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NAVAER 01-60JKD-501

Flight Handbook

NAVY MODELS

FJ-4 • FJ-4B

AIRCRAFT

THIS PUBLICATION TO BE USED IN CONJUNCTION WITH SUPPLEMENTAL FLIGHT HANDBOOK NAVAER 01-60JKD-501A FOR NAVY MODELS FJ-4 AND FJ-4B AIRCRAFT

PUBLISHED BY DIRECTION OF
THE CHIEF OF THE BUREAU OF AERONAUTICS

1 October 1957
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INTERIM REVISION SUMMARY

The following Interim Revisions have been either canceled or incorporated in this Flight Handbook:

Canceled or Previously Incorporated	*Incorporated in This Revision on Pages Indicated*
No. 1	No. 12 Pages 5, 67 and 74
No. 2	
No. 3	
No. 4	
No. 5	
No. 6	
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No. 10	
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INTERIM REVISIONS OUTSTANDING: (to be maintained by custodian of Flight Handbook)

Number	*Date*	*Purpose*

HAGGARD

NAVAER 01-60JKD-501
16 MAY 1958

FLIGHT HANDBOOK INTERIM REVISION No. 9

Navy Model F J -4 -4 B Aircraft

PUBLISHED BY DIRECTION OF THE CHIEF OF THE BUREAU OF AERONAUTICS

Of paramount interest to pilots. To be read by all pilots operating these aircraft

1. Cancellation: None.

2. Purpose: To promulgate operational information concerning the POLAR PATH COMPASS SYSTEM, effective on all Model FJ4 and FJ4B Airplanes.

3. The following change is made to NAVAER 01-60 JKD-501, Flight Handbook, Navy Model FJ-4- 4B Aircraft of 1 October 1957 revised 15 January 1958.

   a. Section IV Navigation Equipment, pages 102 through 105. Under the heading entitled POLAR PATH COMPASS SYSTEM, retain all figures and replace all paragraphs with the following:

POLAR PATH COMPASS SYSTEM

The polar path compass system (figure 4-10) has been designed to furnish continuous, accurate directional reference under normal flight conditions regardless of latitude. Through provisions on the console controller panel (10, figure 4-10), the pilot may select different modes of operation, dependent upon the navigational requirements and the magnetic effects of the terrain where the flight is conducted. Compass headings during flights in areas of established and constant magnetic force should utilize the "SLAVED" mode of operation in order to obtain precise heading from the long period accuracy of the magnetic sensing element coupled with the short period stabilization of the directional gyro component. Flights conducted in areas rapidly converging meridians or changing magnetic forces should normally employ the "DG" or directional gyro mode of operation. The "DG" mode is reliable throughout maneuvers where the airplanes pitch and roll angles do not exceed 70°.

WARNING

> During violent maneuvers pitch and roll angles greater than 70°, the compass system is unreliable in any mode. For compass reliability switch to the "SLAVED" mode and synchronize the system through the use of the synchronizing knob upon completion of the violent maneuver and when the airplane has returned to relatively straight and level flight.

Flights at latitudes and areas where magnetic sensing is reliable will normally employ the "SLAVED" mode of operation which incorporates the stability of the directional gyro combined with the magnetic feature of the flux-gate type compass. The "SLAVED" mode is incorporated to alleviate the necessity for constant manual resetting of a directional gyro while in relatively straight and level flight. To provide a stand-by method for emergency flight use, where compass headings alone are desired, selection of the "COMP" mode of operation may be utilized. The "COMP" mode is subject to short term errors due to local magnetic fluctuations and aircraft maneuvers where the angle of pitch or bank is greater than 20 degrees.

NOTE

> The "COMP" mode should be used only in those cases where components of other operational modes have been damaged or have failed.

The polar path compass system includes a miniature flux gate transmitter, a directional gyro a compass coupler and a console controller panel. These components transmit signals to the radio magnetic course indicator (9, figure 4-10) located on the instrument panel. The console controller panel (10, figure 4-10) is located on the right console and contains all of the controls necessary for the operation of the polar path compass system.

CONSOLE CONTROLLER PANEL

The console controller panel (10, figure 4-10) includes a mode of operation selection switch (D.G. - SLAVED - COMP) (5, figure 4-10), as latitude set (LATITUDE) knob and dial (4, figure 4-10), a course setting (COURSE SET - L, R, - PUSH TURN) knob (6, figure 4-10), a synchronizing knob (PUSH - SYNC) (7, figure 4-10), and annunciator (synchronizing) indicator (L, R), (8, figure 4-10).

MODE SELECTOR SWITCH

Three modes of operation are available to provide the pilot with the desired type of compass directional reference:

NOTE

For all modes of operation, the directional heading is indicated on the rotating compass card of the ID-250A/ARN radio magnetic course indicator (9, figure 4-10)

1. The "D.G" mode of operation uses only the directional gyro to supply heading information. The "D.G." mode may be selected in areas where the earth's magnetic field is unreliable and for navigation techniques such as grid navigation. From this position selection the direction gyro transmits stabilized electrical impuluses through the compass coupler autosyn system to the radio magnetic course indicator. To convert these impulses to a selected heading the pilot must use the COURSE SET - L.R. - PUSH - TURN knob until the desired heading is indicated on the radio magnetic course indicator. In order to maintain the desired heading and to correct automatically for apparent drift due to the turning effect on the earth, the flight latitude must be "set in" through use of the latitude (LATITUDE) knob and dial assembly which is calibrated in degrees. The drift correction will then be maintained by the compass system and reliable headings will be presented throughout maneuvers where the airplane pitch and roll angles do not exceed 70 degrees.

NOTE

The latitude knob and dial should be adjusted whenever the latitude has changed more than 5 degrees.

The Polar Path Directional Gyro as with other directional gyros systems may have instantaneous gimbal turning errors. Normally the gyro spin axis and the associated two gimbals arrangement are mutually perpendicular. However, as the gimbals rotate in a turn, perpendicularity may be compromised. This movement introduces an apparent change in the heading information during turns which is commonly known as "gimbal error". Turn error results from the combined action of the aforementioned gimballing errors and the tendency of the pendulous erection system to precess the directional gyro spin axis from the horizontal plane. The magnitude of instantaneous error is based on bank angle and amount of turn introduced. If the maneuver is such that the gyro hits the gimbal stops, which are approximately $\pm 89^{\circ}$, the gyro will tumble and an error of 5 to 7 degrees can be realized. Upon completion of such a maneuver and when in straight and level flight, the selector switch should be switched to the "SLAVED" mode and the annunciator monitored. If the indicator shows an error the system should be corrected by resynchronizing the system then returning to the "D.G." mode.

2. The SLAVED switch position uses the directional gyro and flux gate compass transmitter to supply heading information. In those latitudes where magnetic sensing is reliable and a gyro stabilized magnetic type compass is desired the "SLAVED" position may be selected. This mode of operation has the directional gyro serving as a short-term directional reference to the magnetic heading and this information is slowly and continuously corrected for drift by the long term magnetic heading information from the flux gate transmitter. Should aircraft heading be different than the magnetic heading as will normally be the case following selection (either on the ground or during flight) the compass system will synchronize the radio magnetic course indicator to the aircraft's magnetic heading. Synchronization through the compass system will take place at the normal or "slow slaving" rate (approximately 1/2 degree per minute) To speed up the synchronization rate so that the cycle will be completed in about 20 seconds, the pilot may depress the PUSH-SYNC knob on the console controller panel and observe the annunciator (synchronizer) indicator. As synchronization is achieved the annunicator needle will normally oscillate about the center position due to the normal vibration and turbulence of the aircraft or to the nulling conditions of the system circuitry. Synchronization is also indicated when the radio magnetic course indicator compass card ceases to move and settles on a heading comparable with the standby magnetic compass. At this point the PUSH-SYNC knob should be released. An alternate method of synchronization is for the pilot to depress and turn the course set knob until the annunciator needle is approximately centered or nulled. If after certain ground or flight maneuvers the annunciator needle remains for several minutes to the right or left of center, the pilot should depress the PUSH-SYNC knob. The "SLAVED" system will then be re-synchronized to the aircraft's magnetic heading. At tilt angles greater than 20 degrees, the flux gate transmitter is subject to error; when this occurs the directional gyro attempts to align itself with the incorrect magnetic reference. At this time the annunciator needle will appear to the right or left of center. Corrective action should be taken by the pilot to resynchronize the system to the aircraft's magnetic heading.

NOTE

During operations with the SLAVED position selected, the latitude knob and dial perform no system function.

3. The third position on the selector switch is the "COMP" position. Selection of the compass (COMP) mode of operation provides an unstabilized magnetic heading presentation on the radio magnetic course indicator. This heading presentation is that of a basic flux gate compass and is provided as an emergency system for use in those cases where components of the other mode selections have been damaged or have failed.

COURSE SETTING KNOB (COURSE SET - L, R - PUSH-TURN)

The course setting knob is provided for manual rotation, left or right of the heading presentation card on the radio magnetic course indicator. The course set knob is used in conjunction with the mode of operation switch at the "D.G" or "SLAVED" selector positions.

LATITUDE SET KNOB AND DIAL (LATITUDE)

The latitude set knob adjusts the latitude indicator dial for introduction of the rate of apparent drift correction. Correction for drift is necessary during flights in unreliable. magnetic areas or at high latitudes when utilizing the "D.G." (directional gyro) mode of operation. Drift correction is accomplished in the compass controller and coupler units of the system. The latitude dial is calibrated in degrees of latitude.

SYNCHRONIZING KNOB (PUSH-SYNC)

The synchronizing knob overrides the normal or "slow slaving" rate of the system which is approximately 1/2 degree per minute. This is maintained constant by system design so as to eliminate transient errors from the system caused by local magnetic distrubances or transmitter vibration. Using this knob enables the pilot to quickly synchronize, in approximately 20 seconds or less, the directional gyro heading presentation of the radio magnetic course indicator to the aircrafts actual magnetic heading. Synchronization is accomplished by depressing the "PUSH-SYNC" knob and is indicated when the annunciator needle is either centered or oscillating about the center position; also when the magnetic course indicator card ceases to turn. When the synchronizing cycle is completed, release the knob. Synchronization may be accomplished either on the ground or during flight.

WARNING

Synchronization in the air should only be accomplished in straight and level flight and when under unaccelerated conditions.

ANNUNCIATOR (SYNCHRONIZING) INDICATOR (L, R)

The annunciator (synchronizing) indicator provides a visual indication as to the degree of "slaved" synchronization between the signals from the directional gyro and the flux gate transmitter. When properly operating in the "SLAVED" mode the annunciator indicator needle will be centered or oscillating about the center position and the aircraft's magnetic heading will appear on the radio magnetic course indicator. When the annunciator needle remains consistantly either to the left or right of center for several minutes, it indicates that the directional gyro signal differs from the flux gate transmitter signal by several degrees (full scale deflection on the indicator is approximately 5 degrees.

NOTE

The annunciator (synchronizing) indicator performs no function during operations when either the "D.G." or "COMP" mode have been selected.

"SLAVED" MODE OF OPERATION OF POLAR PATH COMPASS SYSTEM

1. Battery switch BAT. & GEN.

NOTE

Allow at least one minute for compass system to warm up.

2. Mode of operation (selector) switch to "SLAVED".

3. Depress synchronizing knob (PUSH-SYNC) and hold.

4. Observe the annunciator until the needle centers or oscillates about the center position.

5. Release "PUSH-SYNC" Knob.

6. Observe the radio magnetic course indicator for the gyro stabilized magnetic heading of the aircraft.

DIRECTIONAL GYRO OR "D.G." MODE OF OPERATION OF POLAR PATH COMPASS SYSTEM

1. Battery switch to BAT. & GEN.

NOTE

Allow at least one minute for compass system to warm up.

2. Mode of operation (selector) switch to "D.G."

3. Set LATITUDE dial to local latitude.

4. Set radio magnetic course indicator to the selected aircraft heading through use of the COURSE SET - L, R - PUSH-TURN knob.

WARNING

At no time during flight when operating in D.G. mode should the synchronizing knob (PUSH-SYNC) be depressed.

COMPASS OR "COMP" MODE OF OPERATION OF POLAR PATH COMPASS SYSTEM

1. Battery switch to BAT. & GEN.

NOTE

Allow at least one minute for compass system to warm up.

2. Mode of operation (selector) switch to "COMP".

3. Observe the radio magnetic course indicator dial as it rotates to the magnetic heading of the airplane.

NOTE

The indicated heading should approximately compare to the stand-by compass heading.

TABLE OF CONTENTS

Note

Sections V, VI, Appendix I and a portion of Section IV have been placed in the Supplemental Flight Handbook (NAVAER 01-60JKD-501A) which is classified "Confidential."

IMPORTANT

In order for you to gain the maximum benefits from this handbook, it is imperative that you read this page very carefully.

FOREWORD

This handbook and its Confidential Supplement (NAVAER 01-60JKD-501A) contain all the information you need to fly the FJ-4 and FJ-4B airplanes safely, efficiently and effectively. The information is based on engineering data and the results of extensive flight test programs. These flight tests were conducted by experienced test pilots flying the airplane in many different configurations and under a wide variety of flight conditions.

This handbook is not intended to be a textbook on elementary flight principles. In view of this, instructions of a basic nature have been minimized. Every effort has been made to make this book technically accurate, easy to read and practical to apply.

An index has been provided for both this handbook and the Confidential Supplement. However, do not depend upon the index to give you the location of every piece of specific information contained in the handbooks. Instead, read and study the entire contents of the handbooks to gain an over-all knowledge of the airplane; then, use them as reference manuals to answer specific questions. By understanding the general coverage of each section, it will be much easier for you to find the specific information that you may need from time to time.

Note

- This Flight Handbook is applicable to both Models FJ-4 and FJ-4B airplanes. The airplanes are nearly identical, but the FJ-4B has provisions for carrying multiple external stores or tanks at six stations. Provisions are also included for carrying a buddy tanker package for in-flight refueling of other aircraft. The FJ-4B airplanes also have a second set of speed brakes located on the underside of the aft fuselage. Aircraft designated as FJ-4B are those having BuAer Serial Numbers 139531 through 139555, 141444 through 141489 and 143493 through 143643. The lower case letter following the serial number painted on the side of the airplane designates the production block of the airplane. A tabular listing of the block letters and the related serial numbers is as follows:

SERIAL NUMBER	BLOCK LETTER
139281 through 139283	a (FJ-4 Airplanes)
139284 through 139286	b
139287 through 139300	c
139301 through 139315	d
139316 through 139323	e
139424 through 139430	e
139431 through 139470	f
139471 through 139510	g
139511 through 139530	h
139531 through 139555	i (FJ-4B Airplanes)
141444 through 141489	j
143493 through 143542	k
143543 through 143593	l
143594 through 143643	m

Note

- Information in this handbook and its Confidential Supplement (NAVAER 01-60JKD-501A) will be kept current by quarterly revisions. Since the incorporation of material by regular revision requires a certain amount of time, changes affecting safety of flight will be dispatched to you immediately in the form of "Interim Revision Sheets," or in the form of regular Navy Messages. The Interim Revision Sheets are to be placed at the front of your copy of the handbook and removed only when the Interim Revision Summary (see flyleaf) indicates that the information has been incorporated in the main body of the handbook during a regular quarterly revision.
- To determine if your handbook contains the latest regular revision, consult the Naval Aeronautic Publications Index (NAVAER 00-500A).

The information in this handbook and its Confidential Supplement (NAVAER 01-60JKD-501A) is organized as follows:

Section I, DESCRIPTION — This section contains a description of the airplane and the systems, controls and indicators essential for performing a complete, non-tactical, contact flight. A description of essential emergency equipment which is not a part of some auxiliary equipment is also included. The function of Section I is purely descriptive; operational procedures are covered in the appropriate section.

Section II, NORMAL PROCEDURES — Contained in this section are operating instructions for performing a complete, non-tactical, contact flight. Your duties as the pilot are covered from the time you approach the airplane prior to take-off until the airplane is secured after completion of the flight. Detailed coverage is provided on the techniques to be used in accomplishing operations such as starting, taxiing, take-off, climb, etc.

Section III, EMERGENCY PROCEDURES — The procedures to be followed in coping with any emergency that could be reasonably expected are given in this section. Procedures for emergency operation of auxiliary equipment are given in Section IV.

Section IV, DESCRIPTION AND OPERATION OF AUXILIARY EQUIPMENT — This portion of the handbook contains a description, and normal and emergency procedures for operation of all equipment not directly connected with flight, but which enables the airplane to perform certain specialized functions. Systems and items of equipment included in this category are: armament equipment, oxygen system, communications equipment, navigation equipment, heating and ventilating system, anti-icing and rain removal system, radar equipment and miscellaneous equipment. A portion of this section is included in the Confidential Supplement (NAVAER 01-60JKD-501A).

Section V, OPERATING LIMITATIONS — This section covers all important limitations and restrictions which must be observed during normal operation of the airplane. Those limitations which are imposed as the result of an emergency are discussed in Section III. Section V is contained in the Supplemental Flight Handbook (NAVAER 01-60JKD-501A).

Section VI, FLIGHT CHARACTERISTICS — The flight characteristics of the FJ-4 airplane are covered in this section. Included are descriptions of stall and spin characteristics and the proper techniques for recovering from these maneuvers. Section VI is contained in the Supplemental Flight Handbook (NAVAER 01-60JKD-501A).

Section VII, SYSTEMS OPERATION — This section contains a comprehensive discussion of engine characteristics and a description of the in-flight refueling system.

Section VIII, CREW DUTIES — Since this section is not applicable to single-place airplanes, it has been omitted from this handbook.

Section IX, ALL-WEATHER OPERATION — The techniques and procedures necessary for flight under extreme weather conditions are described in this section. You will also find information concerning instrument flights, cold weather precautions and procedures for desert or hot weather operation.

Appendix I, OPERATING DATA — Efficient pre-flight and in-flight mission planning can be accomplished by making use of the charts and curves contained in this section. Proper usage of this information will enable you to fly greater distances at better cruising speeds and arrive at your destination with more reserve fuel. This section is contained in the Supplemental Flight Handbook (NAVAER 01-60JKD-501A).

Index — Both this handbook and the Supplemental Flight Handbook (NAVAER 01-60JKD-501A) are indexed for ease in referencing.

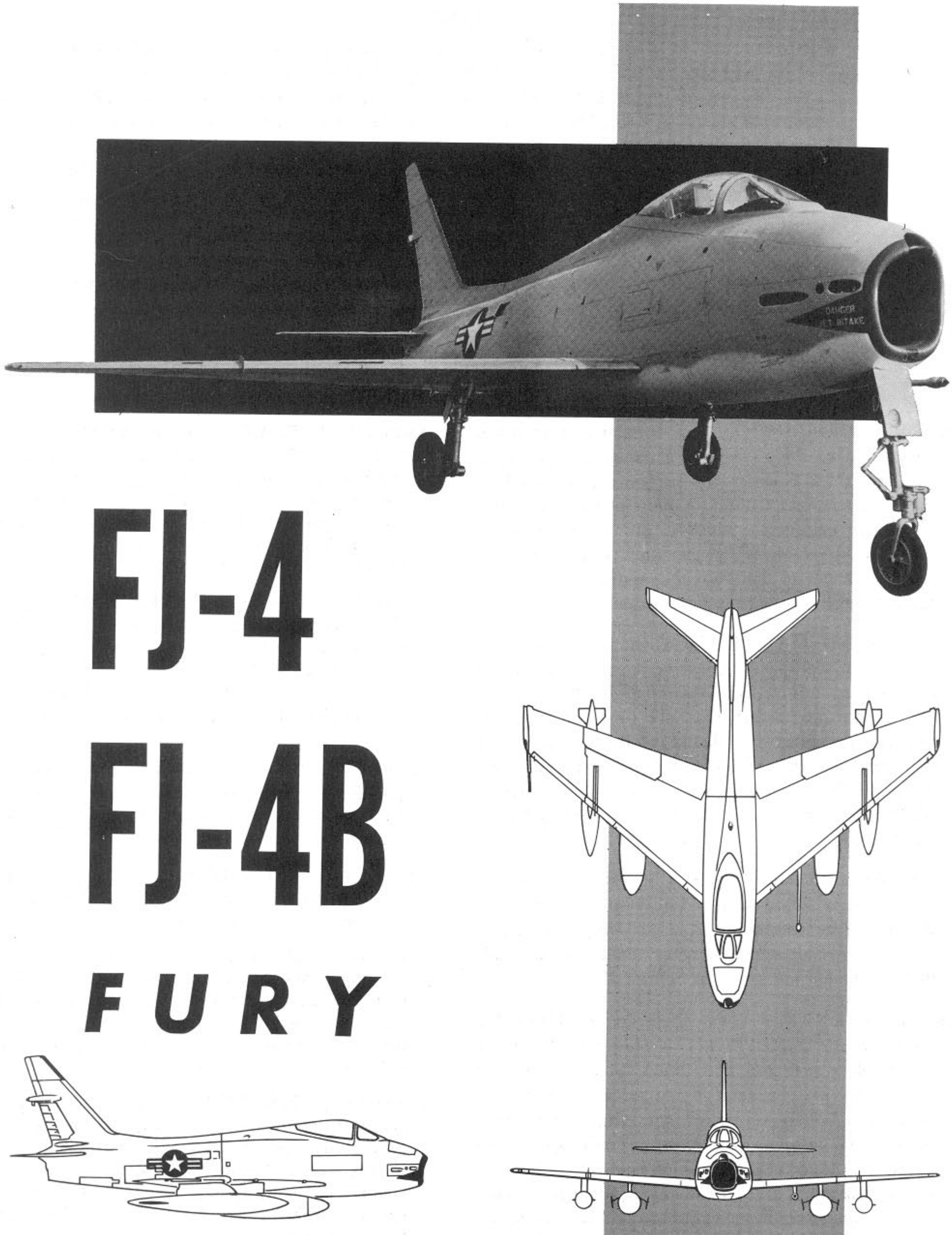


Figure No. 1-1.

THE AIRPLANE.

The FJ-4* is a single-engine, single-place fighter designed for carrier or land based operations. The airplane is characterized by the engine air intake duct, located in the nose, the sweptback tail surfaces and the thin sweptback wing. The FJ-4B* is an attack version of the same airplane and is capable of carrying multiple external stores as well as a "buddy tanker" system for in-flight refueling of other aircraft. Noteworthy design features include combined action of the elevator and horizontal stabilizer, a splitter-plate rudder and a wet wing. Some airplanes† incorporate provisions for in-flight refueling. The tricycle landing gear is fully retractable and the wing is equipped with slotted type landing flaps. Good control is maintained throughout the speed range of the airplane by use of an irreversible hydraulic system, which actuates the ailerons and stabilizer-elevator, a Mach sensing trim system and, on the FJ-4B,* a hydraulic rudder boost system and spoilers for improved lateral control. The hydraulic control system for the ailerons and stabilizer-elevator requires an artificial feel system to simulate the aerodynamic forces of a manual control system into the control stick.This is accomplished through the use of bobweights and bungees. Rudder control is provided through use of a conventional cable control system incorporating a yaw damper. The FJ-4B has a hydraulic boost system for rudder control which incorporates an integral yaw damper. Provisions for carrier operations include: a catapult hook and holdback fittings, an arresting hook and barricade stops on the wing leading edge. Hydraulic wing folding provisions are controlled from the cockpit. Fire control is accomplished electronically and armament includes four Mark 12, 20mm guns and provisions for carrying external stores and rockets. Provisions are also incorporated for target towing.

AIRPLANE DIMENSIONS.

Over-all dimensions of the airplane are as follows:

Wing span	39.11 feet
wings folded	27.48 feet
Length	36.67 feet
Height	13.88 feet

MAIN DIFFERENCES.

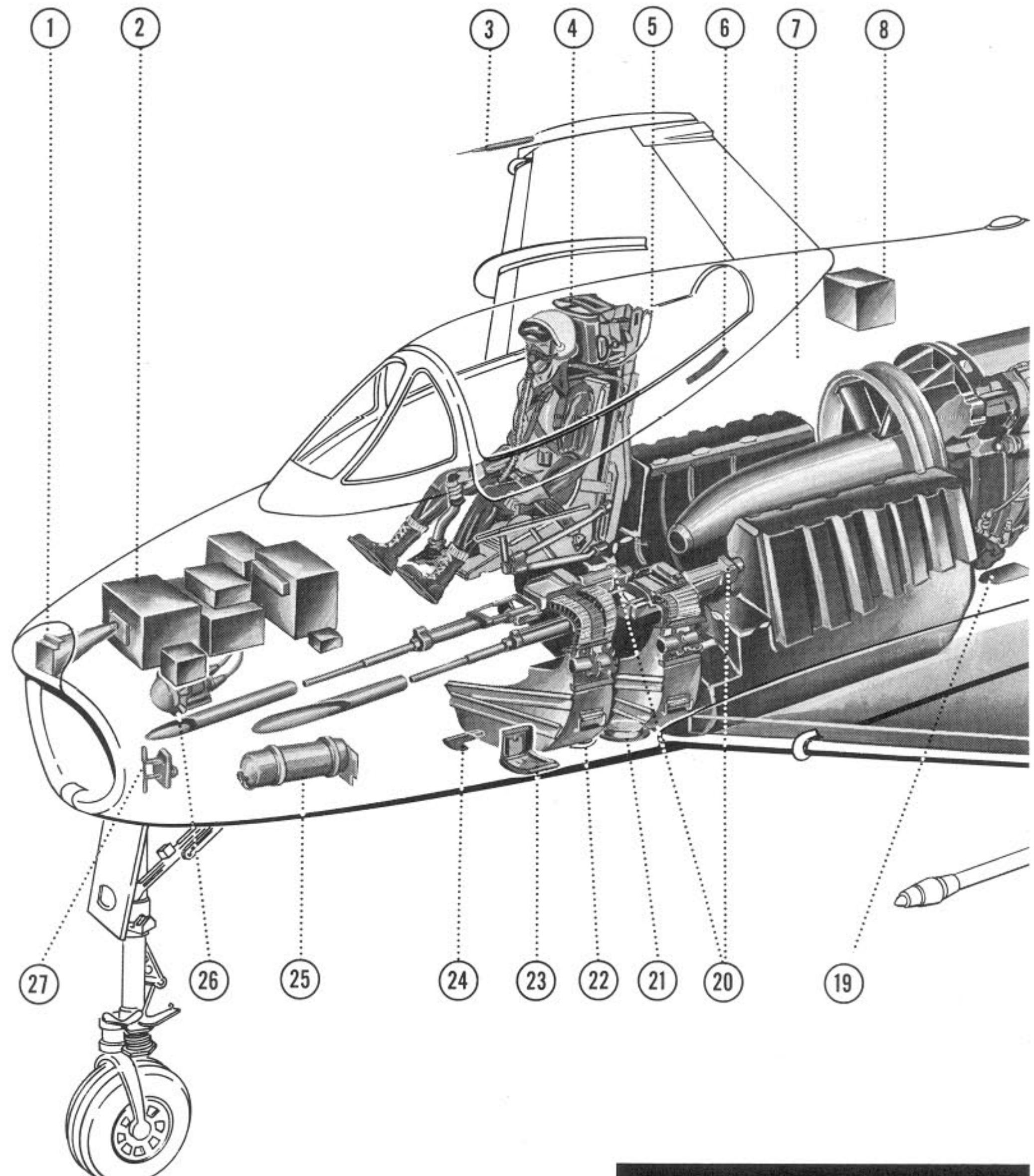
Major differences exist between the FJ-4 and the FJ-4B as compared with the FJ-2 and FJ-3. The FJ-4 series is slightly larger and the side profile views are similar except for the dorsal fin which blends into the FJ-4 canopy. A redesigned flight control system is utilized in the FJ-4 and FJ-4B airplanes as well as a new emergency operation for the system. The big visual difference in the FJ-4 series exists in the wing. The wing area has been increased by approximately 50 square feet by increasing the chord at the wing root. The wing is quite thin and incorporates barrier stops and airflow fences. The FJ-4 series has a splitter-plate rudder.

ENGINE.

The engine installation for this airplane is the J65-W-16A axial flow turbojet (figure 1-3) with a sea level rating of 7700 pounds thrust at 8300 rpm (100%). Some of the FJ-4B airplanes may be equipped with a rebuilt J65-W-4B engine. These engines all incorporate the -16A exhaust cone and thermocouple leads and reflect the same performance as the -16A engine. Air enters the engine air intake duct through the nose of the fuselage and is directed into the engine compressor where it is progressively compressed through thirteen stages. This compressed airflow is then routed to the annular combustion chamber where fuel is mixed with air and the resultant combustion occurs. Partial

*Refer to the Foreword for Block Number and Serial Number designations of FJ-4 and FJ-4B airplanes
†Airplanes 139303 and subsequent

1. AT-561/APG OR AT-234/APG-30 ANTENNA
2. RADAR AND GUNSIGHT EQUIPMENT COMPARTMENT
3. PITOT TUBE
4. EJECTION SEAT
5. AN/ARN-14E ANTENNA
6. EXTERNAL CANOPY EMERGENCY RELEASE
7. AFT EQUIPMENT COMPARTMENT
8. BATTERY
9. J65-W-4B OR J65-W-16A ENGINE
10. D&M TYPE 312 ANTENNA
11. FUEL VENT OUTLET
12. APX-6 ANTENNA††
13. CONTROLLABLE HORIZONTAL TAIL
14. TAIL BUMPER
15. SPEED BRAKES
16. ARRESTING HOOK
17. AS-578/ARA-25 ANTENNA
18. WING CONTROLLABLE LEADING EDGE
19. CATAPULT HOLDBACK FITTING
20. 20 MM GUNS
21. AT-234/APX-6 ANTENNA†
D&M TYPE 1305.126 ANTENNA‡
22. AS-578/ARA-25 ANTENNA **
23. CANOPY CONTROL SWITCH
24. CATAPULT HOOK
25. OXYGEN CYLINDER



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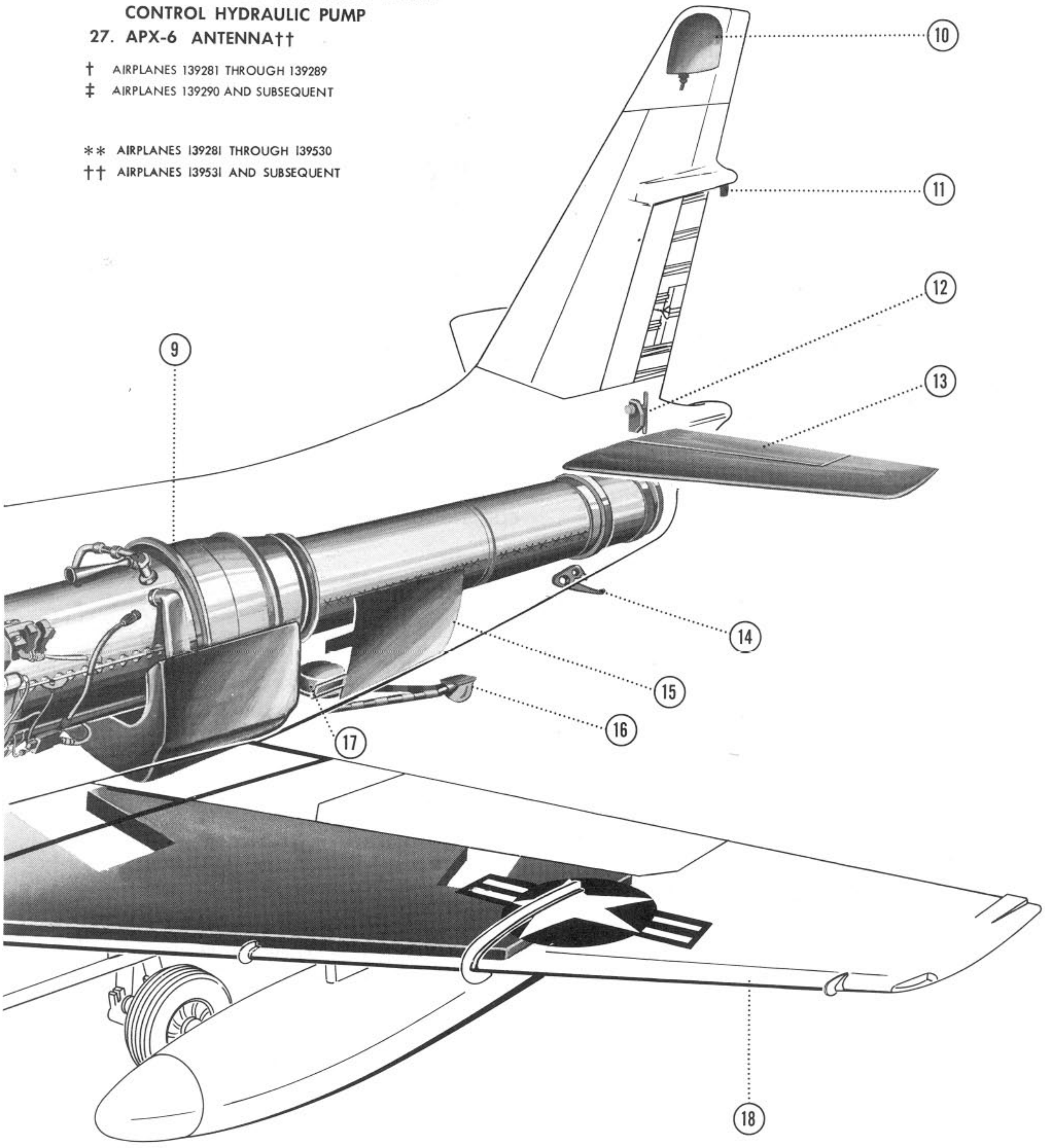
FJ-4/B-1-00-13A

Figure No. 1-2. (Sheet 1)

26. TURBINE-DRIVEN EMERGENCY FLIGHT CONTROL HYDRAULIC PUMP
27. APX-6 ANTENNA††

† AIRPLANES 139281 THROUGH 139289
‡ AIRPLANES 139290 AND SUBSEQUENT

** AIRPLANES 139281 THROUGH 139530
†† AIRPLANES 139531 AND SUBSEQUENT



GENERAL ARRANGEMENT

FJ-4/B-1-00-14A

Figure No. 1-2. (Sheet 2)

J65-W-16A SAPPHIRE ENGINE

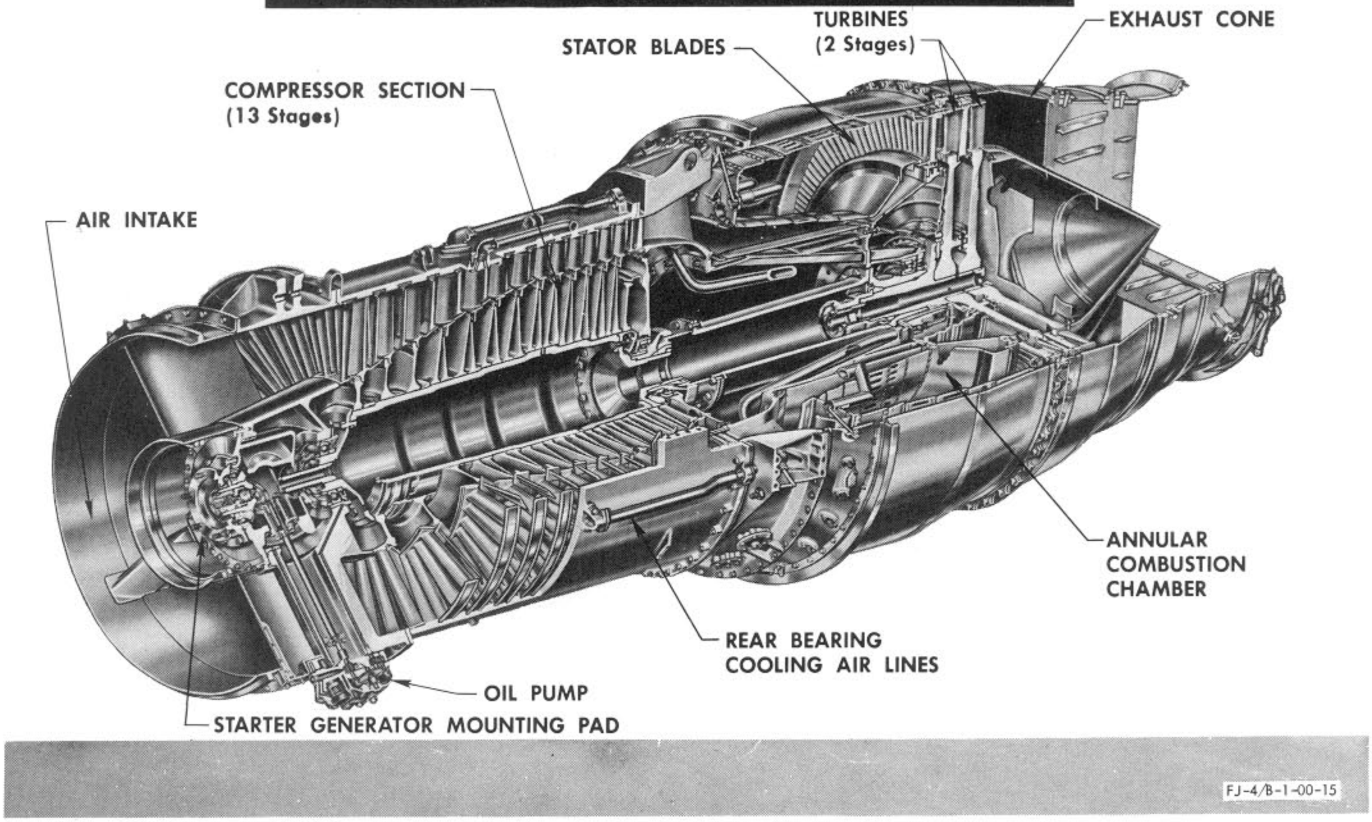


Figure No. 1-3.

expansion of the gases through a two-stage turbine produces mechanical power which is used to drive the 13-stage compressor located in the forward section of the engine. Continued expansion of the gases in the tail pipe produces a high velocity jet exhaust with a resultant forward thrust. The accessories required for the operation of the engine are driven by the engine rotor through gearing in the front main bearing support. These accessories include the starter-generator, fuel control unit, dual element fuel pump, ignition generator, tachometer generator and oil pump. Two flight control hydraulic pumps and the utility hydraulic pump are also driven from this section.

ENGINE FUEL CONTROL SYSTEM.

The engine fuel control system (figure 1-4) is designed to control the rate of fuel flow to the engine combustion chamber, thereby maintaining engine operating conditions selected by the throttle. Variations in compressor inlet air density also are compensated for in the system. The system consists of the following components: the engine-driven dual element fuel pump, an integral boost element, a fuel control unit, the engine fuel filter, six fuel flow dividers, two fuel primer nozzles, 36 fuel nozzles and a combustion chamber drain which drains fuel from the combustion chamber after shutdown or after a false start. A fuel flow transmitter also is a part of the system. Fuel enters the engine-driven fuel pump under booster pump pressure from the airplane's fuel system. The output from the engine-driven pump is directed into the fuel control unit where fuel in excess of the engine's requirements is by-passed back to the main fuel pump inlet. Continued fuel flow within the fuel control unit is shown in figure 1-4. A small quantity of fuel is directed to the primer solenoid valve for use in the starting sequence. During emergency operation, the fuel flow is regulated only by manual operation of the throttle lever, therefore, there is no altitude or airspeed compensation nor is there any automatic control over engine acceleration or deceleration. A solenoid-operated valve, actuated through the fuel control switch on the left-hand console, and a fuel pressure differential system, which correctly positions the regulator valve, control emergency fuel selection. A manual fuel control warning light, located above the wing fold control, illuminates whenever the fuel control switch is in the MANUAL position. On some airplanes,* the manual fuel control warning light is located on the right-hand side of the instrument panel, above the take-off check list.

FUEL CONTROL UNIT. The fuel control unit is a speed density type fuel metering device. Fuel flow is governed to maintain a constant engine speed at any throttle power setting, regardless of airplane altitude or temperature conditions. Fuel flows are compensated by the fuel control unit for variations in compressor inlet air density and temperatures to prevent engine stalling and excessive engine pressures and temperatures. All metered engine fuel flow is controlled by varying the

*Airplanes 139531 and subsequent

spring load on the constant-speed type governor valve to obtain desired engine speeds. Movement of the throttle lever, which is directly linked to the governor, determines the spring loads placed on the governor valve and, consequently, the engine power setting. A manual control valve is incorporated, permitting continued engine operation in the event of malfunction of the primary control elements. (See FUEL CONTROL SWITCH AND WARNING LIGHT, in this section.) For engine fuel control procedures, refer to Sections III and VII. On engines incorporating Engine Bulletin No. 240 (fuel control Part No. 190544-14 and subsequent), a spring balance positioner is incorporated to make the control lever seek the position which gives 85 (±1) percent engine rpm if the airplane throttle linkage should separate. This rpm allows safe flight and controllable landing, including a wave-off. The engine can be shut down with the engine master switch in this emergency situation. The detailed procedure for such operation is given in Section III.

FUEL PUMP. The engine-driven fuel pump is a combination centrifugal boost and dual gear type fuel pump. The pump is driven through the accessory gearbox and incorporates shear sections for each of the two integral gear pump elements to permit continued operation in the event that one pump element fails. Check valves are also provided to facilitate controlled fuel flow in the event one pump element fails. Continued operation of either one of the two elements will provide sufficient fuel flow for continued engine operation. There are no provisions for fuel pressure indication.

FUEL TUBES, FLOW DIVIDERS AND PRIMER NOZZLES. There are six fuel flow dividers, each of which supplies six of the 36 fuel tubes symmetrically located in the annular combustion chamber. The fuel from the tubes vaporizes and thoroughly mixes with primary air for proper combustion. Two primer nozzles, located in conjunction with the igniter plugs within the combustion chamber, supply primer fuel for starting. Fuel supply to the primer nozzles is controlled by the engine rpm through a switch in the magneto generator.

FUEL STOPCOCK VALVE. The fuel stopcock valve is an integral unit of the control unit and is controlled through throttle lever movement. With the throttle lever in the OFF position, the stopcock valve is closed and stops fuel flow through the fuel control unit. Movement of the throttle lever out of the OFF position opens the valve. During emergency fuel operation, the fuel control stopcock valve manually controls, through the throttle lever action, the emergency fuel flow to the combustion chamber.

FUEL CONTROL SWITCH AND WARNING LIGHT. The fuel control switch (21, figure 1-6) is a two-position switch which is located on the left-hand console, inboard of the throttle quadrant. During normal fuel control, the switch is in the PRIMARY position. Placing the switch in the MANUAL (emergency) position for emergency operation will energize a solenoid which will by-pass fuel from its normal course through the control unit. This allows engine operation to continue with unregulated fuel flow and illuminates the manual fuel control warning light, which is located above the wing fold manual pin locking handle (figure 1-16). On some airplanes,* the warning light is located on the right-hand side of the instrument panel, above the take-off check list (14A, figure 1-5, sheet 3). Since there is no governing or altitude compensation while in MANUAL, throttle movements must be made carefully to avoid engine overtemperatures and overspeeding.

STARTER SYSTEM.

The starting system is made up of the starter-generator, the starter controller, the engine master switch, the start-stop switch and the emergency ignition switch. Starter operation, through use of the starter controller, is entirely automatic once the start-stop switch has been actuated to start. With the engine master switch in the MASTER position, momentarily positioning the start-stop switch to the START position will energize the starter controller relay, connecting the external constant current 35-volt d-c power to the starter-generator. When this occurs, a holding coil in the starter controller is energized and will automatically hold the relay closed until the engine reaches approximately 25% rpm, at which time the holding coil is automatically de-energized and the external power circuit is broken. The starter-generator will then continue operating as a generator. Movement of the throttle lever out of the OFF position opens the fuel stopcock valve, supplying fuel to the two primer nozzles, and allows the ignition generator to supply current to the two igniter plugs. At approximately 23% rpm, the primer solenoid valve will shut off the fuel supply to the primer nozzle and the igniter plugs will become inoperative, at which time fuel combustion becomes self-sustaining. It should be remembered that since the starter-generator pulls approximately 1000 (+100/−0) amperes for starting, it is not possible to ground start the engine without an external jet starting power source. In addition, a 28-volt d-c servicing power source capable of supplying 500 amperes should also be connected to the second external receptacle to provide power for the airplane's electrical system. When attempting air starts, the emergency ignition switch, located on the left-hand console, should be placed in the ON position. This will provide both primer fuel and ignition for this condition.

STARTER-GENERATOR.

A 500-ampere combination starter-generator, mounted on the front main bearing support section, functions as a starter and a generator. The unit will function as a starter until engine rpm reaches a value of approximately 25%, at which time it will automatically kick out the external power source from its circuit. Above approximately 25% rpm, the unit will function as a generator, incorporating the conventional type of voltage regulator

*Airplanes 139531 and subsequent

ENGINE FUEL CONTROL SYSTEM

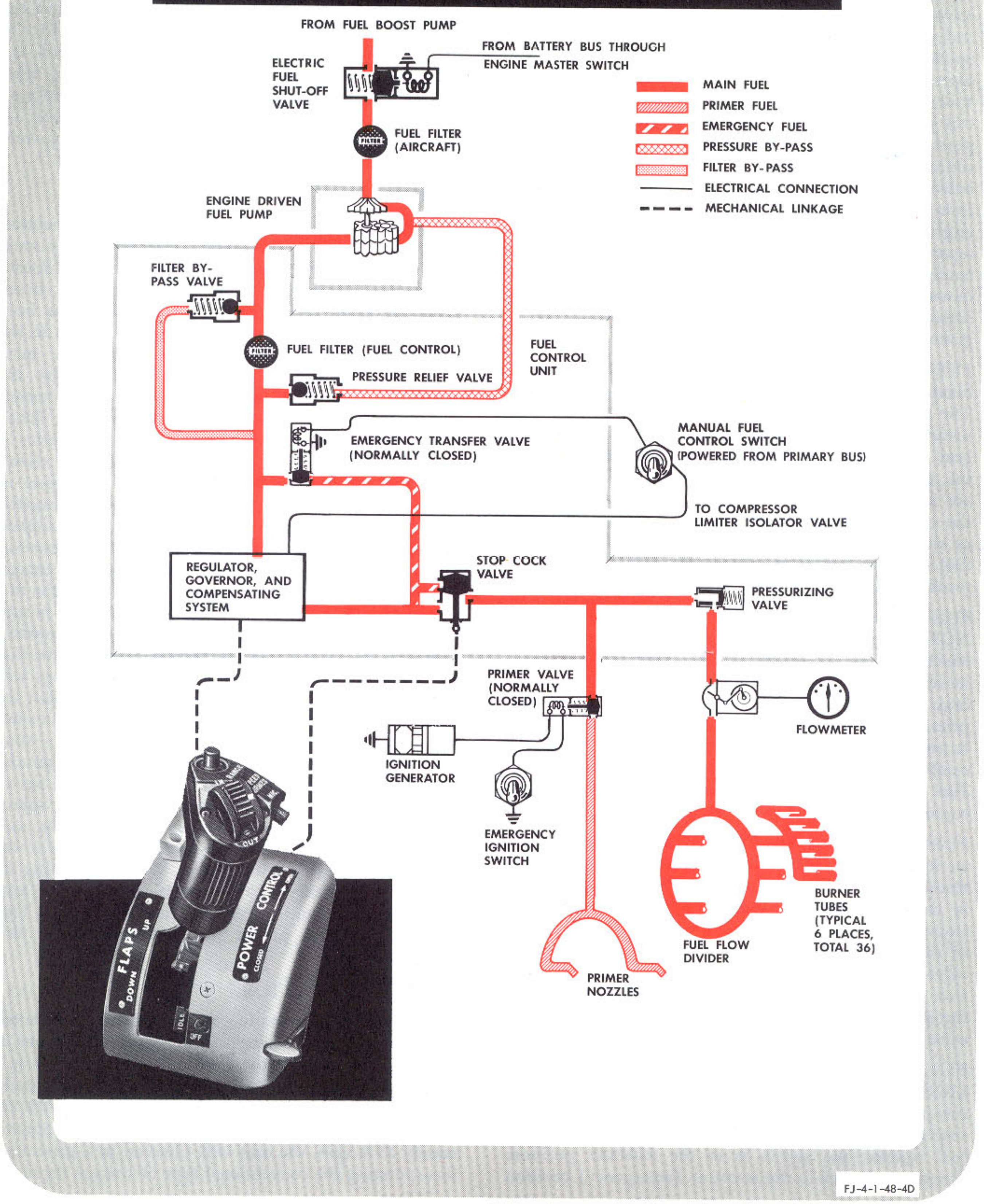


Figure No. 1-4.

and reverse-current cutout. The generator will deliver rated power at approximately 35% rpm.

STARTER SYSTEM CONTROLS.

ENGINE MASTER SWITCH. When external power is connected, moving a guarded engine master switch (22, figure 1-6) on the left forward console to MASTER completes the electrical circuits which start the aft fuel boost pump, energizes the fuel shutoff valve to open and provides power to the start-stop switch for starting. The forward boost pump will start when the landing gear is raised. Ignition is required only during starting as the fuel mixture will burn continuously once it is ignited. Current for ignition is supplied when the start-stop switch is held momentarily in the START position, engine rpm is greater than 11% and the throttle is advanced from the OFF position.

START-STOP SWITCH. A guarded three-position switch (START, off and STOP) is located on the left console and is spring-loaded to the center (off) position. Holding the switch at START for 3 seconds will energize a holding relay which actuates the starter. After 3 seconds, the switch is released and will continue to be energized through the holding relay until the engine reaches approximately 25% rpm. When this engine speed is reached, the holding relay is de-energized automatically and disconnects the starter. If the engine fails to start or a malfunction occurs, momentarily positioning the switch to the STOP position will cut off current to the starter. Since the starter will automatically cut out at approximately 25% engine rpm, the start-stop switch should not be used to disengage the starter after a normal start.

EMERGENCY IGNITION SWITCH. The two-position emergency ignition switch, located on the left console, should be in the OFF (normally closed) position for normal operation. This switch is used to obtain ignition for air starts. When the engine reaches approximately 23% rpm, a centrifugal switch closes, connecting the ignition generator to ground through the emergency ignition switch. This "short" to ground reduces the output voltage of the ignition generator to the extent that the igniters cannot function and the normally closed primer solenoid valve cannot be held open even though they are connected to the ignition generator. In the event an air start is necessary, when the engine is windmilling above 23%, or in case the centrifugal switch should malfunction, the emergency ignition switch should be placed to ON. This will break the circuit to ground from the ignition generator, permitting the output voltage to build up to a level sufficient to operate the igniter plugs and the normally closed primer solenoid valve. This action supplies both fuel and current for starting.

CAUTION

If emergency ignition switch is used, move switch to OFF as soon as start is accomplished to prevent overtemperatures, possible burning of plugs and damage to the ignition generator.

ENGINE CONTROL.

THROTTLE (POWER CONTROL). The engine is controlled by a single throttle lever which is located in a quadrant on the left console. The throttle lever, which is spring-loaded to the inboard side of the quadrant, is provided with a stop to prevent the fuel supply from being accidentally shut off when the throttle is retarded. Outboard movement of the throttle lever allows the stop to be by-passed when the engine is being started or stopped. A throttle friction lock (16, figure 1-6), mounted on the inboard side of the quadrant, locks the throttle at the selected power setting to prevent "throttle creep." The throttle grip contains a microphone button, a switch controlling speed brake operation, a range button for the APG-30 radar ranging system and a gun sight gyro cage switch. Rotating the handle will cage and uncage the gyro. An adjustable catapult holding handle is mounted on the structure forward of the quadrant on the inboard side. This is a spring-loaded handle and, on catapult take-off, can be rotated to the vertical position and held along with the throttle lever to maintain the full power position.

ENGINE INDICATORS.

EXHAUST TEMPERATURE GAGE. The exhaust temperature gage (34, figure 1-5), located on the instrument panel, indicates engine exhaust gas temperature in degrees Centigrade. The indicator system is a self-generating electrical unit and does not require power from the airplane's electrical system. Indications are received from four bayonet-type thermocouples mounted in the engine exhaust cone. For maximum exhaust gas temperatures, refer to ENGINE LIMITATIONS, in Section V of the Supplemental Flight Handbook (NAVAER 01-60JKD-501A).

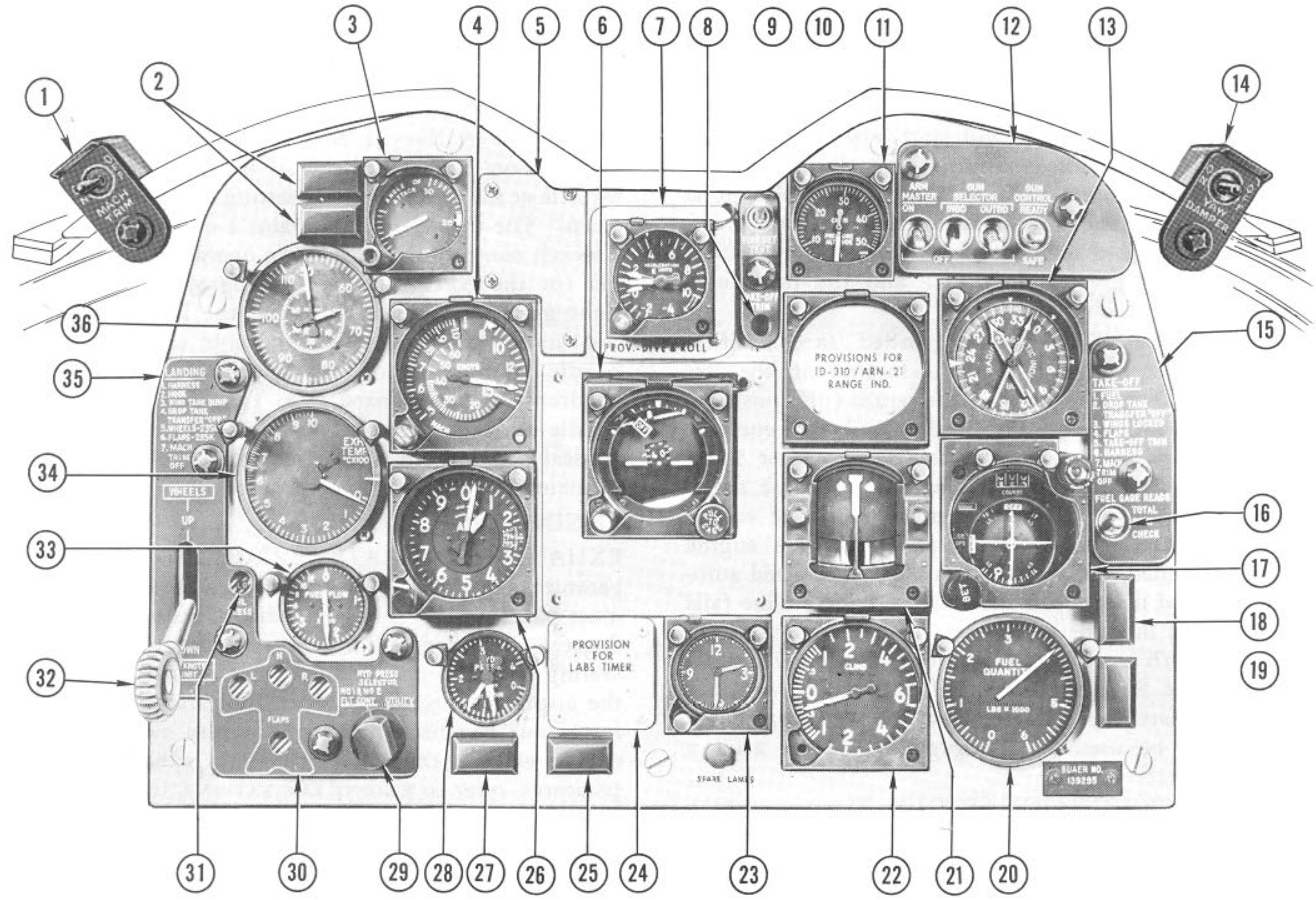
TACHOMETER. The tachometer (36, figure 1-5) is located on the instrument panel and registers engine speed in percentage of maximum rated rpm. This indication, when used in conjunction with that of the exhaust temperature indicator, permits engine power to be accurately set without exceeding engine limitations. The tachometer receives power from the tachometer generator geared to the engine rotor shaft and, therefore, does not depend on the airplane's electrical system. For rpm limits, refer to ENGINE LIMITATIONS, in Section V of the Supplemental Flight Handbook (NAVAER 01-60JKD-501A).

OIL SYSTEM.

Lubrication is provided by a pressure-type oil system. The oil tank, which is assembled to and constitutes a component part of the engine, is mounted on the upper right side of the engine compressor housing and has a capacity of 3 U.S. gallons with a usable capacity of 2.88 U.S. gallons. One gear-type pressure pump, a gear-type scavenger pump and two gear-type oil metering pumps make up the integral components of the engine oil system. In addition, the system makes use of an additional pump which is internally located in the accessory gear box. Oil under pressure is delivered from the pressure pump to the front main bearing and the

INSTRUMENT PANEL

AIRPLANES 139281 THROUGH 139315 NOT HAVING SERVICE CHANGE No. 266 COMPLIED WITH



1. MACH TRIM SWITCH
2. ENGINE FIRE DETECTOR WARNING LIGHTS
3. ANGLE-OF-ATTACK INDICATOR
4. AIRSPEED INDICATOR
5. (DELETED)
6. ATTITUDE GYRO
7. ACCELEROMETER
8. TAKE-OFF TRIM INDICATOR
9. FIRE DETECTOR TEST SWITCH
10. PROVISION FOR ID-310/ARN-21 RANGE INDICATOR
11. CABIN PRESSURE ALTITUDE INDICATOR
12. GUN CONTROL PANEL
13. RADIO MAGNETIC INDICATOR
14. YAW DAMPER SWITCH
15. TAKE-OFF CHECK LIST
16. FUEL GAGE READS SWITCH
17. COURSE INDICATOR
18. WING FUEL SHUT-OFF WARNING LIGHT
19. LOW FUEL WARNING LIGHT
20. FUEL QUANTITY INDICATOR
21. TURN-AND-BANK INDICATOR
22. RATE-OF-CLIMB INDICATOR
23. CLOCK
24. PROVISION FOR LABS TIMER
25. WINDSHIELD ANTI-ICE OVERHEAT LIGHT
26. ALTIMETER
27. FLIGHT CONTROL PRESSURE WARNING LIGHT
28. HYDRAULIC PRESSURE INDICATOR
29. HYDRAULIC PRESSURE SELECTOR
30. LANDING GEAR AND FLAP POSITION INDICATOR
31. OIL PRESSURE INDICATOR
32. LANDING GEAR CONTROL
33. FUEL FLOW INDICATOR
34. TAIL-PIPE TEMPERATURE INDICATOR
35. LANDING CHECK LIST
36. TACHOMETER

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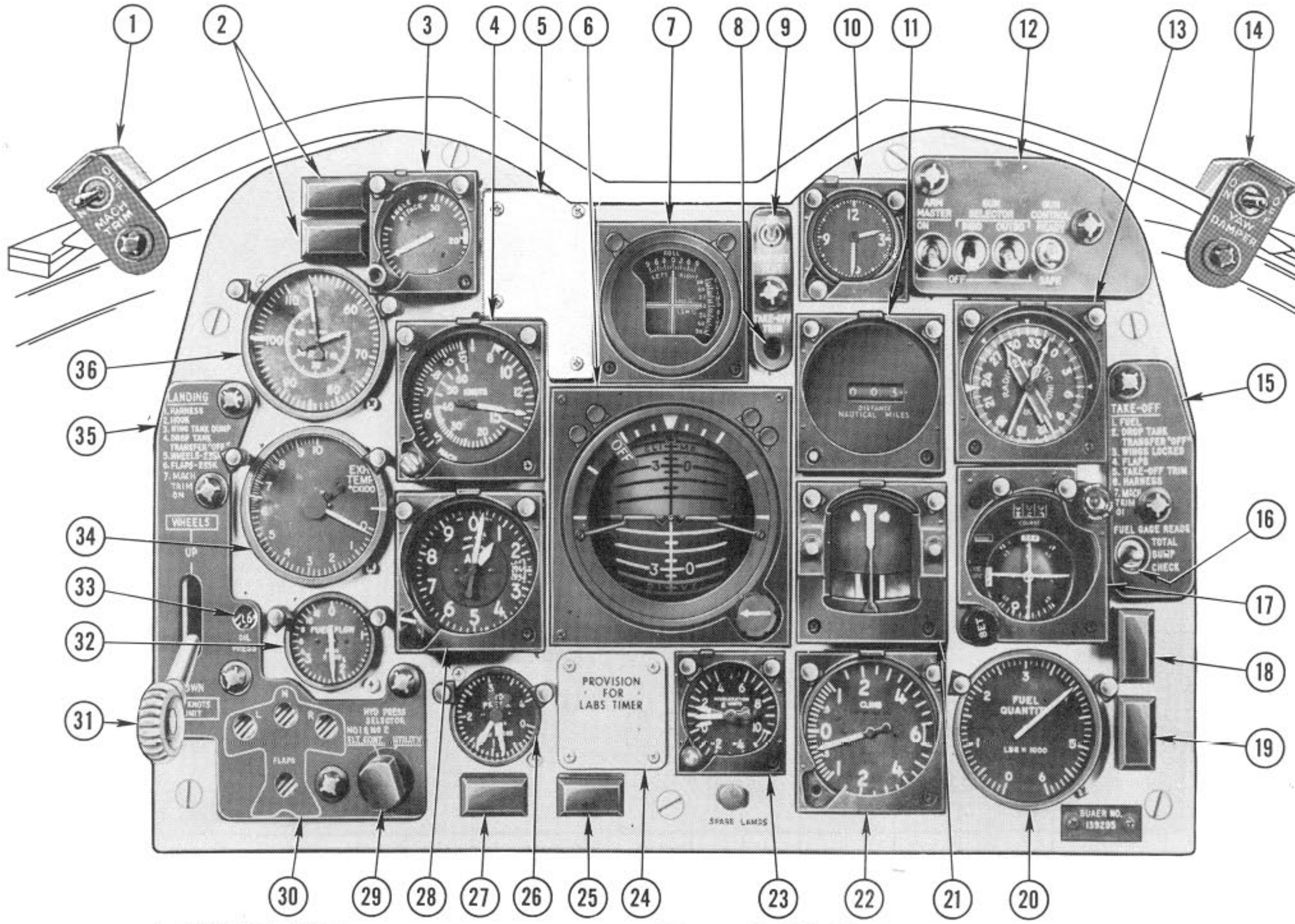
Figure No. 1-5. (Sheet 1)

INSTRUMENT PANEL

AIRPLANES 139316 THROUGH 139530 AND AIRPLANES HAVING SERVICE CHANGE NO. 266 COMPLIED WITH



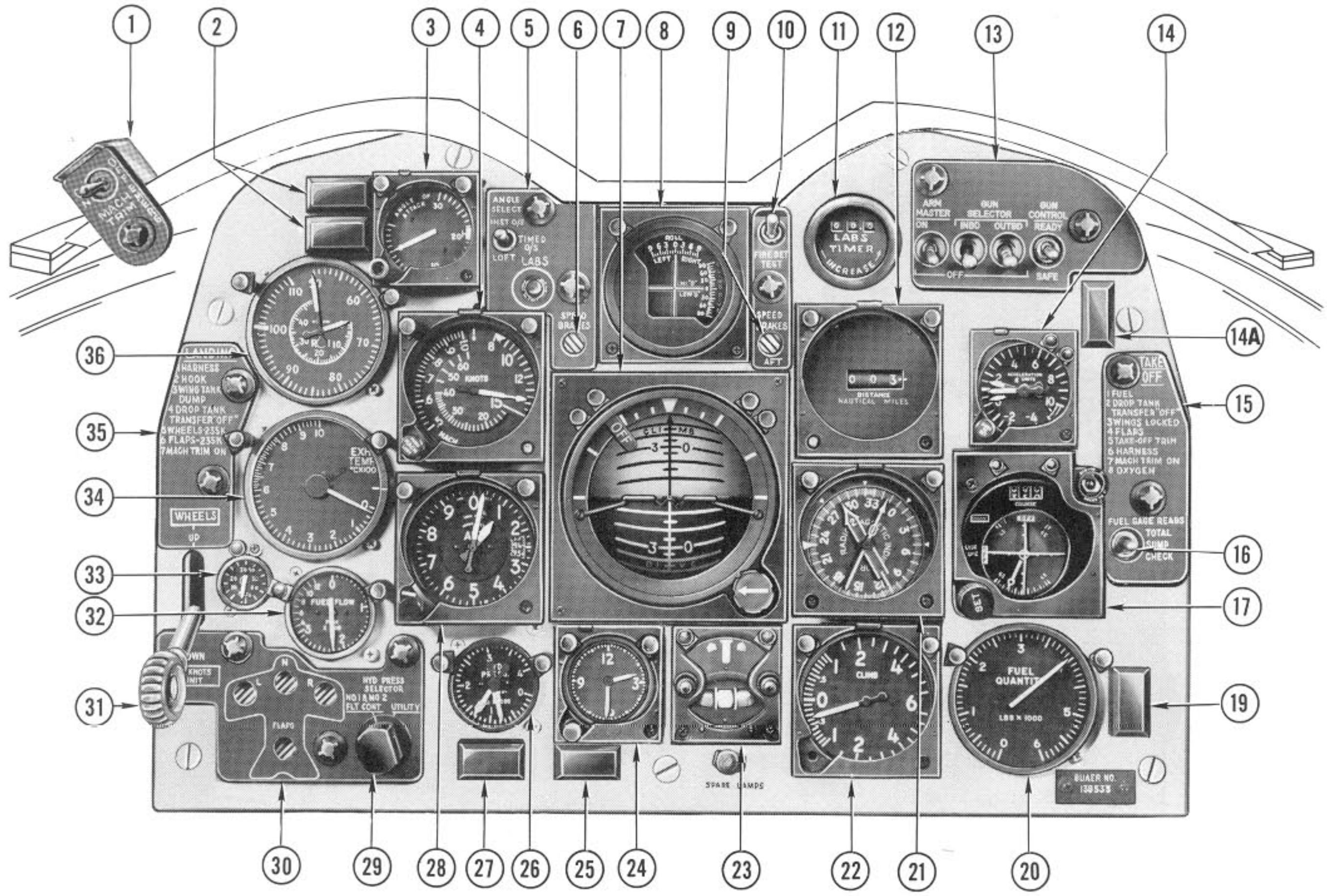
1. MACH TRIM SWITCH
2. ENGINE FIRE DETECTOR WARNING LIGHT
3. ANGLE-OF-ATTACK INDICATOR
4. AIRSPEED INDICATOR
5. (DELETED)
6. ATTITUDE GYRO INDICATOR (VGI)
7. LABS DIVE AND ROLL INDICATOR
8. TAKE-OFF TRIM INDICATOR
9. FIRE DETECTOR TEST SWITCH
10. CLOCK
11. AN/ARN-21 RANGE INDICATOR
12. GUN CONTROL PANEL
13. RADIO MAGNETIC INDICATOR
14. YAW DAMPER SWITCH
15. TAKE-OFF CHECK LIST
16. FUEL GAGE SELECTOR SWITCH
17. COURSE INDICATOR
18. WING FUEL SHUT-OFF WARNING LIGHT
19. LOW FUEL WARNING LIGHT
20. FUEL QUANTITY INDICATOR
21. TURN-AND-BANK INDICATOR
22. RATE-OF-CLIMB INDICATOR
23. ACCELEROMETER
24. PROVISION FOR LABS TIMER
25. WINDSHIELD ANTI-ICE OVERHEAT LIGHT
26. HYDRAULIC PRESSURE INDICATOR
27. FLIGHT CONTROL PRESSURE WARNING LIGHT
28. ALTIMETER
29. HYDRAULIC PRESSURE SELECTOR
30. LANDING GEAR AND FLAP POSITION INDICATOR
31. LANDING GEAR CONTROL HANDLE
32. FUEL FLOW INDICATOR
33. OIL PRESSURE INDICATOR
34. TAIL-PIPE TEMPERATURE INDICATOR
35. LANDING CHECK LIST
36. TACHOMETER

FJ-4/B-1-00-22A

Figure No. 1-5. (Sheet 2)

INSTRUMENT PANEL

AIRPLANES 139531 AND SUBSEQUENT



1. MACH TRIM SWITCH
2. ENGINE FIRE DETECTOR WARNING LIGHTS
3. ANGLE-OF-ATTACK INDICATOR
4. AIRSPEED/MACH INDICATOR
5. LABS CONTROL PANEL
6. SIDE SPEED BRAKE INDICATOR
7. ATTITUDE GYRO INDICATOR (VGI)
8. LABS DIVE-AND-ROLL INDICATOR
9. AFT SPEED BRAKE INDICATOR
10. FIRE DETECTOR TEST SWITCH
11. LABS TIMER
12. AN/ARN-21 RANGE INDICATOR
13. GUN CONTROL PANEL
14. ACCELEROMETER

14A. MANUAL FUEL WARNING LIGHT

15. TAKE-OFF CHECK LIST
16. FUEL GAGE SELECTOR SWITCH
17. COURSE INDICATOR ID-249B/ARN
18. DELETED
19. LOW-FUEL WARNING LIGHT
20. FUEL QUANTITY INDICATOR
21. RADIO MAGNETIC INDICATOR ID-250A/ARN
22. RATE-OF-CLIMB INDICATOR
23. TURN-AND-BANK INDICATOR
24. CLOCK
25. WINDSHIELD ANTI-ICE OVERHEAT WARNING LIGHT
26. HYDRAULIC PRESSURE INDICATOR
27. FLIGHT CONTROL PRESSURE WARNING LIGHT
28. ALTIMETER
29. HYDRAULIC PRESSURE SELECTOR
30. LANDING GEAR AND FLAP POSITION INDICATOR
31. LANDING GEAR CONTROL HANDLE
32. FUEL FLOW INDICATOR
33. OIL PRESSURE INDICATOR *
34. EXHAUST GAS TEMPERATURE INDICATOR
35. LANDING CHECK LIST
36. TACHOMETER

* AIRPLANES 143543 AND SUBSEQUENT AND AIRPLANES HAVING SERVICE CHANGE NO. 460 COMPLIED WITH

FJ-4B-1-00-5D

Figure No. 1-5. (Sheet 3)

accessory gear box, after which it is scavenged and returned to the oil tank. The accessory gear box is lubricated by interconnection to the scavenge pump and bevel gear box. The circulating type of oil system is used for the front main bearing, accessories and drive mechanism while a total loss system is used for the center and rear main bearings. The latter system is supplied by the two metering pumps which deliver oil to the center and rear main bearings at the rate of approximately one drop per second. Air which is bled from the fifth stage of the compressor is directed to these bearings and then mixes with the oil to form a mist which then is vented overboard. The system is so designed that the pilot has no direct control over it other than observing the oil pressure indicator. The maximum allowable oil consumption permitted for this engine is 0.4 gallon per hour which limits mission time to 5 hours. On some airplanes,* a 4-gallon capacity oil tank is installed. This tank, along with the in-flight refueling provisions, increases mission time to approximately 7 hours. Oil grade and specifications are noted in figure 1-19.

OIL PRESSURE INDICATOR.

A three-position "barber pole" type oil pressure indicator is located at the extreme left-hand side of the instrument panel. (See 31, figure 1-5, sheet 1, and 33, figure 1-5, sheets 2 and 3.) The three indicated positions are marked LO, N and HI. With the oil pressure below 25 (±1) psi, the indicator will read LO on a barber pole background, oil pressure ranging from 25 (±1) to 39 (±1) psi will indicate N (normal) on a blue background and any pressure in excess of 39 (±1) psi will indicate HI on a barber pole background. The oil pressure indicator will read LO if the primary bus is not energized.

Note

During ground idle rpm, a low oil pressure reading may be indicated. This indication is acceptable if a normal reading occurs at rpm settings of 50% or greater. The minimum oil pressure for ground idle rpm is 20 psi.

*Airplanes 139500, 139502 through 139517, 139519, 139520, 139531, 139536, 139537, 139538, 139543, 139546 and subsequent

On some airplanes,‡ a one-inch diameter, continuous reading oil pressure indicator replaces the three-position "barber pole" type indicator. The continuous reading indicator is direct reading and is calibrated from 0 to 70 psi with markings at each 5-psi increment. The engine oil pressure limits for both the continuous reading and the "barber pole" type indicator are the same. [Refer to INSTRUMENT MARKINGS, in Section V of the Supplemental Flight Handbook (NAVAER 01-60JKD-501A).]

FUEL SYSTEM.

See figure 1-19 (sheet 2) for approved fuels and specifications.

The main fuel system (figure 1-8) includes two integral fuel tanks (wet wing), two U-shaped fuel cells, two booster pumps, two transfer pumps, a fuel shutoff valve, a filter, vent valves, check valves, dump valves and float switches. The fuel supply on some airplanes† can be augmented by two 200-gallon capacity drop tanks mounted under the wings and on other airplanes* by two additional 150-gallon capacity drop tanks as well as provisions for transferring fuel from a buddy tanker package into the airplane's fuel system. The forward fuselage cell, located between the wings, is of the combination self-sealing and bladder-type construction with a capacity of approximately 339 gallons. The upper portion of the cell (approximately two-thirds) and the complete aft cell are of bladder-type construction while the remainder of the forward cell is self-sealing. The forward cell contains two submerged booster pumps with lines going to a common manifold to provide a single source of fuel to the engine. The integral wing tanks extend from the inboard end of the wing to the wing fold and are sealed by groove-type sealing. Refueling for all internal tanks is accomplished by a single-point refueling filler located on the underside of the fuselage between the wing leading edges. On some airplanes,† all tanks can be refueled in flight. An in-flight refueling probe is located on the left wing to utilize the probe and drogue method of refueling. The operation of this system is described in Section VII.

On some airplanes,* two additional 150-gallon drop tanks can be carried beneath the outer wing panels. These tanks can be filled by single-point or in-flight refueling. Fuel from the tanks is transferred by air pressure into the transfer lines of the inboard drop tanks and then into the internal fuel cells. The inboard and outboard tanks have separate controls for transfer. A three-position transfer switch, located on the left rear console, controls transfer of all drop tank fuel. The stores and tanks jettison button will drop all tanks simultaneously or, by utilizing the bomb release selector controls, the tanks may be dropped in pairs or individually. (Refer to EMERGENCY STORES RELEASE CONTROLS, in this section.)

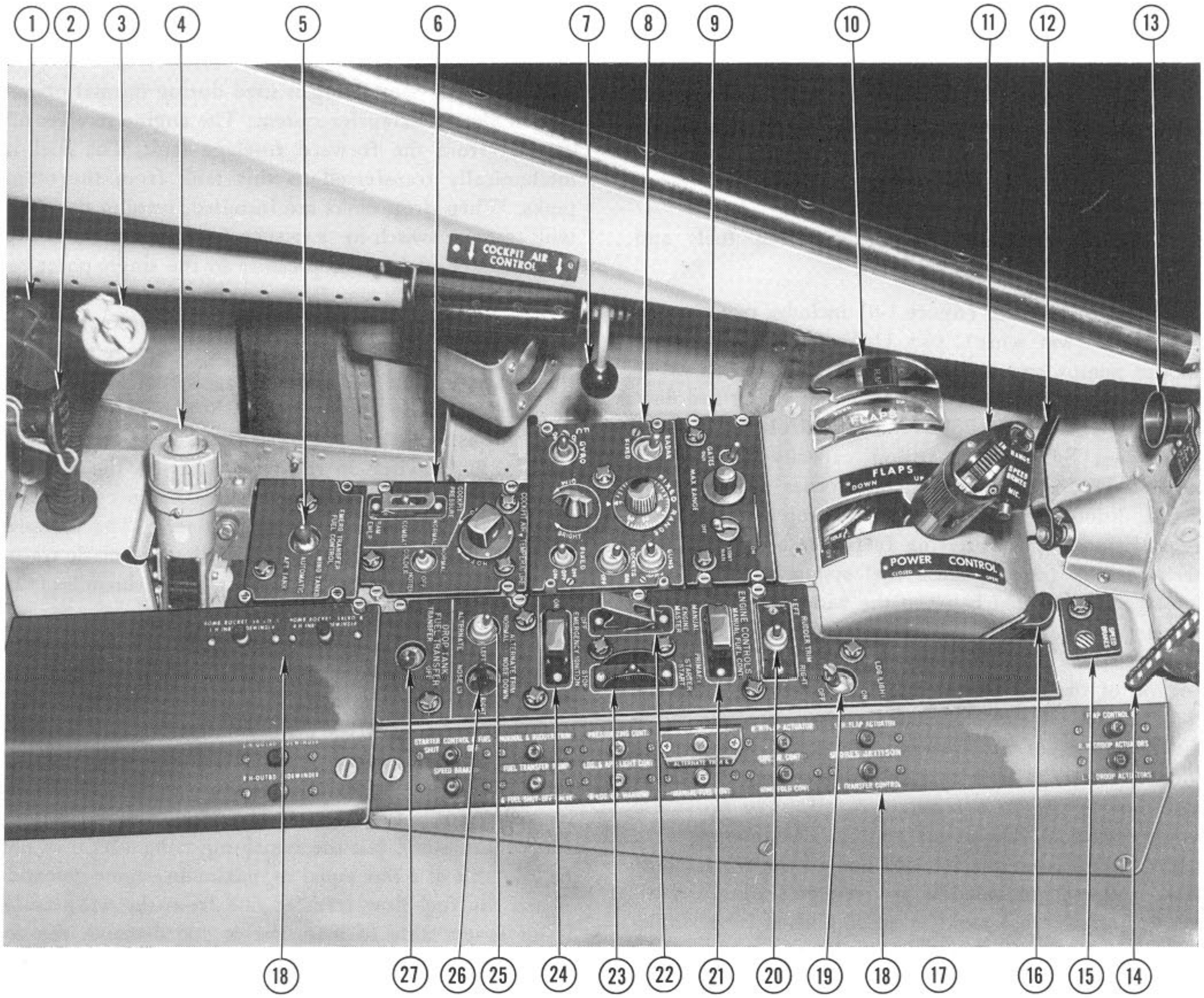
FUEL TRANSFER SYSTEM.

The following sequencing is used during normal operation of the fuel transfer system: The engine receives all its fuel from the forward fuselage tank. The fuel is mechanically transferred to this tank from the other tanks. When drop tanks are installed, turning the drop tank transfer switch to TRANSFER (or INB'D or OUTB'D*) will transfer fuel by air pressure to the single-point refueling line and from there to the aft cell and wing tanks. This flow will continue until the drop tanks are empty. The fuel level in the forward fuselage tank will then start to drop and some aft tank fuel will transfer by gravity to the forward tank. When approximately 150 gallons (or 20 gallons§) are used from the forward tank, a float switch in the tank turns on the transfer pump in the aft fuselage tank. This pump cycles until all of the fuel is used from the aft tank. The forward fuselage cell (sump) indication during automatic transfer from the aft tank remains at approximately 1125 (2030§) pounds. When the aft tank is empty, 25 gallons (or 160 gallons§) more are used from the forward tank, reducing its level to approximately 170 gallons. At this time, a float switch turns on the wing transfer pump. This pump cycles, maintaining a forward fuselage cell (sump) indication of approximately 1000 pounds, until all but approximately 30 gallons of wing tank fuel is used. At this time, the cycling stops and the pumps run continuously, but the remaining wing fuel may not be available at a rate equal to maximum engine demand. When the fuel flow transfer rate from the wing tanks is no longer able to meet the engine demand, the remaining 170 gallons in the forward fuselage tank will be used. During this time, the remaining wing fuel will be transferred at whatever rate fuel is available. Should all boost and transfer pumps fail, most of the fuel will flow by gravity into the forward fuselage tank and will be delivered through the engine-driven pump to give optimum performance at low engine demands and wings-level, low angle-of-attack flight attitudes.

Fuel is pumped from the forward fuselage cell, through a shutoff valve and low-pressure filter, to the engine-driven high-pressure fuel pump by two submerged booster pumps in the forward fuselage tank. One pump is located in the forward portion and one in the aft portion of the tank. The forward booster pump is powered from the monitored bus through control action of

***Airplanes 139531 and subsequent**
†Airplanes 139303 and subsequent
‡Airplanes 143543 and subsequent and airplanes having Service Change No. 460 complied with
§Airplanes 143543 and subsequent

LEFT CONSOLE



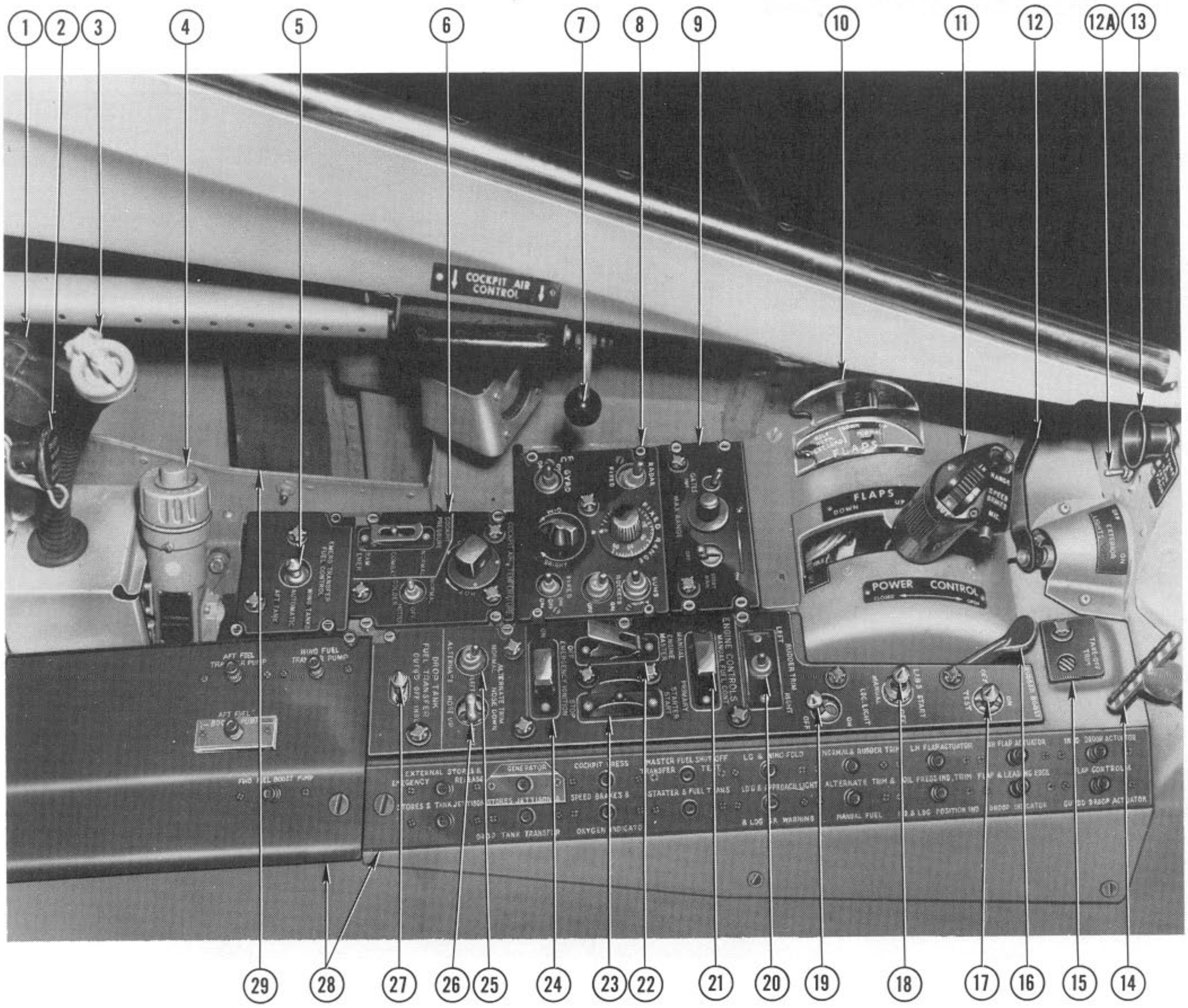
1. COCKPIT LIGHT
2. SPEED BRAKE DUMP VALVE
3. ANTI-G SUIT CONNECTION
4. ANTI-G VALVE
5. EMERGENCY TRANSFER FUEL CONTROL SWITCH
6. COCKPIT AIR TEMPERATURE CONTROL PANEL
7. COCKPIT AIR DEFLECTOR CONTROL
8. AFCS CONTROL PANEL
9. RADAR SET CONTROL PANEL
10. WING FLAP CONTROL
11. THROTTLE
12. THROTTLE CATAPULT GRIP
13. STORE AND TANK JETTISON BUTTON
14. STORE AND TANK MANUAL JETTISON CONTROL
15. SPEED BRAKE POSITION INDICATOR
16. THROTTLE FRICTION CONTROL
17. (DELETED)
18. CIRCUIT-BREAKER PANEL
19. LANDING LIGHT SWITCH
20. RUDDER TRIM SWITCH
21. MANUAL FUEL CONTROL SWITCH
22. ENGINE MASTER SWITCH
23. START-STOP SWITCH
24. EMERGENCY IGNITION SWITCH
25. TRIM CONTROL SELECTOR SWITCH
26. STABILIZER-AILERON ALTERNATE TRIM SWITCH
27. DROP TANK TRANSFER SWITCH

FJ-4-1-00-15B

Figure No. 1-6. (Sheet 1)

AIRPLANES 139531 AND SUBSEQUENT

LEFT CONSOLE



1. COCKPIT LIGHTS
2. SPEED BRAKE DUMP VALVE
3. ANTI-G SUIT CONNECTION
4. ANTI-G SUIT VALVE
5. EMERGENCY TRANSFER FUEL CONTROL SWITCH
6. COCKPIT PRESSURIZATION CONTROL PANEL
7. COCKPIT AIR DEFLECTOR CONTROL
8. AFCS CONTROL PANEL
9. RADAR SET CONTROL PANEL
10. WING FLAP CONTROL
11. THROTTLE
12. THROTTLE CATAPULT GRIP

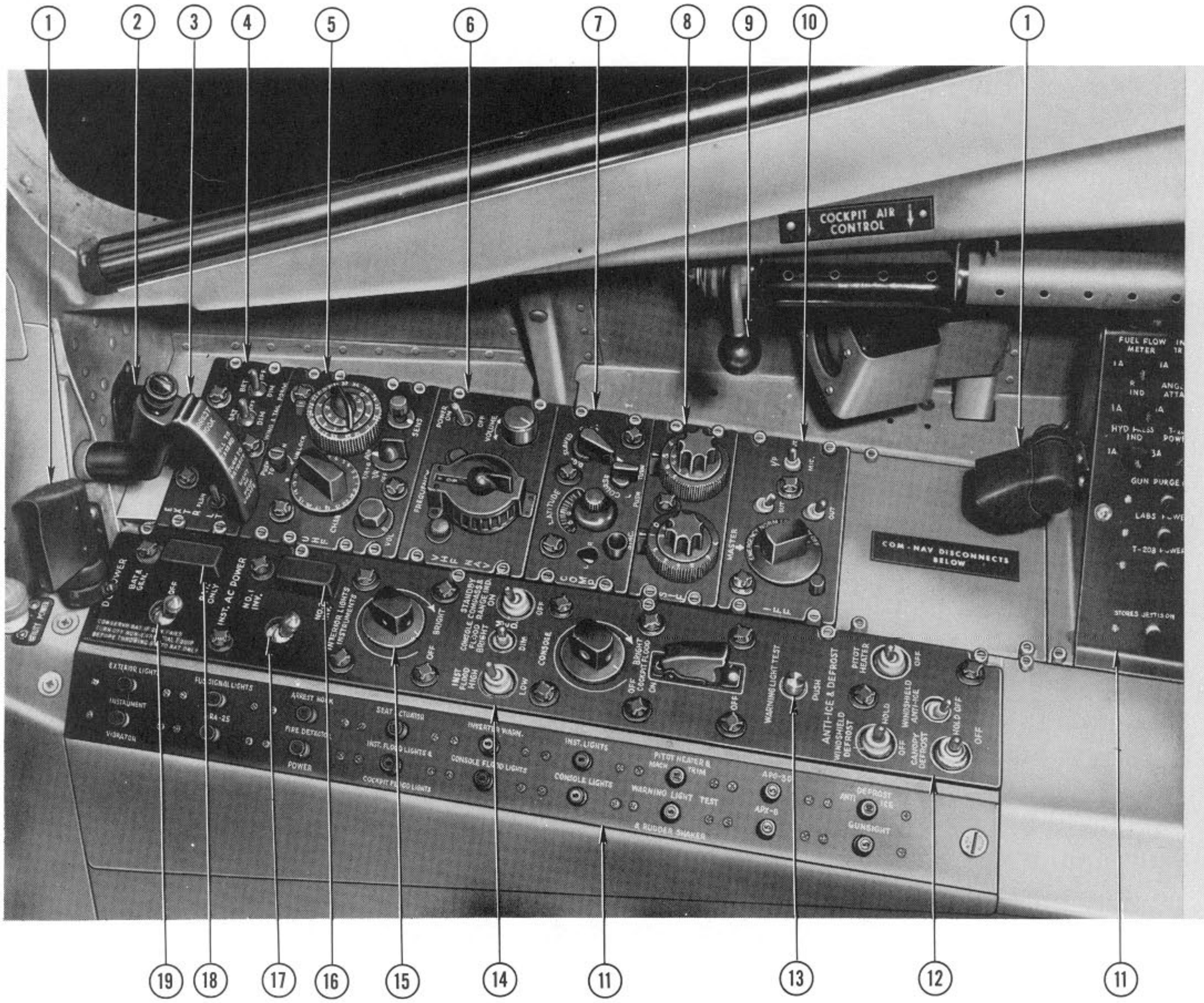
12A. EXTERIOR LIGHTS SWITCH

13. STORE AND TANK JETTISON BUTTON
14. STORE AND TANK MANUAL JETTISON CONTROL
15. TAKE-OFF TRIM INDICATOR
16. THROTTLE FRICTION CONTROL
17. RUDDER BOOST SWITCH
18. LABS START SWITCH
19. LANDING LIGHT SWITCH
20. RUDDER TRIM SWITCH
21. MANUAL FUEL CONTROL SWITCH
22. ENGINE MASTER SWITCH
23. START-STOP SWITCH
24. EMERGENCY IGNITION SWITCH
25. TRIM CONTROL SELECTOR SWITCH
26. STABILIZER-AILERON ALTERNATE TRIM SWITCH
27. DROP TANK FUEL TRANSFER SWITCH
28. CIRCUIT-BREAKER PANELS
29. MAP CASE

FJ-4B-1-00-3B

Figure No. 1-6. (Sheet 2)

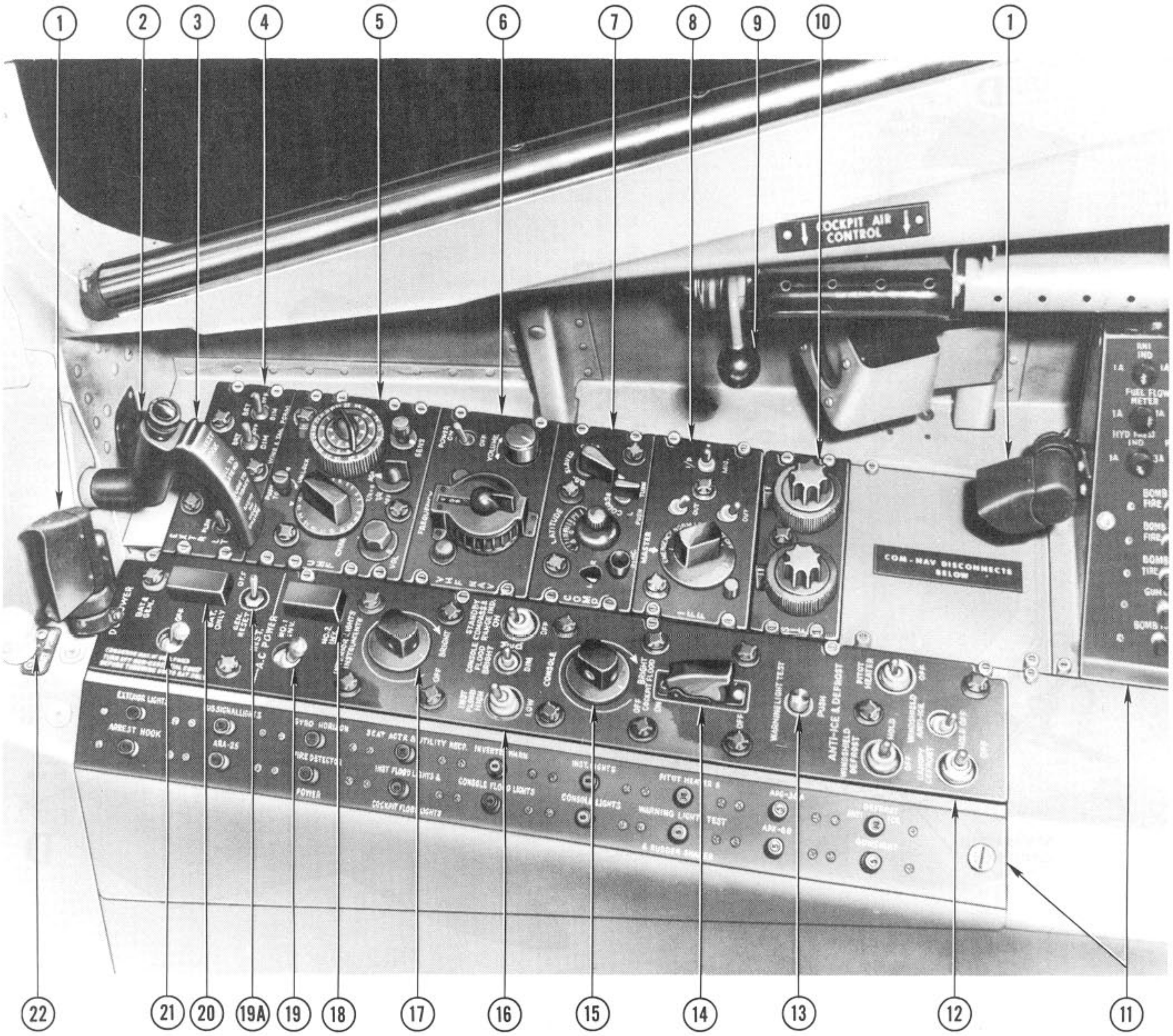
RIGHT CONSOLE



1. COCKPIT LIGHTS
2. IN-RANGE VOLUME CONTROL
3. ARRESTING HOOK CONTROL
4. EXTERIOR LIGHTS CONTROL PANEL
5. UHF COMMUNICATIONS CONTROL PANEL
6. VHF NAVIGATION CONTROL PANEL
7. POLAR PATH COMPASS CONTROL PANEL
8. SIF CONTROL PANEL
9. COCKPIT AIR DEFLECTOR CONTROL
10. IFF CONTROL PANEL
11. CIRCUIT-BREAKER PANELS
12. ANTI-ICE AND DEFROST CONTROL PANEL
13. WARNING LIGHT TEST SWITCH
14. INTERIOR LIGHTS CONTROL PANEL
15. INTERIOR LIGHTS RHEOSTAT
16. INVERTER WARNING LIGHT
17. INSTRUMENT POWER SWITCH
18. GENERATOR WARNING LIGHT
19. BATTERY-GENERATOR SWITCH

Figure No. 1-7. (Sheet 1)

RIGHT CONSOLE AIRPLANES 139531 AND SUBSEQUENT



1. COCKPIT LIGHTS
2. IN-RANGE VOLUME CONTROL
3. ARRESTING HOOK CONTROL
4. EXTERIOR LIGHT CONTROL PANEL
5. UHF COMMUNICATIONS CONTROL PANEL
6. VHF NAVIGATION CONTROL PANEL
7. POLAR PATH COMPASS CONTROL PANEL
8. IFF CONTROL PANEL
9. COCKPIT AIR DEFLECTOR CONTROL
10. SIF CONTROL PANELS
11. CIRCUIT-BREAKER PANEL
12. ANTI-ICE AND DEFROST CONTROL PANEL
13. WARNING LIGHTS TEST SWITCH
14. COCKPIT FLOODLIGHTS SWITCH
15. CONSOLE LIGHTS RHEOSTAT
16. INTERIOR LIGHTS CONTROL PANEL
17. INTERIOR LIGHTS RHEOSTAT
18. INVERTER FAILURE WARNING LIGHT
19. INSTRUMENT A-C POWER SWITCH
19A. GENERATOR RESET SWITCH*
20. GENERATOR OUT WARNING LIGHT
21. D-C POWER SWITCH (BATTERY-GENERATOR SWITCH)
22. UTILITY POWER RECEPTACLE

*AIRPLANES 141444 AND SUBSEQUENT AND AIRPLANES HAVING SERVICE CHANGE NO. 374 COMPLIED WITH

FJ-4B-1-00-4A

Figure No. 1-7. (Sheet 2)

AIRPLANE FUEL SYSTEM

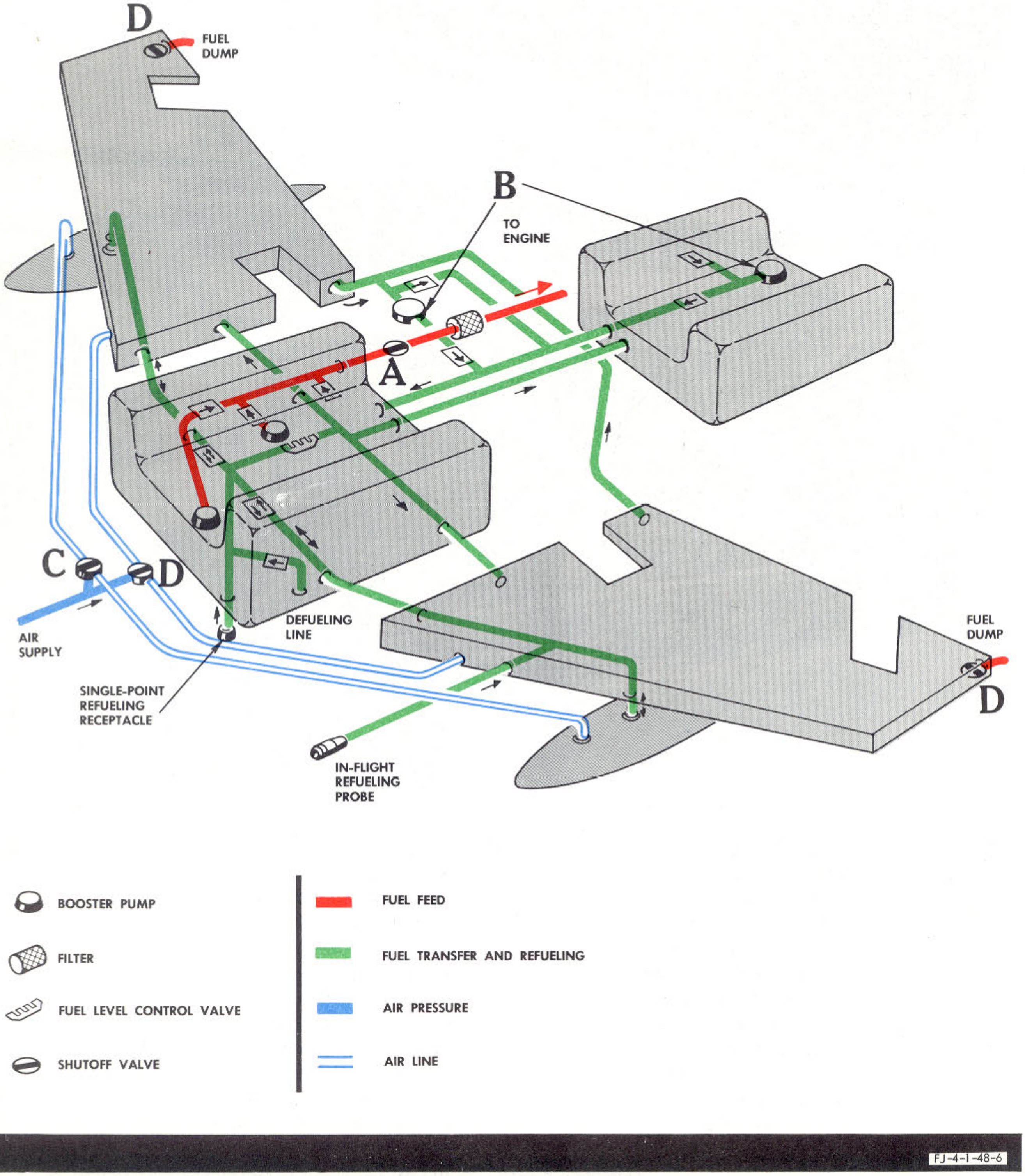


Figure No. 1-8. (Sheet 1)

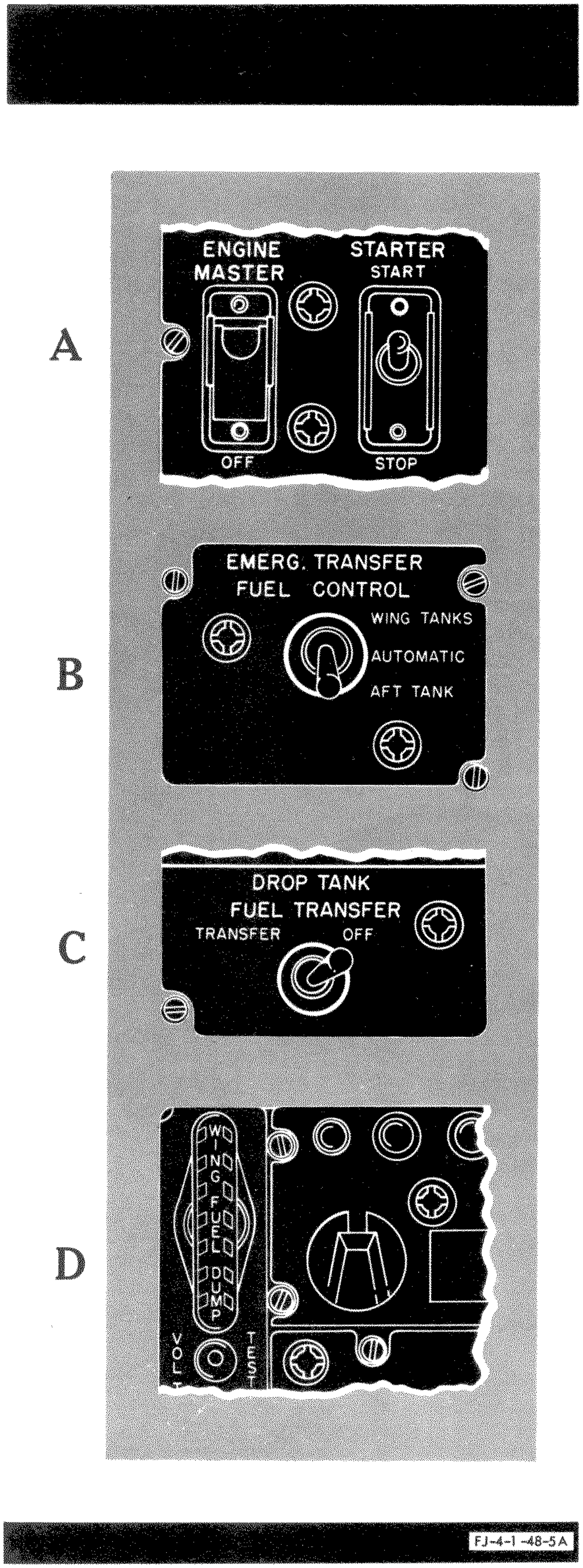


Figure No. 1-8. (Sheet 2)

the landing gear downlock relay. This control action has been incorporated so that the forward booster pump will be inoperative with the landing gear in the down and locked position. This will prevent possible engine fuel starvation through uncovering of the forward booster pump during flight operations where the forward fuselage (sump) tank fuel is low and the angle of attack is high. The aft booster pump is powered from the primary bus and is controlled by the engine master switch. The output of the pumps is joined in a manifold which also incorporates provisions for suction feed by allowing the engine-driven pump to draw fuel direct from the forward fuselage tank. The lines from each pump contain a check valve to prevent one pump from pumping fuel back through the other pump if it is inoperative. The circuit breakers for the fuel booster pumps are located in the cockpit for pilot accessibility. On some airplanes,† the circuit breakers are located on the right-hand rear console while on other airplanes,* the fuel booster pump circuit breakers are located on the left-hand rear console. The suction feed system is incorporated in case both booster pumps should become inoperative. With the suction feed system in use with JP-4 fuel, engine operation should be nearly normal below 20,000 feet. Above this altitude, engine operation will be erratic and a flame-out may occur. Operation on one booster pump should be normal at all altitudes, but, if both pumps should go out in a climb out, the first indication will be a mild fluctuation (200 to 300 pounds) of fuel flow.

Fuel transfer for the wing tanks consists of a line running from each wing sump to the center of the airplane where the two lines join before going to a transfer pump. From the pump a line joins the transfer line from the aft cell. A line and check valve are provided as a by-pass around the pump in case of pump failure. The forward pump in the forward fuselage cell becomes inoperative when the landing gear is lowered to prevent pumping air from the tank into the fuel system when the airplane is in a nose-high landing attitude with low fuel.

On some airplanes,† the fuel transfer circuit breakers are located on the pilot's right aft console while on other airplanes,* the circuit breakers are located on the left aft console. On some airplanes,‡ a low level switch is incorporated in the aft fuel cell which automatically turns off the transfer pump when the fuel cell is empty.

***Airplanes 139531 and subsequent**
†Airplanes 139282 through 139350
‡Airplanes 139491 and subsequent and airplanes having Service Change No. 464 complied with

AIRPLANE FUEL SYSTEM

AIRPLANES 139531 AND SUBSEQUENT

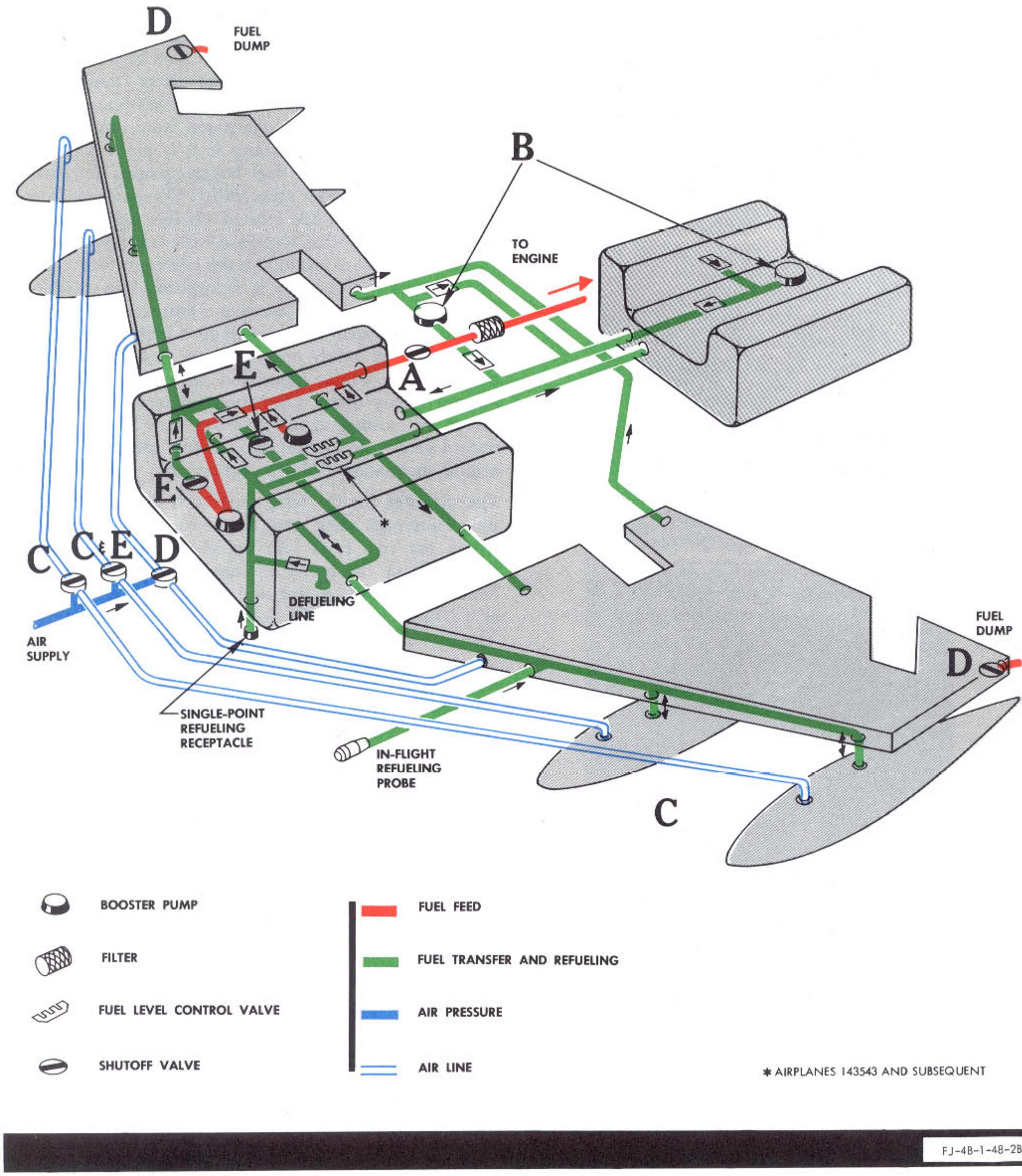


Figure No. 1-8. (Sheet 3)

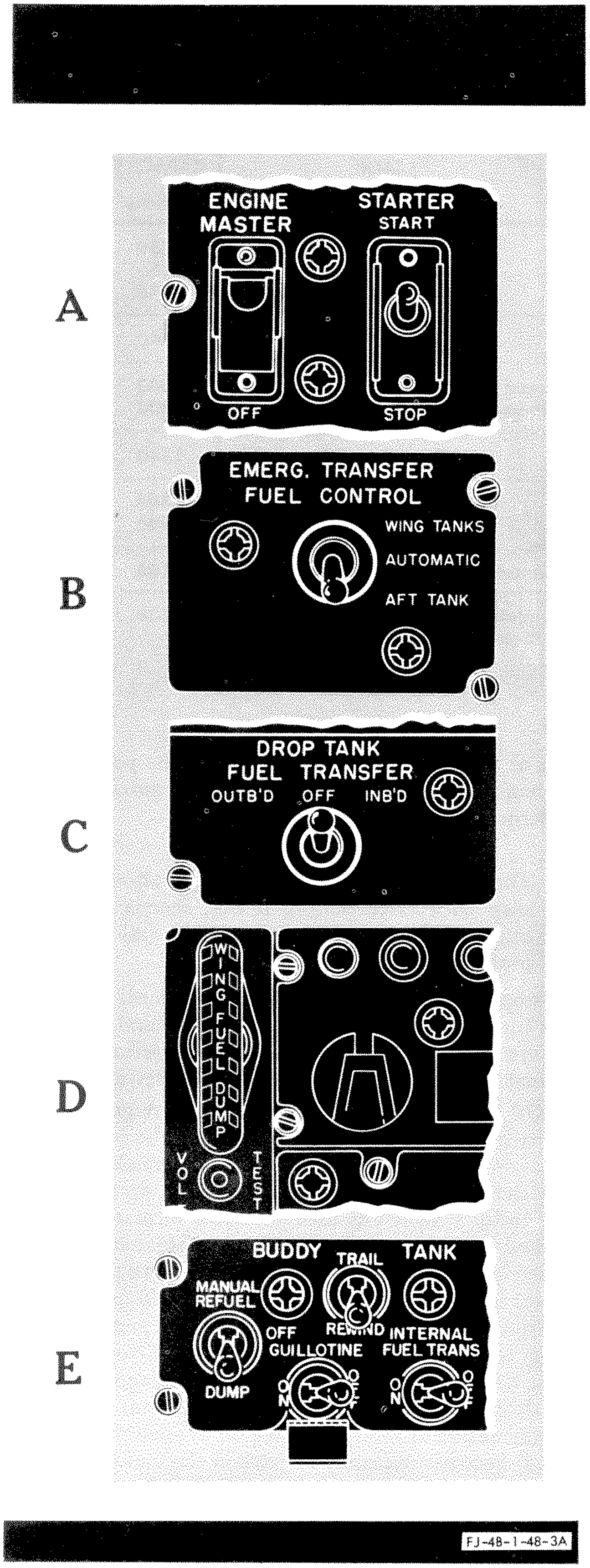


Figure No. 1-8. (Sheet 4)

MANUAL FUEL SEQUENCING.

A switch (5, figure 1-6), located on the left console, is provided for manual selection of fuel in case the automatic sequencing fails. The guarded three-position switch is marked: WING TANK (forward), AUTOMATIC (center) and AFT TANK (aft). Moving this switch out of the AUTOMATIC position will by-pass the automatic fuel sequencing of the related tank. The transfer pump in the selected tank will then provide fuel to the forward fuselage cell. This switch can be actuated for test purposes but should not be used during flight, unless the automatic sequencing malfunctions, as manual selection of the tanks will shift the center-of-gravity location. If manual sequencing is used, the aft tank should be selected and emptied first to maintain a satisfactory wing loading condition.

Note

In order to maintain satisfactory CG and structural load conditions during emergency fuel transfer (manual sequencing), the forward fuselage cell (sump) quantity should not exceed 1200 pounds. On FJ-4B airplanes, the sump quantity should be maintained between 1500 and 2000 pounds during manual transfer of aft tank fuel, and subsequently between 1000 and 1500 pounds during wing tank fuel transfer.

FUEL JETTISONING.

Wing tank fuel may be dumped at the approximate rate of 100 gallons a minute from each tank. Each wing has a line running outboard from the wing sump area through a manually operated shutoff valve to the trailing edge of the wing near the tip. This valve is controlled by a "T" handle located on the center pedestal. [See figure 4-1 in the Supplemental Flight Handbook (NAVAER 01-60JKD-501A).] When the valve is open, fuel is dumped through this line by pressurizing the wing tanks. High-pressure air for dumping is supplied by the heat and vent compressor bleed air. (See figure 4-1.) This air pressure is controlled by relief valves and orifices to 9 psi. Check valves are used to isolate the two

FUEL QUANTITY DATA

FJ-4

TANK	TOTAL CAPACITY Gallons
Forward fuselage tank Aft fuselage tank Integral wing tanks (2)	339 155 346
Total internal fuel capacity	840
Drop tanks (2)	400
Total available fuel	1240

FJ-4B

TANK	TOTAL CAPACITY Gallons
Forward fuselage tank Aft fuselage tank Integral wing tanks (2)	339 155 346
Total internal fuel capacity	840
Inboard drop tanks, STA. 2 & 5 (2) Outboard drop tanks (2)	400 300
Total long range fuel	1540
Buddy tanker package (LH) (RH)	344 224
Total internal plus buddy tanker fuel	1408
Total internal plus buddy tanker plus outboard drop tank fuel	1708

FJ-4/B-1-48-1A

Figure No. 1-9.

sides of the system, making it possible to finish emptying one wing after the other has been emptied. When it becomes necessary to dump fuel, the wing dump lever in the cockpit will mechanically open the outboard wing dump valves, close the wing tank vent valve and open the wing tank dump air supply valve. The pilot should manually close the dump valve when the wing tanks are empty or prior to landing.

FUEL SYSTEM CONTROLS.

FUEL SHUTOFF CONTROL. The main fuel shutoff valve is operated by the engine master switch. The valve opens when the master switch is turned on and closes when the switch is off, regardless of the position of the battery-generator switch.

CAUTION

Do not move master switch to OFF when engine is rotating as fuel lines may collapse.

FUEL JETTISON VALVE. A "T" handle, located on the center pedestal [figure 4-1 in the Supplemental Flight Handbook (NAVAER 01-60JKD-501A)], mechanically controls the wing tank fuel dump valves, the wing tank vent valve and the wing tank dump air valve. Pulling this handle aft will start the fuel dump system operating. The handle is designed to pull out approximately 3¾ inches, at which point a latch in the mechanism will engage to hold the system in the dump position. The handle should then be positioned manually to within ¾ inch of the normal position to prevent any possibility of the handle interfering with control stick movements and to permit continuation of fuel dumping.

Note

The handle is spring-loaded and, if allowed to snap back after pulling it out, inertia forces can cause the handle to return to the full closed position.

To stop the fuel dumping, the handle must be pushed full forward, with the heel of the left hand, to release the system latch. The handle should be returned to the normal position when dumping is completed.

DROP TANK TRANSFER SWITCH. A guarded toggle switch (27, figure 1-6), located on the left aft console, controls air pressure from the windshield anti-icing and defrosting system to the auxiliary drop tanks. A two-position switch is used on some airplanes* and is marked TRANSFER and OFF. Other airplanes† utilize a three-position switch marked INB'D, OUTB'D and OFF. When the switch is in either INB'D, OUTB'D or TRANSFER position, drop tank fuel is directed by air pressure to the wing tanks and the aft fuselage cell. Overflow from these tanks is directed to the forward fuselage cell. When the drop tanks are installed, the outboard tank fuel must be transferred as soon after take-off as possible so that in case it becomes necessary to jettison the tanks, the maximum amount of auxiliary fuel will have been used. The switch may be left in the transfer position after the tanks are empty to allow the air to purge the tanks. A fuel level control valve in the forward fuselage tank prevents

***Airplanes 139281 through 139530**
†Airplanes 139531 and subsequent

this tank from becoming overloaded from drop tank transfer. When the outboard (150-gallon) drop tanks are being utilized, it is necessary that this fuel be used before the inboard (200-gallon) drop tank fuel is used. This fuel should be used as soon as possible after take-off to maintain satisfactory CG conditions. If it is evident that outboard (150-gallon) drop tank fuel is not transferring, it is recommended that a field landing be made as soon as possible to preclude flight under aft CG conditions. However, if a field landing cannot be made, as in the case of carrier or tactical operations, the aft CG control problem can be corrected by jettisoning the outboard drop tanks. (Refer to EMERGENCY STORES RELEASE CONTROLS, in this section.)

On missions that require in-flight refueling, fuel in the inboard (200-gallon) drop tanks should be retained until after the in-flight refueling has been completed. This will provide better CG travel characteristics during the in-flight refueling operation and will also minimize the refueling time.

If the buddy tanker package is being carried, tanker fuel can be transferred to the airplane's system by placing the transfer switch to the INB'D position. This directs air pressure from the engine into the tanker tanks and routes the fuel into the airplane's internal system. If it is desired to transfer internal fuel to the buddy tanker package, the aircraft should be flown only in level flight under one G conditions while the fuel is being transferred. This is necessary since the forward boost pump is used to transfer fuel to the drop tanks and, should the aft boost pumps become uncovered due to attitude or G forces, an engine flame-out would occur after the fuel in the feed line was depleted.

EMERGENCY STORES RELEASE CONTROLS. Both drop tanks (and all stores) can be released simultaneously by depressing the button marked "STORES & TANKS JETTISON," located forward of the left console, or by pulling the emergency stores release handle located forward of the left console (14, figure 1-6). This handle is connected to a cable release and is operative regardless of the airplane's position. Pulling this handle will release all external stores. On some airplanes,* if electrical power is not available, stations 2 and 5 jettison mechanically when the handle is pulled out fully. If a special weapon is installed at station 2, battery power is required for its jettisoning. Other

*Airplanes 139531 and subsequent

methods of releasing the drop tanks are described under SPECIAL STORE JETTISONING, in Section IV of the Supplemental Flight Handbook (NAVAER 01-60JKD-501A) and are part of the special stores release system.

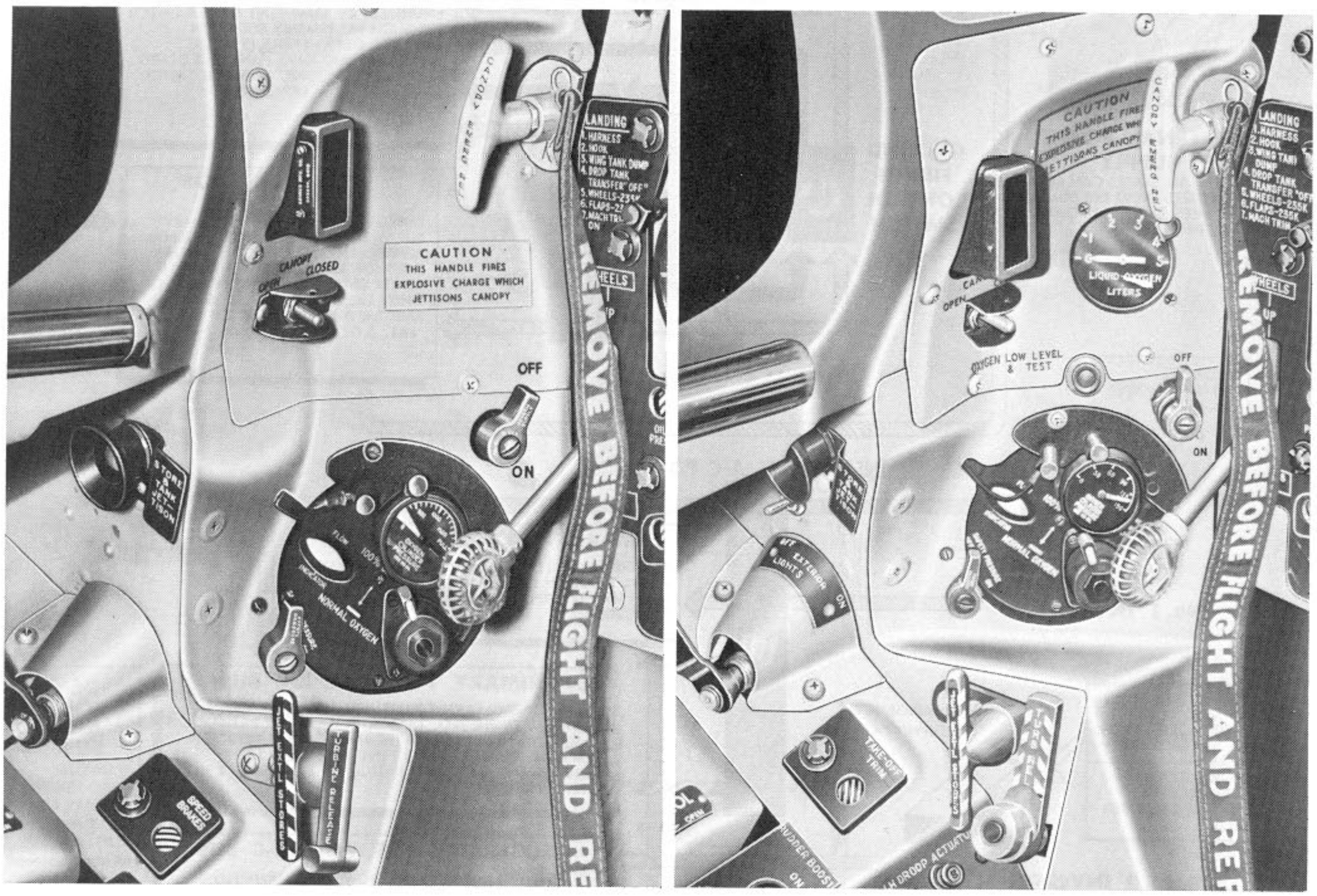
Note

This button will release stores only if the weight of the airplane is off the landing gear.

FUEL SYSTEM INDICATORS.

FUEL QUANTITY INDICATOR. A capacitance-type fuel indicator (20, figure 1-5), which indicates total internal fuel, is mounted on the instrument panel. The gage will indicate the total amount of internal fuel available to the engine. A yellow band appears on the face of the indicator between 1100 and 1000 pounds. With the fuel selector switch positioned to SUMP during automatic fuel sequencing, this band indicates the normal sequence start of fuel transfer. On some airplanes,* the indicator face contains a second yellow band between 2190 and 2030 pounds. This band indicates the range in which aft tank automatic fuel transfer takes place, while the band between 1100 and 1000 pounds indicates the start of automatic fuel transfer from the wing tanks. There are no provisions for indicating the amount of fuel in the drop tanks. A fuel gage selector switch (16, figure 1-5), located on the instrument panel adjacent to the fuel indicator, provides a two-way check of the indicating system. In the TOTAL (up) position, the switch permits measurement of total fuel available. In the SUMP (center) position, the indicator will show only the fuel in the forward fuselage tank. The spring-loaded CHECK (down) position checks the indicator by deflecting the needle counterclockwise.

LEFT FORWARD CONSOLE



AIRPLANES 139281 THROUGH 139530

AIRPLANES 139531 AND SUBSEQUENT

FJ-4/B-1-00-26A

Figure No. 1-10.

***Airplanes 143543 and subsequent**

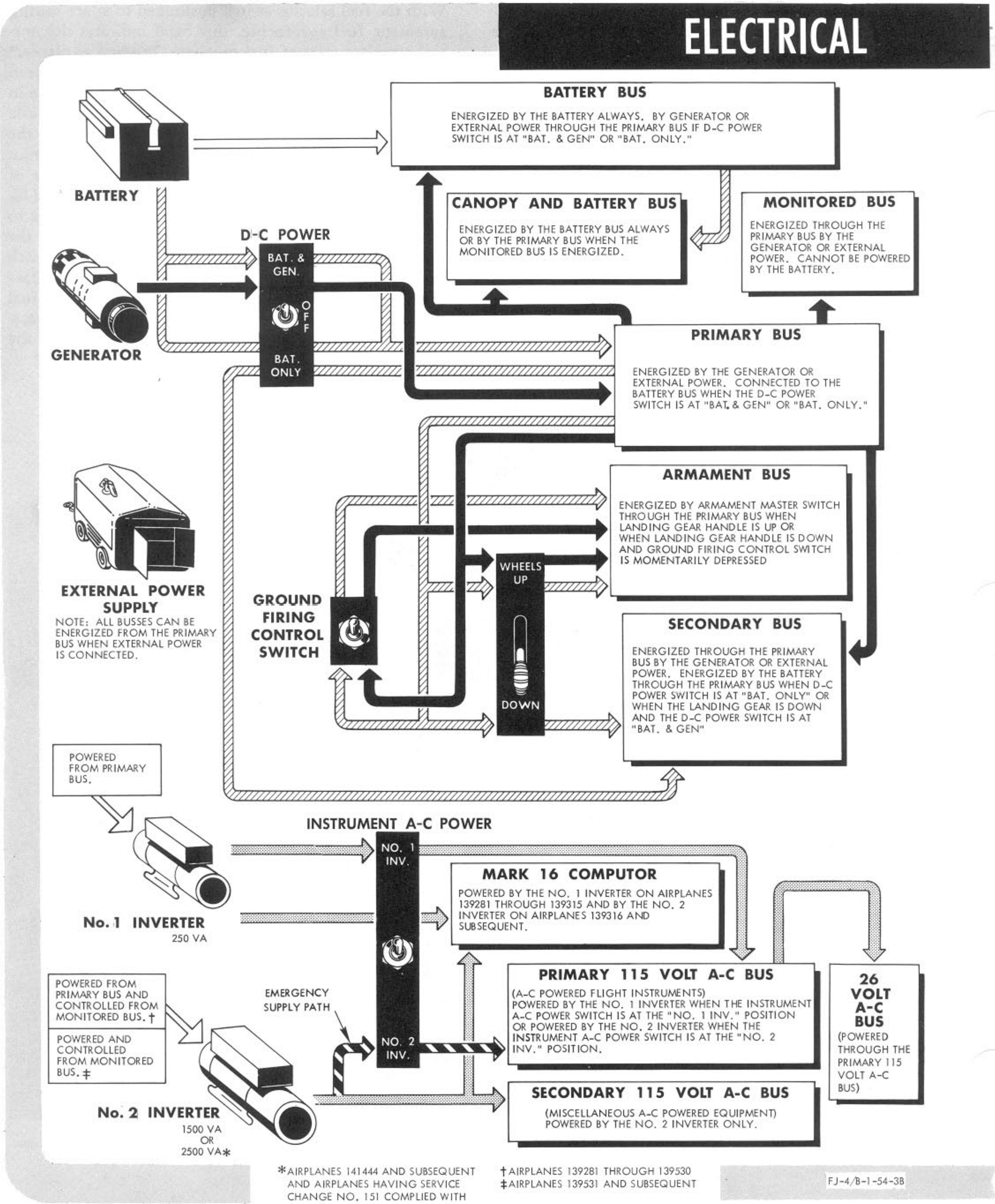


Figure No. 1-11. (Sheet 1)

POWER DISTRIBUTION

PRIMARY BUS

AMPS	
124.00	Ammunition Boosters
67.30	No. 2 Inverter Power†
19.50	Flap Actuators
18.20	Controllable Leading Edge Actuators And Flap Control Relay
17.50	Aft Fuel Transfer Pump
17.10	No. 1 Inverter Power
16.90	Air Compressor*
15.50	Landing Light And Relay
12.70	Wing Fuel Transfer Pump
12.60	Aft Fuel Boost Pump (Forward Cell)
7.90	Pitot Heater
4.00	Pilot's Seat Actuator
3.68	Angle-Of-Attack System
3.40	Wing Fold Selector Valve, Emergency Accumulator Charging Valve, Landing Gear And Door Hydraulic Solenoid Valve
3.20	Cockpit Pressurization System Shut-Off Valve, Ram Air Shut-Off Valve And Cabin Air Safety Valve
3.00	Instruments Lights
3.00	Drop Tank Air Solenoid Valve
2.70	Console And Instrument Panel Lights
2.20	Rudder Trim Actuator
2.00	Warning Light Test Circuit
2.00	Wing Tank Transfer Valve†
2.00	Wing Tank Dump Air Solenoid Valve†
1.50	Air Compressor Dump Valve
1.50	Aft Fuel Shut-Off Valve§§
1.50	Cockpit Floodlights
1.20	Lateral Trim Actuator
1.00	Air Compressor Control System‡
0.80	Compass Controller
0.70	Speed Brake Valve
0.70	Ground Safety Relays
0.70	Longitudinal Trim Actuator
0.60	Secondary Bus Relay
0.60	Monitored Bus Relay
0.50	Rudder Pedal Shaker
0.50	Wing Tank Fuel Vent Valve†
0.35	Armament Master Relay
0.35	Landing Gear Switch Down Relay
0.35	Fire Detector Control Unit
0.34	Fire Detector Warning Lights
0.34	Droop Relays**
0.30	Canopy Seal Regulator
0.30	Cabin Pressure Regulator
0.30	Dual Level Float Valve
0.20	Ground Firing Control Relay
0.17	Inverter Failure Warning Light
0.17	Landing Gear Warning Light
0.17	Windshield Anti-Ice Overheat Warning Light
0.17	Manual Fuel Control Warning Light
0.17	Wing Fuel Shut-Off Warning Light‡
0.17	Mission Data Light**
0.17	Flight Control Hydraulic Pressure Warning Light
0.17	Generator Out Warning Light
0.12	Landing Gear Downlock Relay
0.12	Cockpit Air Control Relay
0.12	Lateral Trim Indicator Control Relay
0.12	Longitudinal Trim Indicator Control Relay
0.12	Landing Gear Retract Control Relay
0.08	Oil Pressure Indicator And Landing Gear Position Indicator
0.05	Speed Brake Position Indicator
0.05	Take-Off Trim Indicator
0.02	Flap Position Indicator
	Inverter Failure Warning Relay
	Special Stores Emergency Power
	Inertia Reel†
	Manual Fuel Control System
	Flap Control Relay
	Warning Light Dimming Relay
	Radio Test Receptacle
	Utility Receptacle
	Aft Speed Brake Retract Valve**
	Mach Trim System
	Aft Fuel Boost Pump Relay
	Aft Fuel Transfer Pump Relay
	Wing Fuel Transfer Pump Relay

BATTERY BUS

AMPS	
70.00	Emergency Flight Control Hydraulic Pump††
5.00	Starter Controller
2.00	Master Fuel Shut-off Valve
0.35	Starter Shunt Field Control Relay

SECONDARY BUS

AMPS	
20.30	AN/ARC-27A Radio Set
5.10	Fuselage Signal Lights
4.90	AN/ARN-14E Omni-Range Receiver
2.80	Exterior Lights
2.80	Approach Light, Hook By-pass Control Relay And Arresting Hook Warning Light
2.00	AN/ARA-25 Direction Finding Equipment
1.00	Heat Exchanger Modulating Valve
1.00	Cockpit Hot Air Modulating Valve
0.90	Gun Bay Purge Doors Hydraulic Solenoid Valve
0.90	Instrument Panel Vibrator
0.70	Arresting Hook Valve
0.20	Approach Light Dimming Relay
0.12	Cockpit Temperature And Anti-Ice Control Relay
	Gun Camera Test Circuits

MONITORED BUS

AMPS	
57.2	No. 2 Inverter
12.6	Forward Fuel Boost Pump
3.60	Water Separator Heater
3.20	Radar Set
1.60	Windshield Anti-Ice Valve
1.50	Gun Sight System
1.45	Gun Camera
0.90	Identification System (APX-6B)
0.50	Windshield Defrost Valve
0.50	Canopy And Battery Bus Relay
0.35	Forward Fuel Boost Pump Relay
	No. 2 Inverter Control†
	Special Stores Power
	Low Altitude Bombing System

CANOPY AND BATTERY BUS

AMPS	
21.30	Canopy Actuator
0.60	Battery Bus Relay
0.35	Canopy Open Relay
0.35	Canopy Close Relay
0.22	Canopy Seal Depressurize Control Relay

ARMAMENT BUS

AMPS	
1.40	Ammunition Boost Relays
1.5	Gun Charging Valves And Relays
1.00	Gun Bay Purge Time Delay Relay
0.36	Gun Firing Controls
0.20	Gun A-C Power Relay
0.20	Gun Firing Relay
0.20	Gun Camera Relay
	Bomb and Rocket Firing System
	Special Stores Systems

PRIMARY 115 VOLT A-C BUS

VOLT-AMPS	
104.7	Gyro Horizon
101.5	Gunsight Computer§‡‡
86.0	Polar Path Compass And Indicators
17.7	Fuel Quantity Indicating System
10.9	Angle-Of-Attack System
9.9	Liquid Oxygen System
7.0	Inverter Failure Warning Relay

SECONDARY 115 VOLT A-C BUS

VOLT-AMPS	
376.1	AN/ARN-21 Radio Navigation Receiver
167.0	Identification System (APX-6B)
130.0	Gunsight System
101.5	Gunsight Computer¶
50.6	Gun Firing Power Supplies
39.0	Low Altitude Bombing System
33.2	Radar Set (APG-30A)
17.1	Anti-Ice Regulator
11.5	Longitudinal Trim Amplifier**

26 VOLT AC BUS

VOLT-AMPS	
	Polar Path Compass and Indicators
9.0	Fuel Flowmeter System And Hydraulic Pressure Indicating System

* AIRPLANES 139282 THROUGH 139290, 139293 AND SUBSEQUENT
† AIRPLANES 139281 THROUGH 139323, 139424 THROUGH 139530
§§ AIRPLANES 143543 AND SUBSEQUENT
‡ AIRPLANES 139291 and 139292
§ AIRPLANES 139281 THROUGH 139315
‡‡ AIRPLANES 139471 AND SUBSEQUENT
¶ AIRPLANES 139316 AND SUBSEQUENT
** AIRPLANES 139_31 AND SUBSEQUENT
†† AIRPLANES 139287, 139289 THROUGH 139322

FJ-4/B-1-54-1C

Figure No. 1-11. (Sheet 2)

CIRCUIT BREAKERS

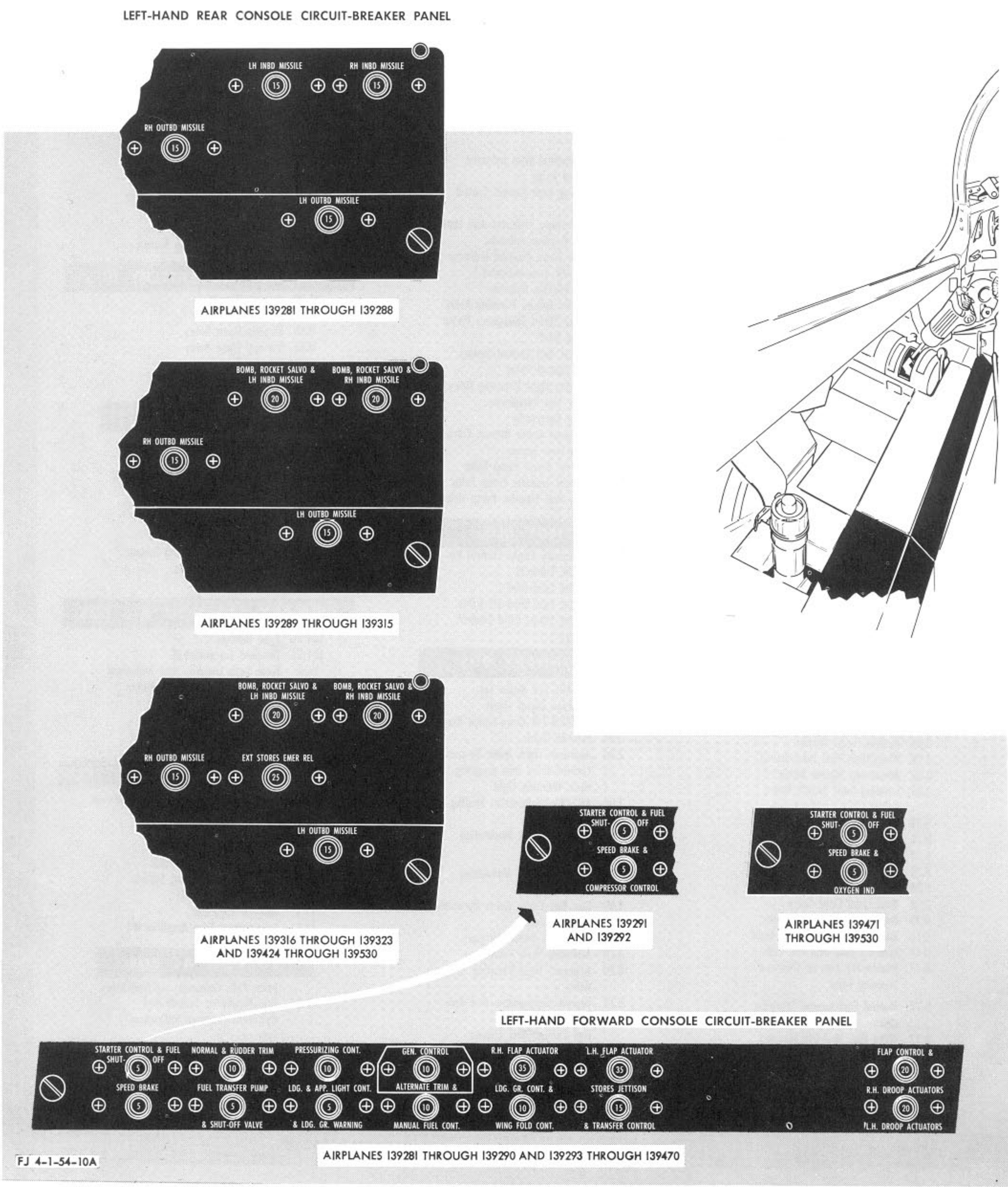


Figure No. 1-12. (Sheet 1)

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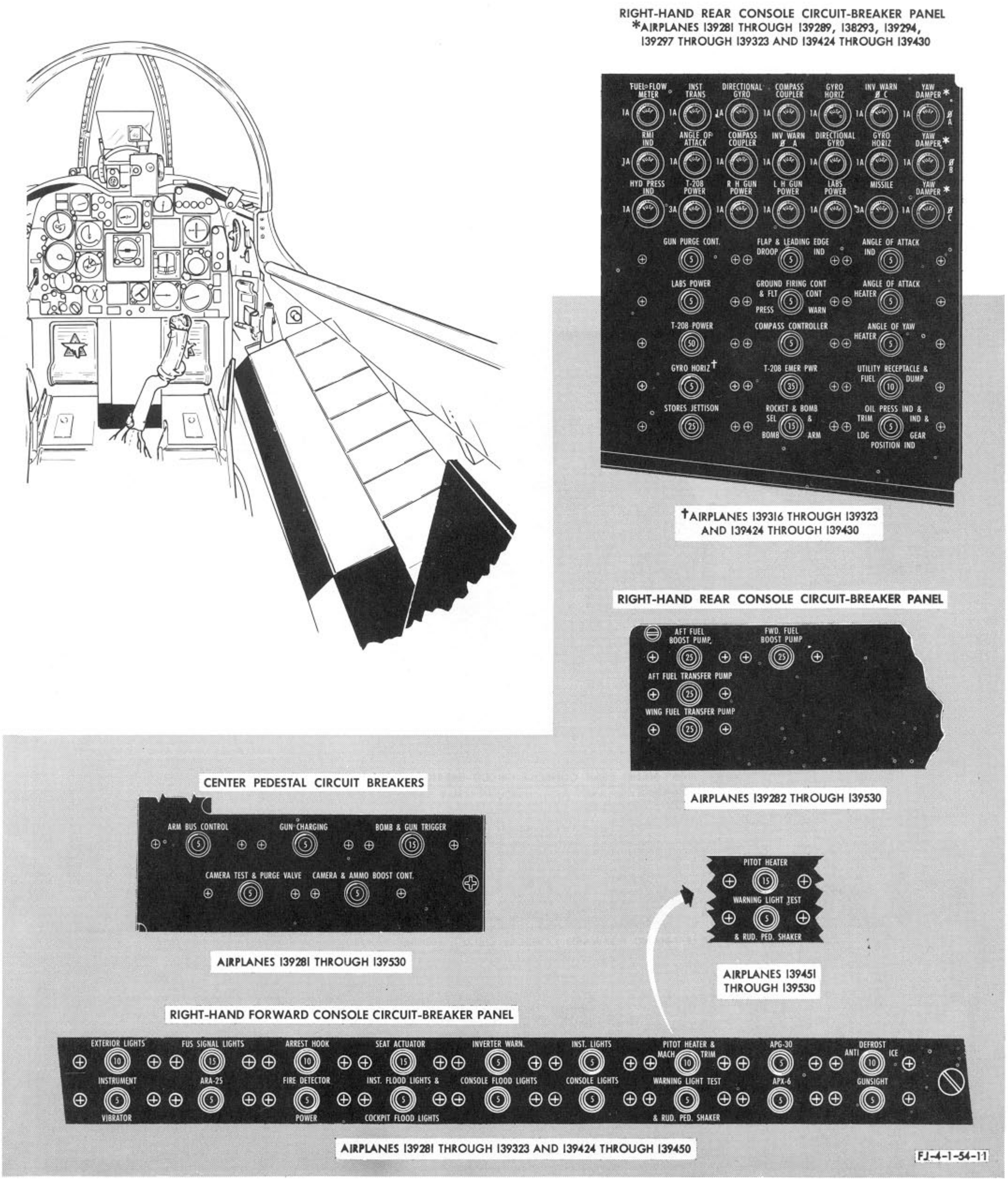


Figure No. 1-12. (Sheet 2)

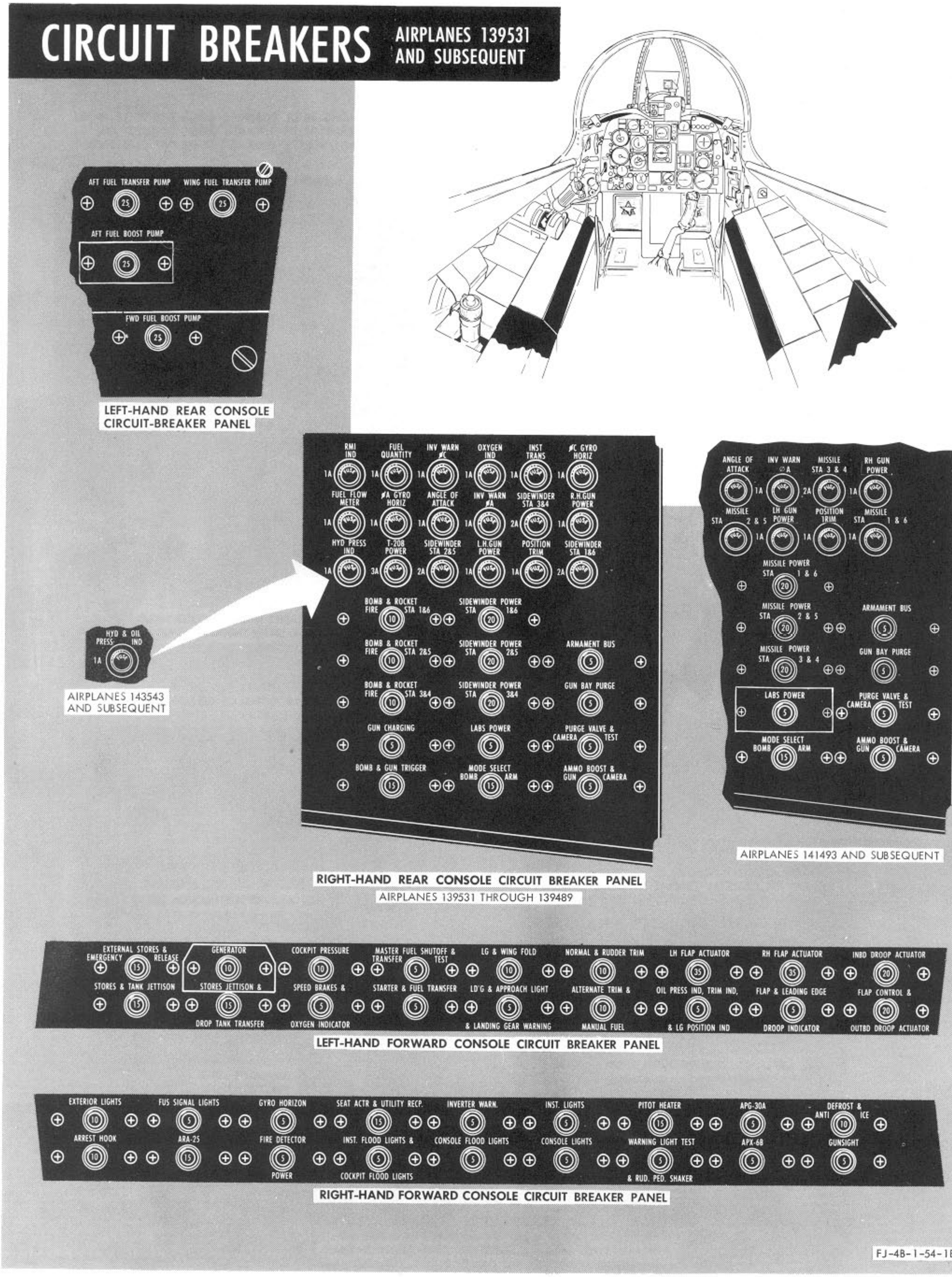


Figure No. 1-12. (Sheet 3)

FUEL LEVEL WARNING LIGHT. A warning light (19, figure 1-5), located on the instrument panel adjacent to the fuel quantity indicator, illuminates when the combined fuselage fuel level is down to approximately 146 gallons [950 (±50) pounds].

CAUTION

The fuel level warning light operates from a float-type switch and may give momentary false low readings during negative "G" maneuvers.

WING FUEL SHUT-OFF WARNING LIGHT. An indicator light (18, figure 1-5, sheets 1 and 2) located on the instrument panel, will illuminate whenever wing fuel is not available for transfer. When the wing tank dump valve is over 10 percent closed, the light will illuminate. On some airplanes,§ the wing fuel shut-off warning light feature has been eliminated.

FUEL FLOWMETER. The fuel flowmeter (33, figure 1-5, sheet 1, and 32, figure 1-5, sheets 2 and 3), mounted on the instrument panel, is an autosyn-type instrument. Indicator readings reflect the voltage transmitted by the fuel flowmeter transmitter. This voltage is proportional to the rate of fuel flow through the transmitter. The indicator scale is graduated in varying increments within a range of 0 to 12. Multiplying the scale reading by 1000 will give the actual rate of fuel flow in pounds per hour.

FUEL CAPACITY.

The fuel capacities of each tank are given in figure 1-9.

ELECTRICAL POWER SUPPLY SYSTEM.

The airplane is equipped with a-c and d-c electrical power systems. During normal flight operation, d-c power is supplied from a 500-ampere, combination starter-generator. In an emergency, power can be supplied from the 24-volt, 24-ampere-hour battery. D-C power can also be supplied through the external power receptacles. Power for the a-c system is supplied by two 3-phase inverters.

DIRECT-CURRENT ELECTRICAL POWER DISTRIBUTION.

The following six busses comprise the interlocking bus system for d-c power distribution (figure 1-11): battery, canopy and battery, primary, secondary, armament and monitored. The primary bus may be connected to any or all of the three sources of power. The battery bus is connected to the airplane's battery by a quick-disconnect plug and is energized whenever the battery is installed in the airplane. The canopy and battery bus is connected to the battery bus if only the battery is available as a power source. It is connected to the primary bus when either external power or generator output is available. The secondary bus, when energized, is always energized from the primary bus. It is energized when the generator is powering the primary bus, or it can be energized from the battery by placing the battery-generator switch in the BAT. ONLY position. The secondary bus will also be energized when the landing gear control is in the DOWN position. The monitored bus is energized from the primary bus when either external power is applied or generator output is available. The armament bus is energized when the armament master circuit-breaker switch is ON and the landing gear control is in the UP position. Some airplanes¶ incorporate overvoltage protection for the generator so that if more than 32 volts should be applied to the d-c electrical system, the generator will automatically cut out. A generator reset switch is incorporated to restore generator operation. (Refer to ELECTRICAL OVERVOLTAGE, in Section III.)

ALTERNATING-CURRENT ELECTRICAL POWER DISTRIBUTION.

The a-c power system consists of one 1500 volt-ampere inverter, one 250 volt-ampere inverter, an inverter failure indicating relay, an instrument power-off warning light and an instrument power selector switch. On some airplanes,* the 1500 volt-ampere inverter has been replaced by a 2500 volt-ampere capacity inverter. During normal operations, both inverters operate and furnish power simultaneously; the No. 1 (small) inverter is powered and controlled by the primary d-c bus and the No. 2 (large) inverter is powered by the primary d-c bus and controlled by the monitored bus on some airplanes† or powered and controlled by the monitored bus on other airplanes.‡ The No. 1 (small) inverter functions whenever the primary d-c bus is energized while the No. 2 (large) inverter functions only when the generator is operating or when an external power source is connected. With the instrument power switch at the NO. 1 INV. position, the No. 1 (small) inverter furnishes instrument power to the primary a-c bus while the No. 2 (large) inverter powers other a-c equipment through the secondary a-c bus.

Should failure of the No. 1 (small) inverter occur, the instrument power load may be transferred to the No. 2 (large) inverter by positioning the instrument power switch to the NO. 2 INV. position. The No. 1 (small) inverter is then disconnected from the primary a-c bus. Should the No. 2 (large) inverter fail, all secondary bus a-c powered equipment will be lost and instrument power through the No. 1 (small) inverter will be maintained as long as the instrument power switch is retained in the NO. 1 INV. position. In the case of generator failure, the battery will provide power to the No. 1 (small) inverter and to the electrically powered emergency flight control hydraulic pump on those airplanes so equipped.

***Airplanes 141444 and subsequent and airplanes having Service Change No. 151 complied with**
†Airplanes 139281 through 139530
‡Airplanes 139531 and subsequent
§Airplanes 139531 and subsequent and airplanes having Service Change No. 466 complied with
¶Airplanes 141444 and subsequent and airplanes having Service Change No. 374 complied with

ELECTRICALLY OPERATED EQUIPMENT.
For electrically operated equipment, see figure 1-11.

EXTERNAL POWER RECEPTACLES.
Two external power receptacles (figure 1-19) are located on the underside of the fuselage, forward of the break point. When external power is connected to the service power receptacle, power is available to all busses except the armament bus. The armament bus may be energized by actuating the ground firing control switch. Because of its location, this switch must be actuated by the ground crew. The engine power receptacle provides power to the engine starter.

ELECTRICAL SYSTEM CONTROLS.

BATTERY-GENERATOR SWITCH. A three-position battery-generator switch (19, figure 1-7, sheet 1, and 21, figure 1-7, sheet 2) is mounted on the forward right console for selection of battery and generator or battery only. For normal operation, the switch should be moved to the BAT. & GEN position. In case of generator failure, the switch can be placed in BAT. ONLY to energize the secondary bus. The toggle must be lifted to unlock the switch before it can be moved. However, to conserve the battery, all nonessential equipment should be turned off before placing the switch in the BAT. ONLY position. The switch should be placed in the OFF position when airplane is secured.

CAUTION

If switch is moved from BAT. & GEN to BAT. ONLY, move switch rapidly as it moves through the OFF position. If the fuel control switch is at MANUAL and movement through OFF is not rapid, temporary engine failure may occur as power to the emergency fuel control system will be interrupted.

Note

Place the battery-generator switch in the OFF position while servicing the airplane with 28-volt power.

GENERATOR RESET SWITCH. On some airplanes,* to provide overvoltage protection for the d-c electrical system, an overvoltage relay, a generator field control relay, which includes trip and reset solenoids, and an anti-cycling relay have been incorporated. Should more than 32 volts dc be applied to the solenoids of the overvoltage relay, the generator will be automatically cut out of the electrical system. Loss of the generator will be indicated in the cockpit by the illumination of the generator-out warning light. If the overvoltage condition is temporary, generator voltage can be regained through momentary use of the generator reset switch (19A, figure 1-7, sheet 2), which is spring-loaded to the OFF position, and momentary contact to the GEN RESET position. An anti-cycling relay in the generator reset circuit provides an override for the reset relay in the event the switch is held in the GEN RESET position in an attempt to regain the generator during overvoltage. Should this occur, it will be necessary to position the switch to OFF before attempting to reset again.

INSTRUMENT A-C POWER SWITCH. The instrument power switch (17, figure 1-7, sheet 1, and 19, figure 1-7, sheet 2), located on the right forward console, is provided to select an alternate source of a-c power for the instruments. (Refer to ALTERNATING-CURRENT ELECTRICAL POWER DISTRIBUTION in this section.)

CIRCUIT BREAKERS. Most of the d-c electrical circuits are protected by push-pull, trip free-type circuit breakers or circuit-breaker switches. Circuit-breaker panels (figure 1-12), accessible to the pilot, are located on each side of the cockpit and center pedestal. All a-c circuits are protected by fuses.

ELECTRICAL SYSTEM INDICATORS.

GENERATOR-OUT WARNING LIGHT. The generator warning light (18, figure 1-7, sheet 1, and 20, figure 1-7, sheet 2) marked GEN. OUT is located on the right-hand console. Normally, the warning light will illuminate whenever the generator output is insufficient to close the reverse-current cutout relay or, on some airplanes,* when an overvoltage condition exists and the generator has been cut out of the electrical circuit. Under normal operation (approximately 25% engine rpm), the reverse-current cutout relay, which ties the generator output to the primary bus, is closed to prevent illumination of the warning light. With external power connected, the reverse-current relay will be held open and the warning light will illuminate at all engine speeds.

INVERTER FAILURE WARNING LIGHT. The inverter failure warning light (16, figure 1-7, sheet 1, and 18, figure 1-7, sheet 2), located on the right-hand console, indicates inverter power failure. When the instrument power switch is positioned at NO. 1 INV., failure of the No. 1 inverter will be indicated by illumination of the inverter failure warning light. By positioning the instrument power switch to the NO. 2 INV. position, the warning light will go out and the a-c instrument power load will be transferred to the electrical power load of the No. 2 inverter. Failure of the No. 2 inverter with the instrument power switch at the NO. 2 INV. position will illuminate the instrument power warning light. During normal operations (instrument power switch at the NO. 1 INV. position), failure of the No. 2 inverter will not illuminate the warning light.

HYDRAULIC SYSTEMS.

The airplane is equipped with three separate hydraulic systems: two normal flight control systems, both of which are utilized simultaneously for normal flight, and a utility system with an integrated emergency system

***Airplanes 141444 and subsequent and airplanes having Service Change No. 374 complied with**

utilizing an accumulator for emergency extension of the nose gear. On airplanes not having an air-driven emergency flight control hydraulic pump, an electrically powered flight control system pump can be manually selected to provide emergency flight control pressure. These systems are of the closed-center, variable-delivery type. The flight control systems supply power for the aileron, rudder boost* and stabilizer control; the utility system supplies power for the rest of the hydraulically powered equipment. (See figure 1-13.) Each hydraulic system is equipped with a reservoir, a pump and separate hydraulic lines. Pressure in the flight control system can be read by a dual indicator (28, figure 1-5, sheet 1, and 26, figure 1-5, sheets 2 and 3) located on the instrument panel. Moving a selector switch adjacent to the indicator will provide a reading for the utility system.

UTILITY HYDRAULIC SYSTEM.

The utility hydraulic system is powered by an engine-driven, variable output pump. This system supplies power for the operation of the landing gear, fairing doors, brakes, speed brakes, wing fold, arresting gear, gun bay purge doors and spoilers.* On airplanes* which incorporate both forward and aft speed brakes and aileron spoilers, a larger hydraulic pump has been incorporated to carry the operating load of the additional equipment. The pilot will notice a higher noise level with the use of this pump, but the condition is normal and should be no cause for concern.

FLIGHT CONTROL HYDRAULIC SYSTEMS.

Two completely separate hydraulic systems are operated simultaneously to provide normal flight control. Both systems are powered by a variable-displacement, engine-driven pump and each provides one-half the power utilized for aileron and stabilizer control. Both systems are of the closed-center type and have a normal operating pressure of 3000 psi. If either one of these systems should fail, the other is capable of maintaining normal flight control for everything except combat conditions. The system is made irreversible by the use of check valves which eliminate the flow between the stabilizer and aileron actuators. This also prevents reversal of motion in a heavily loaded surface when a lighter loaded surface is actuated from a given pressure source. Numerous filters protect the system from foreign matter. If a filter should fail, moderate pilot effort on the control stick is sufficient to provide the forces necessary to clear any particles which might become lodged in moving parts of the valve. If a flame-out occurs and the engine continues to windmill, but an air start is unsuccessful, the windmilling will provide adequate flight control pressure for descent, letdown and landing. A flight control emergency hydraulic pump is provided in case the engine seizes or if there is a mechanical failure within the engine accessory drive section which would make both primary sources (engine-driven) inoperative. No aileron or elevator trim tabs are provided. Trimming is accomplished by repositioning the neutral position of the stick.

HYDRAULIC PRESSURE INDICATOR.

A hydraulic pressure indicator (28, figure 1-5, sheet 1, and 26, figure 1-5, sheets 2 and 3), located on the instrument panel, utilizes two pointers to give pressure readings for both flight control systems and the utility system. Each pointer on the indicator normally reads the pressure of one of the flight control systems. Therefore, when both of these systems are functioning normally, the pointers are aligned and show one reading. If the pressure of one of the systems should drop or fail, the related pointer will follow the corresponding drop and give immediate indication of the malfunction. Moving a selector switch adjacent to the indicator will provide a reading for the utility system. With this switch in the UTILITY position, the two pointers on the indicator will lock together and move as one pointer to the indicated pressure of the utility system. When the switch is moved back to FLT CONT, the pointers will unlock and return to their respective flight control system pressure readings. A warning light (27, figure 1-5), located beneath the selector switch, will illuminate if one of the systems should drop out.

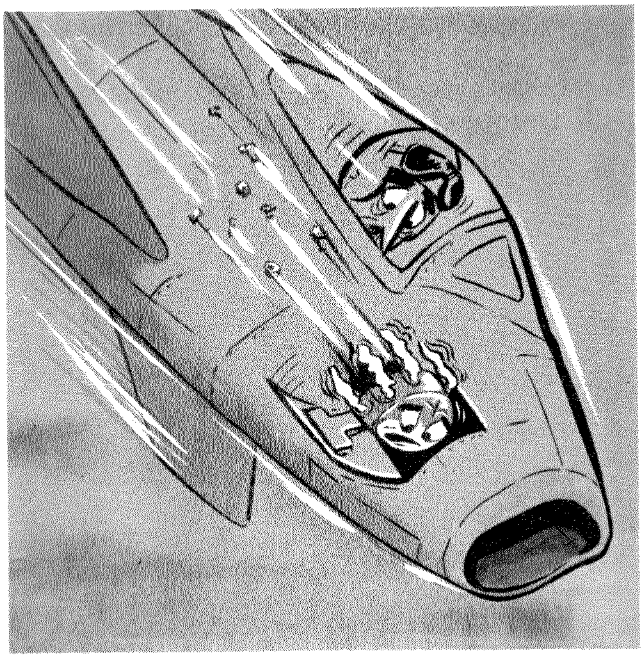
FLIGHT CONTROL HYDRAULIC FLUID LEVEL INDICATOR.

Fluid level of the flight control system is indicated by a shaft that extends up from each of the two hydraulic system reservoirs. These shafts can be checked visually through an access door just forward of the fuselage break point on both the port and starboard sides. (See figure 1-19.) When the fluid level is correct, the shaft will be above the refill mark.

CAUTION

If the shaft is below the refill mark, the system must be serviced prior to flight.

*Airplanes 139531 and subsequent



WARNING

Do not extend the air turbine at speeds above 500 knots.

FJ-4/B-1-0-11A

AIR-DRIVEN EMERGENCY FLIGHT CONTROL HYDRAULIC PUMP. A turbine-driven pump is installed to provide emergency hydraulic power in the event of failure of both No. 1 and No. 2 flight control hydraulic systems as the result of engine seizure or a broken main accessory drive shaft. The turbine, incorporating a speed governor and automatic blade feathering, drives a pump which pressurizes the No. 2 flight control system with approximately the same pressure that is obtained from the engine-driven pump. The unit is mounted on a hinged door which folds flush into the right forward fuselage when it is not in use. (See figure 1-2.) The unit is extended by a cable and is controlled by a cockpit handle located on the left forward console (figure 1-10), inboard of the external stores jettison handle. The control handle normally lies flat on the console fairing and is rotated clockwise 90 degrees to provide a suitable handhold. When the control handle is pulled, an uplock on the pump unit is released and a bungee ejects the unit into the slip stream. The pull force required for this action is approximately 35 pounds. Pump operation will start automatically when the turbine starts rotating. The turbine pump unit must be retracted manually from the ground once it is extended. On airplanes incorporating the turbine pump, the electrically operated emergency pump on the No. 1 flight control system has been removed. The turbine should be checked periodically and after each emergency. A warning flag, located above the top forward corner of the turbine door, will extend when the door is not securely latched. When the door is properly latched, the flag is flush with the fuselage. If the flag is visible, the door must be pushed and secured to retract the flag. *Do not push the flag in to attempt to latch the door.*

Note

A push force of approximately 150 pounds will be required to push the linkage past the overcenter position when the unit is being retracted.

FLIGHT CONTROL SYSTEM.

AILERONS. The ailerons are actuated through an irreversible hydraulic pressure system. Lateral control stick forces position a control valve to port 3000 psi to the aileron actuating cylinders. A spring bungee action opposes control stick forces to provide an artificial feel to the pilot.

FLAP-MOUNTED SPOILERS — AIRPLANES 139531 AND SUBSEQUENT. Flap-mounted spoilers are incorporated on these airplanes to increase the low altitude (under 10,000 feet), high-speed (above Mach 0.95) lateral control effectiveness. Within this speed range, aileron motion becomes limited due to high air loads and, therefore, the spoilers become the primary lateral control. The spoilers are located on the hinge of the forward spar in each flap and are powered from the utility hydraulic system by mechanical linkage and hydraulic actuators. Control of the spoilers is through lateral stick forces applied to the aileron control linkage, which includes a spoiler bungee. Differential force between the aileron and spoiler bungees co-ordinates aileron and spoiler movement. At greater than 4 degrees deflection from the aileron trim position, the spoiler becomes effective, opening more as the aileron is deflected. Aileron trim has no effect on the spoiler action. Under normal air loads, full stick deflection from trim will extend the spoilers to a maximum of 45 degrees. During high-speed flight, when aileron

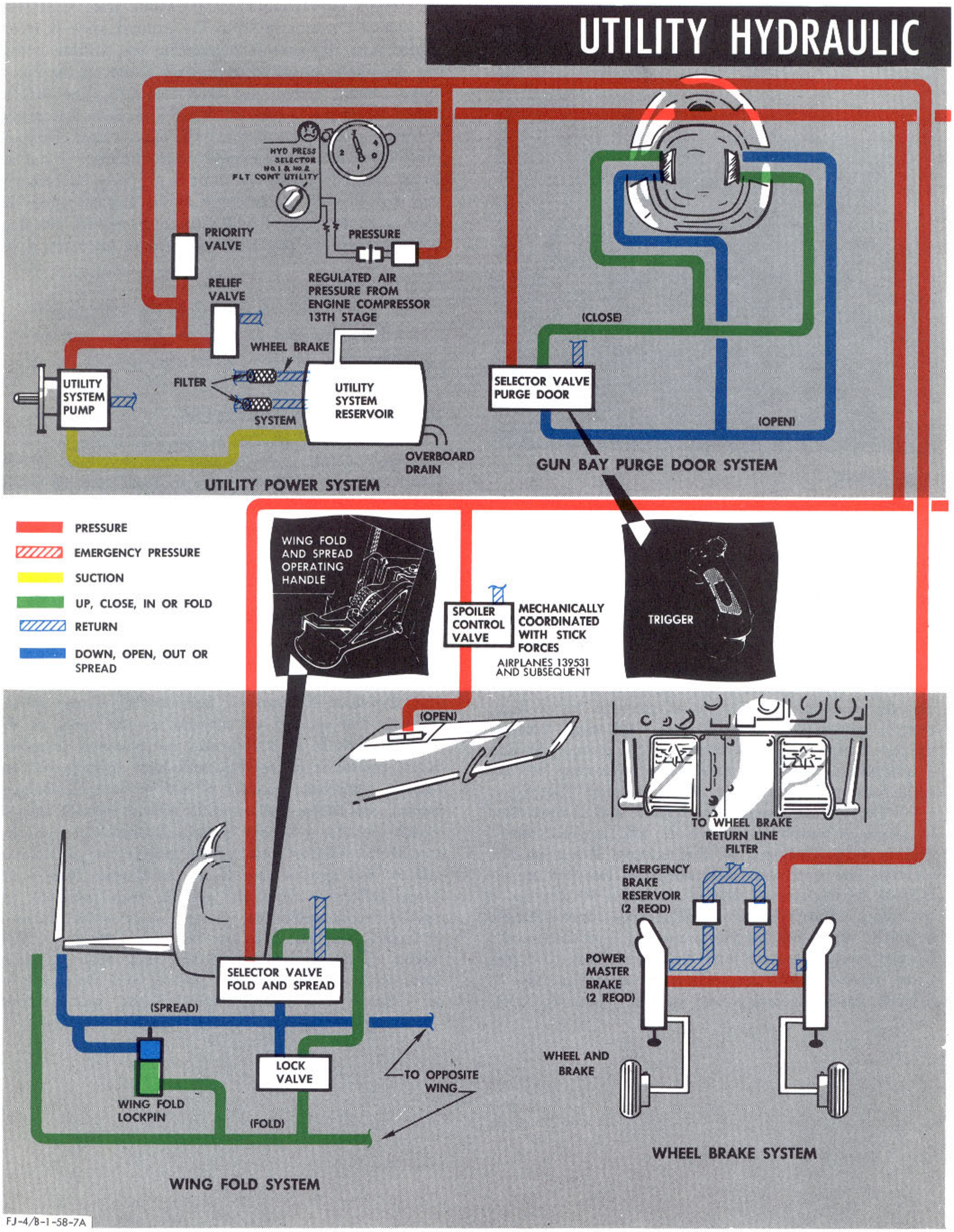


Figure No. 1-13. (Sheet 1)

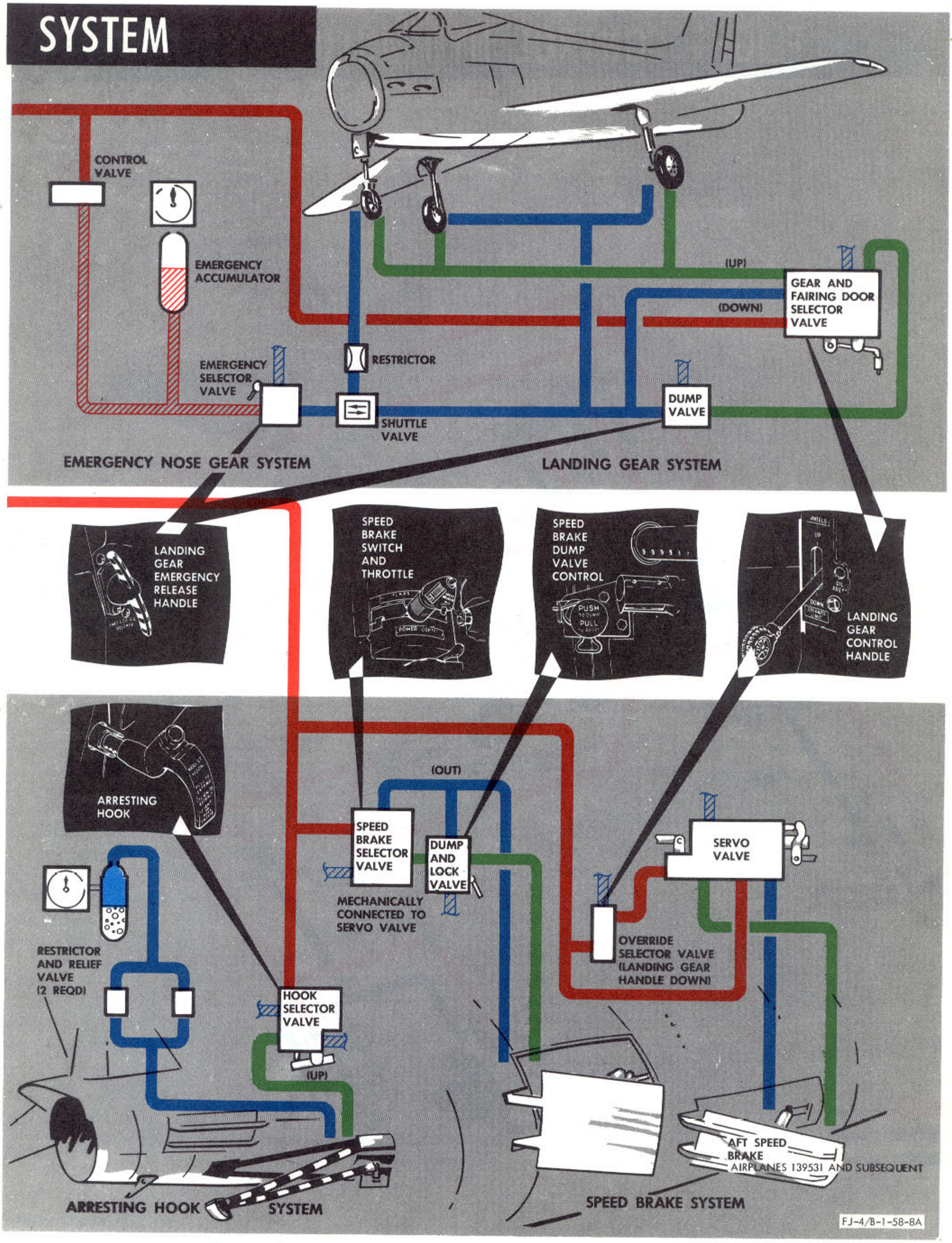


Figure No. 1-13. (Sheet 2)

FLIGHT CONTROL HYDRAULIC SYSTEM

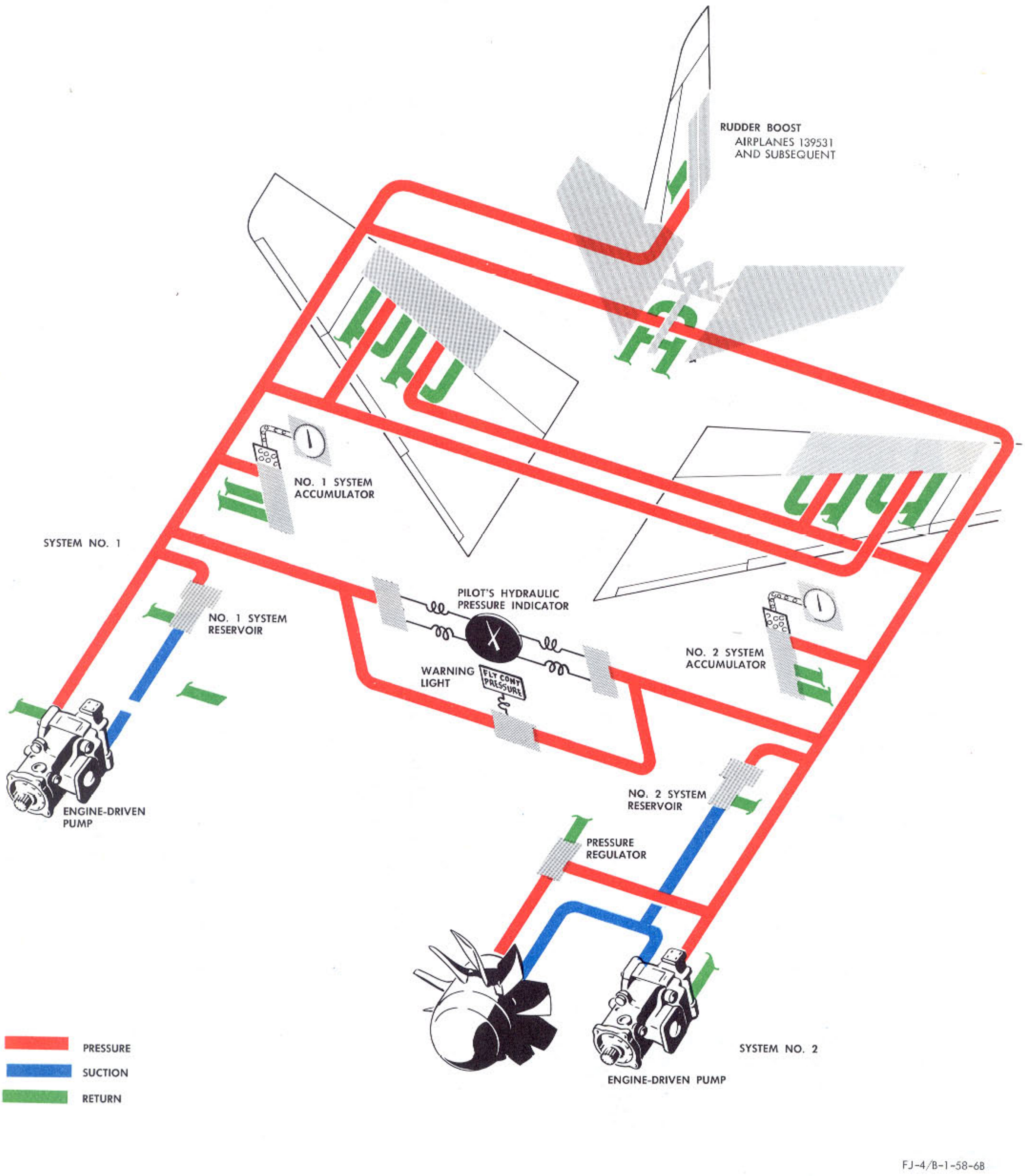


Figure No. 1-14.

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Pages 31 and 32, figure No. 1-14 (Sheets 2 and 3), deleted movement becomes limited, the spoilers will extend to a maximum of 60 degrees when full lateral stick force is applied. Failure of the utility hydraulic system will cause the spoilers to be inoperative, but the ailerons will not be affected since they are powered from the flight control hydraulic systems.

CONTROLLABLE HORIZONTAL TAIL.

The elevators and horizontal stabilizer are operated and controlled as one unit. The stabilizer is pivoted at its spar and the leading edge is moved up or down by normal control stick action. The elevator is connected to the stabilizer by mechanical linkage and moves in a definite relationship to the stabilizer movement. This type of control surface eliminates many of the undesirable effects of compressibility, such as loss of control effectiveness in the transonic region.

ARTIFICIAL "FEEL" SYSTEM.

Because of the completely hydraulically powered flight control system and its irreversible features, air loads are not transmitted to the stick. Therefore, in order that the pilot will have conventional stick forces, an artificial feel system has been incorporated to provide simulated stick forces for all flight conditions. Control surface air loads are simulated by spring bungees connected into the control system, and the normal stick forces, resulting from G loads, are provided through a bobweight. The bungees apply loads to the stick in proportion to the degree of stick deflection from the trimmed position. To trim the ailerons and stabilizer, the no-load position of the stick is changed by actuation of the trim switches.

RUDDER FLUTTER DAMPER—AIRPLANES PRIOR TO 139531.

On these airplanes, a flutter damper unit is located in the rudder at the hinge point. It is completely self-contained and requires no attention from the pilot. The unit consists of a reservoir and a damper housing, containing a vane type device which accomplishes damping by forcing hydraulic fluid through a controlled orifice. The result is that a relatively high degree of damping is achieved at rudder buzz frequencies while very little resistance is offered at pilot inputs. In other airplanes,* the rudder boost system provides similar damping.

RUDDER BOOST SYSTEM—AIRPLANES 139531 AND SUBSEQUENT.

These airplanes incorporate a rudder boost system which combines a yaw damping system to improve directional characteristics during low level, high-speed dives (particularly with an asymmetrical stores configuration). The boost system is only operative under high hinge moments; therefore, low-speed handling characteristics are unchanged except for the bungee effects.

The system includes a hydraulic actuator unit which is connected to a bungee for artificial feel. Another bungee, located in a force transducer, connects through linkage to the push-pull rod that moves the rudder. The bungee allows deflection which is proportional to the load developed in the system. The hydraulic actuator is powered from the No. 1 flight control system and is electrically connected through the landing gear relay so that it will operate only when the landing gear handle is in the UP position. Control for the system is available through a three-position switch (ON-OFF-TEST). The switch is located on the left forward console and the toggle must be lifted before it can be moved to the ON position. When the switch is in the OFF position, conventional rudder control is provided through the cable and pulley system. Moving the switch to the ON position will provide yaw damping control and, when the rudder pedal forces reach approximately 50 pounds, the boost system will take effect. The boost system can be tested by actuating the switch to the spring-loaded TEST position. The TEST position overrides the landing gear relay so that, if a system malfunction has occurred, rudder deflection will be noted.

MACH SENSING TRIM SYSTEM.

A Mach sensing trim system is incorporated in the elevator control system to improve longitudinal stick forces in the transonic flight range. This system reduces the stick force reversal tendencies as noted by pilots of swept wing aircraft when flying in subsonic or transonic flight. This system utilizes a balanced bridge circuit wherein a pressure ratio transducer is used to vary the resistance in one leg of the bridge as a function of a change in Mach number. A controller box, coupled to the stabilizer trim actuator, drives a follow-up potentiometer which functions as the balancing leg of the bridge. A polarized relay senses small increments of voltage unbalance and energizes the trim actuator which repositions the follow-up potentiometer and rebalances the bridge. The resulting movement of the actuator deflects a bungee in the control system. Upon entering the transonic region, when control reversal takes place, the Mach trim unit will counteract the control reversal and maintain positive stick force stability. During manual trimming, the potentiometer is declutched and remains locked in position so the balanced bridge is not disturbed. A toggle switch (1, figure 1-5), located on the left side of the shroud, is provided to cut the Mach sensing trim system out of the elevator control system if it is desired. The system is powered by d-c current from the primary bus.

*Airplanes 139531 and subsequent

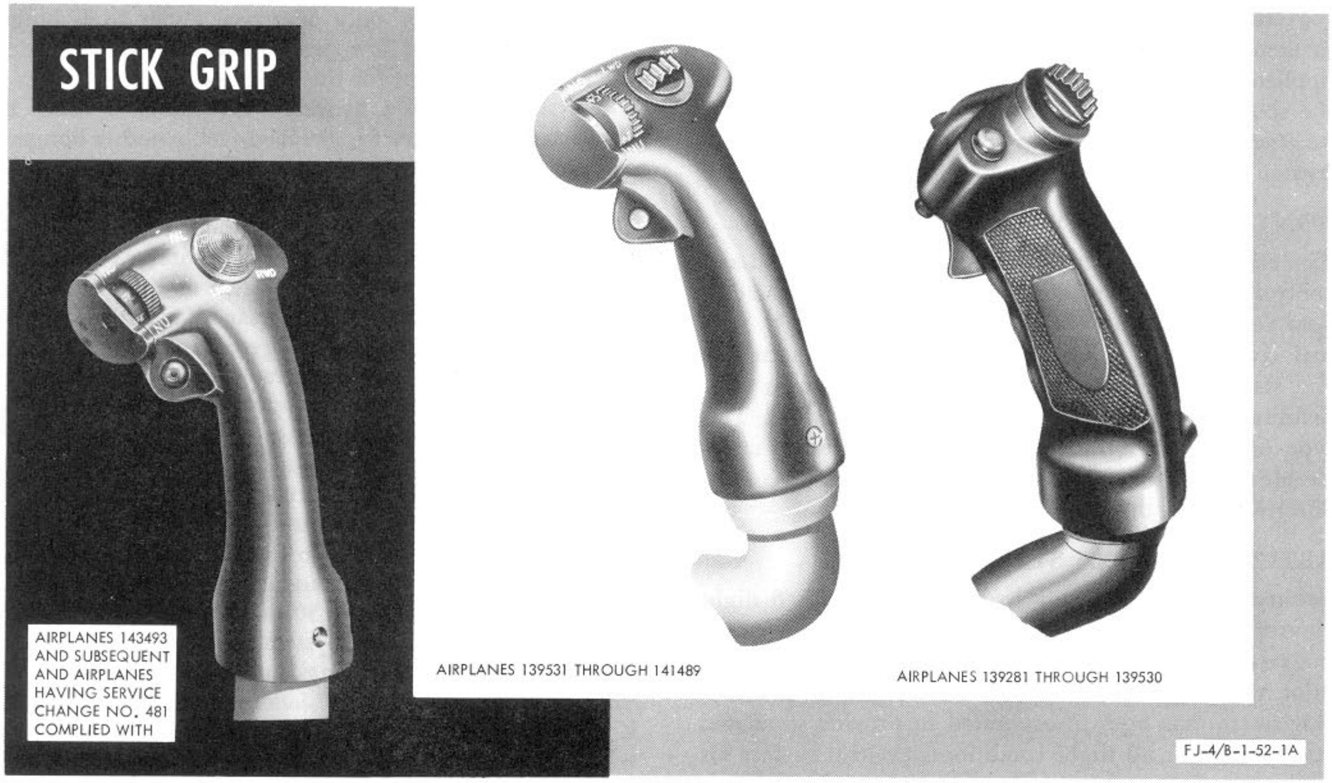


Figure No. 1-15.

CAUTION

The Mach trim switch should be kept in the ON position for take-off, flight and landing. On some airplanes,† if the switch is turned OFF while flying at a speed in the normal operating range of Mach trim (0.85 or higher), a trim shift will not occur; however, when the switch is turned ON again and if the Mach speed has changed, a trim shift will take place. While flying at a speed in the normal Mach trim range in some airplanes,* a trim shift will take place if the Mach trim switch is actuated to either the OFF or ON position. This trim change or a similar trim change caused by a malfunction of the Mach trim system will cause a change in the pilot's stick force (up to 10 pounds maximum at the normal trim rate) which will require correction by opposite trimming or by application of opposite stick.

FLIGHT CONTROLS.

CONTROL STICK. The control stick (figure 1-15) is of conventional design and is equipped with a pistol-type grip. This grip incorporates the gun trigger switch, the bomb-rocket release button and the normal trim switch for the horizontal stabilizer and the ailerons. On some airplanes,‡ the stick grip has been redesigned so that normal longitudinal trim is controlled by a small wheel type potentiometer and normal aileron trim is controlled by a three-position horizontally mounted switch. On other airplanes,§ all normal trim controls are mounted on the stick grip, the rudder and ailerons being controlled through a five-position spring-loaded switch and the horizontal stabilizer being controlled by a small wheel-type potentiometer. On these airplanes the longitudinal trim wheel is illuminated when the landing gear control handle is positioned to DOWN. All stick grip types incorporate the gun trigger switch and the bomb-rocket release button.

RUDDER PEDALS. Conventional hanging rudder pedals are adjustable fore and aft by means of an adjustment lever located on the center pedestal. When the handle is pulled out, both pedals move to the full aft position. After either pedal is pushed back to the desired position, releasing the handle will lock both pedals in place. A rudder pedal shaker is attached to the right rudder pedal as part of the stall warning system.

STALL WARNING SYSTEM. Since the only natural warning given as the airplane approaches a stall is a light buffet at approximately 2 to 4 knots above the stalling speed, an artificial stall warning system is provided. As the airplane approaches the stall angle of attack, a signal from the angle-of-attack indicator energizes a shaker unit mounted on the back of the right-hand rudder

***Airplanes 139531 and subsequent**
†Airplanes 139281 through 139530
‡Airplanes 139531 through 141489
§Airplanes 143493 and subsequent and airplanes having Service Change No. 481 complied with

pedal. An eccentrically mounted counterweight on the shaker unit sets up a vibration in the rudder pedal, giving a positive indication that the airplane is nearing a stall condition.

YAW DAMPER—AIRPLANES 139281 THROUGH 139530. An electrically controlled yaw damper is installed in the rudder control system of FJ-4 airplanes to improve the basic aerodynamic directional damping of the airplane. The yaw damping system includes a gyro amplifier and a constant-rate servomotor which receives power from the primary bus. The gyro feeds signals to a dual unit clutch which drives a servo capstan. Cables from the rudder pedals are secured to the capstan; cables from the capstan to the rudder provide rudder control. The gyro and servomotor provide directional damping and, in case of electrical failure, the unit will automatically declutch to provide normal rudder control with no damping. A toggle switch (14, figure 1-5, sheets 1 and 2), located on the right side of the instrument panel shroud, is provided to turn the servomotor off if the yaw damper is not desired; the system is also de-energized when the landing gear is lowered. The damper induced rudder displacements have a feedback to the rudder pedals, but the amount of this feedback is not objectionable. If the need should arise, the pilot can override the yaw damper by exerting a pressure of approximately 100 pounds on the rudder pedals. This, of course, will only be necessary until the switch can be turned OFF. On FJ-4B airplanes, the yaw damper is integrated with the rudder boost system.

CONTROL SURFACE LOCKS. Under normal conditions, the control surfaces, with the exception of the rudder, are locked against external loads because of the irreversible hydraulic system. The rudder lock consists of a flush door in the floor aft of each rudder pedal. The rudder pedals are spring-loaded to the upright position and pivoted at the base. To lock the rudder, raise the flush doors, pull top of rudder pedals down to horizontal position and pull rudder pedal adjustment handle. Rudder pedals will move aft until tops of pedals are engaged under open doors. When handle is released, the spring-loaded adjustment mechanism will secure the pedals in the locked position. To release the locks, pull adjustment handle out, move rudder pedals forward and close the flush doors. Pedals will return to the upright position when locks are released. The ailerons are locked automatically when the wings are folded and battens may be used on the ailerons when wings are extended in extremely high gusts.

FLIGHT CONTROL TRIM SELECTOR SWITCH. A two-position switch (25, figure 1-6), located on the left console, provides a means of selecting the normal or alternate flight control trim system.

NORMAL TRIM SWITCH. Normal trim of the ailerons and horizontal tail is provided through a five-position knurled switch (figure 1-15) on top of the control stick. This switch is spring-loaded to the center (off) position. When the trim selector switch is at NORMAL, holding the normal trim switch to either side trims the corresponding wing down. Holding the normal trim switch forward trims the nose down, while holding it aft trims the nose up. When the switch is released, it automatically returns to the center (off) position and trim action stops. On some airplanes,* the normal trim switch on top of the control stick has three positions: a center (off) position and a right and left position for corresponding wing trim. On these airplanes, longitudinal trim is controlled by a small wheel (on top of the grip) that operates a potentiometer which controls movement of the stabilizer for trimming. (See figure 1-15.) On other airplanes,† a five-position trim switch, which includes directional trim control, is provided on the control stick grip. Movement of the switch is in the form of an "X" as follows: center position, neutral or off; forward left and forward right, nose left and nose right, respectively; aft left and aft right, left wing down and right wing down, respectively. On these airplanes, the longitudinal trim wheel is illuminated when the landing gear handle is positioned to DOWN. The rudder trim switch on the left console is used as an alternate rudder trim switch on these airplanes.

ALTERNATE TRIM SWITCH. When the trim selector switch is in the ALTERNATE position, stabilizer and elevator trim is accomplished by a five-position toggle switch (26, figure 1-6) on the left console, adjacent to the trim selector switch. Operation of this switch accomplishes trim at the same speed obtained through use of the normal trim control. Holding the switch at LEFT or RIGHT will trim the respective wing down and the NOSE UP or NOSE DOWN positions will trim respectively.

CAUTION

On some airplanes,‡ the selector switch should be returned to NORMAL from ALTERNATE with caution. There is a possibility of getting some input to the trim actuator due to the potentiometer on the trim wheel and the follow-up potentiometer being out of balance.

RUDDER TRIM SWITCH. An electrically actuated rudder trim tab is controlled through a spring-loaded switch (20, figure 1-6) on the left console. The switch is held to LEFT or RIGHT for corresponding trim corrections. Some airplanes† incorporate a five-position trim switch, which includes directional trim control, on the control stick grip. Movement of the switch is in the form of an "X" from the center (neutral or OFF) position. Positioning the switch either forward left or forward right trims the airplane nose left or nose right, respectively. The aft left or aft right switch positions trim for either left wing down or right wing down.

*Airplanes 139531 through 141489
†Airplanes 143493 and subsequent and airplanes having Service Change No. 481 complied with
‡Airplanes 139531 and subsequent

LONGITUDINAL TRIM SYSTEM—
AIRPLANES 139531 AND SUBSEQUENT.

On these airplanes, a servo controlled trimming system is incorporated which provides easy selection of small trim changes and eliminates the tendency to overshoot the trim settings. The system includes a trim actuator that directly drives a follow-up potentiometer which senses actuator movement and governs the amount of actuator travel for a given signal input either by the pilot or by the signal from the pressure ratio transducer. Control for the trim system is through a small knurled wheel in the control stick grip which is calibrated through a range of +8 to −3 units. Above and below the knurled wheel on the stick grip are embossed the letters ND and NU to indicate the wheel rotation direction necessary to achieve nose-down or nose-up trim. In trimming for a nose-down condition, the knurled wheel calibrated units will diminish as the wheel is rotated forward and the stabilizer leading edge will rise. The reverse of this will occur as the airplane is trimmed nose up. The longitudinal trim setting for a normal take-off is +4¼ (±¼) units. If a lightweight or a heavyweight take-off is anticipated, the tolerance of ±¼ units should provide a rule of thumb for adequate longitudinal control. On some airplanes,† the longitudinal trim wheel is illuminated when the landing gear handle is positioned to DOWN.

TAKE-OFF TRIM POSITION INDICATOR.

A blue field indicator (8, figure 1-5, sheets 1 and 2), located on the instrument panel, is provided to indicate safe take-off trim positions for all flight control surfaces. On some airplanes,* the indicator is located on the left forward console. The indicator will show a white IN on a blue background whenever a trim control switch is actuated and the corresponding trim is correct for take-off. A solid white field will appear when the switch is released and will show IN again when the next control is trimmed for take-off, etc. On airplanes* which incorporate the longitudinal trim wheel on the stick grip, the trim indicator will show IN whenever the trim indicator is positioned to +4¼ (±¼) units. This provides the pilot with an in-trim check for horizontal stabilizer.

WING FLAPS.

The slotted-type flaps extend spanwise from the fuselage to the aileron on each wing panel and are electrically controlled and operated. Each flap is powered by an individual electric motor which has individual circuits connected to the primary bus. The flaps are mechanically interconnected so that, if one motor or circuit fails, the respective flap will be actuated through mechanical linkage to the opposite flap. This linkage also prevents individual or uneven flap operation. A brake coil within each flap actuator prevents air loads from moving the flaps. No emergency flap operation is provided as ample protection is afforded by the mechanical interconnection and the individual actuator motors and circuits.

WING FLAP CONTROL LEVER.

The wing flap control lever is located outboard of the throttle and moves in a guarded quadrant marked UP and DOWN. (See 10, figure 1-6.) To position the flaps, the lever is moved to the related position. On some airplanes,* a three-position wing flap control lever is incorporated to permit a means of selecting an intermediate position for the flaps. The lever moves in a guarded quadrant marked UP—DOWN—HALF ASYM. EXT. LOAD.

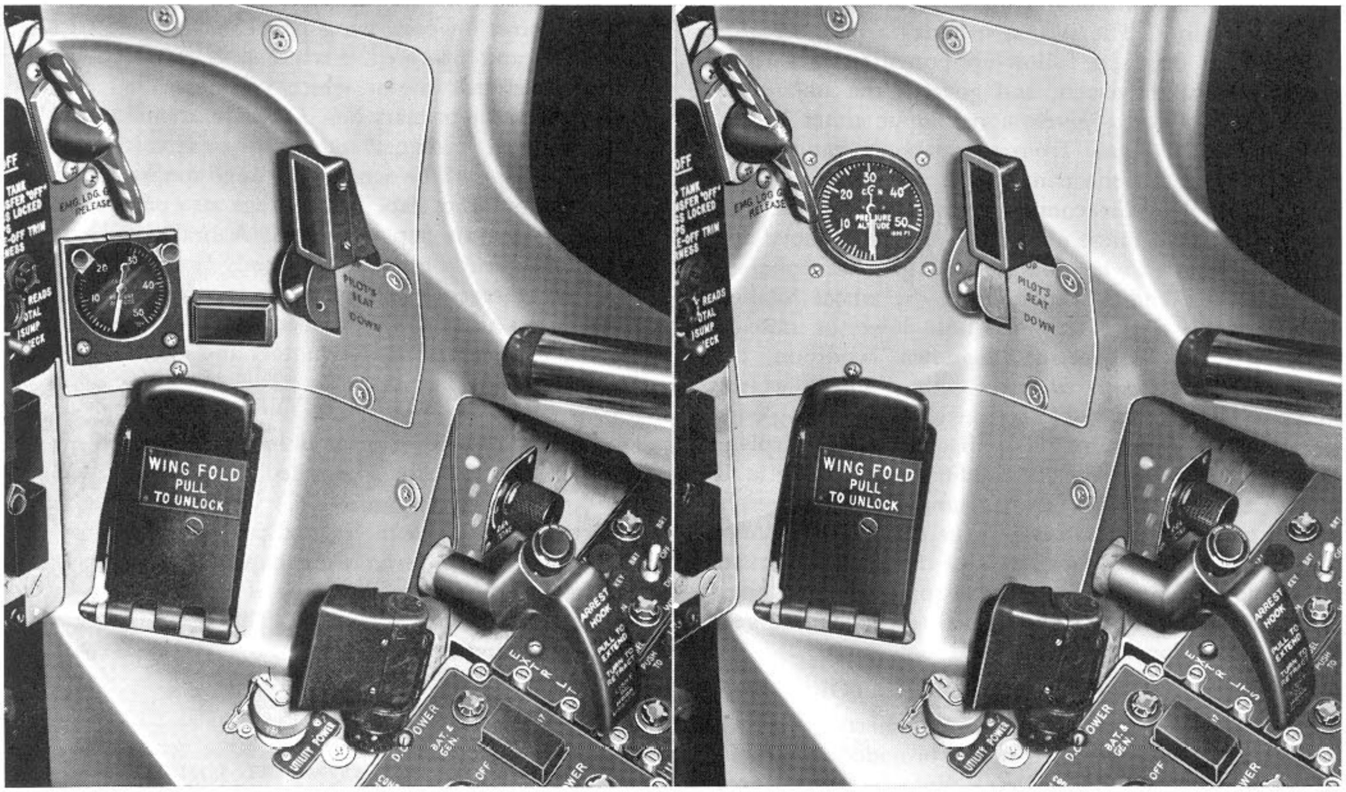
Note

To select the HALF ASYM. EXT. LOAD position, the lever must be raised and pulled aft of the DOWN position. The lever moves freely out of the half-flaps position to DOWN or UP. Care should be taken in moving the lever to ensure obtaining the desired flap position.

The half flap position is incorporated for aircraft configurations which include asymmetrical (uneven) combinations of external stores. Half flaps may be

*Airplanes 139531 and subsequent
†Airplanes 143493 and subsequent and airplanes having Service Change No. 481 complied with

RIGHT FORWARD CONSOLE



AIRPLANES 139281 THROUGH 139530 AIRPLANES 139531 AND SUBSEQUENT

FJ-4/B-1-00-16A

Figure No. 1-16.

selected from either the UP or DOWN position of the control.

WING AND LEADING EDGE FLAP POSITION INDICATOR. The position of the flaps is shown on a combined landing gear and flap position indicator located on the instrument panel. (See 30, figure 1-5.) The flap indicator is marked UP and DOWN and will show a "barber pole" for intermediate positions. The leading edge flap is also connected to the indicator and an UP indication will not be obtained until all leading edges are fully up.

WING LEADING EDGE FLAP.

The leading edge of each wing is composed of three sections each of which is hinged at the bottom side just forward of the front spar. Two of the sections are inboard of the wing fold joint and the third is on the outer panel. An integrated switch in the landing flap system controls the operation of the leading edge flap in conjunction with the landing flap operation. When the landing flaps are lowered to the full down position or, on some airplanes,* to the intermediate (half) position, the wing leading edge moves downward creating a leading edge "droop" which gives more lift at low airspeeds. The movement of the leading edge flap is accomplished by jackscrews, bell cranks and four electric motors which are powered by the primary bus. Two motors in each wing actuate the jackscrews and bell cranks for operation of the leading edge flap. In each wing, one motor powers the jackscrews for operation of the two sections of the inboard leading edge by rotary motion through a flexible cable. The other motor, a combination jackscrew motor, powers the bell crank for linear movement of the single outboard section. On some airplanes,* the outboard flaps are powered by an electric motor in each wing that drives the jackscrews by rotary motion through a flex cable. The travel of the outboard section and the outer portion of the inboard section is approximately 20 degrees. The inner portion of the inboard section has a travel of approximately 15 degrees. While this travel is not directly proportional to the landing flap travel, it is related since landing flap operation actuates the leading edge flap. The travel of the

***Airplanes 139531 and subsequent**

to operate the wing fold is located on the right side of the cockpit below the windshield bow. (See figure 1-16.) A manual pin locking handle, located over the switch, serves as a switch guard. Pulling this handle out releases the wing fold pin locks and permits access to the wing fold switch. The two-position wing fold switch is marked SPREAD and FOLD. The wing fold selector valve, located in the engine bay on the right side of the fuselage, is accessible through the right wheel well. A lock valve, located in the wheel well, adjacent to the selector valve, blocks return flow through the wing fold line when the wings are folded and the selector valve is de-energized. A lever on the lock valve can be depressed to allow the ground crew to manually spread the wings. An indicating flag, inboard of the fold joint at each leading edge, retracts flush to the wing surface when pins are in place and mechanically locked. The flag will appear if the wing fold mechanical lockpins are not in place. Normal wing folding or spreading should be accomplished in 8 to 10 seconds.

SPEED BRAKES.

Hydraulically operated speed brakes (figure 1-2) are located on each side of the fuselage below the dorsal fin. Each speed brake consists of a panel hinged at the forward edge which, when open, extends down and forward into the air stream. Pressure for operation of the speed brakes is supplied by the utility hydraulic system. With high-speed or dive conditions, the opening time is approximately 2 seconds. A barber pole type position indicator on the left console, forward of the quadrant, will show OUT for full open position, a barber pole for intermediate position and IN for closed position.

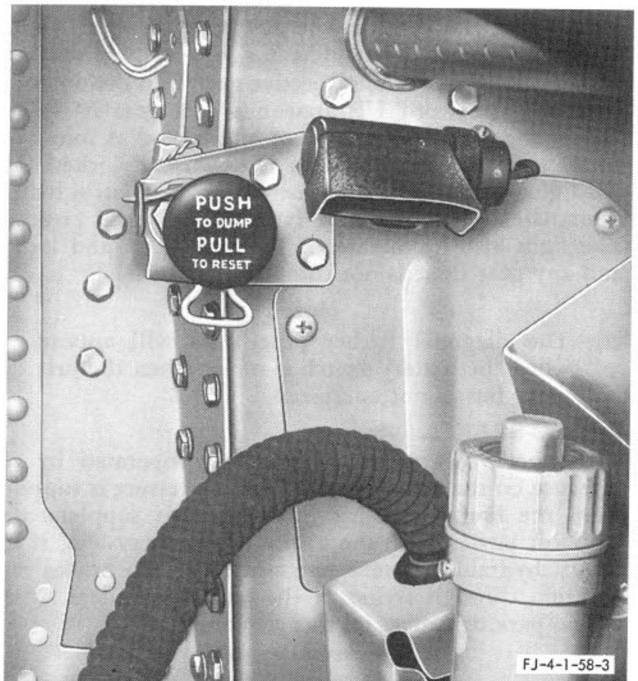
SPEED BRAKE CONTROLS.

SPEED BRAKE CONTROL SWITCH. A serrated switch on top of the throttle (11, figure 1-6) selects the speed brake position. The switch has three fixed positions: IN, OUT and a neutral (hold) position which is indicated by a white alignment mark on the switch guide. The brakes can be stopped in any position by moving the switch to neutral. After the speed brakes have been opened or closed, the switch should be returned to the neutral position. On some airplanes,* the speed brake actuating switch on the throttle incorporates a spring-loaded momentary extend position which returns the switch to neutral when thumb pressure is released.

SPEED BRAKE EMERGENCY OVERRIDE CONTROL. To provide a means of closing the speed brakes if normal operation fails, an emergency dump valve control (figure 1-17) is located to the left of the seat back. For normal operation, the handle is in the forward position and is secured by a latch. When the latch is released, the control handle can be pushed aft. This mechanically opens a dump valve which relieves hydraulic pressure from the speed brake actuating cylinders and permits air loads to close the brakes to a trailing position. Following use of the dump valve, the dump valve control should be returned to the normal (forward) position and latched so that full utility system pressure will be available to operate other equipment.

SPEED BRAKES—AIRPLANES 139531 AND SUBSEQUENT.

Four hydraulically operated speed brakes are located on the aft fuselage. One is located on each side of the fuselage and two are located on the underside of the fuselage just aft of the side speed brakes. Each brake consists of a panel hinged at the forward edge which, when open, extends down and forward into the air stream. All four speed brakes work simultaneously from the control on the throttle grip and will open in approximately 2 seconds. The aft speed brakes will automatically close if the landing gear is moved to the DOWN position. As the aft speed brakes close, a slight nose-up trim change will be experienced. It is, therefore, recommended when lowering the landing gear at speeds above 180 knots with the speed brakes open that the wing flaps and droops not be extended until the landing gear is down and locked, in order to minimize the resulting nose-up trim change. [Refer to SPEED BRAKES, in Section VI of the Supplemental Flight Handbook (NAVAER 01-60JKD-501A).] The aft speed brakes will assume the same position as the side speed brakes with the landing gear in the UP position. A mechanical connection, which incorporates an override bungee, is provided between the two sets of speed brakes. A selector valve is incorporated to limit operation to the side brakes when the landing gear is



SPEED BRAKE DUMP VALVE

Figure No. 1-17.

*Airplanes 143493 and subsequent

extended. Pushing the dump valve (figure 1-17) will dump hydraulic pressure from the side brakes and the air loads will close the brakes to a trailing position. The mechanical linkage between the two sets of brakes will cause the aft speed brakes to follow the side speed brakes to a trailing position, after which integral springs in the system will completely close the aft brakes. Following use of the dump valve, the dump valve control should be returned to the normal (forward) position and latched so that full utility system pressure will be available to operate other equipment.

Separate indicators for speed brake position are located on the instrument panel (6 and 9, figure 1-5, sheet 3). The indicators read IN for the closed position, OUT for full open position and a barber pole for intermediate positions.

Note

During engine shutdown, if the speed brake switch is left OUT, and the battery-generator switch is turned OFF while there is utility hydraulic pressure available, the aft speed brakes will extend.

LANDING GEAR.

The fully retractable tricycle landing gear and the strut and wheel fairing doors are hydraulically actuated and electrically controlled and sequenced. The main gear retracts inboard, into the lower surface of the wing and fuselage; the nose gear retracts aft, into the fuselage, pivoting 90 degrees, so that the nose wheel is horizontal when retracted. After the gear is down and locked, the strut and wheel fairing doors are retracted to the closed position, limiting drag and preventing mud, dirt, etc, from entering the wheel wells during ground operation.

LANDING GEAR CONTROLS.

LANDING GEAR CONTROL HANDLE. The landing gear control handle (32, figure 1-5, sheet 1, and 31, figure 1-5, sheets 2 and 3), located on the left side of the instrument panel, electrically controls the landing gear and gear door hydraulic selector valve. Moving the handle to UP or DOWN causes the utility hydraulic system pressure to position the gear accordingly. When the gear is down and locked and the weight of the airplane is on the gear, a ground safety switch prevents gear retraction if the control handle is inadvertently moved to UP. The wheel portion of the control handle illuminates to serve as the landing gear unlocked warning light. On some airplanes,* the longitudinal trim wheel on the stick grip is illuminated when the landing gear handle is positioned to DOWN.

LANDING GEAR EMERGENCY RELEASE HANDLE. If the utility hydraulic or electrical systems fail, the landing gear may be lowered by use of the landing gear emergency release handle located to the right of the instrument panel. Operation of this control simultaneously releases all the gear and door uplocks and mechanically overrides both the gear up and door closed hydraulic selector valves to ensure that both valves are in the de-energized position. Operation of this control also actuates a dump valve which allows free flow from the return system to the gear down and fairing doors open cylinder and opens the nose gear emergency valve which allows the accumulator to extend the nose gear. This pressure is sufficient for one extension only and the nose gear emergency valve must be reset on the ground. The main gear will lock down by gravity; however, it may be necessary to yaw the airplane to get a safe main gear indication.

WARNING

The emergency release handle must be pulled to the *full out position and held* (full travel is approximately 13 inches) to ensure proper positioning of all gear uplocks and proper positioning of the nose gear emergency hydraulic selector valve. The handle must be held in the full out position until the landing gear position indicator shows down and locked for all three wheels.

Ground safety pins are provided and should be installed when the airplane is secured. The full castering, nonsteerable nose wheel makes use of a shimmy damper, spring centering unit which permits rotation of the nose wheel through a full 360 degrees of travel. The unit is so designed that it will return the nose wheel to the neutral position from any point within a 70-degree wheel right or a 70-degree wheel left position.

LANDING GEAR POSITION INDICATORS. The position of the landing gear is shown by three barber pole type indicators (30, figure 1-5), one for each wheel, located on the lower left corner of the instrument panel. Each indicator will display diagonal barber pole lines if the respective gear is in the unlocked position. The word UP appears if the gear is up and locked and the doors are closed and locked. A miniature wheel appears when the gear is down and locked. The red light within the wheel portion of the control handle illuminates when any gear is in an unlocked position. The light also illuminates if the gear is up and locked and any gear door is not completely closed.

Note

The diagonal barber pole lines will appear when the battery switch is off or when the primary bus is not energized.

WHEEL BRAKES.

The wheel brakes are hydraulically operated by toe pressure on the rudder pedals. Brake pressure is supplied from the brake master cylinders and is supplemented by boost power from the utility hydraulic system. If the utility hydraulic system pressure fails, the brakes will function through action of the master cylinders. There are no parking brakes on this airplane.

CAUTION

If any portion of the utility hydraulic system has been worked on, be sure that the brake system has been bled prior to flight.

*Airplanes 143493 and subsequent and airplanes having Service Change No. 481 complied with

ARRESTING HOOK.

The arresting hook (figure 1-2) is normally actuated by hydraulic pressure. The hook is extended by gravity and pressure from the arresting gear snubber and is retracted by utility hydraulic system pressure. When retracted, the whole arresting hook assembly, except the hook point, is completely covered by doors which fold inward when the hook is extended. The approach light is illuminated when the landing gear and arresting gear hook are extended. The light will dim when the exterior lights master switch is ON. A spring-loaded switch, located on the canopy deck, can be actuated on the ground to allow the approach light to burn steadily when the landing gear is down and the hook is up for simulated carrier landing practice. The switch actuates a holding relay which is broken when the power is shut off or the arresting gear handle is pulled. The switch can also be used to ground test the approach light.

ARRESTING HOOK CONTROL HANDLE.

The arresting hook control handle (3, figure 1-7) is on the inboard face of the right forward console. To extend the arresting hook, pull the handle aft until the pawl on the handle engages the slot at the HOOK DOWN position. Movement of the handle aft to the HOOK DOWN position unlocks the hook mechanical uplock and permits pressure from the arresting gear snubber to lower the hook. The hook is retracted by rotating the handle counterclockwise to release the pawl from the slot. This allows the handle to return to the spring-loaded HOOK UP position. When the handle is returned to this position, the selector valve is actuated and the utility hydraulic system pressure is directed to the upside of the hook actuating cylinder. When the hook reaches the uplock position, the hydraulic selector valve is de-energized to the HOOK DOWN position and the hook is held up by the uplock.

ARRESTING HOOK WARNING LIGHT.

A warning light, located in the arresting hook control handle, illuminates whenever the hook is in the unlocked condition. When the hook is either full up or full down, the light will go out.

Note

The hook can be extended, if any system failure occurs, by pulling the arresting hook handle. However, the hook may not reach the full down position until airspeed is reduced to a point where gravity and the bungee load can overcome the force of the air stream.

CATAPULT EQUIPMENT.

A catapult hook and a holdback fitting are provided for catapulting the airplane from a carrier deck. The fixed catapult hook is located just aft of the nose wheel well and the retractable holdback fitting is located forward of the arresting gear and is covered by a fairing plate when retracted. The holdback fitting is extended manually and is automatically retracted when the airplane is released. A throttle catapult handle is mounted forward of the throttle quadrant to assist in maintaining a full throttle position during catapulting. On some airplanes,* an exterior lights switch (12A, figure 1-6, sheet 2), which may be used to illuminate the exterior lights for signaling during catapult operations, is mounted forward of the catapult handle.

INSTRUMENTS.

The instruments located on the pilot's instrument panel are arranged conveniently in groups relative to their function. Located above the instrument panel shroud are the range indicator, the target indicator and the stand-by compass. The instruments are illuminated by integral lighting, individual shielded lighting, panel secondary lighting and floodlighting. The instrument light switches are located on the right-hand console (14, figure 1-7, sheet 1, and 16, figure 1-7, sheet 2). The majority of the instruments are of a standard type and need no special coverage here. With the exception of the polar path directional gyro compass, the following instruments are also standard but are not as common as the majority. These are described here to enable you to further familiarize yourself with their use and operation.

AIRSPEED AND MACH NUMBER INDICATOR.

The airspeed and Mach number indicator (4, figure 1-5) is so designed that lower airspeeds are indicated in knots while in the higher airspeeds both indicated airspeeds and Mach number are indicated. The indicator consists of a pitot-static operated mechanism to reflect indicated airspeed and a static pressure operated mechanism to actuate the variable Mach number scale. This scale adjusts itself to variations in altitude thereby providing a one pointer, continuous reading of indicated airspeed and Mach number from Mach 0.5 up to Mach 1.6. The face of the instrument is a fixed airspeed scale reading from 80 to 650 knots indicated airspeed, while the variable Mach number scale reads from Mach 0.5 to Mach 1.6 in increments of Mach 0.02. There are two adjustable limit pointers provided for purposes of marking minimum indicated airspeed (stall speed) and maximum Mach number on the Mach number scale. These two pointers are adjusted by the knob located on the lower left-hand side of the instrument. The minimum airspeed pointer (stalling speed) is set by turning the knob while adjustment of the Mach number limit is accomplished by pushing in and turning the knob.

POLAR PATH DIRECTIONAL GYRO COMPASS.

The polar path directional gyro compass system is designed to provide accurate directional reference anywhere in the world. The system includes a miniature pendulous flux gate transmitter, a directional gyro transmitter, a compass coupler and a control panel. These components transmit azimuth heading to the radio magnetic course indicator (13, figure 1-5, sheets 1 and 2, and 21, figure 1-5, sheet 3) located on the instrument panel. The controller (7, figure 1-7), located on the right console, contains all of the controls necessary for operation of

*Airplanes 139531 through 139537, 139541, 139543 and subsequent the system. These include a selector switch, a latitude set knob and dial, a course setting knob, a synchronizing button and a synchronizing indicator. The selector switch provides three modes of operation for the type of directional reference required for any normal flight condition: the directional gyro alone, the directional gyro together with the flux gate transmitter or the flux gate alone which can be used as a stand-by compass. Use of the directional gyro for reference is recommended for effective navigation in the vicinity of the magnetic poles. It is recommended not only because magnetic reference is unreliable in these areas, but because a great circle or grid heading is required in those areas where the rapidly converging meridians make rhumb line flying impractical. Use of the directional gyro is highly desirable at any latitude when flying a great circle course. Using the polar path compass for this purpose not only simplifies navigation but makes possible closer adherence to a true great circle heading. Apparent drift (a trigonometric function of latitude) is corrected automatically with this system. The rate of correction is determined by the setting of the latitude set knob and dial assembly which is calibrated in degrees of latitude. Correction for drift is accomplished in the compass coupler by trimming the signal coming from the directional gyro transmitter. It is not necessary to disengage from other systems when adjusting the knob on the controller since provision is made for automatically interrupting these signals when necessary. Using the directional gyro, slaved with the flux gate transmitter, will give accurate rhumb line readings where magnetic reference is reliable. The signal from the magnetically corrected directional gyro provides short term reference and is gradually overridden by the signal from the flux gate whenever the directional gyro signal and flux gate signal are not aligned. This combines the advantages of both systems and provides accurate, stable readings from the instrument. The synchronizing meter indicates the degree of synchronization at any moment and is used to monitor the system.

Once the selector switch is turned to the SLAVED position and the synchronizing knob is pressed, the system requires no further attention. Turning the selector switch to COMP. position removes the directional gyro and its related circuits in the compass coupler from the system and only the equipment essential to the basic flux gate system will be in operation. This provides for stand-by operation in case other components are damaged or fail. Further description and operation is contained in Section IV under POLAR PATH COMPASS SYSTEM.

COURSE INDICATOR.

The course indicator (17, figure 1-5), located on the instrument panel, consists of vertical and lateral crossbars, a magnetic heading indicating pointer, the FROM-TO window and COURSE window. The vertical crossbar, which moves laterally, indicates lateral deviation from a selected omni-range course. The horizontal crossbar, which is normally used in conjunction with a glide path receiver, is nonoperative for this airplane installation. Whenever the vertical crossbar is off center (off set course) airplane heading is changed in the direction of the crossbar to resume on course flight. A red signal flag marked OFF will come into view at the bottom of the vertical crossbar whenever signal levels decrease to the extent that they are unreliable. The red signal flag for the horizontal crossbar will always be in view since glide path function of this instrument is nonoperative. The magnetic heading pointer, which may be identified by the white circle on the end, indicates the angle between the heading of the airplane and the course set into the course window.

Its travel is calibrated to 45 degrees each side of center at both the top center and bottom center of the instrument. The indicator will facilitate reading for wind correction and desired track. The TO-FROM window indicates whether the selected course is to or from the omni station being received. In the event of signal failure, the TO-FROM indicator will not show either TO or FROM. A selector knob (SET), located on the lower left-hand side of the instrument, selects and indicates course heading in the COURSE window.

ATTITUDE GYRO.*

The attitude gyro (6, figure 1-5, sheet 1), located on the instrument panel, presents a continuous indication of the normal attitude of the airplane in relation to the horizontal plane of the earth. A horizontal bar representing the airplane is attached to the case and is compared to the horizon bar to indicate angular displacements of the airplane in both pitch and bank. A bank index and fixed dial at the top of the case indicate the approximate degree of bank. A trim adjustment knob, located at the lower left front of the instrument, is provided to adjust the miniature airplane to zero pitch indication while a knob at the lower right-hand side of the instrument is used to manually cage the instrument.

ATTITUDE GYRO (V.G.I.)—AIRPLANES 139316 AND SUBSEQUENT AND AIRPLANES HAVING SERVICE CHANGE NO. 266 COMPLIED WITH.

A Model B-1A attitude gyro (7, figure 1-5, sheet 3, and 6, figure 1-5, sheet 2), located on the instrument panel, presents a continuous indication of the normal attitude of the airplane in relation to the horizontal plane of the earth. The gyro is a remote-indicating, synchro-driven type and contains a movable sphere with 10-degree pitch lines up to 82 degrees. These lines have further subdivisions every 5 degrees. The word CLIMB (or DIVE) is written on the 45- and 75-degree pitch lines and the 30- and 60-degree lines are numbered. In level flight, the top of the sphere (Northern hemisphere), representing the sky, is colored light gray and the lower portion (Southern hemisphere), representing the earth, is black. The horizon line is formed by the junction of the two colors and is emphasized by a broken white line. The North and South "Polar Caps" are colored black and white respectively.

***Airplanes 139281 through 139315 and airplanes not having Service Change No. 266 complied with**

The miniature airplane consists of a fixed pair of wings with a dot or "pipper" in the center joined by supports at an angle of 45 degrees. These supports can be used as a reference when executing 45-degree banks. A red flag marked OFF will appear in the upper left corner of the face in case of loss of power to the instrument. The gyros are non-tumbling and will give indications through 360 degrees of roll as well as through a complete loop. During a roll, the readings are constant. In a loop, the two "poles" of the sphere quickly reverse as the airplane passes through the two vertical points of the loop. Normal readings will be obtained in a climb or dive up to 82 degrees. At this point, the gyro reaches a stop where it remains until the climb or dive angle is reduced or increased to vertical. If the angle is reduced, the readings will be normal below 82 degrees. If the angle is increased and the vertical point is reached, the "poles" will reverse.

The bank indices are inscribed at 0, 10, 20, 30, 60 and 90 degrees and the roll index is wedge shaped and similar in size and shape to the zero bank mark. An electric pitch trim knob, in the lower right corner, provides alignment of the simulated horizon with the fixed miniature airplane. Completely automatic operation of the system eliminates manual caging. When power to the system is turned off, a snubber automatically grips the gyro gimbal to keep it from tumbling. When power is then applied, the snubber retains its grip for 15 seconds to allow the rotor to come up to its normal speed before releasing.

TURN-AND-BANK INDICATOR.

The turn-and-bank indicator (21, figure 1-5, sheets 1 and 2, and 23, figure 1-5, sheet 3) is powered by air from the engine compressor. The air is filtered through the anti-G suit regulator filter and then through its own regulator to provide approximately 2 in. Hg pressure. This, along with the airspeed indicator and standby compass, will enable instrument flight if the electrical power is lost to the normal flight instruments. The rate of turn is calibrated at two needle widths deflection for a standard rate turn (180 degrees in one minute). However, due to possible error, the degree of needle deflection should be checked in visual flight before instrument flight is attempted. On some airplanes,* the lighting fixture for the turn-and-bank indicator has been redesigned to permit unobscured pilot observation of full needle deflection.

ANGLE-OF-ATTACK INDICATOR.

The angle-of-attack indicator (3, figure 1-5), located on the instrument panel, provides the pilot with a visual indication of the angle of attack of the airplane as measured by the angle-of-attack detector. An indicating pointer moves over the scale which is graduated from −5 to +30 in increments of one unit each. A movable index marker, operated manually by a knob on the lower left corner of the indicator bezel, may be set to the value desired. The dial of the instrument may be adjusted by turning the Allen screw located in the index marker knob. The dial should be adjusted to position 17.5 units opposite the fixed index located at the three o'clock position of the indicator. During a landing approach, maintaining the pointer at the three o'clock position (17.5 units) will produce an airspeed which is approximately 12 to 15 knots above the stall speed. The angle-of-attack value used in the approach is the same regardless of airplane gross weight and is an excellent aid for speed control during carrier or field landings. A probe on the angle-of-attack detector located on the left forward side of the fuselage (figure 2-2) measures the local airflow direction in the vicinity of the probe. The local airflow direction changes at a ratio of 1.7 to 1.0 with respect to changes of the true angle of attack of the airplane. Signal output from the system is also transmitted to the rudder pedal shaker and to the approach light system. (Refer to

APPROACH INDEXER

AIRPLANES 143594 AND SUBSEQUENT

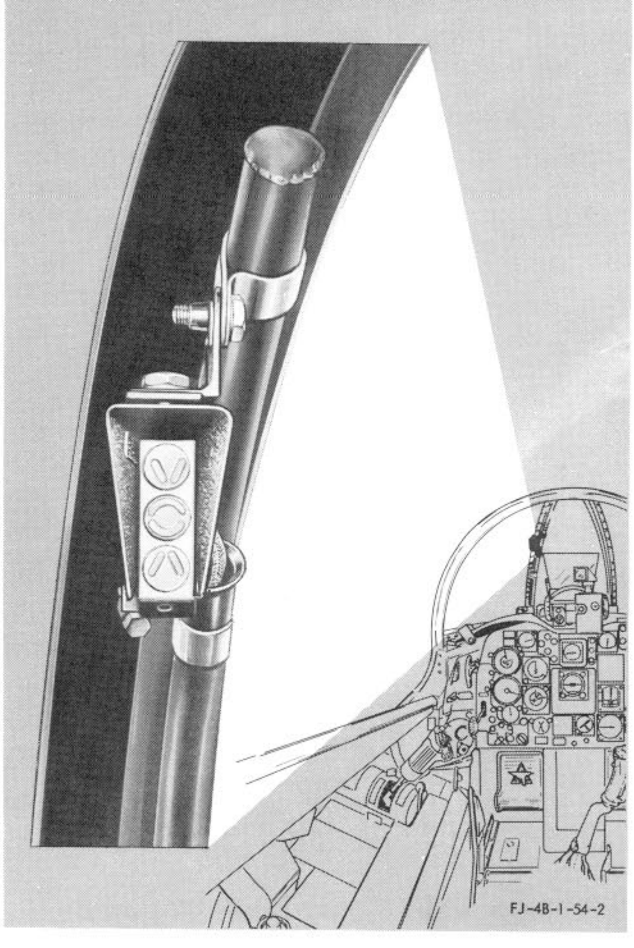


Figure No. 1-17A.

*Airplanes 139531 and subsequent

STALL WARNING SYSTEM in this section and APPROACH LIGHTS, in Section IV.) The rudder pedal shaker is actuated at approximately 1.5 units above the three o'clock position on the dial. Electrical power to the system components is provided from the primary bus. During flight the system is completely automatic and requires no attention from the pilot. The angle-of-attack detector and probe unit contain a heating element which is thermostatically operated from a switch on the landing gear. A probe cover is provided to protect the detector and probe internal mechanism from moisture and dirt. This cover should be removed during airplane preflight checks and replaced when flight is completed. On some airplanes,* an approach indexer (figure 1-17A) is installed above and to the left of the Mark 8 Mod 8 sight unit, which receives its signals from the angle-of-attack indicator. The approach indexer is illuminated when the landing gear is down and locked and is automatically dimmed when the instrument lights are turned on. When the airplane is within 0.5 units of the correct approach angle of attack, the center light will be illuminated. If the angle of attack exceeds the optimum approach angle, the upper light will be illuminated; if the angle of attack is less than the optimum approach angle, the lower light will be illuminated. Then, when the angle of attack deviates between 0.5 and 1.0 units from the optimum angle, the center light and either the upper or lower light will both be illuminated. The approach indexer is located so that it is within the pilot's field of view as he observes the mirror, LSO or runway. Thus, it reduces the instrument scan required for speed control.

ENGINE FIRE DETECTOR SYSTEM.

Two independent, continuous-type fire detector systems are provided to detect and indicate the location of fires in the engine bay areas. A fire forward of the fire wall in the engine bay adjacent to the compressor section energizes any one of several detectors, which in turn illuminates the upper fire warning light on the pilot's instrument panel (FIRE COMPRESSOR). A fire aft of the fire wall, in the engine bay adjacent to the burner section, likewise illuminates the FIRE BURNER warning light through an independent detector network reaction. These warning lights (2, figure 1-5) are located on the instrument panel. A spring-loaded, toggle type test

*Airplanes 143594 and subsequent

switch (9, figure 1-5, sheets 1 and 2, and 10, figure 1-5, sheet 3) integral with the two systems, is located at the top center of the instrument panel. Holding this switch to TEST position disconnects one end of both sensing circuits from the control unit and connects them to ground. This switch checks for continuity of the sensing element, operation of the control units and continuity of the system wiring. When the switch is depressed, both warning lights should illuminate. The system is powered from the primary bus and, when the electrical system battery-generator switch is OFF, the system will not operate. The warning lights alone can be tested by depressing the warning light test button located on the right console (13, figure 1-7).

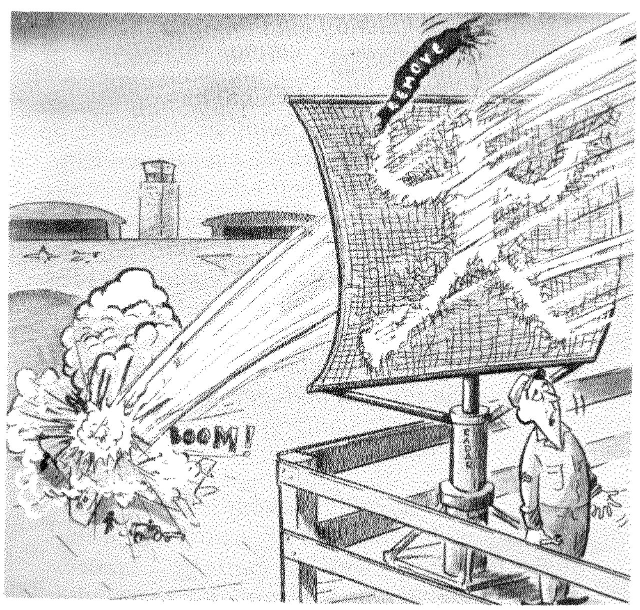
Note

No fire extinguishing provisions are installed in this airplane.

CABIN PRESSURE ALTITUDE INDICATOR. The cabin pressure altitude indicator, located on the right side of the cockpit below the windshield bow (figure 1-16), is an aneroid altimeter which measures the cabin pressure and indicates the cabin altitude in thousands of feet. It provides an indication to the pilot as to the pressurization schedule being maintained by the setting (NORMAL or COMBAT) of the cockpit pressure selector switch. (Refer to COCKPIT AIR CONDITIONING AND PRESSURIZING SYSTEM, in Section IV.)

CANOPY.

The electrically operated sliding canopy can be controlled from either inside or outside of the airplane. The canopy actuator is powered by the canopy and battery bus or external power; therefore, the battery switch does not have to be on to operate the canopy. Provisions are also made for manual operation of the canopy. Air loads delay and may prevent the canopy from being opened



WARNING

Remove ground safety pins before flight and replace immediately after stopping engine.

FJ-4/B-1-0-4

normally at speeds above 235 knots IAS. Emergency release of the canopy in flight is accomplished by an ejection gun which fires the canopy from the airplane. When the canopy is ejected, an interlock on the face curtain pulley is released so that the seat ejection cartridge can be fired.

CANOPY SEAL.

Pressure for inflation of the seal, which seals the canopy in the closed position, is provided by air from the engine compressor section and is automatically controlled by a pressure regulator. The seal is inflated whenever the canopy is fully closed and the engine is operating. When the canopy switch is actuated, the seal automatically deflates to allow the canopy to move. The seal is also automatically deflated before canopy is ejected.

WARNING

If the battery-generator switch is moved to the OFF position, or if the cockpit pressure control switch is moved to RAM EMER, cockpit pressurization will be dumped immediately.

CANOPY CONTROLS.

CANOPY EXTERNAL CONTROL SWITCH. The canopy may be controlled externally by either of two toggle switches located inside of the entrance step on both sides of the fuselage. The three-position switches are spring-loaded to the normal off position. Canopy travel in the open direction is controlled by a limit switch which will override the external control switch and de-energize the canopy actuator when the canopy is in the fully open position. Control of canopy travel in the close position is accomplished by a pressure actuated microswitch internally located in the actuator. The microswitch will de-energize the canopy actuator screw jack when the canopy butts against the windshield bow and will break the motor circuit when the proper preload is obtained. The canopy will not stay in a closed position if the internal canopy switch has been left in the open position. Therefore, if the canopy returns to the open position after you have released the external switch from its closed position, check the internal canopy switch.

CANOPY SWITCH. The cockpit control for the canopy is a three-position switch marked OPEN and CLOSE. The CLOSE position is momentary and spring-loaded to the center (off) position, while the OPEN position is a hold position. The switch should be moved from the OPEN position to the off position, prior to leaving the airplane. Otherwise, it will not be possible for the canopy to remain closed by actuating the external switches. Canopy movement may be stopped at any point by returning the actuator switch to the center (off) position.

Note

If the canopy switch is moved to CLOSE during flight, the canopy seal will be deflated and, at altitude, pressurization will be lost. However, the seal will reinflate and cockpit will pressurize again when the switch is released.

CANOPY EMERGENCY RELEASE HANDLE. The canopy emergency release "T" handle (figure 1-10) is located to the left of the instrument panel under the glare shield and is guarded by a ground safety pin which must be removed before flight. Pulling this "T" handle fires the canopy which, through a cable attachment, releases the face curtain interlock so that the seat can be ejected. This handle should be used for emergency purposes only as the face curtain normally fires the canopy.

CANOPY MANUAL OPERATING HANDLE. An external manual release handle is located on the aft left portion of the lower canopy fairing strip. A manual canopy internal release handle, located on the canopy deck aft of the pilot's seat, can be used for emergency escape from the cockpit when the airplane is on the ground. The internal release handle is connected to the external release linkage so that actuation of either handle disengages the canopy actuator drive and allows the canopy to be manually opened. In opening the canopy from the inside, it is necessary for the pilot to turn around in order to reach the manual canopy internal release handle.

Note

The manual canopy external release handle may be used for ground emergency entry. The canopy manual internal release handle may be used for emergency exit in case of battery power failure or when the canopy cannot be opened through normal procedures.

CAUTION

Care should be used when opening the canopy by this method as it will be possible to push the canopy off the tracks when the actuator drive is disengaged.

EJECTION SEAT.

The ejection seat (figure 1-18) permits bail-out at any speed. A face curtain fires a catapult mounted aft of the seat which supplies the force necessary to eject the seat and pilot from the cockpit. The seat may be adjusted vertically and is provided with stirrups and leg braces on each side of the seat.

EJECTION SEAT CONTROL.

A face curtain with handholds, mounted above the headrest, controls the complete ejection procedure and protects the pilot's face. When the curtain is pulled, the first 3½ inches of travel deflates the canopy seal and fires the canopy. As the canopy leaves, an interlock on the face curtain pulley is released. Further travel of the curtain fires the seat. When the seat is fired, the anti-G suit, oxygen hose, microphone and headset leads, electric seat adjustment actuator leads and the electromagnetic inertia reel leads* are automatically disconnected and the shoulder harness is locked. Ground safety pins inserted in the canopy initiator and, on some airplanes,† in the ejection seat headrest yoke firing mechanism (figures 1-18 and 2-3) prevent accidental firing of the canopy and inadvertent arming of the ejection seat. The ground safety pins must be removed prior to flight.

Note

If ejection is necessary and the canopy does not jettison, the canopy emergency "T" handle, located to the left of the instrument panel, should be pulled to jettison the canopy. The face curtain can then be pulled to eject the seat. If this procedure does not jettison the canopy, the ejection seat emergency pin extractor handle, located on the left side of the headrest, should be pulled. This will release the face curtain interlock, which is normally released by a cable when the canopy is jettisoned. The face curtain can then be pulled and the seat will eject through the canopy. The headrest will break through the canopy first and protect the pilot's head from the initial impact.

SEAT VERTICAL ADJUSTMENT.

A toggle switch, mounted on the right forward side under the windshield bow, provides control for vertical adjustment of the seat. The switch is spring-loaded to the center (off) position and is marked RAISE and LOWER for related seat adjustments.

Note

When adjusting the seat, make sure that the top of your helmet is below the top of the seat headrest to ensure that the canopy bow will clear your helmet in event of jettisoning and to ensure that the headrest will absorb the impact of shattering the canopy should emergency ejection through the canopy become necessary.

AUTOMATIC OPENING SAFETY BELT.

The ejection seat is equipped with an automatic opening safety belt which facilitates pilot separation from the seat following ejection. The belt release is accomplished as part of the ejection sequence and requires no additional operation on the part of the pilot. As the seat leaves the airplane after ejection, a static link between the firing pin and the cockpit shear web fires a ¾-second time delay cartridge which opens the lap belt after the seat and pilot have cleared the aircraft. The pilot then separates from the seat and performs a normal parachute descent.

Note

The automatic seat belt assembly is a "one shot" installation. In the event of inadvertent firing of the mechanism with the cartridge installed, the actuating unit will distort due to powder pressure and cannot be re-used. If this occurs, the belt assembly must be replaced.

*Airplanes 139281 through 139531
†Airplanes 139531 and subsequent

EJECTION SEAT

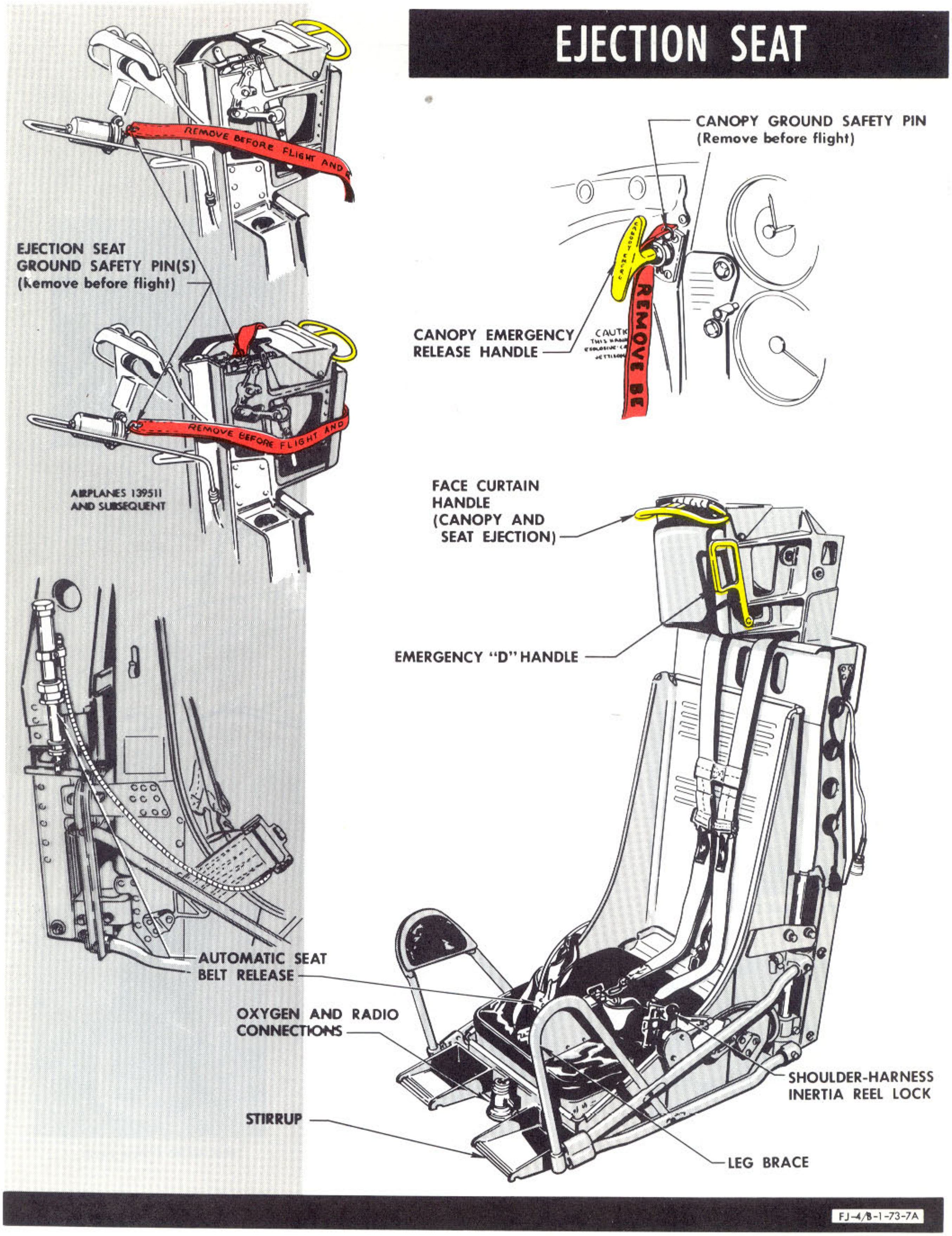


Figure No. 1-18.

SERVICING

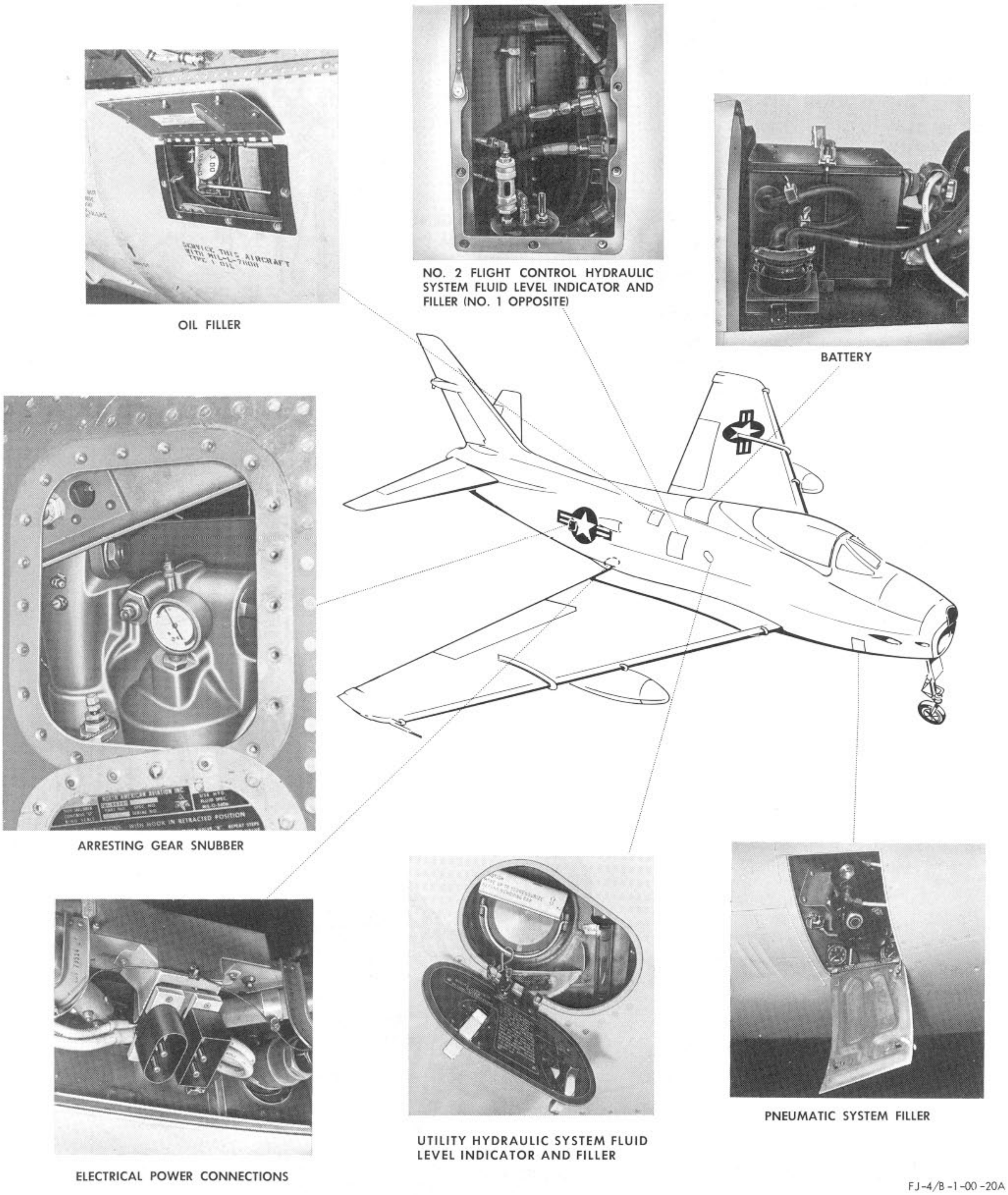


Figure No. 1-19. (Sheet 1)

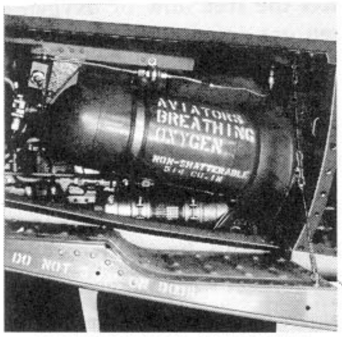
SPECIFICATIONS

APPROVED FUEL*

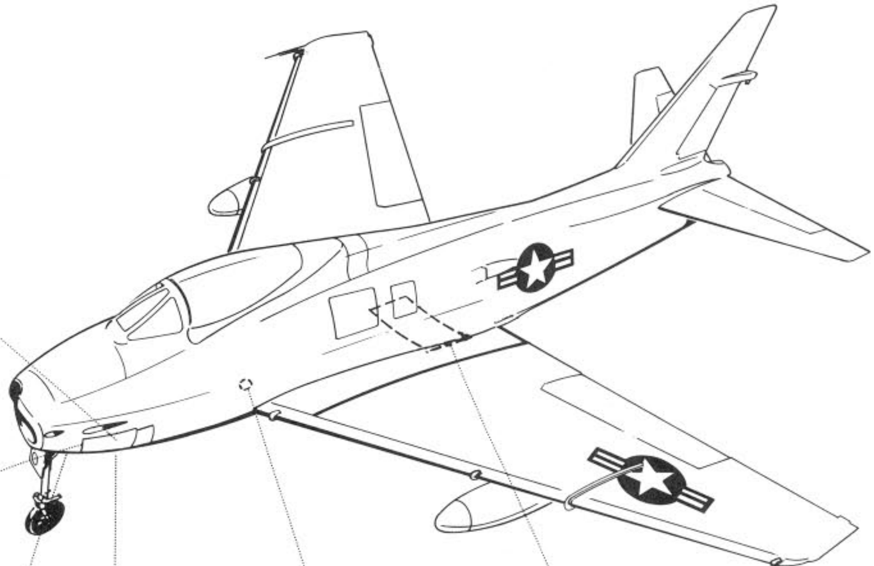
	ASHORE	AFLOAT	EMERGENCY
MIL-F-5624	JP-4	JP-5	AV GAS
	JP-3		MIL-F-5572

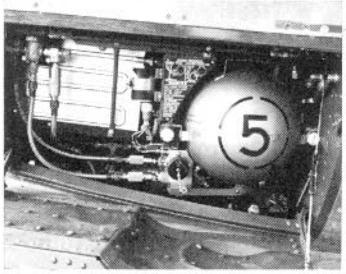
* Approved fuels, although considered equivalent, are listed in order of preference.

OIL—ENGINE LUBRICATION		
NORMAL SERVICE	MIL-L-7808	TYPE I
CORROSION-PREVENTIVE MIXTURE	MIL-L-7808	TYPE II
ALTERNATE	MIL-C-8188	
HYDRAULIC FLUID	MIL-O-5606 (RED)	

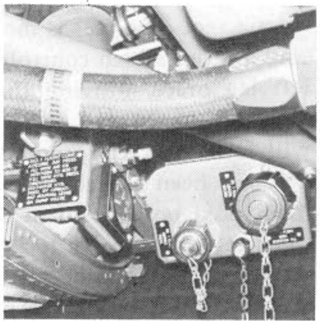


GASEOUS OXYGEN SYSTEM FILLER
AIRPLANES 139281 THROUGH 139470

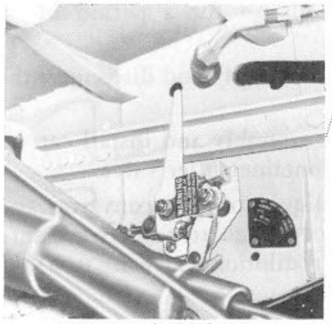




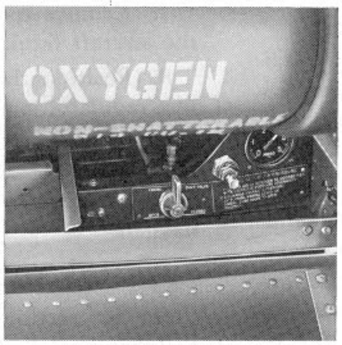
LIQUID OXYGEN SYSTEM FILLER
AIRPLANES 139471 AND SUBSEQUENT AND AIRPLANES HAVING SERVICE CHANGE NO. 357 COMPLIED WITH



NO. 1 FLIGHT CONTROL HYDRAULIC SYSTEM ACCUMULATOR DUMP VALVE AND PRESSURE GAGE. (NO. 2 OPPOSITE)

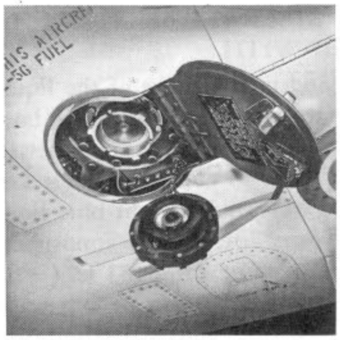


AUXILIARY (NOSE) GEAR EMERGENCY VALVE



EMERGENCY NOSE GEAR ACCUMULATOR FILLER

AIRPLANES 139281 THROUGH 139315



FUEL FILLER

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Figure No. 1-19. (Sheet 2)

SHOULDER-HARNESS INERTIA REEL.

An electromagnetic inertia reel is located on the back of the seat; a lever to lock and unlock the reel is located on the left leg brace. Moving the lever to the forward position locks the reel manually, while a 2 to 3 G forward deceleration, as in a crash landing, will lock the reel automatically. If the harness is manually locked while the pilot is leaning forward, the harness will retract with him as he straightens up and will move into successive locked positions as he moves back against the seat. The reel will also lock any time the electrical circuit to the mechanism is broken, regardless of the position of the locking lever. After automatic locking due to cutting of the electrical circuit, the reel will remain locked except while the lever is retained in the vertical position. After automatic locking due to inertia loads, the harness will remain locked until the handle is moved to the locked position and then to the unlocked position.

CAUTION

Before a forced landing, all switches which are not accessible with the shoulder harness locked should be "cut" before the harness lock handle is placed in the locked position.

SHOULDER-HARNESS INERTIA REEL—AIRPLANES 139531 AND SUBSEQUENT.

These airplanes have a mechanically operated shoulder-harness inertia reel. The reel is mounted on the back of the seat and a lever, which controls the reel, is mounted on the left leg brace. Moving the lever forward will lock the reel manually and forward acceleration of 2 to 3 G will lock the reel automatically. To unlock the reel after it has been locked, the lever must be cycled first to the locked position, then to the unlocked position. If the reel is manually locked while the pilot is leaning forward, the shoulder straps will retract into successive locked positions as the pilot leans back.

SERVICING.

LIQUID OXYGEN SYSTEM PURGE — AIRPLANES 139471 AND SUBSEQUENT AND AIRPLANES HAVING AIRCRAFT SERVICE CHANGE NO. 357 COMPLIED WITH.

Operation and maintenance of the liquid oxygen system can be safe to those who understand both the system and its properties and observe the necessary precautionary measures. (Refer to LIQUID OXYGEN SYSTEM, in Section IV.) Liquid oxygen is a light blue liquid which weighs 2.52 pounds per liter at one atmosphere of pressure. It has a boiling point of −183°C (−297.4°F). If it is improperly handled, it can be extremely hazardous due to its extreme cold and to its boil-off expansion ratio of 862 to 1 which will support violent combustion. Due to its activity (it will generate up to 12,000 pounds of pressure when confined within a sealed container or system), vent and build-up lines are incorporated into the aircraft's liquid oxygen system so that the normal boil-off rate is regulated to approximately one liter per 24 hours. Should the system's liquid oxygen supply become depleted through operational use, normal boil-off or through system maintenance (replacement of parts), condensation will form within the system's components. When this occurs, system purging is mandatory. Failure to purge prior to recharging causes the condensate to freeze and, thereby, restricts the free flow of oxygen to the pilot. Hot, dry nitrogen gas or gaseous oxygen may be used as the purging agent for the liquid oxygen system.

WARNING

Liquid or gaseous oxygen can be extremely hazardous if it comes in contact with oil, grease, hydraulic fluid, dirt or an open flame. Extreme caution should be taken not to touch any uninsulated metal lines, containers or other implements holding liquid oxygen unless gloves are worn. Primarily, protect the eyes and skin when exposed to liquid oxygen.

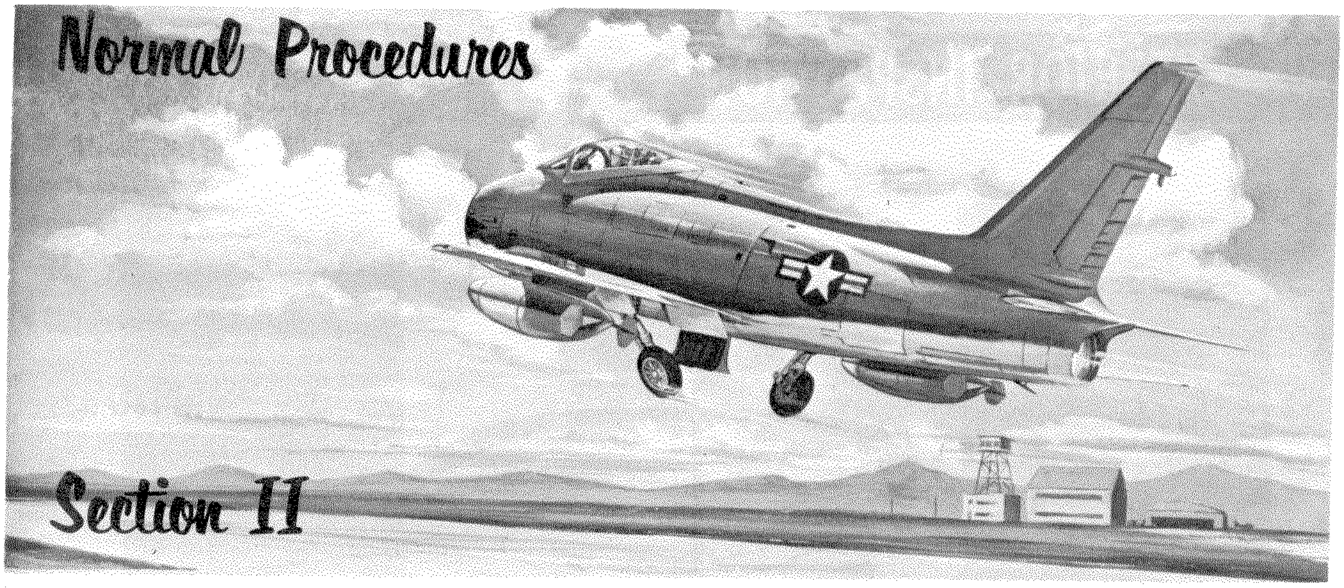
The system can be purged by the following steps:

1. Connect a test gage assembly (calibrated from 0 to 100 psi) to the container filler valve.
2. Connect a service supply line from the purge agent supply to the filler valve on the test gage assembly.
3. Position the aircraft liquid oxygen converter system regulator supply valve to ON, regulator air dilution valve at 100% OXYGEN and regulator safety pressure valve to ON.
4. Turn on the purge agent supply and set the supply regulator to 50 psi.
5. Purge the system at 50 psi for a period of 30 minutes.
6. Shut off the purge agent supply and disconnect the line from the filler valve.
7. Remove the test gage assembly and install cap on the aircraft liquid oxygen container filler valve.
8. Position the aircraft liquid oxygen converter system regulator supply valve OFF, regulator safety pressure valve OFF and regulator air dilution valve to NORMAL OXYGEN.
9. Service the aircraft converter system with liquid oxygen.

AUXILIARY EQUIPMENT.

Refer to Section IV for information concerning the following auxiliary equipment: cockpit air conditioning and pressurization, radio and radar, defrosting and anti-icing, communications, target towing provisions, lighting, oxygen and miscellaneous equipment.

Information concerning armament will be found in Section IV of the Supplemental Flight Handbook (NAVAER 01-60JKD-501A).



BEFORE ENTERING AIRPLANE.

FLIGHT RESTRICTIONS.

Refer to Section V of the Supplemental Flight Handbook (NAVAER 01-60JKD-501A) to determine the limitations which may be imposed upon the aircraft. Check the latest Interim Revision pages for limitations, restrictions or instructions that might not yet be incorporated into the Handbook.

Before entering the airplane, accomplish the following:

1. Determine status of the airplane by consulting the daily inspection form.

WARNING

On airplanes* utilizing the liquid oxygen system, internal condensation may be present if the liquid oxygen system has been empty for several hours or if maintenance (replacement of parts) has been performed without all lines or components capped or plugged. Prior to flight, complete system purge is mandatory to ensure the free flow of oxygen during system use. (Refer to LIQUID OXYGEN SYSTEM PURGE, in Section I.)

2. Determine that the take-off and anticipated landing gross weight and balance are within approved limits. [Refer to WEIGHT LIMITATIONS in Section V of the Supplemental Flight Handbook (NAVAER 01-60JKD-501A) for maximum permissible landing and take-off gross weights.]
3. Conduct an exterior inspection of airplane. (See figure 2-1.)
4. If flight is to be conducted over water, inspect life vest and pararaft pack. If the flight is to be conducted at night, make sure that your personal gear includes a flashlight.

WARNING

If your life vest is not completely free of entrapped air, expansion due to the change in air pressure during climb to high altitudes may cause life vest inflation. Should this occur, DO NOT PUNCTURE THE LIFE VEST. Relief may be accomplished in either of two ways: (1) Unscrew knurled cap of CO_2 inflater, or (2) unscrew and depress oral inflation valve. REMEMBER: Following relief of the entrapped pressure, POSITIVELY SECURE oral inflation valve or the CO_2 inflater cap.

5. Inspect canopy, seat ejection and automatic opening seat belt systems. (See figure 2-3.)

Note

Inspect automatic opening safety belt. In the event of inadvertent actuation of the firing mechanism with cartridge installed, the actuating assembly will distort due to powder pressure and cannot be re-used. The belt assembly must be removed and replaced with a new belt assembly prior to the next flight.

6. Inspect oxygen hose at seat connection for proper fit and security of collar and bumper. (See figure 2-3.)

WARNING

Ejection escape with the oxygen hose seat connection improperly secured may result in the loss of the oxygen mask at ejection altitude or body injury to the pilot. If the oxygen hose does not properly disconnect as the seat is catapulted from the airplane, the hose will stretch to its breaking point and a "slingshot" action will occur.

***Airplanes 139471 and subsequent and airplanes having Service Change No. 357 complied with**

EXTERIOR INSPECTION

STARTING AT NOSE OF AIRPLANE MAKE THE FOLLOWING CHECKS:

NOSE
Nose gear ground safety lock removed.
Nose gear strut extension, tire for slippage, proper inflation and condition, main wheels chocked, hydraulic leaks.
Intake duct clear, approach light.
Access doors secure.
Angle-of-Yaw Transmitter Uncovered.
Auxiliary nose gear emergency valve reset.†

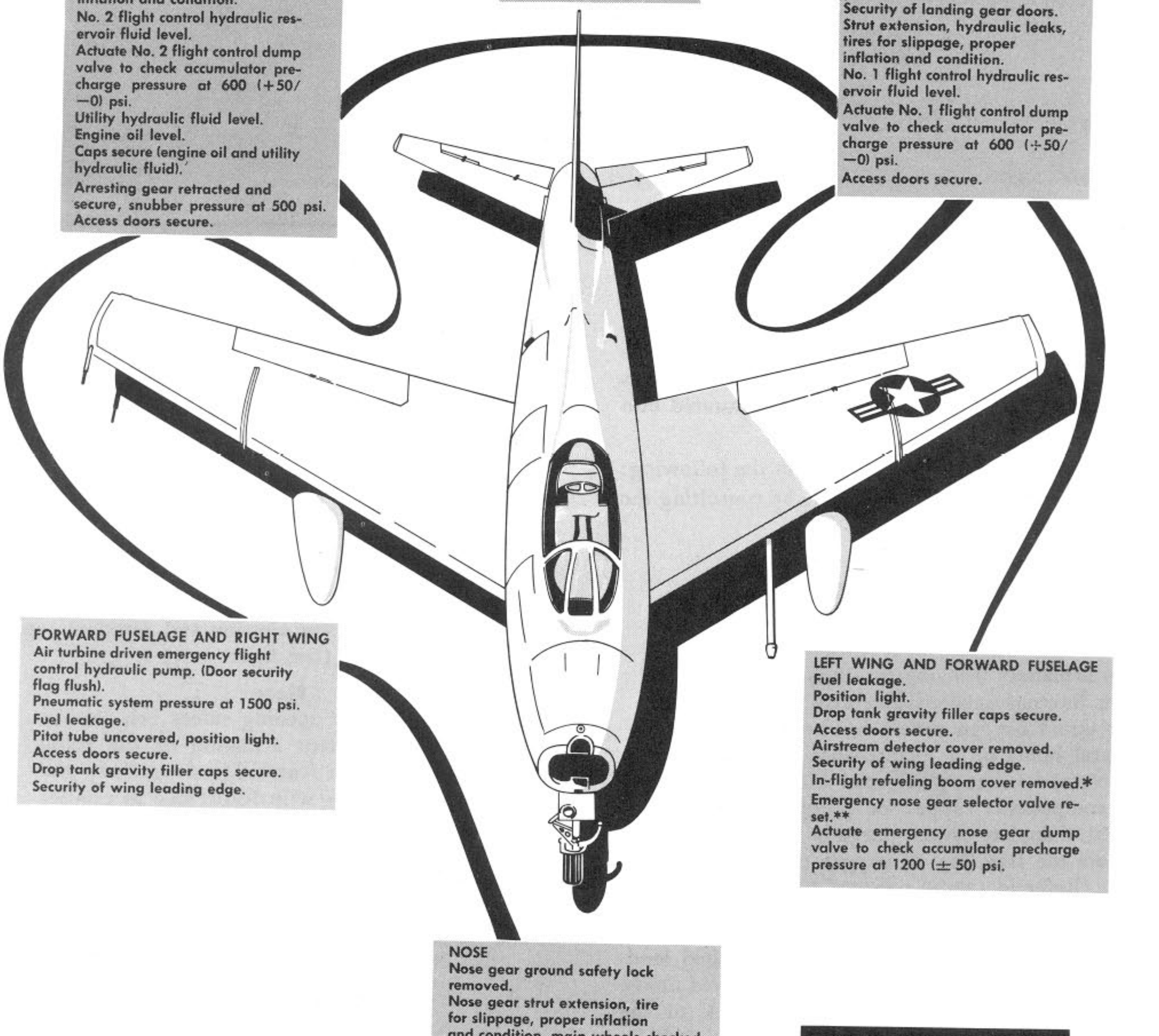
FORWARD FUSELAGE AND RIGHT WING
Air turbine driven emergency flight control hydraulic pump. (Door security flag flush).
Pneumatic system pressure at 1500 psi.
Fuel leakage.
Pitot tube uncovered, position light.
Access doors secure.
Drop tank gravity filler caps secure.
Security of wing leading edge.

RIGHT WING AND AFT FUSELAGE
Aileron lock removed.
Aileron and flap secure.
Landing gear ground safety pin removed.
Security of landing gear doors.
Strut extension, hydraulic leaks, tires for slippage, proper inflation and condition.
No. 2 flight control hydraulic reservoir fluid level.
Actuate No. 2 flight control dump valve to check accumulator precharge pressure at 600 (+50/−0) psi.
Utility hydraulic fluid level.
Engine oil level.
Caps secure (engine oil and utility hydraulic fluid).
Arresting gear retracted and secure, snubber pressure at 500 psi.
Access doors secure.

EMPENNAGE
Rudder trim tab secure.
Position light.
Tail plug removed, tail pipe for cracks, distortion, hot streaks and turbine for bent or missing buckets.
Stabilizer secure.
Tail bumper for position and wear.

LEFT WING AND AFT FUSELAGE
Aileron lock removed.
Aileron and flap secure.
Landing gear ground safety pin removed.
Security of landing gear doors.
Strut extension, hydraulic leaks, tires for slippage, proper inflation and condition.
No. 1 flight control hydraulic reservoir fluid level.
Actuate No. 1 flight control dump valve to check accumulator precharge pressure at 600 (+50/−0) psi.
Access doors secure.

LEFT WING AND FORWARD FUSELAGE
Fuel leakage.
Position light.
Drop tank gravity filler caps secure.
Access doors secure.
Airstream detector cover removed.
Security of wing leading edge.
In-flight refueling boom cover removed.*
Emergency nose gear selector valve reset.**
Actuate emergency nose gear dump valve to check accumulator precharge pressure at 1200 (± 50) psi.



*AIRPLANES 139303 AND SUBSEQUENT
**AIRPLANES 139281 THROUGH 139315
†AIRPLANES 139316 AND SUBSEQUENT AND AIRPLANES HAVING SERVICE CHANGE NO. 368 COMPLIED WITH

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Figure No. 2-1.

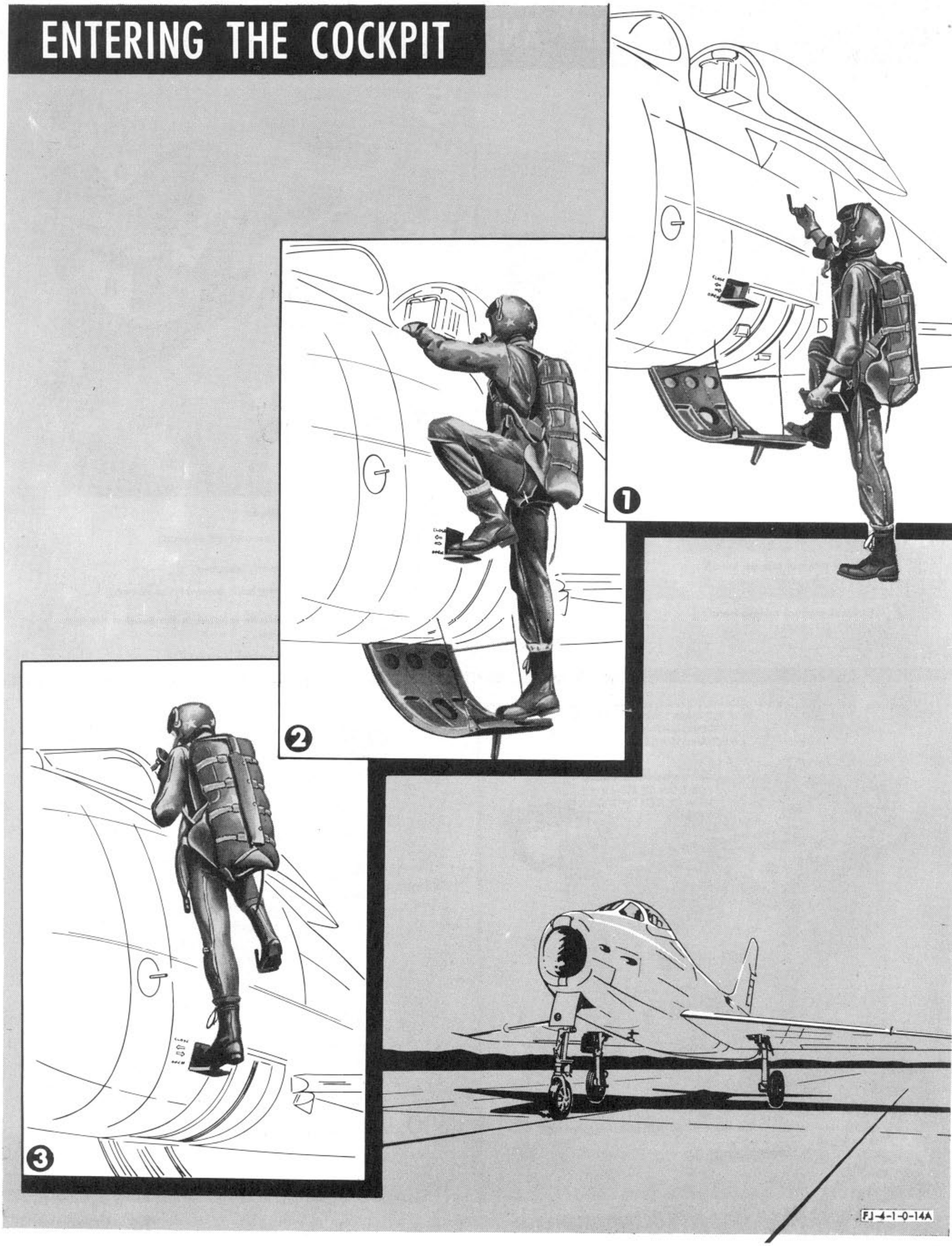
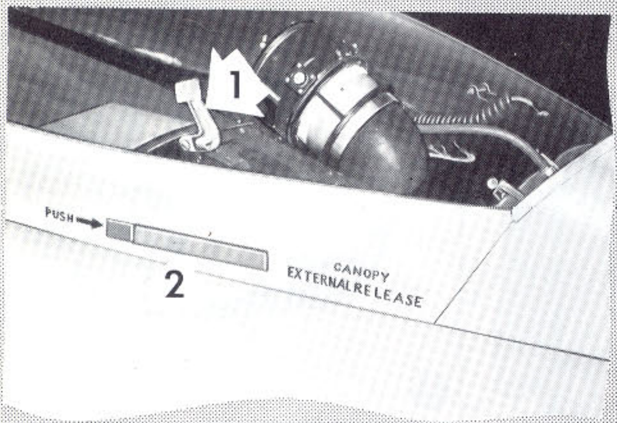


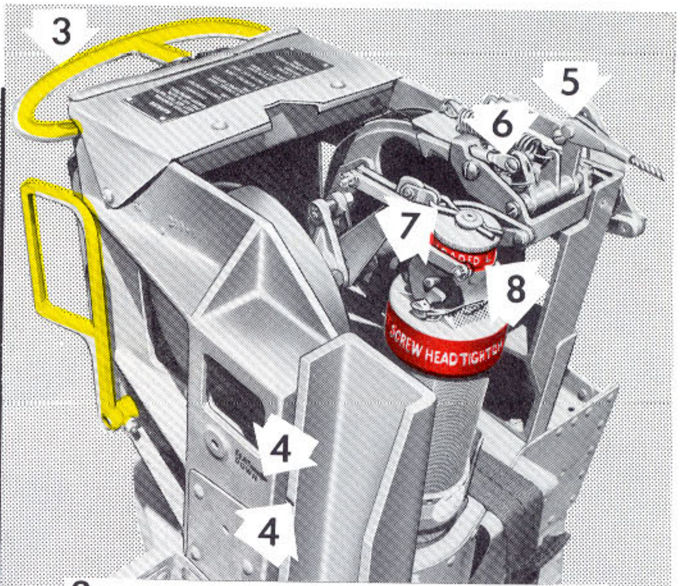
Figure No. 2-2.

INSPECTION OF CANOPY AND SEAT EJECTION SYSTEMS



1, Internal manual release handle

2, External manual release handle



3, Face curtain handle stowed.

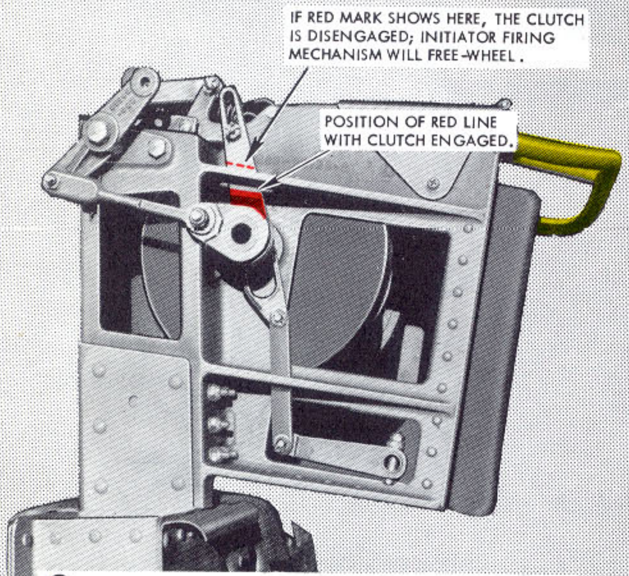
4, Index marks on head rest and rail aligned.

5, Canopy reel cable properly attached.

6, Latch pins inserted in the latch assembly as shown.

7, Catapult safety pin correctly inserted in the head of the seat catapult firing mechanism.

8, Red band labeled "LOADED" showing.



9, Ensure that the clutch for the canopy initiator firing linkage is engaged.

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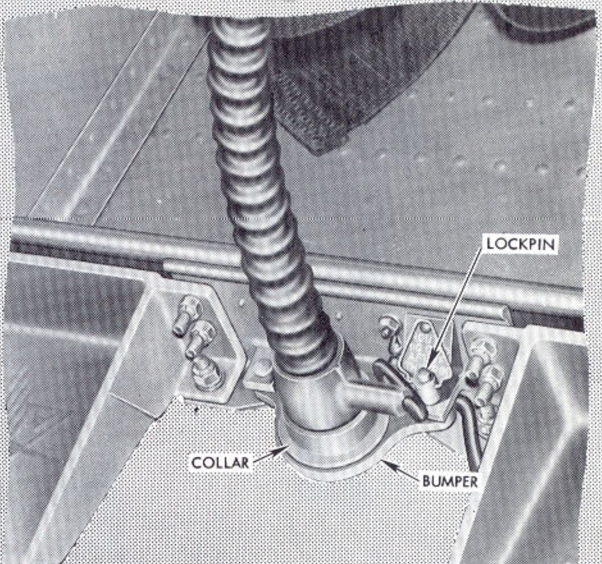
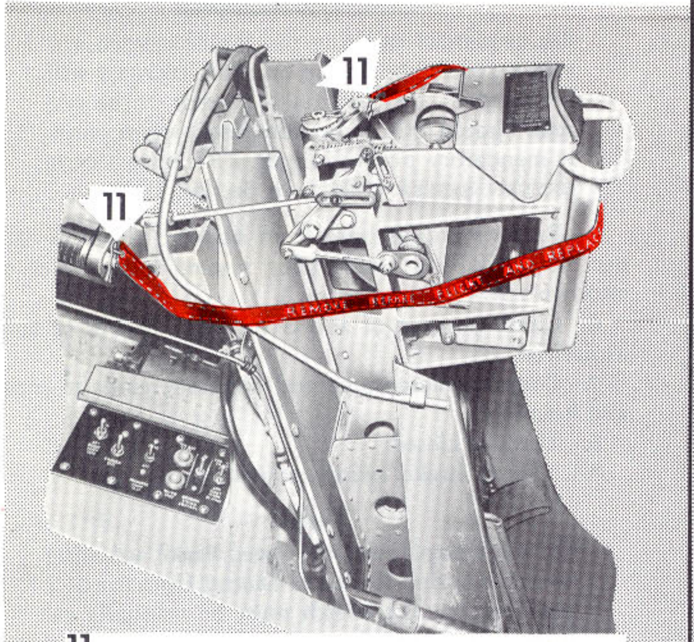
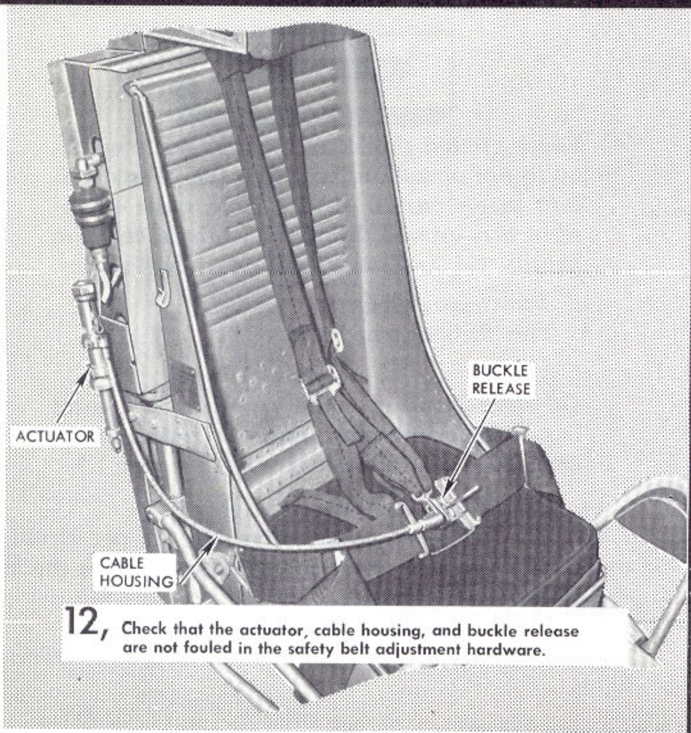


10, Check oxygen hose to make sure collar and bumper are properly locked.

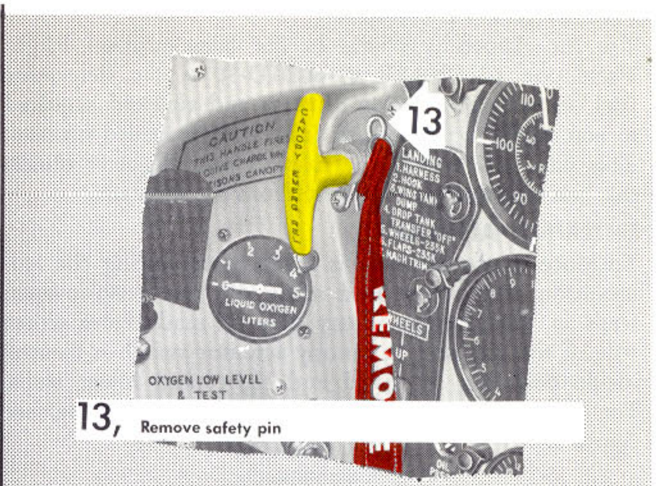
Figure No. 2-3. (Sheet 1)



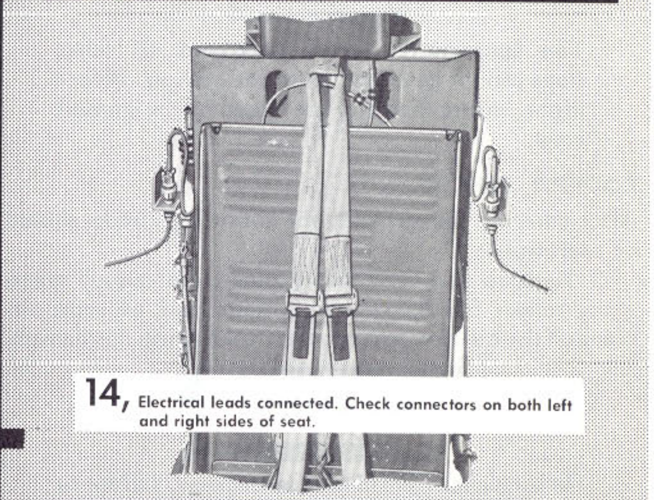
11, Remove safety pins



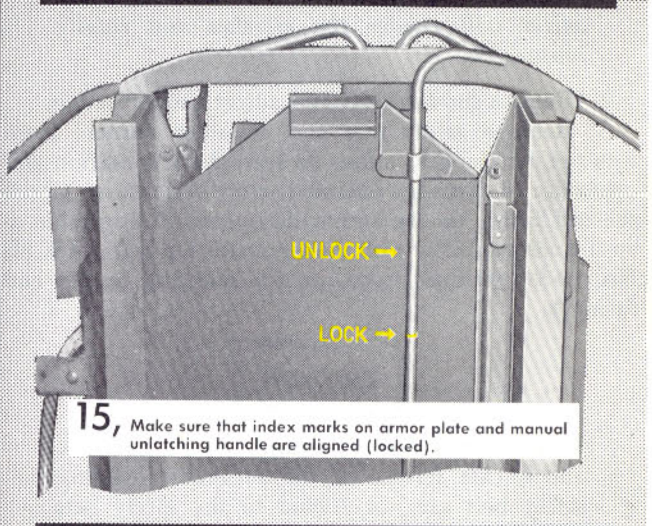
12, Check that the actuator, cable housing, and buckle release are not fouled in the safety belt adjustment hardware.



13, Remove safety pin



14, Electrical leads connected. Check connectors on both left and right sides of seat.



15, Make sure that index marks on armor plate and manual unlatching handle are aligned (locked).

16, Check appearance of equipment generally. Make sure that all linkages are properly connected.

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Figure No. 2-3. (Sheet 2)

PREFLIGHT PLANNING.

Use the Appendix charts in the Supplemental Flight Handbook (NAVAER 01-60JKD-501A) to determine fuel consumption, power settings and airspeed required to accomplish a safe return from your intended mission. This data will enable you to plan your flight to obtain the best possible performance from the airplane.

ENTERING AIRPLANE.

Entrance to the airplane is made by mounting the ammunition access door and using the two push-to-open steps in the fuselage. Entry may be made from either side of the airplane. A canopy actuator switch is located inside both the left-hand and right-hand lower steps. For the proper method of entering the airplane, see figure 2-2.

CAUTION

The ammunition access door and all other steps cannot be closed from the cockpit. Before flight, ensure that they are closed by the ground crew.

COCKPIT CHECKS.

After entering the airplane, the following checks should be performed:

1. Remove and stow safety pins from canopy emergency release handle, canopy initiator and, on some airplanes,* the ejection seat headrest yoke firing mechanism.

WARNING

On airplanes 139511 and subsequent, failure to remove the safety pin from the headrest mechanism will render the ejection seat totally inoperable.

2. Release rudder locks and adjust rudder pedals.
3. Remove safety belt and shoulder harness from stowage provision locations on seat; check condition and operation of cartridge operated safety belt release. Check the end fitting on the automatic opener arming cable to ensure compatibility with the automatic lap belt. (ASCEB No. 10-57 outlines procedure for selecting proper end fitting.)

CAUTION

Ensure that the cable housing, actuating piston, and buckle release of the automatic opening safety belt are not fouled in the safety belt adjustment hardware.

4. Remove oxygen hose from stowage provision on shroud; connect to face mask and check operation of oxygen system on NORMAL OXYGEN and 100% OXYGEN. Attach clip of breathing tube to nearest strap of parachute harness. (Refer to OXYGEN SYSTEM PREFLIGHT CHECK, Section IV.)

WARNING

On airplanes‡ utilizing the liquid oxygen system, restricted breathing on 100% OXYGEN will be noted if condensation is present in the system. Should this occur, complete system purge is mandatory prior to flight. (Refer to LIQUID OXYGEN SYSTEM PURGE, in Section I.)

5. Remove anti-G hose from stowage clip and connect to anti-G suit lead. (For system check, refer to GROUND TESTS, in this section.)
6. Check position of anti-G suit regulator HI or LOW as desired.
7. Connect microphone and earphone cords to mask and helmet.
8. Throttle closed.

8A. Speed brake switch at neutral.

Note

On some airplanes,§ the speed brake actuating switch is spring-loaded to neutral from the OUT position, but the switch must be manually returned to neutral from the IN position.

9. Engine master switch OFF.
10. Landing gear handle DOWN.
11. Radar power switch OFF.

WARNING

Radar ground checks must not be made within 50 feet of operations involving fuel. Tests indicate that electrical energy from radar equipment may ground through steel tools, common pencils, etc, and cause ignition of fuel vapors.

12. Armament switches OFF or SAFE.
13. Yaw damper switch ON.

Note

On some airplanes,† the yaw damper control has been incorporated into the rudder boost control. (Refer to RUDDER BOOST, Section I.)

14. Circuit breakers in; fuses tight.
15. Have external power connected (if not already connected by ground crew) and continue with the checks that follow.
16. Battery-generator switch OFF.
17. If needed, turn on required interior and exterior lights.

*Airplanes 139511 and subsequent
†Airplanes 139531 and subsequent
‡Airplanes 139471 and subsequent and airplanes having Service Change No. 357 complied with
§Airplanes 143493 and subsequent

PILOT EQUIPMENT HOOK-UP

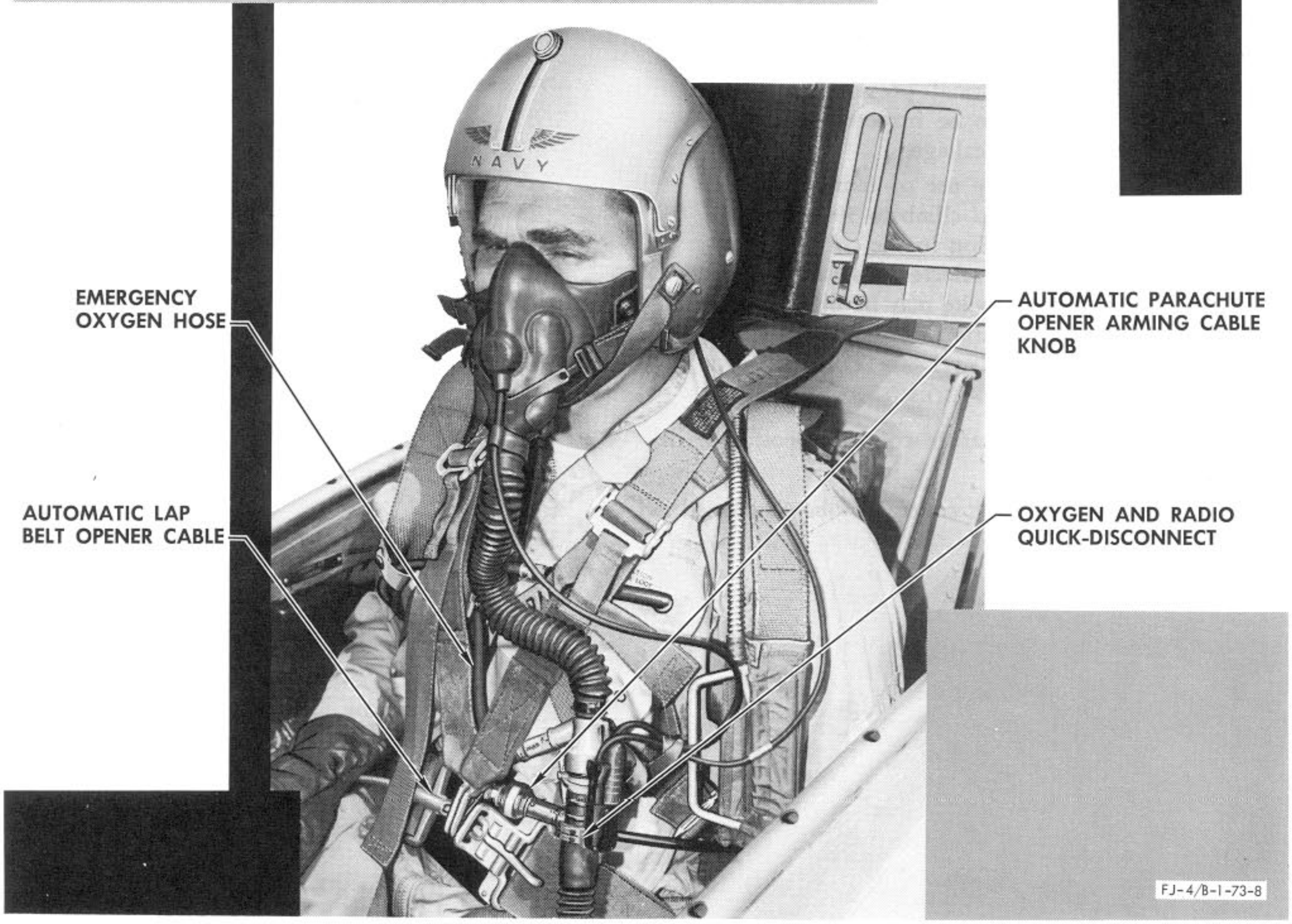

Figure No. 2-3A.

Note

- Request plane captain to check the exterior lights at each position of switch activation.
- On some airplanes,* an exterior lights signal switch is mounted forward of the catapult handle.
- Check all interior lights at all switch and rheostat positions.
- Should any lighting discrepancies be noted, investigate and correct prior to flight.

18. Adjust seat.

CAUTION

Make sure that the top of your helmet is below the top of the seat headrest to ensure that the canopy bow will clear your helmet in the event of jettisoning and to ensure that the headrest will absorb the impact of shattering should emergency ejection through the canopy become necessary.

19. Turn on required communication and navigation equipment (for warm-up).

20. Speed brake dump valve control pulled out to its reset position and latched.

21. Emergency transfer fuel control switch AUTOMATIC.

21A. Drop tank transfer switch OFF.

22. Cockpit pressure selector switch at NORMAL or COMBAT depending on pressurization schedule desired. (Refer to NORMAL OPERATION OF COCKPIT AIR CONDITIONING AND PRESSURIZING SYSTEM, Section IV.)

23. Cockpit air temperature control switch NORMAL.

Note

Ram-air ventilation should be used in the event of heavy smoke in the cockpit during take-off or landing or at airspeeds below 200 knots.

*Airplanes 139531 through 139537, 139541 and 139543 and subsequent

Note

- In the event of the above discrepancy and/or if excessive smoke (excessive oil) is noted during ground operation with the heat and vent system in normal pressurization, the engine will have to be inspected for front main bearing seal leakage.
- On humid days, the use of ram-air ventilation for take-off and climb to 5000 feet will prevent fog formation in the cockpit. However, if ram air is selected for take-off, detecting excessive smoke may be difficult. For additional information, refer to NORMAL OPERATION OF COCKPIT AIR CONDITIONING AND PRESSURIZING SYSTEM, Section IV.

24. Cockpit air temperature control rheostat at desired position.

25. Adjustable air outlet control knobs positioned as desired.

26. (Deleted.)

27. Wing flap control UP.

28. (Deleted.)

29. (Deleted.)

Note

A ram-air, turbine-driven hydraulic pump has been incorporated to replace the emergency electric hydraulic pump. *There is no pilot ground check for the ram-air, turbine-driven hydraulic pump.* (Refer to AIR-DRIVEN EMERGENCY FLIGHT CONTROL HYDRAULIC PUMP, Section I.)

30. (Deleted.)

31. (Deleted.)

31A. (Deleted.)

32. (Deleted.)

32A. (Deleted.)
33. (Deleted.)
34. Emergency ignition switch OFF.
35. Manual fuel control switch PRIMARY.
36. Landing light switch OFF.
37. Rudder boost switch OFF.*
38. External stores jettison handle IN.
39. Canopy emergency release handle stowed.
40. Mach trim switch ON.
41. Actuate fire detector test switch to test fire warning system.
42. Armament master switch OFF.
43. Set angle-of-attack indicator index and note approach indexer† illumination.
44. Set Mach number and airspeed indicator indices.
45. Set altimeter.
46. Erect gyro horizon, or trim simulated horizon with the fixed miniature wings.*
46A. Set clock.
47. Check fuel dump handle in.
48. Push switch marked FUEL GAGE READS down and check that the fuel gage pointer rotates counterclockwise. This rotation indicates that electric power is being supplied to the gage.
49. Check total fuel quantity and then return switch to sump.
50. Landing gear emergency release handle stowed.
51. Instrument a-c power switch at NO. 2 INV. The INST PWR OFF warning light should not be illuminated.
52. Place instrument a-c power switch at NO. 1 INV. position and repeat preceding check. Leave switch in No. 1 position.
53. Push warning light test switch to test all warning lights and indicators, except on-target indicator light.

Note

During daylight operations, the instrument lights rheostat should be maintained at the OFF position so that the automatic dimming feature for some of the warning lights will be inoperative. In this way, illumination of any warning light will be at its brightest intensity.

54. Windshield anti-ice switch OFF.
55. Windshield and canopy defrost switches OFF.
56. Place polar compass mode selector switch at SLAVED; then, press button marked PUSH-SYNC until annunciator (just above button marked PUSH-SYNC) is centered. For additional information, refer to POLAR PATH COMPASS SYSTEM, Section IV.
56A. Request plane captain to test fuel booster and transfer pumps.

Note

The fuel booster and transfer pump test panel is located on the right side aft of the pilot's seat and is not readily accessible to the pilot.

57. Check operation of communication equipment.
58. Check all lights not required OFF.
59. Check that instrument panel is vibrating.

Note

No check can be made of the pitot heater since it is inoperative when the weight of the airplane is on the landing gear.

BEFORE STARTING ENGINE.

WARNING

Before starting engine, make sure that danger areas fore and aft of the airplane are clear of personnel, other aircraft and vehicles. (See figure 2-4.) Danger aft of the airplane is created by high exhaust temperatures and blast from the tail pipe.

CAUTION

- Whenever possible, start and run up the engine on a concrete surface to minimize the opportunity for dirt and foreign objects being drawn into the compressor.
- Start engine with airplane headed into, or at right angles to, the wind whenever possible as a tail wind may increase exhaust temperatures and would aggravate an engine fire during starting.

Normally, external power should be applied to both receptacles for starting. Under this condition, the battery-generator switch should be in the OFF position to prevent the external power source current from causing battery damage (boiling) due to overvoltage. However, if circumstances demand, the engine can be started by using the jet starting power source *only*. To do this, the battery-generator switch must be at either BAT. ONLY or BAT. & GEN. The preferable position is BAT. & GEN as this permits the generator to automatically switch onto the line as soon as speed builds up, thus conserving battery power.

Note

- To prevent battery damage from overheating due to excessive voltage, place the battery-generator switch in the OFF position while servicing the airplane with 28-volt external power.
- It is impossible to ground start the engine if external power is not applied to the jet starting power receptacle.

The power source for jet starting should be a 1000-ampere, constant-current, 35-volt d-c type equipped with a plug which mates with the jet starting power receptacle. The servicing power source should be a 28-volt, constant-voltage, 500-ampere type.

*Airplanes 139531 and subsequent
†Airplanes 143594 and subsequent

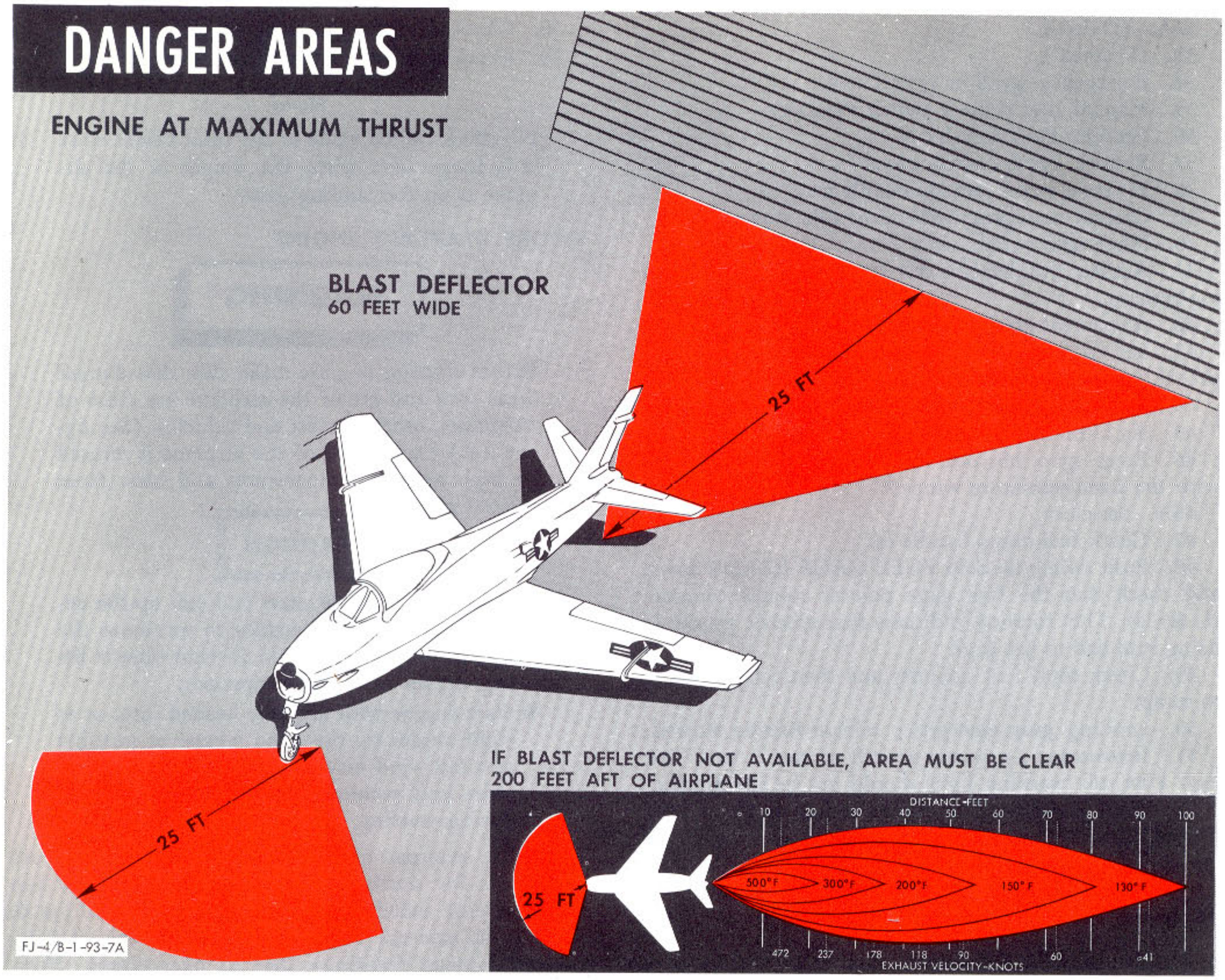

Figure No. 2-4.

STARTING ENGINE.

1. Re-check throttle OFF.
2. Re-check battery-generator switch at OFF. (Place switch to BAT. & GEN if servicing power is not utilized.)
3. Re-check fuel control switch at PRIMARY.
4. Engine master switch at MASTER.
5. Hold engine starter switch momentarily at START.

CAUTION

The high current for starting will burn out the starter within a few seconds if the turbine does not begin to turn as soon as the starter is engaged. If there is no audible indication of engine rotation or if the tachometer fails to register within a few seconds, move the engine starter switch to STOP immediately.

CAUTION

If the engine speed does not reach 11% within 20 seconds after actuating the start switch, move the switch to STOP and investigate the reason for the slow starter acceleration.

WARNING

If idle rpm is not attained within 120 seconds after opening the throttle to IDLE position, abort the start by moving the throttle to the OFF position. Prior to attempting another start, investigate the following: proper starting power, controlled 1000 (−0/+100) amperes and 33 to 35 volts at airplane receptacle. Check for clean and tight power lead connections and for proper connection of jet starter plug in airplane receptacle. Check for proper functioning of fuel control and investigate for excessive engine friction.

Note

Due to connection of the aft fuel boost pump to the battery bus during the starting cycle, should a locked engine rotor occur, throw the engine master switch into the OFF position to conserve the battery.

6. At 11% rpm, move the throttle to IDLE and watch for an increase of tail-pipe temperature indicating that the engine has started. An automatic start with throttle in idle position is recommended. However, if the maximum temperature is anticipated or obtained: (a) Retard throttle as necessary toward cutoff to reduce the starting fuel flow while monitoring the EGT.

Note

It is possible only to meter the fuel flow from idle, halfway to cutoff. In event of an rpm hang up, it is not possible to increase fuel flow by positioning throttle above idle position.

(b) Control fuel flow to prevent hot starts which may occur at ambient temperatures above approximately 80°F. Carefully advance the throttle to keep from exceeding the exhaust temperature limit of 800°C.

CAUTION

- If the exhaust gas temperature does not rise within 15 seconds, close the throttle to OFF. Be sure that all surplus fuel has drained before attempting another start.
- If the engine fails to start after two starting attempts, the starter motor and ignition system must be allowed to cool for a minimum of 30 minutes. If the engine fails to start on the next attempt, after the 30-minute cooling period, the starter motor and ignition system must be allowed to cool an additional 30 minutes before another start is attempted.
- ~~Any one start during which EGT exceeds 900°C constitutes an overtemperature condition, requiring a hot section inspection prior to flight.~~ All instances of overtemperature operation must be entered in the aircraft engine log. The peak temperature, as well as the total time of overtemperature operation, should be recorded. A hot section inspection should also be given any engine known to have exceeded 800°C EGT on acceleration above idle rpm prior to flight.

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Note

Increase EGT limitations 10°C for those engines having J65 Engine Bulletins 195 and 197 or 196 and 197 complied with.

6A. Observe that flight control system low-pressure warning light extinguishes as control system pressure increases above 1100 pounds.

7. Check engine instruments for desired readings. [Refer to ENGINE LIMITATIONS, in Section V of the Supplemental Flight Handbook (NAVAER 01-60JKD-501A).]

Note

On some airplanes,* if a block occurs in the hydraulic lines of the aft fuselage section in either the No. 1 or No. 2 flight control systems, the warning light on the instrument panel will illuminate, even though the system pressure is above 1750 psi. Should this occur, have the aft fuselage hydraulic disconnects checked for proper connection.

AFTER STARTING ENGINE.

As soon as engine stabilizes at idling speed with normal gage readings, throttle may be advanced to full thrust.

Note

Following a ground acceleration, the exhaust gas temperature requires several minutes to stabilize.

Idle rpm should be between 42 and 48% varying with field elevation and outside air temperature. [Refer to GROUND IDLE RPM, in Section V of the Supplemental Flight Handbook (NAVAER 01-60JKD-501A).] After starting engine, proceed as follows:

1. Have external power source disconnected after engine rpm reaches 30%.

2. Place battery-generator switch in BAT. & GEN position.

2A. Re-check circuit breakers in and check generator-out warning light.

Note

Some airplanes† incorporate generator overvoltage protection which automatically cuts the generator out of the electrical system if more than 32 volts is applied to the solenoids of the overvoltage relay. Should this occur, the generator-out warning light will illuminate and, if the overvoltage condition is temporary, generator voltage can be regained through use of the spring-loaded generator reset switch on the right console. When generator voltage is regained, the generator-out warning light will be extinguished. (Refer to ELECTRICAL OVERVOLTAGE, in Section III.)

*Airplanes 139531 and subsequent

†Airplanes 141444 and subsequent and airplanes having Service Change No. 374 complied with

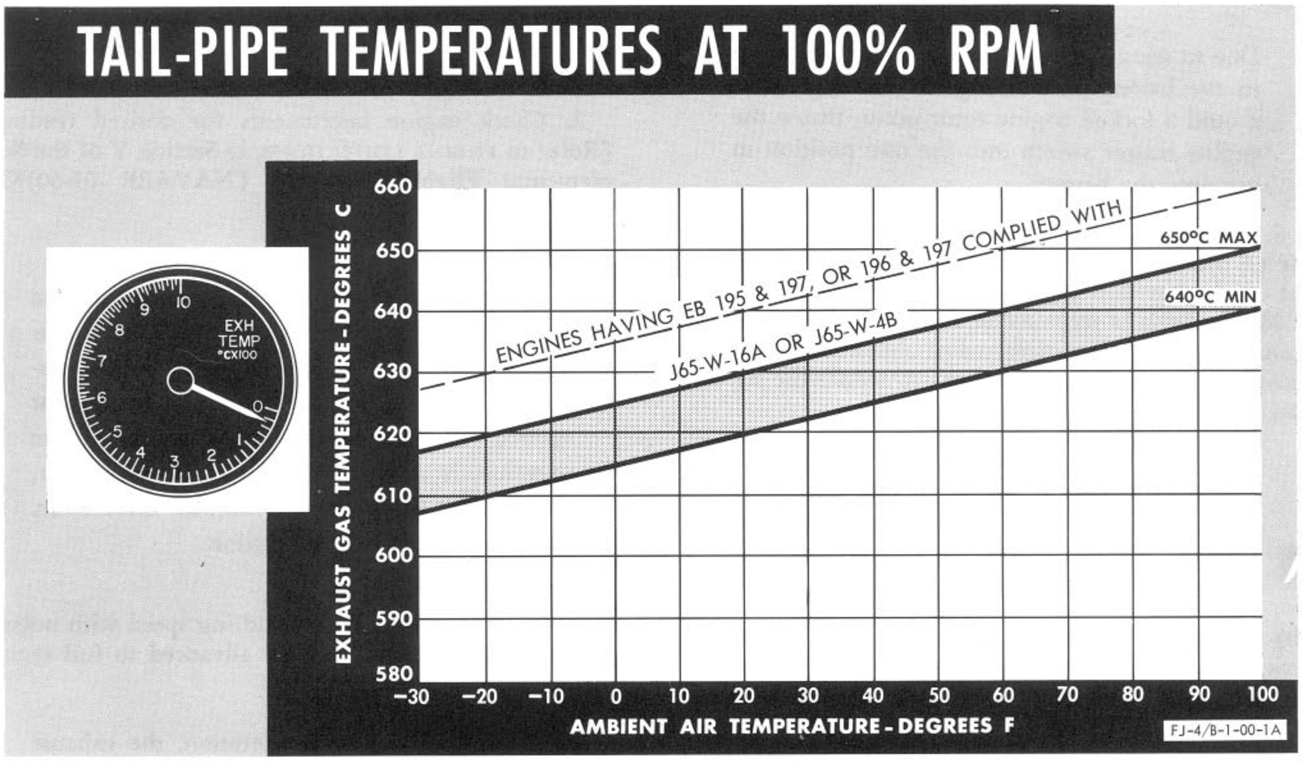

Figure No. 2-5.

3. Spread wings and check that they are locked.

4. Have plane captain check nose gear accumulator gage for pressure build-up to 3000 (+100/−0) psi.

Note

The nose gear accumulator pressure specified is the actual system pressure required and does not include the accumulator gage error. The maximum allowable nose gear accumulator gage error is ±150 psi.

A starter primer solenoid check should be performed after each periodic inspection or engine change. (Refer to Section VII.)

GROUND TESTS.

The ground tests described here should be conducted after the engine is started and after external power has been disconnected.

CAUTION

Avoid steady-state ground operation within the 60 to 80% rpm range with engines not having J65 Engine Bulletin No. 111 incorporated.

ANTI-G SUIT.

Check the operation of the anti-G suit by depressing the manual button located on the top of the anti-G valve.

Note

If the valve has any tendency to stick or fails to return to the closed position, the malfunction should be reported as a "yellow sheet" discrepancy.

FLIGHT CONTROLS.

1. Check hydraulic pressure gage with hydraulic pressure selector switch at NO. 1 & NO. 2 FLT CONT position.

2. Check both the No. 1 and No. 2 pointers for a reading of 2700 to 3100 psi.

3. Check stabilizer, ailerons and spoilers for smooth, correct response to full control stick movement; then, re-check pressures. During this check, the No. 1 and No. 2 pointers should not indicate a pressure differential greater than 200 pounds. A greater pressure differential indicates a low or malfunctioning accumulator.

4. Check rudder for correct response to rudder pedal movements.

WARNING

Before operating speed brakes, be sure aft fuselage area is clear, as the speed brakes move forcefully and will injure any personnel in their path.

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5. Check that the flight control hydraulic pressure warning light on the instrument panel is not illuminated.

Note

Illumination of the flight control pressure warning light indicates a malfunction in the hydraulic system through either low system pressure (below 650 psi) or a blocked hydraulic line. Investigation of the malfunction should be performed by the plane captain prior to flight.

6. Perform alternate trim system check as follows: (a) Place flight control trim selector switch in ALTERNATE and check operation of alternate trim controls through complete cycles. (b) Return flight control trim selector to NORMAL and check operation of normal trim controls through complete cycles. (c) Set rudder, aileron and horizontal stabilizer trim for take-off. On some airplanes,* check for trim system balance by positioning the trim wheel to the full up position (+8 degrees), actuating the alternate trim control switch to full nose up and then returning the selector switch to NORMAL. No appreciable stick movement should be noted. Stick movement greater than 1/8 inch indicates malfunction of the Mach trim system.

UTILITY HYDRAULIC SYSTEM.

Note

On airplanes* which incorporate both forward and aft speed brakes and aileron spoilers, a larger utility hydraulic pump has been incorporated to carry the operating load of the additional equipment. The pilot will notice a higher noise level with the use of this pump, but the condition is normal and should be no cause for concern.

1. Turn hydraulic pressure selector switch to UTILITY and check for a pressure of 3000 psi.

Note

When UTILITY is selected, the No. 1 and No. 2 pointers act as a single pointer. Only the No. 1 pointer will be visible.

2. Run the speed brakes through one complete cycle and check them for proper operation, observing the speed brake indicator and utility pressure.

Note

- On some airplanes,† the speed brake actuating switch is spring-loaded to neutral from the OUT position, but the switch must be manually returned to neutral from the IN position.
- On airplanes* equipped with both fore and aft speed brakes, only the forward speed brakes will operate with the landing gear handle DOWN and the battery-generator switch in BAT. & GEN. (Refer to SPEED BRAKES, Section I.)

3. After closing speed brakes, return speed brake switch to neutral and re-check utility pressure.

Note

Placing the pressure selector switch at UTILITY will provide an indication of utility system pressure. Failure of flight control system pressure will be indicated by the warning light.

3A. On airplanes* incorporating flap mounted spoilers, actuate the stick from neutral to full throw (both left and right) observing spoiler action and utility hydraulic pressure.

4. Turn hydraulic pressure selector switch to NO. 1 and NO. 2 FLT CONT position.

MANUAL FUEL CONTROL SYSTEM.

A complete check of the manual fuel control system should be made after the replacement of an engine or a fuel control unit and after each periodic maintenance inspection. (Refer to Section VII.) Prior to each flight, check manual fuel control as follows:

1. Set throttle to IDLE.
2. Shift to MANUAL fuel control (note warning light illumination).
3. Note rpm increase or decrease.
4. Return fuel control switch to PRIMARY.

*Airplanes 139531 and subsequent
†Airplanes 143493 and subsequent

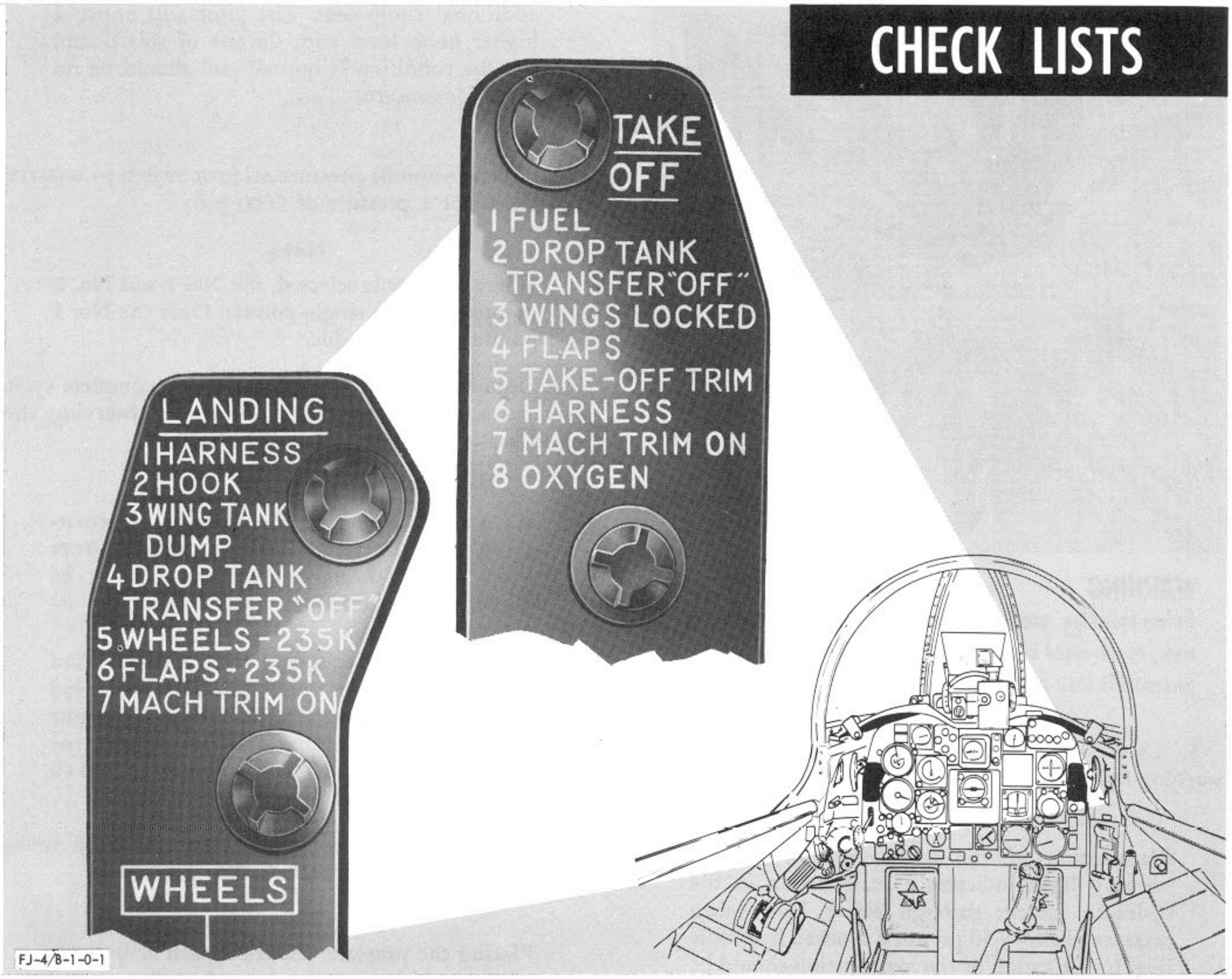
CHECK LISTS
TAKE OFF
1 FUEL
2 DROP TANK TRANSFER "OFF"
3 WINGS LOCKED
4 FLAPS
5 TAKE-OFF TRIM
6 HARNESS
7 MACH TRIM ON
8 OXYGEN
LANDING
1 HARNESS
2 HOOK
3 WING TANK DUMP
4 DROP TANK TRANSFER "OFF"
5 WHEELS-235K
6 FLAPS-235K
7 MACH TRIM ON
WHEELS
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Figure No. 2-6.

TAXIING INSTRUCTIONS.

CAUTION

- To minimize the possibility of dirt and foreign objects being drawn into the compressor when taxiing, maintain adequate distance from other taxiing airplanes.
- Do not cross the slip streams of either jet or propeller-driven airplanes.

1. Signal ground crew to remove wheel chocks.

2. Taxi at lowest practical rpm once airplane is moving.

3. Steer airplane by differential braking; check operation of turn-and-bank indicator and polar path compass.

3A. At this time, the yaw damper may be checked by switching the rudder boost system to TEST while "S" turning. Rudder pedal pressure feedback in opposition to the turn indicates proper yaw damping and rudder boost reliability. Rudder boost switch should be turned OFF prior to take-off.

4. Avoid excessive or rapid jockeying of throttle.

5. Minimize taxi time as airplane range is considerably decreased by high fuel consumption during ground operation. Fuel consumption with engine operating at idle speed will be approximately 1150 pounds per hour.

6. Avoid excessive use or riding of brakes when taxiing with asymmetric loads or when taxiing for long distances.

Note

If possible, allow approximately 30 minutes between flights to permit adequate cooling of wheels and brakes.

TAKE-OFF CHECKS.

A check list for take-off appears on the instrument panel. (See figure 2-6.) An expanded version of this check list follows:

1. Safety belt and shoulder harness tightened and locked.
2. Re-check fuel quantity.
3. Emergency fuel control switch at PRIMARY.
4. Flaps, wing leading edge down.

Note

On some airplanes,* the wing flap control lever incorporates a half-flap position for use with asymmetrical (uneven) configurations of external stores. When the landing flaps are extended to half, the leading edge flaps will be fully extended and the wing and leading edge flap position indicator will show a "barber pole."

5. Cockpit pressurization as desired.
6. Re-check wings locked.
7. Re-check airplane trimmed for take-off.

7A. Re-check approach indexer for illumination.‡

8. Re-check Mach trim and yaw damper† ON.

8A. Rudder boost switch OFF.*

9. Re-check alternate trim selector switch NORMAL.
10. Speed brakes closed.
11. Canopy open or closed as desired.
12. Run up engine to 100% rpm and check engine instruments.

Note

The tail-pipe temperature at 100% rpm will vary somewhat with atmospheric conditions. For the normally expected variation of tail-pipe temperature with ambient air temperature, see figure 2-5 and ENGINE LIMITATIONS, in Section V of the Supplemental Flight Handbook (NAVAER 01-60JKD-501A).

13. Oxygen as desired. (Refer to OXYGEN SYSTEM, Section IV.)

TAKE-OFF.

NORMAL FIELD TAKE-OFF.

For take-off distances, see figure A-11 in the Supplemental Flight Handbook (NAVAER 01-60JKD-501A).

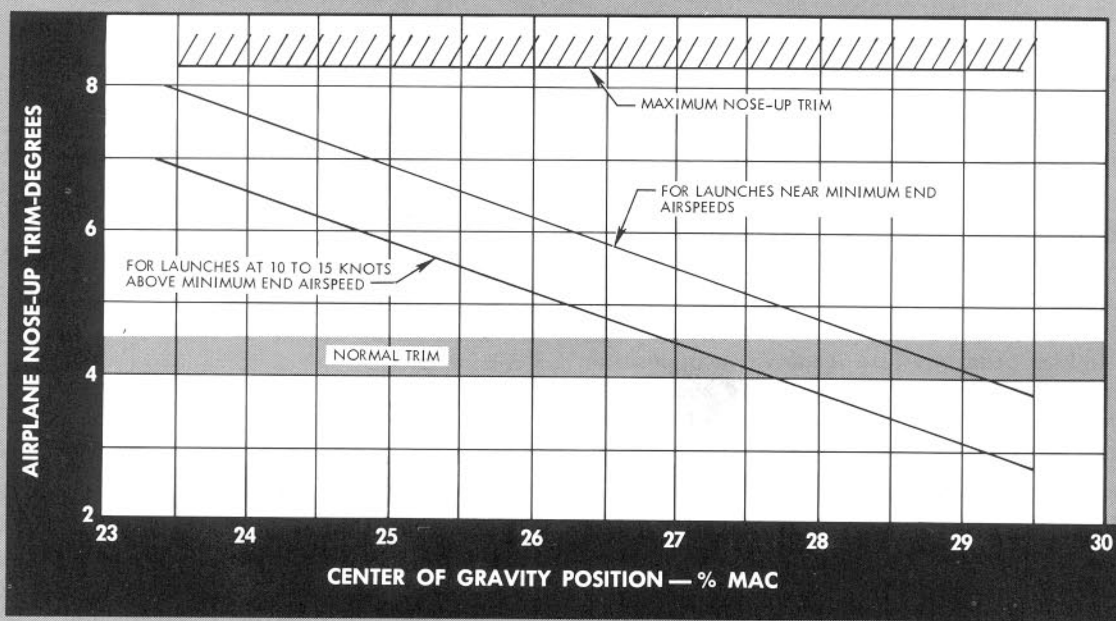
1. With throttle at take-off rpm, release brakes and begin take-off run.
2. During early portion of take-off run, maintain directional control by minimum use of differential braking. Rudder will become effective at about 50 knots.
3. At approximately 90 knots, lift nose wheel slightly to clear the runway. Maintain this attitude until the airplane becomes air-borne or until the recommended take-off speed is attained; then, slowly rotate the airplane until air-borne.

Take-off speeds with full flaps are approximately as follows:

*Airplanes 139531 and subsequent
†Airplanes 139281 through 139530
‡Airplanes 143594 and subsequent

FJ-4 & FJ-4/B LONGITUDINAL TRIM AND CATAPULT END AIRSPEEDS

LONGITUDINAL TRIM SETTINGS FOR CATAPULT LAUNCHES



MINIMUM CATAPULT END AIRSPEEDS

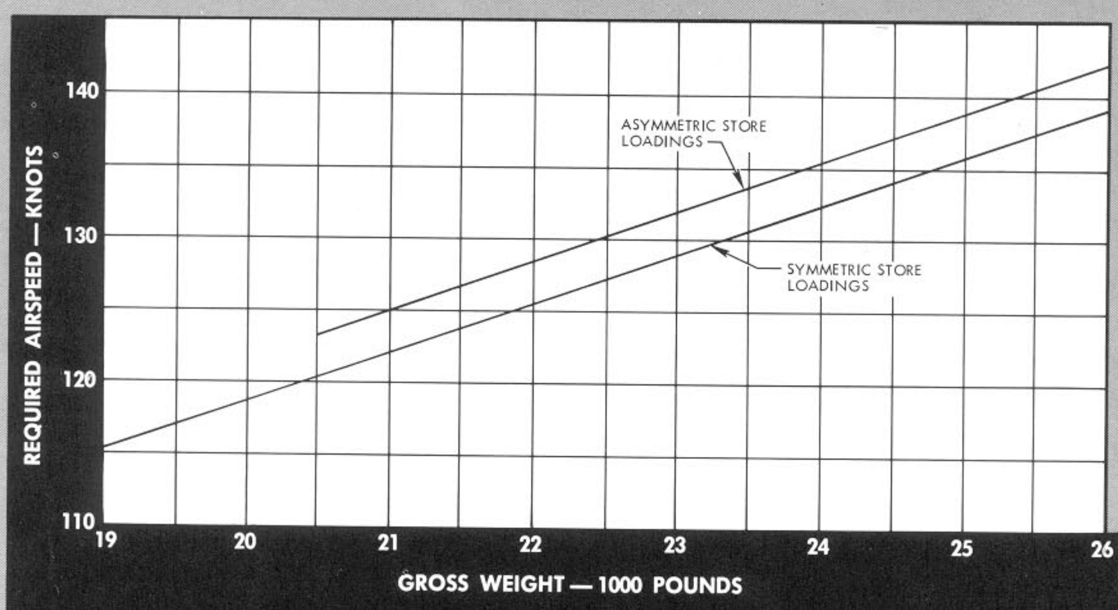


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Figure No. 2-6A.

GROSS WEIGHT (LB)	INDICATED TAKE-OFF SPEED (KNOTS)
16,000	116
17,000	119
18,000	123
19,000	127
20,000	131
21,000	135
22,000	138
23,000	142
24,000	146
25,000	150
26,000	154
27,000	157
28,000	161
29,000	165
30,000	169

CAUTION

No-flap take-offs should be avoided since a stalled condition due to premature lift-off or overrotation after lift-off would be difficult to control.

Note

For emergency procedures to follow in the event of an emergency during take-off, refer to Section III.

HEAVYWEIGHT TAKE-OFF.

In order to ensure safe performance prior to take-off, the Supplemental Flight Handbook (NAVAER 01-60JKD-501A) should be consulted before undertaking missions during which take-off distance and/or controllability may be marginal. In Appendix I, realistic take-off, landing and stopping distances are presented, as well as refusal speeds. Refer to Section VI for pilot techniques. If the predicted refusal speed is not attained within the predetermined ground-roll distance, the take-off should be aborted. (Refer to Section III.)

ASYMMETRIC TAKE-OFF.

Take-offs with asymmetric loadings require moderate application of the brake on the light side of the airplane to maintain directional control until the rudder becomes effective. The amount of differential braking and the resultant increase in take-off distance will depend on the degree of asymmetry and the magnitude and direction of any cross-wind component. Cross winds from the light side of the airplane are more critical than from the heavy side. Refer to TAKE-OFF DISTANCES and RECOMMENDED TAKE-OFF AND APPROACH SPEED in Appendix I of the Supplemental Flight Handbook (NAVAER 01-60JKD-501A). For airplanes asymmetrically loaded with a store on the left intermediate wing station, full right rudder and full right wing down trim should be used. Normal take-off lateral and directional trim settings should be used with stores partially balanced by drop tanks on the opposite wing station. The longitudinal trim settings for catapult take-off at 10-15 knots above minimum end airspeeds listed under CATAPULT TAKE-OFF are recommended.

1. With throttle at take-off rpm, release brakes and begin take-off run.
2. Maintain directional control by minimum use of the brake on the light side of the airplane. Apply full rudder deflection on the same side to obtain maximum rudder effectiveness as the airplane accelerates.
3. At approximately 10 knots below recommended take-off speed, lift the nose wheel about one foot from the runway. Maintain this angle of attack until air-borne at approximately the recommended take-off airspeed.
4. Raise the landing gear when safely air-borne, level off to accelerate and raise the flaps when the wheels are fully retracted.
5. Be prepared to make the necessary corrections for trim changes as the airplane accelerates after take-off.

CATAPULT TAKE-OFF.

Refer to applicable aircraft launching bulletins for recommended trim settings and techniques.

At normal gross weight and center-of-gravity positions (no external stores), the normal longitudinal take-off trim setting is satisfactory for launches at the minimum catapult end airspeed of approximately 118 knots. At end airspeeds above 130 knots, a slight push force will be necessary to avoid climbing after take-off. Normal take-off lateral and directional trim settings should be used for all catapult launches. For launches with external stores, refer to the following table and to figure 2-6A for the minimum catapult end airspeeds and the recommended longitudinal trim settings for launches at 10 to 15 knots above minimum end airspeeds.

LOADING	GROSS WEIGHT JP-5 FUEL (POUNDS)	MINIMUM END AIRSPEED (KNOTS)	AIRPLANE NOSE-UP DEGREES
T-66 One 200-gal tank	23,475	135	6.0
T-63 One 200-gal tank	24,000	136	6.5
T-28 One 200-gal tank	24,400	137	6.0
4 Bullpups Two 150-gal tanks	25,340	138	6.5
2 Buddy Tanks	26,550	142	4.5
T-28 One 200-gal tank Two 150-gal tanks	26,900	146	4.0
Two 2000-lb bombs Two 150-gal tanks	27,950	146	3.5
One T-28		—	5.5
One T-63		—	6.0

Note

- When using JP-4 fuel during catapult launches, the airplane gross weight will be reduced 0.5 pound per gallon of fuel.
- For launches at minimum end airspeeds, increase the longitudinal trim setting 1 degree airplane nose-up.

For some airplanes,* selecting longitudinal trim settings other than for normal take-off trim requires trimming the stick aft 3/4 inch for each additional degree of airplane nose-up trim desired. The normal take-off trim indication of IN represents +4 1/4 (±1/4) degrees airplane nose-up.

Recommended longitudinal trim settings are a function of CG position and are based on full internal fuel (JP-5) and a full load of ammunition. For launches with external stores not previously tabulated, refer to the chart of longitudinal trim versus center-of-gravity position, figure 2-6A.

For catapult launching restrictions with external stores, refer to STORES in Section V of the Supplemental Flight Handbook (NAVAER 01-60JKD-501A). External stores must always be partially balanced by drop tanks on the opposite wing station.

On some airplanes,† if the individual exterior light selector switches are preselected, the exterior lights master switch mounted forward of the catapult handle provides an illumination method for signaling during catapult operations.

Catapult spotting characteristics are normal and either the straight-on or angled approach may be used. A nose wheel spotting bar is recommended.

WARNING

When carrying the T-28 store, spotting the nose gear and/or the main gear more than 2 inches off-center will result in dangerously high side loads on the catapult hooks.

Directional oscillations of the airplane will be encountered during the catapult power stroke when the airplane is spotted off-center. Off-center spotting conditions will not necessarily be apparent from the cockpit and the resultant directional oscillations may not be anticipated by the pilot. Although the pilot may receive the impression during the power stroke that lateral or directional control corrections will be required, the oscillations damp out immediately when the airplane is released from the catapult and neither lateral nor directional corrections should be made during the power stroke. The optimum technique for catapult take-off is to trim the airplane for the loading and expected end airspeed and to hold the hand clear and aft of the stick during the power stroke. The physical pilot/stick relationship does not permit adequate bracing of the arm or elbow for holding the stick. The mass balance of the control system will cause the stick to remain in the trimmed position during the catapult launch. When released from the catapult, the airplane is responsive to small control deflections and adjustments are easily effected for trim settings that are not the optimum for the loading and end airspeed obtained.

CAUTION

If the stick is trimmed or inadvertently moved aft of the recommended trim position, it is possible to overrotate and induce an accelerated stall after leaving the bow. Use of the hand-off (stick) technique is mandatory on short stroke catapults (H-4-B, H-8 and C-11-2).

In addition to the TAKE-OFF check list, perform the following:

1. Safety belt and harness tightened and locked.
2. Emergency fuel control switch at PRIMARY.
3. Speed brakes in.
4. Flaps full down.
5. Wing leading edge down.
6. Rudder boost off.
7. Canopy — as desired.
8. Re-check fuel quantity.
9. Check synchronization of polar compass.
10. Controls free.
11. Stabilize at Military Rated Thrust and check engine instruments.
12. Adjust throttle friction.
13. Grasp throttle and catapult grip.
14. Give launch signal, brace head against headrest and place hand in lap, clear of stick.

For launches at or near minimum end airspeeds, the recommended longitudinal trim setting will provide the required rate of rotation to stop the sink off the bow. Be prepared to apply light forward stick pressure to prevent overrotation into the artificial stall warning angle of attack. Attempt to stabilize the airplane at 17 to 18 units angle of attack. Do not retract the landing gear until the airplane accelerates at least 8 knots above the minimum end airspeed since the drag of the open landing gear doors will reduce the acceleration rate. Do not commence a clearing turn until well above launching airspeed.

*Airplanes 139281 through 139530
†Airplanes 139531 and subsequent

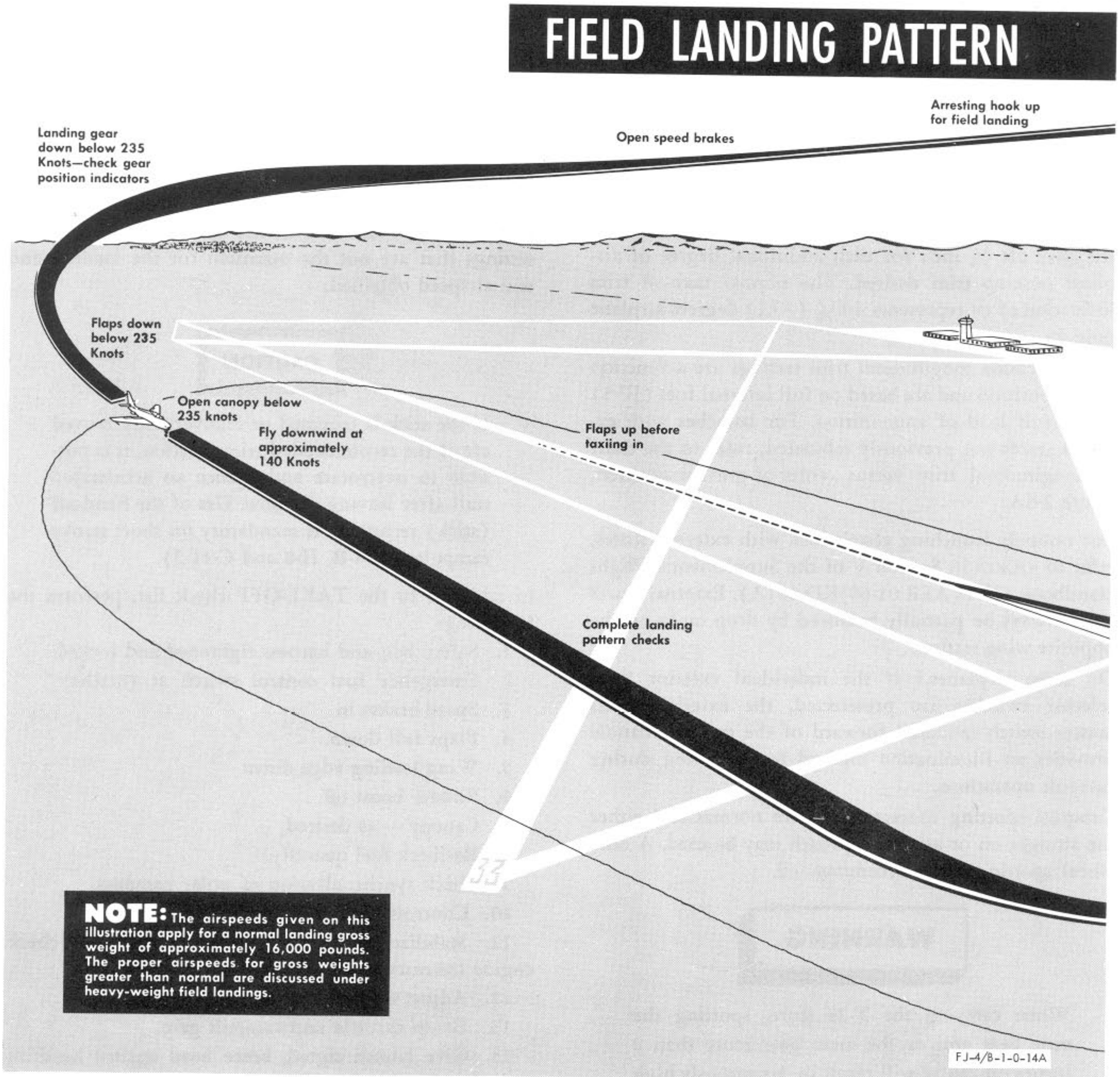

Figure No. 2-7. (Sheet 1)

AFTER TAKE-OFF.

When airplane is definitely air-borne, proceed as follows:

1. Landing gear handle UP. Check gear position indicators for gear up. Approximately 8 seconds is required for gear retraction.

Note

Prolonged taxiing prior to take-off can generate sufficient heat within the wheels and brakes to cause tire failure after take-off. Should excessive taxiing be necessary, it is recommended that the gear remain extended as long as practicable after take-off to permit cooling of the wheels and brakes.

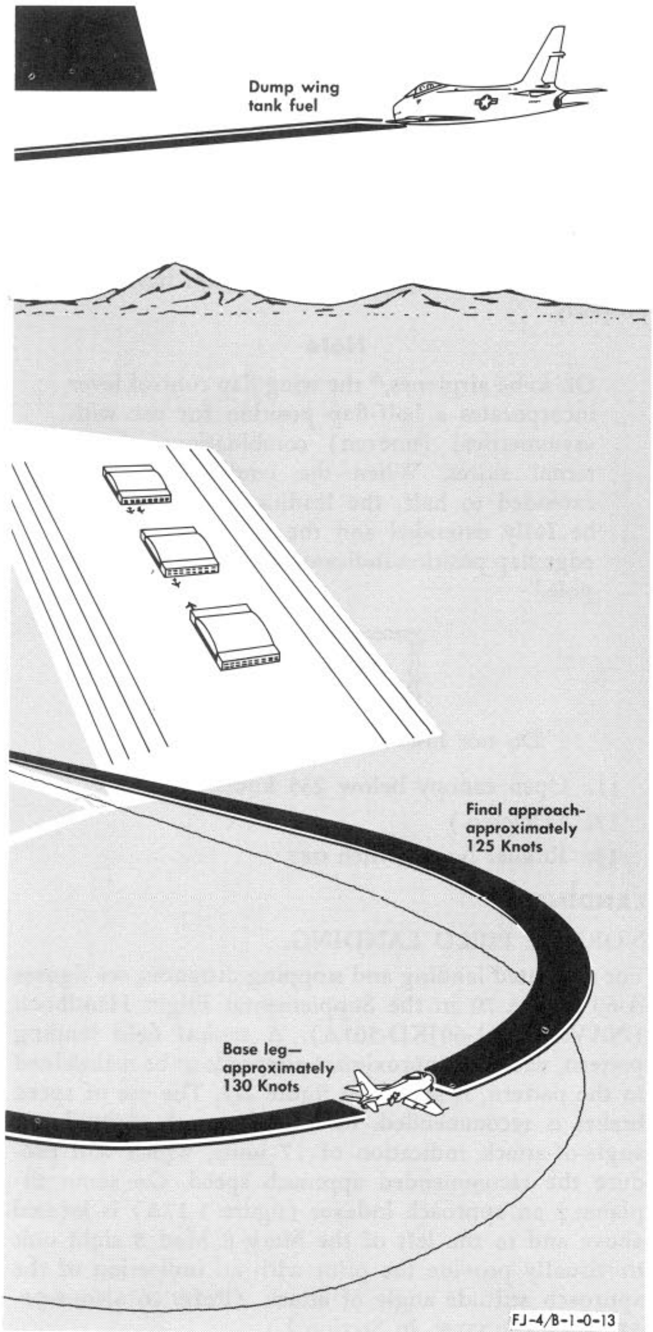

Figure No. 2-7. (Sheet 2)

2. Wing flap lever UP as airplane gains speed above 135 knots. Check flap position indicator for flaps up. Visually check that both right and left wing leading edges have retracted properly.

CAUTION

Raise gear and flaps below 235 knots to prevent possible damage to the associated structure and operating mechanisms. If the flaps do not retract fully, avoid high-speed, high G pull-ups.

3. Close canopy below 235 knots.

CAUTION

During flight, do not move the canopy switch to CLOSE when the canopy is already fully closed. The canopy seal will deflate and cockpit pressure will be lost as long as the switch is in the CLOSE position.

4. Check cockpit pressure selector switch on NORMAL or COMBAT as desired.
5. Trim as required.
6. Transfer drop tank fuel when desired.
7. Turn rudder boost ON* when desired.

CLIMB.

Climb at take-off rpm (time limit 30 minutes) and follow the climb schedule (clean airplane) given below:

ALTITUDE (FEET)	INDICATED AIRSPEED (KNOTS)	MACH NUMBER
Sea Level	430	0.65
10,000	392	0.70
20,000	349	0.75
30,000	302	0.80
35,000	277	0.82
40,000	251	0.83
45,000	224	0.83
50,000	200	0.83

For additional climb data covering elapsed time, distance traveled and fuel consumed during climb, see figures A-24 through A-27 in the Supplemental Flight Handbook (NAVAER 01-60JKD-501A).

DESCENT.

To obtain maximum distance at idle rpm or with dead engine, descend at 200 knots with the speed brakes closed. (See figure 3-1.)

LANDING PATTERN CHECKS.

The maximum permissible gross weights for landing are given under WEIGHT LIMITATIONS, in Section V of the Supplemental Flight Handbook (NAVAER 01-60JKD-501A). A check list for landing appears on the instrument panel. (See figure 2-6.) An expanded version of this check list follows:

1. Safety belt and shoulder harness tightened and locked.

***Airplanes 139531 and subsequent**

2. Check that arresting hook is down for carrier landing, up for field landing.

3. Drop tank transfer switch to OFF.

4. Dump any fuel remaining in the wing tanks by pulling the handle marked WING FUEL DUMP. After fuel is dumped, push handle back in. (Refer to FUEL JETTISONING, Section I.)

Note

An engine speed of 75% or higher is required to actuate the air pressure valve in the wing tank in order to dump wing fuel.

5. Armament switch OFF.

6. (Deleted.)

7. Check utility hydraulic pressure.

8. Open speed brakes. Return speed brake switch to neutral.

Note

- On some airplanes,† the speed brake actuating switch is spring-loaded to neutral from the OUT position, but the switch must be manually returned to neutral from the IN position.
- On airplanes* equipped with both forward and aft speed brakes, the aft speed brakes will retract automatically when the landing gear handle is positioned DOWN. The forward speed brakes will remain "out" unless repositioned by the speed brake control switch. [Refer to SPEED BRAKES, Section I and refer also to Section VI of the Supplemental Flight Handbook (NAVAER 01-60JKD-501A).]

9. Landing gear DOWN. Check gear position indicators.

CAUTION

Do not lower gear above 235 knots. On airplanes* equipped with both forward and aft speed brakes, simultaneous lowering of landing gear and wing flaps results in a mild pitch-up, which is only slightly aggravated by turning flight. It is recommended that when the landing gear is lowered at speeds above 180 knots IAS with the speed brakes open, the wing flaps and droops should not be extended until the landing gear is down and locked. Use of this procedure will minimize the nose-up trim change experienced as the aft speed brakes automatically close.

Note

On some airplanes,‡ the approach indexer (figure 1-17A) provides an auxiliary indication for the landing gear since illumination of the indexer takes place after the landing gear downlock relay is de-energized by extension of all gear.

10. Flaps DOWN. Check flap position indicator. Visually check that wing leading edge flaps have operated properly.

Note

On some airplanes,* the wing flap control lever incorporates a half-flap position for use with asymmetrical (uneven) combinations of external stores. When the landing flaps are extended to half, the leading edge flaps will be fully extended and the wing and leading edge flap position indicator will show a "barber pole."

CAUTION

Do not lower flaps above 235 knots.

11. Open canopy below 235 knots.

12. (Deleted.)

13. Rudder boost switch OFF.

LANDING.

NORMAL FIELD LANDING.

For estimated landing and stopping distances, see figures A-69 and A-70 in the Supplemental Flight Handbook (NAVAER 01-60JKD-501A). A typical field landing pattern, with the approximate airspeeds to be maintained in the pattern, is shown in figure 2-7. The use of speed brakes is recommended. In final approach maintain an angle-of-attack indication of 17 units, which will produce the recommended approach speed. On some airplanes,‡ an approach indexer (figure 1-17A) is located above and to the left of the Mark 8 Mod 8 sight unit to visually provide the pilot with an indication of the approach attitude angle of attack. (Refer to ANGLE-OF-ATTACK INDICATOR, in Section I.)

Just prior to touch-down, reduce power and flare slightly to cushion the landing. An alternate technique is to simulate a mirror approach using 17.5 units angle of attack and maintaining attitude and power until touch-down. After touch-down, if sufficient runway is available, gradually raise the nose as speed decreases to take full advantage of aerodynamic braking. At approximately 85 knots, lower the nose wheel to the runway and commence wheel braking. This procedure will minimize wear of brakes and tires. Do not apply brakes until the nose wheel is on the runway. For minimum stopping distance, immediately after touch-down lower the nose

*Airplanes 139531 and subsequent
†Airplanes 143493 and subsequent
‡Airplanes 143594 and subsequent

CARRIER LANDING PATTERN

GROSS WEIGHT—16,000 POUNDS

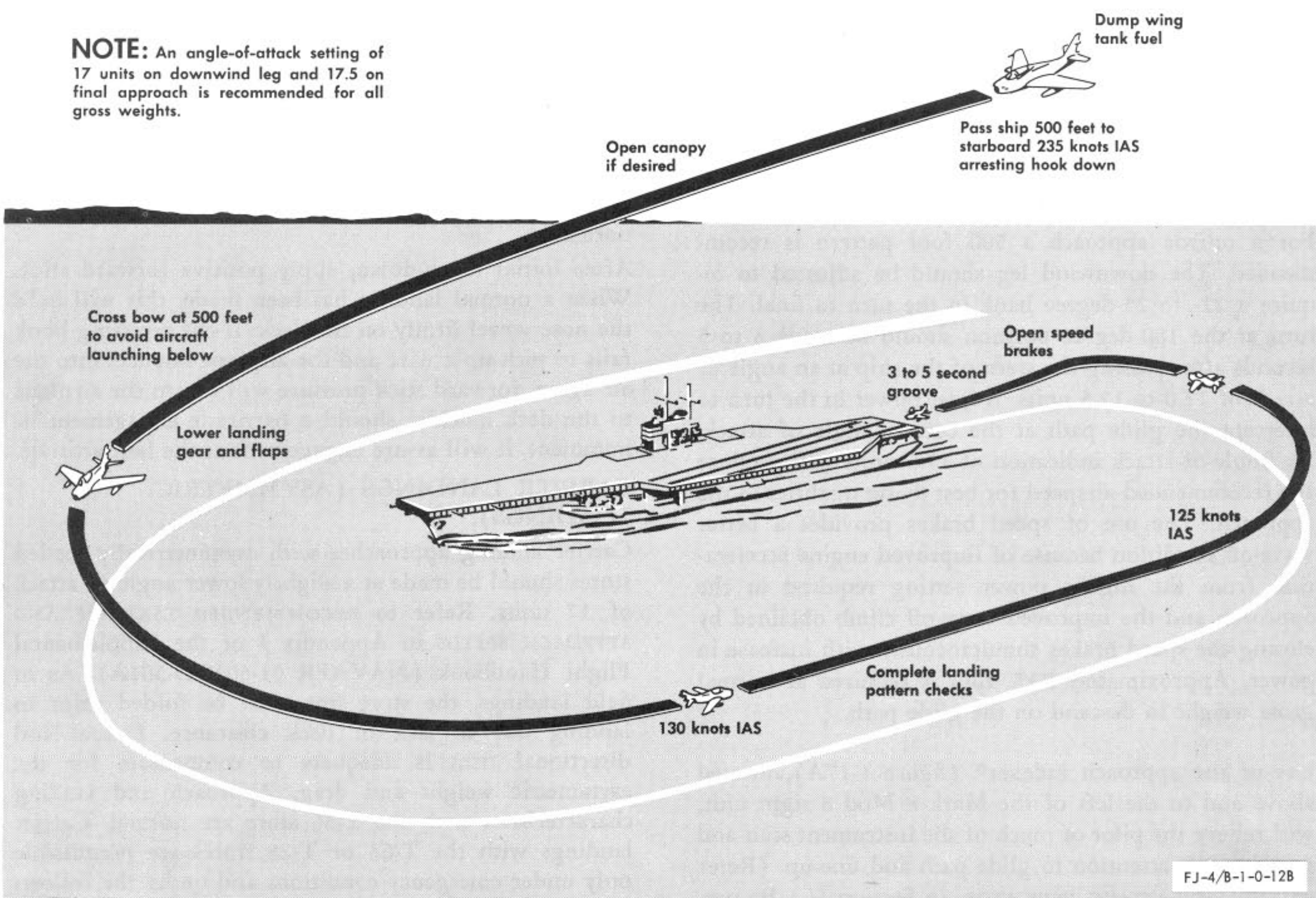

Figure No. 2-8.

wheel to the runway, raise flaps and apply maximum braking without skidding the wheels. If a no-flap landing is necessary, maintain an angle of attack of 16 units to touch-down which will produce an approach airspeed 8 to 10 knots faster than normal. Maintain directional control with brakes after the rudder becomes ineffective at approximately 50 knots.

Note

For emergency landing procedures, refer to LANDING EMERGENCIES, Section III.

HEAVYWEIGHT FIELD LANDING.

Note

By dumping wing fuel, gross weight can be reduced approximately 2100 pounds. Normally, the landing gross weight should not exceed 18,000 pounds.

The same technique and procedure for normal field landings apply to heavyweight landings except for the increased thrust necessary to maintain the higher required airspeeds. An angle-of-attack indication of 17.0 to 17.5 units will produce the required airspeed regardless of gross weight.

FIELD LANDING (ASYMMETRIC LOADING).

The technique and procedure for normal and heavyweight landings apply to field landings with asymmetrically loaded stores. Store fins must be folded prior to landing due to lack of ground clearance. Lateral and directional trim is adequate to compensate for the asymmetric weight and drag. Reduce fuel loading to a safe minimum if possible. Landings with the T-66 store are normal. After landing with a T-63 or T-28 store, be prepared to counter a strong tendency for the airplane to turn away from the store during roll-out. Keep the nose wheel on the runway and use rudder and a minimum of brake to maintain directional control. Landing distances will be increased due to the differential braking required.

CAUTION

Do not raise the nose for aerodynamic braking. Rudder effectiveness is inadequate for directional control and the nose wheel must be kept on the runway to permit differential braking.

CARRIER LANDING.

A typical carrier landing pattern is shown in figure 2-8. For a mirror approach a 500 foot pattern is recommended. The downwind leg should be adjusted to require a 22- to 25-degree bank in the turn to final. The turn at the 180-degree position should be made 3 to 5 seconds after passing the stern of the ship at an angle of attack of 17.0 to 17.5 units. Adjust power in the turn to intercept the glide path at the correct angle of attack. An angle-of-attack indication of 17.5 units will produce the recommended airspeed for best flying qualities in the approach. The use of speed brakes provides a better wave-off condition because of improved engine acceleration from the higher power setting required in the approach and the improved wave-off climb obtained by closing the speed brakes simultaneously with increase in power. Approximately 83% rpm is required at normal gross weight to descend on the glide path.

Use of the approach indexer* (figure 1-17A), located above and to the left of the Mark 8 Mod 8 sight unit, will relieve the pilot of much of the instrument scan and permit more attention to glide path and line-up. (Refer to ANGLE-OF-ATTACK INDICATOR, in Section II.) Be prepared for slight turbulence near the ramp of an angled deck carrier and anticipate a slight right wing drop and increase in rate of descent. Maintain angle of attack, line-up and glide path down to the deck. Do not attempt a late correction back to centerline. Due to the increased arresting gear run-out on angled deck carriers, a right to left drift may result in the airplane coming to rest in the port catwalk. Pushing the nose over prior to touchdown will increase the sink rate and may result in excessive landing gear loads and arresting hook bounce. A flare-out may result in a free flight engagement with attendant high structural loads on the nose gear and tail hook.

CAUTION

Avoid any tendency to dive for the deck or flare-out. Do not reduce power until a wire is positively engaged. If a bolter occurs, select full power and close speed brakes.

The carrier pattern using the LSO is similar to the mirror pattern except that the downwind leg is flown at approximately 200 feet altitude and the turn off the downwind leg is made abeam the LSO platform. Approximately 85% rpm is required in the final approach with speed brakes open. At the cut, maintain power, drop the nose slightly and fly the airplane to the deck. Dives for the deck and flare-outs must be avoided.

If a no-flap landing is necessary, reduce fuel to a minimum. Maintain an angle of attack of 16 units which will produce an approach airspeed 8 to 10 knots faster than normal.

After initial touch-down, apply positive forward stick. When a normal landing has been made, this will hold the nose wheel firmly on the deck; if the arresting hook fails to pick up a wire and the airplane bounces into the air again, forward stick pressure will return the airplane to the deck quickly; should a barricade engagement be imminent, it will assure engagement at the best attitude.

CARRIER LANDINGS (ASYMMETRIC LOADINGS).

Carrier landing approaches with asymmetrically loaded stores should be made at a slightly lower angle of attack of 17 units. Refer to RECOMMENDED TAKE-OFF AND APPROACH SPEEDS in Appendix I of the Supplemental Flight Handbook (NAVAER 01-60JKD-501A). As in field landings, the store fins must be folded prior to landing due to lack of deck clearance. Lateral and directional trim is adequate to compensate for the asymmetric weight and drag. Approach and landing characteristics with the T-66 store are normal. Carrier landings with the T-63 or T-28 stores are permissible only under emergency conditions and under the following restrictions:

1. Maximum engaging speed of 115 knots.
2. When carrying the T-63 store, landing must be made between 10 feet right of center and 20 feet left of center.
3. When carrying the T-28 store, landing must be made between the centerline and 20 feet left of center.

WARNING

The above restrictions must be observed to avoid excessive arresting hook side loads.

For carrier landing restrictions with external stores, refer to STORES in Section V of the Supplemental Flight Handbook (NAVAER 01-60JKD-501A).

WAVE-OFF OR GO-AROUND.

Note

A minimum of 350 pounds of fuel should be allowed for a complete wave-off and go-around.

*Airplanes 143594 and subsequent

CAUTION

- The forward fuel booster pump, in the forward fuselage tank (sump), is automatically turned OFF when the landing gear is extended. This is to avoid fuel starvation should the pump rise above the fuel surface at high nose-up attitudes or landing speeds. If a wave-off or go-around should be necessary with extremely low fuel quantity, avoid raising the landing gear since such action will re-energize the forward fuel booster pump and fuel starvation can occur.
- Do not retract gear immediately if the wave-off is given from a slow condition as the drag of the open landing gear doors is liable to aggravate the slow condition. Do not retract the flaps until sufficient speed is built up.
- On some airplanes,* if the speed brakes are extended in the approach they should be closed before the landing gear is raised for the wave-off. Otherwise, when the gear is retracted, the aft speed brakes will extend and, if airspeed is slow, a stall may occur.

1. Open throttle to take-off thrust.
2. Close speed brakes.

CAUTION

Under standard sea level conditions, the engine takes 4 to 5 seconds to accelerate to take-off thrust from 75% rpm, so take your wave-off promptly.

HOLDING.

Refer to figures A-22 and A-23, in Appendix I of the Supplemental Flight Handbook (NAVAER 01-60JKD-501A), for optimum procedure if a fouled deck is encountered while making the final approach, or if the fouled deck condition occurs near sea level.

If 35,000 feet is reached before the allotted fuel for climb is consumed, level off at 35,000 feet. Adjust power to maintain a level flight holding speed of approximately 200 knots and watch your fuel quantity.

AFTER LANDING.

1. Raise wing flaps prior to taxiing.
2. Speed brakes IN.

2A. Speed brake switch neutral.

3. Fold wings after taxiing in.

STOPPING ENGINE.

1. Chock wheels.
2. When possible, retard throttle to IDLE and permit rpm and exhaust temperature to stabilize for one minute.
3. Retard throttle to OFF.
4. Turn engine master switch OFF *after engine stops rotating.*

WARNING

- To minimize danger of explosion due to accumulated fuel vapor, always park airplane headed into the wind and wait at least 15 minutes after any engine operation before moving airplane into hangar.
- Possible hazard to deck personnel exists,* due to the aft speed brakes opening, if the speed brake switch is left OUT and the battery-generator switch is turned OFF while utility hydraulic pressure is still available.

Note

For procedure to follow in the event of an emergency during engine shutdown, refer to Section III.

BEFORE LEAVING AIRPLANE.

1. Turn off radar, navigation and communication equipment.
2. Landing light switch OFF.
3. Speed brake switch neutral.
4. Fuel control switch PRIMARY.
5. Canopy switch OFF.
6. Conduct oxygen system postflight check. (Refer to OXYGEN SYSTEM POSTFLIGHT CHECK, Section IV.)
7. Rudder locked.
8. Interior and exterior light switches OFF.
9. Install safety pins in canopy emergency release handle and in canopy initiator.
10. Battery-generator switch OFF.
11. Close canopy by using switch in either right-hand or left-hand lower step.

*Airplanes 139531 and subsequent

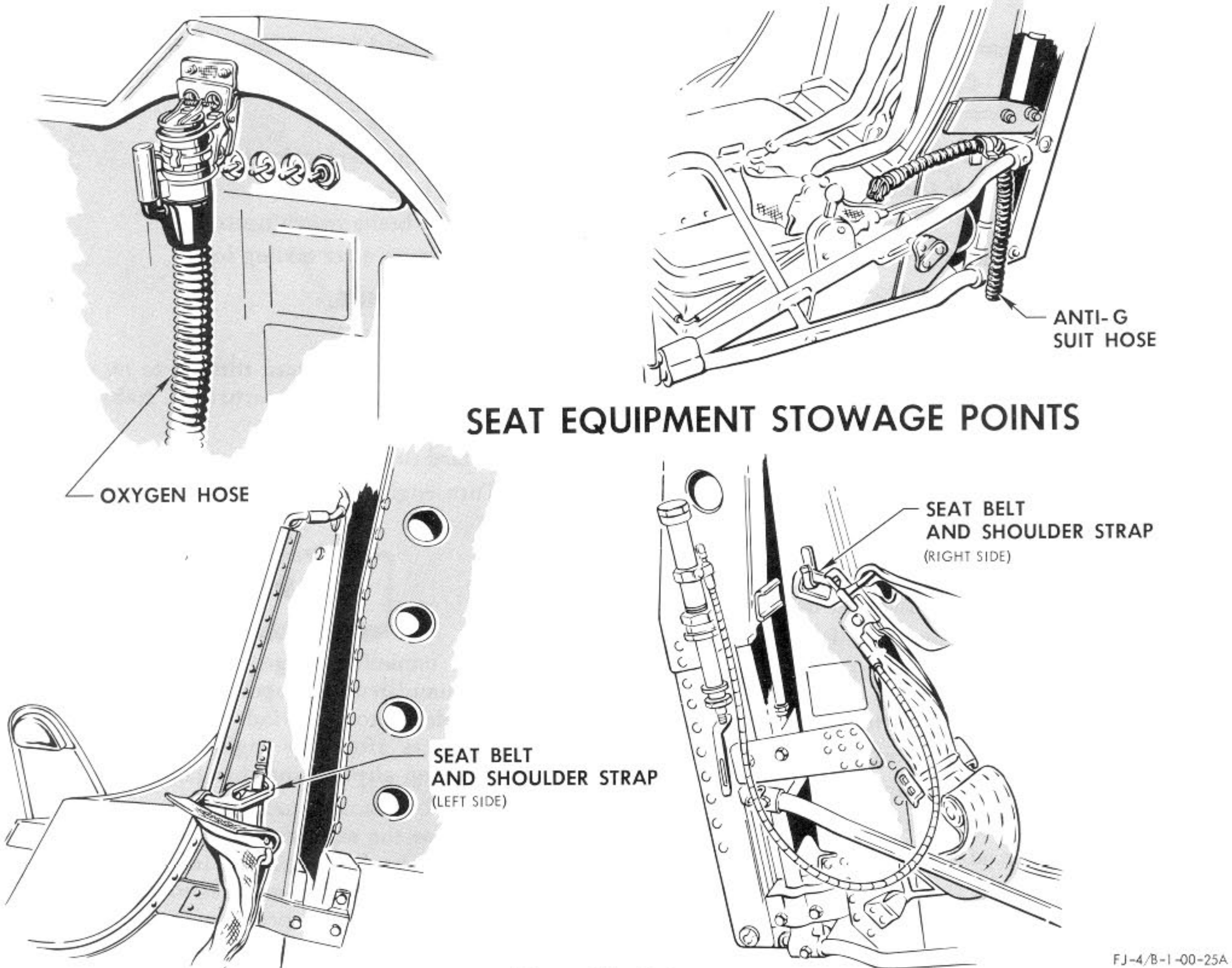

Figure No. 2-9.

Note

If circumstances permit, the canopy can be left open in extremely hot weather to allow air circulation.

12. Instruct plane captain to replace angle-of-attack and angle-of-yaw transmitter probe covers.

Note

If the angle-of-attack and angle-of-yaw probes are left uncovered during adverse weather, moisture may enter the probe openings and short out the transmitters.

13. Note any mechanical discrepancies or abnormal flight reactions on the daily inspection form.

Before leaving the airplane, the following equipment should be stowed as shown in figure 2-9:

1. The oxygen hose should be clipped to the webbing strip provided on the underside of the instrument panel shroud.

2. The anti-G suit hose is stowed under a clip on the left side of the seat back.

3. Clips are provided on both sides of the seat back for securing the ends of the lap belt and shoulder harness.

ENGINE FAILURE.

Engine failure or flame-out can be caused by a malfunction of the fuel control system or by incorrect operating technique. Flame-out may be identified by rapid decrease in EGT and fuel flow, loss of thrust or loss of ability to accelerate. Sometimes flame-out is accompanied by engine vibration. For a complete discussion of engine operation, refer to Section VII. It should be noted that engine instruments often provide indications of fuel control system failures prior to actual engine stoppage.

The airplane has no automatic change-over provisions to an emergency fuel control system if failure of the main fuel control system occurs. Change-over can be accomplished only by moving the emergency fuel control switch from PRIMARY to MANUAL. Fuel metering is then controlled entirely by throttle movements and throttle position. Under these conditions, throttle movement is very critical. Manual fuel control may be selected at any throttle setting during take-off. However, at 6000 feet pressure altitude and above, the throttle should always be retarded to IDLE before switching to MANUAL. If MANUAL is selected at 6000 feet pressure altitude and above without retarding the throttle to IDLE, it is possible to exceed rpm and temperature limitations with less than full throttle travel, with subsequent engine damage. When manual fuel control is used, the system does not have temperature and density compensation features. Therefore, the tail-pipe temperature and tachometer must be watched closely, especially during a climb. Do not return to PRIMARY in flight if fuel control failure is suspected. Operations which cause engine fuel starvation due to uncovering of the boost pumps in the forward fuel cell (sump) can result in engine failure (flame-out). Therefore, negative "G" or inverted flight operations which exceed 4 to 6 seconds duration should be conducted with caution. (Refer to ENGINE, Section VII, and AIR STARTS, in this section.)

If the throttle linkage breaks at some point between the cockpit throttle lever and the engine fuel control, the fuel control will automatically retard to idle power setting on an engine that does not have Engine Bulletin No. 240 incorporated. Since thrust available is negligible, the emergency procedure to be taken would therefore be the same as for a complete engine failure.

If the throttle linkage breaks on an airplane with Engine Bulletin No. 240 incorporated, the fuel control will automatically position at a power setting of 85 (±1) percent rpm (if fuel control is in PRIMARY). Under most circumstances, flight can be maintained at this power setting. (For landing procedure, refer to LANDING EMERGENCIES, in this section.)

ENGINE FAILURE DURING TAKE-OFF RUN.

If the engine fails before the airplane leaves the ground and insufficient runway remains to make a normal stop, proceed as follows:

1. Throttle OFF.
2. Apply brakes as necessary.

Note

By retracting the flaps, the loss of wing lift will add increased weight onto the landing gear and will provide increased tire friction for more effective braking action.

3. Engine master and battery-generator switches OFF.

CAUTION

If airplane is not air-borne, external stores can be jettisoned by pulling the manual stores release handle on the left forward console. Stores can be jettisoned by the emergency release button only if the weight of the airplane is off the landing gear.

ABORTING. If refusal speed is not attained within the predetermined ground roll, the take-off can be aborted by normal landing procedure. If engine failure is evident after reaching refusal speed and distance (such as during heavyweight take-off), immediately switch to MANUAL fuel control and emergency ignition. If the engine does not immediately resume operation at high thrust, lower the nose wheel to the runway and proceed as follows:

1. Pull JET EXTL STORES handle.
2. Throttle OFF, speed brakes OUT.
3. Flaps UP, canopy OPEN.
4. Cautiously apply simultaneously, intermittent braking above 100 KIAS, but do *not* skid tires.
5. Apply simultaneous, moderately heavy, steady braking below 100 knots, without skidding tires.

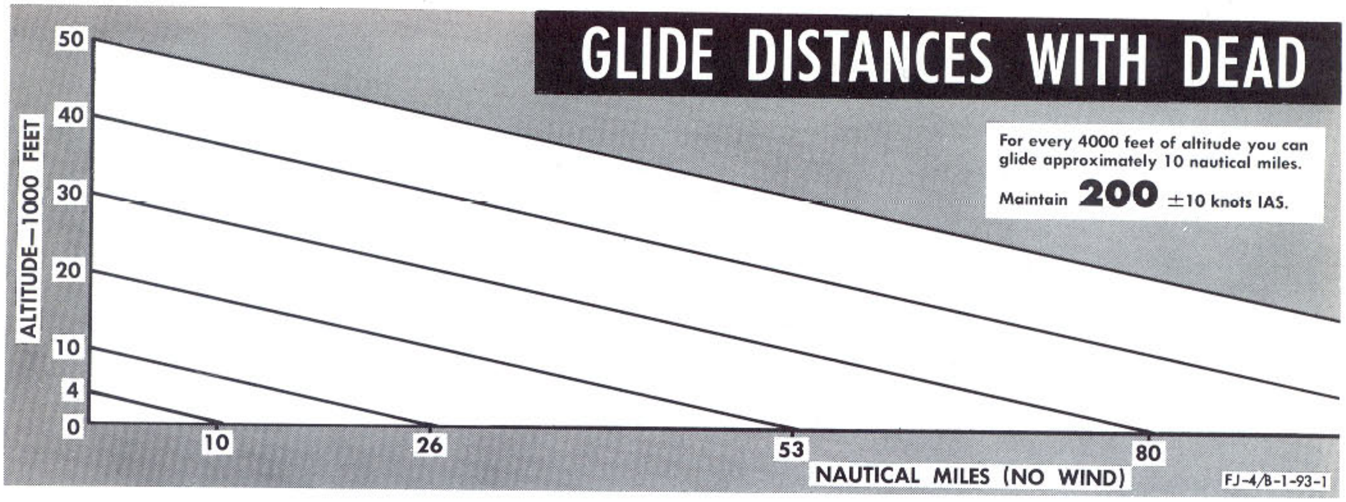

Figure No. 3-1. (Sheet 1)

ENGINE FAILURE DURING TAKE-OFF — AIRPLANE AIR-BORNE.

If the engine fails immediately after the airplane is air-borne, immediately switch engine fuel control to MANUAL and turn the emergency ignition switch ON.

If this fails to restore engine operation, land straight ahead, changing course only enough to miss obstacles.

CAUTION

- External stores can be jettisoned by the emergency release button if the weight of the airplane is off the landing gear.
- Avoid rapid throttle movements when operating the engine on manual fuel control since no acceleration or overspeed protection is incorporated.

1. Throttle OFF.
2. Gear DOWN.
3. Flaps DOWN.
4. Shoulder harness locked.
5. Engine master and battery-generator switches OFF before ground contact.

Note

Consider ejection escape if the following conditions prevail:

a. Fuel load and/or terrain straight ahead indicate an especially hazardous landing.

b. Parachute incorporates an automatic release.

c. Pilot's seat is equipped with automatic seat belt.

d. Altitude, or sufficient speed to gain altitude, is available. (Refer to BAIL-OUT, in this section.)

ENGINE FAILURE DURING CATAPULTING.

In the event of engine failure during catapulting, immediately switch engine fuel control to MANUAL and turn emergency ignition switch ON. If this fails to restore engine operation, ditch airplane straight ahead in a nose-high attitude to prevent diving after contact with the water. Accomplish the following if time permits:

1. Gear UP.
2. Throttle OFF.

Leave the airplane immediately after it comes to a complete stop.

ENGINE FAILURE DURING FLIGHT.

If the engine fails during flight, immediately retard the throttle to IDLE, select MANUAL fuel control and turn on emergency ignition switch, monitoring engine rpm and exhaust gas temperature to maintain steady-state operating limits. If this fails to restore engine operation, the following procedure is recommended:

1. Throttle OFF and emergency ignition switch OFF.
2. Establish glide at 200 knots with gear and flaps UP and speed brakes closed. At this speed, you will obtain maximum gliding distance. (See figure 3-1.)
3. Attempt an air start. (Refer to AIR STARTS, in this section.)
4. If an air start cannot be made and a suitable landing area is within reach, make a "dead-stick" landing. (Refer to LANDING WITH DEAD ENGINE, in this section.)
5. If a suitable landing area is not within reach, abandon airplane using seat ejection procedure. (See figure 3-3 and refer to BAIL-OUT, in this section.)

AIR STARTS.

If it has been determined that engine failure is not due to failure or malfunction of the primary fuel control system, then the first air start should be attempted in PRIMARY. However, if it is suspected that the primary system is faulty, the first attempt should be made following manual fuel control system procedure.

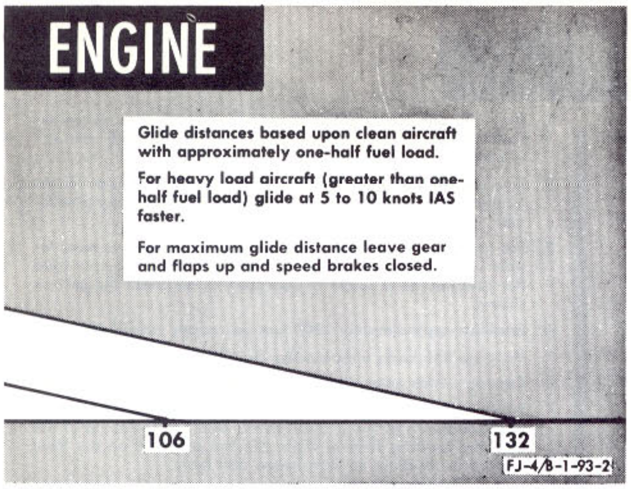

Figure No. 3-1. (Sheet 2)

WARNING

Air starts should not be attempted above 20,000 feet. It has been found that unsuccessful attempts above 20,000 feet tend to reduce the likelihood of obtaining successful starts at lower altitudes, due to the presence of residual fuel in the combustion chamber.

When a landing area is available, air start attempts should be abandoned at an altitude of about 10,000 feet to permit concentration on the landing pattern.

In the event of obvious mechanical failure within the engine, an air start should not be attempted.

AIR STARTS — PRIMARY FUEL CONTROL SYSTEM. To perform an air start using the primary fuel control system, proceed as follows:

1. Check throttle OFF.

1A. If altitude permits, nose over momentarily to impose negative G's on the airplane. (Negative G on the aircraft throws entrapped fuel up into the air stream.) It is recommended that this maneuver be preceded by a slight climb to compensate for any altitude loss and turbine speed-up caused by the pushover.

2. Stabilize airspeed between 150 and 170 knots.

2A. Maintain rpm within 13 to 17%.

3. Place emergency ignition switch ON.

Note

This should be done to ensure engine ignition in the event that engine speed is above 23% rpm during the air start attempt. Below 23% rpm, movement of the throttle from OFF will provide ignition automatically.

4. Place throttle in the IDLE detent. Fuel flow and ignition will be supplied immediately and the exhaust gas temperature should rise in approximately 5 seconds. If the exhaust gas temperature does not rise within 15 seconds, retard throttle to OFF.

5. Place emergency ignition switch OFF.

AIR STARTS — MANUAL FUEL CONTROL SYSTEM. In the event that an air start cannot be obtained on the primary fuel control system, proceed as follows:

1. Check throttle OFF.

2. Fuel control switch MANUAL.

2A. If altitude permits, nose over momentarily to impose negative G's on the airplane. (Negative G on the aircraft throws entrapped fuel up into the air stream.) It is recommended that this maneuver be preceded by a slight climb to compensate for any altitude loss and turbine speed-up caused by the pushover.

WARNING

Excess fuel in the combustion chamber from unsuccessful starting attempts greatly reduces the chances of obtaining a successful start. Drain fuel as recommended above.

3. Stabilize airspeed within 5 knots of 150 knots.

4. Place emergency ignition switch ON.

5. Advance throttle from OFF to control fuel flow to approximately 1000 pounds per hour, or less if necessary. Ignition will be supplied immediately after throttle is advanced from the OFF position.

CAUTION

If fuel flow and exhaust temperature are not monitored constantly during air starts on the manual fuel system, an overtemperature condition will result. The manual system has no automatic compensating devices and relies completely on throttle manipulation to maintain limiting exhaust gas temperatures for all engine thrust settings. (Refer to MANUAL FUEL CONTROL SYSTEM, in Section II.)

6. Emergency ignition switch OFF.

LANDING WITH DEAD ENGINE.

For the procedure to follow when you are forced to make a landing because of engine failure during flight, see figure 3-2. Unless the engine is damaged, it will windmill at sufficient speed to produce power for the hydraulic system. Rapid or large control movements will cause the hydraulic pressure to drop temporarily, but pressure will return to normal within 2 to 3 seconds after termination of control movements. The flight control system will remain operative until near

NO-THRUST LANDING

For maximum glide distance maintain airspeed of 200 knots with flaps up, gear retracted and speed brakes closed. Plan for approximate glide distance ratio of 10 miles for each 4000 feet of altitude available. Abandon air start attempts at 10,000 feet above intended landing area and concentrate on landing pattern. (Glide at 180 knots IAS with gear down only — ratio two miles per 1000 feet altitude).

When over the intended landing area use a circular constant-rate descent pattern as described below. Plan for approximate glide distance ratio of 1 mile per 1000 feet of altitude at 155 knots IAS with gear down, flaps down and speed brakes out.

With seized engine, it will be impossible to extend speed brakes. There will be an excessive drain on the battery if an attempt is made to lower the flaps.

Expect a longer roll-out for no-flap landing.

Cycle emergency control pump as necessary to maintain pressure. Run pump continuously from initial point of forced landing pattern to landing.

NOTE: The described pattern is for FJ-4 aircraft with no external stores and a fuel load below ½ capacity. For aircraft with heavier gross weights, glide at airspeeds 5 to 10 knots above the clean glide and approach speeds.

1. Turn off all non-essential electrical equipment to conserve battery. Turn emergency control pump on or extend ram-air turbine.
2. Plan lowering of gear and flaps to reach initial point at correct altitude. With seized engine, lower gear by emergency procedure.
3. For an up-wind landing, establish a 25 to 30 degree bank for your circular descent. For a cross-wind condition deviate from the specified bank angle as necessary to maintain the pattern shown.
4. Establish approximately 2500 feet per minute rate of descent.
5. Maintain 155 knots until landing flare-out (170 with no flaps).
6. Canopy switch open. Check shoulder harness locked.
7. Play turn onto final approach and use speed brakes as necessary to touch down at the proper point. Aim for first third of the selected landing strip. If high, slip the airplane on the final approach. (Perform no slips below 600 feet).
8. Flare out for landing between 150 and 140 knots IAS (160 with no flaps).
9. Just before touch-down check:
   Throttle OFF.
   Engine master and battery-generator switches OFF.
10. Touch down in normal landing altitude. (Between 150 and 120 knots IAS).

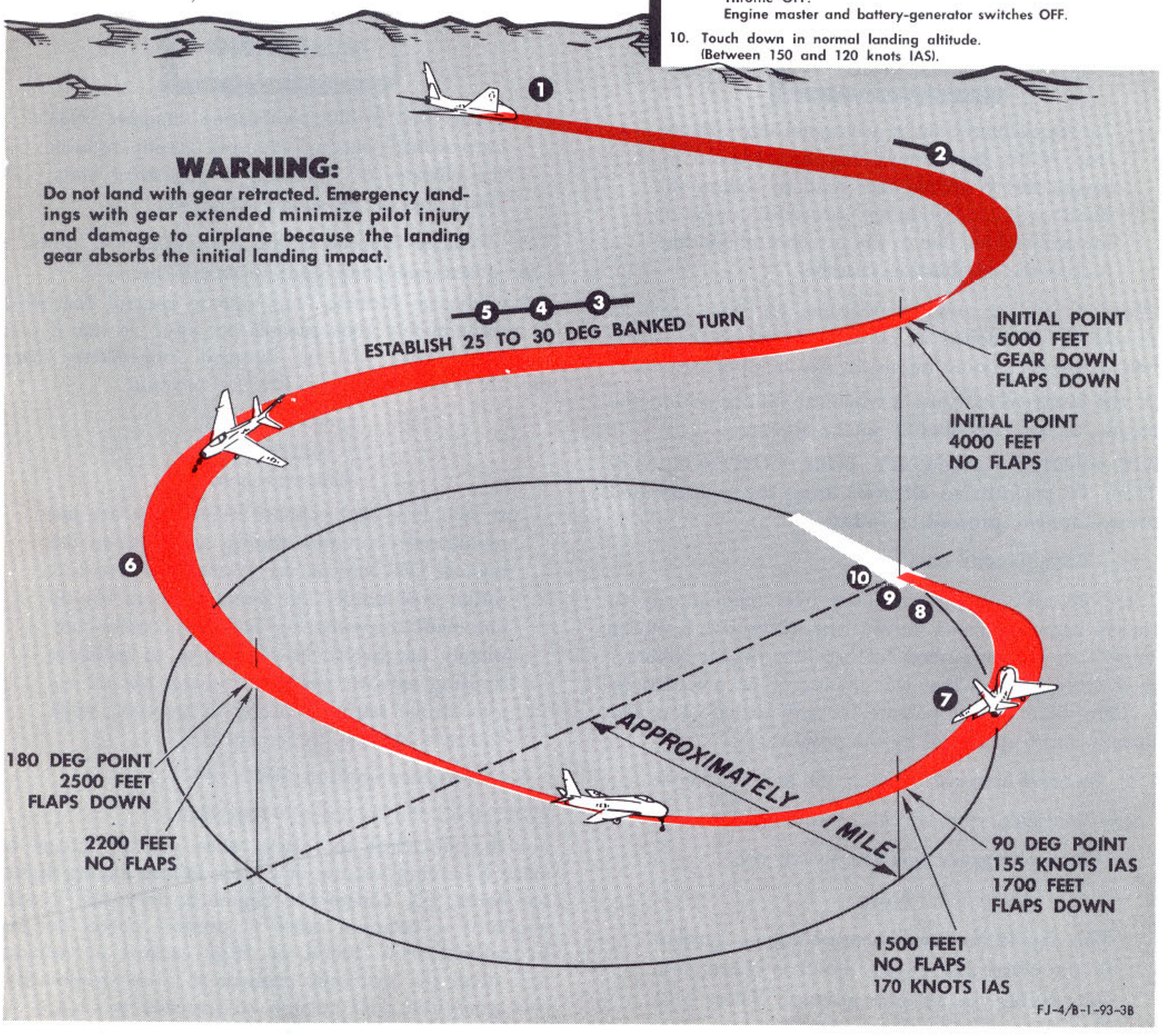

Figure No. 3-2.

the end of roll-out following a dead engine landing. Landing gear operation will be slower than normal. Gear DOWN and locked will require approximately 30 to 45 seconds, while gear UP will take about 1½ minutes. The speed brakes will extend OUT in approximately 8 seconds and retract IN in about 6 seconds. Following the dead engine landing, until the windmilling engine rpm has dropped to approximately 4%, the wheel brakes will provide normal braking action. Thereafter, considerably higher pedal force will be necessary since the brakes operate through the action of the master brake cylinders.

The generator will continue to function for a while after a high altitude flame-out, finally cutting out when the windmilling rpm falls below approximately 20%. At the normal glide speed of 200 knots, this will occur at about 32,000 feet. The generator-out warning light will come on and the procedure given under GENERATOR FAILURE, in this section, must be followed. It is extremely important that all nonessential electrical equipment be turned off to conserve battery power. With a dead battery, it will be impossible to lower the flaps and extend the speed brakes. In addition, it will also become necessary to lower the gear by emergency procedure. (Refer to LANDING GEAR EMERGENCY EXTENSION, in this section.)

LANDING WITH DEAD ENGINE— ENGINE SEIZED.

The control handle for the ram-air turbine-driven hydraulic pump is located on the left forward console (figure 1-10). Upon pilot selection of the emergency flight control system, a mechanical linkage extends the turbine pump into the air stream at the right-hand nose portion of the airplane. Extension of the ram-air turbine should be made at airspeeds below 500 knots IAS. The ram air-driven emergency flight control system is intended for use after an engine seizure when the engine-driven pumps for both the No. 1 and No. 2 flight control systems are inoperative. As a precautionary measure, the air-driven turbine pump should also be extended at the high key point during a flame-out landing in case the engine seizes in the pattern. The air-driven turbine hydraulic pump will supply adequate power for the No. 2 system at all speeds above 120 knots IAS. In case of engine seizure, proceed as follows:

1. Extend air-driven hydraulic pump (below 500 knots IAS).

WARNING

Extension of the emergency ram-air turbine hydraulic pump at airspeeds in excess of 500 knots IAS will result in abrupt left yaw as well as possible damage to the turbine.

2. Place engine master switch in OFF position.
3. Place battery-generator switch in OFF position.
4. Secure all nonessential loads.

Although battery life is not a factor for flight control when the air-driven turbine hydraulic pump is installed, the following additional procedures should be followed under instrument conditions to ensure the operation of instruments for the greatest length of time:

1. Check that all nonessential loads are off.
2. Assure that the instrument power switch is in the NO. 1 INV. position.
3. Turn battery-generator switch to the BAT. & GEN position.

An average battery in flight has a state of charge of 70 percent and provides about 16 minutes of d-c electrical power. However, use of communication or navigation equipment, even on an emergency only basis, reduces this time to 12 minutes. Further battery conservation is effected by pulling out the fuel boost and transfer pump circuit breakers and electing a no-flap landing pattern, if practicable.

If emergency communication is required, move the battery-generator switch to BAT. ONLY position just long enough to communicate and then return switch to BAT. & GEN position. If at any later time instruments are not needed, the battery-generator switch should be turned OFF. With the battery-generator switch OFF, the aircraft must be flown as though a complete electrical power failure has occurred. (Refer to ELECTRICAL POWER SYSTEM FAILURE, in this section.)

PRACTICE FORCED LANDINGS.

The concept that the throttle can be retarded to IDLE to practice forced landings does not apply to airplanes powered by turbojet engines. With the throttle at IDLE, a turbojet engine continues to provide thrust; whereas with complete power failure, the windmilling engine creates drag. Thus, if the throttle is retarded to IDLE to simulate engine failure, thrust will cause the rate of descent to be less and the glide distance to be greater than during an actual flame-out forced landing. The drag of a windmilling engine can be simulated by the use of open speed brakes and the following rpm schedule:

FJ-4 AIRPLANES

ALTITUDE (FEET)	IAS (KNOTS)	ENGINE RPM (%)	CONFIGURATION
40,000 to 30,000	200	80	Clean
30,000 to 20,000	200	77	Clean
20,000 to 10,000	200	75	Clean
10,000 and below	155	67	Gear and Flaps DOWN

FJ-4B AIRPLANES

ALTITUDE (FEET)	IAS (KNOTS)	ENGINE RPM (%)	CONFIGURATION
40,000 to 30,000	200	84	Clean
30,000 to 20,000	200	81	Clean
20,000 to 10,000	200	79	Clean
10,000 and below	155	67	Gear and flaps DOWN; aft speed brakes retracted

As the airplane is flared for landing, the throttle should be retarded to IDLE since the drag of the speed brakes is greatly reduced at landing speed.

In practicing forced landings, the following precautions should be observed:

1. Normal field landing weight limitations should not be exceeded, nor should communications equipment be secured.

2. Before a pilot carries out a simulated flame-out approach to a landing, he should (a) establish radio contact and (b) make at least three approaches, taking a wave-off upon reaching an altitude of 500 feet above the intended landing runway during each approach.

3. Make "touch-and-go" simulated flame-out landings until the pilot becomes thoroughly skilled in the maneuver.

4. Perform simulated flame-out landings on runways shorter than 8000 feet *with extra caution.*

5. Regard the approach speed of 155 knots IAS for flame-out and simulated flame-out landings as a minimum airspeed.

6. Perform slips no closer to the ground than 600 feet.

7. Take care to commence flare-out at sufficient altitude to ensure a smooth touch down and landing.

After skill is once gained in the simulated flame-out landing, the pilot should refresh himself periodically to maintain a high level of proficiency in the maneuver.

Note

A simulated flame-out approach presents a good way to make an emergency landing when the reliability of the engine is questionable or when a low fuel state exists. Set up the standard simulated flame-out pattern. If, at any time during the approach, the engine stops, retract the speed brakes and continue the same approach pattern to a safe landing.

FIRE.

WARNING

There is *no fire extinguishing system* on this airplane. Should evidence of fire be detected either visually or through illumination of the fire warning lights, the following procedures should be adhered to rigidly.

ENGINE FIRE.

ENGINE FIRE DURING STARTING. If a fire warning light comes on, or if there is other indication of fire, proceed as follows:

1. Throttle OFF.
2. Move engine starter switch to STOP.
3. Engine master switch OFF.
4. Battery-generator switch OFF.
5. Do not attempt to restart engine.
6. Leave airplane as quickly as possible.

ENGINE FIRE DURING FLIGHT.

CAUTION

When it is necessary to turn electrical power (battery-generator) switch to OFF, the fire warning lights will be inoperable.

COMPRESSOR FIRE.

If the compressor fire warning light comes on, or if there is other indication of compressor fire, proceed as follows:

1. Reduce power to see if light goes out; if light does not go out, shut down engine by placing throttle OFF and by turning engine master switch OFF.

2. If fire does not go out when engine is dead, abandon airplane by emergency ejection. (Refer to EJECTION SEAT, Section I, and EJECTION SEAT OPERATION, in this section.)

3. If fire does go out, a forced landing may be made, but *do not* attempt an air restart. (See figure 3-2.)

BURNER FIRE.

If the burner fire warning light comes on, proceed as follows:

1. Reduce power to see if light goes out.

2. If light goes out, continue flight at reduced thrust and land as soon as possible.

3. If fire does not go out when thrust is reduced, shut down engine as described in step 1., under COMPRESSOR FIRE, in this section.

ELECTRICAL FIRE.

Circuit breakers and fuses protect most of the circuits and will tend to isolate an electrical fire. However, if electrical fire occurs, turn battery-generator switch OFF and follow the procedure given under ELECTRICAL POWER SYSTEM FAILURE, in this section.

WARNING

When the battery-generator switch is placed in the OFF position, electrical power to all busses, except the battery bus, is lost. The fuel booster pumps will become inoperative and cockpit pressurization will be dumped. At altitudes above 24,000 feet, an engine flame-out may occur because of fuel starvation. (Refer to AIR STARTS, in this section.)

SMOKE FROM TURBINE DURING SHUTDOWN.

The appearance of smoke out of the tail pipe subsequent to shutdown may indicate burning fuel which will damage the engine. It should be cleared immediately as follows:

1. Have both external electric power sources connected.
2. Throttle OFF.
3. Engine master switch ON.
4. Hold engine starter switch momentarily at START.
5. Allow engine to crank to approximately 10% rpm (not to exceed 50 seconds); then, hold starter switch momentarily at STOP.
6. Turn engine master switch OFF.

ELIMINATION OF SMOKE AND FUMES.

If smoke or fumes should enter the cockpit, proceed as follows:

1. Move cockpit pressure control switch to RAM EMER.

CAUTION

At altitudes above 10,000 feet, when the cockpit pressure control switch is positioned to RAM EMER, cockpit pressurization will be dumped immediately. (Refer to COCKPIT PRESSURIZATION, in Section IV.)

2. Turn oxygen regulator diluter lever to 100% OXYGEN.
3. Turn safety pressure lever ON if necessary.

ELIMINATION OF COCKPIT FOG.

Either of the two following methods can be used to eliminate cockpit fog:

1. During take-off and climb to 5000 feet, fog will quickly disappear if the cockpit pressure selector switch is placed at RAM EMER. On an extremely hot day, however, this method may produce an uncomfortably hot cockpit.
2. At the first sign of cockpit fogging, position the cockpit air temperature control rheostat to call for more heat until fogging disappears. This second method, though it results in a cooler cockpit, requires a certain amount of adjusting which may be undesirable when the pilot must give more concentrated attention to other controls.

EMERGENCY DESCENT FROM ALTITUDE.

CAUTION

Prior to rapid descent from altitude, turn on windshield anti-icing and canopy and windshield defrosting systems. Use pitot heat as desired.

Note

Make sure that the airspeed and acceleration limitations set forth in Section V of the Supplemental Flight Handbook (NAVAER 01-60JKD-501A) are not exceeded.

Additional information on emergency descent from altitude will be supplied when available.

LANDING EMERGENCIES.

BELLY LANDING.

If it becomes necessary to make a landing with all wheels up, after actuating both the normal and emergency landing gear systems, fly a normal landing pattern, but observe the following precautions:

1. Make sure your shoulder harness is locked.
2. If time and conditions permit, dump wing fuel and expend any other excess fuel prior to re-entering the traffic pattern. This will minimize the possibility of fire breaking out on landing.

Note

Pulling the fuel jettison handle out approximately 3¾ inches will engage a latch in the mechanism to hold the system in the DUMP position. The handle should be manually positioned to within ¾ inch of the normal position to prevent interference with control stick movements. To stop fuel dumping, the system latch must be released by pushing the fuel jettison handle full forward.

3. Throttle OFF when landing is assured.
4. Just before touch-down, turn off engine master switch and battery-generator switch.
5. Abandon airplane immediately after it comes to a complete stop.

WARNING

Belly landings cause the airframe of the aircraft and, consequently, the pilot to receive the full shock of landing impact. Whether landing on prepared or unprepared surfaces, extend the gear prior to an emergency landing. In this way, the pilot will be afforded the greatest measure of protection since the landing gear will absorb a portion of the initial shock of impact.

LANDING WITH MAIN GEAR DOWN — NOSE GEAR UP.

If it becomes necessary to land with the nose gear up, or with nose gear down but unlocked, after actuating both the normal and emergency landing gear systems, fly a normal landing pattern and follow normal landing procedures, but observe the following precautions:

Note

By reducing the airspeed to approximately 220 knots IAS, the nose gear should extend to the down and locked position since the outside air pressure being exerted on the nose gear fairing door will be reduced.

1. Make sure that your shoulder harness is locked.
2. If time and conditions permit, fire all ammunition, dump wing fuel and expend any other excess fuel prior to re-entering the traffic pattern. This will lighten the airplane, giving lower touch-down speeds, establish an aft CG condition making it easier to hold the nose up and will minimize the possibility of fire breaking out on landing.
3. Throttle OFF when landing is assured.
4. Just before touch-down, turn off engine master switch and battery-generator switch.
5. After touch-down, hold nose wheel off as long as possible, but ease nose down before horizontal stabilizer control becomes ineffective. Otherwise, nose will drop and strike the ground very abruptly.
6. Avoid use of brakes if possible.

Note

If nose gear is down but not locked, you can attempt to snap it into the locked position by making a touch-and-go landing. Make a power-on approach and touch main gear to the runway with a slight bounce; then, go around.

LANDING WITH ONE MAIN WHEEL UP.

If one or both main wheels will not extend after actuating both the normal and emergency landing gear systems, it is recommended that, since the nose gear can not be retracted, the landing be made with as many wheels down as possible. Fly a normal landing pattern and follow normal landing procedure, but observe the following precautions:

1. Make sure that your shoulder harness is locked.
2. If time and conditions permit, dump wing fuel and expend any other excess fuel prior to re-entering the traffic pattern. This will minimize the possibility of fire breaking out on landing.
3. If the left main wheel is down and the right main wheel is up, land on the left side of the runway. Airplane will tend to turn right upon contacting the ground. Similarly, if right main wheel is down and the left main wheel is up, land on the right side of the runway.
4. Throttle OFF when landing is assured.
5. Just before ground contact, turn off engine master switch and battery-generator switch.
6. Abandon airplane immediately after it stops.

LANDING WITH THROTTLE LINKAGE BROKEN.

If the throttle linkage breaks on an airplane having Engine Bulletin No. 240 incorporated, the fuel control will automatically position at 85 (±1) percent rpm. Under most circumstances, flight can be maintained at this power setting. Maximum rate of climb can be attained at 230 knots (clean airplane). Until further flight tests are completed, no carrier landings should be attempted with a failed throttle linkage. Field landings and wave-offs can be easily accomplished using the following procedure. For the approach, there should be no external stores and the fuel remaining should be between 1000 pounds and 2500 pounds to allow for several wave-offs if necessary. Perform landing pattern checks as for a normal landing, and fly the normal field landing pattern as described in Section II with the following exceptions:

1. Landing gear and full flaps down on the downwind leg; fly at 145 to 150 knots.
2. Fly base leg at 135 to 140 knots.
3. Fly a long final approach at 130 to 135 knots using speed brakes to control rate of descent and angle of attack to control airspeed.

Satisfactory wave-offs can be accomplished in the final approach by immediately closing speed brakes. Then retract the landing gear as soon as the airplane is comfortably clear of the ground or obstructions. The landing flaps should remain fully extended to provide necessary lift while re-entering the landing pattern. Immediately upon making a satisfactory touch-down, secure the engine by turning the engine master switch OFF. The time interval from actuation of the switch until initial engine deceleration is approximately 4 seconds. This 4-second delay tends to increase the landing roll-out but the absence of residual thrust after the engine runs down tends to decrease it.

CARRIER BARRICADE ENGAGEMENT.

If, while attempting a carrier landing, a normal arrest is not indicated and a barricade engagement appears imminent, observe the following precautions:

1. Make sure your shoulder harness is locked.
2. Keep the nose wheel on the deck.
3. Keep the airplane aligned with the deck in order to provide straight-on entry and contact with the barricade.
4. If time permits, turn both the engine master switch and the battery-generator switch OFF.
5. KEEP YOUR HEAD DOWN AND FORWARD.

WARNING

Under unusual barricade engagement conditions, such as free flight or severely yawed airplane attitudes, it is possible for the barricade upper loading strap to enter the open cockpit. *It is therefore mandatory for pilot safety that the pilot keep his head down and somewhat forward in the cockpit when barrier and/or barricade engagement is imminent.* Such action can aid substantially in keeping the pilot's head and shoulders away from the back of the seat and headrest where a barricade strap is most likely to lodge should it enter the cockpit.

EMERGENCY ENTRANCE.

For emergency access to the cockpit on the ground when the canopy can not be opened by the normal external electrical switches in the left or right lower steps, pull the emergency canopy release on the left side of the canopy and slide canopy aft. For emergency escape from the cockpit, when the canopy can not be opened by normal procedures, refer to EMERGENCY CANOPY RELEASE, in this section.

Note

If neither of the above procedures opens the canopy, the canopy should be broken with a fire axe or similar implement applied to an area aft of the seat armor plate.

WARNING

Do not strike ejection system equipment when breaking the canopy.

WARNING

If airplane is ditched in a near level attitude, it will dive violently shortly after contact.

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DITCHING.

The hazards of ditching, based on actual ditching experiences, are greater than the hazards of bail-out. Should a forced landing become imminent over water, the pilot should eject if at all possible. There is no advantage in riding the aircraft down since the pilot carries all of his emergency survival equipment. However, if the flight altitude is not sufficient for bail-out, a ditching will be unavoidable. When engine power is available, it should be utilized as it will provide both a lower sink rate during the final approach and time to plan the landing. Take advantage of the wind and/or sea state. If the wind and sea are calm, land into the wind (if known). If there is a swell running, touch down parallel to the swell crest or just after the swell crest has passed. If the wind is high (greater than 25 knots) or the sea is rough, land into the wind, touching down on the crest of a wave. Available test data indicates good planning characteristics for normal nose-high, wings-level ditchings.

The airplane's configuration, its attitude and its airspeed at the time of touch-down are the more important factors in a successful ditching. If external stores and/or drop tanks are installed, they should be jettisoned prior to touch-down, not only to prevent their possible detonation on impact but also to lighten and streamline the airplane. Only limited testing data is available on ditchings in which drops tanks are retained, but it has been demonstrated that drop tanks could be detrimental if they are retained since they tend to "dig in" and, thereby, cause the airplane to decelerate rapidly or to dive. For a successful ditching, the dead engine landing speed (figure 3-2) is recommended with the initial water contact made in a clean configuration using a nose-high attitude of approximately 15 degrees and the wings level. While maintaining a minimum safe gliding airspeed, the pilot should prepare to land with the flaps DOWN, speed brakes IN and the gear UP. If the gear is down or the speed brakes are out, the airplane's diving tendencies will be increased. With the flaps down, the airplane's diving tendency will not be increased since the flaps will collapse on impact. Above all, the pilot should avoid ditching contact from a near-level attitude since this would result in a dive. The canopy should be opened, or it may be jettisoned, during the final stages of descent so that the pilot will not be hindered in separating from the cockpit after the aircraft comes to a stop. A successful water landing can be accomplished if the initial speed is normal and if a normal dead engine landing flare-out is performed. FLY THE AIRPLANE UNTIL IT COMES TO A COMPLETE STOP. On contact and during deceleration after water contact, a longitudinal force of approximately 2 G's will be experienced. The pilot's shoulder harness and seat belt must be tight and securely locked to ensure survival. After the airplane comes to a complete stop, abandon it immediately since it will sink within a few seconds.

If ditching is unavoidable, proceed as follows:

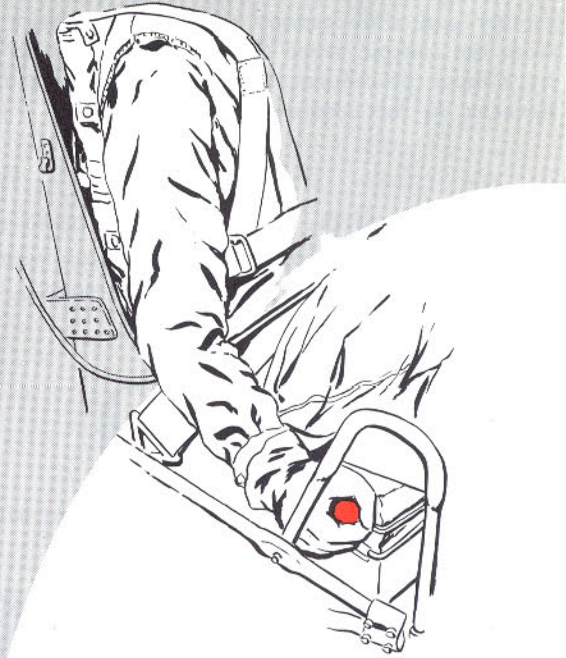
1. Gear up, speed brakes in, flaps down.
2. Jettison drop tanks and external stores.
3. Tighten safety belt; tighten and lock shoulder harness.
4. Canopy open or jettisoned as desired.
5. Follow radio distress procedure as time permits.

EJECTION SEAT OPERATION

1

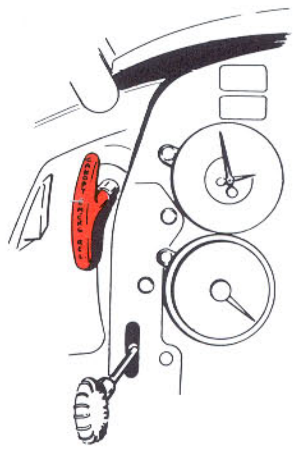
Pull ball handle of emergency oxygen bottle, if at altitude.

Position body in seat, head against headrest, feet in stirrups and legs against braces.



2

Keeping elbows inboard, pull face curtain handle down. Canopy jettisoning allows final travel of curtain to initiate seat ejection.



NOTE:
If canopy does not jettison after the face curtain is pulled, pull the canopy emergency release handle. After the canopy jettisons, continue pulling the face curtain down over the face to eject.

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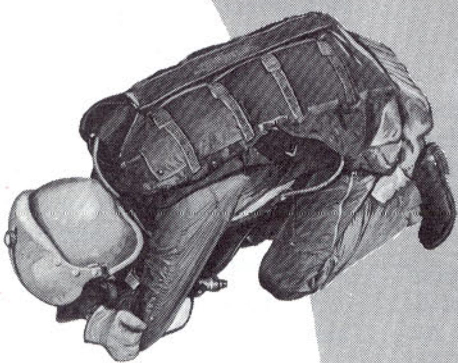
Figure No. 3-3. (Sheet 1)

3

Seat belt releases automatically within ¾ second after ejection through a cartridge operated automatic seat belt release. Kick free from seat as quickly as possible, to actuate automatic parachute opener arming cable.

Warning:

Should the lap belt be opened manually, parachute deployment will require pulling the arming cable for delayed opening. If below 15,000 feet, pull "D" ring to ensure parachute deployment.



Caution:

If use of the canopy emergency release handle fails to jettison the canopy, pull the "D" handle to the left of the headrest and then pull the face curtain down over the face. The seat will be ejected through the canopy. Make sure that the top of your helmet is below the top of the seat headrest so that the ejection seat structure will absorb the shock of shattering the canopy as the seat ejects.

Warning:

If it becomes necessary to eject through the canopy be certain that the canopy is fully closed.

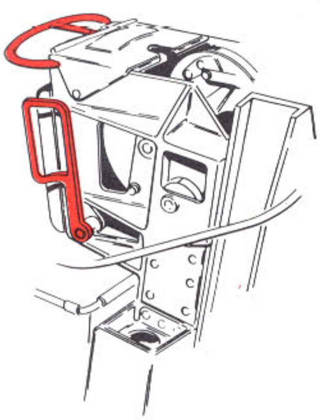


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Figure No. 3-3. (Sheet 2)

6. Touch down at a minimum safe airspeed in a nose-high, wings-level attitude.

Note

If it is impossible to retract the landing gear prior to water contact, touch down in a fully stalled, wings-level attitude at minimum airspeed with a relatively high sink rate.

BAIL-OUT.

All bail-outs should be accomplished by means of seat ejection. (See figure 3-3.)

WARNING

The canopy can be jettisoned from the closed, open, or any intermediate position, but make sure that the top of the helmet is below the top of the ejection seat headrest. Should emergency ejection through the canopy be necessary, the ejection seat structure will absorb the shock of shattering the canopy.

Whenever circumstances permit, slow the aircraft down as much as possible prior to ejection. When ejecting, particularly at low altitudes (below 2000 feet), raise the nose of the aircraft well above the horizon if at all possible.

A study of escape techniques from aircraft by ejection has revealed that relatively minor forces will be exerted upon the body at speeds below 525 knots IAS. At speeds between 525 and 600 knots IAS, the forces on the body are appreciably higher and escape is more hazardous than at lower airspeeds. Above 600 knots IAS, ejection is extremely hazardous because of the excessive forces on the body. Studies of the path of the ejected seat have determined that the trajectory of the seat is not perpendicular to the flight path of the airplane but, rather, is a result of the aircraft velocity and upward velocity of the seat. Since the seat velocity is rather small compared to the aircraft velocity, the seat will tend to follow a nearly horizontal path if ejected from level flight. A nose-up or "zoom" maneuver when ejecting will result in the seat trajectory approaching the vertical, thus effecting an increase in altitude. Depending upon aircraft speed at ejection, a nose-up attitude of 12 degrees may increase the parachute deployment altitude by as much as 200 feet over level flight ejection. This nose-up procedure should always be used, if possible, when ejecting at low altitudes.

CAUTION

When overwater bail-out is made, remove oxygen mask before entering water to prevent sucking water into mask.

Note

The cartridge operated, automatic opening safety belt provides automatic release of the safety belt about 3/4 second after ejection, thus enabling the pilot to perform a more rapid separation from the seat.

WARNING

If the lap belt is opened manually, automatic parachute deployment is not initiated. The orange knob must be pulled for barometric delay of parachute opening, or, if at low altitude, the "D" ring should be pulled.

FAILURE OF SEAT TO EJECT.

If seat does not eject after canopy removal and after the face curtain has been pulled to its maximum extension several times, proceed as follows:

1. Unfasten safety belt, actuate emergency bail-out bottle (if necessary) and disconnect personal leads (anti-G suit, radio, oxygen).

2. If you have control of the airplane, trim for nose-down attitude and pull stick back to slow aircraft as much as possible. Invert airplane. Keep positive "G" load until inverted; then, sharply release stick and fall free of seat.

3. If you do not have control of the airplane, slow aircraft as much as possible; then, bail out over the side.

4. Pull automatic parachute arming lanyard or, if at low altitude, pull parachute rip cord "D" ring.

Note

If oxygen mask is lost and you do not have an automatic parachute release, "free fall" to as low an altitude as possible; then, pull the parachute rip cord "D" ring. The length of time that you can "free fall" before hypoxia prevents you from pulling the "D" ring depends upon your physical condition and the bail-out altitude. In general, "free fall" descent without oxygen is possible from altitudes up to 30,000 feet.

THROTTLE LINKAGE FAILURE.

The incorporation of an automatic throttle positioning bungee on engines having Engine Bulletin No. 240 complied with presents the necessity for the following procedure in the event of an apparent engine control failure:

1. Check for throttle linkage failure by noting a lack of response to throttle lever movement and rpm stabilizing at 79 to 89%.

2. If there is no response, the throttle positioner is in control and a return to base may be governed accordingly.

CAUTION

Should the automatic throttle positioner be in control of the engine, switching to MANUAL fuel control may result in overtemperature and overspeed.

3. After a safe landing is assured, the engine can be shut down by turning the engine master switch OFF, although several seconds of engine operation can be expected before complete power loss occurs.

4. Prior to further flight, a fuel supply lines inspection must be made.

FUEL SYSTEM FAILURE.

The fuel supplied directly to the engine is handled by three boost pumps. Two are electrically driven and are located in the forward fuselage cell; the third, driven by the engine, is part of the engine high-pressure pump. In general, failure of a single boost pump will have little effect on engine operation; however, failure of two boost pumps will cause erratic engine operation above 20,000 feet, dependent upon the fuel temperature, and may possibly cause engine flame-out due to the engine-driven pump being incapable of supplying sufficient fuel to the engine above this altitude. If failure of two boost pumps occurs, decrease engine power and/or altitude to provide satisfactory engine operation. In the case of generator failure, the forward boost pump in the forward fuselage cell will automatically become inoperative. However, the aft boost pump in the forward fuselage cell will continue to operate as long as the primary bus is energized. The circuit breakers for the fuel booster pumps are located in the cockpit. On some airplanes,* the circuit breakers are located on the right-hand rear console while on other airplanes,† the circuit breakers are located on the left-hand rear console. (Refer to GENERATOR FAILURE, in this section.) The main fuel pump, driven by the engine, is a dual-element type, designed so that failure of one element will not impair engine operation.

Failure of the fuel control unit will result in erratic engine operation and possible power loss. In this event, retard the throttle to IDLE and switch to MANUAL fuel control to obtain continued engine operation with ungoverned throttle control. If EGT has dropped below minimum, engine restart may be necessary. (Refer to AIR STARTS, in this section.)

CAUTION

Engine flame-out following prolonged inverted flight (greater than 4 to 6 seconds), or negative "G" operations, is caused by engine fuel starvation due to uncovering of the boost pumps in the forward fuel cell (sump). (Refer to AIR STARTS, in this section.)

If failure of automatic fuel sequencing occurs, an emergency fuel transfer switch, located on the left console, is provided for manual selection of fuel. The guarded, three-position switch is marked: WING TANKS (forward position), AUTOMATIC (center position) and AFT TANK (aft position). Moving this switch out of the AUTOMATIC position will by-pass the automatic fuel sequencing of the related tank. The transfer pump in the selected tank will then provide fuel to the forward fuselage cell.

To determine that the automatic fuel sequencing system is operating properly, proceed as follows:

1. Check all circuit breakers in.

1A. Check the fuel quantity gage for proper operation.

2. Read the fuel quantity gage in the SUMP position. After approximately 1000 pounds (or 100 pounds‡) of fuel is consumed from the sump cell, the SUMP quantity will remain at 1125 pounds (or 2030 pounds‡) or slightly higher for a period of time which is dependent on engine demand. The hesitation at 1125 pounds (or 2030 pounds‡) indicates that the aft fuselage cell transfer pump is operating properly and is replenishing the fuel supply to the sump cell.

3. When the SUMP reading goes below 1125 pounds (or 2030 pounds‡), the TOTAL fuel should then be less than 3400 pounds (or 4200 pounds‡), indicating that the aft tank is empty.

4. The SUMP quantity will then go down until it reaches 1000 pounds or slightly higher for a period of time depending on engine demand. The hesitation at 1000 pounds indicates that the wing transfer pump is operating properly and is replenishing the fuel supply to the sump cell.

5. When the SUMP quantity goes below 1000 pounds and the TOTAL fuel remaining equals SUMP fuel plus or minus 50 pounds, it will indicate that the wing tanks are empty.

If there is no hesitation noted at the 1125-pound (or 2030-pound‡) level, as explained in step 2., proceed as follows:

1. Reduce engine demand to less than 5000 pounds per hour.

***Airplanes 139282 through 139530**
†Airplanes 139531 and subsequent
‡Airplanes 143543 and subsequent

2. Place the emergency transfer fuel control switch (5, figure 1-6) into the AFT TANK or WING TANKS position. Read the fuel quantity indicator to determine if there is a rise in the sump quantity.

3. A rise noted in the SUMP reading for the selected (AFT TANK or WING TANKS) position indicates that the selected cell transfer pump is operating and that it is possible to make fuel available to the sump through manual sequencing.

WARNING

- On FJ-4B airplanes, in order to maintain satisfactory CG and structural load conditions, transfer aft fuselage cell fuel first, maintaining the forward fuselage (sump) cell quantity indication at 1500 to 2000 pounds. Upon depletion of aft cell fuel, switch to WING TANKS and maintain the sump quantity indication at 1000 to 1500 pounds.
- On FJ-4 airplanes, the forward fuselage (sump) cell quantity should not be permitted to exceed 1200 pounds, whether transferring from aft or wing tanks.

4. If no rise is indicated in the SUMP reading after the emergency transfer fuel control switch has been placed in the selected position (AFT TANK or WING TANKS) and maximum range is desired, it is recommended that immediate action be taken to attain an altitude of 35,000 to 43,000 feet after which a maximum range power setting should be utilized. This procedure will provide maximum available fuel and range through gravity flow. Gravity flow from the aft to the forward fuselage (sump) tanks is dependent upon the fuel level of the forward tank. As the fuel level of the forward tank is reduced, fuel from the aft tank will transfer forward by gravity in an attempt to equalize the fuel levels of the forward and aft tanks.

WARNING

Precautions should be taken to prevent any extended high nose-up maneuvers or landings with insufficient sump fuel since gravity flow to the sump tank is greatly reduced in such an attitude.

Note

The low level fuel warning light will illuminate when the sump tank fuel quantity reaches 950 (±50) pounds. For accurate readings of the fuel quantity in the forward fuselage cell (sump), it is recommended that the fuel gage selector switch be maintained in the SUMP position after the low level warning light has illuminated.

The rate of gravity flow from wing and aft tanks is increased by allowing sump tank level to drop below 600 pounds and using minimum practicable rpm settings. However, at the maximum sustained climb nose-up attitude of 14 degrees, no gravity flow can be expected. In cruise or moderate glide attitudes of 1 to 4 degrees nose-up, the amount of unusable fuel remaining in the wing and aft tanks can be estimated to be 1/4 of the engine demand rate, or indicated fuel flow. At a 7.5-degree nose-up attitude, such as is encountered in the landing approach, unusable fuel remaining in the wing and aft tanks can be as much as 400 pounds more than for the cruise attitude.

If there is no hesitation noted at the 1000-pound level, as explained in step 4., proceed in the same manner prescribed for the 1125-pound (or 2030-pound*) hesitation level, except the emergency transfer fuel control switch (5, figure 1-6) is placed into the WING TANKS position for the check against the wing tank transfer pump.

Note

- If the wing fuel does not appear to be transferring, it may be the result of delayed pump priming caused by fuel vapor at the pump inlet at high altitudes. This condition is not considered serious since the pump will generally prime in from 5 to 15 minutes at high altitudes and immediately at low altitudes.
- In some airplanes,† if it is evident shortly after take-off that the outboard (150-gallon) drop tank fuel is not transferring, it is recommended that a landing be made as soon as possible to preclude an aft CG control problem. However, this problem can be corrected if a landing cannot be made by jettisoning the outboard drop tanks. (Refer to EMERGENCY STORES RELEASE CONTROLS, in Section I.)

If either a field or carrier landing is to be made using the normal approach and touch-down speeds during operations employing the manual fuel sequencing system, the sump fuel quantity should not be permitted to exceed 1000 pounds with the aft fuselage tank empty. If the sump tank is manually filled to 1500 pounds, with the aft fuselage tank empty, the approach and touch-down speeds must be increased 10 to 15 knots to ensure adequate longitudinal control during the flare-out and landing.

ELECTRICAL POWER SYSTEM FAILURE.

If a *complete* electrical power failure should occur or, if for any reason, it becomes necessary to turn off the generator (battery-generator switch OFF), follow this procedure:

1. If possible, reduce airspeed and readjust trim before positioning battery-generator switch OFF. Trim is not available when the switch is OFF and a pull force of approximately 37 pounds is required for horizontal stabilizer control in the maximum out of trim condition.

WARNING

Cockpit pressure will be dumped immediately and the fuel boost pumps will become inoperative when the battery-generator switch is turned OFF.

2. If necessary, reduce altitude and engine rpm to maintain engine operation as fuel flow may be impaired due to loss of fuel boost pressure.

3. If it is necessary to reduce rpm, airspeed will be lower than that required for best range; thus, fuel required for a given distance will increase.

CAUTION

Loss of the 115-volt a-c bus will cause the fuel quantity gage to become inoperative. The pointer will remain in position after power fails, resulting in a false gage reading.

4. Plan to make a landing as soon as possible.

Note

- Practically all electrically operated equipment will be inoperative including the gyro instruments, electronic navigation equipment and the communication equipment.
- The landing gear must be lowered by the emergency method.
- It will be impossible to lower the flaps and extend the speed brakes. If the speed brakes have been extended prior to the electrical system failure, they may be closed by pushing the emergency speed brake dump valve handle. On airplanes† which incorporate both forward and aft speed brakes, both will trail at the same time when the emergency speed brake dump valve control is pushed; however, the aft speed brakes will not be sustained by air loads after landing. Normal retraction of the aft speed brakes will not occur when the landing gear is extended, if the battery-generator switch has been positioned to OFF following an electrical system power failure. If the speed brakes remain extended, the additional drag created could cause an uncontrolled rate of descent, a stall or aft speed brake damage through ground contact during landing.

5. Landing on a runway under these circumstances requires an approach speed of 15 knots above the normal flaps down approach speed. [Refer to the Landing Distances and Stopping Distances Charts in Appendix I of the Supplemental Flight Handbook (NAVAER 01-60JKD-501A).]

6. The hook can be lowered by normal procedure for carrier landing.

*Airplanes 143543 and subsequent
†Airplanes 139531 and subsequent

Figure No. 3-4.

ELECTRICAL OVERVOLTAGE.

On airplanes* incorporating overvoltage protection, illumination of the generator-out warning light may be an indication of a temporary overvoltage condition rather than generator failure. The warning light indicates that the generator has been cut out of the system and, by using the generator reset switch (located on the right console, adjacent to the generator-out warning light), the generator may be cut in again if the voltage has dropped below 32 volts and the generator has not failed. If the warning light does not go out after momentarily switching to GEN RESET, generator failure is indicated and the emergency procedure given under GENERATOR FAILURE, in this section, should be followed. If the switch is held in the GEN RESET position in an attempt to regain the generator during an overvoltage condition, an anti-cycling relay will actuate to hold the generator out of the circuit until the switch is returned to the OFF position after which another reset attempt may be made.

***Airplanes 141444 and subsequent and airplanes having Service Change No. 374 complied with**

GENERATOR FAILURE.

Generator failure, a drop in generator output or, on some airplanes,* electrical overvoltage, is indicated by illumination of the generator-out warning light on the right-hand console. When this occurs, all equipment powered by the monitored and secondary busses automatically becomes inoperative. If generator failure has been caused by electrical overvoltage, the generator may be restored through use of the generator reset switch on the right console. (Refer to ELECTRICAL OVERVOLTAGE, in this section.)

All nonessential equipment should be turned off to reduce the load on the battery and the battery-generator switch should then be placed at BAT. ONLY.

Note

When the battery-generator switch is moved from BAT. & GEN to BAT. ONLY, it should be moved rapidly since the OFF position of the switch is located between these two positions. If the emergency fuel control switch is at MANUAL, temporary engine failure can occur. By moving the switch rapidly, this undesirable effect is minimized. Hesitation at the OFF position causes a temporary loss of the fuel booster pumps so that an engine flame-out may occur.

With the battery-generator switch in the BAT. ONLY position, equipment powered by the battery, primary, secondary, armament and battery and canopy busses will be operated by battery power only. (See figure 1-11.) The length of time that usable battery power is available for continued operation of electrically powered equipment is approximately 12 minutes. If the equipment is turned off immediately after use, 16 minutes of battery operation can be expected if the average in-flight state of charge of 70 percent exists and navigation or communication equipment is not used. Pulling the aft and wing tank fuel transfer pump circuit breakers further prolongs battery life. Battery output may be decreased by a number of variable factors, including low state of battery charge, excessive electrical loads and low battery temperature.

INVERTER AND INSTRUMENT POWER FAILURE.

During normal operations, both the No. 1 and No. 2 inverters operate simultaneously to supply a-c electrical power for operation of both the flight instruments and the secondary a-c equipment. The No. 1 inverter is the smaller of the two inverters and normally powers the a-c flight instruments although the airplane's electrical wiring is such that the No. 2 inverter may be selected to power the flight instruments. The instrument a-c power switch, located on the right console, provides pilot selection for the inverter on which the a-c instrument power load is to be placed. Loss of the selected inverter is indicated by illumination of the instrument power-off warning light located adjacent to the instrument a-c power switch. With the instrument a-c power switch at the NO. 1 INV. position (normal operation), illumination of the warning light indicates failure of the No. 1 inverter. The a-c flight instrument power load may then be shifted to the No. 2 inverter through selection of the instrument a-c power switch to the NO. 2 INV. position. When this is accomplished, the warning light will be extinguished and all a-c electrical power will be supplied by the No. 2 inverter. Should failure of the No. 2 inverter occur with the instrument a-c power switch in the NO. 2 INV. position, the warning light will illuminate to indicate the inverter failure. Failure of the No. 2 inverter with the instrument a-c power switch selected at the NO. 1 INV. position will not be indicated by illumination of the instrument power-off warning light but will be evident to the pilot through loss of the a-c powered equipment of the secondary bus.

UTILITY HYDRAULIC SYSTEM FAILURE.

There are no hydraulic emergency provisions in the utility hydraulic system except the nose gear accumulator and the wheel brake reservoirs. However, there are provisions for manual emergency operation of the landing gear (extension), speed brakes (retraction) and arresting hook (extension). (Refer to LANDING GEAR EMERGENCY EXTENSION, SPEED BRAKE EMERGENCY RETRACTION and ARRESTING HOOK EMERGENCY OPERATION, in this section.)

LANDING GEAR EMERGENCY EXTENSION.

The landing gear emergency release handle, located adjacent to the instrument panel on the right-hand side, mechanically releases all gear and fairing door uplocks permitting the gear to extend by gravity. Accumulator

WARNING

For emergency landing gear operation, pull release to the full position (approx. 15 inches) and hold until gear is locked down.

FJ-4/B-1-0-10

*Airplanes 141444 and subsequent and airplanes having Service Change No. 374 complied with

pressure is automatically released to extend the nose gear down. To lower the gear by the emergency method, proceed as follows:

1. Reduce airspeed below 235 knots; otherwise, air loads may hold the fairing doors closed.

2. Place gear handle in DOWN position.

3. Pull release handle to its full extension (approximately 15 to 20 inches) and hold.

4. Check gear indicator for safe gear down indication. If necessary, yaw airplane to lock main gear or reduce airspeed below 220 knots to allow the nose gear to extend to the down and locked position.

Note

> On some airplanes,† the approach indexer (figure 1-17A) provides an auxiliary indication for the landing gear, since illumination of the indexer takes place after the landing gear downlock relay is de-energized by extension of all gear.

5. Release handle *after* safe gear down indication is obtained.

SPEED BRAKE EMERGENCY RETRACTION.

A two-position, emergency speed brake dump valve control (figure 1-17), located aft of the left console, provides an alternate means of closing the speed brakes. When the latch is released and the control is pushed aft, a dump valve is mechanically opened, relieving hydraulic pressure from the speed brake actuating cylinders and allowing air loads to close the brakes to a trail position. Following use of the dump valve, the dump valve control should be returned to the normal (forward) position and latched so that full utility system pressure will be available to operate other equipment. No emergency means of opening the brakes is provided.

On airplanes* having both forward and aft speed brakes, actuation of the emergency speed brake dump valve control allows the forward speed brakes to close to the trail position and the aft speed brakes to close completely through bungee action. (Refer to SPEED BRAKES, in Section I.)

CAUTION

- The normal speed brake switch should be in the neutral (center) position when closing the speed brakes with the emergency speed brake dump valve control.
- Should the battery-generator switch be turned OFF while hydraulic pressure is still available after landing, the aft speed brakes will fall to the full out position.

WHEEL BRAKE EMERGENCY OPERATION.

If the utility hydraulic system fails, the brakes will function through action of the master brake cylinders. A small, separate emergency brake reservoir is installed at each master brake cylinder. Effective braking action can be obtained only by applying very strong, steady toe pressure on the rudder pedals.

ARRESTING HOOK EMERGENCY OPERATION.

Pulling the arresting hook handle releases the hook from a spring-loaded mechanical uplock which permits snubber pressure and gravity to force the hook down. The operation is the same for both normal and emergency lowering. As an added safety feature, the uplock will automatically be released if the control cable breaks.

No provisions are made for emergency retraction of the arresting hook.

FLIGHT CONTROL HYDRAULIC SYSTEM FAILURE.

For normal flight control, two separate primary systems are provided. These two systems operate simultaneously and each is powered by an engine-driven pump which supplies one-half the power necessary for operation of the ailerons and stabilizer.

If one of the systems fails, the remaining system will supply full flight control requirements for all except combat conditions.

Loss of hydraulic power due to engine seizure, failure within the engine accessory drive section or other reasons will result in stiffness of control stick operation. A ram-air turbine-driven hydraulic pump is provided. The pump is an emergency source of hydraulic power to the No. 2 hydraulic flight control system and will supply adequate pressure and flow to control that system, provided there is fluid available in that system. The pump is actuated by extending the ram-air turbine into the air stream when the release handle is pulled. The release handle is located on the left forward console. (Refer to LANDING WITH DEAD ENGINE — ENGINE SEIZED, in this section.)

WARNING

> Extension of the ram-air, turbine-driven hydraulic pump should be made at airspeeds below 500 knots IAS. Extension at airspeeds in excess of 500 knots IAS will result in abrupt left yaw as well as possible damage to the turbine.

TRIM SYSTEM FAILURE.

If the normal aileron or stabilizer trim control fails, move the trim selector switch, located on the left console, from NORMAL to ALTERNATE. When the trim selector switch is positioned at ALTERNATE, the stick switch is inoperative, Mach trim is cut out of the system and the alternate trim switch on the left console is used for trim

*Airplanes 139531 and subsequent
†Airplanes 143594 and subsequent

control. The alternate trim switch supplies four momentary positions: LEFT, RIGHT, NOSE UP and NOSE DOWN. When no power is applied through the alternate trim switch, the trim actuators remain in their fixed irreversible positions.

If alternate trim selection is made while flying at speeds of 0.85 Mach or over (the operational range of the Mach trimmer), the Mach trim system will, in effect, be "frozen" at the last position setting attained prior to selection of ALTERNATE. If, during a subsequent stage of the flight, the trim selector switch is repositioned to NORMAL, the pilot may be confronted with a trim change. This trim change could cause a change in the pilot's stick force (up to 10 pounds maximum at the normal trim rate) and would require correction by opposite trimming or an opposite stick force. The magnitude of this trim change will be in proportion to the differential between the Mach speed at the time of selection to ALTERNATE and the Mach speed at the time of the shift back to NORMAL. On some airplanes,* this trim change is also affected by the setting of the stick-operated, longitudinal trim wheel (NOSE UP — NOSE DOWN) since this control is a manually operated current potentiometer which is inoperative and has no follow-up sensing during operations in the ALTERNATE position.

CAUTION

During flight, after the trim selector switch has been positioned to ALTERNATE, conduct the balance of the flight in the ALTERNATE position, making all trim corrections through the use of the momentary alternate trim switch. *Do not shift the trim selector switch from* ALTERNATE *to* NORMAL *during flight.*

EMERGENCY CANOPY RELEASE.

If an emergency situation makes it imperative for the pilot to remove the canopy quickly, this can be accomplished by pulling the canopy emergency release handle. However, it should be remembered that if the canopy is released on the ground it could possibly cause serious injury to ground personnel since its ejection is actuated by an explosive cartridge. To manually open the canopy from the cockpit, an internal release handle is located on the canopy deck, aft of the pilot's seat. In order to actuate this internal release handle, as in the case of battery power failure, it will be necessary for the pilot to turn around in the seat to reach the handle after the airplane is on the ground. For emergency cockpit access when the canopy can not be opened by normal procedures from the outside, refer to EMERGENCY ENTRANCE, in this section.

EMERGENCY ARMAMENT CONTROL.

If an emergency arises during flight whereby external stores must be jettisoned or runaway guns must be stopped, proceed as follows:

1. To jettison all external stores, including drop tanks, depress the STORE & TANK JETTISON button or pull the JET EXTL STORES handle (figure 1-10), located to the left of the instrument panel, forward of the throttle quadrant.

CAUTION

External stores should be jettisoned with the airplane landing gear and flaps up, to preclude the possibility of stores contacting the airplane after release.

2. To jettison drop tanks only, set armament panel station selector switch to DROP TANK, the mode selector to BOMBS, the armament switch ON. (On some airplanes,* the mode selector must be set to the BOMBS TANKS position, and the desired stations selected.) Depress bomb-rocket release button on the stick.

3. To jettison external stores (bombs and rockets) only, place armament master switch ON, mode selector to BOMBS or ROCKETS, armament panel arming selector switch to SAFE and station selector switch to the applicable PAIRS stations. Depress bomb-rocket release on the stick.

WARNING

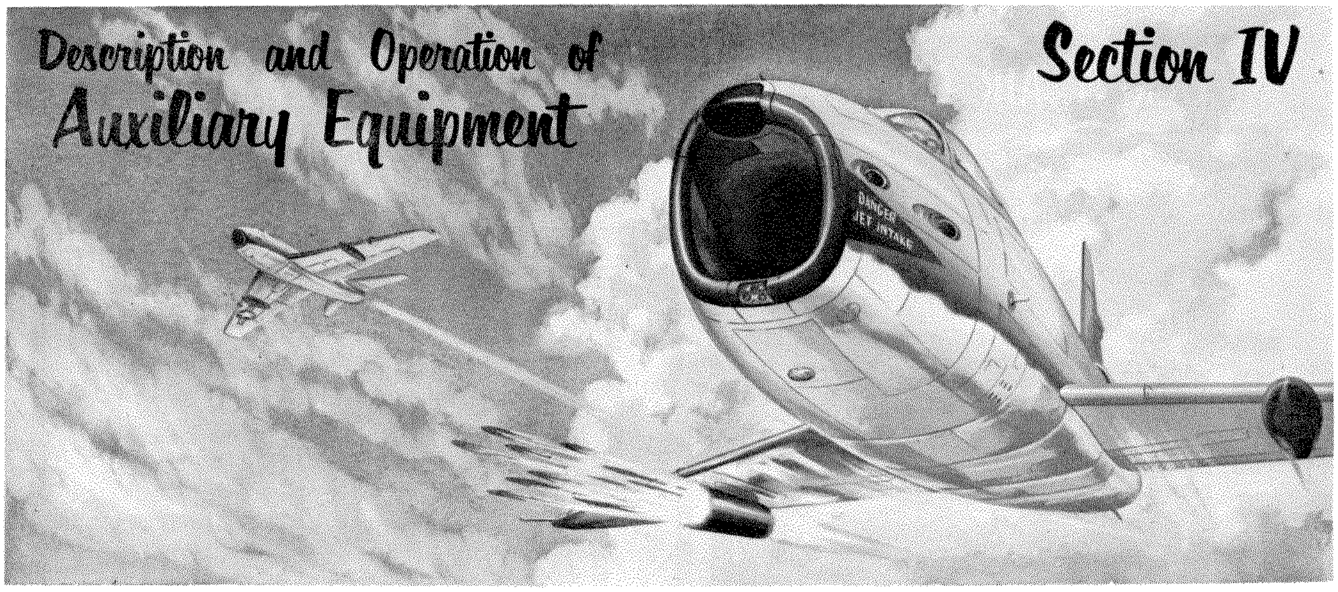
To jettison bombs equipped with proximity fuzes, release singly on SAFE and, if possible, from level flight. A delay of approximately 5 seconds between each release will prevent airplane damage from premature detonation should a bomb inadvertently release in the armed condition.

4. To stop runaway guns, turn the gun control switch to SAFE, turn both gun selector switches OFF and turn master armament switch OFF. The gun control panel on which the switches are mounted is located at the top right corner of the instrument panel. [See figure 4-1 and refer to ARMAMENT EQUIPMENT, in Section IV of the Supplemental Flight Handbook (NAVAER 01-60JKD-501A).]

AUXILIARY EQUIPMENT EMERGENCY OPERATION.

For emergency operation of auxiliary equipment, refer to Section IV.

*Airplanes 139531 and subsequent



COCKPIT AIR CONDITIONING AND PRESSURIZING SYSTEM.

Air for cockpit air conditioning and pressurizing is obtained from two extraction ports in the engine compressor section and is delivered to the cockpit under pressure. Two fixed tubular air outlets are provided in the cockpit to furnish airflow to the pilot's feet and legs. There are also two adjustable outlets, one on each side of the pilot (figure 4-1). These outlets may be rotated to obtain desired airflow direction. Cockpit temperature is regulated by a temperature regulator which proportions the mixing of hot air from the engine compressor and cool air from the expansion turbine of the refrigeration unit. A cabin pressure regulator maintains either of two manually selected pressurizing schedules (figure 4-2). The warm air that is extracted from the engine compressor is routed through the primary heat exchanger where it is partially cooled. The amount of cooling is determined by the position of the modulating valve which controls the flow of ram air through the heat exchanger. The manifold on the primary heat exchanger directs air to the windshield and canopy defrost system, the windshield anti-ice and rain removal system and the cockpit air conditioning and pressurizing system. The air is routed through or by-passes the secondary heat exchanger and expansion turbine and is then directed to the cabin air outlets.

Motorized valves are located throughout the system to control the flow of air. These valves are operated electrically from the switches located on the left console. Figure 4-1 shows the routing of air as described in this paragraph. Emergency ram air is obtained from the engine inlet duct in the event the normal system is inoperative or is contaminated.

CANOPY PRESSURE SEALING SYSTEM.

A pressure seal is provided to ensure sealing between the fuselage and the canopy. Air is routed from the windshield defrost and anti-icing duct, through a check valve and pressure regulator, to the seal. A check valve maintains pressure in the seal in the event engine pressure falls below that in the sealing system. This check valve also holds pressure in the system when ground pressurization is used. The regulator incorporates a valve which, when opened, allows airflow to the seal. The valve is actuated by a solenoid which is energized by a microswitch installed aft of the pilot's seat. When the canopy is closed, the microswitch is depressed, energizing the solenoid in the canopy seal regulator which allows airflow to the seal. When the canopy is opened, the solenoid is de-energized and the valve closes causing the air in the seal to be depressurized. The seal is also depressurized in the sequence of seat ejection. Ground pressurization of the seal is accomplished by the introduction of an external air source to the seal through an air line connector fitting in the left-hand gun bay on the aft bulkhead. Control of the canopy pressure sealing system is entirely automatic.

COCKPIT AIR CONDITIONING AND PRESSURIZING CONTROLS.

COCKPIT PRESSURE REGULATOR. A three-position control is provided on the pressure regulator. For normal operation, this control should be safety-wired in the FLIGHT position, to make pressure control completely automatic. This control cannot be operated during flight. When pressurizing tests are being conducted, the control should be in the ALL OFF position and in DIFFERENTIAL ONLY position for operational check purposes. This control should always be returned to the FLIGHT position and safetied when tests are completed.

COCKPIT PRESSURE SELECTOR SWITCH. The cockpit pressure selector switch (3, figure 4-3), located on the left console, is used to select the pressurizing

COCKPIT AIR CONDITIONING AND PRESSURIZING SYSTEM

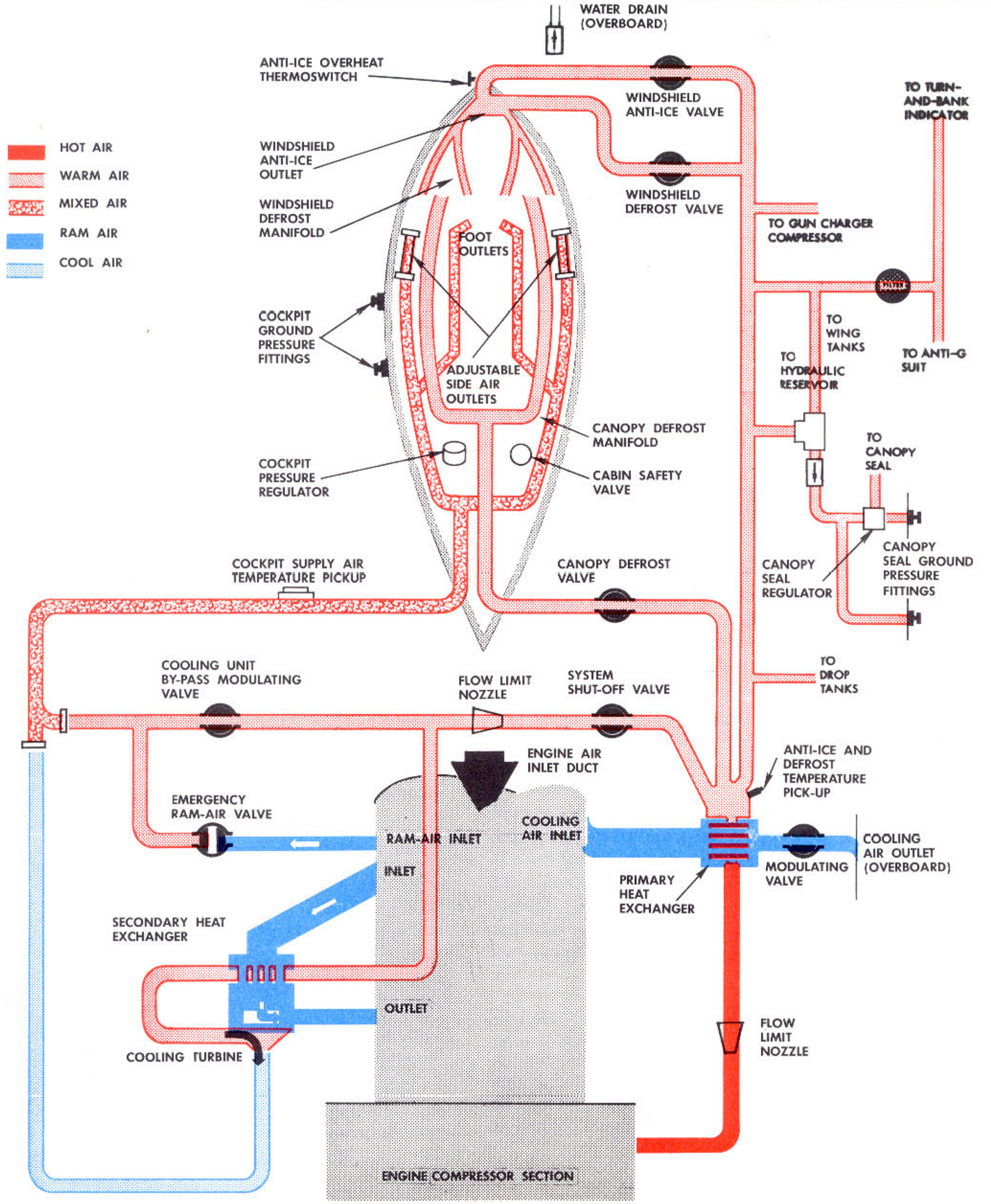


Figure No. 4-1.

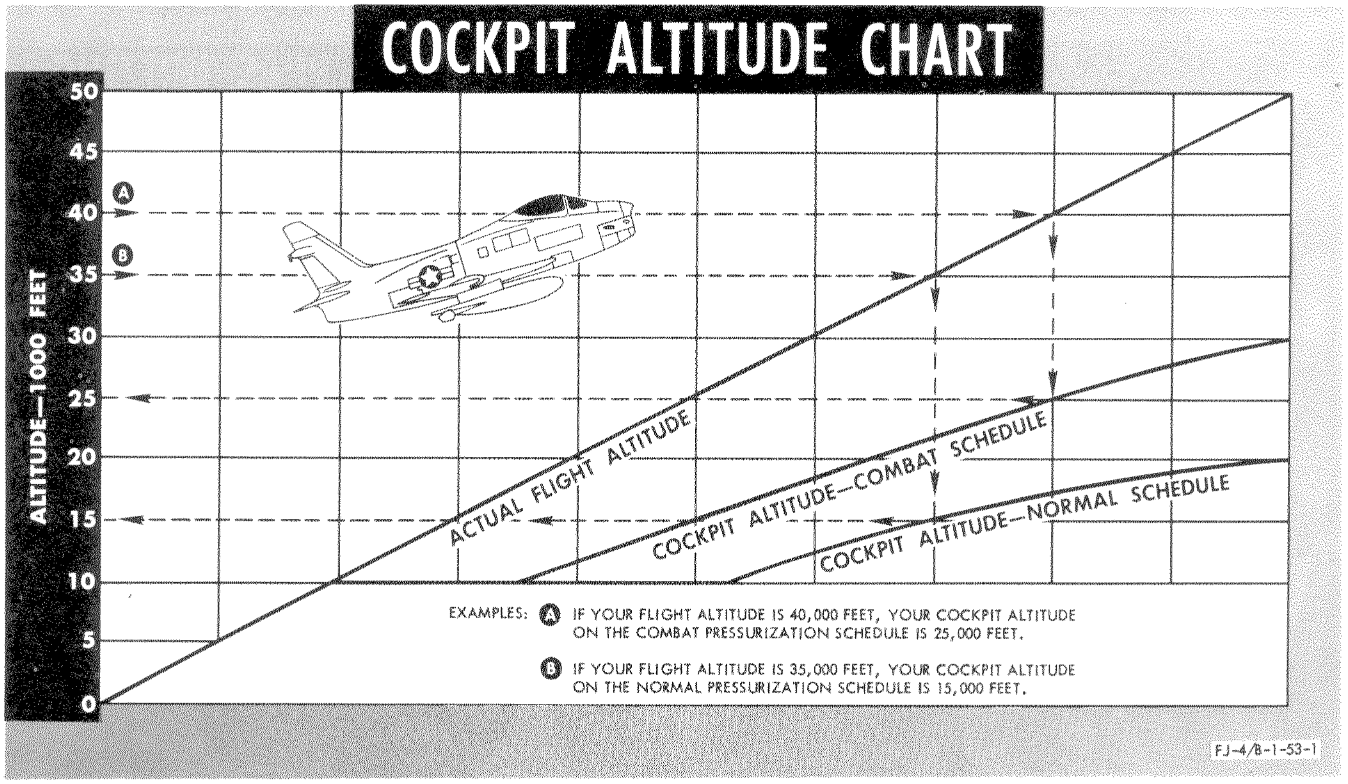


Figure No. 4-2.

schedule desired. When the switch is in NORMAL position, cockpit altitude remains at 10,000 feet from an airplane altitude of 10,000 feet to approximately 26,500 feet; then, a constant 5 psi cockpit differential is maintained at airplane altitudes above approximately 26,500 feet. When the selector switch is in the COMBAT position, a cockpit altitude of 10,000 feet is maintained from an airplane altitude of 10,000 feet to approximately 18,000 feet; then, a cockpit differential of 2.75 psi is maintained at airplane altitudes above approximately 18,000 feet. In either case, the cockpit is not pressurized from sea level to 10,000 feet. When the selector switch is placed in the RAM EMER position, the dump valve is opened, the system shutoff valve is closed, pressurization is lost and air supply is from the ram-air source. To place the selector switch in RAM EMER position, it is necessary to lift the guard and then move the switch. This guard prevents accidental dumping of cockpit pressurization. The altitude of the cockpit is indicated in thousands of feet on the cabin pressure altitude indicator located to the right of the instrument panel, below the windshield bow. (See figure 1-16.)

COCKPIT AIR TEMPERATURE CONTROL SWITCH. The temperature control switch (2, figure 4-3) should be in the NORMAL position for automatic control of the temperature selected by the rheostat. When in the NORMAL position, an air temperature control regulator positions the cooling unit by-pass valve and the primary heat exchanger modulating valve to control the temperature of the cockpit air. When the air temperature control switch is positioned in COLDER, the modulating valve opens and the by-pass valve closes to provide air cooling. When positioned in HOTTER, the by-pass valve opens and the modulating valve closes to provide warmer air. The HOTTER and COLDER positions provide manual control of the cockpit temperature in the event the automatic control system fails. The by-pass valve and the modulating valve are motorized valves and will move only as long as the temperature control switch is in a position other than OFF. For manual control, the switch should be moved to HOTTER or COLDER, momentarily, and then returned to OFF.

COCKPIT AIR TEMPERATURE RHEOSTAT. The temperature control rheostat (1, figure 4-3) provides automatic control of the cockpit temperature. The rheostat is effective only when the temperature control switch is in NORMAL position. Movement of the rheostat causes the temperature control regulator to actuate the modulating and by-pass valves to supply the desired cockpit temperature.

NORMAL OPERATION OF COCKPIT AIR CONDITIONING AND PRESSURIZING SYSTEM. The normal operation of the air conditioning and pressurizing system is entirely automatic after the controls are positioned as follows:

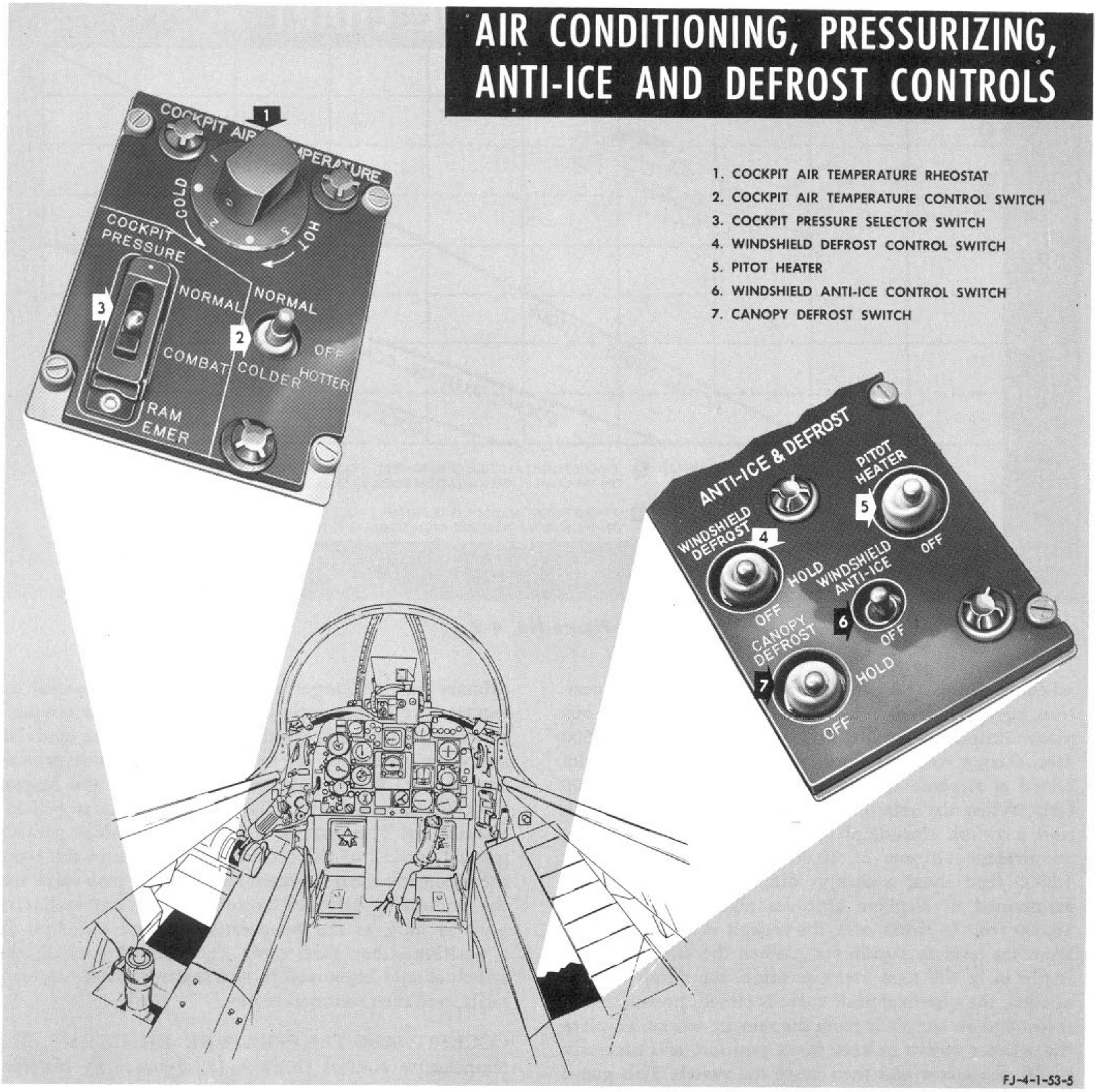


Figure No. 4-3.

1. Cockpit pressure selector switch placed in either NORMAL position for 5 psi cockpit differential or COMBAT position for 2.75 psi cockpit differential.

Note

To prevent formation of fog on warm, humid days and to eliminate temperature control adjustments during take-off and climb to 5000 feet, the cockpit pressure selector switch should be positioned at RAM EMER. The normal air conditioning system can be used to eliminate cockpit fog by positioning the cockpit air temperature control rheostat for more heat.

CAUTION

Canopy fogging is often encountered when flying at night and is not always readily apparent to the pilot. Caution should be exercised at night to prevent this condition, especially during letdown, by positioning the cockpit air temperature control rheostat for more heat.

2. Cockpit air temperature control at NORMAL.

3. Cockpit air temperature control rheostat at desired position.

4. Rotate tubular air outlets to provide airflow in desired direction.

5. Should formation of frost be anticipated, canopy defrost switch should be toggled to momentary DEFROST position for approximately 10 seconds to obtain full defrosting heat. Holding the switch to DEFROST for a time interval of less than 10 seconds will reduce hot airflow into the cockpit by a proportional amount.

Note

If the normal automatic air conditioning system becomes inoperative, temperature can be controlled by momentarily positioning the cockpit air temperature selector switch to HOTTER or COLDER.

EMERGENCY OPERATION OF COCKPIT AIR CONDITIONING AND PRESSURIZING SYSTEM.

Should sudden depressurization become necessary, proceed as follows:

1. If at altitude, or if cockpit air becomes contaminated, use 100 percent oxygen.

2. Place cockpit pressure selector switch to RAM EMER position.

Note

Cockpit pressurization will be lost with the selector switch in the RAM EMER position.

3. Descend to an altitude below 15,000 feet.

DEFROSTING, ANTI-ICING AND RAIN REMOVAL SYSTEMS.

Air for canopy, windshield anti-icing and windshield defrosting is taken from the air manifold supply located on the downstream side of the primary heat exchanger. The air is routed through ducts to the outlets. This air is admitted to the defrosting and anti-icing ducts through motorized valves which are operated by switches on the anti-ice and defrost control panel (figure 4-3) located on the right console. Windshield anti-icing air is discharged into the windshield front and left external boundary layer.

Note

Additional cockpit heat above the heat provided by the normal cockpit heating system can be obtained by turning on the windshield and canopy defrost systems as required. This additional heating is provided so that maximum heating at critical heating operations can be obtained.

The windshield anti-icing system is also used for rain removal.

DEFROSTING AND ANTI-ICING SYSTEM CONTROLS.

WINDSHIELD ANTI-ICE CONTROL SWITCH. The control switch (6, figure 4-3) for windshield anti-icing is located on the anti-ice and defrost panel on the right console. When this switch is in the ANTI-ICE position, the valve opens and permits airflow to the outlet duct located just forward of the front and left panel of the windshield. When the switch is in the OFF position, the valve closes and shuts off the airflow to the windshield external boundary layer.

WINDSHIELD DEFROST CONTROL SWITCH. The windshield defrost control switch (4, figure 4-3), located on the anti-ice and defrost control panel on the right console, actuates a valve which controls the amount of airflow to the defrost outlets. When this switch is in the momentary DEFROST position, the valve opens to admit the defrosting air. When in the OFF position, the valve shuts off the air supply. The amount of defrosting air can be controlled by the length of time the switch is held in the DEFROST position, and then allowing the switch to return to HOLD. The motorized valve will remain stationary until positioning of the switch to DEFROST or OFF causes it to move again.

CANOPY DEFROST CONTROL SWITCH. The operation of the canopy defrost control switch (7, figure 4-3) is identical to the operation of the windshield defrost control switch. Both switches are located on the anti-ice and defrost control panel on the right-hand console. The motorized valve, operated by the canopy defrost control switch, admits air to the canopy defrost outlets.

WINDSHIELD ANTI-ICE OVERHEAT WARNING INDICATOR.

An anti-ice overheat warning light (25, figure 1-5), located on the instrument panel, illuminates when the temperature of the air supply to the windshield exceeds 149°C (300°F). Illumination of this light may be caused by operation of windshield anti-icing and defrosting and canopy defrosting simultaneously at high airplane speeds at low altitudes on relatively warm days. Under these conditions, it is possible to exceed the temperature normally maintained in these systems. When the warning light illuminates, the windshield anti-ice, windshield defrost and canopy defrost switches must be positioned to OFF immediately or these units could suffer permanent damage.

OPERATION OF WINDSHIELD ANTI-ICING AND WINDSHIELD AND CANOPY DEFROSTING SYSTEMS.

Operation of the windshield anti-icing system is accomplished by placing the windshield anti-ice switch to the ANTI-ICE position. Windshield or canopy defrosting operation is as follows:

1. Position the control switch to momentary DEFROST; then, quickly release it to HOLD.

2. If additional defrosting is required, repeat this procedure.

3. Should less defrosting be desired, position the control switch to OFF momentarily; then, quickly return it to HOLD.

PITOT HEATER.

The pitot tube is heated by an electric heater in the pitot head which is operated by a control switch (5, figure 4-3) on the anti-ice and defrost control panel located on the right console.

CAUTION

To prevent overheating and damage to the pitot tube, the pitot heater is inoperative when the weight of the airplane is on the landing gear.

COMMUNICATION AND ELECTRONIC EQUIPMENT.

COMMUNICATION EQUIPMENT.

TYPE	DESIGNATION	FUNCTION	RANGE	LOCATION OF CONTROLS
UHF Command	AN/ARC-27A	Two-way voice communication.	Line of sight.	Control panel on right console.
UHF Direction Finder	AN/ARA-25	Direction finding.	Line of sight.	Control panel on right console.
Radio Navigation Receiver*	AN/ARN-14E or AN/ARN-21*	Reception of VHF omni-range and voice facilities. Visual and aural navigation aid. Reception of UHF omni-range and voice facilities. Visual and aural navigation aid.	Line of sight.	Control panel on right console.
IFF	AN/APX-6B	Automatic identification.	Line of sight.	Control panel on right console.

*Space, weight and wiring provisions only are provided for the AN/ARN-21 equipment in airplanes having Service Change No. 151 complied with

ELECTRONIC EQUIPMENT.

TYPE	DESIGNATION	FUNCTION	RANGE	LOCATION OF CONTROLS
Radar	AN/APG-30A	Ranging, searching in range and furnishing range information to the aircraft fire control system.	225 to 3000 yards.	Control panel on left console.
AFCS	Mark 16 Mod 1	Fire control.		Control panel on left console.

RADIO AND RADAR ANTENNAS.

For location of radio and radar antennas, see figure 1-2.

MICROPHONE SWITCH.

The microphone switch is located on the throttle.

MIKE AND HEADSET JACK.

The mike and headset jack is incorporated in the oxygen-radio tube assembly located forward of the pilot between the foot stirrups.

UHF COMMAND SET (AN/ARC-27A).

The uhf command set provides voice communication between other airplanes or between airplane and ground stations. Reception and transmission are on the same frequency and utilize the same antenna. Incorporated into the uhf transceiver (transmitter-receiver) unit, located in the radio bay, are two receivers and one transmitter which are controlled from the uhf control panel on the right console. The transmitter and one receiver are known as the main unit and the second receiver is called the guard receiver. The guard receiver is crystal controlled (set) to the guard frequency and cannot be changed from the cockpit. By rotating the channel selector (CHAN) to the guard (G) position, the main unit is set up for transmission as well as reception over the guard frequency. The transmitter and one receiver, operating as the main unit, can be used by the pilot to manually tune to any of 1750 channels within the transceiver's operating range of 225.0 through 399.9 megacycles. Both the transmitter and receiver are tuned simultaneously. Within this range, the pilot can select 20 frequencies which may be preset and locked into the main unit transmitter-receiver so that rapid, preset channel selection can be accomplished. An additional preset channel is provided (CHAN position G) to enable the pilot to reserve a known channel for the guard frequency. For manual tuning, channel selector position M is provided. To set or reset a frequency to a preset channel selection, proceed as follows:

1. Place the channel selector switch (CHAN) to the desired channel.

2. Rotate the manual frequency selector to the desired frequency.

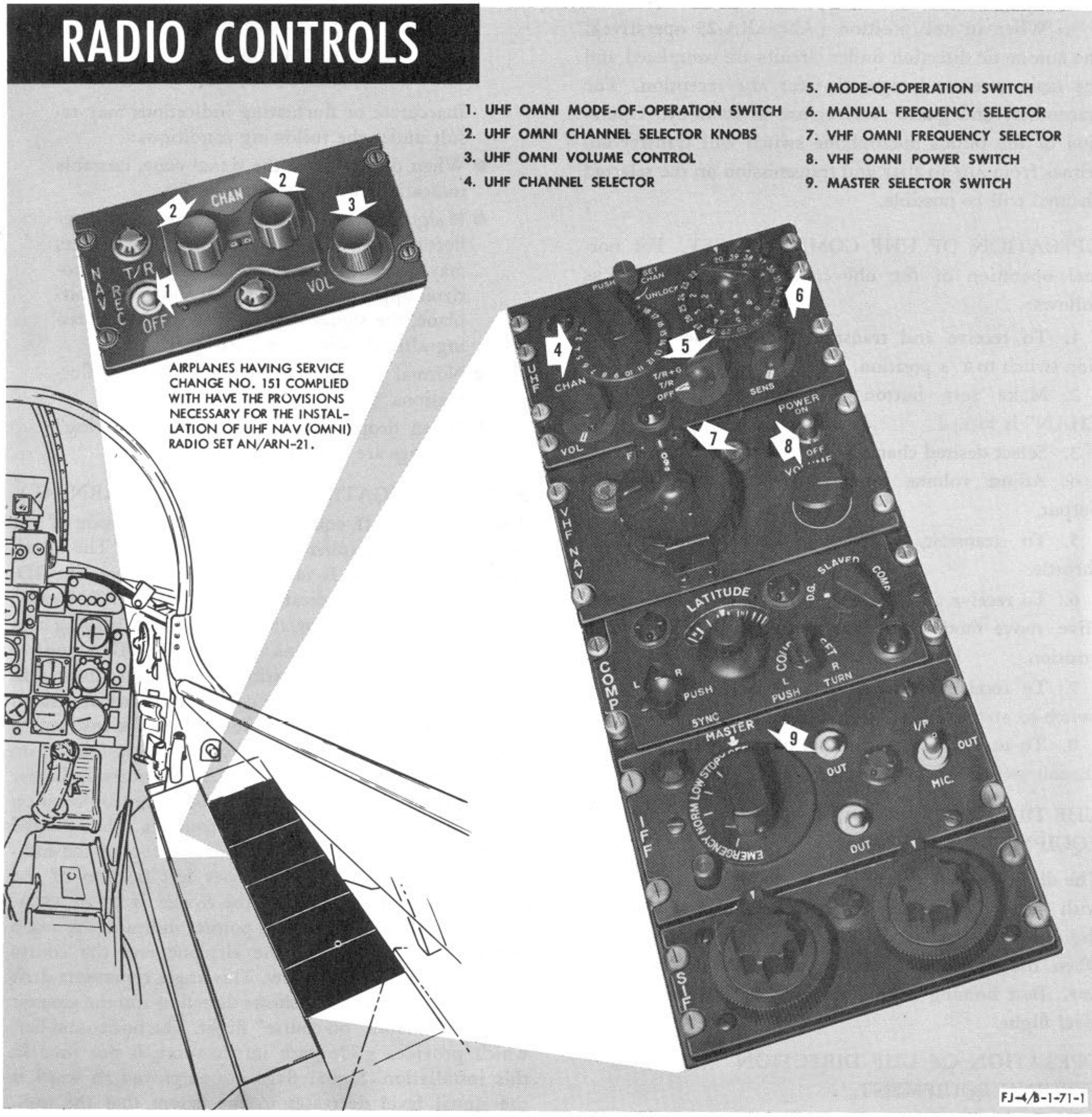


Figure No. 4-4.

3. Rotate the PUSH TO SET CHAN button to the unlocked position and depress.

4. Release the button and rotate it to the locked position.

Receiver sensitivity is bench set for normal operation, but a control knob (SENS) is provided for the purpose of overriding the bench setting. This control knob is located on the uhf control panel and is used to increase the sensitivity level to its maximum on both the main and guard receivers. The control knob (SENS) will never reduce the receiver sensitivity level below that of the bench setting. A volume control (VOL) is provided so that the pilot may adjust the audio level output of the receivers. A microphone switch (MIC) on the throttle activates the main unit transmitter for voice communications. The mode of operation switch provides the primary power control for the uhf transceiver unit and movement of the switch determines the mode of operation. The three modes of operation are as follows:

1. When the switch is in the T/R position, the main receiver is on and the transmitter is in stand-by. The guard receiver is inoperative. The ADF is in stand-by.

2. When in T/R + G REC position, the main receiver and guard receiver are on and the transmitter is in stand-by. The ADF is in stand-by.

3. When in ADF position (AN/ARA-25 operative), the automatic direction finder circuits are completed and the main receiver is operative for ADF reception. The transmitter and guard receiver are in stand-by. Operation of the pilot's microphone switch will transfer antennas from ADF to UHF and transmission on the selected channel will be possible.

OPERATION OF UHF COMMAND SET. For normal operation of the uhf command set, proceed as follows:

1. To receive and transmit, move mode of operation switch to T/R position.
2. Make sure button marked "PUSH TO SET CHAN" is locked.
3. Select desired channel.
4. Adjust volume control to attain desired audio output.
5. To transmit, depress microphone switch on throttle.
6. To receive and transmit with guard channel operative, move mode of operation switch to T/R + G REC position.
7. To receive adf signals, move mode of operation switch to ADF.
8. To turn uhf command set off, move mode of operation switch to OFF.

UHF DIRECTION FINDING EQUIPMENT (AN/ARA-25).

The direction finding equipment operates in conjunction with the uhf command set. An antenna relay transfers the uhf command set to the direction finding antenna when the mode of operation switch is positioned in ADF. Best homing results are obtained in straight and level flight.

OPERATION OF UHF DIRECTION FINDING EQUIPMENT.

Operation of the AN/ARA-25 equipment is accomplished from the uhf control panel, located on the right console, as follows:

1. Select desired channel on channel selector control.
2. Move mode of operation switch to ADF position.
3. If manual frequency selection is desired, turn channel selector control to M and adjust the three concentric frequency controls to any desired frequency.
4. Read bearing direction from pointer No. 1 of radio magnetic indicator on instrument panel.
5. To turn off equipment, move mode of operation switch to any position other than ADF.

CAUTION

Inaccurate or fluctuating indications may result under the following conditions:

- When directly over the signal cone, unstable indications will exist temporarily.
- If signal source is a higher flying aircraft, reflections from the wing and fuselage surfaces may cause inaccurate indications. If the horizon appears between signal source and airplane, the signal may be weakened. Increasing altitude will give a stronger signal.
- Normal maneuvers will cause bearing fluctuations.
- When drop tanks are installed, "off wing" bearings are subject to error.

RADIO NAVIGATION RECEIVER (AN/ARN-14E).

The AN/ARN-14E equipment provides reception of vhf omni-range, ILS localizer and voice facilities. The installation includes the R-540/ARN-14C receiver, the ID-249B/ARN course indicator, the ID-250A/ARN radio magnetic course indicator, the ID-251/ARN bearing converter control, the antenna and the C-760B/A control panel. The receiver and bearing converter are located in the radio compartment. The course indicator and radio magnetic course indicator are located on the instrument panel and the control panel (figure 4-4) is located on the right console. The ID-249B/ARN course indicator permits course selection by means of a control knob on the lower left corner of the instrument. The selected course is shown in the window at the top of the indicator. The window on the upper left portion of the instrument indicates whether the course is TO or FROM the vhf omni-range station. A pointer indicates the angle between the heading of the airplane and the course shown in the course window. This angle represents drift correction. A vertical bar shows direction and the amount of deviation from "on course" flight. The horizontal bar, which provides glide path information, is not used in this installation. Signal flags are employed to warn if the signal level decreases to the extent that the indicators are unreliable. The ID-250A/ARN radio magnetic course indicator shows the heading of the airplane on the circular scale. Pointer No. 1 is connected to the AN/ARA-25 adf equipment and pointer No. 2 indicates the magnetic bearing to the station tuned in on the receiver of the AN/ARN-14E equipment. The control panel contains a power switch, a frequency selector and a volume control.

OPERATION OF RADIO NAVIGATION RECEIVER (AN/ARN-14E). For operation of the radio navigation equipment, proceed as follows:

1. Turn power switch ON.
2. Rotate the large selector knob until the tens and units of the desired frequency appear in the window;

then, rotate the small knob until the tenths of a megacycle of the desired frequency appear. The VOR frequency is normally in the 112 to 118 megacycle band. The ILS localizer frequency is in the 108 to 111.9 megacycle band.

3. Rotate volume control to obtain desired level of audio signal.

Note

Steps 1. through 3. apply to both voice and omni-range reception. The steps listed below are to be performed when the receiver is tuned to an omni-range station and the airplane is flying within receiving distance of that station.

4. Read the magnetic bearing of the omni-range station at pointer No. 2 on the radio magnetic indicator (ID-250A/ARN).

5. Set this magnetic bearing of the omni-range station as the course by rotating the knob marked "SET" until the course appears in the top window of the course indicator (ID-249B/ARN).

6. The vertical pointer will indicate lateral position deviation from the selected course (ID-249B/ARN).

7. The relative heading indicator needle shows the angle between the heading of the airplane and the selected course (ID-249B/ARN).

8. The window in the upper left portion of the course indicator shows whether the course is TO or FROM the selected omni-range station.

9. To shut off equipment, place power switch OFF.

The same procedure, as outlined in the preceding steps, applies to ILS localizer operation, with the exception of step 5. For localizer use, set the magnetic approach bearing to the localizer as the course. To do this, rotate the knob marked "SET" until the course appears in the top window of the course indicator. The airplane is not equipped to receive glide path information.

RADIO NAVIGATION RECEIVER (AN/ARN-21). Some airplanes* have provisions for service installation of the AN/ARN-21 radio navigation receiver. The AN/ARN-21 equipment provides reception of uhf omni-range and voice facilities. The equipment includes an RT-220/ARN-21 radio receiver-transmitter, an ID-249A/ARN course indicator, a CV-279/ARN phase detecting network, an ID-250/ARN radio magnetic course indicator, an ID-307/ARN azimuth indicator, an ID-310/ARN range indicator, an ARN-21/ARC-27 duplex antenna and a C-866/ARN-21 control panel. The receiver-transmitter and the ID-307/ARN azimuth indicator are located in the radio compartment. The course indicator, radio magnetic course indicator and range indicator are located on the instrument panel. The duplex antenna, which is used for both ARN-21 and ARC-27 reception, is located in the vertical stabilizer. The control panel (figure 4-4) is located on the right console. The ID-249A/ARN course indicator (17, figure 1-5) permits course selection by means of a control knob on the lower left corner of the instrument. The selected course is shown in the window at the top of the indicator; the window on the upper left portion of the instrument indicates whether the course is TO or FROM the uhf omni-range station. A pointer indicates the angle between the heading of the airplane and the course shown in the course window. This angle represents drift correction. A vertical bar shows direction and the amount of deviation from "on course" flight. The phase detecting network prepares bearing signals for proper left to right flight instructions on the vertical bar. The horizontal bar is not used in this installation. Red signal flags are used to warn the pilot when the signal strength has decreased to the point where indications are unreliable. The ID-250/ARN radio magnetic course indicator (13, figure 1-5, sheets 1 and 2, and 21, figure 1-5, sheet 3) shows the magnetic heading of the airplane on the circular scale. Pointer No. 2 indicates the magnetic bearing to the station tuned in on the receiver of the AN/ARN-21 equipment. The ID-310/ARN range indicator is mounted on the instrument panel (10, figure 1-5, sheet 1, and 11, figure 1-5, sheets 2 and 3). It has a single window through which distance between the airplane and the omni-range station is indicated in nautical miles. The maximum range of the ID-310/ARN is 195 nautical miles. While the indicator is "searching" for the correct range, the rapidly rotating numbers are partially covered by a red flag which warns the pilot against reading incorrect distance indications. The control panel contains the channel selector knobs, the volume control and a switch marked OFF-REC-T/R for energizing the equipment. With the switch in REC position, bearing information only is supplied. With the switch in T/R position, both bearing and distance information are supplied. The volume control is used to regulate the level of the audio identification signal of the station to which the equipment has been tuned.

OPERATION OF RADIO NAVIGATION RECEIVER (AN/ARN-21).

To operate the radio navigation equipment C-866/ARN-21 control panel, proceed as follows:

1. Turn on the power switch marked OFF-REC-T/R by placing the switch to either REC or T/R.

2. Select a known beacon channel by setting the channel dials to the appropriate channel number. The left-hand knob selects the tens and hundreds figures and the right-hand knob selects the unit figures of the omni-range station channel number. The equipment operates on channels 01 to 126 (a total of 126 channels).

3. Rotate the volume control to the desired level of audio signal to identify the selected station identification signal.

4. Read the magnetic bearing of the omni-range station at pointer No. 2 on the radio magnetic course indicator (ID-250/ARN).

5. Set this magnetic bearing of the omni-range station as the course by rotating the knob marked SET until

***Airplanes 139281 and subsequent having Service Change No. 151 complied with**

the course appears in the top window of the course indicator (ID-249/ARN).

6. The vertical pointer on the ID-249/ARN will indicate lateral position deviation from the selected course.

7. The relative heading indicator needle on the ID-249/ARN shows the angle between the airplane heading and the selected course.

8. The window in the upper left portion of the course indicator shows whether the selected course is TO or FROM the omni-range station.

9. The range indicator (ID-310/ARN) indicates the distance in nautical miles from the omni-range station.

10. To turn the equipment off, place the switch marked OFF-REC-T/R to OFF.

IFF EQUIPMENT (AN/APX-6B).

The IFF equipment enables the airplane to identify itself as friendly when challenged by friendly radar and permits surface tracking of the airplane. The equipment receives challenges initiated by an interrogator-responsor and automatically transmits replies in return. When surface radar receives a radar target accompanied by proper IFF reply, as transmitted by the AN/APX-6B, that target is considered friendly. The equipment also may be used to indicate distress. All controls required for operation are on the control panel located on the right console (figure 4-4). Refer to Section IV of the Confidential Supplement (NAVAER 01-60JKD-501A) for description of the coder group, AN/APA-89.

NORMAL OPERATION OF IFF EQUIPMENT (AN/APX-6B). For normal operation, proceed as follows:

1. Rotate master selector switch to NORM to have equipment respond automatically when interrogated. (The LOW position on the master selector switch should not be used except upon proper authorization.)

2. Set mode switches to the OUT position, unless otherwise directed by proper authority.

3. To maintain the equipment ready for instant use, but inoperative, rotate master switch to STDBY.

4. To shut off the equipment, rotate master selector switch to OFF.

EMERGENCY OPERATION OF IFF EQUIPMENT (AN/APX-6B). To indicate emergency or distress, press red dial stop and rotate master selector switch to EMERGENCY. The equipment will automatically transmit a distress signal.

LIGHTING EQUIPMENT.

EXTERIOR LIGHTING.

The exterior lighting system includes position lights on each wing tip and in the tail of the airplane, two fuselage signal lights, one on the top and one under the fuselage, two flush-type formation lights, located on each side of the fuselage aft of the fuselage break, and a landing light. An approach light is located in the nose section of the fuselage.

LANDING LIGHT. A landing light is installed on the forward door of the nose gear well. The light switch (19, figure 1-6) is on the left console, inboard of the throttle quadrant. The circuit breakers are on the left console circuit-breaker panel.

FORMATION LIGHTS. Two formation lights are located on the fuselage, aft of the fuselage break. The lights are flush-type with one mounted on each side of the fuselage. They are controlled from a three-position toggle switch (FORM) located on the exterior light control panel.

APPROACH LIGHTS. Three external lights, mounted on the lower lip of the jet air intake, are used to assist the landing signal officer in determining the approach attitude of the airplane. There are three lights: red, amber and green, connected and controlled by a sensing device actuated by the angle-of-attack detector. When the airplane is in the proper approach angle of attack, the amber light will be visible to the landing signal officer. If the angle of attack exceeds the optimum approach angle, the green light will be visible; if the angle of attack is less than the optimum approach angle, the red light will be seen. The lights are turned on automatically when the exterior lights master switch is ON, and the landing gear is down and locked and the arresting hook is lowered. No additional attention is required by the pilot. When the wing and taillight switch is turned on (DIM or BRT), the approach lights dim. When the exterior light switch is ON, the approach lights will dim.

A momentary contact switch, located on the canopy deck behind the pilot's seat, actuates the hook by-pass control relay and by-passes the arresting hook circuit for night field carrier landing practice. When night field carrier landing practice is anticipated, the by-pass switch must be actuated by the plane captain, after electrical power is turned on, since the pilot cannot reach the switch during flight. When electrical power is secured, the hook by-pass control relay is de-energized.

FUSELAGE LIGHTS. There are two fuselage lights, one located on the top and one on the bottom of the fuselage. The fuselage lights may be automatically flashed or may be made to burn steady, dependent upon pilot selection of the exterior lights master switch when the fuselage lights switch is positioned to either DIM or BRT. With the fuselage lights switch positioned to MAN and the exterior lights master switch positioned to STDY, the fuselage lights may be manually flashed through use of the pilot-operated code key. On some airplanes,* the exterior lights master switch is mounted on the left forward console ahead of the catapult handle. With the exterior lights master switch positioned to ON, power is supplied to the flash—steady selector switch on the exterior lights control panel. With the flash—steady selector switch in the FLSH position, the fuselage lights will automatically flash when the fuselage lights switch is positioned to DIM or BRT. With the flash—steady selector switch positioned to STDY and the fuselage lights switch at DIM or BRT, the fuselage lights will burn steady or, if the fuselage lights switch is positioned to MAN, they may be flashed through use of the pilot-operated code key.

*Airplanes 139531 and subsequent

EXTERIOR LIGHTING CONTROLS.

For exterior lighting controls, see figure 4-5.

EXTERIOR LIGHTING MASTER SWITCH. The exterior lighting master switch (8, figure 4-5) has three positions: FLASH, OFF and STEADY. When the master switch is positioned at STEADY, all lights will burn steadily when the corresponding toggle switch is positioned other than OFF, except the fuselage lights which may be keyed if desired. When the master switch is in FLASH position, the fuselage lights will flash automatically when the fuselage lights switch is in BRIGHT or DIM position and all other lights will burn steadily if their respective switches are in BRIGHT or DIM position. The master switch must be positioned from the OFF position before any exterior lights except the landing light and approach lights can be illuminated. On some airplanes,* the exterior lights master switch (13, figure 4-5) is a two-position (OFF—ON) toggle switch located on the left forward console, ahead of the catapult handle. Actuation of the switch to ON supplies power to the flash—steady selector switch on the exterior lights control panel for distribution to the exterior lights when the respective switches are actuated to a position other than OFF, except the fuselage lights. (Refer to FUSELAGE LIGHTS, in this section.) If the individual light selector switches are preselected, the exterior lights master switch provides an illumination method for signaling during catapult operations. Provisions for supplying power to the buddy tanker hose floodlight through the trail—rewind switch on the tanker control panel are also incorporated. (Refer to HOSE FLOODLIGHT, in Section VII.)

LIGHT SELECTOR SWITCHES. Three selector switches on the exterior lighting control panel control the brightness of the fuselage, the wings, the tail and the formation lights when the respective switches are actuated to a position other than OFF (or manual as in the case of the fuselage lights). They are all three-position toggle switches. On some airplanes,* a two-position flash—steady selector switch (8A, figure 4-5) replaces the exterior lights master switch on the exterior lighting control panel.

FLASH—STEADY SELECTOR SWITCH. The flash—steady selector exterior lights switch* (8A, figure 4-5) is a two-position toggle-type switch (FLASH and STEADY) which replaces the exterior lights master switch on the exterior lights control panel and provides optional flasher control of the fuselage lights. With the master exterior lights switch (13, figure 4-5) positioned to ON and the flash—steady selector switch to STEADY, all exterior lights will burn steadily when the corresponding toggle switches are positioned other than OFF. The fuselage lights may be keyed if the fuselage lights switch is positioned to MANUAL or will burn steady in the DIM or BRIGHT position. In the FLASH position, the fuselage lights will flash automatically when the fuselage lights switch is in either the BRIGHT or DIM position and all other exterior lights will burn steadily if their respective switches are positioned to either BRIGHT or DIM.

CODE KEY. Through pilot actuation of the code key (9A, figure 4-5), the fuselage lights may be keyed to flash code letters when the fuselage lights switch is positioned to MANUAL and the exterior lights master switch (or the flash—steady selector switch*) is positioned to STEADY (exterior lights master switch,* forward of the catapult handle, ON).

INTERIOR LIGHTING.

The interior lighting system is comprised of both ring and floodlighting for the instrument panel and indirect or edge-lighted panels combined with floodlights for the left and right consoles. Controls for all interior lights are on the right console.

INTERIOR LIGHTING CONTROLS.

For interior lighting controls, see figure 4-5.

INSTRUMENT PANEL LIGHTS RHEOSTAT. The instrument panel rheostat turns on and controls the brightness of the instrument panel ring lights and post lights. When the instrument panel light rheostat is moved from the OFF position, all warning lights (except the two fire warning lights and the hook unsafe warning light) are automatically dimmed. (Refer to WARNING LIGHTS AND WARNING LIGHTS TEST SWITCH, in this section.) On some airplanes,† the approach indexer (figure 1-17A) will also be dimmed.

INSTRUMENT FLOODLIGHTS CONTROL SWITCH. The instrument floodlights switch has three positions: LOW, OFF and HIGH.

STAND-BY COMPASS AND RANGE INDICATOR LIGHTS CONTROL SWITCH. A control switch, with ON and OFF positions, operates the stand-by compass and range indicator lights which are located on the instrument panel shroud as a part of the instrument mounting. On some airplanes,* wiring provisions are incorporated for the buddy tanker fuel quantity transfer meter integral lighting. (Refer to FUEL QUANTITY TRANSFER METER, in Section VII.) This switch is inoperative unless the instrument panel lights rheostat is moved from the OFF position.

CONSOLE FLOODLIGHT SWITCH. The console floodlight switch has three positions: DIM, MED, and BRIGHT. Power for the switch is supplied from the console lights rheostat. On some airplanes,‡ the console floodlight switch supplies power for the mission data light.

CONSOLE LIGHTS RHEOSTAT. This rheostat switch turns on and controls the brightness of the console lights. When the rheostat is moved in a clockwise direction from the OFF position, the console floodlight control switch becomes operative.

*Airplanes 139531 and subsequent

†Airplanes 143594 and subsequent

‡Airplanes 139471 and subsequent and airplanes having Service Change No. 357 complied with

MISSION DATA LIGHT — AIRPLANES 139531 THROUGH 139537 AND 139541, 139543 AND SUBSEQUENT. The mission data light, located on the right-hand instrument panel shroud, provides night illumination for the pilot's knee board. Light intensity is controlled from the three-position console floodlight switch, and a rotary type off-on switch on the light fixture permits pilot actuation of the light.

WARNING LIGHTS AND WARNING LIGHTS TEST SWITCH. The following warning lights are installed:

LIGHTING CONTROLS

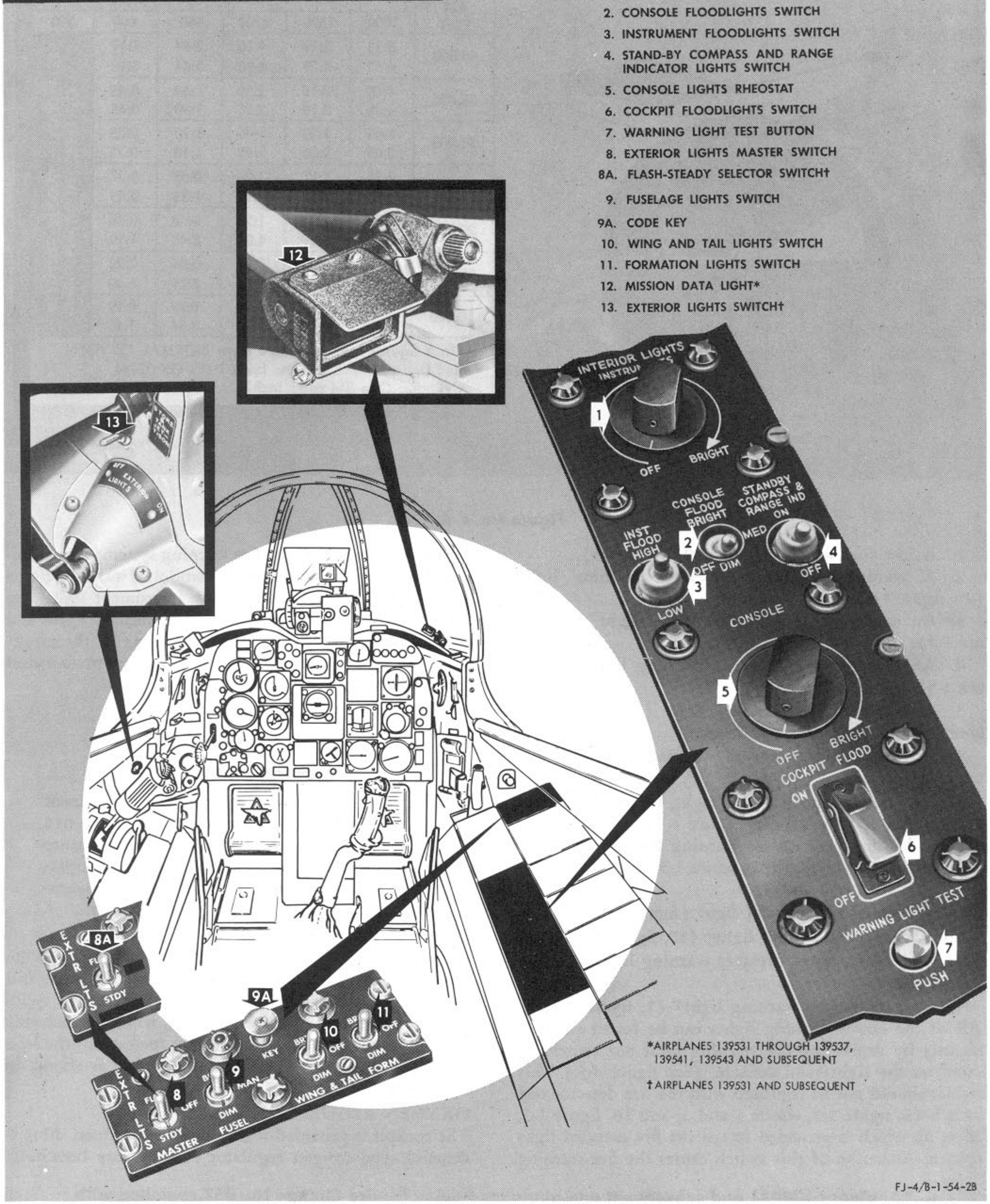
1. INSTRUMENT LIGHTS RHEOSTAT
2. CONSOLE FLOODLIGHTS SWITCH
3. INSTRUMENT FLOODLIGHTS SWITCH
4. STAND-BY COMPASS AND RANGE INDICATOR LIGHTS SWITCH
5. CONSOLE LIGHTS RHEOSTAT
6. COCKPIT FLOODLIGHTS SWITCH
7. WARNING LIGHT TEST BUTTON
8. EXTERIOR LIGHTS MASTER SWITCH

8A. FLASH-STEADY SELECTOR SWITCH†

9. FUSELAGE LIGHTS SWITCH

9A. CODE KEY

10. WING AND TAIL LIGHTS SWITCH
11. FORMATION LIGHTS SWITCH
12. MISSION DATA LIGHT*
13. EXTERIOR LIGHTS SWITCH†

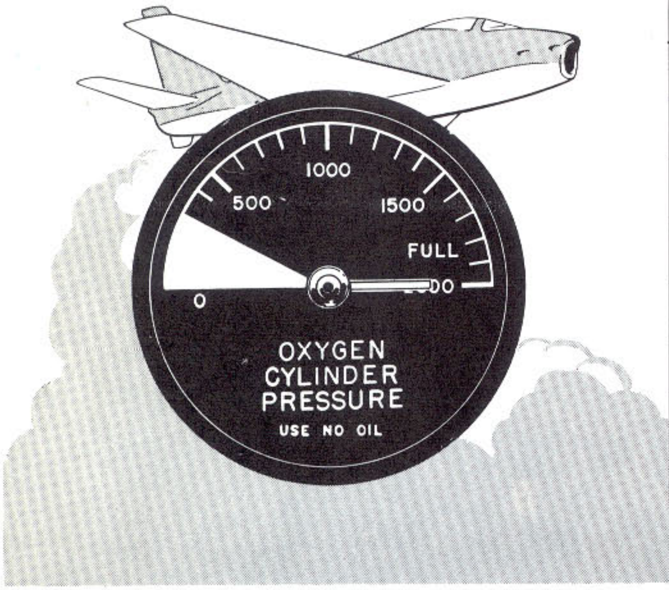


*AIRPLANES 139531 THROUGH 139537, 139541, 139543 AND SUBSEQUENT

†AIRPLANES 139531 AND SUBSEQUENT

Figure No. 4-5.

OXYGEN DURATION—hours:minutes



CABIN ALT FEET	GAGE PRESSURE-PSI 1800	1500	1200	900	600	300
40,000	6:52 6:52	5:29 5:29	4:00 4:00	2:44 2:44	1:19 1:19	EMERGENCY—DESCEND TO ALTITUDE BELOW 10,000 FEET
35,000	4:09 4:09	3:19 3:19	2:30 2:30	1:40 1:40	0:45 0:45	
30,000	3:05 3:05	2:30 2:30	1:49 1:49	1:10 1:10	0:35 0:35	
25,000	2:25 4:04	1:57 3:14	1:24 2:19	0:57 1:35	0:27 0:45	
20,000	2:23 6:49	1:55 5:29	1:26 4:04	0:58 2:45	0:28 1:19	
15,000	1:52 8:28	1:28 6:44	1:07 5:04	0:44 3:19	0:22 1:40	
10,000	1:37 8:58	1:17 7:09	0:58 5:20	0:39 3:34	0:19 1:45	

Black figures indicate dilute lever NORMAL OXYGEN.
Red figures indicate dilute lever 100% OXYGEN. (Upper figure in each cell is red.)
Cylinder: One 514 cubic inch.

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Figure No. 4-6.

1. A low fuel warning light (19, figure 1-5).
2. A windshield (anti-ice) overheat warning light (25, figure 1-5).
3. An engine burner fire warning light (2, figure 1-5).
4. An engine compressor fire warning light (2, figure 1-5).
5. A generator-out warning light (18, figure 1-7, sheet 1, and 20, figure 1-7, sheet 2).
6. An instrument power-off warning light (16, figure 1-7, sheet 1, and 18, figure 1-7, sheet 2).
7. An arresting hook unsafe light, located in the arresting gear control handle (figure 1-7).
8. A landing gear unsafe warning light in the landing gear control handle (32, figure 1-5, sheet 1, and 31, figure 1-5, sheets 2 and 3).
9. A manual fuel control light (figure 1-16).
10. A wing fuel shutoff light† (18, figure 1-5.)
11. A flight control pressure warning light (27, figure 1-5).
12. A low oxygen warning light* (1, figure 4-8).

All of the above warning lights can be tested simultaneously by depressing the warning light test switch located on the right-hand console. (See figure 4-5.) This switch should not be confused with the fire detector test switch (9, figure 1-5, sheets 1 and 2, and 10, figure 1-5, sheet 3) which is provided to test the fire detector light system. Actuation of this switch causes the fire warning lights to illuminate if the fire warning system is functioning properly. All of the afore-mentioned warning lights will be dimmed at any time the instrument lights are on, with the exception of the two fire warning lights and the hook unsafe warning light. Dimming of the arresting hook unsafe light is provided by using a press-to-test light with a dimming feature.

WARNING

During daylight operations, the instrument lights rheostat should be maintained at the OFF position so that the automatic dimming feature for some of the warning lights will be inoperative. In this manner, illumination of any warning light will be at its brightest intensity.

OXYGEN SYSTEM.

Oxygen is supplied from a high-pressure cylinder located forward of the left-hand gun bay. Normal full pressure for the system is 1800 psi. The oxygen cylinder can be refilled at the filler valve, which is accessible through the access door located just forward of the left-hand gun bay. An oxygen duration chart is shown in figure 4-6.

OXYGEN REGULATOR.

The cockpit is provided with a positive-pressure, diluter-demand type oxygen regulator for pressure breathing.

***Airplanes 139471 and subsequent and airplanes having Service Change No. 357 complied with**
†Airplanes 139281 through 139323, 139424 through 139530 and airplanes not having Service Change No. 466 complied with

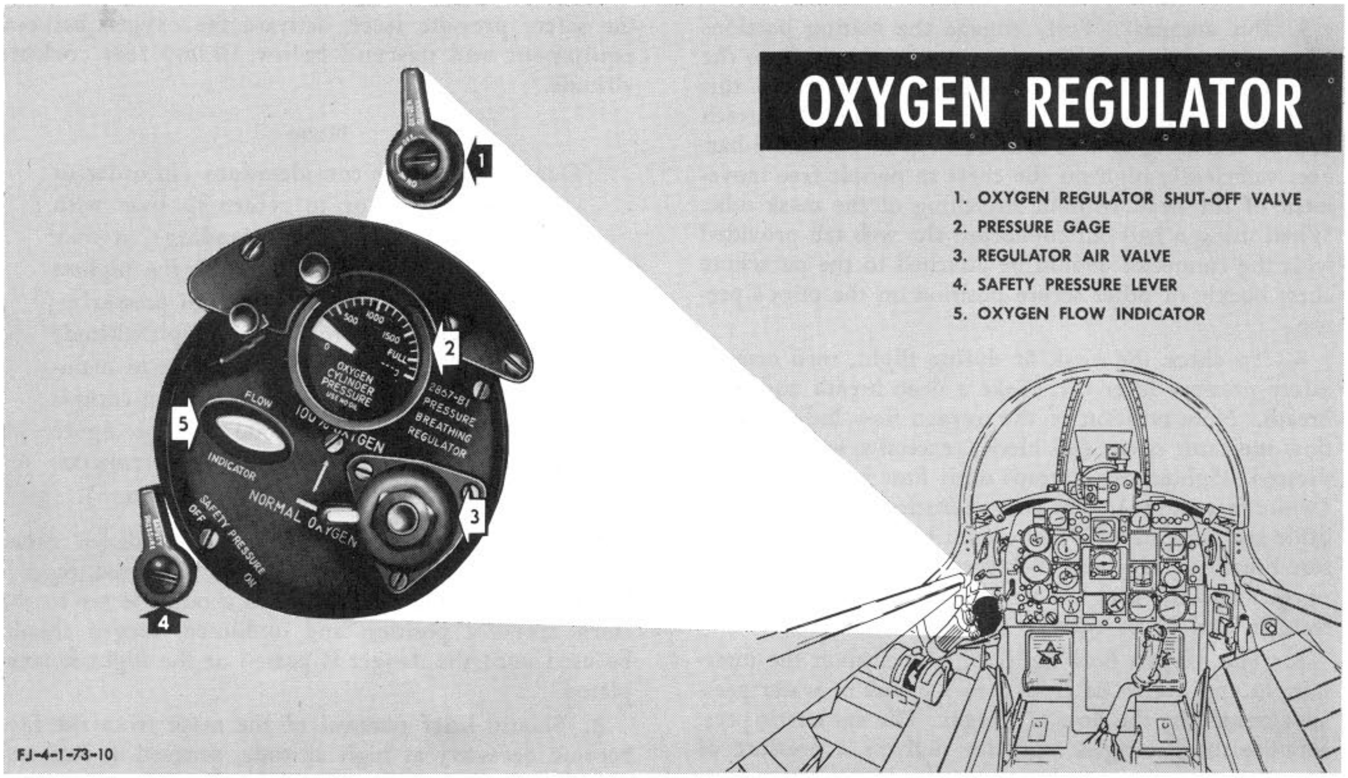


Figure No. 4-7.

(See figure 4-7.) The regulator automatically mixes varying quantities of air and oxygen, the ratio depending on altitude, and delivers the quantity demanded upon inhalation. In addition to a conventional regulator air valve, a safety pressure lever on the regulator can be turned to provide oxygen flow under a positive pressure while operating at either NORMAL OXYGEN or on 100% OXYGEN. When the safety pressure lever is ON, oxygen flows freely.

WARNING

Always have oxygen available for immediate use when flying above 10,000 feet.

OXYGEN SYSTEM PREFLIGHT CHECK.

Before each flight requiring the use of oxygen, inspect oxygen equipment as follows:

1. Oxygen system leakage shall be determined by comparison of the oxygen cylinder pressure gage readings at the beginning and the end of a 24-hour period. A pressure drop of more than 50 psi in a 24-hour period is excessive. Make sure the oxygen regulator shutoff valve is open when these readings are made.

2. Pressure gage should read 1800 (±50) psi if the cylinder is fully charged.

3. Test the oxygen regulator for leakage by obstructing the outlet of the breathing tube. If the flow indicator face opens in less than 30 seconds, excessive leakage exists and the regulator should be replaced.

4. Test the breathing tube couplings, the regular diaphragm and the diluter check valve for leakage by inserting a spare mask tube disconnect fitting into the open end of the disconnect. Blow gently into the end of the disconnect until the flow indicator face opens. Seal the end of the disconnect with the tongue. If the flow indicator does not close within 5 seconds, the leakage is within acceptable limits. If leakage exists, check the couplings, the outlet elbow and the breathing tube clamps for tightness.

5. Check mask fit by putting on the oxygen mask and attaching it to the helmet as in flight. Connect the oxygen mask to regulator couplings and activate the manual safety pressure to ON. Take a deep breath and hold breath. Note the position of the oxygen flow indicator. If flow indicator opens (all black), a leak is indicated. Tighten mask straps until flow indicator closes (white face shows). Resume breathing and release manual safety pressure to OFF.

WARNING

Do not use a mask that leaks.

OXYGEN SYSTEM FLIGHT OPERATION.

Oxygen should be used from take-off to landing on all flights.

1. The pressure gage should read 1800 (±50) psi if the cylinder is fully charged.

2. Set air valve to NORMAL OXYGEN for all normal flight conditions.

3. Put on mask. Fully engage the mating portions of the disconnect couplings to connect the mask to the oxygen system. (The force required to disconnect this coupling should not be less than 10 pounds.) Attach clip of breathing tube to nearest strap of parachute harness sufficiently high on the chest to permit free movement of the head without stretching of the mask tube. When using a bail-out connector, the web tab provided with the connector should be attached to the parachute chest buckle or other secure position on the pilot's person.

4. To check the mask fit during flight, turn manual safety pressure lever ON. Take a deep breath and hold breath. Note position of the oxygen flow indicator. If flow indicator opens (all black), excessive leakage is indicated. Tighten mask straps until flow indicator closes (white face shows). The characteristics of the flow indicator are such that this test cannot be conducted at pressure-breathing altitudes; however, the outward flow of oxygen into the eyes from a leaking mask is readily detectable and is an equally sensitive test.

5. The oxygen flow indicator blinks upon the intermittent application of from 5 to 7 inches of water pressure created by the flow of oxygen. The automatic pressure-breathing oxygen regulator delivers a pressure of 5 to 7 inches of water pressure to the mask at approximately 41,000 feet; this pressure is likewise transmitted to the oxygen flow indicator which will remain open as long as this pressure is applied. Accordingly, the flow indicator will not "blink" above this altitude; however, the positive pressure in the mask is an unmistakable indication that oxygen is being delivered to the mask and no apprehension should be felt as long as the flow indicator remains open above 41,000 feet.

The following should be checked frequently while on oxygen:

1. Cylinder pressure gage for oxygen supply.
2. Oxygen flow indicator for flow of oxygen through regulator.
3. Mask fit for leak tightness.
4. Positive engagement of disconnect couplings.
5. Connection of bail-out fitting to bail-out connector.

OXYGEN SYSTEM POSTFLIGHT CHECK.

Following each flight during which oxygen is used:

1. Turn off oxygen supply.
2. Make sure all oxygen equipment is in proper condition before leaving airplane.
3. Report all difficulties and see that they are corrected.

OXYGEN EMERGENCY CONDITIONS AND PROCEDURES.

1. Should symptoms occur which suggest the onset of hypoxia, immediately activate the safety pressure control. A constant flow of 100 percent oxygen, under slight pressure, will immediately be made available. If, for any reason, the regulator should become inoperative and/or a constant flow of oxygen is not obtained by use of the safety pressure lever, activate the oxygen bail-out equipment and descend below 10,000 feet cockpit altitude.

Note

Due to fuel/range considerations (in order to complete mission or to return to base with sufficient fuel available for landing), it may be necessary to continue flight at the highest aircraft altitude at which the cabin pressurization schedule will provide a cockpit altitude of 10,000 feet. Care should be taken to maintain adequate engine rpm in order that cockpit altitude does not exceed 10,000 feet. (See figure 4-2 and refer to COCKPIT AIR CONDITIONING AND PRESSURIZING SYSTEM in this section).

2. Whenever excessive carbon monoxide or other noxious or irritating gas is present or suspected, regardless of the altitude, the air valve should be set to the 100% OXYGEN position and undiluted oxygen should be used until the danger is passed or the flight is completed.

3. Should brief removal of the mask from the face become necessary at high altitude, proceed as follows: (a) Take three or four deep breaths of 100 percent oxygen. (b) Hold breath and remove mask from face. (c) As soon as practicable, replace mask to face and take three or four deep breaths of 100 percent oxygen. (d) Reset air valve lever to the NORMAL OXYGEN position.

4. Do not exhaust oxygen supply below 300 psi, except in an emergency.

LIQUID OXYGEN SYSTEM—AIRPLANES 139471 AND SUBSEQUENT AND AIRPLANES HAVING SERVICE CHANGE NO. 357 COMPLIED WITH.

Gaseous oxygen is supplied from the aircraft liquid oxygen converter system by evaporation. Liquid oxygen is contained in a double-wall, vacuum sealed sphere located forward and below the windshield on the left side of the airplane. The converter system includes a filler valve, a heat exchanger, an automatic diluter-demand pressure regulator and gage, a quantity indicating gage and a low-level warning light. The container has a capacity of 5 liters (liquid) which expands to produce the equivalent of a gaseous oxygen system utilizing three 514 cubic inch bottles. The system operates on a normal pressure of 70 psig. Gaseous oxygen boils off of the liquid and flows through the system to the regulator with delivery rates up to 20 liters (gaseous) per minute as demanded by the pilot. The normal delivery rate is 10 liters per minute. The heat exchanger is an aluminum plate with a serpentine passage through which the gaseous oxygen flows. The plate is located forward of the liquid oxygen container and is heated by ambient air. The temperature of the oxygen delivered to the pilot will be no greater than 10°F above cabin temperature and no colder than 20°F below ambient temperature. If the system pressure drops below

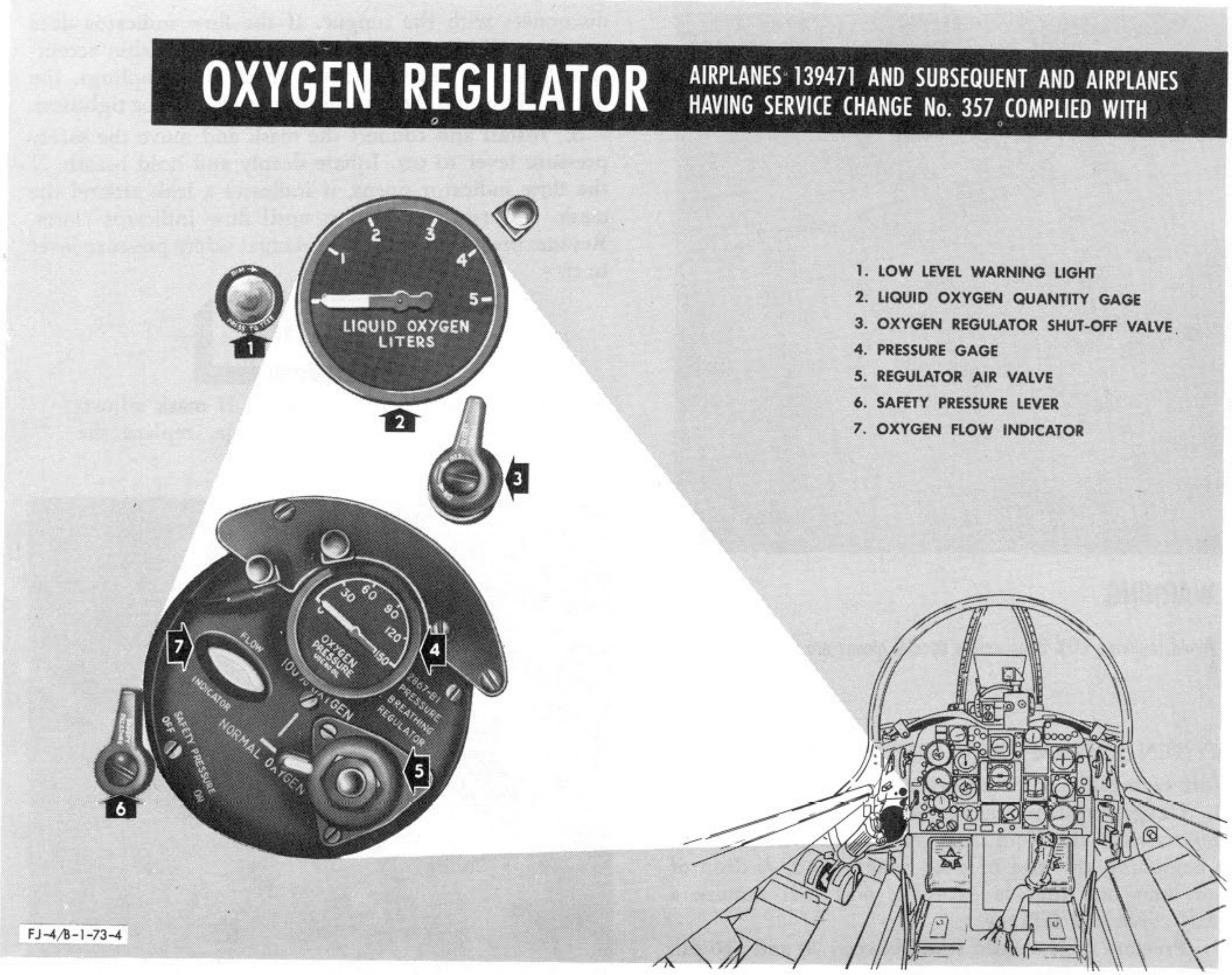


Figure No. 4-8.

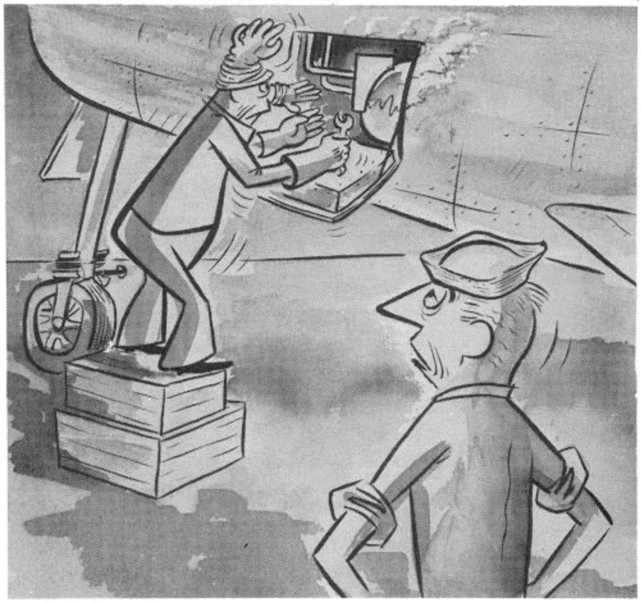
65 psi, the pressure control valve will open and supply the system with oxygen pressure until the system pressure is back up to 70 psi after which the valve will close. When not in use, aircraft liquid oxygen systems should be left in the built-up condition with the supply valve in the OFF position, except while filling the system, pressure will be maintained at approximately 110 psi. When this pressure is exceeded, the relief valve opens and vents the excess pressure overboard. This normal boil-off will deplete the liquid oxygen supply by approximately one liter in 24 hours. The converter system must not be permitted to go dry and be exposed to the surrounding atmosphere. If the system is exposed, water vapors and other gases may condense in the converter bottle, causing malfunction of the system valves and presence of an odor in the oxygen supply. If the aircraft liquid oxygen system is exposed to the atmosphere for any extended period, it should be purged with hot, dry nitrogen gas prior to further use. Gaseous oxygen may be used as an alternate purging agent. (Refer to LIQUID OXYGEN SYSTEM PURGE, in Section I.)

WARNING

Liquid oxygen has a static temperature of −297°F at 14.7 psi. Extreme caution must be taken not to touch any uninsulated metal lines, containers or other implements holding liquid oxygen unless special gloves are worn. The eyes and skin should be protected from freezing when exposed to liquid oxygen. Without gloves, the skin will instantly freeze to an exposed metal surface. Liquid oxygen alone will not burn; however, when it is mixed with, or splashed on, almost any other material, it becomes highly combustible or explosive.

OXYGEN REGULATOR.

The oxygen regulator for this system is identical to the regulator used for the gaseous system except the pressure gage is calibrated from 0 to 150 psi. (See figure 4-8.)



WARNING

Avoid touching LOX lines unless special gloves are worn.

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OXYGEN SYSTEM PREFLIGHT CHECK.

Before each flight, inspect oxygen equipment as follows:

1. Oxygen system leakage shall be determined by comparison of the liquid oxygen quantity indicator at the beginning and end of a 24-hour period. A drop of more than one liter is excessive and will require a system check for leakage.
2. Pressure gage should read between 70 and 110 psi.

WARNING

Should the pressure gage indicate 45 psi or below, consider that a malfunction of the oxygen system has occurred. If the system has been empty for several hours, or if the system has been left open due to replacement of parts without all lines and components being capped or plugged, complete system purge and refilling is mandatory prior to flight. (Refer to LIQUID OXYGEN SYSTEM PURGE, in Section I.)

3. Quantity gage should read no less than 4 liters for a normal mission. Lower readings are satisfactory if the flight is to be short. (See figure 4-9.)
4. Test the regulator for leakage by obstructing the breathing tube outlet. If flow indicator opens in less than 30 seconds, excessive leakage exists and trouble should be remedied.
5. Test the breathing tube couplings, the diaphragm and the diluter check valve for leakage by inserting a spare mask tube disconnect fitting into the open end of the disconnect. Blow gently into the end of the disconnect until the flow indicator opens. Seal the end of the disconnect with the tongue. If the flow indicator does not close within 5 seconds, the leakage is within acceptable limits. If leakage exists, check the couplings, the outlet elbow and the breathing tube clamps for tightness.
6. Install and connect the mask and move the safety pressure lever to ON. Inhale deeply and hold breath. If the flow indicator opens, it indicates a leak around the mask. Tighten mask straps until flow indicator closes. Resume breathing and place manual safety pressure lever to OFF.

WARNING

Do not use a mask that leaks. If mask adjustment will not stop the leakage, replace the mask.

WARNING

Do not use an oxygen mask that leaks.

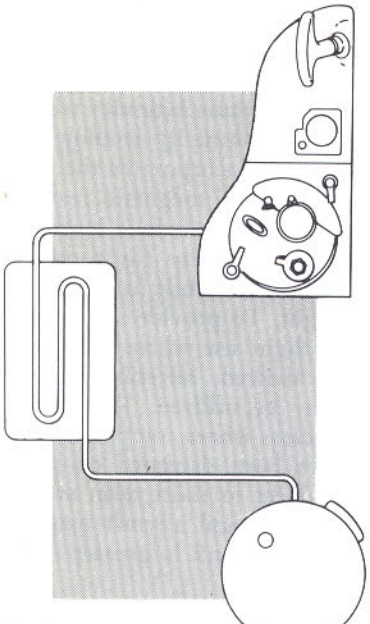
FJ-4/B-1-0-9

OXYGEN SYSTEM FLIGHT OPERATION.

Oxygen should be used from take-off to landing on all flights.

1. Set air valve to NORMAL OXYGEN for all normal flight conditions.
2. Make sure the disconnect fittings between the mask and the airplane system are fully engaged. (The force required to disconnect this coupling should not be less than 10 pounds.) Put mask on and attach clip of breathing tube to nearest strap of parachute harness, high enough to permit free head movement without stretching the mask tube. When using a bail-out connector, the web tab provided with the connector should be attached to the parachute chest buckle or some other secure position on the flight suit.

LIQUID OXYGEN DURATION



FJ-4/B-1-73-5A

CABIN ALTITUDE - FEET	GAGE QUANTITY—LITERS 5	4	3	2	1	½	BELOW 1/2 OR PRESSURE BELOW 45 PSI
40,000 & ABOVE	30.3 / 30.3	24.2 / 24.1	18.2 / 18.2	12.1 / 12.1	6.0 / 6.0	3.0	DESCEND TO ALTITUDE NOT REQUIRING OXYGEN
35,000	18.5 / 18.5	14.8 / 14.8	11.1 / 11.1	7.4 / 7.4	3.7 / 3.7	1.8 / 1.8	
30,000	13.6 / 13.6	10.9 / 10.8	8.2 / 8.1	5.4 / 5.4	2.7 / 2.7	1.4 / 1.3	
25,000	10.2 / 18.0	8.2 / 14.4	6.2 / 10.8	4.1 / 7.2	2.0 / 3.6	1.0 / 1.8	
20,000	8.0 / 30.3	6.4 / 24.1	4.8 / 18.2	3.2 / 12.1	1.6 / 6.0	0.8 / 3.0	
15,000	6.4 / 35.1	5.1 / 28.0	3.8 / 21.0	2.6 / 14.0	1.3 / 7.0	0.6 / 3.5	
10,000	5.0 / 39.2	4.0 / 31.5	3.0 / 23.6	2.0 / 15.7	1.0 / 7.8	0.5 / 3.9	
5,000	4.2 / 33.3	3.3 / 26.7	2.5 / 20.0	1.6 / 13.7	0.8 / 6.6	0.4 / 3.3	
SEA LEVEL	3.5	2.8	2.1	1.4	0.7	0.3	

Red figures indicate lever set at 100% oxygen.
Black figures indicate lever set at normal oxygen.

Consumption data per Specification MIL-1-19326 (AER) from NAVAER 03-50-517.
Based on 800 liter gaseous oxygen per liter of liquid oxygen.
Data assumes the use of a properly fitted face mask.

Figure No. 4-9.

3. Periodically check the mask for leakage during flight. If you are below pressure-breathing altitude, take a deep breath and hold breath. If the flow indicator opens, tighten mask straps until it closes. At higher altitudes, this test cannot be made due to characteristics of the regulator. However, the outward flow of oxygen into the eyes from a leaking mask is readily detectable.

4. The flow indicator blinks upon the intermittent application of from 5 to 7 inches of water pressure created by the flow of oxygen. The regulator will deliver this pressure to the mask up to approximately 41,000 feet. Above this altitude, the pressure is likewise transmitted to the flow indicator which will remain open as long as the pressure is applied. Accordingly, the indicator will not blink above this altitude; however, the positive pressure in the mask indicates that oxygen is being delivered to the mask and no apprehension should be felt as long as the flow indicator remains open above 41,000 feet.

5. Periodically during flight, check the quantity, pressure, mask and all fittings.

WARNING

If pressure gage is observed to indicate 45 psi or below, or if liquid oxygen quantity indicates below ½ liter, initiate oxygen emergency procedures.

OXYGEN SYSTEM POSTFLIGHT CHECK.

Following each flight, note quantity remaining and turn the regulator shutoff valve OFF. Also, check oxygen equipment and take appropriate action.

OXYGEN EMERGENCY CONDITIONS AND PROCEDURES.

1. Should symptoms occur which suggest the onset of hypoxia, immediately activate the safety pressure control lever. A constant flow of 100 percent oxygen, under slight pressure, will immediately be made available. If, through internal system condensation or for any reason, the regulator should become inoperative and/or a constant flow of oxygen is not obtained by use of the safety pressure lever, remove the oxygen mask connector from the breathing tube, activate the bail-out oxygen equipment and descend below 10,000 feet cockpit altitude.

Note

Due to fuel/range considerations (in order to complete the mission or return to base with sufficient fuel available for landing), it may be necessary to continue flight at the highest airplane altitude at which the cabin pressurization schedule will provide a cockpit altitude of 10,000 feet. Care should be taken to maintain adequate engine rpm in order that the cockpit altitude does not exceed 10,000 feet. (See figure 4-2.)

2. Whenever excessive fumes or noxious gases are present or suspected, regardless of your altitude, select 100% OXYGEN and maintain this setting until the danger is past or the flight is completed.

3. Should brief removal of the mask become necessary, take three or four deep breaths of 100 percent oxygen before removing the mask. Hold your breath as long as possible while the mask is removed. As soon as practicable, replace the mask and take several more deep breaths of 100 percent oxygen. Reset the regulator to NORMAL.

OXYGEN SYSTEM LOW LEVEL WARNING LIGHT AND TEST SWITCH.

A press-to-test warning light, located in the lower left corner of the oxygen control panel (figure 4-9), will illuminate when the liquid oxygen supply is down to 1/2 liter. When this light illuminates, there will be sufficient breathing oxygen to make a normal descent to below 10,000 feet, or enough for approximately 30 minutes duration immediately followed by a high speed letdown. The light and the capacitance system can be tested at any time by depressing the plastic cover. If the system is working properly, the needle will rotate counterclockwise and the warning light will illuminate when the needle reaches and drops below one-half liter. On some airplanes,* this warning light will automatically dim when the instrument panel light rheostat is moved from the OFF position.

NAVIGATION EQUIPMENT.

STAND-BY COMPASS.

A conventional magnetic compass, mounted above the instrument panel shroud, is used for navigation in the event of instrument or electrical failure. The compass is illuminated by a light which is controlled by a toggle switch on the right console.

POLAR PATH COMPASS SYSTEM.

WARNING

During violent maneuvers (pitch and roll angles greater than 70 degrees), the polar path compass system is unreliable in any mode. For compass reliability, switch to the SLAVED mode and synchronize the system through the use of the synchronizing knob upon completion of the violent maneuver and when the airplane has returned to relatively straight and level flight.

The polar path compass system (figure 4-10) has been designed to furnish continuous, accurate directional reference under all flight conditions, regardless of latitude. Through provisions on the console controller panel (10, figure 4-10), the pilot may select different modes of operation, dependent upon the regions of magnetic force through which flights are to be conducted. During flights at high latitudes, rapidly converging meridians necessitate constant changes in magnetic reference. In addition to this, compass headings established by magnetic sensing are unreliable and are impractical for directional use. Therefore, it is necessary that the pilot be provided with a gyro-stabilized, polar path directional compass to simplify his navigation so that headings on a great circle course may be flown. This operational mode selection is reliable throughout maneuvers where the airplane's pitch and roll angles do not exceed 70 degrees and is represented on the console controller panel as the D.G. mode. Flights at those latitudes where magnetic sensing is reliable will normally employ the SLAVED mode of operation which incorporates the stability of the directional gyro in the magnetic feature of the flux gate compass. The SLAVED mode is incorporated primarily to alleviate the necessity for constant manual resetting of a directional gyro while in relatively straight and level cruising flight. To provide a stand-by method for emergency level flight use where flux gate compass headings alone are desired, selection of the COMP mode of operation may be utilized. This mode should be used only in those cases where components of other operational modes have been damaged or have failed. The COMP mode is subject to short term errors due to local magnetic fluctuations and aircraft maneuvers where the angle of pitch or bank is greater than 20 degrees.

The polar path compass system includes a miniature flux gate transmitter, a directional gyro transmitter, a compass coupler and a console controller panel. These components transmit signals to the radio magnetic course indicator (9, figure 4-10) located on the instrument panel. The console controller panel (10, figure 4-10) is located on the right console and contains all of the controls necessary for operation of the polar path compass system.

CONSOLE CONTROLLER PANEL.

The console controller panel (10, figure 4-10) includes a mode of operation selector switch (D.G.—SLAVED—COMP) (5, figure 4-10), a latitude set (LATITUDE) knob and dial (4, figure 4-10), a course setting (COURSE SET—L, R—PUSH-TURN) knob (6, figure 4-10), a synchronizing knob (PUSH-SYNC.) (7, figure 4-10) and an annunciator (synchronizing) indicator (L, R) (8, figure 4-10).

MODE OF OPERATION (SELECTOR) SWITCH.

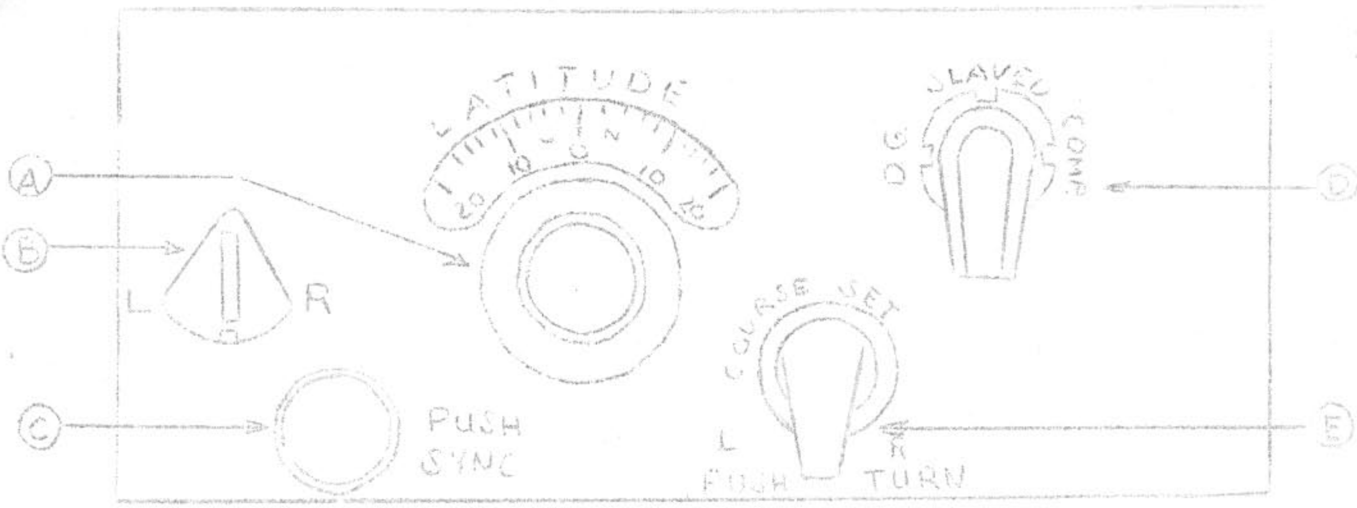
Three modes of operation are available to provide the pilot with the desired type of compass directional reference:

Note

For all modes of operation, the directional heading is indicated on the rotating compass card of the ID-250A/ARN radio magnetic course indicator (9, figure 4-10).

1. The directional gyro alone, switch position D.G. At high latitudes, where magnetic headings are unreliable and the magnetic compass is not desired, the D.G. (directional gyro) position may be selected. From this position selection, the directional gyro alone transmits stabilized electrical impulses through the compass coupler autosyn system to the radio magnetic course indicator. To convert these impulses to a stabilized heading,

*Airplanes 139531 through 139537 and 139541, 139543 and subsequent



The Polar Path Compass System has THREE Modes of operation. The operating mode is selected by the MODE SELECTOR SWITCH, (D) in the diagram above.

"D.G." MODE

The "D.G." mode of operation uses only an inertial reference (directional gyro) to supply directional information. Hence, this mode of operation is used primarily in the polar areas, where magnetic information is unreliable but where an inertial reference is compatible with navigation based on a "grid heading", or equivalent.

1) Allow one minute's time after power is turned on for the system to become operable.

2) Turn the controller selector switch (D) to the "D.G." position.

3) Push in and turn the "Course Set" knob (E) so as to slew the heading indication to the correct or selected heading. Turning the knob clockwise (to "L") gives a decreasing repeater (ID-250) reading; and turning it counterclockwise (to "R") (ID-250) gives an increasing indicator reading.

   The speed of the course setting is proportional to the amount that the knob is turned.

4) Turn the "Latitude" knob (A) to the local latitude.

5) No further adjustments are required for flight preparation except that it may be necessary to readjust the "Course Set" knob (E) once more because at the initial setting the gyro may not have been running long enough for the gyro to reach operating speed so as to give precise heading information.

6) Correct Latitude Control setting in flight for every five degrees of latitude change.

7) Course setting and operation of the selector switch will not introduce signals into an Autopilot if the Polar Path System is being used in conjunction with an Autopilot.

SLAVED MODE

This mode of operation is used when the magnetic information is reliable. In this mode of operation the directional gyro serves as a short-term directional reference to the magnetic heading, and this information is slowly and continuously corrected for drift by the magnetic heading information from the Flux Gate Transmitter.

1) Allow one minute's time after power is turned on for the system to become operable.

2) Turn the controller selector switch (D) to the "SLAVED" position.

3) If the aircraft is located in a reliable area of the earth's magnetic field, push the synchronizing knob (C) on the controller. This should be done only under level, unaccelerated flight conditions. Release the knob when the heading indicator settles at the magnetic indication. In addition, observe the synchronizing indicator pointer (B). It should be centered, but may oscillate slightly owing to the vibration of the aircraft. It normally takes from one to ten seconds to synchronize the system.

4) If the aircraft is in a location of an unreliable magnetic field such as a carrier deck, and the heading of the aircraft is accurately known, push in and set the "Course Set" knob (E) so as to slew the heading indicator to the correct heading indication.

5) No further adjustments are required for flight preparation.

6) During flight the synchronizing indicator (B) should be monitored. Because of the normal vibration and turbulence in the aircraft, the pointer will oscillate about the center position.

7) When it is necessary to synchronize the compass system during flight, the synchronizing knob (C) is used in a normal manner. Such synchronization should be done only under level unaccelerated flight conditions.

8) Synchronizing, course setting, and operating the selector switch in any manner will not introduce signals into an Auto Pilot if the Polar Path System is being used in conjunction with an Auto Pilot.

"COMP." MODE

The "COMP" mode of operation uses only the Flux Gate Transmitter as the directional reference. This mode of operation should be used only as a "Stand-by" condition or for orientation purposes when magnetic conditions are satisfactory. It is also usually used for the deviation (compensation) procedures.

1) Allow a one minute warm-up time to elapse after power is applied for the system to become operable.

2) Turn the controller selector switch (D) to the "COMP" position. This mode is used for heading indication in an emergency only. The Autopilot will be automatically disengaged from the heading reference and will no longer receive heading information when selector switch is turned to this position.

3) This mode of operation should be used when the "D.G" and "Slaved" modes appear to be functioning improperly. If the directional gyro, or its associated circuitry is not functioning properly, then the "COMP" mode will be capable of furnishing stand-by magnetic heading information. This information will be similar to that obtained from a stand-by compass.

DL/gb
3/11/57

Figure No. 4-10.

the pilot must adjust the COURSE SET—L, R—PUSH-TURN knob until the desired heading is indicated on the radio magnetic course indicator. In order to maintain the desired heading and to correct automatically for apparent drift, due to the high latitude, the known flight latitude must be "cranked in" through use of the latitude (LATITUDE) knob and dial assembly which is calibrated in degrees. The drift correction will then be maintained through the compass coupler and reliable headings will be presented throughout maneuvers where the airplane's pitch and roll angles do not exceed 70 degrees.

Note

To maintain a great circle heading, the latitude knob and dial should be adjusted whenever the latitude has changed more than 5 degrees.

2. The directional gyro and flux gate compass transmitter, switch position SLAVED. In those latitudes where magnetic sensing is reliable and a gyro stabilized magnetic type compass is desired, the SLAVED position may be selected. Through the compass controller, signals from the directional gyro and flux gate transmitters are

monitored and "fed" by the autosyn transmitter to the radio magnetic course indicator. Should the aircraft heading be different than the magnetic heading presentation, as will normally be the case following selection (either on the ground or during flight), the compass controller will synchronize the radio magnetic course indicator to the aircraft's magnetic heading. Synchronization through the compass controller will take place at the normal or "slow slaving" rate (approximately 1/2 degree per minute). To speed up the synchronization rate so that the cycle will be completed in about 20 seconds, the pilot may depress the PUSH-SYNC. knob on the console controller panel and observe the annunciator (synchronizer) indicator. As synchronization is achieved, the annunciator needle will center. At this point, the PUSH-SYNC. knob should be released. An alternate, but somewhat slower, method of synchronization is for the pilot to depress and turn the COURSE SET knob until the annunciator needle is centered. If, after abrupt or radical ground or flight maneuvers, the annunciator needle is observed to be to the right or left of center (out of synchronization), the pilot may depress the PUSH-SYNC. knob until the needle centers. The SLAVED system will then be re-synchronized to the aircraft's magnetic heading. At tilt angles greater than 20 degrees, the flux gate transmitter is subject to error; when this occurs, the directional gyro attempts to align itself with the incorrect magnetic reference. At this time, the annunciator needle will appear to the right or left of center. Corrective action should be taken by the pilot to resynchronize the system to the aircraft's magnetic heading by depressing the PUSH-SYNC. knob until the needle is centered.

Note

During operations with the SLAVED position selected, the latitude knob and dial perform no system function.

3. The flux gate compass alone, switch position COMP. Selection of the compass (COMP) mode of operation provides an *unstabilized* magnetic heading presentation on the radio magnetic course indicator. This heading presentation is that of a basic flux gate compass and is provided as an emergency system for use in those cases where components of the other mode selections have been damaged or have failed.

COURSE SETTING KNOB (COURSE SET—L, R—PUSH-TURN). The course setting knob is provided for manual rotation, left or right, of the heading presentation card on the radio magnetic course indicator. The course set knob is used in conjunction with the mode of operation switch at the D.G. or SLAVED selector positions.

LATITUDE SET KNOB AND DIAL (LATITUDE). The latitude set knob adjusts the latitude indicator dial for introduction of the rate of apparent drift. Corrections for apparent drift are necessary during flights at high latitudes when utilizing the D.G. (directional gyro) selector mode of operation. Drift correction is accomplished in the compass controller unit of the system. The latitude dial is calibrated in degrees of latitude.

SYNCHRONIZING KNOB (PUSH-SYNC.). The synchronizing knob overrides the compass controller's normal or "slow slaving" rate (approximately 1/2 degree per minute) and enables the pilot to quickly (in approximately 20 seconds) synchronize the heading presentation on the radio magnetic course indicator to the airplane's actual magnetic heading. By depressing the synchronizing knob until the annunciator needle is centered, synchronization between the gyro stabilizer magnetic flux gate heading and the radio magnetic course indicator will be achieved. When the synchronizing cycle is completed (the annunciator needle centered), release the synchronizing knob. For flights utilizing the SLAVED mode of operation, synchronization is necessary for correct navigation presentation of the magnetic aircraft heading. Synchronization may be accomplished either on the ground or during flight.

ANNUNCIATOR (SYNCHRONIZING) INDICATOR (L, R.). The annunciator (synchronizing) indicator provides a visual indication as to the degree of "slaved" synchronization between the transmitter signals from the directional gyro and the flux gate compass and the airplane's heading presentation of the radio magnetic course indicator. When the annunciator indicator needle is centered, the aircraft's magnetic heading will appear on the radio magnetic course indicator. With the annunciator needle indicating to the right or left of center, the aircraft heading presentation is false if the SLAVED mode of operation is being utilized. By depressing the synchronizing knob (PUSH-SYNC.) or by operating the course setting knob (COURSE SET—L, R—PUSH-TURN) until the annunciator needle is centered, the pilot may resynchronize the SLAVED mode of selected operation.

NORMAL OPERATION OF POLAR PATH COMPASS SYSTEM.

1. Battery switch to BAT. & GEN.

Note

Allow at least one minute for compass system to warm up.

2. Mode of operation (selector) switch to SLAVED.
3. Depress synchronizing knob (PUSH-SYNC.) and hold.
4. Observe annunciator indicator until needle centers.
5. Release PUSH-SYNC. knob.
6. Observe the radio magnetic course indicator for the magnetic heading of the airplane.

HIGH LATITUDE OPERATION OF POLAR PATH COMPASS SYSTEM.

1. Battery switch to BAT. & GEN.

Note

Allow at least one minute for compass system to warm up.

~~2. Mode of operation (selector) switch to D.G.~~

3. LATITUDE dial set to local latitude.

Note

To maintain a great circle heading, the latitude knob should be adjusted whenever the latitude has changed more than 5 degrees.

4. Set radio magnetic course indicator to true aircraft heading through use of COURSE SET—L, R— PUSH-TURN knob.

COMPASS OPERATION OF POLAR PATH COMPASS SYSTEM.

WARNING

The COMP mode should be used only in those cases where components of other operational modes have been damaged or have failed. The COMP mode is subject to short term errors due to local magnetic fluctuations and aircraft maneuvers when the angle of pitch or bank is greater than 20 degrees.

1. Battery switch to BAT. & GEN.

Note

Allow at least one minute for compass system to warm up.

2. Mode of operation (selector) switch to COMP.
3. Observe the radio magnetic course indicator dial as it rotates to the magnetic heading of the airplane. (~~An unstabilized magnetic flux gate heading will be presented.~~)

MISCELLANEOUS EQUIPMENT.

TARGET TOWING PROVISIONS.

Provisions for towing and releasing aerial gunnery targets are incorporated in the design of the airplane. A towing bracket, which must be manually latched by ground handling personnel after the tow ring has been inserted, is mounted aft of the arresting hook. The target and towing cable may be released from the cockpit by lowering the arresting hook. For ground handling, the towing bracket may also be manually released at the bracket. There are no provisions for in-flight launching of tow targets.

WARNING

Make no attempt to jettison towing gear over an area where injury to personnel could result.

AIR REFUELING TANKER PROVISIONS—BUDDY TANKER—AIRPLANES 139531 AND SUBSEQUENT.

WARNING

Prior to installing buddy tanks on FJ-4B aircraft, the buddy tank control panel must be installed in the cockpit. Installation of the tanker control panel will prevent the possibility of a detrimental feedback into the buddy tanker electrical system if power is applied to the airplane.

The air refueling tanker provision (buddy tanker) has been designed to provide in-flight refueling from one aircraft to another of similar type. The installation consists basically of two underwing mounted fuel tanks, the left tank carrying approximately 344 gallons of fuel and the right tank carrying about 224 gallons of fuel plus a hose reel and collapsible drogue unit. The tanker aircraft's internal fuel system has been designed to provide fuel transfer to and from the buddy tanks. A forced ejection system, through mechanical and electrical connections, enables the tanker pilot to jettison the buddy tanks. A guillotine is incorporated into the system to sever the refueling hose at the reel. At the pilot's discretion, fuel may be jettisoned from the buddy tanks. Cockpit control of the entire in-flight refueling system is maintained by the tanker pilot from the tanker control panel. (Refer to AIR REFUELING TANKER PROVISIONS, in Section VII.)

ANTI-G SUIT PROVISIONS.

The anti-G suit pressure is provided by the anti-ice and defrost air, downstream from the engine compressor. A receptacle for the suit (3, figure 1-6) is located on the left side of the seat. Air pressure is supplied to a valve (4, figure 1-6) which meters air pressure to the pilot's anti-G suit when an acceleration of approximately 1.75 G is applied to the aircraft. A HI and LO control allows for adjustment of the rate of inflation of the anti-G suit. In the LO range, the valve opens at 1.75 G and allows 1.0 psi of air pressure to pass to the suit for every increase of 1.0 G force thereafter. In the HI range, the valve also opens at 1.75 G but delivers 1.5 psi per G force thereafter.

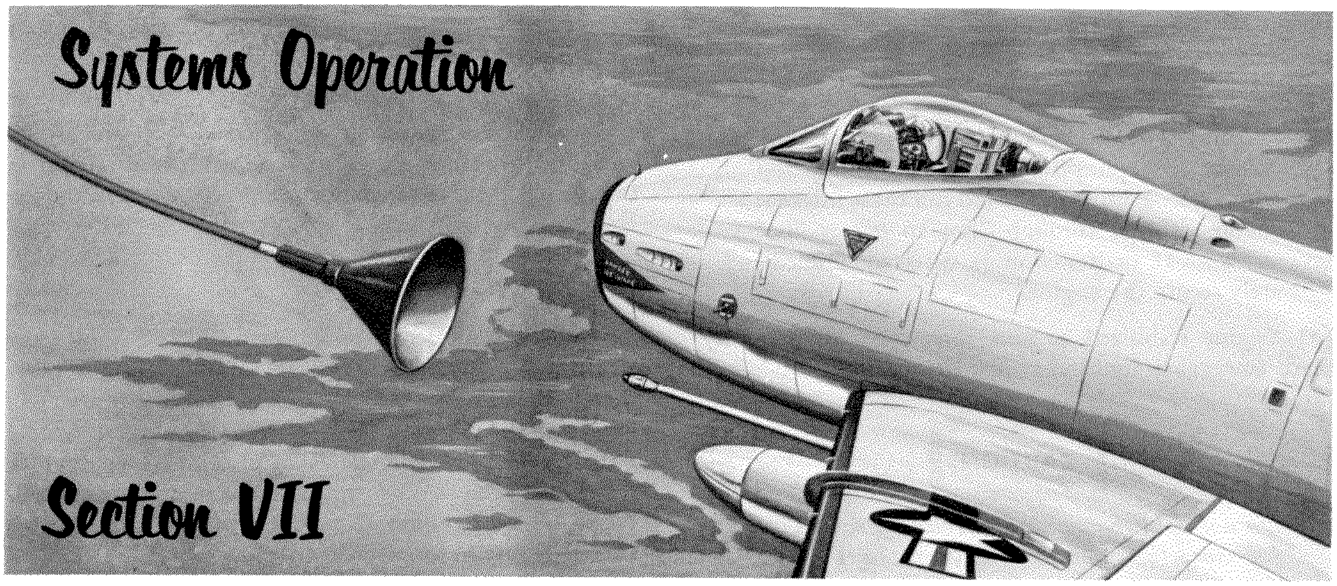
A button is provided on top of the anti-G valve for manually inflating the anti-blackout suit on the ground with engine running, or in straight and level flight. *Prior to each flight*, WITH ENGINE RUNNING AND ANTI-BLACKOUT SUIT CONNECTED, depress this button several times to check the operation of the anti-blackout system. If the valve has any tendency to stick or fails to return to the closed position, it should be replaced. On long flights, this feature makes it possible for the pilot to occasionally inflate the suit for body massage to lessen fatigue.

UTILITY RECEPTACLE.

A 28-volt d-c power utility receptacle (22, figure 1-7, sheet 2) is provided on the forward portion of the right console.

REARVIEW MIRRORS.

Two rearview mirrors are mounted on the canopy bow, one on each side and forward of the pilot. Mounting two mirrors does not obstruct forward vision and adds increased rear vision.



ENGINE.

ENGINE ACCELERATION.

Accelerations can be made at all altitudes. However, at altitudes above 35,000 feet, engine speed may have to be reduced to prevent exhaust temperatures from exceeding maximum limits. Maximum engine speed is limited by the action of the fuel control unit. Engine idle speed at sea level is approximately 42 to 48% rpm, increasing to approximately 82% rpm at 50,000 feet.

FUEL CONTROL UNIT CHARACTERISTICS.

The fuel control unit provides automatic control of all fuel requirements when the emergency fuel control switch is in the PRIMARY position. However, during a locked throttle climb, engine rpm may have to be reduced at altitudes above 35,000 feet to prevent exhaust gas temperature from exceeding maximum limits.

The fuel control system can be switched from PRIMARY to MANUAL in order to investigate a suspected primary fuel control malfunction. However, with the engine under MANUAL fuel control, it is possible to obtain 100% rpm with less than full throttle travel, and EGT is very sensitive to power changes. Fuel control transfer is easier on the engine if done with the throttle in the IDLE position. Should time not permit retarding the throttle, as when flying below 6000 feet, immediate selection of MANUAL is recommended upon flame-out, since the possibility of engine surge increases as rpm decreases. Below approximately 80% rpm, compressor stall may be encountered unless the throttle is retarded. The incorporation of J65 Engine Bulletin No. 240 provides the fuel control unit with an automatic safeguard against complete loss of power in the event of throttle linkage failure. Should such a failure occur, a throttle positioning bungee sets the fuel control throttle lever at approximately maximum cruise power setting (from 79 to 89% rpm), thus providing the capability of return to base. However, caution against the use of MANUAL fuel control must be observed, since overtemperature and overspeed is likely because of the constant throttle setting. For this reason, it is important, upon noting a power loss, that a check for throttle linkage failure be made before switching to the manual fuel control system. (Refer to THROTTLE LINKAGE FAILURE, in Section III.)

MANUAL FUEL CONTROL CHECK.

A complete check of the manual fuel control system should be made after the replacement of the engine or a fuel control unit and after each periodic maintenance inspection. Refer to MANUAL FUEL CONTROL SYSTEM, in Section II.

PRIMER SOLENOID CHECK.

After periodic inspection or engine change, check starter primer solenoid operations as follows:

WARNING

Perform ground check of starter primer solenoid at IDLE rpm prior to taxiing. Malfunction of the starter primer solenoid can cause internal engine damage through "hot spots" or "hot streaks." If malfunction is detected, immediately secure the engine.

(a) Engine stabilized at IDLE rpm. (b) Momentarily place emergency ignition switch ON.

CAUTION

Do not hold the emergency ignition switch ON *for more than one second* since longer operation can damage the primers and igniters.

(c) Observe the fuel flow indicator for a decrease of approximately 100 pounds.

CAUTION

If fuel flow indicator does not decrease, secure engine for investigation of malfunction.

COMPRESSOR PRESSURE LIMITER CHARACTERISTICS.

A compressor discharge pressure limiter in the fuel control system automatically reduces the fuel flow to the engine whenever the compressor discharge pressure exceeds its limits. This fuel flow reduction will cause a gradual reduction in rpm until the compressor discharge pressure returns to its limits. The fuel flow and rpm reduction will occur on cold days at high speed, low altitude conditions and should be recognized by the pilot to prevent unnecessary concern on his part regarding proper functioning of the fuel control.

COMPRESSOR STALL.

Compressor stall is a breakdown of the airflow through the compressor. Rapid throttle advancing injects more fuel into the combustion chamber than can be utilized at the existing rpm. Burning this surplus fuel will result in an increase in combustion pressures and a corresponding increase in pressure against the compressor discharge air, causing the airflow breakdown. The stall reduces the mass airflow through the compressor and the turbine, thus decreasing the energy available to the turbine wheel. Continued operation in a stalled condition increases the temperature of the burning fuel and results in turbine damage and engine failure. Compressor stall may be recognized in flight by one or more of the following characteristics:

1. Loss of thrust and acceleration.
2. Rapid rise in tail-pipe temperature.
3. Pulsating, roaring noise accompanied by heavy vibration.
4. Long flame from tail pipe.

When such conditions are encountered, immediately retard the throttle until the exhaust temperature returns to normal; then, advance throttle more slowly to the desired rpm.

ACCELERATION AND DECELERATION FLAME-OUTS.

Acceleration and deceleration flame-outs can result from a malfunctioning fuel control unit and/or an improperly rigged throttle. Rapid movement of the throttle will not cause flame-outs if the fuel control unit is operating properly and the throttle is correctly rigged. A malfunction of the fuel control unit can cause either acceleration or deceleration flame-outs; while an improperly rigged throttle, by allowing the cut-off valve to close when the throttle is retarded to the IDLE position, can cause deceleration flame-outs. An acceleration which causes a rich blowout floods the combustion chamber with such a rich mixture that the surplus fuel cannot burn. A deceleration that will cause a lean die-out is the result of insufficient fuel being supplied to the engine to support combustion. Both types of flame-out are indicated by loss of thrust and a drop in exhaust gas temperature. To relight the engine, place the throttle in the IDLE position. If the exhaust gas temperature continues to decrease, a flame-out has occurred and an air start is necessary; if no flame-out has occurred, advance the throttle slowly.

ENGINE NOISE AND ROUGHNESS.

Engine roughness may occur when operating at high power settings. This trouble usually can be eliminated by changing the throttle setting or altitude. If the roughness continues at all throttle settings and altitudes, it may indicate some mechanical failure and an immediate landing should be made.

EXHAUST TEMPERATURE VARIATION.

Exhaust temperatures of jet engines with fixed-area exhaust nozzles are affected by outside air temperature, altitude and airspeed. These three factors can change singly or simultaneously, thus causing inconsistent exhaust temperatures for any given rpm. The exhaust nozzle area is adjustable on the ground by placement of tail-pipe segments to ensure proper exhaust temperatures. During flight, no action can be taken by the pilot if the exhaust temperatures are below the limits. It should be remembered that thrust decreases with reduction in exhaust temperatures.

Note

In a constant climb, exhaust temperatures may exceed the maximum limit above 40,000 feet. Therefore, while climbing above this altitude, exhaust temperatures should be watched closely and monitored accordingly with the throttle.

TURBINE NOISE DURING SHUTDOWN.

The light scraping or squealing noise sometimes heard during engine shutdown results from interference between the turbine buckets and turbine shroud. Contact of the two parts is due to the tendency of the shroud to shift and distort under varying temperature conditions as induced by engine shutdown. The scraping is undesirable and may damage either part. To minimize the scraping, it is necessary to idle the engine for approximately one minute before shutdown after any high-power operation (either ground or flight). If, despite this precaution, heavy scraping does occur on shutdown, no attempt to restart the engine should be made until the turbine temperature has dropped sufficiently to provide adequate clearance between the buckets and shroud and the turbine wheel clearance has been checked, since a start attempt might result in destruction of the starter. If a start must be made when interference is suspected, an audible check should be made when the engine begins to turn as the starter is engaged, or tachometer indication should be noticed. If the engine does not begin turning at starter engagement, the start-stop switch must be moved to STOP immediately.

SMOKE FROM TURBINE DURING SHUTDOWN.

During engine shutdown, fuel may accumulate in the combustion chamber where heat from the chamber causes the fuel to boil. (Although a combustion chamber drain is provided, it may not prevent an accumulation of some fuel.) Presence of this residual fuel in the engine will be indicated by emission of fuel vapor or smoke from the tail pipe or inlet duct, depending on ground wind conditions. Boiling fuel, indicated by the appearance of white fuel vapor, is not injurious to the engine but does create a hazard to personnel since the vapor may ignite with explosive violence if allowed to accumulate in the engine or fuselage. Therefore, all personnel should keep clear of the tail pipe for at least 3 minutes after shutdown and at all times when fuel vapor or smoke issues from the tail pipe. The appearance of black smoke from the tail pipe, after shutdown, indicates burning fuel which will damage the engine and should be cleared. (Refer to SMOKE FROM TURBINE DURING SHUTDOWN, Section III.)

ENGINE TAIL-PIPE SEGMENTS.

On turbojet engines equipped with fixed-area exhaust outlets, the exhaust temperature is a direct indication of thrust output, or power, at a given rpm. As the exhaust temperature is increased, the velocity of the exhaust jet is increased and, consequently, engine thrust is increased. It is apparent that although exhaust temperature should be kept below the maximum operating limit to prevent excessive engine wear, it must be held near the limit to obtain maximum thrust output. In order to obtain maximum operating exhaust temperature, tail-pipe segments are added to, or removed from, the aft end of the tail pipe. (See figure 7-1.) These segments correctly adjust the exhaust outlet area to produce as nearly as possible the desired stabilized exhaust temperature at 100% rpm during ground run-up. Fixed area outlets can be adjusted for only one set of operating conditions; thus, for a majority of operating conditions, the exhaust outlet will usually be too large or too small resulting in low or high exhaust temperatures, respectively. When tail-pipe segments are added, increased thrust will be evidenced on an engine previously operating with low exhaust temperatures. The initial segments are installed at the bottom of the tail pipe. As additional segments are needed, they are installed as symmetrically as possible on each side of the tail pipe, starting at the bottom. Initial segment installation beginning at the top of the tail pipe is not recommended as it will reduce the down-tail load. Down-tail loading aids nose wheel lift-off and is a reaction of the force of the jet stream against the tabs. If these tabs are located at the top of the tail pipe, the normal down-tail load is reduced. When this occurs, nose wheel lift-off speed will be increased. If the tabs are located asymmetrically, a yawing tendency will be introduced on the take-off roll and the yawing sensation may be mistaken for that of a dragging brake.

Note

If too many segments are installed, the EGT gage may not give a true temperature indication. Refer to FJ-4 and FJ-4B Maintenance Handbooks (NAVAER 01-60JKD-502 and NAVAER 01-60JKE-502) for proper placing and number of segments.

FUEL SYSTEM OPERATION.

The operation of the fuel system is automatic and requires no tank selection on the part of the pilot, in so far as internal fuel tanks are concerned. If drop tanks are installed, turn the fuel transfer switch to TRANSFER immediately after take-off. Due to the aft CG location of the 150-gallon outboard drop tanks on some airplanes,* it is recommended that a landing be made as soon as possible or the outboard drop tanks be jettisoned if it is evident that outboard drop tank fuel will not transfer. This action will preclude an aft CG flight control problem. If the drop tanks are not installed, the drop tank fuel transfer switch should be left in the OFF position. A manual fuel sequencing switch is provided in case the automatic sequencing system fails. The emergency fuel transfer switch provides manual selection of fuel transfer to the forward tank from either the wing

***Airplanes 139531 and subsequent**

or aft fuel tanks. (Refer to FUEL SYSTEM FAILURE, Section III.) When the manual selection option is being exercised, automatic sequencing for the related tanks becomes inoperative.

Note

For a mission that requires in-flight refueling, it is recommended that the fuel in the inboard (200-gallon) drop tank be retained until after in-flight refueling has been completed. This will provide better CG travel characteristics during the in-flight refueling operation and will also minimize the refueling time since the filling rates to the outboard drop tanks and internal fuel tanks are much greater than those to the inboard drop tank.

IN-FLIGHT REFUELING SYSTEM OPERATION.

An in-flight refueling system is provided on some airplanes* to extend the combat radius and the combat air patrol mission time between landings. A tubular boom, carrying a probe nozzle, is mounted on the left wing. Through this probe nozzle, fuel is received from the tanker and introduced into the airplane's single-point refueling system. All fuel tanks can be refilled during flight. An in-flight refueling operation can be carried out as follows:

Note

Until a larger oil tank is supplied for all the engines, mission time is restricted to 5 hours. On some airplanes,† a 4-gallon capacity oil tank is installed which increases mission time to at least 7 hours.

1. Approach the tanker aircraft from the rear and slightly below the refueling drogue to avoid the slip

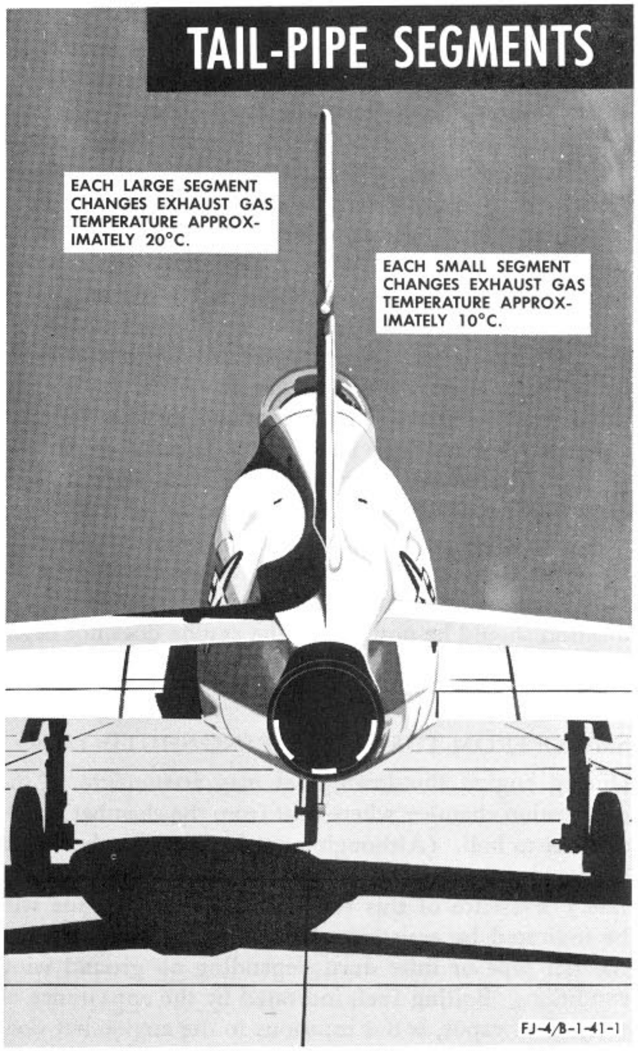


Figure No. 7-1.

*Airplanes 139303 and subsequent
†Airplanes 139471 and subsequent

stream of the tanker. Line up and stabilize at about 15 feet behind the extended drogue.

2. Before engaging refueling drogue, turn off the following items to reduce fire hazards: AN/APG-30A radar system, AN/APX-6B identification system, AN/ARN-14E omni-range receiver, AN/ARA-25 automatic direction finder and external lights.

3. Increase power about 4 percent and maintain an even rate of closure (5 to 8 knots). It is recommended that closure be made with the drogue slightly above the probe. Lower the right wing just before contact to bring the probe into position to meet the drogue cone. If the engagement is missed, roll out of the wing-down attitude and retard the throttle for another attempt.

Note

Rapid rate of closure will move drogue forward too fast for proper reel-in, thus causing slack in the hose and resulting in a violent whipping action which could cause structural damage to the probe or drogue.

4. Reduce speed to that of the tanker (approximately 190 knots IAS) and fly in formation during the refueling operation.

Note

On certain tankers, when the drogue has extended the proper distance for refueling, an amber light, located on the left side of the hose receptacle on the tanker, will illuminate. After contact is made, the drogue must be reeled in approximately 10 feet which automatically turns on the fuel transfer pumps in the tanker. This is indicated by a green light located on the right side of the hose receptacle. When the green light illuminates, the amber light will go out. The sequence of these indicator lights is reversed when dropping back to break contact.

5. The pilot notes progress being made during the refueling process by observing the fuel quantity gage. The refueling rate is approximately 170 to 200 gallons per minute.

If four drop tanks are being carried and the mission requires in-flight refueling, it is recommended that, if possible, the inboard (200-gallon) drop tank fuel be retained until after refueling is completed. This will minimize the in-flight refueling time since the filling rates to the outboard (150-gallon) drop tanks and the internal fuel tanks are much greater than the rates to the inboard drop tanks.

CAUTION

The drop tank fuel selector switch should be in the OFF position during in-flight refueling to provide proper drop tank venting.

Note

On certain tankers, automatic shutoff of the valves in the tanker airplane can be detected by an oscillation of the hose, caused by a decrease in fuel pressure at the instant shutoff occurs. Shutoff can also be detected by no further increase on the fuel quantity gage. Prearranged signals between tanker operator and pilot of the receiver airplane should be used to provide a more positive indication.

6. When tanks are full, pilot reduces speed slightly (approximately 1 percent) to disengage probe from reception coupling.

CAUTION

High rates of separation, when breaking contact, should be avoided to preclude sudden loads on the tanker hose braking system.

7. Turn on items which were turned off in step 2.

BUDDY TANKER SYSTEM—AIRPLANES 139531 AND SUBSEQUENT.

The following information is applicable at such time as the buddy tanker system is released for fleet utilization.

WARNING

Prior to installing buddy tanks on FJ-4B airplanes, the buddy tank control panel must be installed in the cockpit. Installation of the tanker control panel will prevent the possibility of a detrimental feedback into the buddy tanker electrical system if power is applied to the airplane.

The air refueling tanker provision is designed to provide in-flight refueling from one aircraft to another aircraft of a similar type. The installation consists basically of two underwing mounted fuel tanks, the left tank carrying approximately 344 gallons of fuel and the right tank carrying about 224 gallons, plus a hose reel and collapsible drogue unit. The hose reel accommodates approximately 50 feet of hose. The tanker airplane's internal fuel system has been designed to provide fuel transfer to and from the buddy tanks. During fuel transfer from the tanker's internal fuel system to the buddy tanks, a float-type switch, located in the sump tank, is set for a low-level limit of 950 pounds to prevent the transfer of an excessive quantity of internal fuel. Manifold air pressurization of the buddy tanks, controlled by the inboard (INB'D) position of the drop tank fuel transfer switch, located on the left console, permits buddy tank fuel to flow to the tanker's internal fuel system. A forced ejection system, through mechanical and electrical connections, enables the tanker pilot to jettison the buddy tanks. Should the need arise, a guillotine is incorporated to sever the refueling hose at the reel or fuel from the buddy tanks may be jettisoned. Cockpit control of the entire in-flight refueling operation is maintained from the tanker control panel.

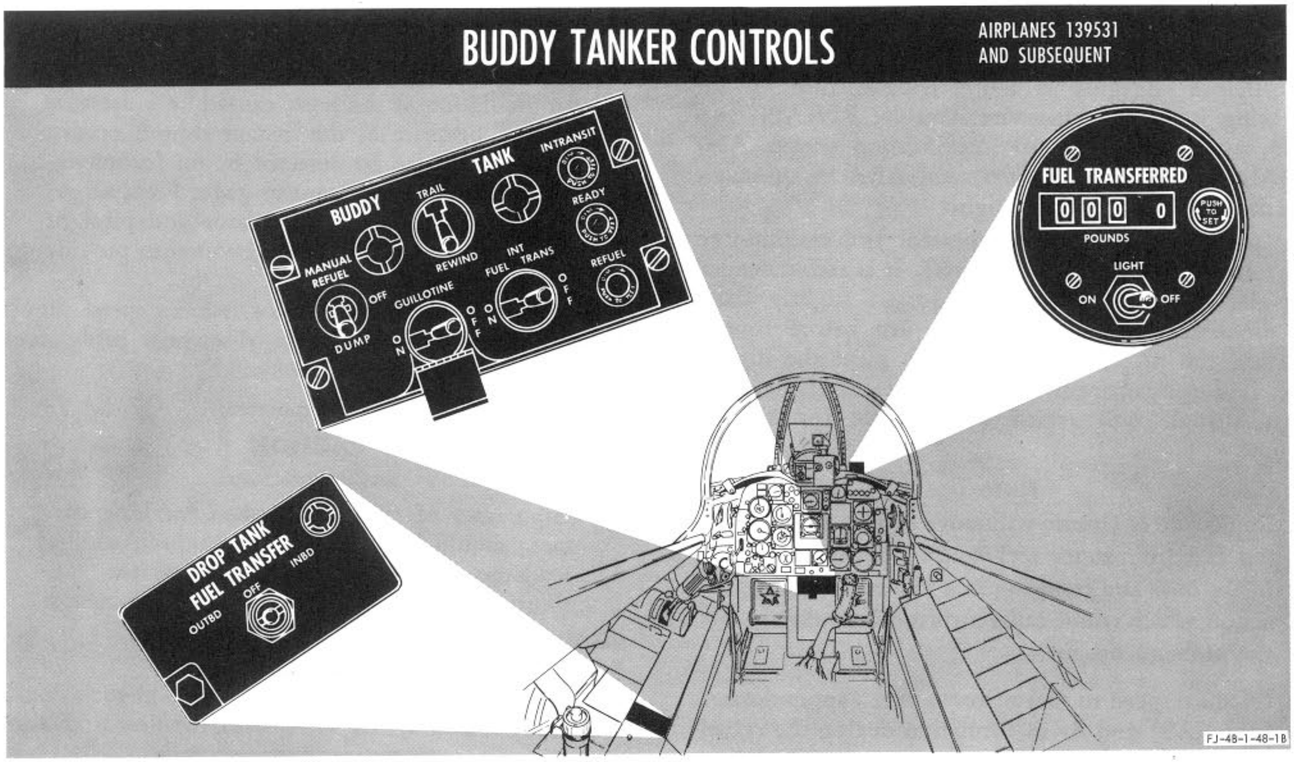


Figure No. 7-2.

TANKER CONTROL PANEL.

The tanker control panel [figure 7-2 and figure 4-1, sheet 3, of the Supplemental Flight Handbook (NAVAER 01-60JKD-501A)] includes a trail—rewind switch (TRAIL—REWIND), an internal fuel transfer switch (ON—OFF), a guillotine switch (ON—OFF), a manual refuel—dump switch (MANUAL REFUEL—OFF—DUMP) and three indicator lights (IN TRANSIT, READY and REFUEL). In addition to the tanker control panel, a fuel quantity transfer meter, located within the proximity of the instrument panel, and the drop tank fuel transfer switch, located on the left console, are components of the buddy tanker system.

TRAIL—REWIND SWITCH. The trail—rewind switch (TRAIL—REWIND), a guarded two-position toggle switch, is the main control switch for the buddy tanker system. Actuating the switch to the TRAIL position releases the drogue and hose and automatically sequences the in-flight refueling system for preparation of fuel transfer to the receiver aircraft. Upon completion of the refueling operations, actuation of the switch to REWIND automatically secures the complete system.

Note

During normal flight operations, when the system is not in use, the trail—rewind switch should be maintained in the REWIND position.

INTERNAL FUEL TRANSFER SWITCH. The internal fuel transfer switch (ON—OFF), a guarded two-position toggle switch, permits the tanker pilot to transfer internal fuel to the buddy tanks by actuating the switch to ON. Movement of the switch to OFF secures internal fuel transfer.

Note

- *With the gear down, internal fuel will not transfer to the buddy tanks* since the forward boost pump in the sump tank, which transfers the fuel, is inoperative.
- When transferring internal fuel to the buddy tanks, the aircraft should be flown in level flight under one G conditions. This is necessary since the sump tank forward boost pump is used to transfer fuel to the buddy tanks. Should the sump tank aft boost pump become uncovered due to attitude or G forces during fuel transfer, an engine flame-out will occur after fuel in the engine feed line is depleted.

GUILLOTINE SWITCH. The guillotine switch, a two-position (ON—OFF) guarded toggle switch, is used to sever the refueling hose at the reel in the event of an in-flight hose-reel rewind malfunction. Positioning the switch to ON severs the refueling hose. The OFF position de-energizes the guillotine circuit. Following use of the guillotine, the guillotine switch automatically secures the buddy tanker system and should, therefore, remain in the ON position throughout the balance of the flight. The guillotine switch will not energize the guillotine when the trail—rewind switch is positioned to TRAIL. During ground handling operations, a ground safety pin is provided for insertion into a receptacle on the drogue tank to ensure positive grounding of the guillotine circuit. With the guillotine circuit grounded (ground safety pin inserted), the guillotine is inoperative. Prior to flight, the ground safety pin must be removed.

WARNING

With the ground safety pin removed, the trail—rewind switch at REWIND and the primary bus energized, the guillotine circuit is operational.

MANUAL REFUEL—DUMP SWITCH. The manual refuel—dump switch, a guarded, three-position switch (MANUAL REFUEL—OFF—DUMP), is used for manual refueling or jettisoning buddy tanker fuel from each underwing tank. When the switch is positioned to DUMP, the dump valves open and fuel is jettisoned from each tank at approximately 200 gallons per minute by the combined action of pressurized air and the hydraulic operated fuel pump in each tank. By positioning the switch to MANUAL REFUEL, the motor-operated refueling shutoff valve opens, the refueling lights illuminate, the hydraulic operated refueling pump starts and fuel will flow to the receiver aircraft.

Note

- The MANUAL REFUEL switch position is powered through the TRAIL position of the trail—rewind switch and is an emergency fuel transfer feature to be used in the event of normal sequence failure.
- If a hydraulic system failure is experienced within the buddy tanker system, actuation of the MANUAL REFUEL switch position will permit gravity fuel flow to the receiver aircraft.

Positioning the switch to OFF secures either the dumping operation or manual refueling.

INDICATOR LIGHTS. Three push-to-test indicator lights (IN TRANSIT, READY and REFUEL), located on the tanker control panel, provide visual indications to the tanker pilot during in-flight refueling operations. Each indicator light is controlled by the system's automatic sequencing, dependent upon the sequence stage. All indicator lights incorporate a manual dimming feature.

IN TRANSIT LIGHT. When the hose reel is operating, unwinding or rewinding the hose and drogue, the red IN TRANSIT indicator light will be illuminated. The light will go out when hose reel action is completed.

READY LIGHT. With the in-flight refueling system automatically sequenced and the hose fully extended, an amber READY indicator light on the tanker control panel and on the drogue tank will be illuminated. The READY lights will go out when the receiver aircraft has engaged and moved the hose forward six feet.

REFUEL LIGHT. When the READY light goes out, a green REFUEL light, mounted on the aft end of the right buddy tank, illuminates, indicating that fuel transfer will begin in approximately six seconds. The refuel lights are also illuminated or extinguished through actuation to or from the MANUAL REFUEL switch position.

FUEL QUANTITY TRANSFER METER.

The fuel quantity transfer meter, located on the right side of the instrument panel shroud (figure 7-2), is a component of the buddy tanker system and is a volumetric sensing device, calibrated in pounds of fuel. The meter indicates the pounds of fuel delivered to the receiver aircraft. Through use of a reset knob on the meter, the tanker pilot may, at his discretion, manually reset the meter to zero. Although there is no provision for indicating the total fuel quantity in the tanker package, the tanker pilot may obtain a close approximation of his remaining tanker fuel by subtracting the sum of the total fuel quantity transferred from the known tank capacity (provided tanks were full at take-off). Integral lighting controlled by a two-position ON—OFF toggle switch (LIGHT), located on the face of the fuel quantity transfer meter, is provided. Electrical lighting power is routed through the stand-by compass and range indicator lights control switch (4, figure 4-5) with dimming provisions provided by the instrument lights rheostat (1, figure 4-5). In this way, independent lighting and light intensity control is provided for the fuel quantity transfer meter.

CAUTION

When fuel is transferred from the buddy tanks to the tanker's internal fuel system, *the fuel quantity transfer meter will not register.* Only the pounds of fuel delivered through the hose and drogue will be indicated on the fuel quantity transfer meter.

HOSE FLOODLIGHT. The hose floodlight, located under the aft end of the drogue tank, provides illumination of the hose at the tunnel entrance so that the receiver pilot can determine hose take-up. It is powered from the exterior lights master switch and is relay-controlled by the position of the trail—rewind switch. During night refueling operations, when the exterior lights are illuminated, the hose floodlight is turned on by positioning the trail—rewind switch to TRAIL and is extinguished by positioning the switch to REWIND. There is no dimming or flashing provision provided, and the floodlight is extinguished at all times when the exterior lights master switch is OFF, regardless of the position of the trail—rewind switch.

DROP TANK FUEL TRANSFER SWITCH.

The drop tank fuel transfer switch (27, figure 1-6, sheet 3) is a guarded, three-position toggle switch which controls air pressurization to the auxiliary drop tanks and to the buddy tanks for fuel transfer to the tanker's internal fuel system. (Refer to DROP TANK TRANSFER SWITCH, Section I.)

REFUELING SEQUENCE FOR BUDDY TANKER AND RECEIVER AIRPLANE.

From the tanker control panel, the tanker pilot controls the in-flight refueling system. Through automatic sequencing, the system responds to his controls, presents operating indications on the tanker control panel and presents operating indications to the pilot of the receiver airplane. The trail—rewind switch is, in effect, the heart of the in-flight refueling system and, during normal operations, the sequence of the system is as follows:

1. Activation of the trail—rewind switch to the TRAIL position unlocks the drogue, starts the hose reel to unwind, electrically unfeathers the air turbine blades in the nose of each tank and illuminates the in transit control panel light. If night refueling operations are being conducted, the hose floodlight illuminates. With the air turbine blades unfeathered, the hydraulic operated fuel pump in the left tank is turned on and directs fuel flow to the drogue (right) tank. The fuel level control valve in the tanker airplane's internal fuel system automatically closes to prevent buddy tank fuel from entering the tanker airplane's internal fuel system.

2. The air-driven hydraulic pump in the drogue (right) tank effects hydraulic braking action to retard the hose and drogue extension speed as it reaches the full trail position (approximately 50 feet). The ready light on the drogue pylon illuminates, the in transit control panel light goes out and the ready control panel light illuminates. The in-flight refueling system is now prepared for "hookup" by the receiver airplane.

Note

As the air turbine blades unfeather, the tanker pilot will notice a slight decrease in airspeed due to increased drag which is created by the rotation of the turbine blades. The left buddy tank turbine blades feather and unfeather as the fuel level control valve in the system actuates. Fuel slosh in the tanks may cause this to occur without the receiver airplane engaged.

3. In making contact with the tanker, the receiver airplane pilot establishes radio contact with the tanker pilot, flies in formation with the tanker, observes that the ready drogue tank light is illuminated and engages the receiver airplane's in-flight refueling boom nozzle with the refueling drogue. Following contact, the pilot of the receiver airplane pushes the drogue and hose ahead slowly until the ready light on the drogue tank pylon goes out and the refuel light is illuminated. After a six-second time delay, fuel from the tanker airplane's in-flight refueling system will commence to flow to the receiver and will continue to flow as long as the refuel light is illuminated, or until the system fuel is depleted, contact is broken, or until the tanker pilot closes the motor-operated refueling shutoff valve by actuating the trail—rewind switch to REWIND.

4. As the pilot of the receiver airplane pushes the drogue and hose ahead approximately 6 feet, the hose rewind action illuminates the drogue tank refuel light, turns out the ready light, illuminates the control panel refuel light, turns out the ready light and routes electrical power to the thermal time delay switch. Following a six-second delay, the thermal time delay switch opens the motor-operated refueling shutoff valve, directs the hydraulic fluid to turn on the hydraulic operated refueling pump and starts fuel flow from the drogue tank of the tanker airplane.

Note

If hose rewind action is insufficient to actuate the normal system sequence, or if a system malfunction is experienced during in-flight refueling, the tanker pilot may select the MANUAL REFUEL switch position to permit fuel flow to the receiver airplane. Fuel flow will be maintained through this system selection until the switch is positioned to OFF or the receiver airplane breaks contact.

5. While in-flight refueling is progressing, the tanker pilot observes the fuel quantity transfer meter and reports fuel transfer information to the receiver pilot. Should the tanker pilot desire to augment the buddy tanks' fuel quantity and thereby transfer internal fuel from the tanker airplane through the buddy tanks to the receiver airplane, actuation of the internal fuel transfer switch to ON will allow the forward boost pump in the sump tank to transfer fuel to the drogue (right) tank. Upon completion, internal fuel transfer will be secured by positioning the internal fuel transfer switch to OFF.

Note

If the sump level reaches 950 pounds, internal fuel transfer will automatically be discontinued through the action of a low-level control switch incorporated in the sump tank, if the drop tanks are not being refueled.

During periods of radio silence, the receiver airplane's pilot, by observing his fuel quantity gage (fuel gage reads switch to TOTAL), will be provided with a close approximation of the total fuel taken aboard.

6. Upon completion of in-flight refueling, the tanker pilot should inform the receiver pilot by radio so that refueling contact can be broken. The receiver airplane pilot must take immediate action to smoothly break contact, avoiding a high rate separation that will cause sudden loads to injure the tanker's hose and reel. As contact is broken and fuel flow ceases, an automatic sequence

takes place. The drogue moves to the TRAIL position, the refuel drogue tank light goes out, the ready drogue tank light illuminates, the refueling pump turns off, the motor-operated refueling valve closes, the REFUEL control panel light goes out and the READY control panel light illuminates.

7. Upon completion of all refueling operations, the tanker pilot secures the buddy tanker system by positioning the control panel trail—rewind switch to REWIND. The system's automatic sequencing (the reverse of the TRAIL sequence) takes over to shut down and secure the system. The left tank turbine blades electrically feather. The tanker's internal fuel system's fuel level control valve opens. Hydraulic pressure from the turbine-driven hydraulic pump in the drogue (right) tank starts hose reel rewind action. This rewind action automatically illuminates the IN TRANSIT control panel light, turns off the READY control panel light and turns out the ready drogue tank light. When the hose is rewound and the drogue is engaged in its stowed and locked position, the drogue (right) tank air turbine blades electrically feather and the IN TRANSIT control panel light goes out. If night refueling operations are being conducted, the hose floodlight goes out. The in-flight refueling system is now completely secured.

Note

During the rewind phase, the tanker pilot will notice that the air turbine blades of the left tank will feather first. This is the normal sequence. The left tank turbine powers only its hydraulically operated fuel pump, while the drogue (right) tank turbine powers not only the hydraulic operated fuel pump but also the action of the hose reel.

PREFLIGHT INSPECTION OF BUDDY TANKS.

Prior to flight, the buddy tanks should be visually inspected to ensure proper in-flight operation as follows:

1. Inspect tanks for damage or leakage.
2. Check both tanks for proper connection of fuel, air and electrical fittings.
3. Check both tank reservoir air storage bottles for proper charge, 1900 (±25) psi.
4. Check reel accumulator for proper charge, 1250 (±25) psi.
5. Inspect drogue and drogue tunnel area.
6. Check guillotine for explosive charge and electrical connection.
7. Ensure installation of cartridges in both ejector racks.
8. Visually check both tanks for fuel quantity.
9. Check all access plates on the tanks and associated pylons for security.
10. Inspect turbine blades and guard ring.
11. Remove ground safety pin from drogue tank guillotine grounding circuit.
12. Remove ground safety pins from tank support pylons.

NORMAL OPERATION FOR IN-FLIGHT REFUELING (TANKER AIRCRAFT).

Recommended airspeed range is 260 to 300 KIAS for normal refueling operations. Maximum altitude for refueling is 36,000 feet. Tanker pilot procedure is as follows:

1. Battery-generator switch to BAT. & GEN.
2. Tanker control panel trail—rewind switch to TRAIL.

Note

The IN TRANSIT indicator light (red) will illuminate as the hose and drogue unreels to the TRAIL position; then, the light will go out.

3. READY indicator light will illuminate (IN TRANSIT light out).

Note

With the READY indicator light (amber) illuminated, the in-flight refueling system is ready to provide fuel to the receiver aircraft.

4. Establish radio contact with receiver aircraft.
5. Following in-flight refueling contact by the receiver aircraft: (a) The REFUEL indicator light (green) will illuminate (READY light out).

Note

- If tanker pilot desires to transfer internal fuel to the receiver aircraft, place internal fuel transfer switch to ON position. When transfer is completed, return to OFF position.
- Internal (sump) fuel will not transfer below 950 pounds.

CAUTION

When transferring internal fuel to the buddy tanks, the aircraft should be flown in level flight under one G conditions. This is necessary since the sump tank forward boost pump is used to transfer fuel to the buddy tanks. Should the sump tank aft boost pump become uncovered due to attitude or G forces during fuel transfer, an engine flame-out will occur after fuel in the engine feed line is depleted.

(b) The tanker pilot should advise the pilot of the receiver aircraft as to the fuel quantity transferred (transferred fuel quantity information available from the fuel quantity transfer meter) so that refueling contact will be "broken off" when the desired quantity is obtained.

Note

The tanker pilot can stop the fuel flow to the receiver aircraft at his discretion by actuating the trail—rewind switch to the REWIND position. This will close the motor-operated refueling shutoff valve in the drogue tank and stop the hydraulic-driven fuel pumps in both buddy tanks. At this point, the reel starts a rewind action. The receiver aircraft will be drawn toward the tanker at a rather high closure rate until breakaway is accomplished.

6. Following breakaway of receiver aircraft, the READY indicator light will illuminate (REFUEL light out).

Note

For in-flight refueling of additional aircraft, repeat steps 4. through 6.

7. Upon completion of refueling operations, proceed as follows: (a) Place trail—rewind switch to REWIND. (b) The IN TRANSIT indicator light (red) will illuminate (READY light out). (c) When the IN TRANSIT indicator light goes out, the system is secured.

NORMAL OPERATION FOR IN-FLIGHT REFUELING (RECEIVER AIRCRAFT).

1. Prepare for in-flight refueling operations. Secure electrical, electronic and radio equipment not required for flight and illuminate the fixed reticle of the Mark 8 Mod 8 sight unit. [Refer to AIRCRAFT FIRE CONTROL SYSTEM CONTROL BOX, in Section IV of the Supplemental Flight Handbook (NAVAER 01-60JKD-501A).]

2. Set variable reflector knob on sight unit to —60 mils (maximum counterclockwise deflection).

3. Place fuel gage reads switch to TOTAL to indicate the approximate quantity of tanker fuel received.

4. Place drop tank fuel transfer switch to OFF to provide proper venting of inboard and outboard drop tanks.

5. Establish radio contact with the tanker.

6. Reduce speed and approach the tanker from the rear to within 20 to 30 feet of the drogue with the gun sight pipper on the tanker reference mark. Observe that the tanker READY light is on (refueling system ready for operation).

Note

The tanker reference mark is located outboard of the wing fold, and the tanker overrun angle reference stripe extends from the center of the fairing of the inboard store station pylon to the wing trailing edge.

7. Maintain the gun sight pipper on the reference mark and close on the tanker until the probe is within 10 to 15 feet behind the drogue.

8. Trim the airplane about all axes. Anticipate a right rudder and right wing down trim requirement.

9. While maintaining lateral alignment on the reference mark, vertically align the probe with the drogue. Note the visual intercept between the tanker reference mark and the vertical mil scale of the gun sight. Receiver contact elevation has now been established.

10. Increase power to obtain a closure rate of 2 to 4 knots, maintaining lateral and vertical alignment on the tanker reference mark with the gun sight.

Note

During probe-drogue closure, maintain the wings level (parallel to the tanker) and, if necessary, skid the airplane slightly to maintain lateral alignment.

11. Maintain the closure rate (2 to 4 knots) until contact is established or the overrun angle is reached.

CAUTION

If the tanker overrun angle reference stripe aligns with the receiver pilot's line of vision, contact has been missed. Reduce power slightly and allow the receiver aircraft to slowly back away from the tanker. MAINTAIN ALIGNMENT, but quickly observe the probe-drogue position to note whether the drogue passed above or below the probe during closure. Realign the receiver aircraft to 10 to 15 feet behind the drogue. In rough air, recalibrate prior to each engagement attempt. In smooth air, correct the vertical alignment 20 mils (equivalent to approximately one foot vertical distance at the drogue) in the proper direction and attempt another engagement. It should be noted that in rough air only an estimate of the proper vertical mil reference can be made due to continuous random movements of the drogue and the receiver airplane.

12. After contact is established, fly the drogue forward until the REFUEL light on the drogue tank illuminates.

Note

- Approximately 6 feet of hose must be rewound to open the motor-operated refueling shutoff valve, turn on the refueling pump, turn out the READY light, illuminate the REFUEL light and commence refueling operations. This sequence is reversed when contact is broken.
- Too high a rate of closure will move the drogue ahead too fast for proper reel-in so that slack in the hose will result in a violent whipping action which can cause structural damage to the probe or drogue.

13. Reduce speed to that of the tanker and fly in formation during the refueling operation.

Note

If both inboard and outboard drop tanks are being carried and the mission requires in-flight refueling, it is recommended that, if possible, the inboard (200-gallon) drop tank fuel be retained until after refueling is completed. This will minimize the in-flight refueling time since the filling rates to the outboard drop tanks and to the internal fuel tanks are greater than those to the inboard drop tank.

14. When advised by the tanker that refueling has been completed, break contact slowly by reducing speed slightly to disengage the probe from the drogue. Maintain alignment on the reference mark with the gun sight while disengaging.

CAUTION

High rates of separation should be avoided, when disengaging, to preclude sudden loads on the tanker hose and reel.

15. Turn on the items which were secured in step 1, set the vertical reflector knob on the sight unit to the zero detent to ensure illumination of the gyro reticle image and, if not required, secure the Mark 8 Mod 8 sight unit.

FUEL TRANSFER FROM BUDDY TANKS TO TANKER'S INTERNAL FUEL SYSTEM.

1. Place fuel gage reads switch to TOTAL.

CAUTION

During fuel transfer from the buddy tanks to the tanker's internal fuel system, the fuel quantity transfer meter will provide *no* indication as to the fuel quantity transferred.

2. Check trail—rewind switch in REWIND position.

Note

The trail—rewind switch must be positioned to REWIND during fuel transfer from the buddy tanks to the tanker's internal fuel system in order that the internal fuel level control valve will remain open to permit fuel flow. With the trail—rewind switch at TRAIL, the internal fuel level control valve is closed.

3. Place drop tank fuel transfer switch on left console to INB'D position.

Note

Manifold air pressurization of the buddy tanks causes fuel to flow into the internal fuel system at the normal drop tank rate.

CAUTION

While internal fuel is being transferred to the buddy tanker package, the aircraft should be flown only in level flight under one G conditions. This is necessary since the forward boost pump is used to transfer the fuel to the drop tanks and, should the aft boost pump become uncovered due to attitude or G forces, an engine flame-out would occur after the fuel in the feed line was depleted.

4. Observe fuel quantity gage for increase in TOTAL fuel quantity.

5. Upon completion of fuel transfer, position drop tank fuel transfer switch to OFF.

FUEL JETTISONING FROM BUDDY TANKER SYSTEM.

With the trail—rewind switch positioned at REWIND, buddy tanker fuel may be jettisoned through selection of the DUMP position of the manual refuel—dump switch located on the tanker control panel. Selection of the DUMP position automatically causes the fuel jettisoning system to sequence. Returning the dump switch to OFF stops fuel jettisoning and automatically secures the system. During an in-flight emergency, fuel from the tanker's internal fuel system may be jettisoned to its low-level limit of 950 pounds by positioning tanker controls as follows:

0A. Internal fuel transfer switch ON.

1. Trail—rewind switch to REWIND.

1A. Manual refuel—dump switch to DUMP.

WARNING

With the battery-generator switch in the BAT. & GEN position (primary bus energized) and the trail—rewind switch positioned to REWIND, fuel from the buddy tanks will be jettisoned (either on the ground or during flight) by actuation of the manual refuel—dump switch to DUMP. During ground operations, gravity fuel flow will occur.

Note

Through solenoid action, the dump valve in each tank opens, the internal fuel level control valve closes and the air turbine blades electrically unfeather and start the hydraulic operated fuel pump in each tank. As the air turbine blades unfeather, the tanker pilot will notice a slight decrease in airspeed due to the increased drag created by the rotation of the turbine blades. Fuel will be jettisoned through the dump valves at approximately 200 gallons per minute per tank. Fuel tank collapse is prevented by atmospheric air entering the tanks through the dive vent check valves of the vent system.

2. Upon completion of fuel jettisoning, position the dump switch to OFF.

Note

When the dump switch is positioned from DUMP to OFF, the dump valves close, the internal fuel level control valve opens and the air turbine blades electrically feather, turning off the hydraulic operated fuel pumps. Fuel jettisoning ceases and the system is secured.

EMERGENCY OPERATIONS OF BUDDY TANKER SYSTEM.

HOSE REEL MALFUNCTION. If a malfunction should occur in the hose reel or in the buddy tanker hydraulic system during in-flight refueling operations, or should the receiver airplane be unable to actuate the automatic system sequencing through hose rewind action, proceed as follows:

1. Retain the trail—rewind switch at TRAIL.
2. Place the manual refuel—dump switch to MANUAL REFUEL.

Note

Actuation of manual refuel—dump switch to the MANUAL REFUEL position will cause the motor-operated refueling shutoff valve to open, the hydraulic-operated fuel pump to turn on, the refuel lights to illuminate and fuel to flow to the receiver airplane. If a malfunction of the refueling pump has occurred, fuel will transfer to the receiver airplane through gravity flow. (Refer to REFUELING PUMP MALFUNCTION, in this section.)

3. Upon completion of fuel transfer, position the manual refuel—dump switch to OFF.
4. Place trail—rewind switch to REWIND to secure the buddy tanker system.
5. Upon completion of flight, report malfunction as a "yellow sheet" entry for investigation and correction.

If a malfunction should occur in the hose reel, during rewind operations, and it becomes necessary to jettison the hose and drogue, proceed as follows:

1. Place the trail—rewind switch to REWIND.

Note

The trail—rewind switch must be in the REWIND position so that the guillotine circuit can be activated.

2. Place the guillotine switch to ON.

Note

Guillotine action will sever the hose at the reel and automatically cause the drogue (right) tank air turbine blades to electrically feather, thereby securing the system.

WARNING

Following use of the guillotine, conduct the remainder of the flight with the guillotine switch in the ON position. DO NOT REPOSITION GUILLOTINE SWITCH TO OFF. If the guillotine switch is repositioned to OFF, it will reactivate the rewind mechanism which will operate indefinitely since the securing feature of the drogue has been jettisoned by guillotining.

3. Upon conclusion of flight, report malfunction as a "yellow sheet" entry for investigation and correction.

REFUELING PUMP MALFUNCTION. If a malfunction should occur in the drogue tank refueling pump during in-flight refueling operations, fuel will transfer to the receiver airplane through gravity flow. Gravity flow will be at a reduced rate, but this rate can be increased through utilization of buddy tank pressurization. Actuation of the drop tank fuel transfer switch, located on the left console, to the INB'D position will pressurize the buddy tanks and thereby increase the fuel flow rate.

Note

As long as the trail—rewind switch is positioned to TRAIL, the fuel level control valve in the tanker's internal fuel system will be closed and no fuel will be transferred to the tanker's internal fuel system.

EMERGENCY DUMPING OF TANKER INTERNAL FUEL.

During an in-flight emergency, fuel from the tanker's internal fuel system may be jettisoned to its low-level limit of 950 pounds in the following manner:

1. Trail—rewind switch to REWIND.

Note

By maintaining the trail—rewind switch in the REWIND position, the internal fuel level control valve remains open to permit fuel flow from the internal forward fuselage (sump) tank to the drogue tank when the internal fuel transfer switch is positioned to ON.

1A. Manual refuel—dump switch to OFF (following completion of buddy tank fuel jettisoning).

2. Fuel control switch to AUTOMATIC.

Note

By positioning the fuel control switch to AUTOMATIC, all internal fuel will be directed to the forward fuselage (sump) tank.

3. Fuel gage reads switch to SUMP.

4. Internal fuel transfer switch to ON.

CAUTION

When transferring internal fuel to the buddy tanks, the airplane should be flown in level flight under one G conditions. This is necessary since the sump tank forward boost pump is used to transfer fuel to the buddy tanks. Should the sump tank aft boost pump become uncovered, due to attitude or G forces during fuel transfer, an engine flame-out will occur after fuel in the engine feed line is depleted.

5. Observe fuel quantity gage for decrease as tanker package fills at approximately 160 pounds per minute (25 gpm).

6. Internal fuel transfer switch to OFF (when tanker package is filled).

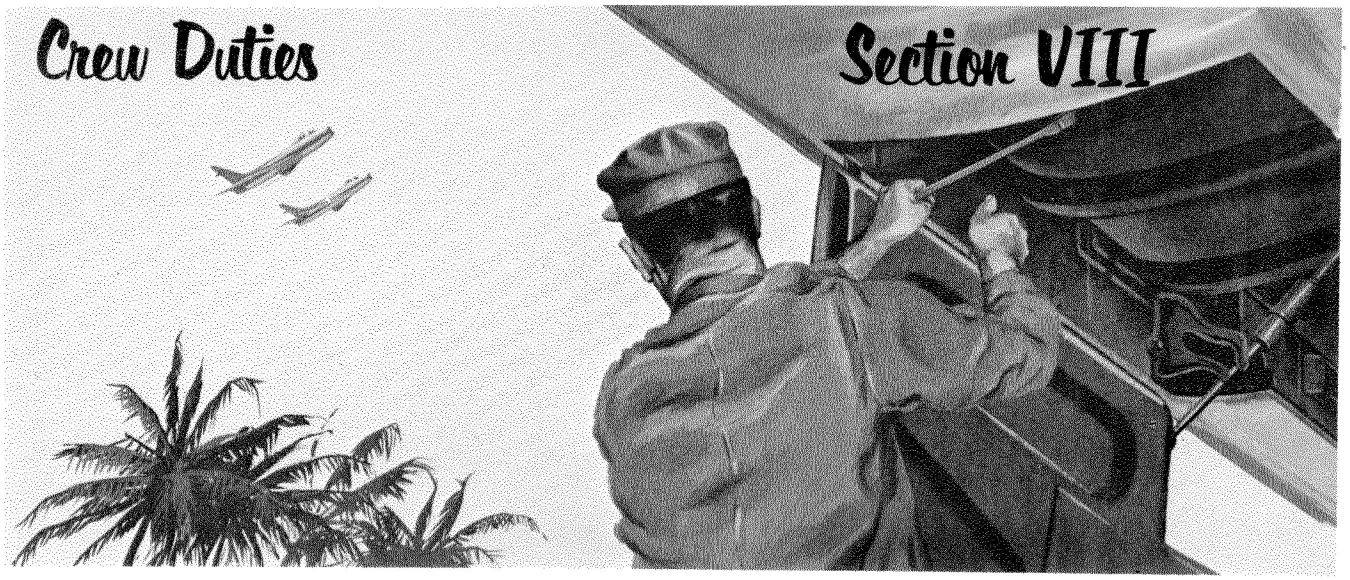
7. Manual refuel—dump switch to DUMP. (Refer to FUEL JETTISONING FROM BUDDY TANKER SYSTEM in this section.)

8. Repeat steps 1. and 4. through 7. until tanker's internal fuel is jettisoned to a safe limit.

Note

The low-level limit control valve in the SUMP tank will automatically discontinue fuel transfer to the buddy tanks when the sump level reaches 950 pounds.

JETTISONING FUEL TANKS OF BUDDY TANKER SYSTEM. Two explosive cartridges are installed within each buddy tank pylon and are electrically fired when the tanks are jettisoned. By depressing the button marked STORE & TANK JETTISON (13, figure 1-6) or by pulling the emergency stores release handle marked JET EXTL STORES (14, figure 1-6), the tanker pilot can jettison the buddy tanks. Through actuation of either tank jettisoning selection, the explosive cartridges will electrically fire and the tanks will be forcibly detached. [Refer to EMERGENCY STORES RELEASE CONTROLS, in Section I, and SPECIAL STORE JETTISONING, in Section IV of the Supplemental Flight Handbook (NAVAER 01-60JKD-501A).]



Not applicable to this airplane.

INTRODUCTION.

Except for some repetition necessary for emphasis, clarity or continuity of thought, this section contains only those procedures that differ from or are in addition to the normal operation procedures covered in Section II. The FJ-4 and FJ-4B are basically not all-weather airplanes as no wing or tail de-icing equipment is provided. However, no trouble should be encountered while flying through weather except in extreme icing conditions.

NIGHT FLYING.

Night flying should present no unusual problems as cockpit glare has been reduced to a minimum. In addition to the procedures listed in Section II, make the following checks:

1. Check and adjust all cockpit, interior, exterior and navigation lights.

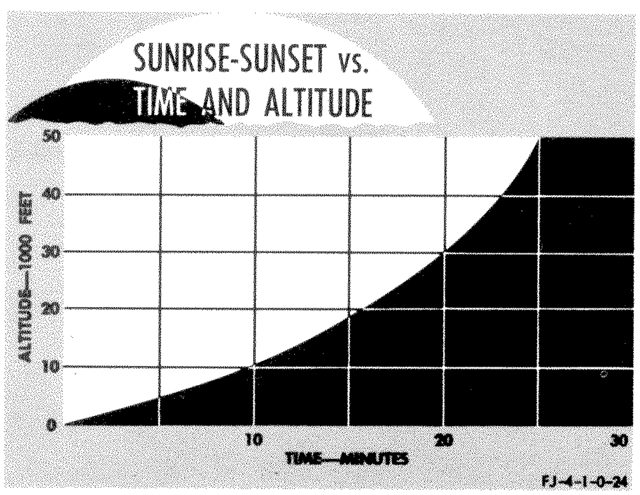


Figure No. 9-1.

Note

On some airplanes,* the longitudinal trim wheel on the stick grip is illuminated when the landing gear handle is positioned to DOWN; the light is extinguished when the handle is UP.

2. Carry flashlight for emergency cockpit lighting.

Figure 9-1 indicates the difference between sunrise and sunset on the ground as compared to various altitudes. This information may be useful in planning a night flight.

INSTRUMENT FLIGHT PROCEDURES.

Some phases of instrument flight, such as descending, radio range orientation, holding and go-around, will reduce range. These factors should be considered when instrument flight is necessary. Flight characteristics and stability of the airplane are satisfactory for instrument flights.

INSTRUMENT TAKE-OFF.

1. Visually line up airplane on runway and allow airplane to roll ahead a few feet to align nose wheel with runway.
2. Set gyro with runway heading. Place gyro switch in SLAVED. (Refer to POLAR PATH COMPASS SYSTEM, Section IV.)
3. Turn pitot heater ON.
4. Hold brakes and advance throttle to take-off thrust.
5. Check instruments.
6. Release brakes; maintain heading with brakes until rudder becomes effective.
7. When air-borne, establish a safe rate of climb.
8. Place landing gear handle UP.
9. Place flap handle UP at safe airspeed and altitude.

*Airplanes 143493 and subsequent and airplanes having Service Change No. 481 complied with

JET PENETRATION AND

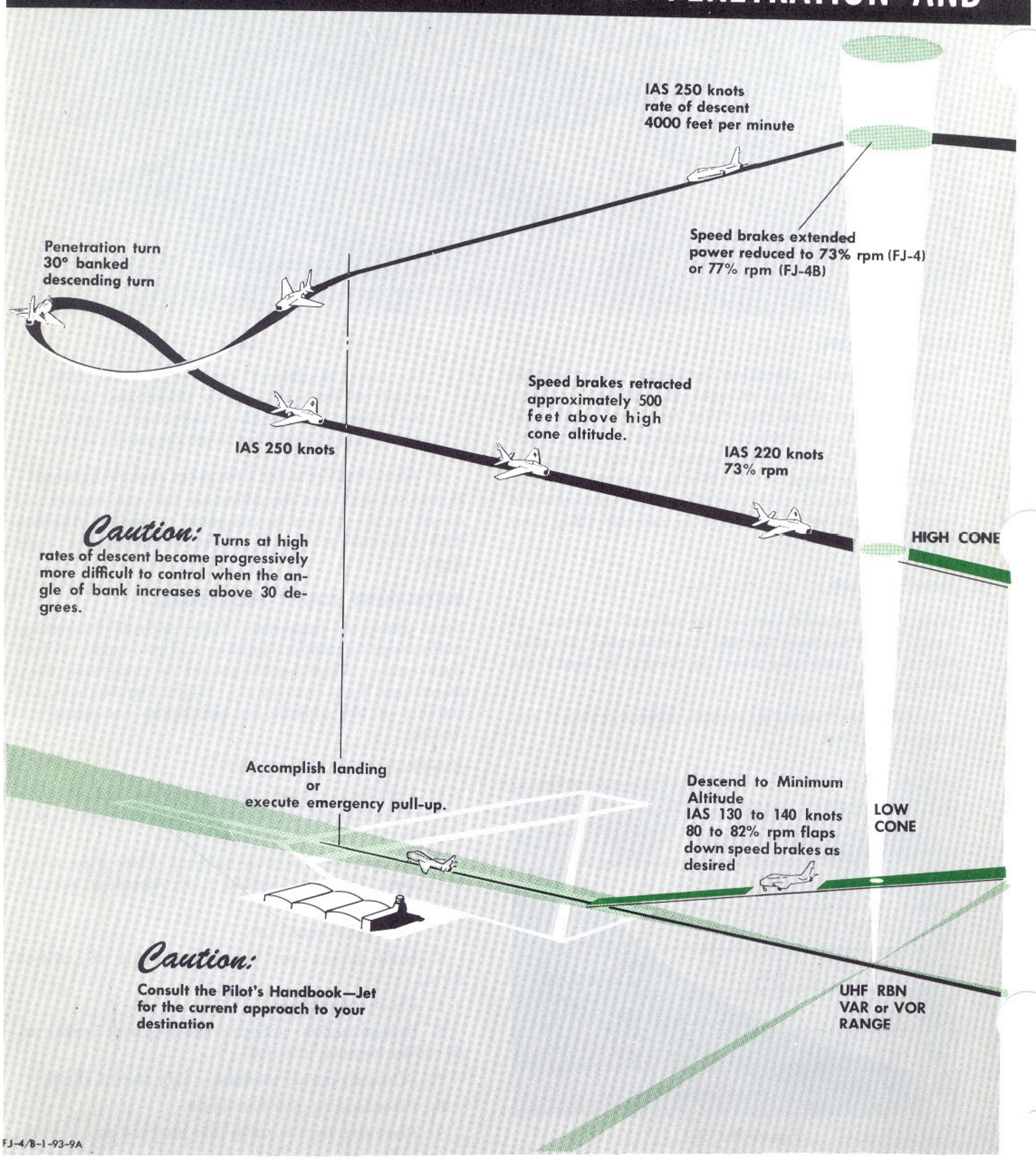


Figure No. 9-2. (Sheet 1)

INSTRUMENT APPROACH

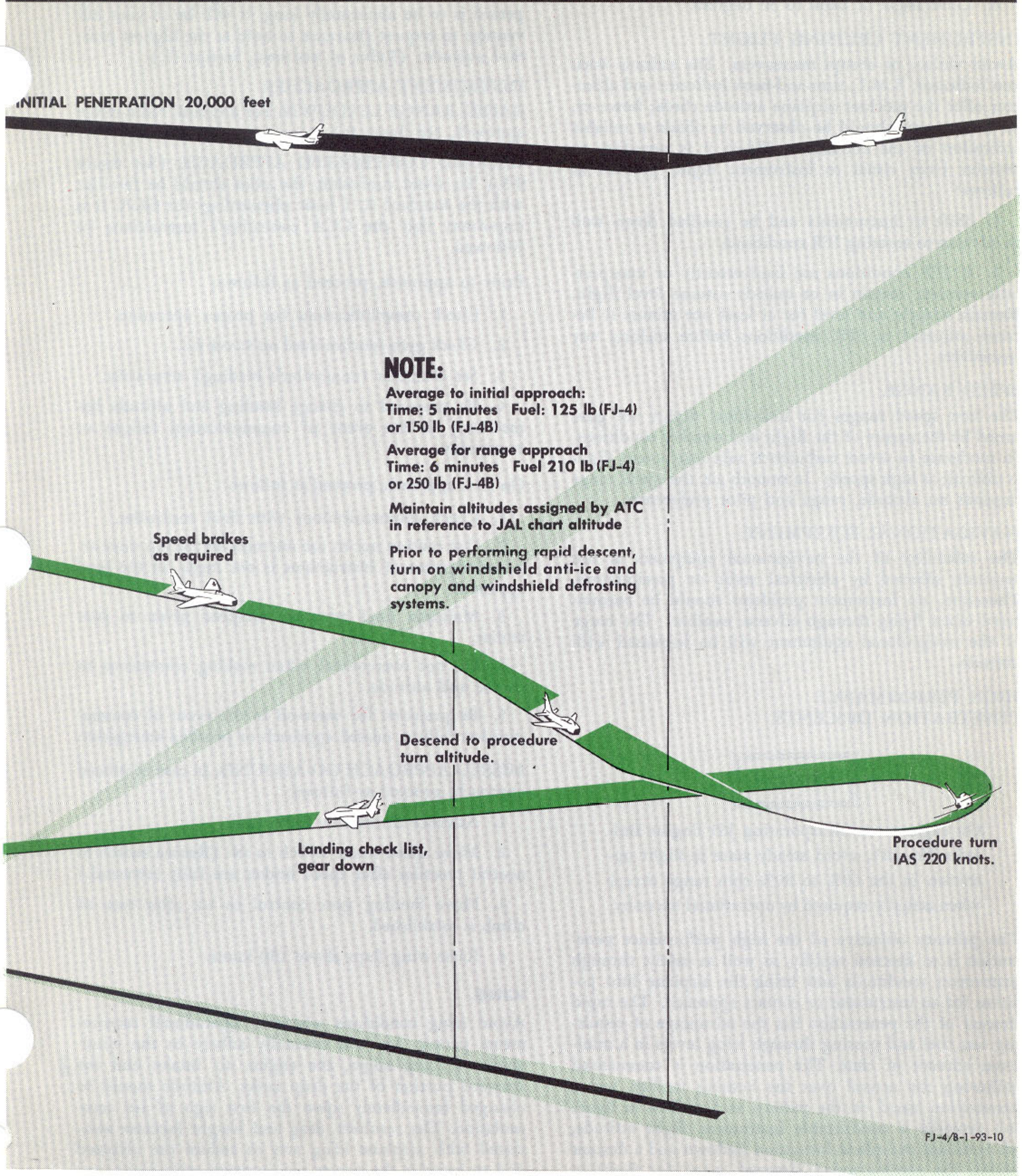


Figure No. 9-2. (Sheet 2)

INSTRUMENT CLIMB.

1. Trim for climb speed.
2. Limit angle of bank to 30 degrees.

INSTRUMENT CRUISING FLIGHT.

Avoid violent or abrupt maneuvers. The attitude horizon indicator, R.M.I., turn-and-bank indicator and altimeter offer the quickest airplane attitude check; however, all instruments should be observed to obtain a reliable indication of the conditions. When it is necessary to transfer from visual to instrument flight, proceed as follows:

1. Shift to instruments and be steadied down well in advance to entering IFR conditions.
2. If IFR conditions are inadvertently or unexpectedly entered, remain in or quickly assume level flight. Remain straight and level for at least one minute to become adjusted to IFR conditions before making any maneuvers.

SPEED RANGE.

The best speed ranges for individual flights are governed by the nature of the flight and weather conditions. In moderate to severe turbulence, safe instrument flight is difficult at high speeds. In smooth air, the speed range depends on altitude, range and pilot preference.

NAVIGATIONAL EQUIPMENT.

The reliability of the navigational equipment is not seriously affected by electrical static or precipitation. Therefore, no instrument problems should be encountered when flying through adverse weather. The range of the navigational equipment will be increased with altitude.

HIGH PERFORMANCE PENETRATION DESCENTS.

CAUTION

On engines not incorporating J65 Engine Bulletin No. 111, avoid steady state in-flight operation in the 60% to 80% rpm range except when actually required by operational necessity.

The primary objective of the high performance penetration is to descend rapidly, as well as safely, through instrument conditions and bring the airplane into position for an instrument or contact approach. The rapid descent of the penetration has the advantage of requiring less fuel and passing through icing levels in a minimum amount of time. The penetration is commenced following the arrival over the homing facility, and a penetration based on the pattern as described in figure 9-2 provides a comfortable instrument flight attitude, an optimum two-plane formation letdown and a descent within the recommended airspeed range for flight in turbulent air.

HOLDING.

Fuel consumption at minimum power for level flight is the most important factor in holding. If the holding period is to be abnormally long, it will be to your advantage to request clearance to hold at the highest practical altitude. (Refer to HOLDING, Section II.)

INSTRUMENT APPROACHES.

RADIO RANGE LETDOWN. For a typical radio range approach, see figure 9-2.

GROUND CONTROLLED APPROACH. (See figure 9-3.) To avoid confusion, the pilot should be familiar with the standard R/T basic phraseology for GCA. It is important that the GCA controller's instructions be followed.

Prior to approach, proceed as follows:

1. Check communications for proper operation.
2. Check gyro synchronized on SLAVE D.G.
3. Set altimeter (controller's reading) accurately.
4. Be prepared to change heading and altitude immediately in the event of communication failure or emergency.

On final approach, proceed as follows:

1. Check communications with final controller.
2. Use caution not to use microphone button since acknowledgment of instructions is not made on the final approach.
3. Maintain final approach airspeed given to controller.
4. Do not overcontrol when making corrections to course and altitude.
5. Be prepared for wave-off in the event of communication failure, missed approach or possible emergency.

MISSED APPROACH GO-AROUND. In case of missed approach, proceed as follows:

1. Advance throttle to 100% rpm.
2. Move speed brake switch to IN. (Return switch to neutral position after speed brakes are fully retracted.)
3. Move landing gear control to UP after rate of climb is established.
4. Raise wing flaps above 150 knots.

ICING.

Avoid icing conditions whenever operational requirements permit. Ice will normally adhere to the windshield, leading edges, the engine air intake and the forward portion of the drop tanks. Altitude should be changed immediately upon the first sign of ice accumulation. The resultant drag and weight increase associated with airplane icing acts to reduce the airspeed and to increase the power requirements with a constant reduction in range.

WARNING

Heavy ice accumulation can cause the stalling speed to greatly increase; therefore, extreme caution must be exercised when landing under such conditions.

Icing of the engine air intake area is an ever present possibility during operation in weather conditions when the temperatures are near the freezing point. A reduction in rpm with a loss of thrust (no mechanical difficulties present) can indicate engine icing. A major rise in tail-pipe temperature with a decrease in thrust is one of the normal indications of compressor inlet guide vane icing. Flight within cloud formations during icing conditions can result in icing of the fuel control pressure pickup. In this case, ice builds up on the inlet guide vanes and blocks the small holes to the fuel control pressure sensing line so that a power loss of approximately 15% rpm will result and cause a decrease in the tail-pipe temperature and fuel flow. When this occurs, normal engine operation may be regained by emerging from the clouds or by descending into warmer air. If a prescribed course and altitude must be maintained, or if the power loss becomes excessive, manual fuel control should be selected so that the fuel altitude compensating circuit is by-passed and power is regained. (Refer to ENGINE FAILURE, in Section III.)

CAUTION

Retard throttle prior to moving the fuel control switch at altitude, since it takes several seconds for the system to stabilize.

WARNING

If icing conditions are encountered and tail-pipe temperature increases, the throttle should be retarded immediately and an effort made to leave the icing area. Low airspeed and high engine rpm are most conducive to engine icing.

Avoid atmospheric icing conditions whenever feasible. It is recognized that the most proficient weather forecast cannot always predict accurately just when or where icing may be encountered. However, many areas of probable icing conditions can be avoided by careful flight planning that utilizes available weather information. Whenever possible, avoid take-offs when the temperature is between —10°C (14°F) and 5°C (41°F) if fog is present or the dew point is within 4°C (7°F) of the ambient temperature. These are the conditions under which engine icing can occur without wing icing. Should it be necessary to take off into fog or low clouds, when temperatures are at or near freezing, obtain a higher than normal climb airspeed before entering the clouds as an additional precaution. Then, if icing is present, wing icing will also be present and will provide an indication of the danger. If icing is encountered, take the following action immediately:

1. Place windshield anti-icing switch to ANTI-ICE.
2. Place windshield momentary contact defrost switch to DEFROST for desired airflow and release to HOLD.
3. Maintain a close watch on tail-pipe temperature.

If icing conditions are encountered during flight at freezing atmospheric temperatures, immediate action can be taken as follows:

1. Change altitude rapidly by climb or descent in layer clouds or vary course to avoid heavy cloud formations.
2. Reduce airspeed to minimize rate of ice build-up.
3. Maintain close watch on exhaust temperature and reduce engine rpm as necessary to prevent excessive exhaust temperature.

CAUTION

Do not reduce airspeed by flaps or other means of drag as ice will collect on the exposed surfaces. Airframe icing will seldom be encountered above 30,000 feet.

FLIGHT IN TURBULENCE AND THUNDERSTORMS.

Note

In rainy weather, the windshield anti-icing system can be used for rain removal at landing approach airspeeds.

Avoid flight through thunderstorms whenever possible by using available weather information. It is necessary that you become familiar with the strength and flight characteristics of the airplane and with certain obvious effects—the reactions of the airplane, motions or accelerations to which you are subjected and the behavior of flight instruments—in order to fly safely in turbulent air. In severe turbulence you will experience:

1. Great difficulty in maintaining steady, straight flight.
2. Violent accelerations in various directions.
3. Difficulty in reaching controls or objects in cockpit.
4. Objects not properly secured being tossed about.
5. Violent pitching, rolling and yawing motions.
6. Unavoidable large changes in indicated altitudes.
7. Erratic fluctuation of flight instruments utilizing static air sources.

In moderate turbulence, changes in altitude are not violent but you may have some difficulty in reaching for controls or other objects in the cockpit. Some changes

RECOMMENDED GCA PATTERN (TYPICAL)

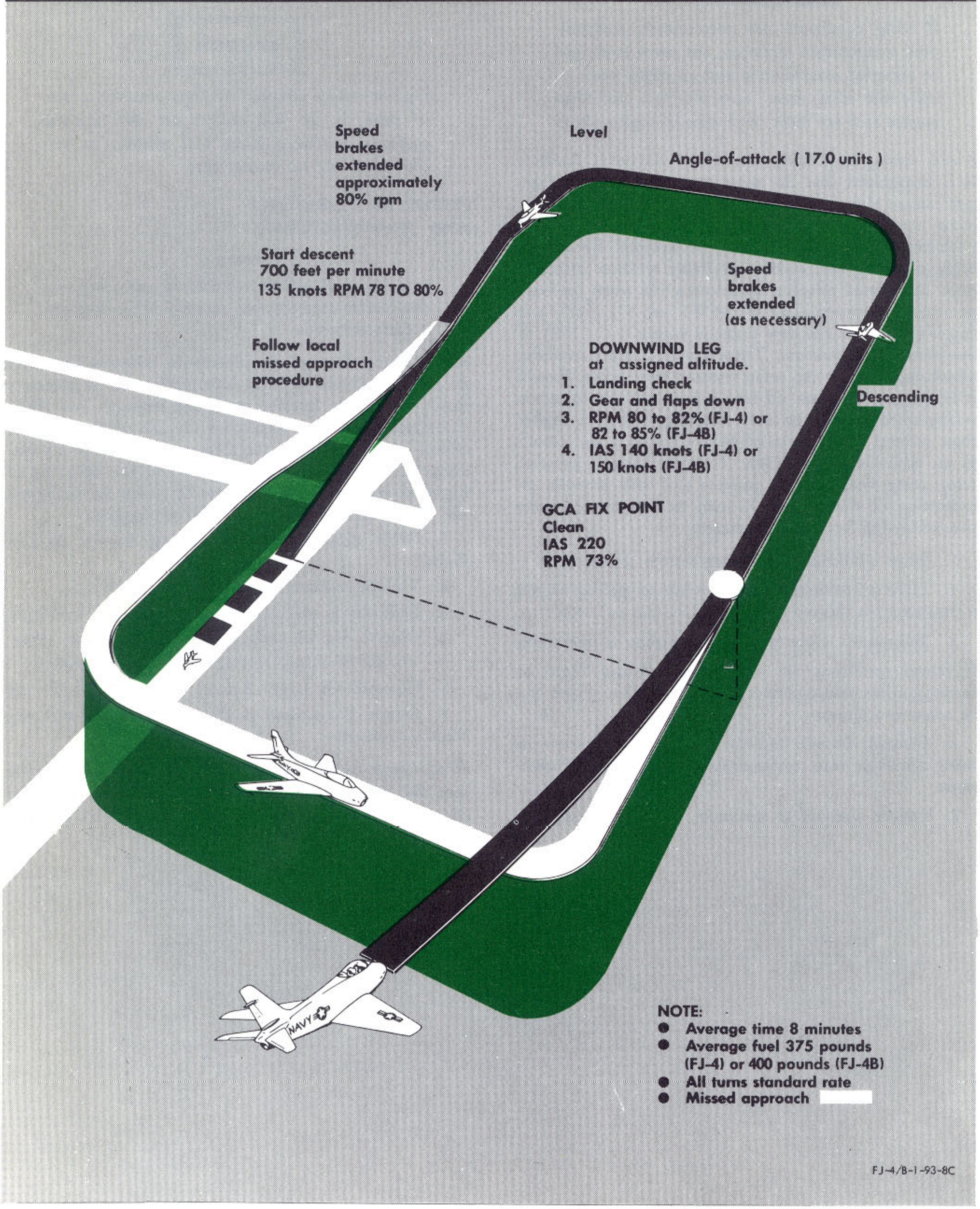


Figure No. 9-3.

in indicated altitude are unavoidable and instruments utilizing static air sources fluctuate but the effects are not as pronounced as in severe turbulence.

To prepare for penetration, proceed as follows:

1. Establish best penetration speed. [Refer to FLIGHT LIMITATIONS IN TURBULENT AIR, Section V of the Supplemental Flight Handbook (NAVAER 01-60JKD-501A).]
2. Secure all loose equipment.
3. Check that safety belt is tight and shoulder harness locked.
4. Turn pitot heater ON.
5. Turn off any radio equipment rendered useless by static.
6. At night, turn on cockpit floodlights.

While in the storm, proceed as follows:

1. Maintain power setting and pitch attitude throughout the storm. Hold these constant, and the airspeed will remain constant, regardless of the airspeed indicator. If lightning is prevalent, turn on cockpit floodlights.

Note

A heavy rain, by partial blocking of the pitot tube pressure head, can decrease considerably the indicated airspeed reading.

2. Devote all attention to flying the airplane.
3. Expect turbulence, precipitation and lightning. Do not allow these conditions to cause undue alarm.
4. Maintain attitude. Concentrate on remaining level by reference to the attitude gyro.
5. Maintain original heading. Do not make turns unless absolutely necessary.
6. Do not chase the airspeed indicator, since doing so will result in extreme airplane attitudes. If a sudden gust should be encountered while airplane is in a nose-high attitude, a stall might easily result.
7. In order to minimize the stress imposed on the airplane, use as little longitudinal control as possible to maintain your attitude.
8. The altimeter may be unreliable in thunderstorms because of differential barometric pressure within the storm. A gain or loss of several thousand feet may be expected.

Note

Altitudes between 10,000 and 20,000 feet are usually the most turbulent areas in a thunderstorm. The least turbulent areas will be below 6000 feet and above 30,000 feet. Therefore, if flying at an altitude near 30,000 feet or over mountainous terrain, altitudes in excess of 30,000 feet are recommended for penetration. However, if flight is at an altitude close to 6000 feet and over known flat terrain, it would be more desirable to let down to 6,000 feet instead of climbing to 30,000 feet or more.

COLD WEATHER PROCEDURES.

Icing conditions are covered under ICING in this section. Jet powered airplanes are well suited for cold weather operation so that very little special action need be taken.

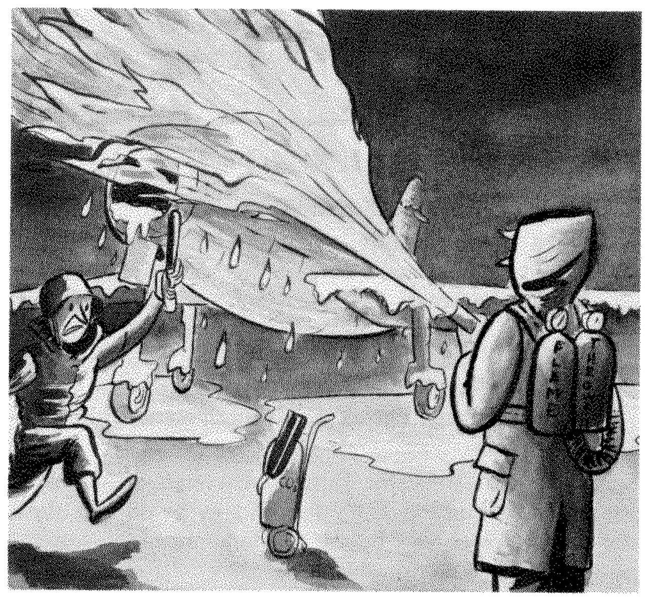
BEFORE ENTERING AIRPLANE.

1. Remove all protective covers as soon as conditions will permit.

Note

At temperatures below —26°C (—15°F), it is important that the canopy, oil system and flight controls be preheated. Hot air from a blower-type heater should be applied to *both* the oil tank and the oil pump. Preheating of either unit alone will not give satisfactory results. The tank can be heated through the oil filler access door and the pump can be heated from the left wheel well access door. On a moderately cold day, the oil pressure will read high until the oil is sufficiently warmed by engine heat. In this case, preheating is not necessary. However, on an extremely cold day, if preheating is not used, sufficient oil pressure will not be obtained for several minutes after starting. Therefore, if the oil pressure indication is low after starting on an extremely cold day, stop engine and apply heat. [Refer to OIL PRESSURE LIMITATIONS, in Section V of the Supplemental Flight Handbook (NAVAER 01-60JKD-501A).]

2. Remove all ice, snow and frost on airplane surfaces.



WARNING

Remove ice, snow and frost before take-off.

FJ-4/B-1-0-2

WARNING

Do not take off with ice, snow or frost on the airplane surfaces. Loss of lift and dangerous stall characteristics will result if ice is not removed.

3. Determine that tires are not frozen to the surface.

Note

Tires may be released by ground heaters or partially released by overinflating. Do not use heat when tires are overinflated.

ON ENTERING AIRPLANE.

1. Check all controls for freedom of movement and full travel.
2. Check canopy operation. Be sure that canopy will fully close and lock.
3. Check electrical and radio equipment.

STARTING ENGINE.

Sufficient moisture from condensation can collect within the engine and freeze the rotor by simply subjecting a cold engine to warm humid air followed by exposure to low temperatures (such as transferring an airplane from the flight deck before the engine dries out). The condensed moisture can be blown out of the engine if it is cranked to a high speed with the starter before the moisture freezes. If there is an abnormal amount of frost present, it can be removed in a few minutes with a ground heater.

WARM-UP AND GROUND CHECKS.

1. Turn cabin heat and defrosting system on as required.
2. Check flight controls. Cycle rudder trim tab, speed brakes and wing flaps to ensure proper operation. When wing flaps are cycled, check for proper operation of wing leading edge droop.

WARNING

Have chocks firmly anchored before engine run-up. Thrust will be greater than normal at low temperatures.

TAXIING.

1. Avoid deep snow if possible.
2. Use only essential electrical equipment while taxiing at low rpm.
3. Maintain sufficient interval between airplanes to permit safe stopping distances and to avoid the slush and snow blown back by the airplane ahead.

BEFORE TAKE-OFF.

1. Turn pitot heater ON.
2. Make normal 100% thrust check.

Note

If a full power check is impossible due to slippage on the runway, it will be necessary to make the full power check in conjunction with take-off.

TAKE-OFF.

Since air is more dense in cold weather, thrust will be increased and a shorter take-off run can be made in cold weather than under normal conditions. Power should be applied as rapidly as possible to enable use of maximum amount of runway for stopping if take-off is discontinued due to engine malfunctioning or failure.

AFTER TAKE-OFF.

1. Cycle landing gear and wing flaps to prevent freezing.

Note

Gear and flap operation may be slower in cold weather.

2. Check instruments, particularly the pressure instruments, for proper operation.

CLIMB.

Rate of climb increases at low altitudes; otherwise cold weather does not affect the flying characteristics of the airplane.

DESCENT.

1. Turn windshield and canopy defroster ON.
2. Check engine operating temperatures during descent. Extending speed brakes and increasing rpm may help to eliminate excessive engine cooling during descent.

Note

Even on clear days, temperature inversions are common in cold weather. Temperature at sea level may be 20°C to 30°C colder than temperature at altitude.

APPROACH.

1. Pump brake pedals several times when on final approach.
2. Make a normal approach pattern.

LANDING.

CAUTION

Cross winds are particularly dangerous when landing on icy runways.

1. Use brakes sparingly and not until absolutely necessary.
2. Do not lock wheels on icy runway.
3. Use only essential electrical equipment while taxiing at low rpm.

BEFORE LEAVING AIRPLANE.

1. Park with wheels on some form of insulation to prevent tires from freezing to surface.
2. Chock wheels firmly.
3. Turn pitot heater switch OFF.
4. Moor airplane.
5. Lock controls.
6. When possible, fully service fuel tanks. Do not permit moisture to enter tanks.

7. Remove battery if airplane is to be parked outside for an extended period of time and temperature is below —29°C (—20°F).

DESERT OR HOT WEATHER PROCEDURES.

BEFORE ENTERING AIRPLANE.

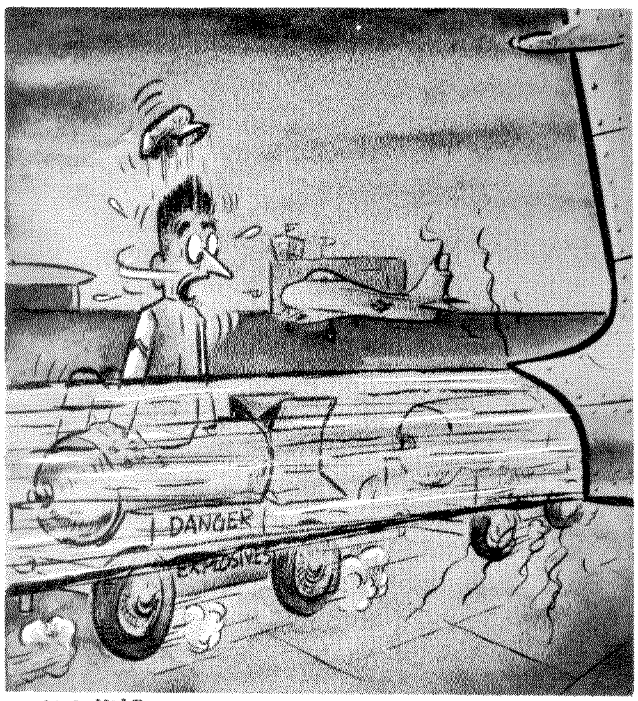
Note

If airplane has been parked in the sun, use caution while making the exterior inspection, particularly if gloves are not worn.

1. Be sure intake duct is clean.
2. Check tires for proper inflation and any signs of deterioration.
3. Check for fuel, oil and hydraulic leaks.

GROUND TEST.

1. Make run-up short as possible.
2. Turn cockpit air temperature control switch to COLDER.



WARNING

Keep jet blast away from people, places and things.

FJ-4/B-1-0-7

CAUTION

When airplane is parked in desert or dusty country, make run-up so that jet blast will be away from personnel, other airplanes and ground installations.

TAXIING.

1. When taxiing, avoid riding or excessive use of brakes.

Note

If possible, allow approximately 30 minutes between flights to permit adequate cooling of wheels and brakes.

TAKE-OFF.

1. If in desert or dusty country, do not take off in the wake of another airplane.
2. Ground roll is considerably increased in hot weather.

AFTER TAKE-OFF.

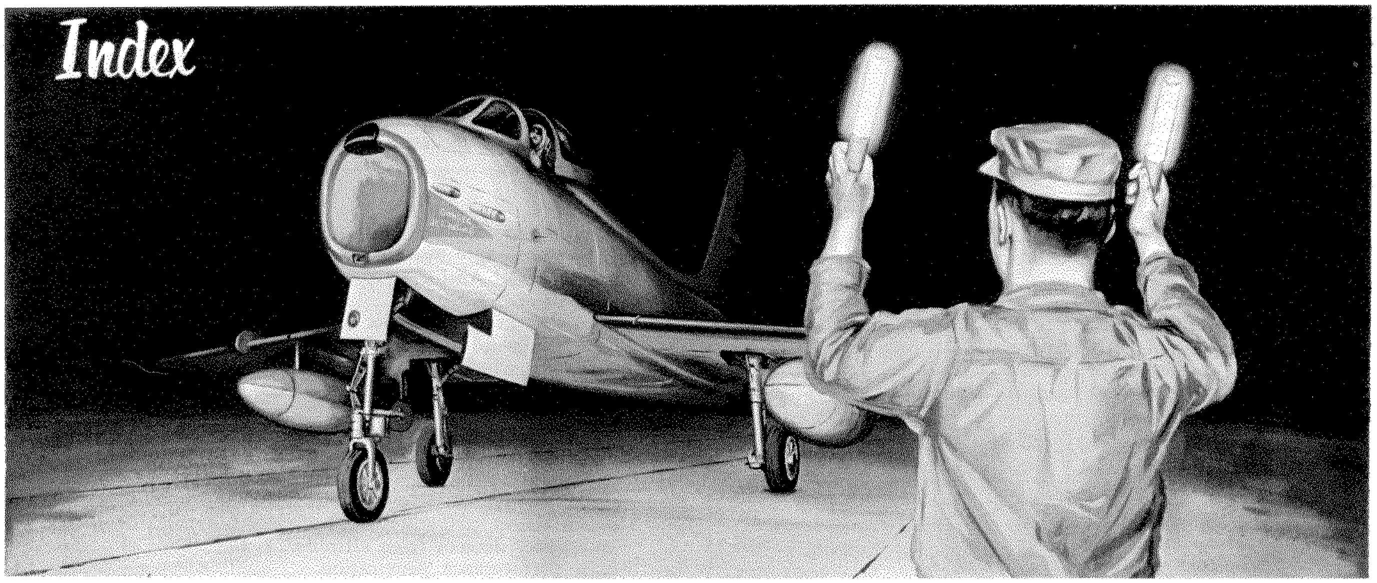
1. Follow normal flight procedures.
2. Be particularly careful to maintain a power setting that will keep exhaust temperatures within the prescribed limits.
3. Expect gusts and turbulence at lower altitude.

APPROACH AND LANDING.

1. True stalling speeds and ground roll will be greater; however, indicated airspeed will be the same.

BEFORE LEAVING AIRPLANE.

1. Park cross wind when possible.
2. Install all protective covers.
3. If blowing sand or dust is not a hazard, keep canopy and access doors open to allow air to circulate.



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