NAVWEPS 01-245FDB-1.1

NATOPS Flight Manual

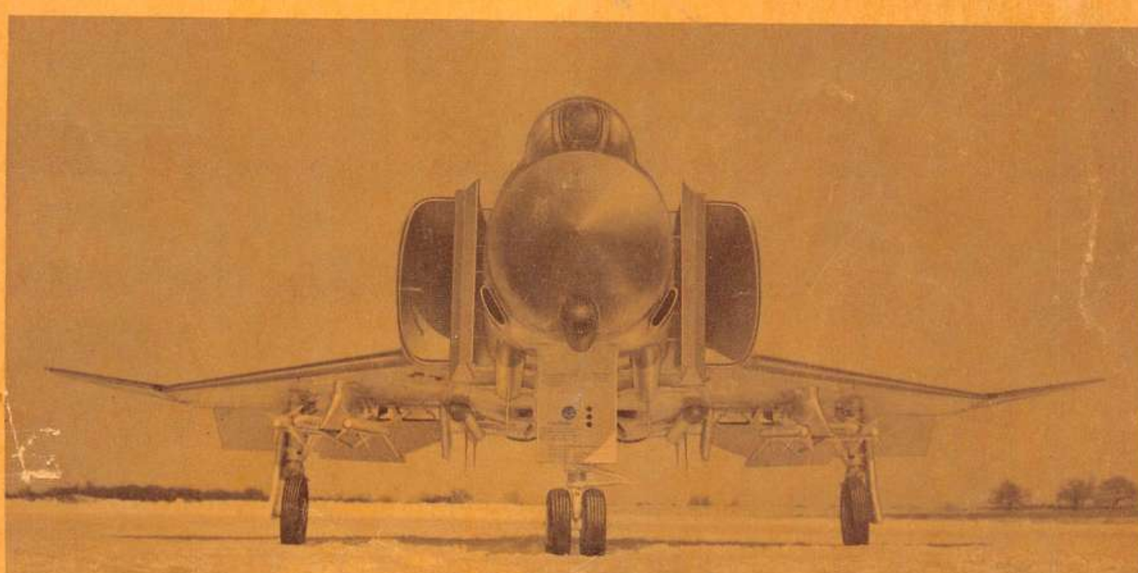
NAVY MODEL

F-4B(F4H-1)
AIRCRAFT

VOLUME I

Aircraft Systems

THIS PUBLICATION IS INCOMPLETE WITHOUT VOLUME II, NAVWEPS 01-245FDB-1.2, AND VOLUME III, NAVWEPS 01-245FDB-1A.



ISSUED BY AUTHORITY OF
THE CHIEF OF NAVAL OPERATIONS

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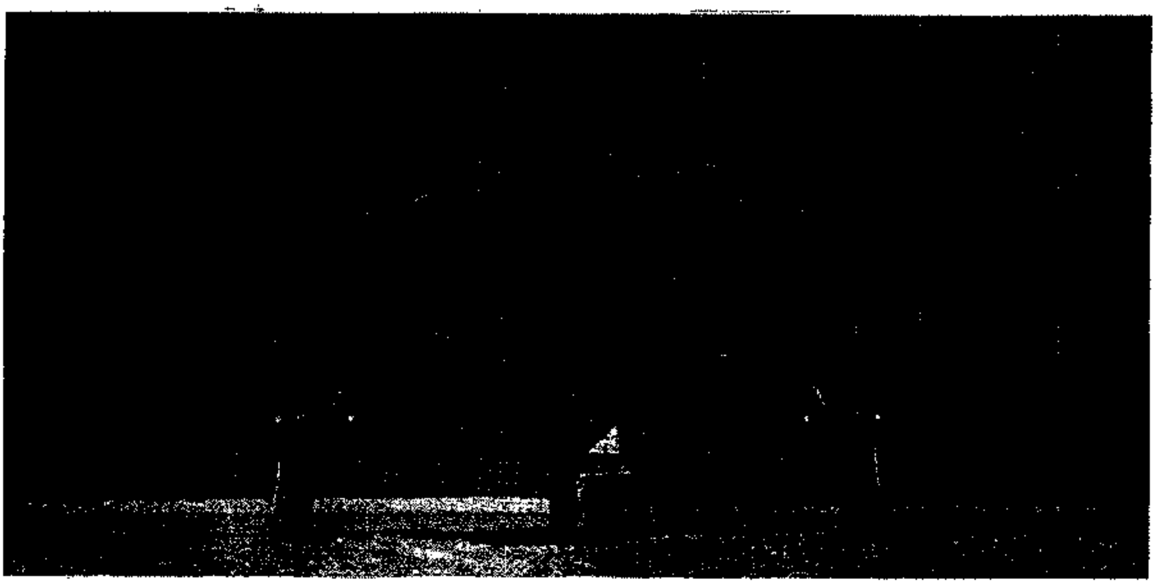
VOLUMES I AND II OF THIS PUBLICATION SUPERSEDES NAVWEPS 01-245FDB-1, DATED 1 FEBRUARY 1962.



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15 December 1962

LIST OF REVISED PAGES ISSUED

INSERT LATEST REVISED PAGES. DESTROY SUPERSEDED PAGES.

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

Page No.	*Date of Latest Revision*	*Page No.*	*Date of Latest Revision*	*Page No.*	*Date of Latest Revision*

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DEPARTMENT OF THE NAVY
OFFICE OF THE CHIEF OF NAVAL OPERATIONS
WASHINGTON 25, D.C.

LETTER OF PROMULGATION

1. The Naval Air Training and Operating Procedures Standardization Program (NATOPS) was developed to provide a source of efficient and sound operating procedures for each aircraft in the Navy's inventory. Compliance with stipulated NATOPS manual procedure, being mandatory, ensures standardization of operating procedures for each model aircraft throughout the Naval Aeronautical Establishment.

2. The operational information contained in NATOPS Manuals is generated by the users and is based on professional knowledge and experience with the aircraft concerned. NATOPS Manuals contain operational information that does not appear in aircraft Flight Manuals. At the semi-annual NATOPS conference held in Minneapolis, in August 1962, it was recommended that the feasibility of combining NATOPS and Flight Manual information be investigated. This would provide a single source of all information necessary to operate any given aircraft efficiently. To this end the S2D (S2F-3) and the F-4B (F4H) were chosen as pilot models and a combined book called the NATOPS Flight Manual has been written for each. These combined manuals are for evaluation only and have been given wide distribution so that a large cross section of users can contribute to an analysis of their relative merits and to the merit contained in the original recommendation to combine the information in one publication. All recipients are enjoined to make a thorough and objective evaluation of the combined manual concept and forward comments to the applicable NATOPS Coordinator prior to April 1963. Recipients are hereby granted authority to use the combined manual concerned in lieu of the applicable NATOPS and Flight Manuals for the duration of the trial period. The termination date of the trial period is 1 December 1963.

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

W.A. SCHOECH
Vice Admiral, USN
Deputy Chief of Naval Operations (AIR)

INTERIM CHANGE RECORD

NATOPS CHANGE NUMBER (CNO)	INTERIM REVISION NUMBER (BuWeps)	PREVIOUSLY INCORPORATED	INCORPORATED IN THIS ISSUE ON PAGES INDICATED
	2		2-89
	4 & 5		2-54 & 2-74

AIRCRAFT SERVICE CHANGE SUMMARY

The following ASC's are of direct interest to the crewmembers and may be noted throughout the manual:

ASC NO.	TITLE	SECTION
88	Adds "Stab Aug Off" light	II
92	Adds hook not up warning light	II
94	Adds AFCS manual heading option circuit	II
96	Adds Improved AN/APN-22 Radar Altimeter lens .	II
115	Replacement of oil pressure transmitter line . . .	I

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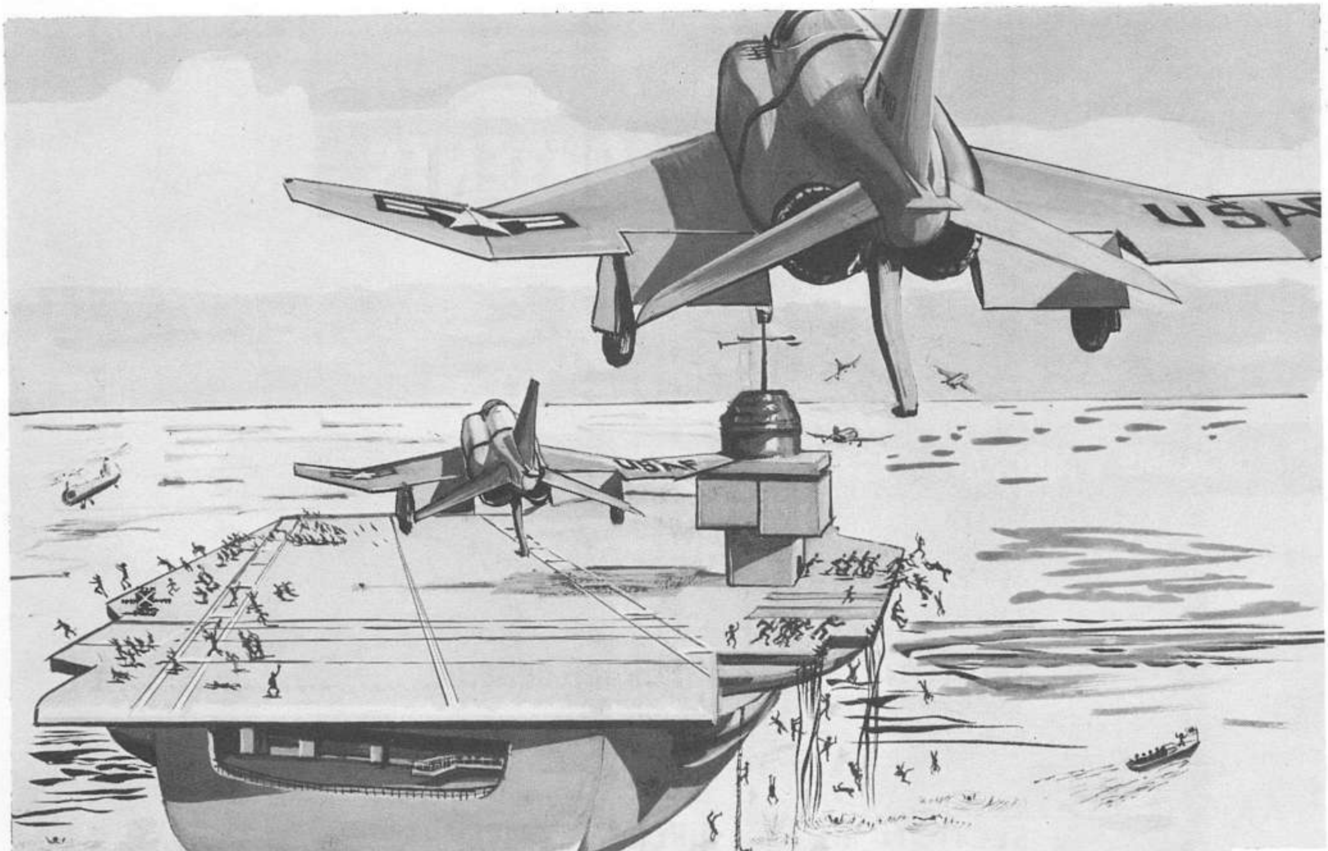


SCOPE

As outlined in the Letter of Promulgation, the F-4B (F4H) 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. This manual, prepared under Contract NOw 62-0383-i, is issued on an evaluation basis for the purpose of determining the feasibility of combining NATOPS and Flight Manual information into a single-source publication series. The basic intent of this three-volume concept is to provide an all-inclusive, easy-to-use manual that is consistent with the best interest of flying safety, standardization, proficiency training, and overall flying efficiency. Every effort has been made to provide adequate data for you, the collective user, to safely and efficiently accomplish all missions within the assigned parameters of the aircraft. However, overall optimization of this type publication is directly proportional to user input. Your job? ; Evaluate and Criticize.

ARRANGEMENT

The three-volume concept of this publication categorically segregates all applicable data as: Descriptive -- Procedural -- Classified.

Volume I - Volume I, Aircraft Systems, is subdivided into three sections and provides detailed descriptive information for the aircraft, its systems and related equipment. Section I contains information relating to the aircraft in general; e.g., cockpit configurations, a summary of aircraft limitations, approximate weights for various external configurations, etc. Section II contains detailed description, normal operation, emergency operation, and limitations for each aircraft system; individual systems being covered as a separate entity and presented in alphabetical order. Section III contains aircraft servicing and ground handling information for the pilot to adequately monitor strange field procedures.

Volume II- Volume II, Operating Procedures, is sub-divided into eight sections and provides the necessary procedural information to safely and efficiently accomplish all phases of flight. The titles of Sections I through VII (General, Shore Based Procedures, Carrier Based Procedures, Flight Procedures, Emergency Procedures, Communication Procedures, and Crew Duties) sufficiently describes their individual scope of coverage. Most of the basic-type procedures and those procedures that are peculiar to land based operation are contained in Section II, Shore Based Procedures. Section III, Carrier Based Procedures, contains only those additional or different procedures required for carrier operation. Section VIII, Standardization Evaluation, is primarily provided as a working-guide for F-4B Squadron Commanders and Evaluators/Instructors in the implementation of the NATOPS program.

Volume III – Volume III, Classified Supplement, is sub-divided into two sections and an appendix. As implied, this volume contains the classified data necessary to supplement the descriptive and procedural information of Volumes I and II. Appendix I contains the charts necessary to compute performance specifics for all intended missions; this includes take-off, climb, cruise, endurance, maximum capabilities, descent, and landing data for the several external configurations of the aircraft.

KEEPING THE MANUAL CURRENT

During the evaluation period, your F-4B NATOPS Flight Manual will be constantly up-dated through an extremely active revision program. This program includes the publication of Regular Revisions, NATOPS Changes, and Interim Revisions.

Regular Revisions – Regular Revisions will normally be prepared and distributed on a regular 90-day cycle, beginning with the date of original issue. These revisions are issued as formally printed changed and/or additional pages to be incorporated into your existing manual. Generally, this is the more formal method of up-dating your manual to include: production/retrofit changes to the equipment; outstanding NATOPS Changes and Interim Revisions; 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.

NATOPS Changes – NATOPS Changes (urgent and routine) are promulgated by the Office of CNO and will be in accordance with OPNAV Instruction 3510.9. These changes will normally be in message or letter form to expedite safety-of-flight changes to operating procedures. The details of these changes should be noted on the appropriate page(s) of the manual and logged in the applicable Interim Change Record.

Interim Revisions – Interim Revisions are promulgated by BuWeps and may be received as a Naval message or on a pre-printed Flight Handbook Interim Revision form. The purpose of these revisions is to expedite new/revised operating limitations, restrictions, and other vital instructions involving the operation of the aircraft. The detailed changes should be noted on the appropriate page(s) of the manual and logged in the applicable Interim Change Record.

Interim Change Record– The Interim Change Record, one for each volume, is provided for the purpose of maintaining a complete record of all interim-type changes issued against the F-4B NATOPS Flight Manual. Each time the manual is revised, the Interim Change Record will be formally up-dated to indicate disposition and/or incorporation of previously issued interim-type changes. When a regular revision is received, the Interim Change Record should be checked to ascertain that all outstanding NATOPS Changes and Interim Revisions have been formally incorporated; those not incorporated should be re-noted as applicable.

USER COMMENTS

Comments and recommendations from the collective user are always welcomed. However, during an evaluation program such as this, your constructive criticism is urgently solicited. During the evaluation period, there will probably be several official channels provided for your evaluation. In the interim, however, two unofficial-type "Phantomouse" forms are provided at the end of Volume II for your on-the-spot comments. It is planned to replenish the "Phantomouse" forms with each revision of Volume II. It should also be remembered that comments of a classified nature must be forwarded in accordance with existing Security Procedures.

WARNINGS, CAUTIONS, AND NOTES

For your information, 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.

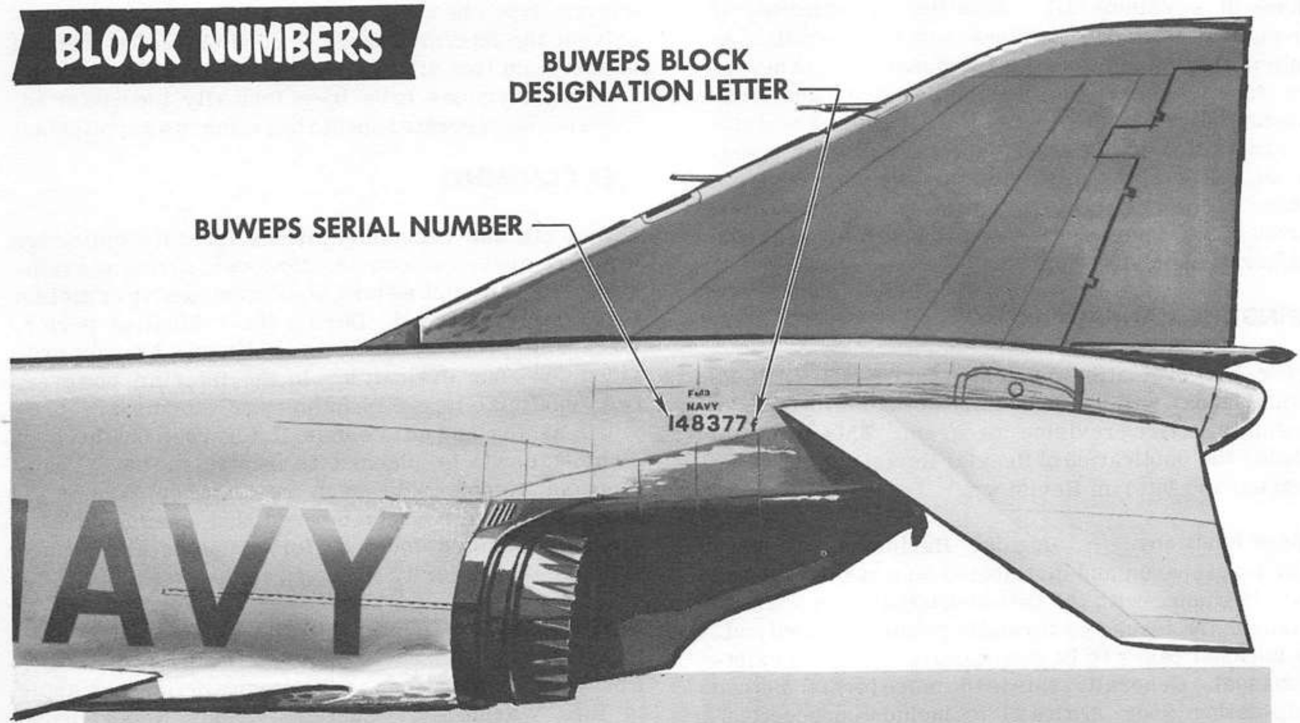
Note

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

REVISION SYMBOL

The lines of text that were revised or added during the current revision (as dated on the lower inboard corner of the page) will be identified by a revision symbol in the outboard margin of the effected column. The revision 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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BLOCK 8 h (24)	148411h thru 148434h
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BLOCK 10 j (24)	149427j thru 149450j
BLOCK 11 k (24)	149451k thru 149474k
BLOCK 12 l (30)	150406l thru 150435l
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BLOCK 14 n (44)	150480n thru 150653n

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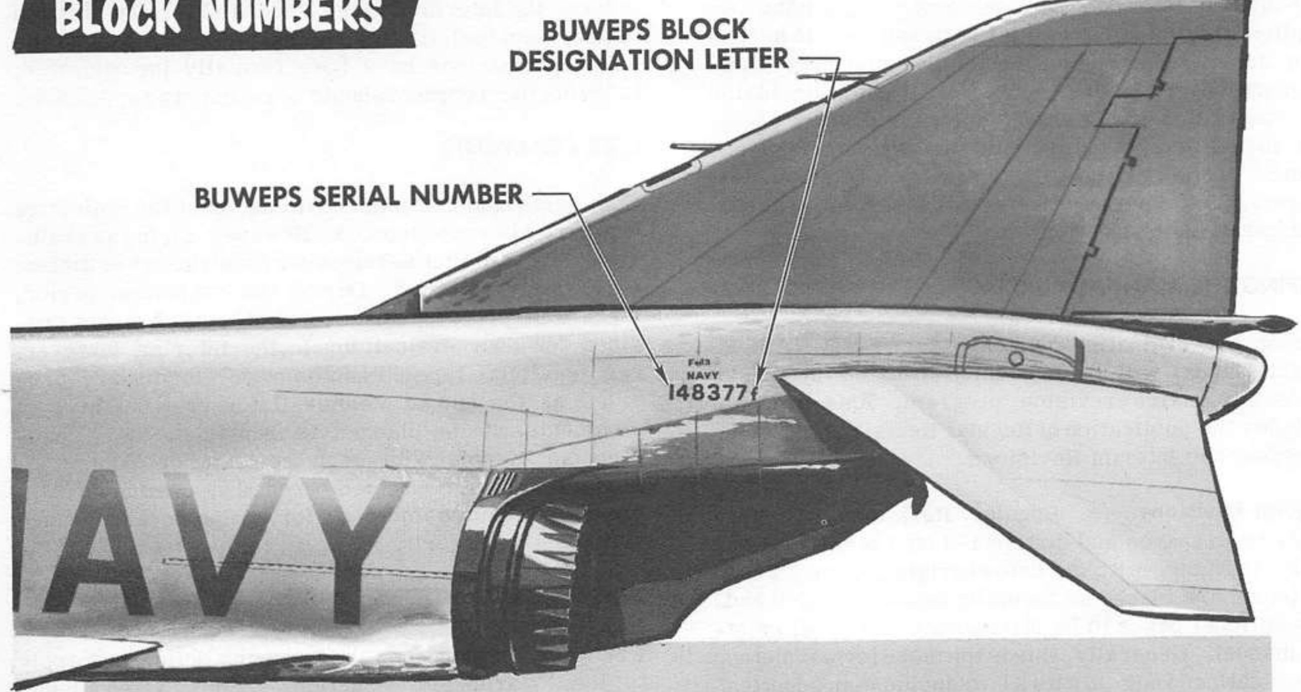

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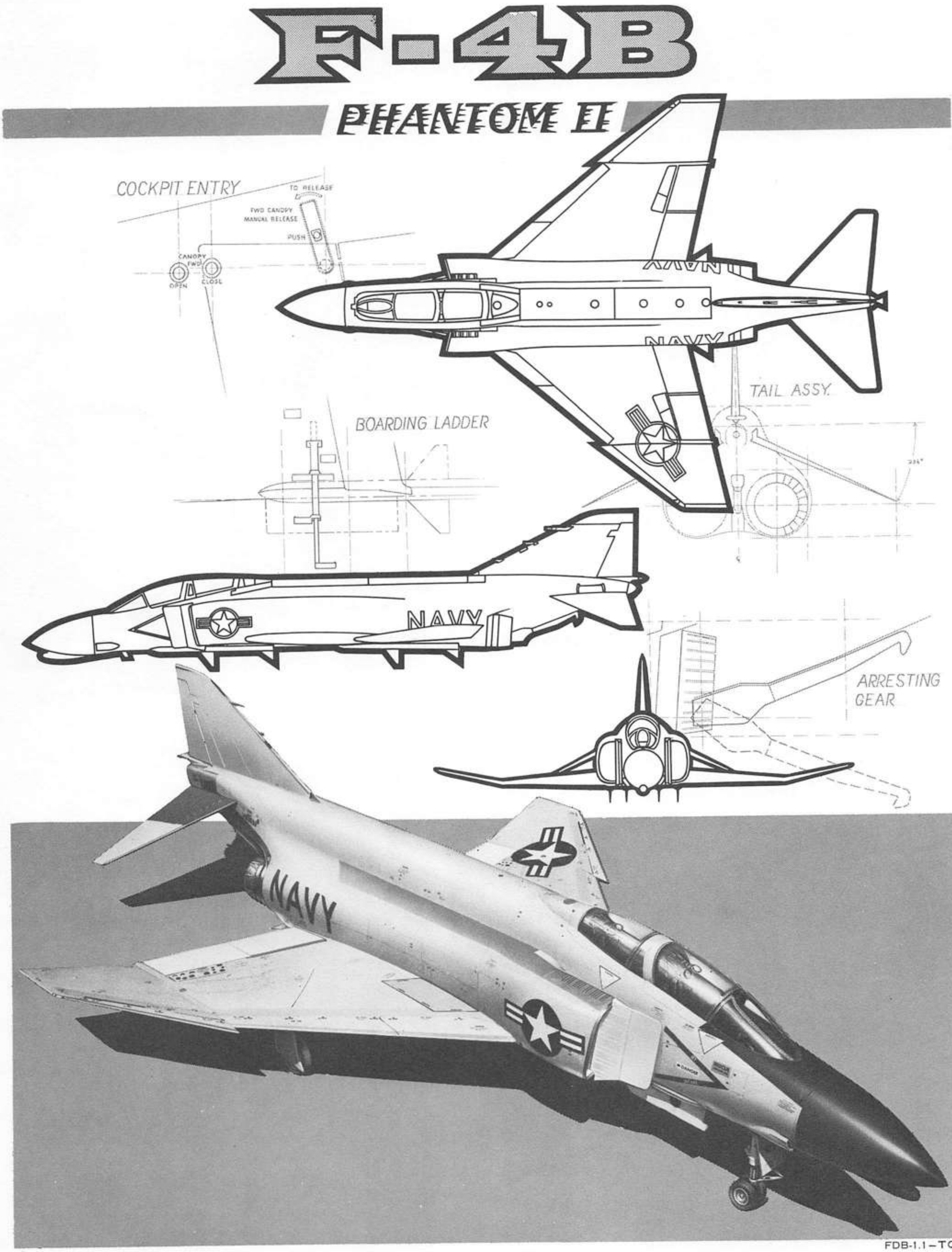
F-4B
PHANTOM II
COCKPIT ENTRY
TO RELEASE
FWD CANOPY MANUAL RELEASE
PUSH
CANOPY FWD
OPEN
CLOSE
NAVY
TAIL ASSY.
BOARDING LADDER
NAVY
ARRESTING GEAR
NAVY

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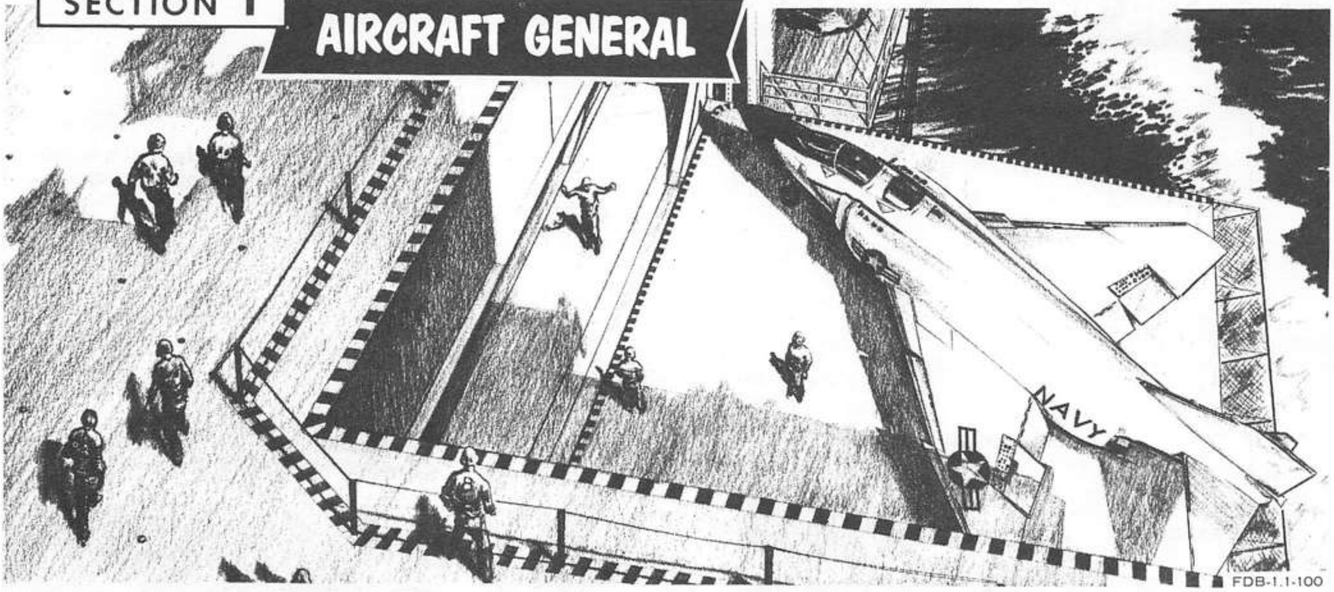
SECTION I
AIRCRAFT GENERAL



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(*) Denotes Illustration

AIRPLANE

DESCRIPTION

The F-4B airplane is a supersonic, two place, twin engine, jet-propelled all-weather fighter built by the McDonnell Aircraft Corporation. The airplane is designed for intermediate and long range high altitude interceptions using missiles as the principal armament and for intermediate or long range attack missions to deliver special or conventional weapons. The radar intercept officer has control over the airborne missile control system, communications and navigation. A retractable air refueling probe and added electronic equipment such as an infrared detection unit, central air data computer and ground position indicator increases the overall effectiveness of the F-4B weapons system. The airplane is powered by two axial flow General Electric J79-GE-8 engines. This power plant is a high pressure ratio, single rotor, turbojet engine with a seventeen stage, variable stator compressor and an afterburner with a variable area, aerodynamic convergent-divergent exhaust nozzle. The airplane features a low mounted swept-back wing with dihedral at the wing tips, and a one piece horizontal stabilator with cathedral (negative dihedral) mounted low on the aft fuselage. The wings have hydraulically operated leading edge and trailing edge flaps, ailerons, spoilers and speed brakes. All the control surfaces are positioned by irreversible hydraulic actuators to provide desired control effectiveness throughout the entire speed range.

AIRPLANE DIMENSIONS

The overall dimensions of the airplane are as follows:

Wing Span (Wings Spread)	38 feet 5 inches
(Wings Folded)	27 feet 6-1/2 inches
Length	58 feet 3 inches
Height (To Top of Fin)	16 feet 3 inches

GENERAL ARRANGEMENT

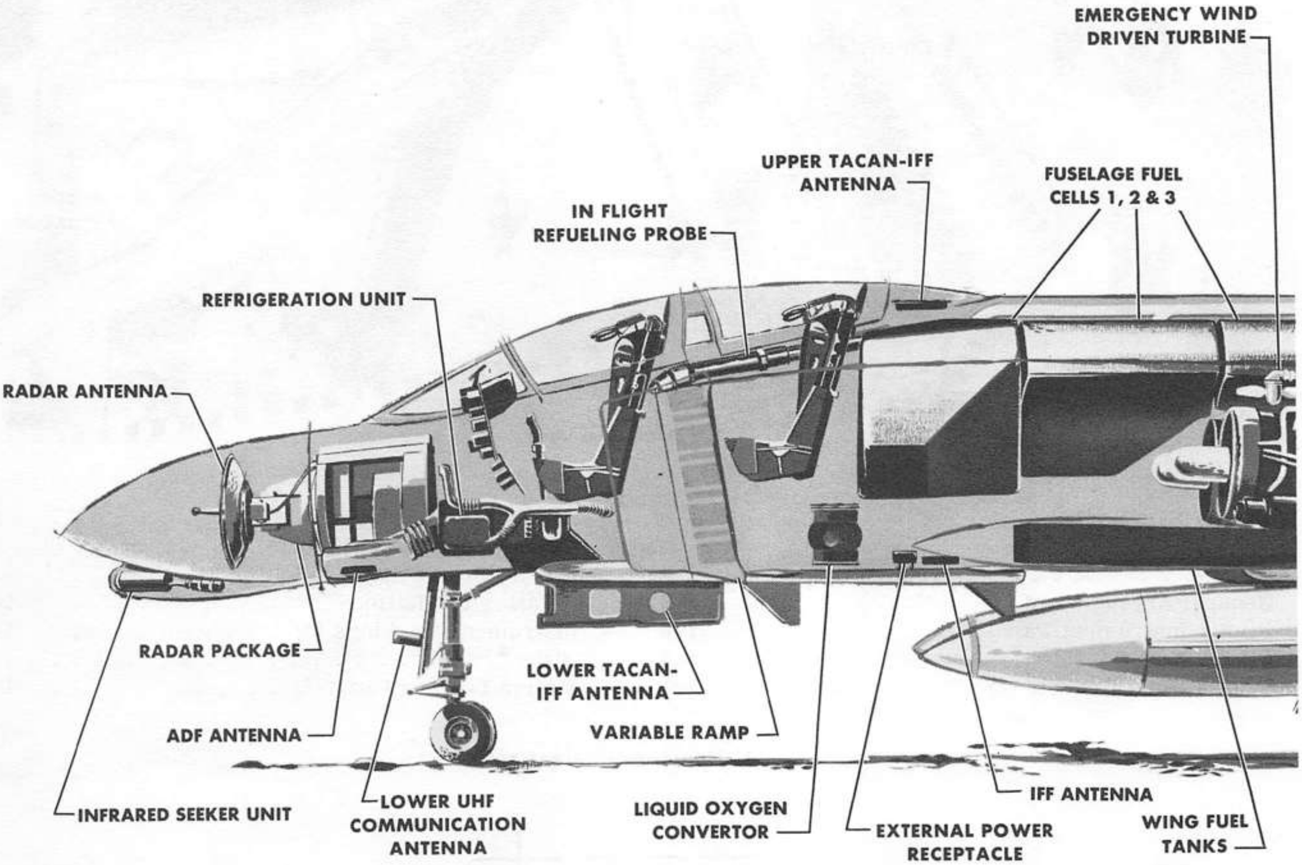


Figure 1-1 (Sheet 1)

ARMAMENT

The airplane is equipped for carrying and launching four Sparrow III guided missiles. The missiles are carried on four independent launchers which are located on the bottom of the fuselage, two launchers located in the forward fuselage and two launchers located in the center fuselage. Provisions are also made to carry missiles on wing stations. The missiles are automatically controlled and fired by the Aero 1A Aircraft Missile Control System.

INTERIOR ARRANGEMENT

The tandem cockpits contain accommodations for a pilot and RIO. Although the cockpits are separately enclosed, the cockpit pressure-oxygen environment is unilateral. Each cockpit incorporates a completely independent ejection seat that is adjustable in the vertical plane for maximum comfort. The forward cockpits main instrument panel contains the flight and engine instruments. Engine controls, autopilot and fuel management panel are located on the left console.

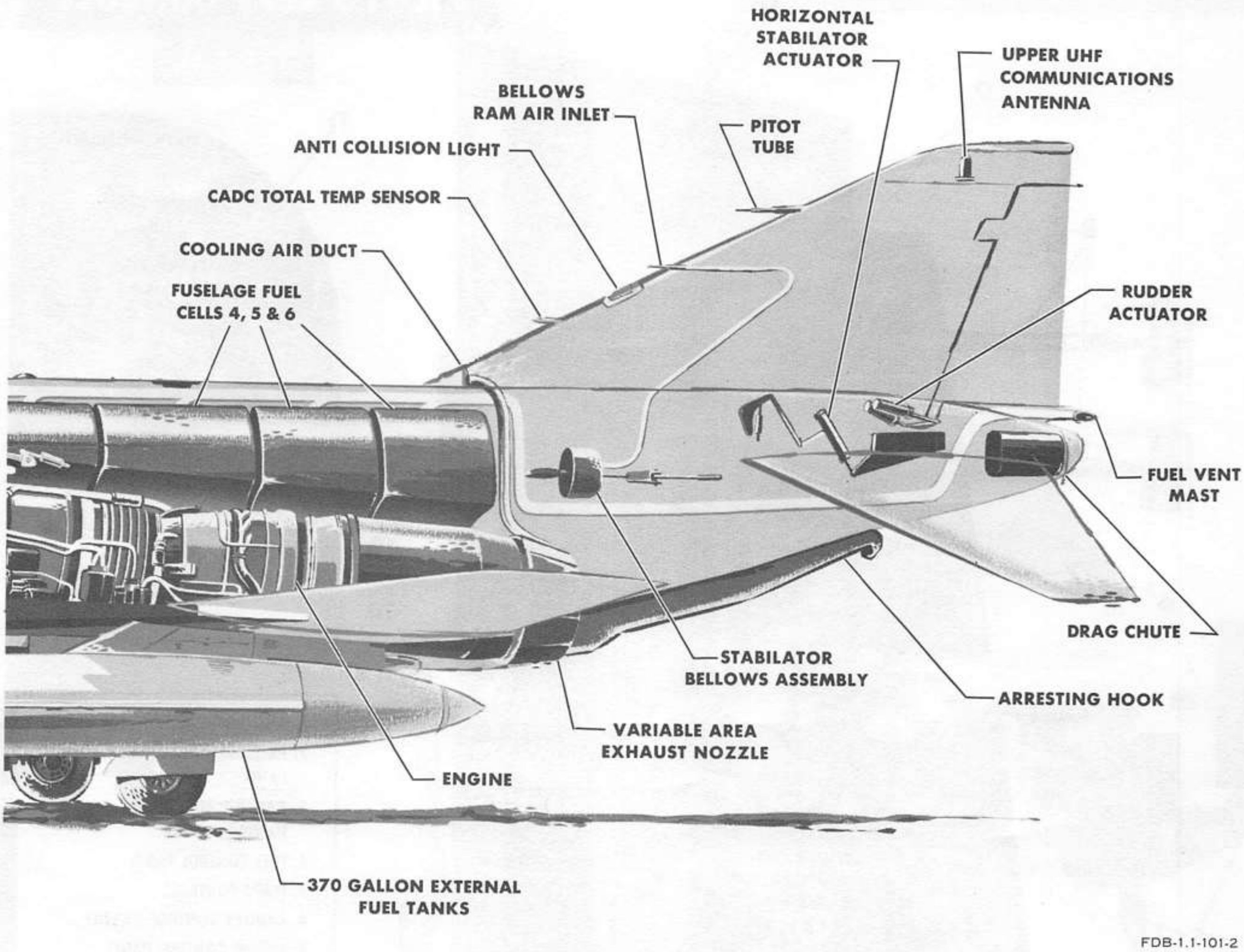


Figure 1-1 (Sheet 2)

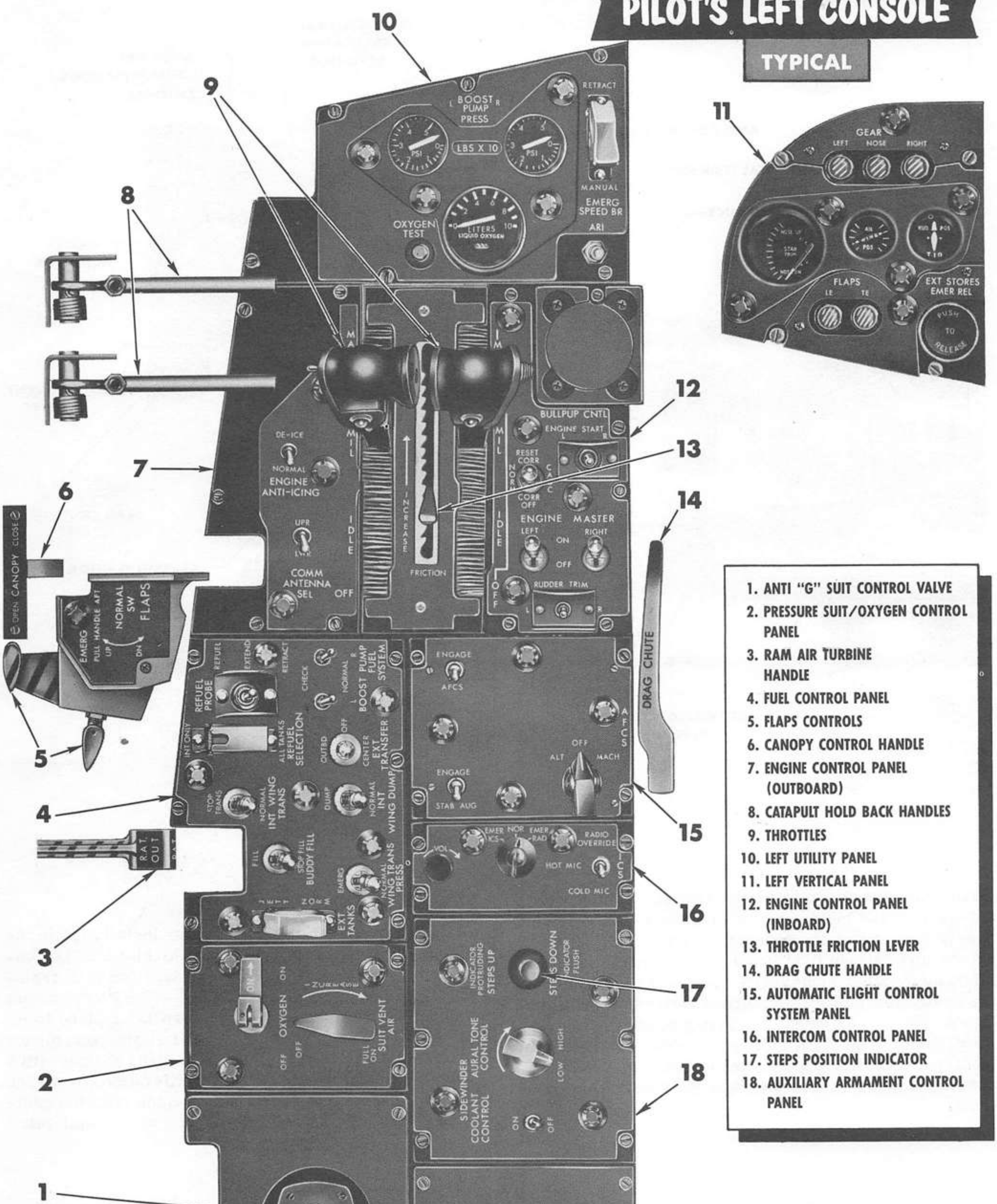
Communication, navigation, heating and lighting controls are on the right console. Left and right vertical panels forward of the consoles contain position indicators and caution light panel. The aft cockpits main instrument panel contains the necessary instruments for navigation, plus miscellaneous switches and caution lights. Radar equipment is located below the instrument panel. The right side of the cockpit is made up of circuit breaker panels, the left side incorporates communication, oxygen and suit pressurization controls.

DUAL CONTROLS COMPATIBILITY

A dual control kit is available for installation in the airplane. These kits enable the airplane to be converted into a dual controlled airplane for pilot training purposes. The kit is installed in the RIO's cockpit and can be easily removed to return the airplane to its pilot/RIO configuration. The dual flight controls kit provides the pilot in the converted RIO's cockpit with a control stick, rudder pedals, throttle controls for each engine, and an instrument panel which contains additional instruments needed by the aft cockpit pilot.

PILOT'S LEFT CONSOLE

TYPICAL

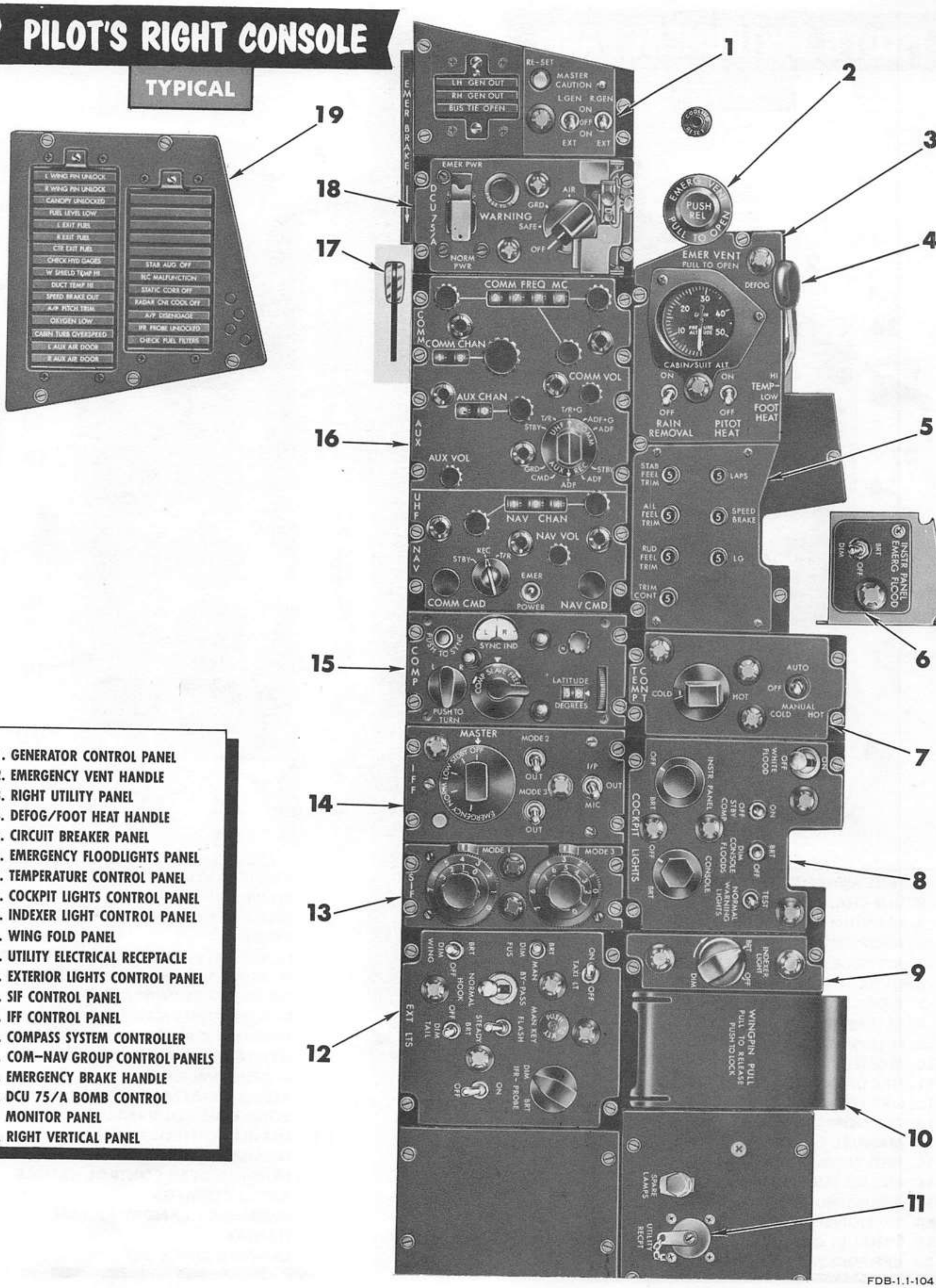


1. ANTI "G" SUIT CONTROL VALVE
2. PRESSURE SUIT/OXYGEN CONTROL PANEL
3. RAM AIR TURBINE HANDLE
4. FUEL CONTROL PANEL
5. FLAPS CONTROLS
6. CANOPY CONTROL HANDLE
7. ENGINE CONTROL PANEL (OUTBOARD)
8. CATAPULT HOLD BACK HANDLES
9. THROTTLES
10. LEFT UTILITY PANEL
11. LEFT VERTICAL PANEL
12. ENGINE CONTROL PANEL (INBOARD)
13. THROTTLE FRICTION LEVER
14. DRAG CHUTE HANDLE
15. AUTOMATIC FLIGHT CONTROL SYSTEM PANEL
16. INTERCOM CONTROL PANEL
17. STEPS POSITION INDICATOR
18. AUXILIARY ARMAMENT CONTROL PANEL

Figure 1-2

PILOT'S RIGHT CONSOLE

TYPICAL



1. GENERATOR CONTROL PANEL
2. EMERGENCY VENT HANDLE
3. RIGHT UTILITY PANEL
4. DEFOG/FOOT HEAT HANDLE
5. CIRCUIT BREAKER PANEL
6. EMERGENCY FLOODLIGHTS PANEL
7. TEMPERATURE CONTROL PANEL
8. COCKPIT LIGHTS CONTROL PANEL
9. INDEXER LIGHT CONTROL PANEL
10. WING FOLD PANEL
11. UTILITY ELECTRICAL RECEPTACLE
12. EXTERIOR LIGHTS CONTROL PANEL
13. SIF CONTROL PANEL
14. IFF CONTROL PANEL
15. COMPASS SYSTEM CONTROLLER
16. COM-NAV GROUP CONTROL PANELS
17. EMERGENCY BRAKE HANDLE
18. DCU 75/A BOMB CONTROL MONITOR PANEL
19. RIGHT VERTICAL PANEL

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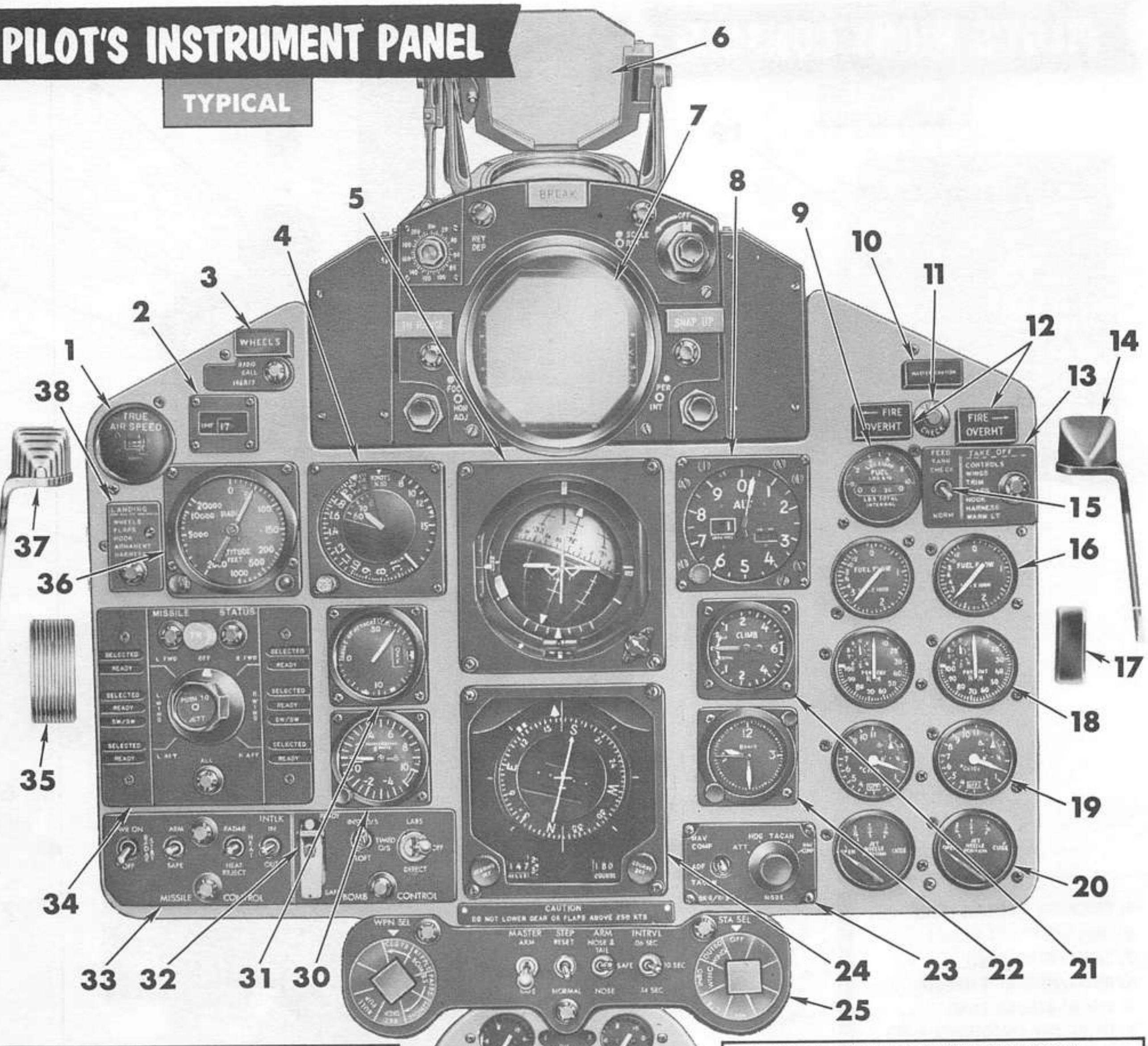
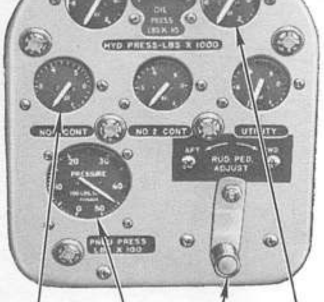
Figure 1-3

PILOT'S INSTRUMENT PANEL

TYPICAL





1. TRUE AIRSPEED INDICATOR
2. UHF CHANNEL INDICATOR
3. LANDING GEAR WARNING LIGHT
4. AIRSPEED AND MACH NUMBER IND
5. ATTITUDE DIRECTOR INDICATOR
6. OPTICAL SIGHT UNIT
7. AZ-EL-RANGE INDICATOR
8. ALTIMETER
9. FUEL QUANTITY INDICATOR
10. MASTER CAUTION LIGHT
11. FIRE DETECTOR CHECK SWITCH
12. FIRE WARNING LIGHTS
13. TAKE-OFF CHECK LIST
14. MANUAL CANOPY UNLOCK HANDLE
15. FEED TANK CHECK SWITCH
16. ENGINE FUEL FLOW INDICATORS
17. ARRESTING CONTROL HANDLE
18. TACHOMETERS
19. EXHAUST GAS TEMP. INDICATORS
20. EXHAUST NOZZLE POSITION INDS
21. VERTICAL VELOCITY INDICATOR
22. CLOCK
23. MODE-BEARING/DISTANCE SELECTOR PANEL
24. HORIZONTAL SITUATION INDICATOR
25. MULTIPLE WEAPONS CONTROL PANEL
26. OIL PRESSURE INDICATORS
27. RUDDER PEDAL ADJUSTMENT CRANK
28. PNEUMATIC PRESSURE INDICATORS
29. HYDRAULIC PRESSURE INDICATORS
30. ACCELEROMETER
31. ANGLE-OF-ATTACK INDICATOR
32. BOMB CONTROL PANEL
33. MISSILE CONTROL PANEL
34. MISSILE STATUS PANEL
35. LANDING GEAR CONTROL HANDLE
36. RADIO ALTIMETER
37. EMERGENCY CANOPY RELEASE HANDLE
38. LANDING CHECK LIST

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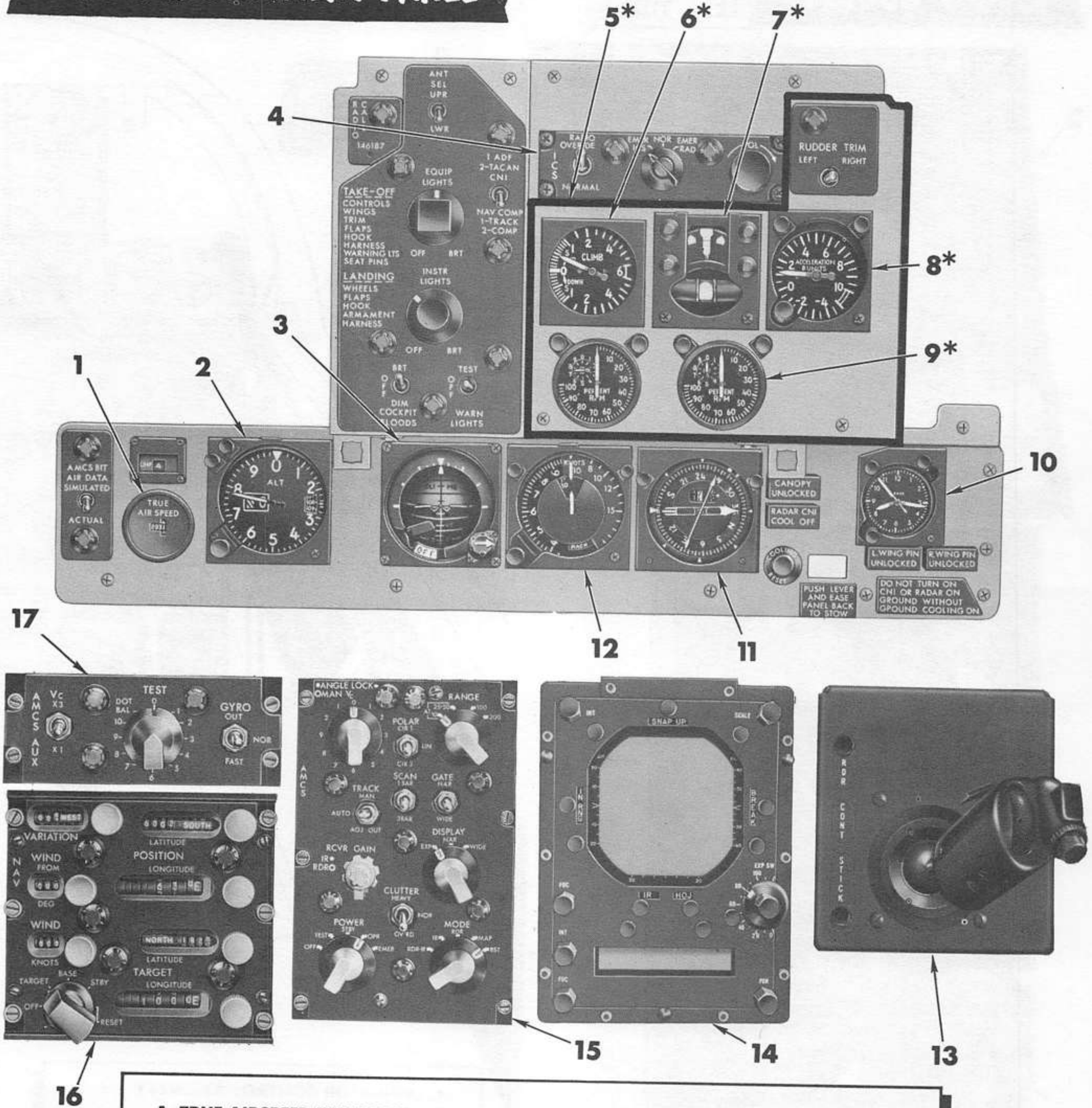
Figure 1-4

RIO'S INSTRUMENT PANEL



1. TRUE AIRSPEED INDICATOR
2. ALTIMETER
3. REMOTE ATTITUDE INDICATOR
4. INTERCOM CONTROL PANEL
5. DUAL CONTROL AIRPLANES*
6. VERTICAL VELOCITY INDICATOR*
7. TURN AND SLIP INDICATOR*
8. ACCELEROMETER*
9. TACHOMETERS*
10. CLOCK
11. BEARING DISTANCE HEADING INDICATOR (BDHI)
12. AIRSPEED AND MACH INDICATOR
13. AMCS ANTENNA CONTROL PANEL
14. AZIMUTH ELEVATION RANGE INDICATOR
15. AMCS CONTROL PANEL
16. NAVIGATION COMPUTER CONTROL PANEL
17. AMCS AUXILIARY CONTROL PANEL

*DUAL CONTROL AIRPLANES ONLY

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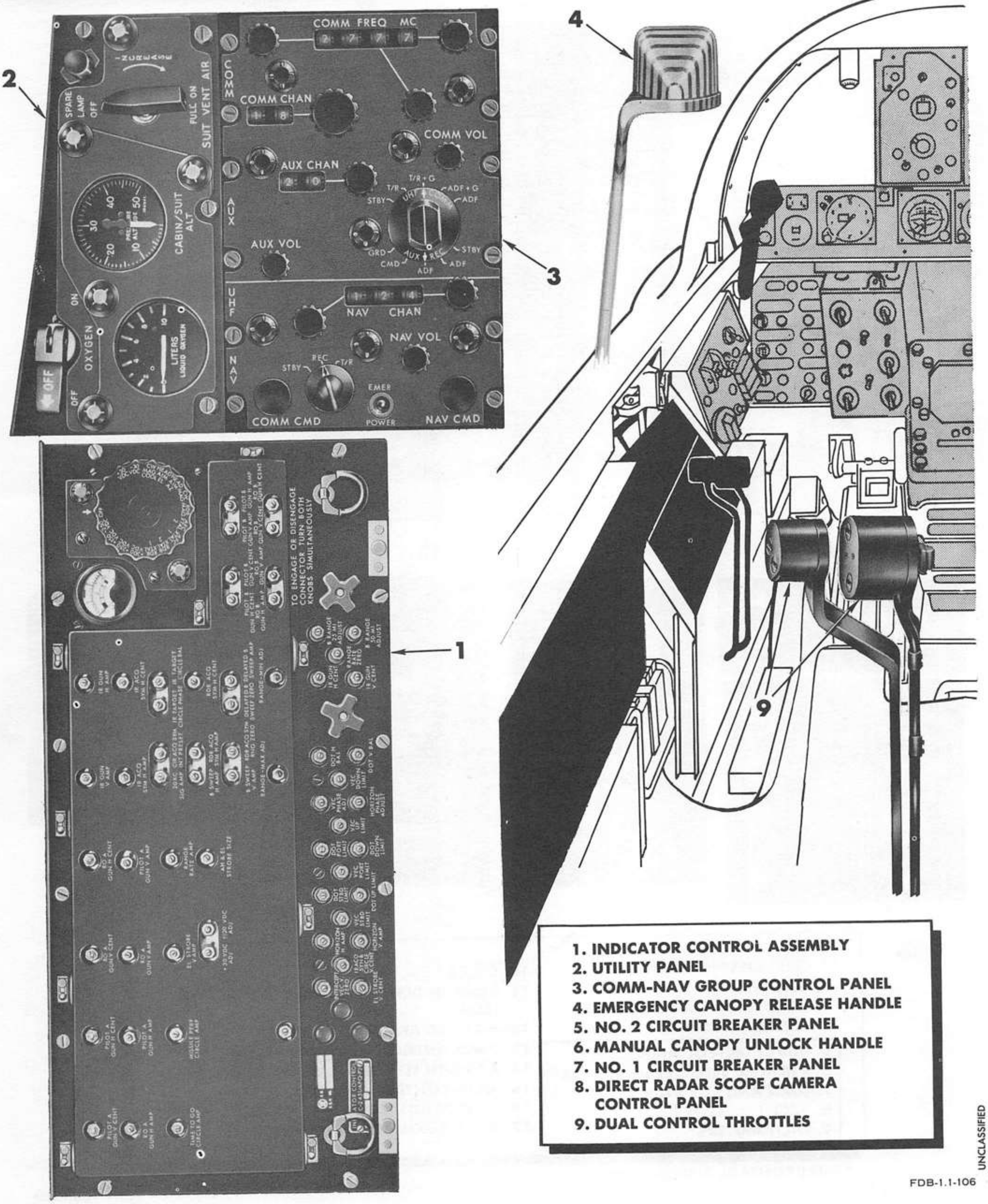
Figure 1-5

RIO'S COCKPIT LEFT SIDE



1. INDICATOR CONTROL ASSEMBLY
2. UTILITY PANEL
3. COMM-NAV GROUP CONTROL PANEL
4. EMERGENCY CANOPY RELEASE HANDLE
5. NO. 2 CIRCUIT BREAKER PANEL
6. MANUAL CANOPY UNLOCK HANDLE
7. NO. 1 CIRCUIT BREAKER PANEL
8. DIRECT RADAR SCOPE CAMERA CONTROL PANEL
9. DUAL CONTROL THROTTLES

Figure 1-6

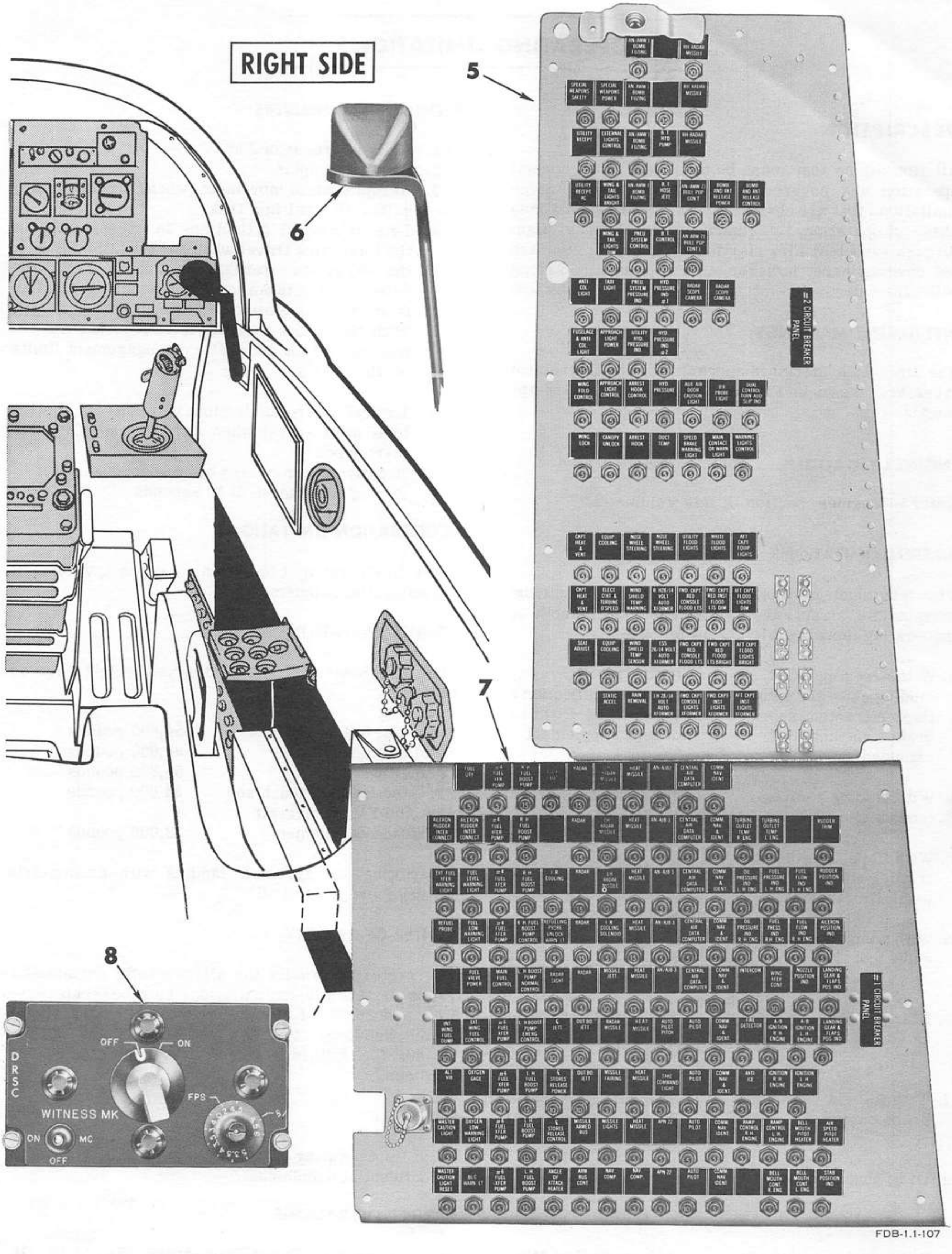

RIGHT SIDE
5
6
7
8
#2 CIRCUIT BREAKER PANEL
#1 CIRCUIT BREAKER PANEL
DRSC
OFF
ON
WITNESS MK
FPS
ON
MC
OFF
FDB-1.1-107

Figure 1-7

OPERATING LIMITATIONS

DESCRIPTION

All limitations that must be observed during normal operation are covered or referenced herein. Some limitations that are characteristic only of a specialized phase of operation, 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 1-8 and noted in the applicable text.

ENGINE LIMITATIONS

Refer to Engines, Section II, this Volume.

AIRSPEED LIMITATIONS

The maximum permissible airspeeds, or minimum permissible airspeeds (where noted) in smooth or moderately turbulent air are as follows:

a. With arresting hook, landing gear and wing flaps retracted, speed brakes retracted or extended.	Refer to Operating Limitations Section I, Volume III Confidential Supplement
b. With landing gear extended.	250 knots CAS
c. With flaps, leading and trailing edge, fully or partially extended.	250 knots CAS
d. With wind driven turbine extended.	515 knots CAS or Mach 1.1 whichever is less
e. Inflight refueling probe extension or retraction.	300 knots CAS or Mach .9 whichever is less.
f. With inflight refueling probe extended.	400 knots CAS or Mach .9 whichever is less
g. Drag chute deployment.	200 knots CAS
h. With autopilot engaged.	150 knots CAS Minimum

PROHIBITED MANEUVERS

1. 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 the total stick travel when carrying the MK 104, the 600 gallon external fuel tank, the 370 gallon external wing tanks, or when launching missiles from the wing station pylons.
5. With the AFCS engaged, intentional maneuvers that exceed the automatic disengagement limits of the AFCS.
6. Lateral control deflections in excess of 1/3 of the 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

Refer to Operating Limitations, Section I, Volume III - Confidential Supplement.

WEIGHT LIMITATIONS

The maximum recommended gross weights are as follows:

Field take-off	54,800 pounds
Field Landing (flared)	38,000 pounds
Catapulting	54,800 pounds
Arrested landing, touch and go, and FMLP aircraft	34,000 pounds
Barricade engagement	33,000 pounds

Catapulting or arrested landing with asymmetric loadings are prohibited.

CENTER-OF-GRAVITY

The center of gravity for all currently permissible gross weights and configurations must be kept between 27% and 36.0% of Mean Aerodynamic Chord. Refer to the Handbook of Weight and Balance Data, AN 01-1B-40, for details regarding the center of gravity loadings.

STORES

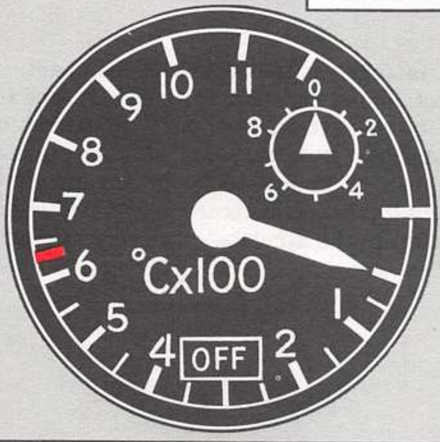
Refer to Operating Limitations, Section I, Volume III - Confidential Supplement.

CARRIER OPERATIONS

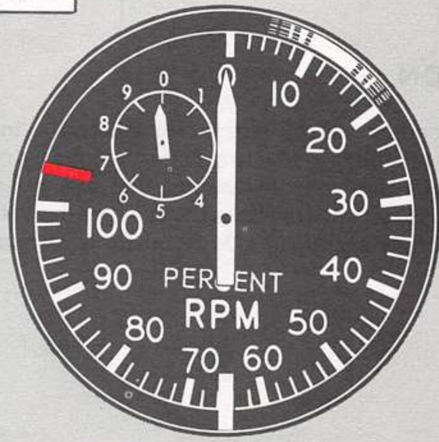
Refer to Carrier Based Procedures, Section III, Volume II - Operating Procedures.

INSTRUMENT RANGE MARKINGS

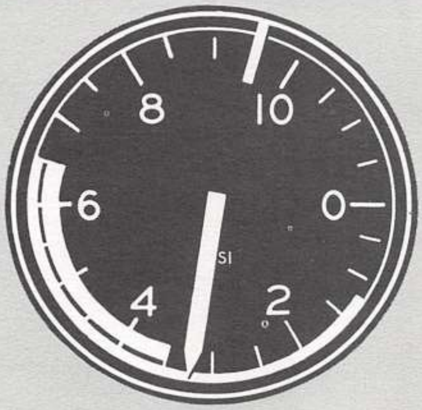
BASED ON JP-5 FUEL



	EXHAUST GAS TEMPERATURE
635°C	MAXIMUM STEADY STATE TEMP.



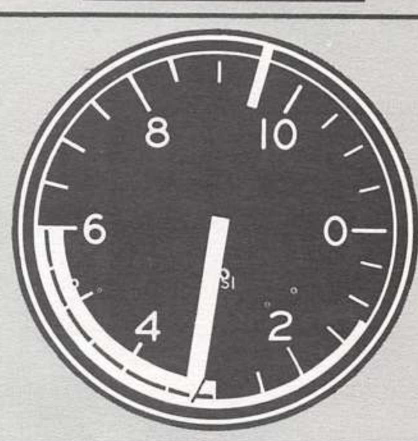
	TACHOMETER
102%	MAXIMUM



OIL PRESSURES AIRPLANES 148363f THRU 150435L PRIOR TO INCORPORATION OF ASC 115	
65 PSI	MAXIMUM
35 PSI	MINIMUM AT MILITARY RPM
12 PSI	MINIMUM AT IDLE RPM
35-65 PSI	NORMAL OPERATION AT MIL POWER AND ABOVE

Notes

- DURING FLIGHT OPERATION AT 100 PERCENT RPM, PRESSURE DECREASES OF 3 TO 7 PSI BELOW GROUND OPERATING VALUES WILL BE EXPERIENCED, WITH THE GREATER DECREASES OCCURRING AT HIGH MACH NUMBERS. ANY GREATER VARIATION FROM THE NORMAL INDICATED PRESSURE SHOULD BE INVESTIGATED.
- DURING T_2 CUTBACK AND OTHER SPEED REDUCTIONS, INDICATED PRESSURE WILL DECREASE APPROXIMATELY 1 PSI PER 1 PERCENT REDUCTION IN RPM.
- PRESSURE CHANGES ARE GRADUAL AND OCCUR WITH MACH NUMBER AND POWER CHANGES; THEREFORE, ANY ABRUPT STEADY STATE PRESSURE CHANGE IS NOT NORMAL AND SHOULD BE INVESTIGATED.



OIL PRESSURES AIRPLANES 150436i AND UP AND ALL OTHERS UPON INCORPORATION OF ASC 115	
60 PSI	MAXIMUM
35 PSI	MINIMUM AT MILITARY RPM STEADY STATE-GROUND OPERATION
12 PSI	MINIMUM AT IDLE POWER
30-60 PSI	IN-FLIGHT NORMAL OPERATION AT MIL POWER AND ABOVE

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.

FDB-1.1-108
R

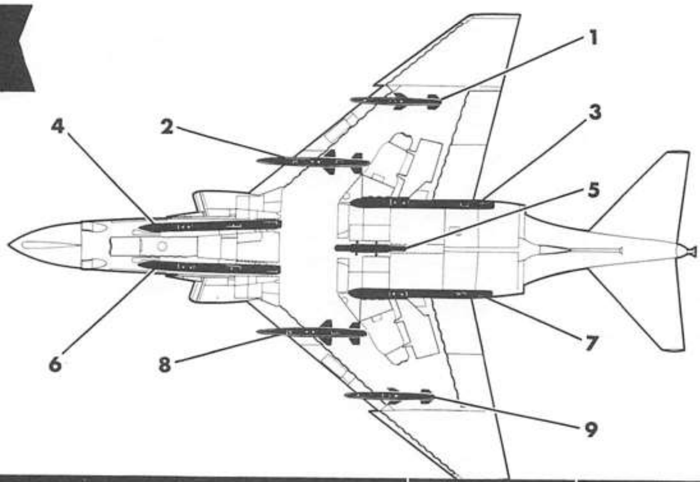
Figure 1-8

STATION LOADING

DESCRIPTION

The station loading chart (figure 1-9) shows the individual weight and station location of the various pylons, adapters, racks and external stores that can be carried on the airplane. It also lists the average operating weight for various airplanes. A definition for average weight is found at the bottom of the chart. The chart does not intend to show the quantity and total gross weight of the external stores that can be carried on each station. However, the airplane take-off gross weight can be computed by adding the internal fuel load, and total external store weight (individual weights x quantity) to the airplane's average operating weight.

STATION LOADING



COMPONENTS		INDIVIDUAL WEIGHT	STATION 1	2	3	4	5	6	7	8	9
EXT. WING TANK PYLON		92 LBS	●								●
370 GAL. EXT. WING TANK (EMPTY) (FULL)		233 LBS 3,029 LBS†	●								●
LAU-17/A GUIDED MISSILE LAUNCHER		146 LBS		●						●	
LAU-7/A LAUNCHER		70 LBS		●						●	
SPARROW III MISSILE		402 LBS		●	●	●		●	●	●	
SIDEWINDER 1A MISSILE		155 LBS.		●						●	
WING ADAPTER ASY, TRIPLE EJECTOR RACK.		22.5 LBS		●						●	
WING ADAPTER ASY, MULTIPLE EJECTOR RACK.		22.5 LBS	●								●
℄ ADAPTER ASY, MULTIPLE EJECTOR RACK.		55 LBS					●				
TRIPLE EJECTOR RACK		82 LBS		●						●	
MULTIPLE EJECTOR RACK		190 LBS	●				●				●
MK 81 LOW DRAG BOMB (GP)		260 LBS	●	●			●			●	●
MK 82 LOW DRAG BOMB (GP)		531 LBS	●	●			●			●	●
MK 83 LOW DRAG BOMB (GP)		985 LBS	●	●			●			●	●
MK 28 MOD 0 SPECIAL WEAPON		2010 LBS					●				
600 GAL. EXT. ℄ TANK (EMPTY) (FULL)		268 LBS 4,362 LBS†					●				
RCPP-105 STARTER POD		2015 LBS					●				

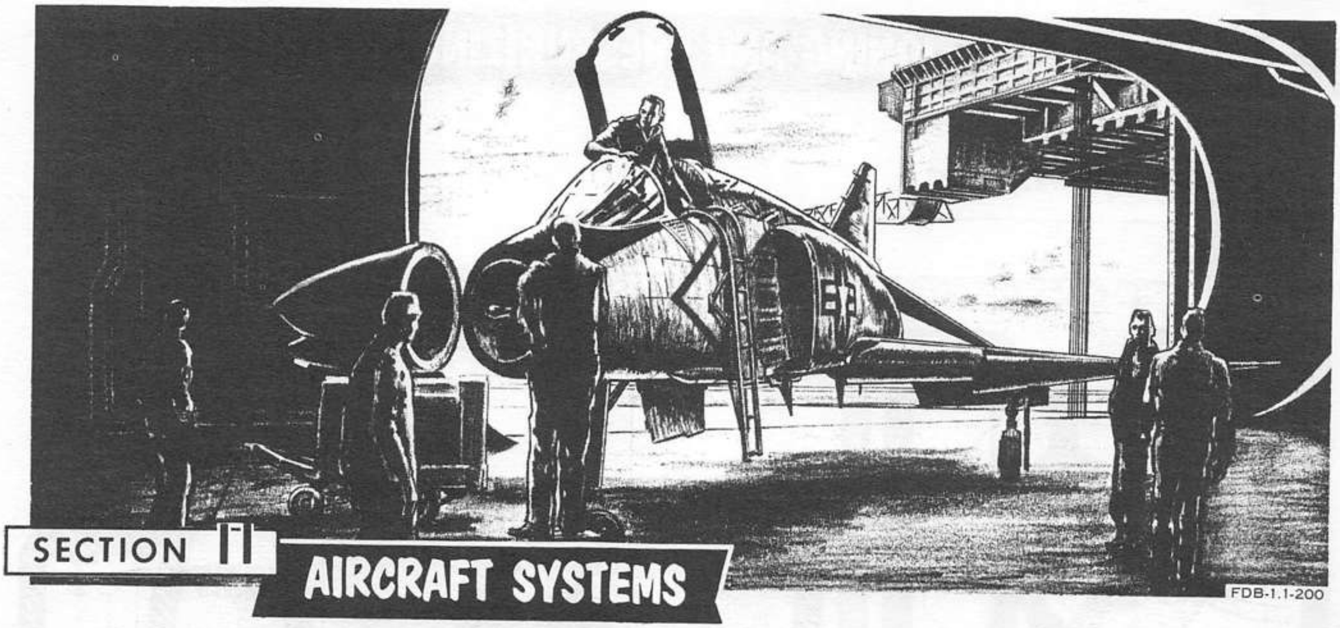
AVERAGE OPERATING WEIGHT* .... AIRPLANES 148363f thru 149474k—28,500 LBS
AIRPLANES 150406L and UP—28,700 LBS

†Based on JP-5 FUEL, 6.8 lbs/gal.

*Operating weight is the basic weight of the airplane plus the weight of oil, ungageable fuel (lines, pumps, manifolds, etc.), and two (2) crewmembers. To obtain exact operating weight, and detailed weight and balance data, refer to AN-01-1B-40 weight and balance data handbook for your airplane.

FDB-1.1-109

Figure 1-9



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(*) Denotes Illustration

AIR CONDITIONING AND PRESSURIZATION SYSTEM

DESCRIPTION

Air conditioning in the airplane is divided into two major systems, one for the cockpit areas and one for electronic equipment cooling. Both cockpits and the pressure suits for both crewmen are pressurized, and supplied with conditioned air from the cabin refrigeration unit. The same air that pressurizes and heats the cockpits also is used to keep the windshield free of fog, frost and rain. The equipment refrigeration unit provides cooling air for the main radar package and communication-navigation-identification equip-

CABIN AIR-CONDITIONING AND PRESSURIZING SYSTEM

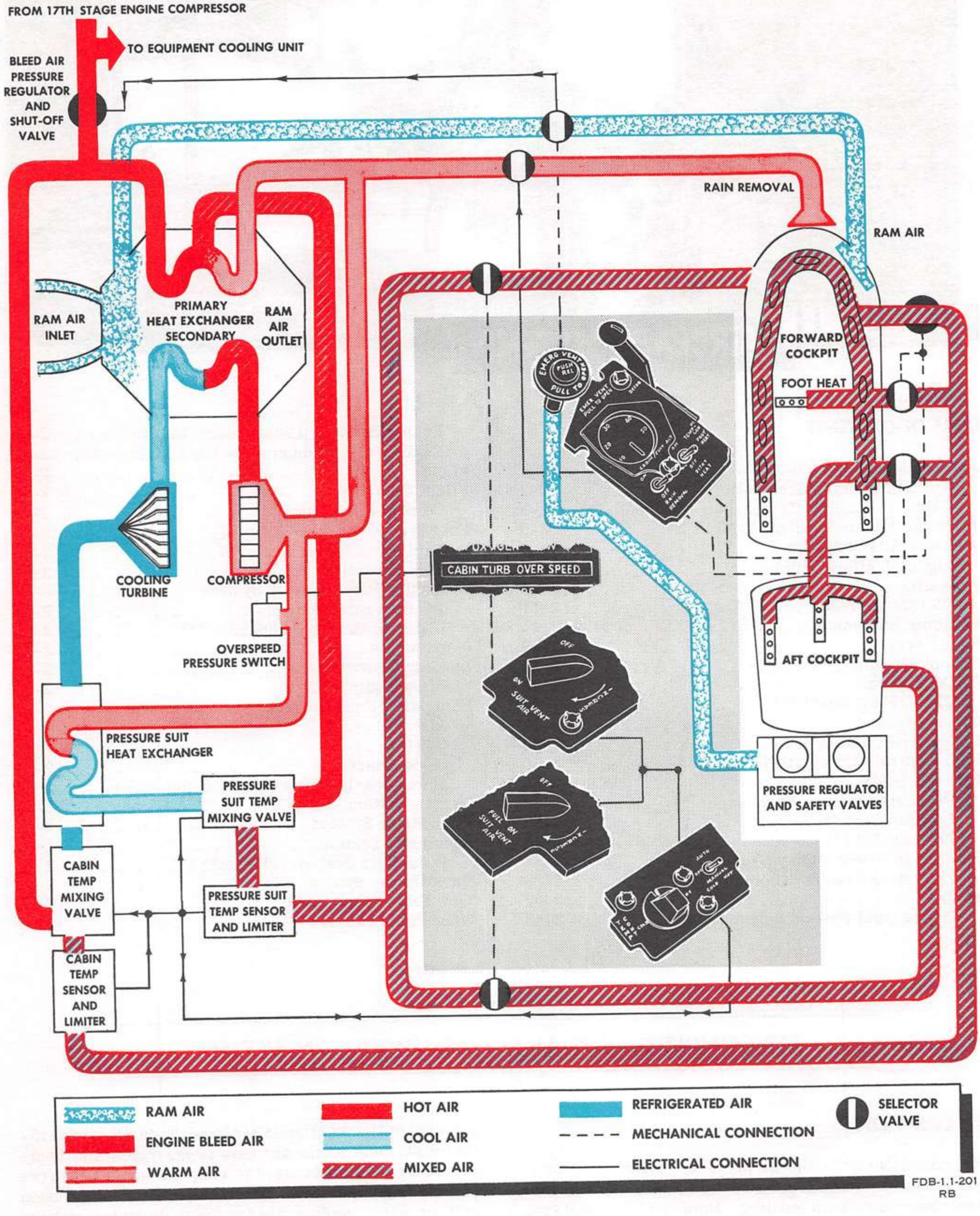

Figure 2-1

ment. Both systems utilize high temperature high pressure 17th stage engine compressor bleed air available from either or both engines. The cabin/pressure suit air conditioning system (figure 2-1) consists of two air-to-air heat exchangers, an expansion turbine, shutoff and pressure regulating mixing valves, and temperature controls necessary to allow the pilot to select cabin conditioning temperatures, pressure suit temperatures, defogging, rain removal and ram air operations. Separate temperature ranges and control systems for the pressure suit and cabin 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 RIO'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 RIO's cockpit. Air is also routed into the aft cockpit via an open tube duct located behind the circuit breaker panels.

CABIN/ PRESSURE SUIT AIR CONDITIONING

The cockpit air conditioning system operation can best be explained and understood by referring to the cabin/pressure suit temperature schedule (figure 2-2). The "normal" 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 cabin temperature - so cabin temperature will be determined by a combination of inlet air and environmental conditions. The "normal" 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 lever is moved forward. But until a switch is made at the HI/LOW position, both defog and foot-heat air enter on the "normal" schedule. Thus full range on the auto rheostat (from 7 o'clock to 5 o'clock positions) will only produce -20°F to 100°F air - unless the defog lever is moved into the HI range. When the switch is made, the temperature schedule of all entering air switches to the "defog" curve. Thus, if 250° were the knob position (about 3:00 o'clock) 87°F would be the temperature of incoming air in the "normal" range, but when the switch is made, the temperature would change to 137°F. As the defog 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. If through some malfunction of the

CABIN/PRESSURE SUIT TEMPERATURE SCHEDULE

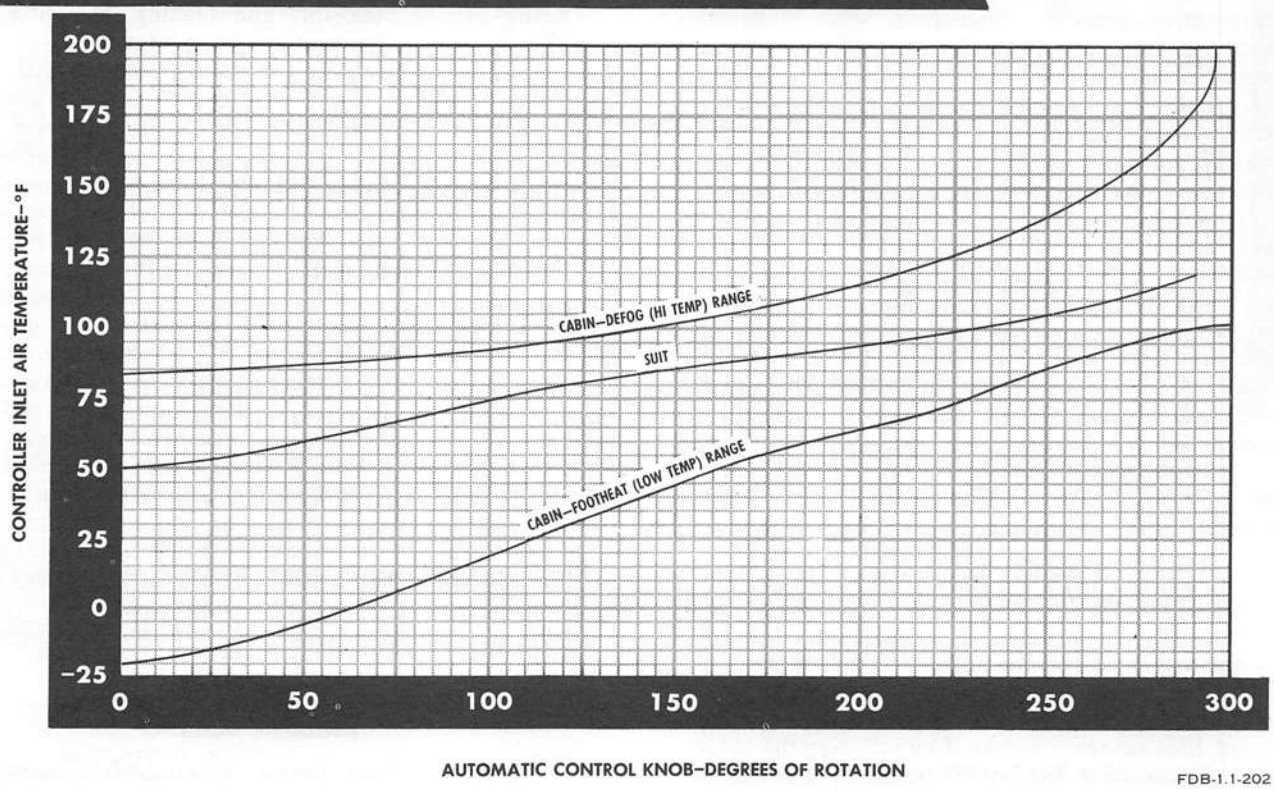

Figure 2-2

automatic temperature control system, it becomes necessary to use manual override, you should realize that "bumping" the switch to cold or hot can give you a full range of temperatures up to 230°F, but the HI/LOW switch on the defog 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 override 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. When the pressure suit mixing valve becomes active (vent air turned on), both pressure suit and cabin air schedules are followed while in automatic temperature control; that is, with the defog 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 "normal" schedule. Moving the defog lever in to the HI range again switches foot-heat and defog air to the higher schedule, but the pressure suit schedule remains unchanged. 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 cabin air mixing valve remains in its last automatic selected position. The relative volumes of defog and foot-heat air can be changed by defog 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. Cabin air temperature will not normally be at a high setting with the pressure suit on, so when manual override is selected, the cabin 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 suit vent air lever is turned off, the suit mixing valve becomes stationary at the cold position and the cabin mixing valve again is operative. Since suit vent air would not be absolutely necessary during letdown into fog producing altitudes, this method to control cabin air temperatures, is plausible. However, it must be remembered when operating in manual override, the suit vent air must be off. Suit vent air can be turned on again after increasing defog air temperature. It also must be remembered that the RIO 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 RIO will be receiving full cold air, unless he elects to turn it off.

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. No advantage will be gained in the amount of heating time required by utilizing the MAN position over the AUTO position. Prolonged use of the full hot MAN position could result in excessive cockpit heat, and/or circuit breaker popping during the take-off phase, since airflow and temperature with the switch in the MAN position is directly proportional to engine rpm.

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 (4, figure 1-3) located on the pilot's right console, outboard of the right utility panel, is provided to select windshield defogging. The lever proportions the cabin airflow between the footheaters and windshield defogging tubes such that in the full aft (FOOT-HEAT) position approximately 90% of the total cabin airflow is delivered to the pilot's and RIO'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 footheat manifolds and 80% through the windshield defog manifold. Actuation of the DEFOG (Hi Temp) range temperature schedule is achieved only after the 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 the crew to high temperatures and defog airflows which are required in order to clear an already fogged windshield.

Windshield Rain Removal

During taxiing, take-off and landing, the pilot, by placing the rain removal switch (3, figure 1-3) located on the right utility panel, to the ON position will open a valve causing warm air to flow through nozzles directed up the outer surface of the windshield center and left side panels. This air breaks up the rain drops into smaller particles and diverts the majority of them over the windshield. The system is adequate when flying through light rain, however, rain removal has been found to be marginal when flying through moderate to heavy precipitation with flaps down (BLC operating). Due to the fact that the rain removal system utilizes engine bleed air, rain removal is better or will be improved when the flaps are up or have been raised. A warning light on the caution lights panel will illuminate in the event the windshield material approaches a temperature which will cause optical deterioration. The pilot should then decide whether to risk optical deterioration or to turn the rain removal switch OFF. If the windshield temperature is known to result from aerodynamic heating (occurs only near level flight maximum speed with maximum afterburning) the overheat signal should be disregarded.

CAUTION

To prevent heat damage to windshield center and left side panels, turn rain removal switch OFF after take-off.

Note

Prior to flight, a rain repellant should be applied to the windshield.

CABIN PRESSURIZATION

With the canopy closed and the engine and cabin refrigeration system in operation, the cabin will automatically become pressurized at an altitude of 8,000 feet and above. The pressure in the cabin is maintained by the cabin pressure regulator (located on the cockpit floor aft of the RIO'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 cabin air as necessary to follow a definite cabin pressure schedule. Operation of the pressure regulator is completely automatic. The cabin safety (and dump) valve is used to prevent the cabin pressure differential from exceeding the limit positive or negative differential pressure in case of malfunctioning of the cabin 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 cabin pressure regulator. Both valves which are operated pneumatically from a single control have sufficient capacity to permit the cabin differential pressure to be reduced from 5.5 psi to .05 psi within 5 seconds or less.

Cabin Pressure Altimeters

The pressure altitude of the cockpit is indicated on a pressure altimeter. The pilot's cabin altimeter (3, figure 1-3), is located on the right console. The RIO's cabin altimeter (2, 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.

Cabin Turbine Overspeed Warning Light

The cabin turbine overspeed warning light (19, figure 1-3), is located on the pilot's caution lights panel. The warning light will illuminate when the cooling turbine in the cabin/pressure suit refrigeration unit is being subjected to pressures and temperatures in excess of normal operation, and is therefore subject to premature failure. 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 cabin/pressure suit air conditioning 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 ± .2 psi above cabin pressure to insure proper flow of ventilating air through the suit. For operation when the cabin altitude exceeds 35,000 feet, the air is provided at a pressure of 6.5 ± .2 psia. In the event the pilot selects ram air for the cabin, 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 and the flow of conditioned air to the suit is stopped, suit pressurization will be automatically and instantly provided by the airplane's oxygen system.

Note

The RIO 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 RIO 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 exits 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. There is no need for the suit to be pressurized when safe cabin pressure prevails, and any slight pressurization that occurs 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 ft. 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 ambient (cockpit) absolute 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.

d. Lastly, if airplane's oxygen fails or in the event of bailout, the bailout oxygen will pressurize the suit as well as supply breathing oxygen.

Helmet

The helmet is equipped with an oxygen regulator (Model GR 70 or 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 .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 any gases from the suit area into the facial area. The face visor is sealed when closed by means of a tube which is inflated by oxygen when the on-off switch on the regulator is switched to ON. To raise the face visor, the seal is deflated on early issue helmets equipped with GR 70 oxygen regulators, by first turning the on-off switch OFF and then by depressing the spring-loaded visor seal relief plunger and inhaling to open the tilt valve allowing the oxygen to escape from the seal. On current issue helmets equipped with GR 90 oxygen regulators, the face visor seal is deflated by merely turning the on-off 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 cheeks 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 face seal. The face seal, when formed properly, and the helmet liner, which adjusted properly, will provide the occupant with the best possible degree of comfort while wearing the helmet. The full pressure suit helmet provides equivalent crash protection to the standard Navy helmet, but the nature of its attachment to the suit body, provides superior helmet retaining qualities.

Suit Controller

The suit controller, located in the survival kit, is the heart of the pressure suit system. 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 ft. 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. 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 air 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 ft. 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, in addition, 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 insertion or in-flight.

Note

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

EQUIPMENT COOLING SYSTEM

The equipment air conditioning system consists of an air-to-air heat exchanger, pressure regulating and shutoff valve, expansion turbine, mixing valve and temperature controls. The unit provides refrigerated air for cooling the nose located radar equipment and the communication navigation identification equipment located under the RIO's cockpit floor. It also provides high pressure, ram-cooled air (auxiliary air) for fuselage fuel tank pressurization, wing fuel tank pressurization and transfer, anti "g" suits, electronic equipment pressurization, high pressure pneumatic system air source, CADC, angle of attack transmitter, canopy seal pressure and turn and slip indicator. Operation of the system is entirely automatic with airflow being initiated on engine start. Engine bleed air, after flowing through the heat exchanger and pressure regulating valve, is expanded through the cooling turbine and then mixed with warm bleed air as necessary to provide a nominal delivery temperature of 85°F from sea level to 25,000 feet, and 40°F above 25,000 feet. The air is then ducted directly to the electronic equipment. In the event of a system failure such that refrigerated air temperatures exceed 150 ± 10°F, the refrigeration unit will be automatically shut off and emergency ram air cooling will be provided. A warning light labeled "Radar CNI Cool Off" will illuminate on the radar intercept officer's instrument panel and the pilot's right vertical panel whenever ram air is being utilized for cooling. A reset button labeled cooling reset is located on the RIO's main instrument panel, and on the console below the pilot's right vertical panel. In the event the "Radar CNI Cool Off" light illuminates, attempt to restart the refrigeration unit by reducing airspeed, waiting at least 15 seconds and then depressing the cooling reset button. If the refrigeration unit fails to restart, no further attempt should be made.

CAUTION

When operating with emergency ram air cooling avoid high speed flight if possible. Maximum allowable cooling temperatures may be exceeded during high speed flight with the result that electronic equipment life and/or reliability may be effected.

Note

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

Nose Radar Compartment Pressurization

The airplane nose section is automatically pressurized to a nominal 1.6 psi above ambient pressure by an out-flow type pressure regulator mounted on the forward wall of the nose gear compartment. Pressurization is initiated when the landing gear is raised, and is relieved when the gear is lowered or equipment package shutoff occurs.

ENGINE ANTI-ICING SYSTEM

The engine anti-icing system is a compressor discharge air bleed type system, controlled by an on-off pressure regulating valve. Air for anti-icing purposes is supplied from the 17th stage of the engine compressor at pressures up to 275 psig, and temperatures up to 593°C. A regulator incorporated in the anti-icing valve reduces the incoming air to a pressure of approximately 14-20 psig. Air from the anti-icing valve is distributed to the engine front frame struts, and to the variable guide vanes.

Engine Anti-Icing Switch

A two-position engine anti-icing switch (7, 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, no anti-icing operation is being performed. Electrical power for the anti-icing circuit is provided by the left main 115 volt a-c bus.

CAUTION

Do not place engine anti-icing switch in the DE-ICE position unless actual engine icing conditions are encountered.

EMERGENCY VENT HANDLE

The cockpits may be cleared of undesired smoke or fumes and the cabin/pressure suit refrigeration unit may be shut off by pulling up on the emergency ventilating handle (2, 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 refrigeration 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 refrigeration 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 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 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 (CP-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 is 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 take-off position is reached where the vent air should be turned down to prevent suit ballooning as power is advanced on the take-off roll. As soon as the airplane is cleaned up after take-off 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 and 20,000 feet, climbing to 40,000 feet and checking that suit inflates, and holds an absolute pressure equal to 35,000 feet.

CAUTION

Prior to pulling pressure suit inflight check turn radar equipment off.

EMERGENCY OPERATION

Although there are no provisions made for emergency operation of the cabin/pressure suit air conditioning system, emergency ventilating air is available. The cockpits may be cleared of undesired smoke or fumes and the cabin/pressure suit refrigeration 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.

AIRBORNE MISSILE CONTROL SYSTEM

Refer to Volume III Confidential Supplement.

ANGLE-OF-ATTACK SYSTEM

DESCRIPTION

The angle-of-attack indicating system is designed to provide the pilot with a visual indication of the airplane's angle-of-attack. This is accomplished through the use of an angle-of-attack indicator, and an angle-of-attack indexer light assembly. The angle-of-attack system also sends signals to the approach lights and stall warning vibrator. Refer to figure 2-3 for angle-of-attack displays.

ANGLE-OF-ATTACK INDICATOR

This indicator (31, figure 1-4) measures the angle-of-attack of the airplane by reflecting the direction of airflow relative to the fuselage. This is accomplished by means of a probe protruding through the fuselage skin. Airstream direction is sensed by means of a pair of parallel slots in the rotating probe protruding horizontally into the airstream. When the airplane changes its angle-of-attack, pressure becomes greater in one slot than the other, and the probe rotates to align the probe slots with the airstream. Probe rotation moves the potentiometer wiper arms a proportional amount, producing resistance variations which are the signals sent to the angle-of-attack indicator. The angle-of-attack indicator is calibrated from 0 to 30 in arbitrary units equivalent to a range of -10 to +40 angular degrees of rotation of the probe. Pointers are provided and are set at the following cruise, stall and approach optimum angle-of-attack reference points:

Cruise	7.9 Units
Stall	30.0 Units
Approach	19.2 Units

The angle-of-attack indicator also contains a switch that actuates the stall warning pedal shaker at 22.3 units. When the indicator is inoperative, the word OFF shows in a small window on the face of the dial. Refer to Angle-of-Attack Conversion Charts Section IV, Volume II for optimum angle-of-attack units for various airspeeds and gross weights. The angle-of-attack indicator derives power from the right main 28 volt d-c bus.

ANGLE-OF-ATTACK INDEXER

An angle-of-attack indexer is installed on the left side of the windshield in the pilot's cockpit. On some airplanes, two angle-of-attack indexers are installed, one on each side of the windshield. The indexer(s) present angle-of-attack information to the pilot while making a landing approach, by illuminating symbolic cutouts. The indexer(s) are energized by cam-operated switches in the angle-of-attack indicator. At very low angle-of-attack an inverted "V" is illuminated and warns the pilot to increase his angle of attack. At slightly low angle-of-attack both the inverted "V" and circular symbols are illuminated. At optimum angle-of-attack only the circular symbol is illuminated. At very high angle-of-attack a "V" symbol is illuminated, warning the pilot to decrease his angle of attack. When approaching at slightly high angle-of-attack both the "V" and circular symbols are illuminated. The indexer information corresponds with the approach light assembly information. The indexer assembly is powered from the left main 26/14 volt a-c bus.

STALL WARNING VIBRATOR

A stall warning vibrator is mounted on the left rudder pedal to warn the pilot of approaching stall conditions. The vibrator consists of an electrical motor which drives an eccentric weight. Rotation of the weight causes the rudder pedals to vibrate, warning the pilot of an impending stall. A sufficient 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. The switch to activate the rudder pedal vibrator is set at 22.3 units. The stall warning vibrator is powered from the right main 28 volt d-c bus.

ANGLE OF ATTACK DISPLAYS

APPROACH LIGHT	INDICATOR	INDEXER	ANGLE OF ATTACK UNIT	AIRSPEED
			20.3-30	VERY SLOW
			19.7-20.2	SLIGHTLY SLOW
			18.7-19.6	ON SPEED
			18.1-18.6	SLIGHTLY FAST
			0-18.0	VERY FAST

FDB-1.1-203
R G A

Figure 2-3

APPROACH LIGHTS

An approach light system with red-amber-green indications is used to show the angle-of-attack of the airplane on approach. This system operates in conjunction with the angle-of-attack system, with the approach lights operated by switches in the angle-of-attack indicator. The system is automatically energized when the arresting gear is down and the landing gear is down and locked. Two switches in the indicator unit determine which one of the three lights will be lit. A Hook switch is located on the exterior lights control panel (figure 4-11), and has switch positions of NORMAL and BYPASS. With the switch in the NORMAL position, landing and arresting gear down, the approach lights will illuminate steadily. With the switch in the NORMAL position, landing gear down and arresting gear up, the approach lights will flash. Placing the switch in the BYPASS position completes a circuit allowing the approach lights to illuminate steadily without having the arresting gear extended. One complete recycling of the arresting gear will reset the Hook switch to the NORMAL position. Approach lights are powered from the left main 28 volt d-c bus.

NORMAL OPERATION

There are no normal operations pertaining to the angle-of-attack system.

EMERGENCY OPERATION

There are no emergency operations pertaining to the angle-of-attack system.

LIMITATIONS

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

ARRESTING GEAR SYSTEM

DESCRIPTION

A conventional arresting hook and actuating cylinder is utilized to pneumatically extend and hydraulically retract the arresting gear. The hook is actuated by one combination shock absorbing actuating cylinder. The arresting gear consists of an arresting hook, a combination hydraulic actuator and dashpot, an up-latch mechanism, and a lever in the cockpit.

ARRESTING GEAR CONTROL

The arresting gear is controlled by a handle (17, figure 1-4) located on the right of the main instrument panel of the forward cockpit. When the control handle is pushed down, the latch is released and the arresting gear is extended by gravity and compressed air in the cylinder. Placing the arresting gear handle in the UP position actuates a switch which energizes a solenoid valve which directs hydraulic pressure to the cylinder to raise the arresting gear. A red warning light inside the control handle will come on when the control handle is placed in the down position and will remain on until the arresting gear is fully extended. The warning light will not illuminate again until the system is recycled. Upon the incorporation of ASC 92 (Addition of Hook Not Up Warning Light Function), the warning light will also illuminate when the control handle is placed in the up position, and will remain illuminated until the arresting gear is fully retracted. Electrical power for the arresting gear is supplied by the left main 28 volt d-c bus.

NORMAL OPERATION

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

EMERGENCY OPERATION

There are no provisions for emergency operation of the Arresting Gear System.

LIMITATIONS

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

AUTOMATIC FLIGHT CONTROL SYSTEM (AN/ASA-32D)

DESCRIPTION

The AN/ASA-32 flight control system is an electro-hydraulic autopilot system designed to provide stable, accurate coordinated flight maneuvers without interferring with effective manual control. The flight control system is capable of performing two modes of operation, stability augmentation and autopilot. Stability augmentation operation provides airplane stability in pitch, roll and yaw; it opposes any changes of attitude but will not return the airplane to a given attitude or heading. This mode of operation may be used while the airplane is under manual control. The autopilot mode of operation will maintain any airplane heading and/or attitude selected within the autopilot limits and will correct for any deviation from the selected heading or attitude of the airplane within the autopilot limits. Two additional operating features are available while in the autopilot mode of operation, they are altitude hold and Mach hold. The altitude hold mode of operation will hold any altitude selected by the pilot while in autopilot operation. The Mach hold mode of operation will hold any indicated Mach number selected while in autopilot operation.

STABILITY AUGMENTATION MODE

In the stab aug mode of operation the system senses motion about the horizontal, vertical and lateral axes, by means of rate gyro sensors. All attitude, heading and bank angle changes will cause these sensing devices to transmit signals representing the changing motion about their respective axes. These signals are sent to servo valves in the control surface actuators, therefore any output signals from the rate gyro sensors indicating yawing or pitching motion causes the flight control system to position the appropriate control surfaces to oppose that motion. This action decreases any tendency of the airplane to oscillate in roll, yaw or pitch. In the stab aug mode the rate gyro sensors will send signals to the surface controls to oppose any deviations from selected flight attitude but will not return the airplane back to its original heading or attitude. The stab aug mode is in operation whenever the Stab Aug switch is in the ENGAGE position.

AFCS MODE

In the AFCS mode of operation, vertical gyro, directional gyro and accelerometer 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 autopilot 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 autopilot utilizes various components to make the system function properly. These components are a control amplifier, the AN/AJB-3A computer, the central air data computer, force transducer, accelerometers, lateral series servos and rate gyro sensors.

Control Amplifier

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

AN/AJB-3 A

The AN/AJB-3A Loft Bomb Release Computer Set provides the vertical and directional references for the autopilot.

Central Air Data Computer

The central air data computer performs 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 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 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.

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 of it. The force transducer contains pressure sensitive switches which react to longitudinal and lateral stick forces. A lateral stick force of three pounds or more closes a switch that will, in effect, disengage the autopilot in roll. The autopilot will stay disengaged as long as the three 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, and the aircraft is being manually controlled by the pilot. When the stick forces are released the autopilot will hold the new pitch attitude. 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 atuopolot operation. The other accelerometer is a lateral accelerometer which is used to perform coordinated maneuvers while in autopilot operation.

G-LIMIT ACCELEROMETER. The normal load factor interlock (g - disengage) feature of the AFCS is designed to inhibit that system from commanding excessive load factor 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 then 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 -0g or +3g'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.

Lateral Series Servos

The lateral series servos function to operate the spoilers and ailerons during autopilot operation.

Rate Gyro Sensors

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

AFCS CONTROLS

The automatic flight control system engaging controller (hereafter referred to as the AFCS panel) (15, figure 1-2) is located on the pilot's left console. This panel contains all the controls for the normal operation of the flight control system.

Stab Aug Switch

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.

AFCS Switch

The AFCS switch is a two-position toggle switch located on the AFCS panel. The switch positions are AFCS and ENGAGE. This switch can become energized only if the stab aug switch is engaged. Placing the switch in the ENGAGE position will energize the AFCS system and the system will become fully effective, holding any attitude and heading selected.

Altitude Hold Switch

The altitude 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 and the Mach hold switch is disengaged. Placing the switch in the ALT position energizes an altitude sensor in the CADC which is controlled by barometer altitude. As the airplane's 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 speed 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 attitude other than the engage altitude. Opening the altitude switch, or moving the control stick fore or aft will disconnect the altitude hold operation.

Mach Hold Switch

The Mach hold switch is a three-position rotary switch located on the AFCS panel. The switch positions are ALT, OFF and MACH. The Mach switch will cause the autopilot to maintain a constant Mach number within ± 0.03 Mach when it is closed. This switch will function only if the AFCS mode is engaged and the altitude hold switch is disengaged. Opening the Mach switch, or moving the control stick fore or aft will disconnect the Mach hold operation. Placing the switch in the MACH position energizes a Mach sensor in the CADC. As the airplane's 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 down to put the airplane in a shallow dive to pick up Mach number or it will deflect the stabilator up to put the airplane in a gradual climb to decrease Mach number. In Mach hold AFCS operation, the airplane will hold a selected heading, 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.

Heading Hold Cutout

Effective airplanes 149403i and up, and all other airplanes upon incorporation of ASC 94 (Addition of Manual Heading Option Circuit) provisions have been added to the airplane to provide the capability of making minor heading or attitude changes when in AFCS operation. The AFCS upon initial engagement will establish heading hold as the roll reference attitude below ±5° angle of bank. The pilot by actuating the nose steer button can cut out the heading hold roll reference and make minor heading changes between 0 and ±5° angle of bank. The heading hold cutout option will remain in the system until the nose gear steer button is again depressed or the AFCS is disengaged.

AFCS/ARI Emergency Disengage Switch

The spring-loaded disengage switch (figure 2-10) is located on the control stick. This switch when depressed will automatically cause all the switches on the flight control panel to return to OFF, and will also disengage the aileron rudder interconnected system as long as the switch is held depressed. When the switch is released the ARI system will again be in operation, but the autopilot will no longer be engaged. To permanently disengage the ARI system, the ARI circuit breaker on the left utility panel must be pulled.

AUTOPILOT PITCH TRIM WARNING LIGHT

An "A/P Pitch Trim" warning light (19, figure 1-3) is located on the warning lights panel. This light when illuminated for twenty seconds or more will inform the pilot that the autopilot pitch trim circuit is not functioning. A momentary illumination of the light will be of no concern since a time delay relay in the circuit causes this condition and it does not indicate a malfunction. If the airplane is in autopilot operation when the light is illuminated, the pilot should make sure the airplane is in a neutral trim and that the control stick is gripped firmly before disengaging the autopilot. The autopilot pitch trim rate is approximately 40% of the rate of manual trim. If the autopilot is disengaged while the autopilot is trimming, and the above precaution is not observed the airplane may perform a severe nose up or nose down maneuver upon disengagement of the autopilot. The "Master Caution" light will illuminate with the "A/P Pitch Trim" warning light. Depressing the master caution reset switch will only extinguish the "Master Caution" light.

AUTOPILOT DISENGAGED WARNING LIGHT

The "A/P Disengaged" warning light (19, figure 1-3) is located on the warning lights panel. After initial engagement of the AFCS mode of operation, the "A/P Disengaged" warning 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 switch. The lights will remain extinguished until the AFCS is again engaged and disengaged.

STABILATOR AUGMENTATION OFF WARNING LIGHT

Effective airplanes 148411 and up, and all other airplanes upon incorporation of ASC 88, a "Stab Aug Off" warning light (19, figure 1-3) has been added to the airplane and is located on the warning lights panel. The "Stab Aug Off" warning 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 switch will clear the "Master Caution" light, however, the "Stab Aug Off" light will remain illuminated until the stab aug switch is engaged.

NORMAL OPERATION

Engagement and operation of the AFCS does not require much effort on the part of the pilot, however, there are some prerequisites involved: the stab aug mode must be engaged; the airplane should be trimmed; and an attitude within the AFCS limits should be established. AFCS operation can then be achieved by engaging the AFCS switch. 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 or aft stick movement will disengage the Mach or altitude modes. 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. There is also a possibility, during AFCS operation, of encountering pronounced airframe structural vibrations at very low indicated airspeeds. This is caused by the pitch rate gyros inadvertently sensing structural vibrations of the airframe, and amplifying these vibrations by generating commands through the autopilot to the stabilator. There should be no cause for alarm if this phenomenon occurs. The vibration or "chatter" can be eliminated by reverting to the stab aug mode or by increasing airspeed above approximately 190 to 200 knots CAS. Autopilot disengagement can be accomplished by placing the AFCS switch off, the airplane will still be in the stab aug mode. The AFCS and stab aug modes can both be disengaged by depressing the emergency disengage lever on the control stick.

OPERATIONAL PRECAUTION

Generator Switching

Power to the autopilot, CADC and AN/AJB-3 may be momentarily interrupted during the starting and stopping of 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 or the engaging controller to disengage. This will necessitate re-engaging the autopilot to bring back autopilot operation. The autopilot, CADC, and AN/AJB-3A will not be effected by starting or stopping the left engine or generator with the right generator on the line.

Roll Reversal

There is a possibility of a condition called "roll reversal" occurring when operating the automatic flight control system 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 channel, and is apparent to the pilot as a slow rolling of the aircraft in the opposite direction of the low lateral stick 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 lateral stick forces are applied. A roll reversal situation may also be caused by operating the manual 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 occurring even if the airplane had 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.

AFCS Operation with Static Correction Off

A malfunction of the Static Pressure Compensator (indicated by the illumination of the STATIC CORR OFF light) will have no effect upon autopilot operation. The autopilot will operate satisfactorily with the Static Pressure Compensator out, however, the MACH and ALT hold modes will be effected and these modes should be disengaged to avoid erratic operation.

Pitch Oscillations

When using the AFCS altitude hold mode, the aircraft may experience pitch oscillations in the transonic regions and below due to fluctuations in the CADC airspeed system. The nature of these oscillations vary from "stick pumping" to divergent pitch oscillations. It is recommended that in the event pitch oscillations occur at subsonic speeds that the following corrective steps be attempted: disengage the AFCS; place the static correction switch off; disengage the stab aug mode; re-engage the AFCS; and engage altitude hold. If the oscillations persist after taking corrective action, or if they are encountered at supersonic speeds, disengage the altitude hold mode. In any event, divergent pitch oscillations should not be allowed to develop. If any divergent pitch activity is noted, corrective action should be taken immediately.

EMERGENCY OPERATION

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

LIMITATIONS

The AFCS is not to be used below 150 knots CAS.

BOMBING EQUIPMENT

DESCRIPTION

Bombing equipment on the airplane consists of a special purpose bomb director system for LABS delivery and a DCU 75/A bomb control and monitor panel (Refer to NAVWEPS 01-245FDA-13 for operation of DCU 75/A). On airplanes 150406L and up, a multiple weapons system incorporated for delivery of conventional bombs and rockets. The special purpose bomb director system is designed to program an Immelmann turn, bomb delivery. The neccessary information to program such a delivery is provided by the Loft Bomb Release Computer set AN/AJB-3A, and displayed on the Attitude Director Indicator (ADI). When a bombing run is initiated the AN/AJB-3A computer set provides the pilot with precision attitude information, commands for executing the Immelmann turn and automatic bomb release.

SPECIAL PURPOSE BOMBING SYSTEM

This special purpose bombing system provides selection of the type of bombing run to be made (loft, timed over-the-shoulder or instantaneous over-the-shoulder); selection of the release point for this bombing run; cancellation of the run at any time prior to bomb release; the exact time interval required from the IP to the pull up warning aural signal; a visual indication of the deviation from the programmed "g's" required for correct bomb trajectory; and automatic bomb release at the proper time. Prior to take-off the following information should be obtained: target information and bombing mode, run-in altitude, speed and heading, time interval from the IP to the pull-up point, and the release angles for both loft and over-the-shoulder bombing. The time interval should be set into the interval timer if loft of timed over-the-shoulder are to be used, and the release angles should be set into the bomb release angle computer.

Bomb Control Panel

The special purpose bombing system is controlled by two three-position toggle switches located on the bomb control panel (figure 1-2). With the Labs-Direct switch in the OFF position the Loft Bomb Release Computer Set is in the all-attitude indicating mode. With the switch in the LABS position the particular bombing mode desired can be chosen by selecting either the INST O/S, TIMED O/S or LOFT position on the bomb mode switch. The AN/AJB-3A computer set will remain in the all attitude indicating mode until the bomb button is depressed at the beginning of the bomb run. When the bomb button is depressed the computer set automatically switches over to a special purpose bombing system and will provide information dependent upon the selected bombing mode (INST O/S, TIMED O/S or LOFT). Upon completion of the bombing maneuver, the computer set automatically switches back to an all attitude indicating mode. When the bomb control Labs-Direct switch is in the DIRECT position, the AN/AJB-3A remains an all attitude indicating system, and bomb release occurs when the bomb button is depressed.

MULTIPLE WEAPONS SYSTEM

Airplane 150406L and up are equipped with a multiple weapons system to provide a convential bomb and rocket capability. The system is comprised of an optical sight unit, a multiple weapons control panel, a control stick bomb release switch (pickle), aircraft armament system wiring, two wing missile pylons (LAU-17A-inboard), two wing tank pylons (outboard), a centerline bomb rack (Aero-27A) and the appropriate multiple bomb racks and pylon adapters. MK81, 82, and 83 bombs, and 2.75 in. or 5 in. rocket launcher packages, or any symmetrical combination of the proceeding stores can be carried and launched.

OPTICAL SIGHT UNIT

The sight unit is located above the pilot's AMCS indicator. A fixed reticle image is projected on the combining glass. The image consists of a pipper and a 50 mil radius segmented ring. Illumination is provided by a two filament bulb. The reticle illumination knob, located on the right side of the sight unit, has a center OFF position. Rotation in either direction illuminates one of the bulb filaments. Reticle brightness is controlled by the amount of rotation from the center OFF position. A reticle depression knob is located on the left side of the sight unit controls the depression of the reticle image. The scale is graduated in mils from Ø mils (SW position) to 220 mils of depression.

BOMB RELEASE SWITCH

The bomb release switch (pickle) located on the control stick is the control for normally releasing all stores in the multiple weapons configuration.

MULTIPLE WEAPONS SYSTEM CONTROL PANEL

Methods of release, sequencing and arming of the multiple weapons system stores are controlled by the station selector and the weapons control selector of the Multiple Weapons Control Panel (23, figure 1-2). Individual selector and switch functions are described in the succeeding paragraphs.

Weapons Selector Switch

The weapons selector provides the method of launch for all types of ordinance. The switch positions are BULLPUP, RKT DISP, and BOMBS (SINGLE, PAIRS RIPPLE, and CLUSTER).

MULTIPLE WEAPONS SEQUENCE AND RELEASE CHART

EFFECTIVE AIRPPLANES 150406L AND UP

WEAPONS SELECTOR SWITCH POSITION– *SINGLE*

STATION SELECTOR SWITCH POSITION			
OUTBOARD	INBOARD	CENTERLINE	ALL
The bombs are released one at a time from the outboard wing station multiple weapons bomb racks alternately from one station and then the other—the left hand station will always receive the first firing signal after reset. One bomb is released for each actuation or triggering of the bomb release switch until both the outboard racks are empty.	The bombs are released one at a time from the inboard wing station multiple weapons bomb racks alternately from one station and then the other—the left hand station will always receive the first firing signal after reset. One bomb is released for each actuation or triggering of the bomb release switch until both the inboard racks are empty.	The bombs are released one at a time from the centerline station multiple weapons rack. One bomb is released for each actuation or triggering of the bomb release switch.	The bombs are released one at a time from the outboard wing station multiple weapons bomb racks, alternately from one station and then the other—the left hand station will always receive the first firing signal after reset. One bomb is released for each actuation or triggering of the bomb release switch. When all the bombs have been released from the outboard stations the signal will automatically be directed to the inboard stations — the left hand station again being first. When the inboard racks are empty the signal will automatically be directed to the centerline rack and the bombs released singly from that station.

WEAPONS SELECTOR SWITCH POSITION– *PAIRS*

STATION SELECTOR SWITCH POSITION			
OUTBOARD	INBOARD	CENTERLINE	ALL
Two single pulses are supplied simultaneously to both the left hand and right hand outboard wing station multiple weapons bomb racks releasing a bomb from each. Each time the bomb release switch is depressed another pair of bombs is released until the racks are empty.	Two single pulses are supplied simultaneously to both the left hand and right hand inboard wing station multiple weapons bomb racks releasing a bomb from each. Each time the bomb release switch is depressed another pair of bombs is released until the racks are empty.	Bomb release is the same as the centerline bombs single mode.	Two single pulses are supplied simultaneously to both the left hand and right outboard wing station multiple weapons bomb racks releasing a bomb from each. Each time the bomb release switch is depressed another pair of bombs is released until the outboard racks are empty at which time the signal or pulse will be directed to the inboard racks and when they are empty on to the centerline rack.

WEAPONS SELECTOR SWITCH POSITION– *RIPPLE*

STATION SELECTOR SWITCH POSITION			
OUTBOARD	INBOARD	CENTERLINE	ALL
By holding the bomb release switch in the depressed position an alternating pulse is supplied continuously — first to the left hand and then to the right hand outboard wing station bomb rack releasing a bomb from each. The rate at which the pulse is supplied is determined by the setting selected on the INTRVL switch. This sequence will continue as long as the bomb release switch is held in the depressed position or until the rack is empty. Releasing the switch will stop the sequence. Depressing it again will restart the sequence from the point at which it was stopped.	By holding the bomb release switch in the depressed position an alternating pulse is supplied continuously — first to the left hand and then to the right hand inboard wing station bomb rack releasing a bomb from each. The rate at which the pulse is supplied is determined by the setting selected on the INTRVL switch. This sequence will continue as long as the bomb release switch is held in the depressed position or until the rack is empty. Releasing the switch will stop the sequence. Depressing it again will restart the sequence from the point at which it was stopped.	By holding the bomb release switch in the depressed position a continuously alternating pulse is supplied to the centerline multiple weapons bomb rack releasing the bombs at a rate selected by the INTRVL switch.	By holding the bomb release switch in the depressed position an alternating pulse is supplied continuously — first to the left hand and then to the right hand outboard wing station bomb rack releasing a bomb from each. The rate at which the pulse is supplied is determined by the setting selected on the INTRVL switch. When the outboard racks are empty the pulse is directed to the inboard centerline rack. An entire load can be released by this "ripple" mode automatically by holding the bomb release switch in the depressed position. Releasing the switch will stop the sequence. Depressing it again will restart the operation from the point at which it was stopped.

FDB-1.1-204-1

Figure 2-4 (Sheet 1)

WEAPONS SELECTOR SWITCH POSITION– *CLUSTER*			
STATION SELECTOR SWITCH POSITION			
OUTBOARD	INBOARD	CENTERLINE	ALL
By holding the bomb release switch in the depressed position a pulsating signal is supplied simultaneously to both the outboard wing station bomb racks releasing a bomb from each. This pulse is repeated at a rate selected on the INTRVL switch for as long as the bomb release switch is depressed or until the racks are empty. Releasing the switch will stop the sequence. Depressing it again will restart the sequence from the point at which it was stopped.	By holding the bomb release switch in the depressed position a pulsating signal is supplied simultaneously to both the inboard wing station bomb racks releasing a bomb from each. This pulse is repeated at a rate selected on the INTRVL switch for as long as the bomb release switch is depressed or until the racks are empty. Releasing the switch will stop the sequence. Depressing it again will restart the sequence from the point at which it was stopped.	By holding the bomb release switch in the depressed position two continuous alternating pulses are supplied simultaneously to the centerline multiple weapons bomb rack releasing the bombs in pairs. The pulse is repeated at a rate selected by the INTRVL switch until the bomb rack is empty.	By holding the bomb release switch in the depressed position a pulsating signal is supplied simultaneously to both the outboard wing stations bomb racks releasing a bomb from each. This pulse is repeated at a rate selected on the INTRVL switch for as long as the bomb release switch is depressed or until all the bombs are released. When the outboard racks are empty the pulse will be directed to the inboard racks and when they are empty on to the centerline until the entire complement of bombs is released. This mode is much the same as the "ripple" mode but because the bombs are released in consecutive pairs the entire load may be released in half the time required using the "ripple" method of release. Releasing the switch will stop the sequence. Depressing it again will restart the sequence from the point at which it was stopped.

WEAPONS SELECTOR SWITCH POSITION– *RKT DISP*			
STATION SELECTOR SWITCH POSITION			
OUTBOARD	INBOARD	CENTERLINE	ALL
Rocket firing is accomplished by momentarily depressing the bomb release switch. This supplies a pulse to the center rack on the left outboard wing station. The bomb release switch must be held depressed for .2 sec. to insure that all rockets are fired from the AERO 7D (2.75 in. FFAR'S) rocket pack and .5 sec. for the LAU-10/A (5 in. FFAR'S). When the rocket pack has fired the bomb release switch must be released and depressed again to supply a firing pulse to the right outboard wing station. Blank or dud stations are manually stepped over by releasing and depressing the bomb release switch.	Same as outboard. Left wing station is fired first.	Same as outboard stations.	This position is not used.

FDB-1.1-204-2

Figure 2-4 (Sheet 2)

Station Selector Switch

The station selector provides a rack selection capability. The switch positions are OFF, OUTBD WING, INBD WING, CTR, and ALL.

Master Arm Switch

The master arm switch has two positions ARM and SAFE. The ARM position supplies armament bus 28 volt d-c power to the multiple weapons armament system.

Step Reset Switch

The step reset switch has two positions, RESET and NORMAL. The switch is spring loaded to remain in the NORMAL position. When the switch is momentarily actuated to the RESET position, the intervalometer is reset to the left wing position and the multiple stores rack selectors are sequenced to the HOME position.

Bomb Arming Switch

The arm-safe switch is a toggle switch with three positions, NOSE AND TAIL, SAFE, and NOSE.

Selection of the NOSE position completes a circuit from the MASTER ARM switch to arm the nose fuses of general purpose bombs after release. Selection of the NOSE AND TAIL position completes a circuit from the MASTER ARM switch to arm both the nose and tail fuses of general purpose bombs after release. The SAFE position disconnects all power from the bomb arming circuit and allows general purpose bombs to be dropped in a safe condition.

Interval Selector Switch

The interval selector switch is a three position toggle switch located on the multiple weapons control panel. The switch positions are .06SEC, .10SEC, and .14SEC. These positions determine the rate at which the aircraft intervalometer will pulse when the weapons selector switch is in the BOMBS RIPPLE or the BOMBS CLUSTER mode. When the weapons selector is on BOMBS RIPPLE the selected interval pulse alternates between the left and right armament circuits. When the weapons selector is on BOMBS CLUSTER the selected interval pulse is supplied simultaneously to both left and right armament circuits.

NORMAL OPERATION

SPECIAL PURPOSE BOMBING SYSTEM

Activation of the special purpose bombing system is accomplished by placing the bomb control Labs-Direct switch in the LABS position. One of three bombing modes (INST O/S, TIMED O/S or LOFT) may then be selected by placing the bomb mode switch in the desired mode. On airplanes 150406L and up, the Master Arm-Safe switch on the multiple weapons control panel must be in the SAFE position to complete the circuit from the bomb button to the bomb control Labs-Direct switch.

Loft Bomb Mode

The loft bomb mode requires an IP, a correct setting of the bomb release angle, and a time interval between the IP and pull-up point. Some time before the IP is reached the bomb control Labs-Direct switch should be placed in the LABS position and the bomb mode switch should be placed in the LOFT position. This starts the interval timer motor. When the airplane passes over the IP at a predetermined ground speed, altitude and heading, the pilot depresses the bomb button and holds it depressed throughout the bomb run. This action arms the circuits, engages the time start clutch in the interval timer and starts the preset time interval. The horizontal director pointer on the ADI will remain centered and the vertical director needle on the ADI will continue to give heading information. One second before the time interval has elapsed a warning tone burst is produced in the pilots headset to alert the pilot that pull-up is imminent and to assume a wings level attitude. At the end of the time interval a continuous tone is produced and the LABS light is illuminated. At this time the pilot begins the Immelmann maneuver. The horizontal director pointer starts moving up and indicates "g" force error, while the vertical director pointer starts presenting yaw/roll deviation. The pilot merely flies the airplane to center the two pointers. If the two pointers are centered throughout the maneuver until the point of bomb release, proper profile and flight in the proper vertical plane will be assured. When the airplanes pitch angle corresponds to the pre-set bomb release angle, the bomb is released. At bomb release the aural tone stops, the LABS light goes out, the AN/AJB-3A computer reverts to an all attitude indicating system, and the pilot releases the bomb button and completes the Immelmann turn.

Timed Over-the-Shoulder Bomb Mode

The timed over-the-shoulder mode is selected by placing the bomb control mode switch in the TIMED O/S position. This type of delivery is the same as a loft bomb delivery except that a high angle release is used and pull-up occurs over the target.

Instantaneous Over-the-Shoulder Bomb Mode

The instantaneous over-the-shoulder mode is selected by placing the bomb control Mode switch in the INST O/S position. This type of delivery is the same as a timed over-the-shoulder delivery except that no IP or timer is utilized.

MULTIPLE WEAPONS SYSTEM

Refer to figure 2-4 for sequence and release information.

EMERGENCY OPERATION

There are no special provisions for emergency operation of the Special Purpose Bombing System or Multiple Weapons System. However, both special weapons and conventional bombs can be jettisoned if the need arises; refer to External Stores Jettison Chart, Volume II Operating Procedures.

LIMITATIONS

Refer to External Stores Limitations, Volume III Confidential Supplement.

BRAKE SYSTEM

DESCRIPTION

The main landing gear wheels are equipped with power-manually operated brakes. Two power brake valves are located in the nose wheel well and each is operated in a conventional manner from linkage attached to the rudder pedals. The brake control valves are power operated rather than a power boost type. Excessive pedal travel and pumping of the brakes in order to obtain a firm pedal is eliminated since the fluid supply to the wheel cylinders is virtually unlimited. This brake system provides differential wheel brake pressures. With no utility hydraulic pressure available, a 25 cubic inch hydraulic accumulator will provide sufficient pressure for approximately 10 maximum effort applications of the normal brake system. In addition the brake control valves will act as master cylinders in a conventional non-power system as long as integrity has been maintained between the control valves and the wheel brakes. Pilot effort in this manual operation will be capable of securing the airplane in deck rolls up to 8°. Although it has not been determined by test flight, pilot assumption is that the manual brake system should probably be capable of successfully stopping the airplane on a typical jet runway provided the drag chute is also used. The manual braking feature is selective and may be used for differential brake steering, while the emergency pneumatic brake system is deployed in stopping the airplane.

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 twenty maximum effort retardations may be made by means of the emergency brake handle (17 figure 1-3) located just inboard of the right console. It is hand-operated and 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 pilot 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. Hydraulic and pneumatic systems are entirely separate; actuation of the emergency pneumatic system will not introduce air into the hydraulic system.

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, and braking effort is fully definable from the cockpit. The pilot is capable of locking the brakes by both normal and emergency braking systems. Caution must be exercised in over-braking, 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. Since no anti-skid system is fitted, 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 wheels to regain full rolling speed before further application of brakes.

CAUTION

Do not pump the brakes at any time, since this action will only reduce the amount of constant pressure available at the brakes and will tend to store heat energy within the brake assembly.

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.

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 slip stream, and a minimum of 30 minutes between landings where the landing gear has been retracted to allow sufficient time for cooling between brake applications. 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 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 assymetrical braking will be prevalent when utilizing the air brakes due to runway crown, crosswinds, and unequal brake torque; however, the normal hydraulic brakes (because of fluid trapped between the brake valves and brakes) are still capable of furnishing flow and pressure to accomplish differential braking.

LIMITATIONS

There are no specific limitations pertaining to the brake system.

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°. Canopy operation, both normal and emergency, is accomplished pneumatically. Clean dry air at 3000 psi is supplied by the basic 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; this is controlled by pneumatic restrictors incorporated in the system. Each cockpit employs an inflatable canopy seal to seal the canopies 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 basic pneumatic system to air bottles which furnish air for both canopy emergency systems. After leaving the air bottles, the system pressure is reduced to 1375 ± 100 psi in order to minimize the possibility of structural damage upon emergency opening of the canopy. Each canopy has individual manual control valves that operate independently of each other to direct the flow of air to the actuating cylinders in each cockpit. These valves can be operated by pulling on the face curtain pull handles, alternate ejection handles ("D" ring), 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.

EXTERNAL CANOPY CONTROLS

External Canopy Buttons

The forward cockpit external canopy control push buttons are located on the left side of the airplane just forward of the engine air intake duct. The aft cockpit external canopy control push 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 of the other but their functions are the same. Operating a push-type latch causes the handle to pop out about

1-3/4 inches. A 63° 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 of the other 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 (14, figure 1-4) is located on the right side of the cockpit above the arresting gear control. 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 of the other but their functions are the same. The handle when pulled aft, breaks the canopy downlock linkage, releasing the downlocks so that the canopy may then 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 systems are depleted.

Note

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

Canopy Unlocked Warning Light

An amber Canopy Unlocked warning light (19, figure 1-3) located in the forward and aft cockpits is used to notify the crew that a canopy is unlocked. The pilot's canopy unlocked warning light will illuminate when either canopy should happen to be unlocked. The RIO's warning light will illuminate only when his canopy is unlocked. Power for the canopy unlocked warning light is supplied by the essential 26 volt a-c warning light bus.

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 Emergency Canopy Control

Emergency Jettison Lanyard

The external emergency canopy jettison lanyard is located on the lower left side of the fuselage just forward of the aft nose gear door. Access to the handle is through a small door hinged at the forward end with a push latch release. Pulling the handle through a cable system operates the emergency canopy valve. This control simultaneously operates both the forward and aft canopy emergency systems and 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 (37, figure 1-14) is located on the left side of the cockpit above the landing gear control. The handle is placarded emergency canopy release and 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 placarded and 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. In addition, operation of the handle stows both the rear cockpit radar scope and radar set controls to provide more room for exit from the cockpit, either by ejection or climbing out under emergency conditions. 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 secondary ejection handle ("D" ring) 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 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 the cockpit. Refer to applicable emergency canopy control, Canopy Systems.

LIMITATIONS

With canopy open, speed should be kept below 60 knots.

CENTRAL AIR DATA COMPUTER SYSTEM (CADC)

DESCRIPTION

The Central Air Data Computer receives four inputs, (figure 2-5), from sensors which measure atmospheric conditions through which the airplane is flying. These inputs are impact air pressure, static air pressure, total temperatures and angle-of-attack and are utilized by the Central Air Data Computer to provide corrected information to various systems, and indicators. The inputs to the CADC are supplied by the angle-of-attack probe, the pitot tube and the total temperature sensor which are located on the vertical fin, and by two static ports which are located immediately forward of the nose wheel well. As obtained from the sensing instruments, these measurements are in error by predictable amounts. The reading of an instrument measuring static pressure, for example, will deviate from the true static pressure, because of its location in the airstream moving over the surface of the aircraft, and the error introduced will vary with the airspeed. These indications from the measuring instruments are continuously corrected by passage through computing elements, so that the outputs are true indications of the required data. Output indications are presented as visual indications on panel-mounted instruments and as electrical signals (or resistance variations) for transmission to associated equipment in the aircraft. One type of indication, static pressure, is also presented as an actual air pressure which may be supplied to other equipment. The CADC system receives operating power from the 115 volt a-c essential bus, 28 volt a-c essential bus, 28 volt d-c essential bus, and 17th stage engine bleed air.

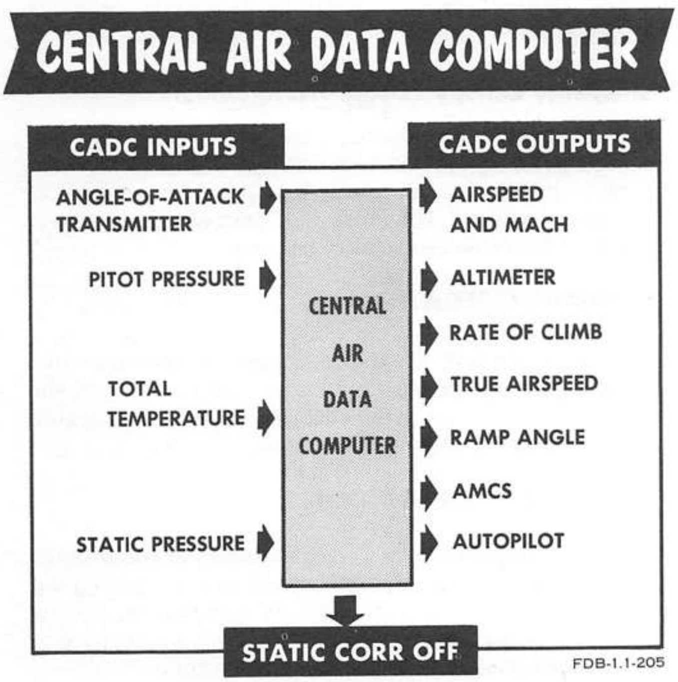

Figure 2-5

CADC SYSTEM FAILURE

The instruments and/or systems utilizing the outputs from the CADC will be inoperative or in error if a failure or an interruption occurs in the following systems; essential a-c power supply, essential d-c power supply, or engine bleed air system. An interruption or failure in any of the above systems will illuminate the "Static Corr Off" warning light.

Static Pressure Compensator Warning Light

The "Static Corr Off" warning light is located on the caution lights panel (figure 1-10). This light, when illuminated, informs the pilot that his instrument readings may be in error due to the lack of a static pressure correction. Static pressure error (without compensation) is appreciable in the transonic and supersonic region. When the "Static Corr Off" light illuminates it is accomplished by a rapid change in the altimeter reading since the altimeter must respond to an instantaneous change in pressure being supplied to the instrument. The magnitude of the change varies with Mach number. A static pressure correction switch is located on the inboard engine control panel. The static pressure compensator switch has positions of RESET CORR, NORM and CORR OFF. In the event the warning light illuminates, indicating a loss of static pressure correction, the RESET CORR position of the switch resets the compensator and breaks the circuit to the warning light. When the switch is released, the warning light should be extinguished indicating that the instruments are reading correctly. If the warning light remains on, the compensator has not been reset, and the instruments are still in error. The static pressure compensator must be reset after the engines have been started prior to each flight. The CORR OFF position removes static pressure correction from the instruments. The static pressure compensator must be reset after the engines have been started prior to each flight.

NORMAL OPERATION

Normal operation of the CADC consists of momentarily placing the static pressure compensator switch in the spring loaded RESET position, after an engine has been started. This action will extinguish the "Static Corr Off" warning light, and the CADC will be operating with compensated static pressure.

EMERGENCY OPERATION

There are no emergency operations pertaining to the Central Air Data Computer System. If the "Static Com. Off" warning light illuminates in flight and cannot be reset, the AFCS, Navigation Computer, AMCS and most flight instruments may be in error. In addition the variable ramp may not function properly and engine stalls may possibly be encountered in the high Mach number range. If practicable speeds above Mach 1.5 should be avoided.

LIMITATIONS

There are no specific limitations pertaining to the Central Air Data Computer System.

COMMUNICATION-NAVIGATION-IDENTIFICATION (CNI) EQUIPMENT

DESCRIPTION

The Integrated Electronic Control AN/ASQ-19 (XN-1) provides communication-navigation-identification (CNI) functions for the aircraft. Communication functions are provided by a UHF receiver-transmitter, an auxiliary receiver, and an intercom. Navigation functions are provided by TACAN (Tactical Air Navigation) and ADF (Automatic Direction Finding) equipment. An IFF (Identification Friend or Foe) Coder Unit provides identification of the aircraft when challenged. The CNI system is supplied with power from a central power supply.

INTERCOM SYSTEM

An intercom panel (16, figure 1-2 and 4, figure 1-5) in both the pilot's and RIO's cockpit provides a means of inter-cockpit communication in the airplane. In the pilot's cockpit the panel is located on the aft inboard portion of the left console. The RIO's intercom panel is located on the instrument panel. An external station, connected in parallel with the aft cockpit microphone and headset, is provided for use by ground personnel. An additional function of the intercom system is to amplify a-f signals received from various sources. Transmission over the UHF receiver transmitter may be accomplished in either cockpit in conjunction with the intercom system.

INTERCOM CONTROLS

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

CONTROLS

Volume Control

The intercom volume control knobs are located at the left side of the pilot's intercom panel, and at the right side of the RIO's intercom panel. The input level of the intercom signals to the headsets is increased by rotating the respective volume control knobs in a clockwise direction. The signals received from the radio receivers are not affected by operation of these intercom volume controls.

Function Selector Switch (Pilot's)

A three-position toggle switch with positions of RADIO OVERRIDE, HOT MIC and COLD MIC is located on the right side of the pilot's intercom control panel. The RADIO OVERRIDE position of the switch is momentary, the HOT MIC and COLD MIC positions are fixed. The HOT MIC position is used when duplex operation of the intercom system is desired. The RADIO OVERRIDE position is identical with HOT MIC except that all radio gain is reduced, communication between cockpits then overrides radio reception. When the switch is set at the COLD MIC position, normal radio reception and transmission is still available, but the pilot can no longer communicate with the RIO over the intercom system without going to the ICS switch on the throttle. However, the RIO can still transmit to the pilot by either placing the radio override switch in the RADIO OVERRIDE position, or by pressing the foot operated intercom switch.

Function Selector Switch (RIO)

A two-position toggle switch with positions of RADIO OVERRIDE and NORMAL is located at the left side of the RIO's intercom panel. The NORMAL position is used for normal duplex operation at the same time the pilot's switch is set at HOT MIC. Radio signals are received at normal volume when the RIO's switch is set at NORMAL. The RADIO OVERRIDE position is used to reduce the reception of radio signals in both cockpits. This switch position may also be employed to accomplish intercockpit communication if the pilot's switch is set at COLD MIC. The RADIO OVERRIDE position is a momentary switch position.

Intercom Foot Switch (RIO)

A foot operated momentary switch is installed on the left foot ramp in the RIO's cockpit. This switch is wired in parallel with the pilot's mounted intercom switch. By depressing his foot switch the RIO may override any of the positions selected on the Radio Override switch, allowing intercom transmission without the necessity of releasing other manual controls.

Emergency Amplifier Selector Switches

The emergency amplifier selector switches are three-position rotary type switches and are located in the center of both the pilot's and RIO's intercom control panel. The operator uses these controls to bypass an amplifier if it should go dead. Both operators may have occasion to switch to one of the emergency settings at the same time. In certain instances of amplifier failure, this arrangement is necessary in order to maintain intercockpit communication. There are three possible settings for each control. The NOR position is used when both amplifying stages in the respective control boxes are functioning properly. The other two positions for each control are EMER RAD and EMER ICS, which are used when it is desired to bypass a faulty or dead amplifier.

Microphone Button

The microphone buttons are used to connect the microphone outputs to the UHF transmitter. The pilot's microphone button is located on the inboard throttle control, the RIO's microphone button is foot-operated by a toe switch on the right foot ramp. When the operator wishes to transmit, he depresses the microphone button, the transmitter portion of the UHF Radio Receiver-Transmitter is on the air 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

The main receiver-transmitter is designed to broadcast and receive UHF frequencies in a range of 225.0 to 399.9 mc for interairplane or airplane-to-base communications. Complete control over the operation of the main radio receiver-transmitter can be maintained by either the pilot or the RIO through the Comm-Nav group control panel (16, figure 1-3 and 3, figure 1-7) one panel located in each cockpit. The pilot's Comm-Nav group control panel is located on the right console, the radar intercept officer's panel is located below the instrument panel, to the left of the radar scope. The Comm-Nav group control panel provides controls for operation of the radio receiver-transmitter on any one of the 1750 channels available, on 18 preset channels, a guard receiver frequency, 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 (16, figure 1-3 and 3, figure 1-6). The controls consist of manual comm frequency controls, comm channel selector knob, function switch and volume control knob.

Communication Frequency Controls (Comm Freq MC)

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

Communication Channel Control (Comm Chan)

The comm channel selector 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 comm channel 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 the pilot's and RIO's instrument panels (2, figure 1-4 and figure 1-5). This enables the crew member 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 push-to-talk 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 is utilized in the airplane communications system that 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 or as an ADF receiver for reception of radio signals in the same frequency. The auxiliary receiver can be placed in either function by operation of the controls on either the Comm-Nav group control panels. 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 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 indication of the direction of arrival of r-f 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 intercept 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 V a-c) is applied to the auxiliary receiver when the aircraft 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 selector switch, volume control, and function switch.

Channel Selector

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 group controls. Operating this control varies the audio input level to the intercom loop.

Function Switch

The function switch labeled Main Rec-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 aircraft communications 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 the 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 away the communication functions from the other operator. The volume controls on each Comm-Nav group control panel are independent of each other, and are not effected 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 SELECTION

A two-position antenna selection switch is located in each cockpit. The pilot's antenna switch is located on the left console outboard of the throttles, the antenna switch for the RIO is located on the RIO's instrument panel. The switch positions are upper and lower and are used to select one of two communication antennas to be used with the command communication set. The circuitry of the antenna selection switch is wired through the take command relay. Therefore, whoever has command of the comm-nav group control panel has command of the antenna selection switch.

TACAN (TACTICAL AIR NAVIGATION) SYSTEM

The TACAN navigation system functions to give an aircraft precise geographical bearing and distance information at ranges up to 196 miles (depending on aircraft altitude) from an associated ground or shipboard radio beacon. It also determines the identity of the beacon and indicates the dependability of the beacon signal. It will also 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 aircraft and the height of the beacon antenna. 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 presents distance information in digital form, superimposed on the conventional RMI display consisting of a moving compass card to show heading and two bearing pointers. The No. 2 (wide) bearing pointer is the TACAN needle and indicates magnetic heading to the TACAN station. The No. 1 (narrow) pointer, provides magnetic heading to the selected UHF station. The BDH 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 CNI-NAV COMP switch located on the aft instrument panel. 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 airborne operating controls for the TACAN system are located on the lower third of the Comm-Nav group control panels. The controls and their functions are as follows:

Function Switch

The function switch is a three-position rotary switch whose positions are marked STBY, REC, and T/R.

STBY - When the function switch is in the STBY position only filament and blower power are being supplied to the system's receiver and transmitter.

REC - The receiver position places only the receiver portion of the system in operation. When the switch is in this position, only bearing information is furnished to the bearing direction heading indicator.

T/R - When the switch is in the transmit-receive position, the airborne transmitter sends a signal to the beacon and receives a signal which is used to determine the aircraft distance from the beacon.

Navigation Channel Controls

Two control knobs, one to the right and one to the left of the navigation channel window permit channel selection. The left knob selects the tens and hundreds figures of the operating channel. The right knob selects the units figures of the operating channel. The dial system is numbered from 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.

Volume Control

The volume control knob is used to adjust the volume of an audio identification signal received from the beacon. The identification signal, audible in the pilot's headphones when they are connected into the intercom system, consists of a two- or three-letter tone signal in International Morse Code and/or a vocal identification. The identification signal is normally transmitted by the beacon every 30 seconds.

Nav Command Control

The navigation command push button transfers control of UHF navigation (TACAN) functions from one cockpit to the other. When the green light in the center of the navigation command button in one cockpit illuminates, command of the TACAN functions has been obtained in that cockpit. Specifically, the navigation channel control and function switch in that cockpit only are effective. The navigation volume control is effective in both cockpits regardless of the take-command situation.

RADAR ALTIMETER SYSTEM-AN/APN-22

The AN/APN-22 radar set is a microwave altimeter which measures the terrain clearance of the aircraft. 28 volt d-c and 115 volt, single-phase a-c power is required to operate the system. No antennas external to the surface of the aircraft are necessary. A frequency-modulated signal is radiated to the ground and a period of time elapses until a portion of this signal is reflected back to the aircraft. During this time lapse, the transmitter frequency changes, causing a frequency difference between the signal being transmitted and the signal arriving from the ground. This difference in frequency is proportional to time lapse which is proportional to height. The system is designed to provide reliable operation over the ranges of 0 to 10,000 feet over land and 0 to 20,000 feet over water. Effective airplanes 149451k and UP, and all other airplanes upon incorporation of ASC 96 (Replacement of Dielectric Lens), the reliability of the system will be improved, allowing higher altitude operation without drop-out. Accuracy of indication is ±2 feet from 0 to 40 feet and ±5 percent of indicated altitude 40 to 20,000 feet. Accuracy is greatly impaired during steep angles of bank, dive or climb.

Radar Altimeter

The radar altimeter (36, figure 1-4), located on the instrument panel, provides indication of the airplane's attitude in a single turn dial calibrated from 0 to 20,000 feet. "Drop-out" occurs when altitude limits of the system are exceeded. This disables the indicator and places the needle behind a mask. An adjustable "bug" pointer at the outside of the calibrated scale of the indicator can be preset to desired altitudes and used as a reference in flying at a fixed altitude. The indicator system provides a low altitude warning light located just below and to the right of the indicator.

Radar Altimeter Control Knob

A control knob marked "ON-LIMIT" is the only operating control in the radar altimeter system. The knob is located just below and to the left of the radar altimeter on the instrument panel. The radar altimeter control knob operates the system on-off switch and is also used to set the "bug" pointer on the desired preset altitude. The knob utilizes 28 volt d-c electrical power. Refer to Operation of Radar Altimeter, this section.

Low Altitude Warning Light

A red warning light located below and to the right of the altimeter, is provided to indicate upon illumination, that the aircraft is below the altitude preset by the radar altimeter control knob ("bug" pointer). The light will also illuminate when "drop-out" occurs. Intensity of the warning light is changed by turning lens housing. Power required is 28 volt d-c.

Drop-Out

The radar altimeter system will stop indicating altitude when the reflected signal is too weak to override the system noise. "Drop-out" should not occur at altitudes below 10,000 feet over land or 20,000 feet over water. However, a climb, bank or dive of 60° or more will somewhat reduce "drop-out" altitude. When "drop-out" occurs, circuits within the system automatically disconnect the indicator synchro from the servo system and apply a fixed signal to it, which causes the needle to assume a position behind the mask on the indicator dial between the 20,000 point and the 0 point. This fixed off scale position indicates to the pilot that the reading is meaningless.

IFF/SIF INTEGRATED RADAR IDENTIFICATION SYSTEM

The APX-6B and APA-89 work in conjunction to form the radar identification system. The identification system provides automatic selective identification of the airplane in which it is installed when properly challenged by surface or airborne radar sets. The system has provisions to identify a specific friendly airplane within a group of friendly airplanes in which the equipment is installed. 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 this 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 interrogation or 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 can be preset on the ground for Mark X operation. In Mark X operation the SIF (Selective Identification Feature APA-89) is eliminated rendering the code selector switches inoperative. However, the set will still operate in all three IFF modes of operation providing limited preset interrogation and response signals.

Radar Identification Controls

Two control panels (13, 14, figure 1-3) marked IFF and SIF, are located on the pilot's right console. No SIF or IFF control panels are located in the aft cockpit. The control panels contain the system master switch, two mode switches, two code selector switches and an I/P switch. The five-position master switch 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 special coded signal to indicate an emergency. The emergency IFF will also be tripped automatically upon seat ejection (regardless of any other switch position). However, if the IFF master switch is in the OFF position upon ejection, no emergency signals will be transmitted until the warm up period has been completed (30 to 45 seconds). The Mode 2 switch, placarded MODE 2 and OUT, is used by the pilot for personal identification. The Mode 3 switch, placarded MODE 3 and OUT, is used by the pilot for traffic identification. The identification of position (I/P) switch, placarded I/P, OUT and MIC, is utilized by the pilot 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.

NORMAL OPERATION

NORMAL OPERATION OF INTERCOM SYSTEM

The intercom system is placed in operation without additional switching as soon as the aircraft receives electrical power. The controls should be set in the following manner in order to check the equipment before take-off:

Pilot's Controls

Switch	Position
Function Selector Switch	HOT MIC
Emergency Amplifier Selector Switch	NOR
Volume	Rotate clockwise

Radar Intercept Officer's Controls

Switch	Position
Function Selector Switch	NORMAL
Emergency Amplifier Selector Switch	NOR
Volume	Rotate clockwise

With controls positioned as stated, check the duplex operation of the equipment by talking into the microphones. Rotate the VOL controls to insure that they are operating properly. Switch to the EMER ICS - NOR - EMER RAD positions to make sure that they are mechanically sound. The radio override functions of the interphone should be checked by each operator. In order to check the equipment properly, care should be taken that the operators do not switch to RADIO OVERRIDE at the same time, since reduction in the volume for the radio receivers is accomplished in both headsets when only one of the operators goes to RADIO OVERRIDE. Therefore, each control must be positioned at different times to check the radio override circuitry in each unit. With all four of the amplifying stages working and the intercom system functioning normally, the pilot and RIO should place their function selector switches in the HOT MIC and NORMAL positions respectively. Both the pilot's and RIO's emergency amplifier switches should be placed in the NOR positions and the volume controls on each panel should be set as desired. No further switching is necessary to operate in duplex. The system will be turned off when aircraft electrical power is removed.

NORMAL OPERATION OF COMMUNICATIONS TRANSMITTER AND RECEIVERS

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 adjusts the main volume control knob to obtain a comfortable listening level in the headset. Observe the bearing pointer on the HSI and the No. 1 needle on the RIO's BDHI, and note that they indicate the approximate direction of arrival of the known 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 arrival of the known signal relative to the airplane 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.

CAUTION

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-DF system should not be relied upon as a primary navigational aid in the gear down configuration.

Note

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 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 channel 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 CNI-Nav Comp switch in the aft cockpit in the TACAN position. Bearing (and distance if T/R position is utilized) to the TACAN station will be displayed on the HSI (bearing pointer) and BDHI (No. 2 needle). The identification signal for the selected TACAN station should be heard in the headphones.

NORMAL OPERATION OF RADAR ALTIMETER

With electrical power supplied, the radar altimeter system is set into operation by the initial turn (clockwise) of the radar altimeter control knob. Further clockwise rotation of the radar altimeter control knob positions the limit bug. After the equipment is once started allow approximately 12 minutes warm-up time before relying upon the system. If the temperature is below -40°C (-40°F) allow a 25 minute warm-up period. In the event "drop-out" occurs, reduce altitude to a point slightly below the point where "drop-out" resulted, or level out from the maneuver which caused "drop-out". The return to normal operation following "drop-out" is indicated by the resumption of normal indicator operation. It should be remembered when utilizing the radar altimeter over artic regions, that radar waves can penetrate the surface of snow and ice fields, therefore, the radar altimeter may indicate greater terrain clearance than actually exists. The radar altimeter system is turned off by rotating the control knob to its full counterclockwise position.

NORMAL OPERATION OF RADAR IDENTIFICATION SYSTEM

To prepare the radar identification system for operation, place the rotary Master switch in the STBY position to maintain the equipment inoperative but ready for instant use. To operate the system, rotate the Master switch to the norm position and set the Mode 2 and Mode 3 switches OUT unless otherwise directed. Mode 1 (security identification feature) is automatically operated when the Master switch is in the NORM position. Set the Mode 1 and Mode 3 code selector switches as directed. The system is now ready for interrogation or response signals. The LOW position on the Master switch should not be used except upon proper authorization. In the event of an emergency, press Master switch dial and rotate switch to the EMERGENCY position. The set will automatically transmit a special coded distress signal in response to interrogation. To turn the equipment off, rotate the Master switch to OFF.

EMERGENCY OPERATION

EMERGENCY OPERATION OF INTERCOM SYSTEM

Each cockpit's ICS unit is equipped with two amplifiers, both of which are used during normal duplex (hot mic) operation. An emergency switch with EMER ICS, EMER RAD and NOR positions is provided on the ICS panels. These selections enable an operator to bypass a faulty or dead amplifier in his unit. Assuming the pilot has selected HOT MIC the operation during the various emergency selections is as follows:

Pilot's	RIO's	
Emer Sw	Emer Sw	ICS Operation
Nor	Nor	Normal hot mic
Emer ICS	Nor	Normal hot mic
Emer RAD	Nor	Normal hot mic
Nor	Emer ICS	Pilot's mic is hot. RIO must actuate radio override sw to transmit on ICS. Foot button inop.
Nor	Emer RAD	Pilot's mic is hot. RIO must actuate radio override sw to transmit on ICS. Foot button inop.

If both pilot's and RIO's intercom systems are in NOR operation and the pilot then selects the COLD MIC position of the function switch, actuation of either front or rear seat radio override switches, or front or rear seat ICS mic switches will open the system to HOT MIC operation from both cockpits. If it is necessary for both front and rear seat operators to select an emergency position, rear seat emergency conditions will prevail. In addition, under NOR operation, both front and rear cockpit ICS mic switches perform the same function as the radio override switches, reducing UHF volume.

Note

It should be pointed out that, even though the pilot's function selector switch is set at COLD MIC, the RIO may talk and listen to the pilot if he switches to RADIO OVERRIDE, or depresses the foot operated ICS switch. This is the only instance where duplex operation may be maintained when the pilot is not at HOT MIC. This switching arrangement is not normally used for intercockpit communication, since the pilot would usually be at HOT MIC position regardless of the settings of the other controls and the RADIO OVERRIDE settings are momentary switch positions.

EMERGENCY OPERATION OF COMMUNICATIONS TRANSMITTER AND RECEIVERS

Warning lights labeled "Emergency Power" are situated at the bottom of each Comm Nav group control panel. The light will illuminate when the power supply goes into emergency operation. Transition from normal to emergency operation is completely automatic and is brought about by a malfunction in one of the major power supply sources. The type of failure which is experienced will determine what portions of the comm-nav-ident 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. If the main receiver-transmitter is still operational it will probably be operating on reduced transmitter power.

LIMITATIONS

Refer to Operating Limitations, Volume III - Confidential Supplement.

DRAG CHUTE SYSTEM

DESCRIPTION

The airplane is equipped with a 16 foot ring slot type parachute which is deployed by the pilot 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 stabilator. The chute is pulled into the airstream by a pilot chute when the spring-loaded compartment door is released. The design of the attaching mechanism is such that should the compartment door open inadvertently, 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 (14, 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 depressing the button and pulling aft on the handle to clear the detent and then by pushing the handle forward and releasing it. 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, depress the button on the drag chute handle, rotate handle further aft to clear detent, 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 CAS.

DUAL CONTROLS CONFIGURATION

DESCRIPTION

Dual flight control kits are available for installation. These kits enable the airplane to be converted into a dual controlled airplane for pilot training purposes. The kit is installed in the RIO's cockpit, and can be easily removed to return the airplane to its pilot, RIO configuration. The dual flight controls kit provides the pilot in the converted RIO's cockpit with a control stick, rudder pedals, throttle controls for each engine, and an instrument panel which contains the additional instruments needed by the aft cockpit pilot. The following controls are not available in the aft cockpit: flaps, speed brakes, landing gear, arresting gear, wheel brakes, and nose wheel steering.

FLIGHT CONTROLS

The conventional type control stick and grip controls the stabilator, ailerons, and spoilers. The grip contains a trim button for aileron and stabilator trim. The rudder pedals are not linked to the brakes, nor are they adjustable. A rudder trim switch is located on the instrument panel.

THROTTLES

Throttle controls for each engine are mounted on the CNI control panel support structure on the left side of the aft cockpit. The throttles have full throw between the range of IDLE and MIL, but they cannot be placed in the OFF or MAX positions. A microphone button with positions of ICS and UHF is the only electrical connections to the rear cockpit throttles. The dual throttle configuration incorporates a load limiter device which enables the pilot in the forward cockpit to overpower the throttle controls in the aft cockpit.

INSTRUMENTS

The dual control instrument panel contains the following instruments in addition to the ones normally installed in the RIO's cockpit: vertical velocity indicator, turn and slip indicator, accelerometer, and engine tachometers. The aft cockpit instruments are powered from the same sources as those in the forward cockpit.

NORMAL OPERATION

Normal operation of the limited equipment as installed in the dual control configured airplanes is the same as its counterpart installed in the forward cockpit with the exception of the throttles.

EMERGENCY OPERATION

Emergency operation of the equipment as installed in the dual control configured airplanes is the same as its counterpart installed in the forward cockpit.

LIMITATONS

Limitations on the equipment as installed in the dual configured airplanes is the same as its counterpart installed in the forward cockpit.

EJECTION SEATS

DESCRIPTION

The airplane ejection seats (figure 2-7) are designed to give the crewmembers both low level and high altitude escape capability. Low level ejection is made possible by the use of a high velocity triple cartridge charge catapult gun, and by use of a stabilizing drogue chute which stabilize the seat and reduce height loss to a minimum. During ejection, the occupant is held in the seat by body harness and leg restraining systems. Time delay mechanisms automatically release the occupant after a safe deceleration and a safe altitude has been reached. All features are discussed in greater detail as this description progresses. The seat catapult uses cartridges which provide sufficient force to insure ejection of the seat and occupant clear of the airplane tail structure. The seat catapult is also used as a guide rail for the seat by means of channels fitted on either side of the catapult barrel. Power to eject the seat and occupant is obtained from one primary and two auxiliary cartridges. Pulling either ejection handle to the fullest extent draws a wedge-shaped sear out of the firing pin, allowing the spring-loaded pin to strike the percussion primer of the primary charge. Expanding gases drive the intermediate and inner tubes upward. As the tubes travel upward ports to the auxiliary cartridges are uncovered and ignited. The seat is controlled after ejection by two drogue chutes which are deployed automatically. The smaller drogue chute (pilot chute) is drawn from the pack by a metal piston fired from a drogue gun one-half second after seat ejection. The pilot drogue chute when withdrawn from the pack, tows the main drogue parachute out of its container. The main chute, when deployed, stabilizes the seat, tilts it to a horizontal position, and slows down the seat. This action ensures deceleration approximately in line with the seat axis, and the horizontal flight path of the seat reduces height loss to a minimum. If ejection is made at a high altitude, a barostatic control attached to the seat delays separation of the occupant from the seat and prevents the crewmember's parachute from opening. This permits the occupant and the seat to descend quickly through the cold rarified atmosphere to a more tolerable altitude (10,000 +3000, -000 ft.) where the automatic mechanism will separate the occupant from the seat and deploy the personal chute. At very high ejection speeds the opening of the personal parachute is delayed by a switch and the crewmember remains strapped in the seat, which is steadied by the controller drogue chute and main drogue parachute until the seat has decelerated to a safe speed (4.5 "g"). His legs are held in place by a restraining harness which keeps them from flailing in the airstream. The seat is built to accommodate the Martin Baker parachute system and a seat pack type survival kit. A composite disconnect is attached to the left rear corner of the seat pack. The composite disconnect houses the quick-disconnect plugs for the pressure suit, anti-G system, suit ventilation, oxygen and electrical lines for communication purposes. By pulling up on the composite disconnect release knob, the unit can be quickly disconnected from the seat. When the crewmember is ejected, bailout oxygen is automatically supplied.

DROGUE GUN

The drogue gun is mounted on the left side of the ejection seat headrest and is used to extract the controller drogue from its container 1/2 second after

PRESSURE SUIT AND HARNESSING

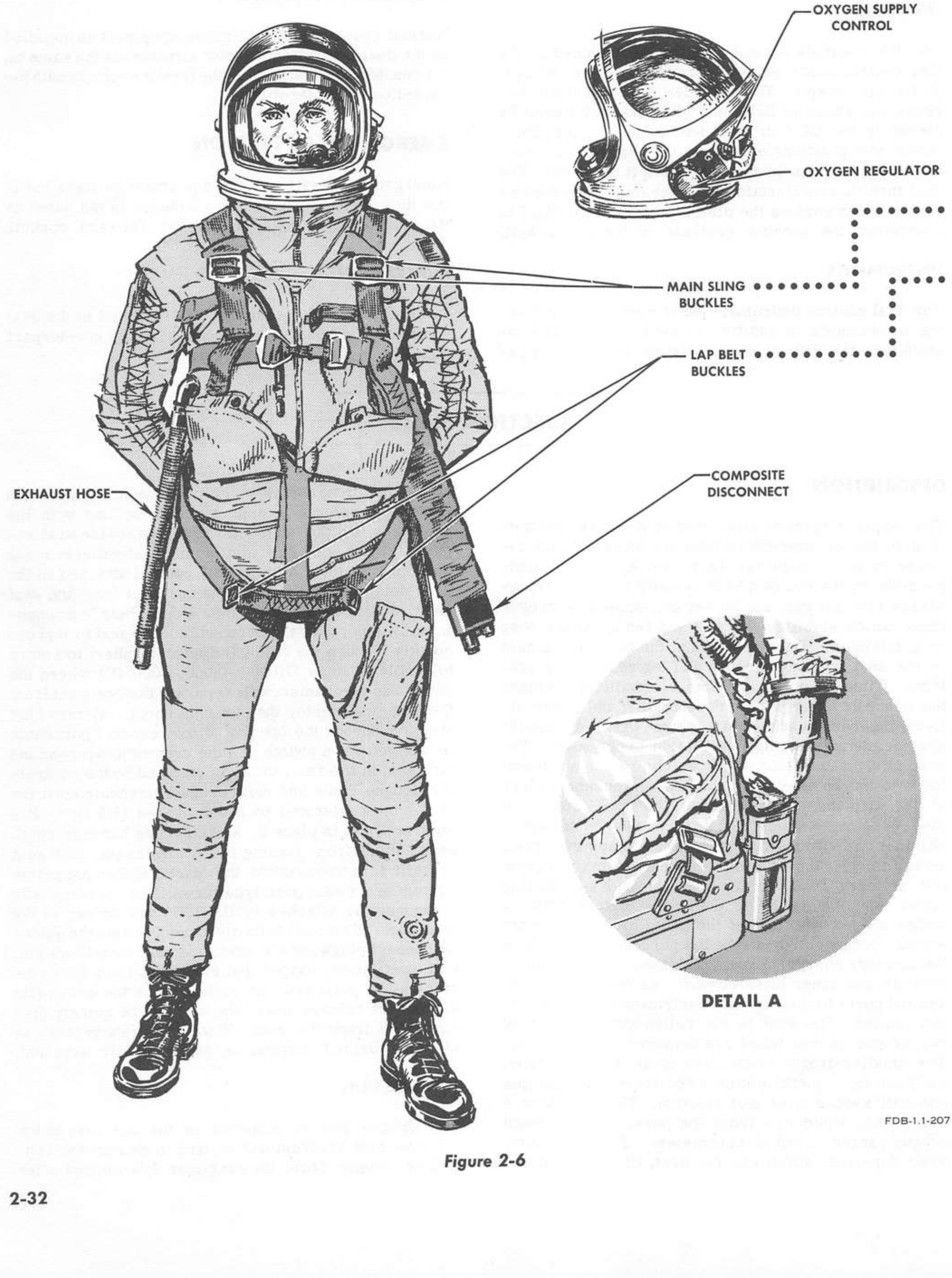

Figure 2-6

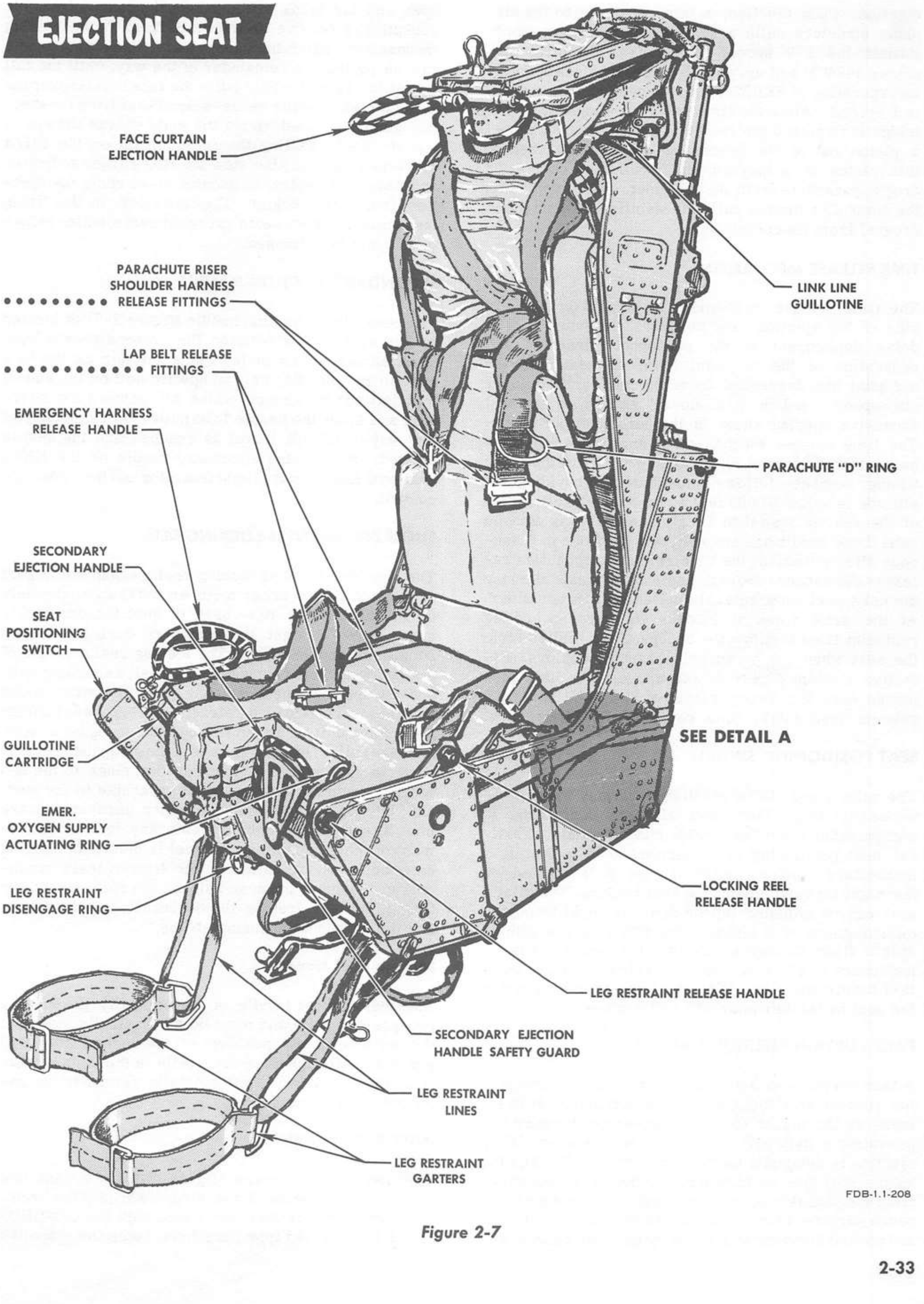
EJECTION SEAT
FACE CURTAIN
EJECTION HANDLE
PARACHUTE RISER
SHOULDER HARNESS
RELEASE FITTINGS
LAP BELT RELEASE
FITTINGS
EMERGENCY HARNESS
RELEASE HANDLE
SECONDARY
EJECTION HANDLE
SEAT
POSITIONING
SWITCH
GUILLOTINE
CARTRIDGE
EMER.
OXYGEN SUPPLY
ACTUATING RING
LEG RESTRAINT
DISENGAGE RING
LINK LINE
GUILLOTINE
PARACHUTE "D" RING
SEE DETAIL A
LOCKING REEL
RELEASE HANDLE
LEG RESTRAINT RELEASE HANDLE
SECONDARY EJECTION
HANDLE SAFETY GUARD
LEG RESTRAINT
LINES
LEG RESTRAINT
GARTERS
FDB-1.1-208

Figure 2-7

ejection. Upon ejection, a trip rod fixed to the airplane structure pulls a sear from the drogue gun to initiate the 1 2 second time delay. Effective airplanes 149403i and up, and all other airplanes upon the incorporation of SEB22-61, the drogue gun time delay is 1 second. After the time delay has elapsed, a cartridge is fired and the resultant gas pressures propel a piston out of the drogue gun barrel. Attached to this piston is a lanyard which pulls the controller drogue parachute from its container. When deployed, the controller drogue pulls the stabilizer drogue (main drogue) from its container.

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 separation of the occupant from the seat until the occupant has descended from the cold rarified upper atmosphere 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 one half seconds after initiation, the time release mechanism releases the drogues from the scissors shackle 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. Effective airplanes 149403i and up, and all other airplanes upon the incorporation of SEB22-61, the time release mechanism time delay is 1 3/4 seconds.

SEAT POSITIONING SWITCH

The pilot's and RIO's ejection seat may be adjusted vertically only. Fore and aft seat positioning is compensated for by adjustable rudder pedals. Vertical seat positioning is accomplished by actuating a momentary contact switch (figure 2-7) located on the right forward side of the seat bucket. The pilot's seat can be adjusted (up or down) in flight through a total distance of 6 inches. The RIO's seat is adjustable in flight through a total of 5 1/4 inches. It is not necessary to adjust the seat height to any certain position before ejection. Electrical power is supplied to the seat by the left main 115 volt a-c bus.

FACE CURTAIN EJECTION HANDLE

A face curtain ejection handle (figure 2-7) is provided for normal seat ejection. The ejection handle is located at the top of the seat, projecting forward and providing a grip surface for the crewmember. When ejection is desired a forward and downward pull on the handle will fire an initiator, and 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 and remove an interlock from the seat firing mechanism. After the canopy has jettisoned the handle can be pulled the remainder of the way, until the 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. Pulling the face curtain on the RIO's ejection seat will also stow the RIO's flight indicator and radar set control to provide more room for ejection from the cockpit. The interlock in the firing mechanism of both seats prevents seat ejection before the canopy is jettisoned.

SECONDARY EJECTION HANDLE

The secondary ejection handle (figure 2-7) is located on the seat bucket between the crewmember's legs. This handle works in the same manner as the face curtain pull handle, i.e., an upward pull on the handle will jettison the canopy, which will remove the interlock and allow the handle to be pulled the remainder of the way until full travel is reached and the seat is ejected. Pulling the secondary handle on the RIO's seat will also stow the flight indicator and the radar set control.

SHOULDER HARNESS LOCKING REEL

The shoulder harness locking reel 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 locking reel consists of a strap wound on a spring-loaded reel, a snubbing unit, and an upper harness release pin. The strap wound around a spring-loaded retraction reel passes through a snubbing unit, and then through the occupant's upper harness roller fitting. The eye of the strap then returns back to the seat and through the rings to the two straps, securing the personnel parachute to the seat, and is then anchored by the upper harness release pin. The snubbing unit prevents any forward movement of the strap unless the reel 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.

Locking Reel Handle

The inertia reel 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.

INTEGRATED HARNESS

The integrated harness (figure 2-6) 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, serves 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, serves as the shoulder harness. The integrated harness eliminates the need for the crewmember to wear his parachute to and from the airplane, and it also eliminates a separate lap belt and shoulder harness with its inherent limited restraint capabilities.

Emergency Harness Release Handle

The emergency harness release handle (figure 2-7) 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 harnessing, 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 harnessing, and leg restraint lines will be released. In addition, a cartridge is fired, and the gas pressures liberated 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 crew 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 shoulder harnessing is released and 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.

LEG RESTRAINERS

A leg restraint assembly is provided on the seat to hold the occupant's legs in place and to prevent them from flailing 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, passes through the snubber unit, through the garter, and then the lock pin on the leg lines, plugs 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 harness is released and the occupant is separated from the seat. Leg restraint disengage rings (figure 2-7) 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.

Leg Restraint Release Handle

The leg restraint release handle (figure 2-7) 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.

SURVIVAL KIT

A modified PK-2 survival kit is packed within a two piece fiberglas container (figure 2-8) 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
50 feet of nylon line
2 packs dye marker
Poncho with reflective surface
Canned rations
Can of sunburn ointment
Emergency code instruction sheets

SURVIVAL KIT

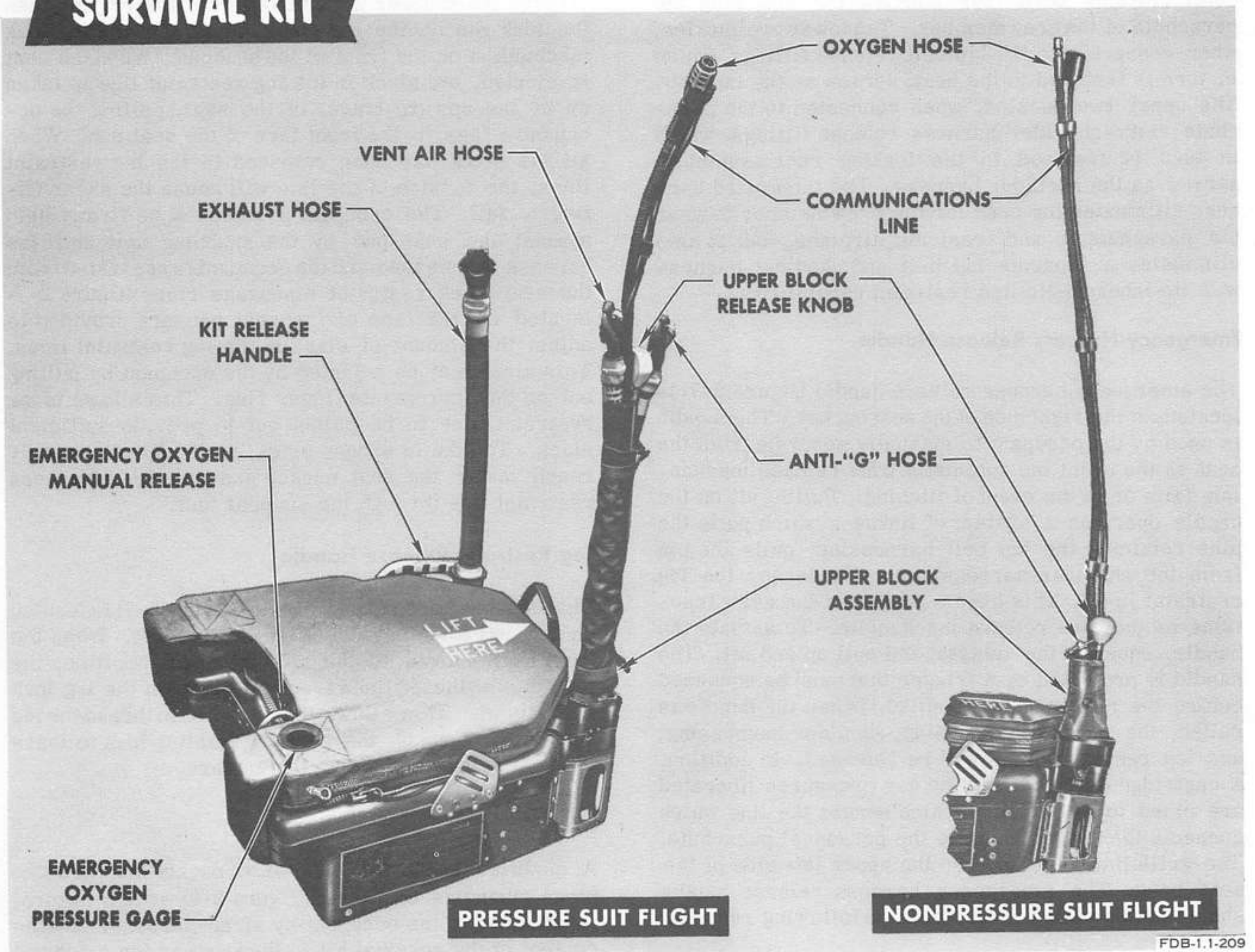

Figure 2-8

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 could 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 and to each other by lanyards.

NORMAL OPERATION

Normal operation of the ejection seats consists of pulling down on the face curtain handle and maintaining a downwind force until a stop is encountered. The initial pull on the face curtain handle rotates a torque tube against the canopy interlock block, which prevents the face curtain handle from being pulled any further until the canopy fires. However, as the torque tube rotates it pulls the canopy initiator stem upward and fires the canopy initiator which subsequently releases 3,000 psi pneumatic pressure to the canopy actuating cylinder and jettisons the canopy. Therefore, the first stop encountered when the face curtain handle is pulled should just be a momentary stop and downward pull on the face curtain should be maintained. After the canopy jettisons, continue pulling the face curtain handle until full travel is reached at which time the seat will be ejected. The secondary ejection handle on the front of the seat pan, operates the same mechanisms and fires the same set of initiators that are fired when the face curtain handle is pulled. The secondary ejection handle is provided for, and should only be used when the face curtain handle cannot be reached. Shortly after the seat is ejected from the airplane, 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, which in turn, actuates to release the occupants harnessing, leg restraint lines, and chute restraint straps, and 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. During the parachute descent the crewmember may desire to jettison the survival kit, or hold it by its carrying strap to be dropped just prior to ground contact. The reason for jettisoning or hand carrying the survival kit is to reduce the bulk and weight of the crewmember, which will minimize the possibility of injuries occurring upon ground impact due to the survival kit weight and normal carrying position. It would probably be to the crewmember's advantage to jettison or hand carry the survival kit when making a parachute descent over land. In the event of a night ejection over land, the survival kit should be removed from its normal carrying position, however, it cannot positively be determined that the crewmember will touchdown on land, the survival kit should be hand carried and dropped just prior to impact. In the event there is insufficient time to jettison or hand carry the survival kit, the life raft with the survival kit should be released. In all over water ejections, the survival kit should be left in its normal carrying position and the life raft should be released during parachute descent. To jettison or hand carry survival kit, open face visor or disconnect oxygen mask; pull the composite disconnect release knob; release the left lap belt release fitting; take hold of survival kit lifting handle with right hand; and release the right lap belt release fitting.

EMERGENCY OPERATION

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

LIMITATIONS

The minimum ejection altitude on airplanes 148363f thru 148434h, without BACSEB 22-61 incorporated is 50 feet, providing the airspeed is at least 135 knots CAS and the airplane has no sink rate. On airplanes 149403i and up and all other airplanes with BACSEB 22-61 incorporated the minimum ejection altitude is ground level, providing the airspeed is at least 130 knots CAS and the airplane has no sink rate. In all airplanes safe escape can be made up to airspeeds of 350 knots CAS below 1,000 feet, and up to 550 knots CAS above 1,000 feet.

ELECTRICAL POWER SUPPLY SYSTEM

DESCRIPTION

The airplane electrical power supply system (figure 2-9) consists of an a-c generator power supply, a transformer-rectifier d-c power supply and the power distribution system. The a-c power supply distributes power to the left and right main 115/200 volt a-c bus, the left main 26/14 volt a-c bus, the essential 115/200 volt a-c bus, the essential 26 volt a-c bus, and the right main 26 volt a-c bus. The d-c power supply distributes power to the left and right main 28 volt d-c bus and the essential 28 volt d-c bus.

A-C ELECTRICAL POWER

The primary source of electrical power on the airplane is a 400 cycle, three-phase, 115/200 volt, parallel a-c power generating system. The system consists of two generators, two static exciter-regulators and two control switches. The two 20,000 volt-ampere a-c generators are located in the forward engine compartments and are mounted one on each engine. The generators are driven by constant speed drive units. The total system and each individual generator system is capable of initiating and delivering power to the entire bus system independently of any outside power source. Either generator may be manually disconnected from the bus system and reset. The controls for the system consists of one generator control switch for each generator. These switches energize and deenergize the generators in the event of a protective trip. The reset operation is trip free. The electrical system is so designed that no one fault will cause a complete loss of electrical power. The 115/200 volt a-c main and essential buses are powered directly by the generators through the line contactors. Under normal conditions, the main and essential buses are connected together and are in effect, one common bus. In the event that one generator fails, the remaining generator will supply all the a-c power. One phase of the generator output powers an auto-transformer for

ELECTRICAL SYSTEM

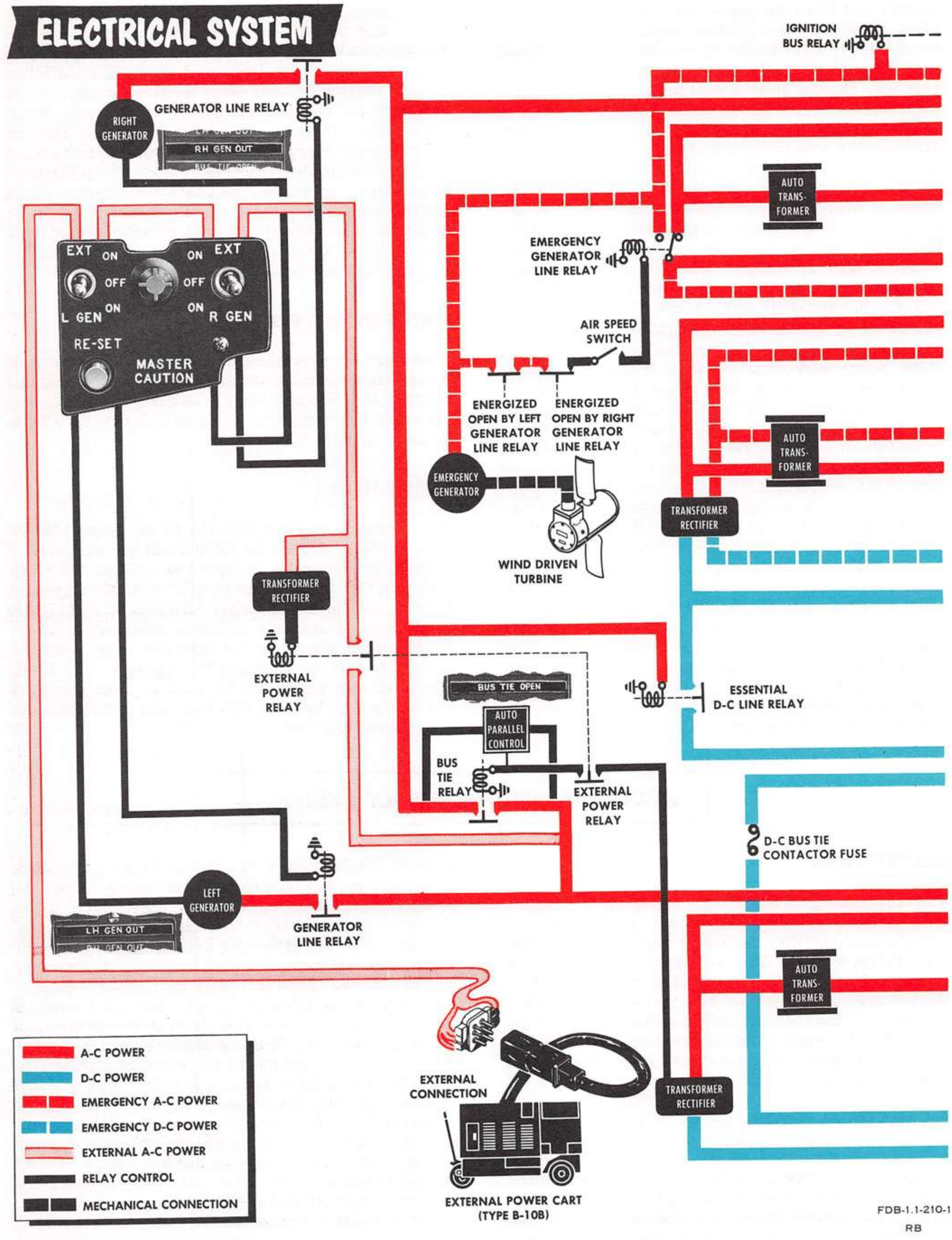

Figure 2-9 (Sheet 1)

IGNITION 115V A-C BUS

- LEFT MAIN IGNITION
- RIGHT MAIN IGNITION

RIGHT MAIN 115/200V A-C BUS

- ADF
- AILERON FEEL TRIM (POWER)
- AILERON RUDDER INTERCONNECT (POWER)
- ALTIMETER VIBRATOR (POWER)
- AUTOPILOT
- COCKPIT HEAT AND VENT (CONTROL)
- ENGINE RAMPS (CONTROL)
- IFF
- IFR PROBE LIGHT
- NAVIGATION RAMPS COMPUTER
- NO. 6 TRANSFER PUMP (POWER)
- OXYGEN GAGING SYSTEM
- PITOT HEATERS
- RADAR ALTIMETER SYSTEM (POWER)
- RADAR SCOPE CAMERA
- RIGHT AUTO TRANSFORMER
- SIDEWINDER
- TACAN
- UHF COMMUNICATIONS

RIGHT MAIN 26V A-C BUS

- AILERON RUDDER INTERCONNECT (CONTROL)
- AIRBORNE MISSILE CONTROL SYSTEM
- ANTI-COLLISION LIGHTS
- UTILITY LIGHTS (FLOOD)
- WHITE FLOODLIGHTS FORWARD COCKPIT
- WING AND TAIL LIGHTS (BRIGHT)

ESSENTIAL 115/200V A-C BUS

- CADC
- COCKPIT INSTRUMENT LIGHTS (FORWARD)
- COCKPIT INSTRUMENT LIGHTS (AFT)
- ESSENTIAL AUTO TRANSFORMER
- EXHAUST GAS TEMPERATURE INDICATING SYSTEM
- FUEL QUANTITY INDICATING SYSTEM
- IFF
- LEFT FUEL BOOST PUMP (POWER)
- LOFT BOMB RELEASE COMPUTER SET
- UHF COMMUNICATIONS
- WINDSHIELD TEMPERATURE SENSING

ESSENTIAL 26V A-C BUS

- AFT COCKPIT FLOODS (BRIGHT)
- AILERON POSITION INDICATOR
- CENTRAL AIR DATA COMPUTER
- CAUTION LIGHT RESET
- CNI (ESS)
- ENGINE FUEL FLOW INDICATING SYSTEM
- ENGINE FUEL PRESSURE INDICATING SYSTEM
- ENGINE OIL PRESSURE INDICATING SYSTEM
- FORWARD COCKPIT RED CONSOLE LIGHTS (BRIGHT)
- LOFT BOMB RELEASE COMPUTER SET
- P.C. 1 HYDRAULIC PRESSURE INDICATING SYSTEM
- PNEUMATIC PRESSURE INDICATING SYSTEM
- RUDDER POSITION INDICATING SYSTEM
- TAXI LIGHTS
- WARNING LIGHTS (BRIGHT)

ESSENTIAL 28V D-C BUS

- BUDDY TANK HOSE JETTISON
- CENTRAL AIR DATA COMPUTER
- EXTERNAL STORES EMERGENCY RELEASE
- EXTERNAL WING TANK JETTISON (POWER)
- FORWARD COCKPIT RED INSTRUMENT FLOOD (BRIGHT)
- FUEL LEVEL LOW WARNING
- IFF
- INTERCOM
- LANDING GEAR AND FLAP POSITION IND.
- LATERAL AND LONGITUDINAL TRIM SYSTEM
- LEFT FUEL BOOST PUMP, EMERGENCY (CONTROL)
- LOFT BOMB RELEASE COMPUTER SET
- MAIN FUEL CONTROL
- MISSILE JETTISON (POWER)
- NOZZLE POSITION INDICATING SYSTEM
- SPECIAL WEAPONS SAFETY
- STABILATOR FEEL TRIM (POWER)
- UHF COMMUNICATIONS

RIGHT MAIN 28V D-C BUS

- ADF
- ANGLE-OF-ATTACK TRANSMITTER HEATER
- ARMAMENT BUS (CONTROL)
- AUTOPILOT
- CENTERLINE STORE RELEASE (PICKLE BUTTON)
- COCKPIT HEAT AND VENT (CONTROL)
- EQUIPMENT COOLING (CONTROL)
- EXTERIOR LIGHTS (CONTROL)
- EXTERNAL WING FUEL TRANS (CONTROL)
- FLAPS (CONTROL)
- INTERNAL WING DUMP
- LANDING GEAR (CONTROL)
- LEFT FUEL BOOST PUMP (CONTROL)
- MISSILES
- NAVIGATION COMPUTER
- NO. 6 TRANSFER PUMP CONTROL
- NOSE WHEEL STEERING (CONTROL)
- RADAR ALTIMETER SYSTEM
- RADAR SCOPE CAMERA
- RUDDER FEEL TRIM (CONTROL)
- RUDDER TRIM SYSTEM
- SIDEWINDER
- SPEED BRAKE (CONTROL)
- STABILATOR FEEL TRIM (POWER)
- TACAN
- UHF COMMUNICATIONS
- UTILITY RECEPTACLE
- WARNING LIGHTS CONTROL

LEFT MAIN 115/200V A-C BUS

- AFTERBURNER IGNITION
- AFT COCKPIT EQUIPMENT LIGHTS
- AIRBORNE MISSILE CONTROL SYSTEM
- ANTI-ICE (CONTROL)
- BUDDY TANK FUEL PUMP (POWER)
- BUDDY TANK HYDRAULIC PUMP (POWER)
- ELECTRICAL BOMB FUZING
- EQUIPMENT COOLING (CONTROL)
- FIRE DETECTOR SYSTEM
- FORWARD COCKPIT CONSOLE LIGHTS
- INFRARED COOLING
- LEFT AUTO TRANSFORMER
- NOSE WHEEL STEERING (POWER)
- NO. 4 TRANSFER PUMP (POWER)
- RIGHT FUEL BOOST PUMP (POWER)
- SEAT ADJUSTMENT
- SIDEWINDER
- SPARROW III
- UTILITY RECEPTACLE

LEFT MAIN 26/14V A-C BUS

- AFT COCKPIT FLOODS (DIM)
- APPROACH LIGHTS (POWER)
- FORWARD COCKPIT RED CONSOLE FLOODS (DIM)
- FORWARD COCKPIT RED INSTRUMENT LIGHTS (DIM)
- FUSELAGE AND ANTI-COLLISION LIGHTS
- P. C. 2 HYDRAULIC PRESSURE INDICATING SYSTEM
- UTILITY HYDRAULIC PRESSURE INDICATING SYSTEM
- WARNING LIGHTS (DIM)
- WING AND TAIL LIGHTS (DIM)

LEFT MAIN 28V D-C BUS

- AILERON RUDDER INTERCONNECT (CONTROL)
- AIRBORNE MISSILE CONTROL SYSTEM
- APPROACH LIGHTS (CONTROL)
- ARRESTING HOOK (CONTROL)
- AUXILIARY AIR DOORS (CONTROL)
- BELLMOUTH (CONTROL)
- BOMB AND ROCKET RELEASE (CONTROL)
- BUDDY TANK (CONTROL)
- FUEL VALVES (POWER)
- IN-FLIGHT REFUELING PROBE (CONTROL)
- INFRARED COOLING SOLENOID
- INTERNAL WING FUEL TRANSFER
- MISSILES (POWER)
- NO. 4 TRANSFER PUMP (CONTROL)
- OUTBOARD TANK JETTISON
- PNEUMATIC SYSTEM (CONTROL)
- RADAR MISSILE FAIRING (POWER)
- RAIN REMOVAL (CONTROL)
- RIGHT BOOST PUMP (CONTROL)
- SIDEWINDER
- SPECIAL WEAPONS (POWER)
- STABILATOR TRIM INDICATOR
- STATISTICAL ACCELEROMETER
- TURN AND SLIP INDICATOR
- WING FOLD (CONTROL)

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RB

Figure 2-9 (Sheet 2)

the 26 volt a-c main and essential loads. The generator output powers a similar auto-transformer for 26 volt a-c main loads only. Two 60-ampere transformer-rectifiers are used to convert three-phase, 200/115 volt a-c power to 28 volt d-c power to accommodate the airplane d-c power requirements.

D-C ELECTRICAL POWER

All d-c power is supplied by the two 60-ampere transformer-rectifiers. The input to one transformer rectifier is connected to the main left a-c bus and the other is connected to the essential a-c bus so that a failure of one a-c bus will not constitute a complete loss of d-c power. The outputs of the transformer-rectifiers are connected in parallel through a current limiter so that in the event of a failure of one of the transformer-rectifiers, the remaining transformer-rectifier will supply all the d-c power for the system. No one fault will cause a complete loss of d-c power.

External Electrical Power Receptacle

To provide adequate power for ground operation of electrical equipment, an external power receptacle (figure 3-2) is located on the bottom of the left air duct. The external power required is three-phase, 400 cycle, 115/200 volt a-c and it is distributed through the entire electrical system in the same manner as generator output.

Circuit Breakers

Most of the d-c circuits are protected by circuit breakers located in the aft cockpit. The circuit breakers in essential circuits are located on a panel (5, figure 1-2) on the outboard side of the right console in the forward cockpit. The majority of the remaining circuit breakers are located on panels in the RIO's cockpit.

Generator Warning Lights

The L.H. and R.H. Gen Out warning lights and the Bus Tie Open warning light are located on a warning lights panel (1, figure 1-2) in the front cockpit. One of the generator warning lights will illuminate any time an applicable generator is not on the line when the generator switch is on. The pilot may attempt to reset the generator by placing generator switch to OFF and then placing it back to ON. No other corrective action can be taken unless both generators are off the line. In this case, all warning lights will be out until the emergency generator is brought into operation by extending the wind-driven turbine which will drive the emergency generator. To extend wind-driven turbine push DOWN on the EMERG HYD PUMP handle (3, figure 1-2). With emergency generator operating, both a-c generator lights will be on, if the generator switches are on and the generators are turning. The "Bus Tie Open" warning light will illuminate when the generators are not in parallel. No corrective action is necessary since this does not affect the operation of the electrical system. The generator warning lights and the "Bus Tie Open" warning light receive their power from the essential 26 volt d-c warning lights bus.

Emergency Electrical System

In the event both engines fail resulting in complete loss of electrical power, a wind-driven turbine, which is extended into the airstream pneumatically, powers a hydraulic pump and a 3 KVA three-phase, 400 cycle emergency generator. When this generator comes up to speed and voltage, it operates an a-c relay which will connect the generator to the essential a-c and d-c buses. If either of the main generators is restored, the emergency generator automatically drops off the line and the wind-driven turbine can be retracted pneumatically. To extend wind-driven turbine, push DOWN on EMERG HYD PUMP handle (3, figure 1-2) located outboard of the left console. Pull UP on EMERG HYD PUMP handle to retract the wind-driven turbine. The emergency generator is designed to put out fully rated power continuously for a period of 15 minutes. Utilizing the maximum generator output for periods greater than 15 minutes creates excessive temperatures within the generator which will drop generator output. However, it is doubtful if maximum utilization of the generator output would ever be required under an actual emergency condition. Therefore, when operating under actual emergency conditions, the generator will probably continue to operate satisfactorily for periods greater than 15 minutes and, if the situation warrants, the design generator limitation can obviously be exceeded.

CAUTION

Do not operate emergency generator for periods greater than 10 minutes unless operating under actual emergency conditions. Operating the generator for periods greater than 10 minutes when not needed jeopardizes the life of the generator under actual emergencies.

Note

- Emergency wind-driven generator operational time shall be logged on the yellow sheet (Op NAV 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. This will result in complete loss of electrical power (except engine ignition) and will allow all of the wind-driven turbine's power to be utilized in driving the emergency hydraulic pumps in order to maintain control of the airplane.

NORMAL OPERATION

Normal operation of the electrical system commences when external power is applied to the airplane 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 and back to ON. If the generator fault has been corrected, the generator will be brought back on the line and the warning light will go out. If the warning light remains illuminated turn the generator OFF, secure the applicable engine, if practicable and land as soon as practicable.

CAUTION

Upon fluctuation of the warning light, immediately check the corresponding oil 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. In most cases the generators will not fail at the same time, 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 due to the generator low speed switches dropping the generators off the line at about 53% rpm, 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 generator to the line by cycling the generator control switches, if the fault has been corrected the generator warning 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. If the gear has been lowered prior to loss of electrical power, the pneumatic system should still be utilized. This procedure assures that any pressure surge in the landing gear up line occurring with electrical power removal has not unlocked the gear. If all electrical power is lost while taxiing, the emergency pneumatic landing gear system should be actuated to assure that the gear remains locked.

GENERATOR FAILURE (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" warning light followed in 5 seconds by the illumination of the "R.H. Gen Out" light, the "Bus Tie Open" warning light will be extinguished. If the "Bus Tie Open" warning light remains extinguished, the short will present no problem since the left generator will supply the power to the right buses. However, if the "Bus Tie Open" warning light illuminates again within 2 seconds of being extinguished, all the buses supplied by the right generator will be lost since the illumination of the "Bus Tie Open" warning 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. 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 LINES AS LONG AS EITHER MAIN GENERATORS IS IN SERVICE. Extension of the ram air turbine must be followed by SWITCHING OFF THE LEFT GENERATOR in this circumstance. After the extension of the ram air turbine and utilization of the emergency generator an attempt may be made to regain the right main generator. This is accomplished by recycling the right generator switch to ON. If the right generator comes on the line, the short is no longer present and the left generator may be placed in operation. The generators will parallel and normal operation will be resumed. If the right generator warning light does not go out when the right generator switch is placed on, the short remains and the emergency generator must still be used. 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 generator right main and essential buses will still be in operation. Refer to Emergency Procedures, Section V, Volume II for action to be taken upon illumination of the "Bus Tie Open" warning light.

ELECTRICAL FIRE

In the event of an electrical fire, immediately extend the ram air turbine and turn generator control switches off. If fire still persists, start pulling the circuit breakers that are powered from the essential busses. If the equipment causing the fire is found, leave that circuit breaker off; turn all other circuit breakers on; turn generator control switches on; and retract the ram air turbine. If fire still persists after pulling all essential circuit breakers, turn all circuit breakers on; turn generator control switches on; and land as soon as possible. If the fire subsides when operating only on essential busses, turn all non-essential electrical equipment off and turn generator control switches on. If fire subsides individually reposition electrical equipment on, beginning with the most essential equipment first. If malfunctioning item is found, leave that electrical power switch off, pull the applicable circuit breaker and turn all other equipment on. If fire still persists after turning off all non-essential electrical equipment, start pulling all non-essential circuit breakers until malfunctioning item is found. If equipment causing the fire cannot be found, turn generator control switches off and land as soon as possible.

Note

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

LIMITATIONS

1. Engine driven generators drop off the line at approximately 53% rpm.
2. Max airspeed for operation of wind driven turbine, 515 knots CAS or Mach 1.1 whichever is less.
3. Emergency generator drops off the line when aircrafts airspeed drops below 195 knots CAS.

ENGINE

DESCRIPTION

The airplane is powered by two General Electric J79-GE-8 engines, a lightweight (approximately 4000 pounds), high thrust, axial flow turbojet engine equipped with an afterburner for thrust augmentation. At Military power the engine develops 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 through-flow combustion chambers, a three-stage turbine, a variable area exhaust nozzle and modulated reheat thrust augmentation. 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 located in the compressor front frame. As it is compressed, the air is forced back through the compressor rear frame into the combustion chamber liners. Fuel nozzles, projecting into the combustion chamber liners, eject a fuel spray which mixes with the compressed air. Ignition is provided by a spark plug located in the No. 4 combustion chamber, the remaining nine combustion cans 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 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 oil system is used for lubricating purposes and to hydraulically actuate the primary and secondary exhaust nozzles. The variable stator vanes and the inlet guide vanes are interconnected externally through a system of half-rings, drag links, and bell cranks, and are positioned by two actuators which use high pressure engine fuel as a hydraulic fluid. The variable stator system positions the inlet guide vanes and the first six stages of the variable stator vanes to control airflow through the engine compressor. Control of compressor airflow greatly reduces problems of compressor stall by improving airflow characteristics at critical engine-airplane speeds, especially during burst acceleration and deceleration. An increase in rpm or decrease in compressor inlet temperature results in a signal from the main fuel control to open the stator blades to allow a greater airflow. A decrease in rpm or increase in compressor inlet temperature positions the stator blades to reduce inlet airflow. The variable nozzle system is hydromechanically controlled and schedules nozzle area by positioning the nozzle opening to obtain optimum thrust in regard to altitude and airspeed conditions, keeping within the safe design limits of the engine. The main function 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 bleed from the 17th stage of the compressor is passed through a heat exchanger and is used for auxiliary equipment cooling, cockpit pressurization, air conditioning, and also supplies the air for the aircraft pneumatic system and the central air data computer unit.

ENGINE FUEL CONTROL SYSTEM

The fuel control system (figure 2-10) 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.

ENGINE FUEL SYSTEM

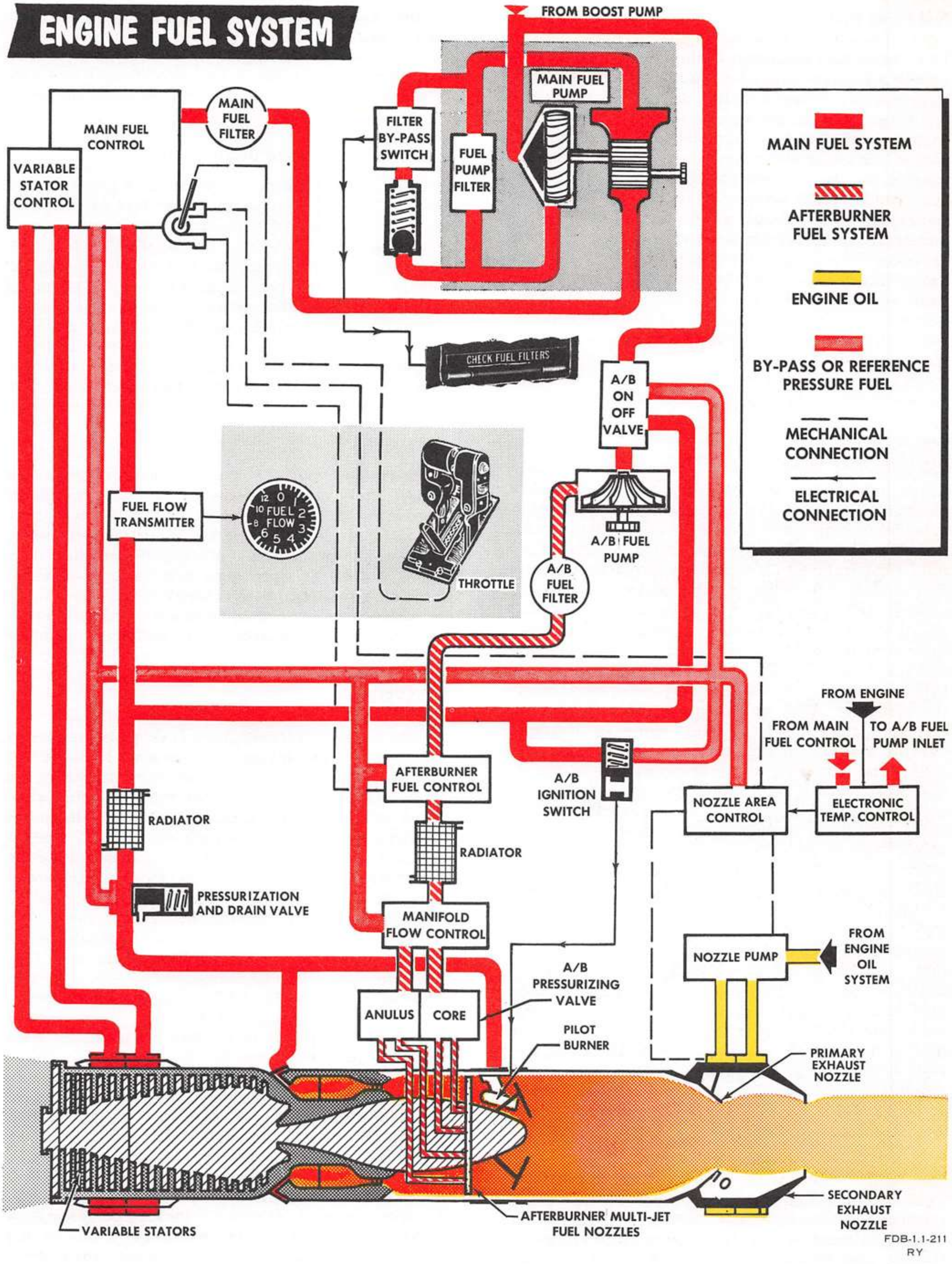

Figure 2-10

Fuel Pump Unit

The engine fuel pump unit consists of a low pressure impeller-type pumping element, a high pressure gear-type pumping element, a low pressure fuel filter, a fuel filter by-pass, and an output pressure relief valve. 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 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 by-pass opens, and a "Check Fuel Filters" warning 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 Controll

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, and 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 cooler which effects a transference of heat from the scavenge oil to the fuel. From the fuel-oil cooler, 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 Radiator

Fuel metered from the main fuel control passes through the cooler tubes of the fuel-oil radiator and then to the fuel nozzles. The fuel serves as the coolant for the scavenge oil which flows around the radiator tubes. The radiator incorporates a bypass valve to regulate the flow and temperature of the oil and fuel. There are two fuel-oil radiators incorporated on the engine, one utilizes normal engine fuel flow as a coolant whereas the other radiator uses afterburner fuel flow as a coolant. Both fuel-oil radiators 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. The pressurization and drain valve is pressure operated. 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 in the proper state of atomization for maximum burning into the compressor discharge air entering the combustion chamber. The nozzles produce a uniformly distributed, cone shaped, hollow fuel spray upon application of pressure at the nozzle inlets. 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

The dry sump, full scavenging oil system is completely contained on the engine. Its purpose is to supply filtered lubrication oil to cool and prevent wear of the engine bearing, gears, and other rubbing surfaces. It filters and cools lubricating oil and returns the oil to the engine mounted oil tank for re-use. The 5.3 gallon oil tank stores the oil reserve and furnishes oil to the main lube and hydraulic pump and constant speed drive. The main lube pump furnishes oil under positive pressure to the lubrication and hydraulic system. The lube element of the main lube and hydraulic pump delivers oil through a filter and then into the main lube line. This line splits into various branches. A portion of the oil in the first branch lubricates the No. 1 bearing, the front gearbox, the A/B fuel pump, and the transfer gearbox. Oil in another branch of the main lube line lubricates the No. 2 and No. 3 bearings, while oil in still another branch goes to the rear gearbox and intermediate damper bearing. A line coming off the main lube pump goes to the pressure transmitter and the lube relief valve. A sump to collect the lubricating oil is located at each lubrication point. Three scavenge pumps return oil through the fuel oil cooler to the reservoir during all flight conditions. The hydraulic element of the main lube pump supplies oil to the nozzle pump to hydraulically actuate the variable nozzle. Refer to Engine Hydraulic Oil System, this section for further information.

Engine Hydraulic Oil System

The actuating force necessary to change exhaust nozzle area is developed hydraulically from the engine oil system. Oil is fed from the engine oil tank to the hydraulic element of the main lube pump. A hydraulic oil filter element in series with the flow removes foreign matter and discharges to the nozzle pump. A check valve in the filter eliminates any possibility of reverse flow through the system. A pressure relief valve located at the inlet to the nozzle pump branches off to the scavenge line. It allows a bleed of oil to the scavenge oil return line when oil pressure at the nozzle pump inlet exceeds 150 psi. The nozzle area control output signal directs the operation of the nozzle pump. Discharge pressure from the pump is supplied to either the rod end or head end of the four nozzle actuators, opening or closing the variable nozzle.

ENGINE AIR INDUCTION

There are two independent and identical air induction systems, one for each engine. The component units are the fixed and variable ramps, which make up the primary air system, and a variable bypass bellmouth, and an auxiliary air door which make up the secondary air system.

Variable Duct Ramp

The variable duct ramp system is utilized to provide primary air at optimum subsonic airflow to the compressor face throughout an extremely 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 and movement of the aft ramp positions the perforated ramp through mechanical linkage. The Central Air Data Computer supplies a Mach and total temperature input to the ramp control amplifier which in turn sends a signal to a utility hydraulic system servo unit which positions the ramps for optimum airflow at Mach numbers 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.

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 referred to as the Secondary Air System. The variable bellmouth is a perforated ring located between the airplane duct structure and the engine compressor inlet. Between .4 to .98 Mach the 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

The auxiliary air doors are opened to relieve excessive engine compartment pressures (13.3 psig or above) or to provide additional airflow for engine cooling during low speed or ground engine operation. The doors are opened by a utility system hydraulic actuator when the landing gear handle is placed in the DOWN position. In flight (landing gear handle UP), the actuating cylinder is held closed by utility hydraulic pressure, however, engine compartment pressure of 13.3 psig, or over will actuate the door open until the overpressure is relieved.

Auxiliary Air Door Warning Lights

The auxiliary air door warning lights (19, figure 1-2) are intended to notify the pilot when the auxiliary air doors are not in the position called for by the gear handle. The lights will illuminate if the landing gear handle is up and the doors are open, or if the landing gear handle is down and the doors are closed.

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, while 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. However, during a rapid throttle burst from below 88% rpm to 91% 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 throttle angle and nozzle feedback to prohibit exhaust gas temperature from exceeding the design limits. Exhaust gas temperature is sensed by 12 dual loop thermocouples 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. 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 (Op NAV 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 2-10) provides the fuel for augmentation of the thrust produced by the engine. A separate afterburner constant pressure drop variable fuel control, meters the afterburner fuel, and ignition is by a separate A/B ignition system. In operation, the airframe boost pump supplies fuel to the inlet of the afterburner pump. The pump supplies fuel to the check and vent valve which will open under pressure and supply fuel to the rest of the system. Fuel passing through the check and vent valve continues to the afterburner fuel control and then passes through the afterburner fuel oil cooler to the inlet of the combined A/B control. The manifold flow control divides fuel from the afterburner fuel control into core and annulus flows. The core and annulus flows are further subdivided 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 annulus, primary core, secondary annulus and secondary core.

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 to the pump is open. To open the inlet to the afterburner fuel pump, the pilot must move the throttle into the afterburner modulation range and engine speed must be sufficiently high (above 92% 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 by the fuel control 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 primary annulus pressurizing valve opens and fuel is delivered to the primary annulus tube in the fuel nozzles. Further advancement will activate the primary core valves which will deliver fuel to the primary core tubes in the fuel nozzles and join the primary annulus in delivering fuel for afterburner operation. When the throttle is advanced still further the secondary annulus valves are also delivering fuel to the nozzles. As the throttle is advanced to the maximum afterburner position the secondary core valves join the three other manifolds in delivering fuel to the nozzle; this is full afterburner operation. The afterburner fuel manifolds and multi-jet nozzles 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 (9, figure 1-4) 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 produces sparks which ignite the atomized fuel-air mixture in the No. 4 combustion can. The remaining nine combustion cans are ignited through the cross fire tubes. Afterburner ignition is controlled by a normally open automatic switch. When the throttle setting calls for afterburner operation afterburner fuel pressure closes the switch activating the system. The afterburner ignition system develops the arc necessary to ignite a fuel-air mixture in the pilot burner. The pressure switch controls the electrical circuits to the

115 volts a-c afterburner ignition system. In operation, fuel from the downstream side of the pressurizing and drain valve passes through a filter then enters the pilot burner orifice, passes through a check valve and enters the pilot burner. The orifice provides the right fuel flow for any flight condition, assuring positive pilot burner operation. The pilot burner operates exactly as an inner combustion can in a conventional jet engine; compressor discharge air enters the can and is mixed with atomized fuel from the pilot burner fuel nozzle. The mixture is ignited by a spark plug and burning mixture emerges from the open end of the liner as an intense flame. A tab on the pilot burner snout conducts the flame to the moddle flame-holder ring, and the main afterburner fuel flow is ignited. Pilot burner operation is continuous during afterburning. Pilot burner ignition is only provided during afterburner operation, however, fuel and air is delivered to the pilot burner during all modes of operation. Therefore, the pilot burner may light from the heat of the main engine and continue burning even though afterburning has not been initiated.

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 115 volt a-c ignition system, which receives its power from the essential 115 volt a-c bus. Depressing the ignition button causes the spark plug to discharge, igniting the fuel-air mixture as the throttle is moved from OFF to IDLE during engine start. The spark plugs 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 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 starter 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. The starter switch receives power from the 28 volt d-c starter cart bus. 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 (12, 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 booster 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 throttle (9, 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, afterburner fuel control and throttle angle switch 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. The throttle mechanism is a "gear shift" type. 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 during catapulting to prevent inadvertently throttling back. The handles are automatically stowed when released.

ENGINE INSTRUMENTS

Engine Fuel Flow Indicators

The engine fuel flow indicators (16, figure 1-4) are mounted on the right side of the pilot's instrument panel. The fuel flow indicating system indicates the amount of main fuel system flow, in pounds per hour, of fuel 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 receive power from the essential 28 volt a-c bus. Afterburner fuel flow bypasses the fuel flow transmitters and therefore A/B fuel flow is not shown on the indicators.

Tachometers

The electric tachometer system is composed of two tachometer indicators (18, figure 1-4) mounted on the pilot's instrument panel and one engine-driven tachometer generator mounted on each engine. The system is completely 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 (19 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 extending from the aft edge of the aft stator case, aft to the turbine frame, and then circumferentially around the engine for approximately 160 degrees. The dual loop thermocouples are connected in parallel and 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 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. Power to operate the exhaust temperature gages comes from the essential 115 volt a-c bus.

Exhaust Nozzle Position Indicators

Exhaust nozzle position indicators (20, figure 1-4) which show the exit area of the exhaust nozzle, 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. Power for the instrument is derived from the essential 28 volt d-c bus.

Oil Pressure Indicators

The oil pressure indicators (26, 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. The oil pressure transmitters are powered by the essential 26 volt a-c bus.

ENGINE FIRE AND OVERHEAT DETECTOR SYSTEM

Fire / Overheat Warning Lights

Two combination Fire and Overheat warning lights (12, 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 overheat 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 approximately 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. In general, illumination of either the Fire or Aft Fuselage Overheat warning lights signals the pilot to reduce power immediately on the affected engine to a setting of military or lower.

Afterburning must never be used if the Overheat warning light illuminates. Unless the warning is false, it 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 loss of flight control if afterburning is used.

Note

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

Fire Detector Check Switch

The warning lights may be tested by momentarily placing the warning lights switch (8 figure 1-3) in the TEST position; this will only check the continuity of the bulbs. By depressing the fire detector check switch (11, figure 1-4) the pilot checks the fire warning circuit from the bulb to the sensing element. The fire warning light circuit receives power from the left main 115/200 volt a-c bus.

NORMAL OPERATION

STARTING ENGINES

Note

- The following procedure establishes the right (No. 2) 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 system indicator cannot be used to determine pump operation unless the right (No. 2) engine is started first.
- 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 start.

1. Throttles - OFF
2. External compressed air source - CHECK
   Check proper external air source is connected to starter system and that sufficient air pressure is available. A 5.5:1 pressure ratio gas turbine compressor starter unit, RCPP-105 or equivalent is desired. Check to insure connection of gas turbine ground power supply remote control cable.
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, shut down immediately and investigate.

5. At 11% rpm, right engine ignition button - DEPRESS
   At approximately 11% rpm, depress right engine ignition button and simultaneously advance the throttle half way up throttle quadrant and immediately return to idle.

Note

The engine usually fires at approximately 13.5 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.

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.
- With only one engine in operation, do not move control stick (surface controls) excessively. If the stick is moved excessively 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 forcing the excess fluid overboard. The seals within the tandem power cylinders may also be damaged due to the ingesting and expeling of air and lack of lubrication. The power control hydraulic systems must be reserviced and checked.

Note

After the engine reaches idle rpm (67 ± .7%) 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 1100 to 1300 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 start will likely result. If fuel flow is in excess of 800 lbs. per hour, 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 No. 2 power control hydraulic system pressure gage and the utility hydraulic system pressure gage should read within normal. The hydraulic pressure warning light will remain illuminated until the other engine is started and all four hydraulic pumps (P.C. No. 1, P.C. No. 2, and utility) are operating properly.

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.

After any wet start or false start, allow one minute or longer for the combustion system to drain before starting the engine.

11. Start 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 OPERATION

ENGINE FAILURE

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.

AIR STARTS

In general, airstart capability is increased by higher airspeeds and lower altitudes. However, airstarts can be made over a wide range of airspeeds, as high as approximately 48,000 feet with JP-4 fuel or 40,000 feet with JP-5 fuel. Before initiating an airstart, assure that engine rpm is above 12%. An airstart is accomplished by depressing the ignition button and advancing the throttle to beyond idle, (to insure fuel flow) and then slowly retarding the throttle back to idle. A start is indicated by a rapid increase in EGT followed by an increase in rpm.

OIL SYSTEM FAILURE

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 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. 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 80-90 percent speed 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% 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.

LIMITATIONS

ENGINE SPEED

Engine speed is limited to 100 ± .5%. Allowable overspeed for sea level static operation in a transient or steady state condition is 103%. The overspeed limitation static operation is 103 to 105% and is allowed for 3 minutes maximum. The allowable overspeed for all other operations is a transient or steady static condition is 102%. The overspeed limitation is 102 to 103.6% for 1 minute maximum.

Note

Any rpm in excess of the above limitations shall be logged on the yellow sheet (OPNAV FORM 3760-2).

RPM DROP

When entering afterburner from throttle settings less than military, the allowable rpm drop is 14%. When entering afterburner from stabilized military power 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 (high Mach number) operation, the engine idle speed is increased as the inlet temperature rises. This is done to maintain the airflow necessary for engine operation and preclude engine stall during high inlet temperature operation. As the inlet temperature (T_2) increases from 56°C to 108°C the engine idle speed increases from 65% to 100% rpm. To reduce engine rpm, the throttle should be retarded below 76.5 degrees to terminate afterburning and reduce engine thrust. Thrust can be further reduced by retarding the throttle to IDLE which will open the exhaust nozzle and decrease the exhaust gas velocity.

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 rpm maximum speed reduction starts at +4°C and is reduced until at -54°C the maximum rpm is approximately 91.5 percent.

T_5 RESET

The engines incorporate an exhaust gas temperature (T_5) reset during military and full A/B operation. This T_5 reset occurs at the same point as T_2 cutback, and reduces EGT at the same time that T_2 cutback is reducing rpm. As a result of T_5 reset, the engines run at lower EGT's, operate with larger nozzle areas, provide less net thrust and consumes less fuel while operating in the speed cutback region at low CIT conditions.

ENGINE TEMPERATURE LIMITATIONS

Engine temperatures are limited by degree and time as shown on figures 2-11 and 2-12.

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

Note

Temperature peaks above 749°C are limited to 3 seconds.

Any exceeded temperature limitation must be entered in the flight forms (yellow sheets).

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Figure 2-11

ENGINES COMPRESSOR BLEED LIMITATIONS

The following throttle-bursts can be safely made using maximum compressor bleed. Maximum compressor bleed occurs with flaps down (BLC) operative and cockpit pressurized.

1. Idle to Min Afterburner.
2. Military to all Afterburner Positions.
3. 86% rpm to all throttle positions.

WARNING

Do not throttle-burst from below 86% rpm to above Min Afterburner, while using maximum bleed. Cyclic engine operation (intermittent afterburner operation accompanied by pronounced engine speed surge) may result.

Note

- Momentary engine stagnation at approximately 95% rpm will be noted when accelerating one engine at a time with flaps down.
- Engine acceleration time with maximum compressor bleed will be approximately double that of an engine acceleration without compressor bleed.

WINDMILLING LIMITATIONS

Except for emergency shutdown, do not allow the engine to windmill below 20% rpm 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 conductive to sump fires when re-lighting. Prior to shutdown under non-emergency conditions, the engine should be decelerated to the coolest operating point (lowest EGT), and this speed maintained long enough to stabilize EGT.

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

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 engine exhaust nozzles close. This in turn will prevent the nozzles from becoming over pressurized due to peak transient pressures between Max A/B and Mil.

ENGINE INLET TEMPERATURE LIMITATIONS

CONDITION	TEMP	TIME
"Duct Temp Hi" Warning Light Illumination	121°C	Prohibited operation with light illuminated below 45,000 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 45,000 ft.

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Figure 2-12

ENGINE G LIMITATIONS

Due to limited oil distribution to the variable nozzle system during negative g and zero g flight, the airplane is limited to the following:

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

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 (5,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. Power is supplied to the switch from the right main 28 volt d-c bus.

Emergency Flap Extension

Emergency extension of the flaps is accomplished pneumatically by high pressure air from emergency air storage bottles. The emergency flap extension handle is mounted on the wing flap control panel (5, figure 1-2) and is marked EMERG. Lowering the flaps pneumatically is accomplished by pulling the emergency handle AFT. Actuation of the emergency flap extension system will extend all flaps to the full down position. The handle is airfoil shaped and painted in black and yellow stripes for ease of identification. The air bottles contain air sufficient for only one extension of the flaps.

Flap Position Indicator

The leading edge and trailing edge flap indicators (11, 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 transient 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. The indicator circuit draws its power from the essential 28 volt d-c bus.

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. This light operates from the essential 26 volt a-c bus. 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 air bled 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 separation 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 Warning Light

A "BLC Malfunction" warning light (19, figure 1-3) is located on the caution lights panel. The purpose of the warning 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" warning light will illuminate. It must be remembered that the illumination of the "BLC Malfunction" warning 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, while 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 lower the leading edge flaps to one-half their full travel. Further movement of the switch to the DWN position energizes the wing-mounted selector valve resulting in complete deflection of the trailing edge flaps. Immediate movement of the switch from the UP position to the DWN position causes both selector valves to become energized simultaneously thereby completely deflecting both the leading and trailing edge flaps. The limit switches, provided on each flap proper, are all connected in parallel to de-energize the electrical circuits to the selector valves after all flaps are retracted. The electrical circuits are continuously energized to maintain hydraulic pressure on flaps down. Should the cockpit switch inadvertently be left in the down position, the leading edge flaps and trailing edge flaps will retract when the airplane reaches an airspeed of 230 + 5 knots. This is accomplished through an airspeed pressure switch which operates the common 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 + 5 knots less than the speed at which they retracted. Flap extension and retraction will be accomplished within six seconds.

EMERGENCY OPERATION

If normal wing flap operation fails, the flaps can be lowered by pulling the flap circuit breaker; and pulling full aft and down on the emergency wing flap extension handle. 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 pneumatic extension of the wing flaps shall be logged on the yellow sheet (OPNAV FORM 3760-2).

LIMITATIONS

Do not lower flaps above 250 knots CAS.

FLIGHT CONTROLS

DESCRIPTION

The airplane flight controls (figure 2-16) consists of the stabilator, ailerons, spoilers and rudder. All control surfaces except the rudder are actuated by irreversible hydraulic dual power control cylinders. The rudder is actuated by a conventional irreversible power cylinder. Artificial feel systems provide the pilot with simulated stick and pedal forces due to the lack of aerodynamic "feedback" forces from the power cylinders. Viscous dampers are used in the stabilator systems. All feel systems have trim actuators which are controlled by the pilot. Cockpit indicators on the left vertical panel in the pilot's cockpit show stabilator trim, aileron and rudder positions. Secondary controls are leading edge flaps, trailing edge flaps and wing mounted speed brakes.

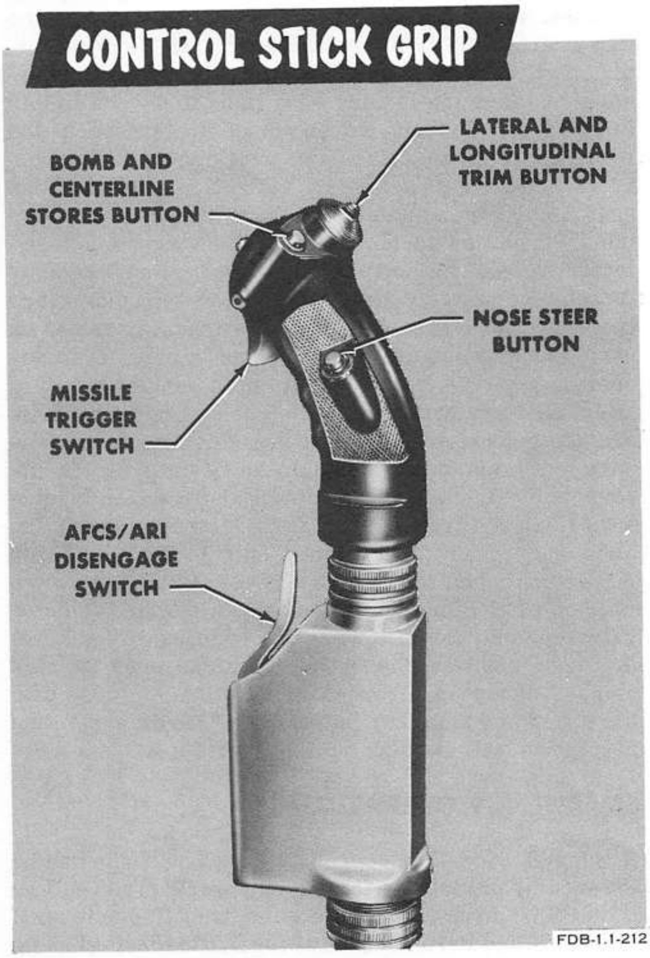


Figure 2-13

CONTROL STICK

The control stick (figure 2-13) is mounted in a yoke which permits both left and right and fore and aft motion. The control grip is a quick removable assembly containing four switches, a trigger switch for missiles, a bomb and centerline stores button located in the upper left side of the grip and a nose steer button located on the left side and halfway down the grip. A trim switch which operates both the aileron feel trim and the stabilator feel trim actuators is located at the top of the grip.

Note

The rear cockpit can be converted to accommodate dual controls. Refer to Dual Control Configuration.

LATERAL CONTROL SYSTEM

The lateral control system which utilizes power control systems No. 1 and No. 2 is a unique aileron-spoiler combination with both surfaces operating in all flight ranges. The use of spoilers for lateral control partially alleviates torsional loading of the wing during high speed rolling maneuvers, and the aileron-spoiler combination increases the roll rate. The ailerons travel downward only, from the full trail position to 30° down. Upward travel is limited to 1° (+2°, -0°) from full trail. Travel of the spoilers is 45° upward from a flush contour position on the upper wing surface. The control linkage is such that if the aileron valve is actuated in one wing, the spoiler valve is actuated in the other. The lateral control system components consist of the stick, push pull rods, aileron dual power control cylinders, spoiler dual servo valves, spoiler tandem cylinders, dampers, feel trim cartridge and autopilot servos. The push rod system includes a spring cartridge in each wing which acts as a push rod during normal operation. If any jamming occurs in the linkage, servo valves or cylinders that the cartridge normally actuates, the spring cartridge will deflect under pilot effort allowing operation of the other lateral system. A self-serviced hydraulic damper attached to the aileron back-up structure is designed to be used as an upstop for the aileron as well as a flutter damper. The use of dual hydraulic cylinders allows simultaneous use of both power control hydraulic systems previously mentioned. In the event of a single failure, the other system will supply sufficient power for control.

AILERON CONTROL

The aileron dual power control cylinders utilize pressure from both No. 1 and No. 2 basic power control systems. Each cylinder has four pistons tied together by a yoke at the rod ends. An integral dual tandem servo valve directs fluid as required to each set of pistons. The two outer pistons are supplied hydraulic pressure by one of the power control systems while the two inner pistons are supplied by the other power control system. This arrangement provides symmetrical loading on the yoke with failure of one system. Valves and pistons supplied by the No. 1 power control system are hydraulically independent of the valves and pistons supplied by the No. 2 power control system.

SPOILER CONTROL

The spoiler dual servo valves direct fluid to the two pistons of each spoiler cylinder, one section directing fluid from the No. 1 power control system to one of the pistons and the other section directing fluid from the No. 2 power control system to the other piston. The spoiler tandem cylinders are dual cylinders utilizing pressure from both the No. 1 and the No. 2 power control systems. Each cylinder has two pistons on a common rod. Pistons in each cylinder are hydraulically independent of each other. The dual system hydraulic cylinders provide spoiler power in case of failure of one of the two hydraulic systems.

Lateral Control Feel and Trim

An artificial feel trim cartridge joined in tandem with a screw jack is attached to the bell crank prior to where spoiler linkage and aileron linkage are separated from the common pilot input effort. The two feel trim cartridges are synchronized by flex shafting and powered by an electric actuator. Forty percent rim authority is designed into the system. A hydraulic servo in each wing, attached in series with the linkage through a walking beam, provides autopilot operation of the lateral system.

STABILATOR SYSTEM

The stabilator system consists of the control stick, push-pull rods, power cylinder valve and an integrated power control cylinder. The stabilator is a single unit horizontal tail which is actuated by an irreversible power control cylinder. Movement of the control stick in the cockpit is translated into stabilator deflection by means of a combination push-pull rod and cable system to the power cylinder. Hydraulic pressure to the actuator is supplied by power control systems No. 1 and No. 2 (figure 2-16). Two hydraulic autopilot servos and a hydraulic damper are integrated into the power cylinder valve. Autopilot operation of the stabilator will move the control stick fore and aft. A "bob" weight is included in the longitudinal control system linkage to increase stick forces as "g" forces increase.

Stabilator Feel and Trim

Artificial feel is provided by a dynamic pressure bellows. The force from this bellows with a variable moment arm is balanced by a spring of nearly constant force on a variable moment arm. As the velocity of the aircraft increases, the bellows force increases necessitating a change in trim which decreases the bellows force moment arm and increases the spring moment arm. The relationship of these two arms is changed with respect to a point of rotation by an electric trim actuator which is operated by a trim button on the control stick. A viscous damper in the bellows linkage increases stick forces with rapid motion of the stick. This feature tends to prevent exceeding structural limitations inadvertently. A spring cartridge is incorporated in the control linkage which enable the pilot to override the feel system in the event of a malfunction. A bellows diaphragm failure in the stabilator feel system would be indicated to the pilot by a mild pitch down tendency which he would be able to correct.

Stabilator Trim Indicator

The stabilator trim indicator (11, figure 1-2) is located on the left vertical panel in the pilot's cockpit. It is directly controlled by a transmitter which is integral with the stabilator feel trim actuator. The left 28 volt d-c bus supplies power for this indicator.

RUDDER CONTROL SYSTEM

The utility hydraulic system (figure 2-14) is used to supply hydraulic pressure to the rudder power control and feel trim cylinders. Movement of adjustable position rudder pedals in the cockpit is translated into rudder deflection by means of combination push-pull rod and cable system to the power cylinder. The power cylinder is of the irreversible type with integral servo valve. Artificial feel is supplied to the pedals through linkage from an artificial feel trim system. A double acting viscous linear damper and a rotary damper are coupled directly to the rudder to dampen rudder flutter. It is possible for the pilot to have limited authority over the rudder in case of failure of the hydraulic system which supplies the rudder power cylinder and rudder feel system. This is done by the internal pressure operated bypass valve in the power control cylinder which opens with loss of system pressure and allows fluid to pass from one side of the piston to the other. Thus, the cylinder acts as another "link" in the rudder system and the rudder can be moved by pilot effort.

Total amount of rudder available would be dependent upon air loads on the rudder. A hydraulic servo for yaw damping and autopilot operation is integrated into the rudder power cylinder. Operation of the autopilot servo does not move the rudder pedals.

Rudder Feel and Trim

Artificial feel is supplied to the pedals through the linkage from an artificial feel trim system attached in parallel to the linkage in the aft fuselage. A hydraulic cylinder with system pressure to both sides of the differential area piston provides a pedal force of 2.33 pounds per degree of rudder deflection below 235 ± 10 knots during acceleration and below 220 ± 5 knots during deceleration. Above approximately 235 knots, a pressure switch in the pitot static system cuts off hydraulic system pressure to the low area side of the hydraulic cylinder piston and the pedal force becomes 10 pounds per degree of rudder deflection. Use of a trim switch on the console, in conjunction with an electric actuator in the feel trim linkage, removes loads from the pedals after the pilot has positioned the rudder to a desired flight attitude. Normal trim range is ± 5 degrees of rudder deflection.

Rudder Trim Switch

The rudder trim switch (12, figure 1-2) is located in the forward cockpit on the inboard engine control panel. This switch controls the trim actuator in the rudder feel system which trims the airplane directionally.

Rudder Position Indicator

The rudder position indicator (11, figure 1-2) is located on the left vertical panel in the pilot's cockpit. The indicator is controlled by a transmitter which is mechanically coupled to the rudder. This indicator operates from the essential 26 volt a-c bus.

RUDDER PEDALS

The rudder pedals are conventional type suspended units which are coupled to the rudder push-pull rods system by individual screw jacks. The screw jacks provide adjustment of the rudder pedals for pilot comfort and are adjusted simultaneously by turning a crank on the pedestal. 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 wheel steering unit when the nose steer button on the control stick grip is depressed.

AILERON RUDDER INTERCONNECT (ARI)

The aileron rudder interconnect (ARI) 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 automatic flight control system is in the stab aug or autopilot mode, and 10° rudder displacement when the stab aug switch is disengaged. The airspeed pressure switch automatically operates to activate the system at airspeeds below 235 ± 10 knots if accelerating, and below 220 ± 5 knots if decelerating. Components of the ARI system include the ARI control amplifier, the 10° servo actuator, the airspeed pressure switch and the aileron transducer. The yaw servo amplifier and the force transducer of the AFCS are also used. The rudder integrated actuator is utilized for part of the rudder movement. Upon incorporation of ASC 125, the ARI circuit is completed through the flap blowup airspeed pressure switch. Therefore, the flaps must be down in order to have the ARI system engaged. When airspeed drops below 220 ± 5 knots or when the flap switch is down on airplanes with ASC 125 incorporated, 28 volts d-c is applied to the engage relay solenoids of the ARI system. The contacts of the engage relays close to energize the 10° servo actuator shut off valve. This allows the hydraulic 10° servo actuator to move the control linkage (if aileron displacement is present) and actuate the integrated rudder actuator for rudder displacement. The system can be 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 Damper switch must be disengaged. Pulling the circuit breaker only, and keeping dampers 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 CAS; 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 CAS; 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

Ice or water blockage of the artificial feel bellows ram air line will result in conditions similar to a complete bellows failure. If ice or water blockage is suspected, longitudinal trim should not be applied to relieve control stick force. The intermittent nature of this condition and the suddenness of return to normal can cause violent pitch transients. When the ram air line 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 CAS; maintain attitude by pilot effort; and if practicable descend to air that is above freezing. If the above condition persists, land as soon as practicable.

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 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 CAS 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 CAS. 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 Damper switch must be disengaged. Pulling the circuit breaker only, and keeping the dampers engaged will still provide 5° of ARI rudder authority.

LIMITATIONS

There are no specific limitations pertaining to the flight controls.

FUEL SYSTEM

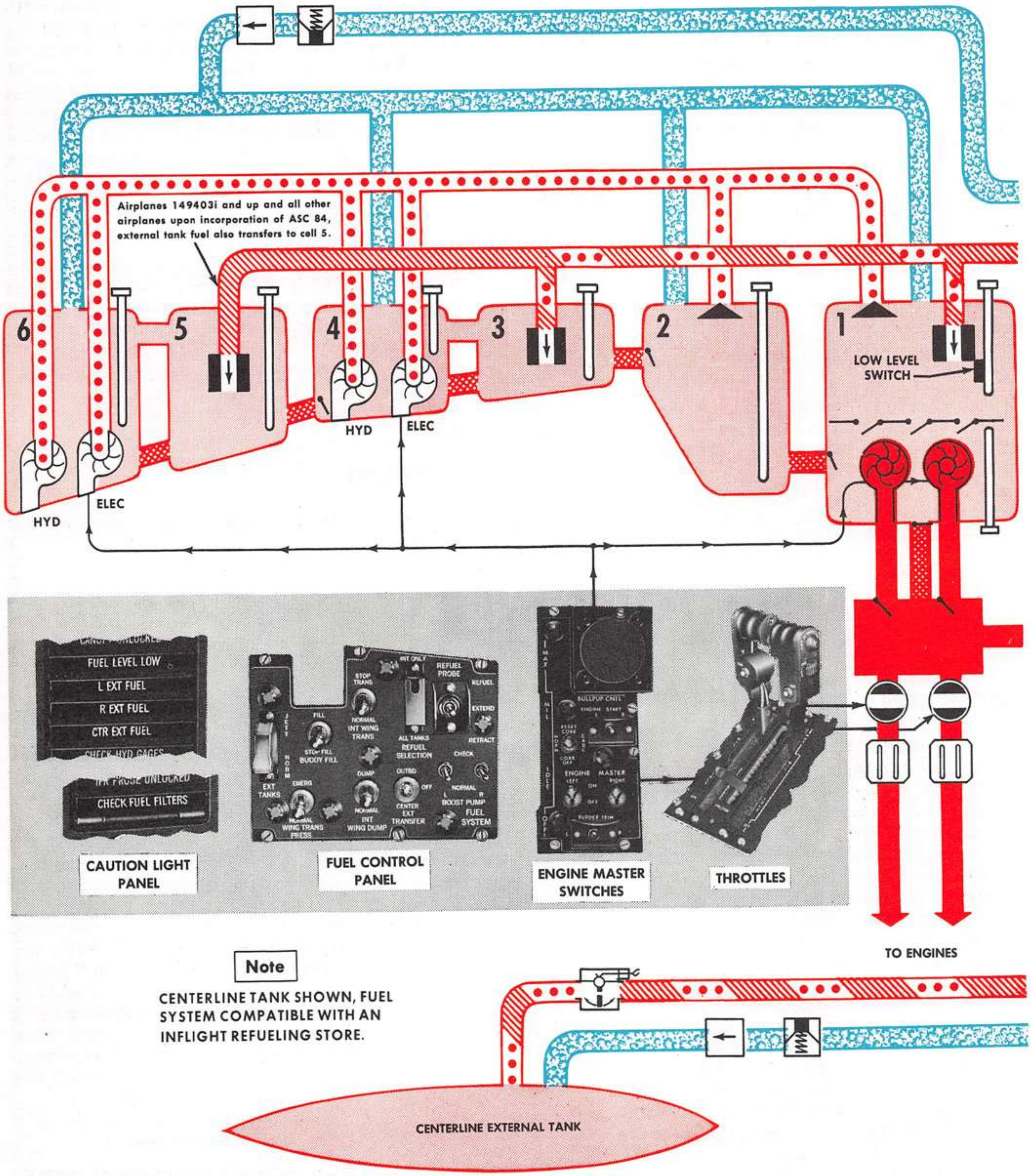
DESCRIPTION

The fuel system (figure 2-14) 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, which is interchangeable with a refueling tanker external store (hereafter referred to as Buddy Tank). Provisions are also made for an in-flight refuleing system. The function of fuselage cells 2, 3, 4, 5 and 6 is to keep tank number 1 supplied with fuel. See figure 2-15, 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 tank 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 pressure fueling is available by using the in-flight refueling probe. There are no gravity fueling or defueling provisions made for the internal or external fuel systems. Single point defueling is accomplished by using the single point fueling receptacle. All internal fuel cells incorporate capacitance type fuel gaging units which 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 or Buddy Tank are all 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. With the Buddy Tank installed, the airplane becomes a tanker with the capabilities of transferring in flight a predetermined amount of its internal fuel supply (plus the Buddy Tank fuel supply) to a receiver airplane or return transfer from the Buddy Tank to its own internal fuel supply.

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 type pump. During normal operation, the two-speed pump

AIRPLANE FUEL SYSTEM

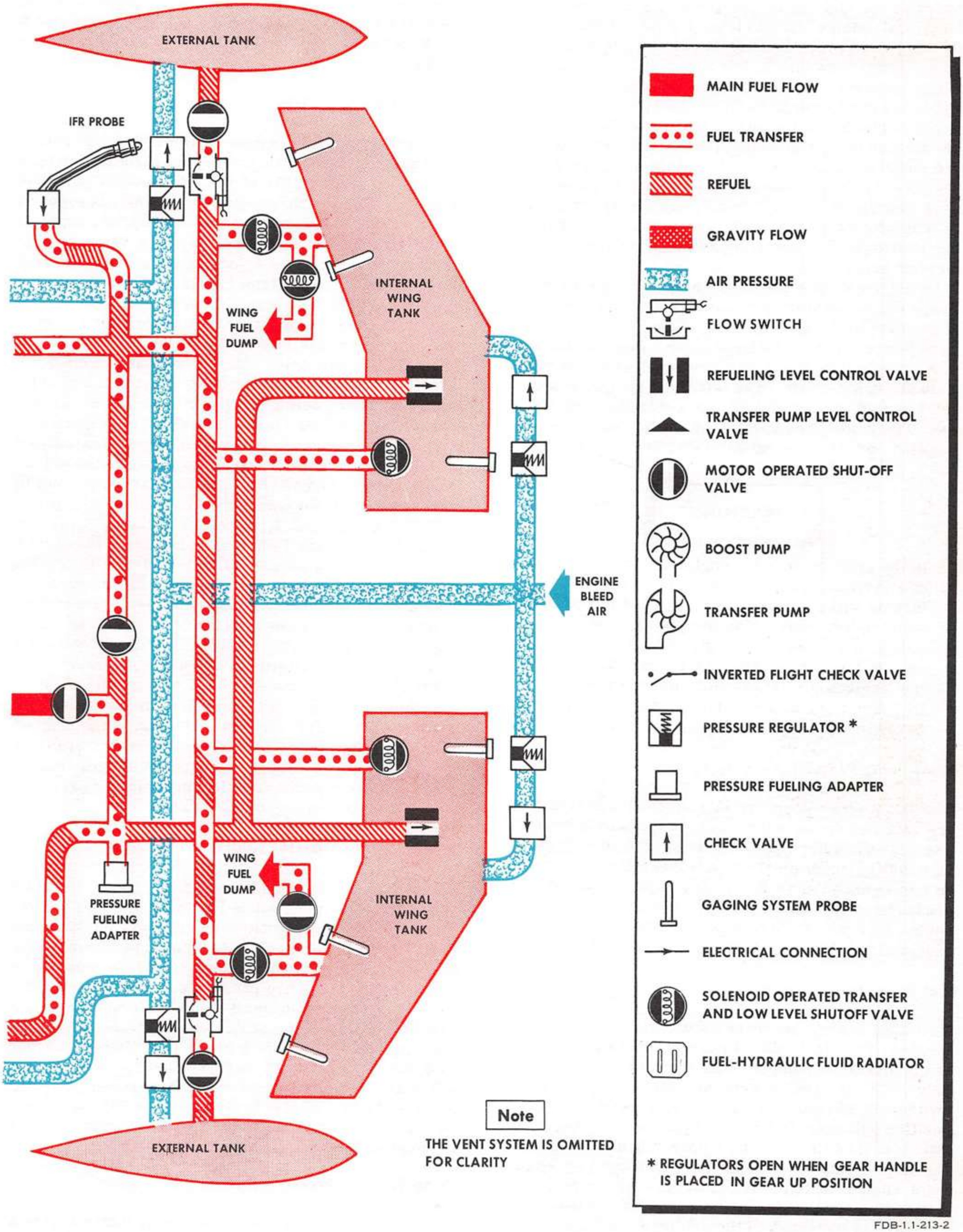


Note

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

FDB-1.1-213-1
RB

Figure 2-14 (Sheet 1)



Note

THE VENT SYSTEM IS OMITTED FOR CLARITY

FDB-1.1-213-2
RB

Figure 2-14 (Sheet 2)

operates at high speed. In the event of a complete electrical failure or double engine failure, extending the wind-driven turbine automatically switches the two-speed pump from high to low speed, thereby reducing a high amperage load and conserving electrical power and at the same time maintaining positive fuel pressure (8 psi minimum) 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 tank and provide for negative "g" requirements. 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 constant fuel flow at 30 ± 2 psi 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. The left main a-c bus supplies power for the right boost pump. Power to the left boost pump high speed relay is supplied by the right main 28 volt d-c bus. The left boost pump low speed relay draws its power from the essential 28 volt d-c bus. The power for operation of the left boost pump is supplied by the essential 115/200 volt a-c bus.

WARNING

In the event of a double engine failure and loss of electrical power, extending the wind-driven 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. Refer to Section III, Emergency Procedures, for additional information.

Boost Pump Pressure Indicators

The boost pump pressure indicators (10, Figure 1-2) are mounted on the left console in the pilot's 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. This signal is transmitted via the essential 26 volt a-c bus to the indicators in the cockpit.

Fuel Boost Pump Check

Two momentary type check switches (4, 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 master switches OFF, since either 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 30 ± 2 psi. 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 below normal discharge pressure reading while a pump is being checked indicates a malfunction. The fuel boost pump check switches should be operated individually in order to obtain a correct reading.

FUEL TRANSFER SYSTEM

The electric transfer pumps located in fuselage cells 4 and 6 will cimmence transferring fuel to the engine feed tank with the selection of the ON position of either engine master switch, providing a-c power is supplied to the system. With external hydraulic power supplied to the airplane or an engine operating, the hydraulic transfer pumps in cells 4 and 6 will also be operating and delivering fuel to tank 1, and cell 2 via float type level control valves located in tank 1 and cell 2. The level control valves open to allow fuel from the transfer pumps to enter tank 1 and cell 2 when the fuel level in these cells drops below that of the floats. Cell No. 2 transfers to tank No. 1 by gravity only; cell 3 gravity feeds cell 4; and cell 5 gravity feeds to cell 6. All internal and external tanks and cells are pressurized when the landing gear control is in the gear up position or the wing transfer pressure switch is in the emergency position and an engine is running. Wing fuel is now capable of being transferred by regulated air pressure to fuselage tank 1, and cell 3. Wing fuel will not normally enter tank 1 unless the fuel level in the tank 1 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, providing the refueling level control valve in tank 3 opens. This action constitutes the automatic wing fuel transfer feature. 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 (4, figure 1-2), providing the landing gear handle is in the gear up position or the wing transfer pressure switch is in the emergency position.

Internal Wing Transfer Switch

The internal wing transfer switch (4, 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 NORMAL position, internal wing fuel is transferred to fuselage tank 3 as soon as the internal wing tanks are pressurized, and the refueling level control valve in tank 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. The left main 28 volt d-c essential bus applies power to operate the fuel level indicator relays and the fuel level switch. Power to operate the fuel level control valves is supplied by the right main 28 volt d-c bus.

Wing Transfer Pressure Switch

The wing transfer pressure switch (4, figure 1-2) is a two-position switch located in the fuel control panel. The switch positions are marked NORMAL and EMER.

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 by the pressure regulator valves being de-energized open and the pressure relief valves energized closed. This maintains 15 ± .5 psi air pressure in the wing and external tanks and 2 ± .5 psi in the fuselage tanks. Placing the switch in the EMER position performs the same functions as did the landing gear handle switch; all pressure regulators open and all pressure relief valves close; the tanks are thereby pressurized and ready to transfer. The left main 28 volt d-c bus supplies power for this circuit.

External Transfer Switch

The external transfer switch (4, figure 1-2) is a three-position toggle switch located in the fuel control panel. The switch positions are marked CENTER, OFF and OUTB'D. Upon the selection of the CENTER 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 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 cell 5 only during refueling operations. Effective airplanes 149403i and up and all other airplanes upon incorporation of ASC 84 (external fuel tank electrical revision) external fuel will transfer to fuselage cells 3 and 5. The right main 28 volt d-c bus supplies power to operate the centerline and external tanks pressurization and selector relays. Power to operate the external and centerline tanks fuel transfer valves is supplied by the right main 28 volt d-c bus.

CAUTION

- To prevent external tank collapse, during high altitude descent with wheels down, place wing trans press switch to EMERG position before lowering the landing gear. Place wing trans press switch to NORMAL prior to landing.
- Wing fuel will not transfer if the external transfer switch is in any position other than OFF.

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 ± .5 psi and 17.5 ± .5 psi. The wing cell pressure relief valves, which provide fuel tank pressure and vacuum relief, dump into a common manifold which is vented overboard under the aft end of the empennage. 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 ± .5 psi and pressure relief at 3.5 ± .5 psi. The fuselage tank and 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 1-3). 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 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. The right main 28 volt d-c bus supplies power for this circuit.

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 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 trans press switch in EMERG position before lowering landing gear. Place wing trans press switch to NORMAL prior to landing.

FUEL QUANTITY 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 at the one cockpit fuel quantity gage. The system is powered by the essential 115 volt a-c bus.

Fuel Quantity Indicator

A combination (counter-sector) fuel quantity indicator (9, figure 1-4) is located in 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. Power for the fuel quantity gage circuit is supplied by the essential 115 volt d-c bus.

WARNING

The fuel quantity gage may give unreliable readings in the low end of the fuel range. This is due to the fuel quantity gage tolerances of ± 150 pounds on the counter, and + 100 pounds on the sector. Therefore, continued aircraft operation after the illumination of the low level warning light should be judiciously considered.

Note

There is a possibility that fuel quantity variations will be noted on the fuel quantity indicator during aircraft accelerations and decelerations. These variations are due to the high acceleration and deceleration rates which can be achieved with the airplane. Transient increases in fuel quantity readings may be noted during deceleration, and transient decreases in fuel quantity readings may be noted during acceleration.

Feed Tank Check Switch

The two-position feed tank check switch (15, 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. 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.

WARNING LIGHTS

In order to reduce the amount of instrument surveillance required of the pilot, warning lights have been incorporated and are grouped on the right vertical panel (19, figure 1-3) of the pilot's cockpit. In addition, a Master Caution light (10, figure 1-4) is located on the upper right corner of the pilot's instrument panel above the fuel quantity indicator. When a malfunction exists, the Master Caution light and a warning light on the panel will illuminate informing the pilot of the condition for which caution should be exercised. The pilot may extinguish the Master Caution light on the instrument panel by depressing a button (1, figure 1-3) located on the right vertical panel. When an additional caution condition exists, the Master Caution light and a warning light will again illuminate. The pilot need only watch the Master Caution light for an indication of caution condition and then refer to the warning lights panel which will inform him of the caution condition existing. Power is supplied to this system by the essential 26 volt a-c bus.

Fuel Level Low Warning Light

The "Fuel Level Low" warning light located on the warning lights panel illuminates when the combined usable fuel in the engine feed tank and tank No. 2 is reduced to approximately 1960 ± 200 lb. level (288 ± 30 gal.) for JP-5 fuel. 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" warning light is not an accurate indication of the amount of fuel remaining in the No. 1 and No. 2 tanks. 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 warning light is a thermistor sensing switch which is located on the engine feed tank fuel quantity probe. When the fuel level in No. 1 and No. 2 tanks is above the sensor switch, 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" warning light is out. When the fuel level drops below the sensor switch the thermistors are exposed to air, and resistances of the reference and sensing thermistors are equal, balancing the bridge circuit. The relay then becomes de-energized and allows current flow to the "Fuel Level Low" warning light.

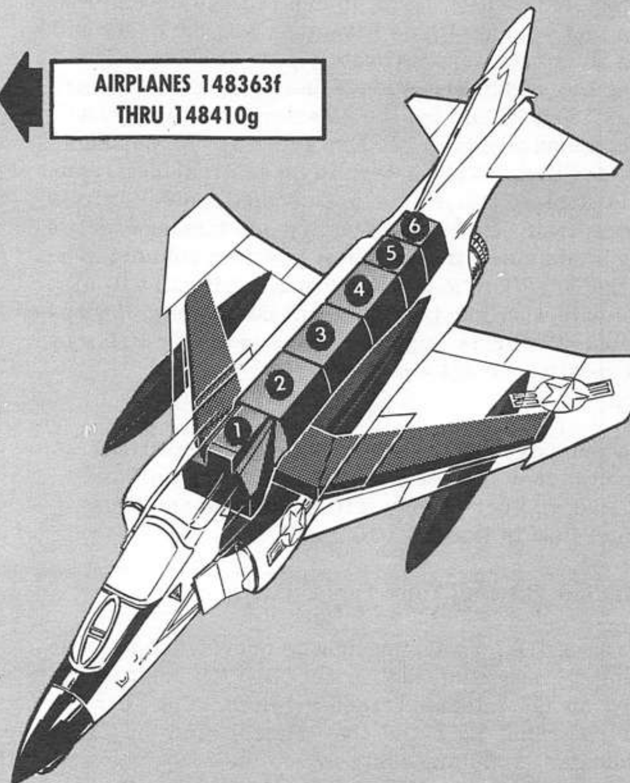
Left and Right External Tank Fuel Lights

The "L. Ext Fuel" or "R. Ext Fuel" warning lights located on the warning lights panel are provided to indicate an empty left or right outboard external tank with OUTB'D position selected on the external transfer switch. One or the other external fuel indicator lights and the Master Caution light will illuminate simultaneously when fuel flow from one of the external wing

FUEL QUANTITY DATA TABLES

AIRPLANES 148363f THRU 148410g

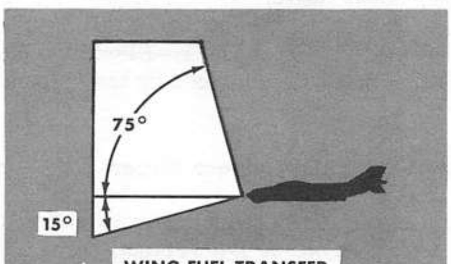
	FULLY SERVICED (GALLONS)	FULLY SERVICED (POUNDS)	USABLE FUEL (GALLONS)	USABLE FUEL (POUNDS)
FUSELAGE CELLS	1,376	9,356	1,351	9,186*
INTERNAL WING TANKS	650	4,420	642	4,366*
TOTAL INTERNAL	2,026	13,776	1,993	13,552*
EXTERNAL WING TANKS	744	5,059	740	5,032
INTERNAL FUEL PLUS EXT. WING TANKS	2,770	18,835	2,733	18,584
EXT. CENTER TANK	602	4,094	600	4,080
INTERNAL FUEL PLUS EXT. CENTER TANK	2,628	17,870	2,593	17,632
MAX. POSSIBLE FUEL TOTAL INTERNAL PLUS ALL EXTERNAL TANKS	3,372	22,929	3,333	22,664



AIRPLANES 148411h AND UP

	FULLY SERVICED (GALLONS)	FULLY SERVICED (POUNDS)	USABLE FUEL (GALLONS)	USABLE FUEL (POUNDS)
FUSELAGE CELLS	1,381	9,391	1,356	9,221*
INTERNAL WING TANKS	638	4,338	630	4,284*
TOTAL INTERNAL	2,019	13,729	1,986	13,505*
EXTERNAL WING TANKS	744	5,059	740	5,032
INTERNAL FUEL PLUS EXT. WING TANKS	2,763	18,788	2,726	18,537
EXT. CENTER TANK	602	4,094	600	4,080
INTERNAL FUEL PLUS EXT. CENTER TANK	2,621	17,823	2,586	17,585
MAX. POSSIBLE FUEL TOTAL INTERNAL PLUS ALL EXTERNAL TANKS	3,365	22,882	3,326	22,617

*GAGEABLE FUEL



WING FUEL TRANSFER LIMITS

Note

WEIGHTS ARE BASED ON 6.8 POUNDS PER GALLON FOR STANDARD DAY TEMPERATURE. JP-5 DENSITY VARIES FROM 6.68 TO 7.0 LB./GAL. IF ACCURACY IS REQUIRED FUEL DENSITY SHOULD BE MEASURED.

FDB-1.1-214

Figure 2-15

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 "Master Caution" light and the "L. Ext Fuel", and the "R. Ext Fuel" warning lights will come on during a temporary halt of fuel flow. Although the "Master Caution" light is cleared and the external tanks fuel warning lights have gone out, the lights will again illuminate (approximately 10 to 30 seconds later) during the next interruption of fuel flow. Effective airplanes 150406L and up, the "Master Caution" light will not come on when the "L. Ext Fuel" or "R. Ext Fuel" lights are illuminated. 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" warning lights will also illuminate when the tanks are full during refueling operation. Power is supplied to the indicator lights by the essential 26 volt a-c bus.

Note

> When selecting the outboard or refuel positions on the fuel control panel, the "L. Ext Fuel", or "R. Ext Fuel" lights will illuminate any time fuel flow is less than 10 gpm.

Centerline External Tank Fuel Light

The Ctr Ext Fuel warning light is provided to indicate an empty centerline tank with CENTER position selected on the external transfer switch. The "Ctr Ext Fuel" warning light and the "Master Caution" light illuminates simultaneously when fuel flow ceases. Effective airplanes 150406L and up, the "Master Caution" light will not come on when the "L. Ext Fuel" or "R Ext Fuel" lights are illuminated. The "Ctr Ext Fuel" caution light will also illuminate when the tank is full during a refueling operation or when fuel flow stops during fuel transfer to the Buddy Tank. Power is supplied to the indicator light by the essential 26 volt a-c bus.

Note

> When selecting the CENTER, BUDDY FILL or REFUEL positions on the fuel control panel, the "Ctr Ext Fuel" light will illuminate any time fuel flow is less than 10 gpm.

IFR Probe Unlock Warning Light

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

Check Fuel Filter Warning Light

The Check Fuel Filters warning light is located on the warning lights panel. The Check Fuel Filters warning light, and Master Caution light will be illuminated when the fuel filter on either engine is being by-passed. The light circuit is completed through a pressure differential switch which senses filter inlet and filter outlet pressure.

EXTERNAL TANK JETTISON SYSTEM

External Tank Jettison Switch

The external wing tanks can be jettisoned by simply selecting the JETT position on the fuel control panel (4, 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 or CENTER 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. The essential 28 volt d-c bus supplies power for the external wing tank jettison circuit.

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.

External Centerline Tank Jettison

Centerline external stores only are jettisoned (providing the landing gear handle is up) by selecting the DIRECT position on the bomb control switch and then depressing the bomb release button on the control stick grip. Effective airplanes 150406L and up to jettison only the external centerline tank, the landing gear must be UP; the ready-safe switch on the bomb control panel must be in the READY position; the mode select switch, on the bomb control panel must be in the DIRECT position; and the master arm switch, on the multiple weapons control panel, must be in the safe position. When these switches are set, depressing the bomb release button, on the control stick grip will jettison the external centerline tank. Electrical power for the jettison circuit is provided by the right main 28 volt d-c bus.

External Stores Emergency Release Button

The external stores emergency release button (11, figure 1-2) is located on the left vertical panel. This button when depressed, will jettison all external stores except missiles, carried on the airplane, providing the landing gear handle is up. Effective airplanes 150406L and up, depressing the external stores emergency release button will jettison all external stores (including missiles and pylons) 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. The external stores emergency release circuit receives power from the essential 28 volt d-c bus.

IN-FLIGHT REFUELING SYSTEM

The inflight refueling prove 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. The refuel selection switch is located on the fuel control panel. This is a two-position guarded switch with ALL TANKS and INT. ONLY position. 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 inflight refueling.

IFR Probe Light

Effective airplanes 148411h and up, an inflight refueling probe light has been installed on the right side of the fuselage forward of the inflight refueling probe. The light is used during night inflight 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 F-4B 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 inflight refueling probe with a special fitting attached. The system 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 lbs.) 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 position before single point pressure fueling. External transfer switch OFF, wing transfer pressure switch NORMAL, refuel selection switch ALL TANKS, buddy fill switch STOP FILL, 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 Buddy Tank is interchangeable with the centerline external tank and is refueled in the same manner as the centerline tank. The landing gear control handle must be in the gear down position and master switches and throttles should be in their OFF positions. If two point pressure refueling is desired the refuel probe switch should be placed in the REFUEL position.

REFUELING OPERATION

Apply auxiliary a-c electrical power to the airplane. 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 on ALL TANKS. 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 tanks 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.

INFLIGHT REFUELING

Prior to the rendezvous with the tanker, check that the Radar Master switch is in the STBY position; the radar altimeter power switch is OFF; the Missile power switch is OFF; the Arming switch is OFF; the UHF NAV function switch is in the REC position; the Int Wing Dump switch is in NORMAL; and unnecessary electrical equipment is OFF. After the aircraft position is stabilized slightly below and aft of the drogue, place the Refuel Probe switch in the REFUEL position, and the Refuel Selection switch in the ALL TANKS position (if refueling of the external tanks is desired). Visually check that the refueling probe is fully extended. An amber light on the tanker will indicate that the refueling tanker is ready for transfer. Move forward to engage the tanker drogue. After engagement of the drogue is accomplished, move forward about ten feet to initiate refueling a green light on the tanker will indicate that fuel is being transferred. An increase in power will be required to compensate for the increase in gross weight while taking fuel aboard. Upon completion of refueling reduce speed slightly to disengage from the drogue.

EMERGENCY OPERATION

FUEL BOOST PUMPS

If fuel booster pumps fail, fuel will still be supplied to the engines by gravity feed. If booster pumps fail at altitudes above 20,000 feet, flameout of both engines may occur. During gravity feed, high fuel flow rates required by afterburner operation cannot be met. 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 to minimum required and descend to below 20,000 feet using JP-5 or 10,000 feet using JP-4. Since the boost pumps feed into a common manifold before branching off to the engines and boost pump pressure transmitters, an operative 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

There are no specific limitations pertaining to the fuel system.

HYDRAULIC POWER SUPPLY SYSTEM

DESCRIPTION

Three independent 3000 psi closed center hydraulic systems are used to supply power to components of the airplane which require application of heavy force. The three systems comprise power control systems No. 1 and No. 2 and a utility system. The power control hydraulic systems supply power to the ailerons, spoilers and stabilator only. The utility system supplies power for the rest of the hydraulically operated systems.

POWER CONTROL SYSTEM NO. 1 (PC-1)

Power control system No. 1 (figure 2-16) is powered by a 25 gpm (at 100% engine rpm) engine driven, variable delivery pump-mounted on the left engine. This system furnishes power to the dual aileron, spoiler and stabilator power cylinders. Fluid is supplied to the pump by power control system No. 1 reservoir that has a usable capacity of one gallon. It is an airless, pressure loaded, piston type reservoir that insures necessary positive pressure at the pump suction port regardless of altitude or flight attitude. In the event of a decrease in system pressure a 2000 psi accumulator is used to maintain pressure in the reservoir. Pressure from the pump flows through a relief valve which opens to return at pressures exceeding 3850 psi. An accumulator precharged to 1000 psi is utilized in the system to reduce pump pulsations and to supplement pump flow when system demands are in excess of pump output. A pressure transmitter for the cockpit No. 1 control hydraulic pressure gage is also located in the main pressure manifold. The system is cooled by an oil to fuel heat exchanger. The cooler is designed to maintain an acceptable bulk oil temperature during all phases of operation. Hydraulic power will be delivered to the power control system No. 1 by a wind-driven emergency hydraulic pump in the event of engine or pump failures.

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 tank 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 tank must be full before the No. 1 tanks fuel 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 respective 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 insalled.

Fuel Boost Pump Check

Two momentary type check switches 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 master switches OFF since either 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 below normal discharge pressure (30 ± 2 psi) reading while a pump is being checked indicates a malfunction. During flight or 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 indicated in excess of 38 psi after an acceptable boost pump preflight pressure check is indicative of a malfunction in the fuselage tank pressurization system. The boost pump pressure check limits are 28 to 32 psi for preflight check with ground electrical power on or engines at idle and fuel tanks unpressurized.

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 OFF. With this switch arrangement the fuel system will be set up for automatic fuel transfer and no further switching will be required. If external tanks are carried, switch positions are the same as with no external tanks, except that the External Transfer switch is positioned to the appropriate external tank position. In this case it will be necessary to switch to another external tank position, or place the External Transfer switch OFF when the fuel in the selected tank(s) is depleted. After all external fuel is expended and the External Transfer switch is OFF, 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 turned OFF.

INFLIGHT REFUELING

Prior to the rendezvous with the tanker, check that the Radar Master switch is in the STBY position; the radar altimeter power switch is OFF; the Missile power switch is OFF; the Arming switch is OFF; the UHF NAV function switch is in the REC position; the Int Wing Dump switch is in NORMAL; and unnecessary electrical equipment is OFF. After the aircraft position is stabilized slightly below and aft of the drogue, place the Refuel Probe switch in the REFUEL position, and the Refuel Selection switch in the ALL TANKS position (if refueling of the external tanks is desired). Visually check that the refueling probe is fully extended. An amber light on the tanker will indicate that the refueling tanker is ready for transfer. Move forward to engage the tanker drogue. After engagement of the drogue is accomplished, move forward about ten feet to initiate refueling a green light on the tanker will indicate that fuel is being transferred. An increase in power will be required to compensate for the increase in gross weight while taking fuel aboard. Upon completion of refueling reduce speed slightly to disengage from the drogue.

EMERGENCY OPERATION

FUEL BOOST PUMPS

If fuel booster pumps fail, fuel will still be supplied to the engines by gravity feed. If booster pumps fail at altitudes above 20,000 feet, flameout of both engines may occur. During gravity feed, high fuel flow rates required by afterburner operation cannot be met. 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 to minimum required and descend to below 20,000 feet using JP-5 or 10,000 feet using JP-4. Since the boost pumps feed into a common manifold before branching off to the engines and boost pump pressure transmitters, an operative 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

There are no specific limitations pertaining to the fuel system.

HYDRAULIC POWER SUPPLY SYSTEM

DESCRIPTION

Three independent 3000 psi closed center hydraulic systems are used to supply power to components of the airplane which require application of heavy force. The three systems comprise power control systems No. 1 and No. 2 and a utility system. The power control hydraulic systems supply power to the ailerons, spoilers and stabilator only. The utility system supplies power for the rest of the hydraulically operated systems.

POWER CONTROL SYSTEM NO. 1 (PC-1)

Power control system No. 1 (figure 2-16) is powered by a 25 gpm (at 100% engine rpm) engine driven, variable delivery pump-mounted on the left engine. This system furnishes power to the dual aileron, spoiler and stabilator power cylinders. Fluid is supplied to the pump by power control system No. 1 reservoir that has a usable capacity of one gallon. It is an airless, pressure loaded, piston type reservoir that insures necessary positive pressure at the pump suction port regardless of altitude or flight attitude. In the event of a decrease in system pressure a 2000 psi accumulator is used to maintain pressure in the reservoir. Pressure from the pump flows through a relief valve which opens to return at pressures exceeding 3850 psi. An accumulator precharged to 1000 psi is utilized in the system to reduce pump pulsations and to supplement pump flow when system demands are in excess of pump output. A pressure transmitter for the cockpit No. 1 control hydraulic pressure gage is also located in the main pressure manifold. The system is cooled by an oil to fuel heat exchanger. The cooler is designed to maintain an acceptable bulk oil temperature during all phases of operation. Hydraulic power will be delivered to the power control system No. 1 by a wind-driven emergency hydraulic pump in the event of engine or pump failures.

POWER CONTROL HYDRAULIC SYSTEM

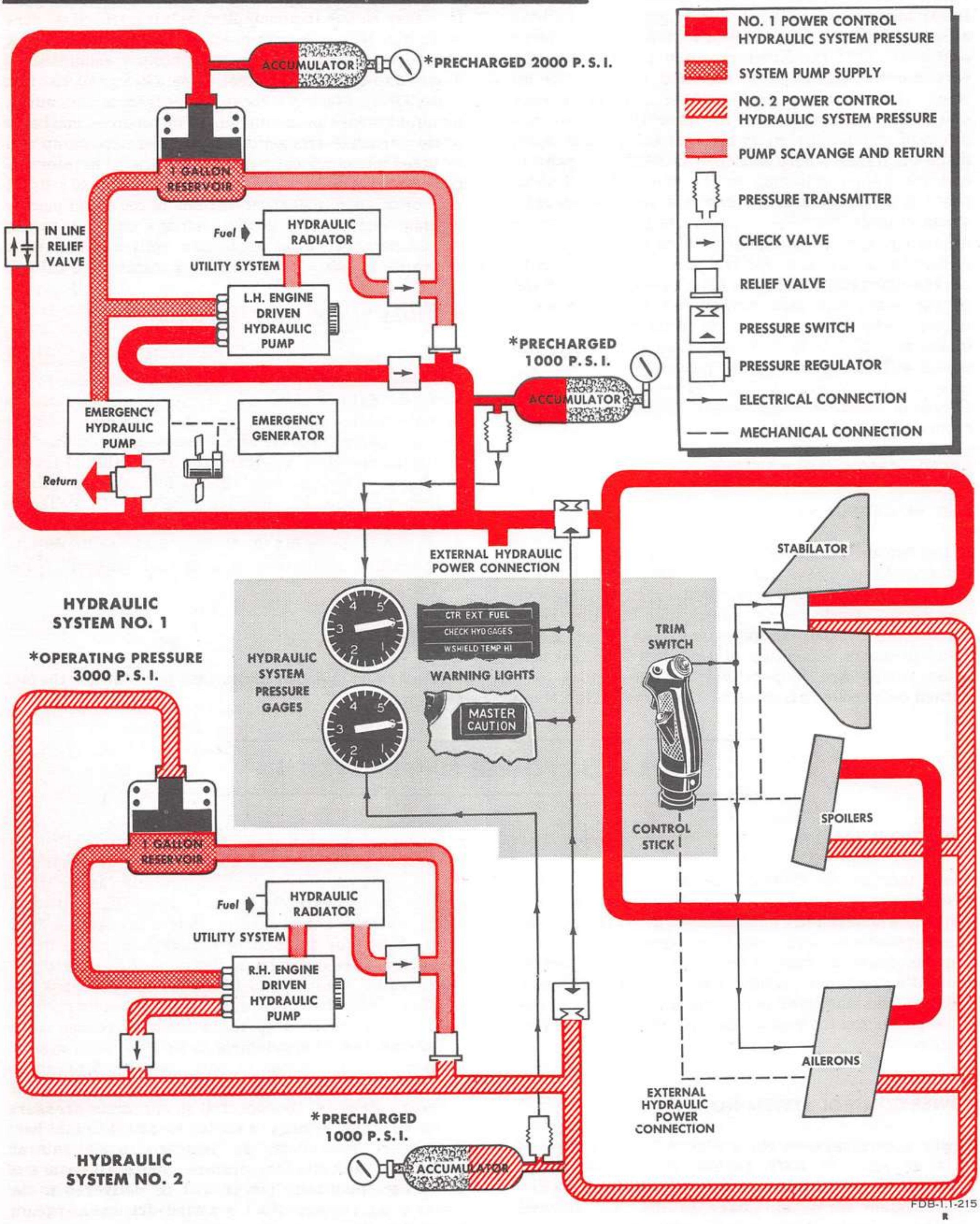


Figure 2-16

POWER CONTROL SYSTEM NO. 2 (PC-2)

Power control system No. 2 (figure 2-16) is powered by a 25 gpm (at 100% engine rpm) engine driven, variable delivery pump-mounted on the right engine. This system also furnishes power to the dual aileron, spoiler and stabilator power cylinders. The system reservoir, relief valve, accumulator, pressure transmitter and heat exchanger are identical and function the same with those in power control system No. 1. No wind-driven emergency hydraulic pump or an accumulator to pressurize the reservoir in the event of a decrease in system pressure are utilized in power control system No. 2.

Note

System No. 1 and No. 2 are independent of each other, but each system satisfactorily functions as an emergency system for the other.

UTILITY HYDRAULIC SYSTEM

The function of the utility hydraulic system (figure 2-17) is to supply fluid under pressure to the following sub-systems:

- Lateral Control Servo
- Wheel Brakes
- Speed Brakes
- Landing Gear
- Wing Fold
- Flap (Leading and Trailing Edge)
- Variable Engine Air Duct Ramp
- Inflight Refueling Probe
- Arresting Gear
- Rudder Power
- Engine Bellmouth
- Aileron and Rudder Flutter Dampers (fluid supplied from return lines)
- Engine Auxiliary Air Doors
- Air Compressor
- Rudder Feel and Rudder Actuators
- Fuel Transfer Pumps
- Nose Wheel Steering
- Missile Cavity Doors
- Autopilot Servo
- Radar Antenna

A 2.5 gallon airless, pressure loaded, piston type reservoir supplies fluid to the utility system's engine driven variable delivery pumps. One pump is driven by the right engine and the other is driven by the left engine. The combined pumps deliver 30 gpm flow at 100% engine rpm. Pump pulsations are reduced by an accumulator which is precharged to 1000 psi. The accumulator also supplements flow when system demands are in excess of pump output. Hydraulic system pressure is transmitted electrically to a cockpit indicator by a system pressure transmitter located in the main pressure manifold. A relief valve limits system pressure to 3850 psi at full system flow. Hydraulic fluid radiators installed in the engine fuel feed lines remove heat from the hydraulic system by means of heat transfer from hydraulic fluid to fuel.

EMERGENCY HYDRAULIC POWER

An emergency hydraulic pump is located in the upper left side of the fuselage behind the aft canopy. The hydraulic pump is powered by a wind-driven turbine which is raised into the airstream penumatically. Fluid under pressure flows from the pump through pressure regulators and check valves into the circuitry of power control system No. 1. In addition the wind-driven trubine drives an a-c generator. The wind-driven turbine extends up and out by pneumatic pressure and drives both the hydraulic pump and the a-c generator. Extending the turbine is accomplished by pushing DOWN on the EMERG HYD PUMP handle (3, figure 1-2) which is located on the left console below the canopy sill immediately outboard of the fuel control panel in the pilot's cockpit. Pull UP on the EMERG HYD PUMP handle to retract the wind-driven turbine. Power control hydraulic systems No. 1 and No. 2 will also function as an emergency system for each other in the event one of the systems should fail.

Note

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 cylinders. This will have no effect upon stick movement and control response but will limit full travel of the lateral control and stabilator systems at high airspeeds.

HYDRAULIC PRESSURE INDICATORS

The hydraulic pressure indicators consist of three individual indicators (29, figure 1-4) and three pressure transmitters. The indicators are mounted on the pedestal panel and are marked No. 1 control, No. 2 control and utility. The three transmitters are located in the two engine accessory compartments. The three indicators are identical having a range of 0 to 5000 pounds with the calibration being 0 to 5 and the reading being multiplied by 1000. The three systems normally will have a pressure range of 2750 to 3250 pounds while the airplane is on the ground and hydraulically operated equipment is not functioning. Electrical power for control system No. 2 indicator and the utility indicator is supplied by the left main 26 volt a-c bus. Control system No. 1 indicator receives power from the essential 26 volt a-c bus.

HYDRAULIC SYSTEMS WARNING LIGHT

An amber "Check Hyd Gages" warning light on the warning light panel (9, figure 1-3) will illuminate when pressure in any system has decreased to 1500 ± 50 psi. The single light serves No. 1 and No. 2 power control systems, and the utility system. The purpose of the light is to warn the pilot that pressure in one of the systems has decreased for some reason and he should check the hydraulic system pressure gages for further information. It should be remembered that the single

UTILITY HYDRAULIC SYSTEM

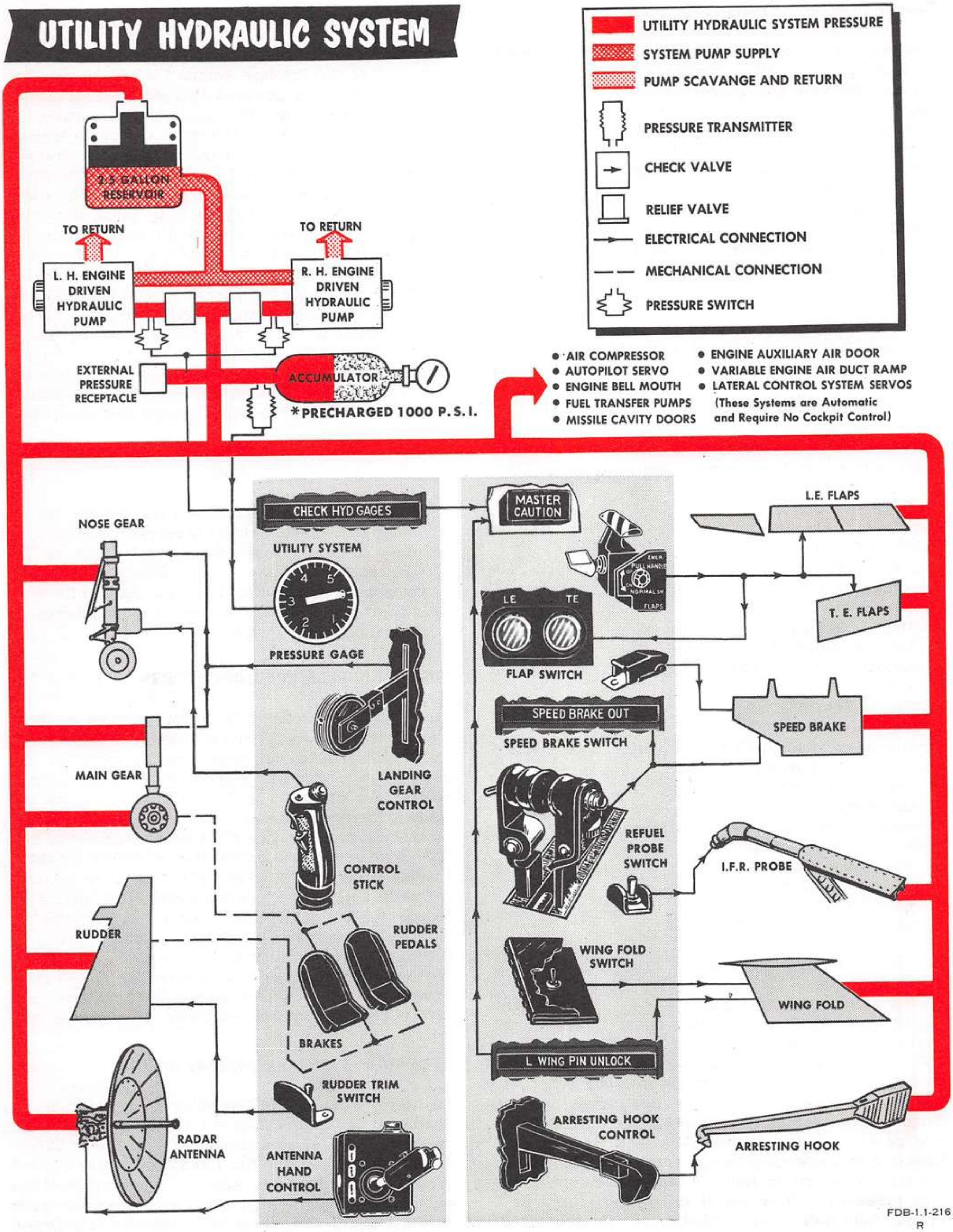


Figure 2-17

warning light serves all three systems, and that the light will illuminate any time the pressure in any one system drops below 1500 ± 50 psi regardless of the pressures on the other two systems. The warning light will be extinguished when the increasing pressure reaches 1750 psi. Power for the warning light circuit is supplied by the essential 26 volt a-c bus.

Note

The "Master Caution" light, "Aux Air Door" caution light, and "Check Hyd Gages" caution 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 pilots pedestal panel.

EMERGENCY OPERATION

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. A hydraulic pump failure in power control system No. 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 PC-2, the full demand of the flight control dual cylinders will be assumed by PC-1. PC-1 and PC-2 are independent of each other, but each system satisfactorily functions as an emergency system for the other. If PC-1 or PC-2 should fail, decrease airspeed to below 515 knots CAS or Mach 1.1 whichever is lower, and extend the ram air turbine.

COMPLETE 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, decrease airspeed to 515 knots CAS or Mach 1.1 whichever is less, and extend the ram air turbine.

UTILITY HYDRAULIC SYSTEM FAILURE

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

a. Rudder
b. Wing flaps
c. Landing gear
d. Speed brakes
e. Variable engine air duct ramps
f. Hydraulic fuel transfer pumps
g. Wheel brakes
h. Arresting gear (retraction)
i. Nose wheel steering

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

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

Speed brake retraction is available by placing the emergency speed brake switch in the RETRACT position. The rudder can still be operated mechanically without hydraulic boost, however, pedal forces will be much higher than noral.

LIMITATIONS

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

INSTRUMENTS

DESCRIPTION

Most of the instruments are electrically operated by power from the electrical system, see figure 2-9. 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 (1, figure 1-4) is located on the pilot's and RIO'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 true airspeed outputs are produced from the signal from the total temperature sensor by routing this signal through a potentiometer driven by one of the Mach number function cams. Thus, Mach number is translated into true airpseed.

ALTIMETER

An altimeter (8, figure 1-4) located on the pilot's and RIO'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 feed units with major 100 feet 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 sea level pressure. This scale range is from 28.10 to 31.00 inches mercury.

AIRSPEED AND MACH NUMBER INDICATOR

The combination airspeed and Mach number indicator (4, 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 rotable 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.

VERTICAL VELOCITY INDICATOR

A vertical velocity indicator (21, 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 static pressure system of the airplane 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 are incorporated in the ADI (5, figure 1-4). The rate of turn needle measures turn rate only around the vertical axis of the airplane. Therefore, increased bank angle will not necessarily be reflected in increased needle deflection. Although the actual turn rate of the airplane increases, the turn rate about the vertical axis of the airplane does not. Consequently, do not depend too strongly on the turn needle for establishing turn rate during IFR flying since, the rate of turn needle should never indicate a single needle width deflection in coordinated flight. Single needle width turns can only be accomplished during low speed flight due to increased turn rate for a given bank angle, however, beyond a certain point needle deflection will not continue to increase with bank angle. The index indicates a turn of 180° in one minute when the pointer is coinciding with the index.

ACCELEROMETER

An accelerometer (30, figure 1-4) with three indicating hands, registers and records positive and negative "g" loads. One hand moves in the direction of the "g" load being applied while the other two, one for positive "g" loads and one for negative "g" loads, following the indicating pointer to its maximum travel. The recording pointers remain at the respective maximum travel positions of the "g's" being applied, thus providing a record of maximum "g" loads encountered. Depressing the push to reset knob at the lower left corner of the instrument, allows the recording pointers to return to the normal (1 g) position.

Note

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

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.

NORMAL OPERATION

Normal operation of the instruments commences with power being applied to the airplane, and the specific instrumentated system energized.

EMERGENCY OPERATION

There are no specific emergency operations pertaining to the instruments.

LIMITATIONS

There are no specific limitations pertaining to the instruments.

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 by the right main 28 volt d-c bus and hydraulically actuated by the basic utility 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 (35, figure 1-4) 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 system pressure to the landing gear. Placing the handle in the gear UP position will energize switches in the fuel tank vent and pressurization, jettison and armament circuit. 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 cu. in. 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 (11, 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. The indicator circuit receives its power from the essential 28 volt d-c bus.

NOSE STRUT CATAPULT EXTENSION

A switch in the left main gear wheel well operates a solenoid valve which controls the inflation of the catapult extension chamber of the strut. Compressed air from the basic pneumatic system is supplied to a cavity above a floating piston in the nose gear shock strut upper cylinder. This air forces the piston down causing the strut to fully extend and giving the desired airplane attitude for catapulting. Retraction of the gear will cause the catapult extension chamber in the strut to be deflated, and the strut returns to the normal configuration. The catapult extension chamber may also be deflated by momentarily placing the cockpit generator switches to the OFF position.

WARNING

Airplane pneumatic system must be fully charged (2750 psi minimum) before extending nose gear. 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.

NOSE WHEEL STEERING

An electrically controlled, hydraulically operated actuated nose wheel steering system is installed in the aircraft. The steering actuator is located on the nose wheel strut and geared to the strut torque collar. It performs the work of both steering and damping. A bypass valve in the steer-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 2-10) is held down, the main gear strut is compressed and the nose gear is 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.

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.

EMERGENCY OPERATION

If normal gear operation fails, the gear can be lowered by pulling the landing gear circuit breaker; pushing the landing gear handle down; and pulling aft on the landing gear handle, and holding 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.

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 of the landing gear is 250 knots CAS.

LIGHTING EQUIPMENT

DESCRIPTION

EXTERIOR LIGHTING

The exterior lights system consist of a exterior lights master switches position lights, join-up lights, fuselage lights anti-collision lights, angle-of-roll light and approach lights. The exterior lights control panel (12, figure 1-3) is located near the aft end of the pilot's right console and contains all the manual controls for the exterior lighting.

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 SIGNAL. Movement of the switch to the ON position will energize the exterior lights panel through which the exterior lights can then be controlled. 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. The master switch and exterior lights panel receive power from the right main 28 volt d-c bus.

Position and Join Up Lights

The position lights include the wing tip position lights and the tail light. 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 wing toggle switch. The tail light is controlled by a separate three position OFF, DIM, BRT tail toggle switch. Both switches are located on the exterior lights control panel. The wing and tail switches are two separate switches but both function 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 and in the case of the wing lights switch and join-up lights will also illuminate. 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 26/14 volt a-c bus. The bright lights circuit is powered by the right main 26 volt a-c bus.

Fuselage and Anti-Collision Lights

Three semi-flush white lights are installed on the fuselage, one above the number two fuselage fuel tank and one light 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 fin. The fuselage switch on the exterior lights control panel controls 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 flash steady switch is in the FLASH position. The MAN position of the switch allows the fuselage lights to be keyed by the manual key button. The fuselage lights are powered by the left main 26/14 volt a-c bus. One of the two lamps in the anti-collision light is powered by the R.H. main 26 volt a-c bus, and the other from the L.H. main 26 volt a-c bus.

Flash Steady Switch

The flash steady switch located on the exterior lights control panel will operate the flasher relay and flasher unit causing the fuselage lights and tail light to glow steadily or flash. The anti-collision light will operate only when the flash steady switch is in the FLASH position. The flasher unit and relay is powered by the right main 28 volt d-c bus.

Manual Key Button

The manual key button located on the exterior lights control panel is used to key the fuselage lights when the fuselage lights switch is in the MAN position and the FLASH STEADY switch is in the STEADY position. An indicator light on the exterior lights panel will glow when the manual key button is depressed. The manual key button receives its power from the left main 26/14 volt a-c bus.

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 approach; 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 FCLP (field carrier landing practice) only and is designed to serve as a roll reference for the mirror landing officer until such time that the right wing tip is visible. The angle-of-roll light is automatically energized when the arresting gear is down and the landing gear is down and locked. The angle-of-roll light can be made to illuminate without the arresting gear being extended by momentarily holding the arresting gear bypass switch in the ON position. One complete recycling of the arresting gear will reset the bypass switch to the normal OFF position. The angle-of-roll light receives its power from the left main 28 volt d-c bus.

Hook Bypass Switch

The hook bypass switch is located on exterior lights control panel. The hook 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 steadily without having the arresting gear extended. With the switch in the NORMAL position, the approach lights will flash unless the arresting gear is down. With the arresting gear down, the approach lights will illuminate steadily.

IFR Probe Light

Effective airplanes 148411h and up, an inflight refueling probe light has been installed on the right side of the fuselage forward of the inflight refueling probe. The light is used during night inflight 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.

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. The instrument panel lights are the only lights that are illuminated by utilizing the emergency generator system.

PILOT'S COCKPIT LIGHTING

Most of the lighting controls in the pilot's cockpit are located on the cockpit lights control panel (8, figure 1-3) which are located on the pilot's right console. The utility light is mounted under the right canopy sill and has its own on-off and intensity control. The instrument panel emergency red floodlight switch is mounted above the cockpit lights control panel on 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 warning lights. 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 is labeled OFF, DIM and BRT and provides only bright or dim positions. The instrument lights are powered from the essential 115 volt a-c bus. The emergency floods are powered by the essential 26 volt a-c bus in the bright position and by the left main 26/14 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 aft inboard corner of the cockpit lights control panel. This knob controls all edge lighting on the left and right console, the pedestal panel and the armament control panel on the pilot's instrument 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 essential 26/14 volt a-c bus supplies power for the bright circuits.

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 standby compass light on and off.

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 and the switch is spring-loaded to the NORMAL position. When placed in the TEST position, the warning lights will be illuminated. The warning lights test circuit receives power from the right main 28 volt d-c bus.

Utility Light

A utility light is provided and 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. The utility light is powered from the right main 26 volt a-c bus.

Spare Edge Lamps

Spare edge lamps are located in a spring-loaded cylindrical container on the wing fold control panel on the right console.

RIO'S COCKPIT LIGHTING

The light controls in the RIO's cockpit are of a simplified nature. All primary lighting both of instrument and control panels is controlled by the three-position "INSTR" switch located on the left side of the instrument panel. The switch positions are OFF, DIM and BRT and provides only two intensities of lighting for the control and instrument panel edge lights. Secondary red floodlighting is provided for the instrument panel and all control panels and is controlled by a three-position cockpit floods switch located inboard of the "INSTR" switch on the instrument panel. The switch positions are OFF, DIM and BRT and they also give fixed intensities of DIM and BRT to the five red floodlights located throughout the RIO's cockpit. When the "INSTR" switch is positioned from OFF to DIM or from OFF to BRT, the drogue in, drogue out and fuel flow warning lights on the Buddy Tank control panel will be automatically dimmed. The instrument and cockpit floods switches in the DIM position receive power from left main 26/14 volt a-c bus. The "INSTR" switch in the BRT position is powered off the right main 26 volt a-c bus. The BRT position of the cockpit floods switch receives power from the essential 26 volt a-c bus.

Warning Lights Switch

The warning lights switch is a two-position switch located on the instrument panel inboard of the cockpit floods switch. The switch positions are OFF and TEST and the switch is spring-loaded to the OFF position. When placed in the TEST position the canopy unlock, left wing pin unlock, right wing pin unlock and radar CNI cool off warning lights will illuminate. The warning lights test circuit receives power from the right main 28 volt d-c bus.

Utility Light

The utility light is mounted above and to the left of the RIO'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. The utility light is powered from the right main 26 volt a-c bus.

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 pilots and RIO's interior lights are controlled by the various switches located on the applicable control panels.

EMERGENCY OPERATION

There are no provisions for emergency operation of the exterior or interior lighting. However, the pilots instrument panel and consoles, and the RIO's cockpit have red flood lights that are powered from an essential bus. These lights can be illuminated when the ram air turbine is extended, by placing the respective floodlight switches in the BRT position.

LIMITATIONS

There are no limitations pertaining to the lighting equipment.

NAVIGATION EQUIPMENT

DESCRIPTION

The three main navigational systems on the airplane consist of the AN/AJB-3A, All Attitude Indicating System, the Flight Director Group (HSI and ADI), and the Navigation-Computer System. Each of these systems provides its share of information to supply the crewmembers adequate navigational assistance.

AN/AJB-3A ALL ATTITUDE INDICATING SYSTEM

The AN/AJB-3A All Attitude Indicating system consists of the following components: (1) a three-axis all-attitude indicator on the pilot's instrument panel, (2) bomb control switches on the pilot's instrument panel, (3) an interval timer on the right-hand side of the radar operator's cockpit, (4) an amplifier-power supply unit, (5) a two gyro reference unit, (6) a switching rate gyro, (7) a distribution box, (8) a bomb release angle computer, (9) a compass adapter unit, (10) a compass controller unit on the pilot's right-hand console and (11) a magnetic flux valve. The AN/AJB-3A all attitude, 3 axis, stabilized platform indicating system (figure 2-18) has two distinct functions. First it furnishes the pilot with all the necessary information to perform low altitude bombing maneuvers. Secondly, the AN/AJB-3A system functions as a pitch and roll stabilized directional gyro compass system. The system also provides heading, pitch and bank signals to the autopilot and navigation computer. The display sphere is painted to give the illusion of visual flight. Heading is marked off in five-degree increments along the horizontal and in 30 degree increments at high or low pitch angles. Bank angle scale around the periphery is graduated in 10 degree increments up to 30 degrees. When the airplane is flying at pitch angles above or below 70 degrees where changes in bank angle actually represents changes in airplane heading, the bank angle graduations automatically disappear from the indicator bezel so that the pilot will think of aileron control in terms of its effect of changing airplane heading rather than in terms of bank angle. The bank graduations automatically return when the airplane pitch or dive angle drops below approximately 70 degrees. Use of a stabilized platform instead of conventional gyro compass and horizon gyro, provides unlimited pitch, roll axis maneuvering without gyro tumbling or discontinuity in pitch axis indication during an Immelmann turn. It also eliminates large heading errors at high pitch and bank angles, or during continuous turns. A flag on the face of the instrument indicates power on and off, and phase reversal. The OFF letters disappear when power is on and phasing is correct. The single control on the indicator is a pitch trim knob which may be used to give normal indications for various angles of attack caused by gross weight airspeed combinations. The limits of pitch trim adjustment are 6° nose down to 20° nose up. Power for the operation of this system is supplied by the essential 115 volt a-c bus, the essential 26 volt a-c bus and the essential 28 volt d-c bus.

COMPASS CONTROLLER

A compass system controller (15, figure 1-3) located on the pilot's right hand console provides the necessary controls and indication to operate the gyro-magnetic compass system. This unit is used to select the mode of directional gyro control, indicate compass vs. heading data synchronization, control manual fast synchronization, and to set up latitude compensation slaving of the directional gyro. The controls include the following:

a. A three-position rotary mode switch labeled FREE, SLAVED and COMPASS.
b. A latitude compensator knob and dial calibrated 90°N - 0° - 90°S in 5° increments.
c. A push-to-turn heading set knob which controls the speed and direction of rotation of the output data shaft in the compass adapter. The speed may be controlled from 1/2 to 10 rpm.
d. A push-to-sync button which is used to synchronize the output data shaft with the magnetic heading.

Free Mode

The Free mode is used in north and south latitudes greater than 70° and in areas where the earth's magnetic field is appreciably distorted. When the

Free mode is initially selected, the magnetic heading of the airplane must be set into the system by positioning the Attitude Director Indicator sphere to this known heading. This is accomplished by rotating the push to turn heading control knob on the Compass System Controller. The system will use this reference for all following heading indications. Apparent and real drift compensation is accomplished by a differential synchro driven at a predetermined rate. Random drift, which cannot be predicted, may cause small errors in this mode. For this reason, the Free mode should be used only when necessary. During shipboard operation, place the compass controller in the FREE mode because of errors in the SLAVE mode due to the magnetic influence of the ship. To establish the Free mode, place the bomb control Labs-Direct switch in the OFF position; the mode switch in the FREE position; the hemisphere knob to the proper north or south latitude; and set the proper latitude in the latitude readout window. If necessary, set the ADI sphere to the actual airplane magnetic heading, and adjust for zero pitch attitude. Readjust the latitude control for each 5 degree change in latitude.

Slaved Mode

In the Slaved Mode, the azimuth system is primarily controlled by signals from the remote compass transmitter. In addition to this signal, bias signals are supplied to compensate for drift. Because system accuracy is not dependent upon the earth's magnetic field, the Slaved mode should only be used in latitudes under 70°, and in areas where the earth's field is not distorted. A visual indication of the synchronization between the azimuth system and the remote compass transmitter is provided by the Sync Indicator. To put the computer set in the Slaved mode, place the bomb control Labs-Direct switch in the OFF position and turn the mode switch to the SLAVE position. Allow ten seconds for automatic fast synchronization and check the Sync Indicator for a center scale indication. Slight deviation of the pointer from the center position will be corrected by normal slaving. Adjust the ADI for zero pitch attitude.

Compass Mode

The Compass mode is considered an emergency mode in the AN/AJB-3A system. It should only be used if the displacement gyro fails, and the Slaved or Free mode cannot be used. The Compass mode furnishes azimuth information to other systems when the Attitude Director Indicator is disabled. It bypasses the displacement gyro completely and depends solely upon the remote compass transmitter for azimuth information. The Sync Indicator remains operational in the Compass mode. The Attitude Director Indicator is still coupled to the displacement gyro in the Compass mode and should not be used. To place the computer set in the Compass mode, place the bomb control Labs-Direct switch in the OFF position, and turn the Mode switch to the COMP position.

CAUTION

In the compass mode, the attitude director indicator (ADI) is still coupled to the displacement gyro and is not receiving magnetic compass correction. Therefore, the azimuth reading of the ADI may be in error and the HSI should be used as the heading reference.

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.

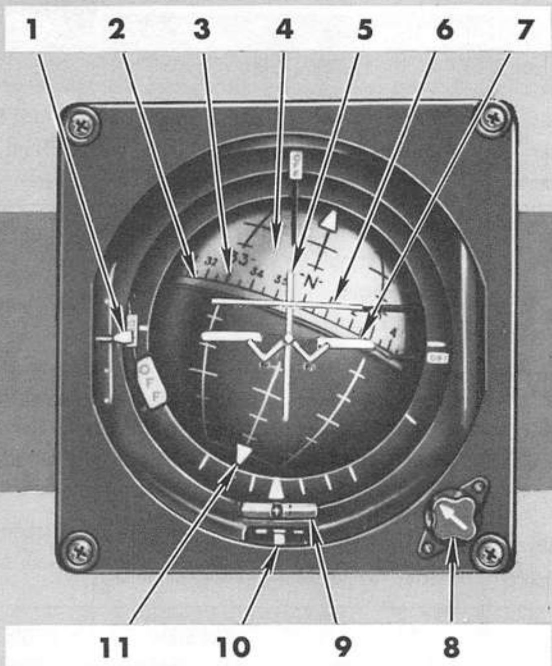
Flight Director Computer

The flight director computer is used in the instrumentation system, and 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. The computer also includes two servo computing mechanisms. The first adds compass heading to the ground track signal from the Nav Computer such that it can be displayed on the course pointer of the HSI. The second mechanism, in conjunction with the first, subtracts ground track from bearing to destination and adds magnetic heading to the difference in order that the command heading marker on the HSI can be positioned. Heading error is then obtained from the control transformer in the HSI and used together with bank angle to compute a steering signal for display on the vertical director pointer of the ADI.

HORIZONTAL SITUATION INDICATOR

The HSI (figure 2-19) provides the horizontal or plan view of the aircraft with respect to the navigation situation. It provides an integrated display of navigation data from various sources and presents this data to the pilot in a symbolic-pictorial display for quick and easy assimilation. The central portion of the display contains a compass card which displays aircraft heading when read against the lubber line and against which a command heading marker, a bearing pointer, and a course pointer may be read for numerical

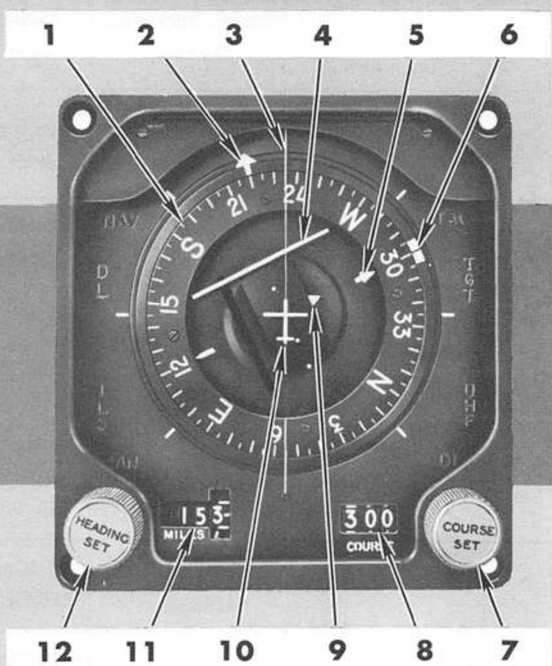
ATTITUDE DIRECTOR INDICATOR



1. VERTICAL DISPLACEMENT POINTER
2. HORIZON
3. AZIMUTH SCALE
4. 3-AXIS SPHERE
5. VERTICAL DIRECTOR POINTER
6. HORIZONTAL DIRECTOR POINTER
7. WINGS SYMBOL
8. PITCH TRIM KNOB
9. BANK INCLINOMETER
10. RATE OF TURN NEEDLE
11. ROLL INDEX

Figure 2-18

HORIZONTAL SITUATION INDICATOR



1. COMPASS CARD
2. BEARING POINTER
3. LUBBER LINE
4. COURSE BAR
5. COURSE POINTER
6. COMMAND HEADING MARKER
7. COURSE SELECTOR KNOB
8. COURSE READOUT WINDOW
9. TO-FROM POINTER
10. AIRPLANE SYMBOL
11. DISTANCE READOUT WINDOW
12. HEADING SELECTOR KNOB

Figure 2-19

MODE CHART

INDICATOR	PARAMETER	MODE SELECTOR SWITCH: ATT	MODE SELECTOR SWITCH: HDG	MODE SELECTOR SWITCH: TACAN	MODE SELECTOR SWITCH: NAV COMP	BOMB MASTER SWITCH: LABS
ATTITUDE DIRECTOR INDICATOR	Vertical Director Pointer Off Flag	Off Scale From Flight Director Computer	Off Scale From Flight Director Computer	From Tacan Set	Off Scale From Flight Director Computer	Off Scale From Flight Director Computer
	Vertical Director Pointer	Off Scale From Flight Director Computer	Steering Signal For Selected Heading	Steering Signal For Selected Tacan Radial	Steering Signal For Selected Destination (BRG To Dest Minus Ground Track)	Steering Signal From AN/AJB-3
	Horizontal Director Pointer Off Flag	Off Scale From Flight Director Computer	Off Scale From Flight Director Computer	Off Scale From Flight Director Computer	Off Scale From Flight Director Computer	Off Scale From Flight Director Computer
	Horizontal Director Pointer	Off Scale From Flight Director Computer	Off Scale From Flight Director Computer	Off Scale From Flight Director Computer	Off Scale From Flight Director Computer	Steering Signal From AN/AJB-3
	Vertical Displacement Pointer	Off Scale From Flight Director Computer	Off Scale From Flight Director Computer	Off Scale From Flight Director Computer	Off Scale From Flight Director Computer	Off Scale From Flight Director Computer
HORIZONTAL SITUATION INDICATOR	Command Heading Marker	MAG Hdg Of A/C	Set By Pilot To Selected Hdg	Set By Pilot To Tacan Radial (Rotates With Compass Card)	Cmd Hdg From Flight Director Computer	Determined By Mode Selector
	Course Pointer	Mag Hdg Of A/C	Mag Hdg Of A/C	Set By Pilot To Selected Tacan Radial	Ground Track From Nav Comp	Determined By Mode Selector
	Course Bar Deviation	Zero	Zero	Deviation From Selected Tacan Radial	Zero	Determined By Mode Selector
	To-From Pointer	Out Of View	Out Of View	From Tacan	Out Of View	Determined By Mode Selector
	Mode Words		MAN	TAC	NAV	Determined By Mode Selector

INDICATOR	PARAMETER	BEARING DISTANCE SELECTOR SWITCH: NAV COMP	BEARING DISTANCE SELECTOR SWITCH: ADF	BEARING DISTANCE SELECTOR SWITCH: TACAN	
HORIZONTAL SITUATION INDICATOR	Bearing Pointer	Bearing To Destination	Bearing To ADF	Bearing to TACAN	Determined By BRG/Dist Selector
	Distance Window	Distance To Destination	Off	Distance to TACAN	Determined By BRG/Dist Selector
	Mode Words	NAV	UHF	TAC	Determined By BRG/Dist Selector

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Figure 2-20

MODE-BEARING/DISTANCE SELECTOR PANEL

values of magnetic bearing, course and heading. The bearing pointer provides pictorial bearing information to the radio facility, destination, target, or computed way-point. The course pointer indicates the selected TACAN, or computed course, while the course bar (center segment of the pointer) indicates the aircraft's deviation from this course as shown pictorially with respect to the stationary miniature airplane symbol at the center of the display. A "to-from" pointer shows the direction along the selected course leading to the radio facility or computed waypoint. A heading marker just outside the compass card indicates the selected heading and by its angular displacement from the lubber line, the heading error angle. Both the course pointer and the heading marker may be set manually by means of the course set and heading set knobs, or remotely by means of the indicator's course command and heading the digital counter at the lower right of the display, while a digital counter at the lower left indicates the distance in nautical miles to the radio facility or computed waypoint. Four mode-of-operation word messages are shown around the display. These are illuminated internally to indicate the selected operating modes.

ATTITUDE DIRECTOR INDICATOR

The attitude director indicator (figure 2-18), as used with the flight director group, provides attitude and heading information in all three axes simultaneously with flight director indication. The vertical pointer is the only pointer used in conjunction with the flight director group, and is used in the following manner. When the HDG, TACAN or NAV COMP mode is selected, a steering signal for the selected heading, TACAN radial or destination, is sent from the flight director computer to the ADI. The vertical director pointer on the ADI is deflected and the pilot merely banks the airplane to center the vertical director pointer. This enables the pilot to make an asymptotic approach to the selected heading, TACAN radial or track to destination. The vertical director pointer does not indicate direction or displacement from the desired heading, TACAN radial or destination, but rather the corrective action required to intercept the heading, TACAN radial or destination.

Note

In the event the ADI is inoperative the artificial horizon on the radar scope display is suitable for use as a standby attitude indicator.

MODE-BEARING/DISTANCE SELECTOR PANEL

The mode-bearing/selector panel (figure 2-21) is located on the pilot's main instrument panel. The panel contains a mode selector switch and a bearing distance selector switch. Refer to figures 2-18 and 2-19 for pointers that are used on the HSI and ADI in conjunction with the mode and bearing distance selector switch positions. Refer to figure 2-20 for HSI and

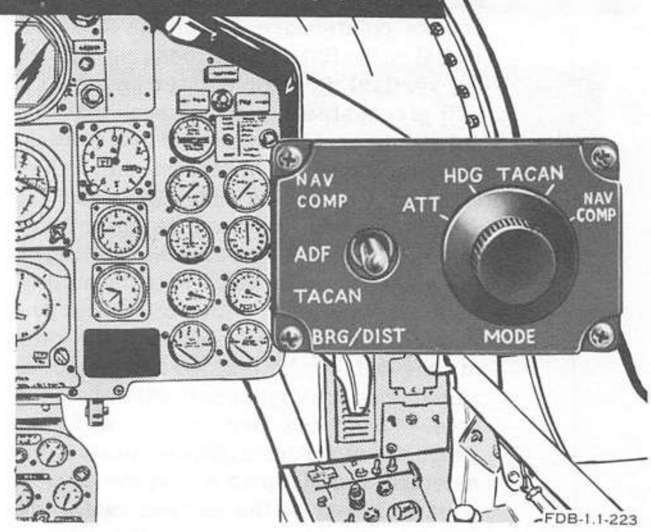


Figure 2-21

ADI pointers that are used during various modes of operation.

Mode Selector Switch

The mode selector switch is a rotary type switch with switch positions of ATT, HDG, TACAN, and NAV COMP. The switch is used to select the source of information to be displayed on the HSI and ADI. The function of each switch position is described below.

ATT - Selection of the ATT position essentially eliminates navigational assistance from all indicators but the bearing pointer and distance window on the HSI. All pointers on the ADI are deflected out of view as is the to-from pointer on the HSI. The heading marker and course pointer on the HSI will be slaved to the lubber line, and the course bar will be centered. Except for the function selected on the BRG/DIST switch all that is left is attitude display and mag. heading indication.

HDG - The HDG position activates circuitry to assist the pilot in steering "asymptotically" to a new heading and holding that heading. The desired heading should be selected by moving the heading marker with the HDG. SET knob on the HSI. The vertical director pointer of the ADI will then deflect to indicate in which direction the airplane should be banked. When the proper bank is established the pointer will center and remain centered until bank angle should be decreased, at which time it will so indicate. Thus, when the aircraft has been turned to the desired heading the director pointer will call for zero bank. When HDG position is active, the word MAN will be illuminated on the HSI face.

TACAN - The TACAN position provides asymptotic steering to a preselected TACAN radial provided both heading marker and course pointer are set at the selected radial on the HSI. Under these conditions the vertical director pointer on the ADI will give a steering signal such that the pointer is centered when the proper bank is established to intercept the radial (similar to steering under HDG above). Simultaneously, the course bar of the HSI will deflect to indicate the position of the selected radial relative to the miniature airplane on the face of the instrument. This bar will deflect at the rate of one dot per 2 1/2° of the selected radial with maximum deflection being 2 dots. Thus, the bar will provide an estimate of aircraft displacement from selected radial up to 5°. If the course pointer is set to the desired radial the course should appear in the course readout window. Also, in TACAN position, a to-from arrow will be present and will indicate whether the aircraft will be flying to or from the station on the radial selected. The mode word TAC will be illuminated on the HSI face when TACAN is selected.

WARNING

When operating in the TACAN mode, the course pointer and command heading marker on the HSI must be aligned or an erroneous signal will be sent to the vertical director pointer of the ADI. This erroneous signal will center the vertical director pointer 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 pointer set at the selected course, both the vertical director pointer (ADI) and the course bar (HSI) will be centered. If it then becomes necessary to establish a crab angle (aircraft heading different from the selected radial) the vertical director pointer 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.

NAV COMP - Effective airplanes 149403i and up the NAV COMP position provides navigational information from the Vertical Director Pointer on the ADI, and the Course Pointer, Command Hdg Marker and course window on the HSI. The NAV light on the HSI will be illuminated. All other indicators on the two instruments will be deflected off scale except the Course Bar of the HSI which will be zeroed. Assuming the proper position information has been set into the navigation computer, positioning the MODE switch to NAV COMP supplies the following information:

Hdg Marker - Computed heading to be flown to destination in order to make good the course shown in the course window (wind drift included).
Course Pointer - computed magnetic ground track being made good by the aircraft.
Course Window - Mag course to the destination from present position.
Vertical Director Pointer - Indicates direction in which to bank in order to intercept the course to destination (similar to TAC or HDG steering).

Under a no wind condition the airplane will be on the computed course to the destination when the course pointer and the heading marker are under the lubber line. This course will also be displayed in the course window. If wind drift correction is required, the command heading marker should still be held under the lubber line, but the course pointer will be offset by an amount equal to the drift angle. The course window will still agree with the course pointer and the vertical director pointer will remain centered as long as the airplane is on the computed course with wings level.

Bearing/Distance Selector Switch

The bearing/distance selector switch is a three-position toggle switch with switch positions of NAV COMP, ADF and TACAN. The NAV COMP position of the switch is inoperative and will not be discussed. The ADF, TACAN, and NAV COMP positions functions as described below.

ADF - With the bearing/distance switch in ADF position, the bearing pointer of the HSI will point at the magnetic bearing of the UHF signal being received. Simultaneously, the UHF mode word will be lit on the HSI instrument if the instrument lights are turned up. The distance window will be covered.

TACAN - Selecting the TACAN position of the bearing/distance switch will light the mode word TAC on the HSI. It will also cause the bearing pointer to indicate the mag. bearing to the selected TACAN station, and will activate the distance measuring capability such that the nautical mileage to the TACAN station appears in the distance readout window.

NAV COMP - Effective airplanes 149403i and up the NAV COMP position on the Brg/Dist switch displays magnetic bearing to selected destination on the bearing pointer of the HSI, and distance to the destination in the mileage window. The word NAV will be illuminated on the HSI face.

It should be noted that simultaneously ADF and TACAN steering can be achieved by setting the bearing/distance switch to ADF and the mode switch to TACAN, ADF bearing will then be available on the bearing pointer and TACAN steering will be reflected by the vertical director pointer and the course bar. The mode words TAC, UHF, and MAN will not be illuminated on the face of the HSI unless the instrument lights are turned on.

NAVIGATION-COMPUTER SYSTEM

The AN/ASN-39A navigation computer is installed in airplanes 149403i and up. It is a great circle computer and consists of a control panel and amplifier. The computer system makes the following dead reckoning computations during flight:

a. The latitude and longitude of the present position of the aircraft, which is displayed on the computer-control.
b. The aircraft ground track angle, relative to true heading.
c. The great circle distance from the present base, as selected.
d. The great circle bearing to the preset target or preset base, as selected, relative to true heading.

Computer Control Panel

All airborne operating controls for the navigation computer are located on the computer control panel (16, figure 1-5) in the aft cockpit. By means of this unit the crewmembers sets in wind, variation and target and base position inputs, and reads out his present position. The controls and their functions are as follows:

Function Switch

The function switch is a five position rotary switch whose positions are marked OFF, TARGET, BASE STBY, and RESET.

OFF - Remove all power from navigation computer.

TARGET - When the switch is in the TARGET position, the range to target, ground track relative to true heading, and course angle (bearing) relative to true heading will be displayed on the BDHI, HSI, and ADI.

BASE - When the switch is in the BASE position, the range and bearing output will be displayed on the BDHI, HSI, and ADI.

STBY - In this position only filament power is supplied to the computer amplifier, and the latitude and longitude integrator channels of the system are inoperative.

RESET - In this position the latitude and longitude of the base, alternate target, or return point can be set into the system. Placing the switch in the RESET mode will cause the original set in coordinates to be lost. A restriction on the selector switch prevents accidental switching to the RESET position.

Wind Velocity Control Knob

The wind velocity control knob is used to manually insert the wind velocity affecting flight into the system and is displayed on the wind velocity counter.

Wind from Control Knob

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, and is not a constant but varies over the face of the earth. The magnetic variation is displayed in degrees on the variation counter.

Position Latitude Control Knob

This knob is initially used to manually insert the base latitude into the system, thereafter, it is used to insert the present position latitude as required. The base latitude is not displayed anywhere during flight, a memory of this ordinate is retained by the system so long as the function switch is not turned to RESET. The position latitude counter continuously indicates the aircraft latitude in degrees and minutes during flight.

Position Longitude Control Knob

The position longitude control knob functions the same as the latitude control knob described above.

Target Latitude Control Knob

The target latitude control knob is used to manually insert the target or destination latitude into the system. This information is displayed target latitude counter in degrees and minutes.

Target Longitude Control Knob

The target longitude control knob functions the same as the target latitude control knob described above.

NAVIGATION COMPUTER DISPLAYS

The navigation computer information is displayed on the HSI, and ADI in the forward cockpit, and on the BDHI in the aft cockpit.

FWD Cockpit Displays

To display navigation computer information on the HSI and ADI select the NAV COMP position on the mode switch and the NAV COMP position on the bearing/distance selector switch of the mode-bearing/distance selector panel. The displayed information is as follows:

1. Bearing to target or base displayed on the bearing pointer of the HSI.
2. Ground track displayed of the course pointer of the HSI.
3. Distance to target or base displayed on the distance counter on the HSI.
4. Command heading (the heading the pilot must fly to align the bearing and course pointers) displayed on the heading marker of the HSI.
5. Steering information to fly an asymptotic approach to the command heading displayed on the vertical pointer of the ADI.

To fly the aircraft directly to the target or base turn the aircraft until the vertical pointer on the ADI is centered. Keep the vertical pointer centered by changing the heading and bank of the aircraft. The heading marker will rotate to the lubber line and the vertical pointer on the ADI will be deflected from center. As long as the mode selector switch on the mode-bearing/distance selector panel is in the NAV COMP position the ADI will present steering information to the NAV COMPUTER course, the course pointer will display ground track, and the heading marker will display command heading to the nav computer course. The bearing/distance switch on the mode-bearing/distance selector panel can be switched to any other function without interrupting the NAV computer display on the ADI. It only removed the NAV computer bearing and distance displays from the HSI.

AFT Cockpit Displays

To display navigation computer information on the BDHI, select the NAV COMP position on the CNI-NAV comp switch. The displayed information is as follows:

1. Bearing to target or base displayed on the #1 needle of the BDHI.
2. Ground track displayed on the #2 needle of the BDHI.
3. Distance to target or base displayed on the range counter.

NORMAL OPERATION

Operation of the AN/AJB-3A All Attitude Indicating System and Flight Director Group is found in the pertinent preceeding paragraphs. To operate the Navigation Computer, dial in the magnetic variation, wind velocity, wind direction, target latitude and target longitude in the respective counter. Place the Function switch in the RESET position. Depress and rotate the Position Latitude and Position Longitude control knobs to set the latitude and longitude of your destination in the counters. If the destination differs from the present position, place the Function switch in STBY and set the Position Latitude and Position Longitude counters to the present position. If the engines have not been started, turn the Function switch OFF, start the engines, and turn the Function switch to STBY. After take-off and airspeed reaches 160 knots CAS place the Function switch to TARGET. This will result in system outputs of range to target, ground track relative to true heading, and course angle (bearing) relative to true heading. Upon completion of mission over target, place the Function switch to BASE. This will orient the system range and bearing output to the previously selected destination.

EMERGENCY OPERATION

There are no provisions for emergency operation of the exterior or interior lighting. However, the pilots instrument panel and consoles, and the RIO's cockpit have red floodlights that are powered from an essential bus. These lights can be illuminated when the ram air turbine is extended, by placing the respective switches in the BRT positions.

LIMITATIONS

There are no specific limitations pertaining to the operation of the navigation equipment.

OXYGEN SYSTEM

DESCRIPTION

A liquid oxygen (LOX) system consisting of a ten liter capacity vacuum insulated container, build-up coils, check valves, vent valves and quantity gages is provided on the airplane. The system is designed to manufacture and deliver gaseous oxygen to the crew at a continuous rate of up to 120 liters per minute at 60 to 90 psi. The liquid oxygen is stored in a double-walled vacuum container. 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 it absorbs heat from the surrounding area and gasifies. The gasified oxygen is now increased in pressure to assure a 40 to 90 psi pressure to the regulators if they should demand it. From the build-up coils the oxygen now flows into the warm-up plate located in the rear cockpit aft of the ejection seat. The warm-up coils will further gasify the oxygen and warm it up to a temperature no colder than 20°F under the cockpit temperature. From the warm-up plate the oxygen is now ready for crewmember 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 RIO with an accurate means of determining the amount of LOX remaining at any time. An oxygen low warning 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 (2, figure 1-2) is located on the aft end of the left console. The RIO's supply lever (2, 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 which reads 10 liters maximum. The pilot's oxygen gage (10, figure 1-2) is located on the forward end of the left console. The radar observer's oxygen gage (2, figure 1-6) is mounted on the utility panel which is located in the left forward section of the cockpit.

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 psig 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.

EMERGENCY OXYGEN

Emergency oxygen is stored in a cylinder located in the upper half of 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 purposes 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 and is attached to the forward left corner of the upper half of the container. 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 purposes. 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 and 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 2-7) 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 supply 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.

PITOT STATIC SYSTEM

DESCRIPTION

A conventional pitot static system is used in the airplane with a single pitot tube located near the top of the vertical fin and two static ports located one on each side of the aft part of the radome. The purpose of the pitot static system is to supply both impact (pitot) and atmospheric (static) pressure to various instruments and system components. The pitot static system is composed of two separate systems. The pitot system obtains its pressure through one source and the static system through two sources. Both pressures may be utilized by the same instruments but at no time do the pressures intermingle. The heating element of the pitot tube is pilot operated by the pitot heat switch located on a panel on the pilot's right console (figure 1-4). Both pitot and static pressures are supplied to airspeed pressure switches that retract the flaps at 230 ± 5 knots, cut out the emergency generator at 195 ± 5 knots, and actuates the rudder feel system and aileron rudder interconnect (ARI) system at 235 ± 10 knots accelerating and 220 ± 5 knots decelerating. The pitot and static pressures are also directed to the central air data computer where they are calibrated and corrected (static pressure only) and then sent out to the various instruments and systems requiring pitot static pressures.

NORMAL OPERATIONS

Operation of the pitot-static system consist 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.

PNEUMATIC SYSTEM

DESCRIPTION

The function of the 3000 psi pneumatic system (figure 2-22) is to provide high pressure air for operation of the following eight normal and emergency subsystems:

EMERGENCY SYSTEMS	NORMAL SYSTEMS
Canopy	Canopy
Landing Gear Extension	Nose Gear Strut Extension
Wheel Brakes	Wind-Driven Turbine Extension
Flaps	
Flooding Doors	

Air supplied from the 17th stage of the engine compressors is used for maintenance of a constant inlet pressure at any altitude and is compressed to 3000 psi by the hydraulically operated air compressor and maintains the air bottles at 3000 psi. A solenoid-operated shutoff valve in the hydraulic line to the compressor motor is controlled by a pneumatic pressure switch cutting hydraulic pressure to the compressor when air pressure is 3100 +100 -50 psi and opening the hydraulic line when air pressure drops to 2750 + 50 -0 psi. The air compressor discharges into a manifold which contains the air drying equipment, ground charging valve, relief valve, ground charging pressure gage and a pressure transmitter for the cockpit gage. The manifold then branches to individual air bottles with check valves installed in each of the pneumatic operated systems. The air bottles are installed in the component systems to preclude loss of the system due to engine or pneumatic pump failure. The branch systems are isolated from return flow to manifold by the check valves. Reverse flow into the compressor is prevented during ground charging by a check valve in the manifold between the compressor and ground charging valve.

PNEUMATIC PRESSURE INDICATOR

The pneumatic pressure indicator (28, figure 1-4) is mounted on the pedestal panel and operates in conjunction with the pneumatic pressure transmitter which is located in the engine accessories compartment. The indicator has a range of 0 to 5000 pounds with calibrations of 0 to 50 and readings multiplied by 100. The normal system pressure reading on the cockpit indicator ranges 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 denotes only the pressure in the manifold supply line. Operating pressures for the emergency subsystems are indicated by their individual pressure gages. To de-activate the air compressor, pull out Pneu. System Control circuit breaker on the No. 2 Circuit Breaker Panel.

PNEUMATIC SYSTEM

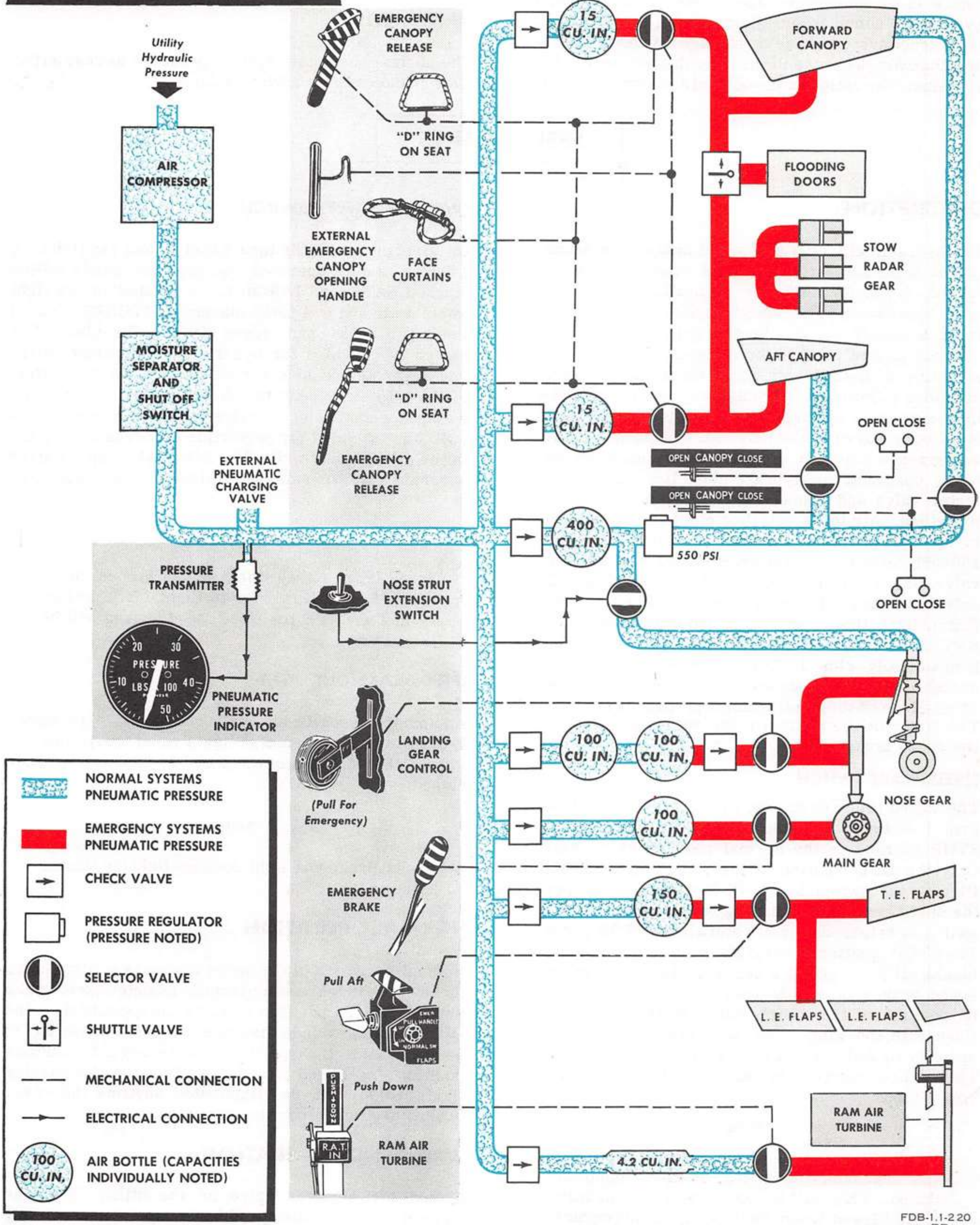


Figure 2-22

EMERGENCY OPERATION

There is no emergency operations 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 pneumatic 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.

SPEED BRAKES

DESCRIPTION

The hydraulically operated speed brakes are mounted on the underside of the inboard wing panels and 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 at any point in their travel. Due to the construction of the selector valve, the speed brakes will not close following a hydraulic pressure failure unless the emergency speed brake switch located on the left console is placed in the RETRACT position. This de-energizes a solenoid bypass valve to block the speed brake open and speed brake close lines from the selector valve and connects both sides of the cylinders to return. Air loads will then close the speed brakes to the trail position. Effective airplanes 148412h and 150406L and UP, a different speed brake selector valve has been incorporated in the airplane. This valve operates differently than the old valve, except that placing the emergency speed brake switch in the RETRACT position will result in the speed brakes being hydraulically closed. The emergency speed brake switch on these airplanes is only useful in the event of a failure of the throttle mounted speed brake switch. The basic utility hydraulic system is used to operate the speed brakes.

SPEED BRAKE SWITCH

The speed brake switch (9, 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 de-energizes the selector valve and blocks all ports giving a hydraulic lock for holding 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 four seconds to fully open and four seconds to fully close. The switch receives power from the right main 28 volt d-c bus.

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.

OVERRIDE SAFETY SWITCH

On airplanes 148363f thru 148411h and 148413h thru 149474k, a deck operated, two-position, safety switch marked SAFE and NORMAL, is located in the right wheel well under a panel marked SWITCHES, Ground Fueling Check, and Speed Brake Disabling. The switch is provided for overriding the cockpit switch that controls the selector valve. The SAFE position of the switch extends the speed brakes and prevents energizing the selector valve from the cockpit. This switch is provided for protection of personnel working in the speed brake well. The NORMAL position of the override switch permits normal speed brake operation.

Note

Speed brake safety switch should be checked for NORMAL position prior to flight. If the switch is in the SAFE position, speed brakes will be inoperative.

SPEED BRAKE OUT LIGHT

An amber "Speed Brake Out" indicator light (19, figure 1-3) located on the caution lights 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 warning lights panel will be illuminated anytime the speed brakes are in any position other than closed.

EMERGENCY OPERATION

Should the selector valve or the utility hydraulic system fail, and the speed brakes are extended, they may be retracted by placing the emergency speed brake switch on the left console to the RETRACT position.

This allows air loads to close the panels to a trailing position. On airplanes 148412h and 150406L and UP the speed brakes will automatically close in the event of an electrical failure. In the event of a hydraulic failure the speed brakes will close by placing the throttle mounted speed brake switch to the IN 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.

TOW TARGET SYSTEM

DESCRIPTION

The Del Mar tow target equipment consists of a combination tow reel/fixed boom launcher, control box, and target. The control box normally mounts adjacent to the starboard side of the RIO's seat and the reel/launcher suspends from the center line AERO 27A rack of the aircraft.

REEL/LAUNCHER

The AERO 43LM is the AERO 43L reel/launcher modified with a short fixed launcher boom which eliminates the necessity of launcher rotation for target launch and recovery. The AERO 43LM is powered by a variable pitch wind driven turbine and may carry 28,500 feet of 0.045 inch constant diameter wire. Wire diameter of 0.051 inches or greater may be used with proportionally less footage.

CONTROL BOX

The reel/launcher control box may be mounted adjacent to the RIO's seat or other accessible location, and has all the instruments and switches required to control and monitor tow reel functions. The instruments indicate turbine pitch and revolutions per minute, and a counter indicates feet of tow wire deployed. Switches include a master switch which controls electrical power to the reel, a cable drum brake switch, a turbine pitch control switch to select reel-out or reel-in turbine rpm, and a cable cutter switch.

TARGETS

The AERO 36, AERO 36A and AERO 42 IR targets may be utilized for subsonic flights only. These targets consist of a streamlined pressed fiber shell body with four expanded polystyrene fins. The canted fins cause the target to rotate approximately 0.35 rpm per knot TAS. The AERO 42 target is capable of carrying four infrared flares which attach to the target near the root of the tail fins. These flares can be activated by the towing aircraft or the attacking aircraft using a 1020 cps UHF tone generator. The flares are ignited by means of a UHF receiver, a stepping relay, and self-contained batteries. The flares may be preselected prior to flight to fire singly, in pairs, or in a four-flare salvo.

NORMAL OPERATION

Refer to Flight Procedures, Section IV, Volume II - Operating Procedures.

EMERGENCY OPERATION

Refer to Flight Procedures, Section IV, Volume II - Operating Procedures.

LIMITATIONS

Refer to Flight Procedures, Section IV, Volume II - Operating Procedures.

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, via the landing gear down lines. A hand operated locking system is installed in the airplane to lock wing pins in hinge fittings when wings are spread. A flat flush mounted control lever (10, 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 an amber L. Wing Pin Unlock and R. Wing Pin Unlock warning lights in both cockpits and energizes the wing fold and spread switch. 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. The wing fold and spread switch receives power from the left main 28 volt d-c bus. The warning lights are operated off of the essential 26 volt a-c bus. On some airplanes the wing pins are released by pulling up on a control handle that juts out of the wing fold panel. The wing fold swich on these airplanes is located immediately forward of the pin pull handle. The wing pin pull handle, and wing fold switch operates the same controls as the previously described wing pin uplock lever and wing fold switch. When folding or spreading the outer panels, ovserve 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 operation consists of folding and spreading the wings and is accomplished through the wing fold panel located on the left console. To fold the wings, pull UP on the wing pin 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. Pin Unlock" warning light will be extinguished.

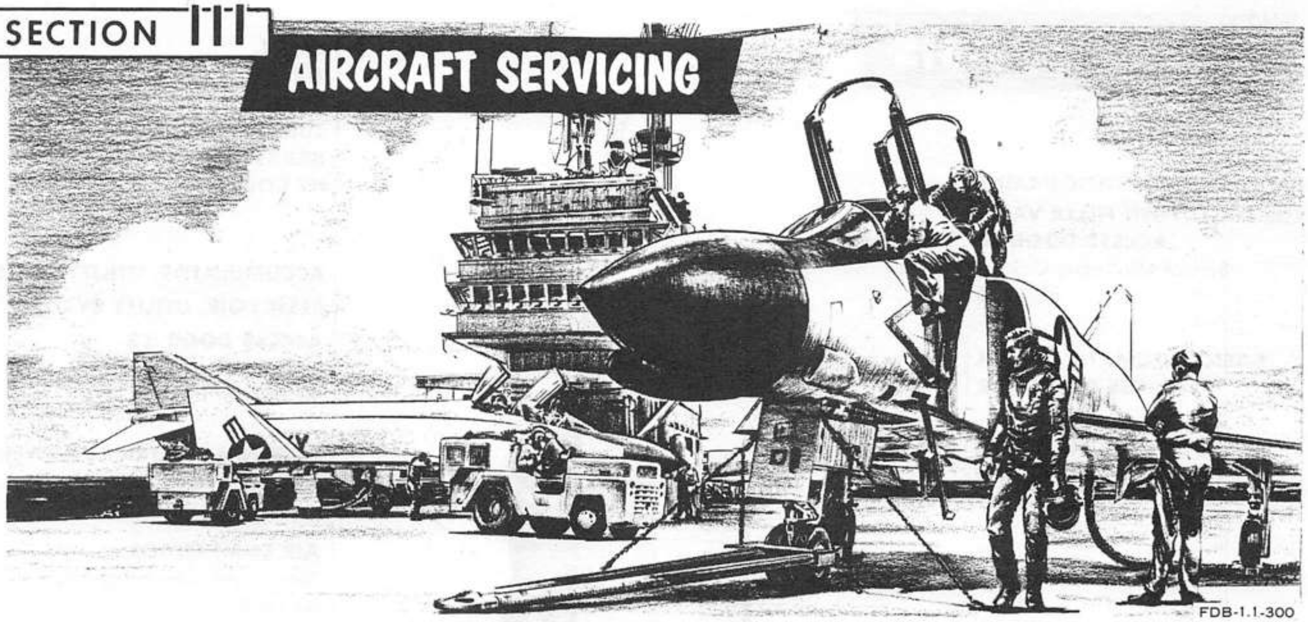
EMERGENCY OPERATION

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 anytime wings are folded.

SECTION III AIRCRAFT SERVICING



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(*) Denotes Illustration

SERVICING DATA

DESCRIPTION

The following servicing data is provided to lend assistance in the event the airplane lands at a strange field, and/or the maintenance crews are unfamiliar with the aircraft. See figure 3-1 for servicing points.

FUELING

Access door 26R
All tanks may be serviced simultaneously through the pressure fueling connection. Electrical power must be applied to open the fuel level control valves. The fuel level control valves are opened by placing the ground fueling switch in the left wheel well to the REFUEL position.

REFUELING PROCEDURE

Engines Off With Electrical Power

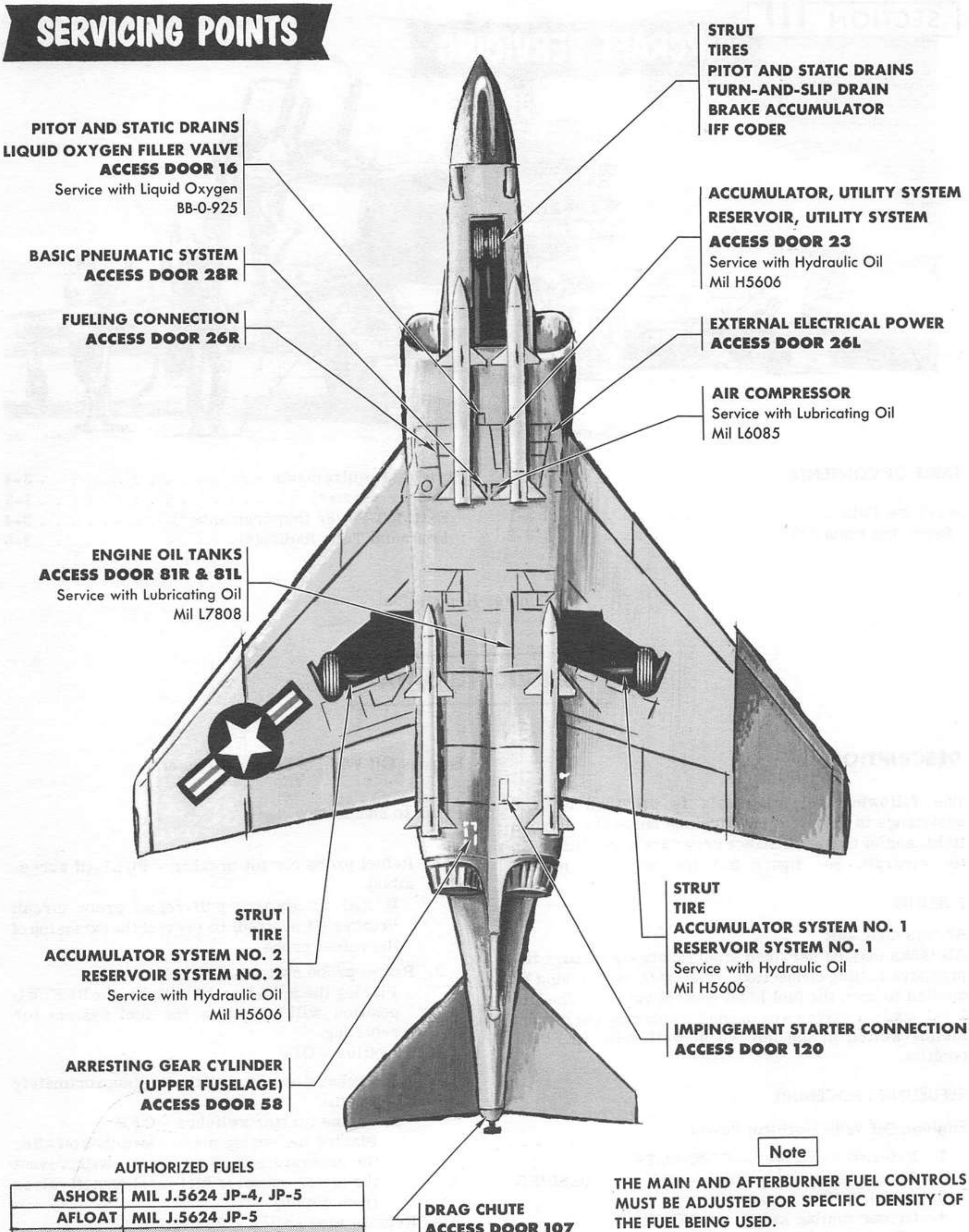
1. External a-c power - CONNECTED
2. Refuel selection switch - SET AS DESIRED
3. Attach fueling nozzle
4. Ground fueling switch - REFUEL
   The ground fueling switch is only effective with engine master switch off.

Engines Off Without Electrical Power

Prior to shutdown:

1. Refuel probe circuit breaker - PULL (if accessible)
   If RIO is aboard, pull refuel probe circuit breaker (if desired) to prevent the extension of the refuel probe.
2. Refuel probe switch - REFUEL
   Placing the refuel probe switch in the REFUEL position will condition the fuel system for refueling.
3. Throttles - OFF
4. When generators drop off the line (approximately 53% rpm):
   a. Engine master switches - OFF
   Placing the engine master switches off after the generators drop off the line will prevent the motor operated fuel level shutoff valves from closing.
5. Refuel probe switch - RETRACT
6. Refuel probe circuit breaker - IN (if previously pulled)

SERVICING POINTS



AUTHORIZED FUELS

ASHORE	MIL J.5624 JP-4, JP-5
AFLOAT	MIL J.5624 JP-5
EMERGENCY	MIL F-5572 AVGAS

Note

THE MAIN AND AFTERBURNER FUEL CONTROLS MUST BE ADJUSTED FOR SPECIFIC DENSITY OF THE FUEL BEING USED.

FDB-1.1-301

Figure 3-1

Engines Operating

1. Refuel probe circuit breaker - PULL (if accessible)
   If RIO is aboard, pull refuel probe circuit breaker (if desired) to prevent the extension of the refuel probe.
2. Refuel probe switch - REFUEL
   Placing the refuel prove switch in the REFUEL position will condition the fuel system for refueling.

AUTHORIZED FUELS

Ashore - MIL-J-5624 JP-4 or JP-5
Afloat - MIL-J-5624 JP-5
Emergency - MIL-G-5572B AVGAS 115/145

Note

The main and afterburner fuel controls must be adjusted for the specific density of the fuel used before operating engines.

HYDRAULIC SYSTEM

Power Control Systems 1 and 2 and the Utility Hydraulic systems are serviced with MIL-H-5606.

Tank Capacities	POSITION
Power Control No. 1 - 1.23 U.S. Gallons	Left Wheel Well
Power Control No. 2 - 1.23 U.S. Gallons	Right wheel well
Utility - 2.22 U.S. Gallons	Access door No. 23

ENGINE LUBRICATING OIL

Engine lubricating oil systems are serviced with MIL-L-7808C.
Access doors 81R and 81L.
(2 Systems) capacity, 6.3 U.S. Gallons each J79-2
(2 Systems) capacity, 5.3 U.S. Gallons each J79-8
Tanks must be checked and filled to capacity not sooner than 15 min., nor longer than 30 min. after engine shutdown.

ARRESTING GEAR CYLINDER

Access door No. 58 (upper fuselage).
Service with MIL-H-5606 Hydraulic fluid and clean dry air or Nitrogen.
Pressure is shown on arresting gear instruction plate.

LANDING GEAR STRUTS

Service with MIL-H-5606 Hydraulic oil.
Inflate with Nitrogen or clean dry air.
Nose Gear - To pressure and dimensions indicated by chart on nose gear strut.
Main Gear - To pressure and dimensions indicated by chart on main gear struts.

To determine the necessity of servicing the main gear struts, check strut gage located at top of strut (if the needle is in the black area, the strut extension and pressure are within limits).

AIR COMPRESSOR

Service with MIL-L-6085 Lubricating oil.

OXYGEN SUPPLY

Access door 17
Service with liquid oxygen MIL-O-21749

BASIC PNEUMATIC SYSTEM

Access door 26R
Charge to 3000 psi air

TIRES

		ASHORE	AFLOAT
Nose	(Take-off G.W. under 42,000 lbs.)	100 psi	300 psi
	(Take-off G.W. 42,000 lbs. to 49,500 lbs.)	125 psi	
	(Take-off G.W. over 49,500 lbs.)	150 psi	
Main	(Take-off G.W. under 42,000 lbs.)	275 psi	425 psi
	(Take-off G.W. 42,000 lbs. to 49,500 lbs.)	340 psi	
	(Take-off G.W. over 49,500 lbs.)	375 psi	

CAUTION

All tires will be serviced with Nitrogen only.

DRAG CHUTE

Serviced through access door No. 107.

SHIMMY DAMPER

Service with MIL-H-5606 Hydraulic fluid.

STARTING REQUIREMENTS

DESCRIPTION

The turbine impingement starting for the F4H-1 airplane requires external power for 28 volt d-c, 115/200 volt 3 phase, 400 cycle a-c and a compressed air source which will supply a minimum of 110 lb./min. of air at 50 pounds pressure at an ambient temperature of 60°F. The external a-c power receptacle (figure 4-2) is located through access door No. 26L. The compressed air and d-c power receptacles (figure 4-2) are located through access door No. 120. The auxiliary power units that are most frequently used are the BUWEPS CP-5 (RCPP-105) (1 unit) or the Douglas GTC 85 (2 units)..

BUWEPS CP-5 UNIT (RCPP-105)

The UWEPS CP-5 (RCPP-105) unit supplies 115/200 volt a-c, 28 volt d-c, and sufficient compressed air (236 lb./min. @ 78 psi) to meet all external power requirements from a single unit.

SUBSTITUTE STARTING UNITS

In the event the preferred starting unit (RCPP-105) is not available, substitute starting units will have to be employed. No substitute starting unit(s) deliver the necessary high pressure air required to start the engine by the normal procedure. When substitute starting units are used, the engine rpm builds up very slowly, and will often hang between 7 and 10%. A normal start procedure under these circumstances would produce an EGT of over 700°C and at times over 800°C. Therefore, a starting technique has been developed which will enable you to perform a start without overtempting the engine even though the starting units are not delivering the required air pressure. The procedure for starting an engine with substitute starting units, and a list of substitute starting units is contained in the NATOPS Essential Checklist, NAVWEPS 01-245FDB-1B.

STARTER AIR

Access door No. 120

A 5.5:1 pressure ratio (138 lb./min. @ 81 psi) gas turbine compressor unit, RCPP-105 or equivalent is desired.

EXTERNAL ELECTRICAL POWER

Access door No. 26L

115/200 Volt 3 Phase, 400 Cycle a-c and 28 volt d-c external power is normally supplied by a RCPP-105 external unit.

An AN3430 plug and cable are utilized.

When substitute starting units are used, a-c and d-c power may have to be supplied by an additional electrical power unit.

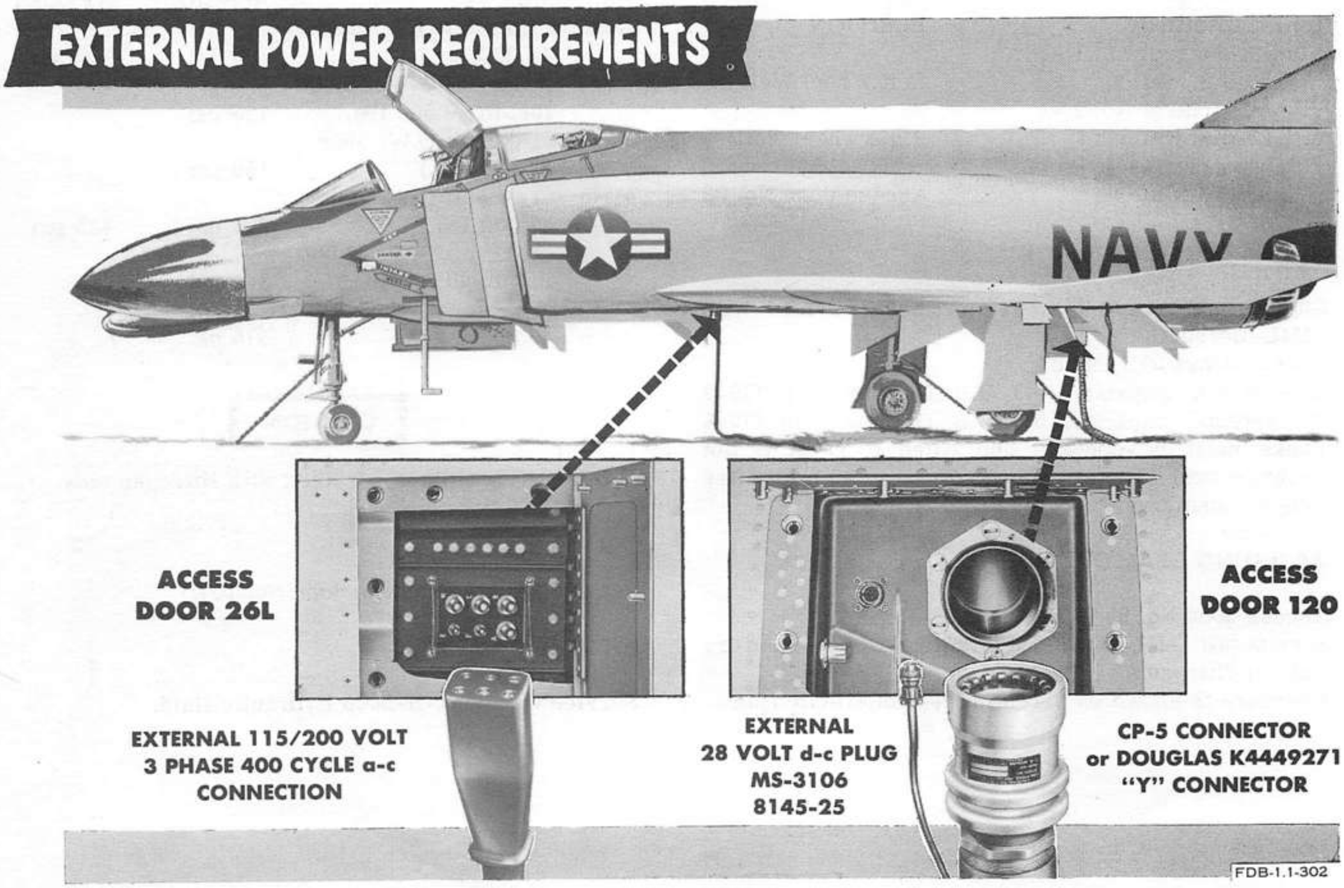


Figure 3-2

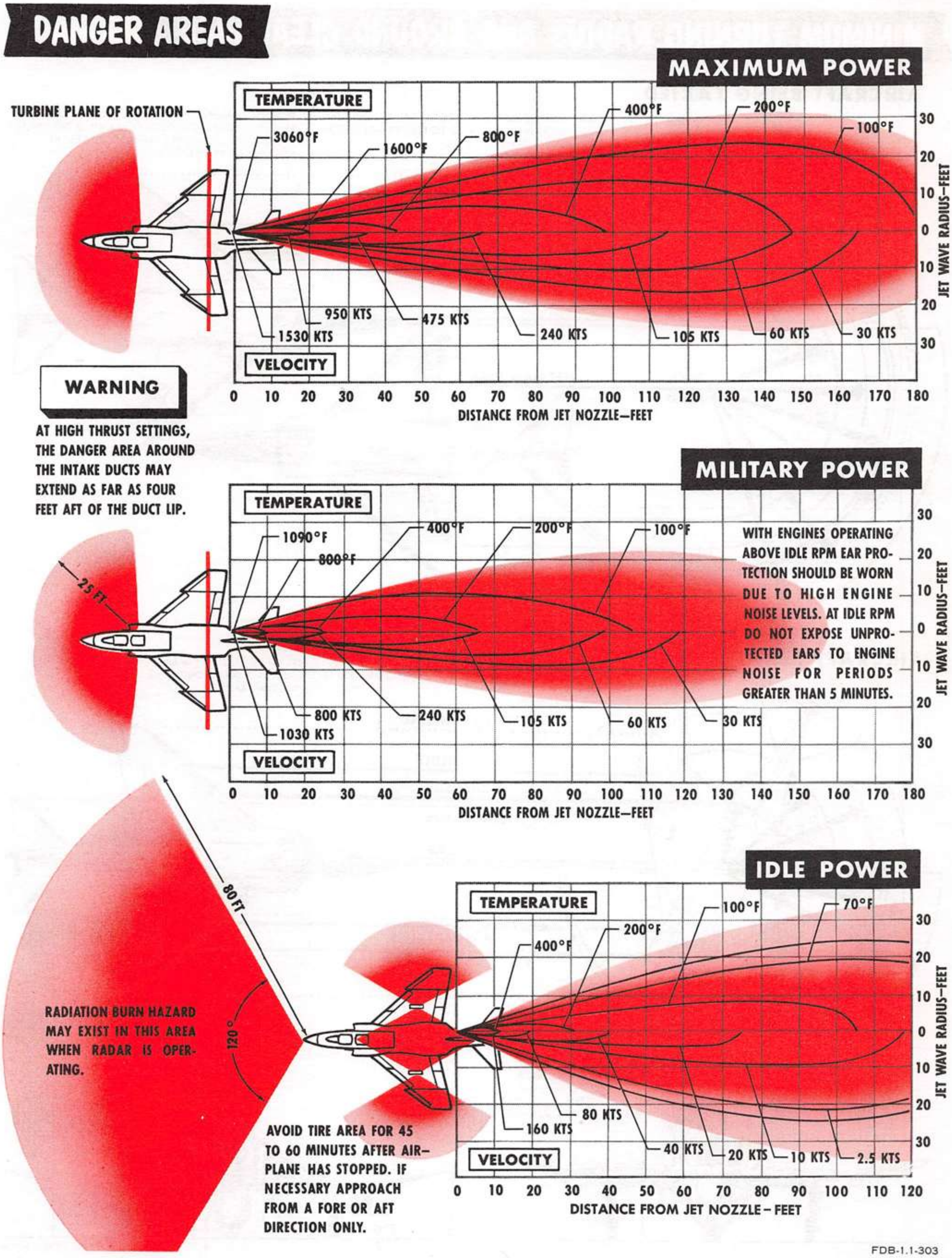

DANGER AREAS
MAXIMUM POWER
TURBINE PLANE OF ROTATION
TEMPERATURE
3060°F
1600°F
800°F
400°F
200°F
100°F
950 KTS
1530 KTS
475 KTS
240 KTS
105 KTS
60 KTS
30 KTS
VELOCITY
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180
DISTANCE FROM JET NOZZLE—FEET
JET WAVE RADIUS—FEET
WARNING
AT HIGH THRUST SETTINGS, THE DANGER AREA AROUND THE INTAKE DUCTS MAY EXTEND AS FAR AS FOUR FEET AFT OF THE DUCT LIP.
MILITARY POWER
25 FT
1090°F
800°F
400°F
200°F
100°F
800 KTS
1030 KTS
240 KTS
105 KTS
60 KTS
30 KTS
WITH ENGINES OPERATING ABOVE IDLE RPM EAR PROTECTION SHOULD BE WORN DUE TO HIGH ENGINE NOISE LEVELS. AT IDLE RPM DO NOT EXPOSE UNPROTECTED EARS TO ENGINE NOISE FOR PERIODS GREATER THAN 5 MINUTES.
IDLE POWER
80 FT
120°
RADIATION BURN HAZARD MAY EXIST IN THIS AREA WHEN RADAR IS OPERATING.
400°F
200°F
100°F
70°F
160 KTS
80 KTS
40 KTS
20 KTS
10 KTS
2.5 KTS
AVOID TIRE AREA FOR 45 TO 60 MINUTES AFTER AIRPLANE HAS STOPPED. IF NECESSARY APPROACH FROM A FORE OR AFT DIRECTION ONLY.
0 10 20 30 40 50 60 70 80 90 100 110 120
DISTANCE FROM JET NOZZLE - FEET
FDB-1.1-303
R

Figure 3-3

MINIMUM TURNING RADIUS AND GROUND CLEARANCE

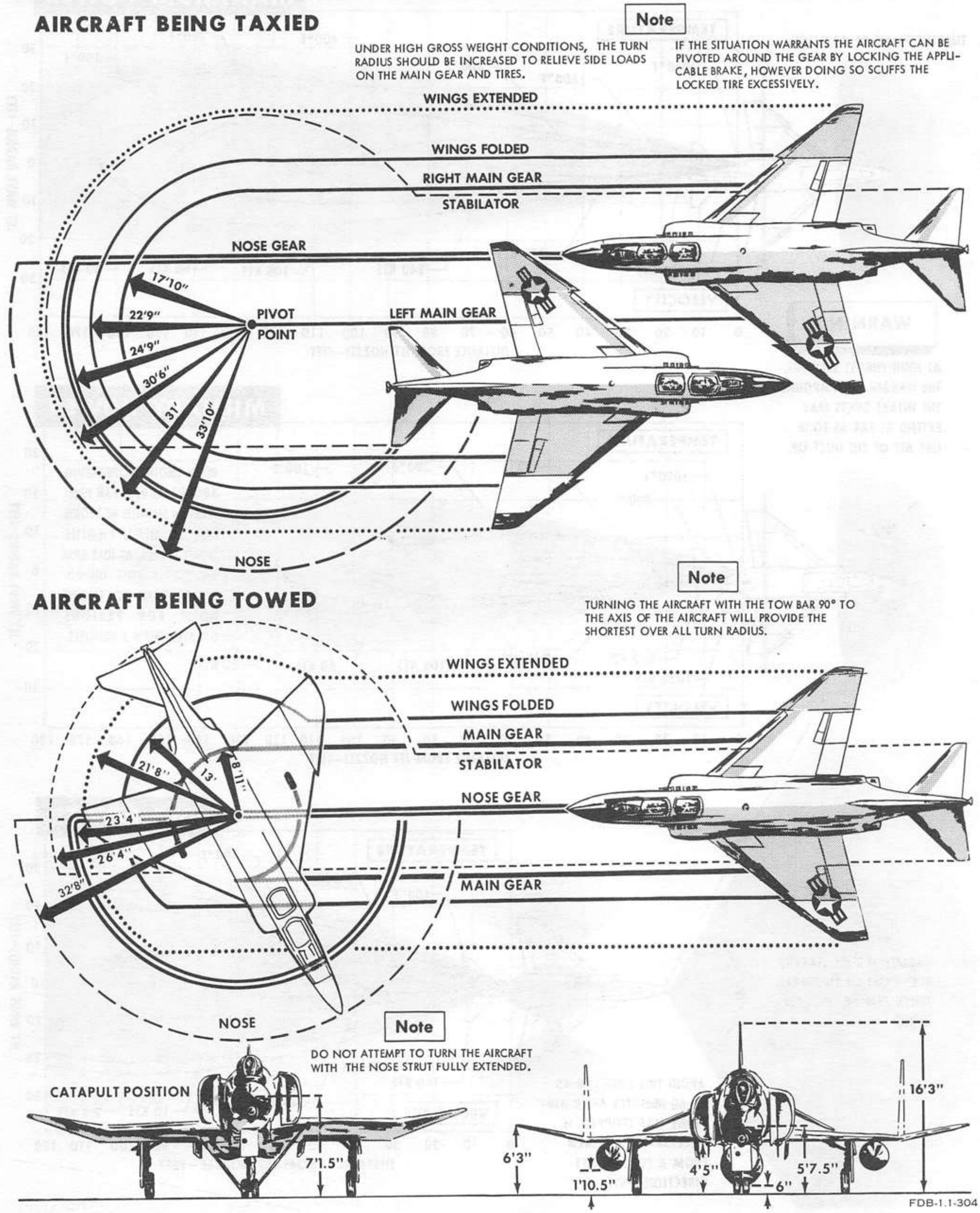


Figure 3-4

ALPHABETICAL INDEX

A

B

C

*Indicates Illustration

*Indicates Illustration

*Indicates Illustration

M

N

O

*Indicates Illustration

P

R

S

*Indicates Illustration

T

W

*Indicates Illustration

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Copy 2

NAVWEPS 01-245FDB-1.2

NATOPS Flight Manual

NAVY MODEL

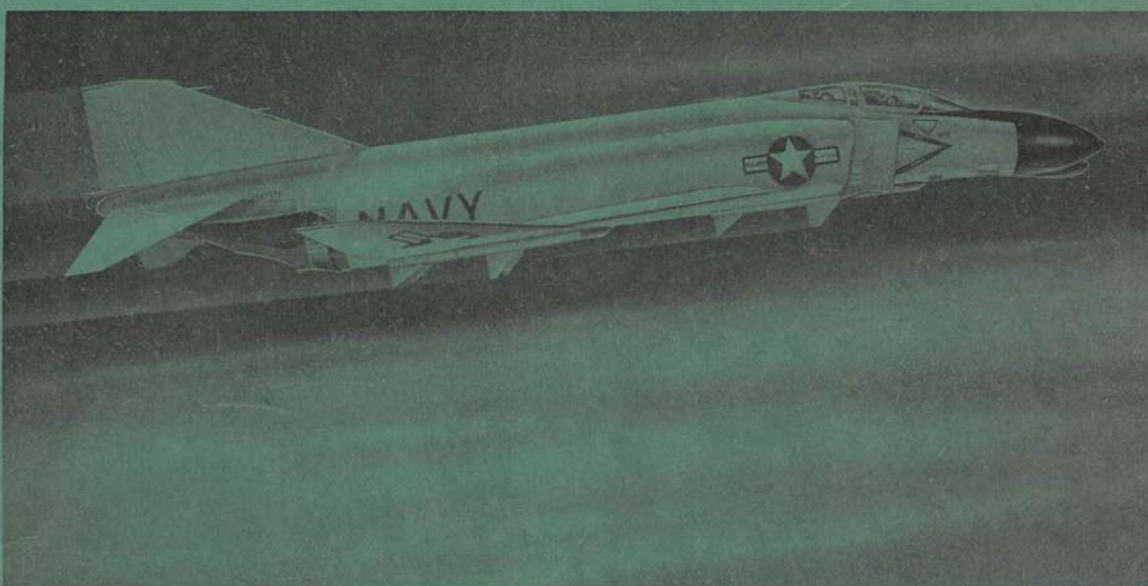
F-4B(F4H-1)

AIRCRAFT

VOLUME II

Operating Procedures

THIS PUBLICATION IS INCOMPLETE WITHOUT VOLUME I, NAVWEPS 01-245FDB-1.1, AND VOLUME III, NAVWEPS 01-245FDB-1A.



ISSUED BY AUTHORITY OF
THE CHIEF OF NAVAL OPERATIONS

DEPARTMENT OF THE NAVY
OFFICE OF THE CHIEF OF NAVAL OPERATIONS
WASHINGTON 25, D.C.

LETTER OF PROMULGATION

1. The Naval Air Training and Operating Procedures Standardization Program (NATOPS) was developed to provide a source of efficient and sound operating procedures for each aircraft in the Navy's inventory. Compliance with stipulated NATOPS manual procedure, being mandatory, ensures standardization of operating procedures for each model aircraft throughout the Naval Aeronautical Establishment.

2. The operational information contained in NATOPS Manuals is generated by the users and is based on professional knowledge and experience with the aircraft concerned. NATOPS Manuals contain operational information that does not appear in aircraft Flight Manuals. At the semi-annual NATOPS conference held in Minneapolis, in August 1962, it was recommended that the feasibility of combining NATOPS and Flight Manual information be investigated. This would provide a single source of all information necessary to operate any given aircraft efficiently. To this end the S2D (S2F-3) and the F-4B (F4H) were chosen as pilot models and a combined book called the NATOPS Flight Manual has been written for each. These combined manuals are for evaluation only and have been given wide distribution so that a large cross section of users can contribute to an analysis of their relative merits and to the merit contained in the original recommendation to combine the information in one publication. All recipients are enjoined to make a thorough and objective evaluation of the combined manual concept and forward comments to the applicable NATOPS Coordinator prior to April 1963. Recipients are hereby granted authority to use the combined manual concerned in lieu of the applicable NATOPS and Flight Manuals for the duration of the trial period. The termination date of the trial period is 1 December 1963.

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

W.A. SCHOECH
Vice Admiral, USN
Deputy Chief of Naval Operations (AIR)

NAVWEPS 01-245FDB-1.2

NATOPS Flight Manual

NAVY MODEL

F-4B(F4H-1)

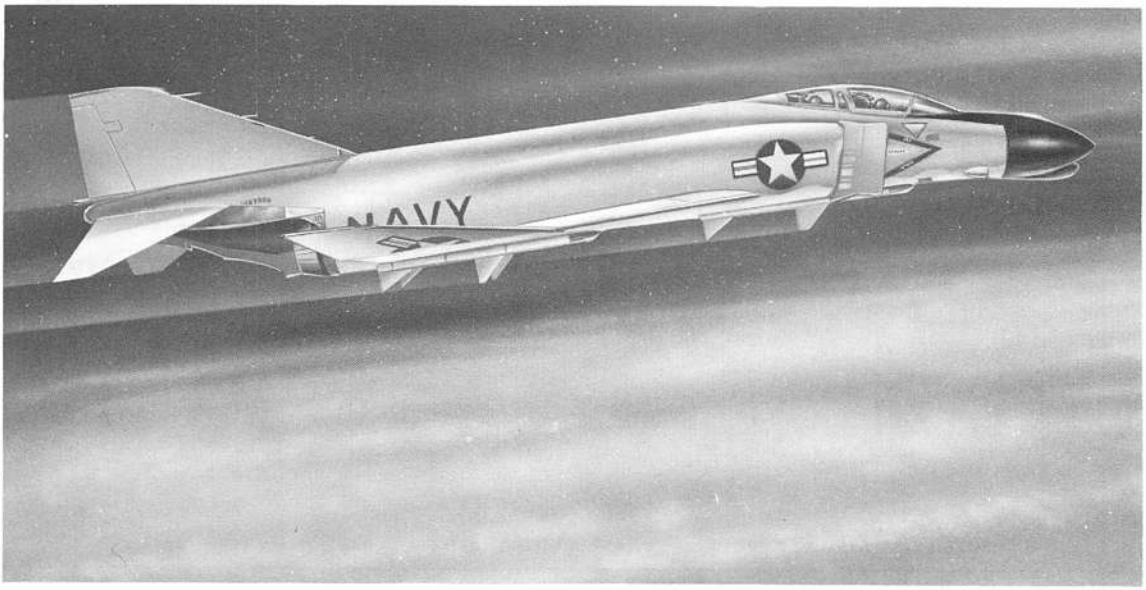
AIRCRAFT

VOLUME II

Operating Procedures

THIS PUBLICATION IS INCOMPLETE WITHOUT VOLUME I, NAVWEPS 01-245FDB-1.1, AND VOLUME III, NAVWEPS 01-245FDB-1A.

VOLUMES I AND II OF THIS PUBLICATION SUPERSEDES NAVWEPS 01-245FDB-1, DATED 1 FEBRUARY 1962.



ISSUED BY AUTHORITY OF
THE CHIEF OF NAVAL OPERATIONS

15 December 1962

LIST OF REVISED PAGES ISSUED

INSERT LATEST REVISED PAGES. DESTROY SUPERSEDED PAGES.

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

Page No.	*Date of Latest Revision*	*Page No.*	*Date of Latest Revision*	*Page No.*	*Date of Latest Revision*

* The asterisk indicates pages revised, added or deleted by the current revision.

ADDITIONAL COPIES OF THIS PUBLICATION MAY BE OBTAINED AS FOLLOWS:

USAF ACTIVITIES. - In accordance with Technical Order No. 00-5-2.
NAVY ACTIVITIES. - Submit request to nearest supply point listed below, using form NavWeps-140; NAS, Alameda, Calif.; ASD, Orote, Guam; NAS, Jacksonville, Fla.; NAS, Norfolk, Va.; NASD, Pearl City, Oahu; NASD, Philadelphia, Pa.; NAS, San Diego, Calif.; NAS, Seattle, Wash.
For listing of available material and details of distribution see NAVSANDA Publication 2002, Section VIII, Part C and supplements.

INTERIM CHANGE RECORD

NATOPS CHANGE NUMBER (CNO)	INTERIM REVISION NUMBER (BuWeps)	PREVIOUSLY INCORPORATED	INCORPORATED IN THIS ISSUE ON PAGES INDICATED
1		1 June 1962	
	1	1 August 1962	
2			2-1
			4-14
	3		5-16
	4 & 5		5-19
	6		4-6

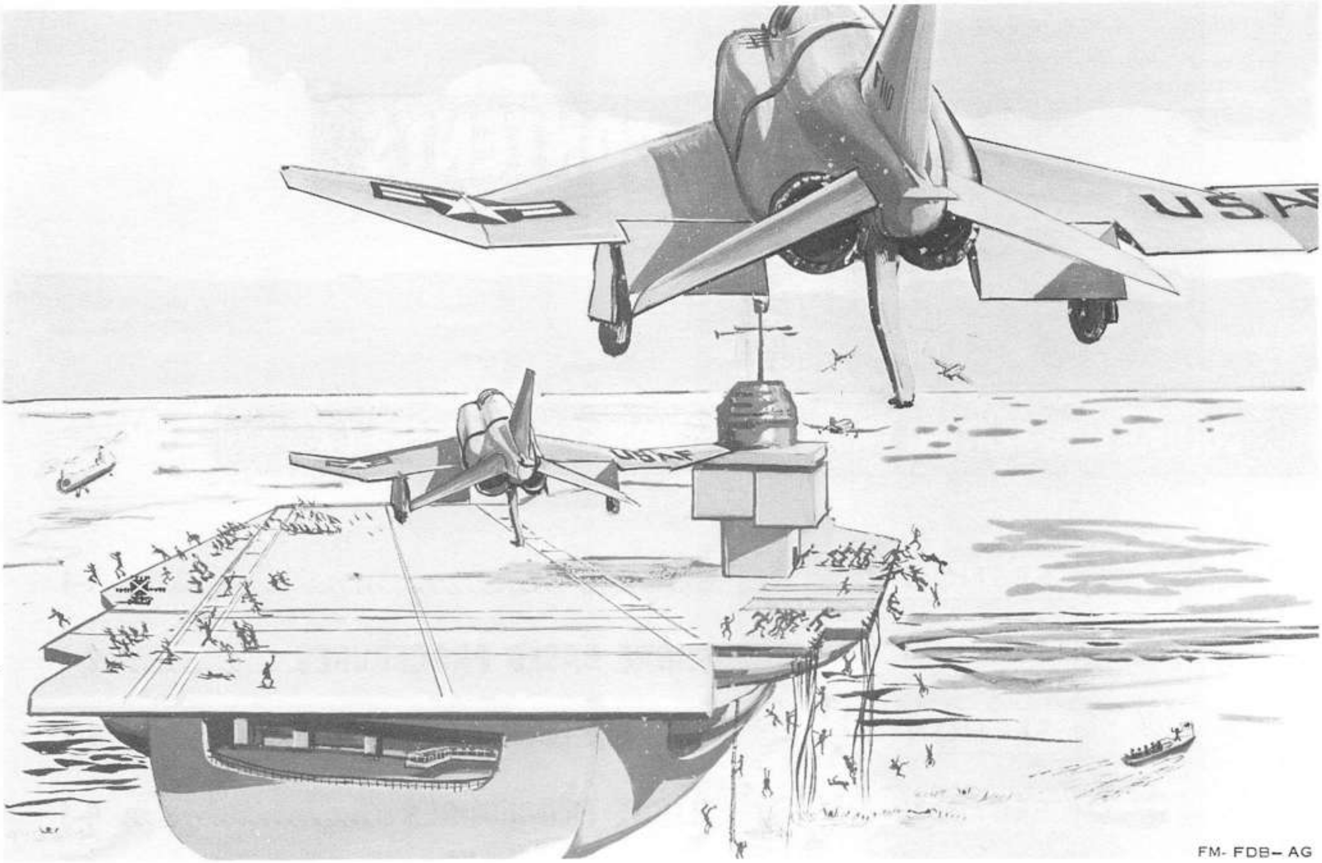
AIRCRAFT SERVICE CHANGE SUMMARY

The following ASC's are of direct interest to the crewmembers and may be noted throughout the manual:

ASC NO.	TITLE	SECTION

TABLE OF CONTENTS

VOLUME II OPERATING PROCEDURES-NAVWEPS 01-245FDB-1.2



FM- FDB- AG

SCOPE

As outlined in the Letter of Promulgation, the F-4B (F4H) 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. This manual, prepared under Contract NOw 62-0383-i, is issued on an evaluation basis for the purpose of determining the feasibility of combining NATOPS and Flight Manual information into a single-source publication series. The basic intent of this three-volume concept is to provide an all-inclusive, easy-to-use manual that is consistent with the best interest of flying safety, standardization, proficiency training, and overall flying efficiency. Every effort has been made to provide adequate data for you, the collective user, to safely and efficiently accomplish all missions within the assigned parameters of the aircraft. However, overall optimization of this type publication is directly proportional to user input. Your job? ; Evaluate and Criticize.

ARRANGEMENT

The three-volume concept of this publication categorically segregates all applicable data as: Descriptive -- Procedural -- Classified.

Volume I– Volume I, Aircraft Systems, is subdivided into three sections and provides detailed descriptive information for the aircraft, its systems and related equipment. Section I contains information relating to the aircraft in general; e.g., cockpit configurations, a summary of aircraft limitations, approximate weights for various external configurations, etc. Section II contains detailed description, normal operation, emergency operation, and limitations for each aircraft system; individual systems being covered as a separate entity and presented in alphabetical order. Section III contains aircraft servicing and ground handling information for the pilot to adequately monitor strange field procedures.

Volume II– Volume II, Operating Procedures, is sub-divided into eight sections and provides the necessary procedural information to safely and efficiently accomplish all phases of flight. The titles of Sections I through VII (General, Shore Based Procedures, Carrier Based Procedures, Flight Procedures, Emergency Procedures, Communication Procedures, and Crew Duties) sufficiently describes their individual scope of coverage. Most of the basic-type procedures and those procedures that are peculiar to land based operation are contained in Section II, Shore Based Procedures. Section III, Carrier Based Procedures, contains only those additional or different procedures required for carrier operation. Section VIII, Standardization Evaluation, is primarily provided as a working-guide for F-4B Squadron Commanders and Evaluators/Instructors in the implementation of the NATOPS program.

Volume III– Volume III, Classified Supplement, is sub-divided into two sections and an appendix. As implied, this volume contains the classified data necessary to supplement the descriptive and procedural information of Volumes I and II. Appendix I contains the charts necessary to compute performance specifics for all intended missions; this includes take-off, climb, cruise, endurance, maximum capabilities, descent, and landing data for the several external configurations of the aircraft.

KEEPING THE MANUAL CURRENT

During the evaluation period, your F-4B NATOPS Flight Manual will be constantly up-dated through an extremely active revision program. This program includes the publication of Regular Revisions, NATOPS Changes, and Interim Revisions.

Regular Revisions– Regular Revisions will normally be prepared and distributed on a regular 90-day cycle, beginning with the date of original issue. These revisions are issued as formally printed changed and/or additional pages to be incorporated into your existing manual. Generally, this is the more formal method of up-dating your manual to include: production/retrofit changes to the equipment; outstanding NATOPS Changes and Interim Revisions; 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.

NATOPS Changes– NATOPS Changes (urgent and routine) are promulgated by the Office of CNO and will be in accordance with OPNAV Instruction 3510.9. These changes will normally be in message or letter form to expedite safety-of-flight changes to operating procedures. The details of these changes should be noted on the appropriate page(s) of the manual and logged in the applicable Interim Change Record.

Interim Revisions– Interim Revisions are promulgated by BuWeps and may be received as a Naval message or on a pre-printed Flight Handbook Interim Revision form. The purpose of these revisions is to expedite new/revised operating limitations, restrictions, and other vital instructions involving the operation of the aircraft. The detailed changes should be noted on the appropriate page(s) of the manual and logged in the applicable Interim Change Record.

Interim Change Record– The Interim Change Record, one for each volume, is provided for the purpose of maintaining a complete record of all interim-type changes issued against the F-4B NATOPS Flight Manual. Each time the manual is revised, the Interim Change Record will be formally up-dated to indicate disposition and/or incorporation of previously issued interim-type changes. When a regular revision is received, the Interim Change Record should be checked to ascertain that all outstanding NATOPS Changes and Interim Revisions have been formally incorporated; those not incorporated should be re-noted as applicable.

USER COMMENTS

Comments and recommendations from the collective user are always welcomed. However, during an evaluation program such as this, your constructive criticism is urgently solicited. During the evaluation period, there will probably be several official channels provided for your evaluation. In the interim, however, two unofficial-type "Phantomouse" forms are provided at the end of Volume II for your on-the-spot comments. It is planned to replenish the "Phantomouse" forms with each revision of Volume II. It should also be remembered that comments of a classified nature must be forwarded in accordance with existing Security Procedures.

WARNINGS, CAUTIONS, AND NOTES

For your information, 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.

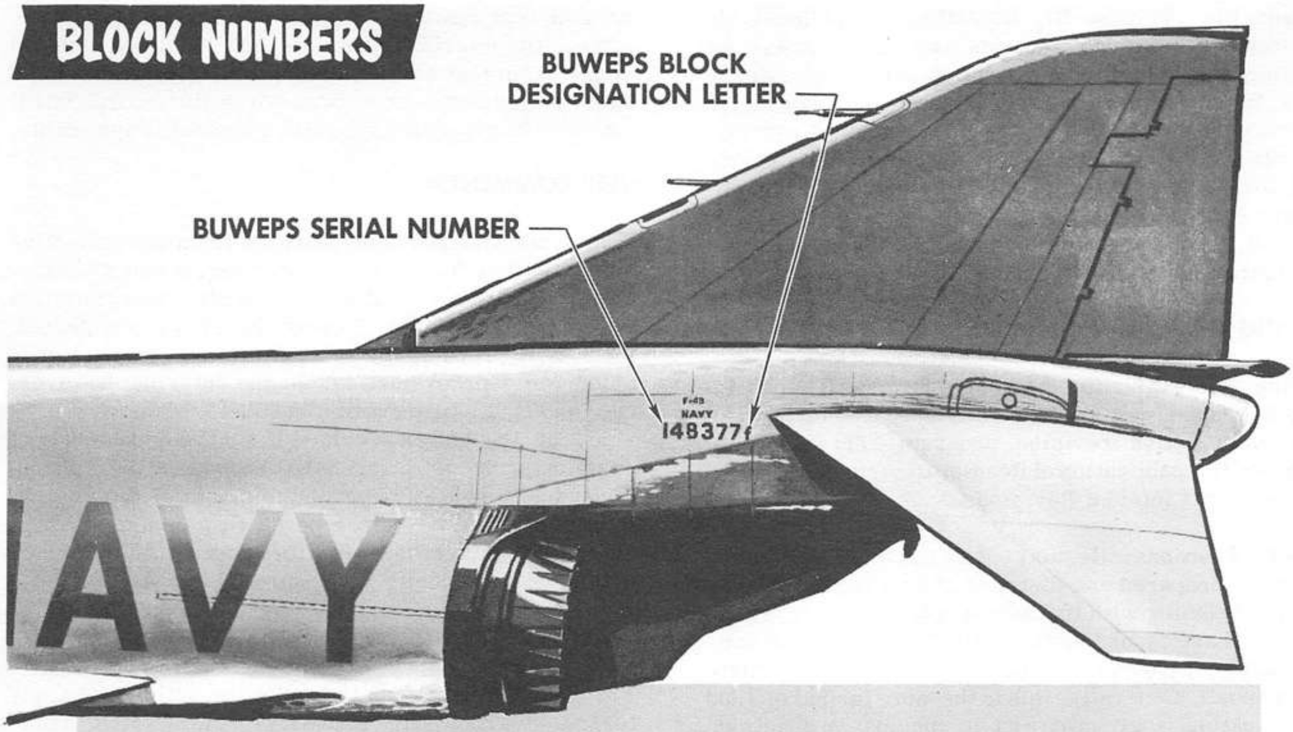
Note

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

REVISION SYMBOL

The lines of text that were revised or added during the current revision (as dated on the lower inboard corner of the page) will be identified by a revision symbol in the outboard margin of the effected column. The revision 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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149427j thru 149450j

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150436m thru 150479m

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SECTION I GENERAL

TABLE OF CONTENTS

GROUND TRAINING SYLLABUS

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/RIO) for each phase is set forth below:

FAMILIARIZATION, TACTICS, AND INSTRUMENTS

Flight physiological training as appropriate

F-4B NAMT pilot's course

F-4B NAMT AERO-1A AMCS course

F-4B COT/WST.

FLIGHT SUPPORT LECTURES AND/OR BRIEFINGS

J79 engine

F-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

Cabin/Pressure suit air conditioning and MK IV Mod I pressure suit

Ejection seat and Scott survival kit

Cockpit procedures/checklists

BIT checks (RIO only)

Climb, loiter, and cruise performance

Fuel management/mission planning

Single engine performance

F-4B CNI equipment

NATOPS Flight Manual (open and closed book) stressing normal and emergency procedures and aircraft/engine limitations.

INTERCEPT FLIGHT SUPPORT LECTURES AND/OR BRIEFINGS

Naval Air Maintenance training group instructions, Sparrow III missile

Naval Air Maintenance training group instructions, Sidewinder missile

AN/APA-128 radar set group functions and computations, Sparrow III missile

AN/APA-128 radar set group computations, AAM-N-7A missile

AN/AAA-4 IR detectors operation procedures

NTDS/ATDS operating procedures

Tactical employment of the F-4B weapons system

Basic intercept procedures

Voice procedures

The pilot and RIO will receive detailed briefings prior to flying the following intercept missions:

High altitude-high Mach intercepts

Low altitude intercepts

Sparrow III beam intercepts with Sidewinder reattack

Forward hemisphere intercepts

Electronic Counter-countermeasures

Air intercept control techniques and procedures - broadcast control

Multiple intercept procedure

Missile firing procedures

WEAPONS FIRING FLIGHT SUPPORT LECTURES

Arming/de-arming procedures

Firing procedures

Safety procedures

Jettison/dump areas

MLP/CARQUAL FLIGHT SUPPORT LECTURES

Mirror landing system

Mirror landing pattern and procedures

Night landing pattern and procedures

Shipboard procedures and landing patterns

CCA procedures

WAIVING OF MINIMUM GROUND TRAINING REQUIREMENTS

Where recent pilot experience in similar aircraft models warrants, 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 briefings on normal and emergency operating procedures

Has received adequate instructions on the use/operation of the ejection seat and Scott 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. Dual control aircraft should be utilized if available. 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 prerogative. 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

TACTICS

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

TYPE INSTRUMENTS

Basic instrument work

Tacan penetrations and GCA's

Local area round robin (day and night) flights

AIRBORNE INTERCEPTS

Radar familiarization

Stern, 90° and head-on subsonic intercepts

90° and head-on supersonic intercepts

High altitude-high Mach intercepts

90° and head-on low altitude intercepts

ECCM flights

Multiple element intercepts

Broadcast control intercepts

Sparrow III firing

Sidewinder firing

MIRROR LANDING PRACTICE AND CARRIER QUALIFICATION

Slow flight

Supervised mirror landing practice

Carrier qualifications flights

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 RIO qualifications after initial qualification in each specific phase will be established by the Unit Commanding Officer. Crewmembers (pilots and RIO's) previously qualified in model and 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 in 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 25 hours in model

Have a valid instrument card

Have completed at least one night familiarization flight

AIR-TO-AIR MISSILE FIRING (PILOT AND RIO)

Have a minimum of 15 hours in model

Have satisfactorily completed a minimum of two intercept flights on which simulated firing runs were conducted utilizing the voice procedures and clear to fire criteria to be utilized in live firings

Be considered qualified by the commanding officer

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 buildups as specified by Type Commander; and have made a minimum of one day touch-and-go and one day trap during the day or night qualification

MINIMUM CREW REQUIREMENTS

The pilot and RIO (or two pilots) constitute the minimum crew for the F-4B 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 RIO'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.

PERSONAL FLIGHT EQUIPMENT

In accordance with OPNAVINST 3710.7 the flying equipment listed below will be worn by crewmembers on every F-4B flight.

Anti-buffet helmet modified in accordance with current aviation clothing and survival equipment bulletins

Oxygen mask

Anti-"g" suit

Fire retardant high visibility flight suit (khaki suit may be worn in combat areas)

Ankle-high laced shoes or laced boots

MK 3C life vest

Integrated torso harness

Sheath knife

Flashlight (for all night flights)

Pistol with tracer ammunition

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.

BRIEFING/DEBRIEFING

BRIEFING

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:

GENERAL

Aircraft assigned, call sign, and deck spot when appropriate

Engine start, taxi, and take-off times

Visual signals and rendezvous instructions

MISSION

Primary

Secondary

Operating area

Control agency

Time on station or over target

WEAPONS

Loading

Safety

Arming, de-arming

Duds

Special routes with ordnance aboard

Minimum pull-out altitude

Jettison area

COMMUNICATIONS

Frequencies

Radio procedure and discipline

Navigational aids

Identification and ADIZ procedures

WEATHER

Local area

Local area and destination forecast

Weather at alternate

High altitude weather for the jet stream, temperature, and contrail band width

NAVIGATION AND FLIGHT PLANNING

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

Wave-off 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

Postflight debriefing is an integral part of every flight. The flight leader should review the entire flight from take-off 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 intercepts should be reviewed using scope camera and controller information when available.

FLIGHT TEST PROCEDURES

Only those pilots designated in writing by the Squadron Commanding Officer will flight test squadron aircraft. Test flights must be flown under VFR conditions from take-off until the completion of applicable test procedures. Flight Test Procedures will be in accordance with the current edition of the F-4B Handbook Procedures of Maintenance Instructions (NAVWEPS 01-245FDA-6).

FDB-1.2-200

TABLE OF CONTENTS

(*)Denotes Illustrations

NORMAL OPERATING PROCEDURES

LINE OPERATIONS

The yellow sheet must be checked for flight status, configuration, armament loading and servicing prior to manning the aircraft. At least the ten previous "B" sections should be reviewed for discrepancies noted and the corrective action taken. Weight and Balance clearance is the responsibility of the Maintenance Department.

AFT COCKPIT INTERIOR CHECK FOR SOLO FLIGHT

1. Seat and canopy safety pins - INSTALLED
2. Circuit breakers - IN

Note

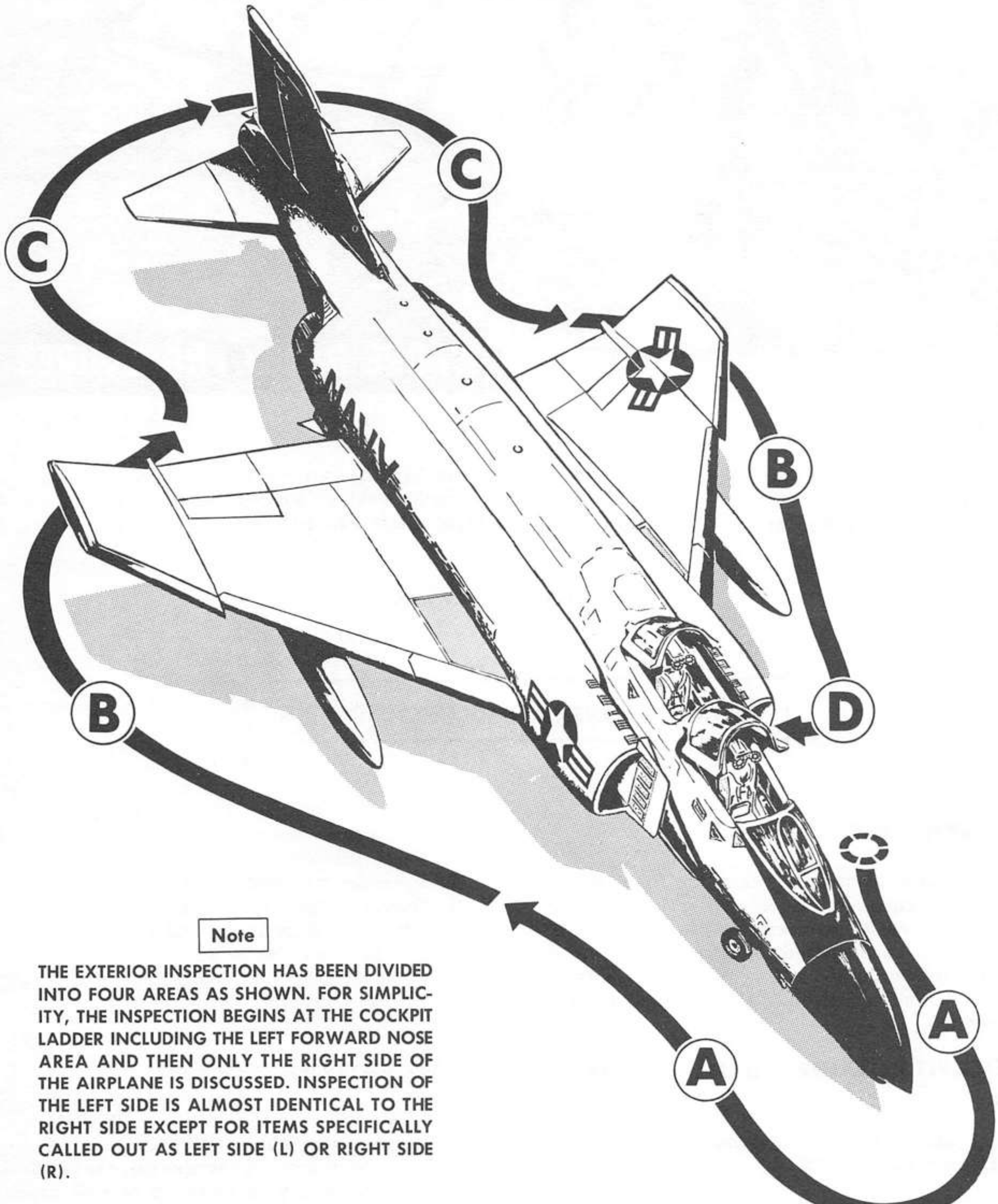
Two circuit breaker panels are located on the starboard side of the cockpit. These circuit breakers control much of the electrical equipment that is essential to flight and are inaccessible to the pilot while in flight.

3. Navigation computer function switch - OFF
4. Radar master switch - OFF
5. Pressure suit vent air valve - OFF
6. Oxygen supply lever - OFF
7. Cockpit light switches - OFF
8. Seat harness - STOWED
9. All loose gear - STOWED
10. Canopy - LOCKED

BEFORE ENTERING COCKPIT

1. Radar scope retaining bolts - CHECK
2. Harness assembly - CHECK
   Check emergency harness release handle down. Check if pin is installed at reel assembly. Check pins that secure lap belt and survival kit to seat are in place.
3. Composite disconnect lower block - CHECK
   Check lower block locking indicator (yellow metal tab) on bottom of lower block is tight.
4. Canopy interlock block - CHECK
   Check canopy interlock block in place, and interlock line secured to canopy.

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).

FDB-1.2-201-1

Figure 2-1 (Sheet 1)

(A) NOSE

1. GENERAL AREA

A. REFRIGERATION UNIT INTAKE CLEAR
B. RADOME SECURE

2. NOSE GEAR

A. TIRE CONDITION, INFLATION
B. STRUT CONDITION, PROPER INFLATION
C. GROUND LOCK REMOVED
D. GEAR DOORS SECURE
E. APPROACH LIGHTS SECURE
F. WHEEL WELL CONDITION
G. PITOT STATIC VENT
H. EMERGENCY FLAP PRESSURE GAGE–2750 PSI TO 3100 PSI
I. WIND DRIVEN TURBINE 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
C. ACCESS DOORS SECURE
D. INTAKE DUCT COVER REMOVED

(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 (IF CARRIED)
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. PITOT COVER REMOVED
D. COLLISION LIGHT SECURE
E. ENGINE ACCESS DOORS (96 L&R) SECURE
F. NOZZLE COVER REMOVED, NOZZLE 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

(D) UNDERSIDE OF FUSELAGE

1. GENERAL AREA

A. GENERAL CONDITION
B. EMERGENCY CANOPY AIR GAGES (ACCESS DOOR #16) 2750 PSI TO 3100 PSI
C. OXYGEN FILLER CAP SECURE, VALVE IN BUILD-UP POSITION (ACCESS DOOR #16)
D. PNEUMATIC SYSTEM AIR GAGE–2750 PSI TO 3100 PSI (ACCESS DOOR #28R)
E. UTILITY SYSTEM ACCUMULATOR AIR GAGE 1000 ± 50 PSI (ACCESS DOOR #23)

2. MAIN GEAR AND GEAR WELL

A. WHEELS CHOCKED
B. TIRE CONDITION, INFLATION
C. STRUT CONDITION, PROPER INFLATION
D. GROUND LOCK REMOVED
E. GEAR DOORS SECURE
F. SPEED BRAKE SAFETY SWITCH–NORMAL, (IF INSTALLED) 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

FDB-1.2-201-2

Figure 2-1 (Sheet 2)

SEAT AND CANOPY SAFETY PINS AND INSPECTION POINTS

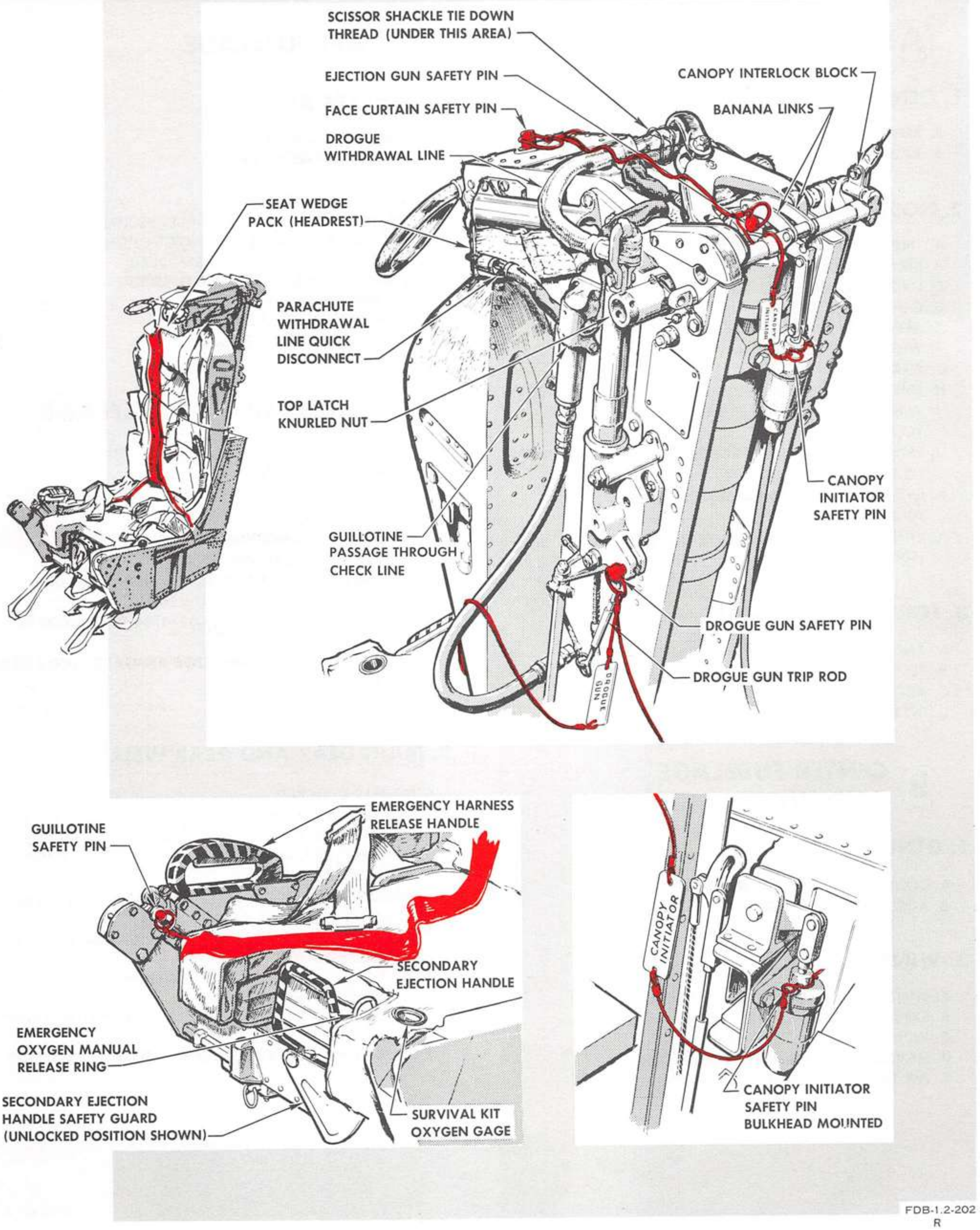


Figure 2-2

5. Drogue withdrawal line - CHECK
   Check drogue withdrawal line (in wire braid sleeve) passes over and lays on top of all other lines.
6. Scissor shackle tie-down thread - CHECK
   Check that scissor shackle tie-down thread passes through the shackle and around the wire loop under the flap securing pin and does not pass through the top of the drogue flap.
7. Banana links - CHECK
   Check links attached to sear pin.
8. Top latch nut - CHECK
   Check top latch nut lockwired and lead sealed.
9. Parachute withdrawal line quick disconnect - CHECK
10. Seat wedge pack (headrest) - CHECK
    Check seat wedge pack (headrest) has approximately one (1) inch side play.
11. Drogue gun trip rod - CHECK
    Check drogue gun trip rod on left side of seat secure to airplane structure.
12. Safety banner - REMOVED
    Check safety banner and all five safety pins - face curtain, ejection gun, canopy initiator (seat mounted), drogue gun, canopy initiator (bulkhead mounted) - and both dust covers (composite disconnect, exhaust port), are removed.

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.

13. Secondary ejection handle safety guard - CHECK UP
14. Survival kit oxygen gage - CHECK
15. Landing gear handle - DOWN
16. Generator control switches - OFF

INTERIOR CHECK

1. Time delay mechanism trip rod - CHECK
   Check time delay mechanism trip rod on right side of seat secured to airplane structure.
2. Composite disconnect intermediate block - CHECK
   Check yellow tubing projects from oxygen connector on top of intermediate block.
3. 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.

4. Pressure suit lines - CONNECTED

WARNING

When the pressure suit is being worn without an anti-G garment, the anti-G hose 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.

5. Pressure suit vent air valve - ON AS DESIRED
6. Oxygen supply lever - ON
   Check for normal flow.

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.

7. Leg restraint lines - CONNECTED
   Pass leg lines through garters 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 necessitates pulling legs aft against seat to preclude hitting canopy bow. This action will cause spine to flex and will increase the possibility of spinal injury during ejection.

8. Harnessing - FASTENED

CAUTION

Make sure that the automatic harness release 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.

9. Rudder pedals - ADJUST
10. Stick grip - CHECK
11. Intercom control panel - CHECK
    a. Volume selector knob - AS DESIRED
    b. Function selector switch - HOT MIC
12. Fuel control panel - CHECK
    a. External tank jettison switch - NORMAL, guard closed.
    b. Buddy fill switch - STOP FILL
    c. Internal wing transfer switch - NORMAL
    d. Refuel selection switch - ALL TANKS, guard closed.
    e. Refuel probe switch - RETRACT
    f. Boost pump check switches - NORMAL
    g. External transfer switch - OFF (AS DESIRED if tanks are carried)
    h. Internal wing dump switch - NORMAL
    i. Wing transfer pressure - NORMAL
13. Emergency hydraulic pump lever - IN PLACE AND SECURE
14. Wing flap switch - UP
15. Wing flap emergency pull handle - UP
16. Communication antenna selector switch - SET AS REQUIRED
17. Engine anti-icing switch - NORMAL
18. Throttles - OFF
19. Master lights switch - OFF
20. Speed brake switch - IN
21. Throttle friction lever - SET AS DESIRED
22. Engine master switches - OFF
23. Engine start switch - NEUTRAL
24. Emergency speed brake switch - GUARD DOWN
25. Emergency canopy release lever - IN PLACE AND SECURE
26. Drag chute handle - IN PLACE AND SECURE
27. Landing gear handle - DOWN
28. Missile jettison selector switch - OFF
29. Missile control power switch - OFF
30. Missile control arm-safe switch - SAFE
31. Missile control radar-heat switch - RADAR
32. Missile control interlock switch - IN
33. Bomb control ready-safe switch - SAFE (Airplanes 150406L and up)
34. Bomb control Labs-direct switch - OFF
35. Multiple weapons master arm switch - SAFE
36. Multiple weapons nose and tail arm switch - SAFE
37. Multiple weapons station selector switch - OFF
38. Accelerometer - SET
39. Altimeter - SET
40. Vertical velocity indicator - CHECK
41. Clock - SET
42. Arresting gear control handle - UP
43. Generator control switches - OFF
44. DCU75/A arming switch - OFF
45. Emergency vent knob - IN
46. Rain removal switch - OFF
47. Pitot heat switch - OFF
48. Communications function selector switch - STANDBY
49. TACAN function selector switch - STANDBY
50. Circuit breakers - IN
51. 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.

52. Instrument panel emergency floodlights switch - OFF
53. IFF master knob - OFF
54. Cockpit lights - OFF
55. Exterior lights - OFF
56. Spare lamps - CHECK
57. Flashlight, charts and reference material - CHECK

WITH EXTERNAL POWER CONNECTED

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.

58. Generator control switches - EXT ON
59. Seat - ADJUST
60. Interphone system - CHECK
61. 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.
62. Liquid oxygen gage - CHECK
63. Flap position indicator - UP
    Check flap position indicator corresponds with flap position.
64. Landing gear indicator - CHECK
    Check landing gear position indicators indicate gear down.
65. Fire warning light - CHECK
    Depress the fire check button and note fire warning lights illuminated.

66. Fuel quantity gage - CHECK
    Actuate feed tank check switch and check fuel gage reads feed tank fuel (approx. 1,900 lbs.).
67. Fuel quantity - CHECK
    Check fuel quantity indicators against known fuel quantity.
68. Warning lights - CHECK
    Depress warning light test switch and note master caution light, warning lights panel, 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.
69. Radio equipment - CHECK
    Check communication and navigation equipment for proper operation and frequency.
70. Flight instruments - CHECK
71. ADI pitch indicator knob - SET FOR TAKE-OFF
72. Compass system controller - SET
    a. Latitude compensator - SET
    b. Mode switch - SLAVED AND SYNCHRONIZED
    c. Sync. button - PUSH
    d. Sync. indicator - CHECK
73. IFF master selector switch - STDBY

INTERIOR CHECK-NIGHT / LOW VISIBILITY FLIGHTS

1. Master lights switch - ON
2. Cockpit lights - AS DESIRED
3. Exterior lights - AS REQUIRED
   Check navigation, join-up, anti-collision and fuselage lights in the BRIGHT, DIM, STEADY, and FLASH positions.
4. Availability and operation of flashlights - CHECK

BEFORE STARTING ENGINES

1. Wheels - CHOCKED
2. Fire bottle - MANNED
3. Intake and exhaust areas - CLEAR
4. Intercom contact with ground crew - ESTABLISHED
5. Boarding steps - UP
6. External air supply - CONNECTED AND PRESSURE UP

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.

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 engines with the nose into or at right angles to the wind as exhaust temperatures may be aggravated by tail wind.

STARTING ENGINES

Note

- The following 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 system indicator cannot be used to determine pump operation unless the right engine is started first.

- 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 start.

1. Throttles - OFF
2. External compressed air source - CHECK
   Check proper external air source is connected to starter system and that sufficient air pressure is available. A 5.5:1 pressure ratio gas turbine compressor starter unit, RCPP-105 or equivalent is required. Check to insure connection of gas turbine ground power supply remote control cable.
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, shut down immediately and investigate.

5. At 11% rpm, right engine ignition button - DEPRESS
   At approximately 11% rpm, depress right engine ignition button and simultaneously advance the throttle half way up the quadrant and immediately return to idle.

Note

The engine usually fires at approximately 13.5 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.

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 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 excessively 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 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 will indicate 500 to 800 lbs. per hour during starting and 1100 to 1300 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 start will likely result. If fuel flow is in excess of 800 lbs. per hour, a hot start will likely result. Refer to Volume I, Section II Engine Limitations.

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

Note

- With the right engine started, the No. 2 power control hydraulic system pressure gage and the utility hydraulic system pressure gage should read within normal. The hydraulic pressure warning light will remain illuminated until the other engine is started and all four hydraulic pumps (P.C. No. 1, P.C. No. 2, and utility) are operating properly.
- 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.
- After any wet start or false start, allow one minute or longer for the combustion system to drain before starting the engine.

11. Start left engine as per items 1 thru 10.
12. Generator control fuses and bus tie relay - CHECK
    a. Both generator control switches from EXT to OFF.
    b. Individually cycle the generator control switches from OFF to GEN ON and back to OFF.
    c. While each generator control switch is in the GEN ON position, check that the respective generator warning light and the bus tie warning light is out.
    d. After checking each system individually, position both generator control switches to GEN ON and check that both generator warning lights and the bus tie warning light are out.

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.

BEFORE TAXIING

1. External power sources - DISCONNECT
2. Static pressure compensator - RESET
3. 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.

4. AFCS - CHECK
   a. Stab Aug switch - ENGAGE
   b. Grasp control column below control stick and neutralize.
   c. Wait 3 seconds.
   d. AFCS switch - ENGAGE
   e. Check for hard forward control stick jump, visually check control surfaces for hard over movement.

If either of the above conditions exist: do not use the AFCS

If none of the above conditions exist:

   f. Altitude switch - ENGAGE
      Move control stick forward; switch should move to OFF. RE-ENGAGE altitude switch and move stick aft; switch should again move to OFF.
   g. Mach switch - ENGAGE (Perform the same check as for altitude hold check)
   h. AFCS/ARI disengage switch - DEPRESS
      Check that all switches on the AFCS panel return to OFF.

Note

Upon engaging and preflighting the autopilot system on the ground, a vibration throughout the airplane may be noticed. This phenomenon is caused by structural feedback from the autopilot and in no way reflects upon autopilot operation in flight.

5. Stab Aug switch - AS DESIRED
6. Trim switches - CHECK OPERATION AND SET FOR TAKEOFF
7. Speed brakes - CYCLE
   Ascertain from ground crew that speed brakes are fully closed and warning light is out.
8. Refuel probe - CYCLE, IFR PROBE LIGHT OUT
9. Wings - SPREAD AND LOCKED
10. Wing flaps - CYCLE, CHECK INDICATORS
11. Canopy - CLOSE

TAXIING

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 to approximately 80% on both engines. After the airplane has started rolling, check the brakes and engage nose wheel steering. Taxi at the lowest practicable RPM and use nose wheel 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 airplane down before entering a turn in order to reduce side loads while in the turn. Make turns as wide as practicable, a 75 foot radius minimum at 12 to 13 knots.

PRE-TAKEOFF

After taxiing to the run up area, allow the aircraft to roll straight ahead to align the nose wheel. Apply the brakes with a firm steady pressure. Check the engines individually at MIL power. The engines develop sufficient power on a cold day to cause the airplane to skid with both engines operating at MIL power simultaneously. With each engine at MIL power, observe that the RPM, EGT, exhaust nozzle, fuel flow, oil pressure and hydraulic pressure are within their normal operating ranges. 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 run ups are completed, complete the remainder of the takeoff checklist.

FLAP POSITIONS

Three flap configurations are available for takeoff; no flaps, half flaps, and full trailing edge flaps. Half flaps are used for all normal field takeoffs. The advantages of reduction in drag, increased power (less bleed air for the BLC), increased stabilator effectiveness, less trim change during transition to climb, and the proper configuration in case of an engine failure outweigh the small loss of lateral control and the slight increase in lift-off speed over a full flap condition. Full flaps provide minimum lift-off speeds and are used for all catapult launches.

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 wheel 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 85% RPM 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, after EGT and RPM are checked at MIL power, afterburner is selected by moving both throttles into the afterburner detent and advancing smoothly to MAX power. MAX power and half flaps will be used for all takeoffs with three full external tanks. 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 wheel steering can be used to maintain directional control until the rudder becomes effective at approximately 70 knots. Nose wheel steering should be disengaged when the rudder becomes effective. In any case, nose wheel 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 Essential Checklist and in Volume III of this publication. The nose strut is extended by applying slight back pressure at approximately 30 knots below the optimum followed by moderate back stick to raise the nose wheel and lift off at the optimum lift-off airspeed. When the airplane is definitely airborne, tap the wheel brakes and raise the landing gear. Immediately afterward, start the flaps up. 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 wheel 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. Pull 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.

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 Essential Checklist. Shut down the engines, but leave the airplane as prepared as possible for takeoff. 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 take-off checklist prior to scramble.

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 85% 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 speed are checked immediately after brake release. Directional control is maintained with either brake or nose wheel 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 VI Communication Procedures of this volume.

TRANSITION TO CLIMB

At applicable lift-off speed, rotate the airplane to a 10 to 12° nose-up attitude. When the airplane is definitely airborne, tap the wheel brakes and raise the landing gear. Raise the flaps at 300 feet or 200 knots CAS 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 CAS. Vary the pitch attitude as necessary to maintain 400 knots CAS until reaching Mach 0.9. Then vary the pitch attitude as necessary to maintain Mach 0.9 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 CAS. At 250 knots CAS smoothly rotate to a 20 to 25° nose-up attitude and hold until reaching Mach 0.92. Vary the pitch attitude as necessary to maintain Mach 0.92 until reaching cruise altitude.

INFLIGHT PROCEDURES

Refer to Section IV of this volume.

DESCENT

In all descents, care will be taken not to exceed any airframe limitations. See Limitations Volume III, Section II. In any descents from altitude, 5 minutes prior to letdown, select full DEFOG position of 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 interior temperature should be maintained. This will aid in defrosting the windshield.

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 2-3.

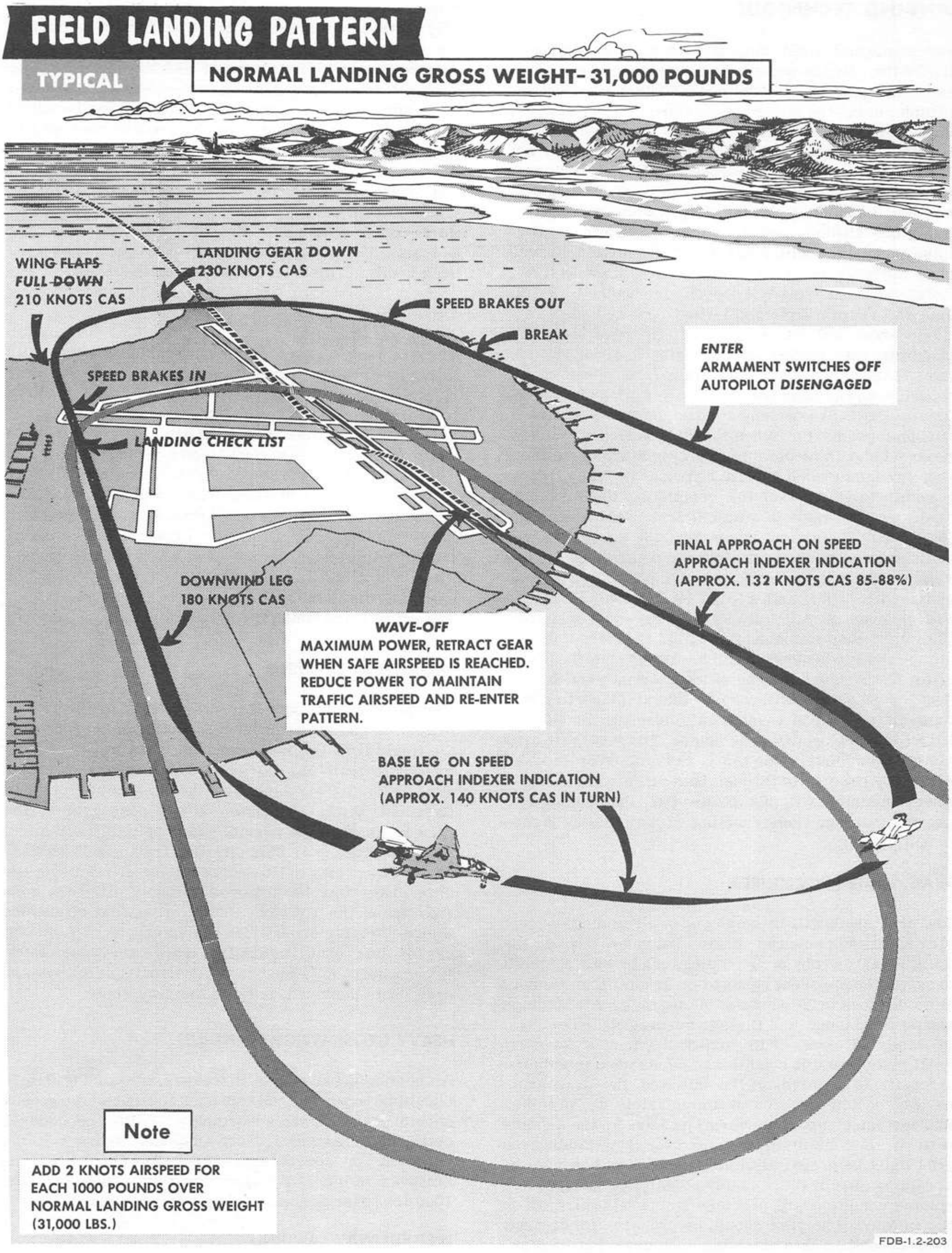

FIELD LANDING PATTERN
TYPICAL
NORMAL LANDING GROSS WEIGHT- 31,000 POUNDS
WING FLAPS FULL DOWN 210 KNOTS CAS
LANDING GEAR DOWN 230 KNOTS CAS
SPEED BRAKES OUT
BREAK
ENTER
ARMAMENT SWITCHES OFF
AUTOPILOT DISENGAGED
SPEED BRAKES IN
LANDING CHECK LIST
FINAL APPROACH ON SPEED
APPROACH INDEXER INDICATION
(APPROX. 132 KNOTS CAS 85-88%)
DOWNWIND LEG
180 KNOTS CAS
WAVE-OFF
MAXIMUM POWER, RETRACT GEAR WHEN SAFE AIRSPEED IS REACHED. REDUCE POWER TO MAINTAIN TRAFFIC AIRSPEED AND RE-ENTER PATTERN.
BASE LEG ON SPEED
APPROACH INDEXER INDICATION
(APPROX. 140 KNOTS CAS IN TURN)
Note
ADD 2 KNOTS AIRSPEED FOR EACH 1000 POUNDS OVER NORMAL LANDING GROSS WEIGHT (31,000 LBS.)
FDB-1.2-203

Figure 2-3

LANDING TECHNIQUE

For a normal field landing with a gross weight of 31,000 lbs., fly the pattern as illustrated in figure 2-3. Enter the pattern at local course rules airspeed and altitude, using the speed brakes and throttles as necessary. On the downwind leg, power should be reduced to obtain gear down speed (250 knots IAS), the gear and flaps should be extended, speed brakes retracted (to decrease buffet) and a mild rate of descent should be started. Landing gear and flap extension requires negligible attitude and trim change. Quite a bit of noise and buffet will come from the nose gear well when the gear is extended, however, this will slowly disappear when approach speeds are reached. By the time the gear is down and locked airspeed should indicate about 200 knots. Roll into the base leg with a moderate rate of descent and maintain about 160-165 knots IAS. When gear and flaps are checked and reported on the base leg, check aileron rudder interconnect (ARI) by watching rudder position response to aileron movements. When the 90° position is reached, airspeed should be down to approximately 10-15 knots above recommended approach airspeed. This will give a comfortable control for completing the turn onto final. Use the angle of attack indexer and maintain the "on speed" indication except that 130 knots CAS will be the minimum approach airspeed regardless of gross weight. Maintaining final approach power of approximately 88% rpm, and a 2 1/2 to 3° glide slope angle will provide a mild rate of descent (approximately 700 fpm). Plan to touchdown within the first 1000 feet of the runway whenever possible. Do not chop the power prior to crossing the end of the runway. The sudden loss of BLC air will cause the airplane to settle immediately. Upon touchdown retard the throttles to IDLE and deploy the drag chute. The nose will drop almost immediately due to CG and stabilator location. After the nose falls through hold full aft stick. Nose wheel steering will not be used on the landing roll except as an emergency method of maintaining directional control.

DRAG CHUTE PROCEDURES

The drag chute will 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 30 knots at 45 degrees or 20 knots at 90 degrees. All landings should be planned and flown as no-drag chute landings. In cases of drag chute non-deployment a wave-off shall be initiated if conditions are not ideal to stop the aircraft. If a wave-off 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. The pilot should be prepared for aircraft weathercocking into the wind upon drag chute deployment. Weathercocking must be corrected by rudder and spoiler control not brakes until such time as rudder and spoiler control is lost and braking is the only method available for directional control. If landing on wet runways with cross wind components of approximately 20 knots weather cocking may become so severe that the drag chute must be released in order to maintain directional control. 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. Directional control can be maintained with rudder and/or spoilers down to approximately 70 knots CAS. Nose wheel steering will not be used on the landing roll except as an emergency method of maintaining directional control.

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 just prior to flare-out. After touchdown, lower nose gear to the runway as soon as possible and apply forward stick. With the nose gear held off, the airplane's "weathervane" effect may not be correctable. If required, the drag chute may be deployed but only after the nose gear is on the runway. Under crosswind conditions where effective crosswinds are in excess of 20 knots, use of drag chute intensifies the weathervane effect. If "weathervane" effect is severely intensified with the drag chute deployed, jettison the drag chute.

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 2-3. To maintain "on speed" approach indexer indication the airspeed is increased approximately 2 knots for each 1000 lbs. over normal landing gross weight.

WET RUNWAY LANDING

This information will be supplied when available.

SECTION LANDING

The leader should transition to optimum approach speed when the runway is sighted, touching down 500-1000' 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. The leader will not actuate his drag chute until hearing the call from the wingman. If the wingman has no drag chute the leader will deploy his chute, allowing the wingman to pass him well clear on the wingman's side of the runway.

WAVE-OFF

The decision to take a wave-off 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. At a safe airspeed and altitude, raise the flaps and clear the runway.

POST FLIGHT 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. In order to check accessory malfunctions of the individual engines that may not be apparent when both engines are running, the engines should be shut down individually, the engine that was started first should be shutdown first. To shutdown an engine, move the throttle to OFF, the engine master switch to OFF and the generator control switch to OFF. During coast down, listen for any unusual engine noises and note that the coast down times are normal. 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 situations occur, the power control hydraulic systems must be reserviced and checked. Perform the postflight checks as listed in the NATOPS ESSENTIAL CHECKLIST.

EXTREME WEATHER PROCEDURES

The following procedures are exceptions and/or additions to the normal operating procedures previously described.

COLD WEATHER PROCEDURES

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.

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.

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 PROCEDURES

TAXIING

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.

NIGHT FLIGHT PROCEDURES

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, aircraft 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.

IN-FLIGHT PROCEDURES

See Section IV of this volume.

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 speed indicator. Rates of descent up to 750 feet per minute are acceptable, use mirror when available.

FDB-1.1-300

SECTION III CARRIER BASED PROCEDURES

TABLE OF CONTENTS

MIRROR LANDING PRACTICE

PREFLIGHT INSPECTION

A normal preflight inspection will be conducted with specific attention being given to tire condition and nose strut extension. 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 Paddles for MLP pattern control. At no time will an aircraft remain in the pattern without a UHF receiver. At the initial 180° position the call will include:

Call sign

Position

Gear down and locked

Fuel state

Pilots name

On each succeeding pass the pilot will report prior to turning downwind; at the 180° position the pilot will report side number and fuel state. When the meatball is observed, the pilot will report side number and meatball.

PATTERN

The pattern will be a 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, about one mile. For maximum gross weight at touchdown refer to Volume I. Angle of attack setting for optimum approach speed should give the following CAS: At a gross weight of 34,000 lbs. a corresponding CAS of 140 kts. will be used with a decrease of two knots per 1000 lbs. of fuel. The downwind turn should be 30° angle of bank and 140-150 knots CAS, climbing to 500' above field elevation. Recommended airspeed at the 180° position is 140 knots CAS. Power will be added to effect a level turn onto final. From the 180 to the 90 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 commence a 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

A 35 second interval is established by turning downwind when sufficient altitude is available. Do not attempt to open the interval by flying at slower than normal speeds.

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.

WAVE-OFF TECHNIQUE

Any time the meatball is lost close in on the groove, the pilot will initiate his own wave-off. Either MIL or MAX power will be used to effect all wave-offs. Normally, wave-offs will be taken straight ahead, especially when close in.

BINGO FUEL

No MLP approach will be commenced with 1500 or less pounds of fuel.

NIGHT MLP

All provisions which apply to day MLP also apply to night MLP plus the following items:

Call prior to turning downwind

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.

CARRIER QUALIFICATIONS

GENERAL

Carrier operating procedures are located elsewhere in this section with the exception of the following inflight procedures.

CARRIER BREAK

The carrier break will be at 600 feet, 250-300 knots maximum on the starboard bow of the ship. Radio procedures will be in accordance with ship procedures.

CARRIER PATTERN

The carrier pattern will be flown 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 MLP 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.

CARRIER OPERATING PROCEDURES

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. The canopy will be closed prior to start. Engines will normally be started ten minutes prior to launch time and the customary functional checks will be performed. Do not let the plane directors hurry these checks. Be prepared to hold brakes when tie downs are removed.

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 wheel 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 release the brake until a three-point tie-down has been installed.

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 directors whistle signal.

LAUNCH OPERATIONS

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 directors signals are followed explicitly. All functional checks will be performed prior to taxiing on to the catapult if practicable. The best technique for positioning is to approach the catapult track with a slight amount of power utilizing nose gear steering. The pilot should sight down the catapult track acquiring the plane director and follow his signals very closely. The pilot should anticipate the initial HOLD immediately after the nosewheel drops over the shuttle. The HOLD will be followed by the nose strut extension signal and an easy COME AHEAD as the tension bar is placed in the hold back. On the COME AHEAD very slow movement must be used to prevent overstressing the holdback lug.

CATAPULT LAUNCH (MIL POWER)

Prior to catapult tensioning, the nose strut will be extended. A pneumatic pressure of 2750 psi is required for nose strut extension at heavy gross weights. For normal CARQUAL weights of 34,000 lbs. and below, strut extension can be accomplished with pneumatic pressure as low as 1400 psi. On signal of catapult tension, release brakes, add power to 75-80% and anticipate a hand off to the catapult officer. The HSI should be set in the FREE position because of errors in the SLAVE position due to the magnetic influence of the ship. Trim should be set in accordance with current launching bulletins. Upon receipt of the two fingers turn-up from the catapult officer, advance throttle to MIL, check engine and flight instruments and when satisfied the aircraft is ready, give an exaggerated salute to the catapult officer. Prior to launch, ensure that the stick is positioned in the vertical position, catapult grip is utilized and the head is firmly against the head rest. Normally there will be a 3-5 second delay prior to catapult firing.

Normal catapult launches provide 10-15 knots excess end speed. The aircraft leaves the catapult in near level attitude, but does require slight rotation after bridle release. The aircraft should avoid crossing the bow or in front of other aircraft. Clearing turns are not required.

CATAPULT LAUNCH (MAX POWER)

The use of afterburner is not required under normal launch conditions; it is not recommended at night, and will not be utilized during CARQUALS. When a MAX 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 towards pilot).

Pilot selects A/B, checks instruments and positions himself, then gives an exaggerated salute to the catapult officer.

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 giving the throttle back signal. Then and only then, will the power be reduced.

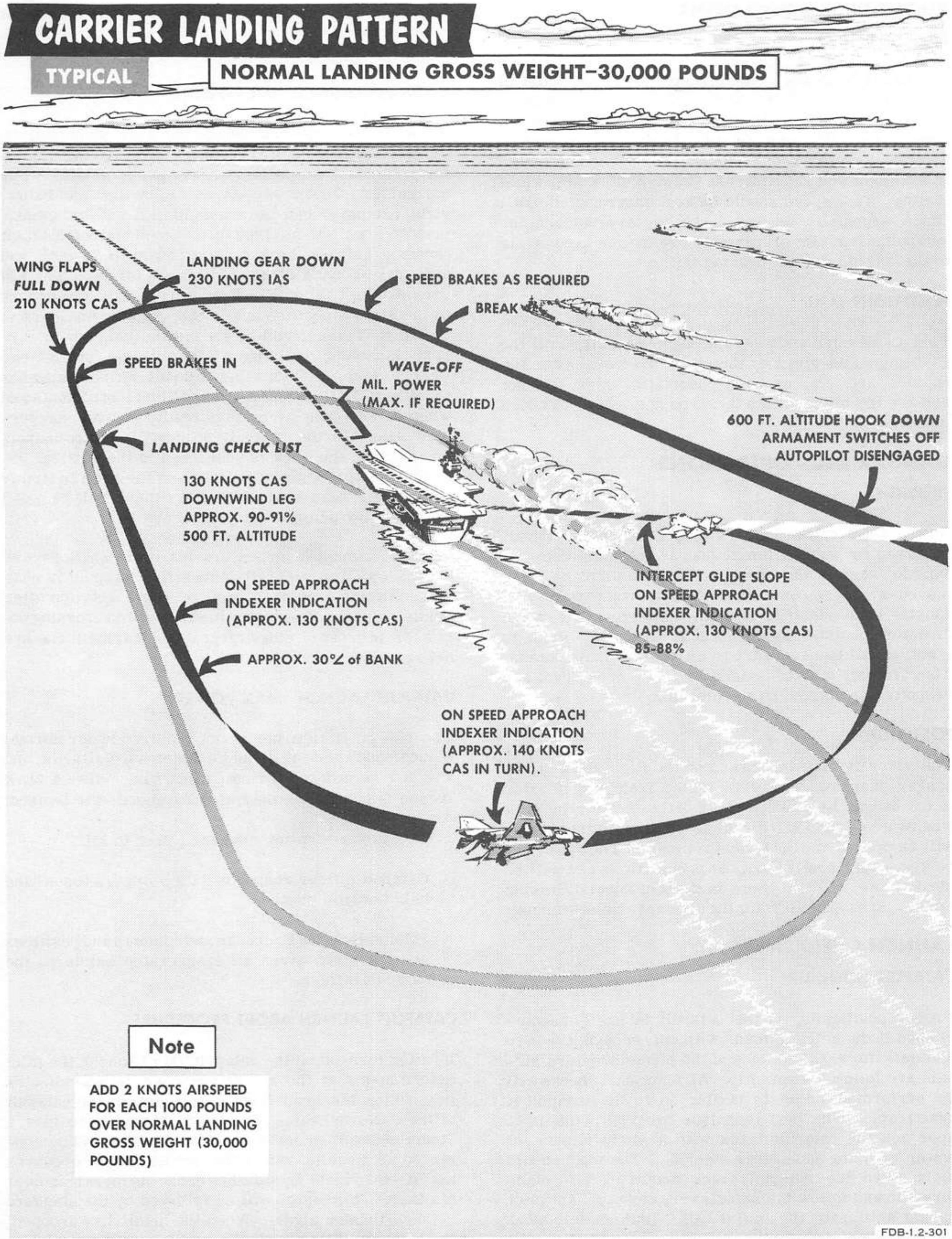

CARRIER LANDING PATTERN
TYPICAL
NORMAL LANDING GROSS WEIGHT–30,000 POUNDS
WING FLAPS FULL DOWN 210 KNOTS CAS
LANDING GEAR DOWN 230 KNOTS IAS
SPEED BRAKES AS REQUIRED
BREAK
SPEED BRAKES IN
WAVE-OFF MIL. POWER (MAX. IF REQUIRED)
600 FT. ALTITUDE HOOK DOWN
ARMAMENT SWITCHES OFF
AUTOPILOT DISENGAGED
LANDING CHECK LIST
130 KNOTS CAS
DOWNWIND LEG
APPROX. 90-91%
500 FT. ALTITUDE
INTERCEPT GLIDE SLOPE
ON SPEED APPROACH
INDEXER INDICATION
(APPROX. 130 KNOTS CAS)
85-88%
ON SPEED APPROACH
INDEXER INDICATION
(APPROX. 130 KNOTS CAS)
APPROX. 30°∠ of BANK
ON SPEED APPROACH
INDEXER INDICATION
(APPROX. 140 KNOTS
CAS IN TURN).
Note
ADD 2 KNOTS AIRSPEED FOR EACH 1000 POUNDS OVER NORMAL LANDING GROSS WEIGHT (30,000 POUNDS)
FDB-1.2-301

Figure 3-1

CARRIER LANDING PATTERN

See Figure 3-1.

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, power is added 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 and add power. Hold brakes to arrest forward movement. Taxi forward on the COME AHEAD. Expedite exit from landing area and retract flaps. 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.

POSTFLIGHT TAXI

Taxi as directed, keep engines running until "cut" by the director. Use the pneumatic brake and do not release the brake until a three point tie down has been installed. The aircraft may be parked on the flight deck or hangar deck. The aircraft may be taxied from the elevator into the hangar bay. When clear of the elevator the pilot will be given the "cut" signal. Open the canopy and remove the helmet. From this point aircraft handlers will move the aircraft. Keep speed under control and listen for the whistle. Always keep in mind that you have an excellent pneumatic emergency brake, use it any time you are in doubt of normal braking action on the flight deck or hangar deck.

NIGHT CARRIER BASED PROCEDURES

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. Flight and survival equipment for night operations will include a red lensed flashlight and a pistol with tracer ammunition.

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 post start light check. The general rule of not showing white lights on the flight deck at night should be observed.

POST START

Adjust cockpit light intensity to desired level. Prior to normal systems checks, an external light check should be made. 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 operations, 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 throttle in MIL, check all instruments. When ready to go, place external light master switch ON (dim/bright and steady), fuselage light off. After launch the pilot must be prepared to establish a wings level climb. Retract the landing gear. 500 ft. is considered to be a minimum altitude for retraction of flaps. When well established in a climb and above 2500 feet switch lights to bright and flashing or as applicable for an instrument climb-out.

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 MRT 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.

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 roll-out turn off external lights and as above follow director's signals.

CARRIER OPERATIONS LIMITATIONS

Carrier operations with asymmetric store loadings are prohibited.

After each arrested landing, inspect the stabilator leading edge for damage from arresting cable.

Barrier engagements are permitted as follows:

No external stores.

Maximum off-center distance not to exceed 10 feet.

Nose wheels on deck.

For carrier approach and arrested limitations, refer to the applicable recovery bulletin.

CARRIER CONTROLLED APPROACH PROCEDURES

GENERAL

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. A diagram at the end of the section illustrates a typical operation. 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 thunderstorm 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. The joint AIRLANT/AIRPAC/CCA instruction does not provide information for formation holding and break-up interval to allow the aircraft to anticipate individual holding fixes.

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.

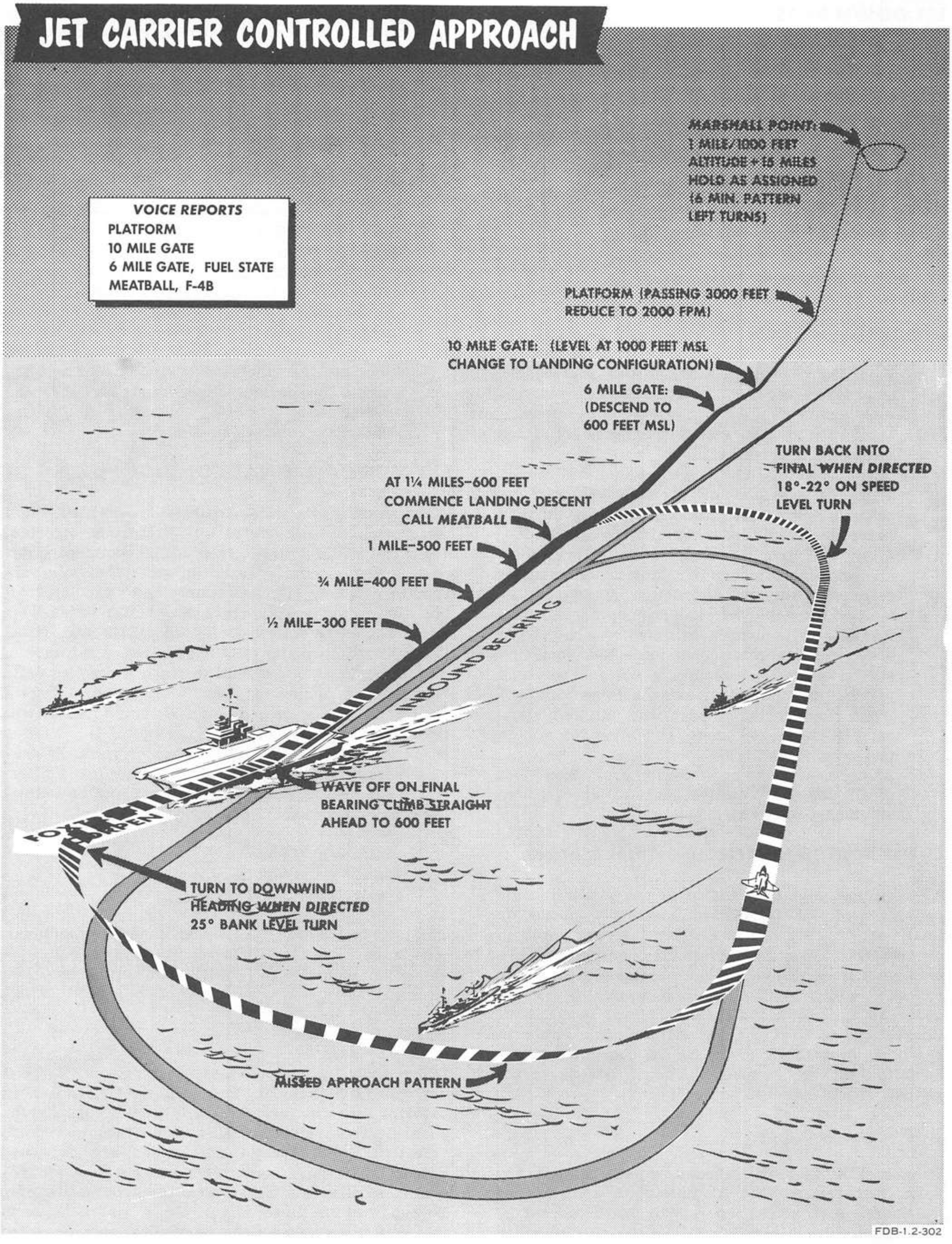

JET CARRIER CONTROLLED APPROACH
MARSHALL POINT: 1 MILE/1000 FEET ALTITUDE + 15 MILES HOLD AS ASSIGNED (6 MIN. PATTERN LEFT TURNS)
VOICE REPORTS
PLATFORM
10 MILE GATE
6 MILE GATE, FUEL STATE
MEATBALL, F-4B
PLATFORM (PASSING 3000 FEET REDUCE TO 2000 FPM)
10 MILE GATE: (LEVEL AT 1000 FEET MSL CHANGE TO 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
WAVE OFF ON FINAL BEARING CLIMB STRAIGHT AHEAD TO 600 FEET
TURN TO DOWNWIND HEADING WHEN DIRECTED 25° BANK LEVEL TURN
MISSED APPROACH PATTERN
FDB-1.2-302

Figure 3-2

LET-DOWN PHASE

The CCA let-down 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 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 and a minimum of 200 knots 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

1. Prior to descent, check inertial reel handle locked and set lights as dictated by existing weather.
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 as outlined in the joint instruction. This is satisfactory for deployed air group operation. For CARQUALS, squadron call sign may have to be added to eliminate confusion. (The joint instruction does not require a voice report departing marshal and leaving holding altitude.)
5. When commencing penetration, initiate a standard descent--250 knots, 4,000 feet per minute minimum, speed brakes extended.
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.

CORRECTIONS TO NEW INBOUND/FINAL BEARING

Although the joint CCA instruction does not include procedure for making corrections to new inbound or final bearing, this 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

Passing 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. Aircraft should be at 20 miles passing 5,000 feet. Descent is continued at 2,000 feet per minute and aircraft are leveled at 1,000 feet, 250 knots, speed brakes in, normal at 10 to 12 miles.

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. (The joint instruction does not establish a uniform speed for interval control after passing the ten mile gate. Squadrons will have to conform to ship's procedures as to speed after passing 10 miles.)
4. Complete the landing checklist, check anti-ice system on normal, lights and pitot heat as appropriate.
5. Select rain removal 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 commenced 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. (Speed passing six miles is not covered in the joint instructions.) 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, 700 to 800 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

The joint instruction does not establish CCA minimum. With a well qualified CCA team and air group, suggested minimum for F-4B is 300-foot ceiling, one-mile visibility.

MEATBALL CONTACT

When ready to continue a visual approach, the pilot reports "side number, meatball, F-4B", and check 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 to 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.

VOICE PROCEDURE

Although the joint instruction does not cover acknowledgement of CCA Final Control instructions, definite pilot/controller voice procedure must be established and thoroughly understood.

WAVE-OFF AND BOLTER PHASE

In the event of a wave-off or bolter, MIL power/afterburner should be added if necessary, and climb straight ahead to 600 feet using catapult take-off techniques of aircraft rotation and speed control. The aircraft will be either cleared to turn to the down-wind vector, or vectored ahead of the ship to establish aircraft intervals. Under no circumstances should the pilot climb or descend in turning flight at or below 600 feet. According to the joint instruction, if no instructions are received within two minutes, a level turn to downwind course should be executed. It is assumed that ships will establish a Tacan distance--approximately six miles--at which pilots will assume communication failure and initiate their own turn to the down-wind. The joint instruction does not establish a uniform wave-off/bolter pattern speed, therefore conformance with ship's pattern speed is required to maintain aircraft intervals. A 25 degree bank angle at 150 knots on the up-wind 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 down-wind leg may be vectored back to a proper abeam position. Approaching the 180-degree position, the aircraft is slowed to approach speed. This position can be established by using a relative Tacan bearing of 10 degrees ahead of the wing when on the down-wind heading. Final Control will clear the aircraft to turn back inbound to intercept the final bearing. With no traffic ahead, the 180-degree position will be such that will allow the aircraft to intercept the final bearing at 1-1/4 to 1-1/2 miles aft the ship. On Tacan, this 180-degree position will be a relative position of approximately 15 degrees aft the wing at 1-3/4 to 2 miles on DME. No attempt should be made to establish visual contact with the ship when executing a CCA until the final approach turn has been completed. Traffic spacing ahead may require aircraft to continue on down-wind heading well past the 180-degree position before turning back inbound to the ship. The joint instruction does not specify a distance aft the ship at which a pilot may assume communication failure and initiate his own turn inbound. However, a level on-speed approach turn of 18- to 20-degree bank angle will allow the aircraft properly to intercept the final inbound bearing from the normal 1-3/8 to 1-1/2 mile abeam down-wind leg.

FOULED DECK HOLDING

One of the most taxing problems that can arise when a full air group CCA recovery is in progress in actual weather is that of initiating fouled deck holding. Basically, it amounts to stopping the flow, maintaining aircraft separation and identification, providing for possible no-radio aircraft--then, resuming the flow and expeditiously feeding the aircraft back into approach with proper interval. Generally, fouled deck holding can come as a result of either a saturated wave-off pattern or a prolonged fouled deck because of a crash or equipment casualty. Fouled deck holding procedures must be thoroughly understood by all pilots and controllers in order that all personnel will know what is expected when the situation arises. The joint instruction establishes fouled deck holding procedures for jet aircraft as follows:

> If the deck becomes fouled or an excessive number of aircraft bolter or wave-off, Center will take action to prevent overloading the traffic pattern. When, in the judgment of the Center supervisor, no more aircraft should be allowed in the pattern, the following action should be initiated.

JET AIRCRAFT ABOVE 5,000 FEET

Center will transmit "All jet aircraft above 5,000 feet will dog. Dog radial is _____." Each individual pilot will level off at the next odd altitude and hold on the dog radial assigned. The dog radial assigned will be displaced from the final bearing in such a manner that it will preclude any closing situations because of non-receipt of the dog signal by any aircraft. Pilots will report their distance and altitude.

JET AIRCRAFT BELOW 5,000 FEET

Up to six aircraft may be allowed in the landing pattern. All others will be assigned individual altitudes of 2,500, 3,500, and 4,500 feet to hold in a six-minute lefthand race track pattern at 10 miles ahead of the ship and oriented on the extension of the final bearing. If propeller aircraft are being held overhead, jet aircraft below 5,000 feet will continue their approach and await specific holding instructions. When traffic permits, aircraft holding below 5,000 feet will be controlled individually into the down-wind leg of the bolter/wave-off pattern. Some of the missing details will have to be established by each ship's CCA doctrine and squadrons must ensure that all concerned thoroughly understand.

COMMUNICATION 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 (NO NAVIGATION AIDS AVAILABLE)

The pilot will have navigated to best position by dead reckoning. The following procedures will apply.

With Radio Receiver

Fly right-hand triangle pattern, one-minute legs.
Conserve fuel and maintain altitude.
Squawk Mode II and be alert for aircraft vectored to join.

Without Radio Receiver

Fly left-hand triangle pattern, one-minute legs.
Conserve fuel and facilitate radar pickup by maintaining highest feasible altitude consistent with situation.
Squawk Mode II and be alert for aircraft vectored to join.
After joining, inform healthy aircraft of all emergency conditions by appropriate hand signals in order to prevent separation during penetration/let-down.

EMERGENCY WITH NAVIGATION AIDS AVAILABLE

Squawking Mode II, proceed to alternate marshal.
Energize I/P function at least once each minute.
Commence penetration/let-down at EAC as briefed.
Be alert for aircraft vectored to join. However, if immediate assistance is required, energize emergency IFF.

EMERGENCY AFTER COMMENCING PENETRATION/LET-DOWN

Even though communication and navigation aids have failed, if navigation equipment is still available, continue approach. Regardless of weather, any jet aircraft having passed PLATFORM must continue its approach. If no contact has been made after two minutes plus individual expected ramp time, the without-radio-receiver procedures of a lost aircraft (no navigation aids available) should be conducted. If all communication and navigation equipment is lost, pilot will proceed as follows:

If last known weather at the ship was 800 feet with two miles visibility or better, pilots may elect to continue approach by dead reckoning and maintain DR until two minutes past individual expected ramp time when the without-radio-receiver procedures of a lost aircraft (no navigation aids available) should be conducted.

If last known weather at the ship was below 800 feet with two miles visibility, procedure is as follows:

Jets will level off, conserve fuel, and execute a one-half standard rate timed turn to a heading 90 degrees to the right of previous penetration heading. This new heading is to be maintained for two minutes. The without-radio-receiver procedures of a lost aircraft (no navigation aids available) will be conducted.

CARRIER EMERGENCY SIGNALS

See Figure 3-3.

SECTION CARRIER CONTROLLED APPROACHES

Should a section approach become necessary because of radio or instrument failure, the wingman should be placed on the right side prior to commencing the descent. During the last part of the final approach, speed should be reduced to 145 knots so as to be approximately on speed when meatball is sighted. The leader should indicate meatball to his wingman, and if at night, blink external lights to indicate carrier in sight. At this time the wingman will continue the approach and land. The leader will make a definite turn to port, and parallel the final bearing. In this way he will be in position to pick up the wingman should he bolter. Following the trap/bolter, the leader will execute the normal CCA wave-off procedure and be vectored in for an additional section approach or final landing.

CARRIER EMERGENCY SIGNALS

EMERGENCY SIGNALS WITHIN VISUAL RANGE OF SHIP

AIRCRAFT TO SHIP

EMERGENCY	SIGNAL
Immediate landing is required.	Fly close aboard port side of ship with hook down, lights bright and steady if at night.
Immediate landing is required while in the landing pattern.	Rock wings from the 45-degree position until in the groove, or from 5 miles to 1-1/2 miles if on a CCA or straight-in approach in daylight. At night, rapidly flash lights at one mile and at one-half mile.
Emergency landing is not required.	Fly close aboard starboard side of ship with hook up, lights bright and flashing if at night.

SHIP TO AIRCRAFT

SIGNAL	MEANING
Blinking green light from tower	Burn down and land.
Blinking red light.	Maximum conserve, stay within visual distance of ship
Flashing green cut lights on mirror and/or all runway lights on.	A ready and clear deck.
Runway lights out with center line lights on or off.	Foul deck.
Flashing green cut and red wave-off lights on mirror and turning off and on of runway lights.	Aircraft in groove proceed to divert field.

EMERGENCY SIGNALS NOT WITHIN VISUAL RANGE OF SHIP

SIGNAL	MEANING
Right-hand triangular pattern, one-minute legs.	Only radio receiver operating.
Left-hand triangular pattern, one-minute legs.	Transmitter and receiver inoperative.
MODE II IFF.	Communication failure.
I/P function with Mode II.	Communication failure, pilot proceeding to alternate marshal at assigned holding altitude.

NOTE: Controllers will use various IFF codes and modes to obtain amplifying information from the pilot in case of radio transmitter failure.

FDB-1.2-303

Figure 3-3

FDB-1.2-400

SECTION IV FLIGHT PROCEDURES

TABLE OF CONTENTS

(*)Denotes Illustrations

FLIGHT CHARACTERISTICS

STALLS

NORMAL STALLS

Normal stalls in the clean configuration are preceded by a wide band of buffet warning. Onset buffet occurs 40 knots above the stall and increases to moderate to heavy buffet immediately preceding the stall. Mild wing rocking will occur 5-10 knots prior to the stall. The stall is usually characterized by a right yaw and right roll, however, the aircraft will occasionally yaw and roll to the left. Recovery is easily effected by positioning stabilator forward of neutral while maintaining neutral ailerons and rudder.

WARNING

If the aircraft is close to or at the stall, use of aileron to raise a wing will aggravate the yawing motion. Left aileron produces right yaw, etc.

STALLS IN LANDING CONFIGURATION

Stalls in the landing configuration are safe and comfortable with satisfactory control about all axes to within 8 knots of the stall. 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 minimum approach airspeed. It actuates approximately 19 knots above the stall.
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 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 as 60° to 80° left and right and the stall approach should be broken off at this point by gentle forward stick movement until recovery attitude is reached.

STALL SPEEDS

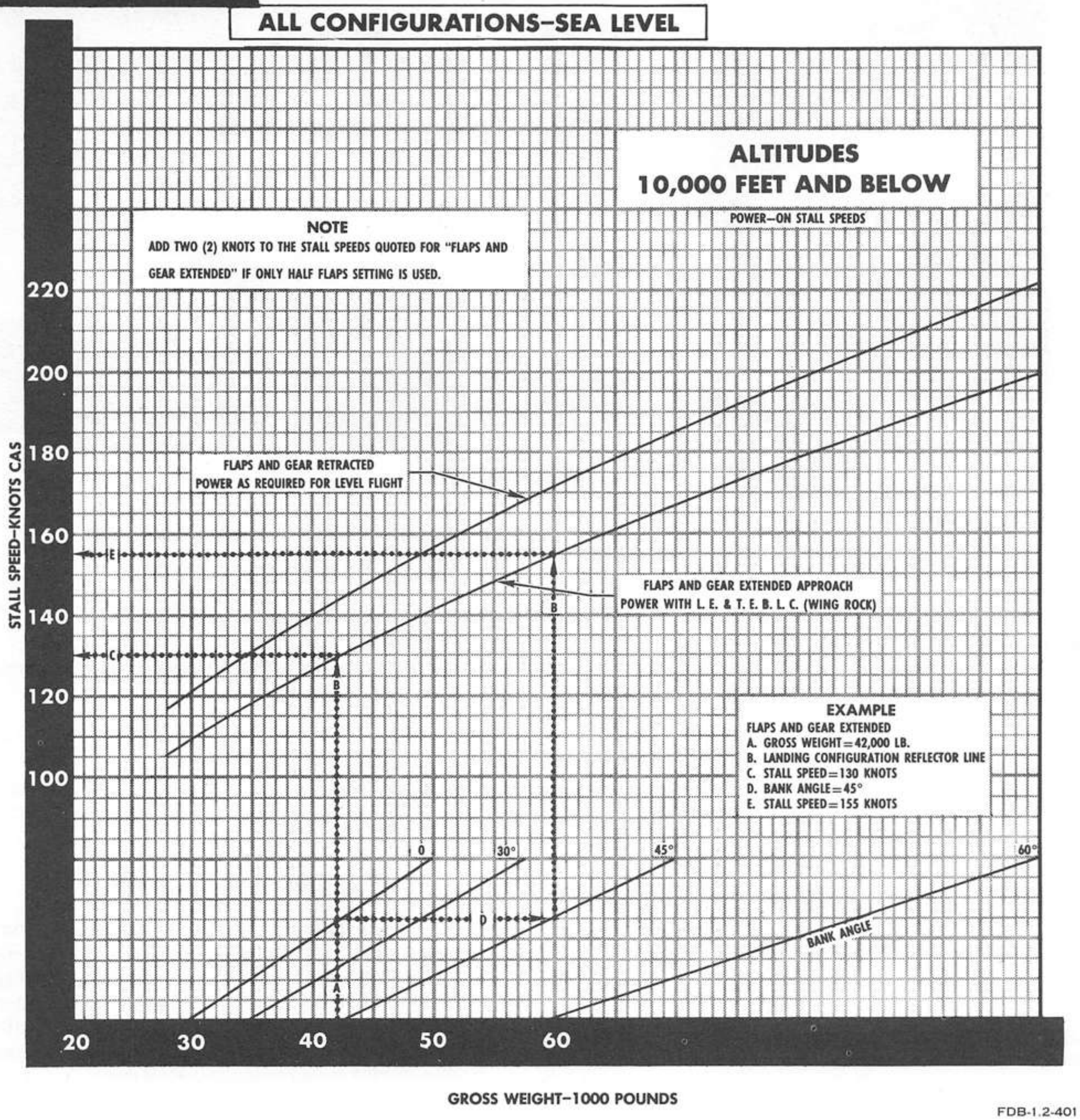


Figure 4-1

4. Buffet - A moderate buffet will usually be detected 1-2 knots above stall.
5. Stall and Recovery - 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. 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 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, and it is also possible that the spin cannot be broken within a one spin 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.

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 and rudder as required will effect an immediate recovery from any stall that does not exceed the above conditions.

CAUTION

Do not practice landing configuration stalls above 10,000 ft. The effectiveness of the BLC system, and engine bleed pressures decrease with altitude. Use of BLC at extreme altitudes may cause systems using engine bleed air to become inoperative.

Supersonic

Supersonic accelerated stalls exhibit less buffet and wing rocking than subsonic stalls.

SPINS

GENERAL

This airplane is considered to be highly spin resistant. Because of excellent longitudinal stability characteristics, the aircraft can usually be flown well past stalled angle of attack with positive control recovery without a spin ensuing. A wide variety of spin entry conditions have been investigated and included spins from:

Level flight.

Accelerated turns below and above 50,000 ft.

Accelerated turn reversals.

Vertical climbs.

Supersonic (1.2 Mach) with speed brakes extended (accelerated turns).

Inverted climbs up to vertical.

All developed upright spins are stable, and none approached a flat spin. Controlled recoveries are possible from all maneuvers.

UPRIGHT SPINS

The upright spin has an oscillatory behavior in pitch, roll and yaw which is predominant on the first two or three turns but diminishes as the spin is increased. Nose position varies from level to slightly above the horizon at the start of each turn to 50° - 70° nose down at the 1/2 turn position. The roll and yaw oscillations that are present do not produce uncomfortable accelerations on the pilot. Altitude loss per turn in a steady state spin is approximately 2,500 feet. Altitude to accomplish a control recovery described below is approximately 15,000 ft. It can take 5,000 ft. to break a steady state spin and regain flying speed and an additional 10,000 ft. to level out while holding onset buffet. This altitude can be shortened by pulling moderate buffet on level out or by having a rapid recovery to flying speed. High energy effects on spin mode are noted during spin entries from supersonic accelerated turn conditions with speed brakes extended. High rotational rates occur during the incipient stage of the spin, but return to the normal spin rate by the conclusion of the third turn. Influence of extended speed brakes on spin mode and recovery is negligible. Forward stick motion during the incipient stages of a spin will cause recovery, however, application of forward stabilator during steady state spins produces a significant increase in rotational rate and a slight increase in aircraft angle of attack. No divergence toward a flat spin mode will be evidenced. Right spin direction evidences higher rotation rates and angle of attack than spins to the left. The aircraft is especially spin resistant from spin entries out of vertical climbs, however, if an incipient spin is entered at a high pitch angle and low airspeed, positioning stabilator forward of neutral while holding neutral ailerons and rudder is the recommended procedure. The aircraft will pitch forward at the top of the trajectory and regain flying speed.

Upright Spin Recovery

If the aircraft enters an out-of-control flight condition, the following recommended steps should be taken for recovery from upright stalls/spins.

1. Position stabilator forward of neutral, neutralize ailerons and rudder, and hold in neutral position for 1 1/2 spin turns. The aircraft should fly out of nearly all out-of-control conditions with these control motions.
2. If the aircraft is not flying after taking the action prescribed above and altitude is over 30,000 ft. with daytime visual conditions prevailing and a control recovery is desired to be attempted, apply:
   a. Aileron with spin (with apparent roll), rudder against spin and stabilator aft. Hold these controls until yaw rate has definitely stopped and then neutralize rudder, ailerons and position stabilator forward of neutral.
   b. If the aircraft then exhibits mild reversals, counter with rudder and aileron while holding stabilator forward of neutral. If reversals are of a magnitude such that it is believed that another spin is being entered, repeat spin recovery technique outlined in 2.a.
3. If under 30,000 ft., at night, or in instrument conditions, and airplane is not flying after the 1 1/2 turn waiting period described in 1 above, deploy drag chute and position stabilator forward of neutral while holding neutral ailerons and rudder for recovery from the spin. The drag chute can then be jettisoned when the aircraft is solidly under control. The drag chute will produce a recovery within one turn from pilot actuation. It takes 1/3 to 1/2 turn to fully deploy and produce load. Drag chute recovery is extremely positive and no reversal tendencies will be encountered.

Control recovery can be more rapid if application of recovery aileron is timed to reinforce the aircraft's roll oscillation.

INVERTED SPINS

No inadvertent inverted spins should be encountered since the aircraft possesses a high degree of directional stability at negative angles of attack. Without introduction and persistence of pro-spin controls, an inverted spin cannot be maintained in a stall attitude at any pitch angle.

Inverted Spin Recovery

Recovery from an inverted spin is as follows:

1. Apply rudder opposite to visual spin direction. Keep stabilator forward of neutral and ailerons neutral.
2. When yaw rate stops, neutralize all controls.

Engine Effects

Spin tests have shown that the engines will probably flame-out during spins and spin entries. Normal flight control operation for recovery will deteriorate after three turns and may not be possible after five turns. Continuous ignition has proved to be effective in keeping the engines running, and will be retrofit to all airplanes.

FLIGHT CONTROL EFFECTIVENESS

STABILATOR

Airplane response to longitudinal stick displacement is good in all flight conditions, however, stabilator effectiveness varies considerable throughout the flight envelope. Longitudinal sensitivity, and consequently stabilator effectiveness is greatest at high "q" i.e., at high subsonic speeds and low altitudes. Effectiveness is greatly reduced in the BLC landing configuration and lessened still further when in ground effect. Enough effectiveness is retained however, that only on rare occasions will it be necessary to use full aft stick for landing. Stabilator effectiveness also deteriorates at high supersonic speeds; here it becomes apparent that more aft stick is required to increase load factor than is necessary at subsonic speeds. It is quite possible to use full aft stick at supersonic speeds at high altitudes without exceeding the airplanes' limit load factor.

LATERAL CONTROL

Lateral control is adequate in all flight conditions except in the single-engine landing configuration, where lateral control becomes marginal below 130-135 knots CAS at landing gross weight. Roll rates at any given altitude remain fairly constant throughout the subsonic speed range, and then start to decrease as speed is increased supersonically. However, the rate of decrease is such that roll rate is still adequate at the maximum airplane Mach number. Caution should be used in lateral control until the pilot has become familiar with their use, due to the extremely high roll rates obtainable under certain conditions. Incorporation of the ARI (Aileron-Rudder Interconnect) effectively prevents adverse yaw with lateral control application at low speeds (below 225 knots). At speeds above 225 knots the ARI system is automatically cut out since adverse yaw is negligible.

ANGLE OF ATTACK CONVERSION

ALL CONFIGURATIONS–FLAPS AS NOTED, GEAR DOWN

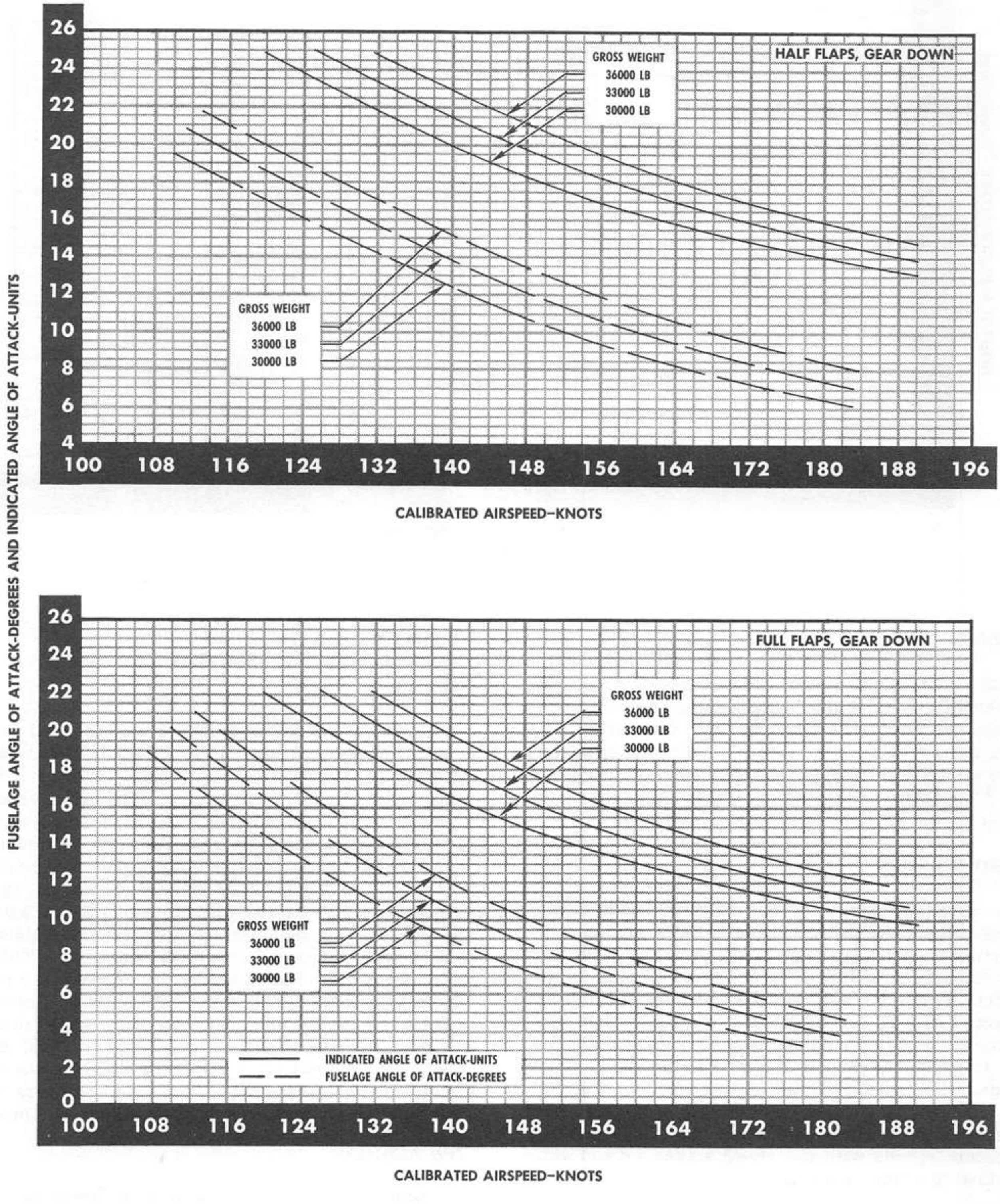


Figure 4-2

ANGLE-OF-ATTACK CONVERSION

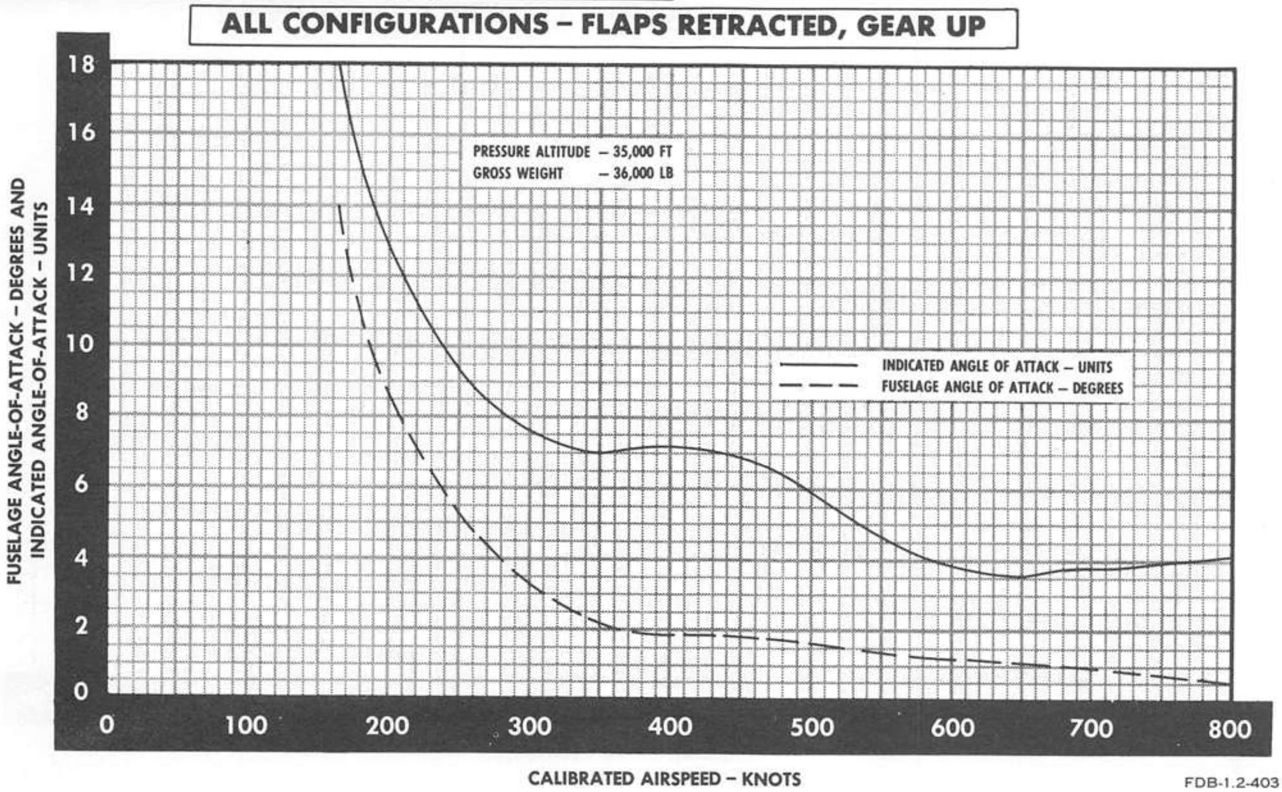


Figure 4-3

RUDDER

Rudder control becomes effective at approximately 70 knots and remains so throughout the high speed range. As in most jet aircraft, very little pilot initiated rudder control is required. The yaw damper is very effective in damping short period oscillations and the ARI system mentioned previously takes care of the adverse yaw which occurs below 225 knots.

SPEED BRAKES

The speed brakes are very effective decelerating devices under most conditions. Extension and retraction occurs with very minor pitch transients. In the extended condition the speed brakes create a mild buffet. For this reason and also because speed brake effectiveness is low at landing approach speed, it is recommended that landings be made with speed brakes in. Only in the case of a no-flaps landing is it recommended that speed brakes be extended. A mild nose up transient is usually experienced in the transonic speed range while decelerating from supersonic to subsonic speeds with the speed brakes out and while holding "g's" on the airplane.

ANGLE OF ATTACK

See figure 4-2 for Angle-of-Attack Conversion Charts.

FLIGHT STABILITY

GENERAL

The stabilator sensitivity is very pronounced in the transonic region at low altitudes. With stability augmentation inoperative at aft C.G. locations this sensitivity contributes to undesirable and potentially hazardous flight characteristics. The amount of sensitivity will vary with the center of gravity through an approximate range of 1.7 "g" per degree of stabilator to 2.5 "g" per degree. For example, when flying in the transonic region at low altitude with 4 Sparrows and the Mk-28 store installed, three degrees of stabilator motion will create 6.6 "g's" of load factor. This is only 1.09 inches of stick travel, measured at the point of the trim button. Therefore, it is strongly recommended to fly the aircraft smoothly while in this regime, steering clear of unnecessary rapid stick inputs. The sensitivity is still present with the stability augmentation operative; however, the dampers will decrease the stabilator response to rapid stick inputs.

LOW ALTITUDE

Transonic flight at low altitude presents low stick force gradients which in turn results in an area of sensitivity or 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 lag and the control system lag become coupled with the airplane motion, thereby inducing negative damping. Such a condition is commonly known as "PIO" or pilot-induced oscillation. Since the dampers will decrease the stabilator response to rapid stick inputs, the possibility of inducing an oscillation are minimized because of the change in the effective time constant in a favorable direction. Therefore, it is recommended that the stability augmentation be used when flying at high speed and low altitude. The standard and most effective recovery technique from a pilot-induced oscillation is to release the controls. Therefore, it becomes advisable to trim out longitudinal stick forces while accelerating in this flight region. Releasing controls while stick forces are present because of an out-of-trim condition could be additive and simply amplify the oscillation. If the altitude of a mission is such that it would not be desirable to release the flight controls, the forcing function must be eliminated by making the arm and body as rigid as possible, and possibly bracing the left hand against the canopy. While flying in this highly sensitive region and a sharp stick input is necessary, a nose up correction is much more desirable than a sharp nose down correction, since the lower lift coefficient is more conducive to PIO. In this regard, caution should be exercised during a rapid afterburner acceleration at low altitude while maneuvering such as steeply banked flight. In this case, an out-of-trim condition will be present when returning to one "g" level flight necessitating a push-over to remain level. This type of correction should be performed smoothly. Always have the shoulder straps locked while flying at low altitude and high speed. The pilot's body from the lap belt up could become the forcing function during an inadvertent pitch input if the shoulder straps are unlocked.

PIO DUE TO AFT CG CONDITIONS

With the aircraft C.G. aft of 32.0 percent of MAC and stability augmentation off, an undamped longitudinal oscillation can occur when flying at airspeeds in excess of 350 knots CAS below 10,000 feet. This undamped oscillation may occur even though the standard recovery technique of releasing the controls is employed. An abrupt input such as that obtained when suddenly releasing the stick in an accelerated maneuver, or the transient obtained when the stability augmentation monitors off in some accelerated flight conditions, will initiate the undamped motion. The entire longitudinal control system, including the stick, moves during this oscillation, which has a frequency of about 1/2 cycle per second. This stick free, undamped oscillation may increase the possibility of inadvertently obtaining dangerous pilot induced oscillations (PIO's) if the pilot attempts to damp the motion. To stop the oscillation the stick must be held firmly in the trim position. Attempts to stop the airplane motion by applying compensating longitudinal control inputs may lead to PIO's with increasing amplitudes. Releasing the stick will not stop the motion but will result in an undamped oscillation. This characteristic is different from the usual PIO's where corrective action requires immediate release of the stick.

CAUTION

Avoid abrupt control movements when flying at airspeeds in excess of 350 knots CAS below 10,000 ft. with aircraft C.G. aft of 32 percent MAC.

SUPERSONIC

Supersonic flight characteristics are essentially the same as exhibited during subsonic flight. There are no unusual trim changes above Mach 1.0. At Mach numbers above 1.3 dihedral effect becomes neutral or slightly negative. This is of little concern to the pilot and usually will escape notice unless a deliberate attempt is made to yaw the airplane at high Mach numbers.

MANEUVERING

Stick force per "g" is fairly constant throughout the speed range, in contrast to some aircraft in which large differences exist between subsonic and supersonic speeds. Stick force per "g" does increase slightly at high supersonic speeds but only on the order of approximately 2 pounds per "g". This is due to a combination of an increase in static stability and a decrease in stabilator effectiveness.

MISSION PLANNING

Refer to Appendix I, Volume III of this publication, to determine fuel consumption, correct airspeed, power settings, and optimum altitude for the intended flight mission. Planning data for specialized missions is contained in the F-4B (F4H) Weapon System Tactical Handbook.

FORMATION AND TACTICS

GENERAL

Formation and tactics set forth in NWIP 41-2 are generally applicable to this aircraft. Specific tactics and weapons system employment are contained in the F-4B (F4H) Weapons System Tactical Handbook.

PARADE POSITION

The parade position is attained when the leader's head is directly above the inlet duct (ramp hinge area). A step down of approximately 5 feet is optimum. The wing tips should not overlap.

RENDEZVOUS

Keep all aircraft ahead constantly in view and join, in order to avoid overshooting, excess speed must be reduced before reaching the wing position. If necessary, the wingman should abort the rendezvous by leveling his wings, visually account for all preceding airplanes and move to the outside of the formation. During rendezvous, only enough step down should be used to insure separation from the aircraft ahead. If one airplane is "sucked", the pilot shall move to the outside of the leader until all other aircraft have joined. All relative motion should be stopped prior to joining on an inside wing position. A cross-under to the outside can then be made. During a running rendezvous, caution must be exercised in the final steps of the join up due to the difficulty of determining relative motion when closing from the rear.

NIGHT RENDEZVOUS

A pilot's ability to detect relative motion is drastically reduced during night operations. The near impossibility of accurate depth and closure rate perception make a night rendezvous a difficult and sometimes hazardous process which demands extra vigilance by all pilots involved. The basic principles of maintaining a steady bearing on the aircraft ahead while turning inside, at or slightly above the speed of the lead aircraft, remain unchanged, however, the bearing should be moved slightly aft and the closure rate reduced. Rendezvous speeds for normal and emergency rendezvous speed must be pre-briefed. A pilot who recognizes his closure rate to be dangerously high must immediately break off the rendezvous to assure separation, preferably by crossing under and to the outside of the leader's turn.

SIMULATED INSTRUMENTS

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 they will be guided by the current OPNAV INSTRUCTION 3710.7 (General Flight and Operating Instructions for Naval Aircraft) and Federal Air Regulations, Part 60.

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 until reaching a minimum of 2000 feet above the terrain on departure.

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 check with the instrument pilot and receive an acknowledgement at 1 minute intervals below FL 240 and at 3 minute intervals above FL 240.

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/infront 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.

Instrument pilot will call indicated altitude each 5000, during descents and at level off to chase pilot, unless under positive control.

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 radio in the following manner: RIO's radio on the frequency in use with CMD in the RIO's cockpit. The pilot's radio will be tuned to guard. 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 CMD and transmit instructions to the instrument pilot on guard channel.

RADAR AND INTERCEPT

Refer to the F-4B (F4H-1) Weapons System Tactical Handbook.

WEAPONS AND MISSILES PROCEDURES

SPARROW III

Pilot's and RIO's will complete the following Sparrow III missile and pylon preflight and checkoff list before manning aircraft.

1. Missile motor and fuze ignitor on SAFE.
2. Missile wings locked in place and at zero elevation.
3. Missile latched and locked securely. On wing station, missile lock indicator will be down and flush with moldline of missile.
4. Sway braces down and snug against missile.
5. Motor weather seal intact.
6. Missile secure on launcher.

Prior to start the following cockpit checks are to be completed:

1. External tanks jettison switch OFF.
2. Rack cartridge ground test switch OFF.
3. Armament safety override switch pulled OUT.
4. Arm-safe switch to SAFE.
5. Landing gear handle DOWN.
6. Missile power switch OFF.
7. Radar power switch in rear observer seat OFF.
8. Circuit breakers IN.

Prior to Arming, the following checks will be made:

1. Switches in positions listed in arming cockpit check.
2. Pilot signals the arming crew with a thumbs up and receives a thumbs up from the arming crew when arming is complete.
3. The pilot checks firing/jettison cartridge continuity and gives safety director a thumbs up or thumbs down as applicable.

SIDEWINDER

Pilot's and RIO's will complete the following missile and pylon preflight checkoff before manning aircraft.

1. No cracks in glass dome (leave G and C cover OFF).
2. Safety pin installed in AERO-3A launcher.
3. Umbilical plug screwed tight and launcher cover closed and locked.
4. No evidence of smoke or carbon around servo grain exhaust gas ports.
5. Control fins for security and movement.
6. Rear fins secure and rollerons locked.
7. Nonpropulsion unit removed.
8. No dents in side of rocket motor case.
9. Missile secure on launcher.

Prior to start the following checks are completed:

1. External stores and tanks jettison switches OFF.
2. Rack cartridge ground test switch OFF.
3. Armament safety override switch pulled OUT.
4. Arm-safe switch SAFE.
5. Landing gear handle DOWN.
6. Missile power switch OFF.
7. Radar power switch in rear observer seat OFF.
8. Circuit Breakers IN.

After starting aircraft but prior to taxiing to the arming area, the following checks will be made:

1. Missile select switch to HEAT.
2. Select light on. (If no select comes on put switch to heat reject until proper light for the station that is loaded comes on).
3. Audio signal adjusted to comfortable volume.
4. Pilot gives ordnanceman a THUMBS UP when rise in audio signal is received as flashlight beam is directed at applicable G and C unit.

Prior to Arming, the following checks will be made:

1. Switches are in positions listed in arming cockpit check.
2. Pilot will signal the arming crew with a thumbs up and receive a thumbs up from them when arming is complete.

3. Thumbs up will be given by safety man. The influence fuze cover is removed, the safety pin is pulled, and the arming crew is clear of the aircraft.
4. The pilot checks firing/jettison cartridge continuity and gives safety director a thumbs up or thumbs down as applicable.

ARMING

Sparrow III and Sidewinder arming procedures will be in accordance with the procedures set forth in the Maintenance Instructions Manual NAVWEPS 01-245-FDB-2-7). These procedures may be modified as local course rules or deck landing procedures dictate.

MISSILE FIRING

Missile firing procedures are set forth in the Weapons System Handbook. Voice procedures and clear to fire criteria vary greatly with the operating area, control site and the type of target in use. Therefore, specific standards cannot be established. However, the following criteria will apply to all firing flights and all targets:

The firing aircraft must have positive communications with the control site.

The firing aircraft may not fire until cleared to fire by the controlling aircraft (tow/Charlie plane) or the GCI/CIC site controlling the firing flight.

The firing aircraft will not fire if there are aircraft or surface vessels within the impact area of the missile.

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 and demand that all instrument flights 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 the engines. When operating the radio with external power connected, the ground operating limitations must be observed.

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 heat 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 symbol 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

Instrument takeoffs should be made with MIL power rather than MAX power unless the urgency of the mission makes this a necessity. MAX power takeoffs at normal gross weights require rapid initial changes in attitude and extreme pitch angles, and also increases the possibility of accelerating past the gear and flaps down limit airspeed.

INSTRUMENT CLIMB

The simplified climb schedules described in Section II of this volume 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/foot heat 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 CAS Maximum). Prior to descent, the pilot will obtain the latest weather information at the destination and at the alternate if required. Prior to commencing the penetration the pilot will make the following checks:

Reset the altimeter.

Check the synchronization of the ADI/HSI with the standby magnetic compass while in level flight.

Select engine anti-ice as required.

Squawk IFF mode and SIF code as directed by Approach Control.

Check missed approach procedure, also course, distance, and fuel required to proceed to alternate.

For a TACAN approach, cross check the azimuth pointer by using the UHF homer (if one is located at the destination).

A standard penetration with a 4000 fpm rate of descent and airspeed of 250 knots requires a power reduction to approx. 75 to 80% and speed brakes as necessary to maintain 250 knots and 4000 fpm.

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 220 knots and lower the landing gear and flaps. If external tanks are carried, place the fuel transfer switch to EMERG before extension of the landing gear to avoid de-pressurizing the fuel tanks. Commencing penetration, reduce the pitch attitude to maintain 195 knots. 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 pick-up or TACAN gate altitude at a speed of 150-160 knots.

RADAR CONTROLLED PENETRATION

The approaches are basically the same as previously described with the following additions. The controlling activity will normally ask for turns or specific IFF squawks for positive identification. The controlling activity will advise turns or headings which will produce the desired flight path. They will also advise as to distance from the destination and direct a descent to lower minimum altitudes as traffic and terrain permit.

GCA (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 axis. When directed, descend to GCA pickup altitude and transition to landing configuration. Slow to 150-160 knots which will require approximately 88-90%. Trim required will be approximately 3-5 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%. Allow the plane to slow to 145 knots minimum (section). If alone adjust the nose to maintain 140 knots 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 clean. The base leg is flown at 150 knots, gear and flaps down. After completing the turn on final and slowing to 140 knots, 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 at subsonic airspeed. Supersonic thunderstorm penetrations have not been investigated to date. 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 Mach 0.9. 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 300 to 350 knots CAS or Mach 0.9, whichever, is less at low and medium altitudes. At high altitudes (above 35,000 feet) the optimum airspeeds are 0.9 Mach or 270 knots CAS, whichever is more.

APPROACHING THE STORM

If the storm cannot be seen, it may be located by radar, radio compass swing and crash static. Adjust power to establish the recommended approach speed. 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 become overly intent on "topping" the storm or allow the airspeed to decrease below the minimum recommended for penetration. 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. Adjust the throttles as necessary to maintain airspeed within the recommended range. 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. The angle-of-attack probe may become distorted by impact ice and/or hail which can result in the actuation of the rudder shakers.

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 encountered, actuate the engine anti-ice switch to DE-ICE and the pitot heat switch to ON.

WINDSHIELD RAIN REMOVAL

Windshield rain removal has been found to be marginal when flying through any precipitation regardless of flap positions or power settings. Rain removal during ground taxiing operations is satisfactory. The windshield rain removal system is somewhat effective in de-icing the windshield.

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.

AIR REFUELING PROCEDURES

RENDEZVOUS WITH TANKER

When available, GCI/CIC control intercept radar, TACAN and/or visual reference points should be used. If the ARA-25 must be used for rendezvous the following technique is recommended:

Set up a collision course with the tanker. The tanker should give a short count every minute.

On passing over the tanker at maximum range altitude start an idle descent penetration. The tanker will start a 360 degree 2 minute turn when so instructed by the receiver.

Once the tanker is sighted visually it MUST be kept in sight.

BEFORE PLUG-IN

The air refueling checklist should be completed prior to plug-in.

1. Radar Master Switch - STBY
2. Radar Altimeter - OFF
3. Missile Power Switch - OFF
4. Arming Switches - OFF/SAFE
5. UHF NAV Function Switch - REC
6. IFF - STDBY
7. INT Wing Dump Switch - NORMAL
8. All unnecessary electrical equipment - OFF
9. Refuel Probe Switch - REFUEL (Extend for dry plug-ins).
10. Refuel Selection Switch - ALL TANKS/INTERNAL as desired.
11. Check Probe fully extended.
12. Trim aircraft for balanced flight.

PLUG-IN AND REFUELING

Most of the problems associated with air refueling in this aircraft, stem from the location of the air refueling probe. The probe nozzle is abeam the pilot's right shoulder when fully extended. Hence the nomenclature, "shoulder probe". Several factors affect the refueling operations from this probe location and are as follows:

The probe is not within the pilot's peripheral vision when the tanker is used as a reference point on engagement attempts.

The drogue is influenced by the air flow around the nose of the airplane during engagement run-in and tends to drift outboard away from the fuselage.

The drogue is in close proximity to the canopies and duct and the possibility of it striking these parts exists during missed approaches.

The receiver pilot must plan and execute the approach so that the drogue passes close to the fuselage. It is important that the pilot line-up in the tankers wash, to the left and slightly below the drogue and turn the aircraft prior to commencing the approach. Misalignment will make the approach much more difficult and will probably result in a missed approach. The receiver pilot must close at a reasonable rate (about 5 knots) in order to minimize drogue and receiver control problems and to seat the probe in the drogue coupling. At low closure rates the movement oscillations are generally induced. Excessive closure rates will sometimes result in hose "whip" following contact. The technique for refueling is generally applicable to all tankers and may be briefly summed up as follows:

Tanker in smooth air and at optimum altitude/air speed for refueling. All electronic/electrical equipment positioned as outlined previously. Place the refuel probe switch to the REFUEL position. Check that the probe is fully extended. Position the receiver aircraft 10-15 feet behind the drogue with the probe in line with the drogue. Using the tanker and hose as a reference increase power to establish a 5 knot closure rate. The drogue has a tendency to move up and to the right as it passes the nose of the receiver. As the receiver approaches the drogue it will be necessary to continue to crowd it by flying slightly up and to the right. DO NOT LOOK AT THE DROGUE. Although the drogue will be visible in the pilot's peripheral vision he should continue to fly on the hose and a reference point on the tanker (usually the point where the hose originates).

DO NOT FENCE with THE PROBE. The RIO can be of invaluable assistance to the pilot during the final phase of the approach, by calling out the probes position in clock code with relation to the drogue thus allowing the pilot to make small corrections. If no engagement occurs reduce power and move straight back slightly to the port of the normal hose trail position. Speed brakes may be employed but are generally not required. The RIO will aid the pilot by calling the clock code of all misses. When engagement is made the receiver pilot will notice a slight ripple in the refueling hose. Following engagement, move the hose forward about 3 marks and adjust power to remain in a refueling position flying formation on the tanker. Sometimes the probe will "tipple" the drogue by hanging up on the outside lip of the basket and not slipping into the drogue. When this occurs the receiver pilot will notice a large amount of slack in the hose that will not be taken up by the tankers take-in reel. In this event the receiver pilot should back out with extreme care. If the probe slips off the drogue it may whip and make contact with the receiver aircraft and possibly cause damage to the aircraft or drogue basket.

PROBE SWITCH OPERATION

Dry plug-ins will be made with the refuel probe switch in the EXTEND position so that the aircraft fuel system will continue normal operation. Wet plug-ins will be made with the refuel probe switch in the REFUEL position. This relieves all tank pressure and positions all the refueling valves in the proper position. Upon completion of the pass the refuel probe switch will be placed in the RETRACT position. Insure that the "IFR Probe Unlocked" light is extinguished on the telelight panel before normal flight operations are resumed. There is a danger of running out of fuel while plugged in. If the indicator falls below 1000# put the IFR probe switch in the EXTEND position until the feed tank is full again. Then resume refueling.

BREAKAWAY

Breakaway from a successful engagement is accomplished by reducing power and dropping back at a three to five knot rate of separation. Care should be taken to maintain alignment and altitude during breakaway. The connection will separate when the hose reaches full extension.

COMMUNICATIONS WITH TANKER

1. When in position for run, the pilot shall transmit "Ready to commence run". The tanker shall reply "Cleared to commence run".
2. When closing, the pilot shall transmit "Commencing run".
3. When contact is made, the pilot shall call "Contact".
4. If contact is missed, the pilot shall report "Missed Contact" and voice procedures begin with "Ready to commence run".
5. After successful contact, the pilot will report "Backing out", when he is ready to break the connection prior to commencing another approach. When separation is accomplished, he will report "Clear".
6. If it is a wet run, the operator in the tanker will report when the tanker starts pumping. The receiver pilot will acknowledge.
7. If at any time the tanker calls "Emergency Breakaway", the receiver pilot will immediately initiate a normal breakaway.
8. When the receiver is taking on a full load of fuel, the pilot should report when within 500 pounds of full load. If external tanks are being refueled the respective "EXT Fuel" light on the telelight panel will illuminate when fuel flow to the external tank is less than 4.5 gpm. The pilot may then assume that the external tank or tanks are full.
9. Refueling should not be attempted when the drogue is streaming fuel.

TOW TARGET PROCEDURES

NORMAL OPERATION

PREFLIGHT CHECK

1. Check reel/launcher for secure attachment to the aircraft.
2. Check launcher assembly for cracks and assembly bolts for proper security.
3. Check security of electrical plug between reel/launcher and aircraft.
4. Check for proper reeving of tow wire and that cable cutter squib is installed.
5. Check reel lockpin in place.
6. With external power applied, place reel/launcher control box master switch in ON position. Check reel/launcher brake switch in ON position.
7. Test for proper function of the reel/launcher turbine pitch control. After test, return reel turbine blades to ZERO (centered) position. Have ground crew visually inspect blades for feathered position.
8. Check reel/launcher brake and counter operation as follows: (Have ground personnel standing by target and tow reel.)
   a. Test tow reel brake operation by having ground personnel remove reel lockpin. Brake operation is satisfactory if turbine cannot be turned by exerting slight pressure on the turbine blades.
   b. For counter assembly check, with crewman holding turbine blades firmly, turn brake switch OFF.

CAUTION

Prior to brake release, insure crewman has firm hold of turbine blades as the spring-loaded target ejector will attempt to eject the target causing turbine blades to spin and endangering the hands. Very little effort is required, however, to hold turbine blades in stationary position and overcome ejector action.

   c. Allow turbine to rotate slowly by restricting blade operation with the hands and allow target to eject into the hands of waiting crewman.
   d. Remove hands from turbine and have crewman holding target pull aft about 20 feet. Monitor counter for proper action.
   e. Recover target by hand-turning turbine blades. Maintain wire tension. Observe proper counter action as target returns into launcher.
   f. When target is properly seated in launcher, continue tensioning tow wire by hand-turning turbine blades until target is difficult to rotate by applying concerted physical effort at the largest diameter of the target. Turn brake switch ON and reinstall lockpin.
9. Check that target is secured in target locking device.
10. When utilizing IR type targets, insure that flare ignition safety plug is installed.
11. Check with weapons crewman for size of tow line and maximum permissible let-out length.

POST-START CHECK

CAUTION

If right generator is cycled to correct for a BUS TIE light, the reel brake and target locking device will be disengaged allowing target to eject out of launcher.

1. Control box master switch ON.
2. Brake switch in the ON position.

3. Tow line footage counter set at "00000".
4. Tachometer indicator in the ZERO position.
5. Turbine pitch indicator 2 units IN position. Verify this by having ground crew visually inspect turbine blades for IN pitch.

CAUTION

If an IR target is being carried, do not remove reel lockpin until flares are installed in ARMING area; then remove reel lockpin and flare ignition safety plug.

TAKE-OFF AND CLIMB

1. Perform normal take-off.
2. Do not exceed 250 knots CAS until target is initially launched. This is necessary as it is not possible to apply sufficient ground tension on the tow wire to prevent the target from rotating in the basket at speeds in excess of 250 knots CAS.

CAUTION

If the operating area is some distance from the operating base higher speeds in proceeding to the area may be desired. If so, stream target to 300-400 feet using procedures outlined below. Airspeed can then be increased to 300 knots CAS. Prior to continuing reel-out reduce airspeed to 250 knots CAS.

LAUNCHING PROCEDURES

1. When over water or an unpopulated area, pilot holds wings level - no turns while launching.
2. RIO calls for IDLE power. Pilot holds airspeed of 250 knots CAS.
3. RIO releases brake and gradually reduces the amount of IN pitch until target breaks free of launcher. Hold 800 to 1,000 rpm until chase plane verifies a good launch, then as counter indicates about 200 feet, RIO calls for power ON and increases OUT pitch to 4,000 rpm.

CAUTION

Continuously monitor turbine rpm. Do not exceed 4,000 rpm.

4. When tow line approaches desired length, begin to slow reel-out by momentary actuation of the turbine pitch control toward IN. At desired tow line length, actuate the switch to IN until tow line counter stops.
5. Stop rpm with turbine pitch and place brake switch ON or allow the tow line to creep in and out at a slow rate if desired. Note turbine position indicator reading required to stop reel-out for reference during tow line length change and target recovery operations. If brake is used to hold tow line length, feather turbine blades.

Note

Turbine rpm is a function of tow line length, airspeed, altitude, and turbine pitch. With constant pitch, turbine rpm will slowly change as operating conditions are varied. The tachometer indicator shall be monitored during the period that the brake system is in the OFF position.

CAUTION

Do not reel out tow line in excess of the maximum permissible length or exceed airspeed for tow line being utilized as shown in figures 4-4 and 4-5.

6. Do not exceed 30 degrees maximum angle of bank.
7. When acceleration or climb with afterburner is required after rolling out of a turn, maintain altitude and airspeed for a minimum of 45 seconds (timed) prior to acceleration. Add afterburner slowly (after 45 seconds) and hold airspeed until reaching desired altitude then accelerate to the desired airspeed. Do not exceed maximum airspeed as shown in figures 4-4 and 4-5.

CHANGING TOW LINE LENGTH

1. Reduce airspeed to 250 knots CAS and RIO momentarily actuates the turbine pitch control to obtain the turbine position indicator reading required.
2. Place brake switch in OFF position, then momentarily actuate the turbine pitch control switch to IN or OUT position as required to obtain the desired tow line length. When desired length is reached, stop operation as previously outlined.
3. Increase airspeed as desired.

FLARE IGNITION

1. Set the proper frequency on the UHF.
2. Select TONE on the tone generator box.
3. Depress the Mike button for at least 10 seconds then release.
4. Turn off time generator and listen for results of HOTSHOT ONE.
5. If another flare is to be fired, wait at least 5 seconds between tone generator signals to allow the stepping relay in the target to actuate.

WIRE LIMITATIONS FOR AERO 36, 36A, AND 42 TOW TARGETS

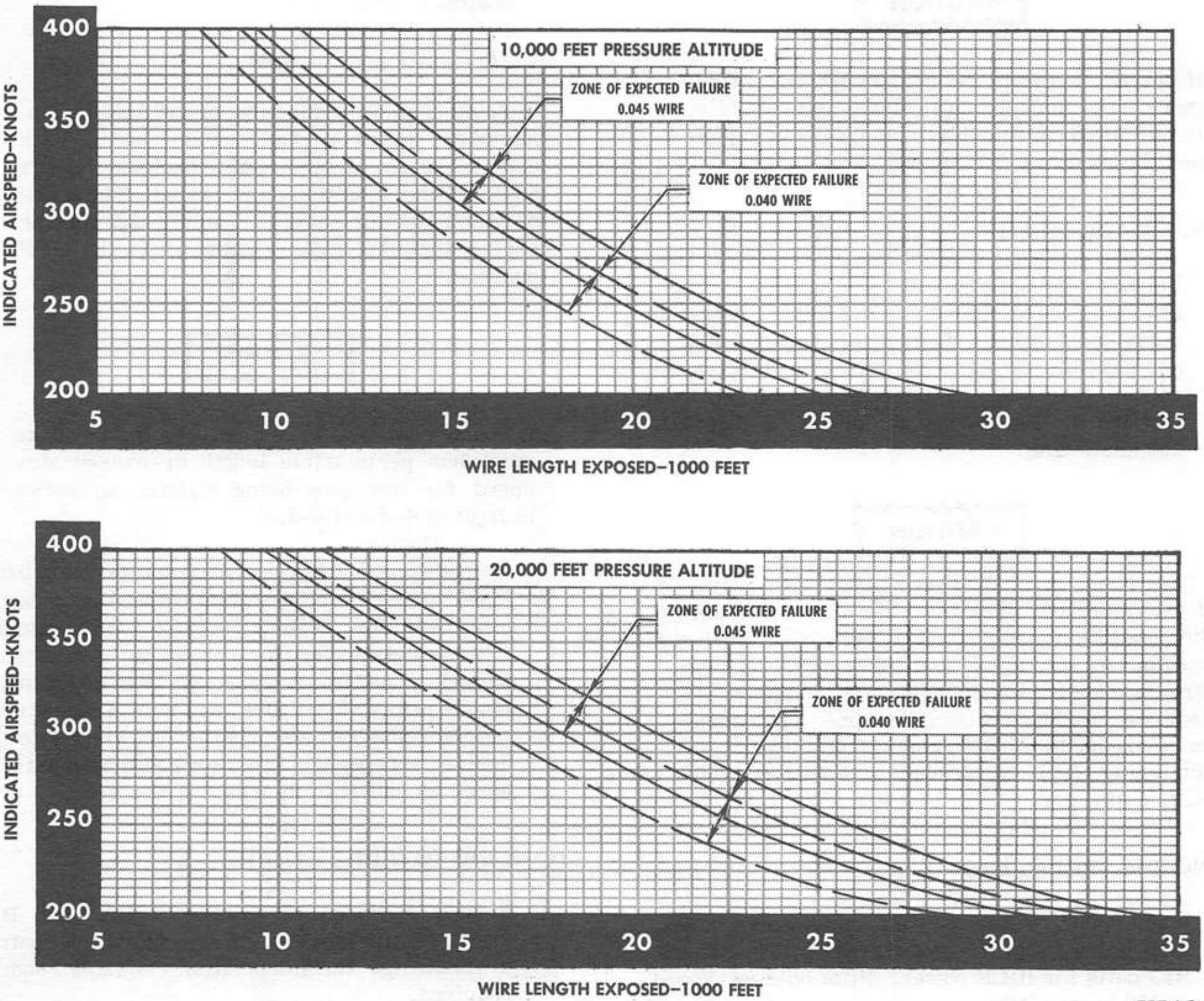


Figure 4-4

RECOVERY PROCEDURES

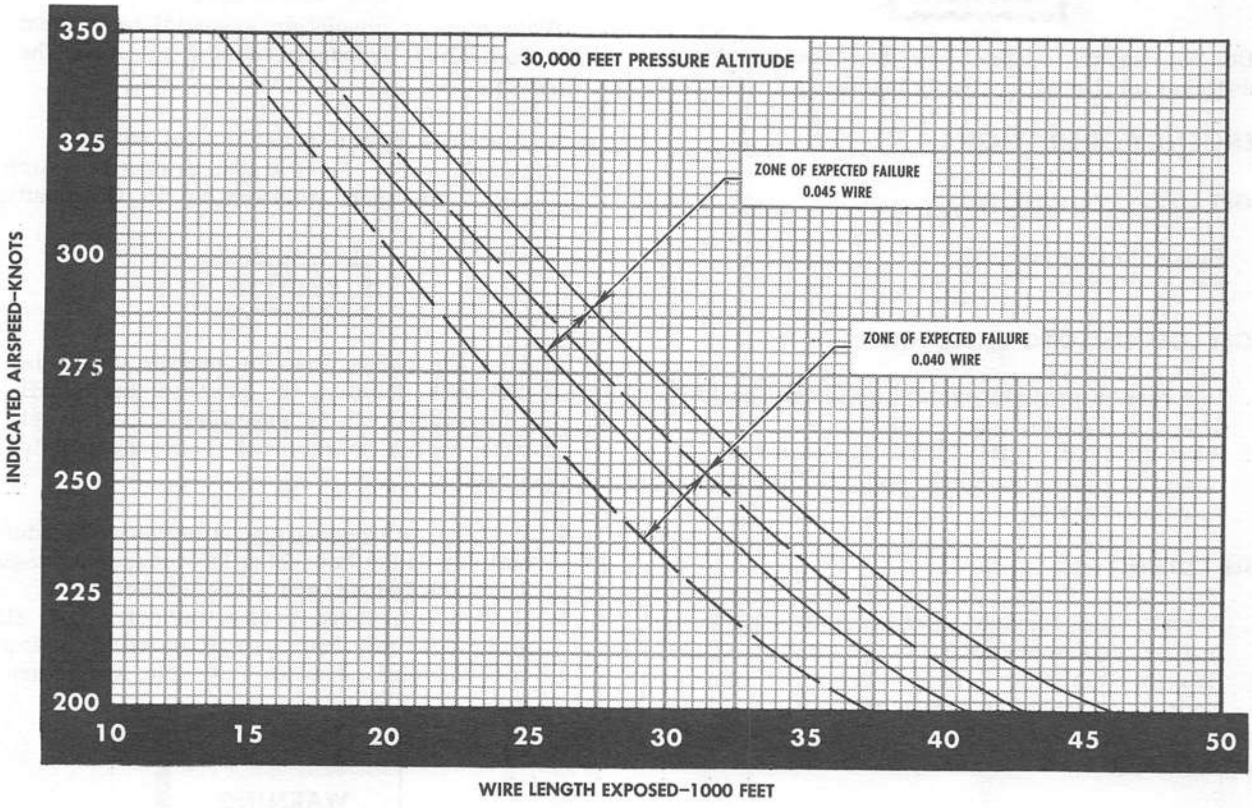
1. Return to 250 knots CAS and utilize the same procedures outlined under Changing Tow Line Length, and slowly establish reel-in speed up to 4,000 rpm.

Note

When using long tow lines, or at low airspeeds, if reel fails to start reel-in with the turbine pitch control switch in the full IN position, gradually increase airspeed or momentarily yaw the aircraft slightly by applying slight rudder opposite the side of the reel. RIO must monitor rpm as it will increase as tow line length decreases. Once 4,000 rpm is obtained, maintain this rpm.

2. When 500 feet of tow line remains, reduce to 1,000 rpm.
3. When counter indicates 100 feet, RIO calls for IDLE power.
4. Pilot holds wings level and airspeed at 250 knots CAS until chase plane advises target cinched in launcher and rotation stops.
5. Add power but do not exceed 300 knots CAS, place brake ON, and feather the turbine. If target starts to rotate, slow down.

WIRE LIMITATIONS FOR AERO 36, 36A, AND 42 TOW TARGETS



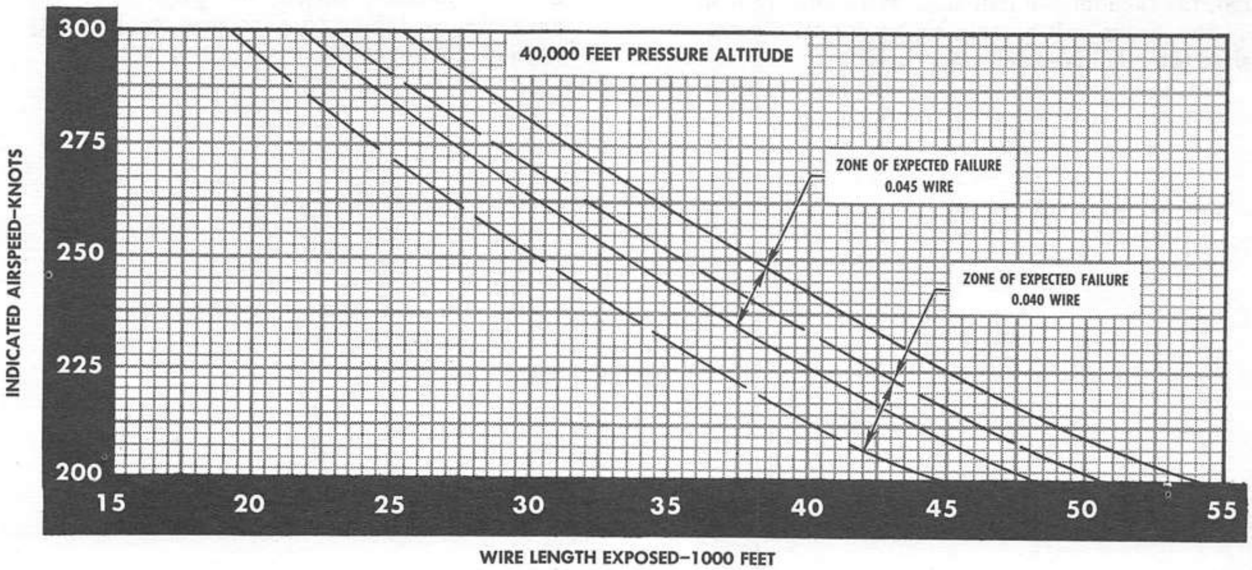


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Figure 4-5

LANDING

1. Make normal landing.
2. If carrying unburned flares, taxi to ARMING area for flare removal, and instruct ground crew to install reel lockpin.

CAUTION

Do not secure engines or tow equipment switches until reel lockpin is installed.

EMERGENCY OPERATION

TARGET LOSS ON LAUNCHING

1. Brake ON immediately.
2. Feather turbine.

TARGET LOSS ON LONG CABLE SCOPE

1. Use reel-in procedures outlined under Changing Tow Line Length.
2. When chase aircraft indicates approximately 500 feet of tow line remaining, stop reel and cut the remaining cable.

CABLE CUTTING

1. Actuate the turbine pitch control switch to feather turbine blades.
2. Brake switch ON.
3. Depress cable cutter switch button.

REEL OVERSPEED

The tow reel contains an overspeed switch set at 6,000 rpm and a relay which will automatically apply the reel brake when overspeed occurs. As the brake is applied, the tachometer indicator will suddenly drop to zero. The brake will remain engaged until electrical power to the reel has been interrupted.

When an overspeed occurs, proceed to reset the system in the following sequence:

1. Actuate the turbine pitch control switch to feather turbine blades.

CAUTION

This step is absolutely essential to prevent uncontrolled overspeed during reset of the system.

2. Place tow system brake in ON position.
3. Briefly cycle the tow system master switch to OFF and then immediately to ON position.

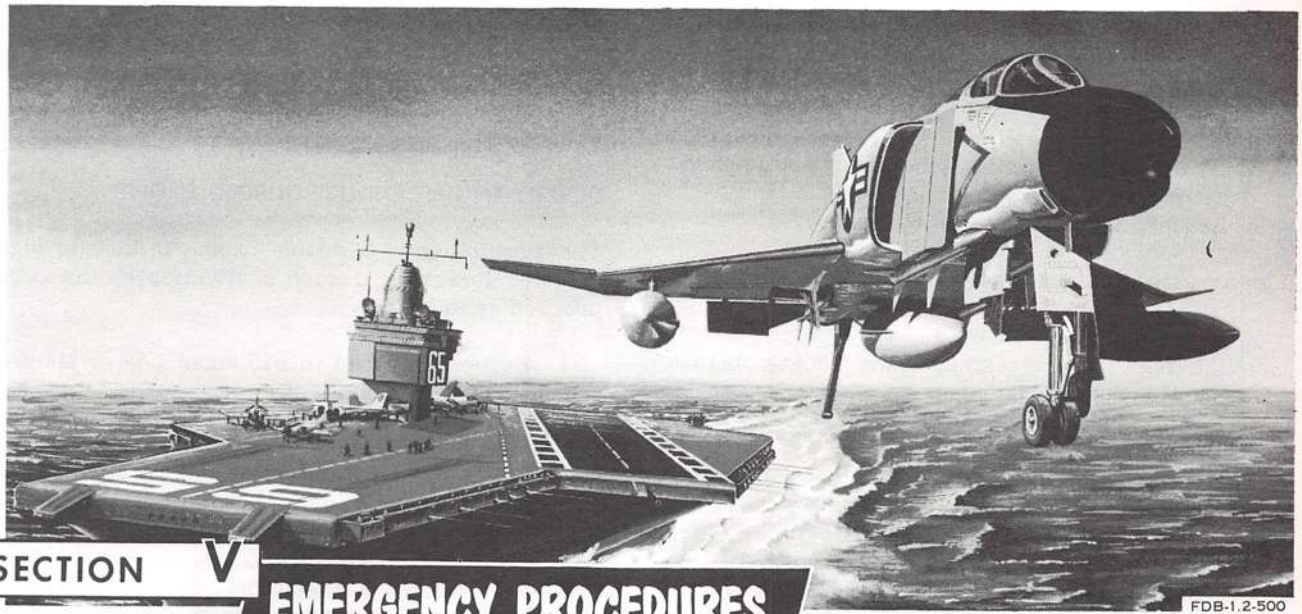
CAUTION

During the period that the master switch is in the OFF position, the tow reel brake will be disengaged. It is essential that the reel master switch be returned to ON as rapidly as possible.

4. Proceed with desired operation using procedures outlined under Launching Procedures, Changing Tow Line Length, and Flare Ignition.
5. If reel overspeed cannot be corrected, slow aircraft to minimum safe airspeed to minimize reel damage, cut excessive cable, and return to base.

WARNING

Do not jettison target or wire over any area where injury to personnel or property damage could result.



SECTION V EMERGENCY PROCEDURES

TABLE OF CONTENTS

(*) Denotes Illustration

AIRCRAFT EMERGENCIES

ENGINE FAILURE

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 TAKE-OFF

Before Airborne

If an engine fails before leaving the ground, the continuation of take-off is dependent on length of remaining runway, gross weight, airspeed, field elevation and ambient temperature.

Note

- During take-off using Military power, where take-off 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 take-off 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 the decision to stop is made, proceed as follows:

1. Throttles - IDLE
2. Drag chute - DEPLOY
3. Wheel brakes - APPLY
4. Notify RIO of existing emergency and intended action.
5. Request arresting gear if necessary.

If an arrested roll out is to be made:

6. Arresting gear - DOWN
   Extend the arresting gear shortly before anticipated engagement.
7. Aim for the center of the wire.

Note

- The hydraulic brakes will remain operative for approximately 10 full brake applications after the loss of the utility hydraulic system.
- It is possible to use differential hydraulic braking in conjunction with metered pneumatic emergency braking.

After Airborne

If an engine fails immediately after take-off, 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 gross weight and air density. Since the pilot's reactions will depend upon the conditions mentioned above, after take-off, and at critical airspeeds with heavy gross weight, the pilot must complete the following if level flight cannot be maintained.

1. Operating engine - MAX (AFTERBURNER)
2. Landing gear - UP
3. External stores - JETTISON (if necessary)
   If altitude cannot be maintained, jettison the external stores.
4. Continue straight ahead.
5. Wing flaps - UP
6. Failed engine - SHUTDOWN

If failure is other than mechanical:

7. ATTEMPT AIRSTART
8. Internal wing fuel - DUMP
9. Land as soon as possible.

ENGINE FAILURE DURING FLIGHT

In the event an engine fails perform the following:

1. Positively determine which engine has failed
2. Throttle - OFF

If failure is other than mechanical:

3. ATTEMPT AIRSTART

If failure is mechanical:

4. Engine - SHUTDOWN
   a. Engine master switch - OFF
5. Land as soon as possible.

DOUBLE ENGINE FAILURE DURING FLIGHT

The possibility of a double engine failure is highly remote. However, if such a situation should occur, proceed as follows:

1. Reduce airspeed to 515 knots CAS or Mach 1.1 whichever is lower.
2. Wind driven turbine - EXTEND
   Extend the wind driven turbine to operate the left fuel boost pump at low speed. This will supply enough fuel to either engine for an air start.

CAUTION

Maintain airspeed above 195 knots CAS 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.

3. Throttles - OFF
4. Either engine - ATTEMPT AIRSTART (45,900 feet or below)
   To provide maximum fuel flow for an airstart, retain the throttle of the remaining engine in the OFF position.

If an airstart has not been accomplished within 30 seconds:

5. Throttle - OFF
6. Remaining engine - ATTEMPT AIRSTART

If neither engine can be started before reaching minimum safe ejection altitude, and the precautionary emergency approach procedure cannot be set up:

7. Notify RIO of existing emergency and intended action.
8. EJECT

AIRSTARTS

In general, airstart capability is increased by higher airspeeds and lower altitudes. However, airstarts can be made over a wide range of airspeeds, as high as approximately 48,000 feet with JP-4 fuel or 40,000 feet with JP-5 fuel.

Note

In order to reduce the possibility of engine seizure, initiation of engine restart should not be prolonged following flameout. If one or both engines flame out, do not delay the airstart attempt.

1. Establish a normal flight attitude.
2. Engine rpm - 12% MINIMUM
3. Ignition button - DEPRESS
4. Throttles - ADVANCE TO BEYOND IDLE, THEN SLOWLY RETARD BACK TO IDLE.
5. A start is indicated by a rapid increase in EGT followed by an increase in RPM.
6. After the engine starts, adjust throttle as required.

In the event:

1. Light-off does not occur within 30 seconds after throttle is advanced;
2. The engine does not continue to accelerate after light-off;
3. The exhaust temperature exceeds maximum limitations;
4. The oil pressure does not attain the minimum limit at idle rpm;

retard the throttle to OFF to discontinue start. Allow engine to windmill approximately 30 seconds minimum prior to next attempted start.

GLIDE DISTANCE

With both engines windmilling, the optimum glide speed for maximum glide distance below 50,000 feet is 215 knots CAS. Above 50,000 feet the airspeed will be decreased 3 knots for each 1000 feet of altitude. For every 10,000 feet above the terrain the aircraft will glide approximately 12 miles.

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 all non-essential electrical equipment.
2. Reduce gross weight to 34,000 lbs or less.
3. Jettison external stores as required.
4. Cycle afterburner of operating engine to insure rapid light-off for possible afterburner operation.
5. Stab Aug switch - ENGAGE
6. Wind driven turbine - EXTEND
7. Wing flaps - 1/2

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 wave-off is necessary.
- In the event the generator on the operating engine is lost, the flaps solenoid operated sesector valves will revert to a full trail position, and the airstream will blow the flaps UP.

8. Landing gear - DOWN
9. Arresting hook - DOWN (CARRIER)
10. Retrim airplane.
11. Abeam position - 1 1/2-2 NM; 1000 ft. altitude; 150 knots CAS.
12. Maintain angle of attack of 20-21 units unless forward field of view is reduced and line up is affected. If line up becomes critical slowly reduce angle of attack (to prevent rapid sink rate) to 19.5 units. Corresponding airspeed for 34,000 lb. airplane are as follows:
    a. 20-21 units - 146 knots CAS
    b. 19.5 units - 150 knots CAS

In the event of wave off:

13. Operating engine - MIL or MAX as required

In the event of field landing:

14. Make normal touchdown
15. Drag chute - DEPLOY

In the event of carrier landing:

16. Upon main gear touchdown:
    a. Operating engine - MAX (AFTERBURNER)
17. Upon arrestment:
    a. Operating engine - IDLE
    b. Observe flight deck crew signals.

LANDING WITH BOTH ENGINES INOPERATIVE

Landing with both engines inoperative will not be attempted.

FIRE

ENGINE FIRE DURING START

1. Throttles - OFF
2. Engine master switches - OFF
3. Continue to crank engine for 20 sec.
4. External compressed air units - DISCONNECTED
5. Leave airplane as quickly as possible.

ENGINE FIRE DURING TAKE-OFF

Before Airborne

If either fire warning light illuminates during take-off roll, it is preferable to abort immediately if sufficient runway is available to stop safely. Refer to Critical Field Length Charts, Appendix I of Volume III.

1. Throttles - OFF
2. Drag chute - DEPLOY

EXTERNAL STORES JETTISON CHART

	EXT STORES	STATION	GEAR HAND. POS.	METHOD
	ALL EXCEPT MISSILES (A/C 148363f thru 149474k)	1, 2, 5, 8, 9	UP	External stores emerg. release button—DEPRESS
	ALL INCLUDING MISSILES (A/C 150406L & UP)	1 thru 9	UP or DWN*	External stores emerg. release button—DEPRESS
TANKS	EXT WING	1 & 9	UP or DWN	External tanks sw.—*JETT*
TANKS	℄ (A/C 148363f thru 149474k)	5	UP	Mode select sw.-*DIRECT* Bomb/℄ store button-*DEPRESS*
TANKS	℄ (A/C 150406L & UP)	5	UP	Ready safe sw-*READY* Mode select sw-*DIRECT* Master arm sw-*SAFE* Bomb ℄ stores button-*DEPRESS*
MISSILES	ALL MISSILE STATIONS	2, 3, 4, 6, 7, 8	UP or DWN	Missile status panel jettison sw.-*ALL* Missile jettison sw.-*PUSH*
MISSILES	LEFT WING RIGHT WING FUS L. FWD FUS R. FWD FUS L. AFT FUS R. AFT	2 8 4 6 3 7	UP or DWN	Missile status panel jettison sw.-*APPROPRIATE STATION* Missile jettison sw.-*PUSH*
SPL WPN	℄ (A/C 148363f thru 149474k)	5	UP	T-249A option selector sw.-*SAFE* Mode select sw.-*DIRECT* Bomb/℄ store button-*DEPRESS*
SPL WPN	℄ (A/C 150406L & UP)	5	UP	T-249A (DCU-75/A) option selector sw.-*SAFE* Ready safe sw.-*READY* Mode select sw.-*DIRECT* Master arm sw.-*SAFE* Bomb/℄ stores button-*DEPRESS*
BOMBS	ALL BOMB STATIONS (A/C 150406L & UP)	1, 2, 5, 8 & 9	UP or DWN *	External stores emerg. release button-*DEPRESS*
BOMBS	OUTBOARD WING (A/C 150406L & UP)	1 & 9	UP or DWN	External tanks sw.-*JETT*
MK 81	INBOARD WING (A/C 150406L & UP)	2 & 8	UP or DWN	Missile status panel jettison sw.-*L. WING* Missile jettison sw.-*PUSH* Missile status panel jettison sw.-*R. WING* Missile jettison sw.-*PUSH*
MK 82 MK 83	℄ (A/C 150406L & UP)	5	UP	Ready safe sw.-*READY* Mode select sw.-*DIRECT* Master arm sw.-*SAFE* Bomb/℄ stores button-*DEPRESS*

*Weight must be off gear

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Figure 5-1

3. Wheel brakes - APPLY
4. Notify RIO of existing emergency and intended action.
5. Arresting gear - DOWN (if wire engagement is anticipated)

Note

- The hydraulic brakes remain operative after loss of the hydraulic power system for approximately 10 brake applications.
- If normal hydraulic braking is inadequate, use emergency brake system. Refer to Brake System Emergency Operation, this section.
- It is possible to use differential hydraulic braking in conjunction with metered pneumatic emergency braking.

6. Aim airplane at the center of the wire.
7. As soon as stopped - LEAVE AIRPLANE

After Airborne

1. Normally operating engine - MAX (AFTERBURNER)
2. Throttle (engine indicating fire) - OFF
3. Engine master switch - OFF
4. External tanks - JETTISON (if necessary to maintain altitude)
5. Landing gear - UP
6. Wing flaps - UP
   Retract wing flaps when safe altitude and airspeed are attained.
7. If warning light remains on and fire is apparent - EJECT

If warning light goes out and no fire is apparent:

8. Internal wing fuel - DUMP
9. Land as soon as possible.

WARNING

Make a single engine landing, DO NOT attempt to restart engine.

10. If fire warning light remains on and no fire is apparent, climb to a safe altitude and investigate.
    Climb to a safe ejection altitude and determine positively that no fire exists. If there is evidence of a fire - EJECT. If there is no fire make a single engine landing. DO NOT attempt to restart the engine.

Note

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

ENGINE FIRE DURING FLIGHT

1. Engine indicating fire - THROTTLE BACK
   Throttle back on the engine indicating fire to reduce EGT. If warnlight remains lighted:
   a. Throttle - OFF
   b. Engine master switch - OFF
2. If fire warning light goes out and there is no evidence of continuing fire, make a single engine landing as soon as possible.
3. If fire warning light remains illuminated and evidence of fire is apparent, EJECT.
4. If fire warning light remains illuminated and fire is not apparent, proceed to a safe ejection altitude and investigate thoroughly. If there is no evidence of fire, make a single engine landing as soon as possible. DO NOT attempt to restart the engine.

ENGINE FIRE DURING SHUTDOWN

If external compressed air source and external electrical power is hooked up or readily available:

1. Throttles - OFF
2. Engine master switches - OFF

When external power is connected to airplane:

3. Generator control switches - EXT ON
4. Engine start switch - LEFT or RIGHT (engine indicating fire)
5. Motor engine until fire is extinguished.

If external compressed air source and external electrical power is not available:

1. Throttles - OFF
2. Engine master switches - OFF
3. As soon as possible - LEAVE AIRPLANE

AFT FUSELAGE OVERHEAT

DURING TAKE-OFF

If there is insufficient runway remaining to stop:

1. Normally operating engine - MAX
2. Throttle (engine indicating overheat) - IDLE
3. Landing gear up
4. External stores - JETTISON
5. Climb straight ahead
6. Wing flaps - UP

If the overheat light remains illuminated and fire is apparent:

7. Engine - SHUTDOWN
8. If the fire ceases, make a single engine landing as soon as possible. If a fire is evident, alert the RIO and EJECT

If the overheat light is illuminated and no fire is apparent:

9. Climb to a safe ejection altitude and investigate.

Note

If it is necessary to shut the engine down, do not attempt to restart the engine.

ELECTRICAL FIRE

1. Generator control switches - OFF
2. All electrical switches - OFF
3. When fire subsides, generator control switches - ON

If fire still persists when generator control switches are turned on:

4. Emergency wind driven turbine - EXTEND
5. Generator control switches - OFF
   This will supply power to the essential buses only.
6. Land as soon as possible.

If no fire is apparent when generator control switches are turned on:

7. 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. If step 2 fails to clear cockpit - JETTISON CANOPY

EJECTION

Escape from the airplane in flight should be made with the ejection seat, and it is an established procedure that the RIO eject first.

The study and analysis of escape techniques by means of the ejection seat reveals that:

1. Ejection at airspeeds ranging from stall speed to 525 knots CAS results in relatively minor forces being exerted on the body, thus reducing injury hazard.
2. Appreciable forces are exerted on the body when ejection is performed at airspeeds of 525 to 600 knots CAS rendering escape more hazardous.
3. At speeds above 600 knots CAS, ejection is extremely hazardous because of excessive forces on the body.

Ejection at low altitudes is facilitated by pulling the nose of the airplane above the horizon ("zoom up" 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 the time available for separation from the seat and deployment of parachute. Ejection should not be delayed when the aircraft is in a descending attitude and cannot be leveled out. When circumstances permit, slow the airplane down 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:

1. 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.
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 shoulder harnessing is released and 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.

On airplanes equipped with a drogue lanyard release knob, actuating the emergency harness release handle without pulling the drogue handle release knob will cause the parachute to deploy immediately upon separation from the seat and the altitude delay feature will be nullified. The seat will remain attached to the deployed parachute until the barostat delay mechanism actuates at approximately 10,000 feet.

LOW ALTITUDE EJECTION

The Martin-Baker ejection seat is considered to give excellent escape capabilities in a range extending from maximum airplane altitude to ground level. It should be realized, however, that the term "ground level" can be easily misinterpreted. 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 ejection procedure is applicable. Furthermore, the "zoom up" maneuver is still useful to slow the airplane to a safer ejection speed or provide more time and glide distance as long as an immediate ejection is not mandatory.

SURVIVAL KIT DEPLOYMENT

During a parachute descent the crewmember may desire to jettison the survival kit, or hold it by its carrying strap to be dropped just prior to ground contact. The reason for jettisoning or hand carrying the survival kit is to reduce the bulk and weight of the crewmember, which will minimize the possibility of injuries occurring under ground impact due to the survival kits weight and normal carrying position. It would probably be to the crewmember's advantage to jettison or hand carry the survival kit when making a parachute descent over land. In the event of a night ejection over land, the survival kit should be removed from its normal carrying position, however, if it cannot positively be determined that the crewmember will touchdown on land, the survival kit should be hand

BEFORE EJECTION SEQUENCE

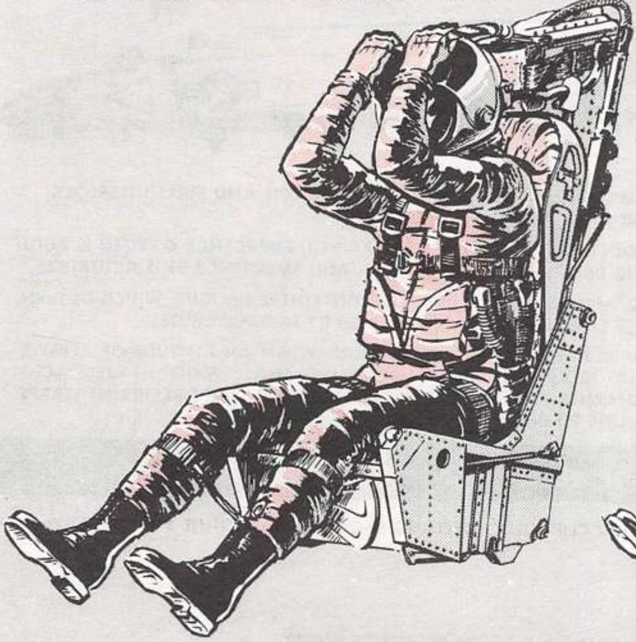
TYPICAL BOTH COCKPITS

IF TIME AND CONDITIONS PERMIT

- SLOW AIRCRAFT AS MUCH AS POSSIBLE.
- STOW ALL LOOSE EQUIPMENT.
- PULL EMERGENCY VENTILATING KNOB TO MINIMIZE DECOMPRESSION EFFECTS WHEN JETTISONING CANOPY.

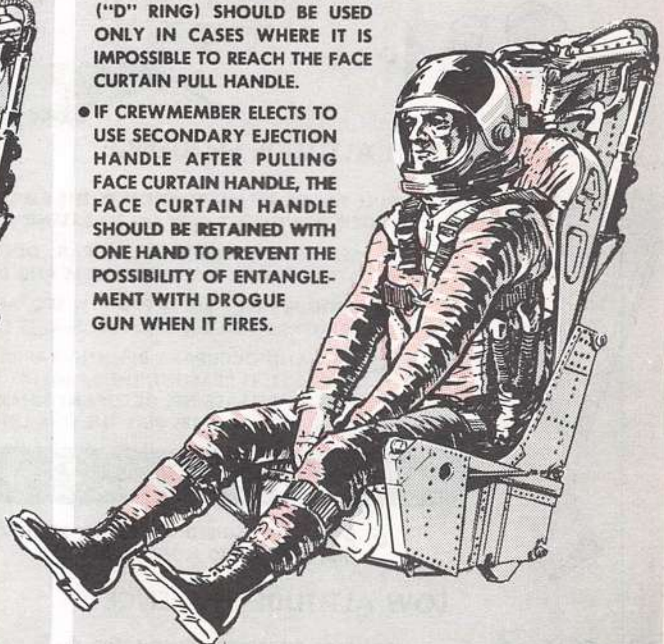
1. ASSUME PROPER EJECTION POSITION

ADJUST SEAT POSITION SO EYES WILL BE AT, OR BELOW GUNSIGHT LEVEL. BRACE THIGHS ON SEAT CUSHION, LEGS EXTENDED. SIT ERECT, BUTTOCKS BACK, SPINE STRAIGHT. HEAD BACK AGAINST HEADREST, AND CHIN IN.



Note

- THE SECONDARY FIRING HANDLE ("D" RING) SHOULD BE USED ONLY IN CASES WHERE IT IS IMPOSSIBLE TO REACH THE FACE CURTAIN PULL HANDLE.
- IF CREWMEMBER ELECTS TO USE SECONDARY 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.



2. 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.***

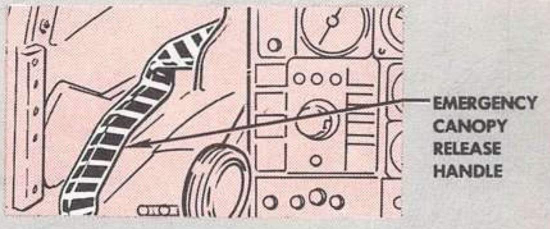
2. SECONDARY EJECTION HANDLE—PULL

POSITION ARMS BETWEEN LEGS WITH PALMS AFT, GRASP SECONDARY EJECTION HANDLE ("D" RING) AND PULL UP UNTIL STOP IS ENCOUNTERED. WHEN CANOPY JETTISONS, CONTINUE PULLING UP ON SECONDARY 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.

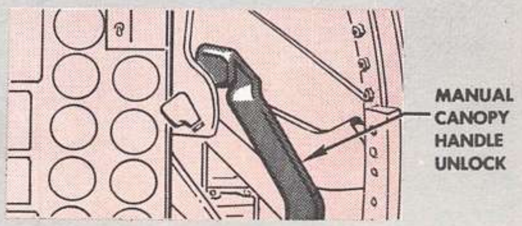


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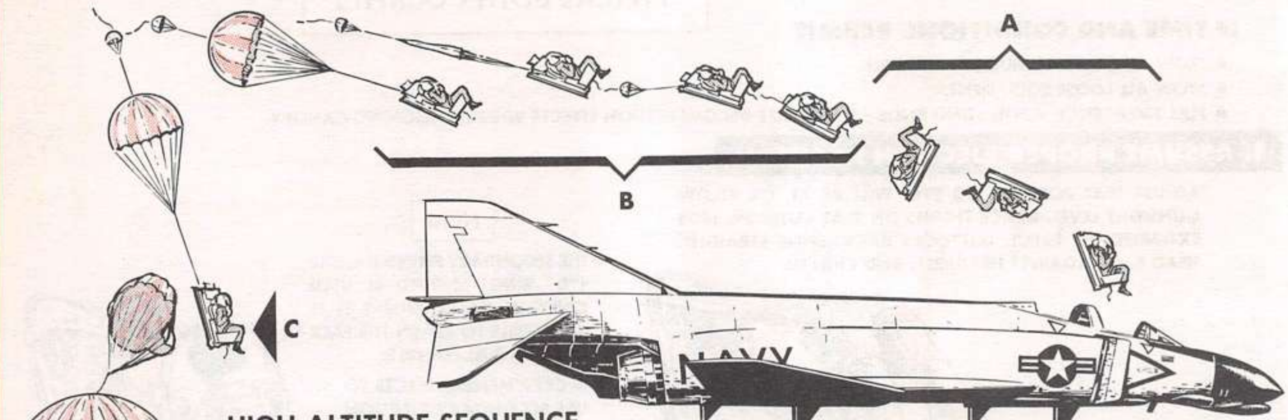
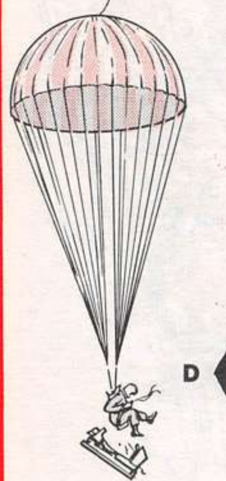
Figure 5-2

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. ½ 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.

D 10,000 FT. . . . . . . IF NECESSARY PROCEED WITH . . . .

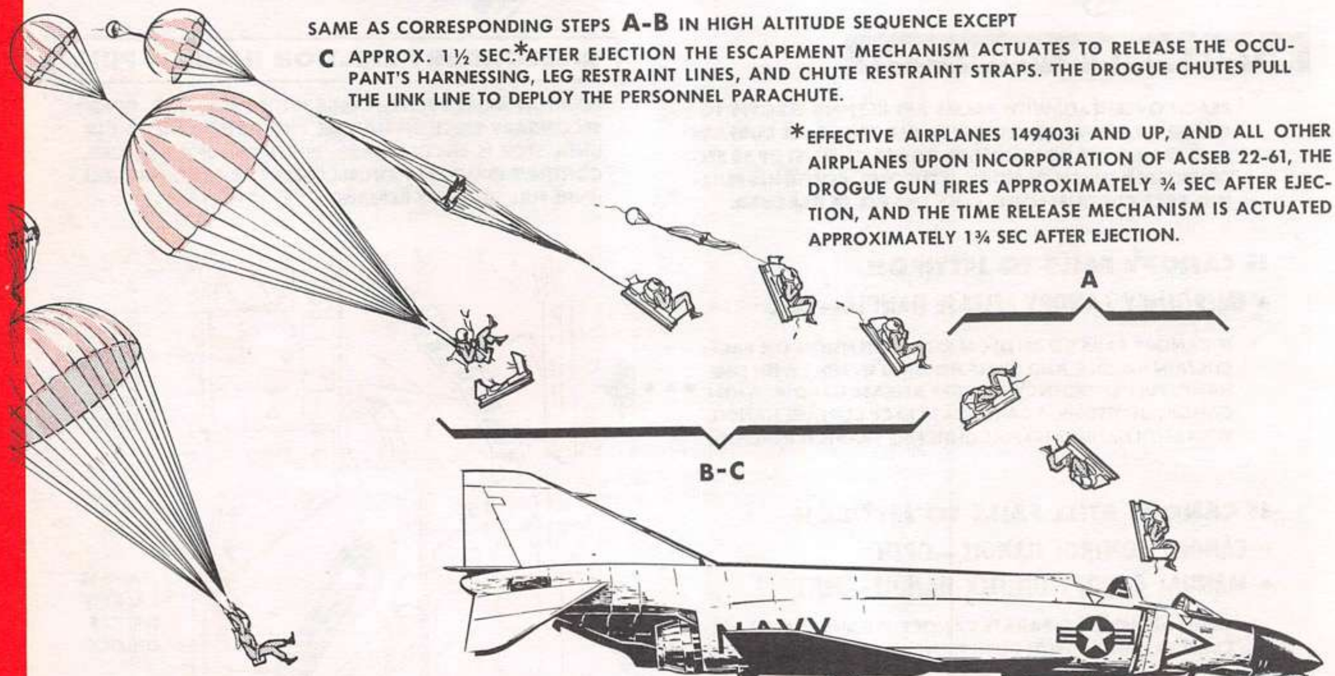
D OCCUPANT IS HELD TO SEAT BY STICKER CLIPS UNTIL OPENING SHOCK OF PARACHUTE SNAPS SEAT FROM HIM PERMITTING NORMAL DESCENT.

LOW ALTITUDE SEQUENCE

SAME AS CORRESPONDING STEPS **A-B** IN HIGH ALTITUDE SEQUENCE EXCEPT

C APPROX. 1½ SEC.* AFTER EJECTION 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.

*EFFECTIVE AIRPLANES 149403i AND UP, AND ALL OTHER AIRPLANES UPON INCORPORATION OF ACSEB 22-61, THE DROGUE GUN FIRES APPROXIMATELY ¾ SEC AFTER EJECTION, AND THE TIME RELEASE MECHANISM IS ACTUATED APPROXIMATELY 1¾ SEC AFTER EJECTION.



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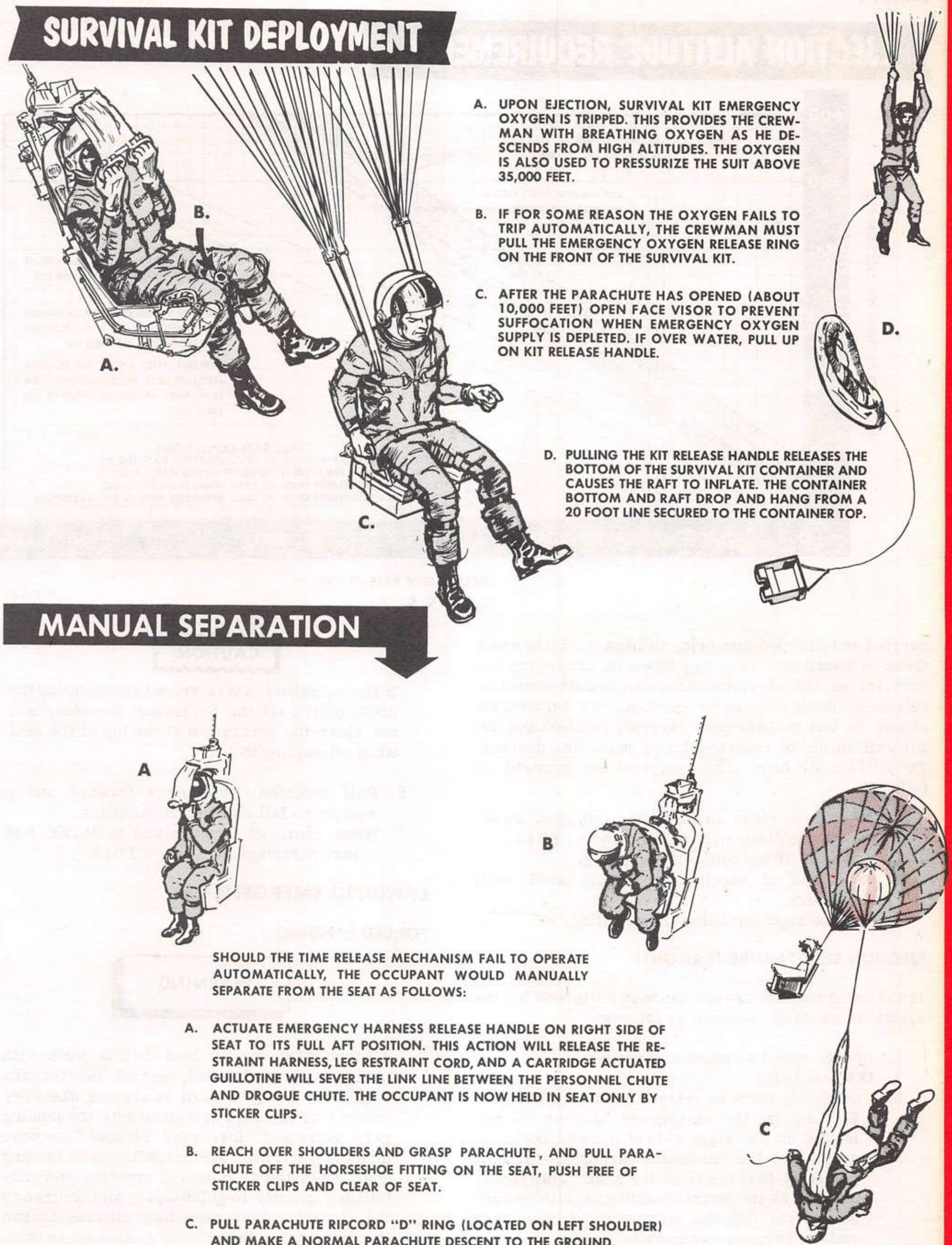
R

Figure 5-3


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.
A.
B.
C.
D.
MANUAL SEPARATION
A
B
C
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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R

Figure 5-4

EJECTION ALTITUDE REQUIREMENTS

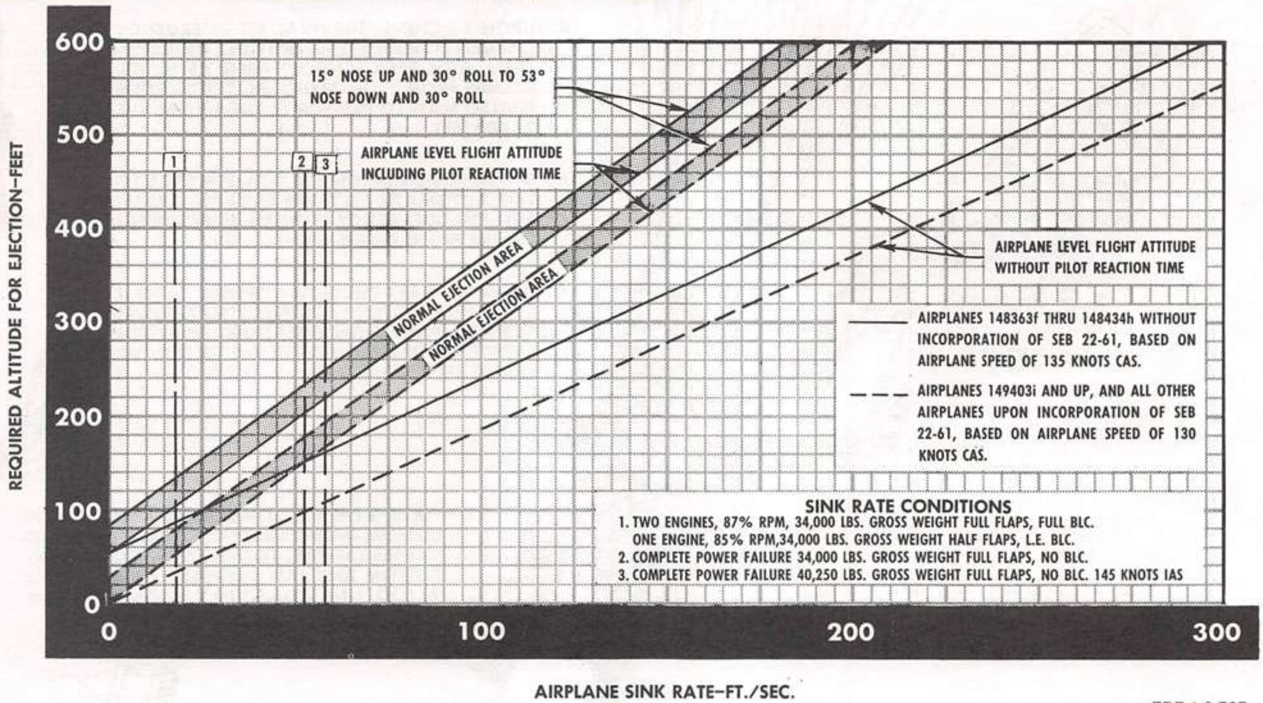

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Figure 5-5

carried and dropped just prior to impact. In the event there is insufficient time to jettison or hand carry the survival kit, the life raft with the survival kit should be released. In all over water ejections, the survival kit should be left in its normal carrying position and the life raft should be released during parachute descent. 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. IFF - 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

LANDING EMERGENCIES

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 gear-up landing NOT be attempted with this aircraft; the crew should EJECT. If a forced landing is unavoidable, proceed as follows:

1. Wind driven turbine - EXTEND
   Extend the wind driven 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 RIO of existing emergency and intended action.
4. Harness inertia reel handle - LOCKED
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. Armament - JETTISON
7. Landing gear - DOWN AND LOCKED
8. Wing flaps - DOWN
9. External tanks - RETAIN IF EMPTY
   Empty external tanks should be retained to absorb the shock of landing.
10. Make normal approach.

Upon touchdown:

11. Drag chute - DEPLOY
12. Engines - SHUTDOWN
    a. Throttles - OFF
    b. Engine master switches - OFF
13. Generator control switches - OFF
14. As soon as stopped - CLEAR AIRPLANE

LANDING GEAR UNSAFE

An unsafe gear indication does not necessarily constitute an emergency. The unsafe indication could be caused by a malfunction with 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:

Emergency Extension and Locking

1. Airspeed - 250 knots CAS or BELOW

If utility hydraulic pressure is within limits:

2. Landing gear - RECYCLE
3. Check gear indicates down and locked.

If unsafe condition still exists:

4. Landing gear circuit breaker - PULL
5. Landing gear handle - DOWN-PULL AFT
   When the landing gear handle is down, pull aft to actuate the emergency pneumatic system.
6. Check gear indicates down and locked.

If unsafe condition still exists:

7. Yaw airplane to assist in locking main gear.
8. Check gear indicators and have gear visually checked by another airplane or by tower "fly by".

Landing With Gear Up or Unsafe

The following factors should be considered before landing:

a. Availability of mid field or short field arresting gear near the approach end of the runway.
b. Crosswind effect.
   Refer to Crosswind Landing, Section II.
c. Utility hydraulic system failure.
   With a utility system failure, normal rudder control, normal wing flaps, and normal braking will not be available.

1. Request foam on runway if desired.
2. Armament - JETTISON
3. Lighten airplane.
   Lighten airplane by dumping or burning excess fuel.
4. External tanks - RETAIN IF EMPTY
5. Notify RIO of existing emergency and intended action.
6. Inertia reel handle - LOCKED
7. Make normal approach.

If one main gear is up or unsafe:

8. Land on side of runway opposite failed or unsafe gear.

If nose gear or all gear is up or unsafe:

9. Land in center of runway.
10. Drag chute - DEPLOY
11. Brakes - APPLIED
12. If gear is up or has collapsed - SHUTDOWN ENGINES
13. As soon as stopped - LEAVE AIRPLANE
14. If gear has not collapsed, roll straight ahead until stopped, keep engines running until crash crew has installed ground locks.

WARNING

Do not attempt arrestment if nose gear is up and main gear is extended.

FIELD ARRESTMENTS

1. Request foam if desired.
2. Notify RIO of existing emergency and intended action.
3. External tanks - RETAIN IF EMPTY
4. Arresting gear - DOWN
5. Plan to engage wire shortly after touchdown.
6. Aim for center of wire.
7. Drag chute - DEPLOY
8. Release brakes 100 feet prior to engaging wire.
9. Apply slightly aft stick.

After engagement:

10. If gear is up or has collapsed - SHUTDOWN ENGINES
11. As soon as stopped - LEAVE AIRPLANE
12. If gear has not collapsed, roll straight ahead until stopped, keep engines running until crash crew has installed ground locks.

BLOWN TIRE

A situation may occur when the pilot must land with a blown tire, or the tire may rupture during ground roll. A blown tire at high speed will require immediate control action to keep the aircraft aligned with the runway. Proceed as follows:

1. Make a normal final approach.
2. Land on side of runway opposite blown tire.
3. Touchdown with weight on undamaged tire.
4. Drag chute - DEPLOY
5. Use light opposite braking and nose wheel steering to slow aircraft and maintain alignment.

CAUTION

- If possible, do not shutdown engines until adequate fire fighting equipment is available. The damaged wheels will be either on fire or very hot and fuel drained overboard after engine shutdown could contact the hot wheel causing a fire.
- Do not retract flaps after landing or taxiing on blown tire. Damage to flaps and/or seals may occur due to flap seals being whipped out by abnormal forces.

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 of approximately 22 knots at all gross weights.

1. Fly a wide normal pattern.
2. Wing flap lever - RETRACT
3. Establish at least a one mile low angle straight in approach.
4. Maintain applicable approach speed.

Total Fuel Remaining Lbs.	Approximate Final Approach Speed Kts. CAS
3000	157
4500	160
6000	163
7500	166
9000	169
10,500	172
12,000	175

5. Maintain a mild rate of descent.
6. Fly the aircraft down to the runway.
   Do not flare the aircraft or "chop" power prior to crossing the end of the runway.
7. Make normal touchdown and roll out.

BOUNDARY LAYER CONTROL SYSTEM 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. A more detailed description of the characteristics and safe handling procedures for the above metioned failures follow.

Trailing Edge BLC Inoperative on One Side

This condition is characterized by a moderate roll when the flaps reach full down. Trim requirements vary only slightly as speed is reduced. Fly a normal "on speed" angle of attack. This will increase airspeed 5 to 7 knots. Increasing the angle of attack in order to fly normal airspeeds will provide satisfactory lateral control, but the increased angle of attack impairs the view over the nose of the airplane. If the above failure occurs proceed as follows:

1. Airplane - RETRIM
2. Fly normal "on speed" angle of attack.
3. Increase minimum approach speed 4 knots.

Leading and BLC Inoperative on One Side

This condition is characterized by little or no lateral retrim requirements when flaps are first lowered, followed by increased trim requirements as airspeed is reduced. Fly "on speed" angle of attack and/or an airspeed six knots higher than normal for the gross weight involved. Use caution on flaring since increasing angle of attack will lower rolling power and increase lateral control required for BLC off. Maintain a constant attitude to touchdown if possible. If the above failure occurs proceed as follows:

1. Airplane - RETRIM
2. Fly normal "on speed" angle of attack.
3. Increase minimum approach speed 6 knots.

Leading and Trailing Edge BLC Inoperative on the Same Side

The initial flap down lateral trim requirements of the trailing edge is first apparent followed by increased trim as airspeed decreases. Full lateral trim will be required well above approach airspeed. Minimum approach airspeed should be increased 18 knots to 150 knots CAS at 30,000 lbs. gross weight. Mild buffet will be noticeable at all airspeeds. If the above failure occurs proceed as follows:

1. Airplane - RETRIM
2. Increase minimum approach speed 18 knots.

There is no reason to raise flaps and land at 155-160 knots to avoid an asymmetrical BLC condition. In general for either type failure, a 5-10 knots increase will give normal angle of attack readings and satisfactory approach control.

BOUNDARY LAYER CONTROL SYSTEM 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. There is a possibility of rectifying this type of malfunction by reducing the engine power settings. The lower engine rpm will reduce the amount of engine bleed air being supplied to the BLC system, and may allow the BLC valve to close. In the event of a BLC malfunction ("BLC Malfunction" light illuminated) proceed as follows:

1. Reduce engine power settings to 90% rpm.

If above procedure fails to allow valve to close and extinguish "BLC Malfunction" warning light:

1. Flap switch - DOWN
2. Land as soon as practicable.

AUXILIARY AIR DOOR MALFUNCTION

In the event the auxiliary air door warning light illuminates in flight, the following precautions should be observed:

If gear handle is up:

1. Do not use afterburner.
2. Decrease airspeed to below 400 Knots CAS.
3. Avoid extended periods at high power settings.

If gear handle is down:

1. Land or retract gear.
   Extended periods of low speed, high power setting flight with doors closed may cause overheating in the engine compartment.

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 5-6) are believed to be the fastest and safest way of evacuating the cockpit, and should be observed. Two alternate methods of evacuating the cockpit are available, and procedures for each follow.

TO EVACUATE THE COCKPIT TAKING SURVIVAL KIT AND PARACHUTE ALONG, PROCEED AS FOLLOWS:

1. Emergency harness release handle - PULL
   After landing impact, pull up on the emergency harness release handle to free the shoulder harness, lap belt, and leg restraint lines.
2. Stand up to release survival kit sticker clips from the seat.

TO EVACUATE THE COCKPIT LEAVING BOTH THE PARACHUTE AND SURVIVAL KIT IN THE AIRPLANE, PROCEED AS FOLLOWS:

1. Leg lock release lever - PULL AFT
   Prior to landing impact, pull aft on the leg lock release lever to disconnect leg restraint lines.
2. Parachute riser-shoulder harness release fittings - SQUEEZE
   After landing impact, squeeze the parachute riser-shoulder harness release fittings on the integrated harness to free the parachute.
3. Lap belt release fittings - RELEASE
   After landing impact, squeeze the lap belt release fittings on the integrated harness to free the survival kit.
4. Helmet face visor - OPEN
   Open helmet face visor or loosen 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.

5. Composite disconnect knob - PULL
   Pull up on the composite disconnect knob and kick free of the seat.

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 CHART

CREW MEMBER	DUTIES BEFORE IMPACT	POSITION	DUTIES AFTER IMPACT	EQUIPMENT	EXIT
PILOT	1. RIO–ALERT. 2. Make radio distress call. 3. IFF–EMERGENCY. 4. External stores–JETTISON. 5. Landing gear–UP. 6. Wing flaps–DOWN. 7. Arresting gear–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. Inertia reel handle–LOCKED. 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. Pull up on the Emergency harness release handle. 2. Squeeze parachute riser-shoulder harness release fittings. 3. Stand up 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 RIO is clear. 7. Inflate life raft and secure Emergency equipment. 8. Proceed away from aircraftand tie rafts together.	1. Oneman raft and Emergency equipment. 2. Life vest 3. Flash light.	Over canopy sill.
RADAR INTERCEPT 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. Inertia reel handle–LOCKED	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.

FDB-1.2-506

Figure 5-6

AFTERBURNER FAILURE

AFTERBURNER FAILURE DURING TAKE-OFF

If the afterburner(s) fail during take-off, the resulting loss of thrust is significant. Take-off 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 a relight may be initiated.

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 overtemperature condition exists:

1. Immediately move throttle to MIL range.

WARNING

DO NOT attempt to relight afterburner. Damage to engine and airframe structure could result.

AFTERBURNER "BLOWOUT" DURING FLIGHT

In the event of afterburner "blowout" or loss of afterburning, the failed engine afterburner throttle should be moved inboard immediately to terminate fuel flow to the afterburner nozzles. If no obvious cause (overheat) is discernible, a relight may be attempted. If cockpit indications of resumed afterburner are normal, continue afterburner operation.

OIL SYSTEM FAILURE

An oil system failure of either engine is recognized by a drop in oil pressure or a complete loss of pressure.

1. If a minimum oil pressure of 40 psi at Military rpm cannot be maintained, throttle - IDLE
2. If a minimum of 12 psi at idle rpm cannot be maintained, engine - SHUTDOWN
3. In either of the above instances - LAND AS SOON AS POSSIBLE.

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 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. 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 percent speed before a complete failure occurs. In view of the above, the following operating procedures are recommended:

1. Throttle - 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%.
2. Avoid abrupt maneuvers causing high G forces.
3. Avoid unnecessary or large throttle burst.

Note

To keep bearing temperatures and loads at a minimum, do not use high thrust settings.

Oil Pressure Change Accompanied by Vibrations:

1. Throttle - OFF
   The throttle should be moved to OFF, when partial power from the affected engine is not essential to mission or flight requirements.

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.

AIRPLANE FUEL SYSTEM FAILURES

FUEL BOOST PUMP FAILURE

If fuel boost pumps fail, fuel will still be supplied to the engines by gravity feed. If booster pumps fail at altitudes above 20,000 feet, flameout of both engines may occur. During gravity feed, high fuel flow rates required by afterburner operation cannot be met. Boost pump pressure indication at 0 psi indicates that both boost pumps are inoperative. Proceed as follows:

If both engines have flamed out:

1. Reduce speed to 515 knots IAS or Mach 1.1 whichever is lower.
2. Wind driven turbine - EXTEND
   Extending the wind driven turbine will operate the left fuel boost pump at low speed. This will supply enough fuel to either engine to accomplish an airstart.
3. Attempt an airstart.

If an airstart has been accomplished or the engines have not flamed out:

1. Reduce power to minimum required.
2. Descent to below 20,000 feet using JP-5 or 10,000 feet using JP-4.
3. Using minimum power required, land as soon as possible.

Since the boost pump 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 below normal boost pump pressure reading 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 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 - EMERG

Note

Selecting the EMERG 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 trans press switch to EMERG. Place wing trans press switch to NORMAL prior to landing.

ELECTRICAL SYSTEM EMERGENCY OPERATION

SINGLE GENERATOR FAILURE

1. Failed generator switch - CYCLE
2. Check generator warning light - OUT

If generator warning light remains illuminated:

3. Generator switch - OFF
4. Secure engine if practicable
5. Land as soon as practicable

DOUBLE GENERATOR FAILURE

1. Reduce speed to 515 knots IAS or Mach 1.1 whichever is lower
2. Wind driven turbine - EXTEND
3. All unessential electric switches - OFF
4. Generator control switches - CYCLE
5. Check generator warning lights - OUT

If generator warning lights remain illuminated:

6. Generator control switches - OFF
7. Land as soon as possible

GENERATOR FAILURE (BUS TIE OPEN)

Left Generator Out

1. Left generator control switch - CYCLE (OFF, wait 20 seconds then ON)

If generator warning light remains illuminated:

2. Turn off all electrical equipment not essential to flight
3. Land as soon as possible

Right Generator Out

1. Right generator control switch - CYCLE (OFF, wait 20 seconds then ON)

If generator warning light remains illuminated:

2. Turn off all electrical equipment not essential to flight

To regain use of the essential bus:

3. Reduce speed to 515 knots IAS or Mach 1.1 whichever is lower
4. Wind driven turbine - EXTEND
5. Left generator control switch - OFF
6. Land as soon as possible

HYDRAULIC SYSTEM EMERGENCY OPERATION

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 FAILURES

A hydraulic pump failure in power control system No. 1 presents no serious problem because of the following reasons:

1. An emergency hydraulic pump can feed the system if the need arises.
2. Power control system No. 2 is capable of assuming the full demand of the flight control dual cylinders.

If a failure should occur in power control system No. 2, power control system No. 1 will assume the full demand of the flight control dual cylinders. Systems No. 1 and No. 2 are independent of each other, but each system satisfactorily functions as an emergency system for the other.

Power Control System No. 1 and No. 2 Emergency Operation

If power control systems No. 1 and No. 2 should fail, proceed as follows:

1. Reduce airspeed to 515 knots CAS or Mach 1.1 whichever is lower
2. Wind driven turbine - EXTEND
3. Land as soon as possible.

COMPLETE POWER CONTROL SYSTEMS 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. Wind driven turbine - EXTEND
2. Reduce airspeed to 515 knots CAS or Mach 1.1 whichever is lower.

If power control hydraulic pressure recovers:

3. Land as soon as possible.

If power control hydraulic pressure does not recover:

4. EJECT

UTILITY HYDRAULIC SYSTEM FAILURE

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

a. Rudder
b. Wing flaps
c. Landing gear
d. Speed brakes
e. Variable engine air duct ramps
f. Hydraulic fuel transfer pumps
g. Wheel brakes
h. Arresting gear (retraction)
i. Nose wheel steering

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

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

Speed brake retraction is available by placing the emergency speed brake switch in the RETRACT position.

The rudder can still be operated mechanically without hydraulic boost, however, pedal forces will be much higher than normal.

FLIGHT CONTROL SYSTEM 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:

1. Reduce airspeed - 250-300 knots
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 nosedown 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
2. Stab. Trim - FULL NOSE UP
3. Avoid abrupt fore and aft stick movements.
4. Land as soon as practicable.

Ice/Water Blockage of Ram Air Line

Ice or water blockage of the artificial feel bellows ram air line will result in conditions similar to a complete bellows failure. If ice or water blockage is suspected, longitudinal trim should not be applied to relieve control stick force. The intermittent nature of this condition and the suddenness of return to normal can cause violent pitch transients. When the ram air line 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:

1. Reduce airspeed - 250-300 knots CAS
2. Maintain attitude by pilot effort.
3. If practical, descend to air that is above freezing.

If this condition persists:

4. Land as soon as practicable.

Runway 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 autopilot, providing:

a. The stab trim circuit breaker has been pulled IMMEDIATELY upon detection of runaway trim.
b. Runaway trim is in the nose up direction.
c. Nose down runaway trim has not exceeded 2 1/2 unit.
d. Airspeed is reduced to 300 knots CAS or less.

If the above conditions are met:

1. Reduce airspeed - 300 knots CAS or less
2. Autopilot - ENGAGE.

CAUTION

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.

3. Plan to land as soon as practicable.

Prior to Landing:

4. Autopilot - DISENGAGE
   When in the landing configuration (gear and flaps extended) and at 180 to 190 knots CAS, grasp stick firmly and disengage the autopilot. 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 autopilot can be re-engaged, and the landing made with control stick steering.

If landing is made with autopilot engaged:

5. Immediately after touchdown - DISENGAGE AUTOPILOT
   Immediately after touchdown disengage autopilot to prevent damage to autopilot components.

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 Damper switch must be disengaged. Pulling the circuit breaker only, and keeping the dampers engaged will still provide 5° of ARI rudder authority. In the event of an ARI system malfunction proceed as follows:

To temporarily disengage system:

1. AFCS/ARI emergency disengage switch - DEPRESS
   Depressing the emergency disengage switch will disengage the ARI system only as long as the switch is held depressed.

To permanently disengage system:

1. ARI circuit breaker - PULL
2. Damper switch - DISENGAGE

SPEED BRAKE SYSTEM EMERGENCY OPERATION

Should the selector valve or the utility hydraulic system fail, and the speed brakes are extended, they may be retracted by placing the emergency speed brake switch on the left console to the RETRACT position. This allows air loads to close the panels to a trailing position.

Note

When speed brakes are closed by use of the emergency switch, the air loads will not completely close the panels.

LANDING GEAR SYSTEM EMERGENCY OPERATION

Do not retract the landing gear following an emergency extension.

CAUTION

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.

LANDING GEAR EMERGENCY LOWERING

If normal gear operation fails, the gear can be lowered by utilizing the following procedures:

1. Airspeed - BELOW 250 KTS. CAS
2. Landing gear circuit breaker - PULL
3. Landing gear handle - DOWN
4. Landing gear handle - PULL AFT
   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 the compressed air from the gear down side of the actuating cylinder to be vented overboard.

5. Landing gear position indicators - CHECK

Note

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

CAUTION

To prevent drop tank collapse, during high altitude descent with wheels down, place wing trans press switch to EMERG. Place wing trans press switch to NORMAL prior to landing.

WING FLAP SYSTEM EMERGENCY OPERATION

Do not retract the flaps following an emergency extension.

CAUTION

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.

WING FLAP EMERGENCY LOWERING

If normal wing flap operation fails, the flaps can be lowered by utilizing the following procedures:

1. Airspeed - BELOW 200 KTS. CAS
2. Flap circuit breaker - PULL
3. Emergency wing flap extension handle - PULL AFT
   Pull emergency wing flap extension full AFT and down, full limit of travel.
4. Wing flap position indicators - CHECK

CAUTION

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.

Note

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

WHEEL BRAKE SYSTEM EMERGENCIES

In the event a utility hydraulic system failure or loss of brake action, the airplane can be stopped by using the emergency brake system.

1. Allow aircraft to decelerate.
   Delay using brakes as long as safety will permit, allowing the airplane to decelerate as much as possible.
2. Hydraulic wheel brakes - APPLY
   Depress brakes and keep a constant increasing brake pressure. Do not pump brakes. There are approximately 6 to 8 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 differential braking. This can be utilized with the emergency brake system to maintain directional control of the airplane. The number of such applications is unlimited, however, higher pedal travel and higher brake pedal forces will be necessary.

If unable to stop airplane using emergency hydraulic accumulator braking and manual brakes, perform the following:

1. Emergency brake handle - PULL
   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 air emergency braking. This asymmetrical braking could be due to runway crown or crosswinds as well as unequal brake torque.

Note

- There is enough air stored in the emergency brake system to provide approximately 20 maximum deceleration applications of the emergency brakes.
- There will be a time lag between pulling the emergency brake handle and the application of pneumatic pressure to the wheel cylinders.

OPERATIONAL EMERGENCIES

PILOT/RIO EMERGENCY COMMUNICATIONS

Provided that the aircraft intercom system is in working order, it is assumed that any communication required between the pilot and RIO 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 connection.
3. Use Emergency ICS and Emergency Radio positions in conjunction with the override switch.
4. Try intercommunication with the UHF transceiver.

The following may be used as pilot/RIO attention signals under emergency conditions with no method of communicating.

1. The pilot will attract the RIO's attention by a rapid rocking of the wings.
2. The RIO will attract the pilot's attention by slamming home his radar hand control or radar set.
3. Acknowledgement of the attention signals will be a thumbs up and future communications will be conducted by visual signals.

HEFOE signals may be utilized by the pilot and RIO. As the RIO is always flying with the left hand 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 be held up to outline the fingers. If the RIO'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 RIO desires an immediate landing he will give a thumbs down signal to the pilot.

EJECTION/BAILOUT DOCTRINE

HIGH ALTITUDE

If the aircraft is descending uncontrolled as a result of a mid-air collison, control failure, spin or any other reason the pilot and RIO will abandon the aircraft at a minimum altitude of 10,000 feet above the terrain if possible and in no case lower than 5000 feet above the terrain. If the pilot has decided to abandon the aircraft while still in controlled flight at altitude, the pilot and RIO 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.

LOW ALTITUDE

Low altitude ejection must be based on the minimum speed, minimum altitude and sink rate limitations of the ejection system. The ultimate decision rests with the pilot.

The subject of ejections has many ramifications under various circumstances and it is impossible to cover every possible situation. The fact that the F-4B has two engines eliminates many of these possibilities. In general it is the pilots responsibility to leave the aircraft last. The reasons for this are twofold:

To avoid injury to the RIO and/or damage of his canopy.

To provide control of the aircraft in the event the RIO's seat fails to fire normally (i.e., to roll the aircraft inverted with a positive "g" and then pop the RIO out with a negative "g". The only foreseeable deviations to this rule are:

1. The aircraft is out of control and the RIO had not ejected or the pilot has not been able to signal for ejection.
2. The aircraft is in a Dirty Configuration at low altitude (MLP etc.) and suffers a double flameout.

It is believed that under condition number (1) the exit of the pilot will be ample signal for ejection and further that even if the RIO's seat will not fire, the pilot will be of no use in aiding him to escape.

Under condition (2), with the aircraft at approach speed the loss of both engines puts the aircraft in a high sink rate condition. It is believed that under these conditions the pilot should command "Eject" as he reaches for the face curtain: that a simultaneous ejection or one in which the pilot ejects slightly ahead is the only chance for survival of either crew member. If at any time during an emergency, especially with loss of intercom the RIO believes that the condition of the aircraft has reached or passed extremus, he must use his own judgement in ejecting. For this reason it is vital that all pilots continuously keep the RIO informed during normal flight as well as in emergency conditions. The following signals will be used by the pilot to order the RIO to eject in the event the intercom is inoperative:

1. ORDER TO EJECT, DAY, NO INTERCOM: Pilot will strike the left side of his canopy repeatedly.
2. ORDER TO EJECT, NIGHT, NO INTERCOM: Pilot will wave his flashlight in a vertical motion over his left shoulder.
3. In the event the RIO does not respond to either of the above signals, the pilot shall jettison his canopy as a last signal if time/altitude permits.

EMERGENCY VISUAL COMMUNICATIONS

MALFUNCTION AND EMERGENCIES

TYPE OF EMERGENCY	SIGNAL	RESPONSE
I am in trouble; followed by landing signal indicates forced landing.	Arms bent across forehead, weeping.	Carry out squadron doctrine of escort for disabled planes.
I must land immediately.	Circular motion of flashlight shined at other aircraft.	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.

"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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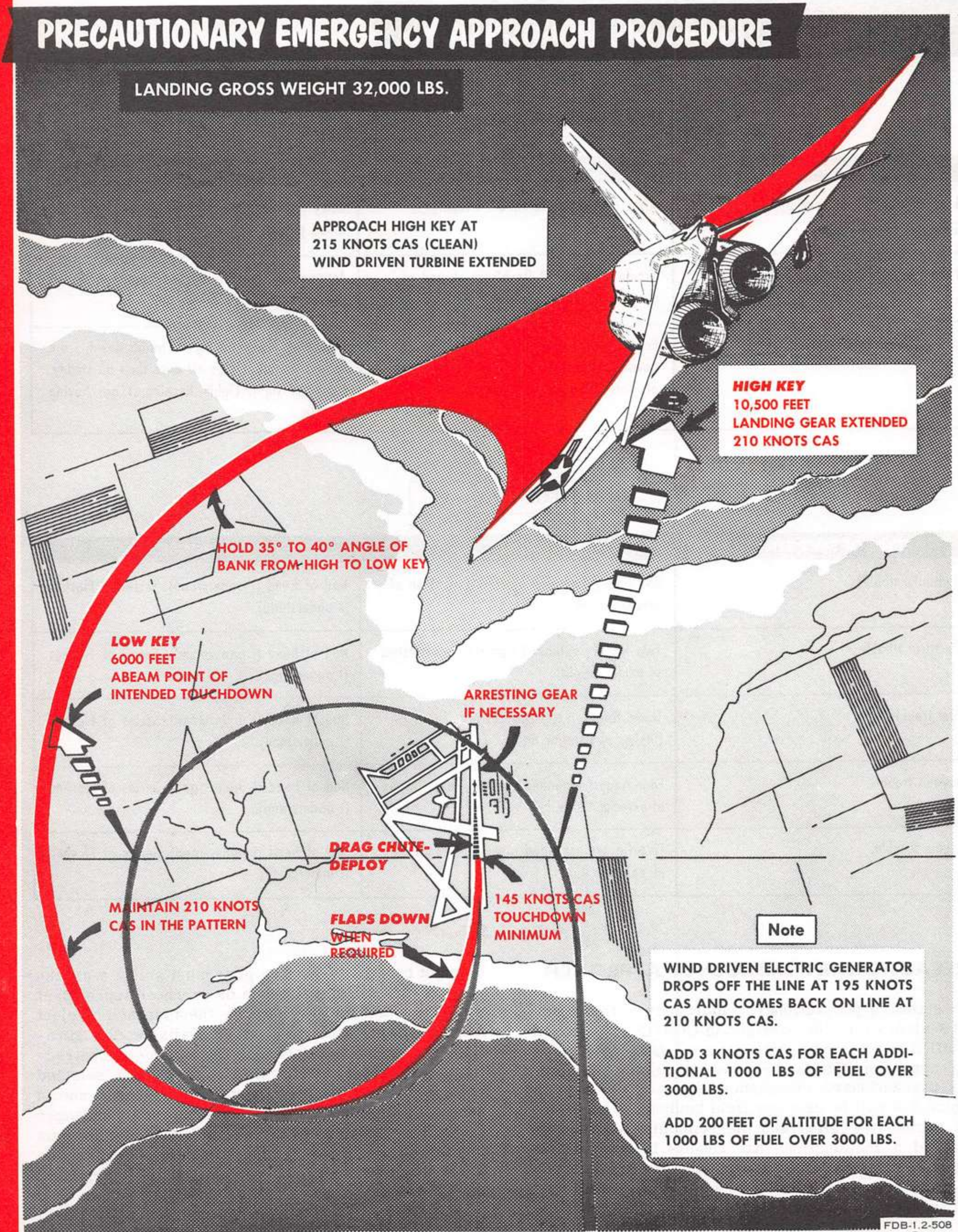
Figure 5-7

PRECAUTIONARY EMERGENCY APPROACH

The standard precautionary emergency approach for F-4B 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 5-8 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 any check point using either a left hand or right hand pattern. The pilot must select a checkpoint 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 checkpoint 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 checkpoint 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


PRECAUTIONARY EMERGENCY APPROACH PROCEDURE
LANDING GROSS WEIGHT 32,000 LBS.
APPROACH HIGH KEY AT
215 KNOTS CAS (CLEAN)
WIND DRIVEN TURBINE EXTENDED
HIGH KEY
10,500 FEET
LANDING GEAR EXTENDED
210 KNOTS CAS
HOLD 35° TO 40° ANGLE OF
BANK FROM HIGH TO LOW KEY
LOW KEY
6000 FEET
ABEAM POINT OF
INTENDED TOUCHDOWN
ARRESTING GEAR
IF NECESSARY
DRAG CHUTE-
DEPLOY
MAINTAIN 210 KNOTS
CAS IN THE PATTERN
FLAPS DOWN
WHEN
REQUIRED
145 KNOTS CAS
TOUCHDOWN
MINIMUM
Note
WIND DRIVEN ELECTRIC GENERATOR DROPS OFF THE LINE AT 195 KNOTS CAS AND COMES BACK ON LINE AT 210 KNOTS CAS.
ADD 3 KNOTS CAS FOR EACH ADDITIONAL 1000 LBS OF FUEL OVER 3000 LBS.
ADD 200 FEET OF ALTITUDE FOR EACH 1000 LBS OF FUEL OVER 3000 LBS.
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R

Figure 5-8

clear area and ejecting instead of attempting the approach. Therefore, it is mandatory that straight in and overhead precautionary approaches be practiced to require and maintain pilot proficiency. The determination of the exact number and type of approaches required to acquire and maintain proficiency must be determined by the Unit Commanding Officer.

DOWNED PLANE PROCEDURE

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 following information should be relayed to a ground station immediately:

Identification
Model Aircraft
Position
Situation
Intentions

The initial radio contact should be preceded with the word PAN, when the situation requires urgent action, but is not actual distress: or MAYDAY when threatened by serious or imminent danger and immediate assistance is required. If a serious emergency has arisen, shift immediately to EMERGENCY IFF/SIF, UHF to "GUARD", and broadcast MAYDAY.

Single Aircraft

If the situation permits prior to ejection or crash landing, make every effort to switch to EMERGENCY IFF/SIF and 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:

Establish contact with a ground station, preferably a GCI site or RADAR control agency. Switch IFF/SIF to EMERGENCY and UHF to GUARD.

Make every effort to follow the other aircraft or crew during descent. It is of primary importance to keep the crew in sight at all times, while on the ground or in the water. Note as accurately as possible bearings, distances from known prominent landmarks or navigational aids in order to direct rescue planes or boats to the scene.

Establish a RESCAP.

Maintain sufficient altitude to assure radio contact with the rescue facility.

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 generally will insure a greater likelihood of a successful rescue. The other member of the section in which the downed crew was flying will follow the aircraft/or crew and circle them at low altitude, making every effort to keep the downed crew in sight.

Other members of the flight remain at altitude, alert appropriate facilities, relay communications, and conserve fuel.

LOST PLANE PROCEDURES

The primary requirements when lost are as follows:

Confess
Communicate
Climb
Conserve
Conform
Know any peculiar local area/ship procedures

WITH RADIO

Perhaps the hardest part of the whole procedure is to admit you are lost. But, remember, it is much better to suffer embarrassment than to be the subject of an accident investigation. Communicate with anyone possible and let your problem be known. Turn your IFF to emergency. Switch to radio guard channel and declare an emergency with the broadcast, MAYDAY, MAYDAY, MAYDAY. Transmit your estimated position, course, speed, altitude and fuel supply in minutes. State your difficulty, request assistance and state your intentions. Remember to use your homing equipment and also to transmit for a D/F steer as requested. Once in contact with a radio facility, make a broadcast that you are in contact with "_____" and ask all others to remain silent unless called. Climb to increase both the range of your radio and the endurance of your aircraft. Conserve your fuel supply and fly maximum endurance power until you know where you want to go. Then use maximum range power to get there. Conform to established procedures and do not try to second guess your benefactor lest you get lost again.

WITH RADIO RECEIVER ONLY

Comply with as much as possible of the above. Fly two triangles to the right using one minute legs. Repeat this pattern every 20 minutes. Be sure to monitor the guard channel and comply with any instruction received.

WITHOUT RADIO

Comply with the above if possible and fly two triangles to the left with one minute legs. Repeat the pattern every 20 minutes. Otherwise maintain your estimated best course and maintain a lookout for an interceptor.

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.

SECTION VI COMMUNICATIONS PROCEDURES

TABLE OF CONTENTS

(*) Denotes Illustration

RADIO COMMUNICATIONS PROCEDURES

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 RIO 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 in local fleet/shore instructions.

PILOT/RIO INTERCEPT COMMENTARY

DESCRIPTIVE COMMENTARY

Descriptive commentary is given in a specific order when existing conditions allow; azimuth, range, elevation, closing rate. Under certain conditions it is impossible to give the description in the desired sequence, since adhering rigidly to the sequence may interfere with positive control of target movement. The description of target action or position is normally given in a conversational tone of voice. The pilot absorbs this information and while it is not necessary for him to echo, he will acknowledge with "ROGER". However, if at any time during an interception the pilot requires a specific bit of information he may demand it from the RIO. Upon initial contact, the RIO will immediately start giving descriptive commentary. It is apparent that if the RIO gives "CONTACT" followed immediately by a range reading, the pilot is aware of the urgency or need of positive action by the RIO. The RIO will also, upon initial contact, give any directive commentary that is necessary to insure that the target does not exceed the limitations of the set. Descriptive commentary is not required to be particularly accurate at long ranges, but as the fighter approaches visual or attack range, the description must be accurate, but still must not interfere with commands to the pilot. Sufficient descriptive commentary should be given to keep the pilot constantly informed of the position of the target in terms of azimuth angle, range, elevation angle, and overtaking speed.

Contact Report

Contact reports will be given to the controlling agency in the following manner:

"CONTACT" followed by AZIMUTH - Degrees followed by LEFT or RIGHT.

RANGE - Nearest mile

Example: CONTACT 25 LEFT, 30 MILES.

Target Position Reporting

Position reports will be given in a specific order, i.e., azimuth angle, range, elevation angle, and overtaking speed. The following terms will be used:

AZIMUTH - Degrees followed by LEFT or RIGHT

RANGE - In miles (yards may be used when appropriate)

ELEVATION - Degrees followed by above, below or level.

OVERTAKING SPEED - Knots

Examples:

10 RIGHT, 8 MILES, LEVEL, OVERTAKE 300
20 LEFT, 12 MILES, 5 ABOVE, OVERTAKE 50
20 RIGHT, 250 YARDS, 20 ABOVE, OVERTAKE ZERO

Judy

"JUDY" will be given to the controlling agency when assuming responsibility and control of the intercept.

DIRECTIVE COMMENTARY

Directive commentary is divided into three categories and is used when the situation calls for a change of the aircraft's direction, speed, or elevation. A considerable amount of information as to the urgency may be obtained from the inflection of the RIO's voice as well as speed with which one command follows the other. Voice modulation properly employed will give flexibility to commentary. If the RIO places emphasis in his voice commands, it insures that the pilot hears each and every command and will also cause the pilot to react accordingly. Directive commentary will at all times take precedence over descriptive commentary. The pilot will echo all directive commentary given by the RIO. The pilot will also inform the RIO whenever the limitations of the aircraft are reached. Upon achieving a speed change, leveling off or resuming straight and level flight the pilot will inform the RIO with commentary such as "SPEED SET", "STEADY AND LEVEL", or "ALTITUDE SET".

Heading Change Commands

"EASY PORT" or "EASY STARBOARD"	15° angle of bank.
"PORT" or "STARBOARD"	30° angle of bank.
"PORT HARD" or "STARBOARD HARD"	45° angle of bank.
"HARD AS POSSIBLE"	Maximum possible turn maintaining airspeed and altitude.
"EASE OFF"	Roll out slowly toward steady.
"HOLD"	Maintain present bank angle.
"STEADY"	Roll out of turn.
"HARDER"	Increase angle of bank to next higher increment. Example: if at 30° angle of bank pilot will increase bank angle to 45°; if at 20° bank, increase to 30°, etc.

Note

Turns may be given as a specific number of degrees, For example: "PORT HARD 40", etc.

Elevation Commands

"CLIMB" or "GO DOWN"	1000 FPM rate maintaining airspeed.
"CLIMB ___" or "GO DOWN ___"	Number of feet designated by RIO. Example: "CLIMB 3000"
"NOSE UP"	Increase climb angle until given "HOLD CLIMB" by RIO or maximum rate of climb established.
"DIVE"	Increase dive angle until given "HOLD DIVE" by RIO or maximum permissible rate of descent is established.
"LEVEL OFF"	Return to level flight.

Speed Commands

"BUSTER"	Full military power.
"GATE"	Maximum power.
"BUSTER ___" or "GATE ___"	Military or maximum power to CAS or indicated Mach number specified.
"SPEED UP"	Increase airspeed by amount specified (CAS or IMN).
* "THROTTLE BACK" ________	Decrease speed by amount specified (CAS or IMN).
"SPEED UP TO ___" or "THROTTLE BACK TO ___"	Change speed to specified IMN or CAS.
* "THROTTLE RIGHT BACK"	Decrease airspeed as rapidly as possible until minimum airspeed reached or RIO gives "HOLD SPEED"
"HOLD SPEED"	Maintain present airspeed.

* Speed will normally be reduced as rapidly as possible utilizing speed brakes and/or throttles as appropriate.

Less Frequent Commands

"BREAK STARBOARD" or "BREAK PORT"	Immediate, hard as possible, turn in the direction indicated.
"OVERSHOOT STARBOARD" or "OVERSHOOT PORT"	Immediate, hard as possible, turn in the direction indicated for 60° heading change from target heading; hold this for 10 seconds then turn toward the target using 30° bank angle. Steady Out after 90° of heading change and hold this heading for 10 seconds; if no contact, continue turn in same direction for 30° heading change using 30° bank angle and hold this heading for 5 seconds. If still no contact, turn toward target heading using 30° bank angle for 60° heading change; placing the interceptor on a parallel heading with the target.
"COMPASS RECOVERY"	Immediate, hard as possible, turn 30° beyond target's last known heading.

VISUAL COMMUNICATIONS PROCEDURES

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 RIO's. For ease of reference, visual signals applicable to flight operations in F-4B aircraft are contained in figure 6-1.

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.	
Perfect, well done.	Hand held up, with thumb and forefinger forming an O and remaining three fingers extended.	
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.
Take over communications.	Tap earphones, point to plane, and hold up one finger.	Execute.

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 6-1(Sheet 1)

FORMATION

MEANING	SIGNAL	RESPONSE
1—I have completed my take-off Check-off and am, in all respects ready for take-off; 2—I have completed my take-off check list and am, in all respects, ready for a section take-off; 3—take-off path is clear, I am commencing take-off.	1—Section take-off 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 take-off; 3—executes section take-off.
Leader shifting lead to wingman.	Leader pats self on head points to wingman.	Wingman pats head and assumes lead.
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 plan 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.
Wingman takes the lead.	Leader shines flashlight on hardhat, then shines light on wingman.	Wingman shines flashlight at leader, then on his hardhat. Turns external light to DIM and STEADY and assumes lead.

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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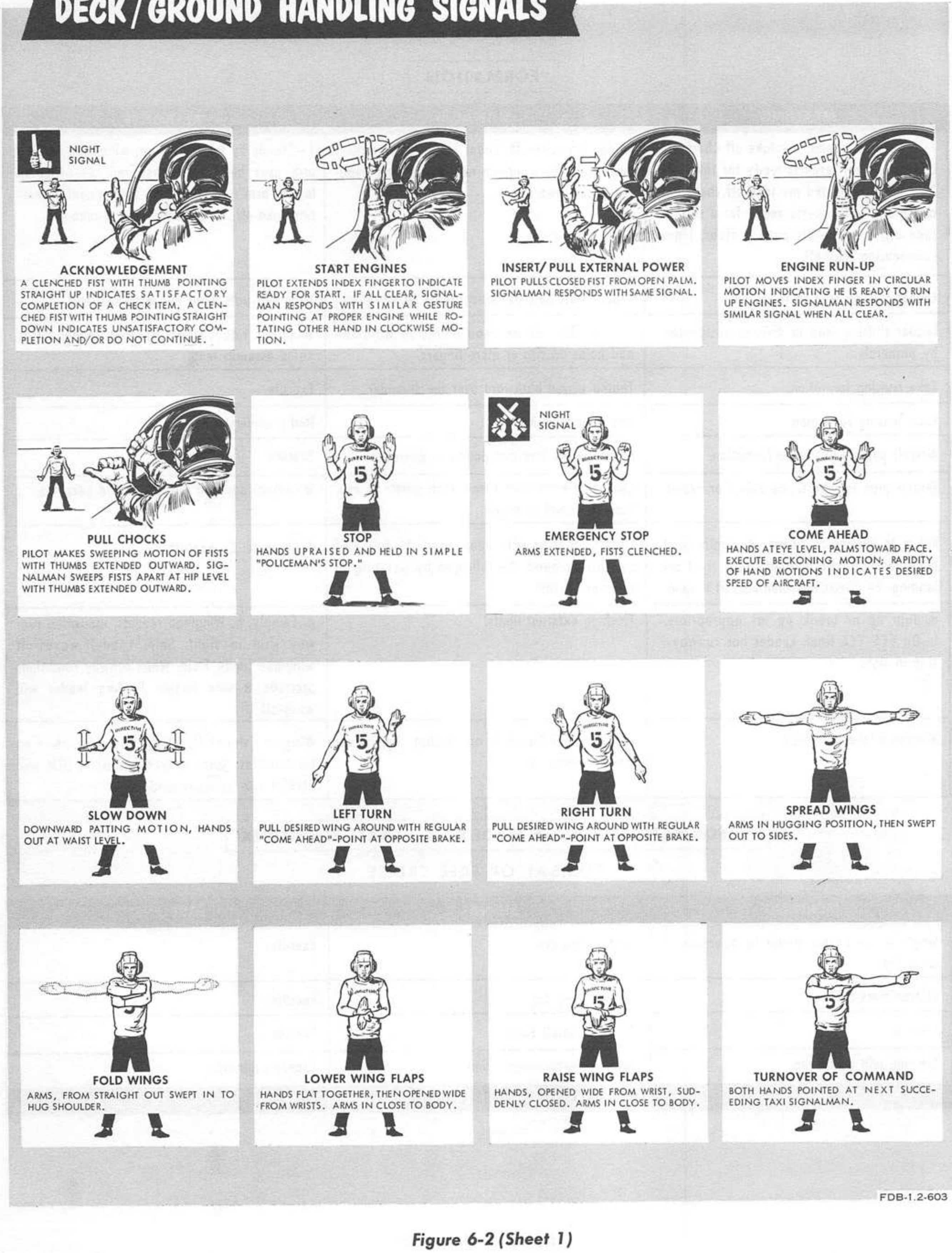
Figure 6-1 (Sheet 2)

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 INDEX FINGERTO INDICATE 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.

STOP
HANDS UPRAISED AND HELD IN SIMPLE "POLICEMAN'S STOP."

EMERGENCY STOP
ARMS EXTENDED, FISTS CLENCHED.

COME AHEAD
HANDS AT EYE LEVEL, PALMS TOWARD FACE. EXECUTE BECKONING MOTION; RAPIDITY OF HAND MOTIONS INDICATES DESIRED SPEED OF AIRCRAFT.

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.

TURNOVER OF COMMAND
BOTH HANDS POINTED AT NEXT SUCCEEDING TAXI SIGNALMAN.

Figure 6-2 (Sheet 1)

HOOK UP

RIGHT THUMB JERKED UP TO MEET HORIZONTAL LEFT HAND.

CUT ENGINES

HAND DRAWN ACROSS NECK IN "THROAT CUTTING" MOTION.

SPECIAL

SPEED BRAKE

ARMS EXTENDED WITH HANDS TOGETHER AND BOTH PALMS DOWN. KEEPING WRISTS TOGETHER MOVE LOWER PALM DOWN.

IFR PROBE OUT

SWING ARM, HELD STRAIGHT AHEAD WITH FIST CLENCHED, 90 DEGREES TO SIDE POSITION. REVERSE PROCEDURE FOR IFR PROBE IN.

NOSE GEAR STEERING

RIGHT INDEX FINGER POINTING TO RIGHT SIDE OF NOSE FOR RIGHT TURN AND VICE VERSA FOR LEFT TURN; OPPOSITE HAND POINTING TO NOSE GEAR.

1 **NOSE GEAR EXTENSION**
(CATAPULT SHOT)

LEFT INDEX FINGER TO THE NOSE, RIGHT HAND PALM UP IN A UPWARD MOTION.

HALF FLAPS

LOWER HALF FLAPS FOR BLC CHECK.

DRAG CHUTE

RELEASE DRAG CHUTE OR CHECK DRAG CHUTE HANDLE POSITION.

CONTROLS/ARI

MOVE RIGHT HAND WITH FIST CLENCHED (NIGHT USE WAND) IN RECTANGULAR PATTERN AT WAIST LEVEL.

RAM AIR TURBINE

RIGHT ARM PULLED DOWN/UP IN SWEEPING ARM MOTION FROM LEFT HORIZONTAL ARM.

Note

1 THE PILOT MUST HAVE CORRECT PNEUMATIC PRESSURE BEFORE EXTENSION AND GIVE ACKNOWLEDGEMENT TO THE GROUND CREW MAN FOR EXTENSION.

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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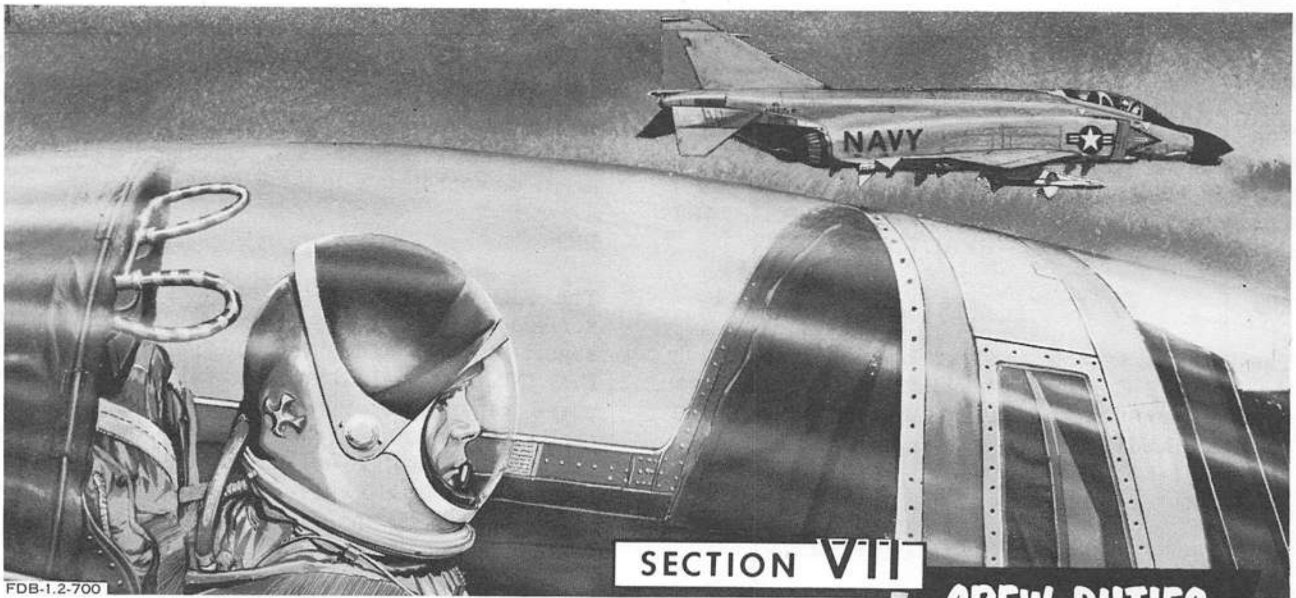
Figure 6-2 (Sheet 2)



SECTION VII CREW DUTIES

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PILOT/RIO RESPONSIBILITIES

GENERAL

The duties of the Pilot/RIO 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 RIO should constitute an extension of the pilot's observation facilities. By intercommunication, the RIO should anticipate rather than await developments.

SPECIFIC PILOT AND RIO 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.

RIO

The RIO, 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.

RIO

The RIO will assist the pilot/flight leader in preparing required flight or briefing forms and may, if applicable, brief that portion of the mission pertaining to the RIO.

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 F-4B NATOPS Essential Checklist (NAVWEPS 01-245FDB-1B).

RIO

The RIO will assist the pilot as directed but in any case will be capable of and proficient in performing a complete aircraft preflight, including all armament. Normally the preflight inspection will be conducted with the pilot.

PRE-START

Pilot

The pilot will execute pre-start checks prescribed by the NATOPS Essential Checklist and, when external power is applied and checks requiring external power are completed, will inform the RIO "PRE-START CHECKS COMPLETED - READY TO START".

RIO

The RIO will execute pre-start checks prescribed by the NATOPS Essential 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 Section II and will keep the RIO informed of any unusual occurrences.

RIO

The RIO 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 RIO "ON INTERNAL POWER; BUS TIE CLOSED/ OPEN". The pilot will then complete all post start checks prescribed by the NATOPS Essential Checklist. When post start checks are completed, he will inform the RIO "READY TO TAXI". The pilot will turn the missile power switch ON when requested by the RIO and will acknowledge by "APA-128 ON".

RIO

When informed that the aircraft is on internal power and the bus tie closed, the RIO will complete the post start checks prescribed by the NATOPS Essential Checklist. The RIO will request the pilot to turn on the APA-128 and may take command of radio and navigation equipment, select appropriate frequencies, and advise the pilot "READY TO TAXI". The RIO may call for taxi clearance as directed by the pilot. The RIO will remain unhooded until cleared to go hooded by the pilot.

PRE-TAKE-OFF

Pilot

The pilot will execute pre-take-off instrument, and take-off checklists prescribed in the NATOPS Essential Checklist and as posted in the aircraft. The pilot will report to the RIO engine oil pressures noted on run-up, instrument checklist, and take-off checklist items. The pilot will receive the "READY FOR TAKE-OFF" report from the RIO and will advise him of the type/ configuration take-off planned prior to rolling or catapulting. The pilot will report "ROLLING" or salute as appropriate to the RIO.

RIO

The RIO will execute pre-take-off checklists prescribed by the NATOPS Essential Checklist and will report "READY FOR TAKE-OFF; CIRCUIT BREAKERS IN" to the pilot. The RIO 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 take-off checklist is not reported as completed. The RIO will remain unhooded until cleared to go hooded by the pilot. The RIO will assist in communications as directed by the pilot.

TAKE-OFF /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 RIO insofar as safety permits. The RIO should be advised of lift-off and any unusual occurrences such as over temperature, overspeed, or BLC malfunction. The pilot will request, copy, and acknowledge all clearances.

RIO

The RIO will remain unhooded unless directed otherwise and will record lift-off speed and take-off distance as appropriate. The RIO will request permission to go hooded and will advise the pilot when this is accomplished. The RIO will maintain a continuous plot of the aircraft position. Where departures are made in actual instrument conditions, the RIO will monitor the published or clearance departure procedures and will inform the pilot of any deviation from the prescribed flight path. The RIO will attempt to 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. BIT checks will not be conducted during instrument climbouts.

INFLIGHT (GENERAL)

Pilot

The pilot will inform the RIO 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 RIO ample opportunity to practice in requesting and copying clearances and in position reporting.

RIO

The RIO will conduct BIT checks and will inform the pilot of the weapon system status. The RIO will maintain a continuous plot of aircraft position. The RIO 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.

INTERCEPT

Pilot

The pilot will maneuver the aircraft as directed by GCI/CIC until radar contact is obtained by the RIO. The pilot will maneuver or coordinate maneuvers of aircraft with or as directed by the RIO, observing normal operating limitations. The pilot will inform the RIO of weapons status, weapons selected and armed, and when the target is sighted visually. The pilot will make all missile away reports. Pilots will monitor aircraft position from initial vector through breakaway by pigeons information or navigational display.

RIO

The RIO will normally handle all communications from initial vector through breakaway, excluding missile away transmissions. The RIO will provide the pilot with descriptive commentary including weapon status and target aspect if available. The RIO will direct and coordinate aircraft maneuvers with the pilot as necessary to complete the intercept.

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 RIO the completion of each item of the instrument checklist. In addition, the pilot will challenge the RIO as to approach plate availability and corrected altimeter setting.

RIO

The RIO 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 RIO will assist with communications as directed by the pilot. BIT checks will not be conducted in actual instrument conditions. The RIO will inform the pilot of the status of the radar gyro horizon and will do nothing to cause the display to be lost.

LANDING

Pilot

The pilot will utilize the landing checklist and will report each item to the RIO prior to reporting "GEAR DOWN; HOOK DOWN" to the final controller/tower/prifly. The pilot will receive a "READY TO LAND" report from the RIO.

RIO

The RIO will remain unhooded in the landing pattern if VFR and will challenge the pilot on gear, flap, and hook position if the report is not received. The RIO will attempt to check the position of the gear handle by looking through the opening on the left side of the instrument panel. The RIO will complete the landing checklist and will report "READY TO LAND" to the pilot. BIT checks will not be conducted in the traffic pattern. The RIO will monitor final approach speed and will advise the pilot if the speed decreases to 130 knots or below.

POST FLIGHT

Pilot

The pilot will inform the RIO of any unusual occurrences on the landing roll or arrestment. The pilot will report flap position to the RIO when clear of the runway/landing area, and will report when the wingfold is actuated. The pilot will inform the RIO when shutting engines down. The pilot will conduct a postflight inspection of the aircraft.

RIO

The RIO 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 RIO will immediately respond with the position of the wings. The RIO will complete the BIT checks remaining and will secure the rear cockpit for shutdown. The RIO will assist the pilot in conducting a postflight inspection of the aircraft.

DEBRIEFING

The pilot and RIO will complete the Yellow Sheet and all required debriefing forms.

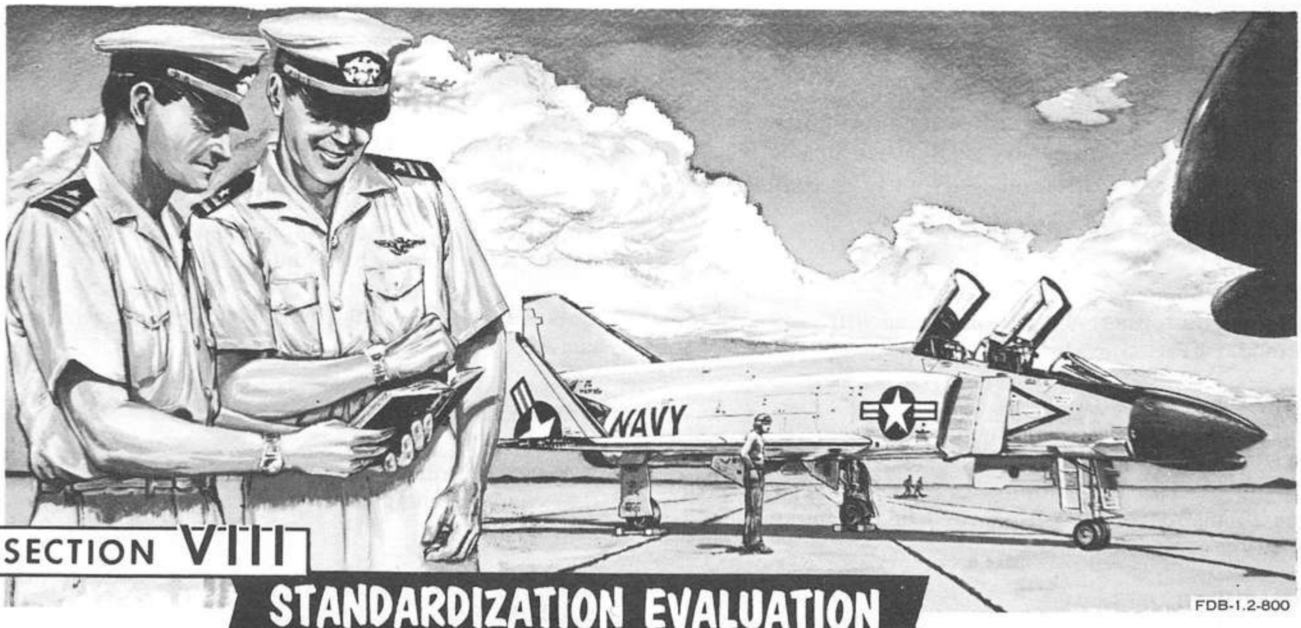
Note

The RIO 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 checklists are specifically designated for the individual pilot or RIO, the entire contents of Volumes I, II, III, and the Essential Checklist should be thoroughly read, understood, discussed, and agreed upon collectively by the Pilot/RIO 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 Volume I. Classified systems (AMCS, IFF-SIF) description and procedures, and Appendix I performance data, are contained in Volume III. The Essential Checklist contains the pilot's and RIO's individual check-items for Preflight, Pre-Start, Start, Post-Start, Take-Off, Built-In Test (BIT), Instrument/Descent, and Post-flight.



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SECTION VIII
STANDARDIZATION EVALUATION

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STANDARDIZATION EVALUATION PROGRAM

GENERAL

The operating procedures prescribed in this volume represents the optimum method of operating F-4B aircraft. The Standardization Evaluation Check 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 Standardization Evaluation Check is tailored to satisfy the requirements of the various employment categories of F-4B squadrons and is intended to provide the flexibility necessary for implementation under most operating conditions. The check, whether performed by the Standardization Instructor or the Standardization Evaluator, is designed to aid the Unit Commanding Officer in improving individual/unit combat readiness through observation and constructive comments. The Standardization Evaluation Program is applicable to all pilots and RIO's maintaining a current flight status in any F-4B series aircraft. Areas to be observed/graded that are applicable to the individual pilot and RIO, 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.

Standardization evaluation checks will be administered to all pilots/RIO's as specified by current directives and in accordance with this section. Standardization checks and annual instrument checks will not be combined.

RESPONSIBILITIES

Specific responsibilities of Standardization Instructors and Standardization Evaluators in the implementation of the standardization 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 standardization program by flying with all squadron crewmembers as often as possible.
3. Administer the standardization evaluation check 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 standardization evaluation checks and standardization evaluation 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 standardization 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 standardization evaluation checks.

QUALIFIED

That desired professional standard demonstrated by a pilot/RIO 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/RIO 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/RIO 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.

STANDARDIZATION EVALUATION RECHECK

A standardization check administered to a pilot/RIO 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 check.

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 a Standardization 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 RIO:

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 Volume III 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 RIO 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 RIO's for the closed book examination. Emphasis should be placed on the information contained in the latest revisions to the NATOPS Flight Manual

(3 Volumes) and applicable portions of the NWP/NWIP series publications. The open book examination will be administered to pilots/RIO's a minimum of ten working-days prior to the flight evaluation. The open book examination for the pilot will consist of 175 questions selected from the questions contained in the Pilot's Question Bank and 25 questions on local course rules and/or squadron SOP. The open book examination for the RIO will consist of 175 questions selected from the questions contained in the RIO Question Bank and 25 questions on local course rules and/or squadron SOP. Open book examinations will not be administered by Evaluators conducting Standardization Evaluation Inspections.

CLOSED BOOK EXAMINATION (*)

The purpose of the closed book examination is to evaluate pilot and RIO knowledge of operating procedures, emergency procedures, and aircraft/weapons system limitations. The closed book examination will be administered to each pilot and RIO a maximum of four working-days prior to the flight evaluation. The closed book examination for the pilot and RIO will consist of a minimum of 50 questions. These questions will be selected from the questions contained in the pilot and RIO open book examinations. Closed book examinations administered by Evaluators conducting Standardization Evaluation Inspections will consist of 50 questions selected at random from the emergency procedures, aircraft limitations, and NATOPS procedures sections of the Pilot and RIO Question Banks.

WRITTEN EXAMINATION QUESTION BANKS

Pilot and RIO Question Banks and answer/reference lists are coordinated, up-dated, and distributed by the Evaluator of the command having cognizance over the model. Distribution is limited to 2 copies per squadron. The Question Banks are for use by Instructor/Evaluator personnel in preparing open and closed book examinations, in the oral examination, or the NAMT Systems Check. Desired changes or additions to the Question Banks should be forwarded direct to the Commanding Officer, VF-121.

WST/COT PROCEDURES CHECK

The Weapons System Trainer, if available, will be used to measure pilot and RIO efficiency in the execution of normal operating procedures, emergency procedures, intercept procedures, and crew duties. All emergencies and at least one malfunction will be given in the Start, Take-Off, Climb, Cruise/Intercept, 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 RIO 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 RIO 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
- Static Correction Off
- Radar CNI 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

(*) Critical Area

NAMT SYSTEMS CHECK

If desired by the individual squadron, Naval Air Maintenance Trainer facilities may be utilized to evaluate pilot and RIO knowledge of aircraft systems and normal and emergency procedures. Questions contained in the Pilot and RIO Question Bank should be used exclusively where the NAMT System Check and the Oral Examination are combined.

FLIGHT EVALUATION

GENERAL

The Flight Evaluation Check may be conducted on any routine syllabus flight with the exception of flights launched for MLP/CARQUAL or ECCM training. The flight will be flown under day VFR conditions. Emergencies will not be simulated.

OPERATIONAL DEPLOYABLE SQUADRONS

Pilots and RIO'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. RIO 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/RIO 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 standardization instructor/evaluator conducting the flight evaluation from the rear seat. A RIO may be individually checked by flying with the standardization instructor/evaluator as his crewmember.

FLIGHT EVALUATION CHECK AREAS

The areas and sub-areas in which pilots and RIO'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/RIO)
b. Briefing (Pilot/RIO)
c. Personal Flying Equipment (*) (Pilot/RIO)

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/RIO)
b. Before Taxiing Procedures (Pilot)

TAKE-OFF

The take-off is considered complete with the transition to the clean condition.

a. ATC Clearance (Pilot)
b. Take-Off (*) (Pilot)

DEPARTURE

Departure is that portion of the flight which commences after the take-off 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 intercept missions covered in the NATOPS Flight Manual, F-4B (F4H) Weapon System Tactical Handbook, and NWP/NWIP's for which standardized procedures/techniques have been developed.

a. Formation - Leader (Pilot)
b. Formation - Wingman (Pilot)
c. Search (RIO)
d. Lock-on (RIO)
e. Commentary (RIO)
f. Response to Commentary (Pilot)
g. Conversion (*) (RIO)
h. Breakaway (*) (Pilot/RIO)

(*) Critical Area

i. Re-Attack (*) (Pilot/RIO)
j. Aim Dot Flying (Pilot)
k. Crew Duties (*) (Pilot/RIO)

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. Missed Approach (*) (Pilot)
g. VFR Recovery (Pilot)

COMMUNICATIONS

a. R/T Procedures (Pilot/RIO)
b. Visual Signals (Pilot/RIO)
c. IFF/SIF Procedures (Pilot)

EMERGENCY/MALFUNCTION PROCEDURES (*)

In this area, the pilot/RIO will be evaluated only in the case of actual emergencies.

POST-FLIGHT PROCEDURES

a. Taxi-in (Pilot)
b. Shutdown (Pilot/RIO)
c. Inspection and Records (Pilot/RIO)
d. Flight Debriefing (Pilot/RIO)

APPLICABLE PUBLICATIONS

The 3 volumes of the NATOPS Flight Manual contains the standard operations criteria for F-4B aircraft. Publications relating to environmental procedures peculiar to shorebased and shipboard operations and tactical missions are listed below:

Weapon System Tactical Handbook

NWP's

NWIP's

ATC/CATCC Manual

Local Air Operations Manual

Carrier Air Operations Manual

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/RIO)

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/RIO)

Qualified	Exterior inspection completed in accordance with NATOPS Essential Checklist, with no more than two minor errors. Demonstrates thorough knowledge of inspection requirements.
Conditionally Qualified	Exterior inspection completed in accordance with NATOPS Essential Checklist with more than two minor errors, but demonstrates adequate knowledge of inspection requirements.

(*) Critical Area

EXTERIOR INSPECTION (PILOT/RIO) CONTINUED

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 /RIO)

Qualified	Completes checks in accordance with the NATOPS Essential Checklist with no errors or omissions and informs his crewmember that checks are completed.
Unqualified	Omits one or more items on the NATOPS Essential Checklists.

AIRCRAFT SERVICING (PILOT/RIO)

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/RIO)

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.
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/RIO)

Qualified	Correctly computed take-off distance and bingo fuel for correct gross weight and configuration, using the performance data contained in Volume III, NAVWEPS 01-245FDB-1A.
Unqualified	Computed bingo fuel with error in excess of 200 pounds. Computed take-off distance with error in excess of + 500 feet and/or used wrong gross weight or configuration.

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/RIO)

Qualified	Completes examination with a minimum grade of 3.3.

CLOSED BOOK EXAMINATION (*) (PILOT/RIO)

Qualified	Completes examination with a minimum grade of 3.5.

(*) Critical Area

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/RIO)

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/RIO)

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.

CREW DUTIES (*) (PILOT/RIO)

Qualified	Demonstrates knowledge of crew responsibility in the specific intercept areas outlined in the NATOPS Flight Manual. Coordinated completion of required checklists, communications, and intercept 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 intercept areas outlined in the NATOPS Flight Manual. Coordinated completion of required checklists, communications, and intercept procedures with the appropriate crewmember. Minor errors or omissions degraded crew coordination but did not compromise safety or the success of the mission/intercept.
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/intercept is compromised.

WEAPON SYSTEM STATUS (PILOT/RIO)

Qualified	Completes prescribed weapon/BIT checks, analyzes optimum weapon attack procedures/weapon system capability.
Conditionally Qualified	Completes prescribed weapon/BIT checks, analyzes weapon system capability with minor errors and/or selection of optimum attack/weapon in error but did prescribe a successful attack.

(*) Critical Area

WEAPON SYSTEM STATUS (PILOT/RIO) CONTINUED

Unqualified	Does not complete weapon/BIT checks, or does not inform the appropriate crewmember of the status or limitations of the weapon system.

SEARCH (RIO)

Qualified	Minor discrepancies in technique to insure maximum utilization of equipment. Demonstrated an acceptable knowledge of scope presentation. Intercept was completed successfully.
Conditionally Qualified	Used undependable technique resulting in marginal utilization of equipment and/or was confused with scope presentation, but intercept was successfully completed.
Unqualified	Used unacceptable technique and/or faulty scope interpretation, resulting in an unsuccessful intercept.

LOCK-ON (RIO)

Qualified	Minor discrepancies noted in lock-on technique. Intercept was completed successfully.
Unqualified	Missed intercept or did not achieve lock-on due to operator technique.

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 (RIO)

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/RIO)

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.

CONVERSION/RE-ATTACK (RIO)

Qualified	Recognizes the capability for re-attack and makes positive conversion to accomplish the attack/re-attack in the minimum amount of time. Informs the appropriate crewmember of the intended maneuver and/or weapon to be utilized.

CONVERSION/RE-ATTACK (RIO) CONTINUED

Conditionally Qualified	Slow in recognizing that re-attack capability exists, but takes positive action to accomplish re-attack without jeopardizing the initial attack.
Unqualified	Sacrifices initial attack in attempting to convert for re-attack.

AIM DOT FLYING (PILOT)

Qualified	Makes smooth positive corrections. Aim dot inside ASE circle at IN RANGE.
Conditionally Qualified	Makes smooth positive corrections. Aim dot is not inside ASE circle at IN RANGE but is within limits prior to minimum range.
Unqualified	Rough erratic corrections and/or aim dot is outside ASE circle at IN RANGE. Possibility of successful firing doubtful.

BREAKAWAY (PILOT/RIO)

Qualified	Breakaway maneuver directed and executed so as not to endanger the aircraft or crew.
Unqualified	Did not direct or execute breakaway maneuver on any one intercept and/or the maneuver performed would have endangered the aircraft or crew.

FLIGHT EVALUATION GRADING CRITERIA

The evaluation flight check 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 check may be conducted on any syllabus flight with the exception of flights launched for MLP/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 check. The criteria for determining area/sub-area adjectival ratings is outlined in the following paragraphs:

MISSION PLANNING/BRIEFING

Flight Planning (Pilot/RIO)

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. LID/IFR departure procedures and routes are obtained, if required, and take-off/climb planned accordingly.
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 possible prevent successful completion of the mission.

Briefing (Pilot/RIO)

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/RIO)

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/RIO)

Qualified	Checks the ten previous yellow sheets (if available) for previous discrepancies and corrective action taken. Checks fuel load, armament load, 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.

TAKE-OFF

ATC Clearance (Pilot)

Qualified	Requires minimum transmissions to understand clearance. Reads back correctly.
Conditionally Qualified	Requires 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.

(*) Critical Area

Take-off (*) (Pilot)

Qualified	Receives and acknowledges take-off 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 condition 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 take-off 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, transition, 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/Tract, 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.
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.

(*) Critical Area

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 take-off, 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 committed.
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 take-off, 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.

Search (RIO) (Team RIO if Scope Camera Film is Available)

Qualified	Minor discrepancies in technique but displayed an acceptable knowledge of scope presentation. Intercept was completed successfully.
Conditionally Qualified	Used undependable technique resulting in marginal utilization of equipment and/or was confused with scope presentation. Intercept was successfully completed.
Unqualified	Used unacceptable technique for equipment utilization and/or faulty scope interpretation resulted in an unsuccessful intercept.

Lock-On (RIO) (Team RIO if Scope Camera Film is Available)

Qualified	Minor discrepancies noted for lock-on technique predicated on target environment, tactics used, etc.
Conditionally Qualified	Used undependable lock-on technique predicated on target environment, tactics used, etc; however, the intercept was completed successfully.
Unqualified	Missed intercept/did not achieve lock-on due to operator technique.

Commentary (RIO)

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 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 configuration or breakaway, overshoot, and compass recovery procedures.

Conversion (*) (RIO)

Qualified	Recognized a need for conversion and completed it successfully.
Conditionally Qualified	Slow in recognizing a need for conversion and had difficulty in positioning for a successful intercept.
Unqualified	Failed to recognize a need for conversion in time to complete a successful intercept.

Breakaway (*) (Pilot/RIO)

Qualified	Breakaway maneuver directed and executed so as not to endanger the aircraft or crew.
Unqualified	Did not direct or execute breakaway maneuver on any one intercept and/or the maneuver performed would have endangered the aircraft or crew.

Re-Attack (*) (RIO)

Qualified	Recognizes the capability for re-attack and makes positive conversion to accomplish the re-attack in the minimum amount of time.
Conditionally Qualified	Slow in recognizing that re-attack capability exists but takes positive action to accomplish re-attack without jeopardizing the initial attack.
Unqualified	Sacrifices initial attack in attempting to convert for reattack.

Aim Dot Flying (Pilot) (Team Pilot if Scope Camera Film is Available)

Qualified	Makes smooth positive corrections. Aim dot inside ASE circle at IN RANGE.
Conditionally Qualified	Makes smooth positive corrections. Aim dot inside ASE circle prior to minimum range.
Unqualified	Aim dot outside ASE circle. Possibility of successful firing doubtful.

Crew Duties (*) (Pilot/RIO)

Qualified	Demonstrates knowledge of crew responsibility in the specific intercept areas as outlined in the NATOPS Flight Manual. Coordinated completion of required checklists, communications, and intercept 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 intercept areas as outlined in the NATOPS Flight Manual. Coordinated completion of required checklists, communications, and intercept procedures with the appropriate crewmember. Minor errors or omissions degraded crew coordination but did not compromise safety or the success of the mission/intercept.
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/intercept is compromised.

(*) Critical Area

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.
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".

(*) Critical Area

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 approach, maintains glide-slope 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".
Unqualified	Deviations and omissions from procedures/instructions and/or checks that jeopardized flight safety, or a missed approach/wave-off 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.

Missied Approach (*) (Pilot)

Qualified	Follows missed approach/wave-off/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 and 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.

(*) Critical Area

COMMUNICATIONS

R/T Procedures (Pilot /RIO)

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.
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/RIO)

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".

(*) Critical Area

POSTFLIGHT PROCEDURES AND DEBRIEFING

Taxi, Shutdown, Inspection, and Records (Pilot /RIO)

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.

Flight Debriefing (Pilot/RIO)

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.
Qualified	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 Standardization Evaluation Check will be determined by the evaluator/instructor and recorded on the Standardization 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/RIO (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/RIO (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/RIO (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/RIO 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:

2 - Qualified

1 - Conditionally Qualified

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 - 1.09	Unqualified
1.1 - 1.49	Conditionally Qualified
1.5 - 2.0	Qualified

EXAMPLE:

Sub-area numerical values

$$\frac{2+2+1+2+1}{5} = \frac{8}{5} = 1.6 = \text{Qualified}$$

MINIMUM GRADES

The minimum grades established for the Standardization Evaluation Check are as follows:

Oral Examination - Conditionally Qualified

Written Examination:

a. Open Book - 3.3
b. Closed Book - 3.5

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 Standardization 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

Two copies each of the Standardization Evaluation Worksheets and Report are provided initially on an evaluation basis. These forms may be removed from the manual (belonging to the individual being evaluated) and used by the evaluator/instructor during the actual phases of the evaluation check. The forms may also be used as basic-artwork for commercial reproduction (local or GPO printing) or as a guide for in-house reproduction.

WORKSHEETS

The Written/Oral Examination Worksheet (figure 8-1), the WST/COT Procedures Worksheet (figure 8-2), the WST/COT Operator's Worksheet (figure 8-3), and the Flight Evaluation Worksheet (figure 8-4) will be used, as applicable, in administering all phases of the standardization evaluation check. Specific results of individual parts of the standardization evaluation check which points out deficiencies in the level of required pilot/RIO 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 Standardization Evaluation Report and in preparing the critique.

REPORT FORM

The Standardization Evaluation Report form (figure 8-5) will be used to report the complete results of the Standardization Evaluation Check. 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 RIO 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.

RECORDS

The Standardization Evaluation Report (figure 8-5) 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 a Standardization Evaluation Check, an entry to that effect will be made on the "Qualification and Achievements" page of the pilot's/RIO's Flight Log Book. An example of this entry is as follows:

F-4B STANDARDIZATION EVALUATION CHECK

Date ____________ Signature ______________

CRITIQUE

The critique is the terminal point in the Standardization 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 Standardization 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/RIO will receive the completed copy of the Standardization Evaluation Report for certification and signature. The completed Standardization Evaluation Report will then be presented to the Unit Commanding Officer.

WRITTEN/ORAL EXAMINATION WORKSHEET
F-4B (F4H) AIRCRAFT

WRITTEN EXAMINATION
PILOT/RIO

1. Open Book Exam Grade
2. Closed Book Exam Grade

NAMT SYSTEMS CHECK
PILOT/RIO

	U	CQ	Q
	☐	☐	☐

ORAL EXAMINATION
PILOT/RIO

	U	CQ	Q
	☐	☐	☐
1. Aircraft Systems	☐	☐	☐
2. Exterior Inspection	☐	☐	☐
3. Interior Inspection	☐	☐	☐
4. Light and Hand Signals	☐	☐	☐
5. Aircraft Servicing	☐	☐	☐
6. Computation of Performance Data	☐	☐	☐

All grades of "Unqualified" must be accompanied with detailed comments.

REMARKS:

Figure 8-1 (Sheet 1)

WST/COT PROCEDURES WORKSHEET
F-4B (F4H) AIRCRAFT

WST/COT PROCEDURES CHECK PILOT/RIO	U ☐	CQ ☐	Q ☐
1. Normal Procedures: Pilot/RIO Pre-Start, Start, Poststart, Systems Checks	☐	☐	☐
2. Emergency Procedures (Pilot/RIO)	☐	☐	☐
3. Crew Duties (Pilot/RIO)	☐	☐	☐
4. Weapons System Status (Pilot/RIO)	☐	☐	☐
5. Search (RIO)	☐	☐	☐
6. Lock-on (RIO)	☐	☐	☐
7. Commentary (RIO)	☐	☐	☐
8. Response to commentary (Pilot)	☐	☐	☐
9. R/T Procedures (Pilot/RIO)	☐	☐	☐
10. Conversion/Re-Attack (RIO)	☐	☐	☐
11. Aim dot flying (Pilot)	☐	☐	☐
12. Breakaway (Pilot/RIO)	☐	☐	☐

All grades of "Unqualified' must be accompanied with detailed comments.

REMARKS:

Figure 8-2 (Sheet 1)

WRITTEN/ORAL EXAMINATION WORKSHEET F-4B (F4H) AIRCRAFT

WRITTEN EXAMINATION
PILOT/RIO

1. Open Book Exam Grade
2. Closed Book Exam Grade

NAMT SYSTEMS CHECK
PILOT/RIO

	U	CQ	Q
	☐	☐	☐

ORAL EXAMINATION
PILOT/RIO

	U	CQ	Q
	☐	☐	☐
1. Aircraft Systems	☐	☐	☐
2. Exterior Inspection	☐	☐	☐
3. Interior Inspection	☐	☐	☐
4. Light and Hand Signals	☐	☐	☐
5. Aircraft Servicing	☐	☐	☐
6. Computation of Performance Data	☐	☐	☐

All grades of "Unqualified" must be accompanied with detailed comments.

REMARKS:

Figure 8-1 (Sheet 2)

WST/COT PROCEDURES WORKSHEET
F-4B (F4H) AIRCRAFT

WST/COT PROCEDURES CHECK
PILOT/RIO

	U	CQ	Q
1. Normal Procedures: Pilot/RIO Pre-Start, Start, Poststart, Systems Checks	☐	☐	☐
2. Emergency Procedures (Pilot/RIO)	☐	☐	☐
3. Crew Duties (Pilot/RIO)	☐	☐	☐
4. Weapons System Status (Pilot/RIO)	☐	☐	☐
5. Search (RIO)	☐	☐	☐
6. Lock-on (RIO)	☐	☐	☐
7. Commentary (RIO)	☐	☐	☐
8. Response to commentary (Pilot)	☐	☐	☐
9. R/T Procedures (Pilot/RIO)	☐	☐	☐
10. Conversion/Re-Attack (RIO)	☐	☐	☐
11. Aim dot flying (Pilot)	☐	☐	☐
12. Breakaway (Pilot/RIO)	☐	☐	☐

All grades of "Unqualified' must be accompanied with detailed comments.

REMARKS:

Figure 8-2 (Sheet 2)

WST/COT OPERATOR'S WORKSHEET
F-4B (F4H) AIRCRAFT

The evalutor/instructor will fill-in intercept conditions and emergencies or malfunctions to be simulated during the start, take-off, climb/cruise, intercept, and recovery phase.

INTERCEPT CONDITIONS

1. Aircraft Configuration (tanks/missiles)
2. Type Intercept
3. Target Altitude/Speed
4. Fighter Altitude/Speed
5. Armament Loading

EMERGENCIES AND MALFUNCTIONS

1. Start:
2. Take-Off:
3. Climb/Cruise:
4. Intercept:
5. Recovery:

Figure 8-3 (Sheet 1)

REMARKS:

WST/COT OPERATOR'S WORKSHEET
F-4B (F4H) AIRCRAFT

The evalutor/instructor will fill-in intercept conditions and emergencies or malfunctions to be simulated during the start, take-off, climb/cruise, intercept, and recovery phase.

INTERCEPT CONDITIONS

1. Aircraft Configuration (tanks/missiles)
2. Type Intercept
3. Target Altitude/Speed
4. Fighter Altitude/Speed
5. Armament Loading

EMERGENCIES AND MALFUNCTIONS

1. Start:
2. Take-Off:
3. Climb/Cruise:
4. Intercept:
5. Recovery:

Figure 8-3 (Sheet 2)

REMARKS:

FLIGHT EVALUATION WORKSHEET
F-4B (F4H) AIRCRAFT
Pilot/RIO/Team

1. FLIGHT PLANNING:

2. BRIEFING: (List items missed)

3. PERSONAL FLYING EQUIPMENT: (List items missing, overdue for inspection, or unserviceable)

4. AIRCRAFT ACCEPTANCE: (List items missed)

5. PRETAXI PROCEDURES: (List non-standard procedures)

6. TAKE-OFF:
ATC Clearance: ________ Configuration ________
Lift-off speed ________ Gear-up speed ________

7. DEPARTURE: (List deviations from procedures)
VFR:
IFR:

8. CLIMB & LEVEL-OFF:
5____10____15____20____25____30____35____40____
Level-off Alt Briefed/Assigned ________ Actual ________

9. RENDEZVOUS:

10. ENROUTE VFR / IFR: (Outbound)
Formation lead/wingman:
R/T procedures/visual signals:
Basic air work:

11. INTERCEPT:

	1	2	3	4	REMARKS
R/T procedures					
Detection RNG					
Commentary					
Response to commentary					
Completed to FOX 1					
Re-attack					
Completed to FOX 2					
Breakaway					
Conversion					
Aim Dot flying					

Figure 8-4 (Sheet 1)

12. **ENROUTE VFR / IFR:** (Inbound)
Formation (leader/wingman):
R/T procedures/visual signals:
Basic air work:

13. **HOLDING:** Entry ________ Assigned Alt ________
Actual ________ Airspeed ________ EAT ________ AAT ________
Remarks:

14. **PENETRATION:** Configuration ________ Airspeed ________
Remarks:

15. **LOW APPROACH GCA:** Final approach speed ________
Line-up/track ________ Level-off Alt ________
Glide path

16. **MISSED APPROACH:** Speed ________
Minimum Alt Deviation ________ Clearance: ________
Remarks:

17. **GCA BOX PATTERN:** Alt Assigned ________
Dev ________ Downwind speed ________ Base leg speed ________
Final app spd ________ Glide path ________ Line-up ________

18. **VFR RECOVERY:** (List deviations from local course rules)

19. **POSTFLIGHT PROCEDURES:**

20. **CREW DUTIES:** (List errors throughout flight as applicable to individual Pilot/RIO)

21. **IFF/SIF PROCEDURES:** (List errors throughout flight)

22. **EMERGENCY/MALFUNCTION:** (Comment on if applicable)

FLIGHT EVALUATION WORKSHEET
F-4B (F4H) AIRCRAFT
Pilot/RIO/Team

1. FLIGHT PLANNING:

2. BRIEFING: (List items missed)

3. PERSONAL FLYING EQUIPMENT: (List items missing, overdue for inspection, or unserviceable)

4. AIRCRAFT ACCEPTANCE: (List items missed)

5. PRETAXI PROCEDURES: (List non-standard procedures)

6. TAKE-OFF:
ATC Clearance: ______ Configuration ______
Lift-off speed ______ Gear-up speed ______

7. DEPARTURE: (List deviations from procedures)
VFR:
IFR:

8. CLIMB & LEVEL-OFF:
5____ 10____ 15____ 20____ 25____ 30____ 35____ 40____
Level-off Alt Briefed/Assigned ______ Actual ______

9. RENDEZVOUS:

10. ENROUTE VFR / IFR: (Outbound)
Formation lead/wingman:
R/T procedures/visual signals:
Basic air work:

11. INTERCEPT:	1	2	3	4	REMARKS
R/T procedures					
Detection RNG					
Commentary					
Response to commentary					
Completed to FOX 1					
Re-attack					
Completed to FOX 2					
Breakaway					
Conversion					
Aim Dot flying					

Figure 8-4 (Sheet 1)

FLIGHT EVALUATION WORKSHEET
F-4B (F4H) AIRCRAFT
Pilot/RIO/Team

1. FLIGHT PLANNING:

2. BRIEFING: (List items missed)

3. PERSONAL FLYING EQUIPMENT: (List items missing, overdue for inspection, or unserviceable)

4. AIRCRAFT ACCEPTANCE: (List items missed)

5. PRETAXI PROCEDURES: (List non-standard procedures)

6. TAKE-OFF:
ATC Clearance: ________ Configuration ________
Lift-off speed ________ Gear-up speed ________

7. DEPARTURE: (List deviations from procedures)
VFR:
IFR:

8. CLIMB & LEVEL-OFF:
5____10____15____20____25____30____35____40____
Level-off Alt Briefed/Assigned ________ Actual ________

9. RENDEZVOUS:

10. ENROUTE VFR/IFR: (Outbound)
Formation lead/wingman:
R/T procedures/visual signals:
Basic air work:

11. INTERCEPT:

	1	2	3	4	REMARKS
R/T procedures					
Detection RNG					
Commentary					
Response to commentary					
Completed to FOX 1					
Re-attack					
Completed to FOX 2					
Breakaway					
Conversion					
Aim Dot flying					

Figure 8-4 (Sheet 2)

12. ENROUTE VFR/IFR: (Inbound)
Formation (leader/wingman):
R/T procedures/visual signals:
Basic air work:

13. HOLDING: Entry ____________ Assigned Alt ____________
Actual ____________ Airspeed ________ EAT ________ AAT ________
Remarks:

14. PENETRATION: Configuration ____________ Airspeed ________
Remarks:

15. LOW APPROACH GCA: Final approach speed ____________
Line-up/track ____________ Level-off Alt ____________
Glide path

16. MISSED APPROACH: Speed ____________
Minimum Alt Deviation ____________ Clearance: ________
Remarks:

17. GCA BOX PATTERN: Alt Assigned ____________
Dev ________ Downwind speed ________ Base leg speed ________
Final app spd ________ Glide path ________ Line-up ________

18. VFR RECOVERY: (List deviations from local course rules)

19. POSTFLIGHT PROCEDURES:

20. CREW DUTIES: (List errors throughout flight as applicable to individual Pilot/RIO)

21. IFF/SIF PROCEDURES: (List errors throughout flight)

22. EMERGENCY/MALFUNCTION: (Comment on if applicable)

STANDARDIZATION EVALUATION REPORT F-4B (F4H) AIRCRAFT									
NAME	RANK				FILE NUMBER			ACTIVITY	
TYPE OF CHECK					OVERALL GRADE			DATE OF CHECK	
PILOT ☐ RIO ☐ 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				
WEAPON SYSTEM STATUS					VFR DEPARTURE				
SEARCH					RENDEZVOUS				
LOCK-ON					CLIMB & LEVEL-OFF				
RESPONSE TO COMMENTARY					IFR PROC. ENROUTE				
COMMENTARY					VFR PROC. ENROUTE				
R/T PROCEDURES					FORMATION - LEADER				
CONVERSION/RE-ATTACK					FORMATION - WINGMAN				
AIM DOT FLYING					RESPONSE TO COMMENTARY				
BREAKAWAY					*BREAKAWAY				
RIO FLIGHT EVALUATION	**Q**	**CQ**	**U**	**NA**	AIM DOT FLYING				
					*CREW DUTIES				
FLIGHT PLANNING					HOLDING				
BRIEFING					EXPECTED APPROACH TIME				
PERSONAL FLYING EQUIP.					*PENETRATION				
AIRCRAFT ACCEPTANCE					*LOW APPROACH				
SEARCH					*GCA/CCA				
LOCK-ON					* MISSED APPROACH				
COMMENTARY					VFR RECOVERY				
* CONVERSION					R/T PROCEDURES				
* BREAKAWAY					VISUAL SIGNALS				
* RE-ATTACK					IFF/SIF PROCEDURES				
* CREW DUTIES					*EMERGENCY/MALFUNCTIONS				
R/T PROCEDURES					POSTFLIGHT PROCEDURES				
* EMERG/MALFUNCTIONS									
POSTFLIGHT PROCEDURES									
NAME, RANK, ACTIVITY OF NATOPS EVALUATOR/INSTRUCTOR					SIGNATURE OF PILOT/RIO EVALUATED				

* CRITICAL AREA

Figure 8-5 (Sheet 1)

REMARKS:

STANDARDIZATION EVALUATION REPORT
F-4B (F4H) AIRCRAFT

NAME	RANK	FILE NUMBER	ACTIVITY

TYPE OF CHECK	OVERALL GRADE	DATE OF CHECK
PILOT ☐ RIO ☐ ANNUAL ☐ RE-CHECK ☐ OTHER ☐	Q ☐ CQ ☐ U ☐	

GROUND EVALUATION	Q	CQ	U	NA
OPEN BOOK EXAMINATION				
* CLOSED BOOK EXAMINATION				
ORAL EXAMINATION				
WST/COT PROCEDURES				
NORMAL PROCEDURES				
* EMERGENCY PROCEDURES				
* CREW DUTIES				
WEAPON SYSTEM STATUS				
SEARCH				
LOCK-ON				
RESPONSE TO COMMENTARY				
COMMENTARY				
R/T PROCEDURES				
CONVERSION/RE-ATTACK				
AIM DOT FLYING				
BREAKAWAY				

RIO FLIGHT EVALUATION	Q	CQ	U	NA
FLIGHT PLANNING				
BRIEFING				
PERSONAL FLYING EQUIP.				
AIRCRAFT ACCEPTANCE				
SEARCH				
LOCK-ON				
COMMENTARY				
* CONVERSION				
* BREAKAWAY				
* RE-ATTACK				
* CREW DUTIES				
R/T PROCEDURES				
* EMERG/MALFUNCTIONS				
POSTFLIGHT PROCEDURES				

PILOT FLIGHT EVALUATION	Q	CQ	U	NA
FLIGHT PLANNING				
BRIEFING				
* PERSONAL FLYING EQUIP.				
AIRCRAFT ACCEPTANCE				
PRETAXI PROCEDURES				
ATC CLEARANCE				
* TAKE-OFF				
* IFR DEPARTURE				
VFR DEPARTURE				
RENDEZVOUS				
CLIMB & LEVEL-OFF				
IFR PROC. ENROUTE				
VFR PROC. ENROUTE				
FORMATION - LEADER				
FORMATION - WINGMAN				
RESPONSE TO COMMENTARY				
* BREAKAWAY				
AIM DOT FLYING				
* CREW DUTIES				
HOLDING				
EXPECTED APPROACH TIME				
* PENETRATION				
* LOW APPROACH				
* GCA/CCA				
* MISSED APPROACH				
VFR RECOVERY				
R/T PROCEDURES				
VISUAL SIGNALS				
IFF/SIF PROCEDURES				
* EMERGENCY/MALFUNCTIONS				
POSTFLIGHT PROCEDURES				

NAME, RANK, ACTIVITY OF NATOPS EVALUATOR/INSTRUCTOR	SIGNATURE OF PILOT/RIO EVALUATED

* CRITICAL AREA

Figure 8-5 (Sheet 2)

REMARKS:

ALPHABETICAL INDEX

A

B

C

D

E

*Indicates Illustration

*Indicates Illustration

O

P

R

S

*Indicates Illustration

T

V

W

*Indicates Illustration

NAVY, Universal Prtg. Co., St. Louis, Mo.—2000