Marshal or earlier. After these changes are made, pilot will make no further changes except under emergency conditions.
4. After departing Marshal, use only three-digit aircraft side numbers in radio transmissions. This is satisfactory for deployed air group operation. For CARQUALS, squadron call sign may have to be added to eliminate confusion.
5. When commencing penetration, initiate a standard descent--250 knots IAS, 4,000 feet per minute minimum, speed brakes (as desired).
6. Using the rule of one mile for every 1,000 feet of altitude plus 15 miles, make all check points and adjust power as necessary.

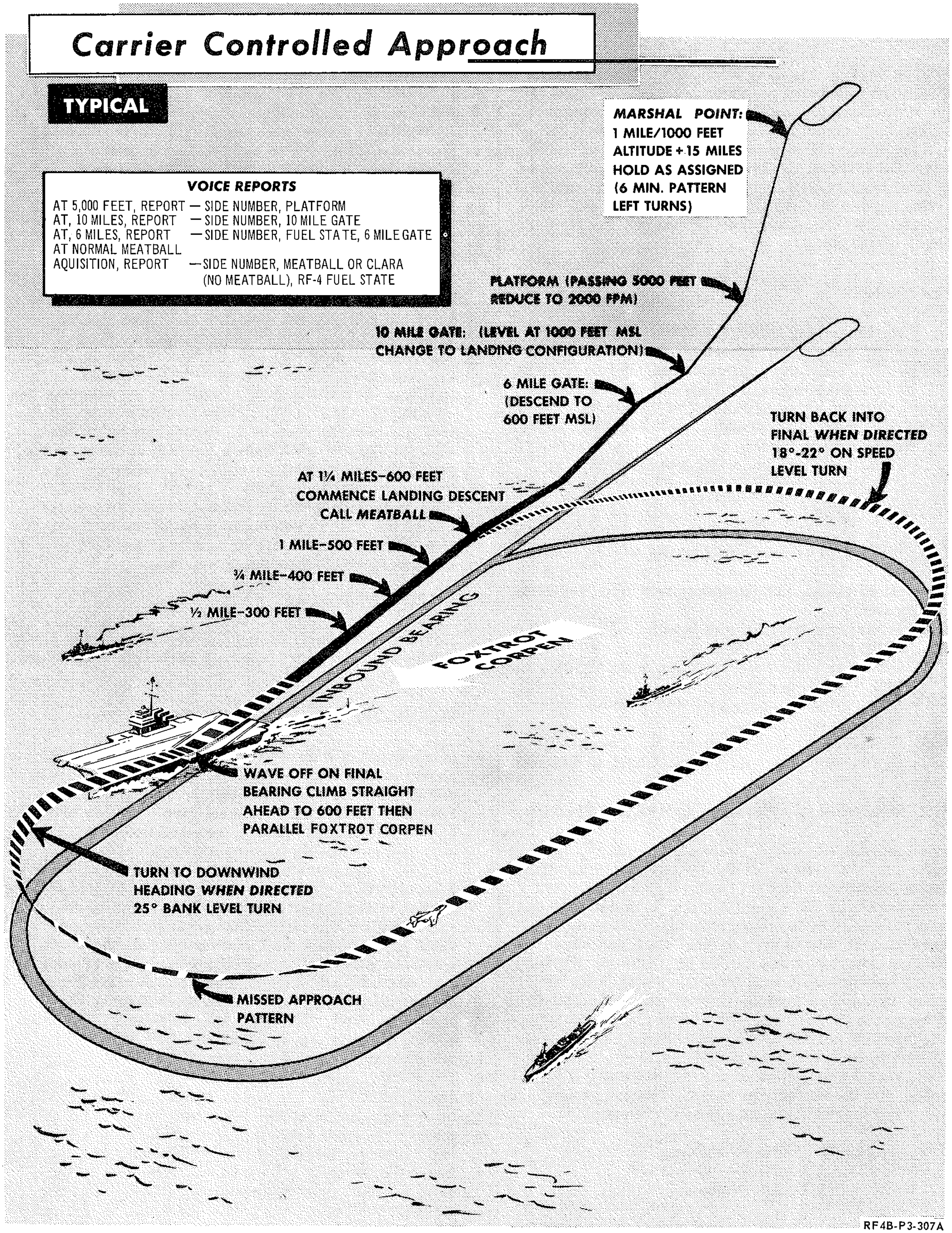

Carrier Controlled Approach
TYPICAL
VOICE REPORTS
AT 5,000 FEET, REPORT — SIDE NUMBER, PLATFORM
AT, 10 MILES, REPORT — SIDE NUMBER, 10 MILE GATE
AT, 6 MILES, REPORT — SIDE NUMBER, FUEL STATE, 6 MILE GATE
AT NORMAL MEATBALL AQUISITION, REPORT —SIDE NUMBER, MEATBALL OR CLARA (NO MEATBALL), RF-4 FUEL STATE
MARSHAL POINT: 1 MILE/1000 FEET ALTITUDE + 15 MILES HOLD AS ASSIGNED (6 MIN. PATTERN LEFT TURNS)
PLATFORM (PASSING 5000 FEET REDUCE TO 2000 FPM)
10 MILE GATE: (LEVEL AT 1000 FEET MSL CHANGE TO LANDING CONFIGURATION)
6 MILE GATE: (DESCEND TO 600 FEET MSL)
TURN BACK INTO FINAL WHEN DIRECTED 18°-22° ON SPEED LEVEL TURN
AT 1¼ MILES-600 FEET COMMENCE LANDING DESCENT CALL MEATBALL
1 MILE-500 FEET
¾ MILE-400 FEET
½ MILE-300 FEET
INBOUND BEARING
FOXTROT CORPEN
WAVE OFF ON FINAL BEARING CLIMB STRAIGHT AHEAD TO 600 FEET THEN PARALLEL FOXTROT CORPEN
TURN TO DOWNWIND HEADING WHEN DIRECTED 25° BANK LEVEL TURN
MISSED APPROACH PATTERN
RF4B-P3-307A

Figure 3-7

CORRECTIONS TO NEW INBOUND/FINAL BEARING

Making corrections to new inbound or final bearing is a maneuver that can result in unacceptable aircraft interval unless corrections are uniform. Squadrons will have to conform to the ship's procedures for making corrections to final bearing in order to insure that aircraft interval is constant. Corrections to final bearing will be made either in response to vectors given by CCA, or by taking a specific "cut" at a specific Tacan distance. Final bearing should be set in on the HSI.

PLATFORM

At 20 miles passing through 5,000 feet, aircraft descent will be slowed to 2,000 feet per minute. At this point, a mandatory unacknowledged voice report will be broadcast by each pilot. The aircraft side number will be given and the word "platform" will be stated. Descent is continued at 2,000 feet per minute and the aircraft is leveled at 1,000 feet (normally 10 to 12 miles out), 250 knots IAS, speed brakes in.

TEN MILE GATE

The following procedures will apply:

1. At 10 miles, call "side number" and "ten-mile gate".
2. Commence transition to landing configuration, maintaining 1,000 feet.
3. Gear down at 10 miles--flaps down at 195 knots IAS. (Uniform speed for interval control after passing the ten-mile gate will have to conform to ship's procedures.)
4. Complete the landing checklist. Check anti-ice, lights, rain removal, and pitot heat as desired.

SIX MILE GATE/FINAL CONTROL PHASE

When passing six miles, call "side number", "fuel state", and "six-mile gate". Unless otherwise directed, a gradual descent to 600 feet will be made when departing the six-mile gate. In order that intervals remain constant, ship procedures as to when aircraft are slowed to final approach speed after passing six miles should be followed. Altitude of 600 feet is maintained until the Final Controller calls "commence landing descent", or the meatball is observed to be centered. At 600 feet, aircraft will intercept the center of the glide slope at 1 1/4 miles on a four-degree slope. If ceilings or visibility preclude visual acquisition of the meatball at 1 1/4 miles, 500 to 700 feet per minute descent passing the following check points should be continued:

1 mile -- 500 feet
3/4 mile -- 400 feet
1/2 mile -- 300 feet

With a well qualified CCA team and air group, suggested minimum for the airplane is 300-foot ceiling, one-mile visibility.

MEATBALL CONTACT

When ready to continue a visual approach, the pilot reports "side number, meatball or clara (no meatball), RF-4, fuel state", and checks exterior lights on. The LSO will acknowledge and the Final Control instructions cease when the pilot reports "meatball". Because of this, pilots are cautioned against premature contact reports during night recoveries when visibility permits sighting the ship beyond two or three miles. There is little depth perception even under the most ideal conditions and it is difficult to judge distance from the ship without reference to Tacan. During night VFR conditions, pilots must cross check Tacan DME to ensure that they are actually at 1 1/4 miles, 600 feet, prior to reporting meatball and commencing descent. The height, dimension of the lens or mirror optical beam at 1 1/4 miles is over 200 feet and the true center is difficult to distinguish. This coupled with the relatively short length of the runway lights, will give the pilot the illusion of being on glide slope and high when, in fact, the aircraft may be 50 to 100 feet below the glide slope. An additional advantage of delaying the meatball report until reaching 1 1/4 miles -- even though the ball is in sight -- is that Final Control will continue line-up instructions that can greatly assist the pilot in establishing satisfactory line-up. Use the vertical velocity indicator to set up a rate of descent of 500 to 700 feet per minute.

NEW

VOICE PROCEDURE

Detailed pilot/controller voice procedure must be established in accordance with each ship's CCA doctrine.

WAVEOFF AND BOLTER PHASE

In the event of a waveoff or bolter, MIL/MAX power should be added as necessary, climb straight ahead to 600 feet, and maintain 150 knots IAS. When directed by CCA, initiate a level turn to the downwind leg. If no instructions are received within two minutes (approximately 6 miles distance on Tacan), assume communications failure and initiate the downwind turn to the reciprocal of Foxtrot Corpen. A 25-degree bank angle at 150 knots IAS on the upwind turn will establish the aircraft at the desired 1 3/8 to 1 1/2 miles abeam on the downwind leg. Aircraft that undershoot or overshoot a proper downwind leg may be vectored back to a proper abeam position. Slow to proper approach speed when approaching the abeam position. This position can be established by using a relative Tacan bearing of 15 degrees aft of the wing at 1 3/4 to 2 miles on DME when on the downwind heading. Final Control will clear the aircraft to turn back inbound to intercept the final bearing. A level, "on speed" approach turn of 18 to 20 degrees bank angle from the normal abeam position will allow the aircraft to properly intercept the final inbound bearing at 1 1/4 to 1 1/2 miles aft on the ship. Traffic spacing ahead may require that the aircraft continue on downwind leg well past the normal abeam position before being directed to turn to final bearing. A distance aft of the ship should be specified at which a pilot may assume communications failure and initiate his own turn to final bearing. No attempt should be made to establish visual contact with the ship when executing a CCA until the final approach turn has been executed. When fuel considerations become critical in an extended bolter pattern, 300 to 400 pounds per pass may be saved by raising the landing gear and selecting half flaps. Lower landing gear and full flaps on final. The "Wheels" light on the pilot's panel will flash with the flaps down.

FOULED DECK HOLDING

Details of fouled deck holding will have to be established in accordance with each ship's CCA doctrine. In general, if fouled deck holding is initiated, aircraft should remain at present altitude and fly maximum endurance airspeeds. Fouled deck holding is initiated by the ship transmitting, "All aircraft signal Delta". The best "gouge" for maximum endurance at any altitude is to fly 9 units on the angle of attack indicator, and utilize minimum bank angles. This pre-supposes that all aircraft in the landing configuration will retract gear and flaps. If necessary, as fuel becomes critical with no Bingo field available, jettison external stores. In extreme emergency situations, a small amount of fuel (approximately 10 pounds per minute) can be saved by securing one engine at sea level, landing gross weights.

NIGHT FLYING

GENERAL

Night carrier operations will have a much slower tempo than daylight operations and it is the pilot's responsibility to maintain this tempo. The procedures outlined here are different from, or in addition to, normal day carrier operations.

BRIEFING

Prior to initial night flight operations, all pilots will receive an additional briefing from the following persons:

Flight Deck Officer
Catapult Officer
Arresting Gear Officer
LSO

Individual flight briefings will include all applicable items outlined above, with particular emphasis on weather and Bingo fuel. The ready room will be lighted for night adaptation during briefings. In addition, pilots may wear night adaptation glasses from the ready room to the flight deck to prevent loss of night vision.

PREFLIGHT

External preflight will be made utilizing the red lensed flashlight. In addition to normal cockpit preflight, insure that external light switches are properly positioned for poststart light check. The general rule of not showing white lights on the flight deck at night should be observed.

POSTSTART

Adjust cockpit light intensity to desired level. When ready for taxi, indicate with appropriate signal.

TAXI

Night deck handling operations are of necessity slower than those used during the day. When a doubt arises as to the meaning of a signal from a taxi director, stop.

CATAPULT HOOK-UP

Maneuvering the aircraft for catapult hook-up at night is identical to that used in day operation; however, it is difficult to determine your speed or degree of motion over the deck. The pilot must rely upon, and follow closely, the plane director's signals.

CATAPULT LAUNCH

On turnup signal from Catapult Officer, assure throttles in MIL and check all instruments. When ready to go, place external light master switch ON (dim/bright and steady), fuselage light OFF. After launch, establish a 10 to 12° pitch angle on the ADI, cross checking the standby attitude indicator, and the pressure instruments to ensure a positive rate of climb. Retrack the landing gear. Five hundred feet is considered to be minimum altitude for retraction of flaps. When well established in a climb, switch lights to bright and flashing or as applicable for an instrument climb-out. The standby attitude indicator or radar gyro should be used in the event of an ADI malfunction.

NEW

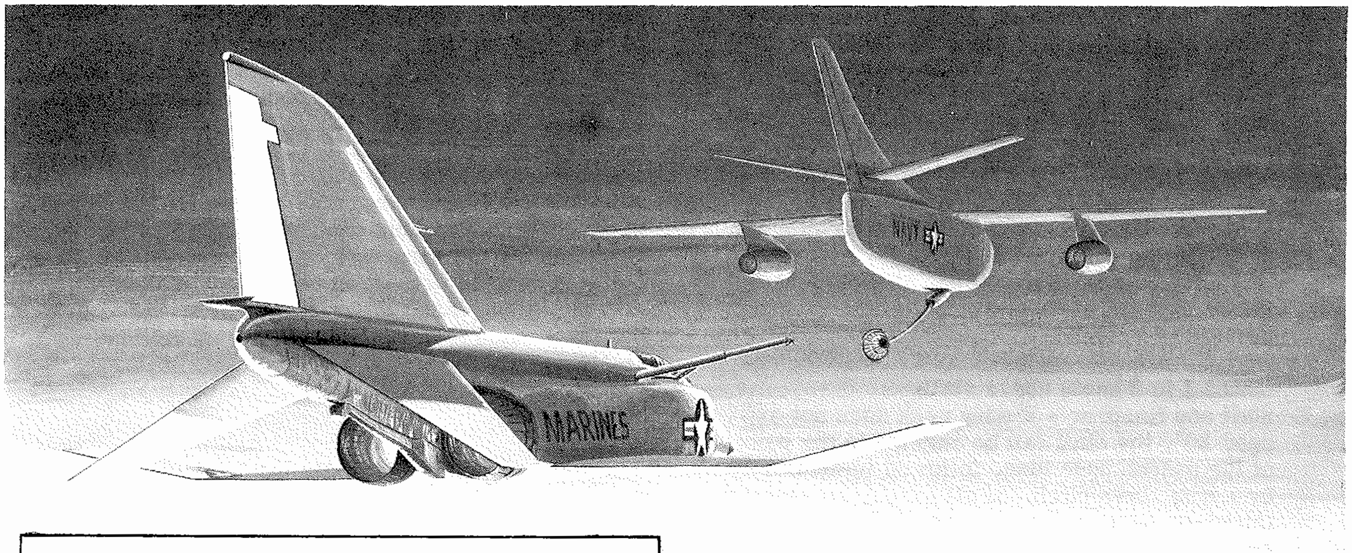
CATAPULT ABORT PROCEDURES

The pilot's "no-go" signal for night launches will be not to turn on his exterior lights. The pilot should also call on land/launch and advise with "Side No., Cat No., is down". Maintain MIL power until the throttle-back signal is received from the Catapult Officer standing in front of the wing of the aircraft. In the event of a catapult malfunction, the above signals will also apply. If the aircraft is down after the "go" signal is given, transmit the words "Suspend", "Suspend". This should cause all catapults to be immediately deactivated.

NEW

ARRESTMENT AND EXIT FROM LANDING AREA

Except for carrier qualifications, all night recoveries will be made utilizing Tacan/CCA approaches. LSO should take control when the aircraft is approximately one mile from the ramp. The pilot should have all lights on bright and steady. At end of arrestment rollout, turn off external lights and follow director's signals.



FLIGHT PROCEDURES

section IV

RF4B-400

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FLIGHT CHARACTERISTICS

STALL

ONE "G" STALLS

Normal 1 "g" stalls in the clean configuration are preceded by a wide band of buffet warning. Onset buffet occurs 40 knots above the stall and increases from moderate to heavy buffet immediately preceding the stall. Mild wing rocking will occur 5 to 10 knots prior to the stall. The stall is usually characterized by a right yaw and right roll; however, the airplane will occasionally yaw and roll to the left. Recovery is easily effected by positioning the stabilator forward of neutral while maintaining neutral ailerons and rudder.

Note

If the airplane is close to or at the stall, use of aileron to raise a wing will aggravate the yawing motion. Left aileron produces right yaw, and right aileron produces left yaw.

WARNING

Stalls performed in the landing configuration should not be carried beyond uncontrollable wing rock. Stalls performed in the clean configuration should not be carried beyond uncontrollable wing rock and/or the onset of airplane nose-right yawing (nose "slicing"). Forward stick with neutral ailerons and rudder will effect an immediate recovery from any incipient stall that does not exceed the above conditions.

CAUTION

Do not practice landing configuration stalls above 10,000 feet. The effectiveness of the BLC system and engine bleed pressure decrease with altitude. Use of BLC at extreme altitudes may cause the systems using engine bleed air to become inoperative.

STALLS IN LANDING CONFIGURATIONS

Approaching the stall in the landing configuration is safe and comfortable, with satisfactory control about all axes to within 8 knots of the stall. The aircraft will stall at approximately 27 units with full flaps and gear down, and at about 24 units with the flaps up and gear down. Longitudinal trim is available down to the actual stall. The three characteristics preceding each stall are: (1) nose rise, (2) roll oscillations, and (3) moderate buffet. The usual sequence of events during an approach to stall are:

1. Pedal Shaker - This is activated by the angle of attack system and is a stall warning device set at 22.3 units. It actuates approximately 19 knots above the stall, and approximately 10 knots before wing rock.

2. Nose Rise - A mild rate 2° to 3° nose rise will occur along with stick force lightening at 10 knots above stall, and occasionally just prior to the stall pitch down.
3. Wing Rock - A gentle roll oscillation will occur at 8 knots above the stall and usually does not exceed 10° bank angles until the stall is reached. However, during some stall approaches, the wing rock increases to as much at 60° to 80° left and right and the stall approach should be discontinued at this point by gentle forward stick movement until recovery attitude is attained.
4. Buffet - A moderate buffet will usually be detected 1 to 2 knots above stall.
5. Stall and Recover - If wing rock does not exceed 20°, the stall can be carried to the point of the second nose rise, followed immediately by a nose down pitch. In all cases, recovery is initiated, or assisted, by easing forward on the stick. Recovery attitude is usually about 30° nose down. External stores, including wing pylon tanks, have no effect on stall speeds or characteristics. Stalls with one-half flaps are very similar to full-flap stalls. Stall airspeeds for various gross weights and bank angles in the clean and landing configuration are shown on the Stall Speed Chart, figure 4-1. A flat final approach can be flown at minimum airspeeds (pedal shaker angle of attack), if necessary. Minimum airspeeds are dictated by flare capability since extremely rapid engine response offers excellent altitude and speed control.

INVERTED STALLS

Inverted stall entries have been made up to a negative pitch angle of 60°. A negative angle of attack stall can be instantaneously obtained only with abrupt full forward stick deflection at a negative (inverted) pitch angle of 20° or more. Light to moderate buffet will occur at the stall, and there are no distinct roll or yaw tendencies.

CAUTION

Loss of engine oil pressure will result from sustained negative accelerations.

ACCELERATED STALLS

Subsonic

Accelerated subsonic stalls are preceded by buffet increasing progressively to a moderate level immediately prior to the stall. Lateral instability in the form of wing rocking occurs concurrently with buffet and progresses to a fairly high frequency, large amplitude roll oscillation. The airplane usually yaws and rolls to the right at the stall; occasionally a yaw and roll to the left may occur. Increasing the rate of aft stick displacement will increase the magnitude and rate of yaw and roll at the stall. Abruptly applying and holding full aft stick can result in a rapid spin entry. Prompt neutralization of ailerons and rudder and positioning the stabilator forward of neutral will usually effect recovery from accelerated stall entries. A right roll may result during recovery if the stall entry was extremely abrupt. Below 35,000 feet, if the stick is abruptly pulled full aft and held, a spin may develop; it is also possible that the spin cannot be broken within one turn. Rapid stall entry with abrupt control applications will result in a stall without noticeable occurrence of the above mentioned buffet and wing rocking as warning prior to stall. Moderate buffet will be evident at the stall. As altitude is increased above 35,000 feet, the aircraft becomes more spin resistant to abrupt full stick stalls.

Supersonic

Supersonic accelerated stalls exhibit less buffet and wing rocking than subsonic stalls.

SPINS

A wide variety of entry conditions have been investigated and include spins entered from:

Level Flight
Accelerated Turns
Accelerated Turn Reversals
Supersonic (1.2 Mach) Deceleration with Speed Brakes Extended (Accelerated Turns)
Vertical Climbs
Inverted Climbs

It is possible to obtain both upright and inverted spins. Following stall, the airplane may enter a 1 to 2-turn post-stall gyration possibly followed by a fully developed spin. Recovery can be made from all maneuvers through the proper use of flight controls. In addition, the drag chute may be used to effect a recovery from either an upright or inverted spin.

POST-STALL GYRATION

A post-stall gyration may be encountered following any of the entries listed above. It is best described as a tumbling motion about roll, pitch, and yaw axes. Airplane motion will depend upon the speed and type of entry and is not predictable. If not countered with proper recovery control, the post-stall gyration can be expected to progress into a fully developed spin (upright or inverted) after 1 1/2 to 2 turns.

UPRIGHT SPINS

The upright spin is moderately oscillatory in pitch, roll, and yaw with yaw predominating in the initial turns but decreasing as the spin progresses. Nose position varies from near level to about 60° nose-down at the 1/2 turn point. The roll and yaw oscillations do not produce uncomfortable accelerations. The upright spin is stable in that once it is fully developed, positive control action is required for recovery. The upright spin is typified by greater than zero "g" and an indicated angle of attack of 30 units. Spin direction can be determined visually by the apparent yaw motion of the airplane and/or by deflection of the turn needle.

Stall Speeds

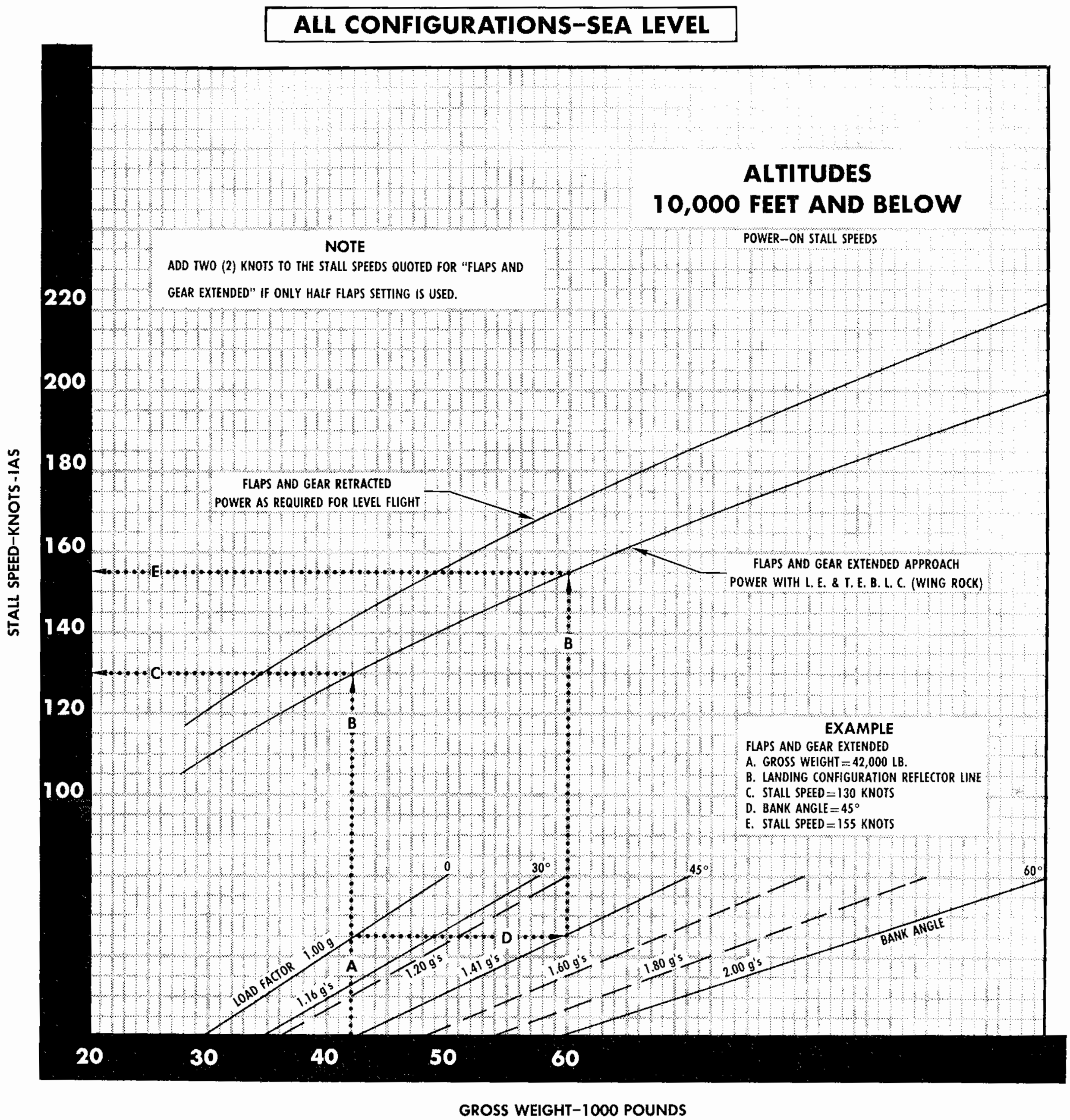


Figure 4-1

INVERTED SPINS

The inverted spin is flatter (nose within approximately 30° of the horizon) and is less oscillatory than the upright spin. An inverted spin may be encountered following improper control use in a post-stall gyration out of a vertical or inverted climb. The spin is not stable in that pro-spin controls (rudder and/or aileron with the spin) must be held to continue the spin. The inverted spin is typified by less than zero "g" and an indicated angle of attack of zero (0) units. Spin direction can be determined visually by the apparent yaw motion of the airplane and/or by deflection of the turn needle.

RECOVERY PROCEDURES

The best spin prevention procedures is to avoid stalling the airplanes. Stall is prevented by proper control of angle of attack and careful use of controls at slow airspeeds. When faced with an unusual attitude and decaying airspeed in an approach to stall, use longitudinal control to attempt to maintain an optimum angle of attack of 5-10 units (near zero "g") while keeping rudder and aileron neutral (regardless of bank angle) and do not reduce power. Once the nose has dropped below the horizon and airspeed builds beyond the possible stall region, normal control use is permissible in regaining the desired flight attitude.

WARNING

Use of rudder or aileron with the airplane close to a stalled condition will produce yawing tendencies favoring a post-stall gyration and a possible fully developed spin.

Post-Stall Gyration

In the event the airplane is stalled and tumbles into a post-stall gyration, the following recovery action should be taken:

1. STICK FORWARD OF NEUTRAL.
   Disengage AFCS, if engaged, while positioning the stick forward of neutral.
2. NEUTRALIZE AILERON AND RUDDER.
3. TERMINATE AFTERBURNER.
4. IF NOT RECOVERED WITHIN 1 1/2 TO 2 TURNS, DEPLOY DRAG CHUTE AND MAINTAIN RECOVERY CONTROLS.
   Holding neutral aileron and rudder with the stick forward of neutral should fly the airplane out of nearly all out-of-control conditions. As the gyration stops, proper control of angle of attack and careful use of aileron and rudder are required until the airplane is solidly under control. However, if recovery is not effected after 2 turns, deploy the drag chute and continue holding recovery controls.
5. Retract gear and flaps (if extended).
6. Extend ram air turbine.

Note

The drag chute should produce a recovery within one turn after deployment. It takes 1/3 to 1/2 turn to fully deploy and take effect. It is not necessary to jettison the chute since it will separate as speed builds up.

WARNING

The drag chute recovery has not been flight tested for inverted spins; however, limited tests have been conducted for upright spins. Even though the drag chute will probably effect a recovery, the pilot should be prepared in all cases to recover using aerodynamic controls.

Upright Spin

If recovery is not effected within 2 turns after drag chute deployment and the airplane has progressed into a fully developed upright spin (characterized by greater than zero "g" and an Indicated angle of attack of 30 units), determine spin direction (visually plus turn needle check) and apply the following controls:

1. Full rudder against the spin.
2. Full aileron with the spin.
3. Full aft stick.
   Aft stick keeps the yaw rate to a comfortable level. Moving the stick forward will increase the yaw rate.
4. Hold these controls until the yaw rate ceases, then neutralize aileron and rudder and return stick forward of neutral.

Note

It may take as long as 20 seconds for controls to become effective.

5. If the airplane shows reversal tendencies, counter these with:
   a. Rudder against the reversal yaw.
   b. Aileron with the reversal roll.
   c. Stick forward of neutral.
6. If the reversals are of such a magnitude that it is believed another spin has developed, reapply:
   a. Full rudder against the spin.
   b. Full aileron with the spin.
   c. Full aft stick.

Inverted Spin

If recovery is not effected within 2 turns after drag chute deployment and the airplane has progressed into a fully developed inverted spin (characterized by less than zero "g" and an indicated angle of attack of units), determine spin direction (visually plus turn needle check) and apply the following controls:

1. Rudder against the spin.
2. Aileron neutral.
3. Stick forward of neutral.
4. When the yaw rate stops, neutralize all controls and fly out of the unusual attitude.

ENGINE EFFECTS

The engines will probably flame out at some point during a post-stall gyration or fully developed spin. Even though throttle position has no apparent effect on this tendency, afterburning should be discontinued early in the post-stall gyration phase. If flame-out occurs, electrical power will be lost within 3 or 4 turns, normal operation of flight controls will deteriorate after approximately 3 turns and may not be possible after 5 turns. The ram air turbine will not be effective while in a spin but will be an immediate aid for hydraulic and electrical power after the spin is broken.

EXTERNAL STORE EFFECTS

All spin tests and demonstrations were performed without external stores and at a mid CG range (31.5 to 32.7% MAC). External stores and CG variation should not materially effect the spin recovery procedures. Tests also show that speed brake position has little effect. It is recommended that stores not be jettisoned in the spin.

ALTITUDE CONSIDERATIONS

Altitude loss in a steady state spin is approximately 2500 feet per turn. It usually takes 5000 feet to break a steady state spin and regain control speed plus another 10,000 feet to pull out holding onset buffet (no more than 15 units angle of attack). Total recovery altitude is approximately 15,000 feet. Recovery from a post-stall gyration may take considerably less altitude depending upon the extent and nature of the gyration. If the pilot considers that there is insufficient altitude for recovery, the crew should eject at the earliest possible moment.

ANGLE OF ATTACK

The angle of attack indicator is the primary instrument to verify uncontrolled flight/spins. During upright uncontrolled flight/spins, angle of attack will indicate 30 units. During inverted uncontrolled flight/spins, angle of attack will indicate 0 units. During uncontrolled flight, when these indications are observed, initiate appropriate spin recovery procedure immediately. See figure 4-2 for Angle-of-Attack Conversion Charts.

STABILITY AND CONTROL

In discussing stability and control, it must be realized that a large variation exists throughout the flight envelope. Stability varies with Mach number and also with c.g. location. Control effectiveness is also effected by Mach number, but just as much, if not more so, by "q" (dynamic pressure). The effects of Mach number, c.g. location, and "q" as pertaining to stability and control will be discussed under Subsonic, Transonic, and Supersonic Flight regions.

SUBSONIC REGION

Landing Configuration

In this configuration, the airplane exhibits positive longitudinal static stability except for an area about 10 knots before stall where a mild stick force lightening occurs. This is followed by a regaining of static stability after the stall so that if back pressure is released, the airplane recovers by itself. In the speed range between 130-180 knots, where most landing configuration flying is done, the airplane demonstrates almost neutral stick force stability up to about 150 knots and mildly positive stick force stability above this speed. This is due to control system friction and rather weak stick centering at this low "q". Stabilator effectiveness is reduced with full flaps due to an aft center-of-pressure shift and a change in the downwash pattern over the tail. However, adequate effectiveness still remains for all known configurations. Since ground effect also decreases stabilator effectiveness, the aft stick stop may be bumped during flare-out from a high sink rate landing. Stabilator effectiveness is not sufficient to hold the nose up after landing since the center of rotation is now about the main gear instead of the c.g. Lateral directional control response in the landing configuration is good; however, the adverse yaw resulting from the strong positive dihedral effect causes roll rate to be somewhat decreased when high roll rates are commanded without use of coordinating rudder. The ARI (Aileron-Rudder Interconnect) feeds in rudder automatically to counteract yaw so that when large amounts of aileron are being used, the turns will be coordinated. Except for unusually asymmetrical external loadings or very rough gusty air, only small lateral control motions are required for landing. The approach to stall is characterized by a decrease in lateral stability which becomes evident by a mild wing-rock (±5-10 degrees) which gets progressively worse as speed is reduced.

Clean Configuration

Lateral and directional control response is good in the clean configuration and the airplane exhibits good pilot feel. Rate of roll is quite high in this area and directional stability is strong enough so that ball-centered turns are made without the use of rudder. During abrupt aileron rolls, where some adverse yaw is experienced, the yaw damper is effective in keeping the ball centered.

TRANSONIC REGION

High Altitude

In the transonic region, longitudinal static stability becomes more positive and stabilator effectiveness somewhat reduced, resulting in slightly higher maneuvering stick force gradient. Transition from transonic to subsonic speeds while holding "g's" on the airplane results in a mild to moderate nose rise. If corrective action is not taken, this could place the airplane in buffet at the higher altitudes or cause a significant load factor increase at the lower altitudes. This is characteristic of most swept-wing airplanes and is a result of going from an area of higher stability and lowered stabilator effectiveness to an area of lowered static stability and higher stabilator effectiveness. Speed brakes increase the nose rise tendency during transition from transonic to subsonic speeds. Lateral and directional control in the transonic region is about the same as that experienced in the subsonic region except that roll rate capability is higher. Roll rates are highest in the transonic regions; however, in both transonic and subsonic regions, roll rate resulting from full aileron is much too great for any practical use.

Low Altitude

Transonic flight at low altitude presents low stick force gradient and high stabilator effectiveness which results in an area of high sensitivity and possible over-control. Even though the inherent dynamic stability of the airplane is positive, it may be possible to create a short period longitudinal oscillation if the pilot's response becomes out of phase with the airplane motion, thereby inducing negative damping. Such a condition is commonly known as pilot-induced oscillation (PIO). Since the dampers will decrease the stabilator response to rapid stick inputs, the possibility of inducing PIO is minimized with dampers on. It is recommended that the stability augmentation be used when flying at high speeds and low altitudes. The standard and most effective recovery technique from a pilot-induced oscillation is to release the controls. An out-of-trim condition is conducive to PIO and releasing controls while stick forces are present, because of an out-of-trim condition, could amplify the oscillation. Therefore, it becomes advisable to trim out longitudinal stick forces during a rapid afterburner acceleration at low altitudes. It should be noted, however, that if longitudinal forces are trimmed out while maneuvering, an out-of-trim condition will be present when returning to wings-level flight necessitating a push-force to hold altitude. If the altitude of a mission is such that it would not be desirable to release the flight controls, recovery from a PIO can be accomplished by making the arm and body as rigid as possible, even bracing the left hand against the canopy, and either holding the stick in the approximate trim position or by applying slight positive "g"-loading. In addition, afterburner shutdown at higher indicated airspeeds can produce a pitch transient. Abrupt pitch inputs could cause an oscillation to begin; therefore, all corrections should be performed smoothly. Always lock the shoulder straps when flying under conditions of high speed and low altitude. The body, from the lap belt up, could become the forcing function during an inadvertent pitch input if the shoulder straps are unlocked.

SUPERSONIC REGION

High Altitude

Longitudinal static stability gets more positive as Mach number is increased in the supersonic region. Stabilator effectiveness decreases somewhat, so maneuvering stick forces become higher but do not exceed 10-12 pounds per "g". Maneuvering capability is limited by stabilator effectiveness at the higher Mach numbers at higher altitudes; for example, full aft stick at Mach 2 at 50,000 feet will produce about 3.5 "g's". No abnormal lateral or directional control problems exist during supersonic flight. Directional stability remains strong and rate of roll, although decreasing with Mach number, remains quite adequate out to limit Mach numbers.

EFFECT OF EXTERNAL STORES

The effect on stability and control of adding external stores is mostly a result of changes in c.g. locations and moments of inertia. However, where a fairly high speed can be achieved even with external stores, a decrease in stability occurs because of the adjusted wing pressure distribution. Flight tests have indicated that some decrease is stability does occur, but that an adequate margin still remains and maneuvering capability is not effected. The other effects mentioned above do occur, of course, but the only one really noticed (other than the effect on performance due to increased drag and gross weight) is the increased amount of inertia about the longitudinal axis. This shows up as simply reducing roll rate and rolling acceleration. In other words, it takes longer to build up to a given roll rate, but once a roll rate is established, it takes longer to stop it. Actually, most of the restrictions with external stores will be those imposed by structural considerations rather than any due to stability and control.

ZOOM CLIMB

A zoom climb can be performed by accelerating to a high energy condition and then slowly rotating to a pitch attitude higher than normal climb. Pitch angles in excess of 60° detract from the zoom climb capability and produce more uncomfortable recovery conditions. During a zoom climb to altitudes above 65,000 feet, the EGT must be monitored. Afterburner blow-out will usually occur around 67,000 to 70,000 feet. When the afterburners blow out, the throttles should be taken out of the afterburner range to preclude unexpected or hard light-offs during descent. Above 70,000 feet, the engines will have to be shut down if they tend to over speed or over temp. Engine windmill speed at altitudes above 70,000 feet are high enough to maintain some cockpit pressurization and normal electrical power. Stabilator effectiveness will decrease noticeably above 50,000 feet and an increased amount of aft stick will be required to hold a given pitch attitude. Zoom climb recovery can be initiated at any time during the zoom maneuver by relaxing back pressure on the control stick and flying the airplane over the top at a "g" loading which will prevent stall. Maintaining a constant value of angle-of-attack between 5 and 10 units will properly decrease "g" with decreasing airspeed during the recovery while still maintaining a safe positive "g" loading on the aircraft. Negative "g" recoveries are not recommended due to aircraft and physiological limitations and lack of pilot ability to detect impending stall. Two basic methods of recovering from the zoom climb are possible. A wings level recovery can be effected by smoothly decreasing angle-of-attack to the minimum positive "g" value and holding this until the aircraft is diving. An inverted recovery can be effected by controlling angle-of-attack while rolling the aircraft to inverted and then increasing angle-of-attack to produce the maximum "g" loading on the aircraft. A comparison of the two techniques show that the positive "g" loading on the aircraft assists the recovery trajectory in the inverted case whereas it detracts from the recovery trajectory in the wings level case. The resulting flatter trajectory of the wings level recovery produces a lower minimum airspeed and higher maximum altitude over the top in addition to a longer overall recovery time. Although the inverted recovery is superior from the standpoint of speed, altitude, and exposure time, it exhibits certain risks due to pilot capabilities to properly control angle-of-attack during the rolling maneuvers. All zoom climb recoveries demand smooth coordinated control action. The angle-of-attack indication is the primary recovery aid regardless of recovery method. As speed decreases, the stabilator required to develop a given pitch command increases. Higher than normal stick displacements and rates will be necessary to command or hold angle-of-attack at very low speeds. Inadvertent pitch inputs due to abrupt roll action or pilot's inattention to required pitch control can quickly put the aircraft in a stalled condition. Zoom climb recoveries initiated from indicated airspeeds in excess of 250 knots IAS can be made inverted or wings level. For the wings level recovery, smoothly reduce angle-of-attack to 5 units and hold this value until the aircraft is in a recovery dive and speed has increased through 250 knots IAS. Attempts to hasten the recovery by pushing over to a value below 5 units of angle-of-attack will produce negative "g" on the aircraft and possible stall. Precise roll attitude is not important during the recovery. Any aileron used to correct or maintain roll attitude should be smooth and coordinated. For the inverted recovery, smoothly reduce angle-of-attack to 5 units and, holding this value, smoothly roll the aircraft to inverted. Increase and hold angle-of-attack at 10 units to produce maximum safe "g" loading on the aircraft. When the aircraft is in an inverted recovery dive, the roll to wings level must again be accomplished with smooth slow control action while holding angle-of-attack between 5-10 units. As before, angle-of-attack should be maintained in the recovery dive until airspeed builds up to 250 knots IAS. Zoom climb recoveries initiated at indicated airspeeds less than 250 knots IAS should be accomplished with pilot's sole attention devoted to proper control of angle-of-attack between 5-10 units. Roll attitude should be completely ignored with aileron and rudder held generally neutral to maintain coordinated flight. In the event a pilot becomes confused or disoriented during any recovery, he should immediately concentrate only on angle-of-attack and ignore all other parameters. If angle-of-attack is maintained between 5-10 units, the aircraft will recover safely to a nose-down accelerating condition regardless of roll attitude.

FORMATION AND TACTICS

GENERAL

Formation and tactics set forth in NWIP 41-2 are generally applicable to this aircraft.

AIR REFUELING

PROBE SWITCH OPERATION

The air refuel probe switch has three positions marked RETRACT, EXTEND, and REFUEL. Placing the switch to EXTEND merely extends the air refueling probe. However, with the switch in this position, fuselage cells 1 and 3 can accept fuel if/when space is available. Selecting REFUEL conditions the fuel system by venting all tanks to atmosphere, shutting off tank pressurization air, opening the refueling level control valves in cells 3 and 5 and the wing tanks, and by opening the fuel shutoff valves to the external tanks (providing the refuel selection switch is in ALL TANKS). Immediately after selecting the REFUEL position, monitor the sector portion of the fuel quantity gage. If the fuel quantity shown on the sector depletes more rapidly than the fuel quantity shown on the counter, it is a positive indication that the defuel valve has failed open and that fuselage fuel is transferring into the internal wing tanks. If the wing tanks are sufficiently empty, the fuselage fuel may be depleted completely. Should this situation occur, move the refuel probe switch to the EXTEND position and allow fuel from the tanker to replenish the fuselage fuel tanks to approximately 6000 pounds to assure against flameout. Then move the switch back to the REFUEL position and continue the air refueling. It is also possible to deplete the fuselage fuel supply when attempting wet plug-ins. Since all tanks are vented, no internal wing or external fuel will transfer. If an excessive amount of time is used in attempting a plug-in, the fuselage cells may deplete to a low fuel state. In this event, place the air refuel probe switch to EXTEND. This will permit the internal wing and external tanks to transfer to the engine feed tank. Once the engine feed tank is full, the air refuel probe switch may again be placed to REFUEL and air refueling resumed.

BEFORE PLUG-IN

The air refueling checklist should be completed prior to plug-in:

1. Radar mode selector knob - STBY
2. Radar altimeter function selector knob - OFF
3. Side looking radar - STBY
4. Internal wing dump switch - NORMAL
5. Refuel probe switch - REFUEL (EXTEND for dry plug-ins).

WARNING

After selecting the REFUEL position, check for an indication of a failed open defuel valve.

6. Refuel selection switch - AS DESIRED
7. Check probe fully extended.
8. Check "Refuel Ready" light illuminated.
9. Trim aircraft for balanced flight.
10. Visor recommended down.

For night air refueling:

11. Exterior lights - STEADY BRIGHT
12. Air refuel probe light - ON

REFUELING SEQUENCE

After rendezvous, the receiver aircraft will form on the tanker in echelon as specified by the tanker pilot and order of refueling sequence. The number of aircraft working a single-drogue tanker in sequence is limited to four; additional receiver aircraft will form a separate division in trail. The lead receiver aircraft, after passing the lead, will move aft to a trail position on the drogue. Upon completion of wet or dry plug-ins, recover on the opposite wing of the tanker, unless detached for operational reasons. Each receiver aircraft will follow in turn until all have recovered to a port/starboard formation on the tanker. For practice, this sequence may be repeated as before with the aircraft recovering on the opposite side upon disengagement. Aircraft in either echelon will maintain a relaxed but forward position on the tanker such that after disengagement each receiver aircraft can readily effect a cross-under to join the opposite formation in sequence.

REFUELING TECHNIQUE

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 KIAS.

APPROACH

Once cleared to commence an approach and refueling checklists are 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 ready (amber) 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 and supplementary remarks by the RSO. Increase power to establish an optimum 3 to 5-knot 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. During the final phase of the approach, the drogue has a tendency to move slightly upward to to the right as it passes the nose of the receiver aircraft due to aircraft-drogue airstream interaction. 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. Realization of this situation can be readily ascertained through the RSO. 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. Here again the RSO can readily inform the pilot by calling contact. 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 ready (amber) light going out and the fuel transfer (green) light coming on. The tanker's fuel transfer (green) light will illuminate only when the receiver aircraft has the REFUEL position selected and the tanker has all required switches selected and other conditions met. 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. The receiver RSO can also assist in maintaining a visual lookout.

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 receiver probe will separate from the drogue coupling when the hose reaches full extension. When clear of the drogue, place the refueling probe switch in the RETRACT position. Ensure that the "IFR Probe Unlock" light is extinguished on the telelight panel before resuming normal flight operations. At night, turn off the probe floodlight.

COMMUNICATIONS WITH TANKER

Although standard voice communications are generally utilized to indicate the phases of sequence involved in aerial refueling operations, they do tend to saturate the particular UHF frequency. Every effort should be made to restrict superfluous transmissions, as might be revised in an EMCON condition, and substitute hand signals if practical. All aircraft immediately involved in aerial refueling formation must guard the same UHF frequency for general safety reasons.

VOICE CALLS

1. Call "lining up" before sliding into position behind the tanker.
2. After engaging the drogue, continue to push in the hose until the amber light is out and then call "contact".
3. After breakaway, when the receiver aircraft is clear of the area behind the hose and drogue, call "clear".

HAND SIGNALS

1. Meaning - Start turbine
   Signal - One finger turnup signal
   Response - Tanker starts turbine. Receiver gives thumbs up when turbine starts.

2. Meaning - Extend drogue
   Signal - Receiver forms cone with hand (fingers aft) and moves cone aft.
   Response - Tanker extends drogue. Receiver gives thumbs up if drogue extends properly.

3. Meaning - Retract drogue
   Signal - Receiver forms cone with hand (fingers aft) and moves cone forward.
   Respone - Tanker retracts drogue. Receiver gives thumbs up if drogue retracts and turbine feathers.

4. Meaning - I am going to dump fuel
   Signal - Tanker makes hand into cup shape and makes pouring motions.
   Response - Receiver nods (I understand). Gives thumbs up when dumping commences.

5. Meaning - I have stopped dumping fuel
   Signal - Tanker makes slashing motion of index finger across throat.
   Response - Receiver gives thumbs up if fuel dumping has ceased.

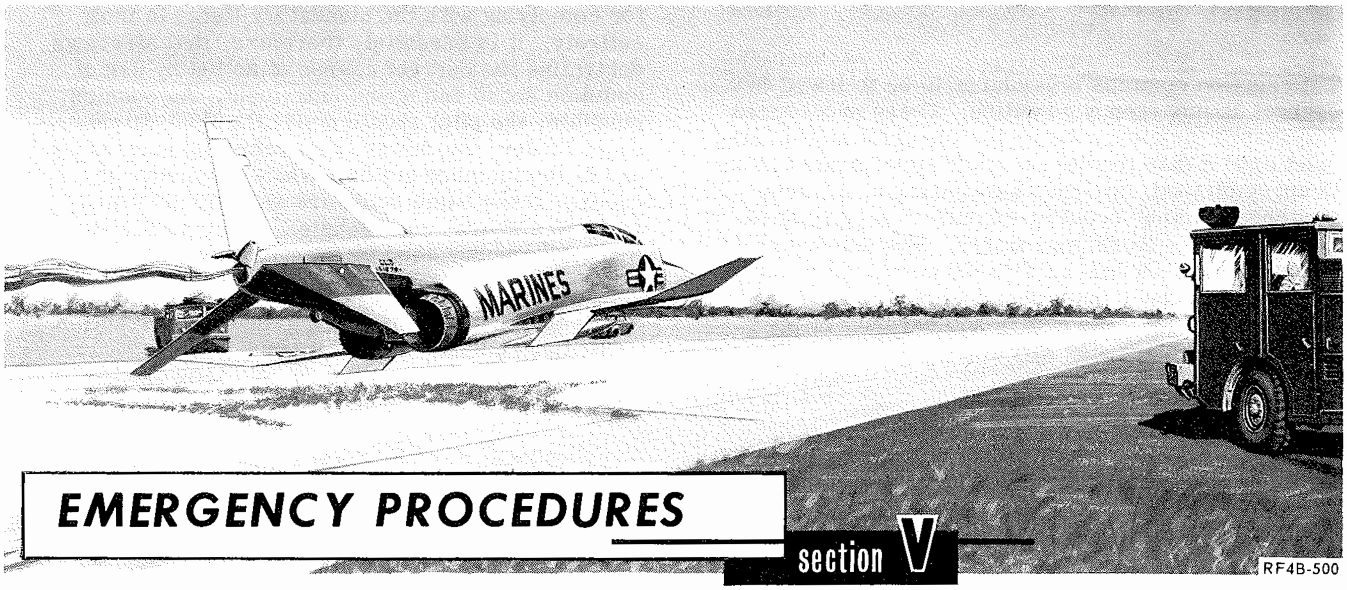
SAFETY PRECAUTIONS

1. Tanker or drogue streaming fuel - do not attempt an approach, information tanker of discrepancy.
2. No tanker ready (amber) light-possibility exists that hose is not fully extended or that reel is jammed so that it will not take up the hose slack upon engagement.
3. Oscillating drogue - caused by ripped canopy on basket rim, unsteady tanker altitude, wash or air turbulence. Tanker can possibly change altitude/airspeed or cycle drogue to minimize effects.
4. Misaligned initial approach position - requires radical corrections to effect engagement, danger of striking receiver aircraft with drogue or hooking the hose with refueling probe.
5. Excessive engagement speed - last minute corrections have to be more abrupt, less chance of alleviating a hazardous situation or preventing damage, and possibility that excessive hose whip upon engagement will break probe - drogue coupling connection.
6. Too slow an engagement speed - induced drogue oscillations with immediate danger to receiver aircraft windscreen and canopy, and unable to properly seat probe into drogue coupling.
7. Overrunning the drogue - possible damage to aircraft and drogue.
8. Excessive disengagement speed - possible separation of probe and drogue coupling prior to full extension of the hose.
9. Misalignment on disengagement - will result in drogue swinging to its natural in-trail position or early probe - drogue separation with possible contact and damage resulting.
10. Damaged probe - do not retract; leave in the EXTEND position and observe published airspeed/Mach restrictions.

FLIGHT TEST PROCEDURES

Only those pilots designated in writing by the Squadron Commanding Officer will flight test squadron aircraft. Flight test procedures will be in accordance with the current edition of the Periodic Maintenance Requirements Manual (NAVWEPS 01-245FDA-6) and BUWEPS INSTRUCTIONS 4700.2. For ready reference, excerpts from BUWEPS INSTRUCTION 4700.2 are quoted below:

1. At the discretion of the Commanding Officer, test flights may be accomplished in combination with operational flight, provided the operational portion is not conducted until the flight test requirements have been satisfied and the results of the test entered on the test flight checklist. The general purpose code assigned to a combination test/operational flight will be the one which most fully describes the purpose of the flight.
2. The crewmember(s) performing the testflight shall be given a thorough briefing by the maintenance officer or his designated representative (normally Quality Control). The briefing should describe the test requirements for the particular flight; the expected results; and when appropriate, corrective or emergency action to be taken if required.
3. The test flight shall be conducted with the minimum crew necessary to ensure proper operation for all required equipment for operational readings.
4. The test flight shall be of sufficient duration to adequately perform the prescribed tests and determine which items, if any, require additional maintenance work.
5. The test flight shall be conducted within the local area and shall normally be conducted under VFR conditions during daylight hours. The necessity for flights under other than VFR conditions should receive adequate considerations by the Commanding Officer (Officer in charge).
6. Test flight forms should be properly completed and, at the termination of the flight, returned to the maintenance department.



EMERGENCY PROCEDURES

section V

TABLE OF CONTENTS

GENERAL

This section contains procedures to be followed to correct an emergency condition. These procedures will insure maximum safety for the crew and/or aircraft until a safe landing or other appropriate action is accomplished. Multiple emergencies, adverse weather and other peculiar conditions may 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 aircrews determine the correct course of action by use of common sense and sound judgement. As soon as possible, the pilot should notify the RSO, 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 aircrews:

1. Maintain aircraft control.
2. Analyze the situation and take proper action.
3. Land as soon as practicable.

AUXILIARY AIR DOOR(S)

GENERAL

The auxiliary air door warning light(s) will illuminate any time the auxiliary air doors are out of phase with the landing gear handle (landing gear up, aux air door(s) open, or landing gear down, aux air door(s) closed). Neither one of these situations constitutes a safety of flight condition, if the problem is recognized and the appropriate action is taken. In the event of either a malfunction, or failure the appropriate corrective procedures must be utilized.

AUX AIR DOOR MALFUNCTION (GEAR UP, DOOR(S) OPEN)

1. Reduce power and slow to 250 KIAS or below. Immediately terminate A/B (if utilized) and/or reduce power to 250 KIAS or below.
2. Landing gear - CYCLE
3. If light(s) remain on with landing gear up, maintain no more than cruise power setting to avoid engine compartment overheating.

CAUTION

Extended engine operation at high power settings will result in engine compartment and aft fuselage overheating.

AUX AIR DOOR FAILURE (GEAR DOWN, DOOR(S) CLOSED)

If the auxiliary air doors fail to open when the landing gear is lowered, there is a possibility that the engines may automatically accelerate up to 100%rpm. A utility hydraulic system failure or double generator failure will render the variable bypass bellmouth and auxiliary air doors inoperative. Operation of an engine with an open variable bypass bellmouth and closed auxiliary air door will allow engine compartment secondary air to recirculate to the engine compressor inlet. During low altitude or ground operation, the temperature of the recirculating air may be high enough to initiate T2 reset through normal detection by the compressor inlet temperature sensor. As T2 reset occurs, it increases the engine idle speed to maintain proper engine airflow and thrust under high temperature conditions, and can cause the idle speed to increase up to 100% rpm. The auto-accelerated engine can be shut down, if on the ground, by placing the throttle to OFF. If a false reset occurs while airborne, a near normal landing can be made by modulating the exhaust nozzles of the affected engine(s).

AUTO-ACCELERATION OF ONE ENGINE

1. Throttle of affected engine - IDLE
2. Make an "on speed" approach
   Modulate throttle of unaffected engine for desired thrust. Under no conditions will the combined thrust of the auto-accelerated engine in idle, and the unaffected engine in idle, be in excess of that required to make an optimum "on speed" approach.
3. At touchdown, affected engine - SHUTDOWN

AUTO-ACCELERATION OF BOTH ENGINES

1. Throttle of either engine - IDLE
2. Modulate the exhaust nozzles of the remaining engine for desired thrust.
3. Make an "on speed" approach
4. At touchdown, left engine - SHUTDOWN

BOUNDARY LAYER CONTROL

BLC MALFUNCTION

A boundary layer control system malfunction will be indicated by the illumination of the "BLC Malfunction" warning light. The only type of malfunction indicated by the light will be a BLC valve stuck open when the flaps are up.

1. Reduce airspeed to 200 knots IAS or below.
2. Flaps - FULL DOWN
3. Land as soon as practicable.

WARNING

- Operating at normal power setting in excess of 30 seconds with the "BLC Malfunction" light illuminated and flaps up may result in damage to the warning circuit wiring which will extinguish the warning light. Continued flight with the flaps up can then result in additional electrical, hydraulic, and structural damage to the wing from overheating.

- A flashing "Wheels" light, with flaps and gear indicating up, should be treated as a BLC malfunction.

BLC FAILURES

A boundary layer control (BLC) system failure will effect the handling characteristics and approach speeds of the airplane. This (BLC) system failure usually will not effect the complete BLC system, but rather a portion of the system, and will probably be of one of the following variations:

a. Trailing edge BLC inoperative on one side.
b. Leading edge BLC inoperative on one side.
c. Leading and trailing edge BLC inoperative on the same side.

The BLC failure will probably occur prior to, or in the transition to flaps down during a landing approach, with the result being an asymmetric BLC condition. The asymmetric BLC condition has been found to be safe and easily controllable even with both leading edge and trailing edge BLC inoperative on the same side. There is no reason to raise flaps to avoid an asymmetrical BLC condition. In general, for any type of BLC failure, an "on speed" angle of attack will give satisfactory approach control.

1. Retrim airplane.
2. Fly "on speed" angle of attack.

CANOPY

CANOPY MALFUNCTION

In the event that either the front or aft "Canopy Unlock" light remains on after an attempted closure, the following procedures will apply:

WARNING

Do not actuate the normal canopy control selector, raise or lower the ejection seat, or allow external canopy control buttons to be operated until it has definitely been determined that the "Canopy Unlock" light is not the result of a canopy actuator shear pin failure.

1. Attempt to operate manual canopy release handle to full aft position. Apply approximately 20 pounds force.
2. If handle can be pulled full aft, canopy actuator shear pin has failed or pneumatic pressure has depleted. Egress can be made by pushing the canopy open manually.

WARNING

The crewmember leaving the affected seat should evacuate with extreme caution, taking care to stay clear of the canopy control lever.

3. If handle cannot be pulled full aft, the crewmember can be assured of integrity of both the canopy actuator shear pin and canopy pneumatic pressure. Therefore, the normal canopy control can be moved to raise the canopy for another locking attempt.

CHARTS

GENERAL

The charts and illustrations in this sub-section contain procedures and information which complements the text in the rest of the Section. These charts should be used as necessary, in conjunction with the text, in order to analyze and judiciously perform the emergency procedures in an expeditious manner.

Landing Gear Malfunction-Emergency Landing Guide

FINAL CONFIGURATION	CARRIER LANDING	Notes	FIELD LANDING (ARRESTING GEAR) AVAILABLE	Notes	FIELD LANDING (NO ARRESTING GEAR) AVAILABLE	Notes
ALL GEAR UP	EJECT	2,4,5,7	NO ARRESTED LANDING	7,9,10	LAND	7,9,10
NOSE GEAR UP	LAND	4,5	NO ARRESTED LANDING	7, 9, 10, 13	LAND	7,9,10
STUB NOSE GEAR	LAND	4,5	NO ARRESTED LANDING	1,7,9,10	LAND	1,7,9,10
ONE MAIN GEAR UP	LAND	4,7	ARRESTED LANDING	7,8	LAND	1,7,9,10,12,14
STUB MAIN GEAR	LAND	4,6	NO ARRESTED LANDING	1,7,9,10,12,14	LAND	1,7,9,10, 12,14
ONE MAIN GEAR UP NOSE GEAR UP	EJECT	1,2,4,5,7	NO ARRESTED LANDING	1,3,7,9,10,12,14	LAND	1,3,7,9,10,12,14
BOTH MAIN GEAR UP	LAND	3,4,7	NO ARRESTED LANDING	7,9,10,11	LAND	7,9, 10, 14

Notes

1. If wing tanks installed and landing gear can be actuated, retract all gear.
2. Option to land if wing drop tanks installed.
3. Option to eject if wing drop tanks not installed.
4. Hook down barricade engagement.
5. Remove No. 1 pendant on CVAs 11, 14, 19, 31, 34, 41, 42, 59, 60, 61, 62, 63, 64, 65. Remove Nos. 1 and 2 pendants on CVA 43. Leave all pendants on deck on CVA 38.
6. Remove Nos. 1 and 2 pendants on CVAs 11, 14, 19, 31, 34, 41, 42, 59, 60, 61, 62, 63, 64 and 65. Remove No. 1 pendant on CVA 38. Remove Nos. 1, 2 and 3 pendants on CVA 43.
7. Retain drop tanks.
8. Foam runway beyond arresting gear if practicable.
9. Foam runway if practicable.
10. Deploy drag chute at touchdown in accordance with crosswind landing criteria.
11. Option of midfield arrestment if 4000 feet of runway plus overrun available. Secure engines on touchdown.
12. Land off-center to gear down side.
13. Before landing, if time permits, remove all field arresting cables forward of the touchdown point.
14. Keep engines operating in order to retain nose wheel steering.

- Multiple emergencies, adverse weather and other peculiar conditions may require modifications to these procedures.
- If available, an LSO is recommended for all field arrested landings.
- If a gear up landing is made with external tanks aboard, depressurize the external tanks by first pulling the landing gear circuit breaker, and then place the landing gear handle down.

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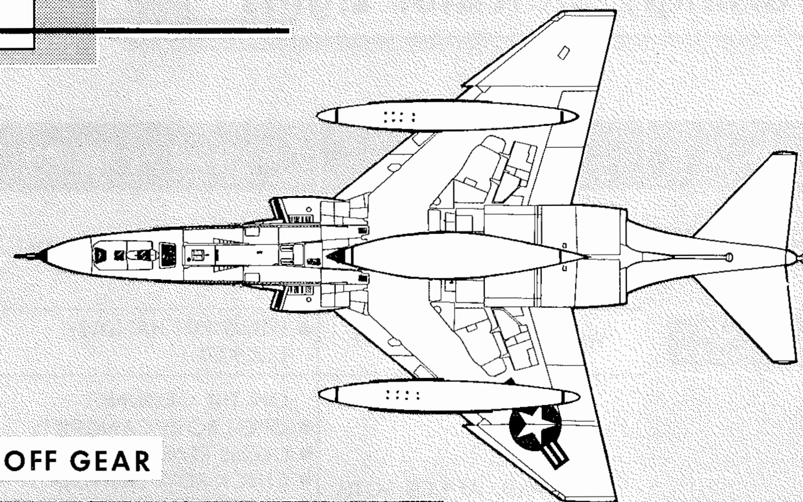
Figure 5-1

Jettisoning Chart



∗ WEIGHT MUST BE OFF GEAR

STORES	GEAR HANDLE POSITION	REMARKS
EXTERNAL WING TANKS	UP or DOWN	WING STATION JETTISON SWITCH-JETT
CENTERLINE TANK	UP or DOWN∗	CENTERLINE STATION JETTISON SWITCH-JETT
PHOTOFLASH CARTRIDGES	UP or DOWN∗	CARTRIDGE SALVO SWITCH-JETT

RF4B-501

Figure 5-2

Warning/Indicator Lights

LIGHT	CAUSE	CORRECTIVE ACTION	REMARKS
MASTER CAUTION	SOME SYSTEM HAS A CAUTION CONDITION.	● CHECK TELELIGHT PANEL.	LIGHT ILLUMINATES WITH LIGHTS ON THE TELELIGHT PANEL EXCEPT: ● L/R/CTR EXT FUEL. ● SPEEDBRAKES OUT.
L WING PIN UNLOCK R WING PIN UNLOCK	WING(S) IS UNLOCKED.	● WING PIN HANDLE-LOCKED.	MAY BE NECESSARY TO RECYCLE THE WING FOLD SYSTEM.
CANOPY UNLOCKED	FORWARD, AFT OR BOTH CANOPIES ARE UNLOCKED.	ON THE GROUND: ● OPEN BOTH CANOPIES. ● CLOSE REAR CANOPY. ● CHECK REAR LIGHT OUT. ● CLOSE FRONT CANOPY. ● CHECK FRONT LIGHT OUT INFLIGHT: ● COCKPIT PRESSURE DUMP ● CHECK CANOPY HANDLE FULLY CLOSED.	INSURE ADEQUATE PNEUMATIC PRESSURE FOR PROPER CANOPY OPERATION.
FUEL LEVEL LOW	1960 ±200 POUNDS FUEL TOTAL REMAINING IN CELLS 1 & 2.	NONE INFO ONLY	CHECK ALL FUEL TRANSFERRED TO THE FUSELAGE
L EXT FUEL R EXT FUEL CTR EXT FUEL	TANK IS EMPTY. FUEL FLOW HAS STOPPED. TANK IS FULL (DURING AIR REFUELING).	NONE INFO ONLY	INTERMITTENT ILLUMINATION DURING FUEL TRANSFER IS NORMAL.
CHECK HYD GAGES	PRESSURE BELOW 1500±100 PSI IN ANY SYSTEM.	ANALYZE SITUATION.	CARRY OUT PRESCRIBED EMERGENCY PROCEDURES.
W SHIELD TEMP HI	WINDSHIELD IS OVER-HEATED.	● RAIN REMOVAL SWITCH-OFF. ● EMER. VENT KNOB-PULL (IF NECESSARY).	INTERMITTENT ILLUMINATION DURING HIGH MACH FLIGHT, RAIN REMOVAL SYSTEM OFF, IS NORMAL.
DUCT TEMP HI	INLET TEMPERATURE IS ABOVE 121°C.	● BELOW 30,000 FEET-REDUCE SPEED.	LIGHT ON OPERATION ABOVE 30,000 FEET: SEE FIGURE 1-20.
SPEED BRAKE OUT	SPEEDBRAKES ARE NOT CLOSED.	NONE INFO ONLY	MASTER CAUTION WILL NOT ILLUMINATE.
A/P PITCH TRIM	PITCH TRIM CIRCUIT IS NOT FUNCTIONING.	● STICK-GRASP FIRMLY. ● AUTOPILOT-DISENGAGE	DISREGARD A LIGHT OF LESS THAN 20 SECOND DURATION.
OXYGEN LOW	SUPPLY DEPLETED TO 1 LITER.	● DESCEND TO SAFE ALTITUDE	REFER TO OXYGEN DURATION TABLE.
CABIN TURB OVERSPEED	TURBINE SUBJECTED TO EXTREME PRESSURE AND/OR TEMPERATURE.	● REDUCE THRUST. ● REDUCE SPEED.	IF LIGHT STAYS ON: ● EMERGENCY VENT KNOB-PULL.
L AUX AIR DOOR R AUX AIR DOOR	DOOR(S) OUT OF PHASE WITH GEAR HANDLE.	● CARRY OUT PRESCRIBED EMERGENCY PROCEDURES AS NECESSARY.	DISREGARD MOMENTARY LIGHT.

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Figure 5-3 (Sheet 1)

LIGHT	CAUSE	CORRECTIVE ACTION	REMARKS
IFR PROBE UNLOCKED	NORMAL INDICATION	INFO ONLY.	IF LIGHT STAYS ON: ● REFUEL PROBE SWITCH-EXTEND. ● REMAIN BELOW PUBLISHED AIRSPEED LIMITATIONS.
	PROBE IS NOT FULLY RETRACTED.	● REFUEL PROBE SWITCH-EXTEND, THEN RETRACT.	
V/R POWER	VOICE RECORDER IS OPERATING.	NONE INFO ONLY	NONE
L ANTI-ICE ON R ANTI-ICE ON	SWITCH ON-NORMAL INDICATION.	INFO ONLY.	SWITCH OFF: ● IF LIGHT GOES OUT, ACCELERATE DISREGARD INDICATION. ● IF LIGHT STAYS ON, REMAIN AT REDUCED SPEED.
	SWITCH OFF-ERRONEOUS INDICATION.	● REDUCE SPEED.	
PITCH AUG OFF	STAB AUG IS DISENGAGED.	NONE INFO ONLY	ILLUMINATES ANY TIME BUSES ARE ENERGIZED AND STAB AUG IS DIS-ENGAGED.
BLC MALFUNCTION	FLAPS ARE UP AND AT LEAST ONE BLC VALVE IS STUCK OPEN.	● REDUCE SPEED BELOW-200KTS IAS ● FLAPS FULL DOWN.	CONTINUED FLIGHT WITH FLAPS UP AND LIGHT ON MAY RESULT IN ELECTRICAL HYD. AND STRUC-TURAL DAMAGE TO AIRCRAFT.
EQUIPMENT COOL OFF	EQUIPMENT COOLING TURBINE SHUTDOWN.	● AIRSPEED - REDUCE. ● WAIT 15 SECONDS. ● RESET - PUSH.	IF LIGHT STAYS ON: ● REMAIN AT REDUCED AIRSPEED TO PREVENT EQUIPMENT DAMAGE.
A/P DISENGAGED	AUTOPILOT HAS DIS-ENGAGED.	● AUTOPILOT-RE-ENGAGE IF PRACTICAL	NONE
CHECK FUEL FILTERS	ONE OR BOTH FUEL FILTERS ARE PARTIALLY CLOGGED.	NONE INFO ONLY	LOG ON YELLOW SHEET (OPNAV 3760-2). MONITOR ENGINE OPERATION.
REFUEL READY	FUSELAGE PRESSUR-IZATION AND VACUUM RELIEF VALVE OPEN	NONE INFO ONLY	INDICATES THAT FUSELAGE TANKS ARE PROPERLY VENTED FOR REFUELING
INERTIAL NAV SYS OUT	INERTIAL NAV SYSTEM MALFUNCTION.	● REFERENCE SYSTEM SELECTOR-STBY.	PERFORM INFLIGHT ALIGNMENT TO REGAIN PRIMARY ATTITUDE REFERENCE.
LH GEN OUT RH GEN OUT	CORRESPONDING GENER-ATOR IS OFF THE LINE.	● AFFECTED GENERATOR SWITCH-CYCLE.	IF LIGHT STAYS ON: ● CARRY OUT EMERGENCY PROCE-DURES AS NECESSARY.
BUS TIE OPEN	GENERATORS ARE OUT OF FREQUENCY, PHASE OR BOTH.	NONE INFO ONLY.	NO LIGHT-ON OPERATING RESTRICTIONS ARE IMPOSED.

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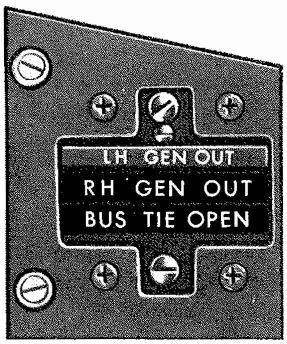
Figure 5-3 (Sheet 2)

Emergency Power Distribution

INOPERATIVE EQUIPMENT

RH Gen Out-Bus Tie Open



AFT COCKPIT INSTRUMENT LIGHTS X-FORMER
AFT COCKPIT RED CONSOLE LIGHTS (MED)
AILERON FEEL TRIM
AILERON RUDDER INTERCONNECT
AIRSPEED PITOT HEATER
ALTIMETER VIBRATOR
ANGLE OF ATTACK CASE HEATER
ANGLE OF ATTACK HEATER
ANTI-COLLISION LIGHTS
APPROACH AND INDEXER LIGHTS POWER
ARMAMENT POWER RELAY CONTROL
AUTOPILOT
BACK UP ATTITUDE REFERENCE
BELLMOUTH PITOT HEATER
CAMERA WARNING AND GO BUS (DIM)
CENTERLINE STORES RELEASE POWER
CENTRAL AIR DATA COMPUTER
CNI
COCKPIT HEAT AND VENT
EXTERNAL WING FUEL TRANSFER
FIRE DETECTOR
FORWARD COCKPIT INSTRUMENT LIGHTS X-FORMER
FORWARD COCKPIT RED CONSOLE LIGHTS (MED)
FORWARD COCKPIT RED INSTRUMENTS FLOOD LIGHTS (BRT)
FORWARD COCKPIT RED INSTRUMENT FLOOD LIGHTS (DIM)
FUEL LEVEL LOW WARNING LIGHT
FUEL QUANTITY INDICATOR
FUEL VALVE POWER
INBOARD STORES JETTISON
INFLIGHT REFUELING PROBE LIGHTS
INFLIGHT REFUELING PROBE POWER
INERTIAL NAVIGATION SYSTEM
INTERNAL WING FUEL TRANSFER CONTROL
LANDING GEAR AND FLAPS POSITION INDICATOR
LEFT ENGINE IGNITION
LEFT ENGINE RAMP
LEFT FUEL BOOST PUMP
LEFT FUEL BOOST PUMP EMERGENCY CONTROL
LEFT MAIN FUEL CONTROL
LEFT TURBINE OUTLET TEMPERATURE (POWER)
MASTER CAUTION LIGHTS RESET
NOZZLE POSITION INDICATOR
NO. 6 TANK FUEL TRANSFER PUMP
OUTBOARD STORE JETTISON (SEC)
OXYGEN GAGE
PHOTO CARTRIDGE EJECTION
RADAR ALTIMETER
RIGHT ENGINE IGNITION
RIGHT ENGINE RAMP
RIGHT MAIN FUEL CONTROL
RIGHT TRANSFORMER RECTIFIER
RIGHT TURBINE OUTLET TEMPERATURE(POWER)
RIGHT 28V A-C X-FORMER
STABILATOR FEEL TRIM
TRIM CONTROL
UTILITY HYDRAULIC PRESSURE INDICATOR
UTILITY LIGHTS
VOICE RECORDER
WARNING LIGHTS POWER (DIM)
WINDSHIELD TEMPERATURE SENSING
WING AND TAIL LIGHTS (BRT)

LH Gen Out-Bus Tie Open

ANTI-ICE
DATA ANNOTATOR
DEHYDRATOR
DEFOG BLOWER
FORWARD CAMERA
FORWARD COCKPIT CONSOLE LIGHTS X-FORMER
FORWARD LOOKING RADAR
FORWARD MOUNT
FUSELAGE AND ANTI-COLLISION LIGHTS
HF COMM
HIGH ALTITUDE CAMERA
INERTIAL NAVIGATION SYSTEM
INFRARED
LEFT CAMERA
LEFT ENGINE AFTERBURNER IGNITION
LEFT TRANSFORMER RECTIFIER
LEFT 14/26V A-C X-FORMER
NOSE WHEEL STEERING
NO. 4 TANK FUEL TRANSFER PUMP
OPTICAL VIEW FINDER
PHOTOGRAPH CONTROL UNIT STABILIZED MOUNT
RADAR SCOPE CAMERA
RIGHT CAMERA
RIGHT ENGINE AFTERBURNER IGNITION
RIGHT FUEL BOOST PUMP
SEAT ADJUST
SIDE LOOKING RADAR
TAXI LIGHTS POWER
UTILITY A-C POWER
VERTICAL CAMERA
WING AND TAIL LIGHTS (DIM)

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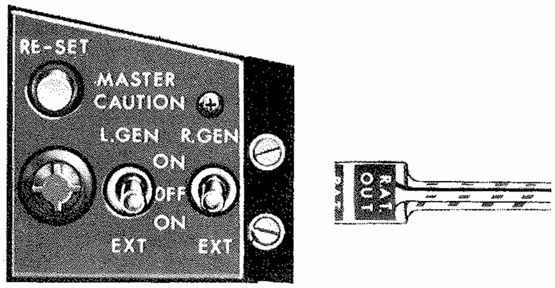
Figure 5-4 (Sheet 1)

OPERATIVE EQUIPMENT



RAT Out (Operative Equipment)

AFT COCKPIT INSTRUMENT LIGHTS X-FORMER
AFT COCKPIT RED CONSOLE LIGHTS (BRT)
AILERON POSITION INDICATOR
ANGLE OF ATTACK HEATER
ARMAMENT POWER RELAY CONTROL
BACKUP ATTITUDE REFERENCE
CAMERA WARNING AND GO BUS (BRT)
CENTERLINE STORES RELEASE POWER
CENTRAL AIR DATA COMPUTER
CNI (UHF TRANSMITTER AT REDUCED POWER)
DATA ANNOTATOR
EXTERNAL WING FUEL TRANSFER
FIRE DETECTOR
FORWARD COCKPIT INSTRUMENT LIGHT X-FORMER
FORWARD COCKPIT RED CONSOLE LIGHTS (BRT)
FORWARD COCKPIT RED INSTRUMENT FLOOD LIGHTS (BRT)
FUEL LEVEL LOW WARNING LIGHT
FUEL QUANTITY INDICATOR
FUEL VALVE POWER
INBOARD STORES JETTISON
INFLIGHT REFUELING PROBE POWER
INS
INSTRUMENT 28V A-C AUTO-TRANSFORMER
INTERNAL WING FUEL TRANSFER CONTROL
LANDING GEAR AND FLAPS POSITION INDICATOR
LEFT ENGINE FUEL FLOW INDICATOR
LEFT ENGINE FUEL PRESSURE INDICATOR
LEFT ENGINE IGNITION
LEFT ENGINE OIL PRESSURE INDICATOR
LEFT FUEL BOOST PUMP
LEFT FUEL BOOST PUMP EMERGENCY CONTROL
LEFT MAIN FUEL CONTROL
LEFT TURBINE OUTLET TEMPERATURE POWER
MASTER CAUTION LIGHTS RESET
NAVIGATION COMPUTER
NOZZLE POSITION INDICATOR
NO. 1 HYDRAULIC PRESSURE INDICATOR
NO. 2 HYDRAULIC PRESSURE INDICATOR
OUTBOARD STORES JETTISON (SEC)
PHOTO CARTRIDGE EJECTION
PNEUMATIC PRESSURE INDICATOR
RADAR ALTIMETER
RIGHT ENGINE FUEL FLOW INDICATOR
RIGHT ENGINE FUEL PRESSURE INDICATOR
RIGHT ENGINE IGNITION
RIGHT ENGINE OIL PRESSURE INDICATOR
RIGHT MAIN FUEL CONTROL
RIGHT TRANSFORMER RECTIFIER
RIGHT TURBINE OUTLET TEMPERATURE POWER
RUDDER POSITION INDICATOR
STABILATOR FEEL TRIM
TRIM CONTROl
WARNING LIGHTS POWER (BRT)
WINDSHIELD TEMPERATURE SENSING

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Figure 5-4 (Sheet 2)

Airspeed Indicator Failure

FLIGHT CONDITION		ANGLE OF ATTACK-UNITS
CATAPULT		
Transition From Catapult		22.0
MILITARY POWER CLIMB		
Drag Index = 0	Sea level	3.7
	combat ceiling	7.6
Drag Index = 120	Sea level	7.6
	combat ceiling	8.5
MAXIMUM POWER CLIMB		
All Drag Indices	Sea level	4.0
	combat ceiling	9.2
CRUISE AT ALTITUDES BELOW 20,000 FT. (all gross weights)		
Drag Index = 0		5.8
Drag Index = 130		8.0
CRUISE AT OPTIMUM ALTITUDE		
Drag Index = 0		6.9
Drag Index = 130		8.0
ENDURANCE AT OPTIMUM ALTITUDE		
Drag Index = 0		7.9
Drag Index = 130		9.3
DESCENTS (low to medium gross weight)		
250 IAS, IDLE POWER		8.5
300 IAS, 80% RPM		6.5
GEAR AND FLAPS EXTENSION		
Safe Gear Extension (with flaps up)		9.0
Safe Flap Extension (with gear down)		13.0
STALL		
Stall Warning (pedal shaker)		22.3
APPROACH		
CCA/GCA Pattern (200 KCAS, gear up, half flaps)		11.0
Final "On Speed" approach (gear down, all engine/flap configurations)		19.2

Notes

- Due to the basic inaccuracy of setting up flight conditions (other than landing approach) by reference to the angle of attack indicator, the information included in this table should be used only in an emergency situation
- The ranges shown for angle of attack versus drag index, while not entirely linear, may be interpolated linearly for practical purposes.

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Figure 5-5

Emergency Visual Communications

MALFUNCTION AND EMERGENCIES

TYPE OF EMERGENCY	SIGNAL	RESPONSE
I am in trouble, I want to land immediately.	Arms bent across forehead, followed by landing motion with open palm. (Day) Circular motion of flashlight shined at other aircraft. (Night)	Carry out squadron doctrine of escort for disabled planes. Assume lead if indicated, and return to base or nearest suitable field.
Are you having difficulty?	Point to pilot and give series of thumb down movements. At night flash a series of dots using exterior lights.	Thumb up, I am all right. Thumb down, I am having trouble. Lights off once then on steady, I am all right. Lights flashing, I am having trouble.
Initiation of "HEFOE" code.	Clench fist held to top of canopy.	Repeat signal to show acknowledgement.

"HEFOE" SIGNALS

TYPE OF EMERGENCY	SIGNAL	RESPONSE
Hydraulic trouble.	One finger extended upward. One flash of exterior lights.	Nod of head (I understand). Series of Flashes (I understand).
Electrical trouble.	Two fingers extended upward. Two flashes of exterior lights.	Nod of head (I understand). Series of Flashes (I understand).
Fuel trouble.	Three fingers extended upward. Three flashes of exterior lights.	Nod of head (I understand). Series of Flashes (I understand).
Oxygen trouble.	Four fingers extended upward. Four flashes of exterior lights.	Nod of head (I understand). Series of Flashes (I understand).
Engine trouble.	Five fingers extended upward. Five flashes of exterior lights.	Nod of head (I understand). Series of Flashes (I understand).

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Figure 5-6

Visual Communications

GENERAL CONVERSATION

MEANING	SIGNAL	RESPONSE
Affirmative (I understand).	Thumb up, or nod of head.	
Negative (I do not know).	Thumb down, or turn of head from side to side.	
Question (repeat). Used in conjunction with another signal, this gesture indicates that the signal is interrogatory.	Hand cupped behind ear as if listening.	As appropriate.
Wait.	Hand held up with palm outward.	
Ignore last signal.	Hand waved in an erasing motion in front of face, with palm turned forward.	
Numerals, as indicated.	With forearm in vertical position, employ fingers to indicate desired numerals 1 through 5. With forearm and fingers horizontal, indicate number which, added to 5, gives desired number from 6 through 9. A clenched fist indicates zero.	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

MEANING	SIGNAL	RESPONSE
Lower landing gear.	Rotary movement of hand in cockpit, as if cranking wheels.	Execute.
Lower arresting gear hook.	Leader lowers hook.	Wingman lowers arresting gear hook. Leader indicates wingman's hook is down with thumb up signal.
Extend or retract flaps or speed brakes as appropriate.	Open and close four fingers and thumb.	

FUEL AND ARMAMENT

MEANING	SIGNAL	RESPONSE
How much fuel have you?	Raise fist with thumb extended in a drinking position.	Indicate fuel in tens of gallons or hundreds of pounds by finger numbers.
1—Arm or safety missiles as applicable; 2—how much ammo do you have? 3—I am unable to fire.	1—Pistol cocking motion with either hand; 2—followed by question signal; 3—followed by nose-held signal.	1—Execute and return signal; 2—thumb up, over half; thumb down, less than half; 3—nod head (I understand).
1—Arm or safety tanks as applicable; 2—how many tanks do I have? 3—I am unable to drop.	1—Shaking fist; 2—followed by question signal; 3—followed by nose-held signal.	1—Execute and return signal; 2—indicate with appropriate finger numerals; 3—nod head (I understand).

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Figure 5-7 (Sheet 1)

Visual Communications

FORMATION

MEANING	SIGNAL	RESPONSE
1) I have completed my takeoff check list and am, in all respects ready for takeoff; 2) I have completed my takeoff check list and am, in all respects, ready for a section takeoff; 3) Takeoff path is clear, I am commencing takeoff.	1) Section takeoff leader raises arm (either) over head; 2) Wingman raises arm over head; 3) Leader lowers arm.	1) Stands by for reply from wingman, holding arm over head until answered; 2) Wingman lowers arm and stands by for immediate section takeoff; 3) Executes section takeoff.
Leader shifting lead to wingman. (Day)	Leader pats self on head points to wingman.	Wingman pats head and assumes lead.
Leader shifting lead to wingman. (Night)	1) Two aircraft – lead aircraft puts external lights on bright and flash. 2) More than two aircraft – leader places flight in echelon and then use two aircraft procedures.	Wingman turns external lights to DIM and STEADY and assumes lead.
	3) With external light failure – leader shines flashlight on hardhat, then shines at Wingman.	Wingman turns external lights to DIM and STEADY and assumes lead. With external light failure – Wingman shines flashlight at leader, then on his hardhat.
Leader shifting lead to division designated by numerals.	Leader pats self on head points to wingman and holds up two or more fingers.	Wingman relays signal; division leader designated assumes lead.
Take cruising formation.	Thumb waved backward over the shoulder.	Execute.
I am leaving formation.	Any pilot blow kiss.	Nod (I understand).
Aircraft pointed out leave formation.	Leader blows kiss and points to aircraft.	Execute.
Directs plane to investigate object or vessel.	Leader beckons wing plane, then points to eye, then to vessel or object.	Wingman indicated blows kiss and executes.
Refers to landing of aircraft, generally used in conjunction with another signal; 1) I am landing; 2) Directs indicated aircraft to land.	Landing motion with open hand; 1) Followed by patting head; 2) Followed by pointing to another aircraft.	1) Execute; 2) Execute.
a) Join up or break up, as appropriate. b) On GCA/CCA final: Leader has runway/ship in sight.	Flashing external lights.	a) Comply. b) Wingman repeats, indicating runway/ship in sight. Ship: Leader waves-off wingman lands. Field: When runway conditions preclude a safe section landing leader will wave-off.

FORMATION SIGNALS MADE BY AIRCRAFT MANEUVER

COMBAT OR FREE CRUISE

MEANING	SIGNAL	RESPONSE
Single aircraft cross under in direction of wing dip.	Single wing dip.	Execute.
Section cross under.	Double wing dip.	Execute.
Close up.	Series of small zooms.	Execute.
Join up; join up on me.	Series of pronounced zooms.	Expedite join-up.

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Figure 5-7 (Sheet 2)

EJECTION

GENERAL

Escape from the airplane in flight should be made with the ejection seat (figure 5-8 thru 5-11). For most conditions requiring ejection, it is the pilot's responsibility to give the "Eject" command and then remain with the airplane until the RIO has ejected. The reason for this is two fold: to avoid injury to the RSO and/or damage of his canopy, and to provide control of the aircraft in the event the RSO's seat fails to fire normally (i.e., to roll the aircraft inverted with a positive "g" and then pop the RSO out with a negative "g"). The only foreseeable deviations to this rule are: an out of control airplane in which the pilot has not been able to signal for ejection, or; a double flameout in a dirty configuration at low altitude. In neither of these conditions can the pilot be of any possible use to the RSO. In the event one of the above conditions occur, the pilot should command "Eject" as he reaches for the ejection handle. A simultaneous ejection or one in which the pilot ejects slightly ahead of the RSO is the only chance for survival of either crew member. If at any time during an emergency, especially with loss of intercom the RSO believes that the condition of the aircraft has reached or passed extremes, he must use his own judgement in ejecting. For this reason, it is vital that all pilots continuously keep the RSO informed during normal flight as well as in emergency conditions. The following signals will be used by the pilot to order the RSO to eject.

a. DAY or NIGHT - WITH INTERCOM - WITH EJECT LIGHT.
   Pilot actuates "Eject" light and verifies light with an "EJECT" transmission.
b. DAY— NO INTERCOM - WITH EJECT LIGHT.
   Pilot actuates "Eject" light and verifies light by repeatedly striking left side of his canopy.
c. NIGHT - NO INTERCOM - WITH EJECT LIGHT
   Pilot actuates "Eject" light and verifies light by moving his flashlight in a vertical motion over his left shoulder.
d. DAY - NO INTERCOM - NO EJECT LIGHT.
   Pilot will strike the left side of his canopy repeatedly.
e. NIGHT - NO INTERCOM - NO EJECT LIGHT.
   Pilot will move his flashlight in a vertical motion over his left shoulder.
f. DAY or NIGHT - NO RSO RESPONSE.
   In the event the RSO does not respond to any of the above signals, the pilot, as a last resort signal, shall jettison his canopy if time/altitude permits.

The study and analysis of escape techniques by means of the ejection seat reveals that:

a. Ejection at airspeeds ranging from stall speed to 525 knots IAS 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 525 to 600 knots IAS rendering escape more hazardous.
c. At speeds above 600 knots IAS, 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. 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. A full understanding of the particular situation must be established between crew members so that there is no mistaken or time consuming activity.
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. Once the emergency harness release handle has been pulled, the lap belt shoulder harnessing is released and cannot be refastened in flight.
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.

Before Ejection Sequence

TYPICAL BOTH COCKPITS

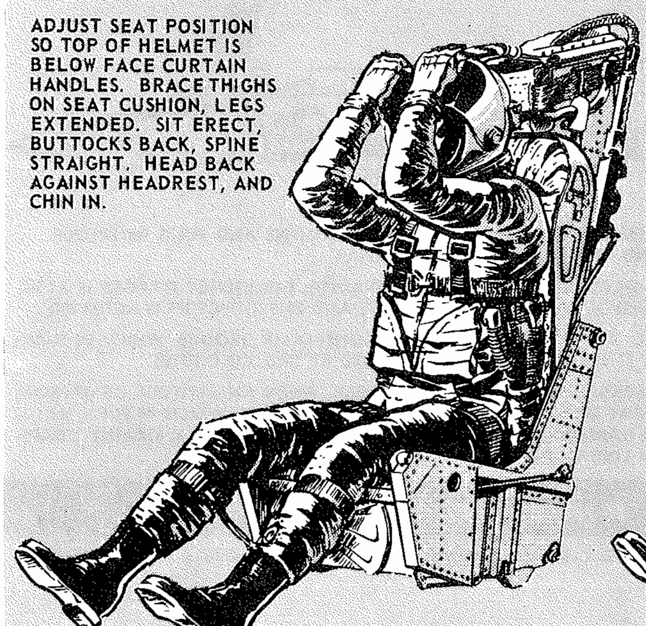
IF TIME AND CONDITIONS PERMIT

- IFF EMERGENCY
- MAKE RADIO DISTRESS CALL
- SLOW AIRPLANE AS MUCH AS POSSIBLE.
- STOW ALL LOOSE EQUIPMENT.
- PULL EMERGENCY VENTILATING KNOB TO MINIMIZE DECOMPRESSION EFFECTS WHEN JETTISONING THE CANOPY.

1. ALERT RSO

2. ASSUME PROPER EJECTION POSITION

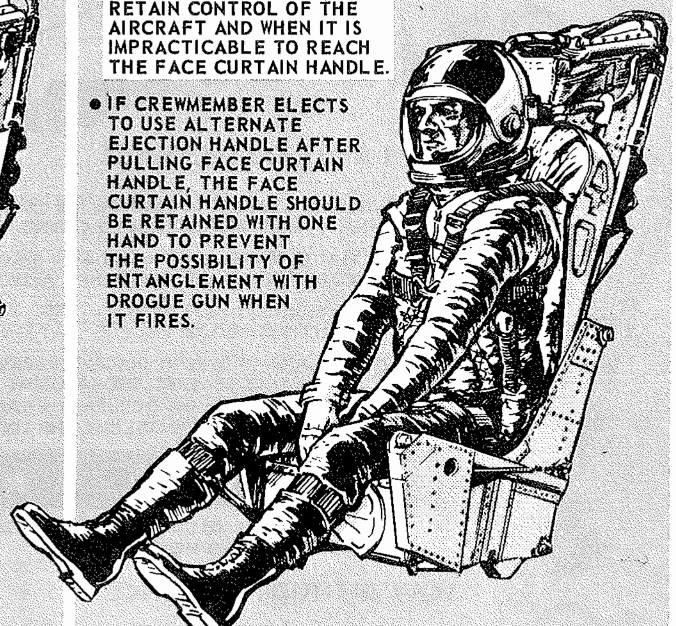
ADJUST SEAT POSITION SO TOP OF HELMET IS BELOW FACE CURTAIN HANDLES. BRACE THIGHS ON SEAT CUSHION, LEGS EXTENDED. SIT ERECT, BUTTOCKS BACK, SPINE STRAIGHT. HEAD BACK AGAINST HEADREST, AND CHIN IN.



Note

THE ALTERNATE EJECTION HANDLE SHOULD BE USED WHEN IT IS NECESSARY TO RETAIN CONTROL OF THE AIRCRAFT AND WHEN IT IS IMPRACTICABLE TO REACH THE FACE CURTAIN HANDLE.

- IF CREWMEMBER ELECTS TO USE ALTERNATE EJECTION HANDLE AFTER PULLING FACE CURTAIN HANDLE, THE FACE CURTAIN HANDLE SHOULD BE RETAINED WITH ONE HAND TO PREVENT THE POSSIBILITY OF ENTANGLEMENT WITH DROGUE GUN WHEN IT FIRES.



3. FACE CURTAIN HANDLE—PULL

REACH OVERHEAD, WITH PALMS AFT KEEPING ELBOWS TOGETHER, GRASP FACE CURTAIN HANDLE, PULL FACE CURTAIN AND MAINTAIN DOWNWARD FORCE UNTIL STOP IS ENCOUNTERED. WHEN CANOPY JETTISONS, CONTINUE PULLING FACE CURTAIN UNTIL FULL TRAVEL IS REACHED.

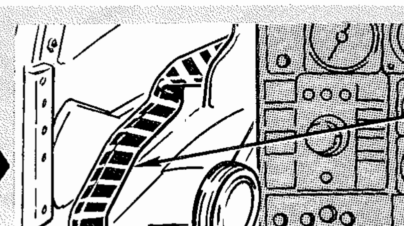
3. ALTERNATE EJECTION HANDLE—PULL

PLACE ONE ARM BETWEEN LEGS WITH PALM AFT, AND GRASP ALTERNATE EJECTION HANDLE. WITH FREE HAND GRASP OPPOSITE WRIST OR A PREVIOUSLY DETERMINED HAND HOLD. PULL UP ON ALTERNATE HANDLE UNTIL STOP IS ENCOUNTERED. WHEN CANOPY JETTISONS, CONTINUE PULLING UP ON ALTERNATE EJECTION HANDLE UNTIL FULL TRAVEL IS REACHED.

IF CANOPY FAILS TO JETTISON

- **EMERGENCY CANOPY RELEASE HANDLE—PULL**

IF CANOPY FAILS TO JETTISON RELEASE TENSION ON FACE CURTAIN HANDLE, AND WHILE HOLDING HANDLE WITH ONE HAND, PULL EMERGENCY CANOPY RELEASE HANDLE. WHEN CANOPY JETTISONS, AGAIN GRASP FACE CURTAIN HANDLE WITH BOTH HANDS, AND PULL UNTIL FULL TRAVEL IS REACHED.



IF CANOPY STILL FAILS TO JETTISON

- **CANOPY CONTROL HANDLE—OPEN**
- **MANUAL CANOPY UNLOCK HANDLE—PULL**

WHEN AIR LOADS SEPARATE CANOPY, AGAIN GRASP FACE CURTAIN HANDLE WITH BOTH HANDS AND PULL UNTIL FULL TRAVEL IS REACHED.

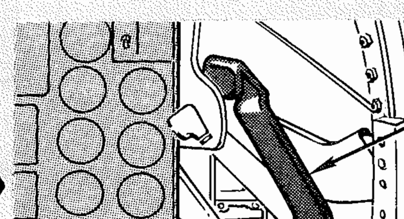


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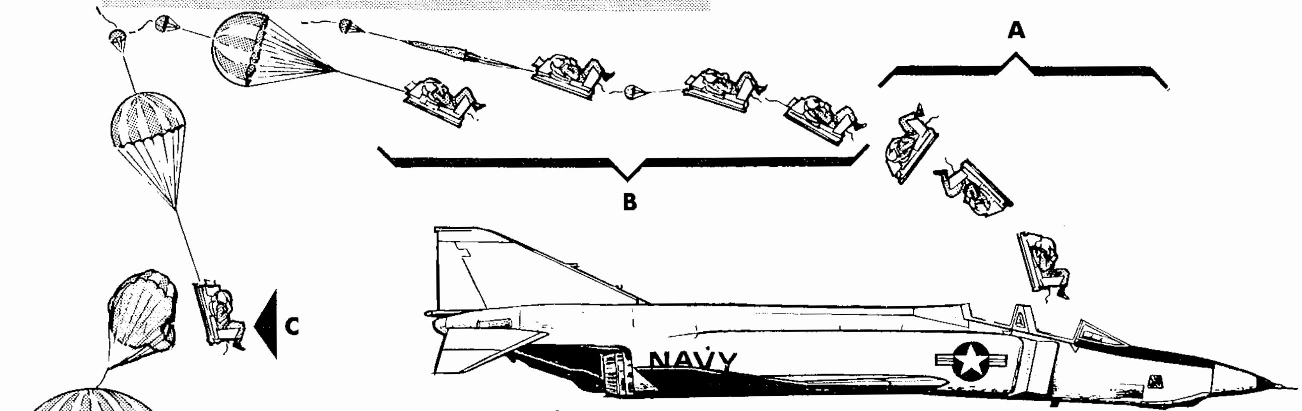
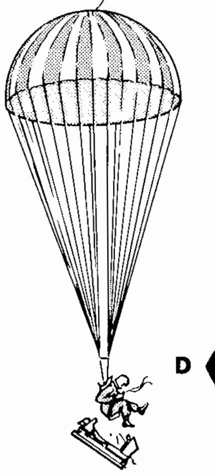
Figure 5-8

After Ejection Sequence





HIGH ALTITUDE SEQUENCE

PULL FACE CURTAIN TO INITIATE THE EJECTION SEQUENCE, CANOPY JETTISONS AND PULLS INTERLOCK BLOCK, PERMITTING CURTAIN TO EXTEND FULLY AND FIRE THE CATAPULT.

A SEAT IS PROPELLED UP GUIDE RAIL. OCCUPANT'S LEGS ARE RESTRAINED, EMERGENCY OXYGEN IS ACTUATED, TIME RELEASE MECHANISM AND DROGUE GUN ARE TRIPPED, AND EMERGENCY IFF IS ACTUATED.

B DROGUE GUN FIRES APPROX. 1 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 APPROX. 10,000 FT. IS REACHED, THE BAROSTAT RELEASES THE ESCAPEMENT MECHANISM, WHICH IN TURN, ACTUATES TO RELEASE THE OCCUPANT'S HARNESSING, LEG RESTRAINT LINES, AND CHUTE RESTRAINT STRAPS. THE DROGUE CHUTES PULL THE LINK LINE TO DEPLOY THE PERSONNEL PARACHUTE.

10,000 FT. . . . . . . **IF NECESSARY PROCEED WITH . . . .**

D OCCUPANT IS HELD TO SEAT BY STICKER CLIPS UNTIL OPENING SHOCK OF PARACHUTE SNAPS SEAT FROM HIM PERMITTING NORMAL DESCENT.

LOW ALTITUDE SEQUENCE

SAME AS CORRESPONDING STEPS **A-B** IN HIGH ALTITUDE SEQUENCE EXCEPT

C APPROX. 1¾ SEC. AFTER EJECTION AND DECELERATION FORCE ON THE SEAT HAVE DECREASED TO 4.5 "g's" OR LOWER, THE ESCAPEMENT MECHANISM ACTUATES TO RELEASE THE OCCUPANT'S HARNESSING LEG RESTRAINT LINES, AND CHUTE RESTRAINT STRAPS. THE DROGUE CHUTES PULL THE LINK LINE TO DEPLOY THE PERSONNEL PARACHUTE.

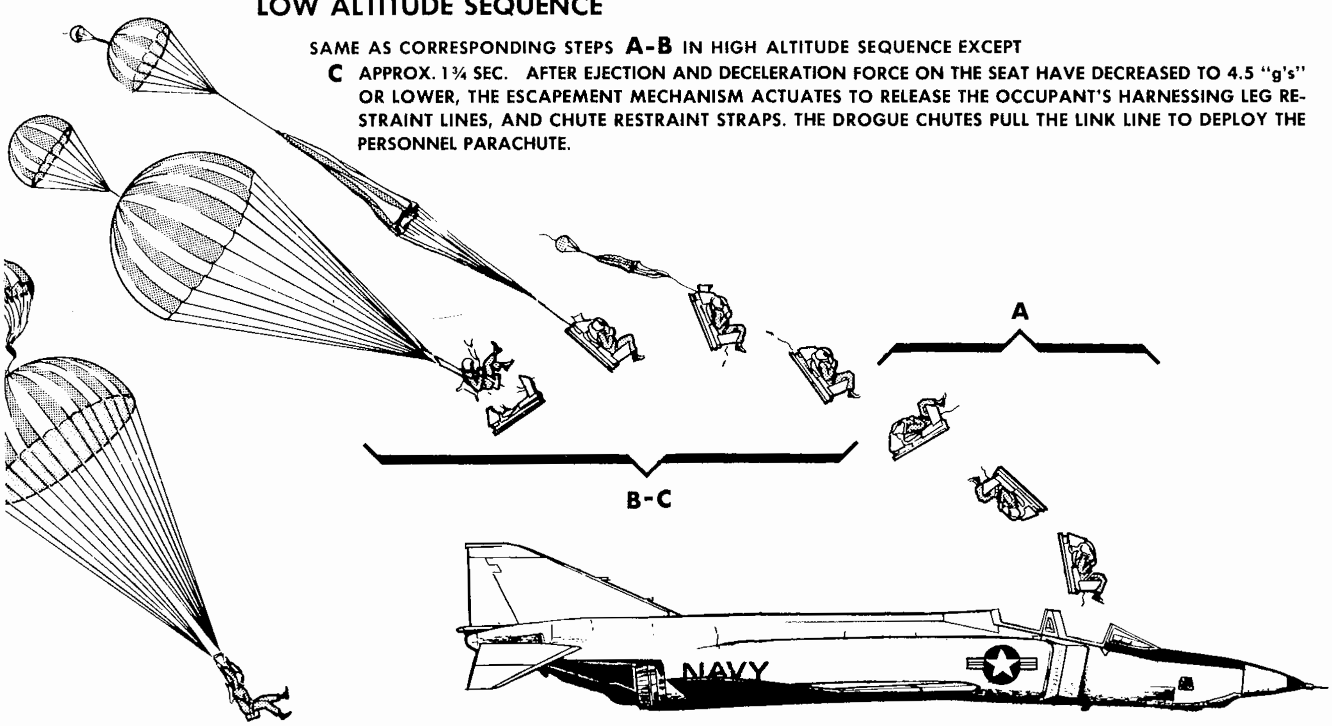


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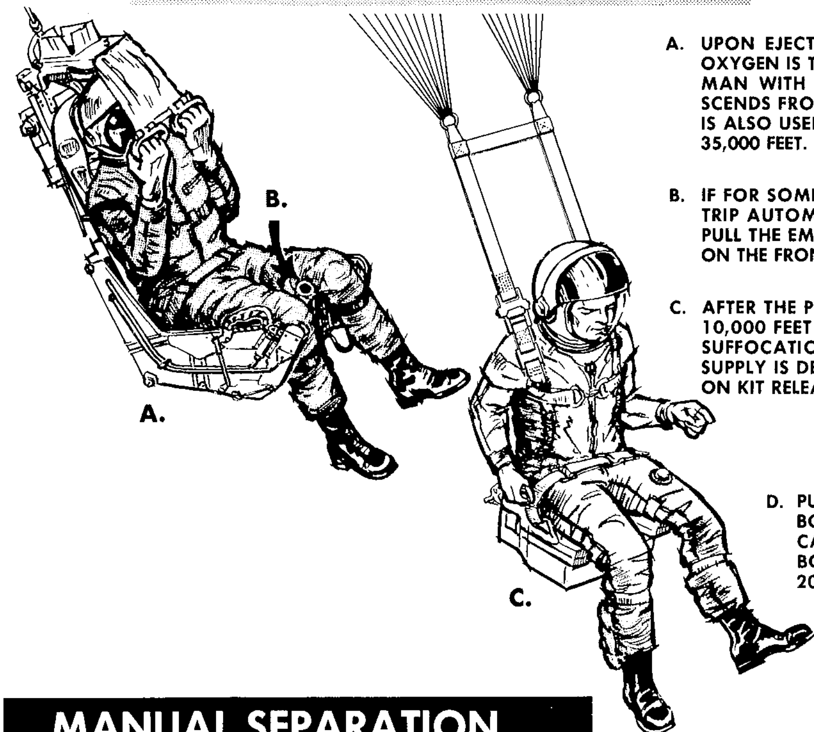
Figure 5-9

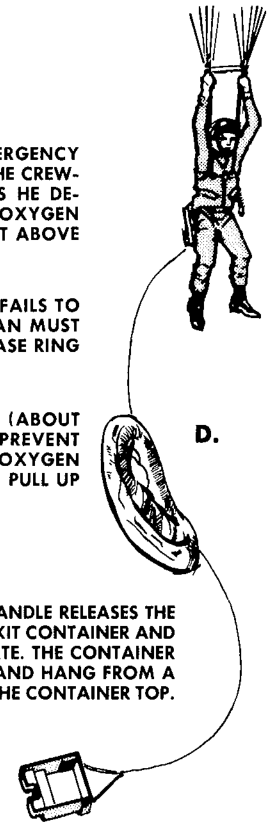
Survival Kit Deployment



A. UPON EJECTION, SURVIVAL KIT EMERGENCY OXYGEN IS TRIPPED. THIS PROVIDES THE CREWMAN WITH BREATHING OXYGEN AS HE DESCENDS FROM HIGH ALTITUDES. THE OXYGEN IS ALSO USED TO PRESSURIZE THE SUIT ABOVE 35,000 FEET.

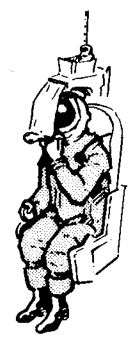
B. IF FOR SOME REASON THE OXYGEN FAILS TO TRIP AUTOMATICALLY, THE CREWMAN MUST PULL THE EMERGENCY OXYGEN RELEASE RING ON THE FRONT OF THE SURVIVAL KIT.

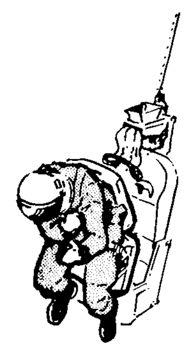
C. AFTER THE PARACHUTE HAS OPENED (ABOUT 10,000 FEET) OPEN FACE VISOR TO PREVENT SUFFOCATION WHEN EMERGENCY OXYGEN SUPPLY IS DEPLETED. IF OVER WATER, PULL UP ON KIT RELEASE HANDLE.

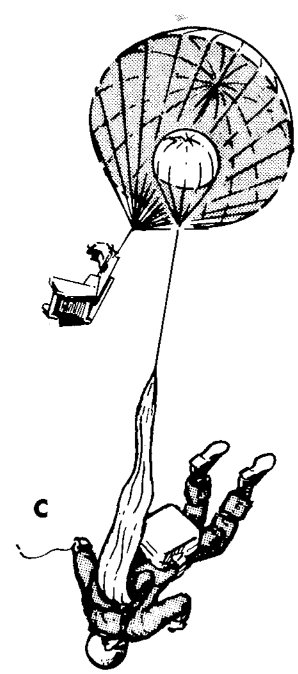


D. PULLING THE KIT RELEASE HANDLE RELEASES THE BOTTOM OF THE SURVIVAL KIT CONTAINER AND CAUSES THE RAFT TO INFLATE. THE CONTAINER BOTTOM AND RAFT DROP AND HANG FROM A 20 FOOT LINE SECURED TO THE CONTAINER TOP.

MANUAL SEPARATION







SHOULD THE TIME RELEASE MECHANISM FAIL TO OPERATE AUTOMATICALLY, THE OCCUPANT WOULD MANUALLY SEPARATE FROM THE SEAT AS FOLLOWS:

A. ACTUATE EMERGENCY HARNESS RELEASE HANDLE ON RIGHT SIDE OF SEAT TO ITS FULL AFT POSITION. THIS ACTION WILL RELEASE THE RESTRAINT HARNESS, LEG RESTRAINT CORD, AND A CARTRIDGE ACTUATED GUILLOTINE WILL SEVER THE LINK LINE BETWEEN THE PERSONNEL CHUTE AND DROGUE CHUTE. THE OCCUPANT IS NOW HELD IN SEAT ONLY BY STICKER CLIPS.

B. REACH OVER SHOULDERS AND GRASP PARACHUTE, AND PULL PARACHUTE OFF THE HORSESHOE FITTING ON THE SEAT, PUSH FREE OF STICKER CLIPS AND CLEAR OF SEAT.

C. PULL PARACHUTE RIPCORD "D" RING (LOCATED ON LEFT SHOULDER) AND MAKE A NORMAL PARACHUTE DESCENT TO THE GROUND.

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Figure 5-10

Minimum Ejection Altitudes

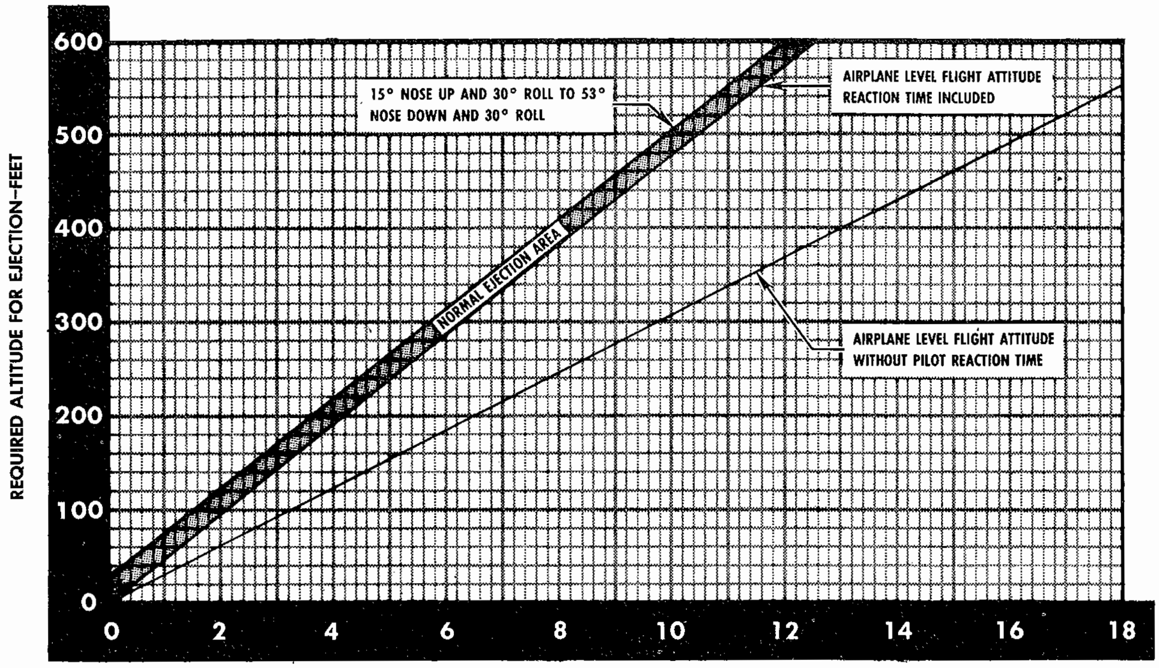


Figure 5-11

LOW ALTITUDE EJECTION

Low altitude ejection must be based on the minimum speed, minimum altitude and sink rate limitations of the ejection system, (figure 5-11) the ultimate decision rests with the pilot. The ejection seat gives excellent low level escape capability from ground level to maximum altitude, at airspeeds from 130 to 350 knots IAS below 100 feet and 550 knots IAS above 100 feet. Ejection at low altitudes is facilitated by pulling the nose of the airplane above the horizon (zoom by maneuver). This maneuver affects the trajectory of the ejection seat providing a greater increase in altitude than if ejection is performed in a level flight attitude. This gain in altitude will increase time available for seat separation and deployment of the personnel parachute. Ejection should not be delayed when the aircraft is in a descending attitude and cannot be leveled out.

WARNING

The minimum airspeed of 130 knots quoted for ground level ejection of necessity assumes a near-level aircraft attitude and NO SINK RATES.

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 safe 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, the pilot and RSO will abandon the aircraft at a minimum altitude of 15,000 feet above the terrain if possible. If the pilot has decided to abandon the aircraft while still in controlled flight at altitude, the pilot and RSO will abandon the aircraft at a minimum altitude of 10,000 feet above the terrain with the aircraft headed to sea or toward an unpopulated area.

SURVIVAL KIT DEPLOYMENT

During ground or low level ejection, the crew member may not have time to deploy or remove the survival kit. However, if time permits, the kit should be deployed and the life preserver inflated during the parachute descent. The following options are available to the crewmember during parachute descent.

a. Land with the survival kit intact.
b. Deploy survival kit prior to ground impact or water entry.
c. Remove survival kit and hold it by the carrying strap to be dropped just prior to ground contact.

If ground contact is anticipated among trees, rugged terrain, high-tension wires, etc., it may be to the crewmembers advantage to remove the survival kit, hold it by the carrying strap and drop it just prior to impact. To jettison or hand carry survival kit, proceed as follows:

1. Open face visor or disconnect oxygen mask.
2. Composite disconnect release knob - PULL.
3. Release left lap belt release fitting.
4. Take hold of survival kit, lifting handle with right hand.
5. Release right lap belt release fitting.

EJECTION SEAT FAILURE (BAILOUT)

In the event that the canopy has been jettisoned but the ejection seat fails, proceed as follows:

1. Reduce speed as much as possible.
2. SIF - EMERG
3. Emergency harness release handle - PULL
   Pull up on the emergency harness release handle on the right side of the seat bucket to disconnect the parachute harness and the leg restraint harness from the seat. This handle also fires the cartridge actuated guillotine and severs the link line between the drogue chute and the personnel parachute.
4. Reach over shoulders and grasp parachute from the horseshoe fitting on the seat.
5. Full nose down trim while holding airplane level.

CAUTION

If the parachute risers are not grasped and the chute pulled off the horseshoe, the chute will not clear the protrusion at the top of the seat when attempting to leave.

6. Roll inverted, push stick forward and push sharply to fall clear of the airplane.
7. When clear of airplane and at 10,000 feet or below, parachute "D" ring - PULL.

ELECTRICAL

GENERAL

In the event of an electrical system failure, various components of the combined aircraft systems will be inoperative. Refer to (figure 5-4) for equipment that will be lost/available with one or both generators inoperative.

WARNING

- If CSD with disconnect feature is ever replaced by one without disconnect feature, insure cockpit placard (embossed yellow or blue plastic tape attached to the console directly below generator warning lights) is installed. The tape will read "Port or Starboard CSD Disconnect " as appropriate.
- If generator without shaft disconnect feature fails, secure that engine as soon as practicable. However, multiple emergencies, adverse weather, and other peculiar conditions may require relighting of the engine. In this case, a relight should be initiated to ensure minimum operating time on the engine.

SINGLE GENERATOR FAILURE OR INTERMITTENT GENERATOR OPERATION

CSD With Shaft Disconnect

1. Failed generator switch - CYCLE (OFF wait 45 seconds then ON)
2. Check generator warning light - OUT
3. If light remains illuminated, failed generator switch - OFF
4. Land as soon as practicable.
5. Monitor engine oil pressure and nozzle operation.
   If oil loss is indicated, secure engine.

CSD Without Shaft Disconnect

1. Failed generator switch - CYCLE (OFF, wait 45 seconds then ON)
2. Check generator warning light - OUT
3. If light remains illuminated, failed generator switch - OFF
4. Secure engine as soon as practicable.
5. Jettison external stores if necessary.
6. Land as soon as practicable.

Note

Multiple emergencies, adverse weather, and other peculiar conditions may require re-lighting of the engine. In this case, a relight should be initiated to ensure minimum operating time on the engine.

DOUBLE GENERATOR FAILURE

1. Ram air turbine - EXTEND
   Reduce airspeed to RAT extension speed and extend RAT.
2. All unessential electrical switches - OFF
3. Generator control switches - CYCLE (OFF wait 45 seconds then ON)
4. Check generator warning light(s) - OUT
5. If generator warning light(s) go out, retract RAT

6. Judiciously continue mission, be prepared to land as soon as practicable.
7. If generator warning lights remain illuminated or re-illuminate, generator control switches - OFF
8. Console floodlights - BRIGHT (at night)
9. Landing gear and flaps - BLOW DOWN (when ready for landing)

WARNING

Blow down gear and flaps even if lowered prior to the generator failure.

10. Land as soon as practicable.

BUS TIE OPEN

Basically, an illuminated "Bus Tie Open" light is an indication that the right and left generator bus systems are no longer inter-connected. A failed generator, or a short within its bus system, will be indicated by momentary illumination of the "Bus Tie Open" light; followed within 5 seconds by illumination of the applicable "Gen Out" light as the "Bus Tie Open" light goes out. If the "Bus Tie Open" light remains extinguished, the fault within the bus system has corrected itself or the fault has been isolated within the generating system. If the "Bus Tie Open" light re-illuminates within 2 seconds after being extinguished, the short is still present within the corresponding generator's bus system and that bus system will be denied power from the normal operating generator. In either case, an attempt should be made to reset the disconnected generator. If the left generator is disconnected and the bus tie relay is open, the left main a-c buses will be lost. If the right generator is disconnected and the bus tie relay is open, the right main a-c and essential buses will be lost. The essential buses may be regained by extending the RAT and placing the left generator switch to OFF when required. This cycling of the emergency generator, with the bus tie relay open, should be done with caution since the original short/fault probably still exists and could be further aggravated by application of emergency power. Upon illumination of the "Bus Tie Open" indicator light:

BOTH GENERATORS OPERATING

1. Continue mission
2. Right generator switch - CYCLE (OFF, wait 45 seconds then ON)

   Cycle the right generator so as not to interrupt power to the INS. Once power to the INS is interrupted, heading and attitude reference may be in error.

LEFT OR RIGHT GENERATOR INOPERATIVE

CSD With Shaft Disconnect

1. Operating generator switch - CYCLE (OFF, wait 45 seconds then ON)
2. Check bus tie warning light - OUT
3. If light remains illuminated, turn off all electrical equipment not essential to flight.
4. Monitor engine oil pressure and nozzle operation on engine with inoperative generator. If oil loss is indicated, secure engine.
5. Land as soon as practicable.

CSD Without Shaft Disconnect

1. Operating generator switch - CYCLE (OFF, wait 45 seconds then ON)
2. Check bus tie warning light - OUT
3. If light remains illuminated, turn off all electrical equipment not essential to flight.
4. Secure engine with inoperative generator as soon as practicable.
5. Jettison external stores if necessary.
6. Land as soon as practicable.

To regain use of the essential bus with right generator out and bus tie open:

1. Ram air turbine - EXTEND

   Reduce airspeed to RAT extension speed and extend RAT.
2. Left generator control switch - OFF

WARNING

With the "Bus Tie Open" light illuminated, cycling of the emergency generator should be done with caution. The original short/fault probably still exists and could be further aggravated by application of emergency power.

ENGINE

GENERAL

Jet engine failures in most cases will be 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 stops. If engine failure is due to a malfunction of the fuel control system or improper operating technique, an air start can usually be accomplished, providing time and altitude permit. If engine failure can be attributed to some obvious mechanical failure within the engine proper, do not attempt to restart the engine.

SINGLE-ENGINE FLIGHT CHARACTERISTICS

Single-engine flight characteristics are essentially the same as normal flight characteristics due to proximity of the thrust lines to the center of the airplane. With one engine inoperative, slight rudder deflection is required to prevent yaw toward the failed engine. Thus, good control is assured in the single-engine range. Minimum single-engine control speed varies with gross weight, flap setting, and landing gear position. The aircraft design is such that no one system (flight control, pneumatic, electrical, etc.), is dependent on a specific engine. Thus, loss of an engine will not result in a loss of a complete system.

ENGINE FAILURE DURING TAKEOFF

If an engine fails before leaving the ground, the continuation of takeoff is dependent on length of remaining runway, gross weight, airspeed, field elevation and ambient temperature.

Note

- During takeoff using Military power, where takeoff will not be aborted, immediately advance operating engine to Maximum power and follow Engine Failure During Flight Procedures, this section, as soon as possible.

- If a single-engine failure occurs using Maximum power and takeoff will not be aborted, immediately retard "dead" engine throttle from afterburning range and follow Engine Failure During Flight Procedures, this section, as soon as possible.

If Decision to Stop is Made -

1. ABORT TAKEOFF
   Refer to Aborted Takeoff, this section.

If Takeoff is Continued -

If an engine fails immediately after takeoff, lateral and directional control of the airplane can be maintained if airspeed remains above stalling speed. However, the ability to maintain altitude or to climb depends upon airplane gross weight and airspeed. If level flight cannot be maintained:

1. OPERATING ENGINE - MAX (AFTERBURNER)
2. EXTERNAL STORES - JETTISON (IF NECESSARY)
   If altitude cannot be maintained, jettison the external stores.
3. Landing gear - UP
4. Wing flaps - UP
5. Failed engine - SHUTDOWN
6. Non-mechanical failure - INITIATE AIRSTART
7. Land as soon as practicable.

ENGINE FAILURE DURING FLIGHT

1. Non-mechanical failure - INITIATE AIRSTART
2. Mechanical failure - SHUTDOWN FAILED ENGINE
3. Land as soon as practicable.

DOUBLE ENGINE FAILURE DURING FLIGHT

1. RAM AIR TURBINE - EXTEND
   Extend the ram air turbine to operate the left fuel boost pump at low speed. This will supply enough fuel to either engine for an airstart.

CAUTION

Maintain airspeed above 195 knots IAS to prevent the emergency generator pressure switch from disconnecting the emergency generator from the essential buses. This would result in a complete loss of all electrical power, except for the engines ignition systems.

2. EITHER THROTTLE - OFF
3. OTHER ENGINE - INITIATE AIRSTART
   To provide maximum fuel flow for an airstart, retain the throttle of the remaining engine in the OFF position.
4. If no start within 30 seconds, throttle - OFF
5. Remaining engine - ATTEMPT AIRSTART
6. If neither engine can be started - NOTIFY RSO AND EJECT

RUNAWAY ENGINE

There is no provision made on the main fuel control for stabilized engine rpm in the event the throttle linkage becomes disconnected from the fuel control. If a disconnect occurs, vibration may cause the fuel control to "hunt" or assume any position between idle and maximum power. In the event of a runaway engine while on the ground, shutdown the engine by turning the engine master switch OFF. For an in-flight runaway engine proceed as follows:

1. Secure engine before entering pattern.

VARIABLE AREA INLET RAMP FAILURE

RAMPS RETRACTED AT SPEEDS ABOVE 1.5 MACH

In the event the inlet ramps fail to move toward the extended (minimum duct area) position while accelerating through approximately 1.5 Mach, reduce airspeed to below 1.5 Mach and continue the mission. Engine performance and operating characteristics with the ramps failed to the retracted (maximum duct area) position are normal below 1.5 Mach.

CAUTION

Compressor stalls may occur at airspeeds above 1.5 Mach with the inlet ramps in the retracted position.

RAMPS EXTENDED AT SPEEDS BELOW 1.5 MACH

In the event that the inlet ramps fail to the fully extended position, engine operating characteristics will be unaffected but a substantial loss of thrust will occur at all power settings. Jam accelerations, afterburner operation and airstarts may be performed without overtemperature conditions or compressor stalls. Range, altitude, and waveoff performance are degraded. Power settings above 94% rpm produce increased fuel flows without increasing engine thrust output. In the event the inlet ramps fail to the extended position, maintain the highest altitude at which the maximum range Mach number recommended for existing gross weight and configuration can be maintained with 94% rpm or less.

Note

With the inlet ramps extended, the reduction in maximum range varies from 5% at 10,000 feet to 18% at 30,000 feet. Single engine range is reduced by 10% at all attainable altitudes.

CAUTION

Sustained power settings above 90% rpm at subsonic airspeeds above 30,000 feet with the inlet ramps in the extended position may result in a faintly glowing fire warning light. Altitude and power setting should be reduced to extinguish the warning light.

LANDING

If both engines are operating, full-flap landings (both field and carrier) can be safely made with the inlet ramp fully extended. Reduce gross weight to below 33,000 pounds prior to landing. Normal power settings must be increased 1% to 2% rpm to maintain "on speed" approach. Safe waveoffs can be performed with Military power at gross weights up to 33,000 pounds. At higher gross weights, afterburner may be required for a late waveoff.

SINGLE-ENGINE LANDING

Single-engine carrier landings should not be attempted with the inlet ramps fully extended. Thrust necessary to maintain approach angle of attack and rate of descent would require a throttle setting between MIL and MIN A/B. Waveoff performance, at all gross weights, is marginal under these conditions. Approximately 100 feet of altitude and 15 seconds are required to stop a normal rate of descent after MAX A/B has been attained. Field landings at minimum gross weight can be made with 1/2 flaps. However, afterburner will be required occasionally to maintain normal approach angle of attack and rate of descent.

COMPRESSOR STALL

A compressor stall is an aerodynamic disruption of airflow through the compressor, and is caused by subjecting the compressor to a pressure ratio above its capabilities at the existing conditions. The compressor capability may be reduced by FOD, corrosion, misrigged or malfunctioning IGV's, or the compressor may be subject to abnormal operating conditions as a result of a malfunction of the ramp or bellmouth system. Compressor stalls may be self clearing, may cause the engine to flameout, or may result in a steady state, fully developed stall. The first case requires no immediate action. In the second case, the flameout clears the stall and an airstart is required. The third case requires recognition and corrective action to restore thrust and prevent engine damage by overtemperature. The stall can be recognized by the simultaneous existance of high EGT, low rpm, low fuel flow, open nozzle, loss of thrust, and lack of engine response to throttle. Compressor stalls may be accomplished by muffled "bangs". The most positive stall clearing procedure is to stopcock the engine and perform an airstart. A throttle chop to IDLE may clear the stall if a significant fuel flow reduction from the stalled condition is achieved. In the event of a compressor stall, proceed as follows:

1. Throttle of affected engine - IDLE

If stall does not immediately clear:

2. Throttle - OFF
3. Initiate airstart.

Note

If stall is cleared but desired thrust cannot be obtained because of repeated stalling, the engine may be operated at any obtainable rpm, as long as EGT is within limits.

EXHAUST NOZZLE FAILED OPEN

In the event an exhaust nozzle fails to the full open position, a significant loss of thrust will be noted; however, it is not necessary that the engine be shut down. Continued engine operation with a fully open nozzle will not damage the engine. The majority of exhaust nozzle failures result from engine oil starvation, but, because the CSD oil standpipe is above that of the nozzle control, oil starvation will usually be first indicated by a generator warning light. In the event of a failed open nozzle:

1. Throttle (engine indicating failed open nozzle) - IDLE
2. Do not advance thrust on affected engine unless necessary.
3. Monitor oil pressure.
4. Land as soon as practicable.

EXHAUST NOZZLE FAILURE IN AFTERBURNER

Upon initiating afterburner, failure of the variable exhaust nozzle to open is recognized by a rapid increase in exhaust temperature and a drop in rpm. If an over-temperature condition exists:

1. Immediately move throttle to MIL range.

WARNING

Do not attempt to relight afterburner. Damage to engine and airframe structure could result.

DOUBLE EXHAUST NOZZLE FAILURE

NEW

In the event both exhaust nozzles fail open, the thrust available above 80% will be approximately equal to the thrust available during single engine operation. Afterburner light-off above 15,000 feet is marginal, however, afterburner light-off probability increases with a decrease in altitude.

AFTERBURNER "BLOWOUT" DURING FLIGHT

In the event of an afterburner "blowout" or loss of afterburning, proceed as follows:

1. Throttle of failed afterburner - MIL RANGE
   The failed engine afterburner throttle should be moved inboard immediately to terminate fuel flow to the afterburner nozzles.
2. If no obvious overheat is discernible - RELIGHT AFTERBURNER
   If cockpit indications of resumed afterburner are normal, continue afterburner operation.

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.

Note

If one or both engines flame out, do not delay the airstart. If no engine mechanical failure is immediately evident, depress and hold the ignition button(s) to restart the engine(s) before excessive rpm is lost.

1. IGNITION BUTTON - DEPRESS (MORE THAN 12% RPM OPTIMUM)
2. THROTTLES - ANY POSITION BEYOND IDLE
3. Engine EGT and rpm - MONITOR

Note

Be sure to give the engine sufficient time for a relight to occur before placing the throttle off and deciding that the engine is not going to start.

4. In the event of an unsuccessful lightoff, retard the throttle to OFF.
   a. Lightoff does not occur within 30 seconds after ignition.
   b. The engine does not continue to accelerate after lightoff.
   c. The EGT exceeds maximum limitations.
   d. The oil pressure does not attain 12 psi minimum at idle.
5. Wait 30 seconds before initiating another restart.

OIL SYSTEM FAILURE

An oil system failure of either engine is recognized by a drop in oil pressure or a complete loss of pressure. Since the constant speed drive unit which drives the generator is supplied with oil under pressure by the engine oil system, a "Gen Out" light, followed by sluggish exhaust nozzle action, are early indications of impending engine oil starvation. The engine oil pressure gage should be monitored closely after a generator failure. In general, it is advisable to shut the engine down as early as possible after a loss of oil supply is indicated, to minimize the possibility of damage to the engine and the constant speed drive unit. The engine will operate satisfactorily at Military power for a period of one minute with an interrupted oil supply. However, continuous operation, at any engine speed, with the oil supply interrupted will result in bearing failure and eventual engine seizure. The rate at which a bearing will fail, measured from the moment the oil supply is interrupted, cannot be accurately predicted. Such rate depends upon the condition of the bearing before oil starvation, temperature of the bearing and loads on the bearing. Malfunctions of the oil system are indicated by a shift (high or low) from normal operating pressure, sometimes followed by a rapid increase in vibration. A slow pressure increase may be caused by partial clogging of one or more oil jets; while a rapid increase may be caused by complete blockage of an oil line. Conversely, a slow pressure decrease may be caused by an oil leak; while a sudden decrease is probably caused by a ruptured oil line or a sheared oil or scavenge pump shaft. Vibration may increase progressively until it is moderate to severe before the pilot notices it. At this time, complete bearing failure and engine seizure is imminent. Limited experience has shown that the engine may operate for 4-5 minutes at 80 to 90% rpm before a complete failure occurs. In view of the above, the following operating procedures are recommended:

1. If a minimum oil pressure of 40 psi (MIL-L-2369 oil) at Military rpm cannot be maintained, throttle - IDLE
2. If a minimum of 12 psi at idle rpm cannot be maintained, or if the oil pressure change is accompanied by vibrations, engine - SHUTDOWN

WARNING

Increasing vibration is an indication of bearing failure. Severe vibration indicates that engine seizure will occur within a few seconds. Chop the throttle to OFF to prevent major engine, and possible aircraft damage.

3. If engine shutdown is not feasible - REDUCE THRUST
   Shut the engine down when partial power is not required from the affected engine. Where mission or flight requirements demand partial power from the affected engine, set engine speed at 86-89%.
4. Avoid abrupt maneuvers causing high G forces.
5. Avoid unnecessary or large throttle movements.
6. In either of the above instances - LAND AS SOON AS PRACTICABLE

Note

To keep bearing temperatures and loads at a minimum, do not use high thrust settings.

FIRE

GENERAL

The pilot's first indication of a fire will be noted by the steady illumination of the "Fire/Overheat" warning light. However, a momentary illumination of the "Fire" or "Overheat" warning light should not be completely ignored. A momentary illumination should be followed by a check of the fire test circuit to determine if a fire actually exists, and has burned through the fire detector wiring.

ENGINE FIRE DURING START

1. THROTTLES - OFF
2. ENGINE MASTER SWITCHES - OFF
3. CONTINUE TO CRANK ENGINE FOR 20 SECONDS
4. External compressed air units - DISCONNECTED
5. Leave airplane as quickly as possible.

ENGINE FIRE OR OVERHEAT DURING TAKEOFF

If "Fire" or "Overht" warning light illuminates during takeoff roll, it is preferable to abort immediately if sufficient runway is available to stop safely. Refer to Critical Field Length Charts, Section XI, Part 2.

If Decision to Stop is Made -

1. ABORT TAKEOFF
   Refer to Aborted Takeoff, this section

If Takeoff is Continued -

1. NORMAL OPERATING ENGINE - MAX (AFTERBURNER)
2. EXTERNAL STORES - JETTISON (IF NECESSARY)
3. THROTTLE (ENGINE INDICATING FIRE OR OVERHEAT) - IDLE
4. Landing gear - UP
5. Wing flaps - UP
6. Climb to safe ejection altitude and investigate.
   After reaching safe ejection altitude, proceed with Engine Fire or Overheat During Flight procedures.

ENGINE FIRE OR OVERHEAT DURING FLIGHT

1. THROTTLE (ENGINE INDICATING FIRE OR OVERHEAT) - IDLE
2. If warning light goes out - CHECK FIRE DETECTION SYSTEM
   Depress fire test button to determine that the fire detecting elements are not burned through.
3. If fire detection system check is normal, land as soon as practicable, do not advance thrust on the affected engine unless absolutely necessary.

CAUTION

Advancing thrust on the affected engine after the throttle has been retarded and the warning light has been extinguished may cause fire or overheat damage, and/or possible burn through the fire detecting elements.

4. If light remains on and/or fire is confirmed - SHUTDOWN ENGINE
   Shutdown engine if the "Fire/Overheat" warning light remains illuminated after reducing thrust; if the fire detection system has been found to be inoperative; or fire is apparent.

5. If fire persists - EJECT
   If fire continues after the engine is shutdown, notify RSO and eject.
6. If fire ceases - LAND AS SOON AS PRACTICABLE.

ENGINE FIRE DURING SHUTDOWN

1. THROTTLES - OFF
2. MASTER SWITCHES - OFF
3. With external power available, generator control switches - EXT ON
4. Engine start switch - LEFT or RIGHT (engine indicating fire)
5. Continue to crank engine for 20 seconds.
6. If external power is not available, leave airplane as soon as possible.

ELECTRICAL FIRE

1. Ram air turbine - EXTEND
2. Generator control switches - OFF
3. All electrical switches - OFF
4. When fire subsides, generator control switches - ON
5. If fire still persists when generator control switches are turned ON, turn generator control switches OFF
   The RAT will supply power to the essential buses only.
6. Land as soon as practicable.
7. If no fire is apparent when generator control switches are turned ON, individually reposition electrical equipment switches to ON beginning with the most essential equipment first.
8. If malfunctioning item is found, turn electric power switch OFF and pull applicable circuit breaker.

ELIMINATION OF SMOKE AND FUMES

1. Descend to below 34,000 feet.
2. Emergency ventilating knob - PULL
3. Front canopy - JETTISON (IF NECESSARY)

FLIGHT CONTROLS

GENERAL

NEW

Upon initial detection of any abnormal flight control movement, immediately depress the paddle switch in order to determine if the stab aug or AFCS was causing the abnormality.

RUNAWAY STABILATOR TRIM

If stabilator trim appears to be running away, it is possible under certain conditions to lessen the situation. Runaway stabilator trim can be alleviated by engaging the AFCS providing:

a. The stab trim circuit breaker has been pulled immediately upon detection of runaway trim.
b. The runaway trim has not exceeded 2-1/2 units nose down.

If the above conditions are met:

1. Reduce airspeed - 300 knots IAS or less.
2. AFCS - ENGAGE

Note

The "A/P Pitch Trim" light may illuminate when the AFCS is engaged.

CAUTION

When the AFCS is used to alleviate a runaway trim condition, and excessive out of trim forces are present (full nose down runaway trim) the AFCS will alternately disengage and re-engage. If this occurs, discontinue use of the AFCS.

3. Plan to land as soon as practicable.
4. Prior to Landing disengage AFCS
   When in the landing configuration (gear and flaps extended) and at 180 to 190 knots IAS, grasp stick firmly and disengage the AFCS. Depending upon severity of the malfunction, the airplane may or may not be in trim; if out of trim the forces should not be too high and the airplane can be landed with the-out-of trim condition, or the AFCS can be re-engaged and the landing made with control stick steering.
5. If landing is made with AFCS engaged, disengage immediately after touchdown
   Immediately after touchdown disengage AFCS to prevent damage to AFCS components.

STABILATOR FEEL TRIM FAILURE

PARTIAL BELLOWS FAILURE

Partial bellows failure is recognized by a mild nose down stick force proportional to the airspeed unless the failure occurs during maneuvering flight at which time it may not be noticeable. Reduction of stick centering and pitch stability will result. Should this failure occur:

1. Reduce airspeed - 250-300 knots IAS
2. Retrim airplane.
3. Avoid abrupt fore and aft stick movements.
4. Land as soon as practicable.

COMPLETE BELLOWS FAILURE

A complete bellows failure is recognized by a heavy nose down feel force at the control stick. The maximum amount that this stick force can attain is 30 pounds, dependent on the trim position. This force can be reduced to 5 pounds by applying full nose up trim. Should a complete bellows failure occur:

1. Reduce airspeed - 250-300 knots IAS
2. Stab trim - FULL NOSE UP
3. Avoid abrupt fore and aft stick movements.
4. Land as soon as practicable.

AILERON RUDDER INTERCONNECT (ARI) SYSTEM DISENGAGEMENT

The ARI system can be temporarily disengaged by depressing the AFCS/ARI emergency disengage switch; this will disengage the ARI only as long as it is held depressed. To permanently disengage the ARI system, the circuit breaker on the left utility panel must be pulled and the stab aug switch must be disengaged. Pulling the circuit breaker only, and keeping the stab aug engaged will still provide 5° of ARI rudder authority. In the event of an ARI system malfunction, proceed as follows:

1. To temporarily disengage system, depress AFCS/ARI emergency disengage switch
   Depressing the emergency disengage switch will disengage the ARI system only as long as the switch is held depressed.
2. To permanently disengage system, pull ARI circuit breaker and disengage stab aug switch

FUEL

FUEL BOOST PUMP FAILURE

The possibility of a simultaneous mechanical failure of both boost pumps is highly remote; however, double failure may occur as a result of an electrical malfunction. Provisions are made to supply fuel to the engines by gravity flow in the event of a double boost pump failure. This will allow engine operation at a reduced power setting. If both boost pumps fail above 20,000 feet and/or at a high power setting, flameout or an unstable rpm indication on one or both engines may occur.

1. If both engines have flamed out, execute procedure for double engine failure.
2. If an airstart has been accomplished, or the engines have not flamed out, adjust engine thrust or descend until a stable rpm can be maintained.
3. Land as soon as practicable.
4. If single boost pump fails, adjust throttle to maintain a minimum of 5 psi boost pump pressure, if practicable.

INTERNAL TANKS TRANSFER SYSTEM FAILURE

Transfer system failure in this airplane can usually be attributed to failure of the fuel system to become pressurized. Failure of the fuselage cells transfer pumps is not likely, since two hydraulic and two electric transfer pumps operate simultaneously and either set of pumps (electric or hydraulic) is capable of transferring all fuselage fuel.

If fuel system fails to become pressurized:

1. Wing transfer pressure switch - OVRD TRANS

Note

Selecting the OVRD TRANS position performs the same functions as did the landing gear handle switch, all pressure regulators open and all pressure relief valves close.

CAUTION

To prevent drop tank collapse during high altitude descent with wheels down, place wing transfer pressure switch to OVRD TRANS. Place wing transfer pressure switch to NORMAL prior to landing.

AIR REFUELING FUSELAGE TANKS ONLY

In the event the internal wing tanks become damaged and cannot hold fuel, emergency refueling of the fuselage tanks only can be accomplished as follows:

1. External transfer switch - OFF
2. Refuel selector switch - INT ONLY
3. Pull Fuel Valve Power circuit breaker (E-14, No. 1 circuit breaker panel)
4. Refuel probe switch - REFUEL
5. Commence refueling

Note

Do not attempt to refuel external tanks. Damage to internal wing tanks may prevent external wing tanks from transferring. The centerline tank cannot be refueled using the above procedure.

HYDRAULIC

GENERAL

The loss of hydraulic pump in power control systems No. 1, No. 2 or in the utility hydraulic system will be noted by the illumination of the "Check Hyd. Gages" warning light. This single light serves all three systems, and the pilot should check the hydraulic gages to assure which system has malfunctioned.

SINGLE POWER CONTROL SYSTEM FAILURE

A hydraulic pump failure of either PC-1 or PC-2 presents no immediate problem, since either system is capable of assuming the full demand of the other system. In airplanes thru 153094x without AFC 220 incorporated, an emergency hydraulic pump powered by the RAT can re-pressurize the PC-1 system in the event of a PC-1 failure.

WARNING

With no PC-1 system pressure available, the stab aug system will be lost; if the AFCS is engaged, the AFCS will remain operative except that stabilator authority will be lost. No indication of a stab aug failure will be noted since the "Stab Aug Disengaged" light will only illuminate upon switch disengagement, and in case of a PC-1 failure the switch will remain engaged. The AFCS, if engaged, should be immediately disengaged since erratic AFCS operation may occur due to the loss of AFCS stabilator authority. Aircraft control will be no problem and can be maintained through manual mode of operation which will be powered by the PC-2 hydraulic system.

Note

If the "Check Hyd Gages" indicator light illuminates and remains illuminated, monitor the hydraulic system gages for the remainder of the flight, since warning of a second hydraulic system failure will not be given.

PC-1 FAILURE

1. Land as soon as practicable.
2. Extend RAT and check pressure build up (1200-1400 psi) prior to landing. (Airplanes prior to 153095y without AFC 220 incorporated.)

PC-2 FAILURE

1. Land as soon as practicable.

DOUBLE POWER CONTROL SYSTEM FAILURE

The pilot should, upon initial detection of hydraulic power loss, note trend of failure as to whether the gages show a definite steady drop, or gage fluctuations. With a steady drop indication, hydraulic power will probably not recover. In the event of complete power control hydraulic failure, the aircraft will become uncontrollable. Before this occurs, proceed as follows:

1. Ram air turbine - EXTEND (airplanes thru 153094x without AFC 220 incorporated)
2. If hydraulic pressure does not recover - EJECT
3. If hydraulic pressure recovers - LAND AS SOON AS PRACTICABLE

UTILITY HYDRAULIC SYSTEM FAILURE

Failure of the utility hydraulic system will prevent hydraulic operation of the following essential items:

a. Air Refueling Probe
   There are no alternate or emergency provisions to extend or retract the air refueling probe.
b. Auxiliary Air Doors
   There are no alternate or emergency provisions for opening the auxiliary air doors. Refer to Auxiliary Air Door Malfunction, for procedures to follow in the event of an auxiliary air door failure.
c. Arresting Hook (retraction)
   There are no alternate or emergency provisions for arresting hook retraction.
d. Flaps (leading and trailing edge)
   Emergency pneumatic operation is provided. Refer to Wing Flap Emergency Lowering, this section.
e. Fuel Transfer Pumps (hydraulic)
   There are no alternate or emergency provisions for hydraulic transfer pump operation
f. Landing Gear
   Emergency pneumatic operation of the landing gear is provided. Refer to Landing Gear Emergency Lowering, this section.
g. Nose Gear Steering
   There are no emergency provisions for nose gear steering.
h. Photoflash Ejector Doors
   There are no alternate or emergency provisions for operation of the photoflash ejector doors.
i. Pneumatic System Air Compressor
   There are no alternate or emergency provisions for operation of the pneumatic system air compressor.
j. Rudder Power Control System
   Limited manual control of the rudder is available; however, pedal forces will be much higher than normal.

k. Speed brakes

There are no alternate or emergency provisions for speed brake extension; however, they may be retracted to a low drag trail position. Refer to Speed Brake Emergency Operation, this section.

m. Variable Bypass Bellmouth

There are no alternate or emergency provisions for operation of the variable bypass bellmouth. Refer to Auxiliary Air Door Malfunction for side effects of simultaneous variable bypass bellmouth and auxiliary air door failures.

n. Variable Engine Intake Ramps

There are no alternate or emergency provisions for operation of the variable engine intake ramps.

o. Wheel Brakes

Emergency pneumatic and hydraulic operation of the wheel brakes is provided. Refer to Wheel Brake Emergency Operation, this section.

p. Wing Fold

There are no emergency provisions for folding the wings.

In the event of a utility hydraulic system failure, proceed as follows:

Note

- If the "Check Hyd Gages" indicator light illuminates and remains illuminated, monitor the hydraulic system gages for the remainder of the flight, since warning of a second hydraulic system failure will not be given.

- Extending the refuel probe prior to a complete utility failure provides the capability of air refueling.

1. Land as soon as practicable.
2. Landing gear and flaps - BLOW DOWN WHEN READY FOR LANDING
3. Make an arrested landing if arresting gear is available.

LANDING GEAR UNSAFE

An unsafe gear indication does not necessarily constitute an emergency. The unsafe indication could be caused by a malfunction within the indicating system, or the result of incorrect gear lowering procedure coupled with a low pressure condition of the utility hydraulic system. Upon initial detection of unsafe gear indication, proceed as follows:

1. Airspeed - 250 knots IAS or BELOW
2. If utility hydraulic pressure is normal, recycle landing gear
3. Landing gear position indicators - CHECK
4. If unsafe condition still exists, place landing gear handle up.
5. Apply negative "g's" to airplane.
6. While under negative "g's", place gear handle down.

   Negative "g's" will help if unsafe gear is caused by high break-out forces.
7. If unsafe condition still exists, utilize landing gear emergency lowering procedure.
8. If unsafe condition still exists, yaw airplane to assist in locking main gear, or bounce airplane on main gear to assist lowering/locking the nose gear.
9. Check gear indicators and have gear visually checked by another airplane or by tower "fly by".

LANDING GEAR EMERGENCY LOWERING

If normal gear operation fails, the gear can be lowered by utilizing the following procedures:

1. Airspeed - BELOW 250 KNOTS IAS
2. Landing gear handle - DOWN
3. Landing gear circuit breaker - PULL
4. Landing gear handle - PULL AFT AND HOLD

   Pull handle full aft (full limit of travel) and hold in full aft position until gear indicates down and locked.

CAUTION

- Hold handle in full aft position until gear indicates down and locked, and then leave the landing gear handle in the full aft position. Returning the handle to its normal position allows compressed air from the gear down side of the actuating cylinder to be vented overboard.

- If the landing gear is inadvertently extended in flight by emergency pneumatic pressure, it must be left in the extended position until post-flight servicing. If retraction in flight is attempted, rupture of the utility reservoir will probably occur with subsequent loss of the utility hydraulic system.

5. Landing gear position indicators - CHECK

CAUTION

To prevent drop tank collapse, during high altitude descent with wheels down, place wing transfer pressure switch to OVRD TRANS. Prior to landing, return wing transfer pressure switch to NORMAL.

Note

Any pneumatic extension of the landing gear shall be logged in the yellow sheet (OPNAV FORM 3760-2).

WING FLAP EMERGENCY LOWERING

If normal wing flap operation fails, the flaps can be lowered by utilizing the following procedures:

1. Airspeed - BELOW 200 KNOTS IAS
2. Flap circuit breaker - PULL

3. Emergency wing flap extension handle - PULL AFT
   Pull emergency wing flap extension handle full aft and down (full limit of travel).

CAUTION

- Asymmetric flap extension may occur when the flaps are extended by the emergency method. This will result in a momentary aircraft roll which can be countered by normal application of aircraft controls.
- Leave the emergency wing flap extension handle in the full aft position. Returning the handle to its normal position allows the compressed air from the flap down side of the actuating cylinder to be vented overboard, and the flaps will be blown up by the wind stream.
- If the flaps are inadvertently extended in flight by emergency pneumatic pressure, they must be left in the extended position until post-flight servicing. If retraction in flight is attempted, rupture of the utility reservoir will probably occur with subsequent loss of the utility hydraulic system.

Note

The flaps will extend to the 1/2 position when the flaps are lowered by the emergency procedure.

4. Wing flap position indicators - CHECK

Note

Any pneumatic extension of the wing flap shall be logged on the yellow sheet (OPNAV FORM 3760-2).

WHEEL BRAKE EMERGENCY OPERATION

In the event of a utility hydraulic system failure or loss of brake action, the airplane can be stopped by using the emergency brake system. However, if arresting gear is available, plan to make an arrested landing.

1. Hydraulic wheel brakes - APPLY
   Depress brakes and keep a constantly increasing brake pressure. Do not pump brakes. There may be brake applications available from the emergency hydraulic accumulator.

Note

With no utility hydraulic system pressure available, the manual hydraulic brakes are still capable of furnishing flow and pressure to accomplish a limited amount of differential braking. This can be utilized with the emergency brake system to maintain directional control of the airplane. The number of such applications is limited and higher pedal travel and higher brake pedal forces will be necessary.

2. If unable to stop airplane, pull emergency brake handle. The emergency brake system meters air pressure in proportion to applied pilot effort but does not provide differential braking.

CAUTION

Asymmetrical braking is prevalent during use of emergency braking. This asymmetrical braking could be due to runway crown or crosswinds as well as unequal brake torque.

Note

There will be a time lag between pulling the emergency brake handle and the application of pneumatic pressure to the wheel cylinders.

SPEED BRAKE SYSTEM EMERGENCY OPERATION

In the event the throttle mounted speed brake switch fails to retract the speed brakes, they can be retracted hydraulically by placing the speed brake emergency switch in the RETRACT position. In the event of a utility hydraulic failure, with speed brakes extended, placing either the speed brake switch to IN or the emergency speedbrake switch to RETRACT, will allow air loads to close the panels to the trail position.

LANDING EMERGENCIES

ABORT-GEAR ENGAGEMENT

This procedure involves only those steps necessary for actual engagement of the abort gear. It is assumed that those steps necessarily required (if available) for slowing the airplane prior to engagement have been accomplished; i.e. reduced thrust, drag chute, speed brakes, flaps, and wheel brakes. Any time the airplane cannot be stopped safely on the runway, attempt to engage the abort gear, executing as many of the following steps as time will permit:

1. ARRESTING HOOK - DOWN
   Lower the tail hook at least 1,000 feet ahead of the wire; 5 seconds are required for full extension.
2. CONTROL STICK - FULL AFT
3. Aim for center of wire.
   Steer to engage the wire near the center and at a 90° angle.
4. Release brakes 100 feet ahead of wire.

SHORT FIELD ARRESTMENT

The short field arresting gear is normally used for landings with a prior known emergency. In most cases, a preparation period of 5-15 minutes is required to rig the gear. A short field arrestment is essentially the same as a carrier landing and should be LOS - assisted whenever possible. In all landing emergencies where there is a possibility that the pilot will lose directional control, the short field arresting gear should be utilized.

1. Notify tower and request LSO assistance
   Notify tower of intended action, request LSO assistance (if required), and supply required information; e.g., type of emergency, estimated landing time, gross weight, etc.
2. Reduce gross weight
   Dump and/or burn fuel to reduce gross weight to lowest practicable.
3. Fly pattern as dictated by emergency.
4. Arresting hook - DOWN
5. Fly final approach on LSO or for touchdown just short of wire. If LSO is available, fly final approach and touchdown as directed. If LSO is not available, fly final approach to touchdown on centerline and just short of the crossdeck pendant.
6. Throttles - IDLE AT TOUCHDOWN
   Immediately upon touchdown, retard throttles to IDLE.
7. Drag chute - DEPLOY (if waveoff is not practicable)
8. Control stick - FULL AFT
9. Engage wire with feet off brakes.

BARRICADE ENGAGEMENT

1. Lower hook if possible.
   Lowering the arresting hook will assist the barricade in stopping the aircraft and will help to keep the aircraft on the deck at barricade entry.
2. Fly a normal "on speed" approach, on centerline and on "meatball". Anticipate loss of "meatball" for a short period of time late in approach due to barricade stanchions obscuring the "meatball".

BLOWN TIRE ON LANDING

The situation may occur when a landing with a blown tire must be made, or a tire may rupture during the landing ground roll. A blown tire and high speed require immediate corrective action to keep the airplane aligned with the runway.

1. Make a short field arrestment (if available).
2. If short field arrestment gear is not available, land on side of runway opposite blown tire.
3. Touch down with weight on good tire.
4. Drag chute - DEPLOY
5. Use nose gear steering to maintain directional control.
6. Use light opposite braking to slow the airplane.

CAUTION

- Avoid braking on the wheel with the blown tire. Heavy braking could cause a flat spot on the wheel which could prevent further wheel rotation and make airplane control more difficult.

- Do not retract the wing flaps. The wing flap seals may have been damaged by pieces of broken tire and retracting the wing flaps will increase the damage.

- The airplane can be safely taxied or towed with a flat tire, provided the wheel rim is not flat spotted.

- If nose wheel tires are blown on landing, secure both engines as soon as possible, to preclude portions on the tire entering either or both intake ducts.

SINGLE-ENGINE LANDING

A single-engine landing is basically the same as a normal landing except that the pattern is expanded to avoid steep turns, final approach speeds are increased for better lateral control, and 1/2 flaps are used in lieu of full flaps.

1. Turn off non-essential electrical equipment.
2. Reduce gross weight to 34,000 pounds or less.
3. Cycle afterburner of operating engine to insure rapid lightoff for possible afterburner operation.
4. Inlet ramp on operating engine - CHECK FULL OPEN
   If inlet ramp is in the closed position, the A/B must be utilized to make a safe approach.
5. Ram air turbine - EXTEND
6. Wing flap switch - 1/2 DOWN

CAUTION

- Full flaps are not recommended during a single-engine approach and landing, since the engine bleed air that would be utilized for the trailing edge BLC system deprives the engine of fully rated thrust. In the 1/2 flaps configuration, trailing edge BLC is inoperative and the operating engine can deliver fully rated thrust if a waveoff is necessary.

- In the event the generator on the operating engine is lost, the flaps solenoid operated selector valves will revert to a full trail position, and the flaps will be blown up by the airstream. The ARI system is inoperative with flaps retracted.

7. Landing gear handle - DOWN
8. Fly "on speed" angle of attack (34,000 lbs., 152 knots IAS)
9. In the event of waveoff, place throttle of operating engine to MIL OR MAX as required.

10. In the event of carrier landing place throttle of operating engine to MAX A/B upon main gear touchdown.

ARRESTING HOOK MALFUNCTION

If the hook fails to extend upon handle actuation, or the handle feels "spongy":

1. Arresting hook handle - CYCLE and HOLD
   Hold the handle in the down position until the warning light is extinguished.

NO-FLAPS LANDING

A no-flaps landing is basically the same as a normal landing except that the pattern is expanded to avoid steep turns; the downwind, base leg, and final approach speeds are increased 22 knots to provide adequate lateral control. An "on speed" angle of attack on the indexer will cause an increased airspeed to approximately 22 knots at all gross weights.

1. Fly "on speed" angle of attack (34,000 pounds, 160 knots IAS)

HOT BRAKE PROCEDURES

Hot brake procedures are contained in BUAER/BUWEPS INST 13420.1. In view of the varied climatic conditions, field conditions, and safety devices available, specific procedures must be covered in local squadron/field SOP.

LANDING WITH BOTH ENGINES INOPERATIVE

Landing with both engines inoperative will not be attempted.

GLIDE DISTANCE

The aircraft will glide approximately 6 nautical miles for every 5000 feet of altitude. The recommended glide airspeed is 215 knots IAS. Below 50,000 feet, 215 knots IAS will provide near maximum glide distance and will allow the windmilling engines to maintain power control hydraulic pressures within safe limits.

PRECAUTIONARY EMERGENCY APPROACH

The standard precautionary emergency approach for the aircraft is the straight-in GCA/CCA approach modified to accomodate single-engine, half-flap, or no-flap approach speeds as power available dictates. The precautionary emergency approach depicted in figure 5-12 will be used for field landings in the event one engine has failed and the remaining engine has suffered a malfunction that results in only partial power. This procedure may be used day or night, provided ceiling and visibility are such that visual contact can be maintained with the field. Although the approach depicted is the classic overhead entry to a left hand pattern, the precautionary approach may be initiated from the check point, using either a left hand or right hand pattern. The pilot must select a check point in either the straight-in or overhead approach at which the decision to continue the approach or eject must be made. Sink rate, power available, configuration, and position relative to the runway or obstructions must be considered. The check point selected must be early enough to permit safe ejection and in such a position so as not to compromise or endanger the safety of populated areas, military installations or other aircraft. In no case should this check point be lower than 1000 feet AGL for the straight-in approach, or 3000 feet AGL for the overhead approach. The pilot should plan the approach to utilize available field arresting gear. If the success of the approach and landing appear to be marginal to the pilot, consideration should be given to heading the aircraft into a clear area and ejecting instead of attempting the approach.

FORCED LANDING

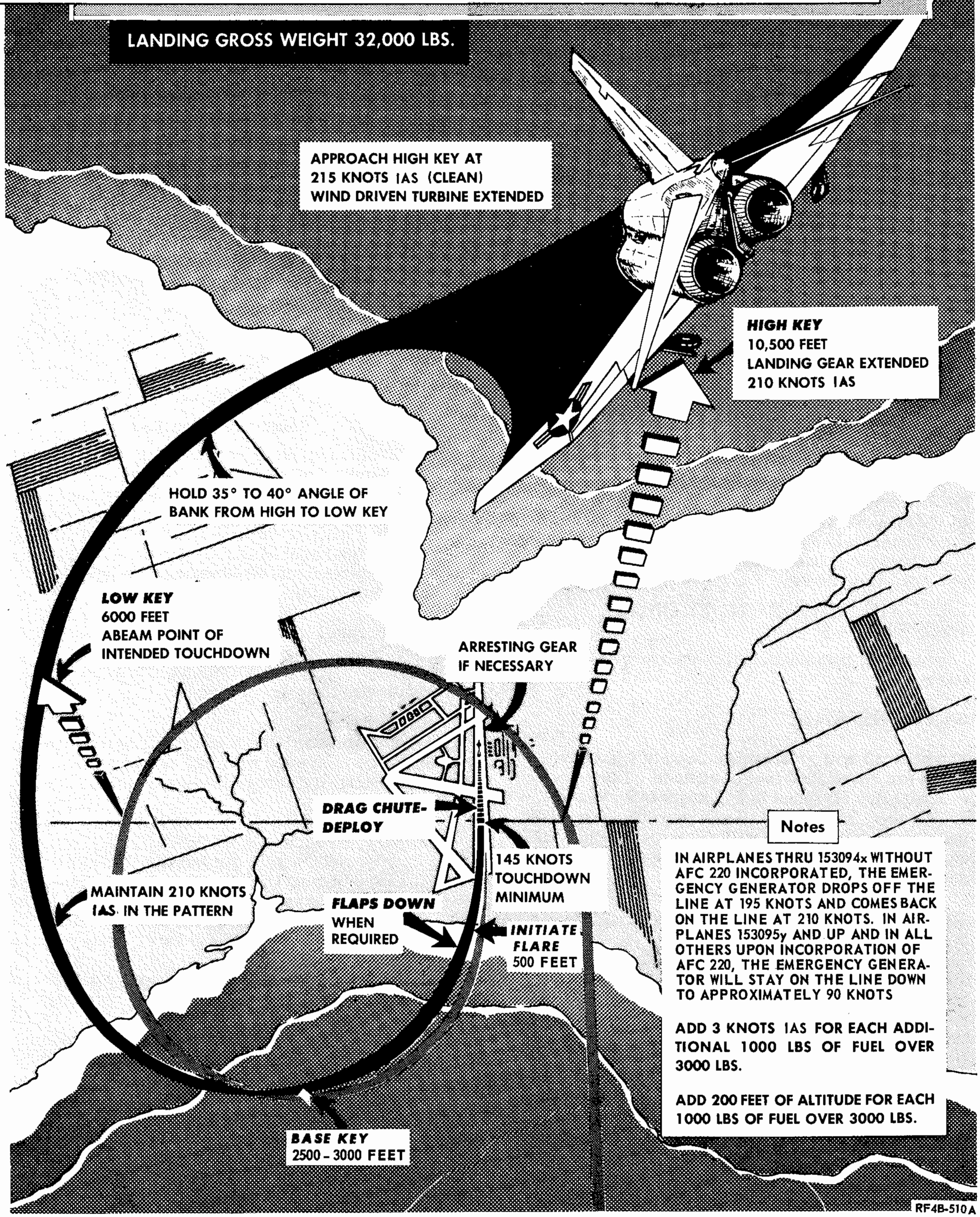
WARNING

All forced landings on land shall be made with the landing gear extended, regardless of terrain. A greater injury hazard is present whenever emergency landings are made with the landing gear retracted. Increased airspeed or nose high angle of impact during landings with landing gear retracted is common practice and contributes greatly to pilot injury and damage to the airplane. This nose high attitude causes the airplane to "slap" the ground on impact, subjecting the pilot to possible spinal injury. Less airplane damage will result with the gear extended.

It is recommended that a landing on unprepared terrain not be attempted with this airplane; the crew should eject. If a forced landing is unavoidable, proceed as follows:

1. Ram air turbine - EXTEND
   Extend the ram air turbine, if needed, to supplement the power control hydraulic or electrical power. Both systems will be inoperative if the engines are windmilling.
2. If time and conditions permit, dump or burn excess fuel.
3. Notify RSO of existing emergency and intended action.
4. Shoulder harness - LOCK
5. Canopies - JETTISON (forward canopy first)
   The aft canopy should be jettisoned last to preclude the possibility of the forward canopy entering the aft cockpit when jettisoned.
6. Photoflash cartridge - SALVO
7. Landing gear - DOWN AND LOCKED
8. Wing flaps - DOWN
9. External tanks - RETAIN IF EMPTY AND UNPRESSURIZED
   Empty external tanks should be retained to absorb the shock of landing.

Precautionary Emergency Approach Procedure



Notes

IN AIRPLANES THRU 153094x WITHOUT AFC 220 INCORPORATED, THE EMERGENCY GENERATOR DROPS OFF THE LINE AT 195 KNOTS AND COMES BACK ON THE LINE AT 210 KNOTS. IN AIRPLANES 153095y AND UP AND IN ALL OTHERS UPON INCORPORATION OF AFC 220, THE EMERGENCY GENERATOR WILL STAY ON THE LINE DOWN TO APPROXIMATELY 90 KNOTS

ADD 3 KNOTS IAS FOR EACH ADDITIONAL 1000 LBS OF FUEL OVER 3000 LBS.

ADD 200 FEET OF ALTITUDE FOR EACH 1000 LBS OF FUEL OVER 3000 LBS.

Figure 5-12

Note

If gear can not be lowered, external tanks can be unpressurized by pulling the landing gear circuit breaker and placing the landing gear handle down.

10. Make normal approach.
11. Drag chute - DEPLOY AFTER TOUCHDOWN
12. Engines - SHUTODOWN
    a. Throttles - OFF
    b. Engine master switches - OFF
13. As soon as stopped - EVACUATE AIRPLANE

EMERGENCY EGRESS

Due to forced landing, ditching or landing emergency such as barricade engagement or runway overrun, rapid egress is essential. To evacuate the cockpit after the aircraft has come to a complete stop, proceed as follows:

1. Emergency harness release handle - PULL
2. Shoulder harness release fittings - RELEASE
3. Composite disconnect - RELEASE (If wearing full pressure suit, open visor; if in standard flight gear, remove oxygen mask.)

WARNING

If the composite disconnect is manually pulled before the face visor is open or the oxygen mask is loosened, the crewmember may suffer from lack of oxygen since oxygen cannot be supplied to the user once the composite disconnect has been pulled.

4. Stand up (standing up applies tension to lap belt release fittings, allowing more rapid release).

WARNING

To prevent binding of the sticker clips or binding of the survival kit in the seat bucket, stand straight up without twisting until the survival kit is clear of the seat bucket.

5. Lap belt fittings - RELEASE
6. Evacuate Cockpit.

To evacuate cockpit with survival kit, omit steps 3 and 5.

Note

In the event of ditching and sinking in water when immediate escape is impossible, it is possible for the crewmember to survive under water with oxygen equipment until escape can be made. The oxygen regulator is a suitable underwater breathing device since the regulator is always on 100% oxygen. If a pressure suit is not being worn it is essential that the mask be tightly strapped in place.

DITCHING

Ditching the airplane should be the pilot's last choice. All survival equipment is carried by the crewmember, thus ejection is advisable. However, if altitude and situation demand ditching, the procedures set forth on the ditching chart (figure 5-13) should be observed.

OPERATIONAL EMERGENCIES

PILOT/RSO EMERGENCY COMMUNICATIONS

Provided that the aircraft intercom system is in working order, it is assumed that any communication required between the pilot and RSO concerning any emergency will be carried out on the intercom. In the event the intercom is inoperative for any reason, the following procedures will be utilized:

1. Check mikes and earphone plugs.
2. Check upper block connections.
3. Use Emergency ICS and Emergency Radio positions in conjunction with the override switch.
4. Try intercommunication with the UHF transceiver.
5. Check all circuit breakers visually and depress transformer rectifier circuit breaker to insure their engagement.

PILOT/RSO ATTENTION SIGNALS

The following may be used as pilot/RSO attention signals under emergency conditions with no method of communicating.

1. The pilot will attract the RSO's attention by a rapid rocking of the wings.
2. Acknowledgement of the attention signals will be a thumbs up and future communications will be conducted by visual signals.

HEFOE signals (figure 5-6) may be utilized by the pilot and RSO. As the RSO is always flying with the left side of the curtain on his hood open, the pilot will be signaling over his left shoulder and looking in his left mirror for return signals. The same signals will apply at night except that a flashlight must

Ditching Chart

WARNING
THE AIRCRAFT SHOULD BE DITCHED ONLY WHEN ALL OTHER ATTEMPTS OF EGRESS HAVE FAILED.

CREW MEMBER	DUTIES BEFORE IMPACT	POSITION	DUTIES AFTER IMPACT	EQUIPMENT	EXIT
PILOT	1. RSO-ALERT. 2. Make radio distress call. 3. SIF-EMERGENCY. 4. External stores–JETTISON. 5. Landing gear–UP. 6. Wing flaps–DOWN. 7. Arresting hook -DOWN 8. Leg restraint release handle–PULL AFT. Release leg restraint lines before ditching to expedite egress from the cockpit. 9. Visor–DOWN. 10. Oxygen mask or face visor–TIGHTEN or SEAL. 11. Canopy – JETTISON (forward canopy first). 12. Lower seat, assume position for ditching. 13. Shoulder Harness-LOCK 14. Fly parallel to swell pattern. 15. Attempt, touch down along wave crest. 16. When hook contacts water –SHUT DOWN ENGINES.	1. In Seat. 2. Feet on rudder pedals knees flexed.	1. Emergency harness release handle-PULL. 2. Shoulder harness release fittings-RELEASE. 3. Stand straight up without twisting to release survival kit sticker clips from the seat. NOTE ● The Bail-Out Bottle will be actuated when the crewmember kicks free of the seat ● In the event of ditching and sinking in water when immediate escape is impossible, it is possible to survive under water with oxygen equipment or full pressure suit until escape can be made. 4. Abandon aircraft. 5. Inflate life vest. 6. See that **RSO** is clear. 7. Inflate life raft and secure Emergency equipment. 8. Proceed away from aircraft and tie rafts together.	1. Oneman raft and Emergency equipment. 2. Life vest 3. Flash light.	Over canopy sill.
RECON SYSTEMS OFFICER	1. Acknowledge pilots ditching order. 2. Radar equipment–STOW. 3. Leg restraint release handle–PULL AFT. Release leg restraint lines before ditching to expedite egress from the cockpit. 4. Visor–DOWN. 5. Oxygen mask or face visor –TIGHTEN or SEAL. 6. Canopy – JETTISON (Aft canopy last). 7. Lower seat, assume position for ditching. 8. Shoulder Harness-LOCK	1. In Seat. 2. Feet on deck knees flexed.	Same as for Pilot Except: 6. See that Pilot is clear.	1. Oneman raft and Emergency equipment. 2. Lifevest 3. Flash light.	Over canopy sill.

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Figure 5-13

be held up to outline the fingers. If the RSO's upper block is unplugged as indicated by the 4 finger signal, the pilot will maintain a cockpit altitude of 10,000 feet or below for the duration of the flight. If the RSO desires an immediate landing, he will give a thumbs down signal to the pilot.

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; or 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 immediate to EMERGENCY SIF, Set up 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

Single Aircraft

If the situation permits, prior to ejection or crash landing:

1. Switch SIF to EMERGENCY, Mode 3, Code 77
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 SIF 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 nagivational 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 insure 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 insure a greater likelihood of a successful rescue. The other member of the section in which the downed crew was flying should:

1. Follow the aircraft/crew and circle them at low altitude, making every effort to keep the downed crew in sight.
2. Other members of the flight, remain at altitude.
3. Alert appropriate facilities.
4. Relay communications.
5. 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 triangular pattern to the right with one-minute legs. Repeat pattern at 20 minute intervals.
2. Conserve fuel and maintain altitude.
3. Squawk Mode II and be alert for aircraft vectored to join.

Without Radio Receiver

1. Fly a triangular pattern to the left with one-minute legs. Repeat pattern at 20 minute intervals.
2. Conserve fuel and facilitiate radar pickup by maintaining highest feasible altitude consistent with situation.
3. Squawk Mode II 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/let-down.

LOST AIRCRAFT (WITH NAVIGATION AIDS)

1. Squawk Mode II, 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 SIF.

PENETRATION/LETDOWN NAV-COM EMERGENCIES

Even though communication aids have failed, if navigation equipment is still available:

1. Continue approach.
   Regardless of weather, any jet aircraft having passed Platform must continue its approach.
2. If no contact has been made after two 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 two 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 with two miles visibility or better:

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 two minutes.
5. Conduct lost aircraft (without navigation aids and without radio receiver) procedures.

SECTION CARRIER 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. Reduce speed to 145 knots during last part of final approach so as to be approximately "on speed" when meatball is sighted.
3. Indicate "meatball" to wingman (blink external lights at night) to indicate carrier 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 bolter.
6. Following the wingman trap/bolter, the leader will execute the normal CCA waveoff procedure and be vectored in for an additional section approach or final landing.

CARRIER EMERGENCY NAV-COMM SIGNALS

Refer to NWP41 (A)

TAKEOFF EMERGENCIES

ABORTED TAKEOFF

1. THROTTLES - IDLE (left engine shutdown if required)
2. DRAG CHUTE - DEPLOY
3. WHEEL BRAKES - APPLY
4. Prepare for abort gear engagement, if required.

ABORT GEAR ENGAGEMENT

1. ARRESTING HOOK - DOWN
   Lower the hook at least 1000 feet ahead of the wire; 5 seconds are required for full extension.
2. CONTROL STICK-FULL AFT
3. Aim for center of wire.
   Steer to engage the wire near the center at a 90° angle.
4. Release brakes 100 feet ahead of wire.

AFTERBURNER FAILURE DURING TAKEOFF

If the afterburner(s) fail during takeoff, the resulting loss of thrust is significant. Takeoff need not be aborted if remaining runway is compatible with power available. After failure, the variable area exhaust nozzle will continue to function as directed by exhaust gas temperature. In this circumstance, the nozzle moves as a function of temperature limiting only. In the event of an afterburner failure, proceed as follows:

1. Throttle of failed afterburner - MIL RANGE
2. If the exhaust nozzle is operating properly, relight when desired.

BLOWN TIRE ON TAKEOFF

A situation may occur when the main wheel tire(s) or nose wheel tire(s) blow on takeoff roll. If the nose wheel tire(s) blow on takeoff, it is likely that one or both engines will receive FOD.

If Decision to Stop is Made -

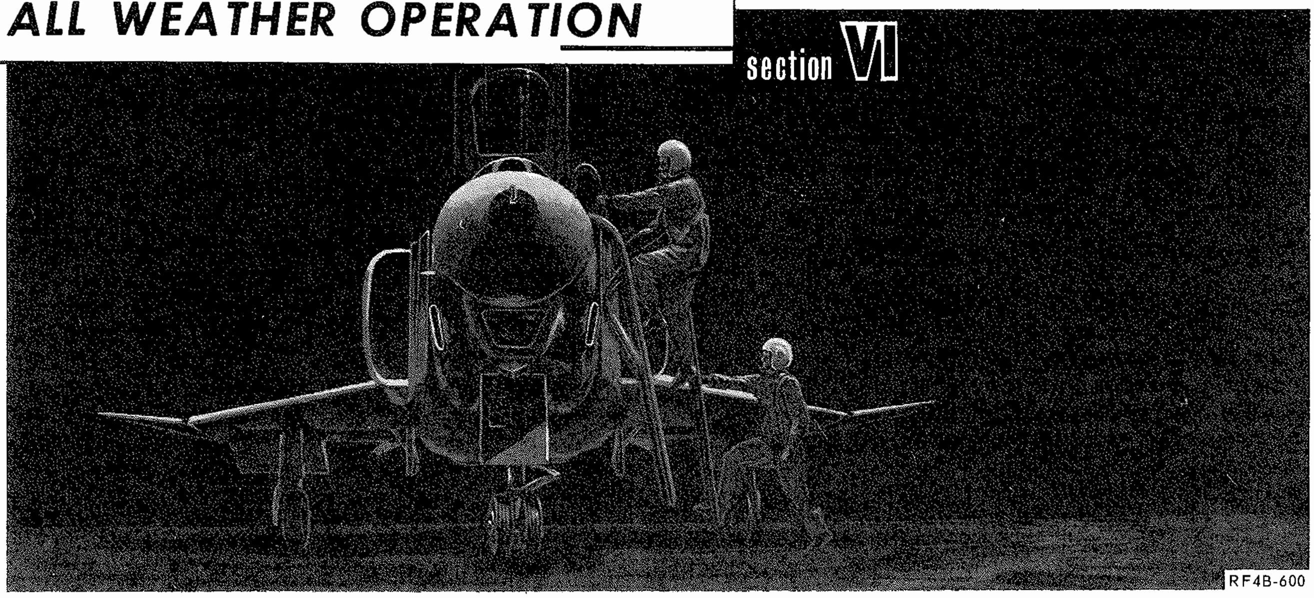
1. ABORT TAKEOFF
   Refer to Aborted Takeoff, this section.
2. LEAVE FLAPS IN POSITION SET FOR TAKE-OFF.
   Leave flaps in their takeoff position to prevent additional damage to wing flaps in the event they have been damaged by pieces of broken tire.

If Takeoff is Continued -

1. LEAVE LANDING GEAR DOWN, AND FLAPS IN POSITION SET FOR TAKEOFF.
   Leave the landing gear extended to preclude fouling the blown tire(s) in the wheel well(s). Leave flaps in their takeoff position to prevent additional damage to wing flap seals in the event they have been damaged by pieces of broken tire.
2. Monitor engine instruments.
   If any abnormal indications, such as RPM, EGT, or engine vibrations are noted, it is possible that FOD is present.
3. Plan to make a short field arrested landing.
   Refer to Short Field Arrestment, this section.

ALL WEATHER OPERATION

section VI



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SIMULATED INSTRUMENT PROCEDURES

GENERAL

Instrument flight is primarily a problem of time and distance navigation wherein all, or part, of the flight will be conducted under instrument conditions. To complete a successful instrument flight, crewmembers 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 insure 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.

In the event of loss of radio contact, 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. Lighting afterburner when passing the instrument pilot will usually get his attention.

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 5,000-foot interval during descent and at level-off.

HOODED RADAR INTERCEPTS

All hooded intercept flights will be pre-briefed prior to launch.

Positive UHF communications must exist prior to "going hooded" and commencing intercepts. All aircraft in the flight will have UHF set on T/R + G. The chase and target aircraft will have the tactical frequency with comm command in one cockpit. The other cockpit will have Guard set in the comm channel, allowing the pilots to take comm command and transmit on guard, if the need arises.

If the chase or target pilot does not have a "Tally Ho" prior to 5 miles, the hooded pilot will go contact.

If the hooded aircraft does not have a "Judy" by 10 miles, the target aircraft will call his altitude and the intercept pilot will go contact, and remain so, for the completion of the run even if a "Judy" is subsequently obtained.

Minimum altitude above all terrain will be 2000 feet.

Target aircraft will not "jink" in altitude.

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 aircraft will set up its radios in the following manner: the frequency in use with comm command in one cockpit, and the guard position set in the comm channel of the other cockpit. The instrument airplane shall monitor the TR + G position. If the chase pilot suspects radio failure or cannot "burn through" transmissions by GCA or other controlling agencies, he can take command and transmit instructions to the instrument pilot on guard channel.

ACTUAL INSTRUMENT PROCEDURES

INSTRUMENT FLIGHT

This is an all-weather airplane that is designed to perform operational missions in all extremes of weather. Rapid acceleration rates and high pitch angles during climb, of necessity dictate 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 flight will be obtained and the appropriate flight plan will be filed.

BEFORE STARTING ENGINES

When practical, an ATC clearance should be obtained from the tower before starting engines. When the radios are operating on external power, they are limited to 10 minutes of accumulated operation in a one-hour span. This limitation applies to all CNI equipment except the intercom, which is "hot" any time power is on the airplane.

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, place the pitot head switch to ON and the engine anti-ice switch to DE-ICE. At IDLE rpm, the operation of the engine de-icers can be checked by noting a slight rise (approx. 10°C) in EGT and a slight increase in fuel flow. The ADI wings symbols should be set with the wings 1° above the horizon and the compass should be aligned with the runway heading. The stab aug should be engaged.

INSTRUMENT TAKEOFF

Same as normal Takeoff.

INSTRUMENT CLIMB

The simplified climb schedules 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 due to the difficulty of determining bank angles and rates of turn while at high pitch angles. Upon reaching clear air, turn off the engine anti-icing and the pitot heat. Follow the clearance exactly as given. If unable to comply with the clearance, it is mandatory that ATC be advised immediately. Climb speed will conform to local procedures, but should be a comfortable airspeed with transition to the published climb schedule accomplished at a comfortable altitude above the terrain.

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 defog/footheat lever to the DEFOG position. Contact approach control ten minutes prior to EAT or as directed by ARTC, and conform to the provisions 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 knots IAS 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.

PENETRATION WITH GEAR AND FLAPS EXTENDED

Under certain conditions, it may be necessary to penetrate with the gear and flaps extended. If such is the case, advise approach control that the approach will be executed with a non-standard approach speed. Prior to commencing the approach, slow to below 250 IAS and lower the landing gear and flaps. If external tanks are carried, place the wing transfer switch to OVRD TRANS before extending the landing gear to avoid de-pressurizing the fuel tanks. Commencing penetration, reduce the pitch attitude to maintain 195 knots IAS. This attitude will seem extremely nose low. Make throttle adjustments as necessary to maintain a 3500 fpm rate of descent. Initiate a round-out in order to reach GCA pickup or TACAN gate altitude at a speed of 150-160 knots IAS. If the descent has been made with the wing transfer in the OVRD TRANS position, return the switch to NORMAL prior to landing.

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 heading 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 (PAR) APPROACHES

This airplane handles exceptionally well in the GCA pattern. It is very stable directionally and is very responsive to minor corrections about all axes. When directed, descend to GCA pickup altitude and transition to landing configuration. Slow to 150-160 knots IAS which will require approximately 88-92% rpm. Trim required will be approximately 3 units nose-up. When the pilot is told to commence a normal rate of descent for his aircraft, he should retard the power to approximately 82-84% rpm. Allow the plane to slow to 145 knots IAS minimum (section). If alone, adjust the nose to maintain 140 knots IAS or a "donut" on the angle of attack indexer, whichever is greater. While holding the attitude constant, make smooth but positive power adjustments to maintain a desired rate of descent of approximately 600-800 feet per minute or as directed. For heading corrections after starting descent, recommended bank angle is 10°. Up to 3° heading corrections may be made by using rudder alone. When the controller announces "minimums have been reached", the pilot will look up. If the runway is not in sight, he will immediately execute a missed approach. If the pilot has the runway in sight, he will adjust power to establish optimum angle of attack/airspeed and complete the landing.

GCA Box Pattern

To enter the GCA pattern from other than a penetration, contact Approach Control and proceed as follows. The downwind leg is flown at 230-250 knots IAS with gear and flaps retracted. The base leg is flown at 150 knots IAS with gear and flaps down. After completing the turn on final and slowing to 140 knots IAS, the normal GCA procedures apply. If entering the GCA pattern after a touch-and-go landing, aircraft will comply with Approach Control instructions.

TURBULENT AIR AND THUNDERSTORM OPERATION

Intentional flight through thunderstorms should be avoided unless the urgency of the mission precludes a deviation from course, due to the high probability of damage to the airframe by impact ice, hail, and lightning. The radar provides an excellent means of navigating between or around storm cells and 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 exceptionally 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 IAS below 35,000 feet, and no less than 300 knots IAS above 35,000 feet. The afterburner should be utilized if necessary to maintain airspeed.

APPROACHING THE STORM

If the storm cannot be seen, it may be located by radar. Adjust power to establish the recommended approach speed. Note stabilator trim position. Place the pitot heat switch to ON, the engine anti-ice switch to DE-ICE, and the autopilot OFF. The seat should be lowered in order to view the instruments and to minimize the buffeting due to turbulence. Do not try to top thunderstorms at subsonic speeds above 40,000 feet; the stall margin of both the airframe and engines becomes critical in this region. 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. If the penetration is made at night, the daylight floodlights should be ON, and the console and instrument lights should be full bright.

IN THE STORM

Maintain a normal instrument scan with added emphasis on the attitude gyro (ADI). 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. If the engine remains stagnated at reduced power and the EGT is within limits, maintain reduced power until clear of the thunderstorm. While in the storm, the longitudinal feel trim, angle of attack, total temperature, windshield overheat, and cabin pressurization systems may experience some abnormalities due to rain, ice, or hail damage. No difficulty should be encountered in maintaining control of the airplane; however, the rapid illumination of numerous warning lights may be somewhat distracting to the pilot if he is not prepared.

Longitudinal Feel Trim Failure

Longitudinal feel trim system failures are caused by ice blockage of the ram air bellows venturi located in the vertical fin. The failure is characterized by either a complete or intermittent failure of the feel system. The failure can also be verified by noting that the pointer on the stab trim indicator has moved from the previously noted position.

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 usally 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.

Total Temperature System Failure

The total temperature sensor may fail due to water or ice damage. This failure is characterized by a flashing or steady "Duct Temp Hi" light, erroneous true airspeed indications, and possible cycling of the engine intake ramps.

Windshield Overheat Sensor Failure

The windshield overheat sensor may fail in heavy rain or icing conditions. The failure is characterized by a steady "W Shield Temp Hi" light.

Cabin Pressurization System Failure

Cabin pressurization fluctuation occurs in precipitation above the freezing level. This is evidenced by a significant decrease in available cabin pressurization flow and is caused by ice at the pressure suit heat exchanger.

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, actuate the engine anti-ice switch to DE-ICE and the pitot heat switch to ON.

WINDSHIELD RAIN REMOVAL

The following precautions must be observed when contemplating the use of the windshield rain removal system.

1. Do not operate on a dry windshield.
2. Turn system OFF immediately if "W Shield Temp Hi" indicator light illuminates.
3. Do not operate above Mach 1.0.

LONGITUDINAL FEEL TRIM

When flying through areas of precipitation, partial or complete failure of the longitudinal control artificial feel system may result due to ice and/or water blockage of the bellows ram air line. If this condition occurs, excessive stick force will be required to maintain the desired airplane attitude. Since sudden longitudinal trim changes may occur several minutes after flying through freezing precipitation (especially during descent to altitudes below the freezing level), the application of corrective longitudinal trim when a blocked bellows inlet is suspected is not recommended.

CENTRAL AIR DATA COMPUTER

The central air data computer may malfunction during flight through ice and/or due to impact forces imposed by water and ice on the CADC total temperature sensor. A momentarily flashing "Duct Temp Hi" warning light usually indicates that the sensor probe has been blocked or shorted by ice accumulation.

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. In addition to the above checks, the BLC duct tape (if applied) should be removed.

WARM-UP AND GROUND CHECK

If the airplane has been parked in heavy rain when subsequent freezing has been anticipated, a protective pressure-sensitive tape should have been applied to the trailing edge wing/flap junctures to prevent precipitation and, thereby, ice from accumulating in the BLC ducts and valves. If the tape has not been applied, and it is suspected that ice has formed in the ducts and valves, the flap actuating check should not be performed until the engines have been running for 12 to 15 minutes at 85% rpm. This permits hot BLC air to thaw any ice which may have accumulated in the BLC valves. After it is felt that the valves have been thawed:

1. Flap switch - CYCLE AND CHECK
   Actuate the flaps to the 1/2 and full down positions. Check that the BLC system is operating. Actuate the flaps to up and monitor the "BLC Malfunction" light for a malfunction indication.

WARNING

A "BLC Malfunction" light illumination with flaps up constitutes a flight hazard. Refer to Boundary Layer Control Malfunction, Section V of this manual.

Note

A "BLC Malfunction" light with flaps in any position other than up, indicates that the flap-up limit switches are not returning to their normal open position. By cycling the flaps three or four times to allow circulating hydraulic fluid to warm the actuators, the switches may be freed so that the BLC malfunction indicating system will function normally.

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.

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. If icing conditions are encountered or expected, place the engine anti-ice switch in the DE-ICE position and the pitot heat ON.

LANDING

If snow and ice tires are installed, use brakes intermittently to keep the tire tread from filling and glazing.

AFTER LANDING

During operations where the temperature is below freezing with heavy rain, or expected to drop below freezing with heavy rain, the aircraft may be parked with wings spread and flaps in the full down position.

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.

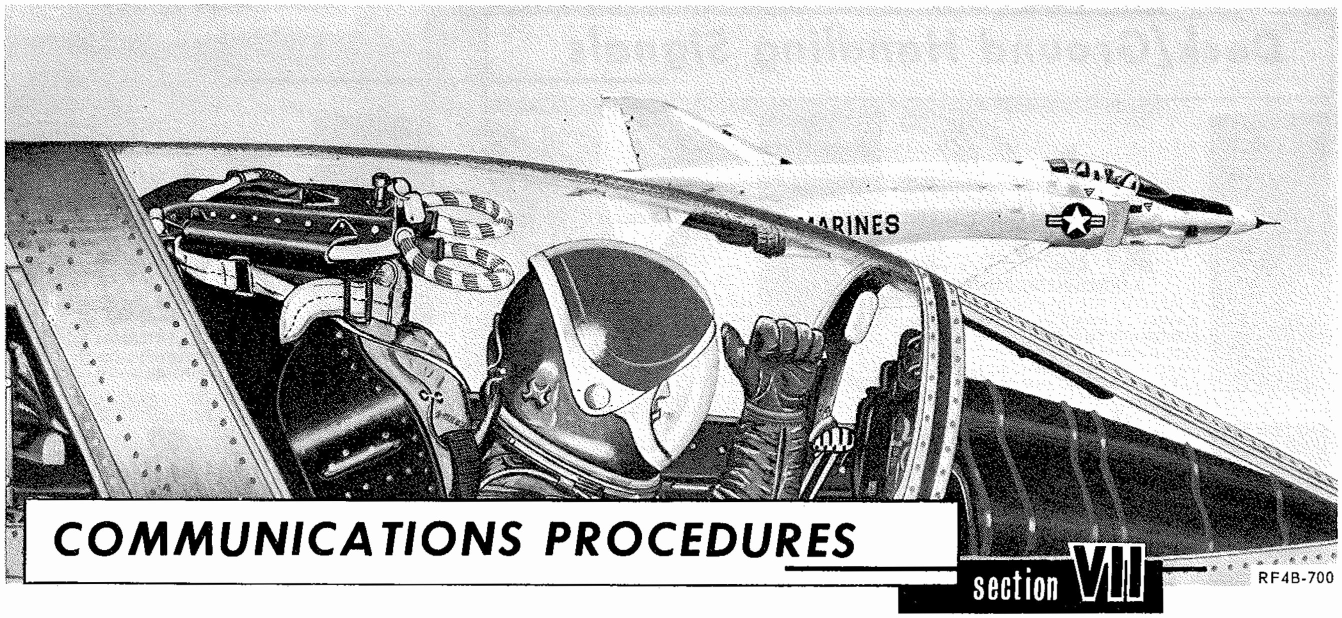
HOT WEATHER OPERATION

TAXIING

While taxiing in hot weather, the canopies may be opened, if necessary, to augment crew comfort. Do not operate the engines in a sand or dust storm if avoidable. Park the airplane crosswind and shut down the engines to minimize damage from sand or dust.

TAKEOFF

The required takeoff distances are increased by a temperature increase. Check the applicable Takeoff Distance charts, Part 2 of Section XI.



COMMUNICATIONS PROCEDURES

section VII

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RADIO COMMUNICATIONS

GENERAL

It is the responsibility of the pilot to ensure that all radio and electronic transmissions from the aircraft are in compliance with applicable directives and squadron doctrine. It is mandatory that the pilot and RSO be thoroughly indoctrinated in all communications equipment, methods and procedures including hand signals. Radio communications will be in accordance with procedures set forth in NWIP 41-1, NWP 41, ACP 165, JANAP 119A, and local fleet/shore instructions.

PILOT/RSO COMMENTARY

This information will be supplied when available.

VISUAL COMMUNICATIONS

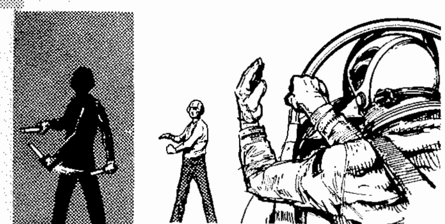
GENERAL

Communications between aircraft will be conducted visually whenever practicable, provided no sacrifice in operational efficiency is involved. Flight leaders shall ensure that all pilots in the formation receive and acknowledge signals when given. The visual communications section of NWP 41 must be reviewed and practiced by all pilots and RSOs. For ease of reference, visual signals applicable to flight operations are contained in Section V, and Deck/Ground Handling Signals are contained in figure 7-1.

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.

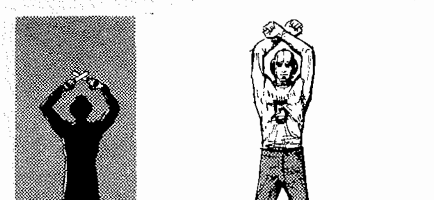
START ENGINES
PILOT EXTENDS FINGERS TO INDICATE WHICH ENGINE IS READY FOR START. IF ALL CLEAR, SIGNALMAN RESPONDS WITH SIMILAR GESTURE POINTING AT PROPER ENGINE WHILE ROTATING OTHER HAND IN CLOCKWISE MOTION.



INSERT/ PULL EXTERNAL POWER
PILOT PULLS CLOSED FIST FROM OPEN PALM. SIGNALMAN RESPONDS WITH SAME SIGNAL.

ENGINE RUN-UP
PILOT MOVES INDEX FINGER IN CIRCULAR MOTION INDICATING HE IS READY TO RUN UP ENGINES. SIGNALMAN RESPONDS WITH SIMILAR SIGNAL WHEN ALL CLEAR.

PULL CHOCKS
PILOT MAKES SWEEPING MOTION OF FISTS WITH THUMBS EXTENDED OUTWARD. SIGNALMAN SWEEPS FISTS APART AT HIP LEVEL WITH THUMBS EXTENDED OUTWARD.



EMERGENCY STOP
ARMS CROSSED ABOVE HEAD, FISTS CLENCHED.

STOP
ARMS UPRAISED, FISTS CLENCHED AND HELD IN SIMPLE "POLICEMAN'S STOP".

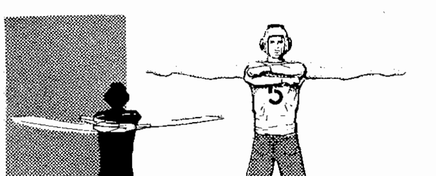
COME AHEAD
HANDS AT EYE LEVEL, EXECUTE BECKONING MOTION; RATE OF MOTIONS INDICATES DESIRED SPEED OF AIRCRAFT. FOR NIGHT OPERATION, WAVE WANDS SIDE TO SIDE.

SLOW DOWN
DOWNWARD PATTING MOTION, HANDS OUT AT WAIST LEVEL.

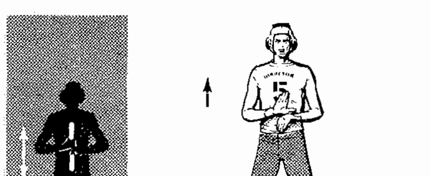
LEFT TURN
PULL DESIRED WING AROUND WITH REGULAR "COME AHEAD"-POINT AT OPPOSITE BRAKE.

RIGHT TURN
PULL DESIRED WING AROUND WITH REGULAR "COME AHEAD"-POINT AT OPPOSITE BRAKE.

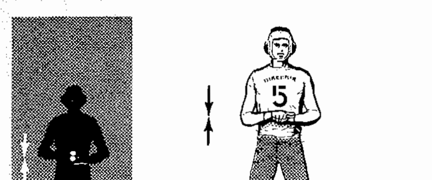
SPREAD WINGS
ARMS IN HUGGING POSITION, THEN SWEPT OUT TO SIDES.



FOLD WINGS
ARMS, FROM STRAIGHT OUT SWEPT IN TO HUG SHOULDER.



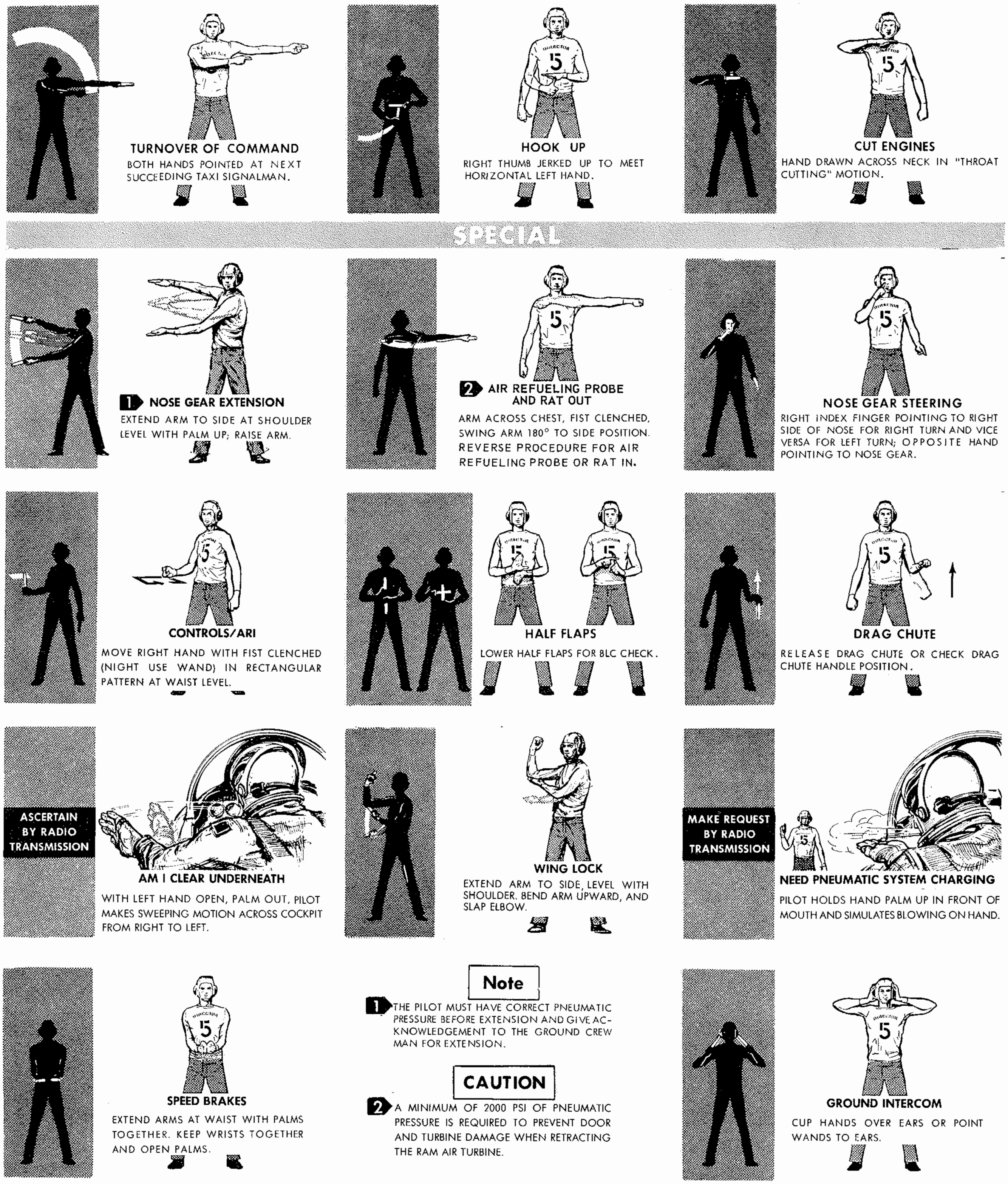
LOWER WING FLAPS
HANDS FLAT TOGETHER, THEN OPENED WIDE FROM WRISTS. ARMS IN CLOSE TO BODY.



RAISE WING FLAPS
HANDS, OPENED WIDE FROM WRIST, SUDDENLY CLOSED. ARMS IN CLOSE TO BODY.

RF4B-703-1

Figure 7-1 (Sheet 1)



CARRIER FLIGHT DECK PERSONNEL COLOR CODING

RED SHIRTS –ORDNANCE, FUEL HANDLING and CRASH CREW
YELLOW SHIRTS–PRI FLY, PLANE DIRECTORS, CATAPULT OFFICER and ARRESTMENT OFFICER
BLUE SHIRTS –PLANE HANDLERS (Pushers, Chock Men, etc.)
GREEN SHIRTS –AIRCRAFT MAINTENANCE, CATAPULT CREW, ARRESTMENT CREW
BROWN SHIRTS–PLANE CAPTAINS
WHITE SHIRTS –MEDICAL

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Figure 7-1 (Sheet 2)

WEAPON SYSTEMS section VIII

NOT APPLICABLE

FLIGHT CREW COORDINATION

section IX

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PILOT/RSO RESPONSIBILITIES

GENERAL

The duties of the Pilot/RSO team are necessarily integrated, and each must support and contribute to the performance of the other. In this section, specific responsibilities are delineated; however, in the event of aircraft system malfunction, emergency, or unfamiliar circumstances where assistance is desired, cooperation and initiative would become paramount. The pilot is the aircraft commander and is responsible for the successful completion of any mission assigned to his aircraft. The RSO should constitute an extension of the pilot's observation facilities. By intercommunication, the RSO should anticipate rather than await developments.

SPECIFIC RESPONSIBILITIES

FLIGHT PLANNING

Pilot

The pilot will 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.

RSO

The RSO, when directed by the pilot, will be required to prepare charts, flight logs, navigation computations including fuel planning, checking NOTAMS and obtaining weather for filing purposes, and for completing required flight plans.

BRIEFING

Pilot

The pilot/flight leader is responsible for briefing all crewmembers on all aspects of the mission to be flown.

RSO

The RSO will assist the pilot as directed but in any case, will be capable of, and proficient in, performing a complete aircraft preflight. Normally, the preflight inspection will be conducted with the pilot.

PREFLIGHT

Pilot

The pilot is responsible for accepting and preflighting the aircraft assigned in accordance with this manual and appropriate preflight checklists contained in the RF-4B NATOPS Pocket Checklist (NAVWEPS 01-245FDC-1B).

RSO

The RSO will assist the pilot as directed but in any case will be capable of an proficient in performing a complete aircraft preflight. Normally the preflight inspection will be conducted with the pilot.

PRE-START

Pilot

The pilot will execute pre-start checks prescribed by the NATOPS Pocket Checklist and, when external power is applied and checks requiring external power are completed, will inform the RSO "PRE-START CHECKS COMPLETED - READY TO START".

RSO

The RSO will execute pre-start checks prescribed by the NATOPS Pocket Checklist and, when external power is applied, will inform the pilot "PRE-START CHECKS COMPLETE".

STARTING

Pilot

The pilot will start engines as prescribed in Part 3 of Section III and will keep the RSO informed of any unusual occurrences.

RSO

The RSO will remain alert for any emergency signals from the ground crew and will inform the pilot if such signals are observed.

POST START

Pilot

After switching to internal power, the pilot will inform the RSO "ON INTERNAL POWER; BUS TIE CLOSED/OPEN". The pilot will then complete all post start checks prescribed by the NATOPS Pocket Checklist. When post start checks are completed, he will inform the RSO "READY TO TAXI".

RSO

When informed that the aircraft is on internal power and the bus tie closed, the RSO will complete the post start checks prescribed by the NATOPS Pocket Checklist. The RSO may take command of radio and navigation equipment, select appropriate frequencies, and advise the pilot "READY TO TAXI". The RSO may call for taxi clearance as directed by the pilot.

PRE-TAKEOFF

Pilot

The pilot will execute pre-takeoff, instrument, and takeoff checklists prescribed in the NATOPS Pocket Checklist and as posted in the aircraft. The pilot will report to the RSO engine oil pressures noted on run-up, instrument checklist, and takeoff checklist items. The pilot will receive the "READY FOR TAKEOFF" report from the RSO and will advise him of the type/configuration takeoff planned prior to rolling or catapulting. The pilot will report "ROLLING" or salute as appropriate to the RSO.

RSO

The RSO will execute pre-takeoff checklists prescribed by the NATOPS Pocket Checklist and will report "READY FOR TAKEOFF; CIRCUIT BREAKERS IN" to the pilot. The RSO will record oil pressures reported by the pilot and shall be alert to challenge the pilot if any item on the instrument checklist or the takeoff checklist is not reported as completed. The RSO will assist in communications as directed by the pilot.

TAKEOFF/DEPARTURE

Pilot

The pilot shall ensure that the intercom remains in the HOT MIKE position for normal flight operations and will report "GEAR UP" and "FLAPS UP" to the RSO insofar as safety permits. The RSO should be advised of lift-off and any unusual occurrences such as overtemperature, overspeed, or BLC malfunction. The pilot will request, copy, and acknowledge all clearances.

RSO

Where departures are made in actual instrument conditions, the RSO will monitor the published or clearance departure procedures and will inform the pilot of any deviation from the prescribed flight path. The RSO will copy all clearances received and will at all times be prepared to provide the pilot with clearance information or navigational information derived from his instruments.

INFLIGHT (GENERAL)

Pilot

The pilot will inform the RSO of any unusual occurrences and will ensure that the aircraft is operated within prescribed operating limitations at all times. The pilot will normally request, copy, and acknowledge all clearances. The pilot should afford the RSO ample opportunity to practice in requesting and copying clearances and in position reporting.

RSO

The RSO will inform the pilot of the reconnaissance system status. The RSO will assist the pilot in changing communications frequencies, and will request, copy, and acknowledge clearances or make position reports in normal or emergency situations as directed by the pilot. The left forward side of the hood will be open at all times in flight, unless the light interferes with the operation of the radar. The pilot will be advised if the panel is closed.

INSTRUMENT APPROACHES

Pilot

The pilot is responsible for the safe control of the aircraft, the decision to commence the approach with existing weather, and the selection of the type approach to be made. The pilot, prior to commencing any penetration, will report to the RSO the completion of each item of the instrument checklist. In addition, the pilot will challenge the RSO as to approach plate availability and corrected altimeter setting.

RSO

The RSO will monitor aircraft instruments and the appropriate approach plate during holding, penetration, and approach and shall be ready to provide the pilot with any required information. He shall be particularly alert to advise the pilot of deviations from the course or minimum altitudes prescribed on the approach plate. The RSO will assist with communications as directed by the pilot.

LANDING

Pilot

The pilot will utilize the landing checklist and will report each item to the RSO prior to reporting "GEAR DOWN; HOOK DOWN" to the final controller/tower/prifly. The pilot will receive a "READY TO LAND" report from the RSO.

RSO

The RSO will remain unhooded in the landing pattern if VFR and will challenge the pilot on gear, flaps, and hook position if the report is not received. The RSO will attempt to check the position of the gear handle by looking through the opening on the left side of the instrument panel. The RSO will complete the landing checklist and will report "READY TO LAND" to the pilot.

POST FLIGHT

Pilot

The pilot will inform the RSO of any unusual occurrences on the landing roll or arrestment. The pilot will report flap position to the RSO when clear of the runway/landing area, and will report when the wingfold is actuated. The pilot will inform the RSO when shutting engines down. The pilot will conduct a post-flight inspection of the aircraft.

RSO

The RSO will challenge the pilot on flap position if the report is not received. When informed by the pilot that the wingfold has been actuated the RSO will immediately respond with the position of the wings. The RSO will secure the rear cockpit for shutdown. The RSO will assist the pilot in conducting a post-flight inspection of the aircraft.

DEBRIEFING

The pilot and RSO will complete the Yellow Sheet and all required debriefing forms.

Note

The RSO will vacate the aircraft first and when he is on the ground/flight-deck/hangar-deck, the pilot will exit. This is particularly important during shipboard operations.

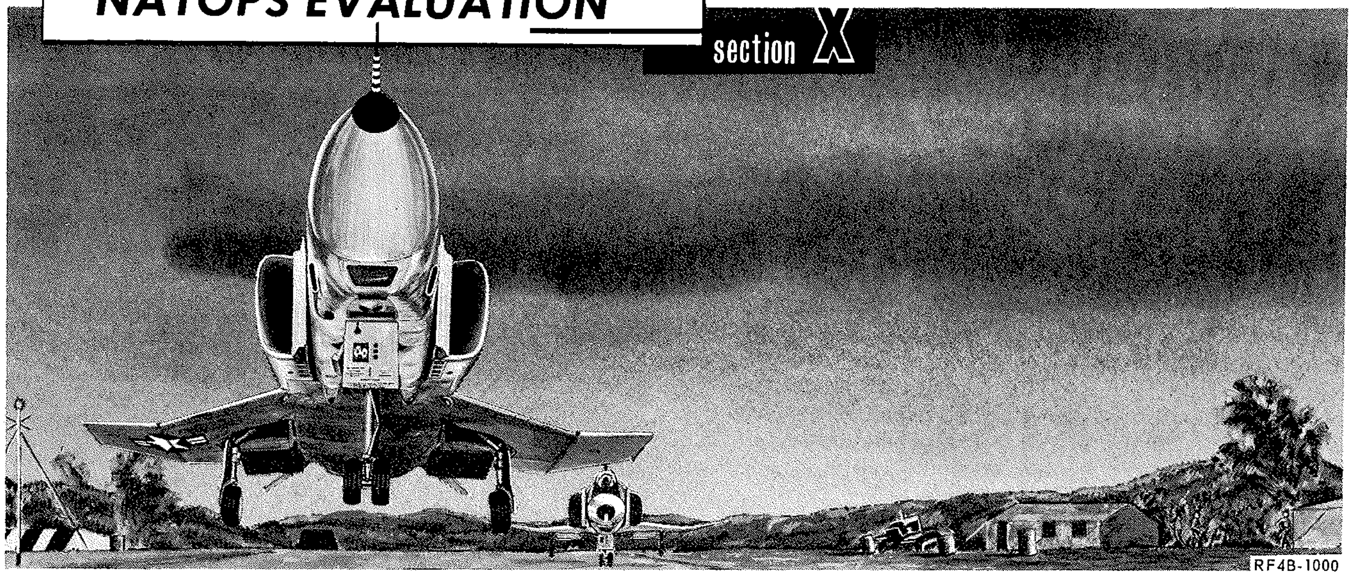
PROCEDURES, TECHNIQUES, AND CHECKLIST

GENERAL

Even though some of the procedures, techniques, and checklist are specifically designated for the individual pilot or RSO, the entire contents of the Flight Manual and the Pocket Checklist should be thoroughly read, understood, discussed, and agreed upon collectively by the Pilot/RSO team. Discrepancies in existing procedures, or the need for additional procedures, should be brought to the attention of your NATOPS Evaluator/Instructor. Most of the procedures (individual and coordinated) are contained in this volume and sub-divided into flight phases/categories. Aircraft systems description, with their individual operating criteria, is contained in Section I. Classified systems description and procedures, are contained in the classified supplement. The Pocket Checklist contains the Pilot's and RSO individual check-items for Preflight, Pre-Start, Start, Post-Start, Takeoff, Instrument/Descent, and Post Flight.

NATOPS EVALUATION

section X



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NATOPS EVALUATION PROGRAM

GENERAL

The operating procedures prescribed in this manual represent the otpimum method of operating RF-4B aircraft. The NATOPS evaluation is intended to evaluate individual and unit compliance with these procedures. This will be accomplished by observing and grading individual/unit adherence to standard operating procedures on a continuing basis. The evaluation is tailored to satisfy the requirements of the various employment categories of RF-4B squadrons and is intended to provide the flexibility necessary for implementation under most operating conditions. It is also designed to aid the Unit Commanding Officer in improving individual/unit combat readiness through observation and constructive comments. The NATOPS evaluation program is applicable to all pilot's and RSO's maintaining a current flight status in any RF-4B series aircraft. Areas to be observed/graded that are applicable to the individual pilot and RSO, as well as areas of dual responsibility, are indicated throughout the ground and flight evaluation phases of this section. Critical areas/sub-areas are specially noted where applicable. NATOPS evaluations will be administered to all pilots/RSOs as specified by current directives and in accordance with this section. NATOPS evaluations and annual instrument checks will not be combined.

RESPONSIBILITIES

Specific responsibilities of Standardization Instructors and Standardization Evaluators in the implementation of the NATOPS evaluation program are outlined in the following paragraphs.

STANDARDIZATION INSTRUCTOR

1. Implement and coordinate an aggressive and continuing standardization education and evaluation program pertaining to all aspects of standard operating procedures.
2. Enhance the educational benefits of the NATOPS program by flying with all squadron crewmembers as often as possible.
3. Administer the NATOPS evaluation to each squadron crewmember at least once each year.

STANDARDIZATION EVALUATOR

1. Advise and assist squadron Standardization Instructors in all phases of the program.
2. Administer NATOPS evaluations and inspections as directed by the applicable Type Commander.

DEFINITION OF TERMS

Terms commonly used throughout this section are defined as to their specific meaning with regard to the NATOPS evaluation program.

GRADING CRITERIA

The parts of this section that prescribe the standards to be used in determining grades as a result of the performance observed or recorded during evaluation.

QUALIFIED

That desired professional standard demonstrated by a pilot/RSO which indicates optimum knowledge of, and compliance with, the standard operating procedures set forth in the NATOPS Flight Manual, NWP/NWIP, and other applicable publications.

CONDITIONALLY QUALIFIED

That standard demonstrated by a pilot/RSO indicating satisfactory knowledge of, and compliance with, standard operating procedures set forth in the NATOPS Flight Manual, NWP/NWIP, and other applicable publications. Conditionally Qualified shows satisfactory adherence with few minor deviations, indicating a need for further standardization.

UNQUALIFIED

That standard demonstrated by a pilot/RSO showing either unsatisfactory knowledge of, or non-adherence to, standard operating procedures as set forth in the NATOPS Flight Manual, NWP/NWIP, and other applicable publications.

NATOPS RE-EVALUATION

A NATOPS evaluation administered to a pilot/RSO who has been placed in an "Unqualified" status. Only those areas in which an unsatisfactory level of knowledge or degree of adherence to prescribed procedures was exhibited will be observed during this evaluation.

EMERGENCY

An aircraft component or system failure, or condition that requires instantaneous recognition, analysis, and proper action.

MALFUNCTION

An aircraft component or system failure, or condition that requires recognition and analysis, but which permits more deliberate action than that required for an emergency.

AREA

A routine of flight preparation, flight, and post-flight procedures which is observed and graded during an evaluation flight.

CRITICAL AREA

Any major area or sub-area which covers items of significant importance to the overall mission requirement, or the marginal performance of which would jeopardize safe conduct of the flight. These areas will be specially noted throughout the section.

GROUND EVALUATION

ORAL EXAMINATION

The oral examination will consist of question and answer periods concerning all phases of flight and ground operations and may be conducted throughout the ground evaluation. The following specific areas will be covered for both the pilot and RSO:

a. Aircraft Systems
b. Aircraft Exterior Inspection
c. Aircraft Interior Inspection
d. Aircraft Servicing
e. Light and Hand Signals
f. Computation of Performance Data utilizing Section XI of the NATOPS Flight Manual and/or the REST Computer.

WRITTEN EXAMINATION

OPEN BOOK EXAMINATION

The purpose of the open book examination is to evaluate pilot and RSO knowledge of the contents of appropriate publications. Secondly, the open book examination is to be used as a training/review device in preparing pilots and RSOs for the closed book examination. Emphasis should be placed on the information contained in the latest revisions to the NATOPS Flight Manual and other applicable portions of the NWP/NWIP series publications. The open book examination will be administered to pilots/RSOs prior to the flight evaluation. Open book examinations will not be administered by Evaluators conducting evaluation inspections.

CLOSED BOOK EXAMINATION (*)

The purposes of the closed book examination is to evaluate pilot and RSO knowledge of operating procedures, emergency procedures, and aircraft/reconnaissance system limitations. The closed book examination will be administered to each pilot and RSO prior to the flight evaluation. The closed book examination for the pilot and RSO will consist of questions selected from the questions contained in the question bank. Closed book examinations administered by Evaluators conducting evaluation inspections will consist of 50 questions selected at random from the emergency procedures, aircraft limitations, and NATOPS procedures sections.

WRITTEN EXAMINATION QUESTION BANKS

The question bank is included at the end of this section. The questions are arranged as they appear in

(*) Critical Area

the NATOPS Flight Manual with the Classified Supplement questions last. Questions which are to be answered by the pilot or RSO only, are so designated. Questions from this bank may be reproduced locally to make up the closed book exam. Instructor/Evaluators are not restricted to these questions alone and are encouraged to add such questions as they consider important.

WST/COT PROCEDURES CHECK

The Weapons System Trainer, if available, will be used to measure pilot and RSO efficiency in the execution of normal operating procedures, emergency procedures, and crew duties. All emergencies and at least one malfunction will be given in the Start, Takeoff, Climb, Cruise and Recovery phases. If the WST is not available, the pilot will be given a normal and emergency procedures check in the Cockpit Orientation Trainer. The check for the RSO will be conducted by placing him in a cockpit and administering appropriate questions. In the event the COT is not available, the entire check will be conducted by placing the pilot and RSO in the cockpits during the oral examination and administering appropriate questions.

EMERGENCY MALFUNCTION SIMULATIONS

The following list of emergencies and malfunctions should be simulated or questions administered if simulation is not possible:

Emergencies

Engine Fire

Engine Overheat

Engine Failure

Airstart

R.H. Gen Failure, Bus Tie Open

Emergency Landing Gear Extension

Emergency Flap Extension

Canopy Jettison Failure

Ejection Procedure

Utility Hydraulic Failure

Power Control Hydraulic Failure

Intercom Failure

Malfunctions

Hot Start

Hung Start

Cabin Turbine Overspeed

BLC Malfunction

L.H./R.H. Aux Air Door

Equipment Cool Off

Air Refueling Probe Unlocked

Check Fuel Filters

Fuel Transfer Failure

Speed Brake Failure

L.H. Gen Failure

Bus Tie Open

CNI Emergency Power

Fuel Boost Pump Failure

NAMT SYSTEMS CHECK

If desired by the individual squadron, Naval Air Maintenance Trainer facilities may be utilized to evaluate pilot and RSO knowledge of aircraft systems and normal and emergency procedures.

FLIGHT EVALUATION

GENERAL

The flight evaluation may be conducted on any routine syllabus flight with the exception of flights launched for FMLP/CARQUAL or ECCM training. The flight will be flown under day VFR conditions. Emergencies will not be simulated.

OPERATIONAL DEPLOYABLE SQUADRONS

Pilots and RSO's assigned to operational deployable squadrons will normally be checked as a team with the flight evaluation being conducted by the check-crew flying wing. RSO commentary will be transmitted on the GCI/CIC control frequency in use.

TRAINING OR EVALUATION SQUADRONS

Units with training or evaluation missions that are concerned with individual instructor pilot/RSO standardization, rather than team standardization, may conduct the flight evaluation with the check-crew/pilot flying wing or on an individual basis. A pilot may be individually checked with the Instructor/Evaluator conducting the flight evaluation from the rear seat. The RSO may be individually checked by flying with the Instructor/Evaluator as his crewmember.

FLIGHT EVALUATION CHECK AREAS

The areas and sub-areas in which pilots and RSO's may be observed and graded for adherence to standardized operating procedures are outlined in the following paragraphs.

Note

If desired, units with training missions may expand the flight evaluation to include evaluation of standardized training methods and techniques.

MISSION PLANNING/BRIEFING

This area encompasses a comprehensive consideration of all factors necessary for successful mission accomplishment.

a. Flight Planning (Pilot/RSO)
b. Briefing (Pilot/RSO)
c. Personal Flying Equipment (*) (Pilot/RSO)

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 (Pilot/RSO)
b. Before Taxiing Procedures (Pilot)

TAKEOFF

The takeoff is considered complete with the transition to the clean configuration.

a. ATC Clearance (Pilot)
b. Takeoff (*) (Pilot)

DEPARTURE

Departure is that portion of the flight which commences after the takeoff has been completed and continues to cruise, on-course, enroute to the assigned area or other destination.

a. IFR Departure (*) (Pilot)
b. VFR Departure (Pilot)
c. Rendezvous (Pilot)
d. Climb and Level-Off (Pilot)
e. IFR Procedures Enroute (Pilot)
f. VFR Procedures Enroute (Pilot)

MISSION

This area includes reconnaissance missions covered in the NATOPS Flight Manual and other applicable manuals for which standardized procedures/techniques have been developed.

a. Formation - Leader (Pilot)
b. Formation - Wingman (Pilot)
c. Radar Navigation - (Pilot/RSO)
d. Reconnaissance Sensor Operation (Pilot/RSO)
e. Commentary (RSO)
f. Response to Commentary (Pilot)
g. Crew Duties (*) (Pilot/RSO)

RECOVERY

Recovery is that portion of the flight which commences with descent from operating altitude and terminates upon completion of the landing phase.

a. Holding - IFR (Pilot)
b. Expected Approach Time (Pilot)
c. Penetration - TACAN, RADAR, ADF (*) (Pilot)
d. Low Approach (*) (Pilot)
e. GCA/CCA (*) (Pilot)
f. Mission Approach (*) (Pilot)
g. VFR Recovery (Pilot)

COMMUNICATIONS

a. R/T Procedures (Pilot/RSO)
b. Visual Signals (Pilot/RSO)
c. SIF Procedures (Pilot)

EMERGENCY/MALFUNCTION PROCEDURES (*)

In this area, the pilot/RSO will be evaluated only in the case of actual emergencies.

POST-FLIGHT PROCEDURES

a. Taxi-in (Pilot)
b. Shutdown (Pilot/RSO)
c. Inspection and Records (Pilot/RSO)
d. Flight Debriefing (Pilot/RSO)

APPLICABLE PUBLICATIONS

The NATOPS Flight Manual contains the standard operations criteria for RF-4B aircraft. Publications relating to environmental procedures peculiar to shorebased and shipboard operations and tactical missions are listed below:

NWP's

NWIP's

ATC/CATCC Manual

Local Air Operations Manual

Carrier Air Operations Manual

(*) Critical Area

GRADING INSTRUCTIONS

ORAL EXAMINATION GRADING CRITERIA

The final oral examination grade, and resulting status, will be determined by the Evaluator/Instructor and entered on the Written/Oral Examination Worksheet. The criteria for determining area adjectival ratings is outlined in the following paragraphs.

AIRCRAFT SYSTEMS (PILOT/RSO)

Qualified	Demonstrates thorough understanding of all phases of aircraft systems operation.
Conditionally Qualified	Demonstrates adequate knowledge of aircraft systems operation to carry out basic missions, safely and successfully.
Unqualified	Shows obvious lack of understanding of aircraft systems operation. Reveals weakness that could result in unsuccessful or unsafe utilization and operation of the aircraft.

EXTERIOR INSPECTION (PILOT/RSO)

Qualified	Demonstrates thorough knowledge of inspection requirements.
Conditionally Qualified	Demonstrates adequate knowledge of inspection requirements.
Unqualified	Omits items which could jeopardize the success or safety of the mission. Accepts the aircraft with visible discrepancies noted on preflight with no attempt made to bring such discrepancies to the attention of the plane captain or line maintenance personnel.

INTERIOR INSPECTION (PILOT/RSO)

Qualified	Completes interior inspection with no errors or omissions.
Unqualified	Omits any major item.

AIRCRAFT SERVICING (PILOT/RSO)

Qualified	Demonstrates acceptable knowledge of strange field servicing.
Unqualified	Lack of familiarity with strange field servicing which could result in unsafe operation of the aircraft.

LIGHT AND HAND SIGNALS (PILOT/RSO)

Qualified	Demonstrates thorough knowledge of light and visual signals.
Conditionally Qualified	Demonstrates adequate knowledge of visual signals, but is hesitant in signal interpretation in minor instances not affecting action required by the signal.

LIGHT AND HAND SIGNALS (PILOT/RSO) CONTINUED

Unqualified	Shows obvious lack of knowledge concerning the interpretation and use of standard light and visual signals. Unfamiliarity causes hesitation and delay to the degree that operations would be hampered.

COMPUTATION OF PERFORMANCE DATA (PILOT/RSO)

Qualified	Demonstrates thorough knowledge of computation of performance data utilizing Section XI of the NATOPS Flight Manual and the REST Computer.
Unqualified	Shows obvious lack of knowledge in computation of performance data utilizing Section XI of the NATOPS Flight Manual and the REST Computer.

WRITTEN EXAMINATION GRADING CRITERIA

The results of both written examinations will be entered on the Written/Oral Examination Worksheet. Minimum acceptable grades are listed in the following paragraphs.

OPEN BOOK EXAMINATION (PILOT/RSO)

Qualified	Completes examination with a minimum grade of 3.5.

CLOSED BOOK EXAMINATION (*) (PILOT/RSO)

Qualified	Completes examination with a minimum grade of 3.3

WST/COT GRADING CRITERIA

The WST/COT procedures check will be conducted in accordance with the Evaluator's/Instructor's entries on the WST/COT Operator's Worksheet, and the results recorded on the WST/COT Procedures Worksheet. The criteria for determining area adjectival ratings is outlined in the following paragraphs.

NORMAL PROCEDURES (PILOT/RSO)

Qualified	Completes pre-start, start, post-start, and systems checks, exhibiting a thorough knowledge of the procedures with no deviations and/or omissions.
Conditionally Qualified	Same as "Qualified", except for minor omissions and/or deviations.
Unqualified	Exhibits obvious lack of familiarity with procedures which result in serious or numerous oversights.

EMERGENCY PROCEDURES (*) (PILOT/RSO)

Qualified	Recognizes emergencies immediately, analyzes them properly, and takes necessary corrective action.
Unqualified	Demonstrates improper and unsafe cockpit procedures. Makes serious errors in cockpit configurations and checks, due to neglect of checklists or lack of understanding of cockpit arrangement and settings. Fails to recognize emergencies, analyzes them improperly, or takes improper corrective action. Fails to recognize and act on immediate reaction situations until such time that the condition has gone beyond salvation.

(*) Critical Area

CREW DUTIES (*) (PILOT/RSO)

Qualified	Demonstrates knowledge of crew responsibility in the specific reconnaissance mapping areas outlined in the NATOPS Flight Manual. Coordinated completion of required checklists, communications, and reconnaissance procedures with the appropriate crewmember in a positive professional manner. Keeps appropriate crewmember informed of optimum tactics and/or limitations.
Conditionally Qualified	Demonstrated knowledge of crew responsibility in the specific reconnaissance mapping areas outlined in the NATOPS Flight Manual. Coordinated completion of required checklists, communications, and reconnaissance procedures with the appropriate crewmember. Minor errors or omissions degraded crew coordination but did not compromise safety or the success of the mission/photo run.
Unqualified	Errors, omissions, lack of knowledge of specific crew responsibilities, or lack of coordination were such that aircraft safety or successful completion of the mission/photo run was compromised.

RECONNAISSANCE SYSTEM STATUS (PILOT/RSO)

Qualified	Completes prescribed sensor/BIT checks, analyzes optimum photo run procedures/reconnaissance system capability.
Conditionally Qualified	Completes prescribed sensor/BIT checks, anaylzes reconnaissance system capability with minor errors and/or selection of optimum reconnaissance sensor in error but did prescribe a successful photo run.
Unqualified	Does not complete sensor/BIT checks, or does not inform the appropriate crewmember of the status or limitations of the reconnaissance system.

RADAR NAVIGATION (PILOT/RSO)

Qualified	Minor discrepancies in technique to insure maximum utilization of equipment. Demonstrated an acceptable knowledge of scope presentation.
Conditionally Qualified	Used undependable technique resulting in marginal utilization of equipment and/or was confused with scope presentation.
Unqualified	Used unacceptable technique and/or faulty scope interpretation.

RECONNAISSANCE SENSOR OPERATION (PILOT/RSO)

Qualified	Minor discrepancies noted in operating technique. Target was photographed successfully.
Unqualified	Missed target or did not achieve photos due to operator technique.

(*) Critical Area

RESPONSE TO COMMENTARY (PILOT)

Qualified	Uses prescribed bank angles for all maneuvers. Uses prescribed throttle/speed brake response for speed commands. Uses prescribed breakaway, overshoot, and compass recovery procedures.
Unqualified	Uses other than prescribed bank angles or throttle/speed brake configuration. Uses other than prescribed procedures for breakaway, overshoot, or compass recovery.

COMMENTARY (RSO)

Qualified	Demonstrates the ability to apply and convey accurate descriptive and directive instructions, and corrective measures to the pilot.
Conditionally Qualified	Demonstrates satisfactory knowledge, but lacks ability in some areas of application.
Unqualified	Demonstrates a lack of knowledge and application to correctly utilize directive commentary.

R/T PROCEDURES (PILOT/RSO)

Qualified	Made all required calls with only minor errors or omissions.
Conditionally Qualified	Did not make all required calls. Procedures were cluttered with unnecessary voice transmissions causing some confusion and delay.
Unqualified	Failed to obtain and/or receive any necessary information vital to safety of ground and/or flight operations. R/T procedure was unacceptable, incomplete, and confusing.

FLIGHT EVALUATION GRADING CRITERIA

The evaluation flight is intended to evaluate unit/individual compliance with approved standardized operating procedures. The successful completion of all ground checks and examinations is required before commencement of the flight evaluation. Insofar as possible, checks will be scheduled so as not to interfere with squadron operations. The flight evaluation may be conducted on any syllabus flight with the exception of flights launched for FMLP/CARQUAL or ECCM training. The flight will be flown under day VFR conditions and only those areas observed/required by the mission assigned will be evaluated. The Evaluator/Instructor will utilize the Flight Evaluation Worksheet to enter adjectival grades for the areas/sub-areas evaluated during the flight. The criteria for determining area/sub-area adjectival ratings is outlined in the following paragraphs:

MISSION PLANNING/BRIEFING

Flight Planning (Pilot/RSO)

Qualified	Flight plan and clearance executed in accordance with local, FLIP, CATCC, OPNAV, and other governing instructions. Special factors, if required by the mission or aircraft configuration, are computed and recorded where applicable. Completes flight planning log for route and/or operating area without error. Fuel consumption is properly computed based upon available planning factors, and recorded on the flight log. Insures that maps and charts for route, destination, alternate, or operating areas are available. Weather factors, temperatures and winds aloft information, and NOTAMS are used in planning the mission. SID/IFR departure procedures and routes are obtained, if required, and takeoff/climb planned accordingly.

Flight Planning (Pilot/RSO) CONTINUED

Conditionally Qualified	Same as "Qualified", but with minor discrepancies which did not adversely affect successful completion of the mission or jeopardize safety.
Unqualified	Flight planning was incomplete or resulted in discrepancies which could possibly prevent successful completion of the mission.

Briefing(Pilot/RSO)

Qualified	Adequately covered all applicable items and presented briefing in an acceptable manner.
Conditionally Qualified	Uses prescribed briefing guide but did not follow format and omitted one or more applicable items.
Unqualified	Disregarded briefing guide or was not adequately prepared to give complete concise briefing. Conducted briefing in an unprofessional manner.

Personal Flying Equipment (*) (Pilot/RSO)

Qualified	Has all required items of personal equipment necessary for the mission and area over which the flight is to be conducted.
Unqualified	Does not possess all items of personal flying equipment.

PREFLIGHT/LINE OPERATIONS

Aircraft Acceptance (Pilot/RSO)

Qualified	Checks the ten previous yellow sheets (if available) for previous discrepancies and corrective action taken. Checks fuel load, camera configuration, pertinent aircraft data, and aircraft status data prior to accepting the aircraft.
Conditionally Qualified	Checks the ten previous yellow sheets (if available) for previous discrepancies and corrective action taken. Checks aircraft status data, but omits checking other minor pertinent data.
Unqualified	Fails to check previous yellow sheets for discrepancies and corrective action taken and/or aircraft status data.

Before Taxiing Procedures (Pilot)

Qualified	Uses correct R/T procedures, standard visual signals, and pre-taxi checks with the flight as briefed with no unnecessary deviations, omissions, or delays.
Conditionally Qualified	Uses correct R/T procedures, standard visual signals and pre-taxi checks with the flight, but with minor deviations and omissions as briefed.
Unqualified	Fails to use correct R/T procedures, standard visual signals and pre-taxi checks with the flight. Deviates and omits procedures as briefed to the extent that misunderstanding results in unnecessary delays in departing on the mission.

(*) Critical Area

TAKEOFF

ATC Clearance (Pilot)

Qualified	Requires minimum transmissions to understand clearance. Reads back correctly.
Conditionally Qualified	Required repeat transmissions to understand clearances. Transmissions require additional questions and calls.
Unqualified	Proceeds without being certain of clearances. Requires repeated transmissions. Is unable to communicate and give information without excessive time and words. Poor radio discipline.

Takeoff (*) (Pilot)

Qualified	Receives and acknowledges takeoff clearances. Executes engine runup, instrument checks, and necessary visual signals. Brake release is smooth and good directional control is maintained. For catapult launch, the brakes are released and controls are properly positioned prior to launch. Lift-off is accomplished as required by field/WOD conditions and a smooth transition is accomplished to clean configuration with aircraft in positive climbing attitude and safe separation above the ground/water. Acceleration to climb schedule is expeditiously and safely accomplished.
Conditionally Qualified	Same as "Qualified", except for minor deviations in procedure and technique not detrimental to flight safety.
Unqualified	Does not receive and acknowledge takeoff clearance causing unnecessary delay or traffic disruption. Fails to use signals or uses improper signals. Exhibits poor or unsafe technique in directional control, catapult launch, lift-off, transistion, climb attitude, and establishing climb schedule.

DEPARTURE

IFR Departure (*) (Pilot)

Qualified	Departure executed in accordance with clearance. Heading /Track and airspeed maintained as briefed. Anticipates cruising airspeed requirements.
Conditionally Qualified	Same as "Qualified", except for minor deviations not constituting a violation of assigned clearance.
Unqualified	Departure not in accordance with clearance and/or the limits for "Conditionally Qualified" were exceeded. Heading/ Track, airspeed, altitude, or attitude is unsafe.

VFR Departure (Pilot)

Qualified	Departure executed in accordance with local traffic rules and/or traffic clearance. Level-off is accomplished as briefed with positive correction where necessary. Anticipates cruising airspeed requirements.
Conditionally Qualified	Same as "Qualified", except for minor deviations.

(*) Critical Area

VFR Departure (Pilot) CONTINUED

Unqualified	Departure not in accordance with traffic rules and/or traffic clearance and/or the limits for "Conditionally Qualified" were exceeded.

Rendezvous (Pilot)

Qualified	Executes and facilitates rendezvous expeditiously and in accordance with procedures as briefed or currently prescribed.
Conditionally Qualified	Executes and facilitates rendezvous, except for minor technique errors and delay. Rendezvous accomplished so as not to be detrimental to mission completion.
Unqualified	Rendezvous executed in a manner that indicates a lack of knowledge of procedure and technique required. Resulting delay causes mission accomplishment to be adversely affected or delayed. Any unsafe maneuver.

Climb and Level-Off (Pilot)

Qualified	Climbed,utilizing appropriate climb schedule, leveled-off at assigned or pre-briefed altitude and cruise speed, or corrected immediately to the assigned altitude/speed.
Unqualified	Did not utilize appropriate climb schedule. Did not level-off at the assigned or pre-briefed altitude, or made no effort to correct to the proper altitude or airspeed.

IFR Procedures Enroute (Pilot)

Qualified	Maintains heading/track as briefed or cleared by controlling agency. Observes good radio discipline. Gives position reports clearly and in proper sequence.
Conditionally Qualified	Maintains heading/track except for minor deviations not affecting limits of clearance. Makes unnecessary transmissions. Position reports are complete, but not in correct order.
Unqualified	Maintains heading/track, altitude, or airspeed in excess of limits for "Conditionally Qualified". Little or no radio discipline. Unable to communicate without excessive words and time. Position reports incomplete, requiring repeated transmissions.

VFR Procedures Enroute (Pilot)

Qualified	Maintains cruising Mach, altitude, and heading as briefed and/or as dictated by the mission/regulations.
Conditionally Qualified	Selects and maintains a cruising Mach, altitude, and heading that provides less-than-optimum tactical disposition, but not to the extent of precluding successful completion of the mission.
Unqualified	Cruising Mach, altitude, and formation selected and maintained are not as briefed and/or without consideration for mission. Results in poor tactical employment and/or lookout doctrine to the detriment of mission completion or safety.

MISSION

Formation-Leader (Pilot)

Qualified	Pilot is smooth on the controls, uses proper visual signals throughout takeoff, departure, mission, and recovery. Is considerate of wingman.
Conditionally Qualified	Pilot is generally smooth on the controls, uses proper visual signals, but lacks consideration for his wingman. No unsafe maneuvers commited.
Unqualified	Pilot is very rough on the controls, does not use or uses unorthodox visual signals. Would be unsafe to fly wing on in weather and/or no consideration for wingman. Executes unsafe maneuvers.

Formation-Wingman (Pilot)

Qualified	Pilot maintains proper wing position smoothly throughout takeoff, departure, mission, and recovery. No tendency to over control. Responds promptly and correctly to all signals.
Conditionally Qualified	Pilot varies wing position frequently but maintains formation safely. Has a tendency to over control. Slow to respond to some signals.
Unqualified	Pilot is unable to maintain proper wing position. Over controls. Fails to respond to signals. Pilot could not execute a formation weather penetration. Pilot is forced to discontinue flying formation and/or safety is compromised.

Radar Navigation (Pilot/RSO) (Team RSO If Scope Camera Film is Available)

Qualified	Minor discrepancies in technique but displayed an acceptable knowledge of scope presentation.
Conditionally Qualified	Used undependable technique resulting in marginal utilization of equipment and/or was confused with scope presentation.
Unqualified	Used unacceptable technique for equipment utilization and/or faulty scope interpretation.

Reconnaissance Sensor Operation (Pilot/RSO)(Team RSO If Scope Camera Film is Available)

Qualified	Minor discrepancies noted for operating technique predicated on target environment, tactics used, etc.
Conditionally Qualified	Used undependable operating technique predicated on target environment, tactics used, etc; however, photos were achieved.
Unqualified	Missed target/did not achieve photos due to operator technique.

Commentary (RSO)

Qualified	Demonstrates the ability to apply and convey accurate, descriptive, and directive instructions and corrective measures to the pilot.

Commentary (RSO) CONTINUED

Conditionally Qualified	Demonstrates satisfactory knowledge, but lacks ability in some areas of application.
Unqualified	Demonstrates lack of knowledge or ability to use standard directive commentary.

Response to Commentary (Pilot)

Qualified	Uses prescribed bank angles for all maneuvers. Uses prescribed throttle/speed brake response for speed commands. Uses prescribed breakaway, overshoot, and recovery procedures.
Unqualified	Uses other than prescribed bank angles, throttle speed brake configurations, breakaway, overshoot and compass recovery procedures.

Crew Duties (*) (Pilot/RSO)

Qualified	Demonstrates knowledge of crew responsibility in the specific areas as outlined in the NATOPS Flight Manual. Coordinated completion of required checklists, communications, and procedures with the appropriate crewmember in a positive professional manner. Keeps appropriate crewmember informed of optimum tactics and/or limitations.
Conditionally Qualified	Demonstrated knowledge of crew responsibility in the specific reconnaissance areas as outlined in the NATOPS Flight Manual. Coordinated completion of required checklists, communications, and reconnaissance procedures with the appropriate crewmember. Minor errors or omissions degraded crew coordination but did not compromise safety or the success of the mission.
Unqualified	Errors, omissions, lack of knowledge of specific crew responsibilities, or lack of coordination were such that aircraft safety or successful completion of the mission was compromised.

RECOVERY

IFR Holding/Marshal Procedures (Pilot)

Qualified	Enters holding/marshal at the assigned altitude and in accordance with published procedures. Slows to appropriate entry and holding airspeed within prescribed time limitations. Remains within pattern limits.
Conditionally Qualified	Enters holding with minor deviations from published procedures. Slow in reaching prescribed holding airspeed. Minor deviations in pattern, but within limits.
Unqualified	Unorthodox pattern entry. Has difficulty in maintaining prescribed pattern. In excess of limits for "Conditionally Qualified".

Expected Approach Time (Pilot)

Qualified	Made expected approach time within time limits.

(*) Critical Area

Expected Approach Time (Pilot) CONTINUED

Conditionally Qualified	Made expected approach time in excess of time limits, but requested an amended clearance.
Unqualified	EAT was made in excess of time limits and did not request amended clearance.

Penetration-TACAN, RADAR, ADF (*) (Pilot)

Qualified	Complies correctly with procedures and/or instructions received. Completes appropriate checks prior to reaching initial approach fix/marshal point. Uses proper power settings and/or descent attitude/configuration. Intercepts penetration course using correct tracking technique and levels-off at proper penetration turn and/or minimum penetration/gate altitude.
Conditionally Qualified	Same as "Qualified", except for minor deviations from procedures and/or instructions received not affecting flight safety.
Unqualified	Deviations and omissions from procedures/instructions and/or checks that jeopardize flight safety. Fails to maintain limits of "Conditionally Qualified".

Low Approach (*) (Pilot)

Qualified	Executed low approach as published and/or instructed. Completes pre-landing checks and executes smooth safe aircraft configuration transition. Reaches minimum altitude at, or prior to, reaching visibility minimum from which a successful straight-in or a circling approach and landing can be made.
Conditionally Qualified	Same as "Qualified", except for minor deviations from procedures and errors in technique not affecting flight safety.
Unqualified	Deviation from procedures and errors in technique that jeopardize flight safety. Fails to maintain the limits of "Conditionally Qualified".

GCA/CCA (*) (PILOT)

Qualified	Acknowledges all transmissions and complies with instructions received. Reads back all headings, altitudes, altimeter settings, and missed approach/lost communications instructions properly and without difficulty. Performs all landing checks and transition is completed as prescribed and when instructed. On final appraoch, maintains glideslope and heading as directed by final controller. Occasionally off, but accomplishes appropriate and positive corrections.
Conditionally Qualified	Same as "Qualified", except for minor deviations from procedures/instructions and/or checks not affecting flight safety. On final approach, same as "Qualified".

(*) Critical Area

GCA/CCA (*) (PILOT) CONTINUED

Unqualified	Deviations and omissions from procedures/instructions and/or checks that jeopardized flight safety, or a missed approach/waveoff is required. Fails to maintain the limits of "Conditionally Qualified".

Note

Instructor/Evaluator must exercise good judgement in application of GCA criteria in consideration of such factors as: GCA pick-up point, straight-in/box pattern, crosswinds, controllers ability, and errors evident from controller transmissions.

Missed Approach (*) (Pilot)

Qualified	Follows missed approach/waveoff/bolter procedures as published or instructed. Does not descend below minimum altitude. Established a smooth and positive climb attitude. Maintains smooth control throughout aircraft configuration transition. Calls approach control requesting further clearance upon reaching safe altitude.
Conditionally Qualified	Same as "Qualified", except for minor deviations from procedures and errors in technique not affecting flight safety.
Unqualified	Deviation from procedures and errors in technique that jeopardize flight safety. Fails to maintain the limits of "Conditionally Qualified".

VFR Recovery (Pilot)

Qualified	Pattern entry was made as prescribed, in accordance with local course rules and/or instructions received. Landing checklist completed. Break, pattern, and altitude at the 180° position as prescribed. Final approach speed at optimum. Touchdown between first 500 and 1000 feet of runway or on mirror touchdown deck area.
Conditionally Qualified	Same as "Qualified", except for minor deviations at break, pattern, or altitude at the 180° position. Final approach speed within limits. Touchdown between first 500 to 1500 feet of runway or on mirror touchdown deck area.
Unqualified	Exceeds the limits for "Conditionally Qualified". Landing gear and flaps lowered above airspeed limitations. Does not complete landing check. Touches down before first 500 feet or past 1500 feet down the runway or attempts to land short of mirror touchdown deck area. Unsafe entry, break, approach, or landing.

COMMUNICATIONS

R/T Procedures (Pilot/RSO)

Qualified	Complies with procedures prescribed by Military and FAA Regulations. Transmissions are made correctly on the proper frequency in minimum time, and without interruption of other transmissions. Monitored frequencies and/or facilities at appropriate time. Transmissions are received, understood, properly acknowledged, and complied with in minimum time. Familiar with communications equipment and facilities. Utilizes back-up facilities without hesitation.

(*) Critical Area

R/T Procedures (Pilot/RSO) CONTINUED

Conditionally Qualified	Same as "Qualified", except for minor deviations or delays which indicate lack of thorough familiarity with procedures. equipment or facilities, but which do not preclude successful completion of mission or jeopardize safety.
Unqualified	Fails to transmit or receive mandatory reports through omission or lack of familiarity with equipment or procedures, Any violation of Military/FAA Regulations. Any violation of safety.

Visual Signals (Pilot)

Qualified	Uses standard visual signals correctly and without confusion. No delay due to questionable signals.
Conditionally Qualified	Same as "Qualified", except for minor deviations and delay.
Unqualified	Uses non-standard signals resulting in misinterpretation and confusion. Excessive delay or non-communications caused by questionable signals.

IFF/SIF Procedures (Pilot)

Qualified	Uses proper route codes, facilitating timely compliance with all interrogation instructions.
Conditionally Qualified	Same as "Qualified", except reaction time to interrogation instruction is slow.
Unqualified	Fails to use equipment properly, resulting in confusion and undue delay.

EMERGENCY PROCEDURES (*) (PILOT/RSO)

Qualified	Properly analyzes the emergency situation (if any actually occur) and takes appropriate action without deviation, error, or omission.
Conditionally Qualified	Properly analyzes the emergency situation and accomplishes all required action safely, but not necessarily in the prescribed sequence.
Unqualified	Not up to standards of "Conditionally Qualified".

POSTFLIGHT PROCEDURES AND DEBRIEFING

Taxi, Shutdown, Inspection and Records (Pilot /RSO)

Qualified	Proper taxi interval and speed. Aircraft shutdown procedures as prescribed. Aircraft postflight inspection and yellow sheet completed without error or omission.
Conditionally Qualified	Same as "Qualified", except for minor deviations and omissions not affecting continued flight safety.
Unqualified	Errors or omissions in shutdown, checks/inspections, or yellow sheet entries that could jeopardize the safety of personnel and/or the aircraft.

(*) Critical Area

Flight Debriefing (Pilot/RSO)

Qualified	Provides thorough information, in chronological order, of events occuring during the mission. Debriefs the flight and gives error analysis with definite corrective action indicated.
Conditionally Qualified	Same as "Qualified", except for minor deviations and omissions not affecting the value of mission debriefing. Debriefs the flight with adequate error analysis.
Unqualified	Unfamiliarity with debriefing requirements. Inadequate flight debriefing. No error analysis on corrective action given. Totally inadequate information for other pilots in the flight.

FINAL GRADE DETERMINATION

GENERAL

The final grades (area, sub-area, and overall) for all phases of the NATOPS evaluation will be determined by the Evaluator/Instructor and recorded on the NATOPS Evaluation Report. Area and sub-area adjectival grades will be based on the applicable grading criteria as outlined in this section. Final determination of all adjectival ratings should be based on the following general criteria:

Qualified	That desired professional standard demonstrated by a pilot/RSO (individually or as a team) which indicates optimum knowledge of aircraft systems operation with close adherence to the standard operating procedures as set forth in the NATOPS Flight Manual, the NWP/NWIP series, and other applicable publications.
Conditionally Qualified	That standard demonstrated by a pilot/RSO (individually or as a team) which indicates satisfactory knowledge of aircraft systems operation with adequate adherence to the standard operating procedures as set forth in the NATOPS Flight Manual, the NWP/NWIP series, and other applicable publications. A grade of "Conditionally Qualified" shows satisfactory adherence (few minor deviations) to standard operating procedures, but indicates a need for further standardization knowledge or effort.
Unqualified	That standard demonstrated by a pilot/RSO (individually or as a team) which indicates unsatisfactory knowledge of aircraft systems operation and is unfamiliar with, or does not adhere to, standard operating procedures as set forth in the NATOPS Flight Manual, the NWP/NWIP series, and other applicable publications. Any unsafe act or dangerous flight procedure will be cause for a grade of "Unqualified" and the flight check will be terminated. However, momentary deviations from standard operating procedures will not be considered as disqualifying, providing the pilot/RSO being evaluated is alert in applying corrective action and the deviation does not jeopardize flight safety.

ADJECTIVAL/NUMERICAL CONVERSION

All area or sub-area grades will be initially determined by using the adjective grading criteria as outlined in this section. To determine area grades containing two or more sub-areas, numerical weight factors will be assigned to the adjectival ratings as follows:

4.0 - Qualified
2.0 - Conditionally Qualified
0.0 - Unqualified

When all areas/sub-areas have been assigned a numerical weight factor, the following formula will be used to determine the final area grade and/or the overall flight evaluation grade:

$$\frac{\text{Sum of sub-area or area numerical values}}{\text{Number of sub-areas or areas evaluated}} = \text{Area grade or final flight evaluation grade}$$

To convert a final numerical grade to an adjectival grade, the following applies:

0.0 - 2.19 Unqualified
2.20 - 2.99 Conditionally Qualified
3.0 - 4.0 Qualified

EXAMPLE:

Sub-area numerical values

$$\frac{3.5 + 2.5 + 4.0 + 2.0 + 3.0}{5} = \frac{15}{5} = 3.0 \text{ Qualified}$$

MINIMUM GRADES

The minimum grades established for the NATOPS Evaluation are as follows:

Oral Examination - Conditionally Qualified

Written Examination:

a. Open Book - 3.5
b. Closed Book - 3.3

WST/COT Procedures Check - Qualified in all Critical Areas

NAMT Procedures Check - 3.3

Flight Evaluation - Conditionally Qualified in all Areas

Note

A grade of "Unqualified" in a non-critical area will result in a recheck of that area An unqualifying rating in any critical area will result in an overall grade of "Unqualified".

OVERALL GRADE

The overall grade will be determined by the Evaluator/Instructor and entered in the NATOPS Evaluation Report. This grade will be based on the applicable grading criteria and determined, where necessary, by the adjectival/numerical conversion formula as prescribed in this section.

FORMS AND RECORDS

WORKSHEETS

The Written/Oral Examination Worksheet, the WST/COT Procedures Worksheet, the WST/COT Operator's Worksheet, and the Flight Evaluation Worksheet will be used, as applicable, in administering all phases of the NATOPS evaluation. Specific results of individual parts of the NATOPS evaluation which points out deficiencies in the level of required pilot/RSO knowledge or degree of adherence to standard operating procedures should also be recorded. Use of the worksheets is highly desirable in the preparation of final grades for entry in the NATOPS Evaluation Report and in preparing the critique.

REPORT FORM

The NATOPS Evaluation Report form (figure 10-1) will be used to report the complete results of the NATOPS evaluation. Upon completion of the check and critique, the applicable sections of the report will be prepared in duplicate by the Evaluator/Instructor for each pilot and RSO checked. All areas/sub-areas graded as "Unqualified" or "Not Applicable" must be amplified in the "Remarks" column. The original of the completed report will be delivered to the Commanding Officer for review and comment. The copy of the completed report will be filed in the Evaluator's/Instructor's files upon completion of the Log Book entry.

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/RSO 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.

RECORDS

The NATOPS Evaluation Report (figure 10-1) will be retained by the squadron for a period of one year after completion or until a subsequent check has been completed. Upon successful completion of an evaluation, an entry to that effect will be made on the "Qualified and Achievements" page of the pilot's/RSO's Flight Log Book. An example of this entry is as follows:

"QUALIFICATION"	"DATE"	"SIGNATURE"
"NATOPS (Aircraft (Crew Eval." Model) Posit.)	(Date)	(Authenticating (Unit which ad- Signature) ministered eval.)

NATOPS EVALUATION REPORT
RF-4B AIRCRAFT

NAME	RANK	FILE NUMBER	ACTIVITY

TYPE OF CHECK	OVERALL GRADE	DATE OF CHECK
PILOT ☐ RSO ☐ ANNUAL ☐ RE-CHECK ☐ OTHER ☐	Q ☐ CQ ☐ U ☐	

GROUND EVALUATION	Q	CQ	U	NA	PILOT FLIGHT EVALUATION	Q	CQ	U	NA
OPEN BOOK EXAMINATION					FLIGHT PLANNING				
* CLOSED BOOK EXAMINATION					BRIEFING				
ORAL EXAMINATION					* PERSONAL FLYING EQUIP.				
WST/COT PROCEDURES					AIRCRAFT ACCEPTANCE				
					PRETAXI PROCEDURES				
NORMAL PROCEDURES					ATC CLEARANCE				
* EMERGENCY PROCEDURES					* TAKE-OFF				
* CREW DUTIES					* IFR DEPARTURE				
RECONN. SYSTEM STATUS					VFR DEPARTURE				
RADAR NAVIGATION					RENDEZVOUS				
RECONN. SENSOR OPERATION					CLIMB & LEVEL-OFF				
RESPONSE TO COMMENTARY					IFR PROC. ENROUTE				
COMMENTARY					VFR PROC. ENROUTE				
R/T PROCEDURES					FORMATION - LEADER				
					FORMATION - WINGMAN				
					RESPONSE TO COMMENTARY				
					* CREW DUTIES				
RSO FLIGHT EVALUATION	**Q**	**CQ**	**U**	**NA**	HOLDING				
					EXPECTED APPROACH TIME				
FLIGHT PLANNING					* PENETRATION				
BRIEFING					* LOW APPROACH				
PERSONAL FLYING EQUIP.					* GCA/CCA				
AIRCRAFT ACCEPTANCE					* MISSED APPROACH				
RADAR NAVIGATION					VFR RECOVERY				
RECONN. SENSOR OPERATION					R/T PROCEDURES				
COMMENTARY					VISUAL SIGNALS				
* CREW DUTIES					SIF PROCEDURES				
R/T PROCEDURES					* EMERGENCY/MALFUNCTIONS				
* EMERG/MALFUNCTIONS					POSTFLIGHT PROCEDURES				
POSTFLIGHT PROCEDURES									

NAME, RANK, ACTIVITY OF NATOPS EVALUATOR/INSTRUCTOR	SIGNATURE OF PILOT/RSO EVALUATED

* CRITICAL AREA

Note

THIS FORM MAY BE REPRODUCED LOCALLY

RF4B-1005-1A

Figure 10-1

REMARKS:

Note

THIS FORM MAY BE REPRODUCED LOCALLY

RF4B-1005-2

RF-4B NATOPS QUESTION BANK

1. Operating procedures, conditions, etc., which are essentail to emphasize in the NATOPS manual are indicated by__________.
2. Operating procedures, practices, etc., which will result in personnel injury or loss of life if not carefully followed are indicated in the NATOPS manual by__________.
3. The eight circuit breakers in the front cockpit are: (OPEN BOOK ONLY)
   a.______________________________
   b.______________________________
   c.______________________________
   d.______________________________
   e.______________________________
   f.______________________________
   g.______________________________
   h.______________________________
4. List the warning lights in the RSO's cockpit:
   a.______________ h.______________
   b.______________ i.______________
   c.______________ j.______________
   d.______________ k.______________
   e.______________ l.______________
   f.______________ m.______________
   g.______________ n.______________
5. The cockpit will begin to pressurize at_______feet. At 40,000 feet, the cabin altitude should be approximately__________.
6. The rain removal system directs_________over the center windshield panel.
7. To stop the cooling turbine if the "Cabin Turb Over Speed" light illuminates,____________________.
8. The RSO can select his own pressure suit temperature. T / F
9. The only control the RSO has over his pressure suit environment is the volume of airflow. T / F
10. With cabin pressure system inoperative above 35,000 feet, the pressure suit will be pressurized with __________.
11. The first indication of composite disconnect separation from the seat pan will be free and easy breathing with a fitted oxygen mask. T / F
12. Illumination of the "Equipment Cool Off" light shall be logged on the yellow sheet. T / F
13. To prevent engine bleed air from entering the cockpit, pull the__________________.
14. Either the pilot or RSO can reset the equipment cooling reset button. T / F.
15. Prior to reseting the equipment cooling reset button, what action must be taken?
    a.______________________________
    b.______________________________
16. If the "Equipment Cool Off" light cannot be extinguished, high speed flight should be avoided. T / F
17. Suggested angle of attack settings are:
    Climb (400 KIAS)______units
    Max Endurance______units
    Stall Warning______units

QUESTION BANK CONTINUED

18. The arresting hook is lowered by______and_________. It is raised by_____________.
19. The arresting hook uplatch is mechanically operated. T / F
20. With a loss of electrical power, the arresting hook cannot be extended. T / F
21. The two modes of operation of the automatic flight control system are: (PILOT ONLY)
    a.______________________________
    b.______________________________
22. In Airplanes 153095y and up and in all other airplanes upon incorporation of AFC 203, the stab aug switches can be engaged individually or in any combination. T / F
23. In the AFCS mode of operation, the pitch limits are______degrees, and the roll limits are__________ degrees. (PILOT ONLY)
24. In Airplanes 153095y and up and in all other airplanes upon incorporation of AFC 203, the__________ hold mode of the AFCS has been removed.
25. The autopilot will disengage when acceleration forces exceed plus____or minus______"g's".
26. In the AFCS mode, pitch trim correction will be made automatically, within a range of_____to_____ "g's".
27. Only__________maximum effort brake applications should be anticipated when utility hydraulic pressure is lost.
28. Actuation of the emergency pneumatic braking system will introduce air into the wheel brake hydraulic system. T / F
29. The emergency pneumatic brake system does not provide differential braking. T / F
30. The canopies can be stopped at any intermediate position. T / F
31. Before actuating the canopy manual unlock handle, the normal canopy control handle must be in the __________position.
32. The pilots's "Canopy Unlocked" indicator light will illuminate if the RSO's canopy is jettisoned. T / F
33. The canopy is designed to remain in the full open position up to______knots and to separate from the airplane at___________knots.
34. Canopy closure should not be attempted with engines running above a stabilized idle rpm. T / F
35. Actuation of the canopy emergency system also actuates the cockpit flooding doors. T / F
36. Four sensor inputs in the CADC are:
    a.______________________________
    b.______________________________
    c.______________________________
    d.______________________________
37. The CADC supplies corrected information to the following instruments and systems:
    a.______________________________
    b.______________________________
    c.______________________________
    d.______________________________
    e.______________________________
    f.______________________________
38. When in the CNI mode, the #1 needle on the BDHI will indicate______bearing, and the #2 needle will indicate_______bearing.

QUESTION BANK CONTINUED

39. The RSO can select the UHF antenna to be utilized when the pilot has control of the CNI equipment. T / F

40. Emergency operation of the intercom system is provided by placing the amplifier selector knob to the EMER ICS position, thereby bypassing the faulty amplifier. T / F

41. With the intercom in the EMER ICS position on the RSO's control panel, hot mike operation is possible. T / F

42. If the pilot selects emergency intercom operation, it is necessary for the RSO to also select emergency in order to regain satisfactory intercom communications. T / F

43. The position of the intercom controls will not affect UHF radio operation from either cockpit. T / F

44. The ASQ-88 is limited to____minutes of ground operating time without external coolant air applied.

45. The items that are released or disconnected when the emergency harness release handle is actuated are:

    a.____________________

    b.____________________

    c.____________________

    d.____________________

46. The primary source of all electrical power is two,____cycle,____phase,____volts a-c generators.

47. With external electrical power connected and either generator control switch in the EXT position, the aircraft buses will be energized. T / F

48. If the left generator is inoperative and the "Bus Tie Open" light is illuminated, all d-c busses will be energized. T / F

49. You are making a night GCA with the RAT extended, due to a right generator failure with the "Bus Tie Open" light illuminated. When you break out at 800 feet and reduce speed to below 195 knots, all cockpit lighting is lost. Without increasing speed, you may regain cockpit lighting by placing the________switch to the______position, and the lighting switches to the______position.

50. When operating on emergency electrical power, the following items of CNI equipment will be lost:

    a.____________________

    b.____________________

51. When operating on the emergency generator in airplanes prior to 153095y without AFC 220 incorporated, all electrical power except________will be lost when the airspeed drops below________knots IAS. The emergency generator will come back on the line at approximately______knots IAS.

52. In airplanes 153095y and up and in all other airplanes upon incorporation of AFC 220, the emergency generator will drop off the line at approximately______knots.

53. Upon illumination of a generator warning light, pilot action is to____the generator control switch. If the generator does not come back on the line, secure the______and______as soon as practicable. (CSD without shaft disconnect only)

54. After a complete electrical failure, landing gear and flaps should be lowered by__________.

55. The "Bus Tie Open" light will illuminate when one generator goes off the line. T / F

56. Prior to retracting the RAT, insure at least______psi on the pneumatic pressure gage.

57. The sea level, standard day, static thrust ratings for the J79-8 engine are,________pounds in MIL, and________pounds in MAX.

58. The torch igniter plug will operate momentarily each time the throttles are moved to afterburner. (PILOT ONLY) T / F

59. The engine start switch should be moved to_____when the engine is operating at a self-sustaining rpm (approx. 45% rpm). (PILOT ONLY)

60. In the event of a generator or exhaust nozzle failure, the pilot should immediately check the corresponding________pressure gage.

QUESTION BANK CONTINUED

61. The ignition duty cycle is_____minutes ON,_______minutes OFF,_____minutes ON and________ minutes OFF.

62. Operation with the "Duct Temp Hi" warning light illuminated is prohibited below_____feet.

63. MIL and MAX thrust are time limited to_____minutes below 35,000 feet, and____ hours above 35,000 feet.

64. Due to limited oil distribution to the variable nozzle system during negative "g" and zero "g" flight, the aircraft is limited to the following:

    a.________seconds of negative "g" flight

    b.________seconds of zero "g" flight

65. The emergency flap system air bottles store enough air for_________extension(s) of the wing flaps.

66. If pneumatic pressure is lost when the flaps are blown down, they (will/will not) be blown up by the airstream.

67. When lateral trim corrections are made, the control stick moves in proportion to the amount of trim applied. T / F (PILOT ONLY)

68. The stabilator system utilizes a __________________to increase stick forces during rapid fore and aft stick movement. (PILOT ONLY)

69. To temporarily disengage the ARI: (PILOT ONLY)

    1.____

    To permanently disengage the ARI: (PILOT ONLY)

    1.____

    2.____

70. The stall warning vibrator is set at______units angle of attack and is located______________________

71. Disengagement of the stability augmentation mode decreases the ARI authority by 5°. T / F

72. Normal rudder trim range is______±______degrees of rudder deflection. (PILOT ONLY)

73. All fuel tanks can be pressure or gravity filled. T / F

74. Two electrically operated fuel boost pumps are located in fuselage fuel cell number_____. In the event of an electrical failure, the left pump, which is a______speed pump, will operate on low speed when___________.

75. The internal and external wing tanks are vented to the atmosphere when the landing gear is down and the wing transfer pressure switch is in the OVRD TRANS position. T / F

76. Two methods available to pressurize the internal fuel cells and the external wing tanks are:

    a. Landing gear handle - ______________________________

    b. Wing transfer pressure switch - ______________________________

77. With an engine running, fuel from the centerline tank will start transferring upon selection of the _________position of the external transfer switch provided that the landing gear handle is in the ______ position or the wing transfer pressure switch is in the_________position.

78. When operating on RAT electrical power, external tanks may be transferred normally. T / F

QUESTION BANK CONTINUED

79. The internal wing tanks can be pressurized on the ground by moving the wing transfer pressure switch to the__________position. Transfer of internal wing fuel can then be accomplished by moving the internal wing transfer switch to the_________position if the external tanks transfer switch is in the **OFF** position.

80. The internal wing tanks will be pressurized any time the wing transfer pressure switch is placed to OVRD TRANS and an engine is running. T / F

81. Fuel transfer pumps are located in fuselage cells__________and__________. Two are__________and two are____________operated.

82. 17th stage engine bleed air is used to transfer__________and____________fuel. Fuel in fuselage cells_____, ______and_________is transferred by__________only.

83. Wing fuel may be dumped at any time, regardless of any other transfer switch position, by selecting the DUMP position on the internal wing dump switch. T / F

84. Wing fuel will be dumped on the deck if the internal wing dump switch is in the DUMP position and external electrical power is applied to the airplane. T / F

85. The fuel quantity indicator counter indicates fuel quantity in the___________and__________. The tape indicates fuel quantity in the____________cells only.

86. To prevent external tank collapse during high altitude descent with the gear down, place the________ ______________________in the__________position.

87. The internal wing dump control operates normally on RAT electrical power. T / F

88. Internal wing fuel can be dumped, regardless of the landing gear handle position. T / F

89. Illumination of the external fuel warning light is an indication of no flow, rather than low fuel quantity. T / F

90. When the air refueling probe is fully extended, the "IFR Probe Unlock" warning light will not be illuminated. T / F

91. The "Fuel Level Low" warning light will illuminate any time the combined fuel in fuselage cells_______ and_______ reaches__________pounds.

92. The total internal fuel capacity is approximately__________pounds.

93. Fuel boost pump pressure limits on preflight check is______to______psi.

94. Wing fuel transfer limits are______degrees nose-up, and______degrees nose-down.

95. When carrying external tanks, internal wing fuel will not transfer unless the transfer switch is in the__________ position.

96. If both fuel boost pumps fail while operating above______feet, flameout of both engines may occur.

97. Fuel will be supplied to the engines by gravity feed, if a failure of both fuel boost pumps occur. T / F

98. In the event one fuel boost pump fails, engine thrust settings should be reduced until a minimum boost pump pressure of______psi can be maintained. (PILOT ONLY)

99. The power control systems supply hydraulic power to the_________ , _________and_________.

100. There are three independent hydraulic systems in the airplane; they are the________ , the________ and the________ systems.

101. The utility hydraulic pumps utilize the same reservoir. T / F

102. The right engine utility hydraulic pump pressure is________, the left utility pump pressure is_______ psi.

103. The three hydraulic systems operate in a pressure range of_______PSI. The "Check Hyd Gages" light will illuminate when any system pressure drops below______ ± 100 PSI, and will go out when system pressure recovers to above_________ PSI.

104. The emergency hydraulic pump supplies power to the power control system no.____.

105. A PC-1 or a PC-2 failure will limit full travel of the lateral control surfaces and the stabilator at high airspeeds. T / F

QUESTION BANK CONTINUED

106. A "Check Hyd Gages" warning light, with all three gages indicating 3000 PSI, indicates________________ ________________________________.

107. The PC-1 and PC-2 hydraulic systems utilize the same accumulators and reservoirs. T / F

108. The rudder will be completely inoperative in the event of a utility hydraulic system failure. T / F

109. There is no safety feature incorporated in the landing gear system to prevent retraction on the ground. T / F

110. Nose gear steering is limited to______ degrees either side of center.

111. Two possible ways to deflate the nose gear strut while airborne are:

a.________________________________

b.________________________________

112. The nose gear steering system also functions as a__________.

113. Actuation of the warning lights test switch by the RSO will illuminate the pilot's master caution light. T / F

114. List the data that must be pre-set into the navigation computer: (RSO ONLY)

a.________________________________

b.________________________________

c.________________________________

d.________________________________

e.________________________________

115. The "Oxygen Low" warning light will illuminate when the supply is reduced to one liter. T / F

116. The normal pneumatic system pressure range on the cockpit indicator is________ to________ psi.

117. The systems operated with pneumatic system pressure are:

a. Normal system operation:

1.________________________________

2.________________________________

3.________________________________

b. Emergency system operation:

1.________________________________

2.________________________________

3.________________________________

4.________________________________

5.________________________________

118. If the "Speed Brake Out" indicator light illuminates, the "Master Caution" light will also illuminate. T / F

119. The wings cannot be folded with the landing gear retracted. T / F

120. The authorized fuels for the airplane are:

a. Ashore -________________________________

b. Afloat -________________________________

c. Emergency -________________________________

121. To refuel the airplane's internal tanks on the ground with engines running, place the refuel probe switch to the__________________position.

QUESTION BANK CONTINUED

122. For ground pressure refueling with engines off and external electrical power connected, list the fuel control panel switch positions:

  a. External transfer switch - ____________________

  b. Wing transfer pressure switch - ____________________

  c. Refuel selection switch - ____________________

  d. Buddy fill switch - ____________________

  e. Refuel probe switch - ____________________

123. When you are pressure refueling on the ground, engines not running and electrical power connected, the engine master switches should be in the ________ position.

124. The ground fueling switch is located in the ________ wheel well.

125. The main and afterburner fuel controls should be adjusted for the specific density of the fuel grade being used. T / F

126. The maximum airspeed for drag chute deployment is ________ knots IAS.

127. List the airspeed limitations for:

  a. Landing gear extended - ____________________

  b. Wing flap extended - ____________________

  c. Canopy open - ____________________

  d. RAT extension - ________ Knots IAS or ________ Mach, whichever is less.

128. The center of gravity limitations for all current permissible gross weights and configurations are between ________ % and ________ of the Mean Aerodynamic Chord.

129. The weight limitations for the following conditions are:

  a. Field takeoff - ________ pounds.

  b. Field landing (flared) - ________ pounds.

  c. Catapulting - ________ pounds.

  d. Arresting landing, touch-and-go, and FMLP - ________ pounds.

  e. Barricade engagement - ________ pounds.

130. What is the maximum airspeed and Mach number for the air refueling probe:

  a. Extension ________ knots IAS or ________ Mach, whichever is less.

  b. Fully extended ________ knots IAS or ________ Mach, whichever is less.

131. The maximum gross weight for a flared field landing is ________ pounds.

132. Maximum gross weight for a field mirror landing is ________ pounds.

133. List eight prohibited maneuvers: (OPEN BOOK ONLY)

  a. ____________________

  b. ____________________

  c. ____________________

  d. ____________________

  e. ____________________

  f. ____________________

  g. ____________________

  h. ____________________

134. Full pressure suits will be worn on all flights above ________ feet.

135. The limiting wind velocity for crosswind drag chute deployment is:

  a. 45° ________ Knots

  b. 90° ________ Knots

136. The FMLP pattern altitude is ________ above ground level.

QUESTION BANK CONTINUED

137. The pilot's NO-GO signals for catapult abort are:

 a. Day - ______________________________

 b. Night - ______________________________

138. If a BLC failure is experienced, approach and landing speeds must be increased. T / F

139. The day signal for HEFOE code commencing is ______________________________
______________________.

140. The RSO has just given you a HEFOE signal - four fingers - followed by a thumbs down. What pilot action is required? ______________________________

141. The HEFOE signals and meanings are:

FINGERS	ONE	TWO	THREE	FOUR	FIVE
MEANINGS -	____	____	____	____	____

142. The RSO will normally eject before the pilot. According to the NATOPS manual, what are the only foreseeable deviations from this?

 a. ______________________________

 b. ______________________________

143. The ejection signals given to the RSO if the intercom is inoperative with no eject light are:

 a. ______________________________

 b. ______________________________

 If there is not response to either (a) or (b):

 c. ______________________________

144. You are attempting to eject but the canopy fails to jettison. What would you do to manually jettison the canopy?

 a. ______________________________

 If the canopy still fails to jettison:

 b. ______________________________

 c. ______________________________

145. After ejection, the crewmember must manually actuate his oxygen supply. T / F

146. The recommended maximum airspeeds for ejection are:

NEW

 a. ______________ below 100 feet

 b. ______________ above 100 feet

147. The minimum published altitude for safe ejection is 200 feet. T / F

148. During a normal approach-full flaps, gear down, gross weight 34,000 pounds, the minimum safe ejection altitude for a seat having ground level capability is approximately _______ feet. This includes normal sink rates and pilot reaction time.

149. List the procedures required to obtain the use of the essential bus when the right generator failed and the "Bus Tie Open" light is illuminated.

 a. ______________________________

 b. ______________________________

150. List the NATOPS procedure for engine failure during takeoff, if takeoff is continued (PILOT ONLY).

 a. ______________________________

 b. ______________________________

 c. ______________________________

 d. ______________________________

 e. ______________________________

 f. ______________________________

QUESTION BANK CONTINUED

151. List the NATOPS procedure for double engine failure during flight (PILOT ONLY).
   a. ______
   b. ______
   c. ______
   d. ______
   e. ______
   f. ______

152. List the NATOPS air start procedure (PILOT ONLY).
   a. ______
   b. ______
   c. ______

153. List the NATOPS procedure for engine fire during start (PILOT ONLY).
   a. ______
   b. ______
   c. ______
   d. ______
   e. ______

154. After the gear and flaps are extended, using the emergency systems, their respective control handles should be reset by the pilot to ready the systems for normal operation. T / F

155. The emergency procedure for lowering the landing gear is:
   a. ______
   b. ______
   c. ______
   d. ______

156. The flap position for a single-engine landing is ______ flaps.

157. If a forced landing on unprepared terrain is unavoidable, land with the wheels ______ .

158. If it becomes necessary to jettison both canopies, jettison the ______ canopy first.

159. If it is necessary to ditch the airplane, ditch with the wheels ______ .

160. What steps should be taken in the event the intercom became inoperative:
   a. ______
   b. ______
   c. ______
   d. ______
   e. ______

161. The pilot-RSO attention signals, under emergency conditions, with no other means of communication are:
   a. Pilot - ______
   b. RSO - ______

162. If you are lost and have an operative radio receiver, you should fly two triangles to the ______ , repeating the pattern at ______ minute intervals.

163. If you are lost and have no operative radios, you should fly two triangles to the ______ , repeating the pattern every ______ minutes.

164. The minimum altitude above the terrain at which a pilot may go "hooded" on departure is ______ feet.

165. Instrument chase planes will make checks with the "hooded" plane at ______ minute intervals above flight level 240, and at ______ minute intervals below this level.

QUESTION BANK CONTINUED

166. The minimum altitude a pilot may remain "hooded" on a descent is_________ feet.

167. Supply the bank angles for the following directive commentary:

   a. EASY_________

   b. PORT (STBD)_________

   c. HARD_________

   d. HARD AS POSSIBLE_________.

   e. WRAP IT UP_________.

168. The proper sequence for information given in description commentary is:

   a. _________

   b. _________

   c. _________

   d. _________

169. The pilot will echo all directive commentary given by the RSO. T / F

170. Supply the interpretation of the following directive commentary:

   a. Ease - _________

   b. Hold - _________

   c. Harder - _________

   d. Break - _________

   e. Compass recovery - _________

   f. Buster - _________

   g. Gate - _________

171. The daylight emergency stop signal is raised crossed arms with clenched fists. T / F

172. In the landing pattern, the RSO will challenge the pilot on the gear, flaps, and hook positions if a report is not received. T / F

173. The RSO will monitor all instrument departures and approaches, and will advise the pilot of any course or minimum altitude deviations. T / F

174. A gradual afterburner shutdown must be made at speeds above_________knots IAS or_________ Mach, whichever is less, when operating at 40,000 feet.

175. The maximum limiting Mach number for a clean airplane is_________and begins at_________ feet on a standard day.

176. The maximum allowable airspeed for a clean airplane below 10,000 feet with C.G. forward of 30 MAC is_________knots IAS.

177. Maximum allowable acceleration limits of the centerline tank are:

   a. Full_________ to_________.

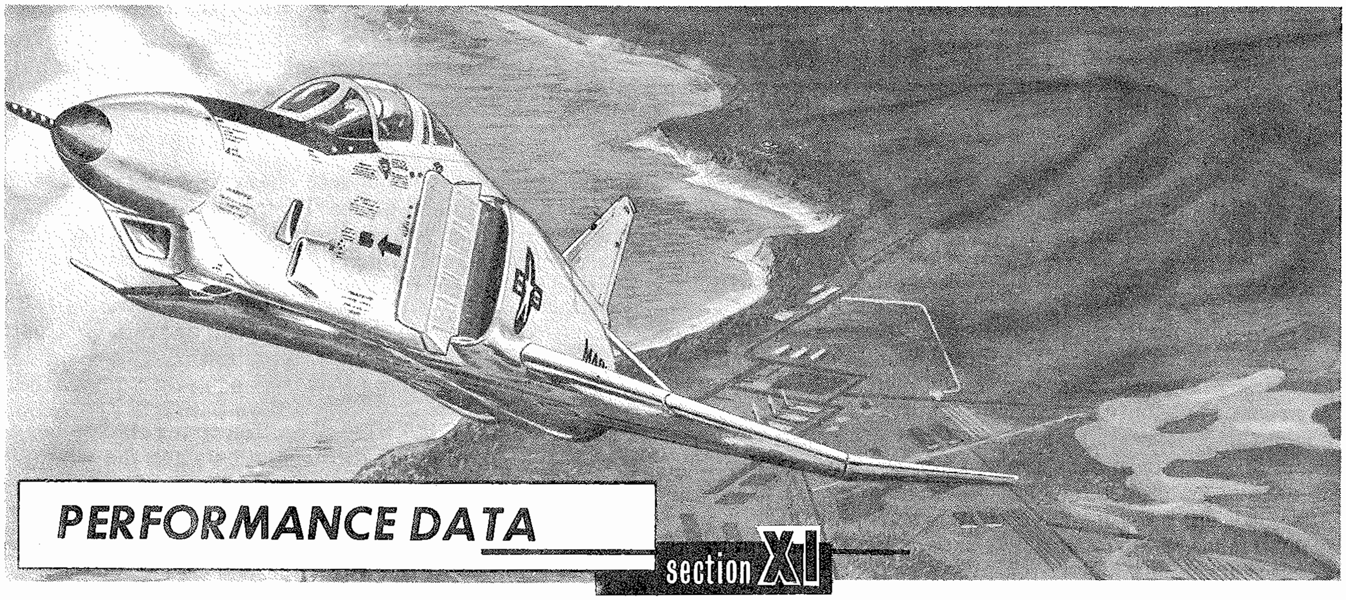
   b. Empty to 3/4 Full_________to_________.

178. Maximum allowable acceleration limits of the external wing tank are:

   a. Full_________ to_________.

   b. Empty to 3/4 Full_________ to_________.

179. The maximum speed for jettisoning external tanks is_________IAS, or_________Mach in level flight.



PERFORMANCE DATA section XI

RF4B-PTCA

INTRODUCTION part 1

CHARTS

This section is divided into parts (1 through 10) to present performance data in proper sequence for preflight planning. The drag index concept is used to present subsonic climb data, nautical miles per pound for cruise/endurance, and recommended descent. All other data are presented as a specific configuration per chart. All performance data are based on flight tests or the contractor's estimate, ICAO standard day conditions and/or provisions to correct for non-standard temperatures, and J79-GE-8 engines using JP-5 fuel.

Note

The indication of the fuel quantity indicator presents the readings of actual fuel weight remaining. This is accomplished by means of compensator capacitors which provide accurate readings regardless of changes in the dielectric value of the fuel or variations in specific density due to temperature changes. Therefore, adjustment for various fuel densities is not necessary.

DRAG INDEX SYSTEM

The drag indexes chart (figure 11-1) presents, in tabular form, the drag number for each externally carried store and its associated suspension equipment. Drag numbers for additional stores will be added to the chart as they become available. The total drag index for a specific configuration may be found by multiplying the number of stores carried by its corresponding drag number. The total drag index may then be used to enter the planning data charts. The drag index on the planning data charts will be noted in one of two ways: "All configurations, drag index individually noted" or "Limited configurations, drag index-X". Charts marked "All configurations, drag index individually noted" contain data for a range of drag numbers; i.e., individual curves/columns for a specific drag number. Charts marked "Limited configurations, drag index-X" contain data applicable to the single drag number listed on that chart.

Note

The drag of the clean airplane is 6.9.

Sample Problem

Configuration: Basic airplane with (2) 370-gal. tanks and ℄ 600-gal. tank.

A. Clean airplane drag	6.9
B. 370-gal. tank drag	4.8 X 2 = 9.6
C. 600-gal. tank drag	9.6
D. Total drag index	26.1

WIND COMPONENTS CHART

A standard wind components chart (figure 11-2) is included. It is used primarily for breaking a forecast wind down into crosswind and headwind-tailwind components for takeoff computations. It may, however, be used whenever wind component information is desired.

USE

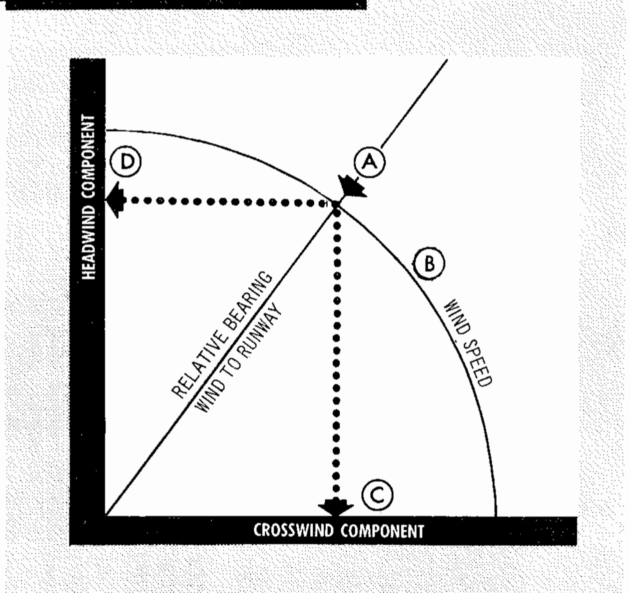
Reduce the reported wind direction to a relative bearing by determining the difference between the wind direction and the runway heading. Enter the chart with the relative bearing. Move along the relative bearing to intercept the wind speed arc. From this point, descend vertically downward to read the crosswind component. From this intersection of bearing and wind speed, also project horizontally to the left to read headwind component.

Sample Problem

Reported wind 050/35, runway heading 030.

A. Relative bearing	20°
B. Intersect windspeed arc	
C. Crosswind component	12 Kts
D. Headwind component	33 Kts

SAMPLE WIND COMPONENTS



PS102A

AIRSPEED CONVERSION

The airspeed conversion chart (figure 11-3) provides a means of converting calibrated airspeed to true Mach number and true airspeed. Enter the chart at the bottom with the calibrated airspeed. Proceed vertically upward to intersect the altitude. From this point, proceed horizontally to the left and read true Mach Number. From the calibrated airspeed-altitude intersection, proceed horizontally to the right to intersect the sea level line. From this point, proceed vertically downward to intersect the temperature corresponding to flight level temperature. Then proceed horizontally to the right and read true airspeed. It is also possible to obtain the standard day true airspeed by proceeding parallel to the curved dash lines on the plot from the calibrated airspeed-altitude intersection to the sea level line. The standard day true airspeed may be read directly on the airspeed scale along the sea level line. For clarity, the sample problem and procedure guide is presented on the chart.

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.

EQUIVALENT AIRSPEED

Equivalent airspeed is calibrated airspeed corrected for compressibility. There is no provision made for reading equivalent airspeed; however, if it is required, simply multiply the TAS by the $\sqrt{\sigma}$ (obtained from any standard atmosphere table).

TRUE AIRSPEED

True airspeed (TAS) is equivalent airspeed corrected for density altitude. Refer to the airspeed conversion charts (figure 11-3). True airspeed may be read directly from the cockpit true airspeed indicators.

AIRSPEED POSITION ERROR CORRECTION

The design and location of the pitot-static boom provides a static source with a very small position error. The indicated airspeed and Mach number may be corrected to calibrated and true values respectively by using the Airspeed Position Error Correction charts (figures 11-4 and 11-5).

Sample Problem

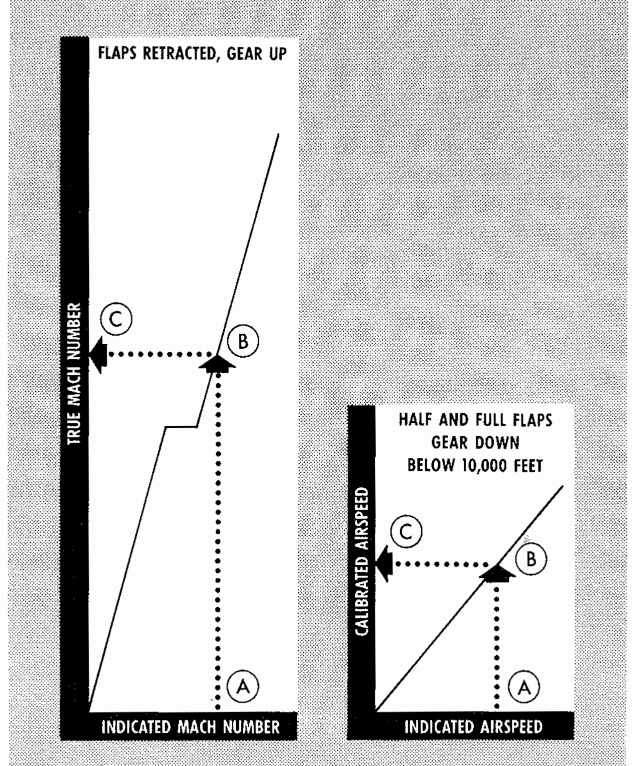
Configuration: Full Flaps, Gear Down

A. Indicated airspeed	180 Kts.
B. Reflector line	
C. Calibrated airspeed	182 Kts.

Configuration: Flaps Up, Gear Up

A. Indicated Mach number	1.4 Mach
B. Reflector line	
C. True Mach number	1.39 Mach

SAMPLE AIRSPEED POSITION ERROR CORRECTION



PS100

ALTIMETER POSITION ERROR CORRECTION

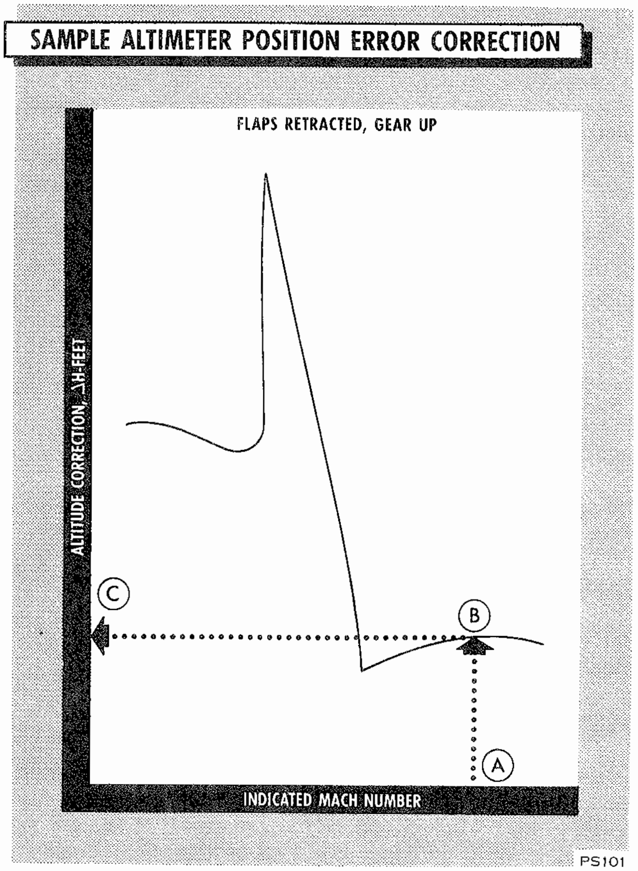
The design and location of the pitot-static boom provides a static source with a very small position error. The altimeter can be corrected for static source error by using the Altimeter Position Error Correction chart (figure 11-6). This chart supplies "Δ H" (incremental change) corrections from sea level for gear and flaps retracted. The curves shown are assigned altitude. The "Δ H" correction is to be added algebraically to the assigned altitude to obtain indicated altitude. Fly indicated altitude. In the gear down, one half or full flaps configuration the correction is a constant ("Δ H" = -30 feet) and, therefore, a chart is not necessary.

USE

Enter the chart with the indicated Mach number. Proceed vertically to intersect the assigned altitude curve closest to the assigned (or desired) altitude. Proceed horizontally to the left and record the altitude correction. Add the correction algebraically to the assigned altitude. Fly indicated altitude. If the intersection of Mach number and assigned altitude occurs in the shaded area of the chart, the airplane is lower than the assigned altitude and a climb must be initiated. If the intersection occurs in the unshaded area of the chart, the airplane is higher than the assigned altitude and a descent must be initiated.

Sample Problem

A. Indicated Mach number	1.4
B. Assigned altitude reflector	40,000 Ft.
C. "Δ H" correction	240 Ft.
D. Indicated altitude necessary to maintain 40,000 feet (B + C.)	40,240 Ft.



PS101

Drag Indexes

TANK OR STORE	UNIT DRAG NUMBER	MAXIMUM STORES LOAD AND LOCATION
370 GALLON EXTERNAL TANK	4.8	1 ON EACH OUTBOARD STATION
600 GALLON EXTERNAL TANK	9.6	1 ON THE CENTERLINE STATION
RCPP-105 STARTER POD	7.8	

Notes

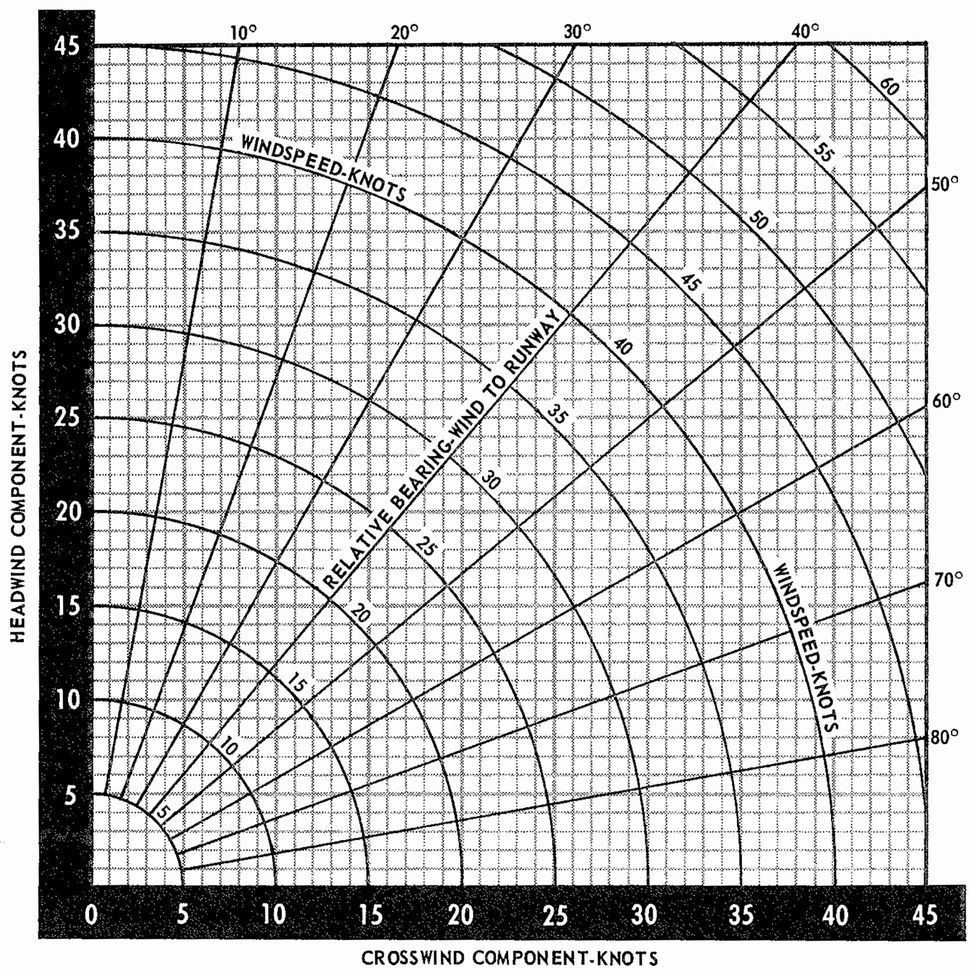
- USE A DRAG INDEX OF 6.9 FOR THE CLEAN AIRPLANE.
- INDIVIDUAL STORE DRAG X NUMBER OF STORES TO BE CARRIED = DRAG INDEX.
- REFER TO EXTERNAL STORES LIMITATIONS CHART (PART 4, SECTION I) FOR INFORMATION ON LOADINGS AND LIMITATIONS.

UNCLASSIFIED

RF4BS-P107

Figure 11-1

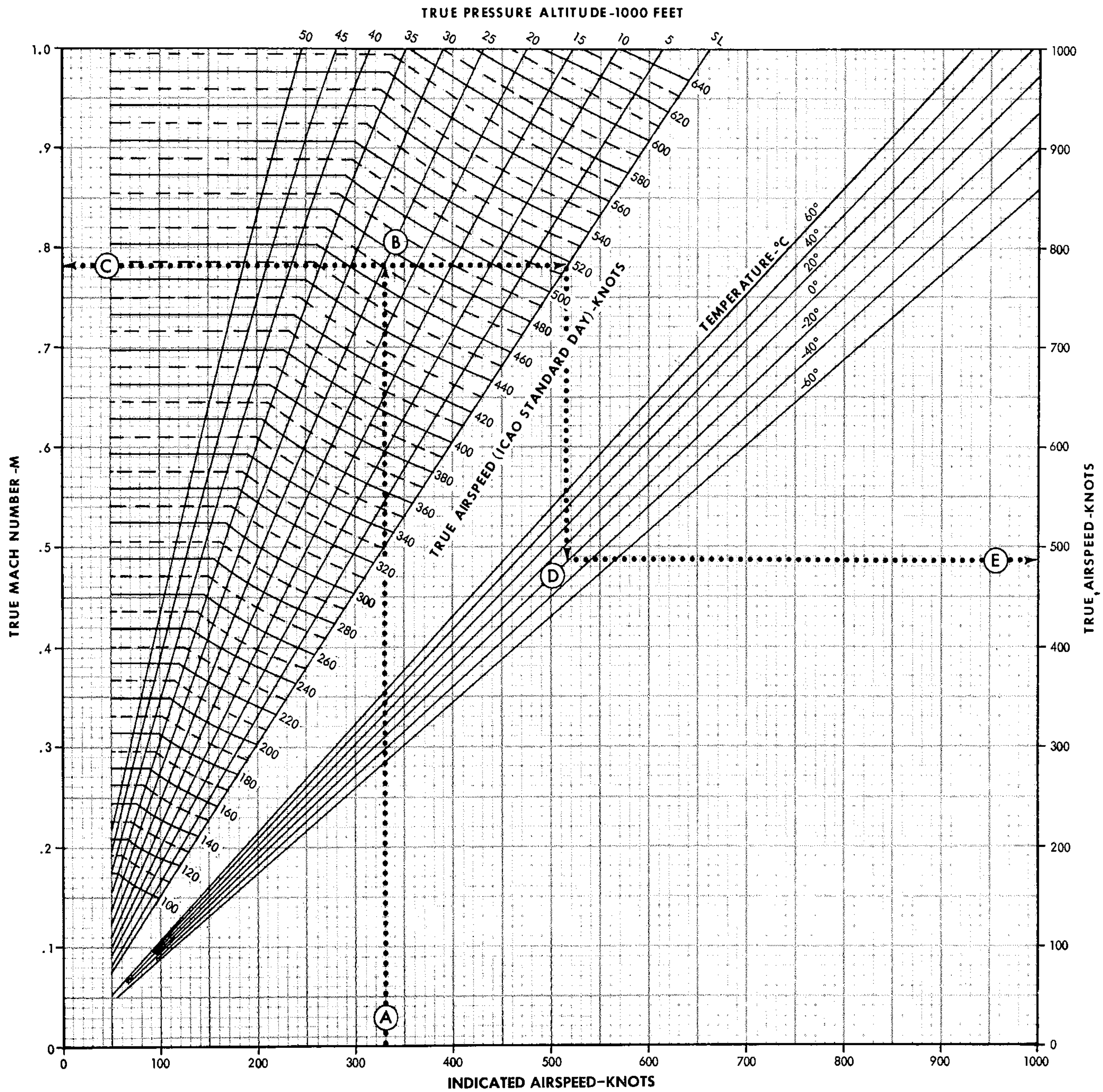
WIND COMPONENTS



RF4B-P108A

Figure 11-2

AIRSPEED CONVERSION

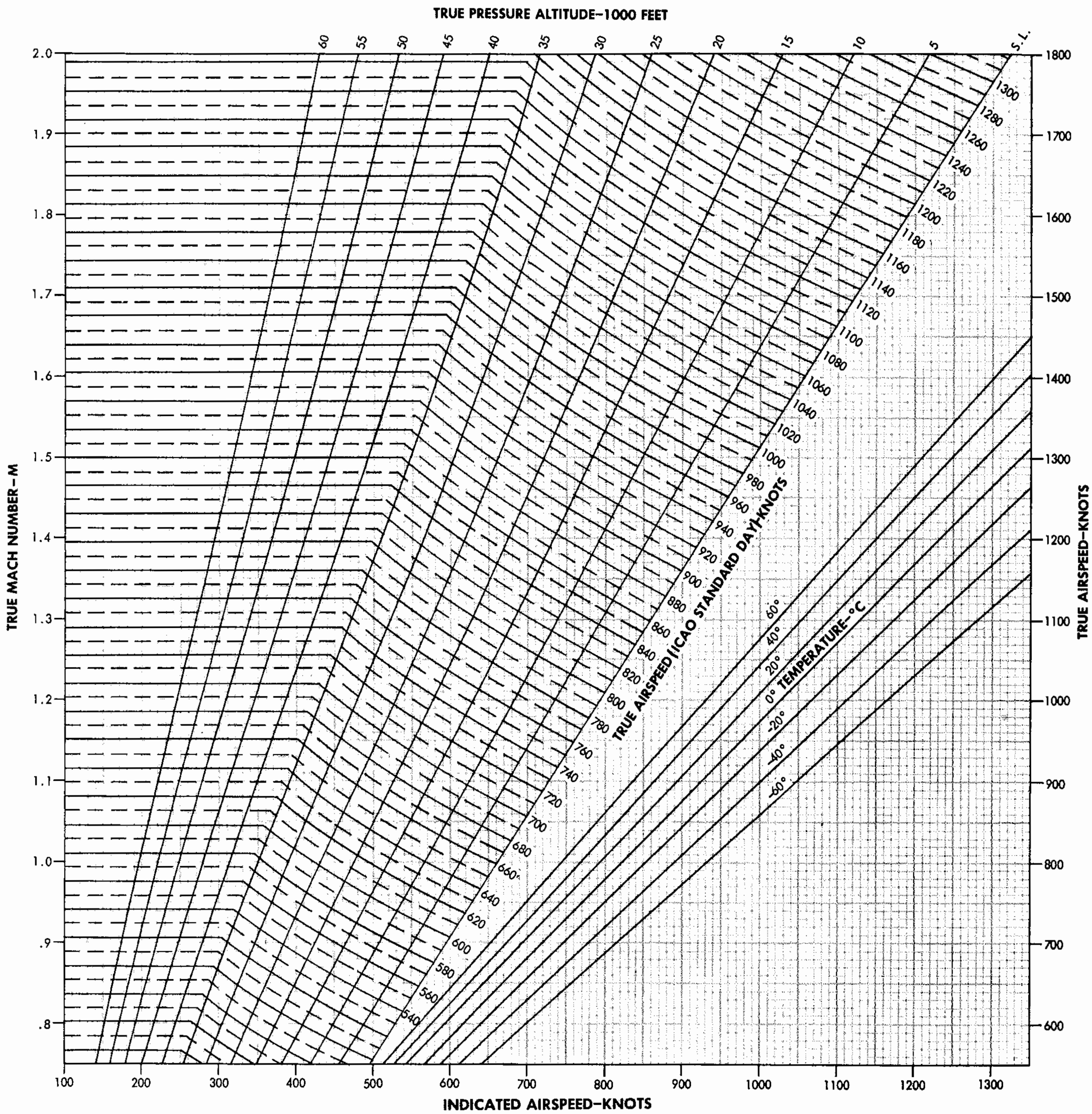


EXAMPLE
A=IAS=330 KNOTS
B=ALTITUDE=25,000 FEET
C=MACH=.782
D=TEMPERATURE=-20°C
E=TAS=486 KNOTS

RF4B-P102-1

Figure 11-3 (Sheet 1)

AIRSPEED CONVERSION



RF4B-P102-2

Figure 11-3(Sheet 2)

AIRSPEED POSITION ERROR CORRECTION

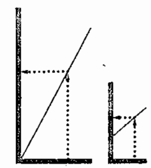
AIRPLANE CONFIGURATION

ALL CONFIGURATIONS
FLAPS AND GEAR AS NOTED

REMARKS

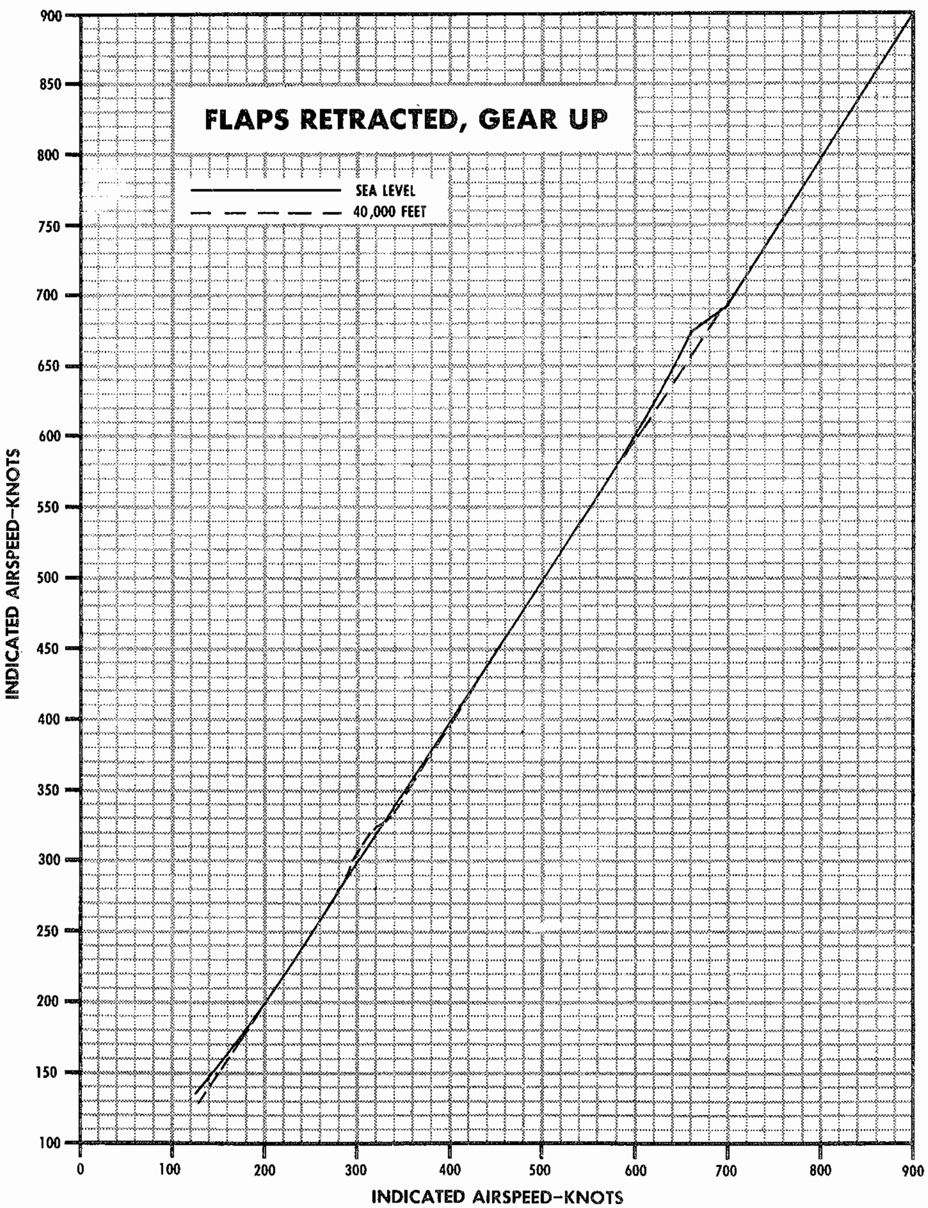
ENGINE(S):(2) J79-GE-8

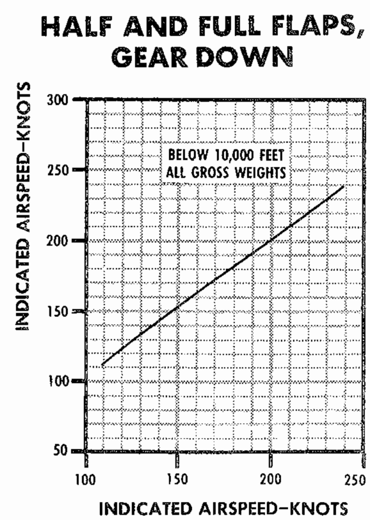
GUIDE



DATE: 27 APRIL 1964
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL





RF4B-P104

Figure 11-4

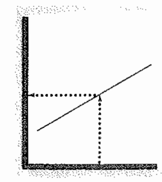
AIRSPEED POSITION ERROR CORRECTION

AIRPLANE CONFIGURATION

ALL CONFIGURATIONS
FLAPS RETRACTED, GEAR UP

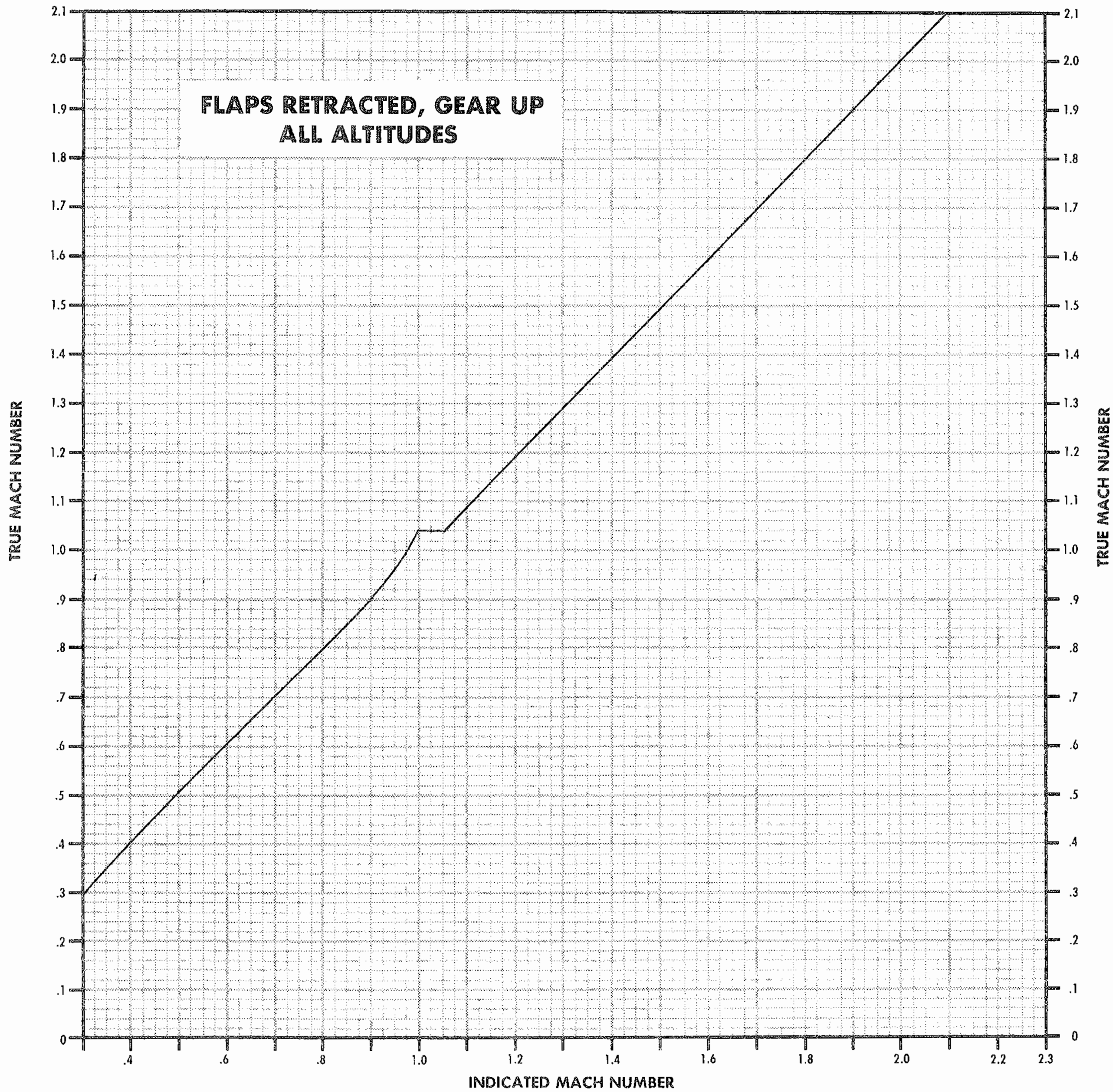
REMARKS
ENGINE(S):(2) J79-GE-8

GUIDE



DATE: 27 APRIL 1964
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



RF4B-P105

Figure 11-5

ALTIMETER POSITION ERROR CORRECTION

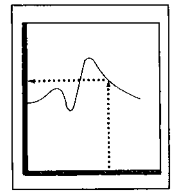
AIRPLANE CONFIGURATION
FLAPS AND GEAR AS NOTED

DRAG INDEX
ALL CONFIGURATIONS

REMARKS
ENGINE(S):(2) J79-GE-8
ICAO STANDARD DAY

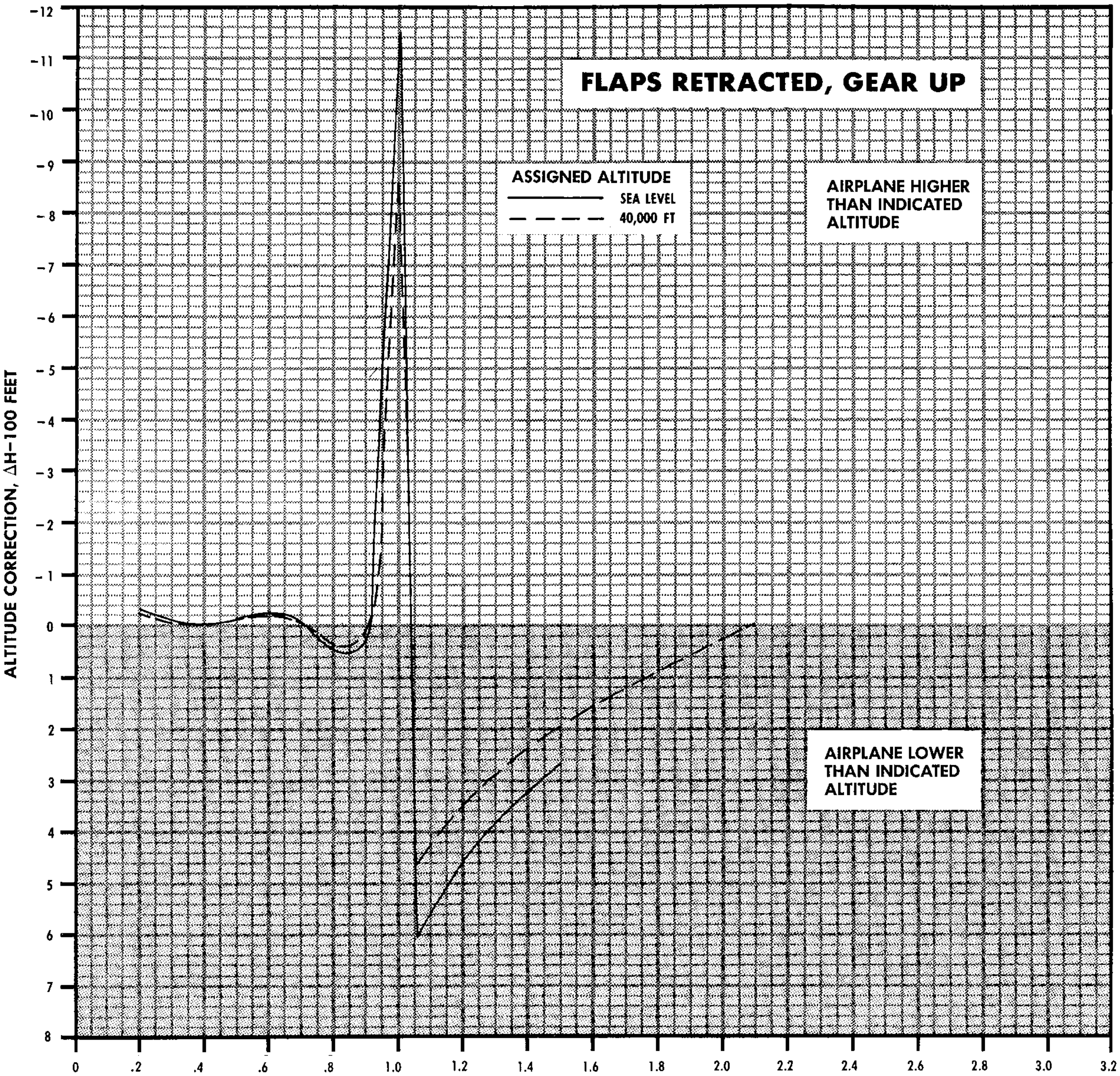
NOTE: ASSIGNED ALTITUDE +ΔH= INDICATED ALTITUDE. FLY INDICATED ALTITUDE.

GUIDE



DATE: 15 NOVEMBER 1965
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



RF4B-P106A

Figure 11-6

TAKEOFF part 2

CHARTS

DEFINITIONS OF TERMS USED

REFUSAL SPEED

The maximum speed to which the aircraft can accelerate and then stop in the available runway length.

REFUSAL DISTANCE

The distance required to accelerate to the refusal speed under normal conditions.

GO NO-GO DISTANCE

The distance to the runway marker which is the first 1000-foot marker below the normal refusal distance. It is also the point at which the final decision to continue or abort the takeoff is made.

GO NO-GO SPEED

The minimum allowable speed at the go no-go distance marker.

CRITICAL ENGINE FAILURE SPEED

The speed at which engine failure permits acceleration to takeoff in the same distance that the aircraft may be decelerated to a stop.

CRITICAL FIELD LENGTH

The total length of runway required to accelerate on both engines to the critical engine failure speed, experience an engine failure, then continue to takeoff or stop.

DECISION SPEED

The minimum speed from which a safe takeoff can be continued in the remaining runway length should engine failure occur.

CRITICAL FIELD LENGTH CHARTS

The critical field length charts (figures 11-7 and 11-8) are used to obtain the total runway length required to accelerate the aircraft, experience an engine failure, and then either continue the takeoff or decelerate the airplane to a full stop.

USE

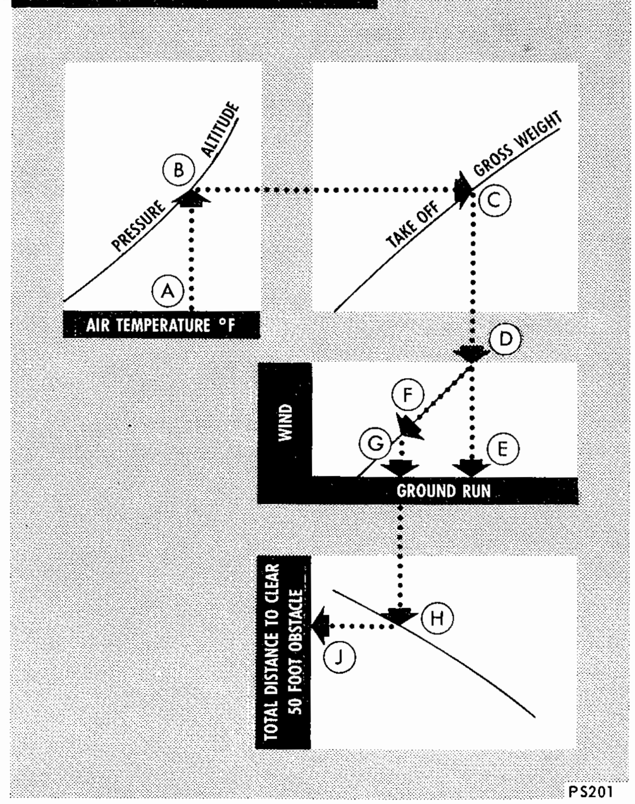
Enter the chart at the temperature scale and proceed vertically to intersect the pressure altitude. Proceed horizontally to intersect the takeoff gross weight line. From this point, descend to the ground run for critical field length. Proceed along the proper guide line to adjust for wind effects and vertically downward to the applicable reflector line for the distance required to clear a 50-foot obstacle.

Sample Problem

Configuration: Gear Down, 1/2 Flaps, Maximum Power

A.	Air temperature	75°F
B.	Pressure altitude	Sea level
C.	Takeoff gross weight	45,000 Lbs.
D.	Wind base line	
E.	Critical field length (no wind)	5,000 Ft.
F.	Effective Headwind	20 Kts.
G.	Critical field length (with wind)	4,000 Ft.
H.	Reflector line (20 Knot Headwind)	
I.	Distance required to clear 50-foot obstacle (with wind)	6,400 Ft.

SAMPLE CRITICAL FIELD LENGTH



MAXIMUM REFUSAL SPEED OR CRITICAL ENGINE FAILURE SPEED CHARTS

These charts (figures 11-9 and 11-10) present data for both refusal speed and critical engine failure speed. The refusal speed is read in conjunction with the total runway length available, and represents the maximum speed to which the airplane may be accelerated and then stopped within the runway length. The critical engine failure speed is read in conjunction with the critical field length, and represents the conjugate speed at which a single engine failure permits acceleration to takeoff on the remaining engine in the same distance that it takes to decelerate the airplane to a full stop. The speeds are based on 1/2 flaps and with or without drag chute.

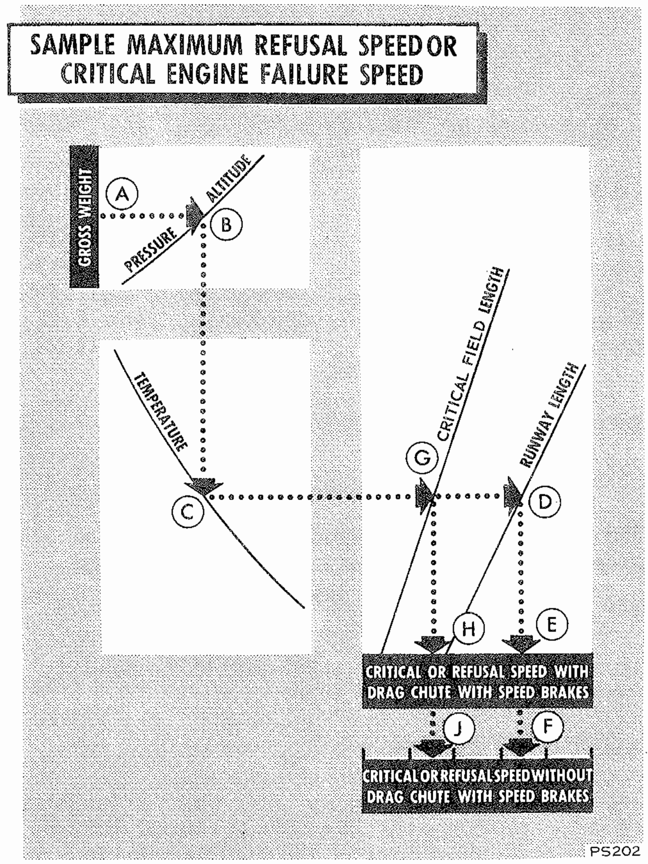
USE

Enter the chart corresponding to the takeoff power (MIL or MAX) with the airplane gross weight. Proceed horizontally to the right and intersect the field pressure altitude. Proceed vertically downward to the temperature. From this point, proceed horizontally to the right. If critical engine failure speed is desired, intersect the critical field length (taken from the Critical Field Length Chart). If Refusal Speed is desired, intersect the available runway length. From the critical field length or runway length intersection, proceed vertically downward to read the corresponding speeds with drag chute deployed (black) or without drag chute deployed (red).

Sample Problem

Configuration: Gear Down, 1/2 Flaps, Maximum Power

A.	Takeoff gross weight	45,000 Lbs.
B.	Pressure altitude	Sea Level
C.	Temperature	75°F
D.	Length of actual runway	7,500 Lbs
E.	Refusal speed (with drag chute)	167 Kts.
F.	Refusal speed (without drag chute)	157 Kts.
G.	Critical field length (Critical Field Length Chart)	4,000 Ft.
H.	Critical engine failure speed (with drag chute)	112 Kts.
I.	Critical engine failure speed (without drag chute)	107 Kts.



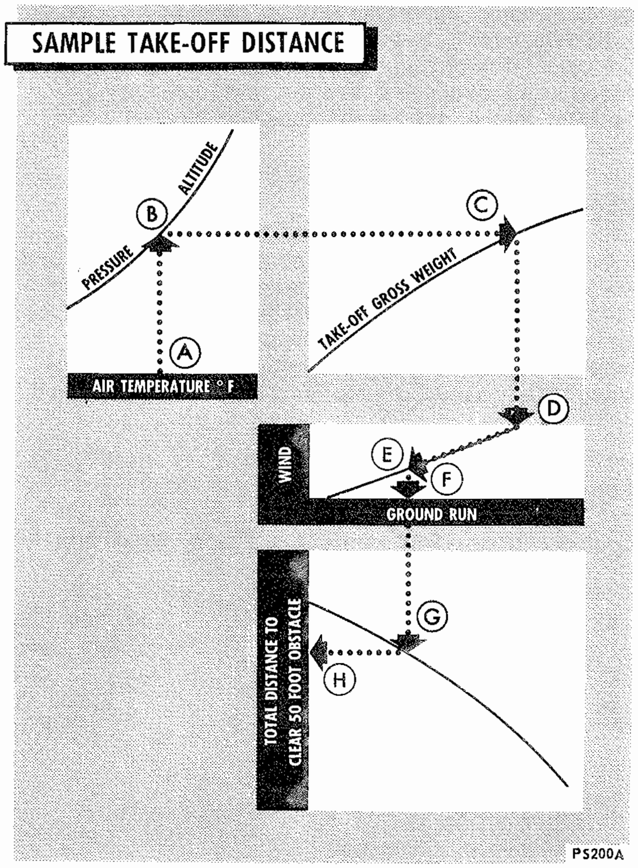
TAKEOFF DISTANCE CHARTS

Takeoff ground run distances and distance required to clear a 50-foot obstacle using Maximum or Military power are shown in the Takeoff Distance Charts (figures 11-11 and 11-12). The Maximum power chart is plotted for both 1/2 flaps and no-flaps takeoffs. Distances are computed for normal takeoff technique on a hard, dry runway. Temperature, pressure altitude, gross weight, and head winds are variables plotted in these graphs. The graphs may be used for any configuration considering gross weight.

NEW

USE

Enter the chart at the temperature scale, proceeding vertically to intersect the pressure altitude. Proceed horizontally to the takeoff gross weight and read takeoff airspeed. Descend to the base line for wind effect and apply effective wind. Descend to the ground run scale reading ground run distance required for lift-off and further to the reflector line for reading total distance required to clear a 50-foot obstacle.



Sample Problem

Configuration: 1/2 Flaps, Maximum Power

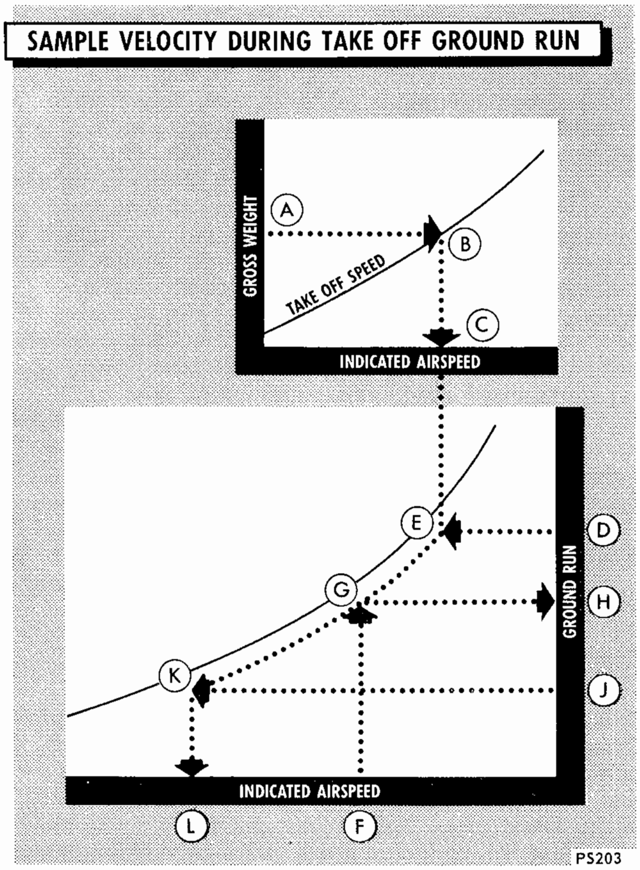
A.	Temperature	65°F
B.	Pressure altitude	4,000 Ft.
C.	Takeoff gross weight	40,000 Lbs.
D.	Wind base line	
E.	Effective headwind	20 Kts.
F.	Takeoff ground run distance	2,000 Ft.
G.	Reflector line	
H.	Distance required to clear a 50-foot obstacle	2,500 Ft.

VELOCITY DURING TAKEOFF GROUND RUN CHARTS (GO NO-GO LINE CHECK)

These charts (figures 11-13 and 11-14) present the normal takeoff speed for various gross weights. The maximum power chart provides for 1/2 flap and no-flap takeoffs. They may also be used to determine any line distance-speed relationship; e.g., line distance at critical engine failure speed, line distance at refusal speed, speed at any runway marker, and takeoff ground run for other than normal takeoff speed. It is recommended that the go no-go distance, as defined, be used as the criteria for decision to abort or takeoff after engine failure. If a definite failure occurs prior to reaching the go no-go distance marker, the airplane should be stopped. If the marker is reached and partial failure is indicated by the fact that the airplane speed is less than that predicted for that marker, the airplane should be stopped. If failure occurs, the pilot must not attempt to rotate the airplane to lift-off attitude until single-engine takeoff speed is attained. If critical field length exceeds the total runway length or 7,700 feet for any takeoff gross weight, temperature and altitude combination, climbout capability with one engine is insufficient.

USE

Enter the upper plot with the airplane gross weight. Proceed horizontally to the right to intersect the takeoff speed reflector. From this point, project a line vertically downward to the acceleration curves in the lower plot. Note the takeoff speed at the intersection of the projected line and the base of the upper plot. Enter the lower plot with the ground run distance (obtained from the takeoff distance chart for the given conditions) and project a line horizontally to the left to intersect the line projected down from the upper plot. At this intersection, plot in a line parallel to the acceleration curves. Re-enter the lower plot with the refusal speed (obtained from the maximum refusal speed chart for the given conditions) and proceed vertically upward to intersect the plotted acceleration curve. From this intersection, proceed horizontally to the right to read the refusal distance. Next, re-enter the lower plot at the ground run scale with the go no-go distance marker (the first 1000-foot marker below refusal distance; i.e., if the refusal distance fell between 2000 and 3000 feet, the go no-go distance marker would be the 2000-foot marker), proceed horizontally to the left to intersect the plotted acceleration curve, then vertically downward to read to go no-go line check speed.



Sample Problem

Configuration: Gear Down, 1/2 Flaps, Maximum Power

A. Takeoff gross weight	45,000 Lbs.
B. Takeoff reflector line	
C. Takeoff speed	160 Kts.
D. Takeoff ground run (Takeoff Distance Chart)	4,000 Ft.*
E. Intersection of C. and D.	
F. Refusal speed (without drag chute) (Maximum Refusal Speed or Critical Engine Failure Speed Chart)	157 Kts.*
G. Intersection of E. and F.	
H. Refusal distance	3,900 Ft.
J. Go No-Go distance (First runway marker before refusal distance)	3,000 Ft.
K. Intersection of E. and J.	
L. Go No-Go speed	138 Kts.

* These values selected for clarity only.

DECISION SPEED

The decision speed chart (figure 11-15) is provided to show graphically an indication of the minimum speed at which an engine failure could occur, with sufficient runway remaining to complete a takeoff on the remaining engine. If an engine failure is experienced at an airspeed below the previously computed decision speed, the takeoff must be aborted.

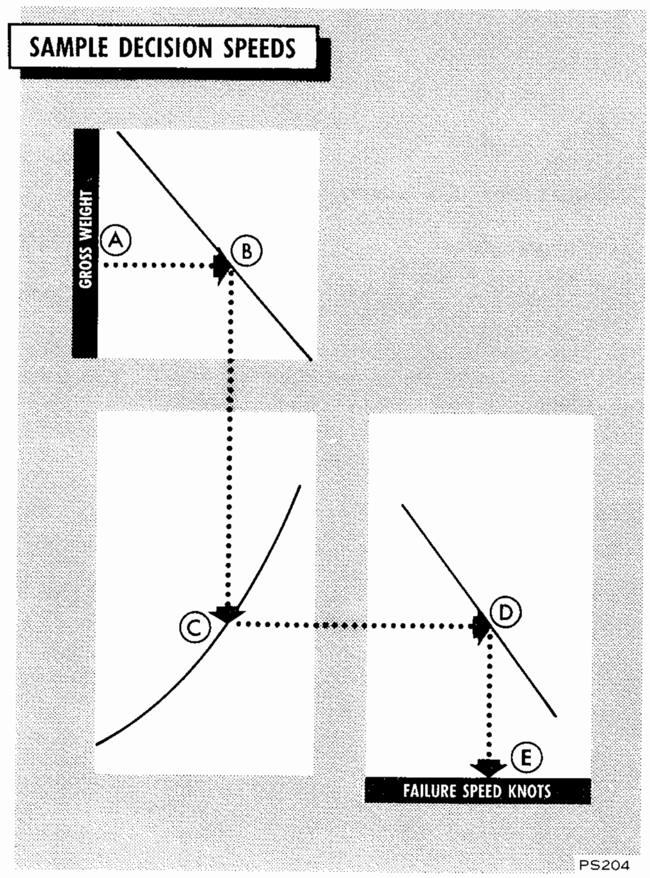
USE

Enter the chart at the airplane gross weight and proceed horizontally to the intersection of the pressure altitude. Descend to intersect the temperature scale and proceed horizontally to intersect the runway length. From the runway length intersection, descend to the base of the chart to read decision speed.

Sample Problem

Configuration: Gear Down, 1/2 Flaps, Maximum Power

A. Takeoff gross weight	45,000 Lbs.
B. Pressure altitude	Sea Level
C. Temperature	80°F
D. Length of runway	8,000 Ft.
E. Decision (failure) speed	105 Kts.



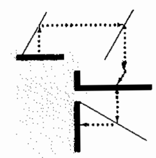
CRITICAL FIELD LENGTH

MAXIMUM POWER
HARD DRY RUNWAY

AIRPLANE CONFIGURATION
ALL CONFIGURATIONS
1/2 FLAPS, GEAR DOWN

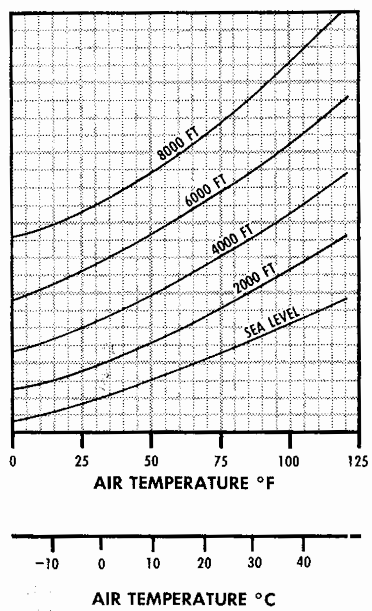
REMARKS
ENGINE(S):(2) J79-GE-8
SINGLE ENGINE FAILURE

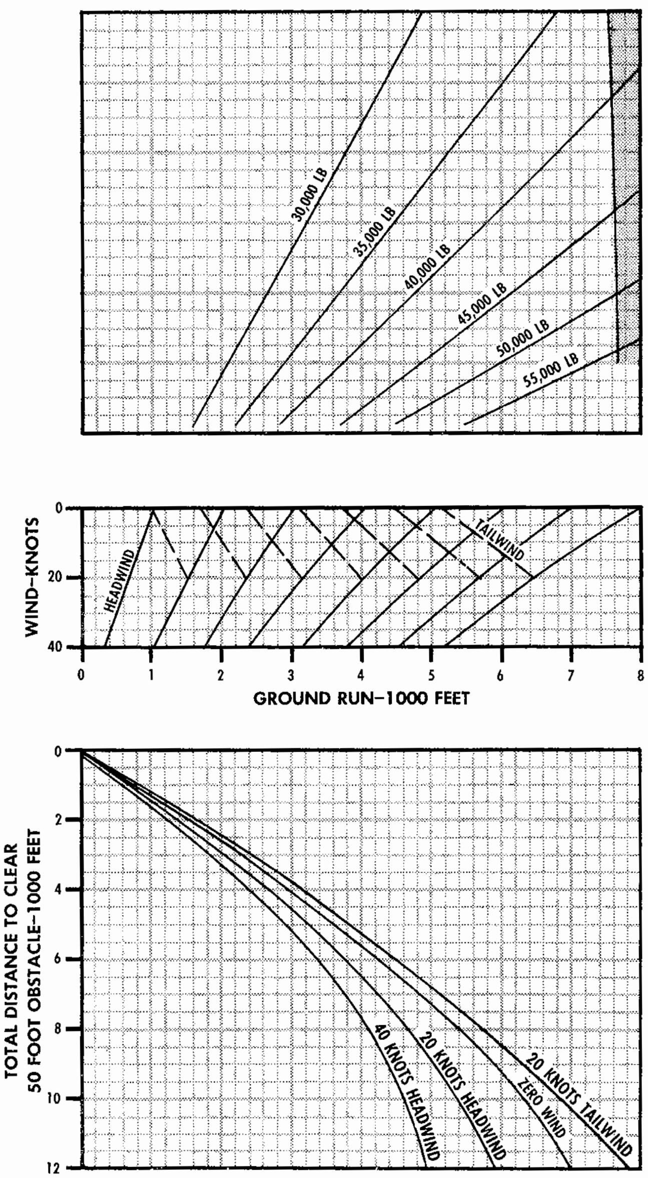
GUIDE



DATE: 1 JUNE 1961
DATA BASIS: **ESTIMATED**

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL





NOTES

1. CRITICAL ENGINE FAILURE SPEED (THE SPEED AT WHICH ENGINE FAILURE PERMITS ACCELERATION TO TAKEOFF IN THE SAME DISTANCE THAT THE AIRPLANE MAY BE DECELERATED TO A STOP) IS READ FOR CRITICAL FIELD LENGTH ON "REFUSAL SPEED CHARTS."
2. IN THIS AREA, NORMAL TAKEOFF SPEED MUST BE INCREASED TO PERMIT SINGLE ENGINE TAKEOFF.
3. CRITICAL FIELD LENGTH BASED ON STOPPING WITH DRAG CHUTE. STOPPING WITHOUT DRAG CHUTE INCREASES GROUND RUN 3%.

RF4B-P204

Figure 11-7

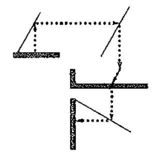
CRITICAL FIELD LENGTH

MILITARY POWER
MAXIMUM POWER AFTER ENGINE FAILURE
HARD DRY RUNWAY

AIRPLANE CONFIGURATION
ALL CONFIGURATIONS
1/2 FLAPS, GEAR DOWN

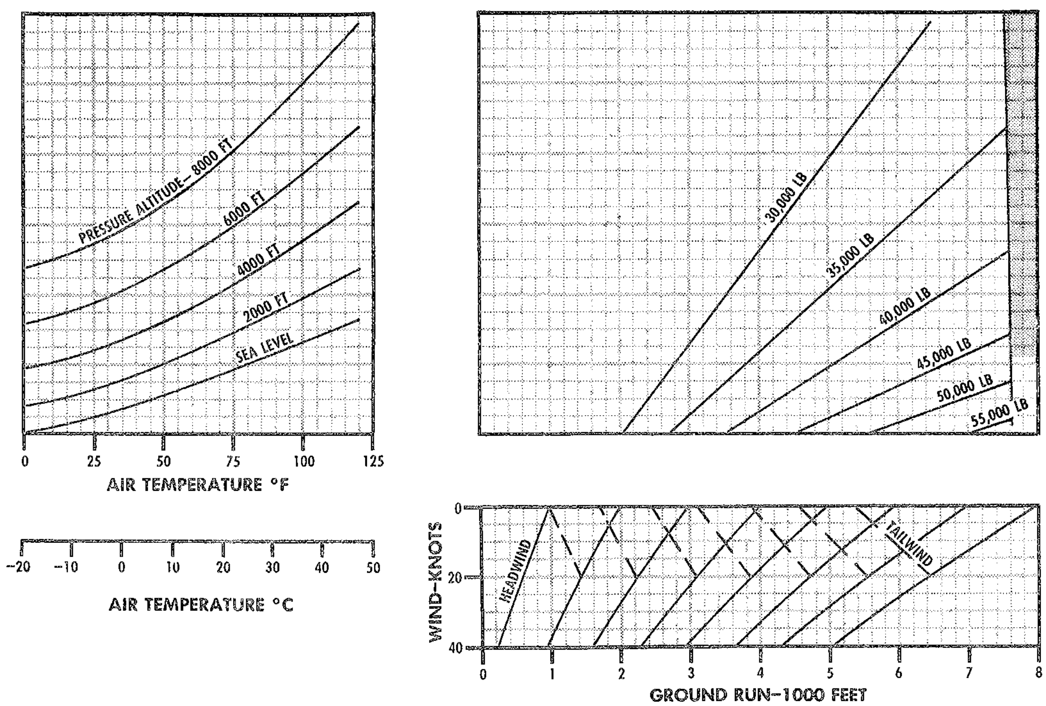
REMARKS
ENGINE(S):(2) J79-GE-8
SINGLE ENGINE FAILURE

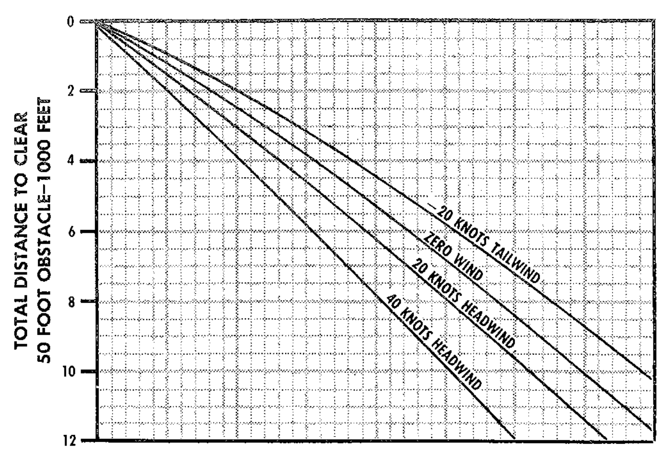
GUIDE



DATE: 1 AUGUST 1961
DATA BASIS: **ESTIMATED**

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL





NOTES

1. CRITICAL ENGINE FAILURE SPEED (THE SPEED AT WHICH ENGINE FAILURE PERMITS ACCELERATION TO TAKEOFF IN THE SAME DISTANCE THAT THE AIRPLANE MAY BE DECELERATED TO A STOP) IS READ FOR CRITICAL FIELD LENGTH ON "REFUSAL SPEED CHARTS."
2. IN THIS AREA, NORMAL TAKEOFF SPEED MUST BE INCREASED TO PERMIT SINGLE ENGINE TAKEOFF.
3. CRITICAL FIELD LENGTH BASED ON STOPPING WITH DRAG CHUTE. STOPPING WITHOUT DRAG CHUTE INCREASES GROUND RUN 1%.

RF4B-P205

Figure 11-8

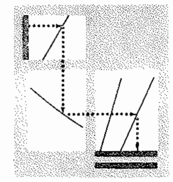
MAXIMUM REFUSAL SPEEDS OR CRITICAL ENGINE FAILURE SPEEDS

MAXIMUM POWER
HARD DRY RUNWAY

AIRPLANE CONFIGURATION
ALL CONFIGURATIONS
1/2 FLAPS, GEAR DOWN

REMARKS
ENGINE(S):(2) J79-GE-8
SINGLE ENGINE FAILURE

GUIDE



DATE: 1 JUNE 1961
DATA BASIS: ESTIMATED

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

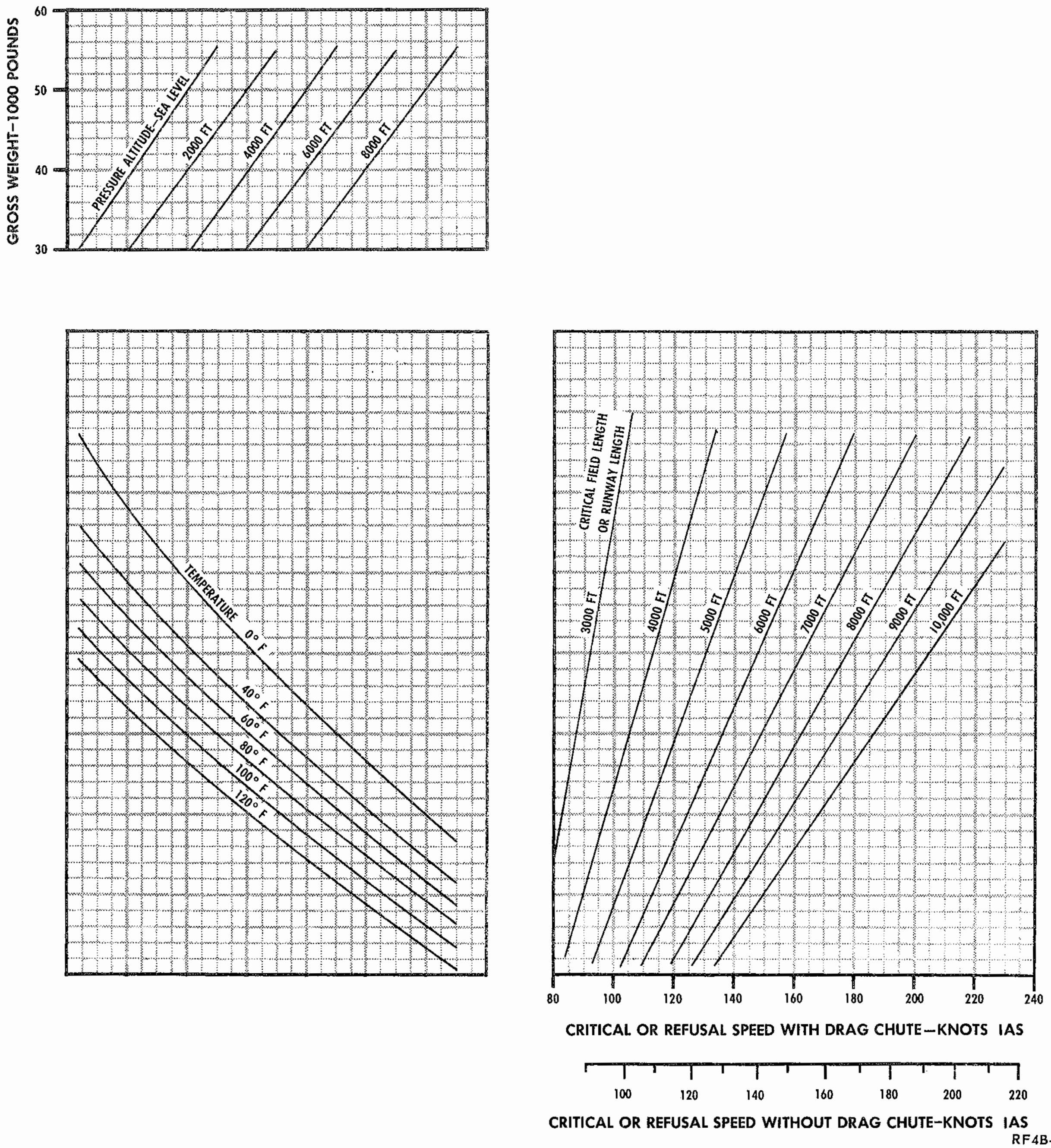


Figure 11-9

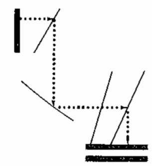
MAXIMUM REFUSAL SPEEDS OR CRITICAL ENGINE FAILURE SPEEDS

MILITARY POWER
MAXIMUM POWER AFTER ENGINE FAILURE
HARD DRY RUNWAY

AIRPLANE CONFIGURATION
ALL CONFIGURATIONS
1/2 FLAPS, GEAR DOWN

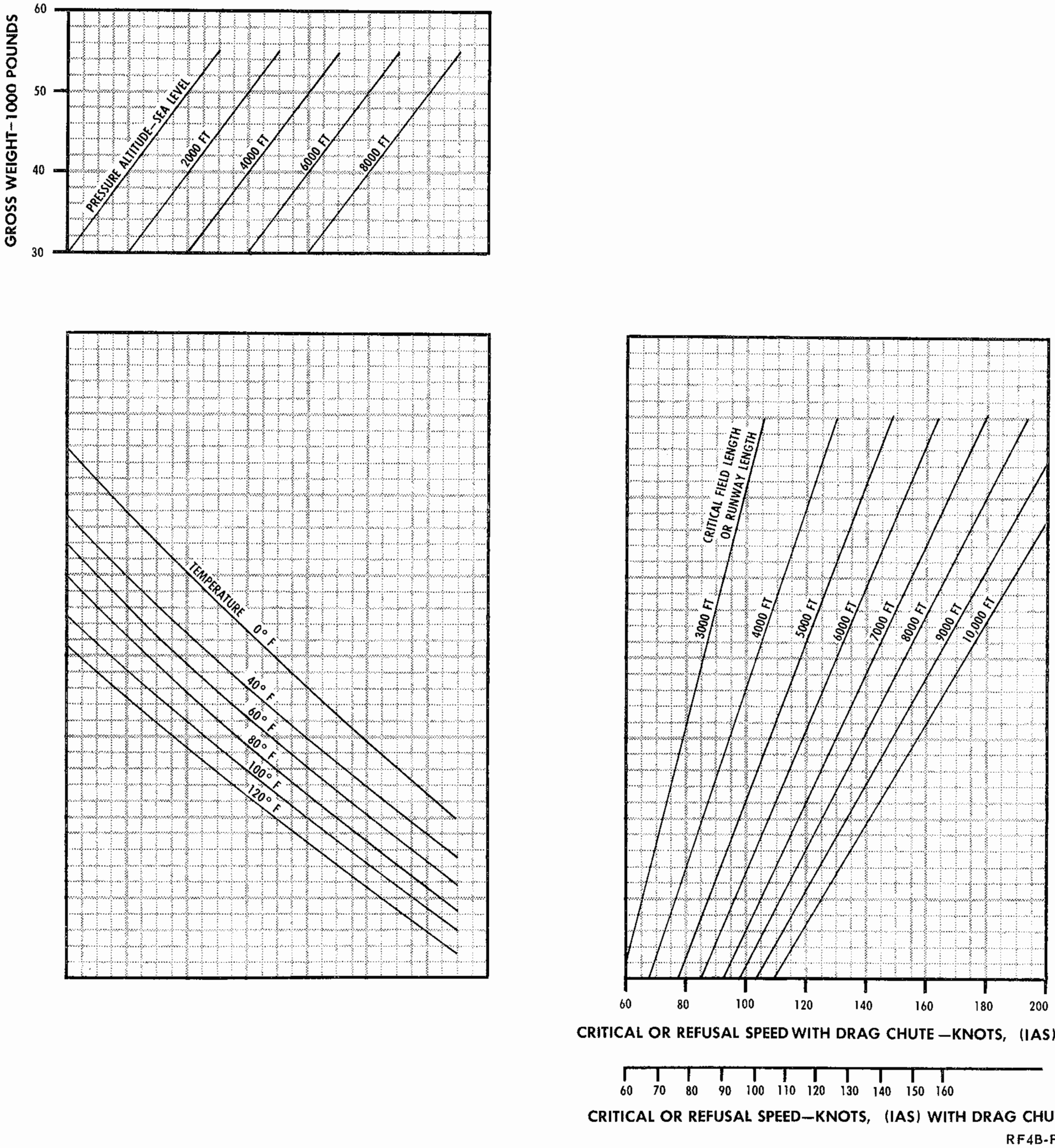
REMARKS
ENGINE(S):(2) J79-GE-8
SINGLE ENGINE FAILURE

GUIDE



DATE: 1 AUGUST 1961
DATA BASIS: **ESTIMATED**

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



RF4B-P207

Figure 11-10

TAKEOFF DISTANCE

MAXIMUM POWER
HARD DRY RUNWAY

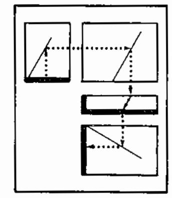
AIRPLANE CONFIGURATION
½ FLAPS, AND NO FLAPS
GEAR DOWN

DRAG INDEX

ALL CONFIGURATIONS

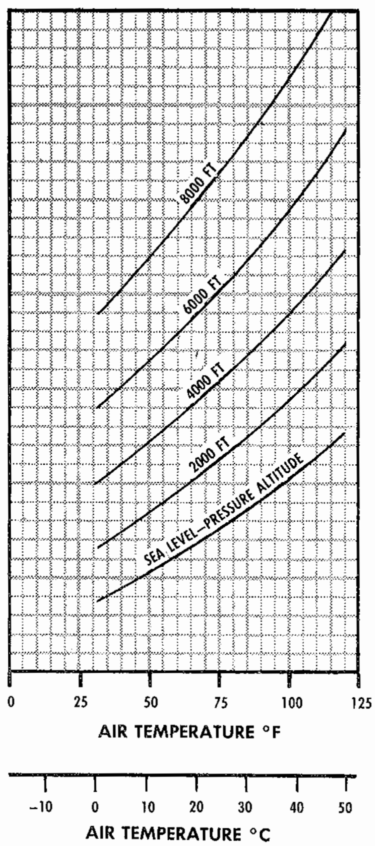
REMARKS
ENGINE(S):(2) J79-GE-8
ICAO STANDARD DAY

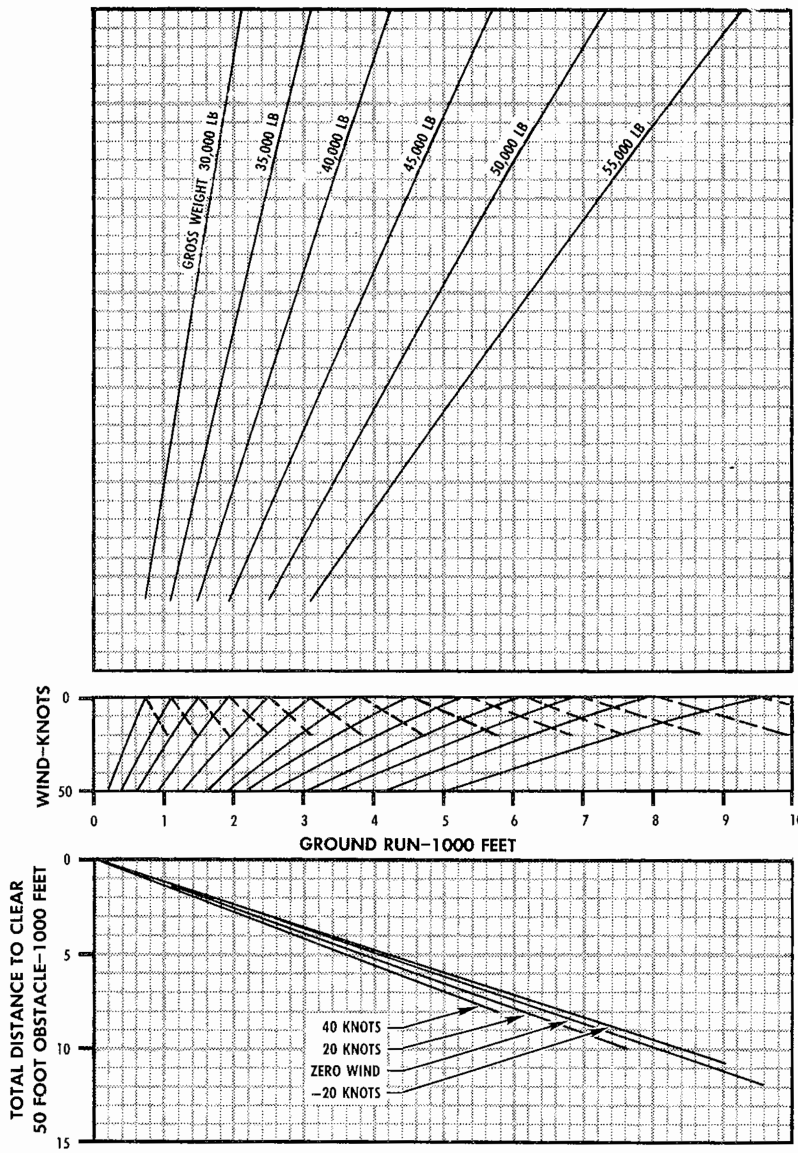
GUIDE



DATE: 15 DECEMBER 1965
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL





RF4B-P201A

Figure 11-11

TAKEOFF DISTANCE

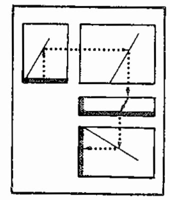
MILITARY POWER
HARD DRY RUNWAY

AIRPLANE CONFIGURATION
1/2 FLAPS, GEAR DOWN

DRAG INDEX
ALL CONFIGURATIONS

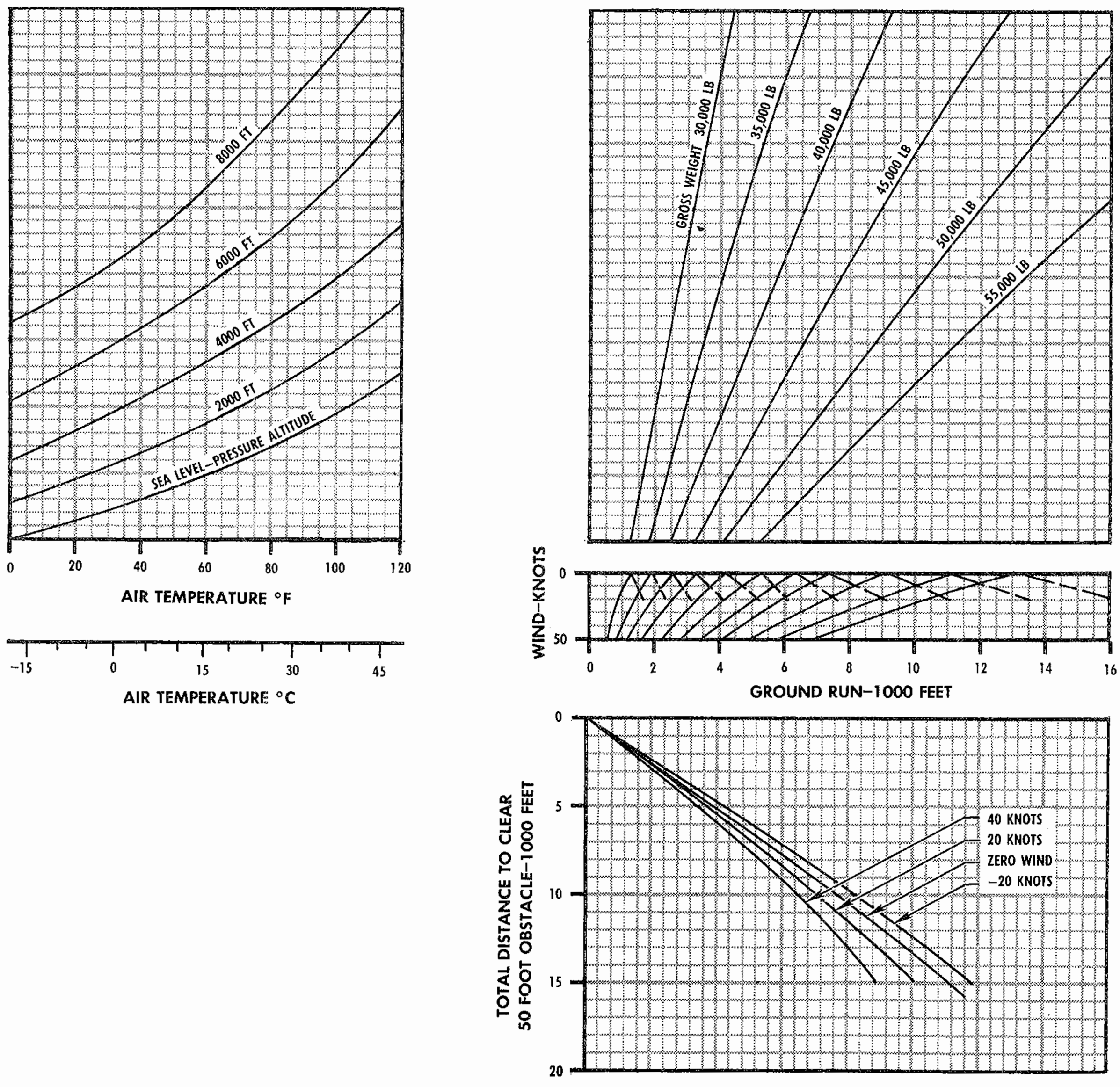
REMARKS
ENGINE(S):(2) J79-GE-8
ICAO STANDARD DAY

GUIDE



DATE: 15 DECEMBER 1965
DATA BASIS: ESTIMATED (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



RF4B-P202A

Figure 11-12

VELOCITY DURING TAKEOFF GROUND RUN

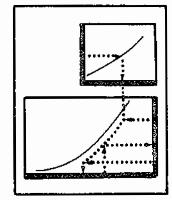
(GO - NO GO LINE CHECK)
MAXIMUM POWER
HARD DRY RUNWAY

AIRPLANE CONFIGURATION
½ FLAPS, AND NO FLAPS GEAR DOWN

DRAG INDEX
ALL CONFIGURATIONS

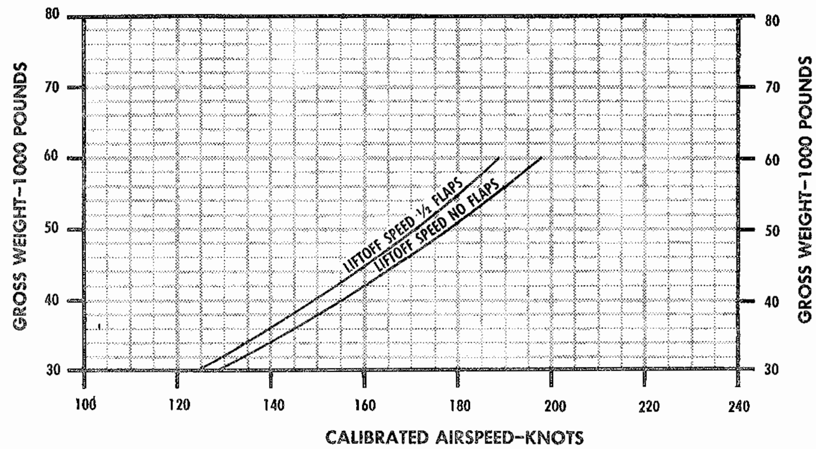
REMARKS
ENGINE(S): (2) J79-GE-8
ICAO STANDARD DAY

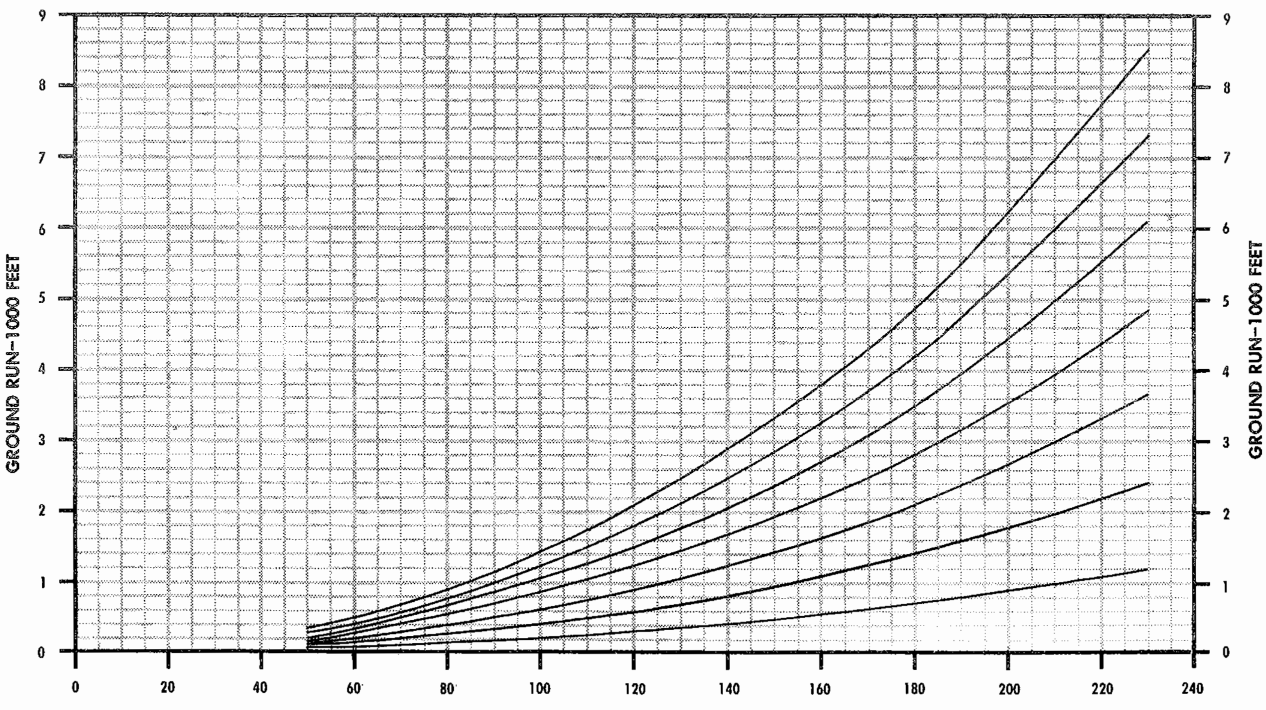
GUIDE



DATE: 15 NOVEMBER 1965
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL





RF4B-P208A

Figure 11-13

VELOCITY DURING TAKEOFF GROUND RUN

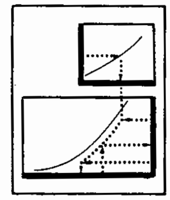
(GO - NO GO LINE CHECK)
MILITARY POWER
HARD DRY RUNWAY

AIRPLANE CONFIGURATION
½ FLAPS, GEAR DOWN

DRAG INDEX
ALL CONFIGURATIONS

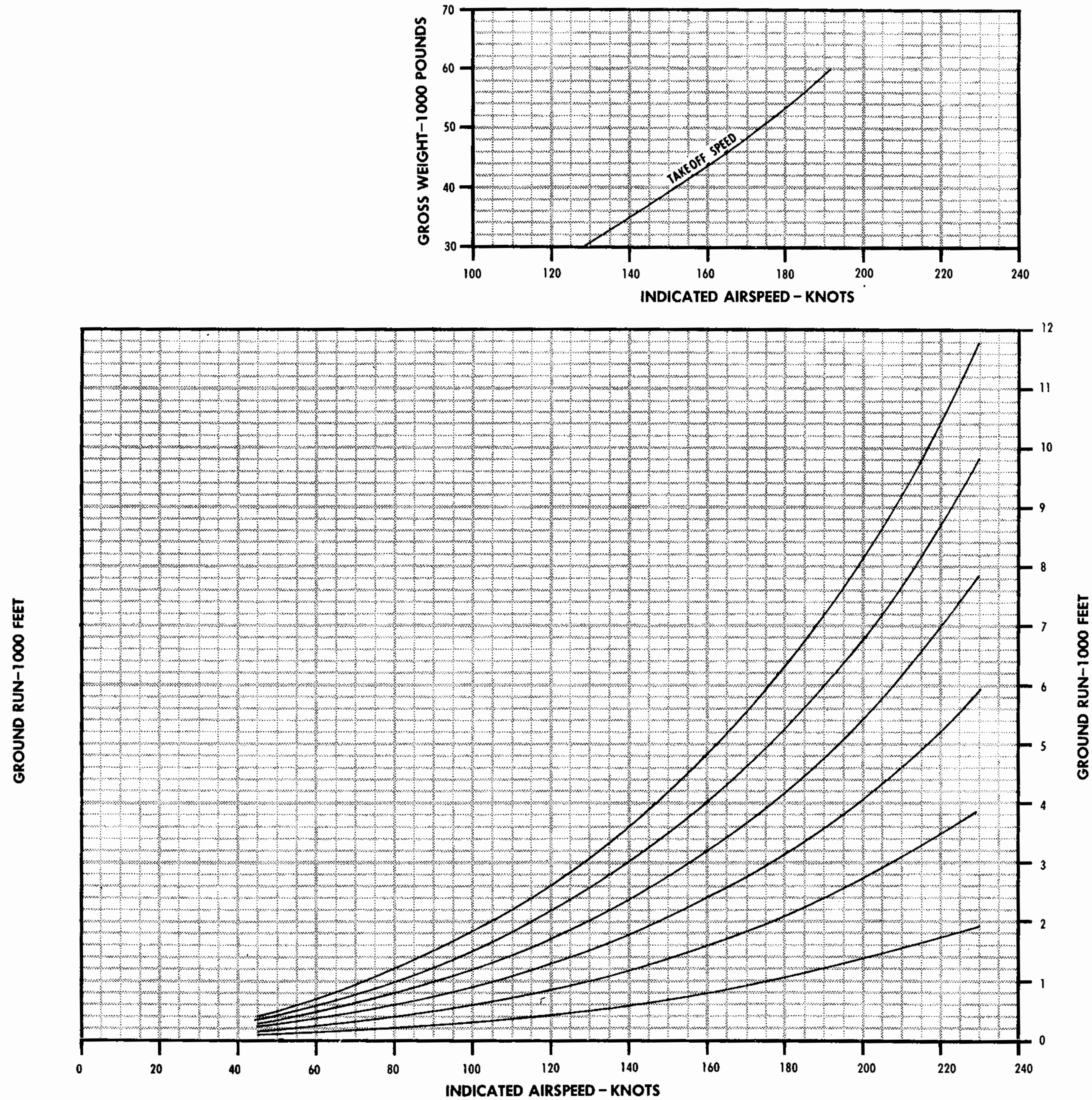
REMARKS
ENGINE(S):(2) J79-GE-8
ICAO STANDARD DAY

GUIDE



DATE: 15 NOVEMBER 1965
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



RF4B-P209A

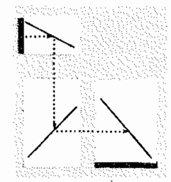
Figure 11-14

DECISION SPEEDS
MAXIMUM POWER

AIRPLANE CONFIGURATION
ALL CONFIGURATIONS
1/2 FLAPS, GEAR DOWN

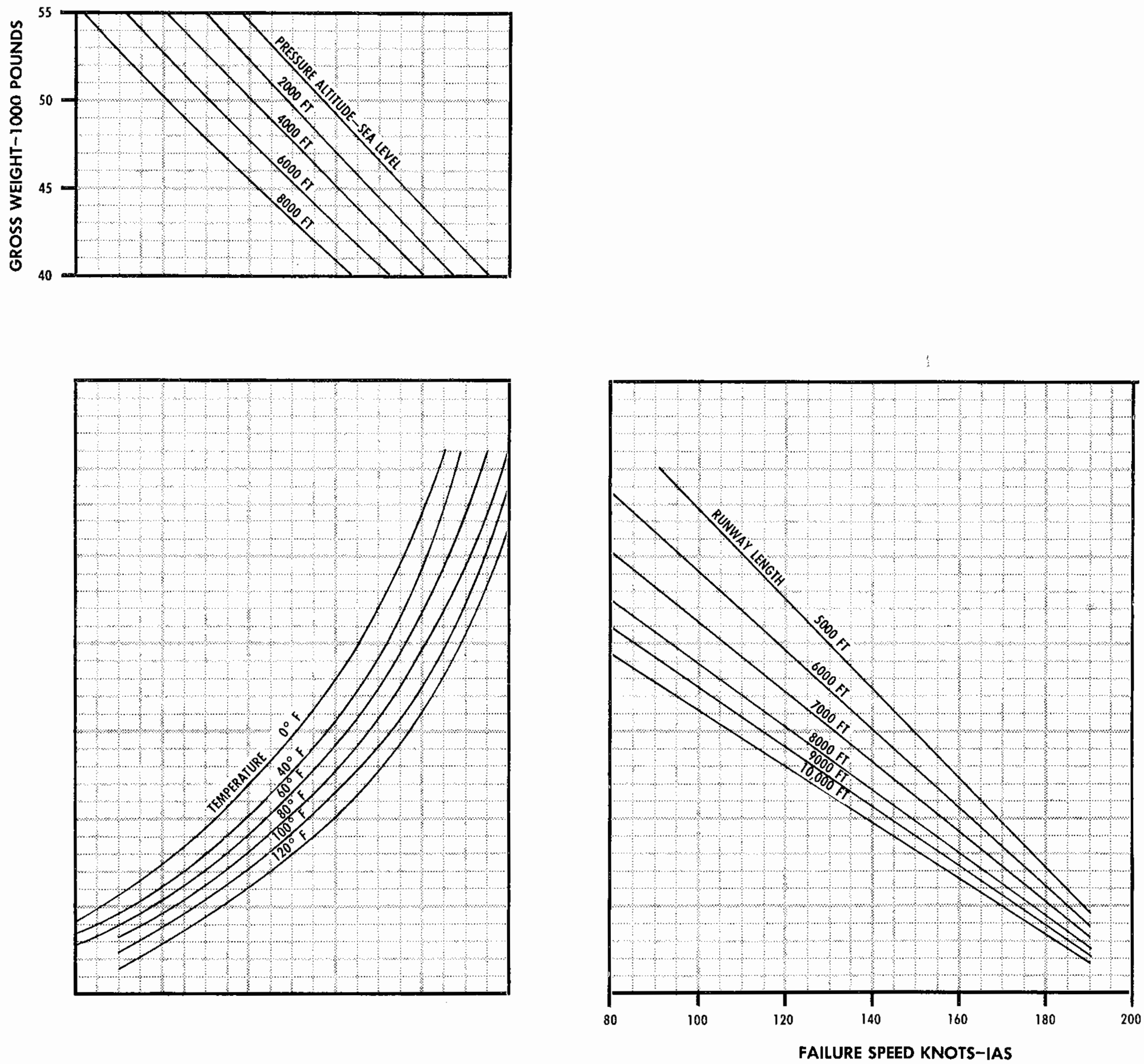
REMARKS
ENGINE(S):(2) J79-GE-8

GUIDE



DATE: 1 AUGUST 1961
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



RF4B-210

Figure 11-15

CLIMB part 3

CHARTS

CLIMB CHARTS

Subsonic climb data (figures 11-16 thru 11-23) are provided for both Maximum and Military power climb schedules. Separate charts are utilized to present speed, time, fuel, and distance data for the entire drag index range. The charts may be used to obtain climb data from "brake-release" to desired altitude, or incrementally between altitudes.

USE

Tables

Select the Climb Speed Schedule table corresponding to the desired climb thrust (MIL or MAX) setting. From the applicable drag index column, read the optimum climb speeds (indicated airspeed with corresponding standard-day (Mach number) for each 5000-foot increment of the climb. The listed pre-climb requirements (time, fuel, and distance required to intercept the climb schedule) should be noted if the takeoff/acceleration phase is to be considered in the climb planning.

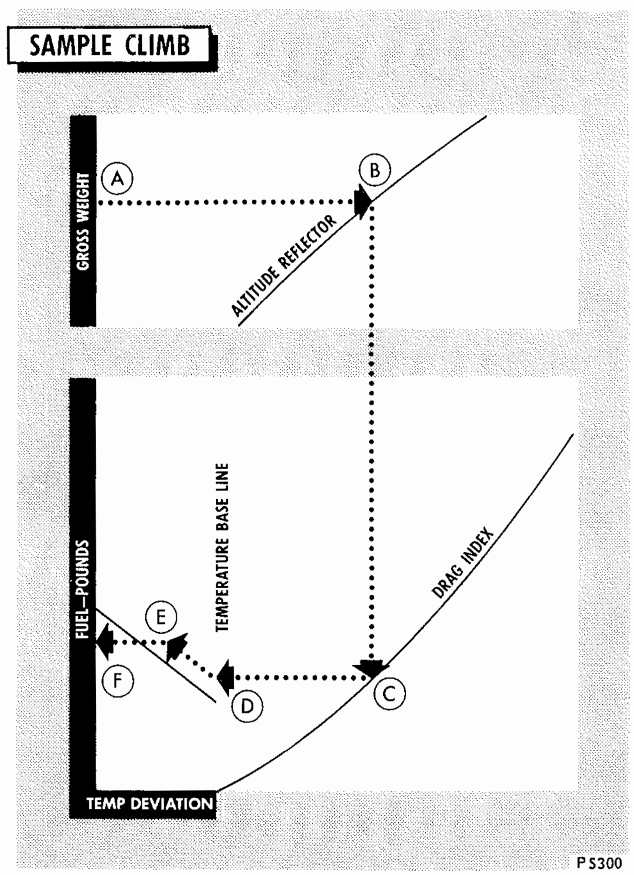
Charts

The method of presenting data on the Time, Fuel, and Distance charts is identical and the use of all three charts will be simultaneously undertaken in this example. Enter the charts with the initial climb gross weight and project horizontally to the right to intersect the desired cruise altitude. Project vertically downward to intersect the computed drag index, then horizontally to the left to intersect the temperature deviation base line (corresponds to ICAO Standard Day). If nonstandard-day temperatures are forecast, project parallel to the applicable guide line (hotter or colder) to intersect a vertical grid line corresponding to the degree of temperature deviation. From the temperature intersect-point (standard day or deviation), continue horizontally to the left to read the planning data (time, fuel, and distance).

Sample Problem

Fuel Required to Climb - Maximum Power

A.	Gross weight	50,000 Lbs.
B.	Cruise altitude	30,000 Ft.
C.	Computed drag index	50.0
D.	Temperature base line	
E.	Temperature deviation	+5°
F.	Fuel required to climb	1950 Lbs.
G.	Fuel required for MIL power takeoff and acceleration to climb speed	525 Lbs.
H.	Fuel used from brake-release to cruise altitude	2475 Lbs.



COMBAT CEILING AND CRUISE ALTITUDE CHARTS

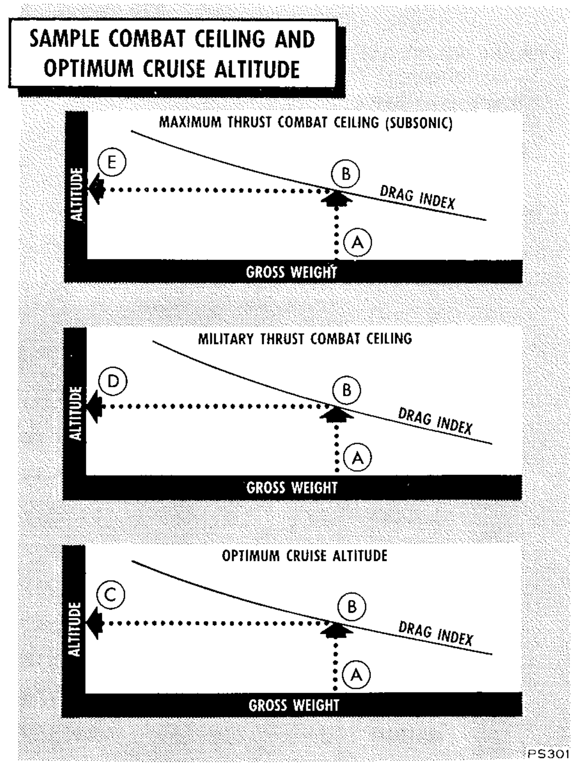
These charts (figures 11-24 and 11-25) present combat ceilings for Maximum and Military Power, and optimum cruise altitude for normal two-engine and emergency single-engine operation. They are used to obtain instantaneous check points for inflight verification of pre-planned missions. That is, optimum altitude at the beginning of cruise and at various check points enroute. The complete range of operating gross weights and drag indexes are included.

USE

Enter the chart with the aircraft gross weight corresponding to the fuel on board at the desired check point. Project vertically upward to intersect the applicable drag index reflectors on all three plots. From these intersections, project horizontally to the left and read optimum cruise altitude, Military power combat ceiling, and Maximum power combat ceiling.

Sample Problem

A.	Aircraft gross weight	53,000 Lbs.
B.	Computed drag index	50.0
C.	Optimum cruise altitude	31,500 Ft.
D.	Military power combat ceiling	31,700 Ft.
E.	Maximum power combat ceiling	41,500 Ft.



CLIMB SPEED SCHEDULE

AIRPLANE CONFIGURATION
ALL CONFIGURATIONS

DRAG INDEX
INDIVIDUALLY NOTED
0-130

MAXIMUM POWER

REMARKS
ENGINE(S):(2) J79-GE-8
ICAO STANDARD DAY

DATE: 20 AUGUST 1963
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

	DRAG INDEX													
	0		10		20		30		40		50		60	
ALTITUDE	KIAS	MACH	KIAS	MACH	KIAS	MACH	KIAS	MACH	KIAS	MACH	KIAS	MACH	KIAS	MACH
S. L.	594	.90	596	.91	594	.90	586	.89	575	.87	562	.85	546	.83
5000	562	.92	560	.91	555	.90	547	.89	537	.88	526	.86	513	.84
10000	516	.91	511	.90	505	.89	501	.89	494	.88	486	.86	480	.85
15000	471	.91	469	.91	465	.90	460	.89	454	.88	448	.87	441	.86
20000	435	.92	432	.92	427	.91	424	.90	419	.89	413	.88	408	.87
25000	399	.93	396	.92	391	.91	387	.91	384	.90	380	.89	376	.88
30000	357	.93	354	.92	352	.91	349	.91	346	.90	341	.89	339	.88
35000	321	.93	319	.92	316	.91	314	.91	311	.90	307	.89	305	.89
40000	286	.93	285	.92	284	.92	281	.92	280	.91	278	.91	276	.90
45000	260	.94	259	.94	257	.93	259	.94	257	.93	256	.93	255	.93
50000	227	.93	226	.92	225	.92	224	.92	223	.91	222	.91	221	.91

	DRAG INDEX													
	70		80		90		100		110		120		130	
ALTITUDE	KIAS	MACH	KIAS	MACH	KIAS	MACH	KIAS	MACH	KIAS	MACH	KIAS	MACH	KIAS	MACH
S. L.	526	.80	513	.78	486	.74	465	.70	445	.67	426	.65	412	.62
5000	496	.81	477	.78	460	.76	442	.73	425	.70	410	.68	396	.65
10000	469	.83	456	.81	444	.79	431	.77	418	.75	404	.72	390	.70
15000	434	.84	426	.83	416	.81	406	.79	396	.77	384	.75	370	.73
20000	404	.86	397	.85	390	.84	382	.82	373	.80	362	.78	349	.75
25000	371	.87	365	.86	358	.84	352	.83	345	.82	337	.80	328	.78
30000	334	.87	330	.86	326	.86	324	.85	318	.84	312	.82	309	.81
35000	304	.88	300	.87	298	.87	295	.86	292	.85	289	.84	285	.83
40000	270	.89	271	.89	270	.88	266	.87	265	.87	261	.86	259	.85
45000	253	.92	252	.92	250	.91	249	.91	247	.90	246	.90	245	.89
50000	220	.90	220	.90	218	.90	217	.89	217	.89	–	–	–	–

TAKEOFF ALLOWANCES & ACCELERATION TO CLIMB SPEED

START – 65 LBS.

TAXI – 42 LB./MIN.

	BRAKE RELEASE TO CLIMB SPEED MAX. T. O. MAX. ACCEL. TO MAX. CLIMB SPEED
FUEL – LBS.	1225
DIST. – NA. MI.	5.0
TIME – MIN.	1.0

RF4B-315-1

Figure 11-16

TIME TO CLIMB

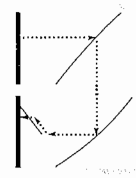
MAXIMUM POWER

AIRPLANE CONFIGURATION
ALL CONFIGURATIONS

DRAG INDEX
INDIVIDUALLY NOTED
0-130

REMARKS
ENGINE(S):(2) J79-GE-8

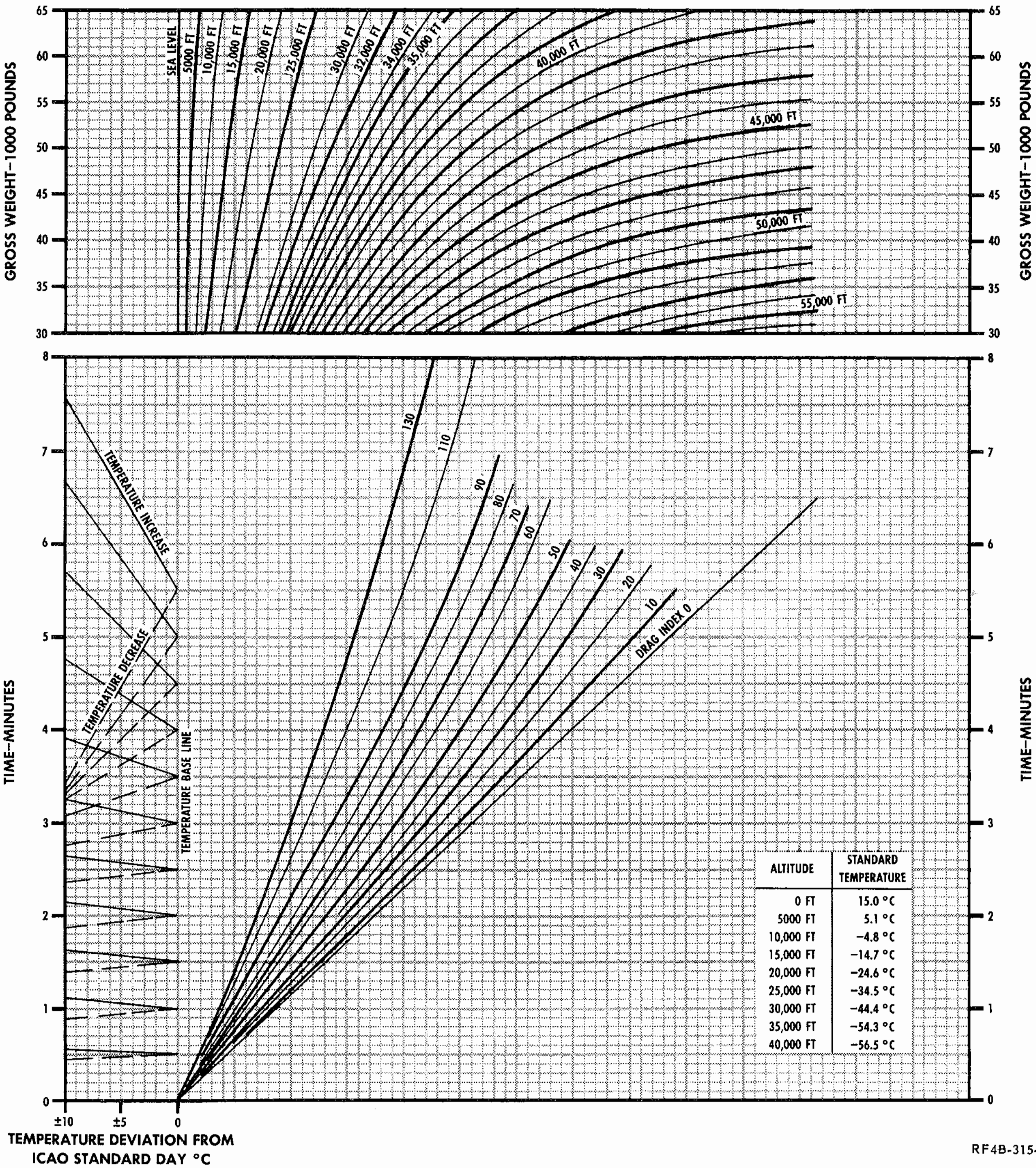
GUIDE



NOTE: OPTIMUM CRUISE ALTITUDE AT END OF CLIMB MUST BE READ ON THE OPTIMUM CRUISE ALTITUDE CHART.

DATE: 20 AUGUST 1963
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



ALTITUDE	STANDARD TEMPERATURE
0 FT	15.0 °C
5000 FT	5.1 °C
10,000 FT	−4.8 °C
15,000 FT	−14.7 °C
20,000 FT	−24.6 °C
25,000 FT	−34.5 °C
30,000 FT	−44.4 °C
35,000 FT	−54.3 °C
40,000 FT	−56.5 °C

RF4B-315-2

Figure 11-17

FUEL REQUIRED TO CLIMB

MAXIMUM POWER

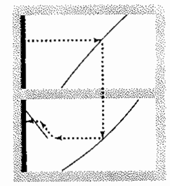
AIRPLANE CONFIGURATION
ALL CONFIGURATIONS

DRAG INDEX
INDIVIDUALLY NOTED
0-130

REMARKS
ENGINE(S):(2) J79-GE-8

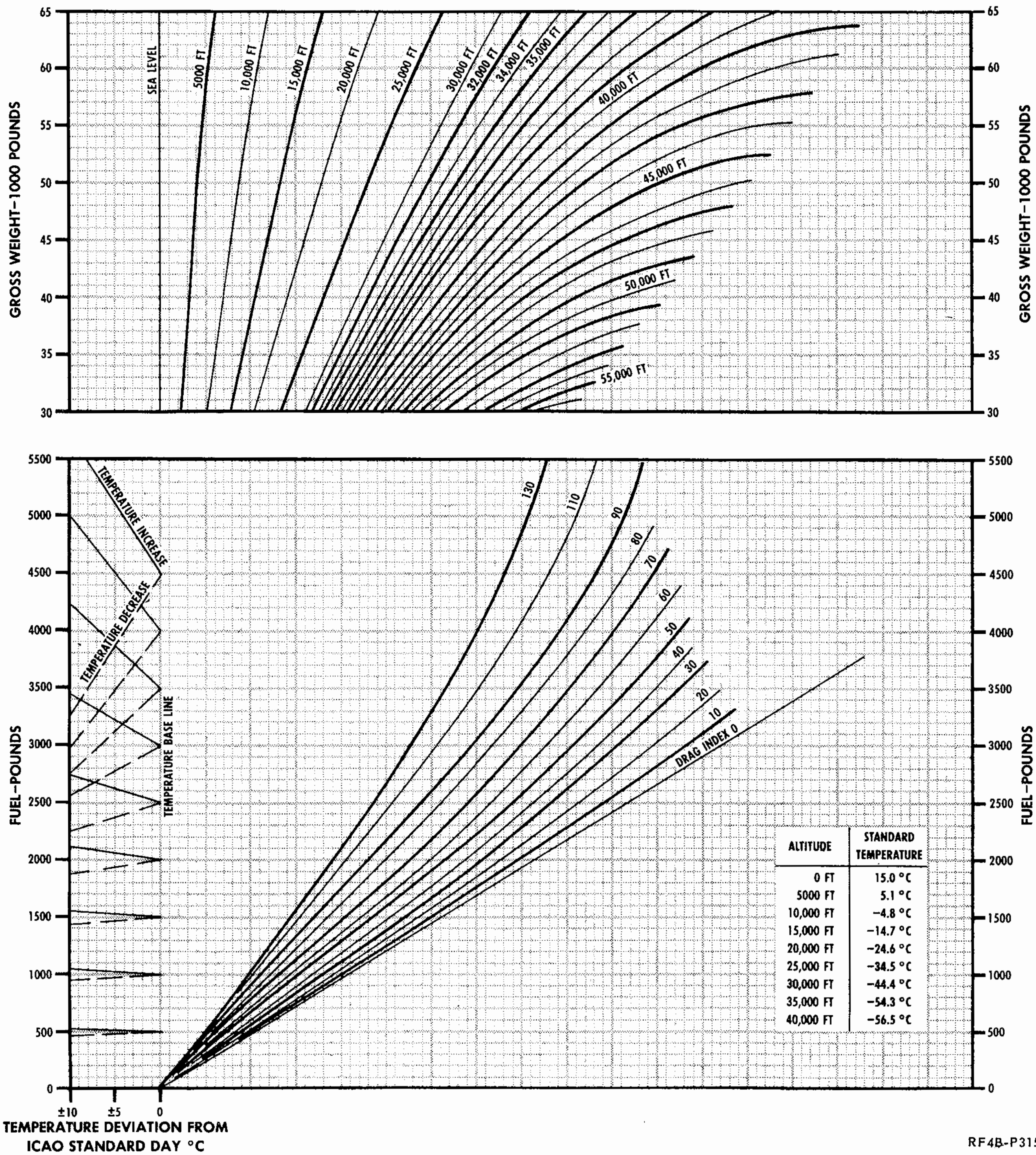
NOTE: OPTIMUM CRUISE ALTITUDE AT END OF CLIMB MUST BE READ ON THE OPTIMUM CRUISE ALTITUDE CHART

GUIDE



DATE: 20 AUGUST 1963
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



ALTITUDE	STANDARD TEMPERATURE
0 FT	15.0 °C
5000 FT	5.1 °C
10,000 FT	−4.8 °C
15,000 FT	−14.7 °C
20,000 FT	−24.6 °C
25,000 FT	−34.5 °C
30,000 FT	−44.4 °C
35,000 FT	−54.3 °C
40,000 FT	−56.5 °C

RF4B-P315-3

Figure 11-18

DISTANCE REQUIRED TO CLIMB

MAXIMUM POWER

AIRPLANE CONFIGURATION
ALL CONFIGURATIONS

DRAG INDEX
INDIVIDUALLY NOTED
0-130

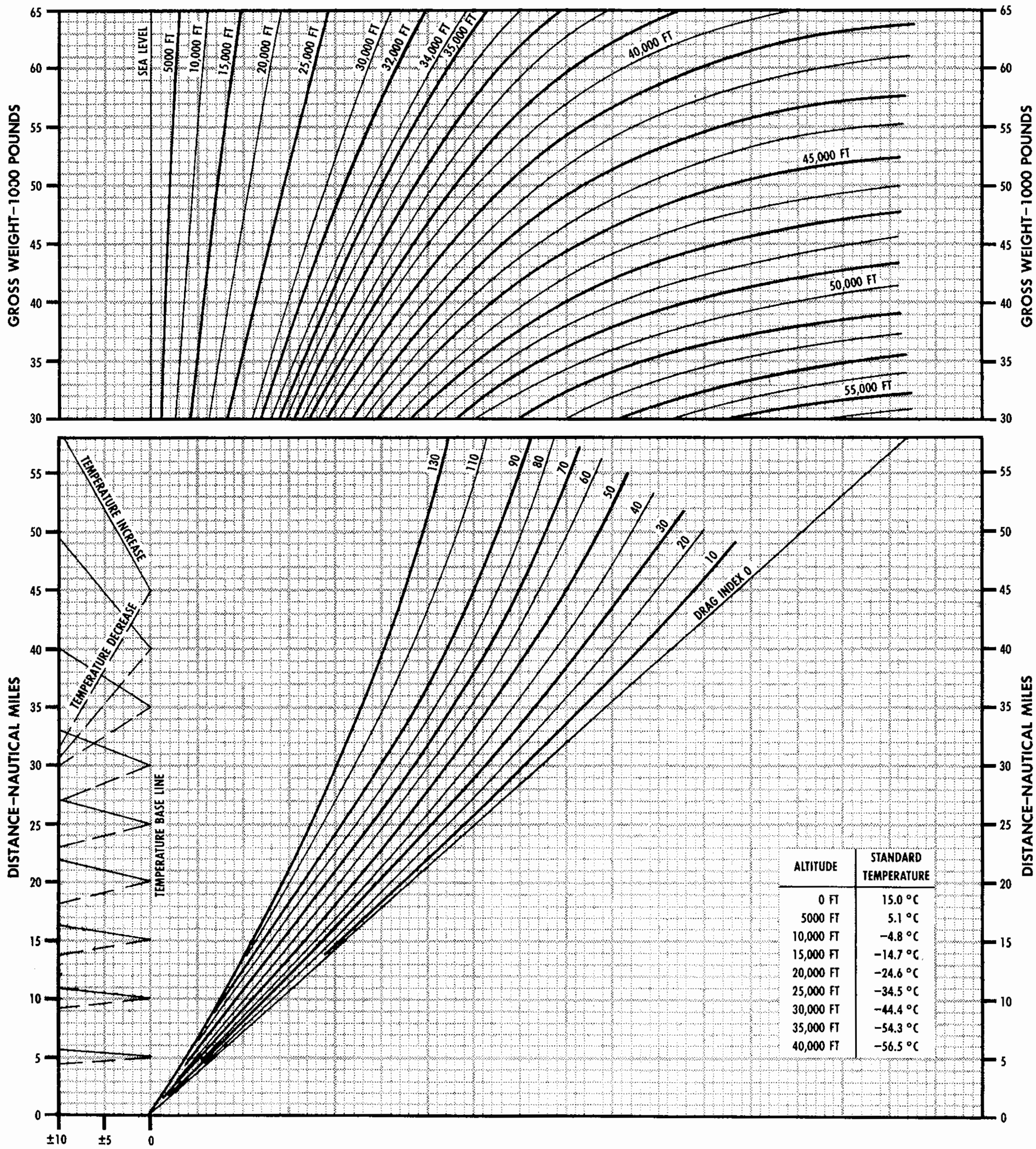
DATE: 20 AUGUST 1963
DATA BASIS: FLIGHT TEST

REMARKS
ENGINE(S):(2) J79-GE-8

NOTE: OPTIMUM CRUISE ALTITUDE AT END OF CLIMB MUST BE READ ON THE OPTIMUM CRUISE ALTITUDE CHART

GUIDE

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



ALTITUDE	STANDARD TEMPERATURE
0 FT	15.0 °C
5000 FT	5.1 °C
10,000 FT	−4.8 °C
15,000 FT	−14.7 °C
20,000 FT	−24.6 °C
25,000 FT	−34.5 °C
30,000 FT	−44.4 °C
35,000 FT	−54.3 °C
40,000 FT	−56.5 °C

Figure 11-19

CLIMB SPEED SCHEDULE

AIRPLANE CONFIGURATION
ALL CONFIGURATIONS

DRAG INDEX
INDIVIDUALLY NOTED
0-130

MILITARY POWER

REMARKS
ENGINE(S):(2) J79-GE-8
ICAO STANDARD DAY

DATE: 20 AUGUST 1963
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

ALTITUDE	DRAG INDEX 0 KIAS	0 MACH	10 KIAS	10 MACH	20 KIAS	20 MACH	30 KIAS	30 MACH	40 KIAS	40 MACH	50 KIAS	50 MACH	60 KIAS	60 MACH
S. L.	520	.79	481	.73	454	.68	428	.65	406	.62	387	.59	370	.56
5000	522	.85	479	.79	444	.73	415	.68	390	.64	370	.61	353	.59
10000	487	.86	458	.82	434	.77	412	.74	394	.71	377	.68	362	.65
15000	446	.87	440	.86	429	.84	418	.82	400	.78	379	.74	355	.70
20000	412	.88	408	.87	401	.86	390	.84	375	.81	359	.77	337	.73
25000	375	.88	375	.88	372	.87	363	.86	352	.83	338	.80	324	.77
30000	336	.88	336	.88	335	.87	330	.86	324	.85	314	.83	302	.80
35000	305	.89	307	.89	306	.89	304	.88	298	.87	290	.85	280	.82
40000	276	.90	275	.90	273	.89	271	.88	267	.88	262	.86	259	.85
45000	254	.92	252	.92	250	.91	247	.90	–	–	–	–	–	–

ALTITUDE	DRAG INDEX 70 KIAS	70 MACH	80 KIAS	80 MACH	90 KIAS	90 MACH	100 KIAS	100 MACH	110 KIAS	110 MACH	120 KIAS	120 MACH	130 KIAS	130 MACH
S. L.	355	.54	343	.52	333	.51	324	.49	316	.48	311	.47	304	.46
5000	340	.56	330	.55	322	.53	316	.52	311	.52	307	.51	305	.51
10000	350	.63	338	.61	327	.59	316	.57	307	.56	298	.54	290	.53
15000	345	.68	327	.64	317	.62	305	.60	298	.59	291	.58	284	.56
20000	320	.70	306	.67	296	.65	288	.63	281	.62	276	.61	274	.60
25000	307	.73	294	.70	285	.68	278	.67	273	.66	270	.65	267	.64
30000	291	.77	284	.75	278	.74	273	.73	270	.72	268	.71	266	.71
35000	273	.80	267	.79	263	.77	259	.76	255	.76	253	.75	251	.74
40000	256	.84	251	.83	249	.82	–	–	–	–	–	–	–	–
45000	–	–	–	–	–	–	–	–	–	–	–	–	–	–

TAKEOFF ALLOWANCES & ACCELERATION TO CLIMB SPEED

START – 65 LBS.

TAXI – 42 LB./MIN.

	BRAKE RELEASE TO CLIMB SPEED° MIL. T. O. MIL. ACCEL. TO MIL. CLIMB SPEED	MAX. T. O. MIL. ACCEL. TO MIL. CLIMB SPEED	MAX. T. O. MAX. ACCEL. TO MIL. CLIMB SPEED
FUEL – LBS.	525	725	925
DIST. – NA. MI.	6.0	5.3	3.0
TIME – MIN.	1.7	1.3	.8

RF4B-P316-1

Figure 11-20

TIME TO CLIMB
MILITARY POWER

AIRPLANE CONFIGURATION
ALL CONFIGURATIONS

DRAG INDEX
INDIVIDUALLY NOTED
0-130

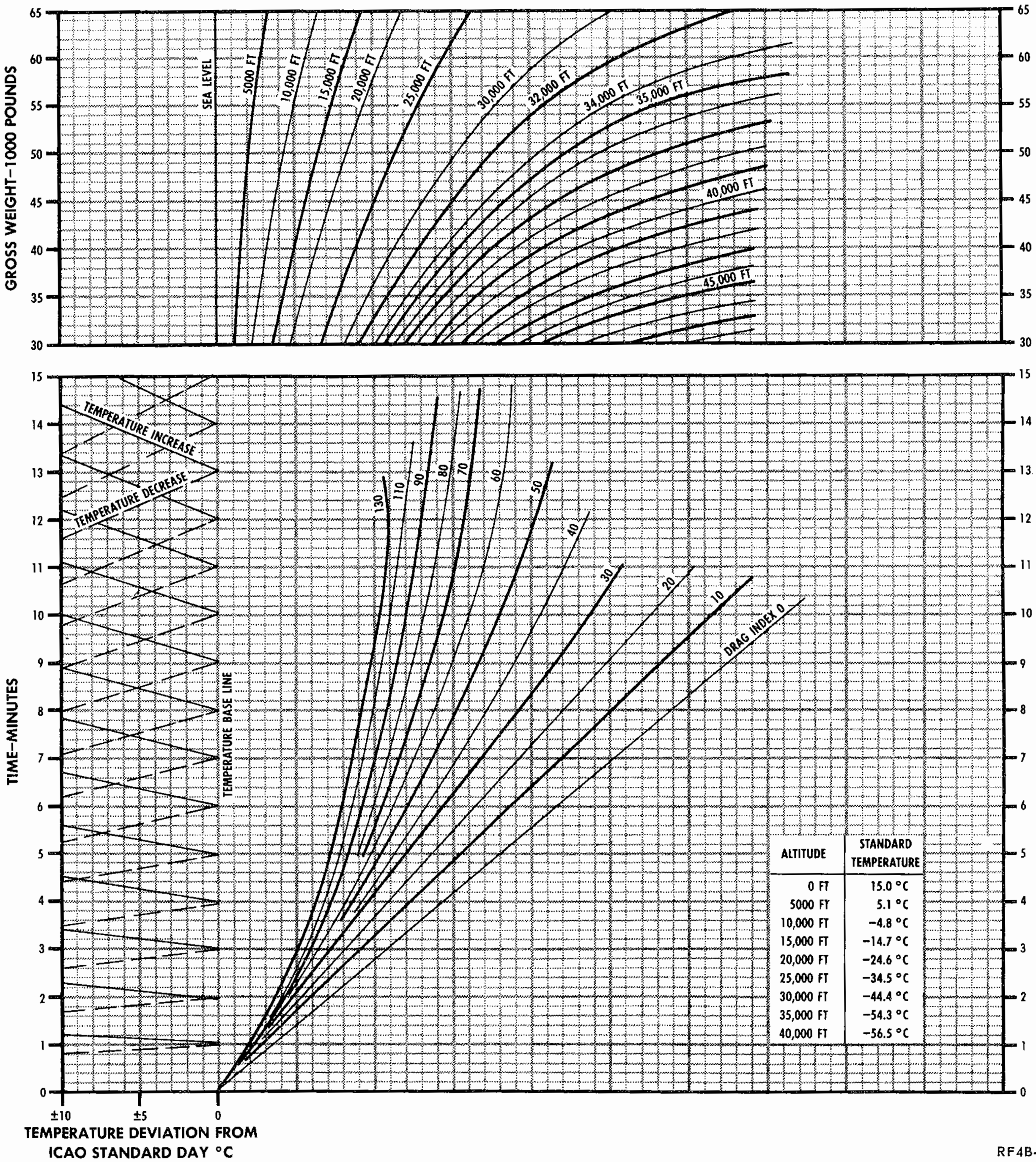
REMARKS
ENGINE(S):(2) J79-GE-8

NOTE: OPTIMUM CRUISE ALTITUDE AT END OF CLIMB MUST BE READ ON THE OPTIMUM CRUISE ALTITUDE CHART.

GUIDE

DATE: 20 AUGUST 1963
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



ALTITUDE	STANDARD TEMPERATURE
0 FT	15.0 °C
5000 FT	5.1 °C
10,000 FT	−4.8 °C
15,000 FT	−14.7 °C
20,000 FT	−24.6 °C
25,000 FT	−34.5 °C
30,000 FT	−44.4 °C
35,000 FT	−54.3 °C
40,000 FT	−56.5 °C

RF4B-P316-2

Figure 11-21

FUEL REQUIRED TO CLIMB

MILITARY POWER

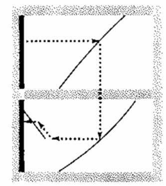
AIRPLANE CONFIGURATION
ALL CONFIGURATIONS

DRAG INDEX
INDIVIDUALLY NOTED
0-130

REMARKS
ENGINE(S):(2) J79-GE-8

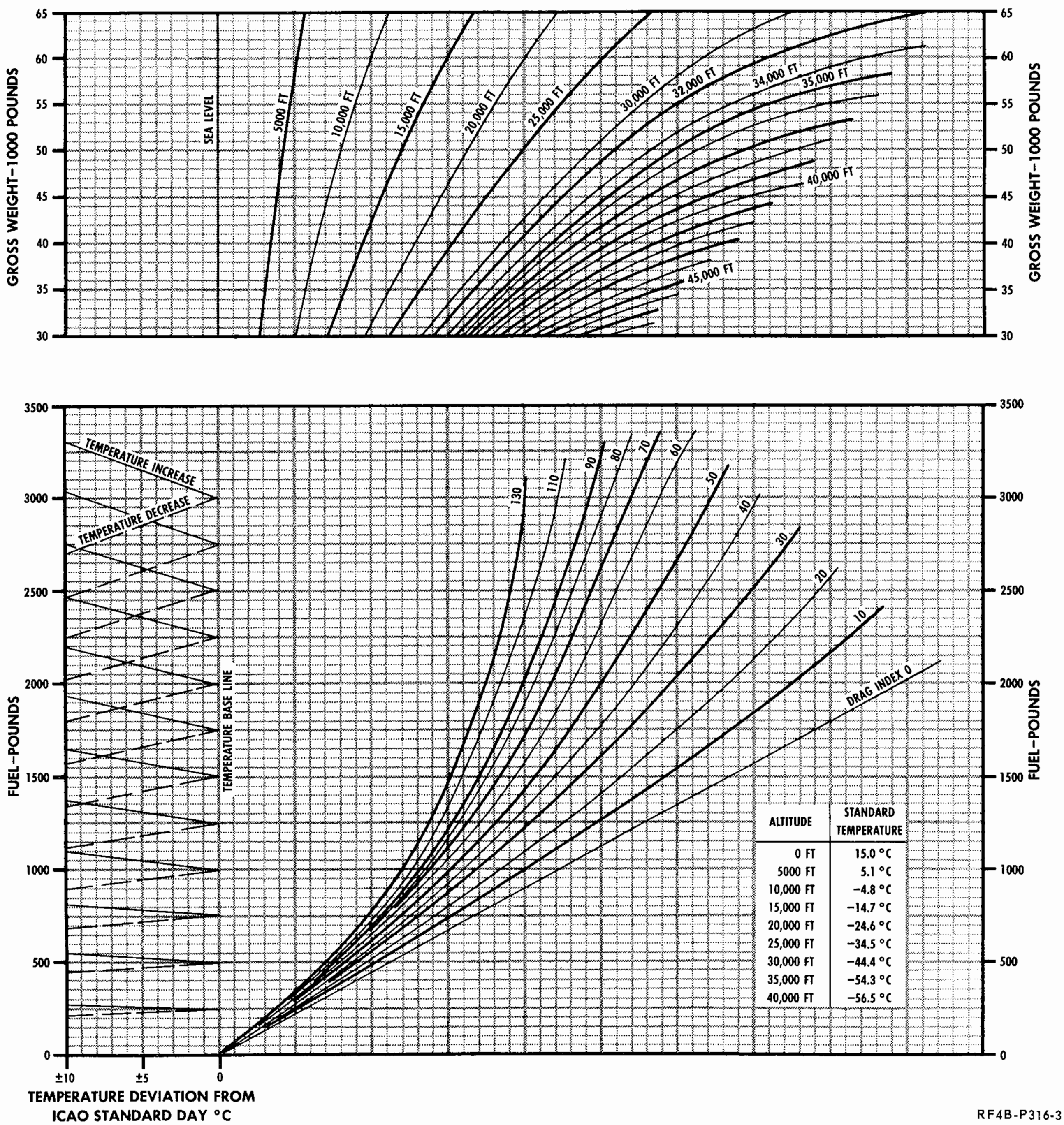
NOTE: OPTIMUM CRUISE ALTITUDE AT END OF CLIMB MUST BE READ ON THE OPTIMUM CRUISE ALTITUDE CHART

GUIDE



DATE: 20 AUGUST 1963
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



ALTITUDE	STANDARD TEMPERATURE
0 FT	15.0 °C
5000 FT	5.1 °C
10,000 FT	−4.8 °C
15,000 FT	−14.7 °C
20,000 FT	−24.6 °C
25,000 FT	−34.5 °C
30,000 FT	−44.4 °C
35,000 FT	−54.3 °C
40,000 FT	−56.5 °C

RF4B-P316-3

Figure 11-22

DISTANCE REQUIRED TO CLIMB

MILITARY POWER

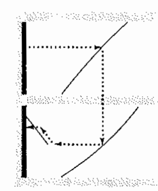
AIRPLANE CONFIGURATION
ALL CONFIGURATIONS

DRAG INDEX
INDIVIDUALLY NOTED
0-130

REMARKS
ENGINE(S):(2) J79-GE-8

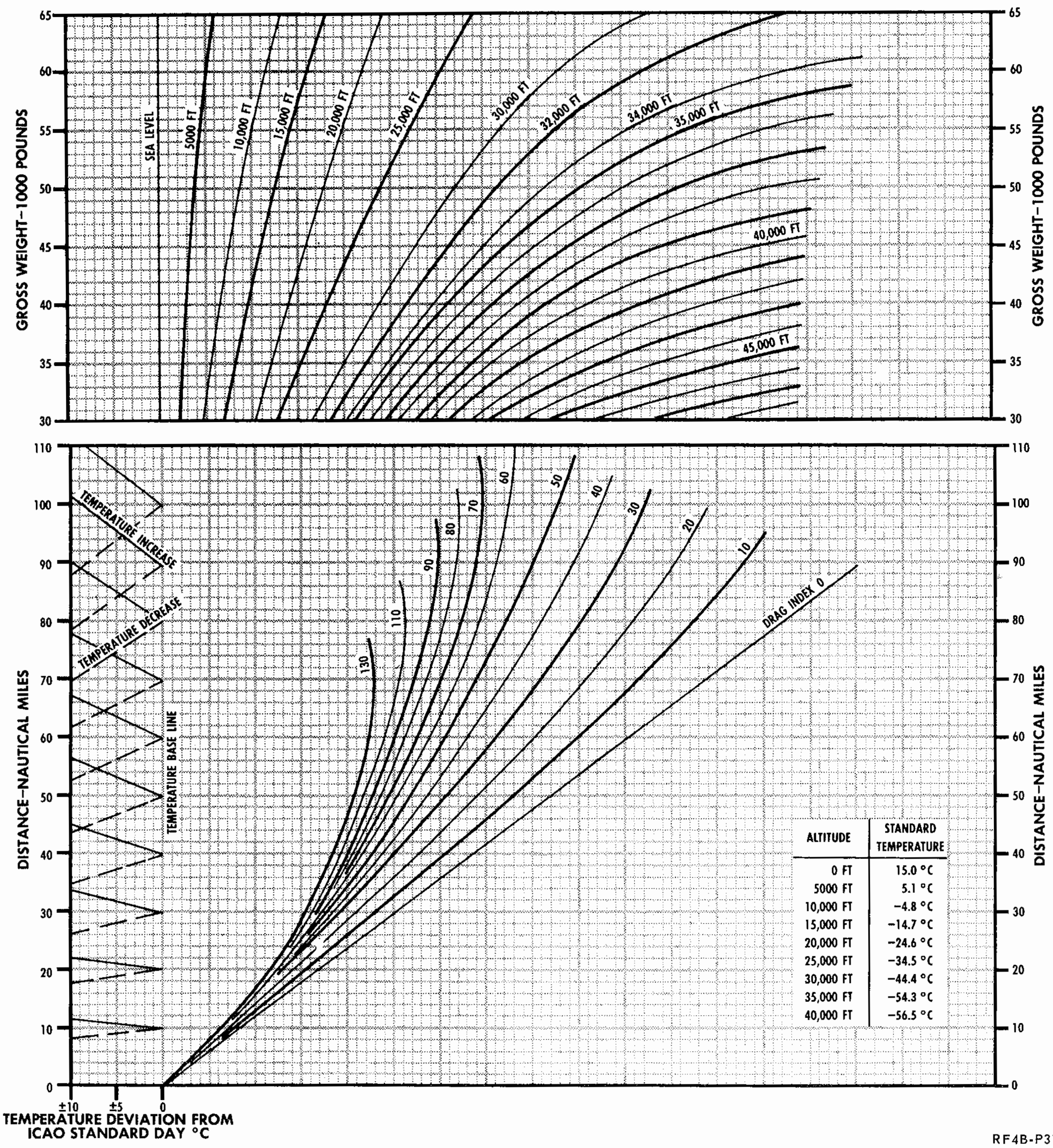
NOTE: OPTIMUM CRUISE ALTITUDE AT END OF CLIMB MUST BE READ ON THE OPTIMUM CRUISE ALTITUDE CHART.

GUIDE



DATE: 20 AUGUST 1963
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



ALTITUDE	STANDARD TEMPERATURE
0 FT	15.0 °C
5000 FT	5.1 °C
10,000 FT	−4.8 °C
15,000 FT	−14.7 °C
20,000 FT	−24.6 °C
25,000 FT	−34.5 °C
30,000 FT	−44.4 °C
35,000 FT	−54.3 °C
40,000 FT	−56.5 °C

RF4B-P316-4

Figure 11-23

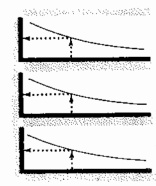
COMBAT CEILING AND OPTIMUM CRUISE ALTITUDE

AIRPLANE CONFIGURATION
ALL CONFIGURATIONS

DRAG INDEX
INDIVIDUALLY NOTED
0-130

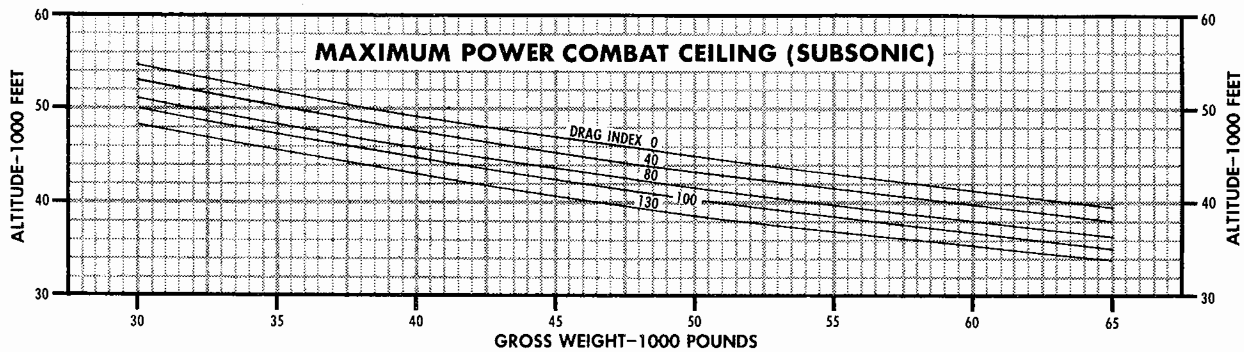
REMARKS
ENGINE(S):(2) J79-GE-8
ICAO STANDARD DAY

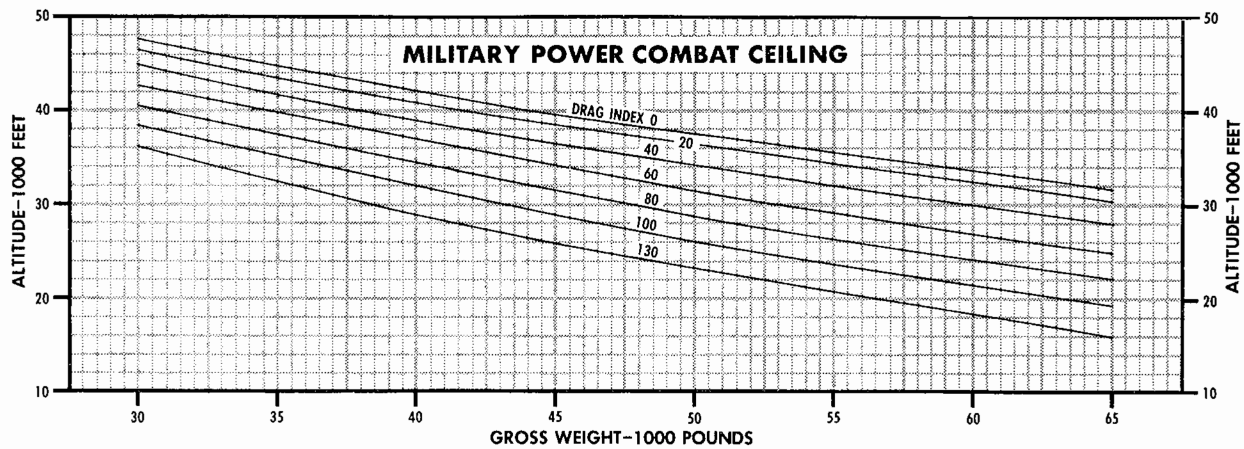
GUIDE

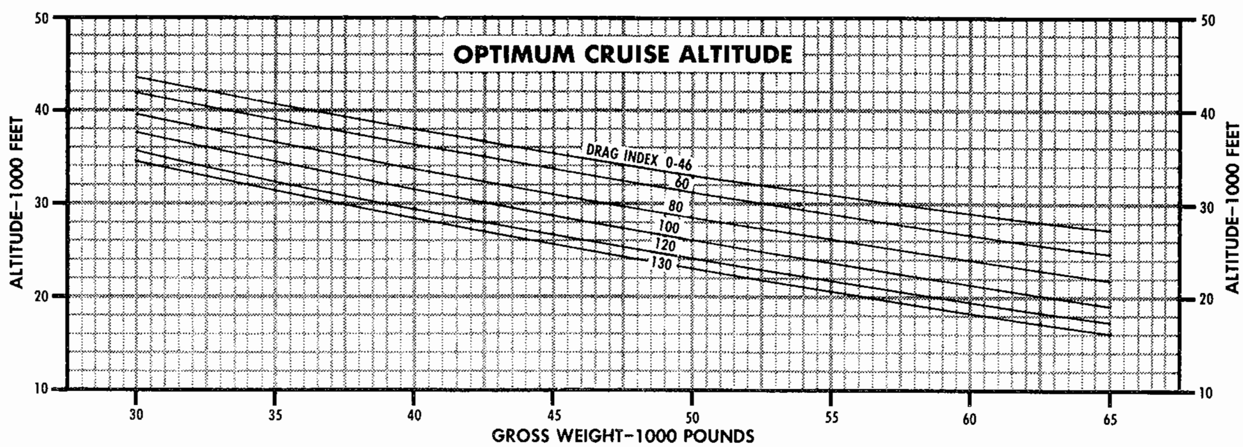


DATE: 20 AUGUST 1963
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL







RF4B-P317

Figure 11-24

COMBAT CEILING AND OPTIMUM CRUISE ALTITUDE

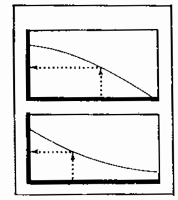
ONE ENGINE OPERATING

AIRPLANE CONFIGURATION
ALL CONFIGURATIONS

DRAG INDEX
INDIVIDUALLY NOTED
0-130

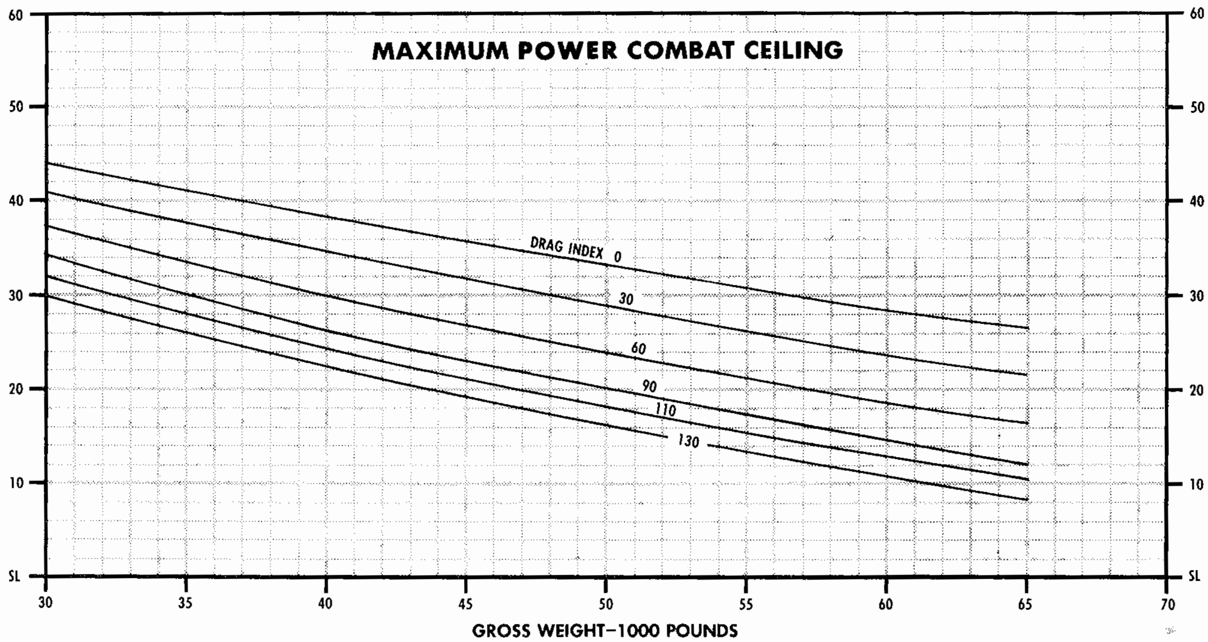
REMARKS
ENGINE(S):(2) J79-GE-8
ICAO STANDARD DAY
INOPERATIVE ENGINE WINDMILLING

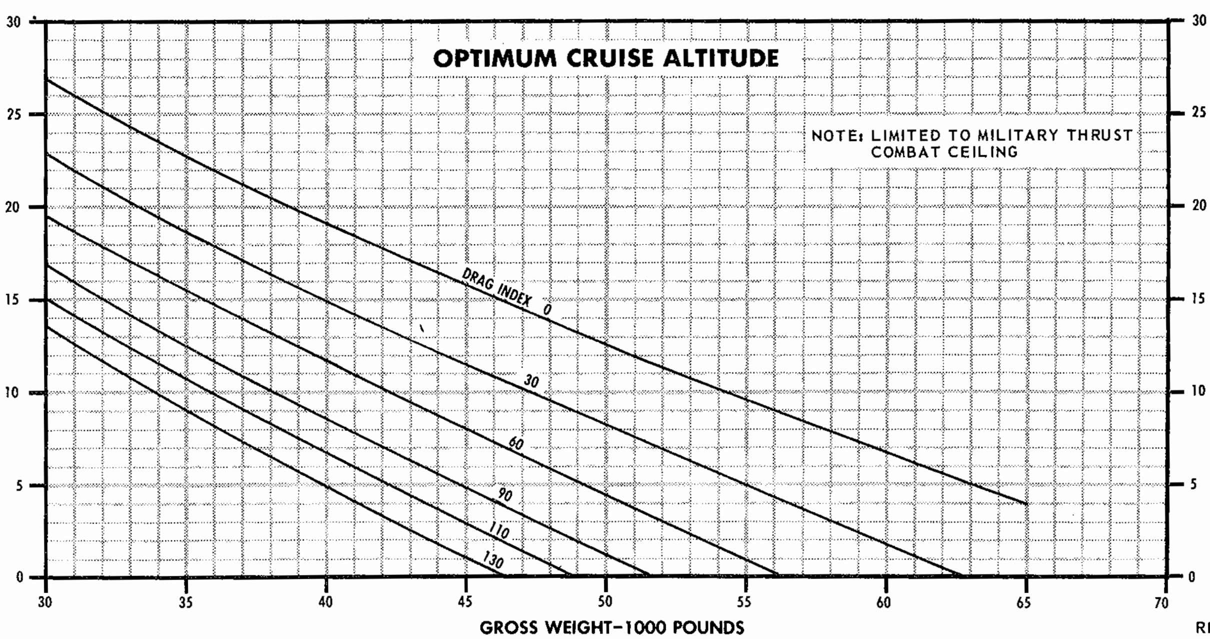
GUIDE



DATE: 1 NOVEMBER 1964
DATA BASIS: ESTIMATED (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL





RF4B-P318 A

Figure 11-25

RANGE part 4

CHARTS

CRUISE AT CONSTANT ALTITUDE

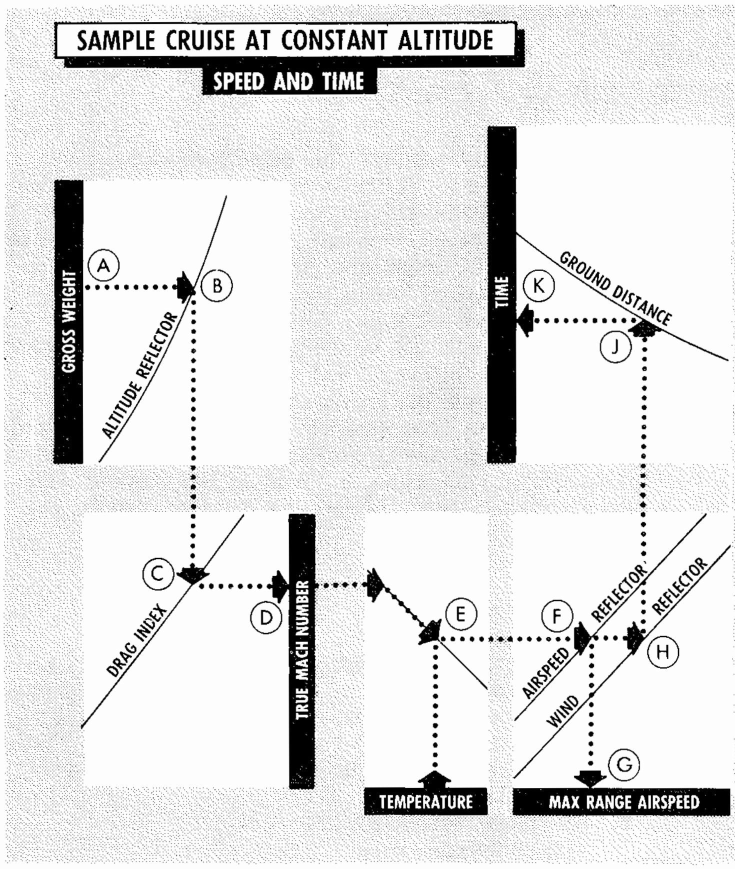
This chart (figure 11-26) presents the necessary planning data to set up cruise schedules for a constant altitude. The recommended procedure is to use an average gross weight for a given leg of the mission. It is possible, however, to obtain instantaneous data if the mission is to be flown at varying (near optimum) altitudes. The user must know the aircraft gross weight, the computed drag index, the cruise altitude(s), the forecast wind/temperature, and the distance to be covered. It is then possible to obtain from the chart: maximum range cruise speeds (true Mach number and true airspeed), time enroute, nautical miles per pound, fuel flow, and total fuel required.

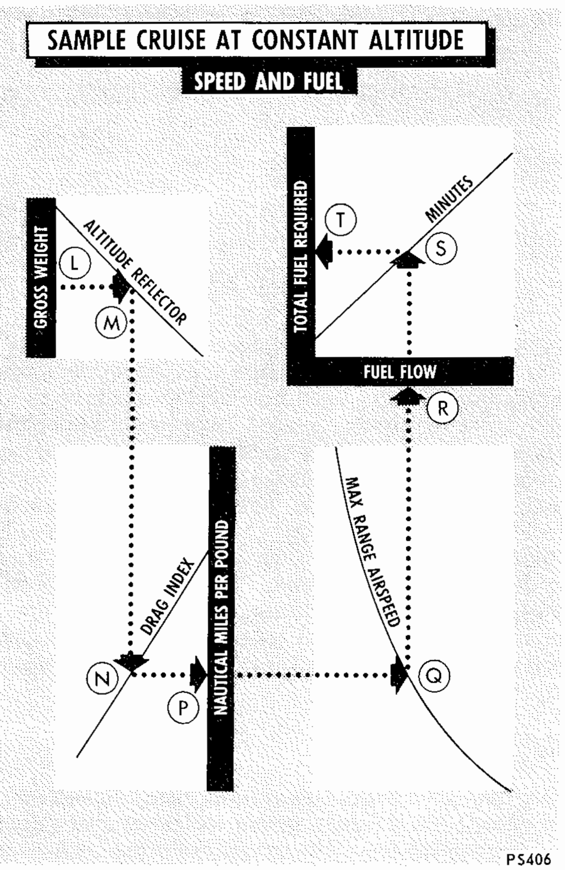
USE

Enter the first chart (Maximum Range Speed and Time) with the average gross weight and project horizontally to the right to intersect the cruise altitude. Project vertically downward to intersect the computed drag, then horizontally to the right to intersect and read maximum range cruise Mach number. Project horizontally further to the right to the temperature base line, then parallel along the guide lines to intersect the vertical grid line that corresponds to the flight-level temperature. From this point, project horizontally to the right to intersect the airspeed reflector (zero wind) and, if applicable, further to apply effective headwind or tailwind. From the intersection of the airspeed reflector (zero wind) project vertically downward to intersect and read the corresponding thru airspeed for cruise. From the intersection of the effective headwind or tailwind, project vertically upward to intersect the required ground distance, then horizontally to the left and read time required. Enter the second half of the chart (Fuel Consumption) with the average gross weight and project horizontally to the right to intersect the cruise altitude. Project vertically downward to intersect the computed drag, then horizontally to the right to intersect and read nautical miles per pound. Continue the horizontal projection to intersect the cruise true airspeed, then vertically upward to intersect and read resulting fuel flow. Continue the vertical projection to intersect the enroute time, then horizontally to the left and read total fuel required.

Sample Problem

A. Average gross weight	45,000 Lbs.
B. Cruise altitude	35,000 Ft.
C. Computed drag index	40.0
D. True Mach number	.85
E. Temperature at flight altitude	-55°C
F. Airspeed reflector (zero wind)	
G. True airspeed	490 Kts.
H. Tailwind	50 Kts.
J. Distance	500 Miles
K. Time	55.5 Mins.
L. Average gross weight	45,000 Lbs.
M. Cruise altitude	35,000 Ft.
N. Computed drag index	40.0
P. Nautical miles per pound	.082
Q. True airspeed	490 Kts.
R. Fuel flow	2975 Lb./Hr./Eng.
S. Time enroute	55.5 Mins.
T. Total fuel required	5,500 Lbs.





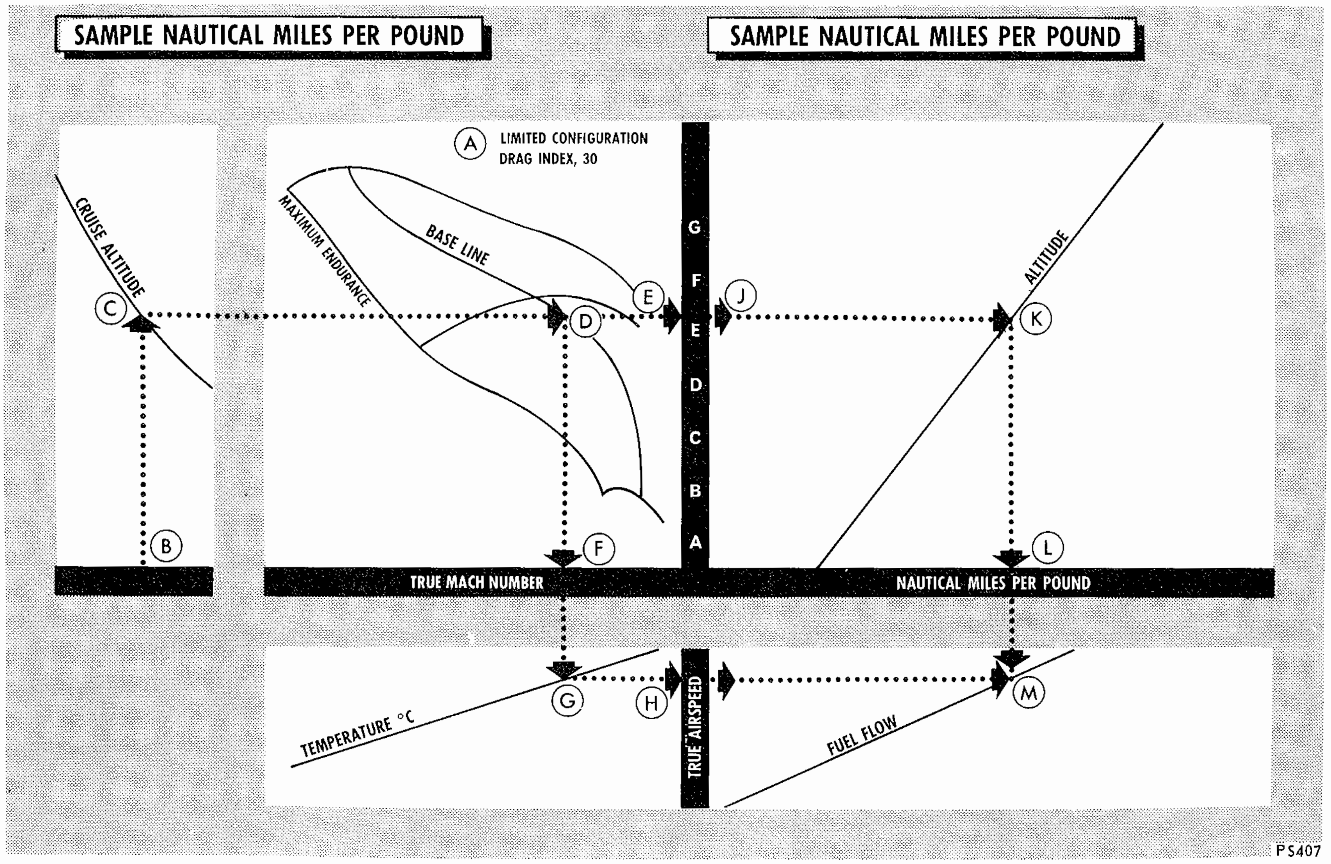
PS406

NAUTICAL MILES PER POUND CHART

Nautical miles per pound charts (figures 11-27 thru 11-30) are provided for each drag index interval of 10 units. The charts graphically present cruise data throughout the gross weight/speed range of the aircraft. Use the chart whose drag index is closest to that computed. If the computed drag falls half-way between two charts, use both charts and average the data. By entering the charts with the average aircraft gross weight, the true Mach number and the cruising altitude, it is possible to obtain true airspeed, fuel flow and nautical miles per pound for any speed desired. However, lines for maximum endurance and maximum range are plotted to present the recommended specific speeds for optimum endurance/cruise. Curves of optimum cruise and maximum endurance altitude are included on the altitude plot.

USE

After computing the drag index for the mission, enter the first page of the applicable chart with the average gross weight. Project vertically to the desired cruise altitude, then horizontally to the right to intersect the Base Line. If maximum range cruise is desired, continue the horizontal projection to intersect the plot-edge reference and note for future use. From the intersection of the Base Line (Maximum Range), project vertically downward to obtain cruise Mach number. However, if specifics for off-optimum cruise or maximum endurance are desired, the projections in this area would be somewhat different. From the intersection of the Base Line, parallel the contour of the closest guide line (either right or left) to intersect the desired cruise Mach number grid line. From this point, project horizontally to the right edge of the graph and note the plot-edge reference for future use. From the cruise Mach number (True Mach Number scale), project vertically downward and intersect the cruise altitude temperature line. From this point, project horizontally to the right to intersect and read the corresponding true airspeed for cruise. Enter the second page of the chart at the previously noted plot-edge reference and project horizontally to the cruise altitude reflector line. From this point, project vertically downward to intersect the true airspeed grid line and read the resulting fuel flow.



Sample Problem

A.	Computed drag index	30.0
B.	Average gross weight	40,000 Lbs.
C.	Cruise altitude	35,000 Ft.
D.	Base line (Max. range)	
E.	Intersect plot-edge reference	A.95
F.	Optimum cruise Mach	.851
G.	Flight-level temp.	-55°C
H.	Optimum cruise TAS	492 Kts.
J.	Plot-edge reference	A.95
K.	Cruise altitude	35,000 Ft.
L.	Nautical miles per pound	.095
M.	Fuel flow	2600 Lb./Hr./Eng.

CRUISE AT CONSTANT ALTITUDE

MAXIMUM RANGE SPEED AND TIME

AIRPLANE CONFIGURATION
ALL CONFIGURATIONS

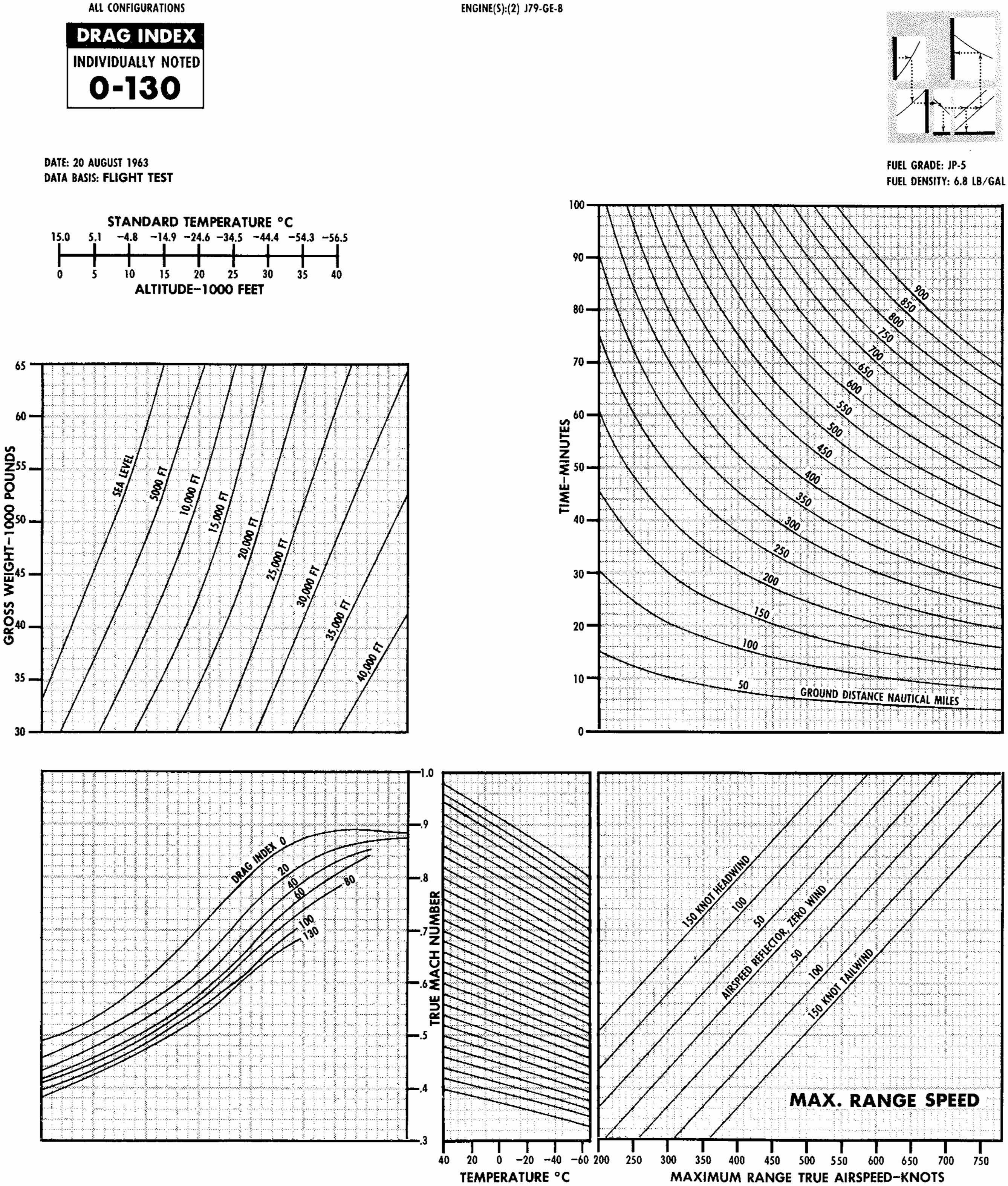
DRAG INDEX
INDIVIDUALLY NOTED
0-130

REMARKS
ENGINE(S):(2) J79-GE-8

GUIDE

DATE: 20 AUGUST 1963
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



RF4B-P463-1

Figure 11-26 (Sheet 1)

CRUISE AT CONSTANT ALTITUDE

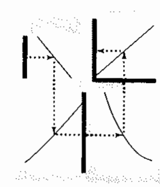
FUEL CONSUMPTION

AIRPLANE CONFIGURATION
ALL CONFIGURATIONS

DRAG INDEX
INDIVIDUALLY NOTED
0-130

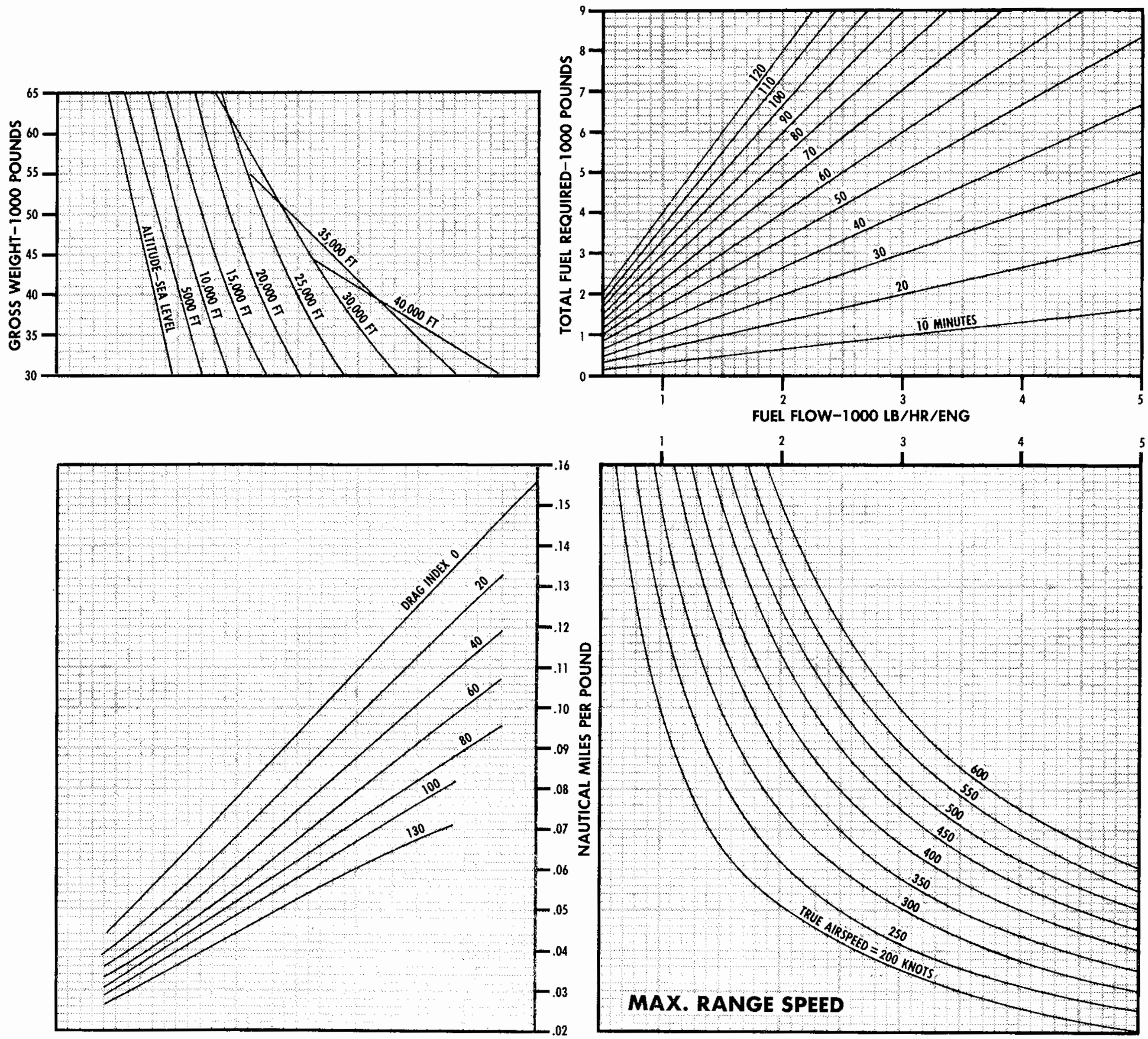
REMARKS
ENGINE(S):(2) J79-GE-8

GUIDE



DATE: 20 AUGUST 1963
DATA BASIS: **FLIGHT TEST**

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

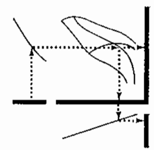


RF4B-P463-2

Figure 11-26 (Sheet 2)

NAUTICAL MILES PER POUND

GUIDE



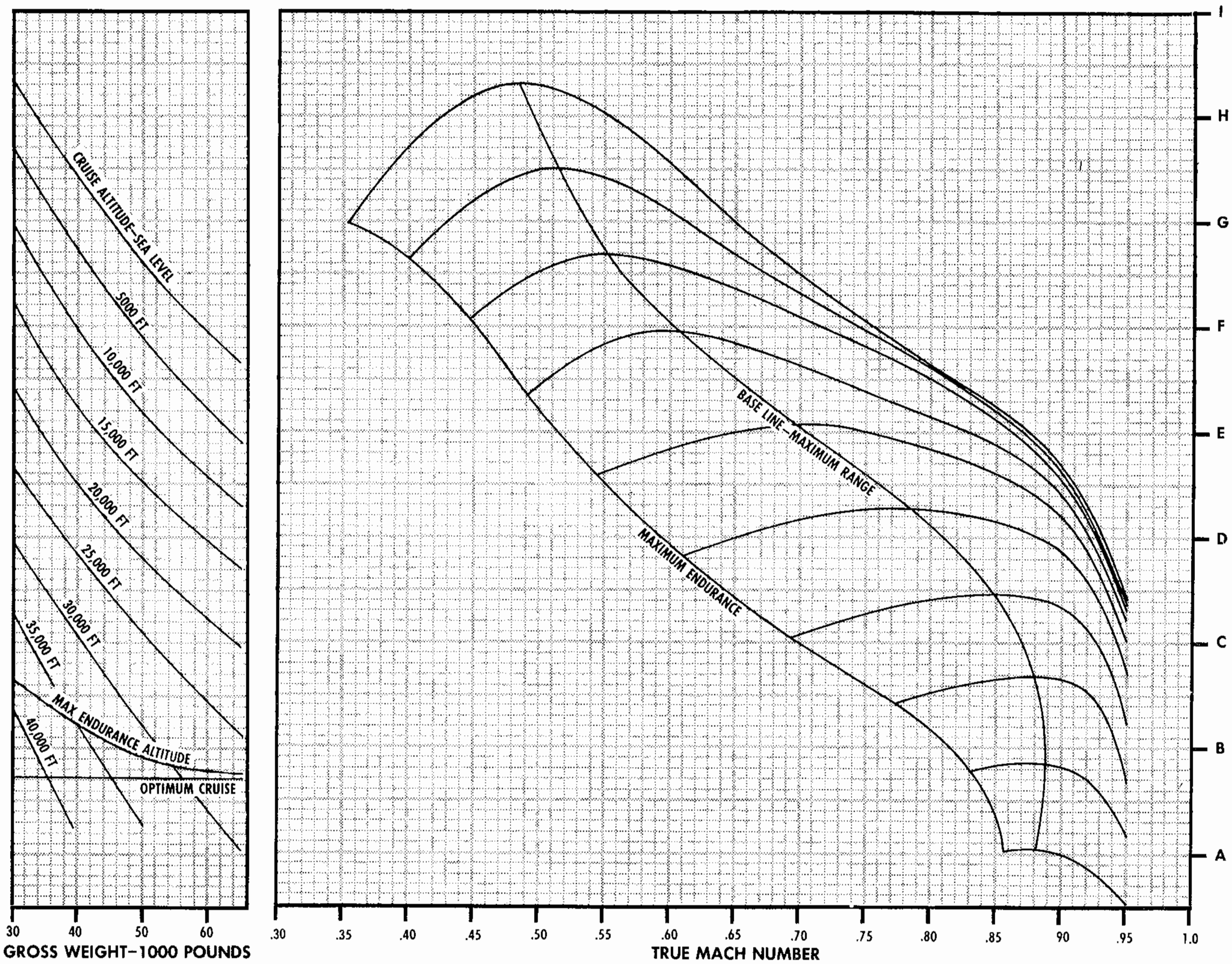
AIRPLANE CONFIGURATION
LIMITED CONFIGURATIONS

DRAG INDEX

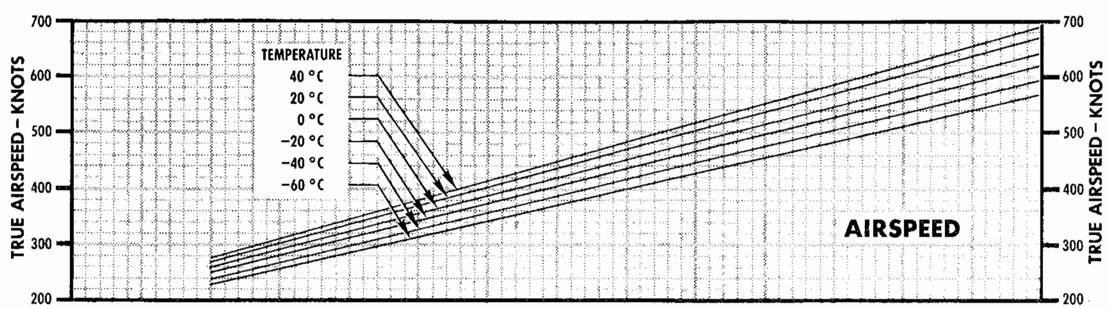
0

REMARKS
ENGINE(S):(2) J79-GE-8
ICAO STANDARD DAY

DATE: 20 AUGUST 1963
DATA BASIS: FLIGHT TEST



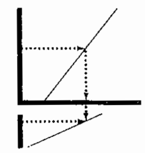
ALTITUDE	STANDARD TEMPERATURE
0 FT	15.0 °C
5000 FT	5.1 °C
10,000 FT	−4.8 °C
15,000 FT	−14.7 °C
20,000 FT	−24.6 °C
25,000 FT	−34.5 °C
30,000 FT	−44.4 °C
35,000 FT	−54.3 °C
40,000 FT	−56.5 °C



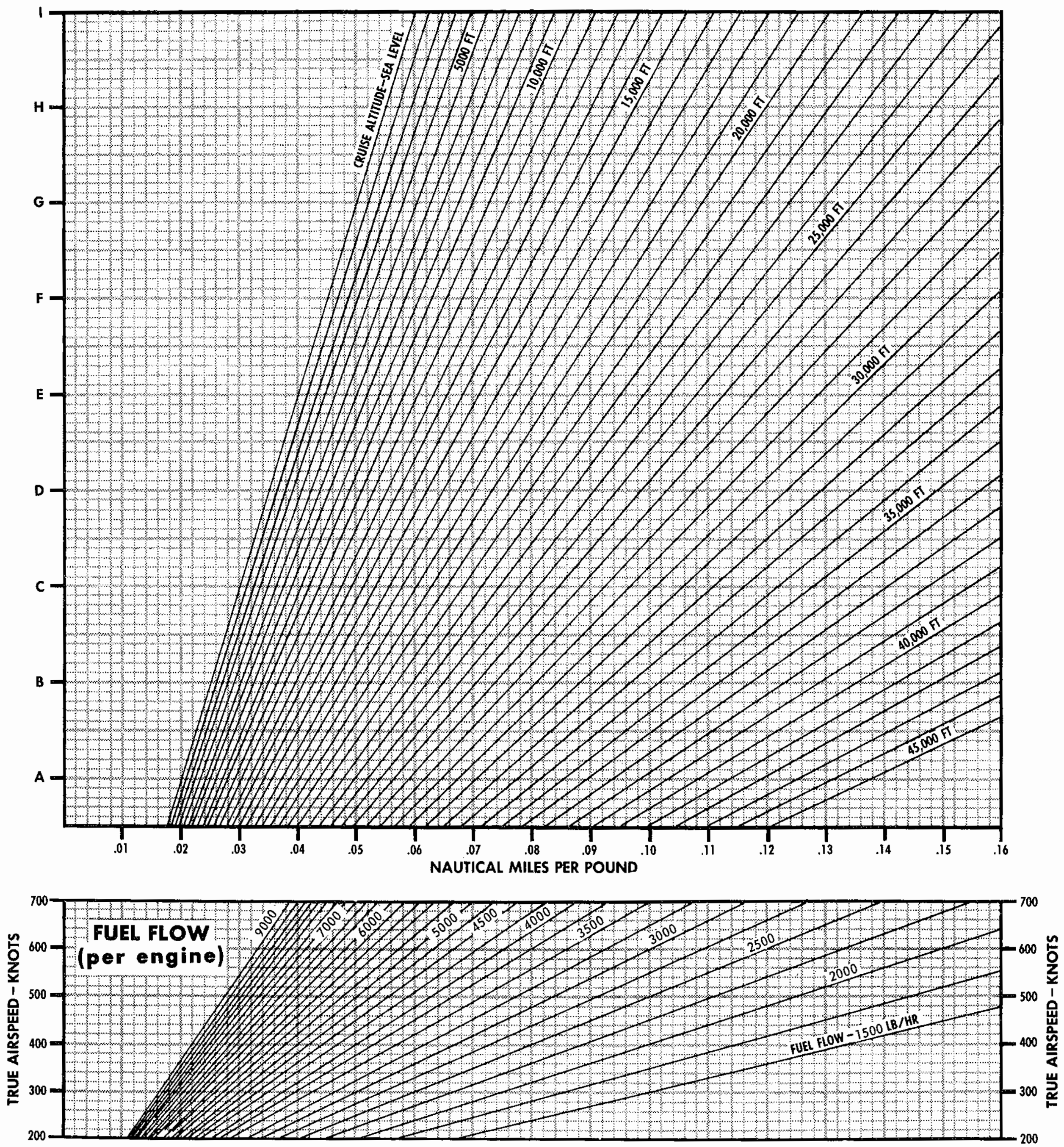
RF4B-P464-1

Figure 11-27 (Sheet 1)

NAUTICAL MILES PER POUND



FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

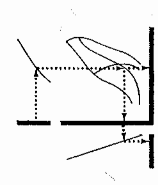


RF4B-464-2

Figure 11-27 (Sheet 2)

NAUTICAL MILES PER POUND

GUIDE

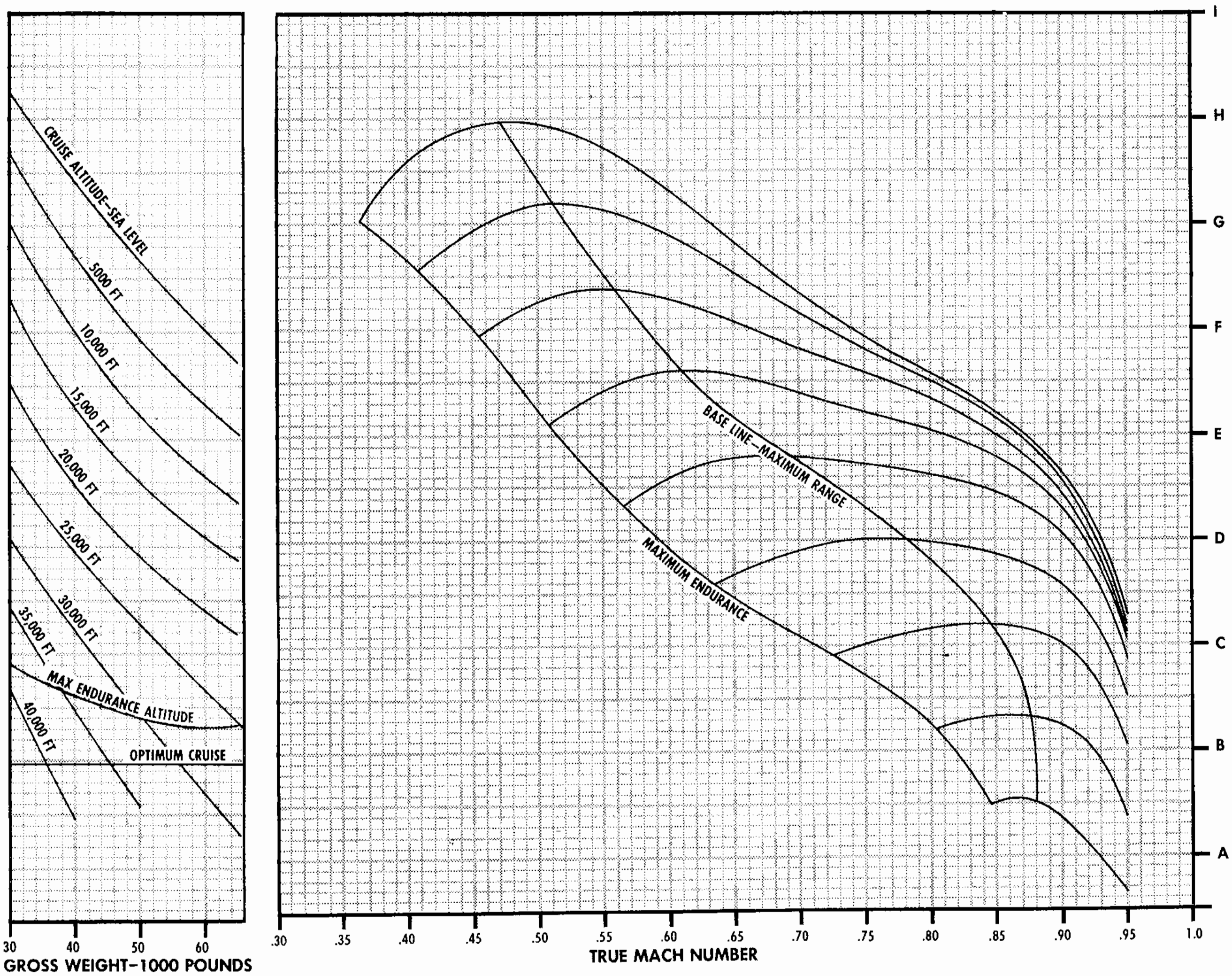


AIRPLANE CONFIGURATION
LIMITED CONFIGURATIONS

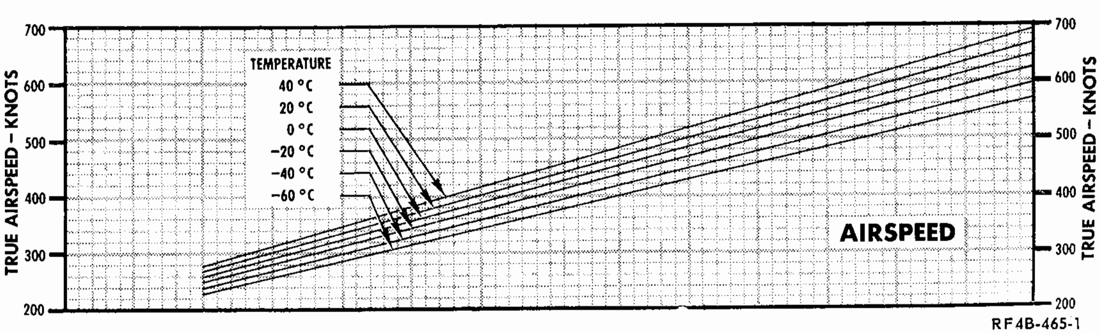
DRAG INDEX
10

REMARKS
ENGINE(S):(2) J79-GE-8
ICAO STANDARD DAY

DATE: 20 AUGUST 1963
DATA BASIS: FLIGHT TEST



ALTITUDE	STANDARD TEMPERATURE
0 FT	15.0 °C
5000 FT	5.1 °C
10,000 FT	−4.8 °C
15,000 FT	−14.7 °C
20,000 FT	−24.6 °C
25,000 FT	−34.5 °C
30,000 FT	−44.4 °C
35,000 FT	−54.3 °C
40,000 FT	−56.5 °C



RF4B-465-1

Figure 11-28 (Sheet 1)

NAUTICAL MILES PER POUND

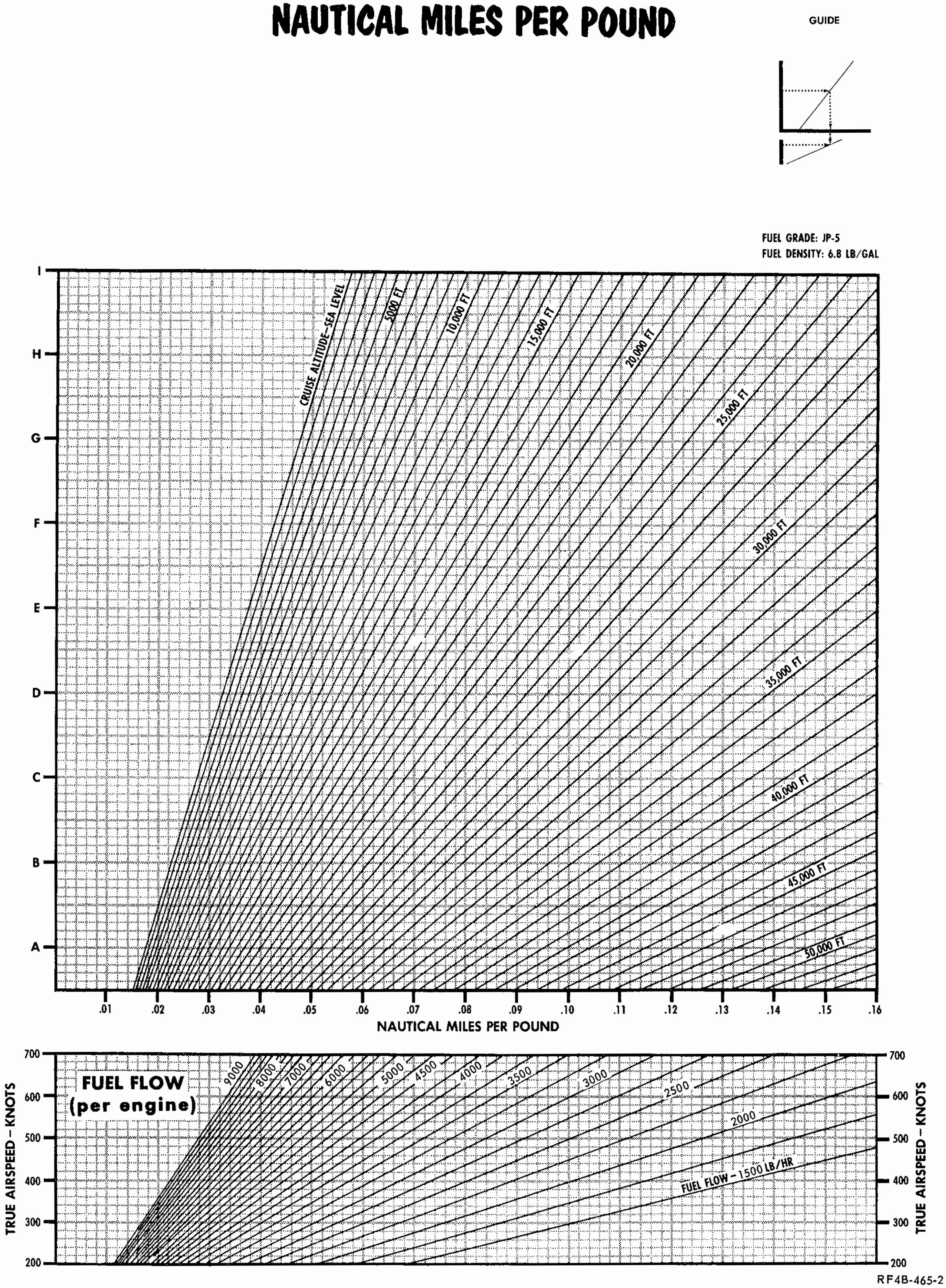
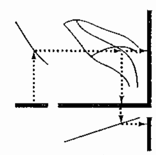


Figure 11-28 (Sheet 2)

NAUTICAL MILES PER POUND

GUIDE

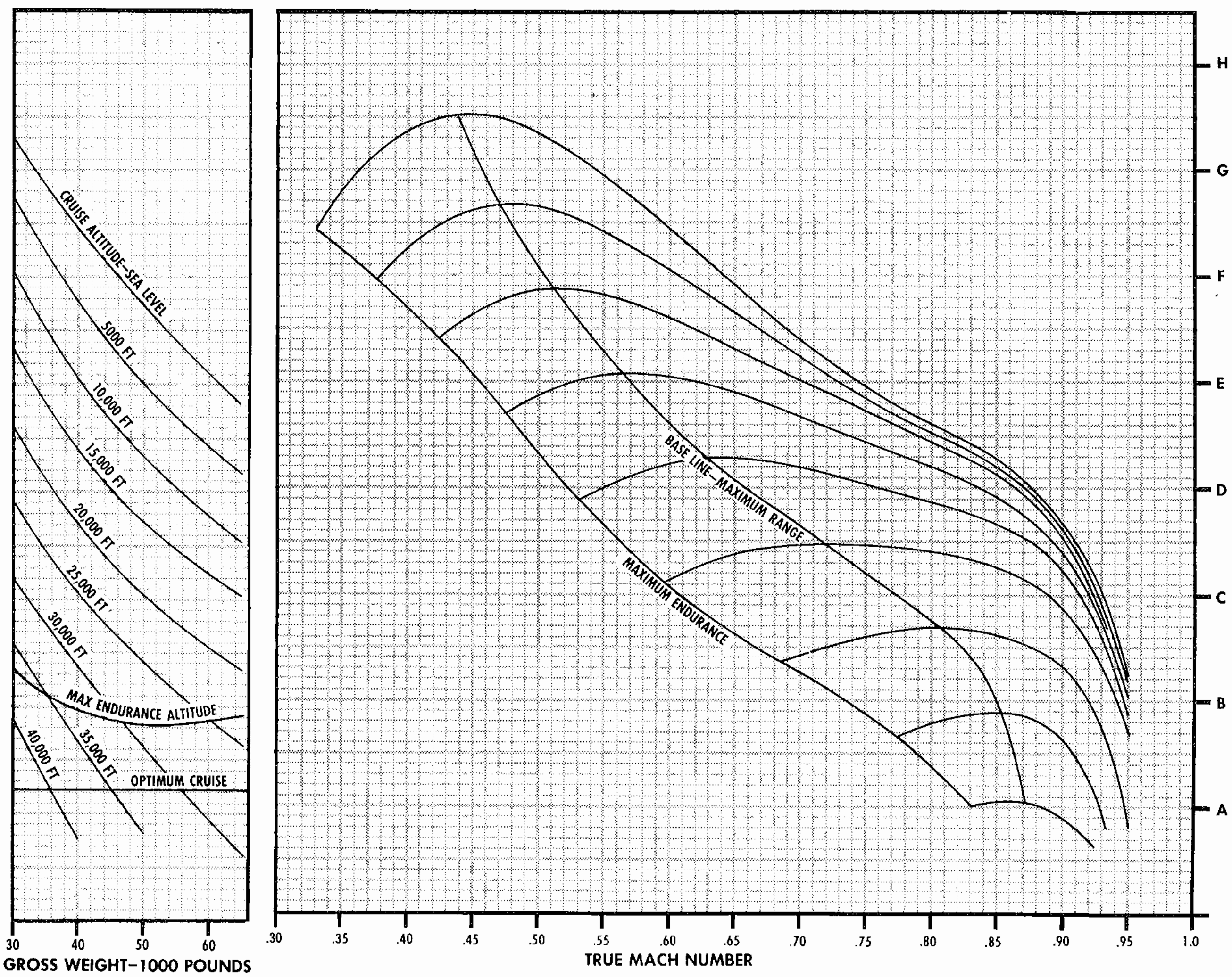


AIRPLANE CONFIGURATION
LIMITED CONFIGURATIONS

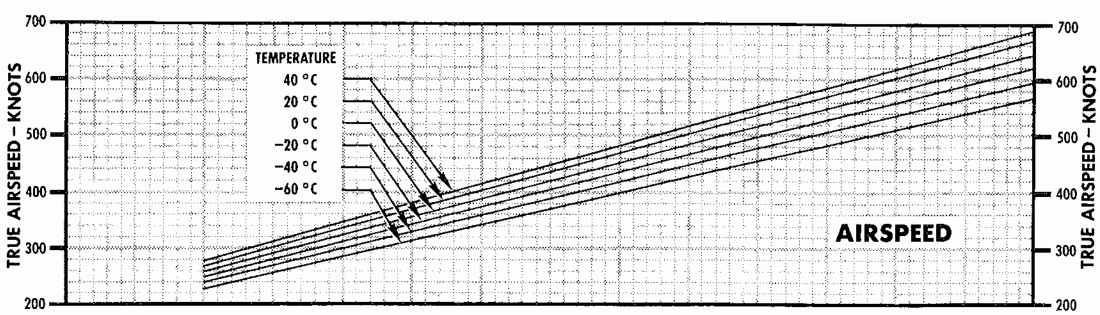
DRAG INDEX
20

REMARKS
ENGINE(S):(2) J79-GE-8
ICAO STANDARD DAY

DATE: 20 AUGUST 1963
DATA BASIS: FLIGHT TEST



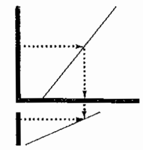
ALTITUDE	STANDARD TEMPERATURE
0 FT	15.0 °C
5000 FT	5.1 °C
10,000 FT	−4.8 °C
15,000 FT	−14.7 °C
20,000 FT	−24.6 °C
25,000 FT	−34.5 °C
30,000 FT	−44.4 °C
35,000 FT	−54.3 °C
40,000 FT	−56.5 °C



RF4B-466-1

Figure 11-29 (Sheet 1)

NAUTICAL MILES PER POUND



FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

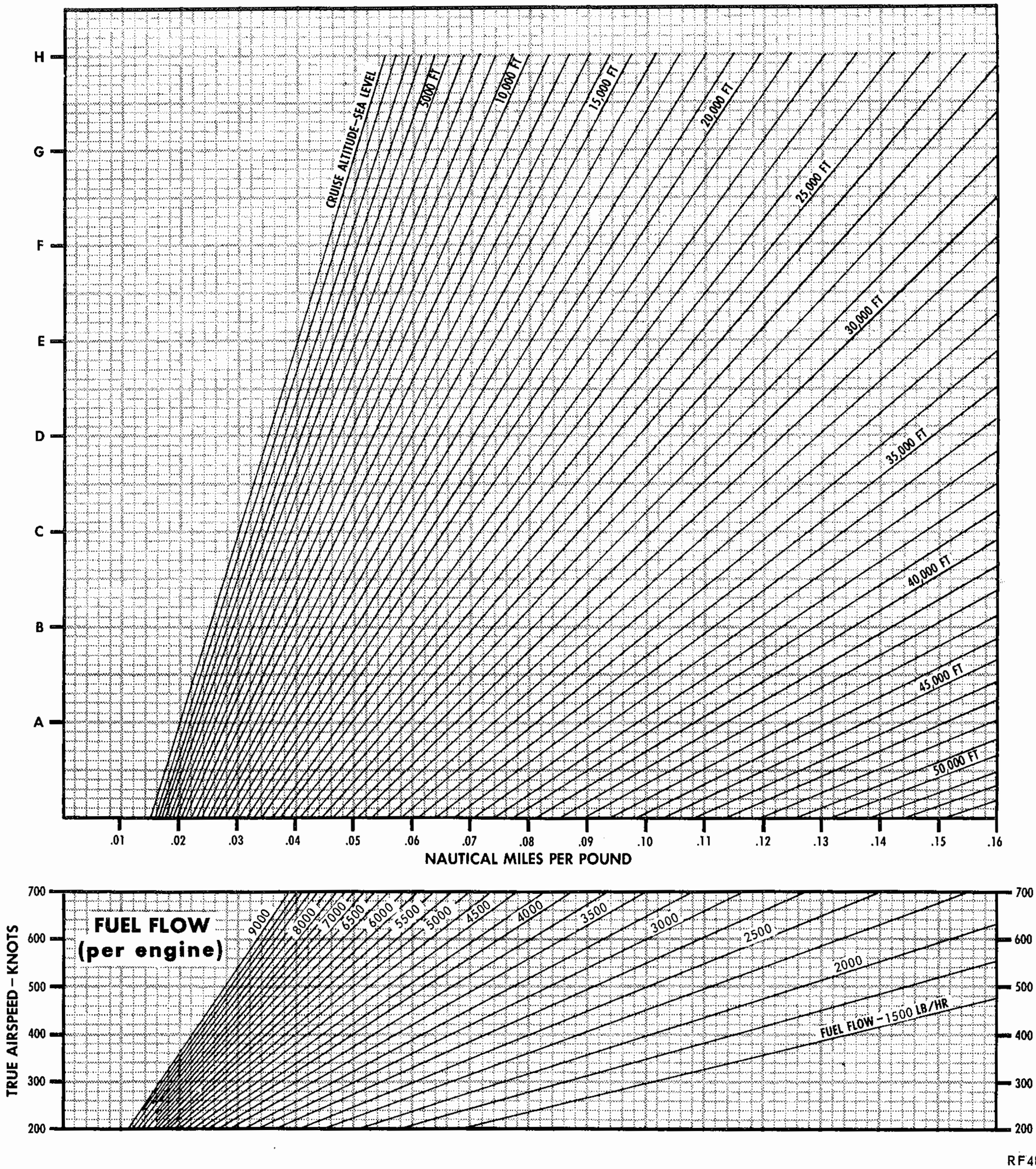
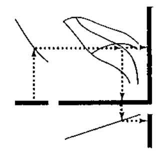


Figure 11-29 (Sheet 2)

NAUTICAL MILES PER POUND

GUIDE

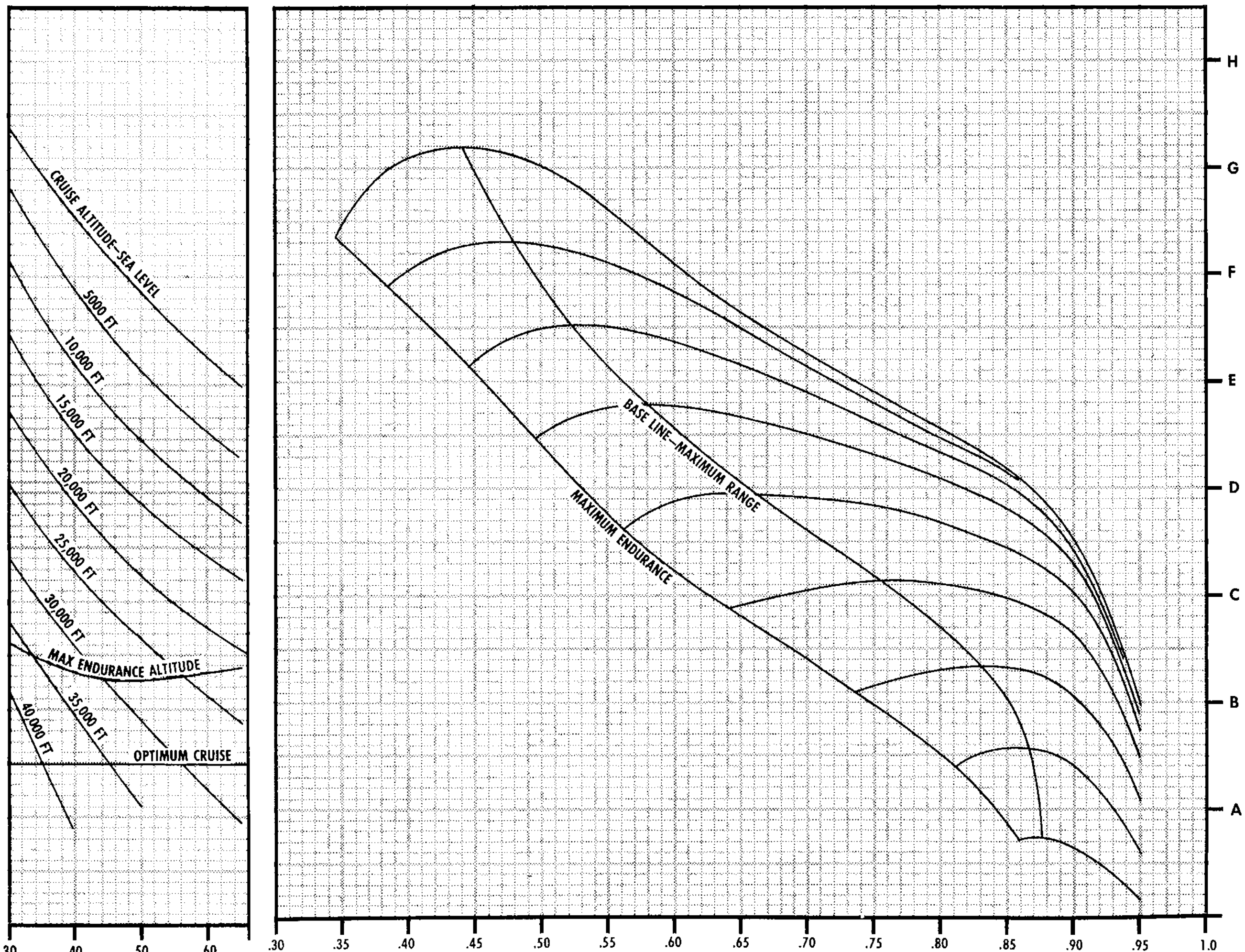


AIRPLANE CONFIGURATION
LIMITED CONFIGURATIONS

DRAG INDEX
30

REMARKS
ENGINE(S):(2) J79-GE-8
ICAO STANDARD DAY

DATE: 20 AUGUST 1963
DATA BASIS: FLIGHT TEST



ALTITUDE	STANDARD TEMPERATURE
0 FT	15.0 °C
5000 FT	5.1 °C
10,000 FT	−4.8 °C
15,000 FT	−14.7 °C
20,000 FT	−24.6 °C
25,000 FT	−34.5 °C
30,000 FT	−44.4 °C
35,000 FT	−54.3 °C
40,000 FT	−56.5 °C

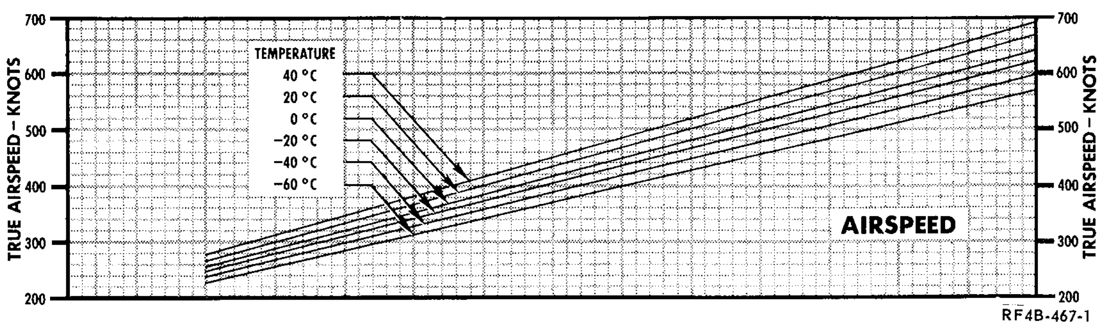
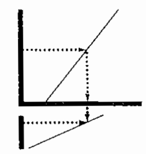
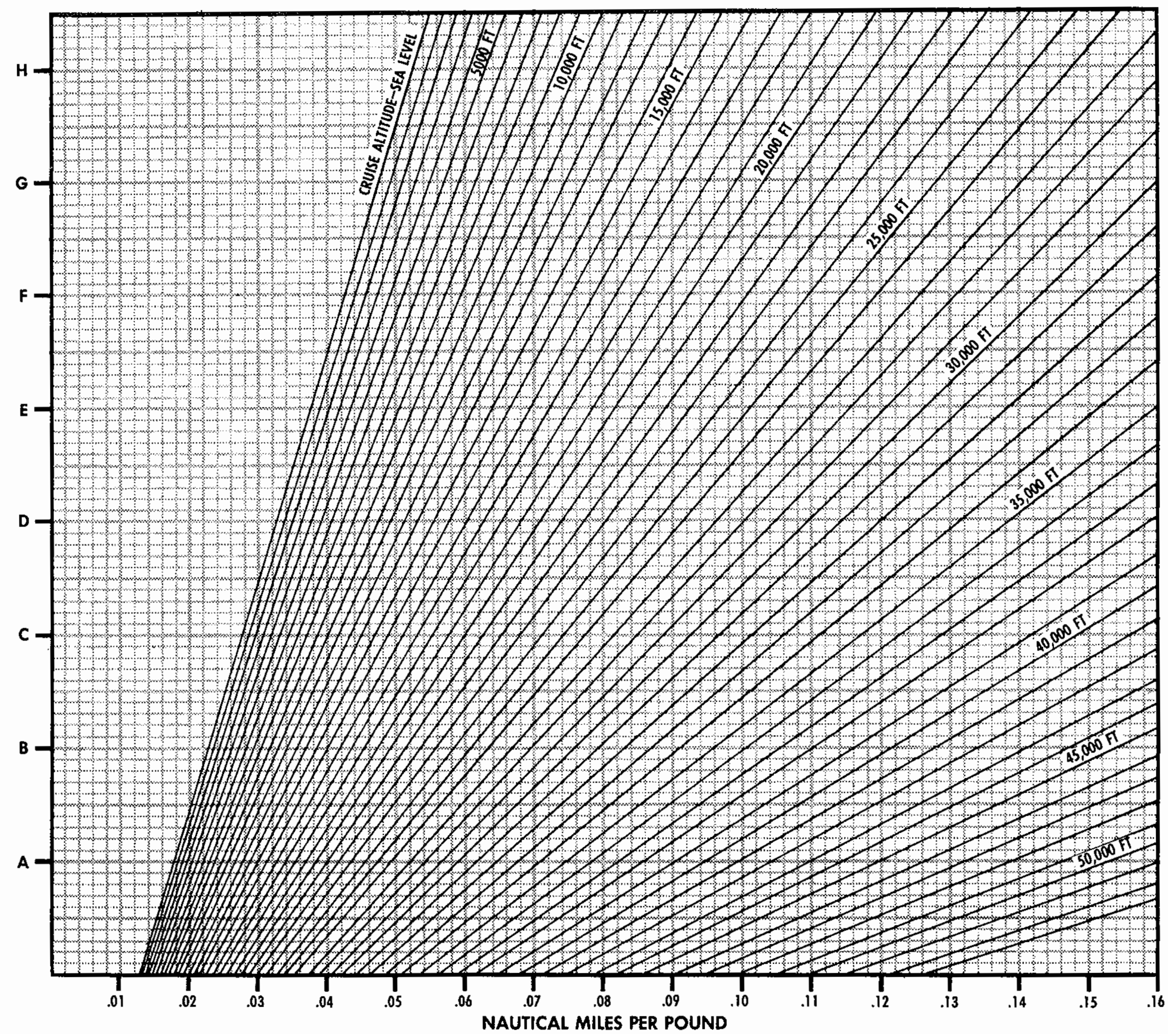


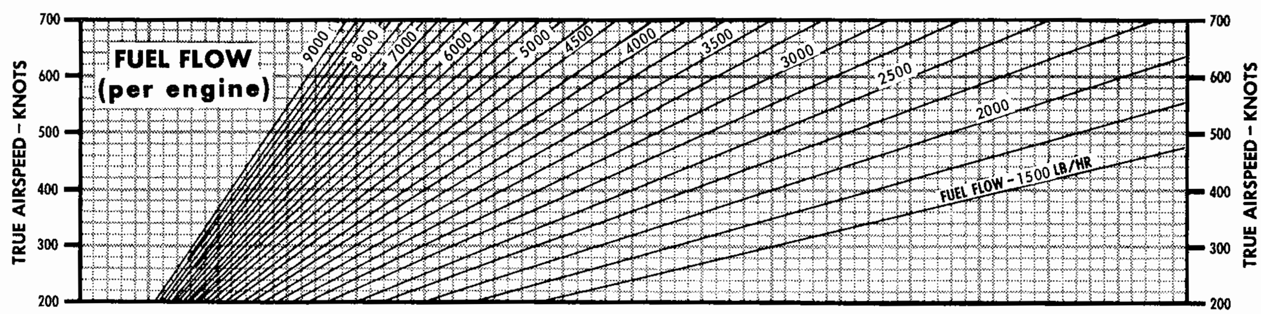
Figure 11-30 (Sheet 1)

NAUTICAL MILES PER POUND



FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL





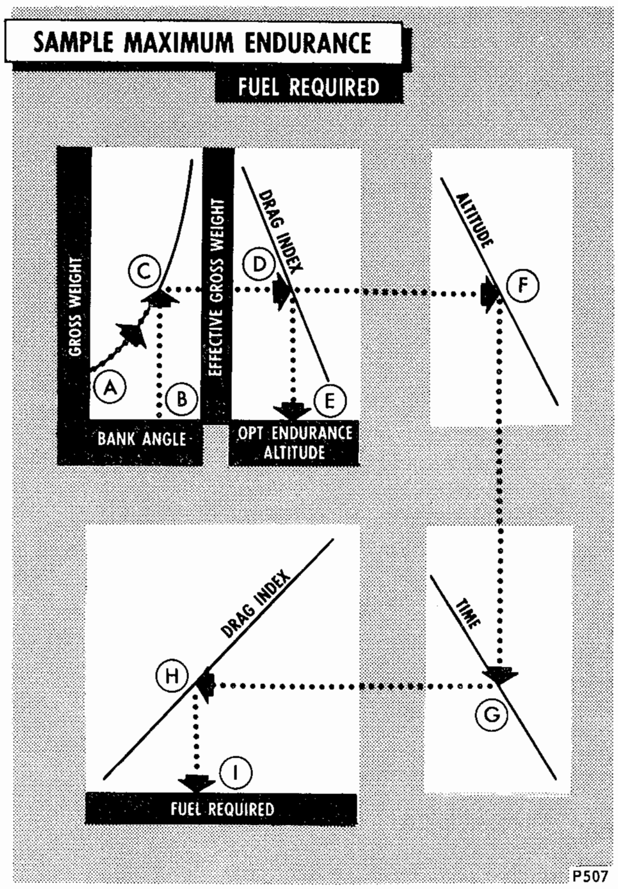
RF4B-467-2

Figure 11-30 (Sheet 2)

ENDURANCE part 5

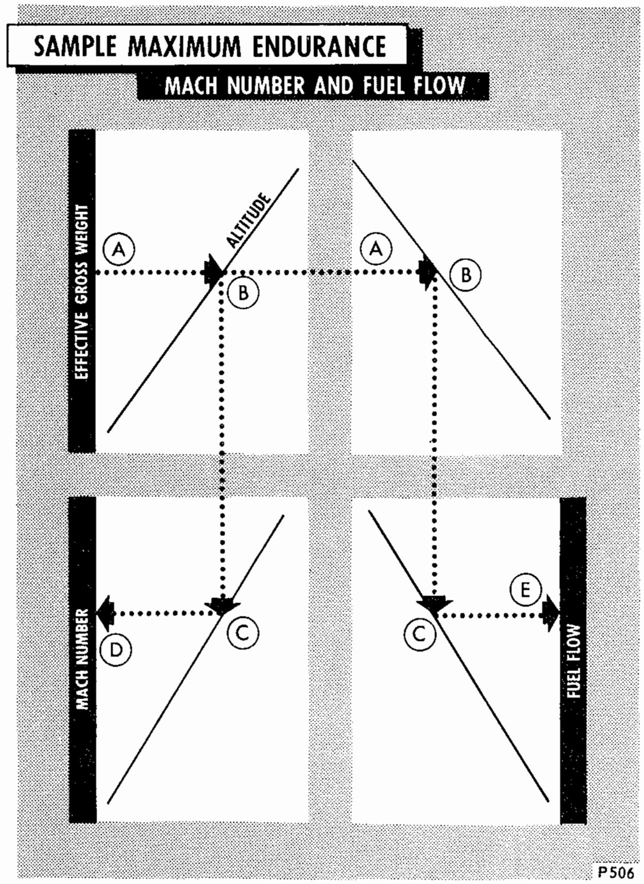
MAXIMUM ENDURANCE CHARTS

Maximum endurance data (figures 11-31 and 11-32) is presented on the Maximum Endurance Fuel Required and Maximum Endurance, Mach Number and Fuel Flow charts. It is possible to obtain either optimum or off-optimum endurance data for both two-engine and single-engine operation.



USE

Enter the Fuel Required chart with the average gross weight for the period that maximum endurance is to be used. Follow the gross weight curve until it intersects the bank angle to be used. From this point, proceed horizontally to the right and intersect the computed drag index. Descend and read optimum endurance altitude. From the previous intersection with the drag index, proceed further to the right, note the effective gross weight, and intersect the altitude at which the endurance is to be flown (either optimum or desired). From this point, descend to the time line corresponding to the expected time in maximum endurance. Proceed horizontally to the left to intersect the computed drag index, then descend and read fuel required. Enter the Mach and fuel flow plots with the effective gross weight, proceed to the correct altitude line, descend to the computed drag index and then proceed horizontally to read the required data.



Sample Problem

Two engine - fuel required

A.	Gross weight	35,000 Lbs.
B.	Bank angle	30°
C.	Effective gross weight	40,000 Lbs.
D.	Drag index	20
E.	Optimum endurance altitude	33,000 Ft.
F.	Desired endurance altitude	35,000 Ft.
G.	Time on station	30 Mins.
H.	Drag index	20
I.	Total fuel required	2250 Lbs.

MAXIMUM ENDURANCE

FUEL REQUIRED

AIRPLANE CONFIGURATION
ALL CONFIGURATIONS

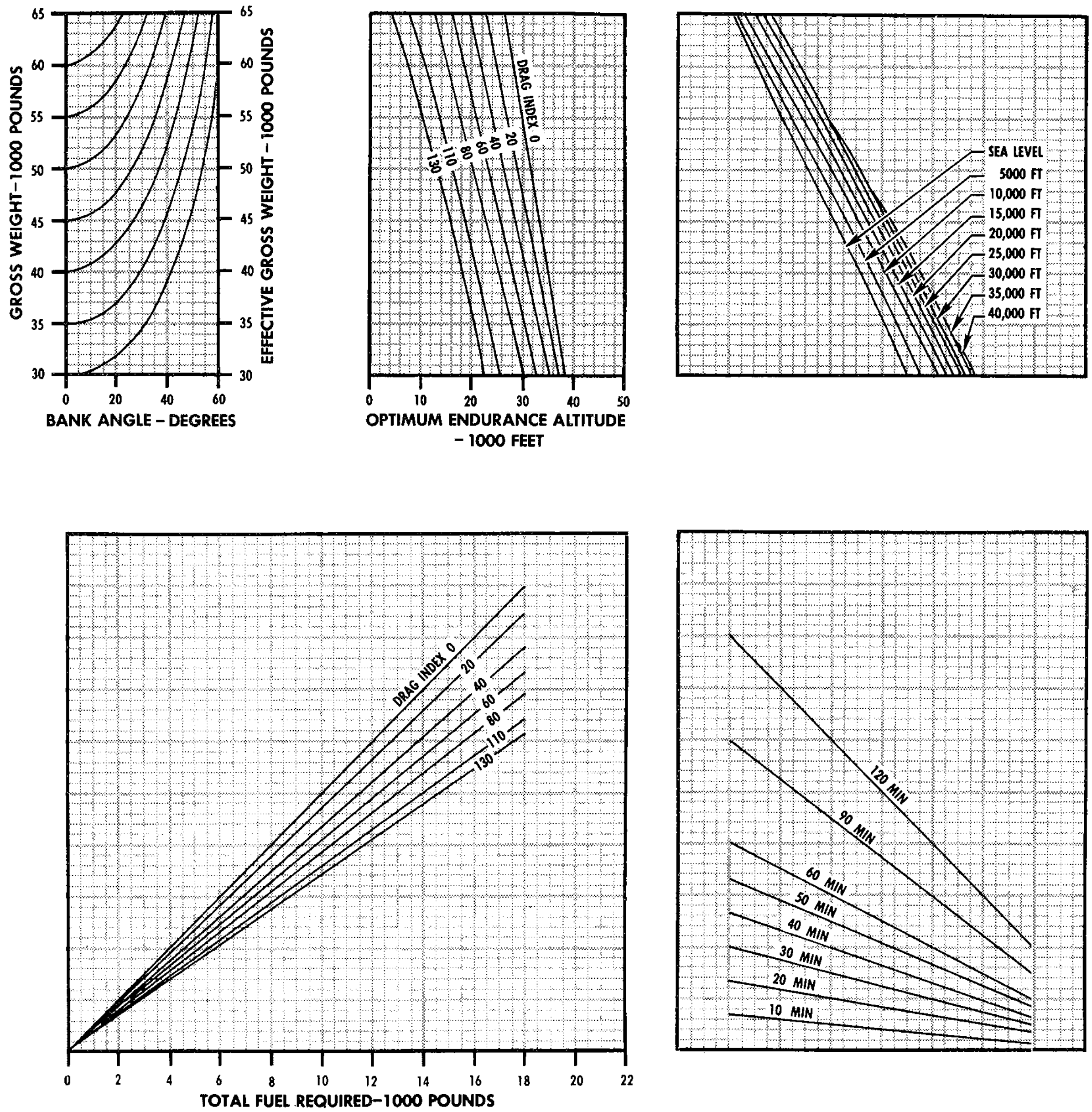
DRAG INDEX
INDIVIDUALLY NOTED
0-130

REMARKS
ENGINE(S):(2) J79-GE-8
ICAO STANDARD DAY

GUIDE

DATE: 15 NOVEMBER 1965
DATA BASIS: ESTIMATED (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



RF4B-P520

Figure 11-31 (Sheet 1)

MAXIMUM ENDURANCE
MACH NUMBER AND FUEL FLOW

AIRPLANE CONFIGURATION
ALL CONFIGURATIONS

DRAG INDEX
INDIVIDUALLY NOTED
0-60

REMARKS
ENGINE(S):(2) J79-GE-8
ICAO STANDARD DAY

GUIDE

DATE: 15 NOVEMBER 1965
DATA BASIS: **ESTIMATED** (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

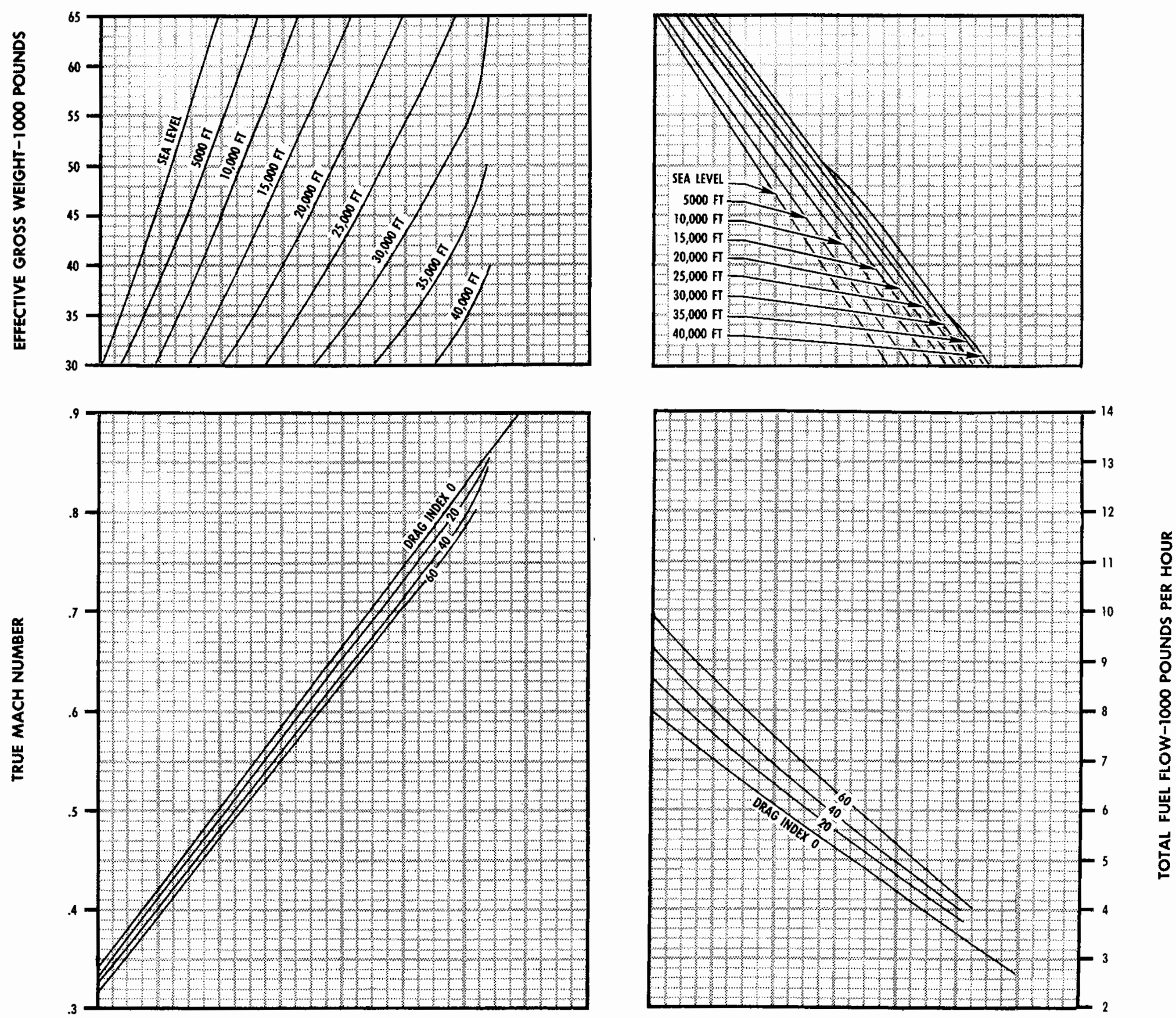


Figure 11-31 (Sheet 2)

MAXIMUM ENDURANCE

FUEL REQUIRED
ONE ENGINE OPERATING

REMARKS
ENGINE(S):(2) J79-GE-8
ICAO STANDARD DAY

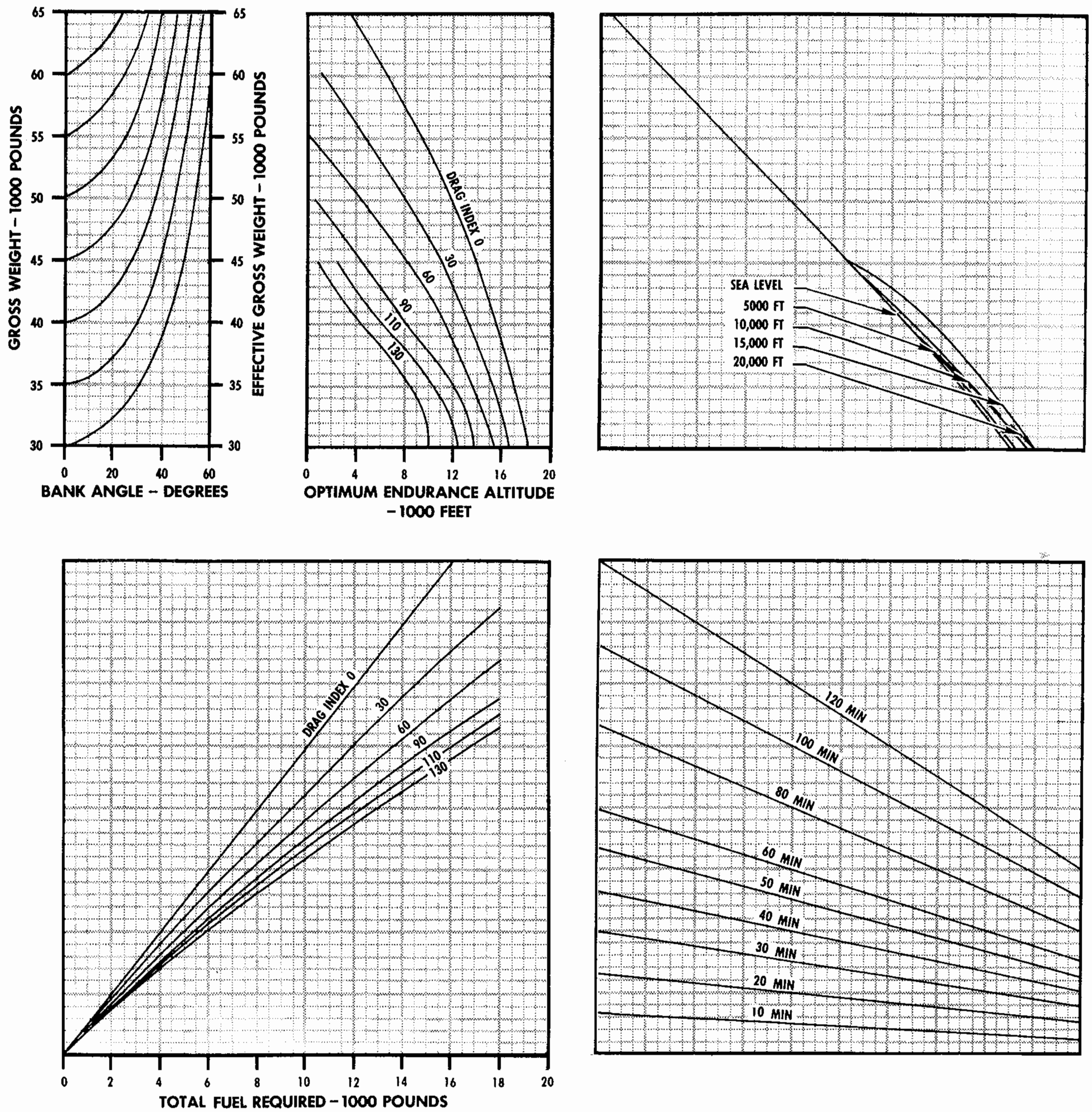
AIRPLANE CONFIGURATION
ALL CONFIGURATIONS

DRAG INDEX
INDIVIDUALLY NOTED
0-130

GUIDE

DATE: 15 NOVEMBER 1965
DATA BASIS: ESTIMATED (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



RF4B-P523

Figure 11-32 (Sheet 1)

MAXIMUM ENDURANCE
FUEL FLOW
ONE ENGINE OPERATING

AIRPLANE CONFIGURATION
ALL CONFIGURATIONS

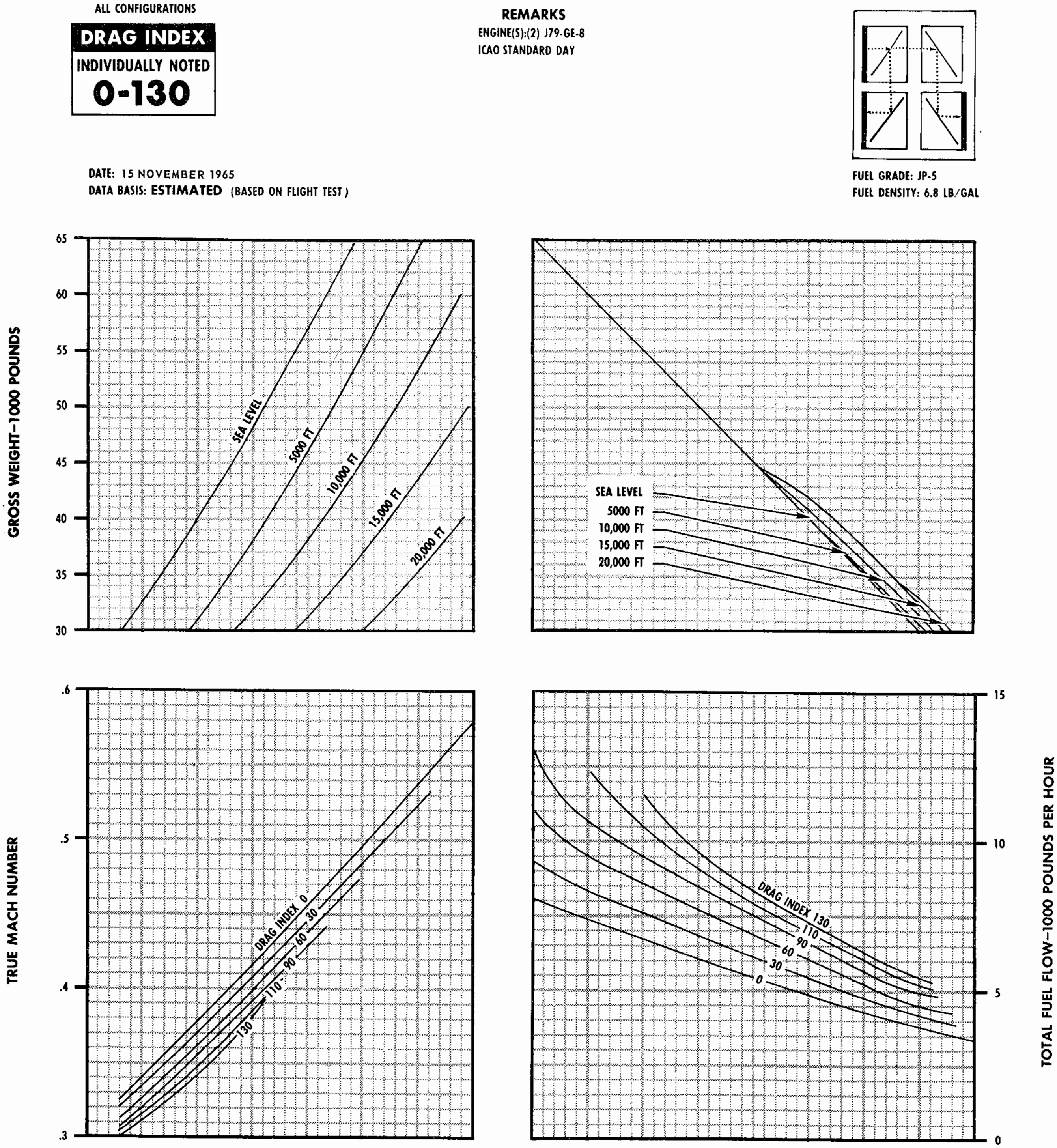
DRAG INDEX
INDIVIDUALLY NOTED
0-130

REMARKS
ENGINE(S):(2) J79-GE-8
ICAO STANDARD DAY

GUIDE

DATE: 15 NOVEMBER 1965
DATA BASIS: ESTIMATED (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



RF4B-P524

Figure 11-32 (Sheet 2)

AIR REFUELING part 6

(This data will be supplied when available.)

DESCENT part 7

CHARTS

DESCENT CHARTS

Three descent charts (figures 11-33 thru 11-35) are provided. These include an idle thrust power descent and two 300-knot, 80% rpm descents (one with speed brakes retracted and one with speed brakes extended). The format of all three charts is identical. The charts supply the pilot with the distance, time, fuel used and Mach number 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 cursing altitude.

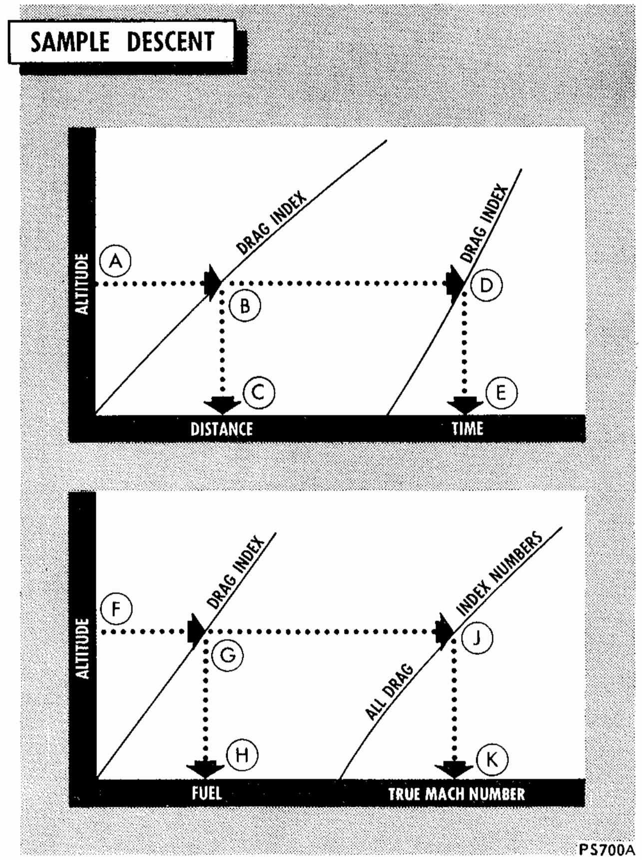
USE

Enter the upper plot of the appropriate chart with the cruising flight-level and project horizontally across the graph to intersect both drag-index reflectors at the applicable computed drag index. From the first intersection, project vertically downward to intersect and read distance traveled. From the second intersection, project vertically downward to intersect and read time required. Enter the lower plot with the cruising altitude and project horizontally across the graph to intersect both drag-index reflectors at the applicable computed drag index. From the first intersection, project vertically downward to intersect and read fuel required. From the second intersection, project vertically downward to intersect and read corresponding Mach number at start of descent.

Sample Problem

Descent (idle power)

A.	Altitude	30,000 Ft.
B.	Computed drag index	20.0



PS700A

C.	Distance traveled	44 Miles
D.	Computed drag index	20.0
E.	Time required	8.5 Mins.
F.	Altitude	30,000 Ft.
G.	Computed drag index	20.0
H.	Fuel used	182 Lbs.
J.	Single drag reflector	
K.	Mach number	.665

DESCENT

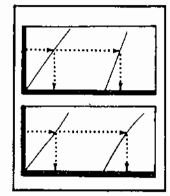
IDLE POWER

AIRPLANE CONFIGURATION
ALL CONFIGURATIONS

DRAG INDEX
INDIVIDUALLY NOTED
0-130

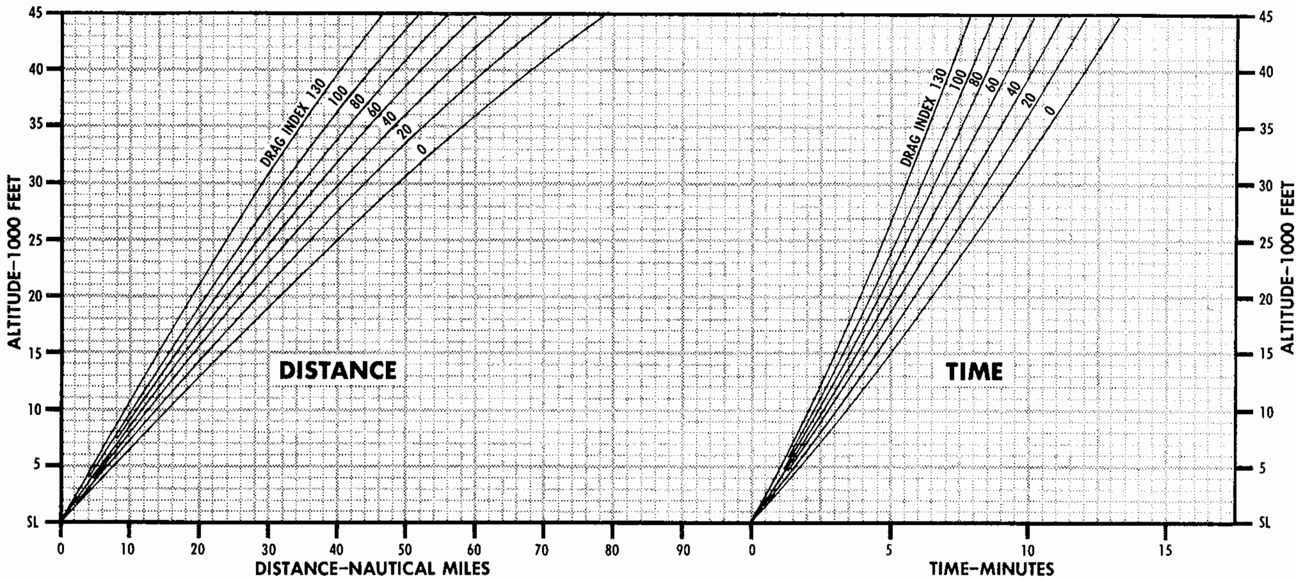
REMARKS
ENGINE(S): (2) J79-GE-8
SPEED BRAKES RETRACTED
APPLICABLE TO ALL GROSS WEIGHTS
ICAO STANDARD DAY

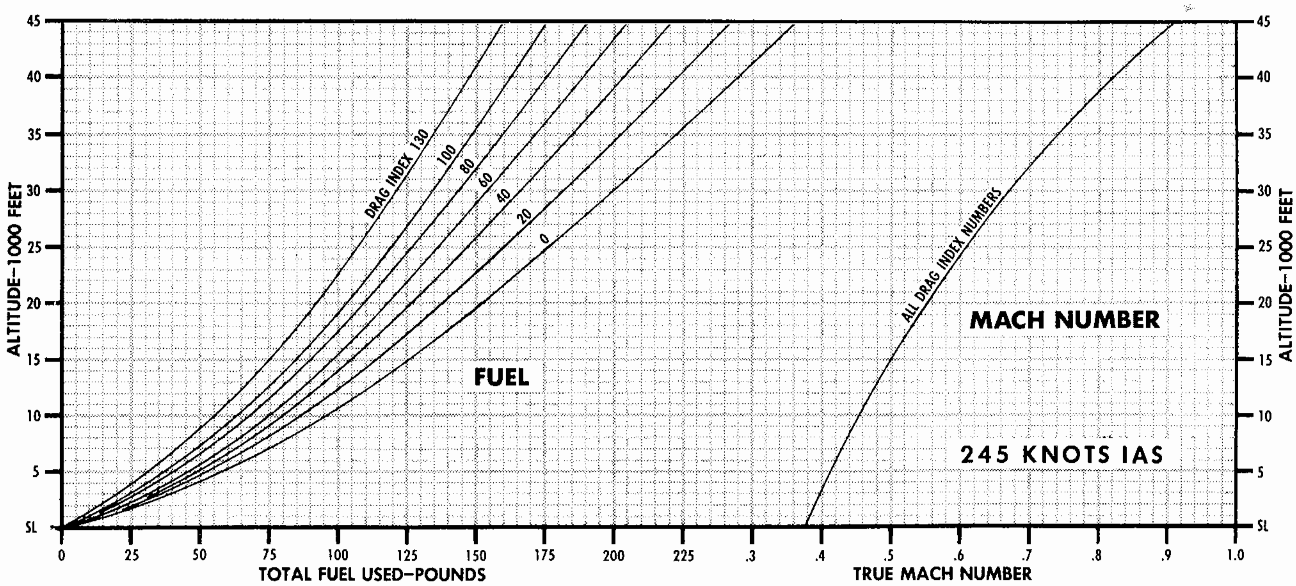
GUIDE



DATE: 20 AUGUST 1963
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL





RF4B-P700A

Figure 11-33

DESCENT

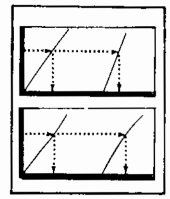
300 KCAS-80% RPM
SPEED BRAKES EXTENDED

AIRPLANE CONFIGURATION
ALL CONFIGURATIONS

DRAG INDEX
INDIVIDUALLY NOTED
0-130

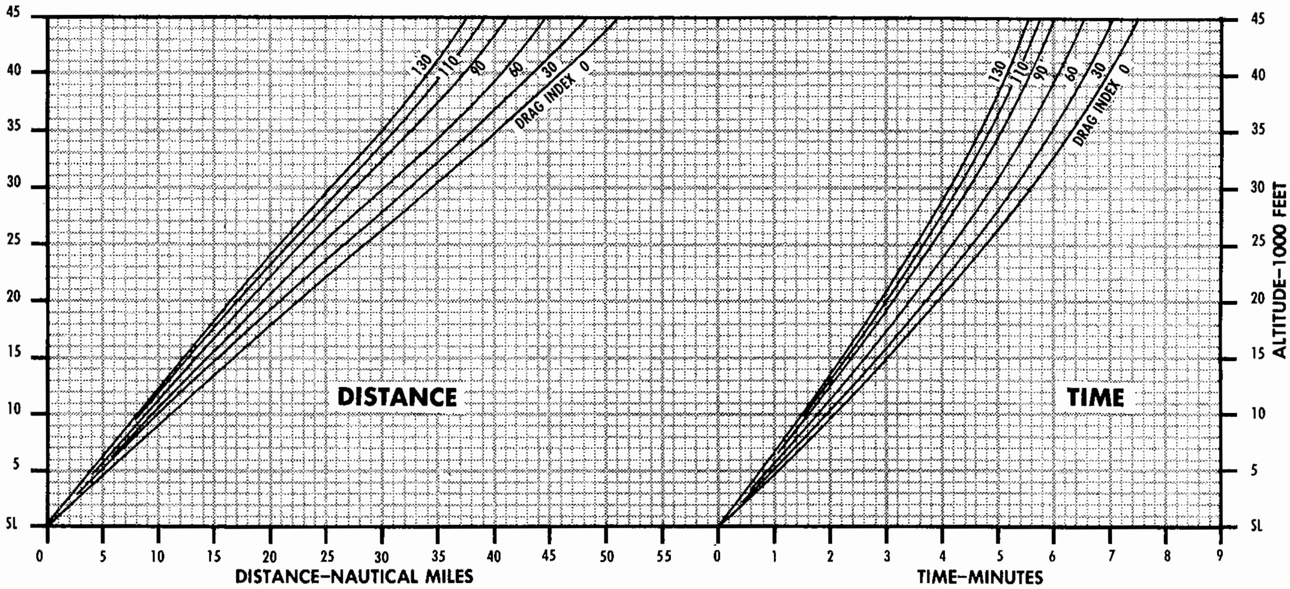
REMARKS
ENGINE(S): (2) J79-GE- 8
APPLICABLE TO ALL GROSS WEIGHTS
ICAO STANDARD DAY

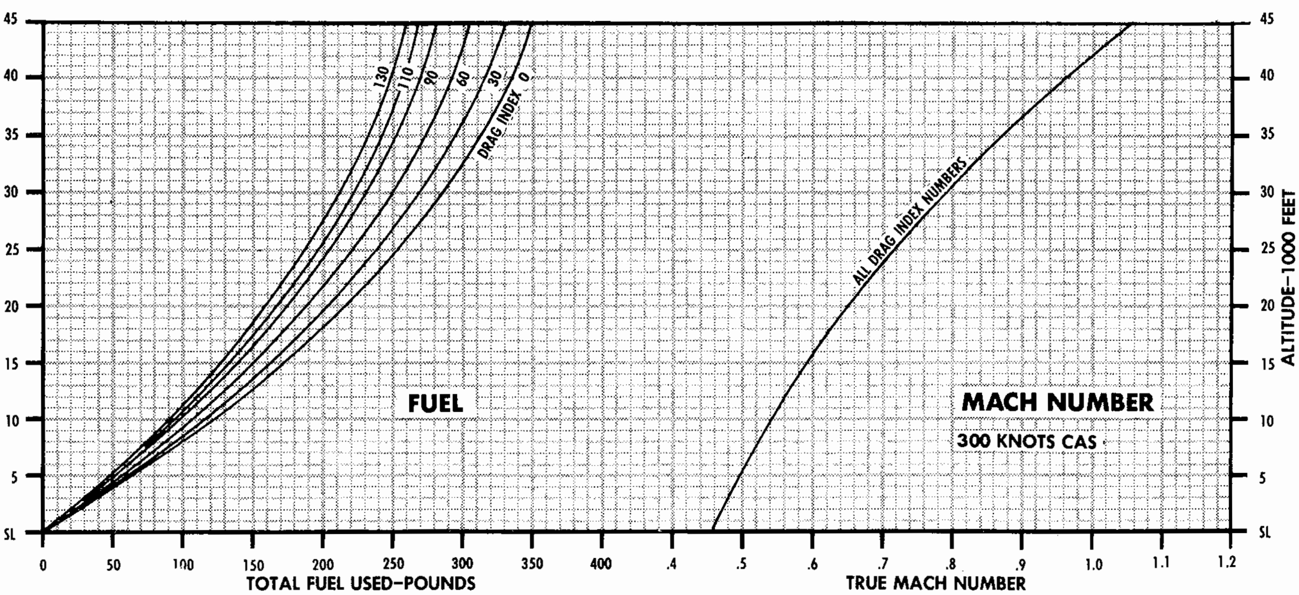
GUIDE



DATE: 20 AUGUST 1963
DATA BASIS: ESTIMATED (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL





RF4B-P701A

Figure 11-34

DESCENT

300 KCAS-80% RPM
SPEED BRAKES RETRACTED

AIRPLANE CONFIGURATION
ALL CONFIGURATIONS

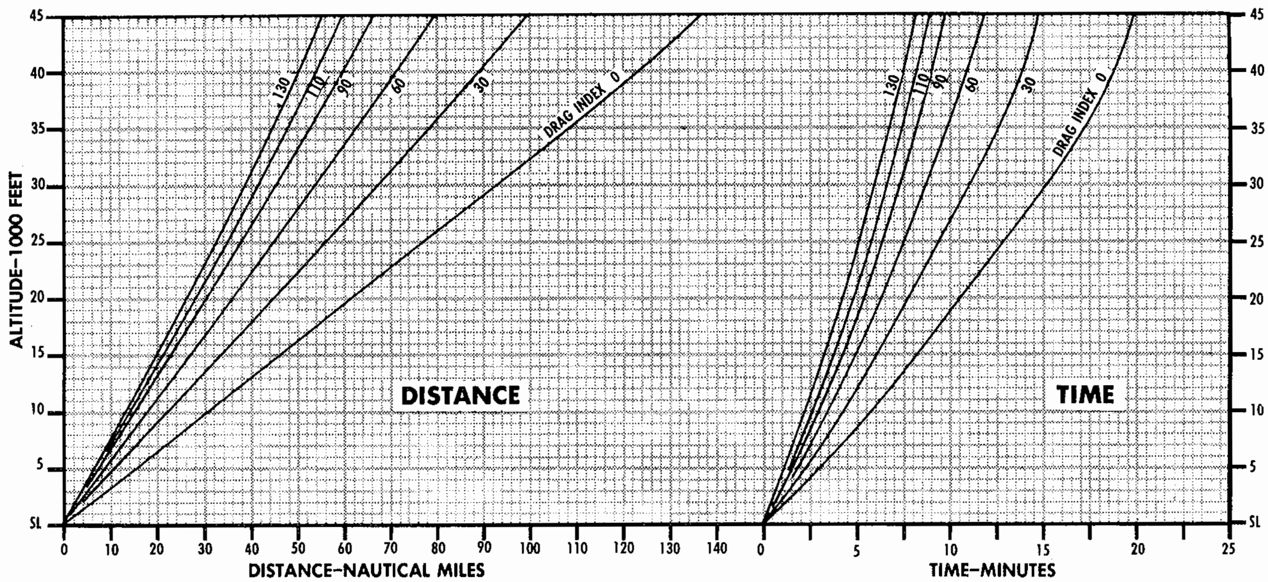
DRAG INDEX
INDIVIDUALLY NOTED
0-130

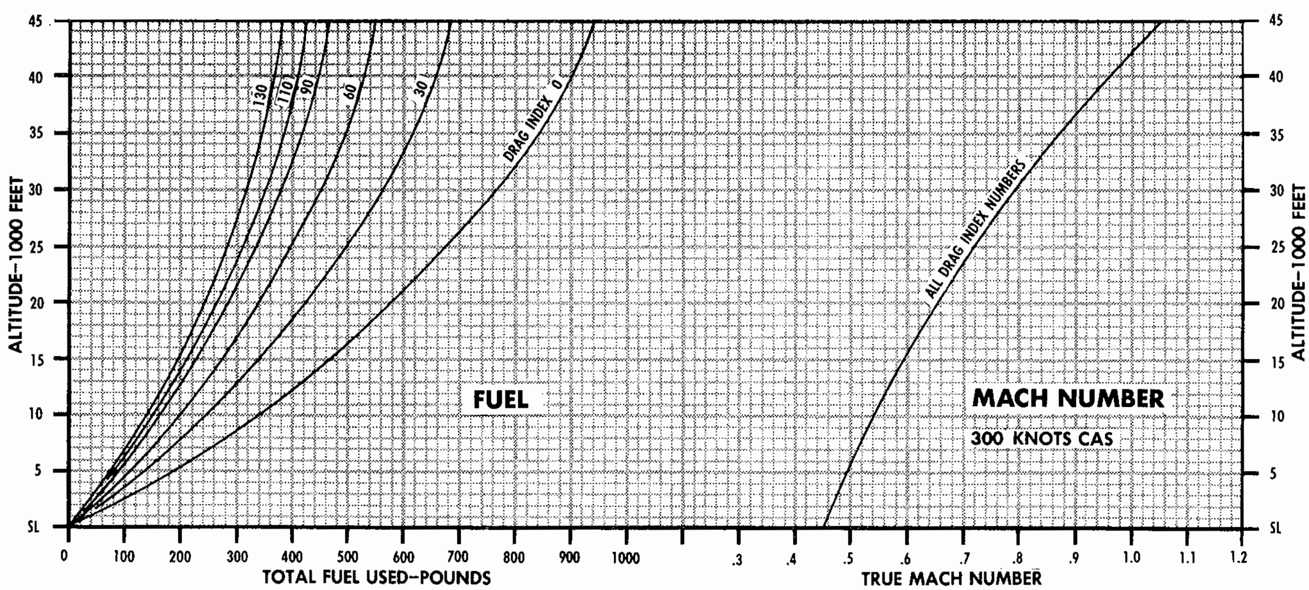
REMARKS
ENGINE(S): (2) J79-GE- 8
APPLICABLE TO ALL GROSS WEIGHTS
ICAO STANDARD DAY

GUIDE

DATE: 20 AUGUST 1963
DATA BASIS: ESTIMATED (BASED ON FLIGHT TEST)

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL





RF4B-P702A

Figure 11-35

LANDING part 8

CHARTS

LANDING SPEED CHART

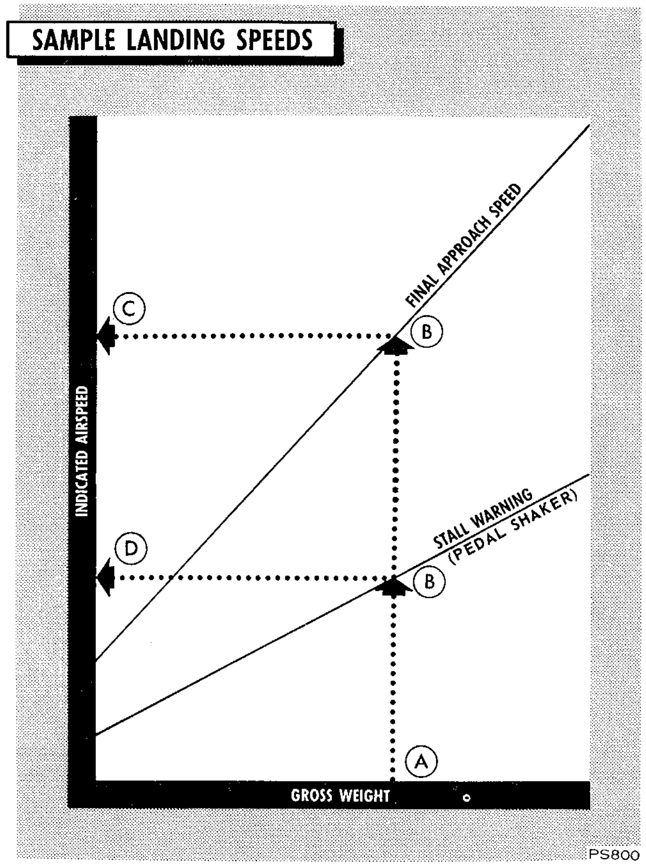
The landing speed chart (figure 11-36) shows recommended approach and stall warning (pedal shaker) speed curves for the gross weight range of the airplane.

USE

Enter the chart with the estimated landing gross weight and proceed vertically to intersect both reflector lines. From these intersections, project horizontally to the left to read recommended approach and stall warning speeds.

Sample Problem

A.	Landing gross weight	32,000 Lbs.
B.	Intersect both reflector lines	
C.	Approach speed (IAS)	133 Kts.
D.	Stall warning speed (IAS)	120 Kts.



LANDING DISTANCE CHARTS

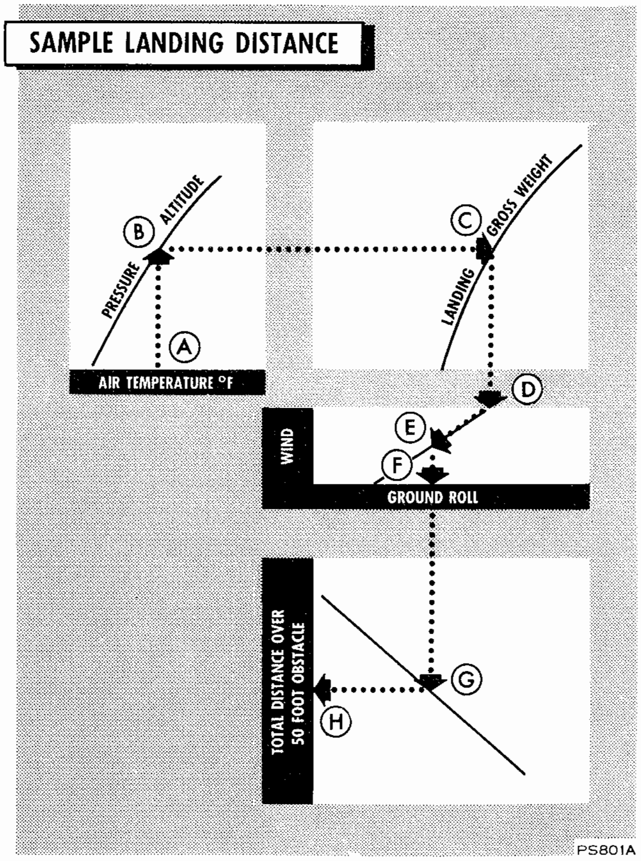
Landing distances, ground roll and total distance required to clear a 50-foot obstacle, are shown in figure 11-37. The following conditions are considered: Landing on a hard dry runway; temperature in °F and °C; pressure altitude, sea level through 8,000 feet; gross weight, 25,000 pounds through 40,000 pounds; touchdown speeds for each gross weight; and headwind effect, 0 to 40 knots.

USE

Enter the chart with the surface temperature and proceed vertically to intersect the field pressure altitude. Proceed horizontally to the estimated landing gross weight. Descend directly to the wind base line and parallel the nearest guide line to apply effective wind. From this point, descend vertically to read landing ground roll distance and further to the reflector line to read total distance required to clear a 50-foot obstacle.

Sample Problem

A.	Temperature	60°F
B.	Pressure altitude	2,000 Ft.
C.	Gross weight	30,000 Lbs.
D.	Wind base line	
E.	Effective headwind	20 Kts.
F.	Landing ground roll distance	1,800 Ft.
G.	Reflector line	
H.	Distance required to clear a 50-foot obstacle	2,600 Ft.

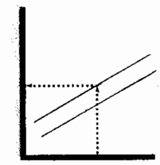


LANDING SPEEDS

AIRPLANE CONFIGURATION
ALL DRAG INDEXES
FULL FLAPS, GEAR DOWN

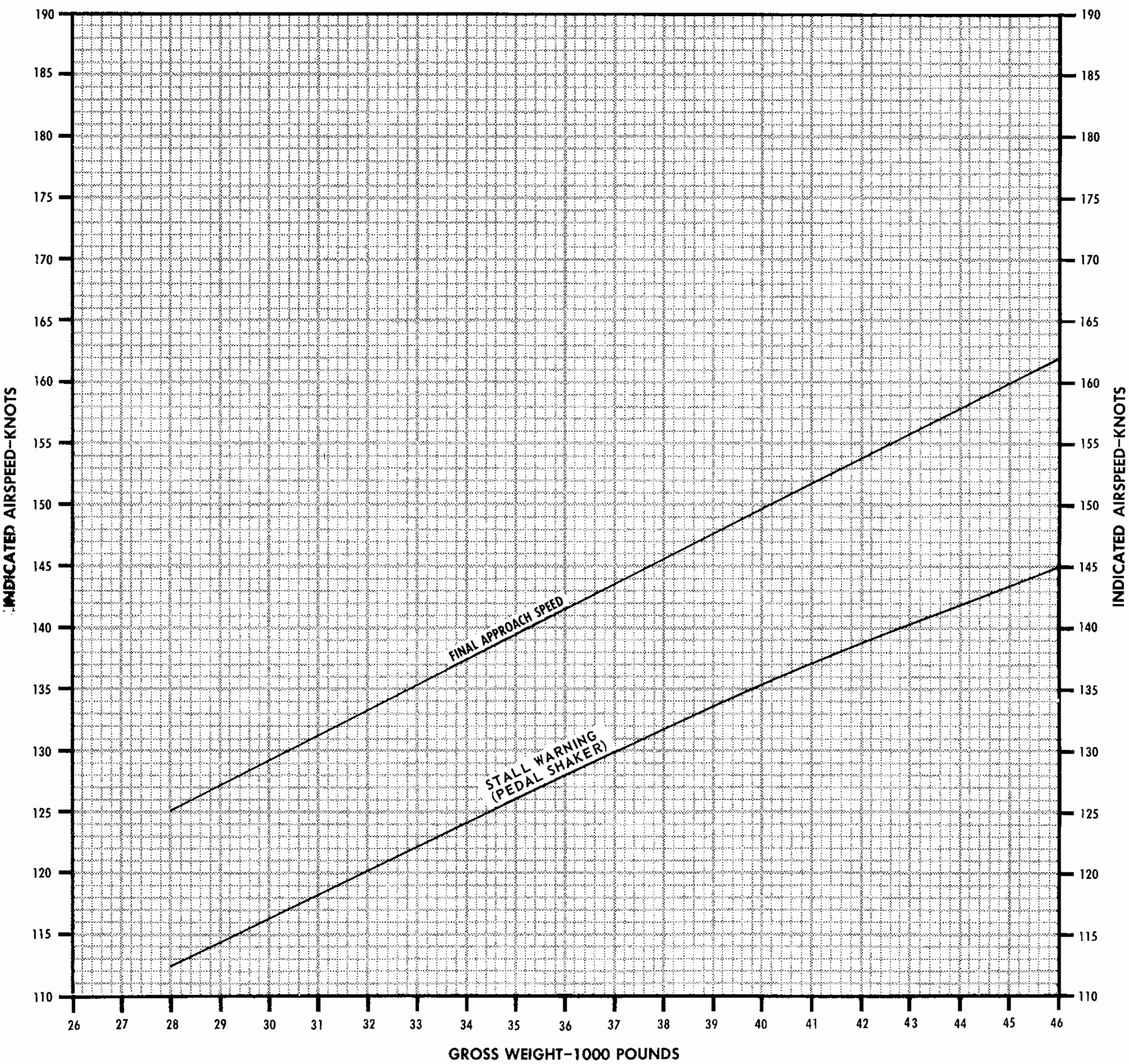
REMARKS
ENGINE(S):(2) J79-GE-8
ICAO STANDARD DAY

GUIDE



DATE: 15 MARCH 1965
DATA BASIS: ESTIMATED

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



RF4B-P800

Figure 11-36

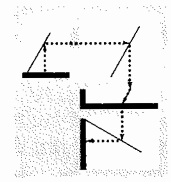
LANDING DISTANCE
HARD DRY RUNWAY

AIRPLANE CONFIGURATION

ALL CONFIGURATIONS
FULL FLAPS, GEAR DOWN
DRAG CHUTE DEPLOYED

REMARKS
ENGINE(S): (2) J79-GE-8

GUIDE



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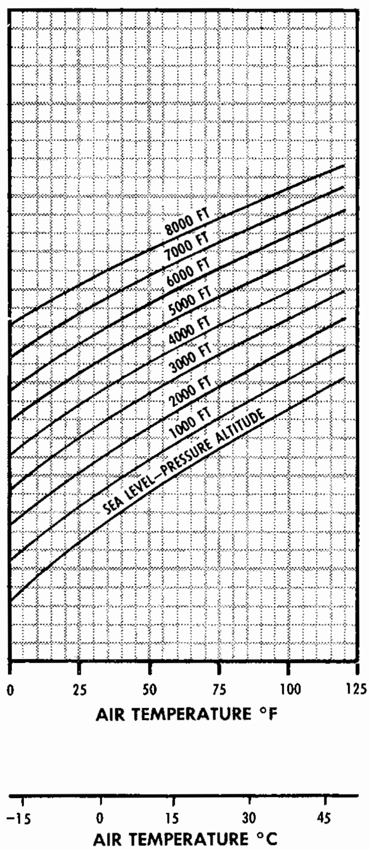
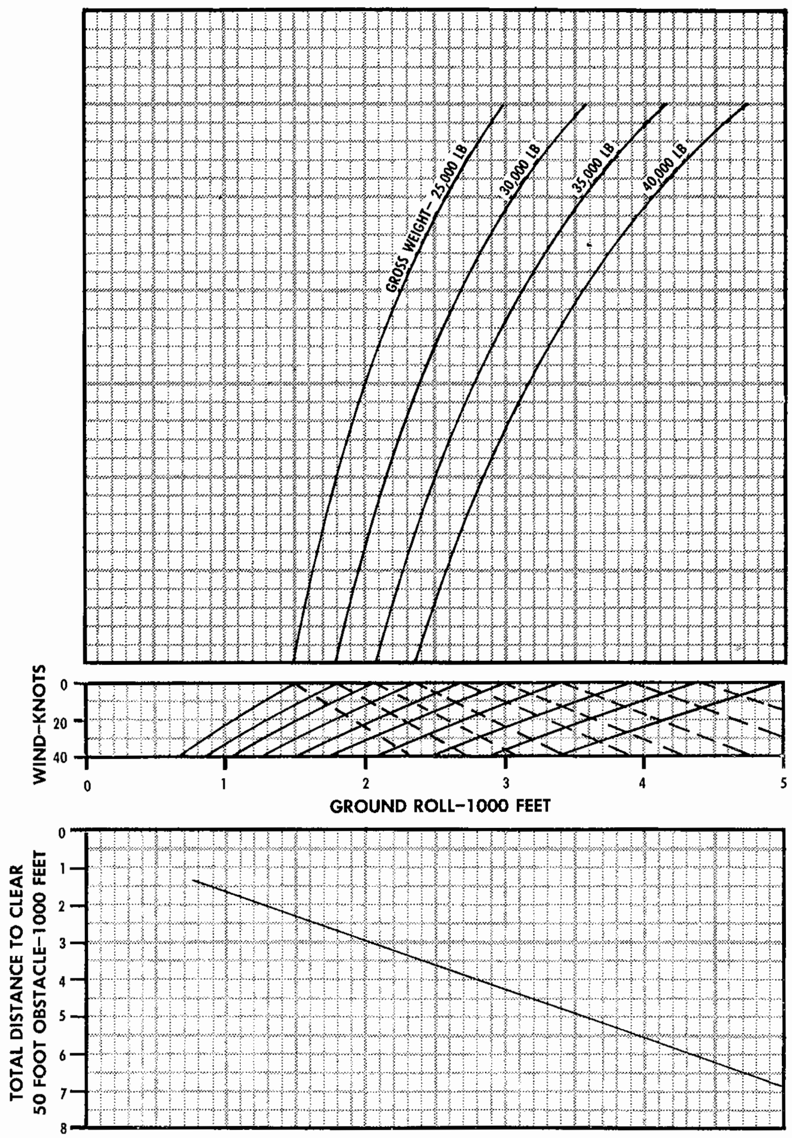
DATA BASIS: ESTIMATED

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL





NOTE

LANDING WITHOUT DRAG CHUTE INCREASES THE GROUND ROLL 30% AND THE TOTAL DISTANCE OVER A 50 FOOT OBSTACLE 20%.

RF4B-P801

Figure 11-37

COMBAT PERFORMANCE part 9

TURN CAPABILITIES

This chart (figure 11-38) 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.

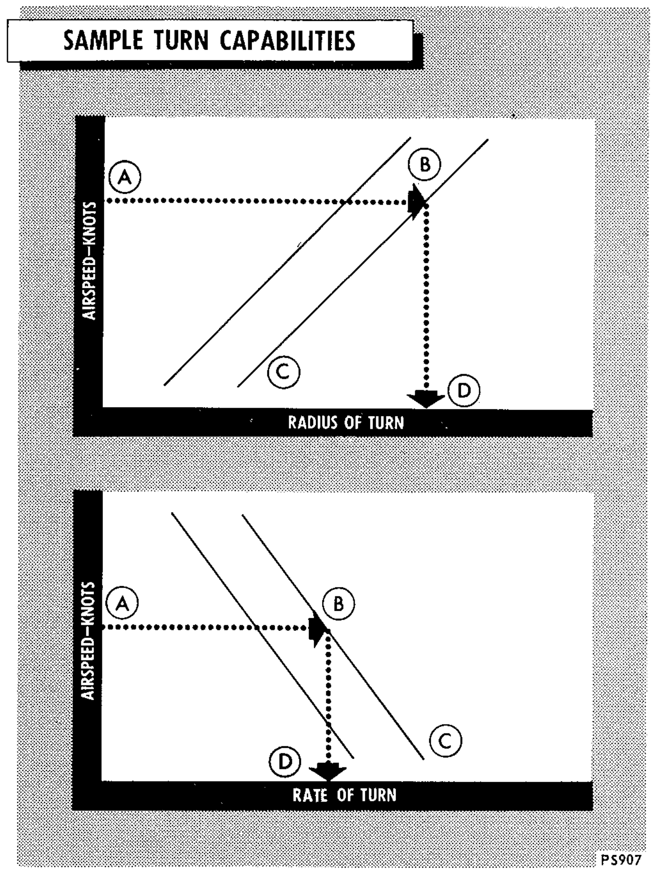
Sample Problem

Radius of Turn

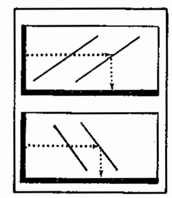
A.	True Airspeed	400 Kts.
B.	Bank angle	30°
C.	Load factor	1.1 "g"
D.	Radius of turn	2500 Ft.

Rate of Turn

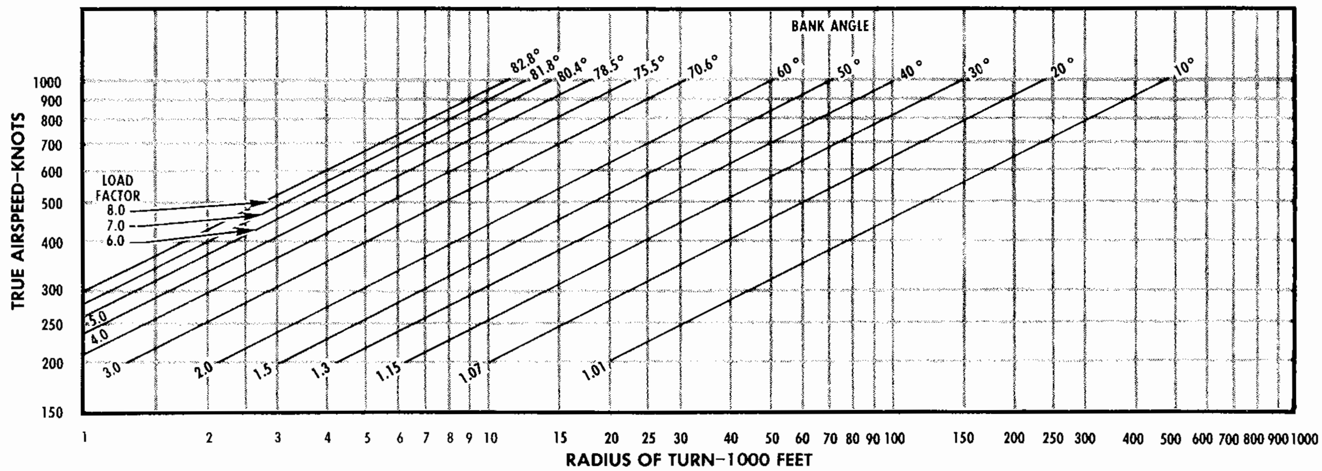
A.	True airspeed	600 Kts.
B.	Bank angle	40°
C.	Load factor	1.3 "g"
D.	Rate of turn	1.5 Degrees/Sec.



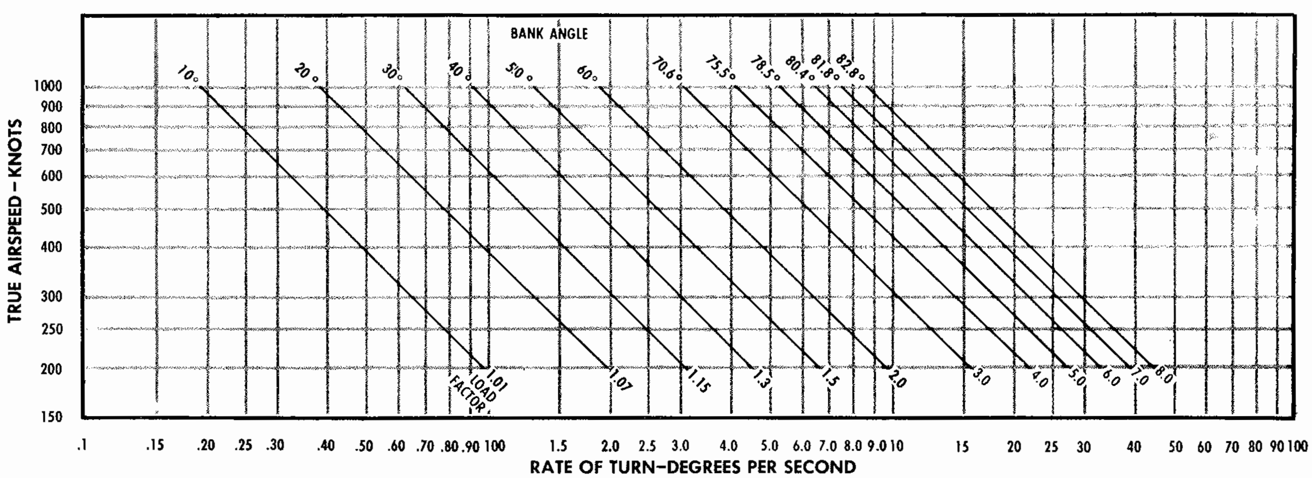
TURN CAPABILITIES
CONSTANT SPEED AND ALTITUDE



RADIUS OF TURN



RATE OF TURN



RF4B-P980

Figure 11-38

MISSION PLANNING part 10

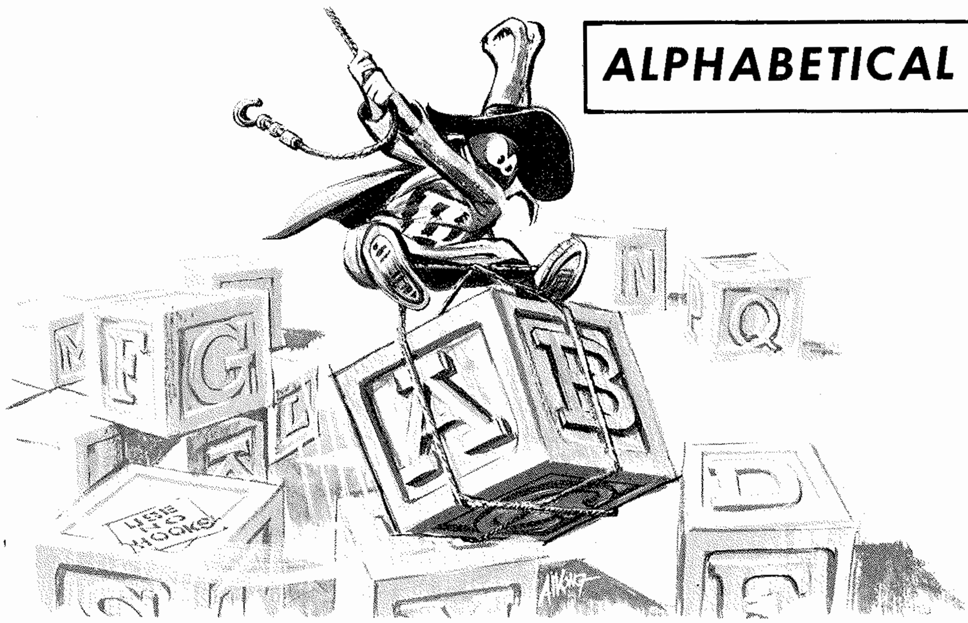
(This data will be supplied when available.)

NATOPS FLIGHT MANUAL GLOSSARY

ac	Alternating current
ACP	Aircraft Communications Procedures
ADCS	Air Data Computer Set
ADI	Attitude Director Indicator
ADIZ	Air Defense Identification Zone
AFCS	Automatic Flight Control System
APN	Airborne, radar, navigational aid
APQ	Airborne, radar, special purpose
ARI	Aileron Rudder Interconnect
ARTC	Air Route Traffic Control
ARC	Airborne, radio, communications
ASA	Airborne, special type, auxiliary assembly
ASN	Airborne, special type, navigational aid
ASQ	Airborne, special type, combination of purposes
ATC	Air Traffic Control
AR	Air Refueling
BACSEB	BuWeps Aviation Clothing and Survival Equipment Bulletin
BDHI	Bearing Distance Heading Indicator
BINGO	Return to this channel (radio). Return fuel state
BIT	Built-In-Test
BLC	Boundary Layer Control
Bolter	Hook down, unintentional touch-and-go (missed wire)
Buster	Full Military power
CAT	Catapult
CAT	Clear Air Turbulence
CATCC	Carrier Air Traffic Control Center
CADC	Central Air Data Computer
CAP	Combat Air Patrol
CARQUAL	Carrier Qualifications
CAS	Calibrated Air Speed
CCA	Carrier Control Approach
CG	Center of Gravity
Charlie Time	Expected time over ramp
CIC	Combat Information Center
CIT	Compressor Inlet Temperature
CNI	Communication Navigation Identification
COT	Cockpit Orientation Trainer
cps	Cycles per second
CVA	Aircraft Carrier (Attack)
CV	Aircraft Carrier
cw	Continuous Wave
dc	Direct current
Dead Beat	Causing the object, when disturbed, to return to its original position without oscillation.
DME	Distance Measuring Equipment
Dog Radial	An assigned radial on which to set up a holding pattern.
DR	Dead Reckoning
EAC	Estimated Arrival Carrier
EAS	Equivalent Airspeed
EAT	Estimated Approach Time
ECCM	Electronic Counter-Countermeasure(s)
ECM	Electronic Countermeasure(s)
EGT	Exhaust Gas Temperature
FAM	Familiarization
FL	Flight Level
FMLP	Field Mirror Landing Practice
Foxtrot Corpen	Fleet Course

g's	Gravity
Gate	Maximum Power
GCA	Ground Control Approach
GCI	Ground Control Intercept
gpm	Gallon per minute
Hand Start	A start that results in a stagnated rpm and temperature
Hot Start	A start that exceeds normal starting temperatures
HSI	Horizontal Situation Indicator
IP	Identification Point
IAS	Indicated Airspeed
IFR	Instrument Flight Rules or In Flight Refueling
ILS	Instrument Landing System
IR	Infrared
I/P	Identification of Position
JANAP	Joint Army Navy Airforce Publication
JP	Jet Propulsion
KTS	Knots
LE	Leading Edge
LID	Limited Instrument Departure
LOX	Liquid Oxygen
lpm	Liters per minute
LSO	Landing Signal Officer (Paddles)
MAC	Mean Aerodynamic Chord
Meatball	Glide slope image of mirror landing system
MIL	Military
MIM	Maintenance Instruction Manual
MLP	Mirror Landing Practice
MSL	Mean Sea Level
NAMT	Naval Air Maintenance Training
NATOPS	Naval Air Training and Operating Procedures Standardization
NMPP	Nautical Miles Per Pound
NTDS	Naval Tactical Data System
NWIP	Naval Warfare Intercept Procedures
NWP	Naval Warfare Publications
OAT	Outside Air Temperature
OMNI	Omni Directional Range
Paddles	Landing signal officer
PC	Power Control
Pigeons	Bearing and distance
Platform	20 miles, 5000 feet commence descent at 2,000 ft/min., level-off at 1,000 feet.
pps	Pulses per seconds
prf	Pulse repetition frequency
psi	Pounds per square inch
q	Dynamic Pressure, psf
RADAR	Radio Detection and Ranging
RCVG	Replacement Carrier Air Group
rf	Radio Frequency
RF	Reconnaissance - Fighter
RSO	Reconnaissance System Officer
SAR	Sea Air Rescue
SID	Standard Instrument Departure
SIF	Selective Identification Feature

TACAN	Tactical Air Navigation
TAS	True Airspeed
TE	Trailing Edge
TMN	True Mach Number
Trap	Arrested Landing
UHF	Ultra High Frequency
VFR	Visual Flight Rules
VHF	Very High Frequency
Vn	Velocity Acceleration Relationship
VORTAC	Very high frequency - omni range and tactical air navigation
WST	Weapons System Trainer
WSTH	Weapon System Tactical Handbook
10 MILE GATE	10 mi; transition to landing configuration; maintain 1,000 feet.
6 MILE GATE	6 mi; descent to 600 feet.



ALPHABETICAL INDEX

index

RF4B-AI

Note

All numbers in this alphabetical index refer to page numbers, not paragraph and figure numbers.

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G

H

H (Continued)

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