AN 01-60JKC-1

Flight Handbook

NAVY MODEL

FJ-3

AIRCRAFT

THIS PUBLICATION TO BE USED IN CONJUNCTION WITH SUPPLEMENTAL FLIGHT HANDBOOK (NAVAER 01-60JKC-501A)

PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE AND THE CHIEF OF THE BUREAU OF AERONAUTICS

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AN 01-60JKC-1
3 FEBRUARY 1958

FLIGHT HANDBOOK INTERIM REVISION No. 26

Navy Model FJ-3-3M 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 delete the requirement for performing an emergency ignition check during the ground test checks.

3. The following change is made to AN 01-60JKC-1, Flight Handbook for FJ-3, -3M Aircraft, dated 1 October 1955, Revised 1 August 1957.

Section II, page 44B, under AFTER STARTING ENGINE, starting with "To check that the starting primer solenoid ---" delete all material down to NOTE.

END

AN 01-60JKC-1
7 OCTOBER 1957

FLIGHT HANDBOOK INTERIM REVISION No. 23

Navy Model F J -3 -3M 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 flight information concerning revised air start procedure for FJ-3, -3M Aircraft.

3. The following change is made to AN 01-60JKC-1, Flight Handbook for Navy Model FJ-3, -3M Aircraft, dated 1 October 1955, revised 1 August 1957.

(a) Section III, Page 57, under AIR STARTS - PRIMARY FUEL CONTROL SYSTEM, replace Item 2 with the following:

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 preceeded by a slight climb to compensate for any altitude loss and turbine speed-up caused by the push over.

(b) Section III, Page 57, under AIR STARTS - MANUAL FUEL CONTROL SYSTEM, replace Item 3 with the following:

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 preceeded by a slight climb to compensate for any altitude loss and turbine speed-up caused by the push over.

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.

END

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. 16 Pages 4, 5 and 6 [Confidential Supplement (NAVAER 01-60JKC-501A)]
No. 2	No. 17 Page 47
No. 3	No. 18 Page 3
No. 4 (Superseded by No. 6)	No. 19 Page 89
No. 5	No. 20 Page 80A
No. 6	No. 21 Page 6 [Confidential Supplement (NAVAER 01-60JKC-501A)]
No. 7	
No. 8	
No. 9	
No. 10	
No. 11	
No. 12	
No. 13	
No. 14 (Superseded by No. 16)	
No. 15	

INTERIM REVISIONS OUTSTANDING: (to be maintained by custodian of Flight Handbook)

Number	*Date*	*Purpose*

NOTICE

This Flight Handbook is applicable to both the Model FJ-3 and FJ-3M aircraft. The FJ-3M aircraft incorporates external missile provisions.

Aircraft designated FJ-3 consist of Navy Serial Numbers 135774 through 136117 inclusive. Aircraft designated FJ-3M consist of Navy Serial Numbers 136118 through 136162, 139210 through 139278 and 141364 through 141443.

TABLE OF CONTENTS

Note

Sections V, VI, and Appendix I and a portion of Section IV have been placed in the Supplemental Flight Handbook (NAVAER 01-60JKC-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 carefully.

FOREWORD

This handbook contains all the information necessary for normal and emergency operation of the FJ-3 airplane. The handbook is divided into nine sections and one appendix. Any information of a classified nature is removed and placed in the confidential supplement. Sections V, VI, Appendix I and a portion of Section IV have information of this nature and have been placed in the Supplemental Flight Handbook (NAVAER 01-60JKC-501A). The information in these flight handbooks will provide you with a knowledge of the Airplane, its flight characteristics and limitations, as well as the procedures to use and the operational use of all related equipment. The information herein is kept current by frequent revisions. Since the incorporation of this material takes time it is imperative that the pilot stay abreast of the pertinent interim revisions, which frequently contain new restrictions, limitations, and operational techniques. The handbook is divided as follows:

SECTION I, DESCRIPTION—contains a detailed description of the airplane, and the equipment and controls which contribute to the physical act of flying. All emergency equipment which is not a part of the auxiliary equipment is also discussed.

SECTION II, NORMAL PROCEDURES—contains complete operating instructions for a normal flight. Procedures are arranged in proper sequence from the time you approach the airplane until it is secured after the flight.

SECTION III, EMERGENCY PROCEDURES—describes the procedures to be followed during any emergency that may reasonably be expected to occur. Emergency procedures for auxiliary equipment are described in Section IV.

SECTION IV, DESCRIPTION AND OPERATION OF AUXILIARY EQUIPMENT — contains the description, normal operation, and emergency operation of equipment which is not essential to flight but which enables the airplane to perform certain specialized functions such as gunnery, oxygen, air conditioning and pressurization, radio, etc. A portion of this section is included in the Confidential Supplemental Flight Handbook (NAVAER 01-60JKC-501A).

SECTION V, OPERATION LIMITATIONS—covers all limitations and restrictions for the airplane and engine that must be observed during flight. This Section is contained in the Supplemental Flight Handbook (NAVAER 01-60JKC-501A).

SECTION VI, FLIGHT CHARACTERISTICS — is a summary of flight characteristics that are peculiar to the airplane. Descriptions of stalls, spins, dives and accelerated flight, as well as recovery techniques, are covered. This Section is contained in the Supplemental Flight Handbook (NAVAER 01-60JKC-501A).

SECTION VII, SYSTEMS OPERATION — discusses operation and characteristics of the various systems, with emphasis on the engine, under various operating conditions.

SECTION VIII, CREW DUTIES—is omitted as not applicable to this airplane.

SECTION IX, ALL-WEATHER OPERATION—contains techniques and procedures to be followed under instrument flight, inclement weather, and extreme temperature conditions.

APPENDIX I, OPERATING DATA (7700 pound thrust engine)—contains operating data charts for the most efficient mission planning. Data includes best climb and descent speeds, and the necessary cruise control information for various configurations. This section is contained in the Supplemental Flight Handbook (NAVAER 01-60JKC-501A).

INDEX — a complete list of text and illustrations alphabetically arranged for ease in referencing.

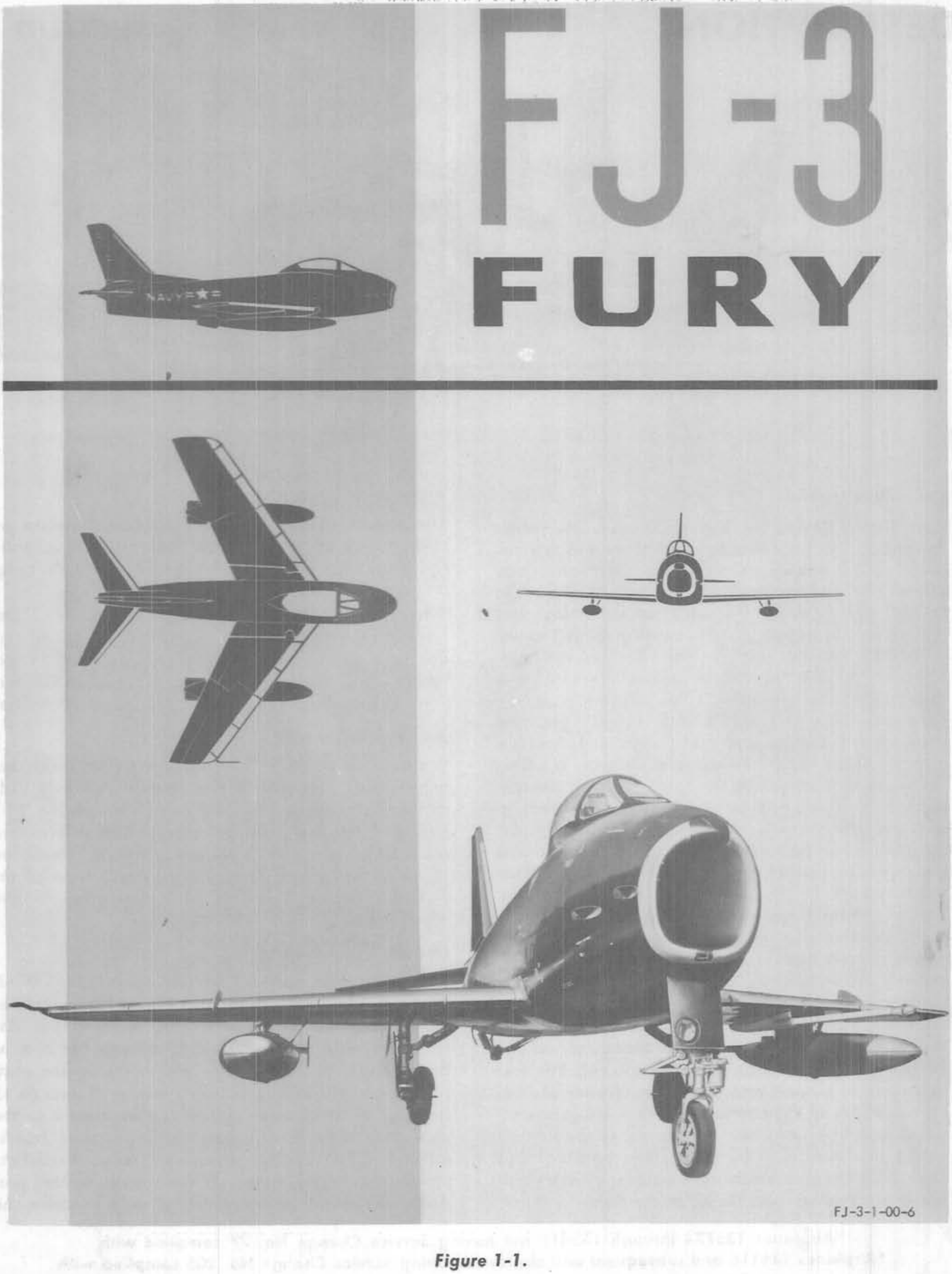
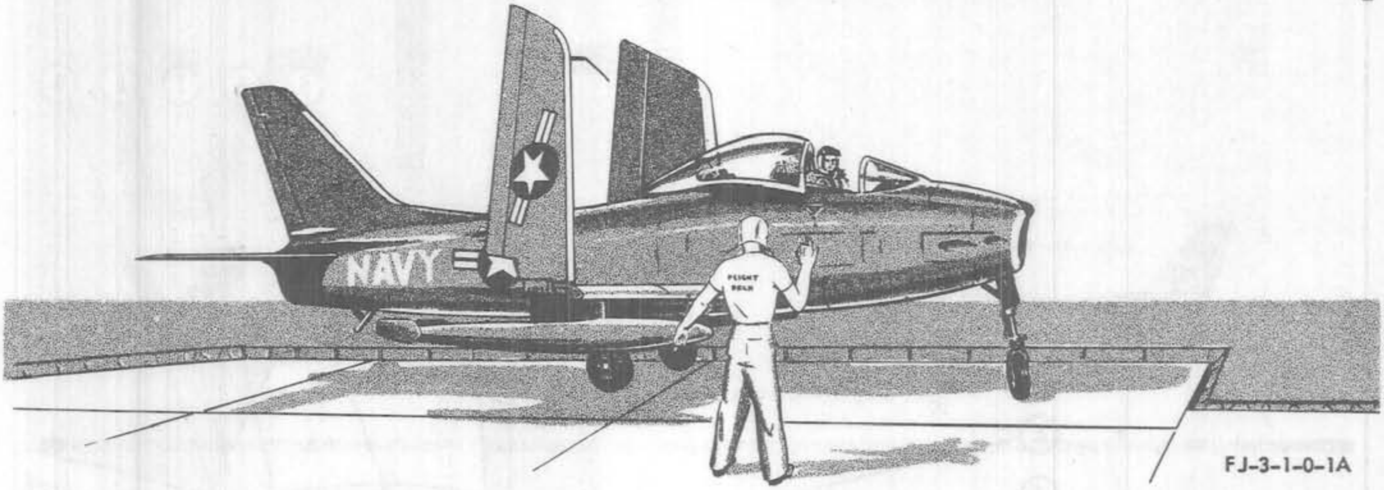


Figure 1-1.

DESCRIPTION

section I



FJ-3-1-0-1A

THE AIRPLANE.

The FJ-3 is a single-place, high-performance day fighter designed for carrier or land based operation and powered by an axial flow turbojet engine. The airplane is characterized by the large engine intake duct, located in the nose of the fuselage, and the sweptback wings and empennage. (See figure 1-1.) Noteworthy design features include a cambered "wet" leading edge and combined action of the elevator and horizontal stabilizer, commonly called the "flying tail." The airplane has a conventional, fully retractable tricycle landing gear and single-slotted Fowler type wing flaps and fuselage-mounted speed brakes. To maintain desirable handling characteristics throughout the speed range of the airplane, the ailerons and horizontal tail are actuated by an irreversible hydraulic control system. The use of irreversible controls necessitates the inclusion of an artificial feel system to simulate desired aerodynamic feel, and has the advantage of providing comfortable stick forces. Rudder control is provided through use of a conventional cable control system. The airplane is provided with a catapult hook and holdback fittings for catapult take-off, and an arresting hook, a barrier guard,* and a barrier pickup for carrier landings. The outer panel of each wing may be folded for ease in deck handling and storage aboard an aircraft carrier. Sequencing of the internal fuel supply is completely automatic. The fuel system can be serviced by single-point refueling and has provisions for in-flight refueling.† Two 200-gallon external fuel drop tanks may be attached to the inboard wing panels. Armament for the airplane consists of four Mark 12 20mm guns which are mounted in pairs on each side of the fuselage near the air intake duct.

AIRPLANE DIMENSIONS.

The over-all dimensions of the airplane (airplane on landing gear at normal weight and with tire inflation and gear strut extension as specified and with wings spread and folded) are as follows:

Wing span	37.12 feet
wings folded	22.50 feet
Length	37.55 feet
Height	13.67 feet
wings folded	15.76 feet

MAIN DIFFERENCES.

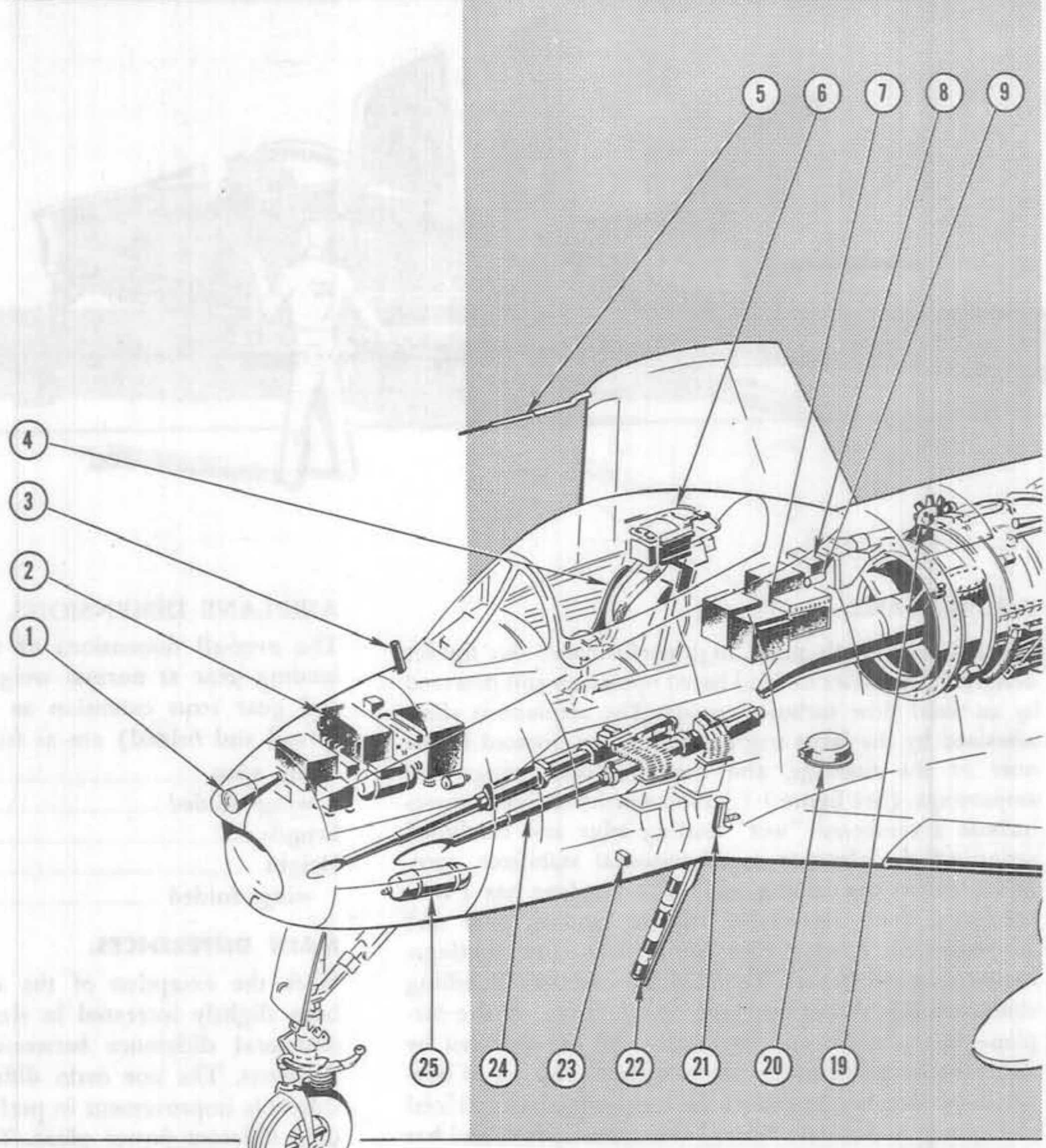
With the exception of the air intake duct which has been slightly increased in size, there is relatively little structural difference between the FJ-2 and the FJ-3 airplanes. The one main difference which reflects considerable improvement in performance is the installation of a different power plant. The FJ-2 makes use of the J47-GE-2 engine while the FJ-3 is powered by the J65-W-4B or J65-W-16A engine.

ENGINE.

The engine installation for this airplane is the J65-W-4B or J65-W-16A axial flow turbojet (figure 1-3) with a sea level rating of 7700 pounds thrust at 8300 rpm. Air enters the engine air intake duct through the nose of the fuselage. The air then passes to the engine compressor where it is progressively compressed through 13 stages. This compressed airflow is then routed to the annular combustion chamber where vaporized fuel is injected and the resultant combustion occurs. Partial expansion of the gases through a two-stage turbine produces mechanical power which is used to drive the

***Airplanes 135774 through 135812 not having Service Change No. 77 complied with**
†Airplanes 136118 and subsequent and airplanes having Service Change No. 205 complied with

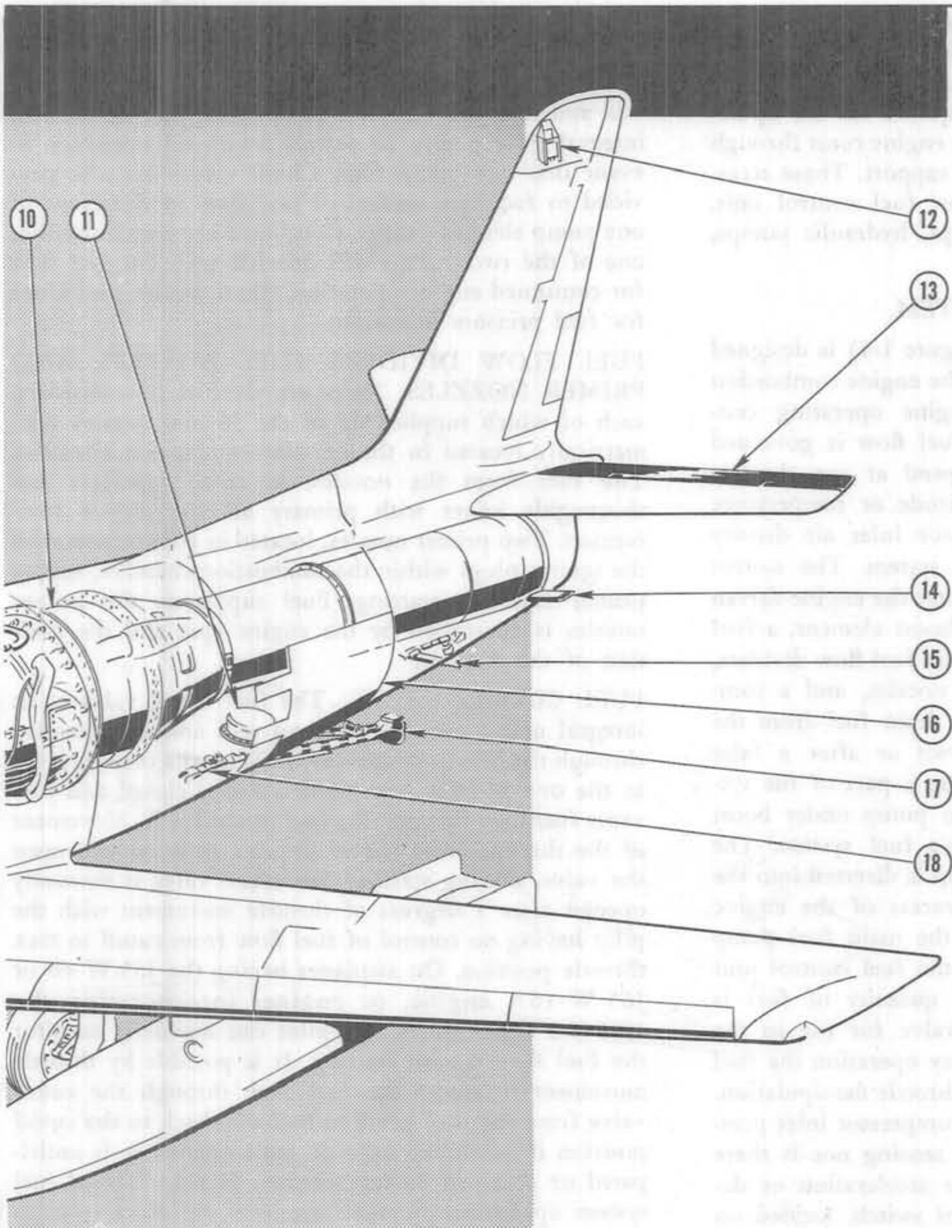
GENERAL ARRANGEMENT



1. RADAR ANTENNA
2. RADAR AND GUN SIGHT EQUIPMENT COMPARTMENT
3. BARRIER GUARD*
4. EJECTION SEAT
5. PITOT TUBE
6. AN/ARN-14 ANTENNA
7. BATTERY
8. AFT EQUIPMENT COMPARTMENT
9. EXTERNAL CANOPY EMERGENCY RELEASE
10. J65-W-4 ENGINE
11. AS578/ARA-25 ANTENNA
12. AN/ARC-27 AND AN/ARN-21† ANTENNA
13. CONTROLLABLE HORIZONTAL TAIL

FJ-3-1-00-78

Figure 1-2. (Sheet 1)



14. FUEL VENT OUTLET
15. TAIL BUMPER
16. SPEED BRAKE
17. ARRESTING HOOK
18. CATAPULT HOLDBACK FITTING (RETRACT)
19. RAM-AIR TURBINE GENERATOR‡
20. AT-234/APX-6 ANTENNA
21. CATAPULT HOOK
22. BARRIER PICKUP
23. CANOPY CONTROL SWITCH
24. 20MM GUNS
25. OXYGEN CYLINDER

*AIRPLANES 135774 THROUGH 135812 NOT HAVING SERVICE CHANGE NO. 77 COMPLIED WITH
†AIRPLANES 136118 AND SUBSEQUENT AND AIRPLANES HAVING SERVICE CHANGE NO. 151 COMPLIED WITH
‡AIRPLANES HAVING SERVICE CHANGE NO. 381 COMPLIED WITH

FJ-3-1-00-8B

Figure 1-2. (Sheet 2)

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, oil pumps, hydraulic pumps, and tachometer generator.

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. Fuel flow is governed to maintain a constant engine speed at any throttle setting, regardless of airplane altitude or temperature conditions. Variations in compressor inlet air density are also compensated for in the system. The system consists of the following components: the engine-driven dual element fuel pump, 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 will drain fuel from the combustion chamber after shutdown or after a false start. A fuel flow transmitter is also a part of the system. Fuel enters the engine-driven pump under boost 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 requirement 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 cautious throttle manipulation. Therefore, there is no altitude or compressor inlet pressure or temperature compensation sensing nor is there any automatic control over engine acceleration or deceleration. The manual fuel control switch, located on the left-hand console, controls fuel selection (PRIMARY or MANUAL) through the three solenoid-operated valves located in the fuel control unit. The manual fuel control warning light (FUEL CONT ON MANUAL), located on the instrument panel, will illuminate whenever the manual fuel control switch is placed in the MANUAL position.

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 to prevent engine stalling and excessive engine pressures and temperatures. All metered engine fuel flow is controlled by varying the spring load on the 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.

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

FUEL FLOW DIVIDERS, FUEL NOZZLES, AND PRIMER NOZZLES. There are six fuel flow dividers, each of which supplies six of the 36 fuel nozzles symmetrically located in the annular combustion chamber. The fuel from the nozzles, in turn, 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 and the position of the throttle.

FUEL CUTOFF VALVE. The fuel cutoff valve is an integral unit of the fuel control unit and is controlled through throttle lever movement. With the throttle lever in the OFF position, the cutoff valve is closed and prevents fuel flow through the fuel control unit. Movement of the throttle lever out of the OFF position will open the valve. During starting, the cutoff valve is manually opened after 5 degrees of throttle movement with the pilot having no control of fuel flow from cutoff to IDLE throttle position. On airplanes having the J65-W-4B or J65-W-16A engine, or engines incorporating the 190544-2 fuel control, the pilot can manually monitor the fuel flow during starting. It is possible by throttle movement to meter the fuel flow through the cutoff valve from the IDLE position half-way back to the cutoff position if maximum exhaust gas temperature is anticipated or obtained during starting. During manual fuel system operation, the fuel regulator cutoff valve manually controls, through the throttle lever action, the fuel flow to the combustion chamber.

MANUAL FUEL CONTROL SWITCH. The manual fuel control switch (22, figure 1-6) is a two-position switch, PRIMARY and MANUAL, which is located on the left-hand console, inboard of the throttle quadrant. With the switch in the PRIMARY position, delivery of regulated fuel to the burners is a function of the throttle position and the regulator, governor, and compensating systems of the fuel control unit. Placing the switch in the MANUAL position will energize three solenoid-operated valves which will by-pass the regulator, governor, and compensating systems in the fuel control unit and thereby provide for unregulated fuel only. Delivery of fuel to the burners from the MANUAL position of this switch is controlled by throttle position only.

MANUAL FUEL CONTROL WARNING LIGHT. The manual fuel control warning light (7, figure 1-5) is located on the instrument panel and will illuminate

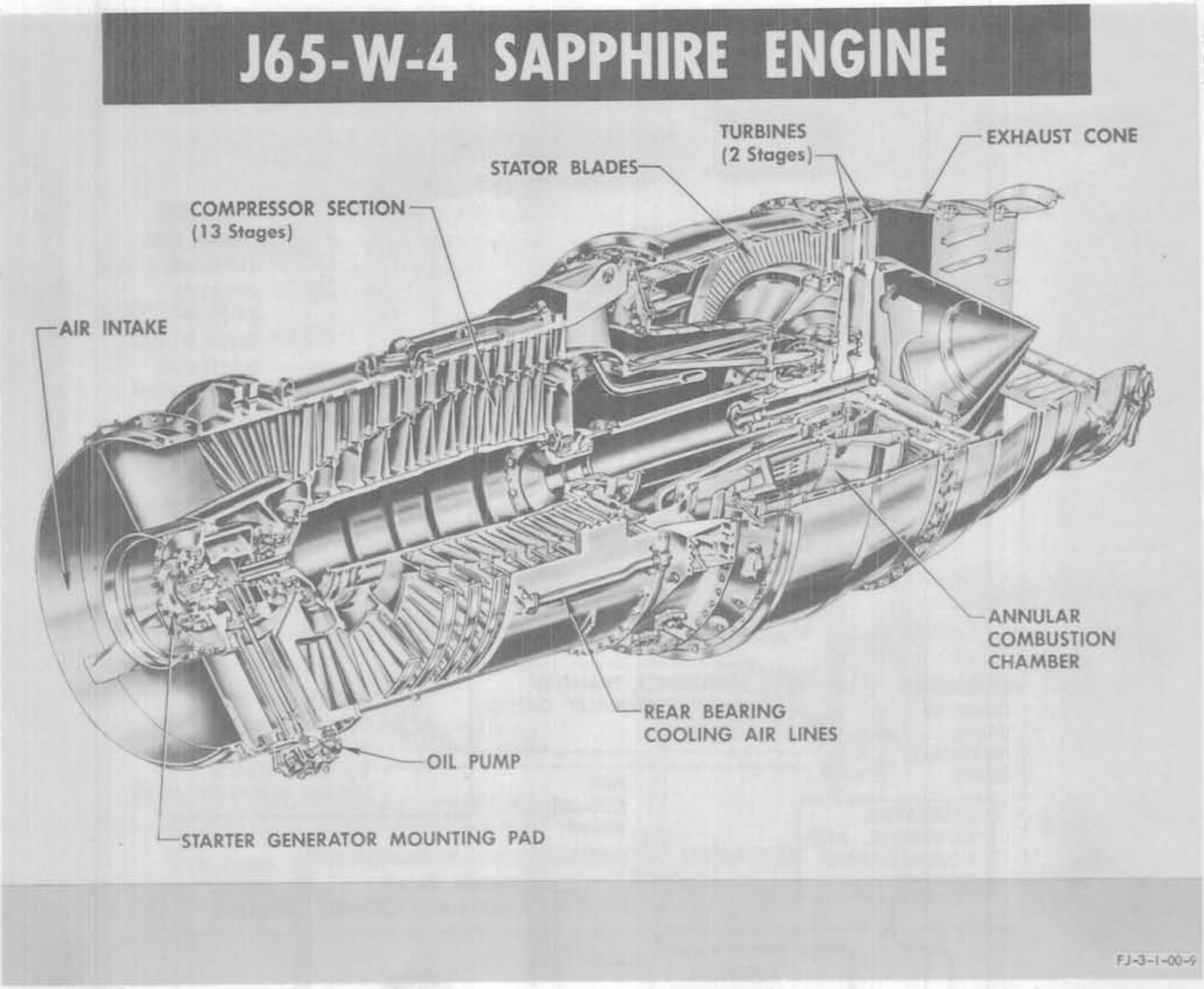


Figure 1-3.

FUEL CONT ON MANUAL when the fuel control switch is placed in the MANUAL position. This will indicate that delivery of fuel to the burners is non-compensated and controlled only by careful throttle movement.

STARTER SYSTEM.

The starting system is composed 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 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 18% 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 amps for starting, it is not possible to ground start the engine without an external supply of power. In addition a 28-volt d-c power source must also be connected to the second external receptacle to provide power for the airplane's electrical system. However, the aircraft is able to start without a 28-volt external power source but should only be attempted when the source *is not* available. When attempting air starts above 23% engine rpm, 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.

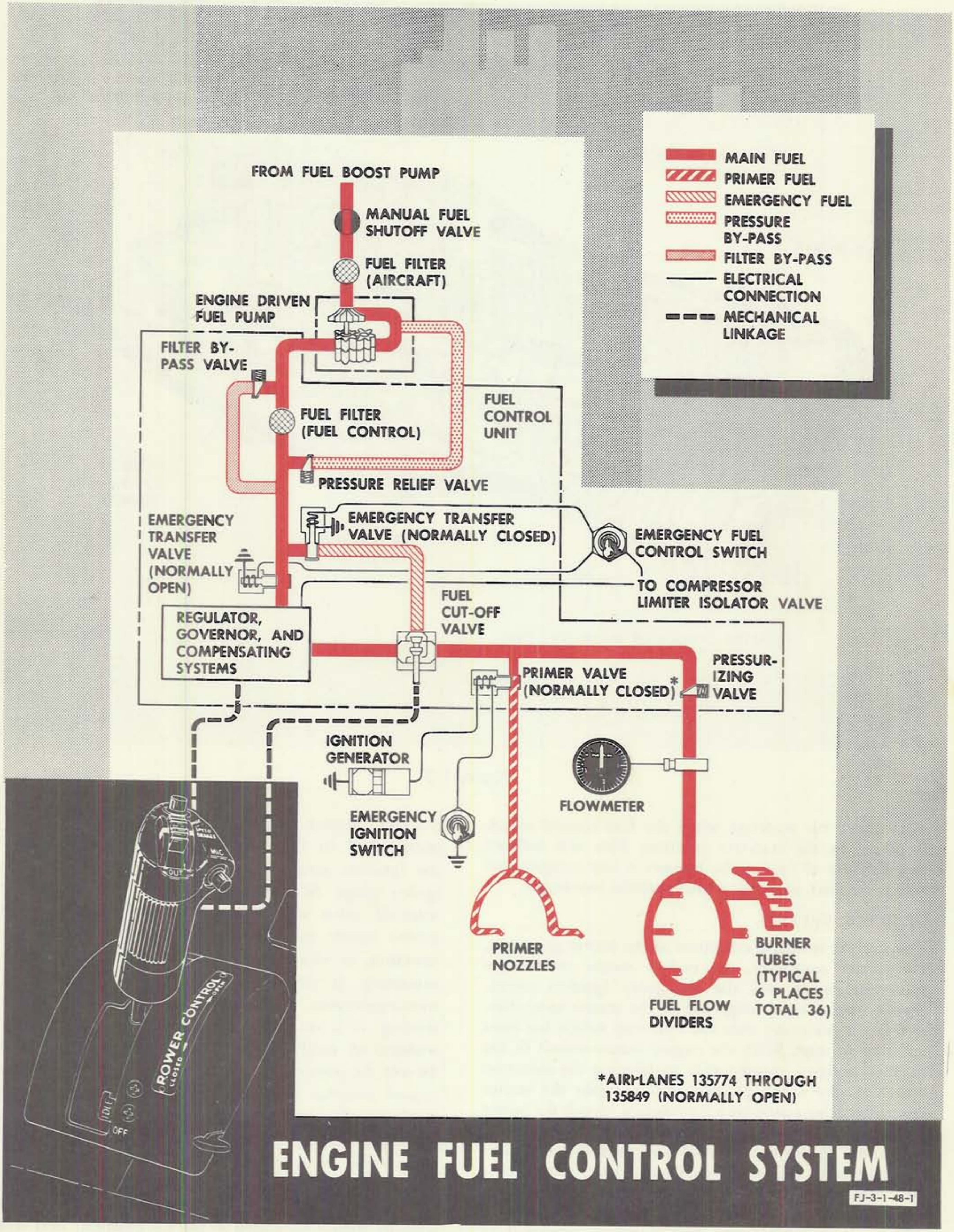

MAIN FUEL
PRIMER FUEL
EMERGENCY FUEL
PRESSURE BY-PASS
FILTER BY-PASS
ELECTRICAL CONNECTION
MECHANICAL LINKAGE
FROM FUEL BOOST PUMP
MANUAL FUEL SHUTOFF VALVE
FUEL FILTER (AIRCRAFT)
ENGINE DRIVEN FUEL PUMP
FILTER BY-PASS VALVE
FUEL FILTER (FUEL CONTROL)
FUEL CONTROL UNIT
PRESSURE RELIEF VALVE
EMERGENCY TRANSFER VALVE (NORMALLY CLOSED)
EMERGENCY FUEL CONTROL SWITCH
EMERGENCY TRANSFER VALVE (NORMALLY OPEN)
TO COMPRESSOR LIMITER ISOLATOR VALVE
FUEL CUT-OFF VALVE
REGULATOR, GOVERNOR, AND COMPENSATING SYSTEMS
PRIMER VALVE (NORMALLY CLOSED)*
PRESSUR-IZING VALVE
IGNITION GENERATOR
FLOWMETER
EMERGENCY IGNITION SWITCH
PRIMER NOZZLES
BURNER TUBES (TYPICAL 6 PLACES TOTAL 36)
FUEL FLOW DIVIDERS
*AIRPLANES 135774 THROUGH 135849 (NORMALLY OPEN)
POWER CONTROL
OPEN
CLOSED
IDLE
OFF
OUT
ENGINE FUEL CONTROL SYSTEM
FJ-3-1-48-1

Figure 1-4.

Note

In case of emergency only, the airplane may be started without the 28-volt, external servicing power by placing the battery-generator switch in either the BAT. & GEN (preferably) or the BAT. ONLY position. This procedure supplies no servicing power from the airplane battery and should not be used when external servicing power is available.

STARTER-GENERATOR.

A 400-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 18%, at which time it will automatically kick out the external power source from its circuit. The starter-generator is designed as a soft start, constant-current starting motor, operating from a variable voltage, constant-current power source. The power source provides an initial voltage of not greater than 8 volts and an initial current of 1000 amperes to the starter. As the starter motor accelerates, the current is maintained at 1000 amperes until the voltage reaches 30 volts, at which time the current begins to reduce to 200 to 250 amperes, where it is then cut off by an undercurrent relay. As the current is reducing from 1000 amperes, the terminal voltage increases until it is 34 volts at the time of starter cutoff. Above the 18% rpm the unit will function as a generator incorporating the conventional type of voltage regulator and reverse-current cutout.

Note

In the event a Navy type constant current power supply is not available, a power source having the following characteristics may be used. The supply voltage should be maintained at 28 volts until the starting contactor closes. The resultant high transient inrush of current should be limited to 1200 (+0/−180) amperes. As the start progresses, the voltage builds up to approximately 35 volts, while the current tapers off to 235 (±15) amperes, at which time the starter-controller relay normally drops out the starter contactor.

The generator will deliver rated power at approximately 36% rpm.

STARTER SYSTEM CONTROLS.

ENGINE MASTER SWITCH. When external power is connected, moving a guarded engine master switch (19, figure 1-6), on the left forward console, to MASTER completes electrical circuits which start the fuel booster pumps and provide power to the start-stop switch for starting. Ignition is required only during starting as the fuel mixture will burn continuously once it is ignited. Current for ignition is supplied by the ignition generator when the engine is rotating at more than 10% rpm or less than 23% rpm and the throttle is advanced from the OFF position.

START-STOP SWITCH. A guarded three-position switch, marked START, OFF, and STOP, is located on the left console and spring-loaded to the center (off) position. When the switch is momentarily placed at START the starter is actuated and continues to be energized through a holding relay until the engine reaches approximately 18% 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 the current to the starter. Since the starter will automatically cut out at approximately 18% engine rpm, the start-stop switch should not be used to disengage the starter after normal start.

EMERGENCY IGNITION SWITCH. The two-position emergency ignition switch, located on the left-hand console, should be placed to the OFF (normally closed) position for normal operation. Normally, this switch is not used except where a start is attempted when the engine is windmilling above 23% rpm (1900 rpm). In starting airplanes having a normally closed primer valve, the primer solenoid valve is energized to the open position and fuel flows through the valve until the engine reaches a speed of approximately 23% rpm. In airplanes having a normally open primer valve, fuel flows through the valve until the engine reaches a speed of approximately 23% rpm. When the engine rpm is in excess of approximately 23% rpm during normal operation, the ignition generator centrifugal switches will close and energize the primer solenoid valve to a closed position. This will shut off the primer fuel and ignition for all power settings above approximately 23% rpm. The emergency ignition switch provides the ground for this primer solenoid circuit. During attempted emergency air starts above 23% rpm, some method must be provided to break the primer solenoid circuit so that the primer solenoid is opened and the igniter plugs are functioning. This is accomplished when the emergency ignition switch is placed in the ON position.

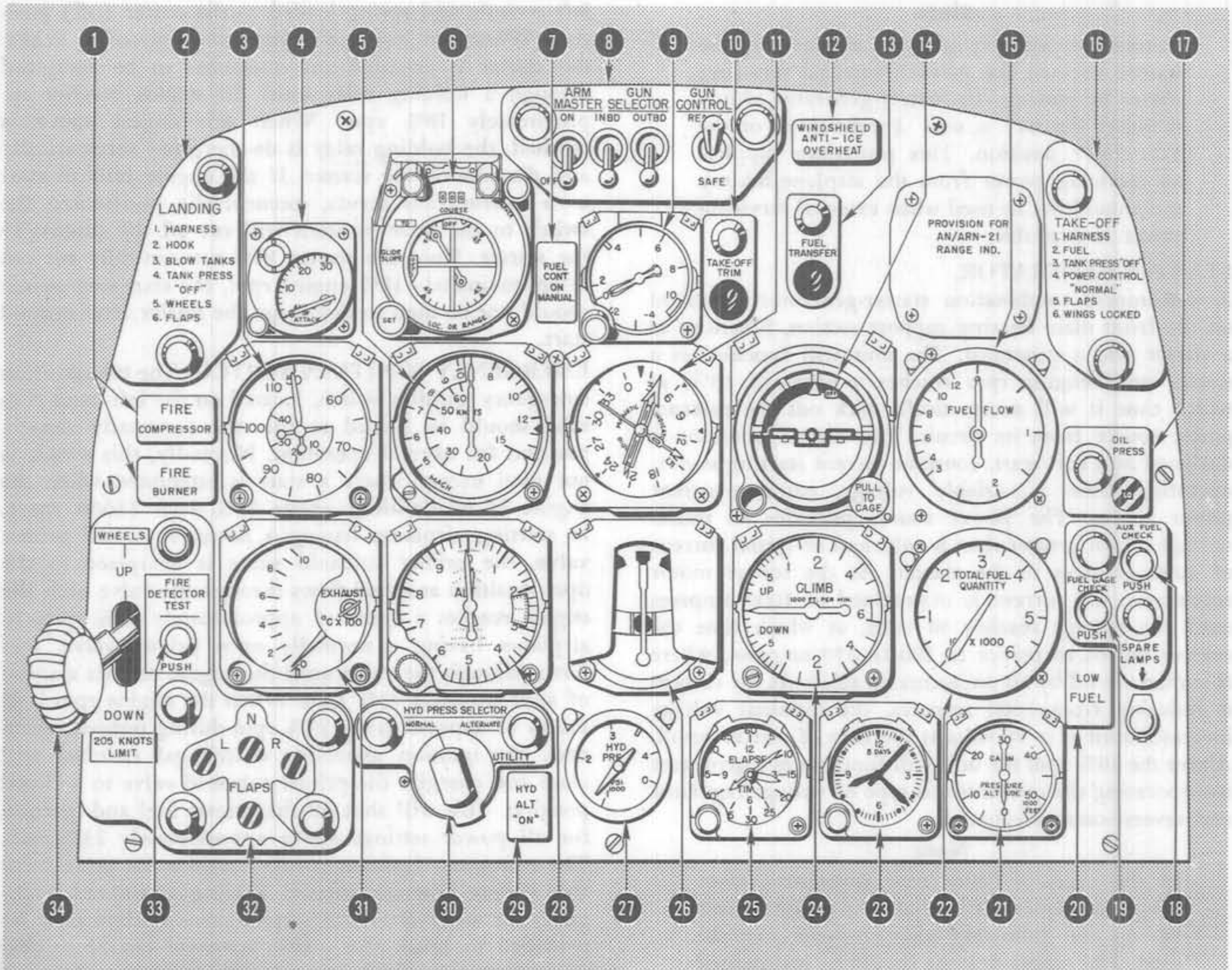
CAUTION

If the emergency ignition switch is used, move switch to OFF as soon as start is accomplished to prevent overtemperatures, possible burning of plugs, hot streaks on combustion chamber, and burning out of the igniter unit.

ENGINE CONTROLS.

THROTTLE (POWER CONTROL).

Engine power is controlled by the throttle which is located in a quadrant on the left console. The throttle 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 (23, 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



INSTRUMENT PANEL

AIRPLANES 135774 THROUGH 141363

1. **Engine Fire Detector Warning Lights**
2. **Landing Check List**
3. **Tachometer**
4. **Angle-of-attack Indicator**
5. **Airspeed-Mach Number Indicator**
6. **Course Indicator**
7. **Manual Fuel Control Warning Light**
8. **Gun Control Panel**
9. **Accelerometer**
10. **Take-off Trim Indicator**
11. **Radio Magnetic Course Indicator**
12. **Windshield Anti-ice Overheat Light**
13. **Fuel Transfer Indicator**
14. **Gyro Horizon Indicator**
15. **Fuel Flowmeter**
16. **Take-off Check List**
17. **Oil Pressure Indicator**
18. **Auxiliary Fuel Check Switch**
19. **Fuel Gage Check Switch**
20. **Low Fuel Level Warning Light***
21. **Cabin Pressure Altitude Indicator**
22. **Fuel Quantity Indicator**
23. **Clock**
24. **Rate-of-climb Indicator**
25. **Elapsed-time Clock**
26. **Turn-and-bank Indicator**
27. **Hydraulic Pressure Indicator**
28. **Altimeter**
29. **Hydraulic Alternate System "ON" Light**
30. **Hydraulic Pressure Selector**
31. **Tail-pipe Temperature Indicator**
32. **Landing Gear and Flap Position Indicator**
33. **Fire Detector Test Switch**
34. **Landing Gear Control**

*DISCONNECTED AND PLACARDED "THIS LIGHT NOT USED" PENDING REDESIGN OF SYSTEM

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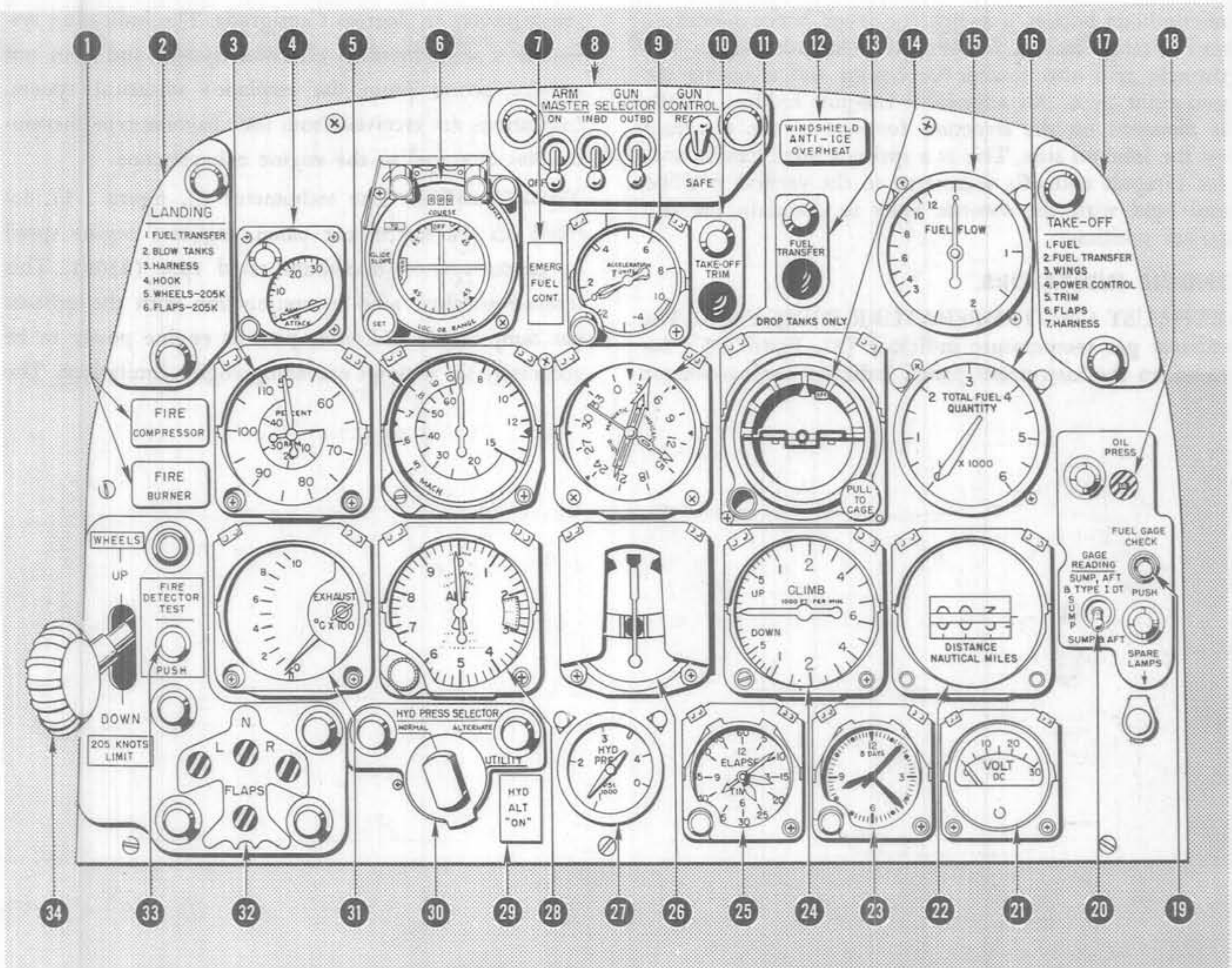
Figure 1-5.



INSTRUMENT PANEL

AIRPLANES 136118 AND 141364 AND SUBSEQUENT

1. Engine Fire Detector Warning Lights
2. Landing Check List
3. Tachometer
4. Angle-of-attack Indicator
5. Airspeed-Mach Number Indicator
6. Course Indicator
7. Manual Fuel Control Warning Light
8. Gun Control Panel
9. Accelerometer
10. Take-off Trim Indicator
11. Radio Magnetic Course Indicator
12. Windshield Anti-ice Overheat Light
13. Fuel Transfer Indicator
14. Gyro Horizon Indicator
15. Fuel Flowmeter
16. Fuel Quantity Indicator
17. Take-off Check List
18. Oil Pressure Indicator
19. Fuel Gage Check Switch
20. Fuel Gaging Switch
21. Voltmeter
22. AN/ARN-21 Range Indicator
23. Clock
24. Rate-of-climb Indicator
25. Elapsed-time Clock
26. Turn-and-bank Indicator
27. Hydraulic Pressure Indicator
28. Altimeter
29. Hydraulic Alternate System "ON" Light
30. Hydraulic Pressure Selector
31. Tail-pipe Temperature Indicator
32. Landing Gear and Flap Position Indicator
33. Fire Detector Test Switch
34. Landing Gear Control

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Figure 1-5A.

microphone button, a switch for speed brake operation, and a range button for the APG-30 radar sight. The throttle grip also rotates for caging and uncaging the gun sight 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, for catapult take-offs, is rotated to the vertical position and held with the throttle lever to maintain the full power position.

ENGINE INDICATORS.

EXHAUST GAS TEMPERATURE INDICATOR. The exhaust gas temperature indicator (31, figure 1-5), located on the instrument panel, indicates engine exhaust temperatures in degrees Centigrade. The indicating system is a self-generated electrical system 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.

TACHOMETER. The tachometer (3, figure 1-5), located on the instrument panel, registers engine speed in percentage of maximum rated rpm (8300). This indication when used in conjunction with the exhaust gas 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. The engine rpm "red line" is 101%.

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 2.5 U.S. gallons with a usable capacity of 2.38 U. S. gallons. On some airplanes,* a 3.0 U. S. gallon capacity tank is installed having 2.88 U. S. gallon usable capacity. One gear-type pressure pump, a gear-type scavenger pump, and two piston-type oil meter 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 accessory gear box, after which it is scavenged and returned to the oil tank. The accessory gear box is lubricated by interconnection to the scavenger 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 is then vented overboard. The system is so designed that the pilot has no direct control over it other than observing the oil pressure indicator. The normal oil consumption for this engine is 0.4 gallons per hour. Oil grade and specifications are noted in figure 1-19.

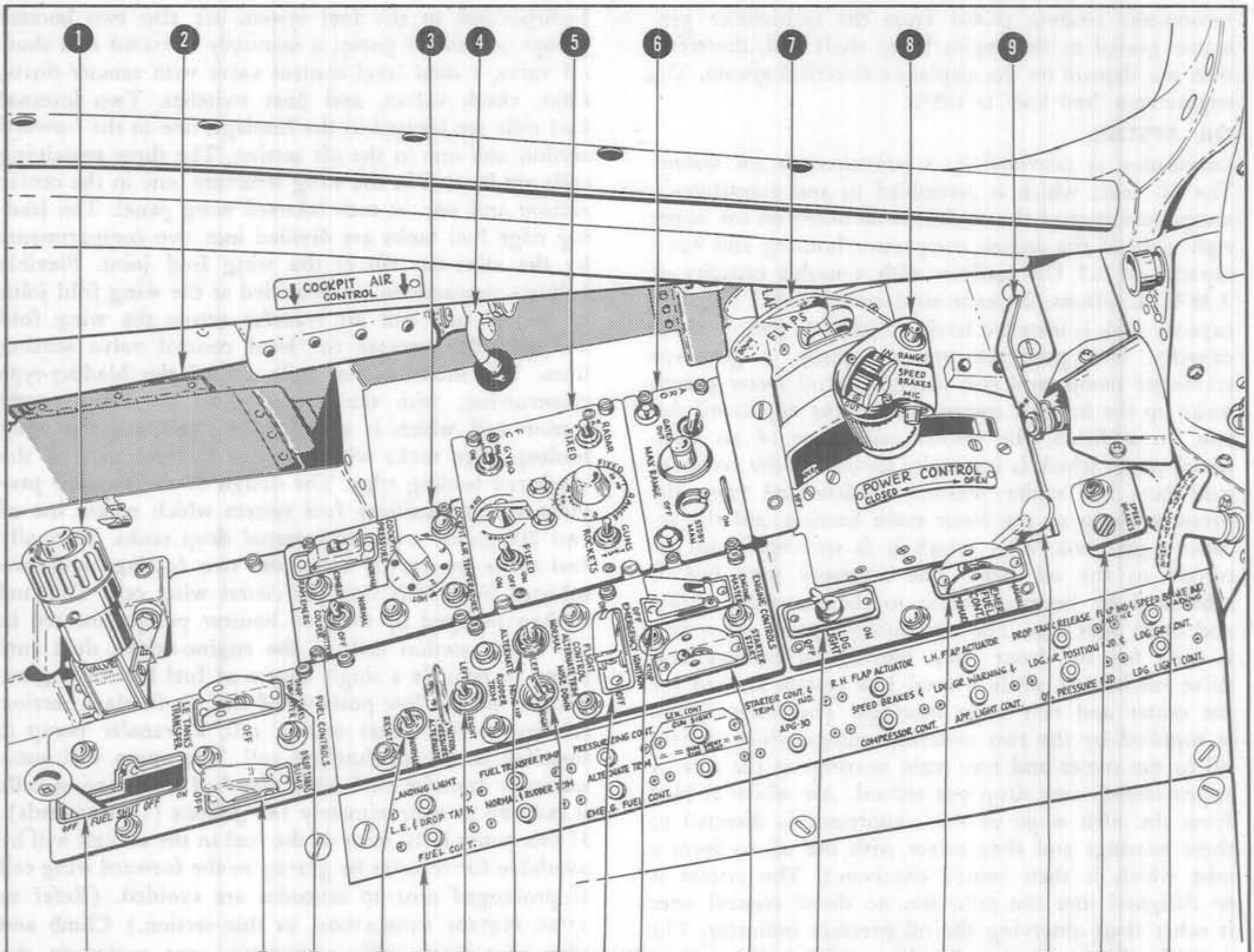
OIL PRESSURE INDICATOR.

A three-position "barber pole" type oil pressure indicator is located at the extreme right-hand side of the instrument panel. (See 17, figure 1-5.) The three indicated positions are marked LO, N, and HI. With the oil pressure below 15‡ psi, the indicator will read LO on the barber pole background, oil pressure ranging from 15‡ to 40 psi will indicate N (normal) on a blue background, while any pressure in excess of 40 psi will indicate a HI on a barber pole background. During ground idle operation, the oil pressure indicator may read LO since approximately 45% of maximum rpm (3735) is required to raise the oil pressure to the normal range. The oil pressure indicator will read LO if the engine is in the idle setting or when the primary bus is not energized.

FUEL SYSTEM.

The main fuel system (figure 1-8) includes five internal fuel cells and on some airplanes,† two integral fuel tanks are also contained in the wing leading edges. Incorporated in the fuel system are also two booster pumps, a transfer pump, a manually operated fuel shutoff valve, a dual level control valve with remote floats, filter, check valves, and float switches. Two internal fuel cells are located in the fuselage, one in the forward section and one in the aft section. The three remaining cells are located in the wing structure, one in the center section and one in each inboard wing panel. The leading edge fuel tanks are divided into two compartments by the close-out rib at the wing fold joint. Flexible bellows connections are provided at the wing fold joint to permit fuel and air transfer across the wing fold and provide passages for level control valve sensing lines. The internal fuel cells are of the bladder-type construction, with the exception of the wing center section cell which is a self-sealing cell and the wing leading edge tanks which are an integral part of the cambered leading edge. The design of the airplane provides for an auxiliary fuel system which makes use of two 200-gallon capacity external drop tanks. Normally fuel flows by gravity from the two fuselage and two inboard wing cells into the center wing cell. The fuel is then pumped by the two booster pumps, located in the center section cell, to the engine-driven dual fuel pump to provide a single source of fuel for the engine. Because of the low position of the aft fuselage section relative to the center section cell, a transfer pump is installed in the aft fuselage cell. The pump will automatically transfer fuel when the fuel in the wing cells is reduced to approximately 188 gallons (1128 pounds). If this pump fails, most of the fuel in the aft cell will be available for transfer by gravity to the forward wing cell if prolonged nose-up attitudes are avoided. (Refer to FUEL SYSTEM INDICATORS, in this section.) Climb and dive vent lines, with a common vent outlet on the fuselage aft left side, maintain the proper cell internal pressure during all flight conditions. The main fuel supply for this airplane may be supplemented with two combat-type auxiliary drop tanks which are externally attached to the wing, inboard of the wing fold break. The tanks are interconnected with the aft fuselage and the two inboard wing cells by making use of the single-point refueling lines. Transfer of fuel is accomplished by air pressure diverted from the windshield anti-ice and defrosting system. The drop tanks which may be electrically or mechanically released are provided with dump valves (Type I drop tanks only) to facilitate fuel jettisoning. The wet leading edge fuel transfers from the outboard compartment of the wet leading edge by gravity flow through the flexible bellows at the wing fold to the inboard compartment. Fuel is transferred by air pressure to the drop tank fuel transfer line from where it flows into the single-point refueling system of the airplane. All fuel delivered to the engine must flow through the center wing cell. Normally flight sequencing begins with take-off on internal fuel from the forward fuselage and

***Airplanes 136008 and subsequent and airplanes having Service Change No. 283 complied with**
†Airplanes 136118 and subsequent and airplanes having Service Change No. 138 complied with
‡Airplanes 136135 and subsequent



LEFT-HAND CONSOLE

1. Anti-G Suit Regulator Valve
2. Map Case
3. Cockpit Air Temperature Control Panel
4. Cabin Air Deflector Control
5. AFCS Control Panel
6. Radar Set Control Panel
7. Wing Flap Control
8. Throttle
9. Throttle Catapult Handle
10. Fuel Shutoff Control
11. Drop Tank Fuel Dump Switch
12. Drop Tank Transfer Switch
13. Flight Control System Selector Switch
14. Circuit-breaker Panel
15. Rudder Trim Switch
16. Trim Control Selector Switch
17. Stabilizer-aileron Alternate Trim Switch
18. Emergency Ignition Switch
19. Engine Master Switch
20. Starter Start-stop Switch
21. Landing Light Switch
22. Emergency Fuel Control Switch
23. Throttle Friction Lock
24. Speed Brake Position Indicator
25. Manual Emergency Change-over Handle

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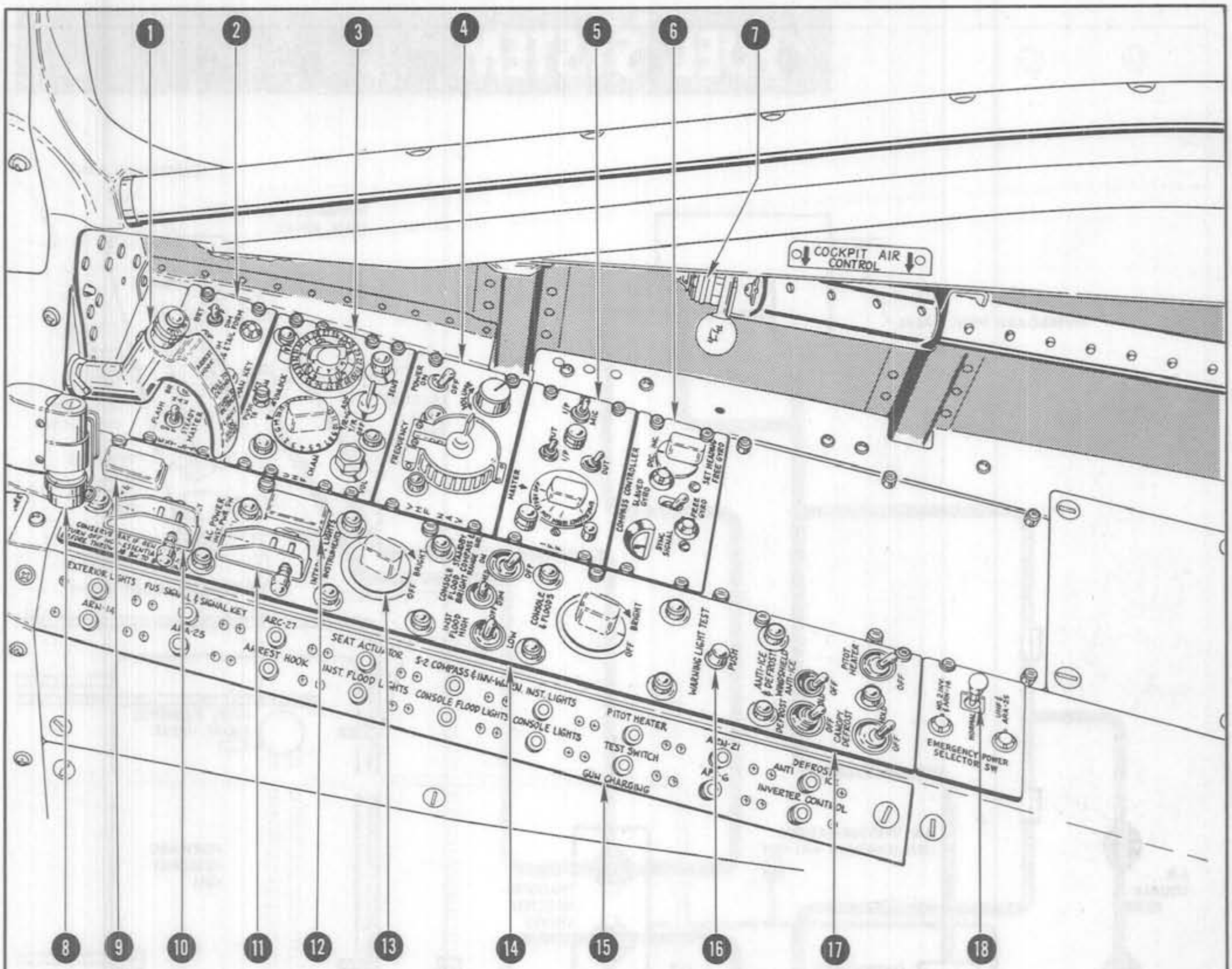
Figure 1-6.



RIGHT-HAND CONSOLE

1. Arresting Hook Control
2. Exterior Lighting Control Panel
3. UHF Communications Control Panel
4. VHF Navigation Control Panel
5. IFF Control Panel
6. Gyrosyn Compass Control Panel
7. Cabin Air Deflector Control
8. Cockpit Light
9. Generator Warning Light
10. Battery and Generator Switch
11. Instrument Power Switch
12. Inverter Warning Light
13. Interior Light Rheostat
14. Interior Light Control Panel
15. Circuit - breaker Panel
16. Warning Light Test Switch
17. Anti - ice and Defrost Panel
18. Emergency Power Selector Switch*

*AIRPLANES HAVING SERVICE CHANGE NO. 381 COMPLIED WITH

FJ-3-1-00-11A

Figure 1-7.

FUEL SYSTEM

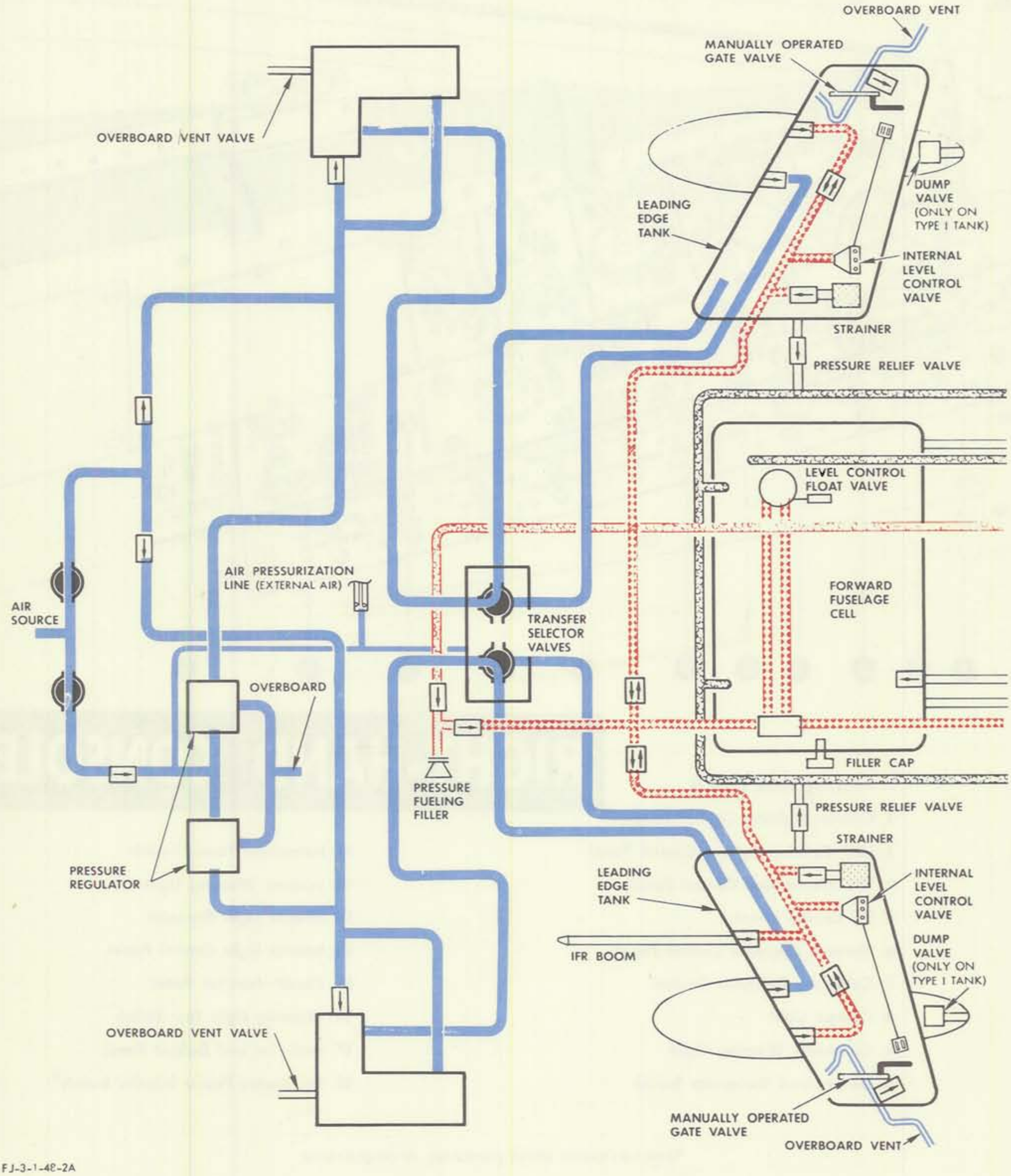
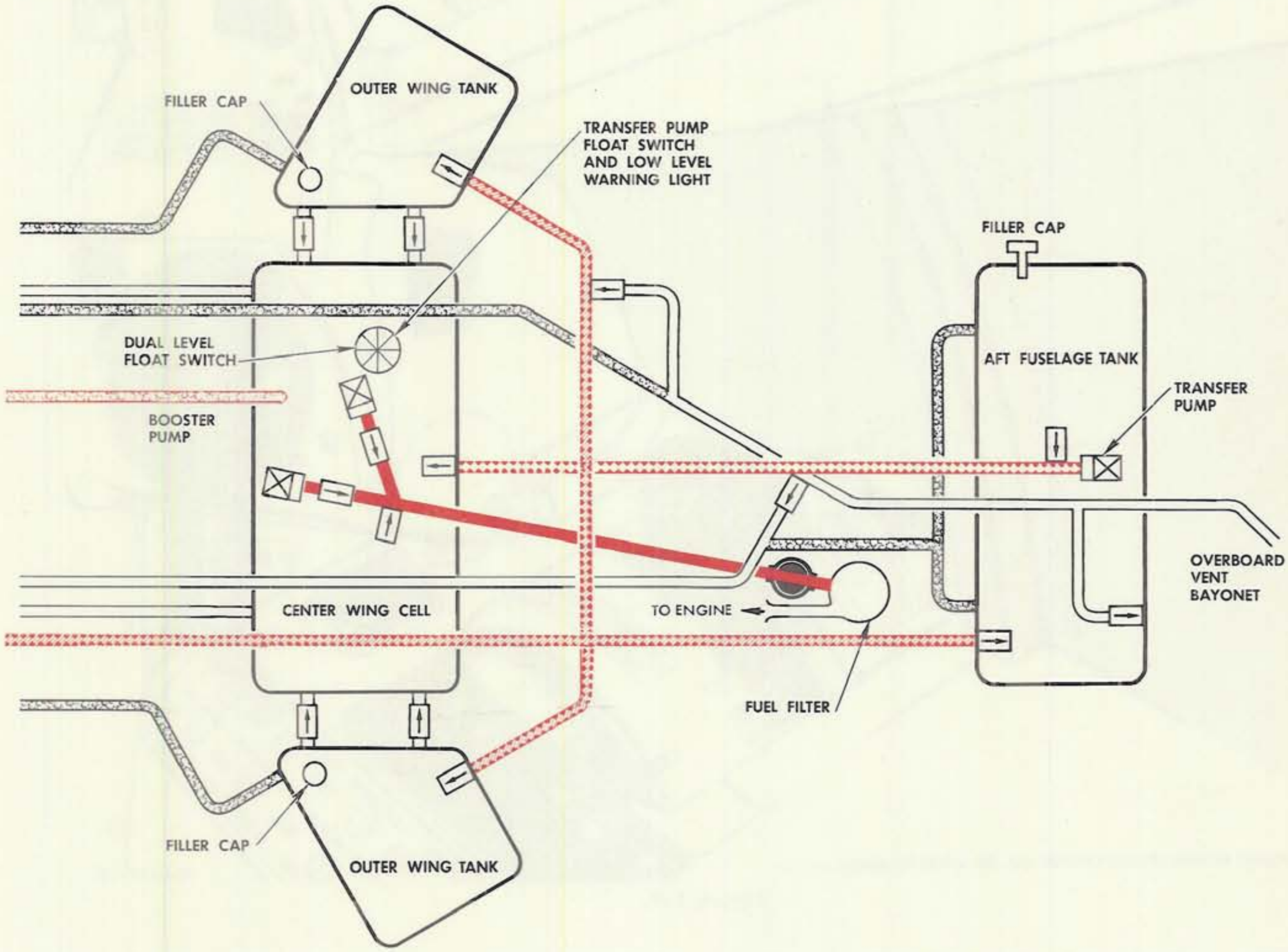


Figure 1-8. (Sheet 1)

[redacted]



NOTE: The check valve in the drop tank transfer line will be held open when type II drop tanks are installed, with type I drop tanks or no tanks the valves will close.

The check valve in the air supply line will be closed if no drop tanks are installed, and open if either type I or type II drop tanks are installed.

Only type I drop tanks have dumping provisions.

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Figure 1-8. (Sheet 2)

LEFT FORWARD CONSOLE

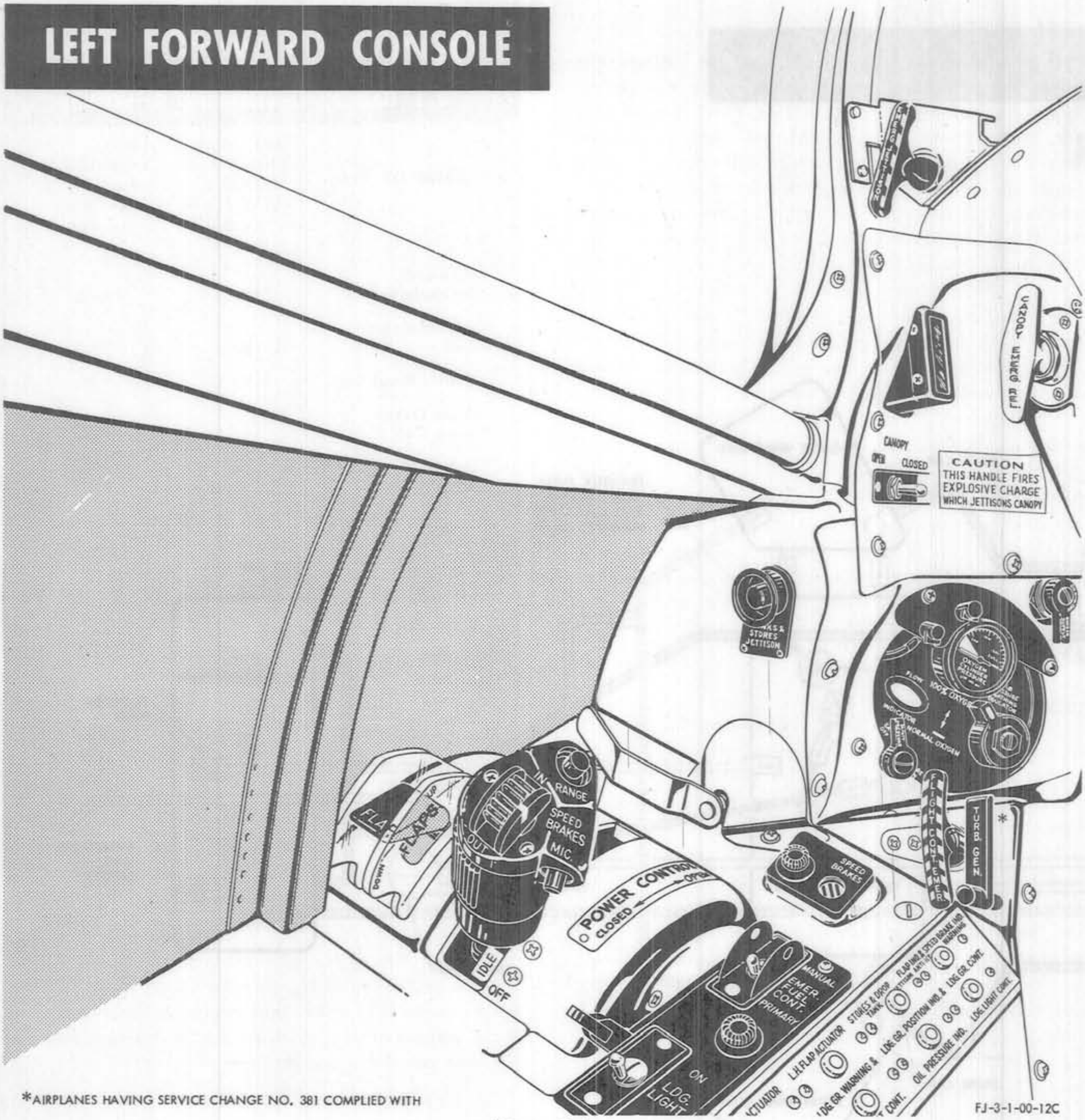

Figure 1-9.

aft fuselage cells. Once the aircraft is air-borne and the auxiliary fuel transfer system is placed into operation, auxiliary fuel will be delivered to the center and aft fuselage and two inboard wing cells through the single-point refueling lines. Through interconnecting lines this auxiliary fuel will also replenish the fuel supply in the center wing cell. Wet leading edge fuel is also transferred this way. The dual level control valve will shut off auxiliary fuel when the forward fuselage cell is full to prevent overflow of fuel overboard. After all drop tank fuel and wet leading edge fuel has been transferred to the internal fuel system, continued engine operation will then deplete the forward fuselage cell. The inboard and center wing cells and the aft fuselage cell will continue to supply the engine with fuel until a predetermined level is reached in the wing center section. At this time the transfer pump is energized to pump fuel from the aft fuselage cell to the center wing cell. This transfer pump continues operating until all of the aft fuselage fuel has been depleted. Remaining fuel in the two inboard and center wing cells will continue to supply fuel. There are no provisions in the fuel system for fuel pressure indication. Fuel tank capacities are shown in figure 1-10.

FUEL DUMPING.

Fuel from the auxiliary drop tanks (Type I drop tanks only) may be dumped, when necessary, by placing the fuel dump valve switch, located on the left-hand console, in the DUMP position. This will energize the two electric dump valve actuators which will open the valves. Travel of both dump valve actuators to the full open position will energize the dump system air pressure shutoff valve to the open position and energize the fuel transfer air selector valve to the DROP TANK TRANSFER position. Air pressure from the windshield anti-icing and defrosting system is automatically routed directly to the tanks allowing the fuel to be dumped overboard through the dump lines. The system is designed so that each tank will dump fuel at the rate of approximately 100 gallons per minute at 150 knots IAS, at sea level. Returning the fuel dump valve switch to the OFF position will close the air pressure shutoff valves, de-energize the fuel transfer air selector valve, and energize the two electric actuators to close the dump valves. The switch should be in OFF before landing. On some airplanes,* a safety switch is actuated into the open position when the airplane's weight is on the landing gear to prevent jettisoning of fuel while the airplane is on the ground.

FUEL BOOSTER PUMPS.

Two submerged-type booster pumps are installed in the center wing fuel cell. The forward pump is powered by the monitored bus while the aft pump is powered by the primary bus. These pumps operate continuously when the engine master switch is in the ON position. In the event of generator failure, the forward boost pump will become inoperative. The aft booster pump, however, will continue to operate and provide sufficient fuel flow to the engine-driven fuel pump for normal operation. Due to nose high attitudes in landing approaches, the forward booster pump may be above the fuel surface and cause fuel starvation. Therefore, on some airplanes,† when the landing gear is extended, the forward booster pump is automatically turned off. As the landing gear is raised, the forward booster pump is automatically turned on. Two momentary-type toggle switches, located aft of the pilot's seat on the canopy deck, are used to ground-check the booster pumps.

TRANSFER PUMP.

The transfer pump, located in the aft fuselage cell, pumps through a connecting line to the center wing cell. Control of the pump is accomplished by two float switches, one located in the wing center section fuel cell and the other located in the forward fuselage fuel cell. Initial actuation of the transfer pump takes place at a predetermined level, when the center wing cell float drops, closes the switch and energizes the pump. The pump will continue operating until the forward fuselage cell float switch is opened.

FUEL QUANTITY DATA

U. S. GALLONS (SINGLE-POINT REFUELING)

TANK OR CELL	FUEL AVAILABLE TO ENGINE IN LEVEL FLIGHT GALLONS	FUEL CAPACITY FULLY SERVICED GALLONS
Forward Fuselage Cell	134.3	134.3
Aft Fuselage Cell	88.7	89.0
Center Wing Cell	75.8	77.0
Right Outer Wing Cell	68.4	72.0
Left Outer Wing Cell	68.4	72.0
Right Leading Edge Cell (estimated)	55.0	62.4
Left Leading Edge Cell (estimated)	55.0	62.4
Right Drop Tank	200.0	200.2
Left Drop Tank	200.0	200.2
Total Fuel With Drop Tanks	945.6	969.5
Total Fuel Without Drop Tanks	545.8	569.1

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Figure 1-10.

FUEL SYSTEM CONTROLS.

FUEL SHUTOFF VALVE. A lever (10, figure 1-6), located on the aft end of the left console, mechanically controls the fuel shutoff valve. Forward movement of the lever opens the valve and aft movement of the lever closes the valve. To ensure that the fuel shutoff valve remains open, the lever must be moved full forward, then moved to the left and slightly aft to the detent position. When closing the fuel shutoff valve, ascertain that the fuel shutoff control is positively placed

***Airplanes 135776 through 135784 and 135787 through 135812 not having Service Change No. 138 complied with**

†Airplanes 136043 and subsequent and airplanes having Service Change No. 294 complied with

in the full closed position. Under no condition should the handle be left in a midway position.

WARNING

Do not move the fuel shutoff valve control lever to OFF before the engine stops rotating. If the fuel shutoff valve is closed when the engine-driven fuel pump is operating, the fuel line between the shutoff valve and the pump may collapse due to pump suction.

LEADING EDGE AND DROP TANK TRANSFER SWITCH.* A shielded three-position toggle switch replaces the present two-position switch on some airplanes. Located on the aft section of the left console, this switch controls the air pressure from the windshield anti-icing and defrosting system to the auxiliary drop tanks and wet leading edge. When the switch is in TRANSFER or on some airplanes‡ in the L. E. TANK TRANSFER or DROP TANKS TRANSFER position, fuel is directed from the auxiliary drop tanks or wet leading edge under air pressure to the two inboard wing cells and to the center and aft fuselage cells. When drop tanks are installed, the switch should be placed in the DROP TANKS TRANSFER position as soon after take-off as possible so that, in the event that it becomes necessary to jettison the drop tanks, all possible auxiliary fuel will have been used. The switch may be left in either TRANSFER position after tanks are empty to allow purging of the tanks. Overloading the main fuel cells by transferring the auxiliary fuel is prevented by the fuel level control valve.

Note

If the leading edge tanks are empty when transferring drop tank fuel, the integral fuel level valve in the leading edge tanks will allow fuel to partially fill the leading edge tanks before transferring fuel to the main fuel cells. Therefore, to utilize all auxiliary fuel after the drop tanks are empty, place the leading edge and drop tank transfer switch in the L. E. TANK TRANSFER position.

DROP TANK RELEASE BUTTON. Both drop tanks may be released simultaneously by a button located forward of the throttle quadrant (figure 1-9). Depressing the release button energizes the two drop tank release solenoids to release the tanks. A safety switch is actuated into the open position when the airplane's weight is on the landing gear to prevent inadvertent drop tank release while the airplane is on the ground.

EMERGENCY DROP TANK RELEASE HANDLE. Both drop tanks may be mechanically released in the event the electrical release system becomes inoperative. By pulling the emergency drop tank release handle, located on the center pedestal, mechanical release is accomplished through a cable system. The cable system is independent of the electrical release system and is operative regardless of airplane position.

FUEL SYSTEM INDICATORS.

FUEL QUANTITY INDICATOR. A capacitance-type fuel indicator (22, figure 1-5), located on the instrument panel, indicates the total amount of fuel in pounds, including the fuel in the Type I drop tanks. However, if the drop tank transfer switch is not turned on or if the system fails and the fuel level in the forward fuselage cell drops below 48.5 gallons, a dummy (empty) capacitance will be switched in to replace the capacitance units in the drop tanks and the drop tank fuel will not be included in total available fuel on the gage. At any time, however, the pilot can actuate the auxiliary fuel check switch (18, figure 1-5), located to the right of the indicator, which will temporarily add in the quantity of fuel remaining in the drop tanks (Type I drop tank only). If the transfer switch is in TRANSFER and due to a malfunction fuel is not transferring, the fuel quantity indicator will show the drop tanks have stopped transferring in normal nose-up attitude of 4 degrees when the fuel in the internal cells has reached 2300 pounds. At a nose-up attitude of 14 degrees, it will be 2100 pounds and will continue to read only internal fuel thereafter unless the auxiliary fuel check switch is depressed. In some airplanes,† a three-position switch is installed to permit selective gaging of the total fuel carried, except the wet leading edge and Type II drop tanks which are not gaged. The switch positions are as follows:

SELECTOR SWITCH POSITION	FUEL CELLS GAGED
SUMP	**Forward fuselage, outboard wing (2) and center wing.**
SUMP & AFT	**Forward fuselage, outboard wing (2), center wing and aft fuselage.**
SUMP, AFT, & TYPE I D. T.	**Forward fuselage, outboard wing (2), center wing, aft fuselage and Type I drop tanks.**

SUMP and SUMP & AFT are hold positions while SUMP, AFT, & TYPE I D. T. position is momentary. A failure of the aft fuselage fuel transfer system will result in approximately 200 pounds of trapped aft fuel at an attitude of 4 degrees nose up and 500 pounds at an attitude of 14 degrees nose up. By selecting sump fuel quantity gaging, the pilot can read the minimum quantity of fuel

***Airplanes 136118 and subsequent and airplanes having Service Change No. 138 complied with**
†Airplanes 136118 and 141364 and subsequent and airplanes having Service Change No. 323 complied with
‡Airplanes 136118 and subsequent

available to the engine, thereby eliminating any uncertainties about the aft fuselage fuel transfer system while in prolonged nose high attitudes such as during field and carrier landing practice. With the switch in SUMP or SUMP & AFT positions, a malfunction of the auxiliary fuel transfer system is immediately indicated by a steady decrease in the gage reading.

FUEL TRANSFER INDICATORS.* Fuel gaging probes are not provided in either the wet leading edges or the Type II drop tanks. Fuel-air flow thermistor indicators are provided in each fuel transfer line to indicate the cessation of fuel transfer from the drop tanks. The indicators located on the right-hand side of the instrument panel (13, figure 1-5), will show a blank dial when fuel is being transferred from the drop tanks. When tanks are empty, the indicator will show "E." A barber pole type indicator will show when the switch is in the OFF position.

FUEL GAGE CHECK SWITCH. A push-to-test switch (19, figure 1-5), located on the instrument panel adjacent to the fuel quantity indicator, will cause the indicator hand to rotate when the button is depressed, thereby signifying that the indicator is receiving current.

FUEL LEVEL WARNING LIGHT. A warning light (20, figure 1-5), located on the lower right corner of the instrument panel, illuminates when the total wing fuel level is down to approximately 95 gallons (618 pounds, JP-4 fuel). The fuel level warning light is removed on some airplanes.†

Note

This light has been disconnected and placarded "THIS LIGHT NOT USED" pending redesign of the system.

FUEL FLOWMETER. The fuel flowmeter (15, figure 1-5), mounted on the instrument panel, is an autosyn type of 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 readings by 1000 will give the actual rate of fuel flow in pounds per hour.

ELECTRICAL POWER SUPPLY SYSTEM.

The airplane is equipped with a-c and d-c electrical power systems. The 28-volt d-c system is powered by a 400-ampere, engine-driven starter-generator. A 24-volt, 36-ampere-hour battery serves as a stand-by for d-c power. Direct current can also be supplied by an external source. Power for the alternating-current system is supplied by two three-phase inverters.

DIRECT-CURRENT ELECTRICAL POWER DISTRIBUTION.

Direct-current power (figure 1-11) is distributed from six electrical busses: battery, primary, monitored, secondary, canopy-and-battery, and armament. The battery bus is hot, regardless of the position of the battery-generator switch. The primary bus is energized by the battery when the battery-generator switch is at the BAT. ONLY or BAT. & GEN. position, or is energized directly when the generator is functioning or when external power is supplied. The secondary bus receives power through the primary bus and is energized when generator output is available, or when external power is connected to the No. 1 receptacle and the landing gear handle is down. It is also energized when the battery-generator switch is at BAT. ONLY, or when the switch is at BAT. & GEN. and the landing gear handle is down. The monitored bus is powered by the primary bus and is energized when generator output is available or when external power is connected to the No. 1 receptacle.

ALTERNATING-CURRENT ELECTRICAL POWER DISTRIBUTION.

Alternating-current power is supplied by the No. 1 three-phase inverter and the No. 2 three-phase inverter. The No. 1 inverter, which is the main source of a-c power, is controlled by the d-c monitored bus power and, therefore, will function only when the generator is operating or when an external power source is connected. With the instrument power switch (11, figure 1-7) in the No. 1 inverter position and the electrical system operating normally, the No. 2 inverter will power all primary bus a-c loads, including the flight instruments, the left- and right-hand gun power, the liquid oxygen system and the 26-volt a-c system which consists of the fuel, oil, fuel flowmeter, hydraulic pressure, RMI and gyro compass indicating systems. When in the No. 1 inverter position, the No. 1 inverter powers all other a-c loads, including main power for the cockpit air conditioning and pressurizing system, the defrosting and anti-icing system, the ARN-21 omni-range receiver, the Mark 16 Mod 5 aircraft fire control system, the APG-30 radar equipment, the APX-6B IFF equipment and missile power. If the inverter warning light illuminates, indicating that the No. 2 inverter is out, all functions of the No. 2 inverter are lost, that is, the flight instruments, the left- and right-hand gun power, the liquid oxygen system and the 26-volt a-c system, including the fuel, oil, fuel flowmeter, hydraulic pressure, RMI and gyro compass indicating systems are inoperative. To regain power to the primary bus a-c loads, position the instrument power switch to the NO. 2 position, thus placing the primary bus in parallel with the Mark 16 Mod 5 aircraft fire control system load from the No. 1 inverter through the wye-delta transformer. The inverter warning light goes out, indicating that power is being supplied to the primary bus. The No. 1 inverter operates in either position of the instrument power switch and supplies power to the monitored bus a-c loads at all times. In the NO. 2 position, the No. 1 inverter also takes over all primary bus a-c loads of the No. 2 inverter. If generator output fails, causing loss of the No. 1 inverter, all a-c loads controlled

***Airplanes 136118 and subsequent and airplanes having Service Change No. 138 complied with**
†Airplanes 136118 and 141364 and subsequent and airplanes having Service Change No. 323 complied with

by the a-c monitored bus will be lost. The inverter warning light will not illuminate, but erratic operation of the ARN-21 omni-range receiver (red signal flags indicating insufficient signal strength) and gun sight will indicate loss of the No. 1 inverter. Placing the instrument power switch in the NO. 2 position with the No. 1 inverter out will cause loss of all a-c power. Therefore, the instrument power switch should remain in the NO. 1 position so the No. 2 inverter will continue to power the primary bus a-c loads, providing power to the flight instruments, the left- and right-hand gun power, the liquid oxygen system and the 26-volt a-c system, including the fuel, oil, fuel flowmeter, hydraulic pressure, RMI and gyro compass indicating systems.

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 at the break point.

When external power is connected to the oval service receptacle, power is available to all the busses except the armament bus. The armament bus may be energized by actuating the ARM SAFETY DISABLE SWITCH. This switch is not available to the pilot and is actuated by the ground crew. Square starting receptacle provides power only to the engine starter. To provide adequate electrical power for starting the engine, external power must be connected to both receptacles.

ELECTRICAL SYSTEM CONTROLS.

STARTER, START-STOP SWITCH. Refer to STARTER SYSTEM CONTROLS in this section and see 20, figure 1-6.

BATTERY-GENERATOR SWITCH. A three-position battery-generator switch 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 a guard bar can be moved and the switch placed in BAT. ONLY to energize the secondary bus. 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.

INSTRUMENT POWER SWITCH. The instrument power switch, located on the forward right console, is positioned to select the source of a-c power. (Refer to ALTERNATING-CURRENT ELECTRICAL POWER DISTRIBUTION in this section and see figure 1-7.)

CIRCUIT BREAKERS. Most of the d-c electrical circuits are protected by push-to-reset type circuit breakers or circuit-breaker switches. Circuit-breaker panels (14, figure 1-6; 15, figure 1-7, and figures 1-12 and 1-13) accessible to the pilot are located on each side of the cockpit and center pedestal. All a-c circuits are protected by fuses. Those located on the center pedestal can be replaced in flight. Spare fuses are located on the pedestal.

AIR TURBINE GENERATOR — AIRPLANES HAVING SERVICE CHANGE NO. 381 COMPLIED WITH.

An air-driven generator, located on the right side of the fuselage just aft of the canopy, provides electrical power in case of engine seizure or generator failure. The generator retracts into the fuselage when not in use and is concealed by a fairing door. A handle, located adjacent to the emergency flight control handle, is marked TURB GEN. and controls the release mechanism of the generator. Pulling the handle straight out releases a latch and allows spring and bungee action to eject the generator into the slip stream. Once the generator is released into the slip stream, it can only be retracted manually from the ground.

CAUTION

If the generator is to be released on the ground, make certain that all personnel are clear before pulling the release handle. The generator is ejected with a force of approximately 380 pounds and a force of approximately 156 pounds holds it in the extended position.

A three-position switch, located on the right aft console, is provided for selective power after the generator is released for optional selection of instruments or radio equipment. The main purpose of the turbine generator is to provide power to the alternate flight control hydraulic pump in case of engine seizure. If this should occur, pulling the generator release handle and the emergency flight control handle will automatically connect the emergency flight control hydraulic pump to the turbine generator. With this condition, the battery will still be available for the radio and instruments by placing the battery-generator switch in the BAT. ONLY position. In case of generator failure with no engine seizure (normal flight control system operating), the turbine generator can be used to power instruments and radio equipment. The emergency power selector switch, located on the right aft console, is marked UHF & ARA-25, NORMAL and NO. 2 INV. & ARN-14. In case of generator failure with the normal flight control system operating, pull the turbine generator release handle and select whichever switch position is desired. Do not pull the emergency flight control handle as this will remove power from the switch and will provide power to the emergency flight control hydraulic pump only. If the UHF & ARA-25 position is selected on the switch, the No. 2 inverter must be energized from the battery to obtain visual indication on the ID-250 (RMI).

Note

For all normal conditions both in flight and on the ground, the switch should be in the NORMAL position. If this is not done, the switch may energize a relay in the system and put a constant drain on the battery.

The turbine generator will not power any bus system in the airplane; therefore, no indication of generator output will be obtained on the voltmeter.

Note

The drag of the extended turbine generator with a dead engine will reduce glide distance by approximately 10 percent.

ELECTRICAL SYSTEM INDICATORS.

GENERATOR OUT WARNING LIGHT. The generator warning light (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. Under normal operation the reverse-current cutout relay is closed, ties the generator output to the aircraft electrical system and breaks the warning light circuit.

INVERTER FAILURE WARNING LIGHT. The inverter failure warning light, located on the right-hand console, will indicate instrument power failure when the No. 2 inverter fails. The instrument power switch will then be placed in the NO. 2 INV. position and the warning light will go out. During normal operation (instrument power switch in NO. 1 INV. position), No. 2 inverter failure will illuminate the warning light; however, if the failure occurs when the instrument power switch is in the NO. 2 INV. position the warning light will not illuminate. With the instrument power switch in the NO. 1 INV. position, failure of the No. 1 inverter will not illuminate the warning light. Indication of failure will be indicated by erratic operation of the ARN-21 radio equipment, ID-249A/ARN course indicator and the Mark 11 Mod 1 gun sight.

VOLTMETER. Airplanes 141364 and subsequent have a voltmeter located in the lower right-hand corner of the instrument panel (21, figure 1-5A). This d-c voltmeter provides the pilot with a continuous battery bus voltage indication. The normal d-c voltmeter indication will be approximately 27.5 volts. If the generator becomes inoperative, the d-c voltmeter will show a battery bus voltage of approximately 24 volts. This drop in voltage provides the pilot with a basis for suspecting generator failure. The voltmeter can be used to indicate loss of generator output and to estimate battery life in the event of engine seizure. In the event of engine seizure, when the d-c voltmeter indicates a voltage of 22 volts (which is marked with a red line on the face of the voltmeter), the pilot can estimate that the battery will last for approximately 5 minutes and that approximately 5 minutes of controlled flight time remains, provided no electric loads other than the alternate hydraulic pump electric motor are applied to the battery.

HYDRAULIC SYSTEMS.

The airplane is equipped with three separate hydraulic systems: a utility hydraulic system with an integrated emergency hydraulic system used for emergency extension of the nose gear, a flight control normal hydraulic system (figure 1-14), and a flight control alternate hydraulic system (figure 1-15). These systems are of the closed-center, constant-pressure type. The flight control normal hydraulic system and the flight control alternate hydraulic system supply hydraulic power for operation of the ailerons and the controllable horizontal tail. (Refer to FLIGHT CONTROL HYDRAULIC SYSTEM in this section.) Each hydraulic system is equipped with a reservoir, a pump, and separate hydraulic lines, except the emergency hydraulic system which has an accumulator with separate lines. Pressure in any individual hydraulic system (except the emergency system) can be selectively read on a single hydraulic pressure gage when the pressure gage selector switch is properly positioned.

UTILITY HYDRAULIC SYSTEM.

The utility hydraulic system is a constant-pressure type system incorporating a variable-output pump. The system supplies power for operation of the landing gear, speed brakes, wheel brakes, wing fold, arresting hook retraction, tail bumper, nose gear catapult extension, and gun bay purge door, as well as the motor which operates the air compressor.

FLIGHT CONTROL HYDRAULIC SYSTEM.

A constant-pressure hydraulic system normally powers the ailerons and horizontal stabilizer, and an electrically powered (d-c) alternate hydraulic system is provided to operate the controls should the normal system not function properly. Two hydraulic cylinders in tandem actuate the surface controls. The cylinders are hydraulically independent of each other (whether on normal

ELECTRICAL

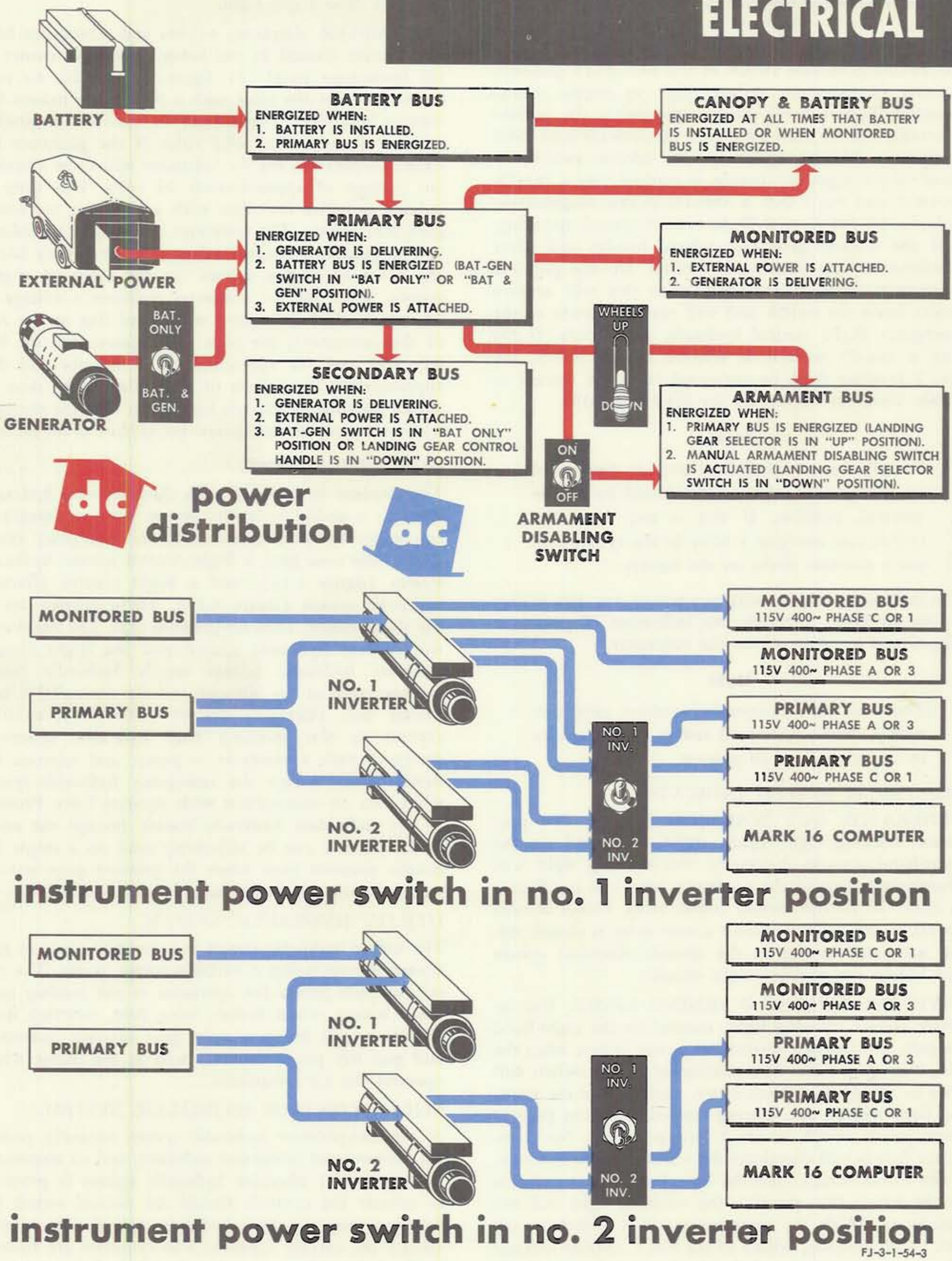


Figure 1-11. (Sheet 1)

POWER DISTRIBUTION

PRIMARY BUS

TOTAL AMPS.	
124.00	Ammunition Booster (4 Reqd)
100.00	No. 1 Inverter (Power) with AN/ARN-21 Operating
76.30	No. 1 Inverter (Power) with AN/ARN-14 Operating
50.00	Alternate System Hydraulic Pump
32.00	Landing Flap Actuators (2 Reqd)
19.60	Aft Fuel Boost Pump
18.00	Landing Light
16.80	Drop Tank Release Solenoids (2 Reqd)
14.40	No. 2 Inverter (Power)
8.00	Pilot's Seat Actuator
6.50	Drop Tank Fuel Dump Actuator (2 Reqd)
5.00	Starter Control
5.00	Test Power for Warning Lights
4.80	Console and Instrument Panel Lights
4.60	Pitot Heater
3.50	Rudder Trim Actuator
2.50	Angle-of-Attack Probe Heater
2.50	Angle-of-Yaw Transducer Probe Heater ¶
2.20	Dump Valves (2 Reqd)†
2.00	Air Stream Shut-off Valve
2.00	Drop Tank Pneumatic Pressure Solenoid Valves
2.00	Ram Air Valve
2.00	Fuel Control Solenoid Valve
1.60	Lateral Trim Actuator§
1.50	Compressor Dump Valve
1.50	Fuel Dump Pneumatic Solenoid Valves
1.02	Windshield Overheat and Fire Detector Lights (3 Reqd)
1.00	Alternate Flight Control Change-over Valve
1.00	Angle-of-Attack Servo System
1.00	Emergency Accumulator Charging Valve
1.00	Fuel Quantity System Disconnect Relay
1.00	Gun Charger Selector Solenoid Valve
1.00	Hook, Tail Bumper, and Speed Brake Valve (Bumper Down)*
1.00	Landing Gear and Landing Gear Door Hydraulic Solenoid Valve
1.00	Long. Trim Actuator
1.00	Speed Brake Valve‡
1.00	Tail Bumper Valve‡
1.00	Wing Fold Selector Valve
0.90	Normal Flight Control Change-over Valve
0.80	Gyro Compass System
0.60	Alternate Flight Control Power Relay
0.60	Battery Disconnect Relay
0.60	Monitored Bus Relay
0.60	Secondary Bus Relay
0.51	Fuel Transfer Selector Valve
0.50	Dimming Control Unit
0.50	Rudder Pedal Shaker Motor¶
0.35	Aft Fuel Boost Pump Relay
0.35	Armament Master Relay
0.35	Cockpit Air Control Relay
0.35	Forward Fuel Boost Pump Relay
0.35	Fuel Transfer Pump Relay
0.35	Jettison Relay
0.35	Landing Gear Position Down Relay
0.35	Starter Shunt Field Control (Relay)
0.34	EMERG. FUEL Warning Light
0.34	GEN. OUT Warning Light
0.34	HYD. ALT. ON Warning Light
0.34	INST. POWER OFF Warning Light
0.30	Canopy Pressure Regulator
0.30	Canopy Seal Regulator
0.25	Landing Gear Retract Control Relay
0.25	Landing Light Relay
0.20	Armament Disabling Control Relay
0.20	Bumper Retract Control Relay
0.20	Cabin Air Safety Valve
0.20	Fire Detector Relay
0.20	Lateral Trim Indicator Control Relay
0.20	Long. Trim Indicator Control Relay
0.20	Pneumatic Compressor Control Relay
0.17	Arresting Hook Warning Light
0.17	Landing Gear Warning Light
0.15	Approach Light Control Relay
0.15	Charging Control Relay†
0.15	Flight Control Electric Power Control Relay
0.15	Forward Fuselage Tank Float Switch Relay
0.15	Transfer Pump Float Switch Slave Relay
0.09	Landing Gear Position Indicators (3 Reqd)
0.03	Flap Position Indicator
0.03	Oil Pressure Indicator
0.03	Speed Brake Position Indicator
0.03	Trim Indicator
0.03	Fuel Transfer Indicator
	Canopy and Battery Bus
	Seat Reel and Radio Test Receptacle
	Utility Receptacle

CANOPY & BATTERY BUS

24.00	Canopy Actuator
0.60	Battery Disconnect Relay
0.35	Canopy Open Relay
0.35	Canopy Closed Relay
0.20	Canopy Seal and Depressurization Control

SECONDARY BUS

23.10	Exterior Lights
22.00	Command Radio
6.00	Omni-range Radio AN/ARN-14
5.00	Cockpit Temperature Control Regulator
5.00	Defrost and Anti-ice Control Regulator
4.00	G. S. A. P. Camera (Test)
2.50	Automatic Direction Finder AN/ARA-25
2.00	Timer Motor
1.20	Approach Light**
1.10	Angle-of-Attack Internal Heater
1.00	Cockpit Hot Air Modulating Valve
1.00	Heat Exchange Modulating Valve
1.00	Gun Bay Purge Door Hydraulic Solenoid Valve
0.35	Approach Light Dimming Relay
0.35	Cockpit Temperature and Anti-ice Control Relay
0.30	Instrument Panel Vibrator
0.15	Arresting Hook By-pass Control Relay

MONITORED BUS

19.60	Fuel Boost Pump (Forward)
3.60	Water Separator Heater
3.22	Voltage Regulator AN/APG-30
2.30	Camera Heater
2.00	Canopy Defrost Valve
2.00	G. S. A. P. Camera (Terminal No. 3)†
2.00	Windshield Anti-ice Valve
2.00	Windshield Defrost Valve
1.80	AN/APX-6B
1.10	MK 16 Computer (AFCS)
1.00	No. 1 Inverter (Control)
0.70	RT-220/ARN-21
0.50	Canopy and Battery Bus Relay

A-C BUS

TOTAL AMPS.	
4.20	RT-220/ARN-21
2.80	Voltage Regulator (Phase B) AN/APG-30
2.00	Gun Firing Power Systems (2 Reqd)
2.00	MK 16 Computer (AFCS)
1.50	AN/APX-6B
1.00	Attitude Horizon Indicator
1.00	Cockpit Temperature Control Regulator
1.00	Defrost and Anti-ice Control Regulator
1.00	Fuel Flowmeter System
1.00	Fuel Quantity Indicator
1.00	Hydraulic Pressure Indicator System
0.80	Gyro Compass System
0.74	Voltage Regulator (Phase A) AN/APG-30
0.14	Angle-of-Attack and Yaw Compensator
0.04	Inverter Failure Indicating Relay

ARMAMENT BUS

3.00	Gun Charging Valves (2 Reqd)
2.00	G. S. A. P. Camera (Terminal No. 2)
1.40	Ammunition Booster Relay (4 Reqd)
1.00	Gun Bay Purge Time Relay Unit (Terminal No. 2)
0.36	Gun Firing Control Units (4 Reqd)
0.35	Bomb and Rocket Firing Relay
0.35	External Stores Selector Relay
0.35	Salvo Relay
0.20	Gun A-C Power Control Relay
0.20	Gun Firing Relay
	Aero 15A Bomb Rack and Rocket Launcher (4 Reqd) Station Selector Switch

BATTERY BUS

50.00	Alternate System Hydraulic Pump (Emergency Operation Only)
10.00	Fuel Transfer Pump
1.20	Dual Level Float Valve
1.00	Alternate Flight Control Change-over Valve (Emerg Only)
0.90	Normal Flight Control Change-over Valve (Emerg Only)
0.70	Landing Gear Oleo Load Relays (2 Reqd)
0.60	Alternate Flight Controls Power Relay (Emerg Only)
0.35	Fuel Transfer Pump Relay
0.34	HYD. ALT. ON Warning Light (Emerg Only)
0.15	Forward Fuselage Tank Float Switch Slave Relay
0.15	Transfer Pump Float Switch Slave Relay
	Canopy and Battery Bus (On Deck, No External Power or Generator Output)

*Airplanes 135774 through 135780
†Airplanes 135774 through 135852
‡Airplanes 135781 and subsequent
§Airplanes 135948 and subsequent
¶Airplanes 136118 and subsequent
**Airplanes 139210 and subsequent

FJ-3-1-54-2C

Figure 1-11. (Sheet 2)

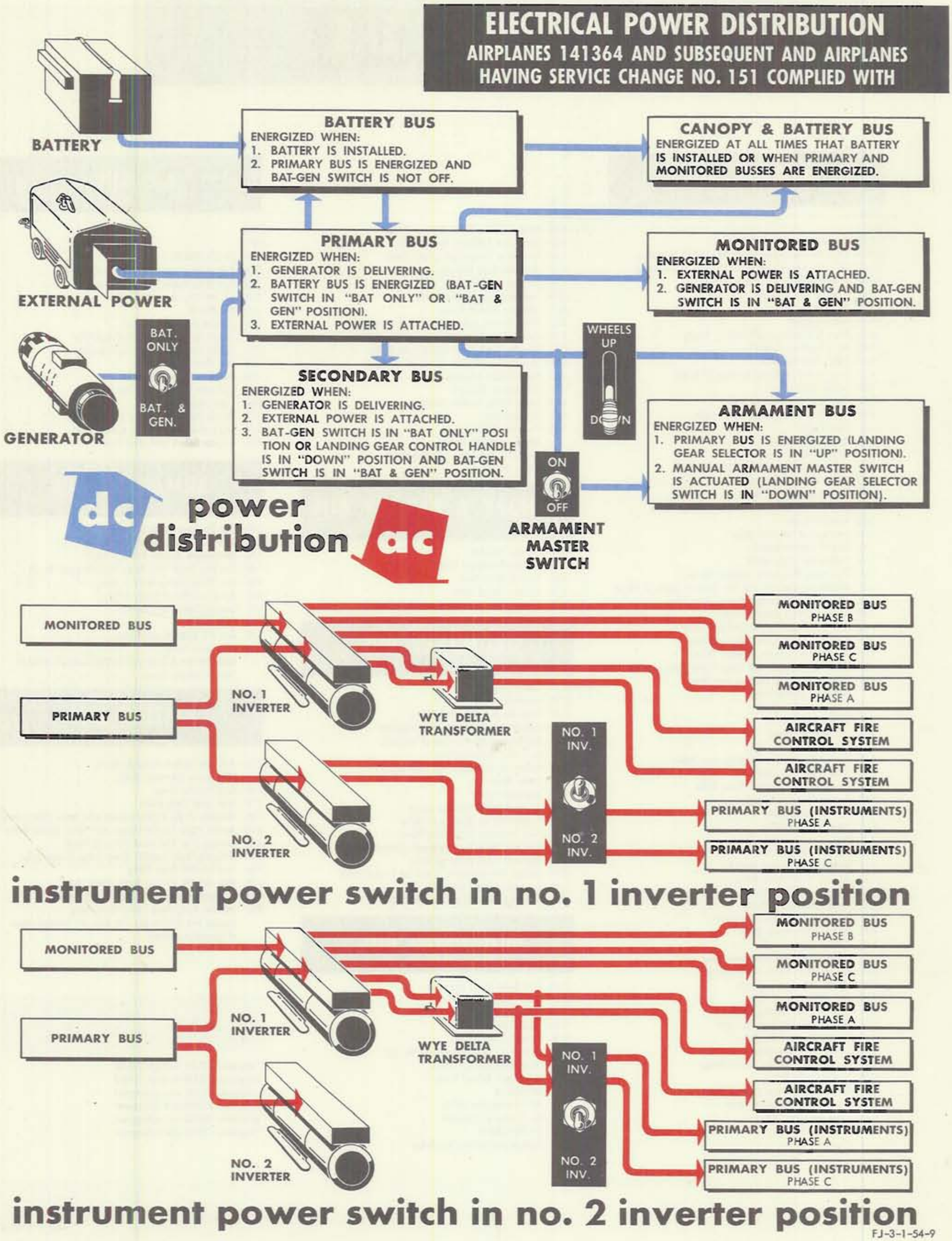


Figure 1-11. (Sheet 3)

CIRCUIT BREAKERS

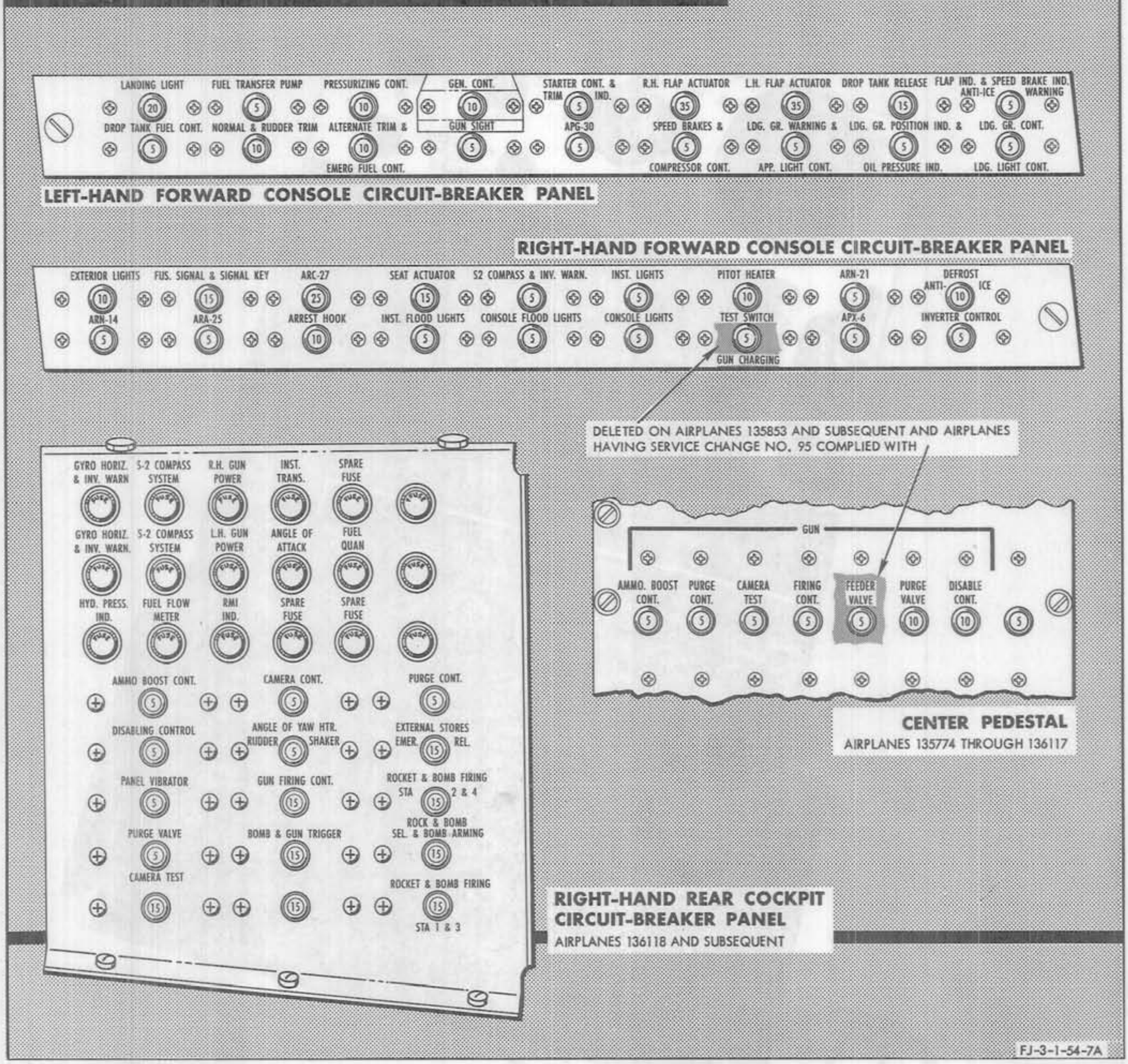
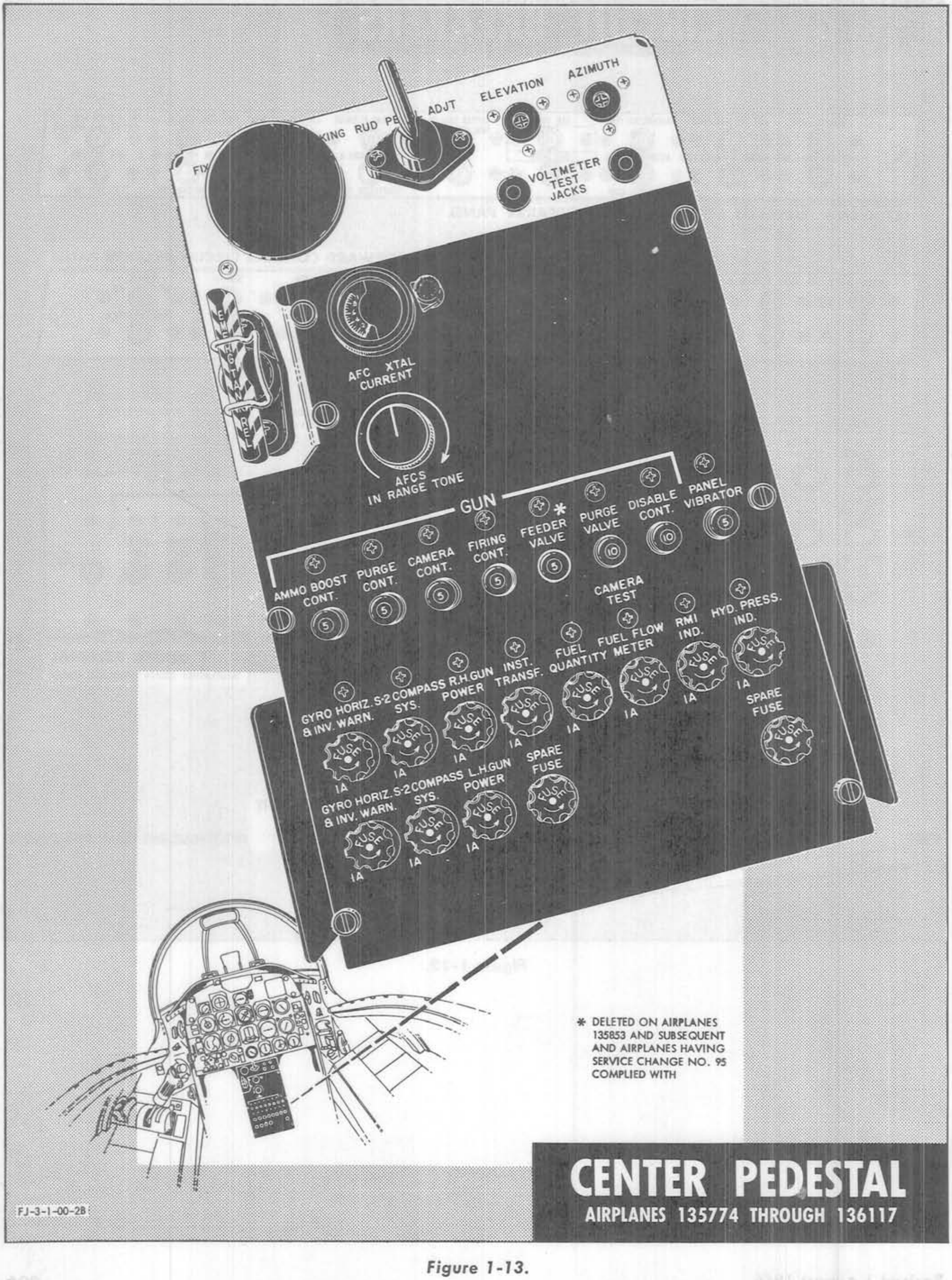


Figure 1-12.



CENTER PEDESTAL

AIRPLANES 135774 THROUGH 136117

Figure 1-13.

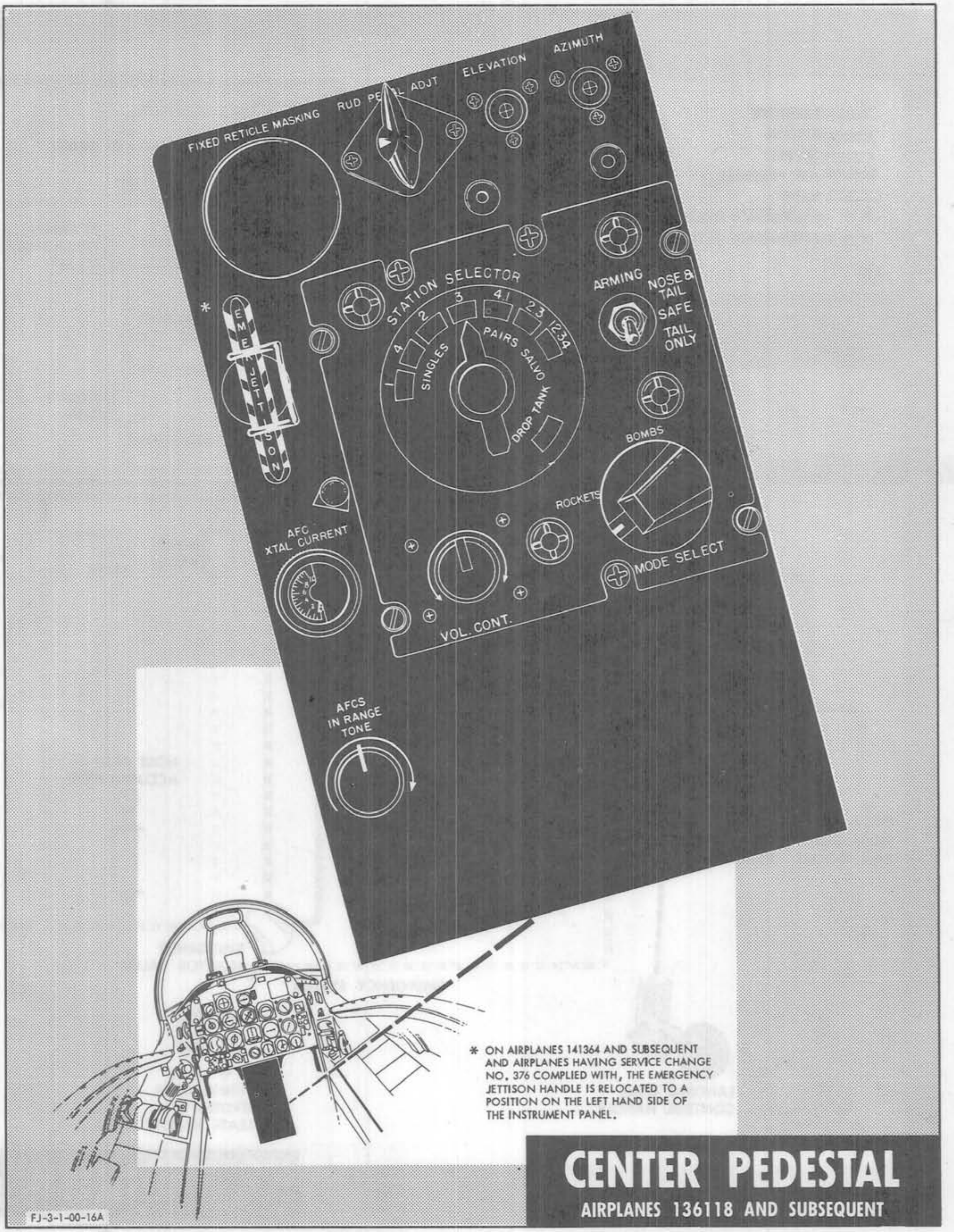

FIXED RETICLE MASKING
RUD PEDAL ADJT
ELEVATION
AZIMUTH
STATION SELECTOR
ARMING
NOSE & TAIL
SAFE
TAIL ONLY
SINGLES
PAIRS
SALVO
DROP TANK
BOMBS
ROCKETS
MODE SELECT
VOL. CONT.
AFC XTAL CURRENT
AFCS IN RANGE TONE
EMER JETTISON
* ON AIRPLANES 141364 AND SUBSEQUENT AND AIRPLANES HAVING SERVICE CHANGE NO. 376 COMPLIED WITH, THE EMERGENCY JETTISON HANDLE IS RELOCATED TO A POSITION ON THE LEFT HAND SIDE OF THE INSTRUMENT PANEL.
CENTER PEDESTAL
AIRPLANES 136118 AND SUBSEQUENT
FJ-3-1-00-16A

Figure 1-13A.

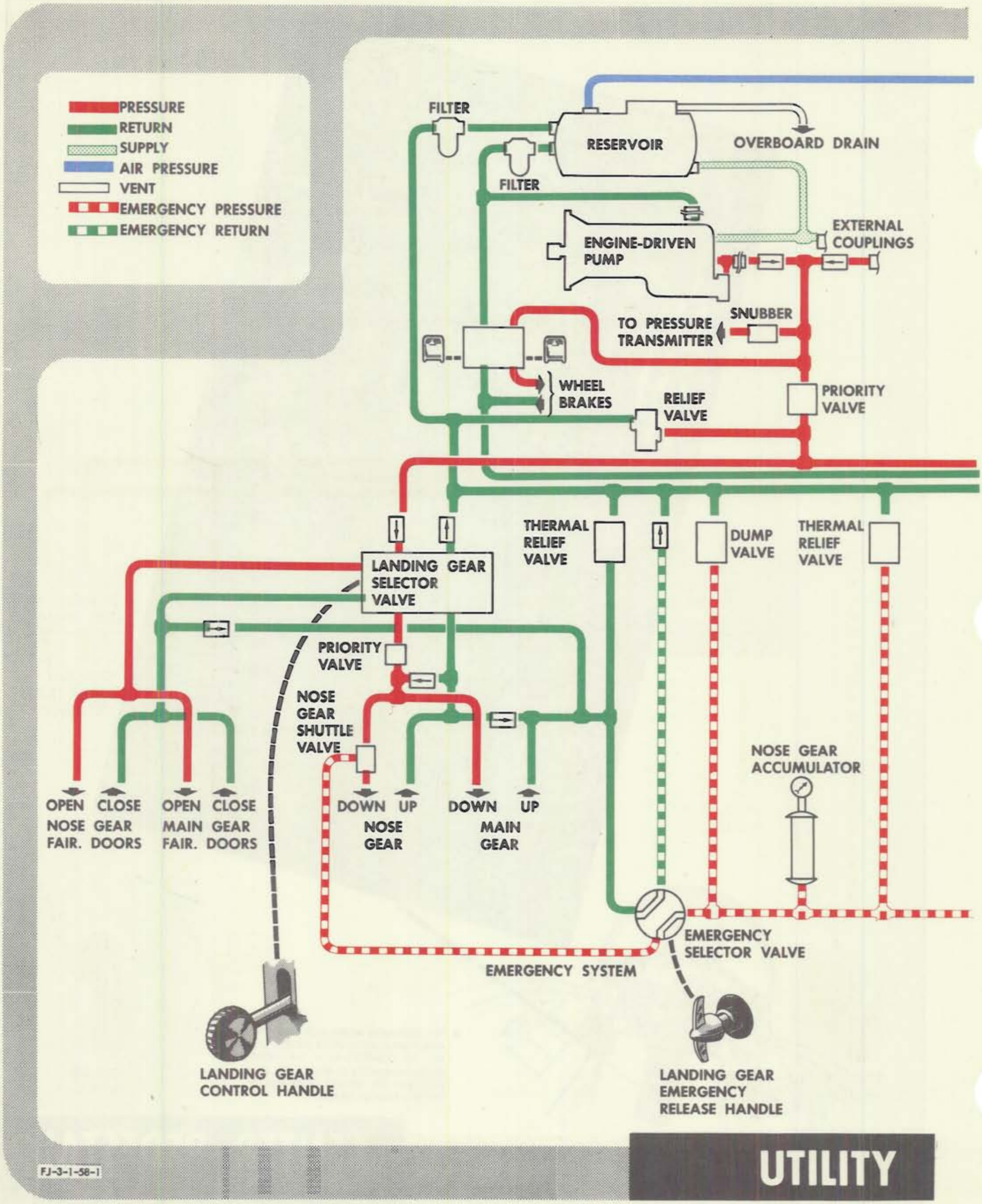


Figure 1-14. (Sheet 1 of 2)

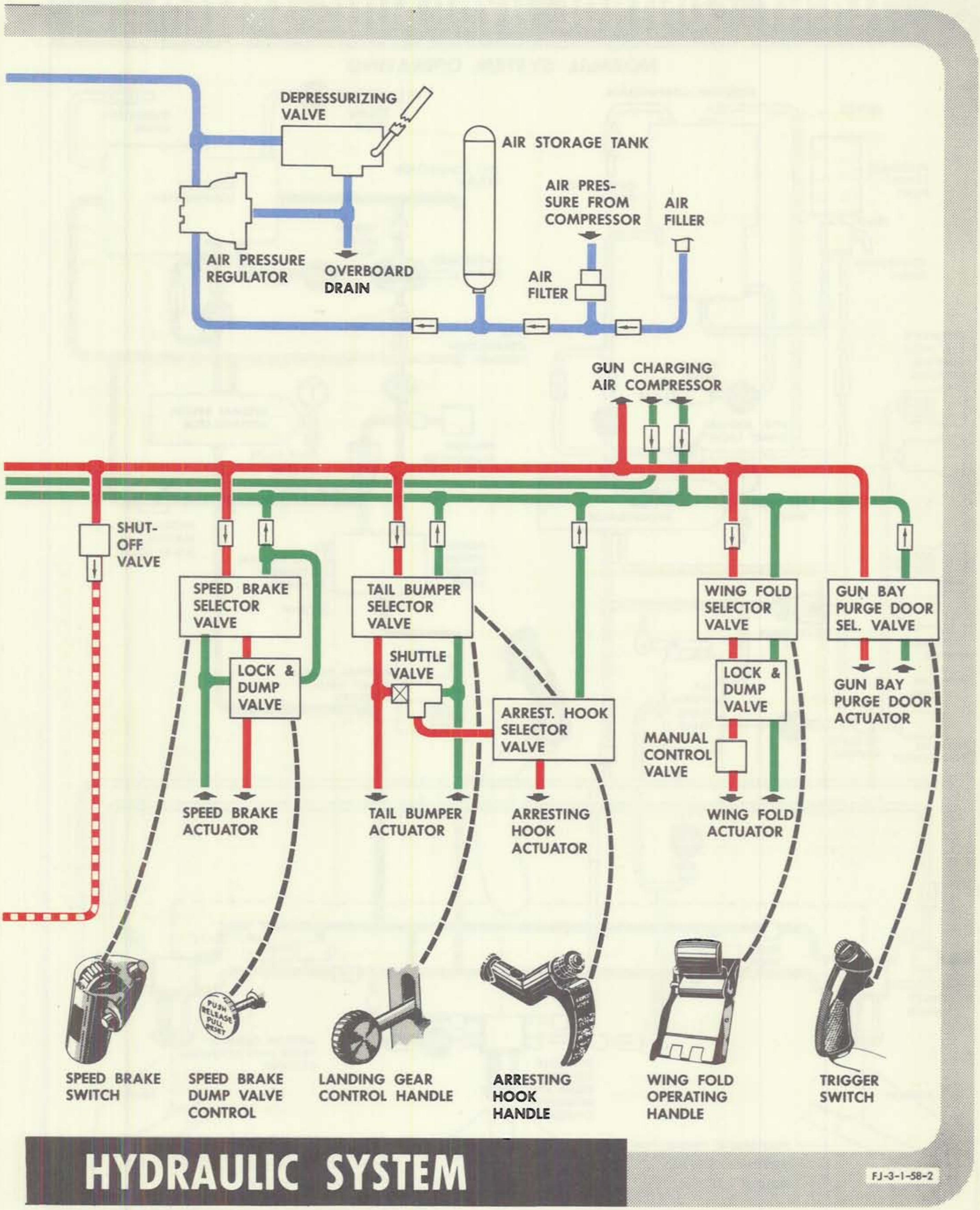


Figure 1-14. (Sheet 2 of 2)

FLIGHT CONTROL HYDRAULIC SYSTEM

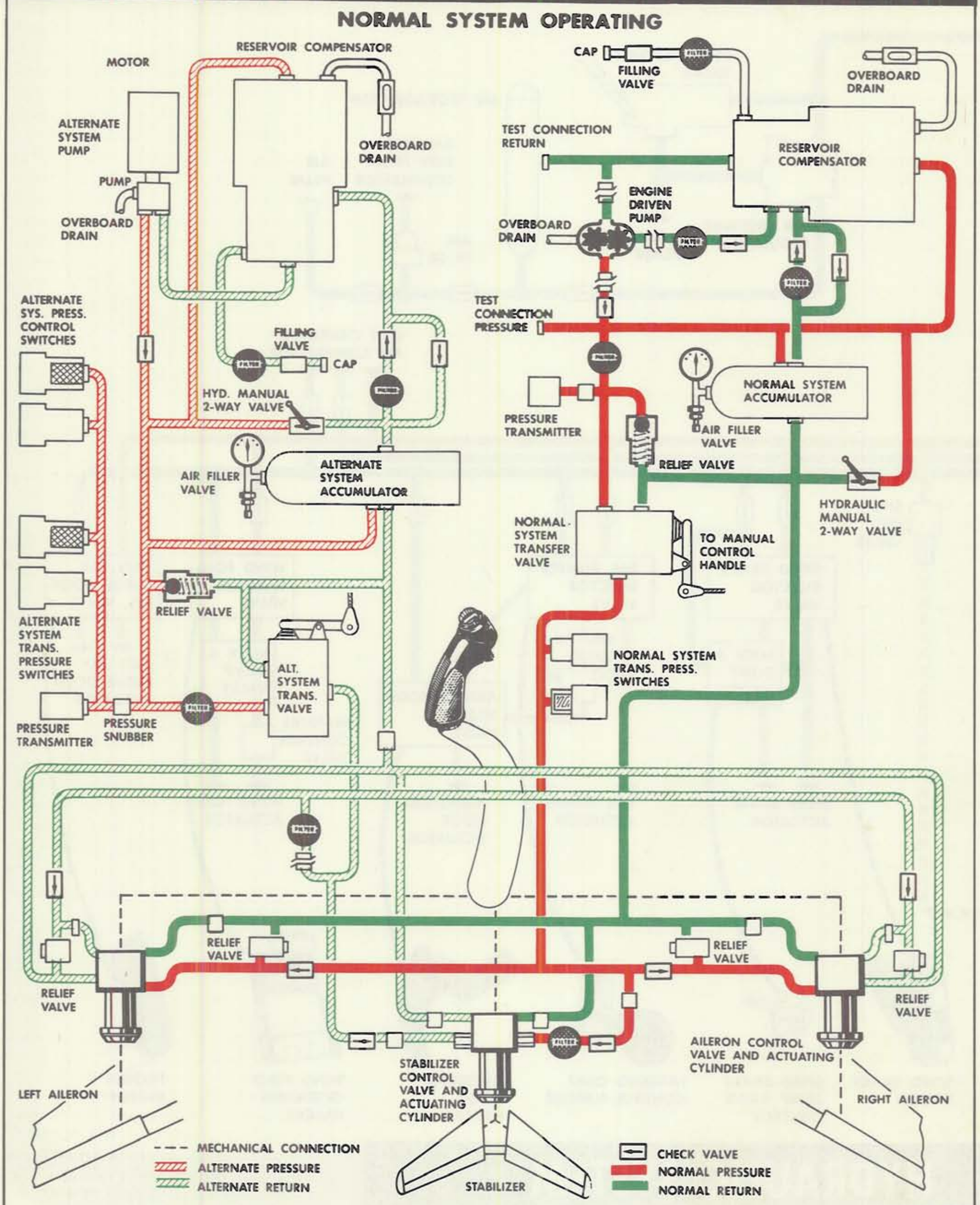


Figure 1-15.

or alternate systems), and loss of pressure to one cylinder does not affect operation of the other. Movement of the control stick positions the control valves so that the system pressure is directed to the actuating cylinders and the cylinder actuates the related movement to the control surface. There are two electrical methods and one manual emergency method of affecting change-over between the hydraulic systems. Automatic change-over from the normal system to the alternate system is effected by means of pressure switches and two solenoid-operated valves, which automatically become energized when the normal system pressure drops below 650 psi. The secondary electrical transfer is used if the automatic transfer malfunctions. This permits the pilot by use of a cockpit switch to transfer to the alternate system for flight or test purposes. Electrical transfer to either system is prevented if the pressure in the system to be selected is below the minimum operating pressure (650 psi). A manual control for the alternate system, operated by a handle on the left forward console, provides manual change-over should electrical failure occur. Pulling this handle out will mechanically position the transfer valves to select the alternate system, regardless of the pressure in this system and will connect the alternate system pump motor directly to the battery bus. A warning light, on the instrument panel, will illuminate when the flight controls are operating on the alternate system. If the warning light comes on, showing that the alternate system is in operation, the selector switch may be momentarily held in the reset position. If the normal system does not cut back in, this procedure will indicate that it has failed and further flight should be governed accordingly. If the mission is one that requires no violent stick movements or evasive action the flight may be continued. However, the alternate system pump is not designed to provide for repeated rapid or violent stick movement and such movement will be noticed by the alternate system pressure rapidly falling with the movement and stick forces will increase due to becoming stiff with loss of pressure. A diagram of the flight control hydraulic systems is shown in figure 1-15.

HYDRAULIC PRESSURE INDICATOR AND HYDRAULIC PRESSURE SELECTOR.

Individual pressure readings of the hydraulic systems may be obtained through use of a selector switch in conjunction with the hydraulic system pressure indicator. Both the switch and indicator are located on the instrument panel. (See 27 and 30, figure 1-5.) For all normal operation, the switch should be kept at NORMAL. (Moving the switch to the other marked detents will give corresponding readings on the pressure indicator.)

FLIGHT CONTROL SYSTEM.

Four unique features are incorporated in the flight control system. First, the ailerons and horizontal stabilizer are completely operated by a flight control hydraulic system; movement of the control stick mechanically positions hydraulic control valves which direct pressure to the respective control surface actuating cylinders. Second, the horizontal stabilizer and the elevators are both primary control surfaces, known as the controllable horizontal stabilizer, and are jointly operated for longitudinal control through normal stick action. Third, to provide normal stick feel, an artificial feel system is built into the ailerons and horizontal stabilizer control systems. Fourth, no aileron or horizontal stabilizer trim tabs are provided; trimming is accomplished by changing the neutral position of the stick. The rudder is conventionally operated by a cable control system and has an electrically actuated trim tab. The aileron system will hold the control surface against external forces creating up to 3450 psi back pressure on the hydraulic system. When this pressure is reached, the fluid is bypassed through a relief valve permitting the aileron to move toward neutral. This will prevent failure or structural damage to the ailerons under extreme stress conditions. The stabilizer control system holds the control surfaces against any forces which do not originate from control stick action and prevents these forces from being transmitted back to the stick. This irreversible feature of the hydraulic flight control system permits a tremendous amount of aerodynamic force to be overcome with relatively small pilot effort. This type of longitudinal control system affords more positive action and greater control effectiveness, with less control surface movement than a conventional control system.

CONTROLLABLE HORIZONTAL TAIL.

The elevators and horizontal stabilizer are controlled and operated as one unit, known as the controllable horizontal stabilizer. The horizontal 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. Travel of the elevator is slightly greater than that of the stabilizer. This type of control surface eliminates many of the undesirable effects of compressibility, such as loss of control effectiveness at high Mach numbers. In order to reduce elevator shudder or "buzz" during maneuvers at supersonic speeds, some aircraft* have been equipped with the "splitter plate" elevator, in which the aft 50 percent of the conventional elevator chord configuration is replaced with a splitter plate that is integrally stiffened for torsional rigidity.

ARTIFICIAL "FEEL" SYSTEM.

Because of the irreversible characteristics of the aileron and horizontal stabilizer hydraulic flight control system, air loads are not transmitted to the stick, and, as a result, no conventional stick feel is present. Therefore, an artificial feel system is installed to supply the usual stick feel under 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 horizontal tail, the no-load position of the stick is changed by actuation of the normal or alternate trim switches.

***Airplanes having Service Change No. 432 complied with**

Figure 1-16.

FLIGHT CONTROLS.

CONTROL STICK. The control stick is of conventional design and is equipped with a pistol-type grip, which incorporates the normal trim switch for the ailerons and horizontal tail, the gun trigger switch and stores release switch.* (See figure 1-16.)

RUDDER PEDALS. Conventional hanging rudder pedals are adjustable fore and aft by means of an adjustment lever located on center pedestal. When 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.

STALL WARNING SYSTEM.† With the cambered extended leading edge, there is an insufficient natural warning of an approaching stall; therefore, an artificial warning system is provided. As the airplane approaches the stall angle of attack, the airstream direction detector automatically initiates the rudder pedal shaker, mounted on the back of the right-hand rudder pedal, when a setting of 21.0 units on the angle-of-attack indicator is reached. 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.

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 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 upright position when locks are released. Ailerons are equalized and locked automatically when wings are folded. Battens are used on the ailerons when wings are extended.

FLIGHT CONTROL TRIM SELECTOR SWITCH. A two-position switch (16, figure 1-6), located on the left console, provides a means of selecting the normal or alternate flight control trim system.

NORMAL AILERON AND STABILIZER TRIM SWITCH. Normal trim of the ailerons and horizontal tail is provided through a five-position knurled switch (figure 1-16) 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.

ALTERNATE AILERON AND STABILIZER TRIM SWITCH. When the trim selector switch is in the ALTERNATE position, stabilizer and elevator trim is accomplished by a five-position toggle switch (17, 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.

RUDDER TRIM SWITCH. An electrically actuated rudder trim tab is controlled through a spring-loaded switch (15, figure 1-6) on the left console. The switch is held to LEFT or RIGHT for corresponding rudder trim.

TAKE-OFF (TRIM) POSITION INDICATOR.

A blue field indicator (10, figure 1-5), located on the instrument panel, is provided to indicate safe take-off trim positions for ailerons, horizontal tail and rudder. The indicator will show IN whenever any one of these controls is trimmed to TAKE-OFF position and will show a blue field when the trim switch is released. It will show IN again when the next control is trimmed for take-off, etc.

FLIGHT CONTROL HYDRAULIC SYSTEMS.

FLIGHT CONTROL NORMAL HYDRAULIC SYSTEM. The flight control normal hydraulic system has a separate reservoir and is pressurized by a combination of spring and system pressure. The pump is supplemented by an accumulator for sudden high rates of demand. Normal system pressure is approximately 3000 psi, but pressure will be slightly lowered during control stick movement. If engine failure occurs, adequate control for normal flight will be maintained as long as engine is windmilling over 10% rpm. As windmilling speed increases, flight control will improve.

***Airplanes 136118 and subsequent**

†Airplanes 136118 and subsequent and airplanes having Service Change No. 333 complied with

FLIGHT CONTROL ALTERNATE HYDRAULIC SYSTEM. The flight control alternate hydraulic system has a separate reservoir, electrically driven pump and an accumulator to provide additional control power. The system has separate hydraulic lines to each cylinder and system pressure is automatically maintained by pressure switches.

Note

When the flight control alternate system is in operation, rapid movement of flight controls for prolonged periods may result in a slightly lower rate of control surface response than when the normal system is in operation. This is accompanied by a reduction in indicated alternate system pressure.

CAUTION

The flight control alternate hydraulic system is engaged automatically when external power is connected for engine start, as normal system pressure is not built up until after the engine is running. Therefore, the electrical transfer system should be used to change over to the normal system prior to flight.

In flight, the alternate system pump motor is powered by the primary bus. If the generator should fail, the pump will be automatically transferred to the battery bus. Due to the heavy drain on the battery by the alternate pump motor, the alternate system should not be operated on the ground unless the engine is running above approximately 23% rpm or an external power source is connected.

FLIGHT CONTROL HYDRAULIC SYSTEM CONTROLS.

FLIGHT CONTROL SYSTEM SELECTOR SWITCH. A three-position switch (13, figure 1-6) on the left aft console provides a means of manually selecting the normal or alternate flight control hydraulic system. With the switch at NORMAL (engine running), the normal system supplies pressure to the flight controls, and the alternate system will cut in automatically should the normal system not function properly. When the switch is moved to ALTERNATE, a solenoid-operated shutoff valve in the normal system is actuated to block normal system pressure and a solenoid-operated shutoff valve in the alternate system is opened, permitting alternate system pressure to power the flight controls. (This transfer cannot be completed unless adequate pressure is available in the alternate system.) The RESET position which is spring-loaded to NORMAL, de-energizes both the normal and alternate system valves, allowing them to return to their normal positions (normal system operating). The RESET position of the flight control system selector switch must be used whenever a transfer from the alternate to the normal system is desired.

FLIGHT CONTROL EMERGENCY HANDLE. The emergency override handle, located on the left forward console (figure 1-9), permits the flight control alternate hydraulic system to be engaged should the automatic or selective electrical transfer systems fail. Pulling the handle out to the full aft position engages the alternate system by mechanically actuating two solenoid-operated valves to transfer flight control operation to the alternate system. The manual emergency change-over may be accomplished regardless of normal or alternate system pressure, and the alternate system will be engaged as long as the handle remains in the extended position. If the handle is returned to its normal position, the alternate system will remain in operation until the flight control switch is held momentarily at RESET and then released to NORMAL.

FLIGHT CONTROL HYDRAULIC SYSTEM INDICATORS.

FLIGHT CONTROL HYDRAULIC FLUID LEVEL INDICATOR. Fluid level of the flight control hydraulic systems is indicated by a shaft that extends up from each of the two hydraulic system reservoirs. The white indicator shaft for the alternate system is checked visually through an access door just forward of the fuselage break point on the port side. (See figure 1-19.) The normal system reservoir is on the starboard side of the engine bay. When 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.

ALTERNATE-ON WARNING LIGHT. An amber, alternate-on warning light (29, figure 1-5) mounted on the instrument panel is illuminated whenever the flight control alternate hydraulic system is operating.

WING FLAPS.

Electrically controlled and operated, single-slotted, Fowler type wing flaps extend spanwise from the fuselage to the aileron on each wing panel. An individual electrical circuit and individual electric motor powered by the primary bus are provided to actuate each flap. The flaps are mechanically interconnected, so that if one actuating motor or electrical circuit fails, the respective flap will be actuated through mechanical linkage with the opposite flap. This mechanical interlinkage also prevents individual or uneven flap operation, and a brake coil within each actuator prevents air loads from moving the flaps. No emergency system is provided as enough protection is afforded in the normal system by the mechanical interconnection, the individual actuator motors, and individual actuator motor circuits.

WING FLAP CONTROL LEVER.

The wing flap control lever (7, figure 1-6) outboard of the throttle moves in a guarded quadrant marked UP and DOWN. To position the flaps, the lever is moved to the related position. If an intermediate position is desired, move the lever to the selected setting, and then return to HOLD to prevent further travel.

On some airplanes,‡ a two-position control lever has been installed with two positions marked UP and DOWN. There are no intermediate flap positions.

Note

Do not reverse the flap control switch while the flaps are in motion during ground check-out operations. In flight the pilot may reverse the flap control switch if for any reason a reversal during extension or retraction of flaps is necessary.

WING FLAP POSITION INDICATOR.

The position of the flaps is shown on a combined landing gear position and flap position indicator-refractor located on the instrument panel. The flap indicator is marked for UP and DOWN and will show a "barber pole" for intermediate positions.

WING SLATS.*

Wing slats extend from just outboard of the fuselage to the wing tip along the leading edge of each wing (figure 1-2). Aerodynamic forces acting upon the slats cause them to open and close automatically, depending upon the airspeed and attitude of the airplane. Upon opening, the slats move forward along a curved track to create a slot in wing leading edge. This slot formation changes the airflow over the upper surface of the wing and increases lift, resulting in lower stalling speeds. At speeds above 190 knots, in unaccelerated flight, the slats remain closed to offer minimum drag for maximum flight performance.

WING FOLDING SYSTEM.

The wing folding and spreading cycles are controlled through a solenoid-operated, four-way selector valve using mechanical sequencing in the spread cycle only. The switch to operate the wing fold is located on the right side of the cockpit below the windshield bow. 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 is located in the right forward fuselage and is accessible through a door marked "HYDRAULIC EQUIPMENT." A lock valve, located 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 button on the lock valve can be depressed to allow the ground crew to manually spread the wings. An indicating flap inboard of the fold joint at each leading edge folds flush to the wing surface when pins are in place and mechanically locked and will appear if the wing fold mechanical lockpins are not in place. Normal wing folding should be accomplished in 10 to 15 seconds.

CAUTION

- To prevent bellows damage, the wings should not be extended while transfer pressure is on the wet leading edge tanks. The bellows take on an abnormal shape under pressurization, causing them to become pinched between the inboard and outboard tanks of the wing if an attempt is made to extend the wings.
- Do not fold wings with wet leading edge air pressure on. If wing fold is accidentally initiated, turn drop tank transfer switch to OFF position and continue to fold.

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 normal operation of the speed brakes is supplied by the utility hydraulic system. An emergency control is provided to close the speed brakes. With high speed or dive conditions, the opening time is approximately 4 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 (figure 1-9) 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.

Note†

When speed brake switch is in the IN or OUT position, the compressor which supplies pressure to the gun charging system is inoperative.

SPEED BRAKE DUMP VALVE CONTROL HANDLE. To provide a means of closing the speed brakes if normal operation fails, an emergency dump valve handle is located to the left of the seat back. When pushed aft, the handle mechanically opens a dump valve which relieves hydraulic pressure from the speed brake actuating cylinders and permits air loads

***Airplanes not having Service Change No. 138 complied with**
†Not applicable to airplanes having Service Change No. 183 complied with
‡Airplanes 136028 and subsequent

to close the brakes to a trailing position. On some airplanes,* a safety clip which will prevent inadvertent actuation of the control handle into the dump position is installed.

Note

If the speed brake dump valve is actuated a considerable loss of utility hydraulic pressure may be lost.

LANDING GEAR.

The fully retractable tricycle landing gear and the gear 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

*Airplanes 135774, 135775, 135813 and subsequent

wheel fairing doors are retracted to the closed position reducing drag and preventing mud, dirt, etc, from entering the wheel wells during ground operation. Ground safety pins are provided and should be installed when the airplane is secured. A hydraulically actuated tail bumper is extended and retracted in conjunction with the landing gear. An emergency accumulator permits lowering of the nose gear if the utility hydraulic system fails. The 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 CONTROLS.

LANDING GEAR CONTROL HANDLE. The landing gear control handle (17, figure 1-5), 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 and tail bumper correspondingly. 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.

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. When the release handle is pulled to its full travel, the main gear, the nose gear, and the fairing doors are mechanically unlocked. Pressure of the landing gear on the fairing doors will open the doors and the gear will lower by gravity. When the nose gear is extended to approximately 45 degrees, an emergency selector valve is automatically positioned to complete the extension. Pressure for this comes from the nose gear emergency accumulator. This pressure is sufficient for one extension only, and the selector 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 down indication.

WARNING

The emergency release handle must be pulled to the *full out position and held*. (Full travel is between 15 and 20 inches.) This must be done to ensure proper release of all gear uplocks and proper positioning of the nose gear emergency hydraulic selector valve. The handle must be held out until landing gear position indicator shows all wheels down and locked.

LANDING GEAR POSITION INDICATORS.

The position of the landing gear is shown by three barber pole-type indicators, 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. It is also illuminated 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 provisions for parking brakes on this airplane.

ARRESTING GEAR.

The arresting hook (figure 1-2), located forward of the tail bumper, is normally actuated by hydraulic pressure. The hook is extended by pressure from the arresting gear accumulator and 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. However, there is no emergency retraction system. The barrier pickup is automatically released and the approach light is illuminated when the landing gear and arresting gear hook is extended and exterior light 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.

BARRIER GUARD.

A tubular barrier guard is located just forward of the windshield and to the right of the airplane centerline. The guard is spring-loaded to the UP position and automatically extends when the arresting hook is lowered. After landing, the guard is manually returned to the retracted position, flush with the fuselage. On some airplanes* the barrier guard has been removed.

BARRIER PICKUP.

The crash barrier pickup is in the lower surface of the fuselage, directly aft of the nose wheel well. The pickup

***Airplanes 135813 and subsequent and airplanes having Service Change No. 77 complied with**

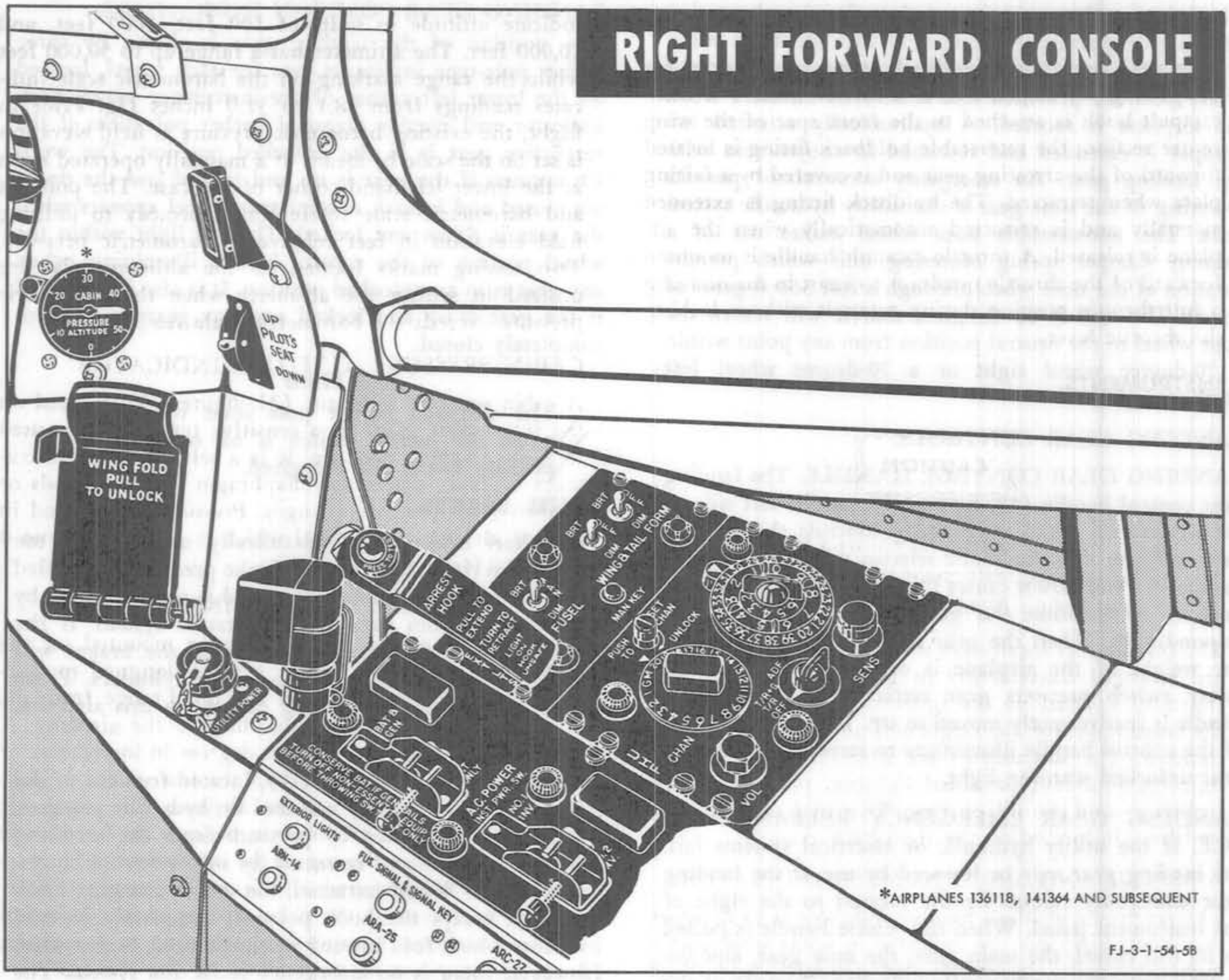


Figure 1-17.

is pivoted on the catapult hook fitting and held by a latch at the forward end. The latch is actuated, releasing the barrier pickup when the arresting gear is lowered, and must be retracted manually. For land based operation, the barrier pickup will be secured in the stowed position. An airplane log book entry will be made when the barrier pickup system is made inoperative and also when the system is re-activated for carrier operation. On some airplanes the barrier pickup is removed.†

ARRESTING GEAR CONTROL HANDLE.

The arresting gear control handle (1, 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 actuates the hydraulic selector valve which permits pressure from the arresting gear accumulator to lower the hook. When the handle is pulled aft, the barrier guard,* and barrier pickup are also released. Extension of the hook is accomplished mechanically and hydraulically. The hook is retracted by rotating the handle counterclockwise to release the pawl from the slot, allowing 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.

ARRESTING GEAR UNLOCKED WARNING LIGHT.

A warning light (figure 1-7), located in the arresting gear control handle, illuminates whenever hook is in a position that does not correspond to handle position.

Note

The hook will be extended if a cable failure occurs. However, the hook may not show a down position until airspeed is reduced.

***Airplanes 135774 through 135812 not having Service Change No. 77 complied with**
†Airplanes 141364 and subsequent and airplanes having Service Change No. 322 complied with

CATAPULT EQUIPMENT.

A catapult hook and a holdback fitting are provided for catapulting the airplane from a carrier deck. The fixed catapult hook is attached to the front spar of the wing center section; 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 retracted automatically 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 catapult without locking the throttle lever.

INSTRUMENTS.

CAUTION

If any autosyn instrument shows a tendency to motorize, have instrument removed and bench checked before flight.

The instruments located on the pilot's instrument panel are arranged conveniently in groups relative to their function. Located on 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.

AIRSPEED AND MACH NUMBER INDICATOR.

The airspeed and Mach number indicator 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, in increments of 10 knots, 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 for the marking of 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 the knob in and turning.

SENSITIVE ALTIMETER.

The sensitive altimeter indicates altitude relative to the existing atmospheric pressure. A barometric scale indicates pressure in inches of mercury while three pointers indicate altitude in units of 100 feet, 1000 feet, and 10,000 feet. The altimeter has a range up to 50,000 feet while the range marking on the barometric scale indicates readings from 28.1 to 31.0 inches Hg. Prior to flight, the existing barometric pressure at field elevation is set on the scale by means of a manually operated knob at the lower left-hand corner of the case. The pointers and barometric scale rotate simultaneously to indicate field elevation in feet relative to barometric pressure. Two setting marks located on the altimeter dial are utilized in setting the altimeter when the barometric pressure exceeds the barometric scale readings.

CABIN PRESSURE ALTITUDE INDICATOR.

A cabin pressure indicator (21, figure 1-5), located on the instrument panel, is a sensitive type altimeter used to measure cabin pressure. It is a self-contained instrument utilizing a sensitive diaphragm which expands or retracts with pressure changes. Pressure is indicated in feet of altitude on the dial which is graduated from 0 to 50,000 feet.

RADIO MAGNETIC COURSE INDICATOR.

The radio magnetic course indicator mounted on the instrument panel (11, figure 1-5) is designed to indicate the magnetic bearing of the omni-range from the airplane and the magnetic heading of the airplane. A circular scale calibrated to 360 degrees in increments of 2 degrees, rotates in the face of the instrument to indicate magnetic heading of the airplane. The magnetic heading is indicated on the scale, beneath the fixed index which is located at the top of the instrument. A double-barred pointer numbered 2 indicates the magnetic bearing to the station on the circular scale. A single-barred pointer numbered 1 indicates the bearing to the station from the airplane as determined by the AN/ARA-25 radio equipment, or when not used in this manner is "slaved" to the No. 2 pointer.

COURSE INDICATOR.

The course indicator located on the instrument panel (6, figure 1-5)consists of vertical and lateral crossbars, a magnetic heading indicating pointer, the "FROM-TO" window, and the "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 indicator, 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 indicator. 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 airplane is flying the omni-range signal toward (TO) the station or away from (FROM) the station. In the event of signal failure, the "TO-FROM" indicator will not show either TO or FROM. A marker light, "PRESS-TO-TEST" switch, and "DIM" control are located in the upper right-hand corner of the instrument while a selector knob "SET" located on the lower left-hand side of the instrument selects and indicates course heading in the "COURSE" window.

GYRO HORIZON INDICATOR.

The gyro horizon indicator (attitude gyro) provides the pilot with a constant visual indication of the pitch and roll attitude of the aircraft. The instrument (14, figure 1-5) is powered by three-phase a-c current. An OFF indicator flag appears in the upper right arc of the dial whenever power is not being supplied to the instrument. The pitch and roll of the airplane are indicated by a movable sphere with a horizon line mounted behind a fixed miniature airplane. The sphere is maintained in a fixed relationship to the movement of the nose of the airplane. A controlled precession of 180 degrees occurs when the airplane reaches 90 degrees in pitch. In a roll, the attitude of the airplane is shown by the angular setting of the horizon bar with respect to the miniature airplane and by relation of the bank index to the degree markings on the bezel mask. After certain maneuvers, the instrument may lag 4 or 5 degrees upon return to level flight. When this happens the unit will begin to correct itself immediately. The miniature airplane mounted just inside the glass cover is fixed in a horizontal position with respect to the instrument housing and dial frame. This airplane can be raised or lowered with respect to the horizon bar to compensate for flight trim. The adjustment knob is located in the lower left corner of the instrument face. The gyro must erect in order to indicate correctly. A knob on the lower right corner of the instrument face allows manual erection of the gyro 10 seconds after power has been applied. Quick erection of the gyro is accomplished in this instrument by means of a mechanical caging device. The gyro must be caged immediately after power is supplied to the instrument by pulling out the caging knob on the front bezel. The knob should be held in the extended position until the horizon bar and bank index cease to oscillate, at which time they should indicate zero roll and pitch within approximately 3 degrees. The caging time will depend upon the position of the gyro; however, the longest time will be approximately 10 seconds. Instantaneous erection may be obtained by holding the caging knob in the extended position when power supply is turned on.

WARNING

- Since the caging device cages the gyro to true attitude of the gyro and not to the true vertical, *the indicator should not be caged in flight* unless the aircraft is known to be in straight and level flight during the caging process. The indicator contains a power warning flag that is visible whenever power is not being supplied properly to the instrument. The flag will disappear when power is restored.
- Consider the instrument to be inoperative if the power warning flag appears.

TURN-AND-BANK INDICATOR.

The turn-and-bank indicator (21, figure 1-5) 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 stand-by 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 needle deflection should be checked in visual flight before instrument flight is attempted.

RATE-OF-CLIMB INDICATOR.

The rate-of-climb indicator measures the rate at which an airplane in flight changes altitude. The operation of the rate-of-climb indicator is based on rate of change in atmospheric pressure due to changes in altitude. The static or atmospheric pressure from the pitot-static tube is routed directly to and is rapidly exhausted from a diaphragm located within the instrument case. A diffuser, on the other hand, will cause the static pressure to enter and leave the case relatively slowly. This difference in rate of pressure change, or the lag of pressure change within the case relative to diaphragm pressure change, determines the eventual indicator reading. This pressure differential is transmitted by means of the mechanism assembly to the pointer which indicates rate of climb or descent in feet per minute. The scale is graduated in varying increments within two ranges, reading 0 to 6 UP and 0 to 6 DOWN. Multiplying the reading by 1000 will give the actual rate of climb in feet per minute.

ANGLE-OF-ATTACK INDICATOR — AIRPLANES HAVING SERVICE CHANGE NO. 121 COMPLIED WITH.

The angle-of-attack indicator* (4, figure 1-5) is a servo instrument which provides the pilot with a visual indication of the angle of attack of the airplane. On some airplanes,* three external lights are mounted on the lower lip of the jet air intake for observation of the

***Airplanes having Service Change No. 121 complied with**

LSO in night landings. If the green light is on, the angle of attack is too high (too slow). An amber light shows when the angle of attack is correct and a red light will show if the angle of attack is too low (too fast). The sensing device for the system consists of a cylindrical slotted probe extending outward from the left forward side of the fuselage. Air entering the slots runs through the probe and terminates at the airstream direction detector which sends electrical signals to the indicator. The indicator dial is marked from 0 to 30 in 15 increments of 2 units each. A pointer sweeps from 0 to 30 as the probe of the airstream direction detector is rotated from one limit to the other. A movable lubber mark can be positioned along the outer edge of the scale by rotating a knob at the lower left corner of the mounting plate. This may be set to any desired value of angle of attack. For the approach configuration, this angle should be set at an indicated angle of attack equivalent to approximately 10 knots above stall speed. The setting will not be affected by changes in gross weight. The airstream direction detector probe measures local (in the vicinity of the probe) airflow direction and, since this airflow direction changes at a ratio of approximately 1.7 to 1 with respect to changes of true angle of attack, the position of the pointer on the dial represents the local airflow direction and not the true angle of attack of the airplane. The system operation in flight is entirely automatic and requires no attention from the pilot. The probe and the indicating unit each contain a heating element which is also automatic in operation. The unit heater is thermostatically operated and the probe heating element is controlled by a switch in the landing gear. The probe heater is energized whenever the weight of the airplane is off the landing gear. A rubber cover is provided to protect the internal mechanism and should be installed when the airplane is to be stored, washed down, or parked in a dusty or icy area.

Note

Make certain that the rubber cover is removed before flight. If the airplane is in cold weather operation and the probe is coated with ice before take-off, the probe heater should be energized by momentarily shunting the landing gear cutout device to energize the heating element and remove the ice.

CAUTION

Do not allow the probe to become hotter than the hand can touch.

ACCELEROMETER.

An accelerometer, with one indicating hand and two recording hands, registers and records positive and negative G-loads. The indicating hand moves in the direction of the G-load being applied while the two recording hands, one for positive G-loads and one for negative G-loads, follow the indicating pointer to its maximum travel. The recording pointers remain at the respective maximum travel position to provide a record of maximum positive and negative G-loads encountered. The recording pointers will not return to the normal (1 G) position until the knob at the lower left corner of the instrument is depressed.

STANDARD AND ELAPSED-TIME CLOCKS.

A standard 8-day clock (23, figure 1-5) with a 12-hour dial is provided on the instrument panel. The clock, which operates the same as any conventional clock is wound by turning the knob clockwise and is set by pulling the knob out and turning as required. The elapsed-time clock (25, figure 1-5), located just to the left of the standard clock on the instrument panel, is provided to aid the pilot in timing turns, maneuvers, and navigation. Successive depressions of the knob, located on the lower left-hand side of the clock, will cause the hour, minute and sweep second hand to start, stop, and return to zero.

EMERGENCY EQUIPMENT.

ENGINE FIRE DETECTOR SYSTEM.

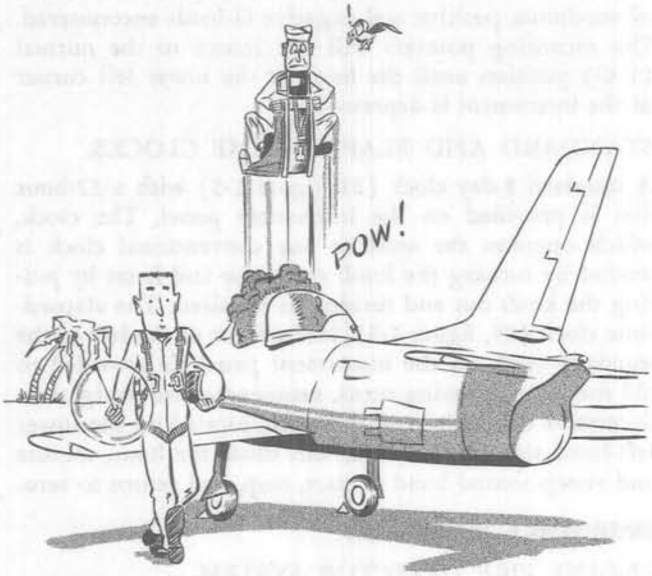
Two fire detector systems are provided to detect and indicate engine fires. The system consists of warning lights in the cockpit and of fire detector units, mounted throughout the engine compartment in the cooling air paths. No fire extinguishing system is installed. A fire within the engine compartment is indicated by red warning lights, mounted on the instrument panel, marked "BURNER" or "COMPRESSOR" (1, figure 1-5). Operation of the system can be checked by means of a push-button test switch (33, figure 1-5) located under the lights. The two systems have independent circuits and the lights can be checked by a push button located on the right console.

CANOPY.

The electrically operated sliding canopy may be controlled from either inside or outside of the airplane. The canopy actuator is powered by the canopy-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. When opening the canopy manually, the canopy manual operating handle must be held down in the extended position until the canopy has moved aft a minimum of 1¼ inches. Air loads prevent the canopy from being opened normally at speeds above 205 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, it pulls a safety pin from the seat firing mechanism so the seat can be ejected.

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:

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

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CANOPY CONTROLS.

CANOPY EXTERNAL CONTROL SWITCH. The canopy may be controlled externally by one of two toggle switches located inside of the entrance step on either side 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 when the canopy butts against the windshield bow. The actuator will continue to ratchet until the external switch is released. 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.

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 1-18) 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, extracts the safety pin, and arms the seat catapult. 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 beneath a quick-access door on the left side of the fuselage above the wing. Pulling this handle disengages the canopy actuator drive and allows the canopy to be manually opened by using two recessed handholds on the aft section of the canopy.

Note

The external release may be used for ground entry in case of battery power failure or when the canopy cannot be opened through normal procedure.

WARNING

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, a safety pin is removed from the seat catapult. Further travel of the curtain fires the seat. On some airplanes,* the face curtain extension will be automatically stopped until the seat ejection catapult has been armed by either the canopy

***Airplanes 141363 and subsequent and airplanes having Service Change No. 396 complied with**

being jettisoned or the pilot utilizing the manual arming system. This interlock prevents the pilot from extending the face curtain to the seat firing position before the seat safety pin is removed. 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. A ground safety pin

EJECTION SEAT

AIRPLANES NOT HAVING SERVICE CHANGE NO. 396 COMPLIED WITH

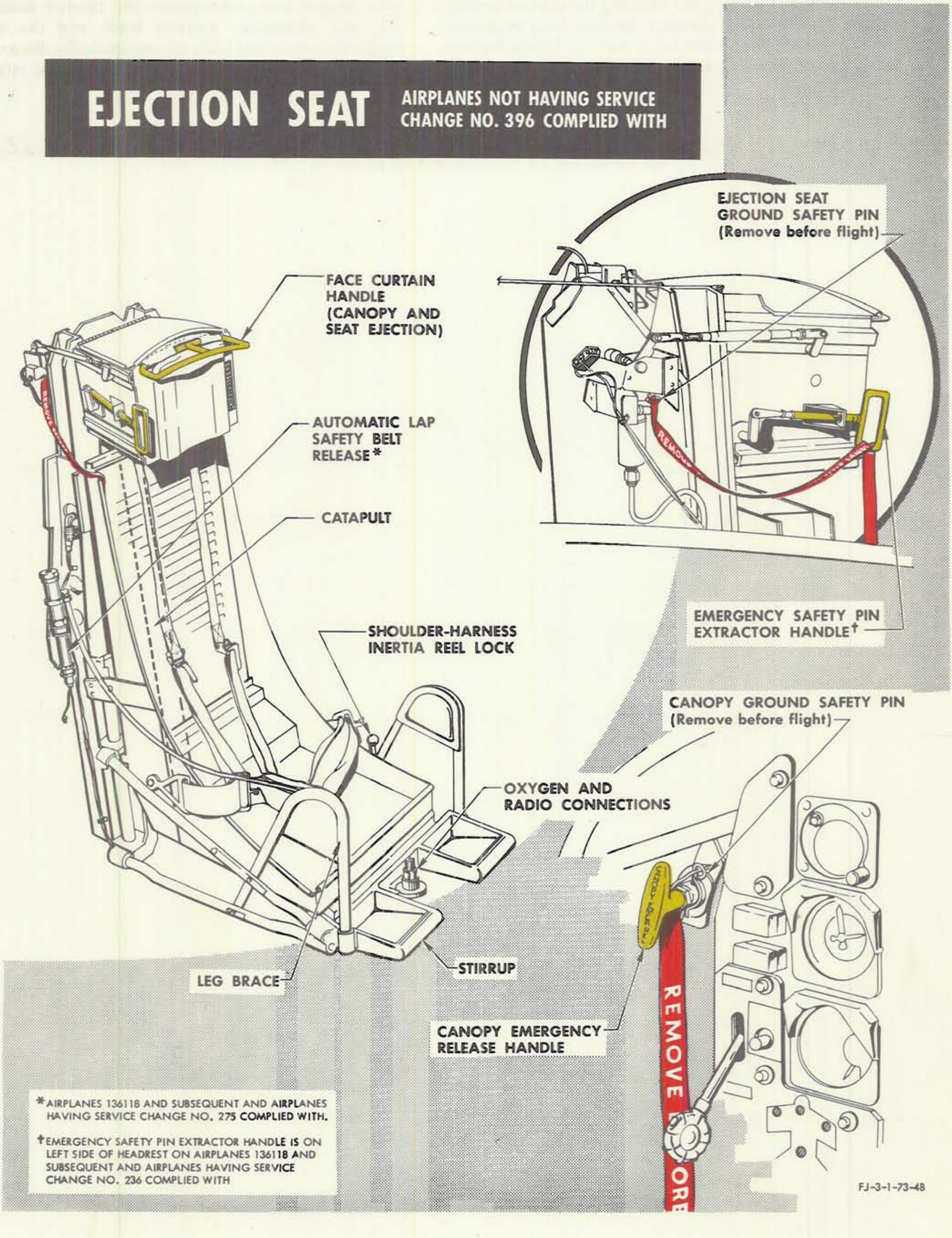


Figure 1-18.

EJECTION SEAT AIRPLANES HAVING SERVICE CHANGE NO. 396 COMPLIED WITH

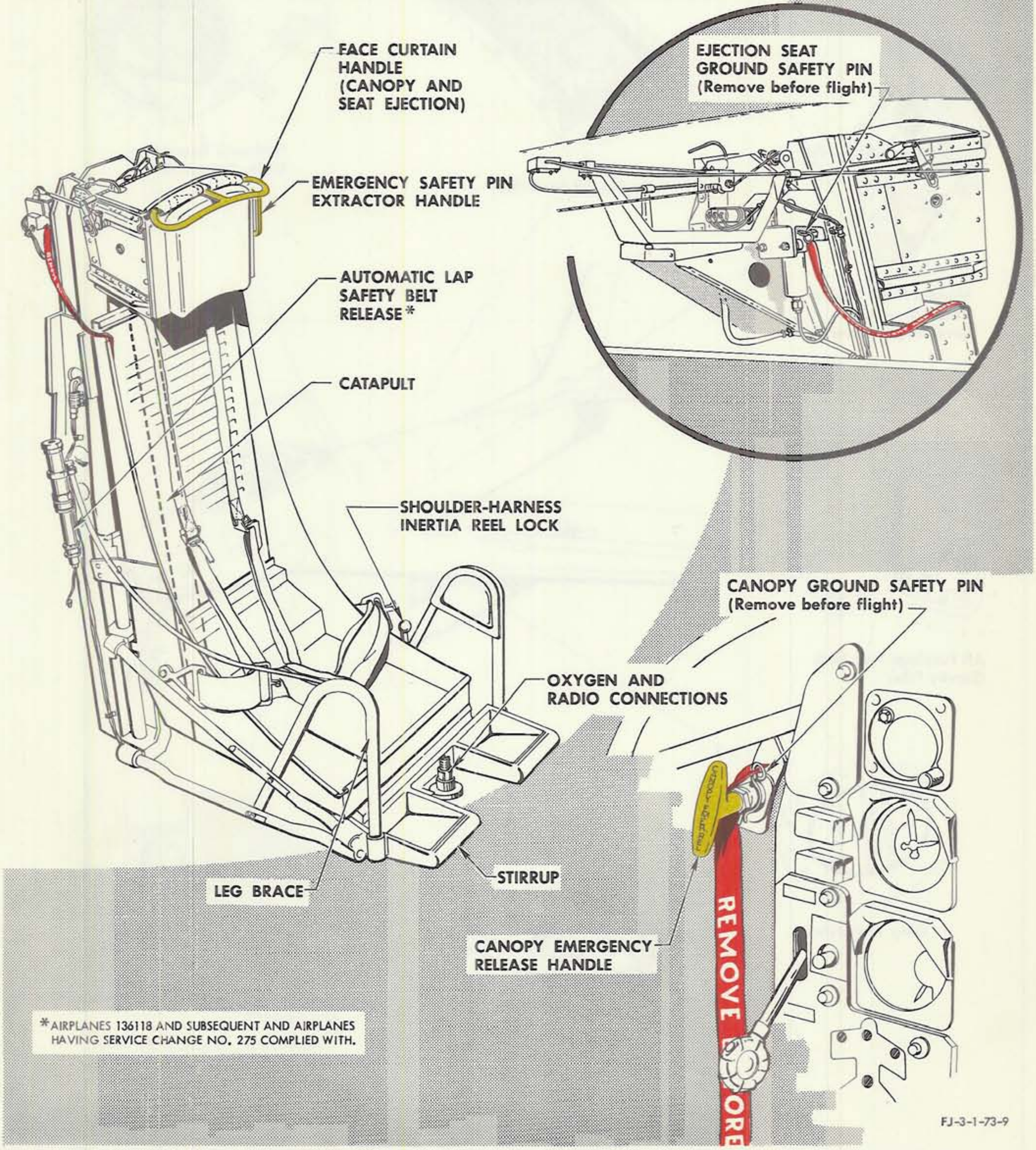


Figure 1-18A.

SERVICING DIAGRAM

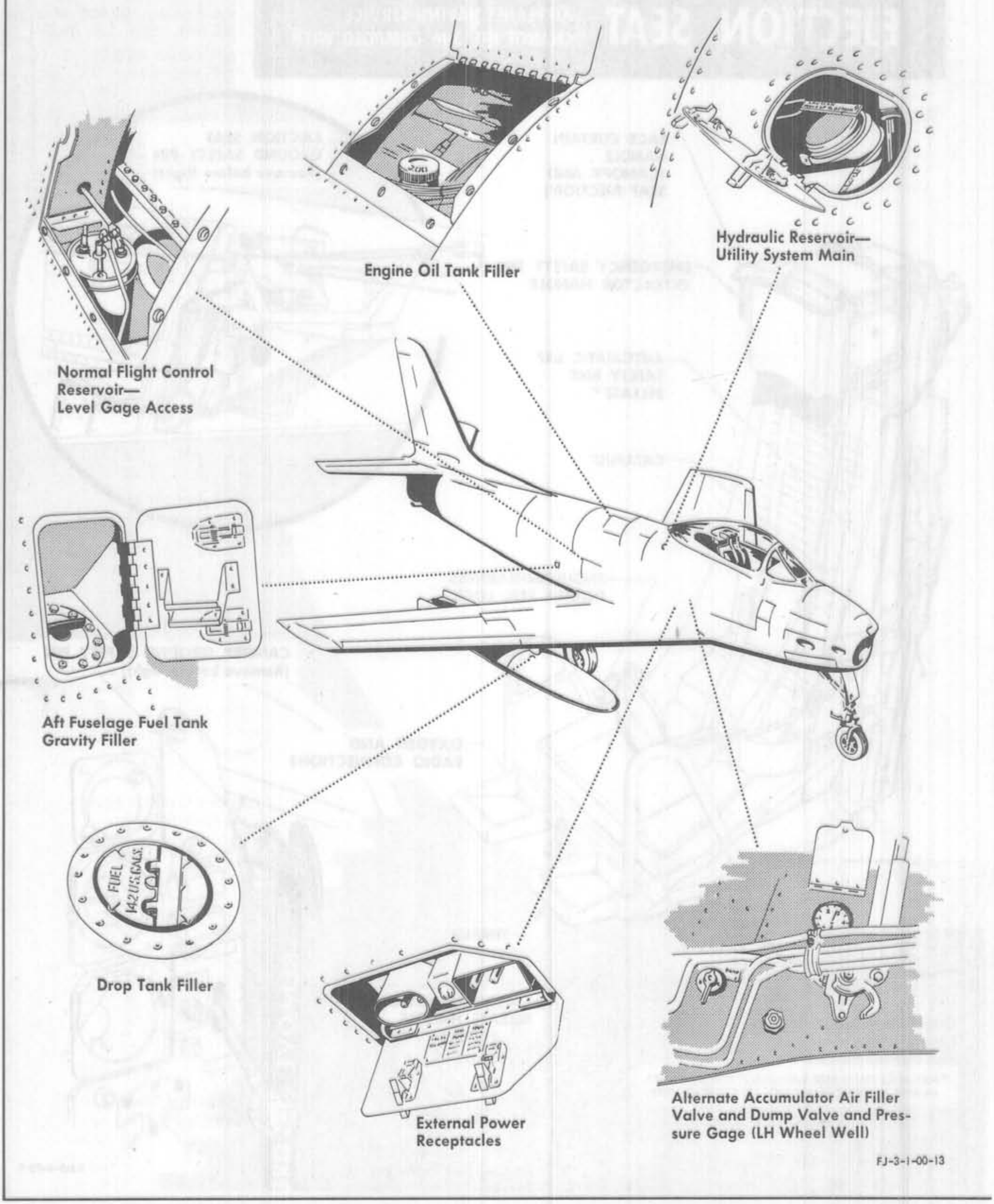


Figure 1-19. (Sheet 1 of 2)

SPECIFICATIONS

Fuel		
Recommended	MIL-F-5624	GRADE JP-4
Alternates	MIL-F-5624	GRADE JP-3
	JET MIX: 3:1	
Emergency	MIL-F-5572 AVGAS	
	JET MIX: 2:1	
Oil—Engine Lubrication		
Normal Service	MIL-L-7808B Type I	
Corrosion-preventive Mixture	MIL-L-7808B Type II	
Alternate	MIL-C-8188B	
Hydraulic Fluid	MIL-O-5606 (Red)	

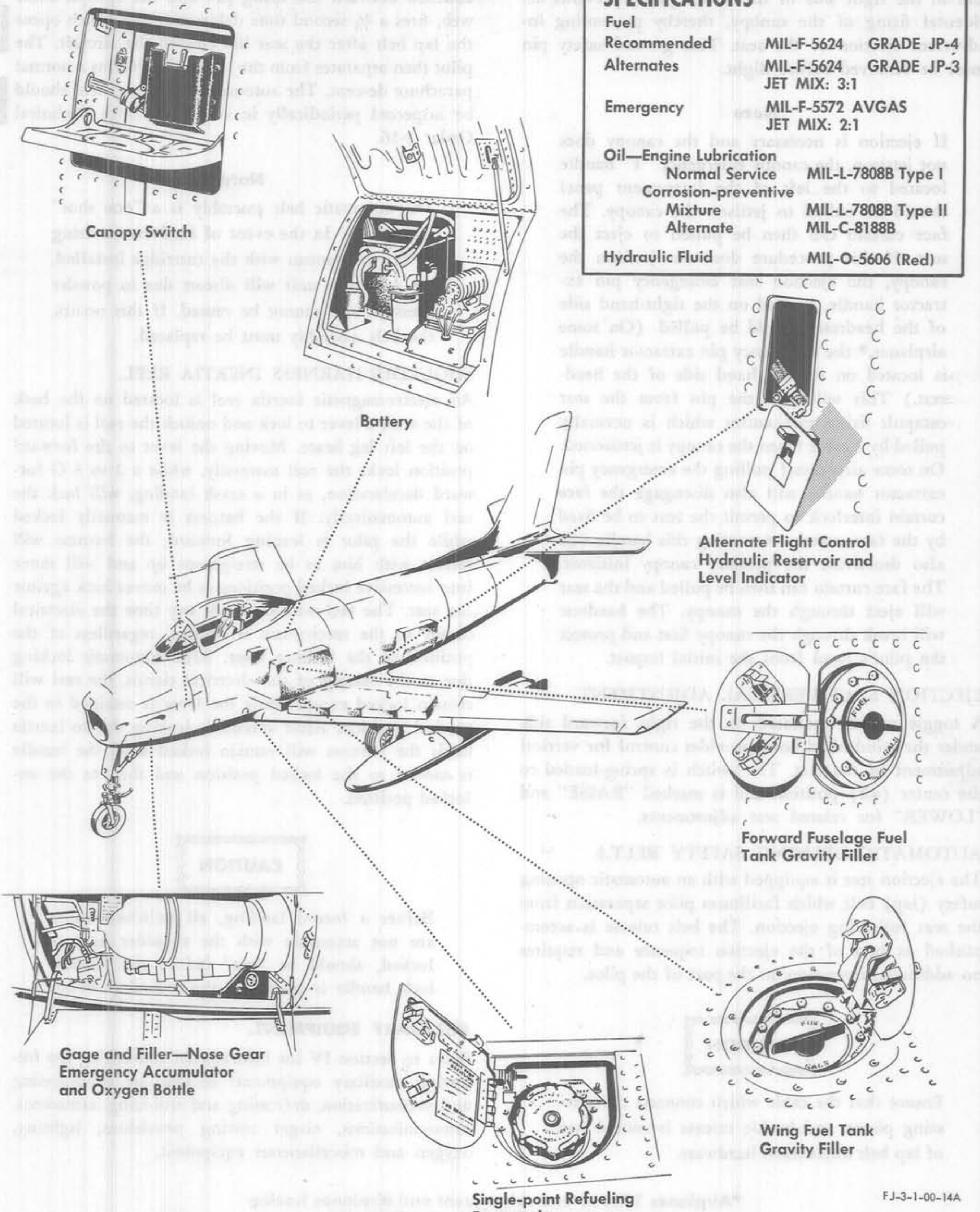


Figure 1-19. (Sheet 2)

inserted in the canopy initiator, located to the rear of and to the right side of the armor plate, prevents accidental firing of the canopy, thereby preventing inadvertent ejection of the seat. This ground safety pin must be removed before 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 right-hand side of the headrest, should be pulled. (On some airplanes,* the emergency pin extractor handle is located on the left-hand side of the headrest.) This will pull the pin from the seat catapult firing mechanism which is normally pulled by a cable when the canopy is jettisoned. On some airplanes,† pulling the emergency pin extractor handle will also disengage the face curtain interlock to permit the seat to be fired by the face curtain. Actuating this handle will also deactivate the primary canopy initiator. 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.

EJECTION 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.

AUTOMATIC OPENING SAFETY BELT.‡

The ejection seat is equipped with an automatic opening safety (lap) 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.

CAUTION

Ensure that the cable which connects the actuating piston and buckle release is routed free of lap belt adjustment hardware.

As the seat leaves the aircraft after ejection, a static link, attached between the firing pin and the cockpit shear web, fires a 3/4-second time delay cartridge which opens the lap belt after the seat has cleared the aircraft. The pilot then separates from the seat and performs a normal parachute descent. The automatic lap belt system should be inspected periodically in accordance with Technical Order 2-56.

Note

The automatic 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 reused. If this occurs, the belt assembly must be replaced.

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 the 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

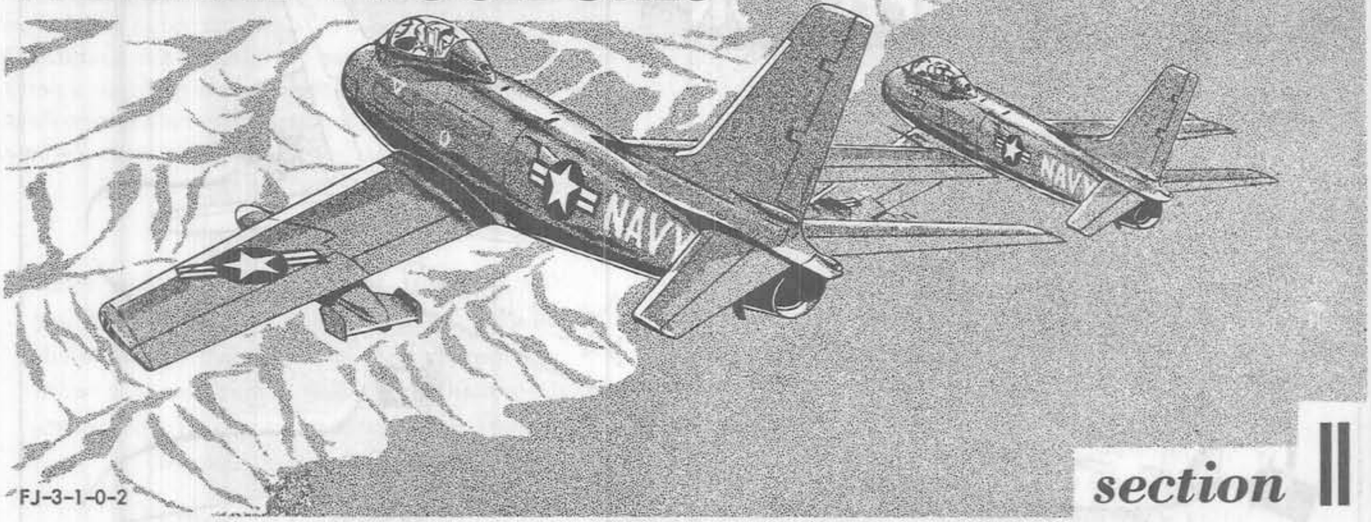
Before a forced landing, all switches which are not accessible with the shoulder harness locked, should be "cut" before the harness lock handle is placed in the locked position.

AUXILIARY EQUIPMENT.

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

*Airplanes 139210 and subsequent and airplanes having Service Change No. 236 complied with
†Airplanes 141364 and subsequent and airplanes having Service Change No. 396 complied with
‡Airplanes 139210 and subsequent and airplanes having Service Change No. 275 complied with

NORMAL PROCEDURES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section II

INTRODUCTION.

When you read this section do not read with the thought in mind that it contains all the information you will need to fly the airplane. You undoubtedly have considerable flying experience in other type aircraft as well as jets. Therefore, you can realize each airplane has its own individual flight characteristics, handling qualities and limitations. This is to remind you that it is extremely important to read about these matters, and retain their valuable information. Reports indicate that pilots who get into trouble are very often the ones who have not familiarized themselves with the restrictions and flight characteristics of their airplanes. For information on the flight characteristics and limitations of the airplane, refer to the Supplemental Flight Handbook (NAVAER 01-60JKC-501A).

Learn how the various systems of the airplane operate by studying Section I. The text of Section VII is written exclusively as a comprehensive discussion of engine operation. Because an emergency situation could arise during *any* phase of airplane operation, you should become thoroughly familiar with the emergency procedures given in Section III. In this connection, a thorough understanding of the airplane systems will enable you to carry out an emergency effectively and intelligently.

BEFORE ENTERING THE AIRPLANE.

Check the "yellow sheet" from the previous flight to be sure all discrepancies have been remedied and signed off, and make certain the airplane has been properly serviced. If the flight is to be conducted at night, make sure your personal gear includes a flashlight. Before an overwater flight is conducted, inspect your life jacket, emergency equipment and pararaft.

WEIGHT AND BALANCE.

Consult Form "F" to determine that the take-off and anticipated landing gross weight and balance are within the approved limits. If no ammunition is to be carried, be sure the proper ballast has been loaded.

Note

Gross weight and CG limits are covered in Section V of the Supplemental Flight Handbook (NAVAER 01-60JKC-501A). For loading information, refer to the Handbook of Weight and Balance Data (AN 01-1B-40).

EXTERIOR INSPECTION.

Conduct an exterior inspection of the airplane with your plane captain. For the items to be checked, see figure 2-1.

ENTERING THE AIRPLANE.

Entrance to the airplane (figure 2-2) 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. Before getting into the cockpit a thorough inspection of the canopy and ejection systems should be conducted in accordance with figure 2-3.

COCKPIT CHECKS.

Upon entering the cockpit, remove ejection seat and canopy safety pins, release rudder locks and check condition of lap belt and shoulder harness before fastening. Also, connect oxygen hose, anti-G hose and radio leads. Check oxygen system and adjust anti-G regulator as desired; then, make the following checks:

1. Landing gear control handle DOWN.
2. Armament switches OFF.
3. Engine master, emergency ignition, and battery-generator switches OFF.
4. Throttle OFF.
5. Speed brake switch NEUTRAL.
6. Circuit breakers IN.
7. Signal plane captain to connect external power, and continue with the checks that follow:
8. Battery-generator switch at OFF until ready to start engine.

EXTERIOR INSPECTION

STARTING AT NOSE OF AIRPLANE, MAKE THE FOLLOWING CHECKS:

1 NOSE

Nose gear ground safety lock removed.
Nose gear oleo strut extension, tire for slippage and proper inflation, main wheels chocked, hydraulic leaks.
Intake duct clear, approach light.
Access doors secure.
Angle of skid detector cover removed.*

2 FORWARD FUSELAGE AND RIGHT WING LEADING EDGE

Gun camera.
Fuel cap secure. (wing).
Drop tank ground safety pin removed.
Drop tanks secure and undamaged, fuel caps secure.
Fuel cell leaks.
Pitot tube uncovered, position light.
Access doors secure.

3 RIGHT WING TRAILING EDGE AND AFT FUSELAGE

Aileron and flap secure.
Landing gear ground safety pin removed.
Security of landing gear doors, strut extension, hydraulic leaks, tires for slippage and proper inflation.
Air turbine generator stowed.†
Fuel cap secure (fuselage).
Arresting gear retracted and secure.
Aileron batten removed.
Access doors secure.

4 EMPENNAGE

Rudder trim tab secure.
Position light.
Tail-pipe plug removed, tail-pipe for cracks or excessive distortion.

5 LEFT WING TRAILING EDGE AND AFT FUSELAGE

Landing gear ground safety pin removed.
Security of landing gear doors, strut extension, hydraulic leaks, tires for slippage and proper inflation.
Aileron and flap secure.
Access doors secure.
Aileron batten removed.

6 LEFT WING LEADING EDGE AND FORWARD FUSELAGE

Position light.
Drop tank ground safety pin removed.
Drop tank secure and undamaged, fuel caps secure.
Fuel caps secure (wing and fuselage).
Fuel cell leaks.
Access doors secure.
Angle of attack detector cover removed.

† AIRPLANES HAVING SERVICE CHANGE NO. 381 COMPLIED WITH
*AIRPLANES 136118 AND SUBSEQUENT

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Figure 2-1.

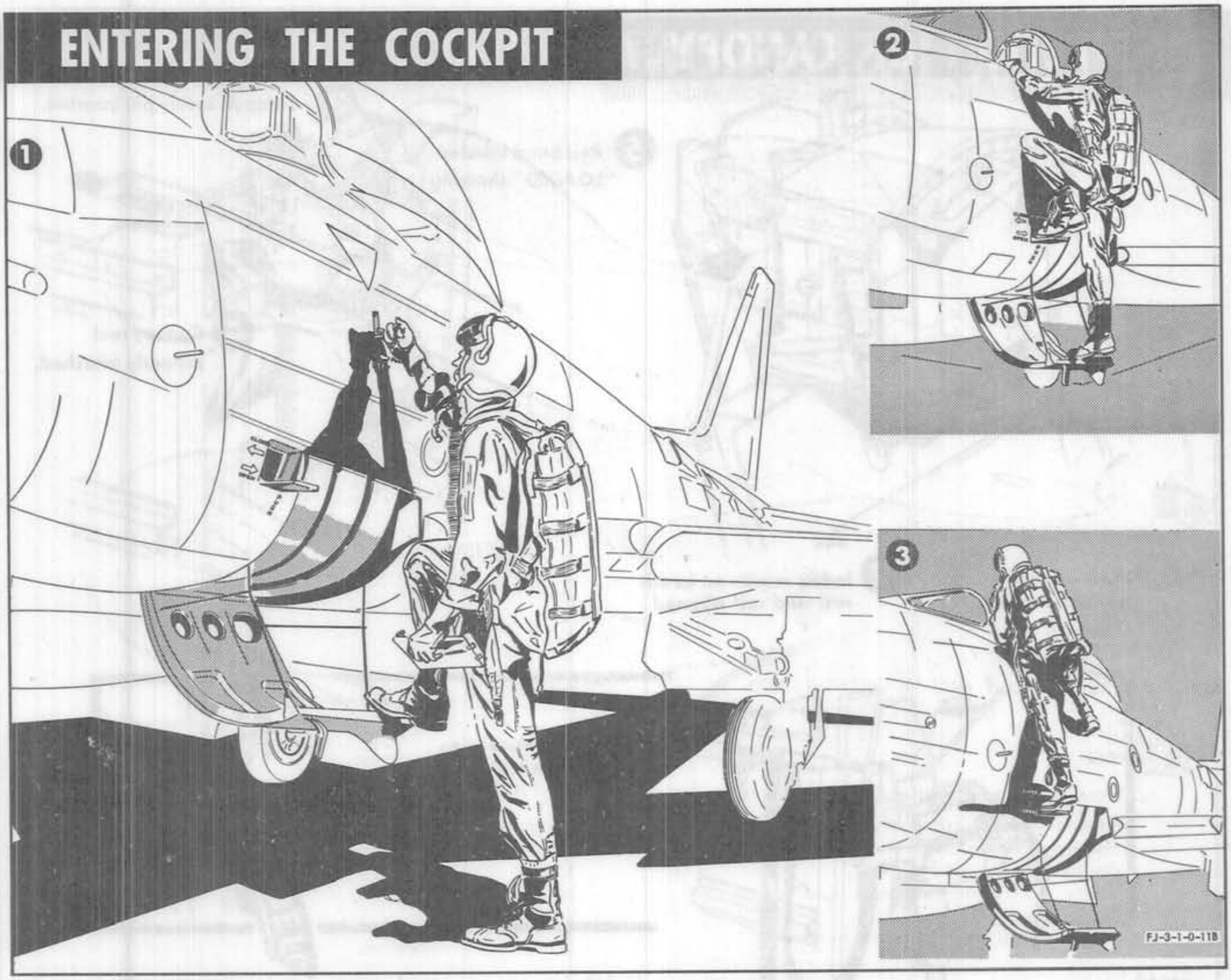

Figure 2-2.

9. (Deleted.)

10. If needed, turn on the required interior and exterior lights and check for proper illumination.

CAUTION

The use of wing tip lights during ground operation should be limited to 30 minutes maximum continuous operation with wings spread and 15 minutes with wings folded.

11. Adjust seat and rudder pedals.

CAUTION

Check that top of helmet is below top of seat headrest to ensure that canopy bow will clear helmet if jettisoned and to ensure that headrest will absorb the initial impact should ejection through the canopy become necessary.

12. Turn on required communication and navigation equipment.

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

14. Anti-G suit regulator at HI or LO as desired.

15. Fuel shutoff control OFF.

16. Drop tank dump switch guarded OFF.

17. Drop tank transfer switch OFF.

18. Cockpit pressure selector switch at NORMAL or COMBAT as desired.

Note

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

INSPECTION OF CANOPY AND SEAT EJECTION SYSTEMS

Figure 2-3.

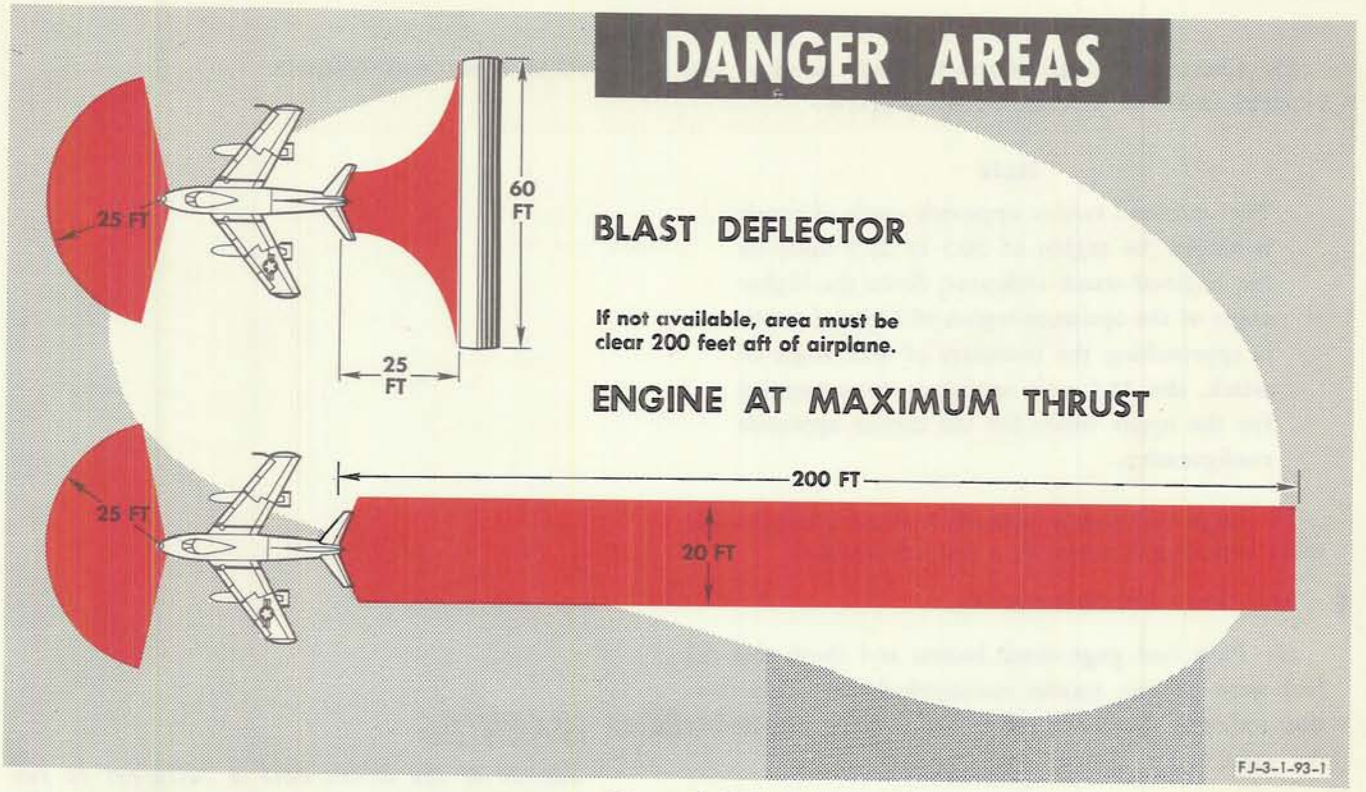

Figure 2-4.

Note

On humid days, the use of ram-air ventilation for take-off and climb to 5000 feet will prevent fog formation in the cockpit. For additional information, refer to NORMAL OPERATION OF COCKPIT AIR CONDITIONING AND PRESSURIZING SYSTEM, Section IV.

19. Cockpit air temperature control switch NORMAL.
20. Cockpit air temperature control rheostat at desired position.
21. Adjustable air outlet control knobs positioned as desired.
21A. Turbine generator release handle in.*
22. Flight control pressure selector switch and gage selector to ALTERNATE. Move the control stick until pressure drops to about 2000 psi. Allow system pressure to recover. If pressure returns to 3000 (±200) psi, the system is operating properly.
22A. Pull the flight control emergency handle and listen for operation of alternate hydraulic pump. Return handle to normal position.
22B. Flight control pressure selector switch NORMAL.

Note

The flight control *alternate* hydraulic system becomes operative automatically when external power is connected. The flight control normal hydraulic system must be engaged for operation after the engine is started by holding the spring-loaded flight control pressure selector switch momentarily at RESET; then releasing it to NORMAL.

23. Check rudder, ailerons, and horizontal tail for freedom of movement and proper response to control action.
24. Place flight control alternate trim selector switch at ALTERNATE and check operation of alternate trim switch through a complete cycle.
25. Return flight control alternate trim selector switch to NORMAL and trim through a complete cycle; adjust aileron, stabilizer and rudder trim for take-off.
26. Reticle brightness control knob (fire control power) to OFF.
27. Radar power switch (ARO panel) OFF.

WARNING

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

28. Wing flaps lever UP.
29. Landing light switch OFF.
30. Emergency fuel control switch PRIMARY.
30A. Push fire detector test button to test fire warning system.
31. Canopy emergency release handle stowed.
32. Drop tank emergency jettison handle stowed.

*Airplanes having Service Change No. 381 complied with

33. Check that angle-of-attack, Mach number, and airspeed indicator indexes are set properly.

Note

The optimum carrier approach angle of attack is within the region of 20.5 to 22.5 units on the angle-of-attack indicator. Since the higher angle of the optimum region of angle of attack is approaching the boundary of stall angle of attack, the 22.5 unit setting is recommended for the upper limits for the carrier approach configuration.

34. Cage and uncage altitude horizon indicator and make sure that it erects in a normal position.

35. Clocks and altimeter set.

36. Push fuel gage check button and check that the fuel gage pointer rotates counterclockwise. This rotation indicates that electrical power is being supplied to the gage.

37. Check fuel quantity.

37A. (Deleted.)

38. (Deleted.)

39. Landing gear emergency release handle stowed.

40. Instrument a-c power switch at NO. 2 INV. Instrument power off warning light should not be illuminated.

40A. Instrument power switch at NO. 1 INV. Instrument power off light should not be illuminated.

41. Push warning light test switch to test all warning lights and indicators.

42. Windshield anti-ice switch OFF.

43. Cycle windshield and canopy defrost switches to OFF; then return to HOLD to prevent hot air blasts during take-off.

43A. Emergency power selector switch NORMAL.*

43B. Battery-generator switch BAT. & GEN.

44. Align S-2 compass.

45. (Deleted.)

46. (Deleted.)

47. (Deleted.)

48. Check operation of communication equipment.

BEFORE STARTING ENGINE.

WARNING

Suction at the intake duct is sufficient to kill or severely injure personnel drawn into or pulled against the duct.

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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 engine on a concrete surface to minimize the possibility of dirt and foreign objects being drawn into the compressor and damaging the engine.
- Start engine with airplane headed into, or at right angles to the wind whenever possible, as 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; however, if circumstances demand, the engine can be started using the jet starting

***Airplanes having Service Change No. 381 complied with**

power source *only*. To do this, the battery-generator switch must be positioned to either BAT. ONLY or BAT. & GEN. The preferable position is BAT. & GEN, as this permits the generator to switch automatically onto the line as soon as speed builds up, thus conserving battery power.

Note

It is impossible to 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 28-volt, constant voltage.

Note

- In the event a Navy type constant current power supply is not available, a power source having the following characteristics may be used. The supply voltage should be maintained at 28 volts until the starting contactor closes. The resultant high transient inrush of current should be limited to 1200 (+0/−180) amperes. As the start progresses, the voltage builds up to approximately 35 volts while the currrent tapers off to 235 (±15) amperes, at which time, the starter-controller relay normally drops out the starter contactor.
- When servicing the airplane with 28-volt external power, place the battery-generator switch in the OFF position to preclude overcharging and subsequent damage to the battery.

STARTING ENGINE.

Start engine as follows:

1. Re-check throttle OFF.
2. Re-check battery-generator switch at BAT. & GEN.
3. Fuel shutoff control ON.

WARNING

If the fuel shutoff control is in the OFF position so that the fuel shutoff valve is closed when the engine-driven fuel pump is operating, the fuel lines between the shutoff valve and the pump might collapse due to pump suction.

4. Re-check emergency fuel control switch at PRIMARY.
5. Engine master switch MASTER.
6. Hold engine starter switch momentarily at START.

CAUTION

- The high current required during starting will burn out the starter within a few seconds if the turbine does not begin to rotate 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, immediately move the starter switch to STOP.
- If the engine speed does not reach 11% rpm within 30 seconds after actuating the start switch, position the switch at 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, 33 to 35 volts at aircraft receptacle. Check for clean and tight power lead connections. Check for proper connection of jet starter plug in aircraft receptacle. Check for proper functioning of fuel control and investigate for excessive engine friction.

7. At 11% rpm move the throttle to IDLE and watch for an increase in tail-pipe temperature, thus indicating the engine has started.

For airplanes with the J65-W-4B or J65-W-16A engines, 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 only possible to meter the fuel flow from IDLE, halfway to cutoff. In event of an rpm hang up, it is not possible to increase the fuel flow by positioning the throttle above the IDLE position.

(b) By operating the throttle in the region from IDLE halfway back toward cutoff, it is possible to 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 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.

CAUTION

In the event of an attempted start during which the engine does not "light off" properly, the starting current should not be applied in excess of 20 seconds. If the engine fails to start after two 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.

WARNING

Any one start during which the exhaust gas temperature exceeds 900°C or five starts during which the exhaust gas temperature reaches 800°C to 900°C shall require an overtemperature inspection of the engine. All instances of overtemperature operation must be noted on the daily inspection form and the "yellow sheet" and entered on the aircraft engine log. The peak temperature and the total time of the overtemperature operation should be recorded.

8. Check engine instruments for desired readings. {Refer to ENGINE LIMITATIONS, Section V of the Supplemental Flight Handbook)NAVAER 01-60JKC-501A)}

9. Re-check all circuit breakers IN.

10. After engine stabilizes at idle, the plane captain checks the nose gear accumulator for pressure build-up. The pressure should read between 2850 to 3250 psi.

AFTER STARTING ENGINE.

As soon as the engine stabilizes at idling speed which should be between 42 and 48% rpm varying with field elevation and outside temperature {refer to GROUND IDLE RPM, Section V of the Supplemental Flight Handbook(NAVAER 01-60JKC-501A)}and all gage readings are normal, the throttle may be advanced to full thrust.

~~To check that the starting primer solenoid is operating satisfactorily, the following procedures should be followed:~~

~~1. With the engine operating at idle rpm, momentarily place the emergency ignition switch in the ON position. Observe the fuel flow rate indicator for a fluctuation of approximately 100 pounds per hour.~~

CAUTION

Do not keep the emergency ignition switch in the ON position for more than one second. Longer operation may damage the primers and igniters and cause hot spots in the engine.

2. If the fuel flow rate does not fluctuate when the emergency ignition switch is moved to the ON position, shut down engine and investigate the cause for malfunction.

Note

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

After determining that the engine is functioning properly, have external power source disconnected.

GROUND TESTS.

The ground tests described here should be conducted after external power has been disconnected.

CAUTION

Any time a high power engine run-up is made during ground operation be sure that wheels are chocked and that brakes are applied.

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 a periodic inspection. With the exception of these checks, the manual fuel system should be used only when an emergency situation exists.

MANUAL FUEL CONTROL SYSTEM.

1. Set throttle at 90% rpm.
2. Move emergency fuel control switch from PRIMARY to MANUAL and check that manual fuel control warning light illuminates.

CAUTION

Manual system has no automatic compensating devices and relies completely on cautious throttle manipulation to maintain limiting exhaust gas temperatures and rpm. When switching from PRIMARY to MANUAL, the engine rpm will increase or decrease immediately depending upon the variation of ambient conditions from standard.

3. When engine is stabilized, accelerate slowly to maximum obtainable power without exceeding operating limits. With standard sea level static conditions and manual system functioning properly, the following rpm's should be obtained:

AMBIENT TEMP.	RPM
100°	99%
60°	97%
0°	92%

Note

The above rpms are minimum; higher values are satisfactory, provided 101% rpm or limited temperature is not exceeded.

4. Retard throttle to IDLE. While decelerating through 60% rpm range, move emergency fuel control switch from MANUAL to PRIMARY. Manual fuel control warning light should go off.

The manual fuel control system check on airplanes having J65-W-4B or J65-W-16A engines is as follows:

1. Set throttle for 90% rpm.
2. Move fuel control switch from PRIMARY to MANUAL and check that manual fuel control warning light illuminates.
3. When engine is stabilized, accelerate slowly to maximum obtainable power without exceeding operating limits. With standard sea level static conditions and manual system functioning properly, the rpm's noted in step 3. of the preceding paragraph should be obtained.
4. Retard throttle to IDLE.
5. Move fuel control switch from MANUAL to PRIMARY when idle rpm is reached.

FLIGHT CONTROLS.

Note

The flight control alternate hydraulic system will become operative automatically when external power is applied. It will remain engaged until the flight control normal hydraulic system is manually selected after the engine is started.

1. Move pressure gage selector to UTILITY to check system pressure; then, spread wings and check that they are locked.

WARNING

Do not attempt to activate wing fold manual lockpins until utility system pressure has returned to normal (approximately 3000 psi) following wing spread operation. This procedure ensures that the wing spread cycle has been completed.

CAUTION

To prevent bellows damage, the wings should not be extended while transfer pressure is on the wet leading edge tanks. The bellows take on an abnormal shape under pressurization, causing them to become pinched between the inboard and outboard tanks of the wing if an attempt is made to extend the wings.

2. Check that the alternate-on warning light is on.
3. Move the pressure gage selector and flight control selector switches to ALTERNATE: check electric-driven pump cut in at a minimum of 2500 psi and cutout at maximum of 3300 psi.

4. Rotate the control stick through 360 degrees with a deliberate wiping motion, actuating all surfaces to full deflection. A minimum of two 360-degree cycles of the control stick should be required to exhaust the alternate flight control system to approximately 650 psi, causing the pressure switches to reset hydraulic control to the normal system. The alternate flight control warning light should go out, indicating that hydraulic power is being furnished by the normal flight control system. Observe the pressure build-up in the alternate flight control system. The alternate flight control system should cut back in as the system pressure reaches a maximum of 1150 psi, and the alternate flight control warning light should come back on.

Note

If it is found that less than two 360-degree cycles of the control stick exhausts the alternate flight control system, it may be assumed that either the accumulator pressure is low or that the electric-driven pump is not providing sufficient output. In either case the system should be checked prior to flight.

5. Engage normal flight control hydraulic system by holding the flight control pressure selector switch momentarily at RESET. Check alternate-on warning light out.

6. Move the pressure gage selector switch to NORMAL and check for a pressure of 2900 to 3250 psi.

7. Again rotate the control stick and check that the control surfaces respond correctly.

WARNING

When visually checking the ailerons, always check both surfaces — not just one.

8. With flight control system selector switch at NORMAL and with the pressure gage selector switch at ALTERNATE, check manual emergency override system by pulling the flight control emergency handle to the extreme aft position. The alternate-on warning light should illuminate, the pressure gage should indicate 3200 to 3800 psi, and the control surfaces should respond correctly to stick movements.

9. Return flight control emergency handle to its normal position.

10. Hold flight control pressure selector switch momentarily at RESET, and check that alternate-on warning light goes out.

UTILITY HYDRAULIC SYSTEM.

Run speed brakes through one complete cycle and check for proper operation. Check operation of speed brake indicator. With the pressure gage selector switch at UTILITY, check pressure for 3000 psi. After closing speed brakes, return speed brake switch to neutral and return pressure gage selector switch to NORMAL.

WARNING

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

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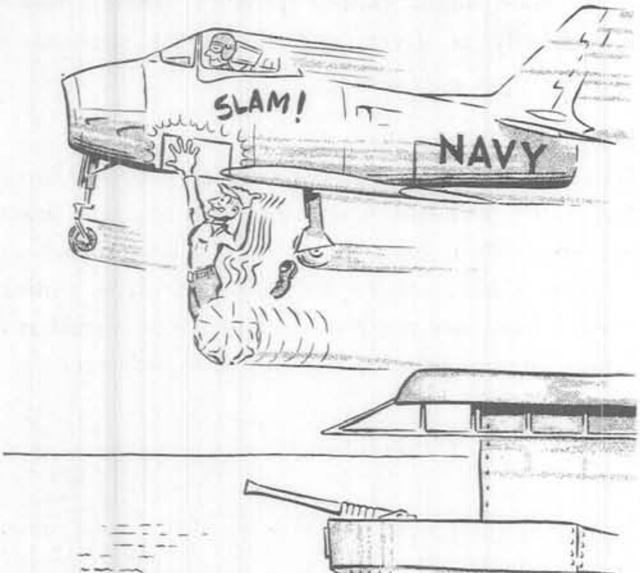
TAXIING INSTRUCTIONS.

To minimize the possibility of dirt and foreign objects to be drawn into the compressor when taxiing, maintain adequate distance from other taxiing airplanes. Avoid crossing slip streams of jet or propeller-driven airplanes.

1. Signal plane captain to remove chocks.
2. Taxi at the lowest practical rpm once the airplane is moving.
3. Steer airplane by differential braking; check operation of flight instruments while taxiing.
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 the engine operating at idle speed is approximately 1100 pounds per hour.



CAUTION

Ammunition access doors and all other steps cannot be closed from the cockpit. Before taxiing, be certain they are closed by the plane captain.

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TAKE-OFF CHECKS.

The check-off list to be accomplished just prior to take-off appears on the instrument panel. (See figure 2-5.) An expanded version appears below:

1. (Deleted.)
2. Re-check fuel quantity.
3. Drop tank transfer switch OFF.

3A. Wings locked.

4. Flight control pressure selector switch NORMAL.
5. Airplane trimmed for take-off.
6. Flaps DOWN.
7. Lap belt and shoulder harness tightened and locked.
8. Oxygen as desired.
9. Canopy as desired.
10. Check anti-G system.
11. Run up engine to 100% rpm and check engine instruments for desired readings.

Note

Acceleration from idle to military rpm should not take longer than 17 seconds.

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 2-6.

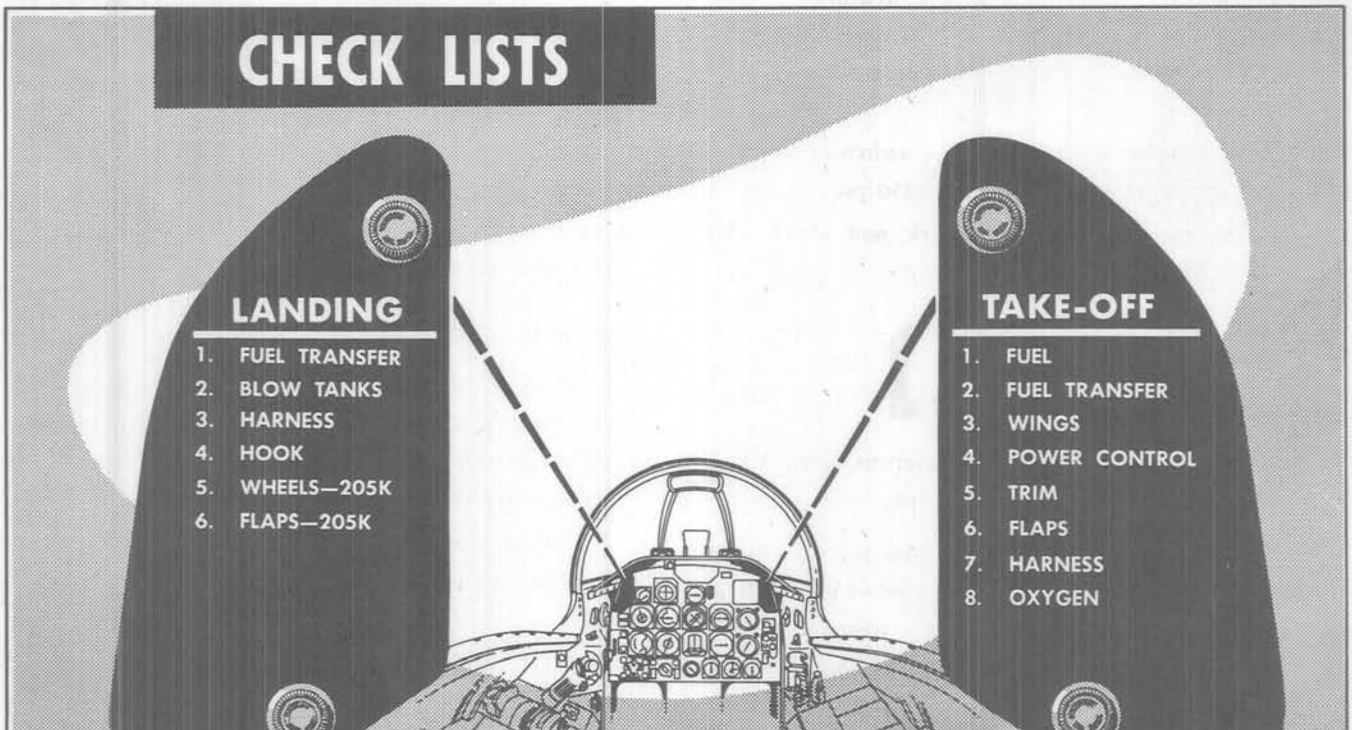

Figure 2-5.

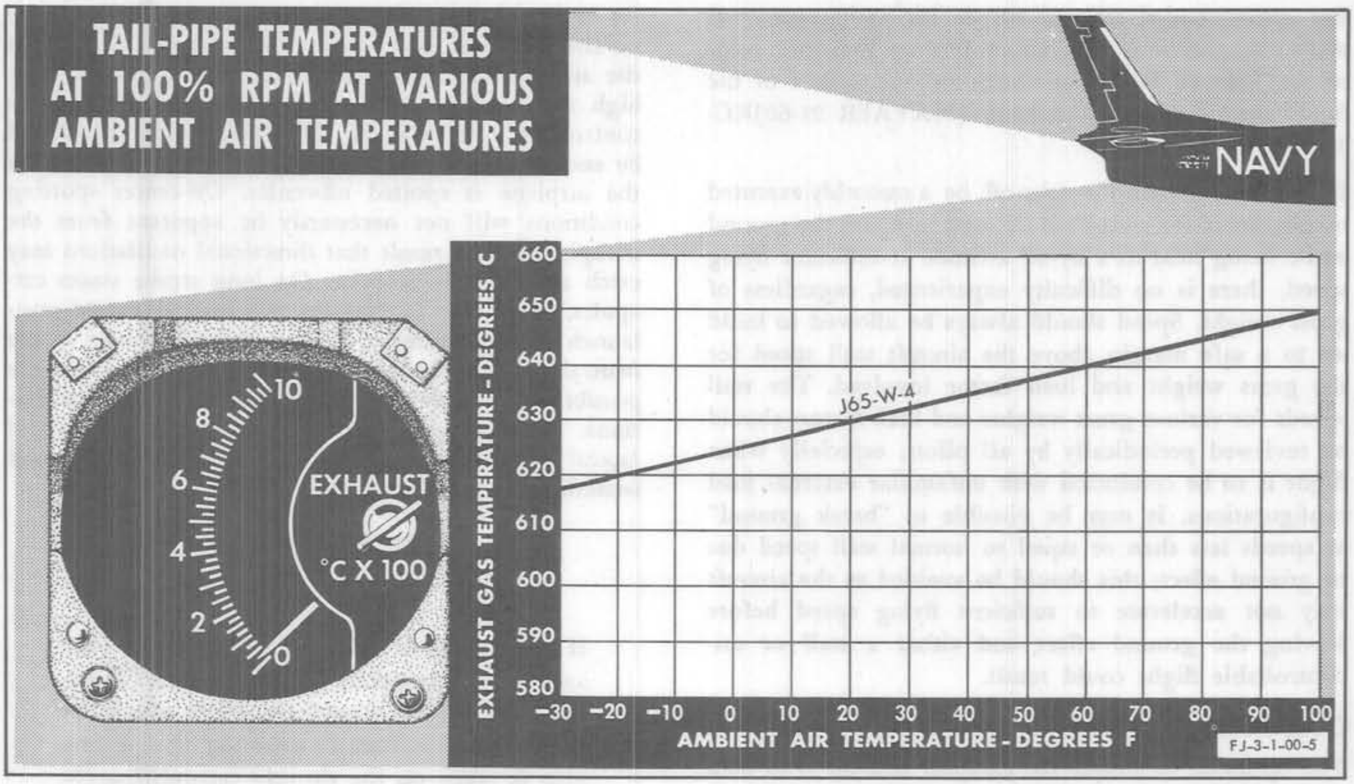

Figure 2-6.

TAKE-OFF.

Note

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

NORMAL FIELD TAKE-OFF.

For take-off distances, see figures A-13 through A-15 in the Supplemental Flight Handbook (NAVAER 01-60JKC-501A). The take-off procedure with or without drop tanks is the same, essentially, except that at higher gross weights, higher take-off speeds are required. For take-off, the lateral and directional controls should be trimmed to IN on the take-off trim position indicator and the top of the control stick trimmed approximately ½-inch forward of the IN trim position.

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.

Note

Excessive use of brakes during take-off run will increase the take-off distance.

3. At approximately 90 knots IAS, or when the nose wheel is felt to be "bouncing" on the runway, lift the nose wheel just off the runway and maintain this attitude as the aircraft continues to accelerate. At approximately 5 knots below the recommended take-off speed, increase the pitch angle slightly and the aircraft will become air-borne at the recommended airspeed. Allow the aircraft to continue to accelerate in a shallow climb.

4. Retract the landing gear when touch-down can no longer be made on the take-off runway.

Recommended normal (not minimum) take-off speeds with full flaps and with drop tanks installed are approximately as follows:

GROSS WEIGHT	INDICATED TAKE-OFF SPEED (KNOTS)
16,000	120
17,000	124
18,000	128
19,000	132
20,000	136
21,000	140
22,000	144

Gross weights for this aircraft, including pilot and full ammunition load, for various fuel load configurations are as follows:

Full internal fuel, drop tanks empty:

fueled with JP-4 .... 17,400 pounds
fueled with JP-5 .... 17,540 pounds

Full internal fuel, full 200-gallon drop tanks:

fueled with JP-4 .... 20,000 pounds
fueled with JP-5 .... 20,300 pounds

For recommended take-off speeds for various external store configurations with either JP-4 or JP-5 fuel, refer to the Take-off Distances charts, in Appendix I of the Supplemental Flight Handbook (NAVAER 01-60JKC-501A).

It is essential that the take-off be a smoothly executed maneuver. If the aircraft is allowed to fly off the ground while being held in a fly-off attitude at sufficient flying speed, there is no difficulty experienced, regardless of gross weight. Speed should always be allowed to build up to a safe margin above the aircraft stall speed for the gross weight and load factor involved. The stall speeds for various gross weights and load factors should be reviewed periodically by all pilots, especially when flight is to be conducted with unfamiliar external load configurations. It may be possible to "break ground" at speeds less than or equal to normal stall speed due to ground effect; this should be avoided as the aircraft may not accelerate to sufficient flying speed before leaving the ground effect and either a stall or uncontrollable flight could result.

CATAPULT TAKE-OFF.

The optimum technique for catapult take-off is to trim the airplane at the normal IN trim settings and to hold the hand clear of the stick at the start of the power stroke. Approach the IN trim position with short "beeps" of the trim switch to prevent coasting beyond the desired setting. Form a "V" with the right-hand thumb and fingers and keep the hand aft of the stick until longitudinal acceleration loads have decreased to the point where pilot capability for smooth control is assured. The stick will not move from the trimmed position during the power stroke unless such movement is pilot-induced.

CAUTION

If the stick is trimmed or inadvertently moved aft of the IN trim position, there is danger of over-rotation possibly to the point of inducing accelerated stall after leaving the bow. The physical pilot/stick relationship does not facilitate adequate bracing of the arm or elbow for holding the stick in the trimmed position.

After running up engine to 100% and checking engine instruments, proceed as follows:

1. Adjust throttle friction lever as necessary.
2. Grasp the throttle catapult handle securely.
3. Place head back firmly against headrest.
4. Signal catapult officer, "ready for take-off."

At endspeeds near the minimum, slight back pressure on the stick may be necessary to rotate the airplane to the attitude required to maintain level flight. At very high endspeeds, some push force may be required to control the rate of climb. Directional oscillations 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 with the result that directional oscillations may catch the pilot by surprise. On long stroke steam catapults, directional oscillations may lead to a mild post-launch rolling tendency. Rudder should be held in the neutral position during the power stroke to avoid the possibility of inadvertent augmentation of yaw oscillations. The airplane is very sensitive to longitudinal and lateral control movements in low-speed flight and smooth handling during the fly-away is paramount.

CAUTION

If a transition is made from long stroke (C-7 and C-11-1 catapults) to short stroke (H-4-1, H-8 and C-11-2 catapults), pilots should be particularly cautious in ensuring that a firm grip is taken on the throttle catapult handle. Peak acceleration loads are obtained in a much shorter period on short stroke catapults, and this characteristic must be anticipated by pilots who are accustomed to the smoother characteristics of the long power stroke. Use of the hand-off (stick) technique is mandatory on short stroke catapults to prevent inadvertent movement of the stick from the trimmed position during the launch.

Note

It is essential that catapult officers be informed of specific aircraft gross weights and endspeeds required for safe catapult take-off and that all pilots be familiar with stall speed and load factor increases due to maneuvering.

CAUTION

Do not attempt catapult take-off without ammunition or ballast in the magazines.

AFTER TAKE-OFF.

When airplane is definitely air-borne:

1. Landing gear handle UP. Check landing gear position indicators for gear up. Approximately 7 seconds is required for gear retraction.

2. Wing flap lever UP as airplane gains speed above 130 knots IAS. Check flap position indicator for flaps up.

CAUTION

If the flaps do not fully retract, avoid high speed, high G pull-ups. Failure of the flap actuating mechanism may occur if the flaps are not supported against the up-stop during accelerated maneuvers at high speed.

3. Close canopy.

CAUTION

During flight, do not move canopy switch to CLOSE when 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. Trim horizontal tail as required.

Note

The leading edge slats will become fully closed at approximately 200 knots IAS, with or without external load.

5. Turn drop tank transfer switch ON if drop tanks are installed and contain fuel.

CLIMB.

Climb at take-off rpm (time limit 30 minutes), and follow the climb schedule given as follows:

DROP TANKS ON

ALTITUDE FEET	IAS KNOTS	MACH NO.
Sea Level	340	.51
10,000 feet	330	.59
20,000 feet	310	.67
30,000 feet	275	.73
35,000 feet	255	.76
40,000 feet	230	.76
45,000 feet	205	.76

For additional climb data covering climb with tanks off, rates of climb, fuel consumption during climb and optional climb schedule refer to Appendix I Supplemental Flight Handbook (NAVAER 01-60JKC-501A).

FLIGHT CHARACTERISTICS.

Refer to Section VI in the Supplemental Flight Handbook (NAVAER 01-60JKC-501A) for information regarding flight characteristics.

It is considered good practice to check the utility and flight control hydraulic pressure periodically in flight. Accomplish these checks as follows:

1. Place pressure gage selector at UTILITY and read gage for proper utility hydraulic system pressure.
2. Fly straight and level; then with gage selector switch at NORMAL, read pressure gage for flight control normal hydraulic system pressure.
3. While still in level flight, position gage selector at ALTERNATE and read pressure gage for the flight control alternate hydraulic system pressure. Return gage selector switch to NORMAL.

For discussion of engine and systems operation in flight, refer to Section VII. For emergency procedures to follow during flight, refer to Section III.

DESCENT.

To make a rapid descent, open the speed brakes, retard the throttle, and establish the dive angle or dive speed desired. It is permissible to operate the speed brakes at any time and the airplane can be dived at any angle without exceeding the design limits. To obtain maximum distance, descend at 200 knots with speed brakes closed.

PRE-TRAFFIC PATTERN CHECK LIST.

A check list to be accomplished prior to landing appears on the instrument panel. (See figure 2-5.)

1. Leading edge and drop tank transfer switch OFF.

Note

The leading edge and drop tank transfer switch must be turned OFF while in the traffic pattern to ensure that the tanks are depressurized when folding the wings.

1A. Jettison any fuel remaining in the drop tanks by placing drop tank dump switch at DUMP.

2. (Deleted.)

2A. Lap belt and shoulder harness tightened and locked.

3. Armament switches OFF.
4. (Deleted.)
5. Check that utility hydraulic pressure is available.

CAUTION

In the event of suspected utility hydraulic system failure (fluctuating pressure or less than 1000 psi), the number of brake applications should be limited during landing roll-out to minimize the possibility of depletion of hydraulic fluid from the emergency brake reservoirs.

TRAFFIC PATTERN CHECK LIST.

For maximum permissible landing gross weights, refer to Section V in the Supplemental Flight Handbook (NAVAER 01-60JKC-501A). A typical landing pattern for normal field landing is shown in figure 2-7.

1. Check that arresting hook is up for field landing.

Note

The barrier pickup extends when the arresting hook is lowered and is not retractable in flight. Under unusual conditions, such as failure to land aboard a carrier due to fouled deck where landing must be made at a land base, indicated airspeeds with the barrier pickup extended shall not exceed those given in Section V of the Supplemental Flight Handbook (NAVAER 01-60JKC-501A). For cruising conditions the recommended maximum range CAS given in the Flight Operation Instruction Charts {Appendix I of the Supplemental Flight Handbook (NAVAER 01-60JKC-501A)} and on the REST computer should be decreased 20 knots. Cruising at these lower airspeeds will result in an approximate 10 percent reduction of range as compared to cruising at the recommended CAS with the barrier pickup in the up position.

2. Landing gear DOWN. Check landing gear position indicators.
3. Flaps DOWN. Check flap position indicator.
4. Re-check safety belt and shoulder harness tight and locked.
5. Open canopy when desired.

LANDING.

Note

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

NORMAL FIELD LANDING.

For landing distances and stopping distances see figures A-45 and A-46 in the Supplemental Flight Handbook (NAVAER 01-60JKC-501A).

CAUTION

Do not attempt a full-stall landing, because the angle of attack at the stall is so high the tail bumper will drag.

1. Maintain an airspeed of approximately 120 knots on the final approach.
2. Do not apply brakes until nose wheel is on runway.
3. After rudder control loses effectiveness, maintain directional control with brakes.

CROSS-WIND LANDING.

For cross-wind landings use the same airspeeds and procedures given for a normal landing. (See figure 2-7.) Normal cross-wind techniques can be employed on the final approach. After touch-down, get nose wheel down as soon as possible to afford better direction control.

MINIMUM RUN LANDING.

For a minimum run field landing, use the same procedures and airspeeds given for a normal field landing — with these exceptions:

1. On final approach, maintain an airspeed of approximately 120 knots. Carry sufficient power to maintain desired altitude, and shoot for the beginning of runway.
2. When over the selected landing spot, close throttle.
3. Set nose wheel down quickly after touch-down to allow for braking. Apply brakes smoothly and steadily to a point just short of locking wheels; then release and apply brakes intermittently and forcefully at one-second intervals, holding for approximately 2 to 3 seconds, but avoid skidding wheels.

CAUTION

If brakes are applied at speeds above 100 knots IAS, be alert to prevent locking wheels.

HEAVY-WEIGHT FIELD LANDING.

Note

By jettisoning drop tanks, gross weight can be reduced approximately 2500 pounds.

The same techniques and procedures for a normal field landing apply to heavy-weight field landing, except for the necessary increase in thrust to maintain the higher required airspeed. For each 1000 pounds over the normal landing gross weight, add approximately 3 knots to the normal pattern airspeeds. Through flight test data, it has been determined that the optimum angle of attack on landing approach is between 20.5 to 22.5 units on the angle-of-attack indicator. The angle of attack is independent of gross weight, so you may use an angle of attack of 20.5 to 22.5 units for any gross weight, increasing the indicated airspeed as the weight increases. This angle of attack versus airspeed will give the best landings for any weight condition.

NIGHT FIELD LANDING.

The same technique and procedure used in a normal field landing apply for night landings; however, the following additional precaution should be observed: if there is fog, smoke or haze, it may be undesirable to use the landing light. Vision is often impeded or distorted by reflection from the light.

CARRIER LANDING.

The carrier approach and landing characteristics are good. The indicated angle of attack for approach is given in figure 2-9 which contains a plot of indicated angle of attack versus indicated airspeed for gross

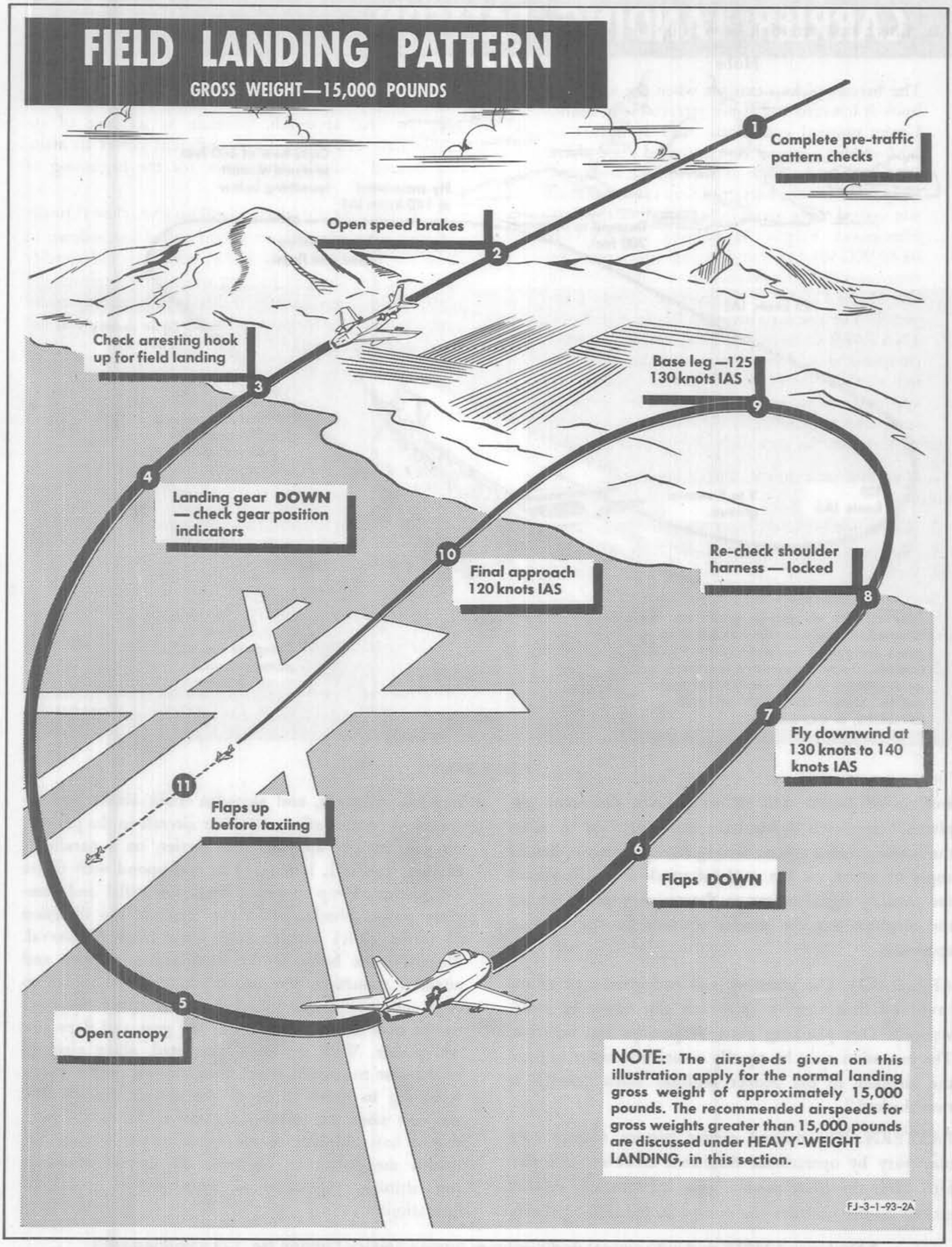
FIELD LANDING PATTERN
GROSS WEIGHT—15,000 POUNDS
1 Complete pre-traffic pattern checks
2 Open speed brakes
3 Check arresting hook up for field landing
4 Landing gear DOWN — check gear position indicators
5 Open canopy
6 Flaps DOWN
7 Fly downwind at 130 knots to 140 knots IAS
8 Re-check shoulder harness — locked
9 Base leg —125 130 knots IAS
10 Final approach 120 knots IAS
11 Flaps up before taxiing
NOTE: The airspeeds given on this illustration apply for the normal landing gross weight of approximately 15,000 pounds. The recommended airspeeds for gross weights greater than 15,000 pounds are discussed under HEAVY-WEIGHT LANDING, in this section.
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Figure 2-7.

CARRIER LANDING PATTERN

GROSS WEIGHT—15,000 POUNDS

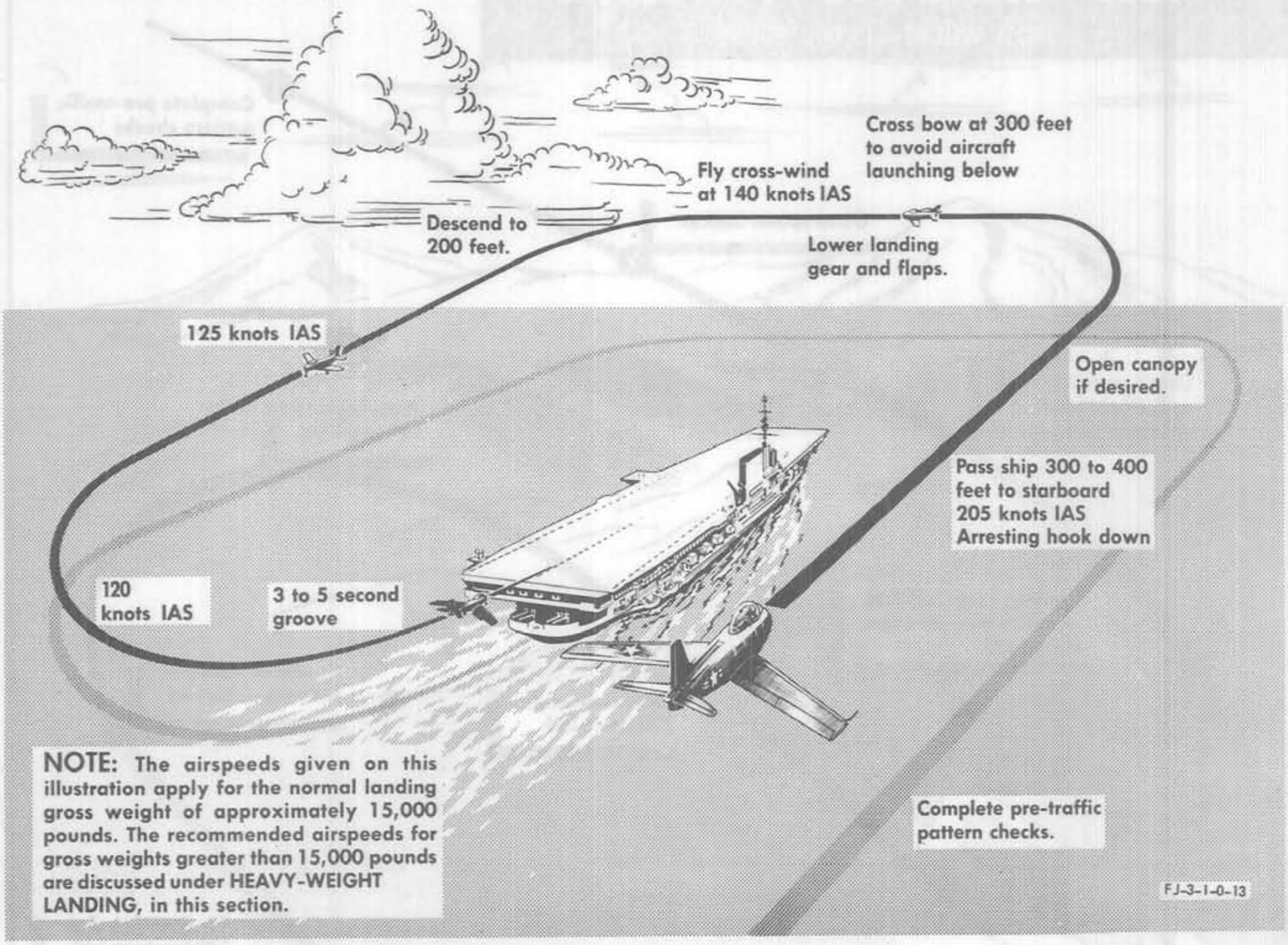


Figure 2-8.

weights of 14,000 and 16,000 pounds. On some airplanes,* approach lights have been installed to assist the landing signal officer. Setting the optimum or desired angle of attack on the angle-of-attack indicator allows the landing signal officer to determine whether or not the airplane has the proper attitude in the landing approach.

APPROACH. The planning and anticipation of events involved in a carrier approach can never be overstressed. This planning must be prompt and accurate. The execution must be equally accurate in order to have the airplane in the proper position when "charlie is two-blocked."

PATTERN. The normal carrier pattern (figure 2-8) may vary by operational direction; however, this pattern gives the pilot needed basic information. Adhere strictly to the position you occupy in the traffic pattern, interval, airspeeds, and altitudes. Your ability and accuracy of control affects all other aircraft in the pattern. As you initially approach the carrier, on a paralleled heading (initial), lose speed to correspond with figure 2-8 pattern. Drop arresting hook on initial and complete proper checks. Make the break in the direction of traffic (left) and establish your landing interval. Normally the break is the combination of turn and airspeed reduction. On the break, pull off power to IDLE and extend speed brakes; as the speed decreases to the gear down limits, lower the gear and flaps and add power. With the turn completed, allow airspeed to decrease to pattern speed. Lose altitude on the downwind leg in order to be at the correct altitude and airspeed when the 180-degree point is reached. A pilot should not endeavor to memorize power settings but should use power to maintain the desired airspeeds and altitude, regardless of gross weight and configurations.

***Airplanes 135913 and subsequent and airplanes having Service Change No. 121 complied with**

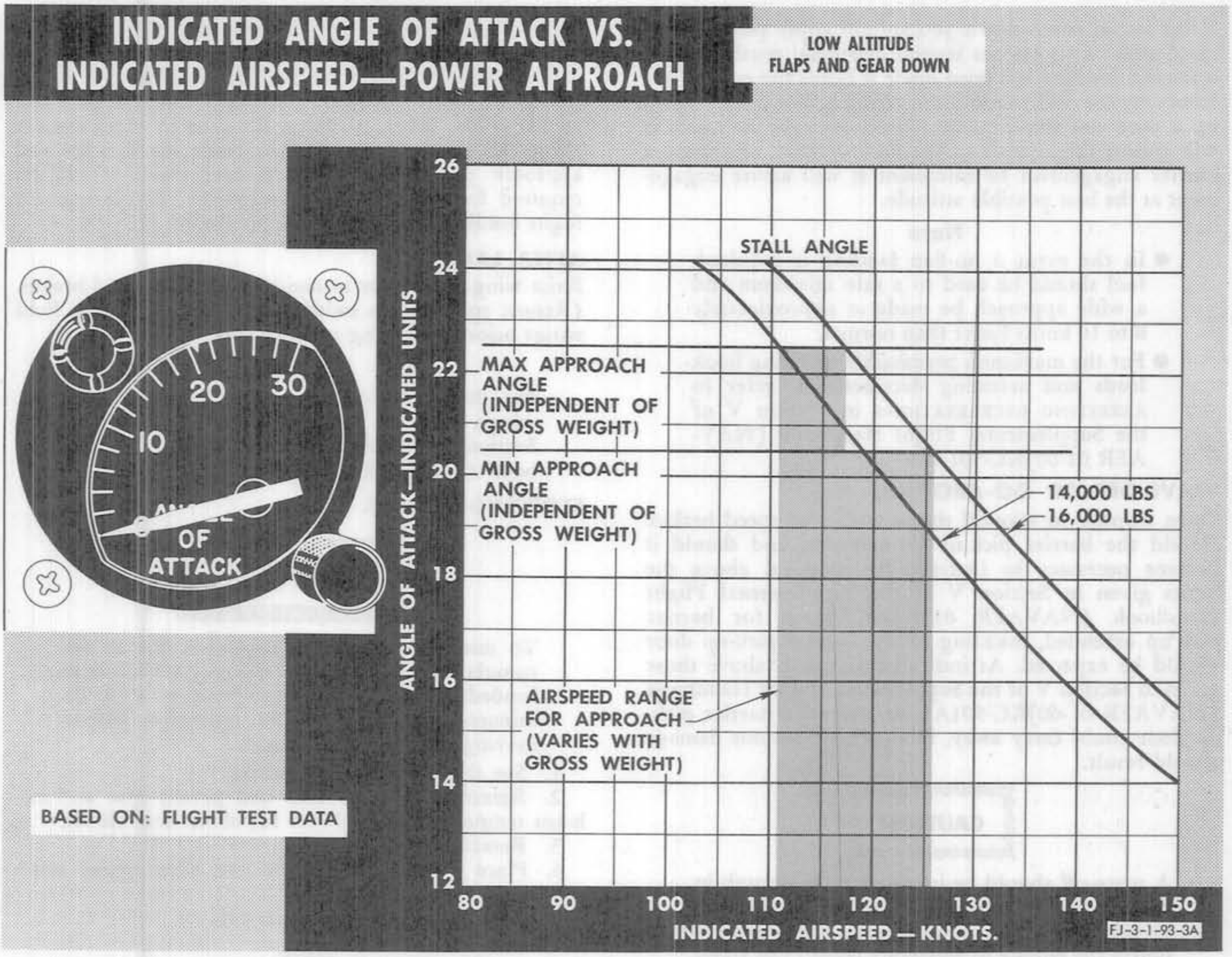


Figure 2-9.

Note

Use of open speed brakes requires additional thrust for the approach; however, it is recommended that this technique be used in order to take advantage of increased wave-off capability which is obtained by the reduced time interval to reach 100% rpm from the higher initial power setting and also the improved wave-off climb obtained by closing the speed brakes simultaneously with increase in power.

From the 180-degree point, start a level turn with power and altitude established. At completion of the turn, wings are level and airspeed can safely be lowered to final approach speed. The LSO will direct your landing but YOU MUST CONTROL IT. Enter the groove in position to provide a straight-away of about 5 seconds. When the "cut" is given, retard throttle and reduce the nose-high attitude slightly allowing the airplane to fly down to the deck, landing with nose wheel a few inches off deck. For angled deck landings, do not retard the throttle.

CAUTION

Care should be exercised not to rotate to extreme nose-high attitudes during flare to prevent free flight engagements. Nose-high free flight engagements impose high structural loads on the nose gear fork and tail hook bumper support structure.

Usually any trouble in the approach occurs from about 300 feet out from the ramp to the "cut." It is here that the pilot must overcome the tendency to lower the nose. A level approach gives a false impression that altitude is gained as the distance to the carrier decreases. By maintaining a constant altitude and airspeed in the groove you establish an attitude. After the initial transition period you will establish a control feeling after the "cut." This is generally in the form of easing off back pressure or almost undiscernible control movements to make a smoother landing.

After initial touch-down you should apply positive forward stick. This assures several beneficial results. When a normal landing has been made it holds the nose wheel firmly on the deck; should the arresting hook fail to pick up a wire and the airplane bounce into the air again it will return the aircraft to the deck quickly, or should a barrier engagement be imminent it will assure engagement at the best possible attitude.

Note

- In the event a no-flap landing is required, fuel should be used to a safe minimum and a wide approach be made at approximately 8 to 10 knots faster than normal.
- For the maximum permissible arresting hook loads and arresting decelerations, refer to ARRESTING DECELERATIONS in Section V of the Supplemental Flight Handbook (NAVAER 01-60JKC-501A).

WAVE-OFF OR GO-AROUND.

Open throttle to take-off thrust and close speed brakes. Should the barrier pick up be extended and should it become necessary to increase the airspeed above the limits given in Section V of the Supplemental Flight Handbook (NAVAER 01-60JKC-501A) for barrier pick up extended, buckling of the barrier pick-up door should be expected. At indicated airspeeds above those given in Section V of the Supplemental Flight Handbook (NAVAER 01-60JKC-501A), an extended barrier pick-up door could carry away, however, no serious damage should result.

CAUTION

A wave-off should be initiated early enough in the approach to allow for engine acceleration to take-off power. A safe carrier wave-off requires the engine to accelerate from 75 to 100% rpm in 5 seconds or less. Since acceleration times vary between individual engines and airplanes, it is suggested that pilots familiarize themselves with any differences in wave-off characteristics between aircraft resulting from differences in acceleration time.

On some airplanes,* when the landing gear is extended, the forward fuel boost pump in the center wing cell is automatically turned off to avoid fuel starvation should the fuel surface fall below the pump at high nose-up attitudes during landing approaches. If a wave-off should be necessary with extremely low fuel quantity (less than 250 pounds), avoid raising the landing gear as such action will re-energize the forward fuel boost pump and may cause fuel starvation.

HOLDING.

In the event of a fouled deck, do not climb if the remaining fuel load is less than 500 pounds. The best altitude for holding may be computed by multiplying all fuel in excess of 500 pounds by 20. Climb immediately to this altitude or to 35,000 feet, whichever is lower, using Military Thrust and the best climb speeds. If your altitude is already higher than this best altitude, remain at the higher altitude. At holding altitude, maintain 200 knots if below 35,000 feet or 210 knots if above 35,000 keeping rpm as low as possible for level flight, or a speed at which the wing slats will remain closed. Approximately 80 pounds of fuel will be required for each 10,000 feet of descent at idle rpm and at 200 knots. When planning the time to begin descent allow for the fuel required to make the descent and approach plus 250 pounds of fuel which would be required for wave-off and re-approach. For instrument flight holding procedure, refer to Section IX.

AFTER LANDING.

Raise wing flaps prior to taxiing and close speed brakes. (Return speed brake switch to neutral position.) Fold wings prior to entering parking area.

Note

For the limitations to observe when folding wings, refer to WING FOLD LIMITATIONS in Section V of the Supplemental Flight Handbook (NAVAER 01-60JKC-501A).

STOPPING ENGINE.

WARNING

To minimize danger of explosion due to accumulation of fuel vapor, always park airplane headed into the wind, and wait at least 15 minutes after any engine operation before moving airplane into hangar.

1. See that wheels are chocked.
2. Retard throttle to IDLE and permit rpm and exhaust temperature to stabilize for about one minute.
3. Retard throttle to OFF.
4. Place fuel shutoff control OFF after engine stops rotating.
5. Turn engine master switch OFF.

Note

For emergency procedures to follow during engine shutdown, refer to Section III.

BEFORE LEAVING AIRPLANE.

Before leaving airplane, accomplish the following:

1. Turn off radar, navigation, and communications equipment.
2. Flight control pressure selector switch NORMAL.
3. Landing light switch OFF.
4. Emergency fuel control PRIMARY.
5. Canopy switch OFF.
6. Rudder locked.
7. Conduct oxygen system postflight check. Refer to OXYGEN SYSTEM POSTFLIGHT CHECK, Section IV.
8. Ground safety pins in seat catapult and canopy emergency release handle installed.
9. Interior and exterior light switches OFF.
10. Battery switch OFF.
11. Close canopy by using switch in either right-hand or left-hand lower step.

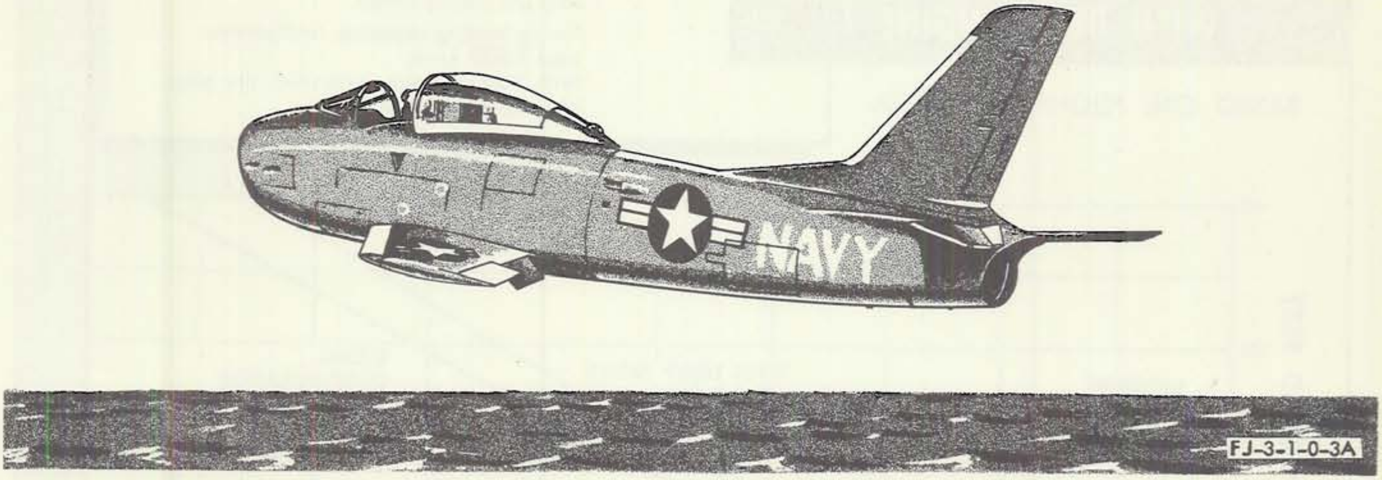
Note

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

12. Note any mechanical discrepancies or abnormal flight tendencies on the "yellow sheet."

***Airplane 136043 and airplanes having Service Change No. 294 complied with**

EMERGENCY PROCEDURES section III



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ENGINE FAILURE.

The majority of jet-engine flame-outs are the result of improper fuel flow caused by fuel control system malfunction or incorrect operating techniques during certain critical flight conditions. Specific information on this type of engine failure is given in FUEL SYSTEM FAILURE in this section. Flame-out may be identified by rapid rise of exhaust temperature just prior to failure, loss of thrust, or loss of ability to accelerate. Sometimes flame-out is accompanied by engine vibration. It should be noted that the engine instruments often provide indications of fuel control system failures before the engine actually stops.

The airplane has no automatic change-over provisions to an emergency fuel control system when the normal fuel control system fails. 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 critical. Selection of the manual control should be done with the throttle in the IDLE position, provided time and altitude permits. However, in an actual emergency at *low* altitude the manual control may be selected at any power setting. Checking the manual fuel control in flight should not be done just for practice. At altitude on the manual control, it will be possible to obtain 100% rpm with less than full throttle travel; therefore, the tachometer and tail-pipe temperature should be watched closely as the airplane climbs. Small movements of the throttle may produce large changes in rpm.

ENGINE FAILURE DURING TAKE-OFF RUN.

If engine failure occurs before the airplane leaves the ground and insufficient runway remains for a normal stop, perform the following as rapidly as possible:

1. Apply hard braking action.
2. Throttle OFF.
3. Fuel shutoff control OFF.
4. Engine master and battery-generator switches OFF.

If stopping distance is marginal before reaching end of runway and drop tanks are on, drop tanks may be released at the pilot's discretion by pulling the EMER JETTISON handle on the pedestal.

ENGINE FAILURE DURING TAKE-OFF (AIRPLANE AIR-BORNE).

If the engine fails on take-off after airplane is air-borne, immediately switch to the MANUAL fuel control system. If this fails to restore engine operation, prepare for an emergency landing, accomplishing as much of the following as time permits:

1. Throttle OFF.
2. Release drop tanks, if installed, by pushing the tanks and stores jettison button on the left forward console.
3. Landing gear handle DOWN.
4. Check wing flaps full DOWN.
5. Engine master and battery-generator switches OFF.
6. Land straight ahead, changing course only enough to miss obstacles.

Consider ejection escape if the following conditions prevail:

1. Fuel load and terrain straight ahead indicate an especially hazardous landing.
2. Parachute incorporates an automatic release.
3. Aircraft seat is equipped with an automatic opening safety belt.
4. Altitude (or sufficient speed to gain altitude) is available. See instructions relative to ejection at low altitudes.

GLIDE DISTANCES AND RATES OF DESCENT WITH DEAD ENGINE

BASED ON: FLIGHT TEST DATA

NOTE: For maximum glide distance gear and flaps should be up, and speed brakes closed. Hold **200** knots or speed at which wing slats just remain closed.

For the landing approach configuration hold **150** knots.

With barrier pickup extended, the glide distance is reduced by 5%.

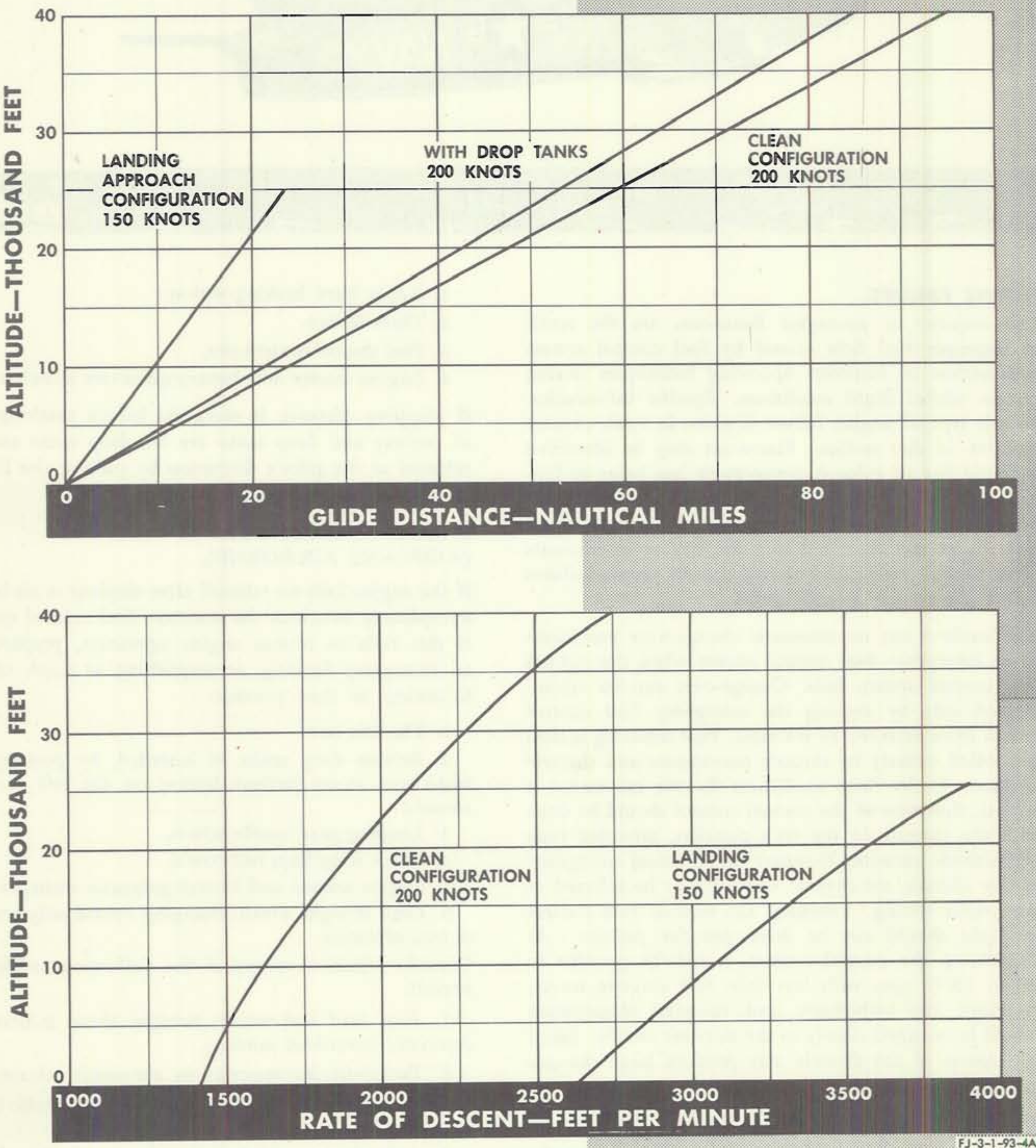


Figure 3-1.

ENGINE FAILURE DURING CATAPULTING.

In the event of engine failure during catapulting, immediately move the emergency fuel control switch to MANUAL. If this fails to restore engine operation, ditch airplane to the right or left of ships course (time or altitude permitting), in a nose-high attitude to prevent diving after contact with the water. Accomplish as much of the following as time permits:

1. Throttle OFF.
2. Gear UP.
3. Fuel shutoff control OFF.
4. Leave airplane immediately after it has stopped.

Note

The airplane may sink in a matter of only a few seconds after ditching.

ENGINE FAILURE DURING FLIGHT.

If engine failure occurs during flight, follow this procedure:

1. Throttle OFF.
2. Establish glide at 200 knots IAS or speed at which wing slats just remain closed. Wheels and flaps up and speed brakes closed for maximum glide distance. (See figure 3-1.)
3. Turn off equipment such as navigation, radar, armament and communication, if nonessential.

Note

At 35% engine rpm, the generator is capable of sustaining a full current load; however, this windmilling rpm cannot be obtained at the optimum glide speed except at very high altitudes.

4. Attempt an air start. (Refer to AIR STARTS, in this section.)

CAUTION

Attempt an air start only if it is suspected that the power failure was caused by a fuel system failure or a flame-out. If engine failure was accompanied by an explosion or similar noise that would indicate damage to the engine, an attempted air start may only result in a fire.

5. If an air start is impossible and a suitable landing area is within gliding distance, make a dead engine landing. (Refer to LANDING WITH DEAD ENGINE, in this section.)
6. If no suitable landing area is available, abandon airplane using ejection procedure (figure 3-3).

AIR STARTS.

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

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 uccessful starts at lower altitudes due to the presence of residual fuel in the combustion chamber.

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

1. Check throttle OFF.
2. If altitude is available, hold airplane in nose-high attitude for at least 5 seconds to drain any fuel that may be trapped in the combustion chambers or the turbine section.
3. Stabilize airspeed between 150 to 170 knots.
4. Maintain rpm within 13 to 17%.
5. Emergency ignition switch ON.

Note

- This should be done to ensure engine ignition in the event engine speed is above 23% rpm during the air start attempt. Below 23% rpm, movement of the throttle from OFF will provide ignition automatically.
- Flight tests indicate air starts at altitudes below 20,000 feet are more positive than attempted starts at high altitudes.

6. Place throttle in the IDLE detent. Fuel 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.
7. Place emergency ignition switch OFF.

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

1. Check throttle OFF.
2. Fuel control switch MANUAL.
3. Nose airplane up sharply to drain excess fuel from the combustion chambers and turbine section.

WARNING

Excess fuel in the combustion chamber accumulated from an unsuccessful starting attempt decreases drastically the chances of obtaining a successful start on a subsequent try. Drain excess fuel from the combustion chambers and turbine section by pulling the airplane up momentarily into a 50 to 60 degree climb attitude.

4. Stabilize airspeed within 5 knots of 150 knots.
5. Place emergency ignition switch ON.
6. Advance throttle from OFF to control fuel flow to approximately 1000 pounds per hour, or less if possible. Ignition will be supplied immediately after throttle is advanced from the OFF position.

CAUTION

If fuel flow and exhaust gas temperature are not monitored constantly during air starts on the manual fuel control 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.

7. 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 utility hydraulic system, although landing gear operation will be slower than normal. The flight control hydraulic system will operate normally; however, excessive use of the controls should be avoided in order to conserve accumulator pressure. 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 30,000 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 be necessary to lower the gear by emergency procedure. (Refer to LANDING GEAR EMERGENCY EXTENSION, in this section.)

LANDING WITH ENGINE SEIZURE.

Engine seizure creates a critical situation and the best action to be taken by the pilot depends upon a number of variables. Engine seizure causes loss of the engine driven hydraulic flight control pump and the d-c generator. The most important variable is the state of charge of the battery at the time of seizure; however, there is no way to measure the amount of energy left in the battery at the present time. Airplanes 141364 and subsequent have a voltmeter installed in the lower right-hand corner of the instrument panel (21, figure 1-5A). In case of engine seizure, when the voltmeter indicates a voltage of 22 volts (which is marked with a red line on the face of the instrument), the pilot can estimate that the battery will last for 5 minutes if no electric loads except the alternate hydraulic pump motor are applied to the battery. This voltmeter gives the pilot an indication of the time remaining in which controlled flight can be maintained. The pilot should require proper battery maintenance by seeing that electrolyte in the battery is inspected for proper electrolyte level and full charge.

Note

The specific gravity for a fully charged battery is 1.275 to 1.300. If the specific gravity is less than 1.240, the battery should be replaced by a fully charged one.

In general, if a landing is to be attempted, it should be accomplished as quickly as possible.

Since the electric hydraulic pump depends on electrical energy for its operation the pump will slow down and eventually stop when the battery becomes exhausted. To conserve the battery, small control movements will keep the hydraulic pressure low and the alternate hydraulic pump working at a constant rate, thereby reducing the load on the battery and prolonging battery life. Therefore, if a landing is attempted, controlled movement of the stick should be continuous after the pilot is committed to land.

The following procedure is recommended to make the best use of the remaining battery energy and sustain controlled flight for the maximum time:

1. Move battery-generator switch to OFF position.
2. Turn off all nonessential electrical loads.
3. Return battery-generator switch to BAT. & GEN position as necessary to trim airplane or to BAT. ONLY to transmit emergency voice report.
4. Return battery-generator switch to OFF position.

Note

If landing gear is to be used, it must be lowered by the emergency system.

This procedure will allow the battery to provide electrical power only to the alternate hydraulic pump, thereby providing a capability of controlled flight for approximately 60 minutes.

Note

The capability of 60 minutes depends on an initially fully charged battery. If the battery is nearly discharged (specific gravity of 1.17), the capability is approximately 20 minutes.

In case instruments are required with a seized engine, remember that the capability of the battery to support controlled flight will be greatly reduced. Under instrument conditions the following additional procedure should be followed:

1. Assure that all nonessential electrical loads are off.
2. Instrument power switch in the NO. 1 position.
3. Turn battery-generator switch to the BAT. & GEN position. If at any later time instruments are not needed, the battery generator switch should be turned OFF.

If emergency communication is required, move the battery generator switch to BAT. ONLY position only long enough to communicate, and then return switch to either BAT. & GEN or OFF position.

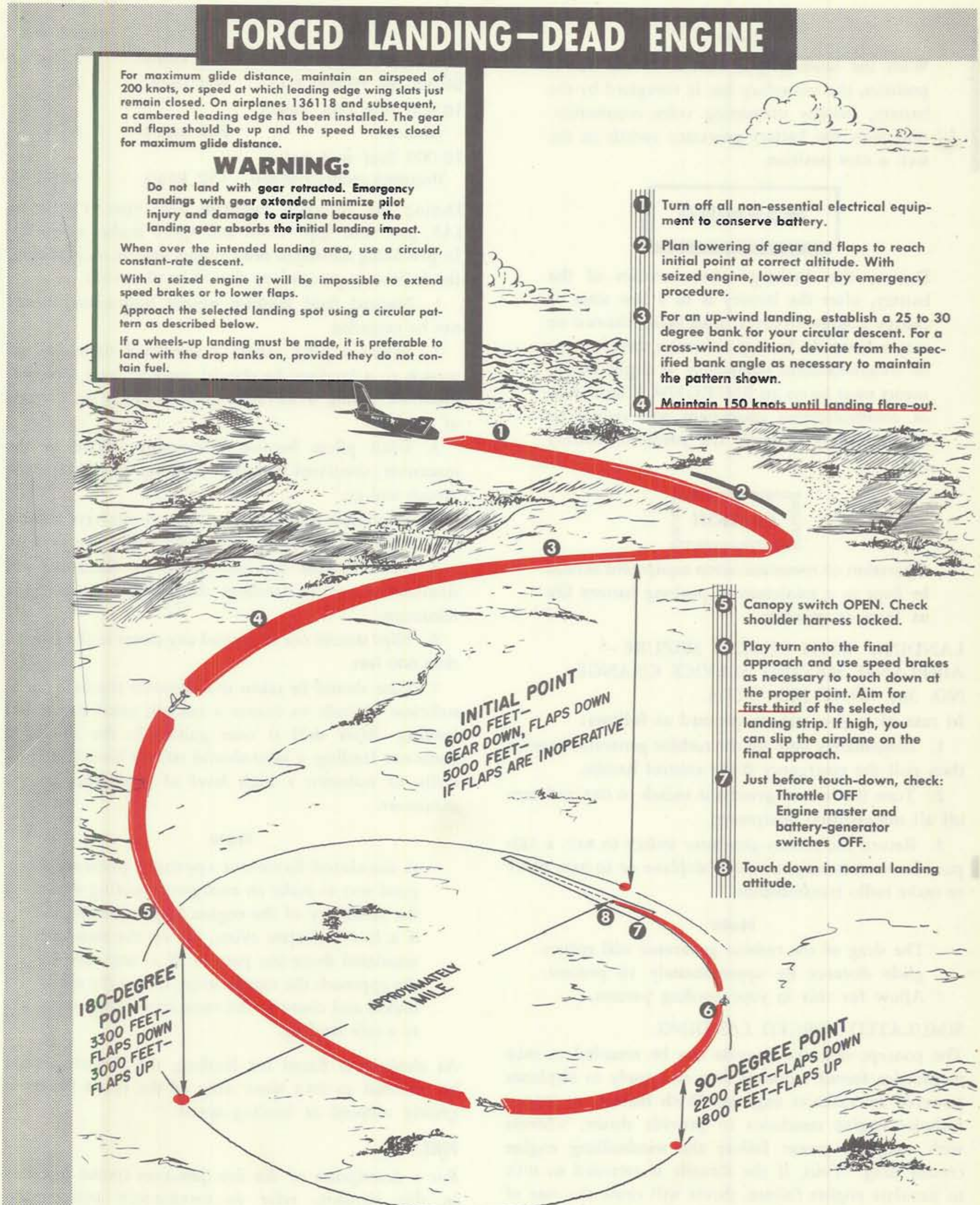

FORCED LANDING—DEAD ENGINE
For maximum glide distance, maintain an airspeed of 200 knots, or speed at which leading edge wing slats just remain closed. On airplanes 136118 and subsequent, a cambered leading edge has been installed. The gear and flaps should be up and the speed brakes closed for maximum glide distance.
WARNING:
Do not land with gear retracted. Emergency landings with gear extended minimize pilot injury and damage to airplane because the landing gear absorbs the initial landing impact.
When over the intended landing area, use a circular, constant-rate descent.
With a seized engine it will be impossible to extend speed brakes or to lower flaps.
Approach the selected landing spot using a circular pattern as described below.
If a wheels-up landing must be made, it is preferable to land with the drop tanks on, provided they do not contain fuel.
1 Turn off all non-essential electrical equipment to conserve battery.
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 Maintain 150 knots until landing flare-out.
5 Canopy switch OPEN. Check shoulder harness locked.
6 Play turn onto the 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, you can slip the airplane on the final approach.
7 Just before touch-down, check: Throttle OFF Engine master and battery-generator switches OFF.
8 Touch down in normal landing attitude.
INITIAL POINT
6000 FEET—GEAR DOWN, FLAPS DOWN
5000 FEET—IF FLAPS ARE INOPERATIVE
180-DEGREE POINT
3300 FEET—FLAPS DOWN
3000 FEET—FLAPS UP
90-DEGREE POINT
2200 FEET—FLAPS DOWN
1800 FEET—FLAPS UP
APPROXIMATELY 1 MILE
FJ-3-1-93-5B

Figure 3-2.

Note

With the landing gear handle in the DOWN position, the secondary bus is energized by the battery, thereby permitting voice communication with the battery-generator switch in the BAT. & GEN position.

WARNING

Due to the discharge characteristics of the battery, after the battery is in a low state of charge a large electrical load being thrown on may exhaust the battery suddenly; therefore use of communication equipment or flight instruments must be on an EMERGENCY basis. Use of communication equipment will reduce by approximately one-half the predicted battery life.

CAUTION

Operation of communication equipment should be kept to a minimum to prolong battery life as long as possible.

LANDING WITH ENGINE SEIZURE— AIRPLANES HAVING SERVICE CHANGE NO. 381 COMPLIED WITH.

In case of engine seizure, proceed as follows:

1. Immediately pull out the turbine generator handle; then pull the emergency flight control handle.
2. Turn the battery-generator switch to OFF and turn off all nonessential equipment.
3. Return the battery-generator switch to BAT. & GEN position as necessary to retrim airplane or to BAT. ONLY to make radio transmissions.

Note

The drag of the turbine generator will reduce glide distance by approximately 10 percent. Allow for this in your landing pattern.

SIMULATED FORCED LANDING.

The concept that the throttle can be retarded to IDLE to practice forced landings does not apply to airplanes powered by turbojet engines. With 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:

ALTITUDE	IAS	ENGINE RPM
30,000 to 20,000 feet	200 knots	75%
20,000 to 10,000 feet	200 knots	70%
10,000 feet and below (clean)	200 knots	65%
10,000 feet and below (landing configuration)	150 knots	62%

During the approach maintain 62% rpm, 150 knots IAS, gear and flaps down and speed brakes extended. In practicing simulated dead engine descent and landing, the following precautions should be observed:

1. Normal field landing weight limitations should not be exceeded.
2. Before a pilot carries a simulated flame-out approach to a landing, he should make at least three approaches, taking a wave-off upon reaching an altitude of 500 feet.
3. Until pilots become thoroughly skilled in the maneuver, simulated flame-out landings should be made "touch and go."
4. Simulated flame-out landings on runways shorter than 6000 feet should be performed with extra caution.
5. The 150-knot approach speed for flame-out and simulated flame-out landings should be regarded as a minimum.
6. Slips should not be carried any closer to the ground than 600 feet.
7. Care should be taken to commence the flare-out at sufficient altitude to ensure a smooth touch-down and landing. After skill is once gained in the simulated flame-out landing, a 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 if a low fuel state exists. Set up the standard simulated flame-out pattern. If at any time in the approach the engine stops, retract the speed brakes and continue the same approach pattern to a safe landing.

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

FIRE.

For a description of the fire detection system installed in this airplane, refer to EMERGENCY EQUIPMENT, Section I.

Note

There is no fire extinguishing system on this airplane.

ENGINE FIRE DURING STARTING.

If the burner fire-warning light comes on:

1. Stopcock the quadrant power control lever.

2. Leave the battery switch in the BAT. ONLY or BAT. & GEN position and the engine master switch in the ON position to ensure power to the starter system.

3. Move the stop-start switch to the START position. When 12% rpm is obtained, move the stop-start switch to STOP.

4. If the fire is not extinguished by starter operation, move the stop-start switch to STOP and direct dry chemical powder into the tail pipe.

5. If the fire is not extinguished by the above methods, direct the stream of extinguishing agent into the inlet duct.

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

1. Stopcock the quadrant power control lever.

2. Turn the engine master switch to the OFF position and the battery switch to the OFF position; then, leave the cockpit.

3. Direct dry chemical extinguishing agent through any open access door or through any cooling air opening.

Note

Due to the corrosive nature of the fire extinguishing chemical, consult the Handbook of Maintenance Instructions (AN 01-60JKC-2) for postfire procedure.

ENGINE FIRE DURING FLIGHT.

CAUTION

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

COMPRESSOR FIRE.

The fire-warning system consists of two detector systems; each system controls a cockpit red warning light. If the FIRE COMPRESSOR warning light comes on, or if there is other indication of compressor fire:

1. Shut engine down by placing throttle OFF, fuel shutoff control OFF, and by turning engine master switch OFF.

2. If light is extinguished and there is no other indication of continuing fire, such as smoke in the cockpit, engine roughness, trailing smoke, etc, make a power-off emergency landing or abandon the airplane.

WARNING

DO NOT attempt an air restart.

3. If light remains on, abandon airplane.

BURNER FIRE.

If the burner fire-warning light comes on:

1. Reduce power in an attempt to extinguish light.

2. If light goes out, continue flight at reduced power, landing as soon as possible.

3. If light cannot be extinguished with throttle retarded to IDLE, check for other indications of fire, such as trailing smoke, etc.

4. If positive indication of fire exists, retard throttle to OFF, fuel shutoff control OFF, and turn engine master switch OFF.

5. If fire ceases, make a power-off emergency landing or abandon airplane.

6. If fire continues, abandon airplane.

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.

SMOKE FROM TURBINE DURING ENGINE SHUTDOWN.

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

1. Have both external power sources connected.

2. Throttle OFF.

3. Fuel shutoff control OFF.

4. Engine master switch ON.

5. Hold engine starter switch momentarily at START. Audibly check that engine starts to rotate when starter is engaged, and note tachometer indications.

6. Allow starter to crank engine to approximately 6% rpm; then hold engine starter switch momentarily at STOP.

7. Turn engine master switch OFF.

ELIMINATION OF SMOKE AND FUMES.

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

1. Move cockpit pressure control switch to RAM EMERG.

2. Turn oxygen regulator diluter lever to 100% OXYGEN.

3. Turn oxygen safety pressure lever ON.

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 EMERG. 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 than when using RAM EMERG., requires a certain amount of adjusting which may be undesirable when the pilot must give more concentrated attention to other controls.

CAUTION

Prior to rapid descent from altitude, turn on windshield anti-icing and canopy and windshield defrosting.

LANDING EMERGENCIES.

CARRIER BARRICADE ENGAGEMENT.

If, while attempting carrier landing, a normal arrest is not indicated and a barricade engagement appears imminent, proceed as follows:

1. Keep the nose wheel on the deck.
2. Keep the aircraft aligned with the deck in order to have a straight-on entry and contact with the barricade.
3. If time permits, turn engine master and battery-generator switches OFF.
4. Keep head down and forward.

WARNING

Under unusual wing retardation barricade engagement conditions, such as free flight or severely yawed aircraft attitudes, it is possible for the upper loading strap to enter the open cockpit. Therefore, it is mandatory for pilot's safety that pilots keep their heads down and 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 liable to lodge should it enter the cockpit.

BELLY LANDING.

If it becomes necessary to make a wheels-up landing, fly a normal landing pattern and follow normal landing procedure, but observe the following precautions:

1. Release the drop tanks (electrically or mechanically) over a clear area prior to re-entering the traffic pattern.
2. If time and conditions permit, expend any excess fuel prior to re-entering the traffic pattern. This will minimize the possibility of fire breaking out on landing.
3. Perform normal landing cockpit check.
4. Make normal approach with flaps down and speed brakes out.
5. When landing is assured, throttle OFF.
6. Just before touch-down, turn off fuel shutoff control, master switch, and battery-generator switch.
7. Abandon airplane immediately after it stops.

LANDING WITH MAIN GEAR DOWN—NOSE GEAR UP.

If it becomes necessary to land with the nose gear up or with the nose gear down but not locked, fly a normal landing pattern and follow normal landing procedure but observe the following precautions:

1. Release drop tanks (electrically or mechanically) over a clear area prior to re-entering traffic pattern.
2. If time and conditions permit, fire all ammunition and expend any excess fuel prior to re-entering traffic pattern. This will lighten the airplane, giving lower touch-down speeds, establish an aft CG condition, making it easier to hold nose up, and minimize the possibility of fire breaking out on landing.
3. Perform normal landing cockpit check.
4. When landing is assured, throttle OFF.
5. Just before touch-down, turn off fuel shutoff control, engine master switch, and battery-generator switch.
6. After touch-down, hold nose up as long as possible.
7. Avoid use of brakes if possible.
8. Get clear of airplane as soon as 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, retract gear and make a belly landing. Refer to BELLY LANDING, in this section.

If gear cannot be retracted, land with as many wheels down as possible. Fly a normal landing pattern and normal landing procedure, but observe the following precautions:

1. Release drop tanks (electrically or mechanically) over a clear area prior to re-entering traffic pattern.

2. If time and conditions permit, expend any excess fuel prior to re-entering traffic pattern. This will minimize the possibility of fire breaking out on landing.

3. Perform normal landing cockpit check.

4. If the left main wheel is down and right main wheel is up, land on the left side of the runway as the airplane will tend to turn right upon contacting the ground. Similarly, if the right main wheel is down and the left main wheel is up, land on the right side of the runway.

5. When landing is assured, throttle OFF.

6. Just before touch-down, turn off fuel shutoff control, engine master switch, and battery-generator switch.

7. Abandon airplane immediately after it stops.

EMERGENCY ENTRANCE.

For emergency access to the cockpit on the ground if the canopy cannot 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 fuselage just below the canopy frame, and slide canopy aft.

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.

DITCHING.

OVERWATER EJECTION PREFERABLE TO DITCHING.

The hazards of ditching are much greater than the hazards of an ejection. Since all emergency survival equipment is carried by the pilot and since the airplane may sink in a matter of only a few seconds after ditching, there is no advantage in making a water landing. When the pilot must choose between ditching and ejection, the following procedure is recommended:

1. If time permits, follow radio distress procedure.

2. If airplane has sufficient altitude, eject.

3. The minimum altitude for successful ejection from aircraft not equipped with automatic opening lap belts and parachute openers is approximately 2000 feet above the terrain in level flight. With automatic opening lap belts and parachute openers, tests indicate that successful ejections may be possible from altitudes as low as 250 feet in level flight. If insufficient altitude is available, it is recommended that a zoom maneuver to gain altitude be accomplished with a positive climb angle of about 45 degrees, maintaining a 45-degree nose-high attitude until airspeed drops to 200 knots, at which time the climb angle is reduced to 30 degrees. Flaps should be lowered at 150 knots. This flight path will allow recovery to a glide if the pilot decides not to eject. Minimum speeds required to reach 2000 feet of altitude, with a clean airplane, are approximately as follows:

ORIGINAL ALTITUDE	MINIMUM INDICATED AIRSPEED
Sea Level	300 knots
500 feet	260 knots
1000 feet	215 knots
1500 feet	175 knots

4. When an altitude of 2000 feet or higher has been obtained, eject in a normal manner. If ejection is necessary below 2000 feet and an automatic lap belt is not installed, and acceleration forces do not prevent maintaining an erect position in the seat, open the lap belt and disconnect oxygen and radio leads prior to ejection. If an automatic lap belt is installed, do NOT open the belt prior to ejection.

If ditching is unavoidable, proceed as follows:

1. Follow radio distress procedure, time permitting.

2. Dump drop tank fuel. If fuel cannot be dumped, jettison drop tanks.

3. Check that personal equipment will not foul when you leave the cockpit. Disconnect anti-G suit. Remove oxygen mask as you leave cockpit.

Note

In the event of ditching and sinking in water where you find yourself unable to escape immediately due to any number of factors, it is possible for you to survive under water with your oxygen equipment until you can free yourself. The pressure breathing-type oxygen mask and the positive-pressure, diluter-demand oxygen regulator are suitable underwater breathing devices when the regulator is set at 100% OXYGEN.

4. Tighten safety belt and shoulder harness.

WARNING

The shoulder harness should be as tight as possible to prevent the pilot from striking his head against the stick.

5. Check gear UP, speed brakes IN and arresting hook DOWN.

6. Canopy switch OPEN.

7. Flap control lever DOWN. Flaps collapse on impact and do not cause the airplane to dive.

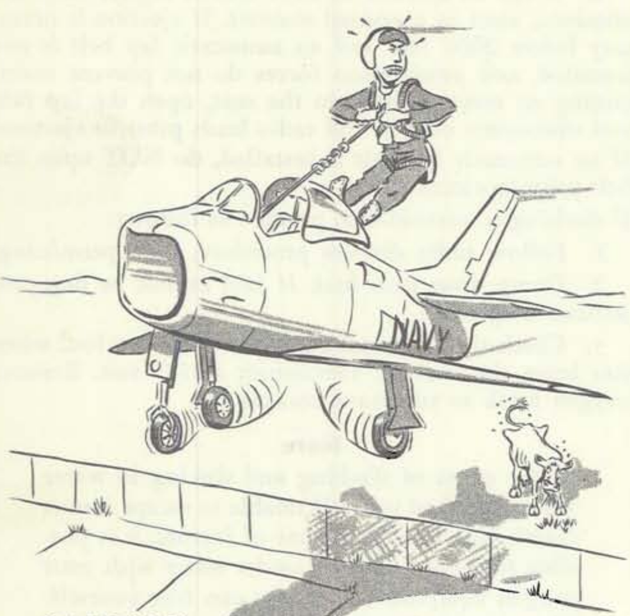
8. Before contact, throttle and fuel shutoff control OFF, if not already off; engine master and battery-generator switches OFF.

9. Unless wind is high or sea is rough, plan your approach heading parallel to any uniform swell pattern and try to touch down along wave crest or just after crest passes. If wind is as high as 20 to 25 knots or surface is irregular, approach into the wind and touch down on the crest of a wave.

10. Make a normal approach and touch down in a nose-high landing attitude.
11. Abandon airplane immediately after it stops.

WARNING

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



CAUTION

The emergency release handle must be pulled to its full extension to ensure release of all uplocks.

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Note

The following is an abbreviated check-off list for ditching:

1. Follow radio distress procedure.
2. Dump fuel.
3. Check cockpit equipment.
4. Tighten belt and harness.
5. Check gear, speed brakes and hook.
6. Canopy open.
7. Flaps down.
8. Fuel and master switches OFF.
9. Plan approach.
10. Make nose-high landing.
11. Abandon airplane.

EJECTION.

In all cases of emergency exits in flight, seat ejection should be used for escape. This is the safest method in either high speed or low speed flight since it eliminates the possibility of being injured through collision with the tail surfaces. For seat ejection procedure, see figure 3-3.

Whenever circumstances permit, slow the aircraft down as much as possible prior to ejection. When ejecting, particularly at low altitudes (below 2000 feet), pull 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 aircraft but, rather, is a resultant 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 the mask.

FUEL SYSTEM FAILURE.

The fuel supplied to the engine is handled by two electrically driven boost pumps in the center wing cell. One pump is located forward in the cell; the other, to the rear of the cell. Failure of a single pump will have little effect on engine operation except in cases where the combined conditions of low fuel and excessive maneuvering results in the operative boost pump becoming uncovered. This will produce a condition equivalent to both pumps being inoperative. Should both boost pumps fail, the engine will operate normally on the main engine driven fuel pump at Military Thrust up to approximately 16,000 feet.

In case of generator failure, the forward boost pump will automatically become inoperative, being powered by the monitored bus. The aft boost pump will continue to operate, however, as long as battery power is available. If for any reason, the battery-generator switch must be turned OFF, both boost pumps will become inoperative. (Refer to ELECTRICAL POWER SYSTEM FAILURE, in this section.) Failure of the engine fuel control system, or improper throttle manipulations at high altitudes, can cause engine flame-out. If the engine failure is due to improper operating technique, engine operation can be restored by performing an air start. (Refer to AIR STARTS, in this section.)

OIL SYSTEM FAILURE.

The oil pressure indicator should read NORMAL during all flight conditions. At altitudes above approximately 40,000 feet, pump cavitation can result in insufficient internal pump lubrication, indicated by an oil pressure indication of LO. LO oil pressure indication is to be regarded as zero pressure. Therefore, the following action is recommended:

1. If above 40,000 feet altitude, reduce altitude and/or engine rpm immediately.

2. If oil pressure returns to NORMAL in less than one minute, further engine operation is permissible; however, maximum altitude for that particular engine should be restricted to maintain a NORMAL oil pressure reading at all times.

ELECTRICAL POWER SYSTEM FAILURE.

Should a complete electrical failure occur or if for any reason it becomes necessary to turn off both the battery and generator, remember that much of the equipment and many controls will be inoperative. Flight under this condition will be limited, and the following precautionary measures should be observed:

1. If possible, reduce airspeed and readjust trim before turning off electric power as trim is not available without electric power.

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 reduction in rpm is necessary, the airplane may have to be held in a slightly nose-high attitude to maintain altitude. If prolonged flight in this attitude is necessary, a small amount of fuel will be trapped in the aft fuselage tank. If sufficient altitude is available, nose airplane down slightly for a short period to drain some of the trapped fuel into the center wing cell. Also, remember that since the flight is being made at a speed lower than that required for best range, the 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, keeping in mind the following required deviations from normal procedure: (a) It will be impossible to lower the flaps or extend the speed brakes. (b) The landing gear must be lowered by the emergency method. (c) Practically all electrically operated equipment will be inoperative including the gyro instruments, electronic navigation equipment, and the communications equipment.

5. Landing on a runway under these circumstances will require a final approach speed of approximately 140 knots and a touch-down speed around 120 knots.

WARNING

The required runway length will be greater than normal. Approximately 6000 feet will be required from touch-down.

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

GENERATOR FAILURE.

Generator failure, or drop in generator output, 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.

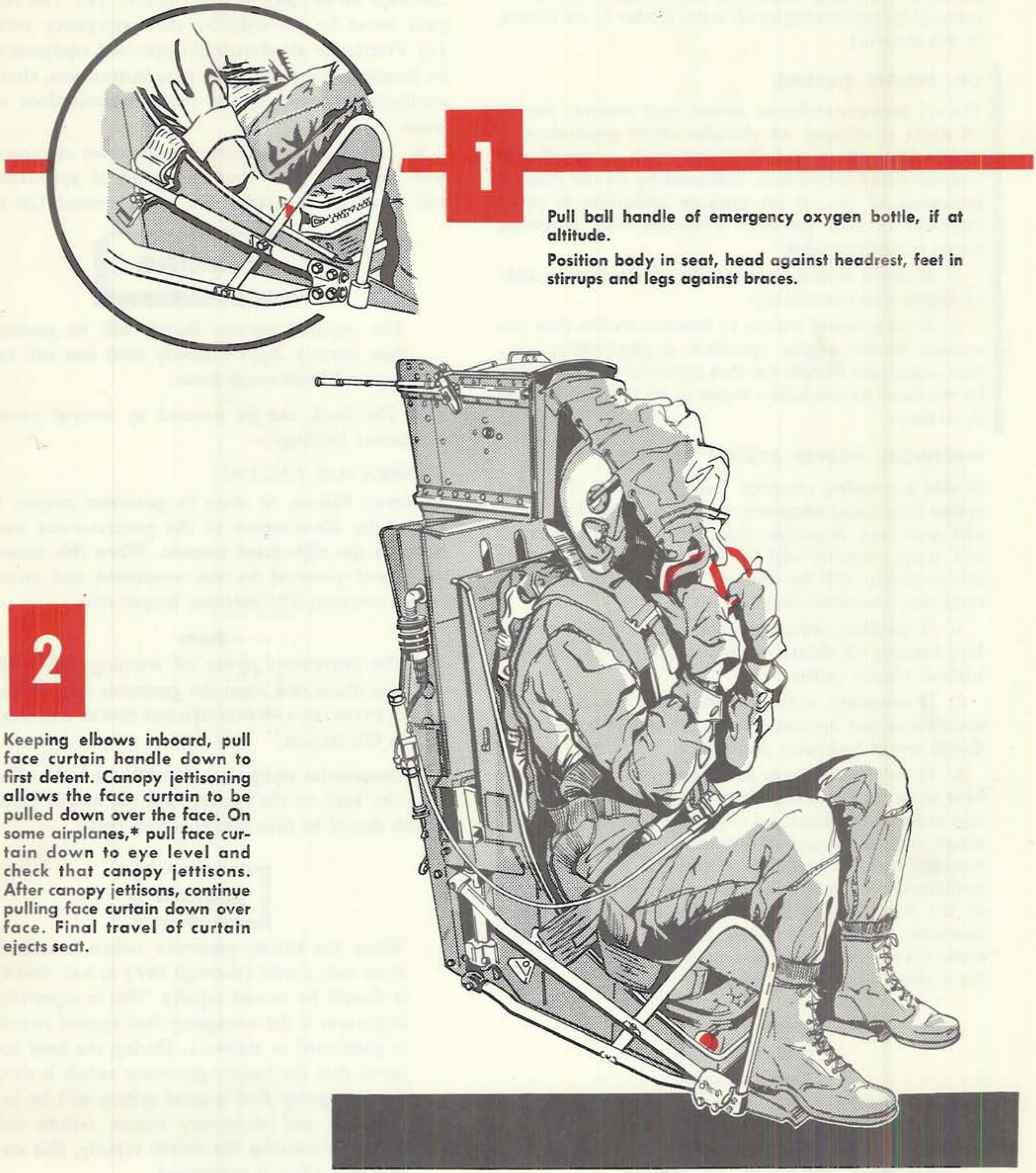
Note

The instrument power off warning light will also illuminate when the generator fails. Refer to INVERTER AND INSTRUMENT POWER FAILURE, in this section.

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

CAUTION

When the battery-generator switch is moved from BAT. & GEN (through OFF) to BAT. ONLY, it should be moved rapidly. This is especially important if the emergency fuel control switch is positioned at MANUAL. During the brief interval that the battery-generator switch is OFF, the emergency fuel control system will be inoperative and temporary engine failure can occur. By moving the switch rapidly, this undesirable effect is minimized.



*AIRPLANES NOT HAVING SERVICE CHANGE NO. 396 COMPLIED WITH

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Figure 3-3. (Sheet 1)

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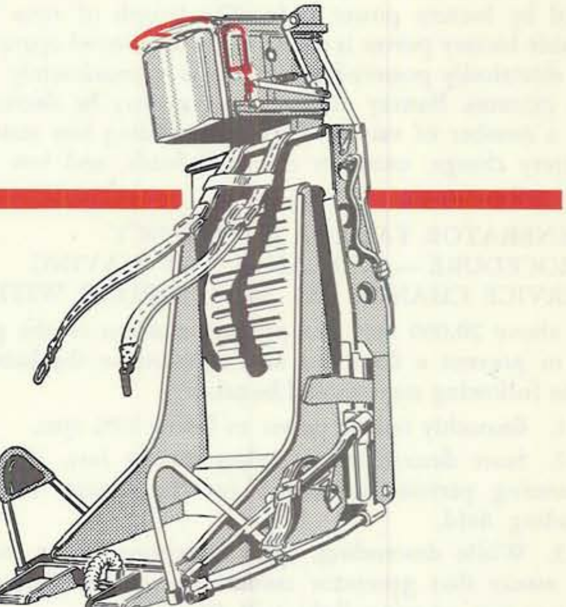
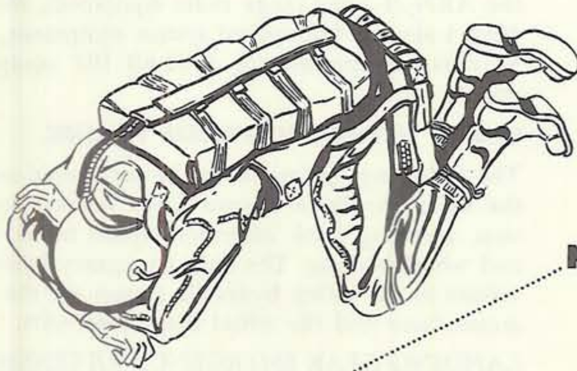
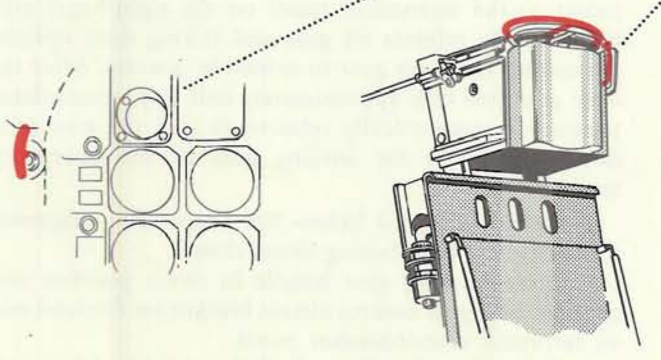


Release seat belt, kick free from seat as quickly as possible and perform normal parachute descent*





NOTE

If the canopy does not jettison as the face curtain is pulled to the first detent (or to eye level on some airplanes §), pull the canopy emergency release. Continue pulling the face curtain down over the face to eject.

If use of the canopy emergency release handle fails to jettison the canopy, pull the handle to the right† of the headrest and then pull the face curtain down over the face. The seat will be ejected through the canopy. The top of the headrest which is higher than your head shatters the canopy as the seat ejects.

WARNING

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

EJECTION SEAT OPERATION

*SEAT BELT OPENS AUTOMATICALLY 3/4 SECOND AFTER EJECTION ON AIRPLANES 139210 AND SUBSEQUENT AND AIRPLANES HAVING SERVICE CHANGE NO.275 COMPLIED WITH.

†EMERGENCY SAFETY PIN RELEASE HANDLE IS LOCATED ON THE LEFT SIDE OF THE HEADREST ON AIRPLANES 139210 AND SUBSEQUENT AND AIRPLANES HAVING SERVICE CHANGE NO. 396 COMPLIED WITH.

§AIRPLANES NOT HAVING SERVICE CHANGE NO. 396 COMPLIED WITH

FJ-3-1-73-3E

Figure 3-3. (Sheet 2)

With the battery-generator switch in the BAT. ONLY position, equipment powered by the battery, primary, secondary, and battery and canopy busses will be operated by battery power only. The length of time that usable battery power is available for continued operation of electrically powered equipment is approximately 7 to 28 minutes. Battery output duration may be decreased by a number of variable factors, including low state of battery charge, excessive electrical loads, and low battery temperature.

GENERATOR FAILURE EMERGENCY PROCEDURE — AIRPLANES NOT HAVING SERVICE CHANGE NO. 381 COMPLIED WITH.

If above 20,000 feet, the primary concern of the pilot is to prevent a flame-out and to conserve the battery. The following steps should be taken:

1. Smoothly reduce power to below 89% rpm.
2. Start descending to below 20,000 feet, if flight planning permits, and head for the nearest suitable landing field.
3. While descending, cycle battery-generator switch to assure that generator cutout has opened (the generator out warning light will illuminate).
4. Switch positioned to No. 1 inverter.
5. Turn off all nonessential electrical equipment.
6. When below 20,000 feet and instruments are not required, turn off battery-generator switch to conserve power until just prior to landing.

GENERATOR FAILURE — AIRPLANES HAVING SERVICE CHANGE NO. 381 COMPLIED WITH.

In case of generator failure with the normal flight control operating, pull the turbine generator handle out and select the desired equipment on the emergency power selector switch. These selections can be alternated if desired. If the emergency flight control handle is pulled, all power from the turbine generator will be transferred to the emergency flight control hydraulic pump and the emergency power selector switch will be inoperative.

INVERTER AND INSTRUMENT POWER FAILURE.

Loss of instrument power is indicated by illumination of the instrument power-off warning light on the forward end of the right console. This indication is provided when operating in the normal NO. 1 position of the instrument power switch. When the instrument power-off warning light illuminates, indicating failure of the No. 2 inverter, the instrument power switch should be placed in the NO. 2 position. When it becomes necessary to operate in the NO. 2 position of the instrument power switch, the No. 1 inverter takes over all a-c loads of both the monitored and primary a-c busses by placing the primary bus in parallel with the Mark 16 Mod 5 aircraft fire control system load from the No. 1 inverter through the wye-delta transformer.

Failure of the No. 1 inverter when operating in the NO. 1 position of the instrument power switch will not be indicated by illumination of the instrument power-off warning light, but will be indicated by erratic operation of the ID-249A omni-range course indicator and gun sight system. When the No. 1 inverter fails, all loads powered by the a-c primary bus are lost, including the main power for the cockpit air conditioning and pressurizing system, the defrosting and anti-icing system, the ARN-21 omni-range radio equipment, the Mark 16 Mod 5 aircraft fire control system equipment, the APG-30 radar equipment, the APX-6B IFF equipment and missile power.

UTILITY HYDRAULIC SYSTEM FAILURE.

The following operations can be performed in the event the utility hydraulic system fails: landing gear extension, arresting hook extension, speed brake retraction, and wheel braking. The only emergency hydraulic provisions in the utility hydraulic system are the nose gear accumulator and the wheel brake reservoirs.

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 main gear to extend by gravity. After the nose gear free falls approximately half way, accumulator pressure is automatically released to lock the nose gear down. To lower the landing gear by the emergency method:

1. Reduce airspeed below 205 knots IAS; otherwise air loads may hold fairing doors closed.
2. Place landing gear handle in down position and pull landing gear control circuit breaker on forward end of left-hand circuit-breaker panel.
3. Pull release handle to its full extension. (Approximately 15 to 20 inches and *hold*.)

4. Check gear indicator for safe gear down indication. It may be necessary to yaw airplane to ensure that main gear locks down.

5. Release handle when indicator shows gear down and locked.

ARRESTING HOOK EMERGENCY EXTENSION.

Pulling the arresting hook handle releases the hook from a spring-loaded mechanical uplock which then permits snubber pressure and gravity to force the hook down. The operation is the same for both normal and emergency operation. As an added safety feature, the uplock will automatically be released if the release cable breaks. No provisions are made for emergency retraction of the arresting hook.

SPEED BRAKE EMERGENCY RETRACTION.

A two-position speed brake emergency dump valve control aft of the left console provides an alternate means of closing the speed brakes (to a trailing position). When the knob is pushed aft, a dump valve is mechanically opened, relieving pressure from the speed brake actuating cylinder and allowing air loads to close the brakes. No emergency means of opening the speed brakes is provided.

CAUTION

The normal speed brake switch, on the throttle, must be in the neutral position when closing the speed brakes with the emergency speed brake dump valve.

WHEEL BRAKE EMERGENCY OPERATION.

If the utility hydraulic system fails, the wheel 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. The brake reservoir contains enough fluid for four to five full applications of the brake pedals before hydraulic fluid is exhausted. On some airplanes,† check valves have been installed in the pressure lines at the brake master cylinders to prevent loss of hydraulic fluid during brake application when the utility hydraulic system has failed.

FLIGHT CONTROL HYDRAULIC SYSTEM FAILURE.

When the flight control normal hydraulic system fails, the alternate system will automatically take over, as indicated by illumination of the alternate-on warning light. Because a malfunction of the normal flight control system could, in some instances, be temporary, always attempt to return to the normal system by momentarily placing the flight control pressure selector switch at RESET. If the alternate-on warning light remains on, or if the hydraulic pressure gage indicates a significant loss in normal system pressure, a permanent malfunction of the normal system exists.

If the normal system fails and the alternate system does not take over automatically, move the flight control pressure selector switch to ALTERNATE. Should this fail to engage the alternate system, pull the manual emergency override handle located just forward of the left console.

Note

To ensure that the override handle locks properly pull it straight out against the stop; then rotate the handle clockwise against the stop, and then rotate the handle counterclockwise.*

When operating on the alternate system, the flight controls will respond normally for all flight operations except those requiring violent evasive action, such as encountered in combat maneuvers. Because of the lower output of the alternate system hydraulic pump, such maneuvers can quickly exhaust the emergency system accumulator.

WARNING

Stick will be frozen if both the normal and the alternate flight control systems are inoperable. As a result, under such conditions control of the airplane in cruising flight becomes very difficult, and control at high speeds or during extreme maneuvers is impossible. Therefore, should both systems fail, attempt to reduce airspeed to about 200 knots, and try to maintain all possible control by using rudder and trim switches and varying power as necessary. If control cannot be maintained, *bail out* immediately. However, if some control is available and altitude permits, attempt to effect recovery and return to a suitable area. Then *bail out,* as extended flight and a landing with this limited control should not be attempted under *any* circumstances.

TRIM 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 and the alternate trim switch on the left console is used for trim control. The alternate trim switch supplies four momentary positions: LEFT, RIGHT, NOSE UP, and NOSE DOWN. When there is no power applied to the trim actuators they remain in their fixed, irreversible positions.

DROP TANK EMERGENCY RELEASE.

If the drop tank release button (forward of the left console) fails to jettison the drop tanks, pull the emergency jettison handle located on the center pedestal.

*Airplanes 139210 through 139222
†Airplanes 136118 and subsequent and airplanes having Service Change No. 296 complied with

AUXILIARY EQUIPMENT EMERGENCY OPERATION.

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

EMERGENCY CANOPY RELEASE.

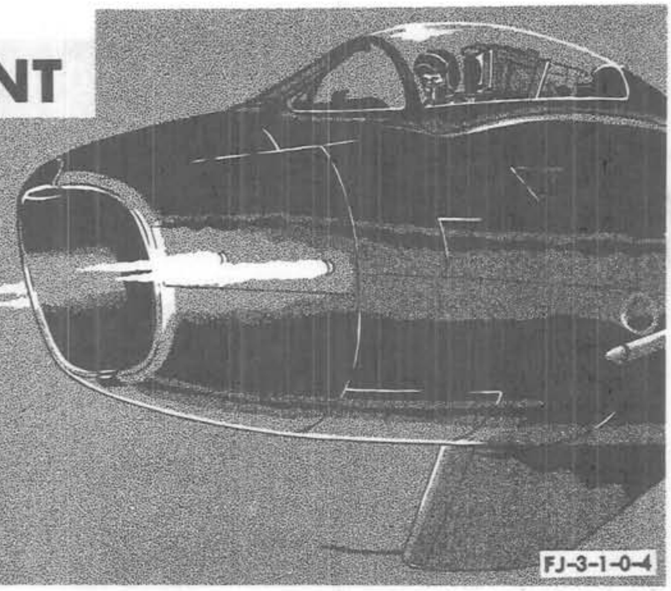
If an emergency situation makes it imperative for the pilot to remove the canopy quickly, this can be accomplished by pulling the emergency canopy release handle. It should be remembered, however, that the canopy may strike and damage the vertical stabilizer and, if released on the ground, can cause serious injury to ground personnel.

WING FLAP EMERGENCY OPERATION.

No emergency flap control system is provided. If unequal retraction or extension of the flaps should occur during normal flap operation, hold airplane level and return flap control to original position. (Sufficient aileron control is available to hold wings level in this condition or to roll against the down flap if necessary.) Make a landing as soon as possible without any further attempt to operate the flaps.

DESCRIPTION AND OPERATION OF

AUXILIARY EQUIPMENT



section IV

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 positon 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 then routed to either the cockpit air outlets, the secondary heat exchanger and expansion turbine of the cooling unit, or partially through both. 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 and right console. The minimum engine rpm necessary for optimum cockpit air conditioning, pressurization and defrosting for any particular altitude is as follows:

ALTITUDE — FEET	PERCENT RPM
10,000	70
15,000	72
25,000	77
35,000	82
40,000	87
45,000	96

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. The 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 on the canopy operating mechanism. When the canopy is closed, the solenoid is energized and the valve in the pressure regulator opens and allows airflow to the seal. When the canopy circuit is opened, the solenoid is de-energized and the valve closes and air in the seal is vented. The seal is also depressurized in the sequence of seat ejection. Ground pressurization of the seal is accomplished by the introduction of external source air 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 CONTROL. A three-position manual control is provided on the pressure regulator which is located on the canopy deck. For normal operation, this control should be in the FLIGHT position which makes pressure control entirely automatic. When pressurizing tests are being conducted, this control should be in the ALL ON position, and in the DIFFERENTIAL ONLY position for operational test purposes. This control should always be returned to the FLIGHT position when tests are completed.

COCKPIT AIR CONDITIONING AND PRESSURIZING SYSTEM

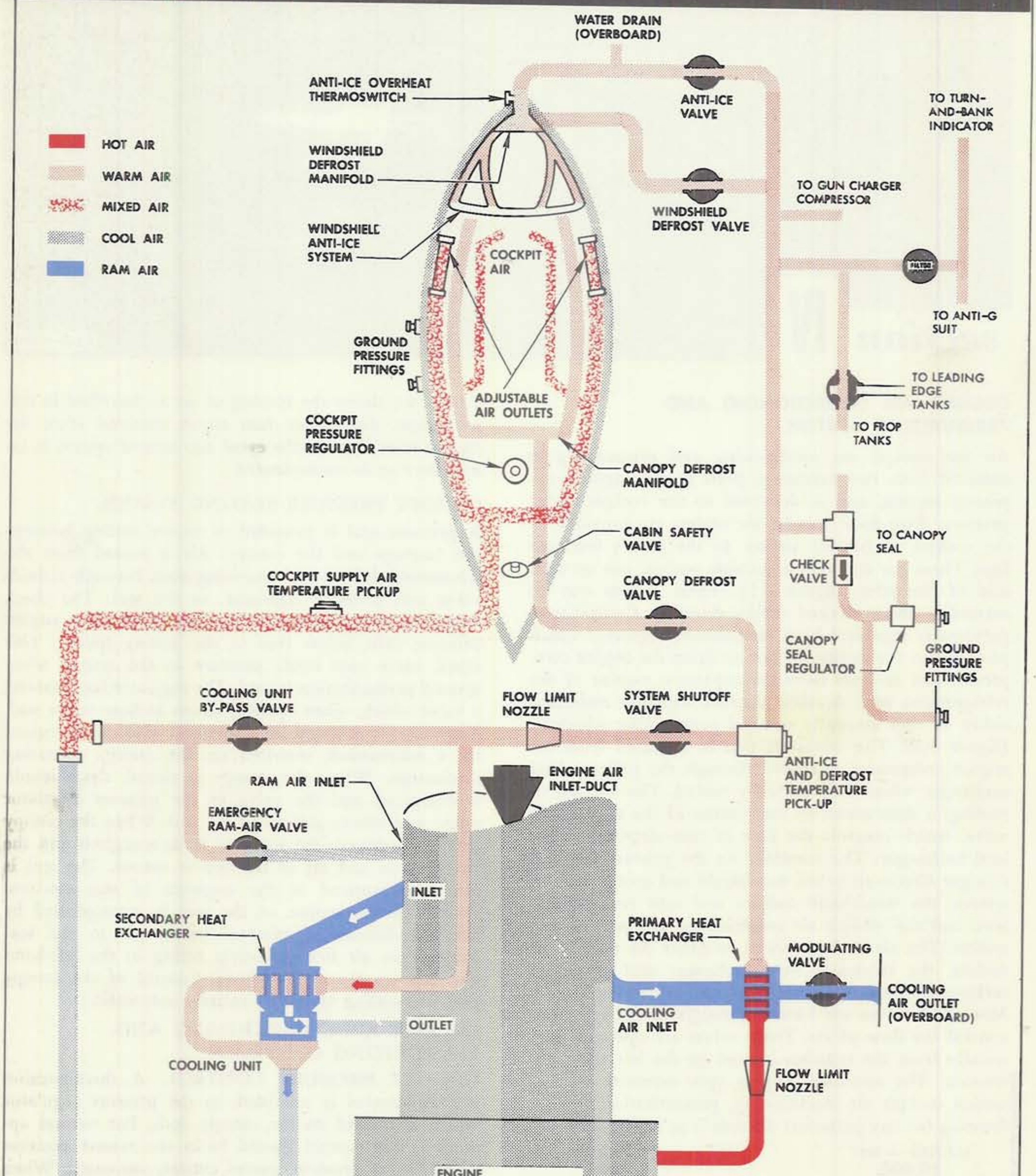


Figure 4-1.

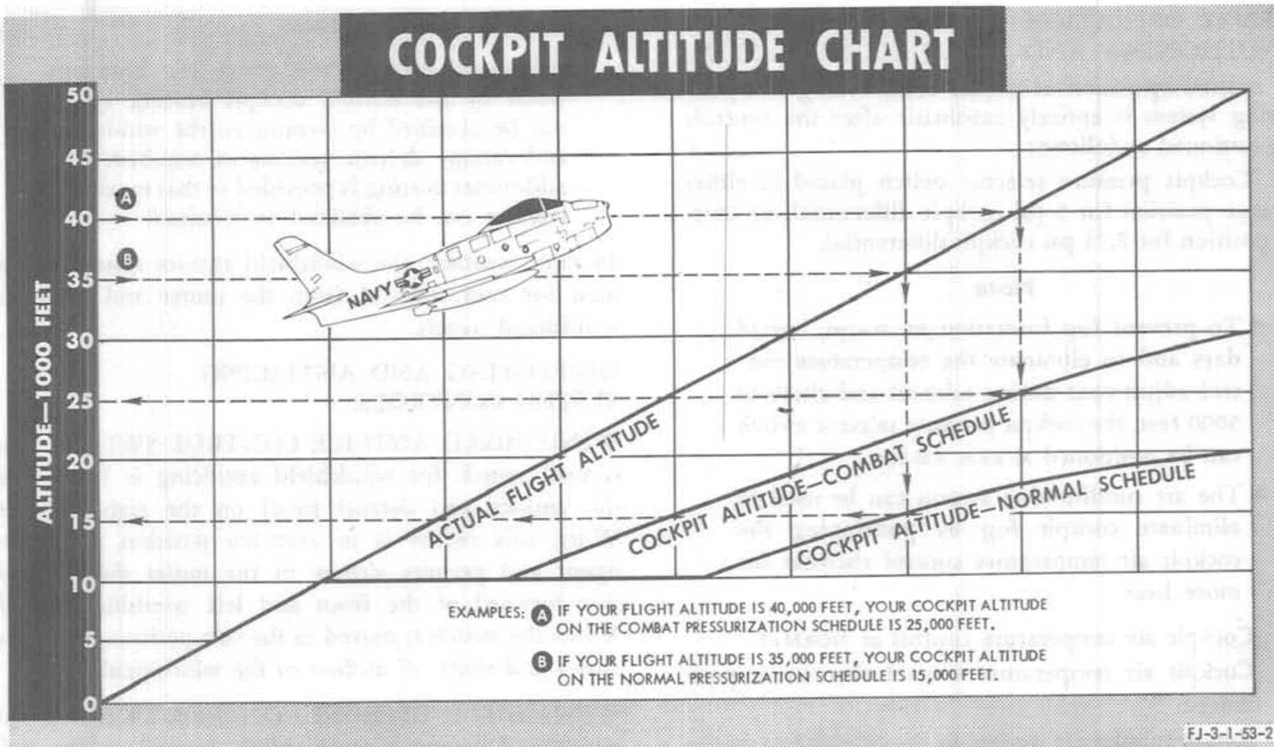


Figure 4-2.

COCKPIT PRESSURE SELECTOR SWITCH. The pressure selector switch (figure 4-3), located on the left console, is used to select the pressurizing 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 EMERG. position, the dump valve is opened, pressurization is lost, and air supply is from the ram-air source. To place the selector switch in RAM EMERG. position, it is necessary to lift the guard, and then move the switch. This guard prevents accidental dumping of cockpit pressurization.

CAUTION

Explosive decompression can result above 34,000 feet if the canopy is punctured with the cockpit pressure selector switch at the NORMAL position. Therefore, it is recommended that the switch be in the COMBAT position above 34,000 feet when combat conditions are encountered or other conditions prevail that might puncture the canopy.

COCKPIT AIR TEMPERATURE CONTROL SWITCH. The temperature control switch (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 will position the cooling unit by-pass valve and the primary heat exchanger modulating valve to control the temperature of 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, move the switch to HOTTER or COLDER momentarily, and then return to OFF.

COCKPIT AIR TEMPERATURE RHEOSTAT. The temperature control rheostat (figure 4-3) provides automatic control of the cockpit temperature. The rheostat is effective only when the temperature control switch is in NORMAL position. As the rheostat is moved from COLD to HOT, the amount of cold air routed through the primary heat exchanger and refrigerating unit decreases until the cockpit air reaches the desired warmth. Movement of the rheostat causes the temperature control regulator to recognize the variation in cockpit and supply air temperature, and the modulating and by-pass valves are actuated to provide desired 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:

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 fog formation on warm, humid days and to eliminate the temperature control adjustment during take-off and climb to 5000 feet, the cockpit pressure selector switch can be positioned at RAM EMERG.
- The air conditioning system can be used to eliminate cockpit fog 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 position desired.
4. Rotate tubular air outlets to provide airflow in the desired direction.
5. If necessary turn on canopy defrost.

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.

If sudden depressurization should become necessary, proceed as follows:

1. If at altitude or if air is contaminated, use 100 percent oxygen.
2. Move cockpit pressure selector switch to RAM EMERG. position.
3. Descend to an altitude below 15,000 feet.

DEFROSTING, ANTI-ICING SYSTEMS AND RAIN REMOVAL SYSTEMS.

Air for canopy, windshield anti-icing, windshield defrosting and rain removal 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 manifold.

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 can be obtained as required.

In rainy weather, the windshield anti-ice system can be used for rain removal from the center and left-hand windshield panels.

DEFROSTING AND ANTI-ICING SYSTEM CONTROLS.

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

WINDSHIELD DEFROST CONTROL SWITCH. The windshield defrost control switch, 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 the 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 time the switch is held in the DEFROST position, and allowing it 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 is identical to the operation of the windshield defrost control switch. 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 (figure 1-5) is located on the instrument panel and illuminates when temperature of the air supply to the windshield exceeds 149°C (300°F). Illumination of this light may be caused by a malfunction of the automatic temperature control system or 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 OFF immediately.

*Airplanes 135852 and subsequent

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

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

1. Momentarily position control switch in DEFROST; then quickly release it to HOLD.
2. If additional defrosting is necessary, repeat this procedure.
3. If less defrosting is desired, position control switch in OFF momentarily; then quickly return it to HOLD.

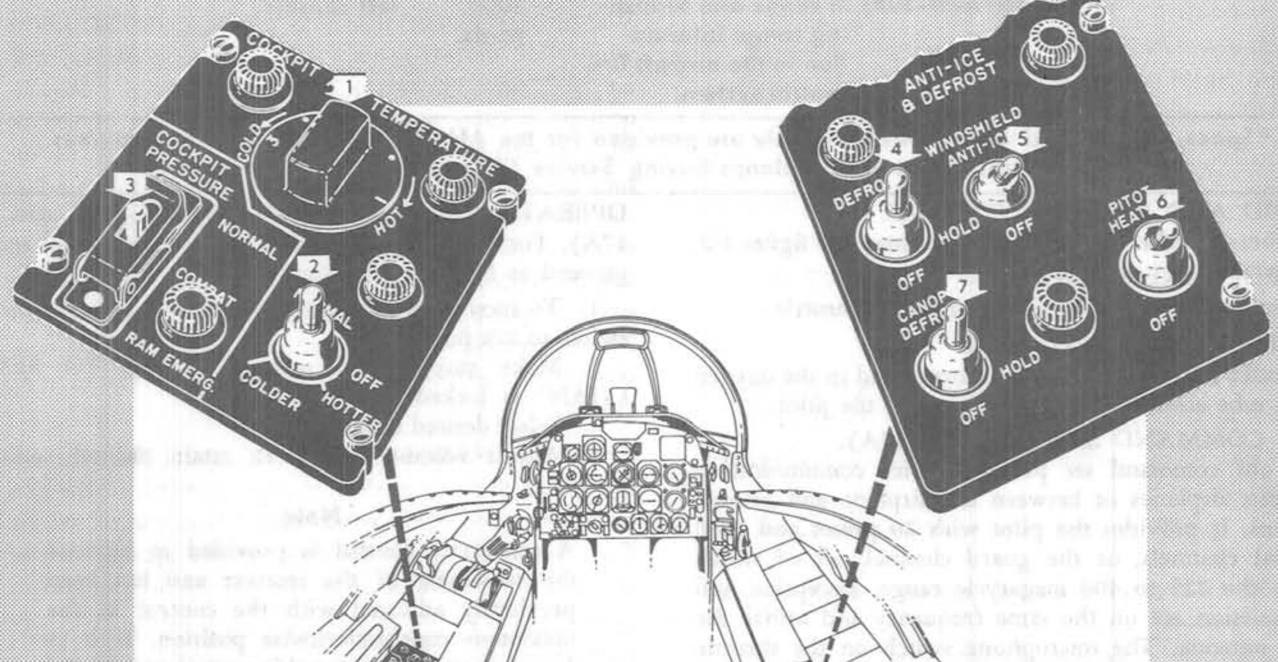
PITOT HEATER.

The pitot tube is heated by an electric heater in the pitot head which is operated by a control switch 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.

AIR CONDITIONING, PRESSURIZING, ANTI-ICE AND DEFROST CONTROLS



1. Temperature Rheostat
2. Temperature Control Switch
3. Cockpit Pressure Selector Switch
4. Windshield Defrost Control Switch
5. Windshield Anti-ice Control Switch
6. Pitot Heater Switch
7. Canopy Defrost Control Switch

FJ-3-1-53-3

Figure 4-3.

COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT.

TABLE OF COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT.

TYPE	DESIGNATION	FUNCTION	RANGE	LOCATION OF CONTROLS	FIGURE
UHF Command	AN/ARC-27A	Two-way voice communication.	Line of sight.	Control panel on right console.	Figure 4-4.
UHF Direction Finder	AN/ARA-25	Direction finding.	Line of sight.	Control panel on right console.	Figure 4-4.
Radio Navigation Receiver	AN/ARN-14E or AN/ARN-21*	Reception of VHF omni-range and voice facilities. Reception of UHF omni-range and voice facilities. Visual and aural navigation aid.	Line of sight.	Control panel on right console.	Figure 4-4.
IFF	AN/APX-6B	Automatic identification.	Line of sight.	Control panel on right console.	Figure 4-4.
Radar	AN/APG-30 (or 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.	Figure 4-8.

*Space, weight, and wiring provisions only are provided for the AN/ARN-21 equipment in airplanes 136118 and subsequent and airplanes having Service Change No. 151 complied with

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.

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

The uhf command set provides voice communication between airplanes or between the airplane and ground stations. It provides the pilot with 20 preset and 1750 manual channels, or the guard channel, all of which lie in the 225 to 400 megacycle range. Reception and transmission are on the same frequency and utilize the same antenna. The microphone switch on the throttle changes the set from receiving to a transmitting condition. A mode of operation switch provides a primary power control and movement of the switch causes the following conditions:

1. When switch is in T/R position, main receiver is on and transmitter is on in stand-by. The guard channel is inoperative.
2. When in T/R + G REC position, main receiver and guard receiver are on and transmitter is on in stand-by.
3. When in ADF position (AN/ARA-25 operative), automatic direction finder circuits are completed and 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 (AN/ARC-27A). For normal operation of the uhf command set, proceed as follows: (See figure 4-4.)

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.

Note

A sensitivity control is provided to increase the sensitivity of the receiver and has been previously adjusted with the control in the maximum counterclockwise position. If it is found necessary to turn this control toward the clockwise position in an effort to increase the sensitivity of the receiver, it is possible that the noise level will increase to an undesirable level. For normal operation, the sensitivity control should be in the full counterclockwise position.

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. For manual tuning of the various frequencies turn channel selector control to M position and adjust the three concentric frequency controls.

9. To change frequency of any channel, select channel to be changed, unlock button marked "PUSH TO SET CHAN," adjust three concentric controls to desired frequency, and then push and lock the reset button.

Note

If channel selector switch fails to "set up" the channel selected, manually tune to the desired frequency.

10. To turn uhf command set off, move mode of operation switch to OFF.

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

The direction finding equipment indicates the relative bearing of uhf stations for homing purposes, which may either be a carrier, ground station, or another airplane. The AN/ARA-25 extracts the information from signals received by the AN/ARC-27 on a frequency range from 225 to 400 megacycles and indicates the bearing on the radio magnetic course indicator. Successful operation depends on adequate power of the transmitting station and the distance being not too great from the transmitting station to the airplane. Best homing results are obtained in straight and level flight. Air-to-air homing may be accomplished by homing on a transmitting airplane.

Note

Inaccurate or fluctuating indications may result under the following conditions:

- When directly over the signal cone, unstable indication will exist temporarily.
- If signal source is a higher flying airplane, reflections from the wing and body 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 manuevers will cause bearing fluctuations.
- When drop tanks are installed, "off wing" bearings are susceptible to error.

OPERATION OF UHF DIRECTION FINDING EQUIPMENT (AN/ARA-25). 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 direction indicated by pointer No. 1 of the radio magnetic course indicator on the instrument panel.
5. To turn off equipment, move mode of operation switch to any position other than ADF.

RADIO NAVIGATION RECEIVER (AN/ARN-14E). The AN/ARN-14E equipment provides reception of vhf omni-range, ILS localizer, and voice facilities. The equipment includes the R-540/ARN-14C receiver, the ID-249A/ARN course indicator, the ID-250/ARN radio magnetic course indicator, the ID-251/ARN bearing converter control, the omni-range antenna (AN/ARN-14C), and the C760A/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-249A/ARN course indicator (figure 1-5) permits course selection by means of a control knob on the lower left corner of the instrument.

Note

The ID-351A/ARN and ID-387/ARN course indicators are interchangeable with and may be substituted for the ID-249A/ARN course indicator.

The selected course is shown in the window at the top of the indicator, and the window on the upper left portion of the instrument indicates whether the course is *to* or *from* the vhf omni-range. 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 is not used in this installation. Signal flags are employed to warn if the signal level decreases to the extent that the indications are unreliable. The ID-250/ARN radio magnetic course indicator (11, figure 1-5) shows the magnetic 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, frequency selector, and volume control.

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

For operation of the radio navigation equipment C-760 control box, proceed as follows:

1. Turn power switch ON.
2. Rotate the large selector knob until the tens and units of the desired frequency, in the VOR frequency band (108 to 122 mc), 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 mc. band. The ILS localizer frequency is in the 108 to 111.9 mc. band.
3. Rotate volume control to obtain desired level of audio signal.

Note

Steps 1., 2. and 3. apply to both voice and omni-range reception, and the following steps 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 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 the course appears in the top window of the course indicator (ID-249A/ARN).

RADIO CONTROLS

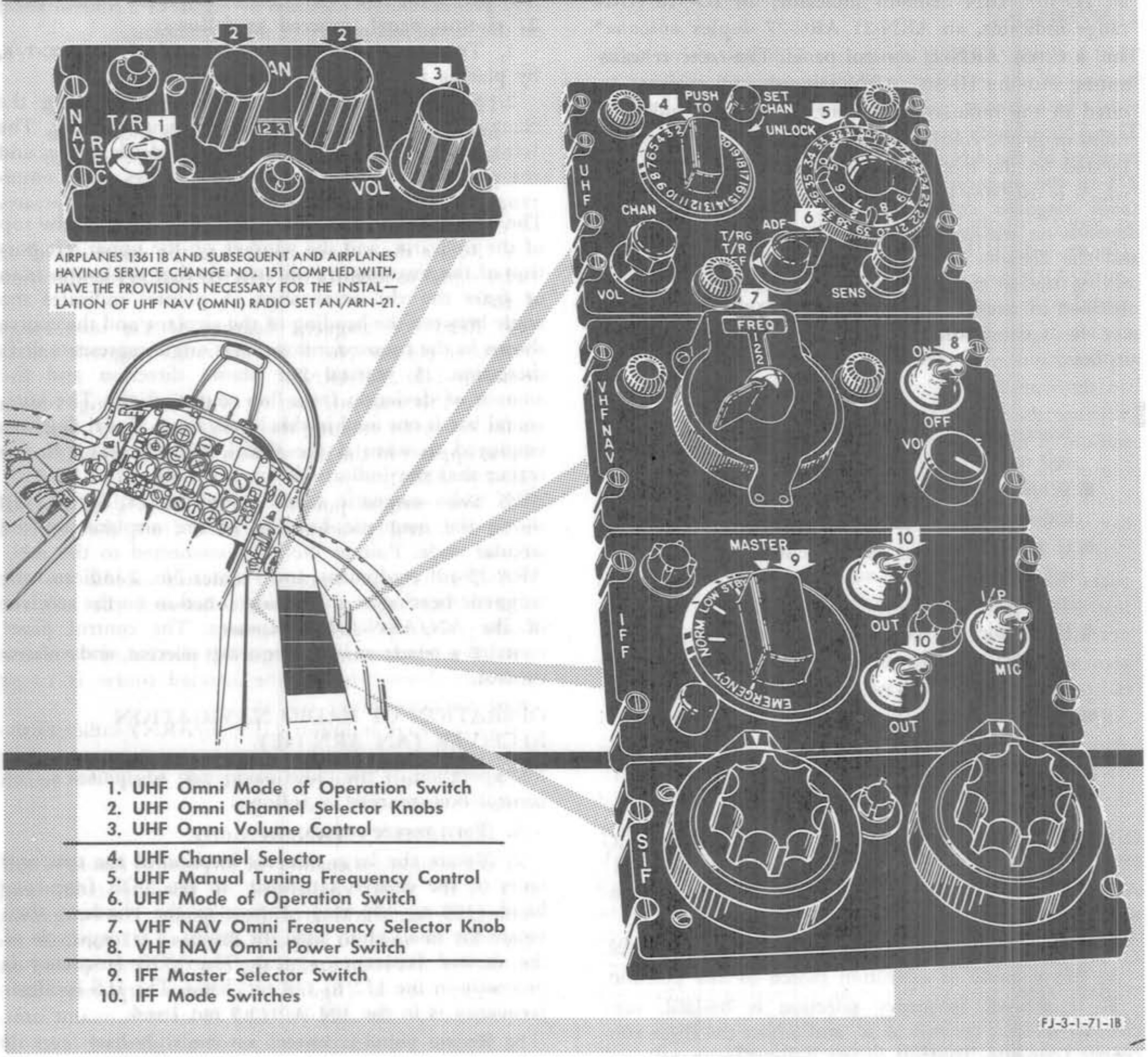


Figure 4-4.

6. The vertical pointer, on the ID-249A/ARN, will indicate lateral position deviation from the selected course.

7. The relative heading indicator needle, on the ID-249A/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. To shut off equipment, place power switch to OFF. The same procedure as outlined above applies to ILS localizer operation, with the exception of step 5. where you set the magnetic approach bearing to the localizer as the course, by rotating the knob marked "SET" until the course appears in the top window of the course indicator. The aircraft 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

***Airplanes 136118 and subsequent and airplanes having Service Change No. 151 complied with**

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 (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 (11, figure 1-5) 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 (22, figure 1-5). 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-886/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 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 may also be used to indicate distress. All controls required for operation are on the control panel located on the right console (figure 4-4). Some airplanes† have provisions for the AN/APA-89 radar side mount unit. The control panel is located on the right-hand console (figure 4-4). Refer to Section IV of the Supplemental Flight Handbook (NAVAER 01-60JKC-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.)

***Airplanes 135983 and subsequent and airplanes having Service Change No. 218 complied with**

†Airplanes 136118 and subsequent and airplanes having Service Change No. 114 complied with

2. Set mode switches to the OUT position, unless otherwise directed by the proper authority.

3. To maintain the equipment ready for instant use, but inoperative, rotate master selector switch to STDBY.

4. To shut off 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 and 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 top and one under the fuselage; and four formation lights, one on each wing tip and one on each side of the fuselage. An approach light is located in the fuselage nose section.

LANDING LIGHT. Provisions are made for a removable landing light to be installed on the forward door of the nose gear well. The landing light switch is on the left console, inboard of the throttle quadrant. The circuit breakers are on the left console circuit-breaker panel.

APPROACH LIGHTS. Three approach lights, located in the lower lip of the jet air intake duct, are used as a signaling device to assist the LSO in determining if the airplane has the proper angle of attack during approach in night landings. The lights are colored green, red and amber and will illuminate when the airplane angle of attack is too high, too low or correct, respectively. The lights are turned on automatically when the exterior lights master switch is on and the landing gear and arresting hook are lowered. The lights are controlled by a sensing device actuated by the angle-of-attack probe and indicating system. They require no additional attention from the pilot.

FUSELAGE SIGNAL LIGHTS. There are two fuselage signal lights, one located on top and one on the bottom of the fuselage. Both lights can be made to burn steadily or to flash when the switch is in either BRIGHT or DIM. These lights are the only ones that can be flashed, and they provide manual keying of code letters.

EXTERIOR LIGHTING CONTROLS.

For exterior lighting controls, see figure 4-5.

EXTERIOR LIGHTING MASTER SWITCH. The master switch 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 lamps will flash automatically when the fuselage lights switch is in BRIGHT or DIM position and all other lights will burn steadily. The master switch must be positioned from the OFF position before any exterior lights can be illuminated.

LIGHT SELECTOR SWITCHES. Three selector switches on the exterior lighting control panel control the brightness of the fuselage, the wing, the tail, and the formation lights. They are all three-position toggle switches.

MANUAL CODE KEY. A keying switch is used to flash code letters after the master switch is in STEADY or FLASH positions and the fuselage switch is in MAN position.

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 lighting.

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. This switch is inoperative unless the instrument panel lights rheostat is moved from the OFF position.

CONSOLE AND FLOODLIGHTS RHEOSTAT. This switch turns on and controls the brightness of the console lights. When the switch is moved in a clockwise direction from the OFF position, the console floodlight control switch becomes operative.

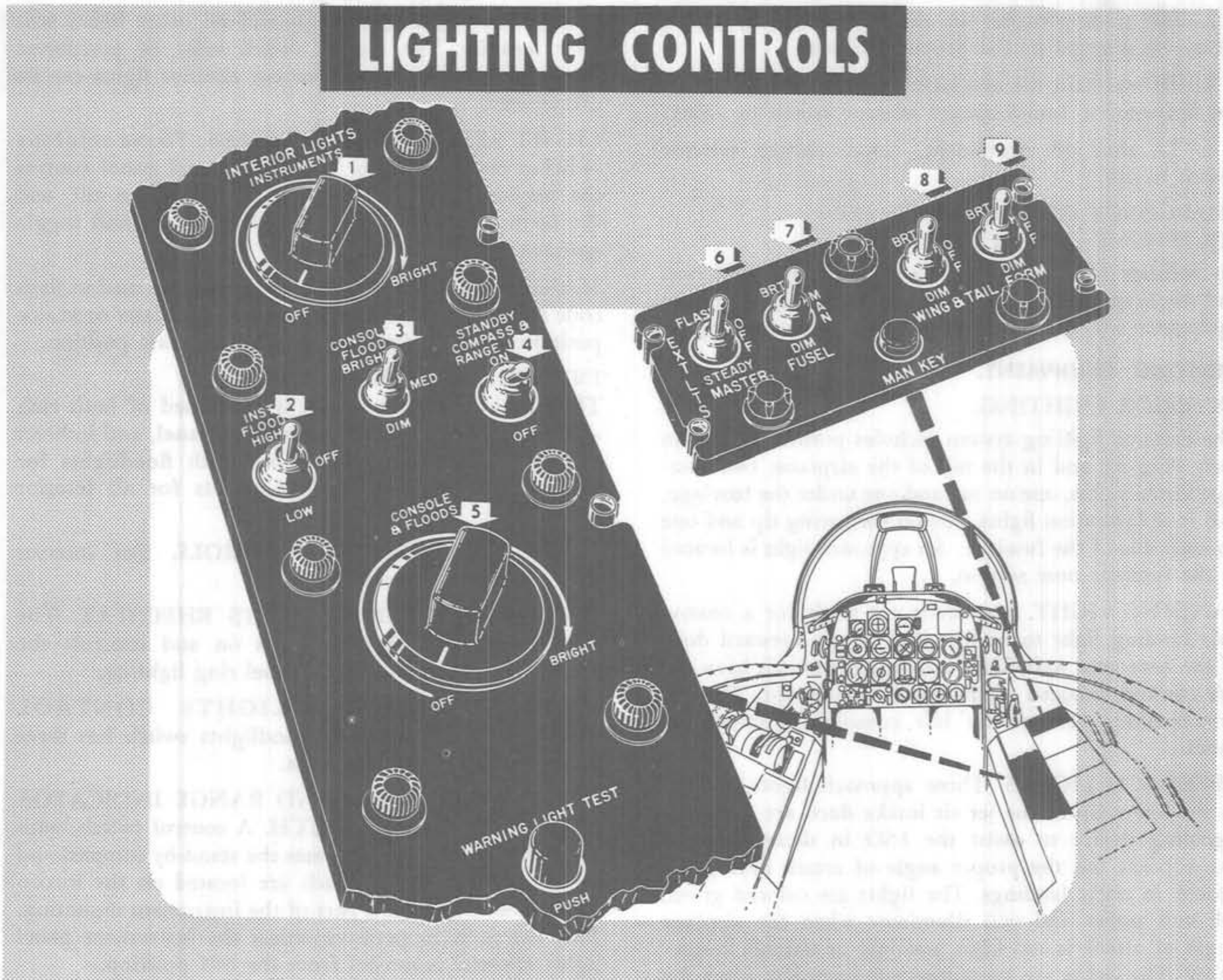
CONSOLE FLOODLIGHT CONTROL SWITCH. The console floodlights are controlled, after the rheostat is rotated from OFF, by a three-position (BRIGHT, MED, DIM) toggle switch.

WARNING LIGHTS.* Provisions for dimming cockpit warning lights are provided for night flying. As the instrument panel lights rheostat is turned on for night flights, all warning lights except the arresting hook unsafe and fire compressor and fire burner warning lights are automatically dimmed.

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 an access door located just forward of the left-hand gun bay.

***Airplanes 136118 and subsequent and airplanes having Service Change No. 338 complied with**



1. Instrument Panel Lights Rheostat
2. Instrument Floodlights Control Switch
3. Console Floodlights Control Switch
4. Standby Compass and Range Indicator Lights Control Switch
5. Console Lights Rheostat
6. Exterior Lighting Master Switch
7. Fuselage Lights Selector Switch
8. Wing and Tail Lights Selector Switch
9. Formation Lights Selector Switch

Figure 4-5.

OXYGEN REGULATOR.

The cockpit is provided with a positive-pressure, diluter-demand type oxygen regulator for pressure breathing. (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 on 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.

OXYGEN DURATION— hours

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.
Cylinder: One 514 cubic inch.

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Figure 4-6.

A pressure drop of more than 50 psi in a 24-hour period is excessive. Be 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 regulator diaphragm, and the diluter check valve for leakage by inserting a spare mask tube disconnect fitting into the open end of the disconnect. Blow 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. 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.

WARNING

Do not use a mask that leaks.

OXYGEN SYSTEM FLIGHT OPERATION.

Oxygen shall be used constantly during day flights when above 10,000 feet. Oxygen shall be used constantly during night flights when above 5000 feet when on combat or training flights. The following procedures shall be followed when oxygen is used.

1. The pressure gage should read 1800 (±50) psi if the cylinder is fully charged.

2. Set the air valve to NORMAL OXYGEN for all normal flight conditions.

3. Put on mask. Fully engage the mating portion 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 shoulder 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 37,000 to 39,000 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 37,000 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. Report all difficulties and make sure that they are corrected.

OXYGEN EMERGENCY CONDITIONS.

WARNING

Should symptoms occur which suggest the onset of hypoxia, immediately activate the safety pressure control. A constant flow of 100% 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 control, remove the oxygen mask connector from the breathing tube, 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 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.

The minimum engine rpm necessary for optimum cockpit air conditioning, pressurization and defrosting for any particular altitude is as follows:

ALTITUDE — FEET	PERCENT — RPM
10,000	70
15,000	72
25,000	77
35,000	82
40,000	87
45,000	96

WARNING

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.

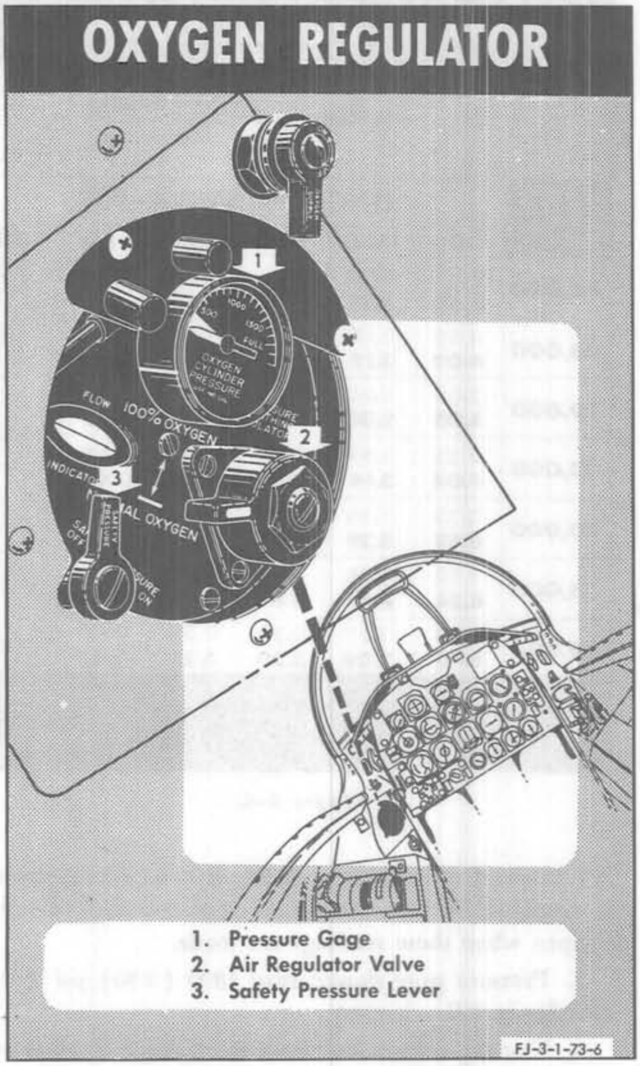


Figure 4-7.

WARNING

- Should brief removal of the mask from the face become necessary at high altitude, proceed as follows:
  1. Take three or four deep breaths of 100 percent oxygen.
  2. Hold breath and remove mask from face.
  3. As soon as practicable, replace mask to face and take three or four deep breaths of 100 percent oxygen.
  4. Reset air valve lever to the NORMAL OXYGEN position.
- Do not exhaust oxygen supply below 300 psi, except in an emergency. (See figure 4-6.)

LIQUID OXYGEN SYSTEM — AIRPLANES HAVING SERVICE CHANGE NO. 357 COMPLIED WITH.

Oxygen is supplied in a gaseous form by evaporation of liquid oxygen which is contained in a double-wall,

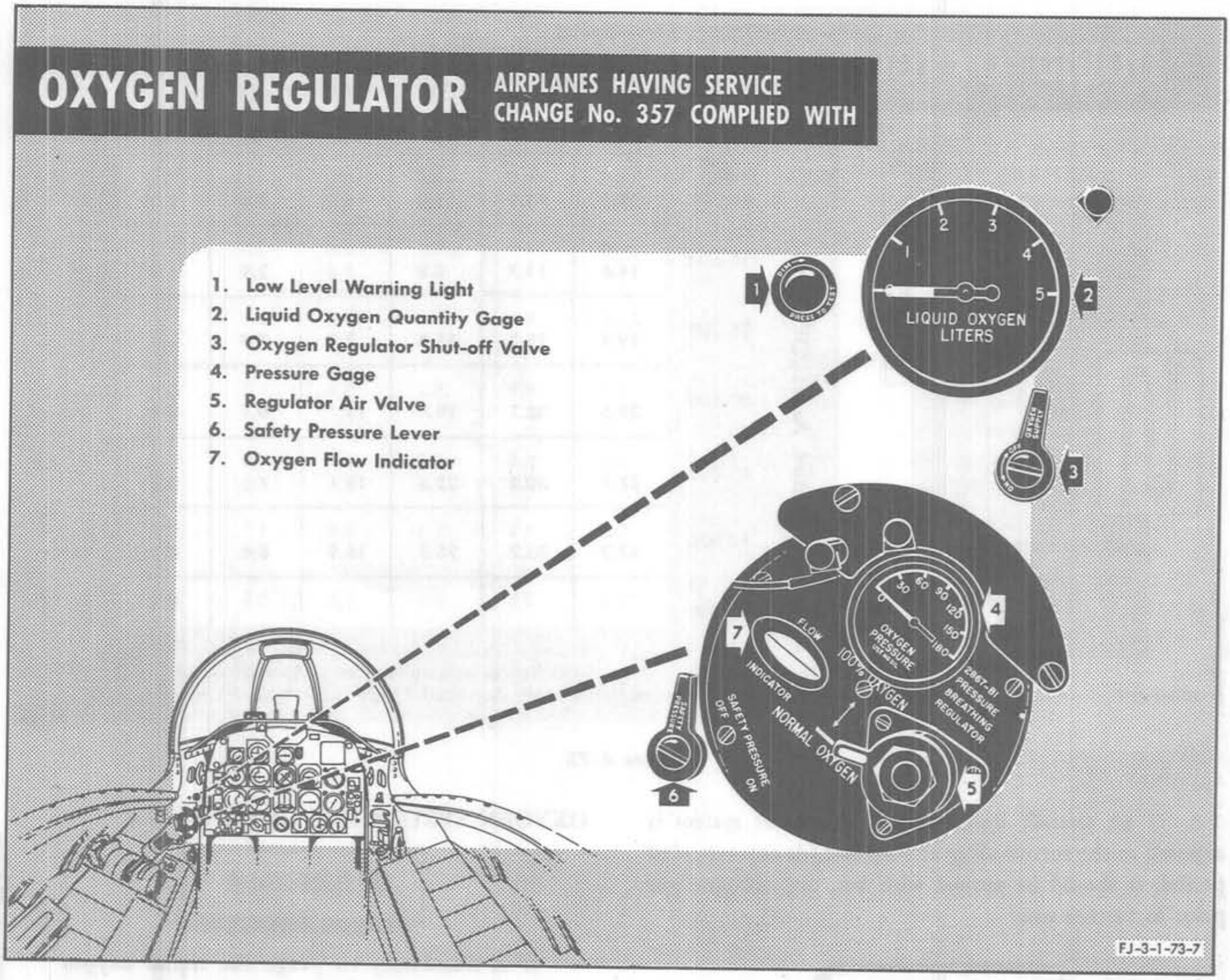


Figure 4-7A.

vacuum sealed sphere located forward and below the windshield on the port side of the airplane. The 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) and 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 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 the system is not in use, the 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 supply of breathing oxygen to the pilot with this system is equal to a gaseous oxygen system utilizing three 514-cubic inch bottles.

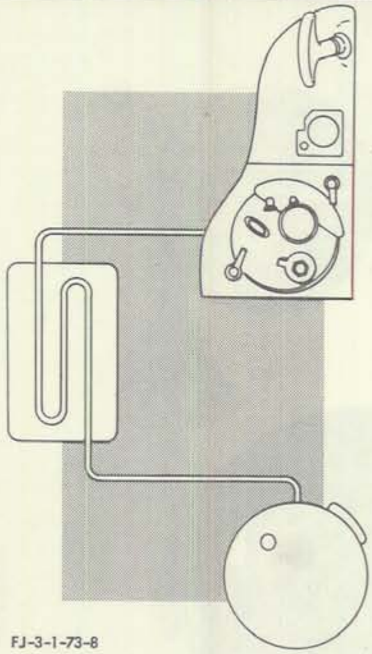
Note the following requirements to prevent malfunction of the aircraft liquid oxygen converter systems and to prevent the formation of odors in the aircraft oxygen supply through the introduction of water vapor or other gases into the system:

1. Aircraft liquid oxygen converter systems must not be permitted to go dry and become exposed to the surrounding atmosphere. If the converter system is exposed, water vapors or other gases may condense in the converter bottle and cause malfunction of the system valves or cause odors to be present in the oxygen supply.

2. Aircraft liquid oxygen converter systems should be left in the built-up condition with the supply valve in the off position except while filling the system.

LIQUID OXYGEN DURATION

AIRPLANES HAVING SERVICE CHANGE No. 357 COMPLIED WITH



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CABIN ALTITUDE—FEET	GAGE QUANTITY—LITERS 5	4	3	2	1	½	BELOW ½
35,000 & ABOVE	19.9 19.9	15.9 15.9	11.9 11.9	8.0 8.0	4.0 4.0	2.0 2.0	DESCEND TO ALTITUDE NOT REQUIRING OXYGEN
30,000	14.6 14.6	11.7 11.7	8.8 8.8	5.8 5.8	2.9 2.9	1.5 1.5	
25,000	11.0 19.4	8.8 15.5	6.6 11.6	4.4 7.7	2.2 3.9	1.1 1.9	
20,000	8.6 32.6	6.9 26.1	5.2 19.5	3.4 13.1	1.7 6.5	0.9 3.3	
15,000	6.9 37.7	5.5 30.2	4.1 22.6	2.7 15.1	1.4 7.5	0.7 3.8	
10,000	5.4 42.2	4.3 33.7	3.3 25.3	2.2 16.9	1.1 8.4	0.5 4.2	
SEA LEVEL	3.8	3.0	2.3	1.5	0.8	0.4	

Red figures indicate lever set at 100% oxygen.
Black figures indicate lever set at normal oxygen.
Table prepared from Specification MIL-T-19326 (AER) dated 20 January 1956.

Figure 4-7B.

3. If an aircraft liquid oxygen converter system is exposed to the surrounding atmosphere for any extended period, it should be purged with hot, dry nitrogen gas prior to further use.

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 4-7A.)

OXYGEN SYSTEM PREFLIGHT CHECK.

WARNING

It is mandatory to purge the liquid oxygen system with gaseous oxygen at 50 psi for 30 minutes if the system has been empty for several hours or if the system has been left open for parts replacement without all lines and components being capped or plugged.

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.

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 4-7B.)

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 open 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.

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 be not 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.

3. Periodically check the mask for leakage during flight. If you are below pressure breathing altitude, take a deep breath and hold it. 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. During flight, periodically check the quantity, pressure, mask, and all fittings.

OXYGEN EMERGENCY CONDITIONS.

1. Should symptoms occur which suggest the onset of hypoxia, immediately activate the safety pressure control lever. If the regulator should become inoperative and a constant flow of oxygen is not obtained by use of the safety pressure lever, disconnect the breathing tube, activate the bail-out oxygen equipment and descend below 10,000 feet.

2. Whenever excessive fumes or noxious gas is 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 4-7A), will illuminate when the liquid oxygen supply is down to ½ 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 warning 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 fluctuate as the light illuminates.

NAVIGATION EQUIPMENT.

STAND-BY COMPASS.

A conventional magnetic compass, located above the instrument panel shroud, is used for navigation in the event of instrument or electrical failure. On some airplanes,* the stand-by compass is located on the lower right-hand side of the windshield bow. The compass is illuminated by a light which is controlled by a toggle switch on the right console.

GYROSYN COMPASS.

The Type S-2 gyrosyn compass system includes the following components: a Type C-2 transmitter, located in the left wing panel; a manual slaving control panel (6, figure 1-7), located on the aft section of the right-hand console. The system is connected to the ID-250A/ARN radio magnetic course indicator (11, figure 1-5) on the

***Airplanes 135913 and subsequent and airplanes having Service Change No. 124 complied with**

instrument panel. The transmitter furnishes a reference for slaving the gyro to the earth's magnetic field. The rotating card of the indicator provides the directional indication from the gyrosyn compass system. The control panel contains a two-position (FREE GYRO and SLAVED GYRO) gyro switch, a slaving signal indicator to show the direction of precession required to obtain a null and to show when that null is obtained, and a spring-loaded, two-position (DEC and INC) slaving control. When the gyro switch is in FREE GYRO position, precession of the gyro is possible by the manual slaving control, and the system will operate as a directional gyro. When the gyro switch is in the SLAVED GYRO position, the gyro is precessed by the remote transmitter and operates as a gyrosyn (magnetically slaved) compass. The system derives power from the primary d-c and a-c busses.

OPERATION OF GYROSYN COMPASS. Complete control of the compass is obtained from the control panel (6, figure 1-7) for both shore and carrier operations at all altitudes.

1. Place gyro switch in SLAVE GYRO prior to take-off.

2. Place gyro switch in either FREE GYRO or SLAVED GYRO position to give the desired operation when airborne.

3. Precess the gyro by placing the gyro switch to the FREE GYRO position then turning the slaving control to INC or DEC to obtain the desired heading.

4. At any time during flight if free directional gyro operation is desired, move gyro switch to FREE GYRO.

5. To obtain a null when gyro switch is in FREE GYRO position, move slaving control to INC or DEC, whichever is opposite to the reading shown on the slaving signal indicator. When a null is obtained, the needle on the indicator will be centered. To correct any large error accumulated during flight maneuvers, the gyro should be slaved manually. To accomplish this, place the gyro switch in the FREE GYRO position, move slaving control to INC or DEC, whichever is opposite the reading shown on the slaving signal indicator. When a null is obtained, the needle on the indicator will be centered.

Note

After the gyro reaches operating speed, the indicator should be checked against the standby compass indication to make sure indicator does not show 180-degree ambiguity. The slaved gyro magnetic compass is not operating properly if such ambiguity exists.

ARMAMENT EQUIPMENT.

The armament equipment consists of four Mark 12, 20mm guns, four bomb and/or rocket external store stations, four Aero 15A combination bomb-rocket racks, two Aero 65A bomb racks, an Aero 10B armament control system, a bomb and rocket control box and a Mark 11 Mod 1 sight.

GUNS.

The four Mark 12, 20mm guns are mounted in pairs, one pair being located in the left gun bay, the other in the right gun bay. (See figure 1-2.) A pneumatic charging system provides air pressure for gun charging and for the operation of the feed system. The ammunition boost system is electrically operated. The charging and operation of the guns are controlled primarily from the gun control panel.

GUN CONTROLS.

ARMAMENT MASTER SWITCH. The master armament switch is labeled "ARM MASTER" (figure 4-8). When the switch is ON and the landing gear handle is UP, the armament bus is energized and the gun control switches and trigger switch become operative.

GUN SELECTOR SWITCHES. The gun selector switches are used to determine whether the inboard or outboard guns fire. All four guns may be fired simultaneously by positioning both switches at INB'D and OUTB'D.

GUN CONTROL SWITCH. The gun control switch is a two-position (READY and SAFE) toggle switch. When the switch is in SAFE position, the gun bolts are held back. After take-off, with the landing gear UP, positioning the gun control switch to READY causes the bolts to go into the battery or charged position, and the guns are then ready to be fired. To charge the guns in the event of a misfire, move the gun control switch to SAFE momentarily and then return it to READY.

Note

The guns are safe when any of the following switches are positioned as indicated:

1. Master armament switch OFF.
2. Gun control switch SAFE.
3. Both gun selector switches OFF.
4. Landing gear handle DOWN.

To fire guns, the following switches must be positioned as noted before the trigger is depressed:

1. Master armament switch ON.
2. Gun control switch READY.
3. Either or both gun selector switches ON.
4. Landing gear retracted.

Note

When the landing gear is extended for landing, the gun bolts are pulled back, the last rounds in the chambers are ejected, and the bolts are held in this position.

TRIGGER SWITCH. The trigger switch is located in the stick grip. It has two detents. The first detent is provided to start the gun cameras prior to gun firing. Depressing the trigger switch to the second detent, fires the guns while the gun camera continues to operate.

GUN CAMERA.

Provisions for mounting one or two type AN-N6A gun cameras are incorporated in the airplane. One installation can be made to photograph the sight reticles, as well as the target. The other installation is made through access doors on the inboard section of the right wing. The cameras will operate when the trigger switch is depressed to either the first or second detent. This method provides training facilities without actual firing of the guns.

AIR COMPRESSOR AND STORAGE BOTTLES.

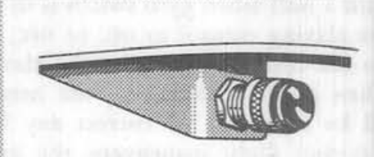
Air pressure for gun charging, ammunition feeding, and for maintaining pressure in the gun buffers is obtained from two storage bottles, charged to a pressure of 2700 to 3000 psi by a hydraulically driven air compressor. Air for the compressor is extracted from the cockpit air conditioning and pressurization system.

A pressure gage and valve, located aft and below the hydraulic equipment access door, are provided for ground introduction of external source of air pressure. On some airplanes* a pressure gage is installed to indicate the pressure of the right-hand storage bottle.

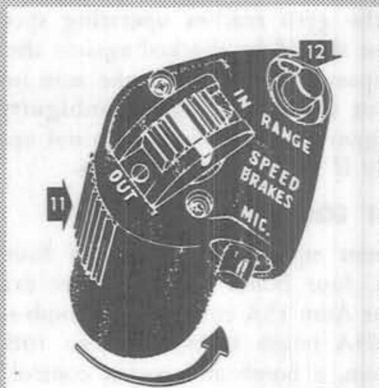
***Airplanes 135853 and subsequent and airplanes having Service Change No. 95 complied with**

ARMAMENT CONTROLS

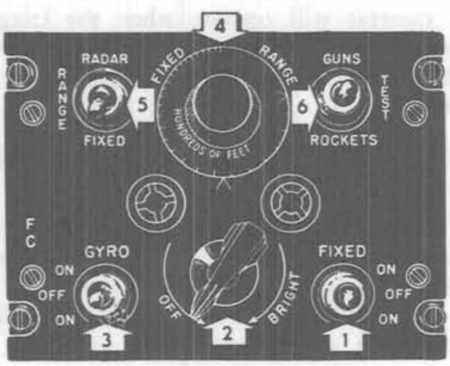
1. Fixed Reticle Lamp Switch
2. Reticle Brightness Control
3. Gyro Reticle Lamp Switch
4. Fixed Range Control
5. Range Switch
6. Guns—Test—Rockets Switch (Test—Rockets positions not used)
7. Deleted
8. Radar Range Gates-out Switch
9. Radar Range Control
10. Radar Power Switch
11. Counterclockwise Rotation to Uncage Gyro
12. Range Switch
13. Armament Master Switch
14. Gun Selector Switches
15. Gun Control Switch
16. Fixed Reticle Masking Knob
17. Sight Unit Adjustments
18. Trigger Switch
19. Crystal Current Meter
20. In-range Volume Control
21. Circuit Breakers



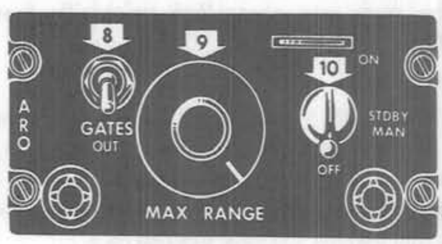
ON-TARGET INDICATOR LIGHT



THROTTLE



FIRE CONTROL PANEL



RADAR CONTROL PANEL

FJ-3-1-61-1C

Figure 4-8. (Sheet 1)

AND INDICATORS

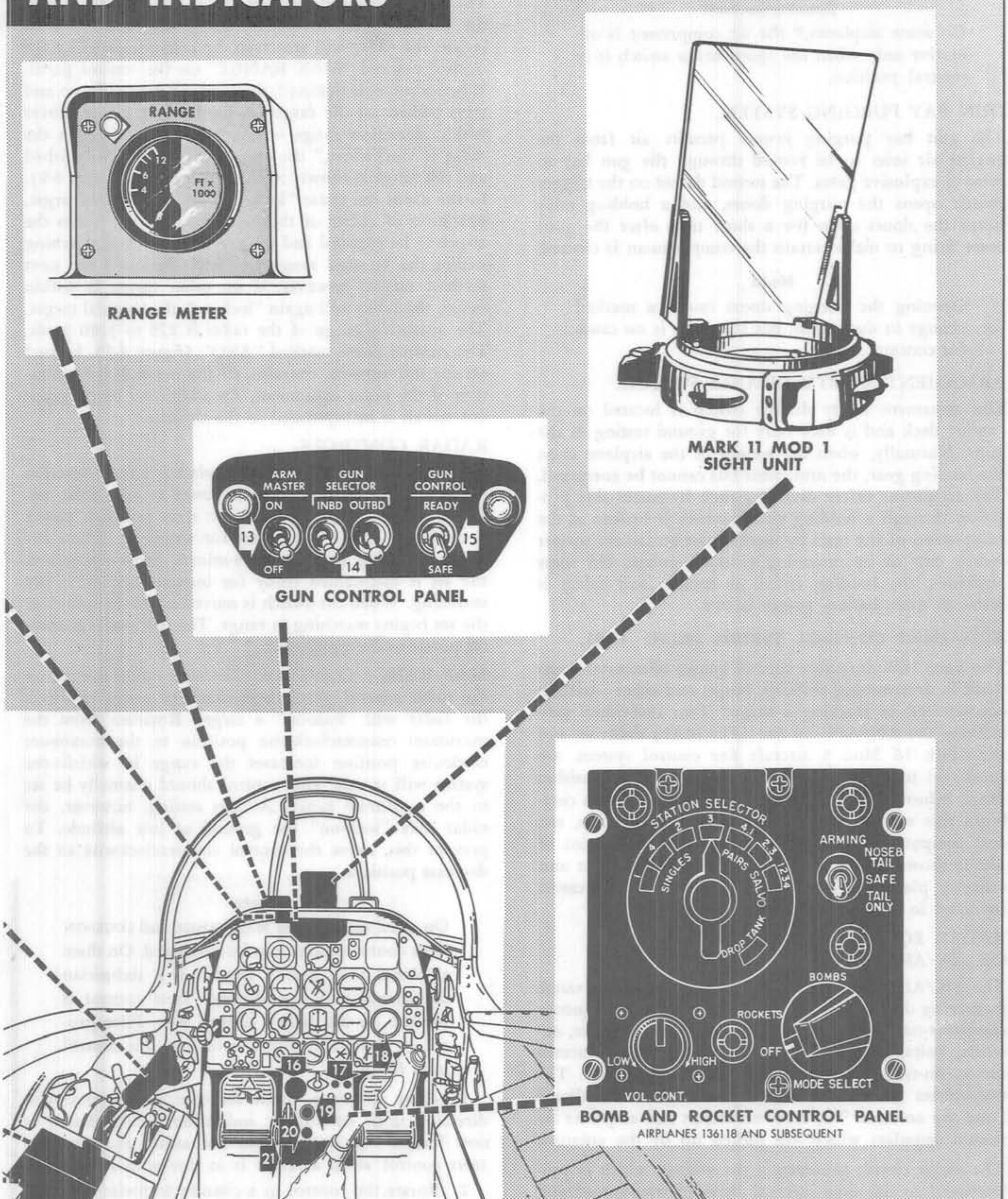


Figure 4-8. (Sheet 2)

CAUTION

On some airplanes,* the air compressor is operative only when the speed brake switch is in neutral position.

GUN BAY PURGING SYSTEM.

The gun bay purging system permits air from the engine air inlet to be routed through the gun bay to remove explosive gases. The second detent on the trigger switch opens the purging doors, and a holding relay keeps the doors open for a short time after the guns cease firing to make certain the compartment is cleared.

Note

Opening the purging doors causes a marked change in duct noise, but the noise is no cause for concern.

ARMAMENT SAFETY DISABLE SWITCH.

The armament safety disable switch is located on the canopy deck and is used only for ground testing of the guns. Normally, when the weight of the airplane is on the landing gear, the armament bus cannot be energized. The armament safety disable switch by-passes this provision through a holding circuit which is broken at the completion of the tests by turning the armament master switch OFF or by removing external power. On some airplanes, the holding circuit is broken and safety is restored when battery switch is OFF.

ARMAMENT CONTROL SYSTEM (AERO 10B).

The Aero 10B armament control system eliminates guess work in determining velocity, range, and other variables encountered in tracking a target. Two individual subsystems, the AN/APG-30 (or APG-30A†) radar set and the Mark 16 Mod 5 aircraft fire control system, are combined to make up the system. The radar furnishes range information to the fire control system which combines this with range rate, ballistics, gravity drop, etc, and computes an accurate point of aim. The point of aim is shown by the gyro reticle image in the sight unit reflector plate. For location of controls and indicators involved in operating this system, see figure 4-8.

RADAR EQUIPMENT (AN/APG-30 OR AN/APG-30A†).

The AN/APG-30 radar equipment is an automatic range measuring device. The equipment consists of a frequency converter-transmitter, power supply-range computer, antenna, voltage regulator, control panel, crystal current meter, on-target indicator light, and range meter. The transmitter generates a search pulse which is radiated from the antenna. The receiver detects and amplifies reflected impulses which are picked up by the antenna.

The range circuit generates a d-c voltage which is proportional to the time interval between transmitted and reflected pulses. Since the velocity of energy through space is constant, the time between the transmitted and the reflected pulse is directly proportional to distance. The d-c voltage generated by the range circuit is fed to the aircraft fire control system. In the absence of a target, the radar will search in the range selected by the control marked "MAX RANGE" on the control panel. When a target is detected, the tracking gate locks on and stays locked on the target as long as the target moves within detection range of the search cone. When the radar is "locked-on," the on-target light is extinguished and the range is shown on the range meter (figure 4-8). In the event the radar "locks-on" an undesirable target, operation of either of the gates-out switches causes the target to be rejected and the set will continue searching within the selected range and will "lock-on" the next farthest target; however, if no other target is within range, the radar will again "lock-on" the original target. The operating range of the radar is 225 to 3000 yards. The control panel marked "ARO" (figure 4-8), located on the left console, contains all the controls for operation of the radar equipment. An additional range gates-out switch is incorporated in the throttle.

RADAR CONTROLS.

POWER SWITCH. The power switch is a three-position toggle switch which furnishes power to the radar set. When this switch is in the STDBY MAN position, power is furnished to the equipment for warm-up. When left in this position beyond the 3-minute warm-up period, the set is maintained ready for instant use, but is not searching. When the switch is moved to the ON position, the set begins searching in range. The OFF position shuts off power to the equipment.

MAX RANGE CONTROL. The max range control on the radar control panel determines the range in which the radar will "lock-on" a target. Rotation from the maximum counterclockwise position to the maximum clockwise position increases the range in which the system will search. This control should normally be set to the maximum range. At this setting, however, the radar may "lock-on" the ground at low altitude. To prevent this, move the control counterclockwise to the decrease position.

Note

On some aircraft, the MAX RANGE and LOCK-ON SENS controls have been interchanged. On these airplanes MAX RANGE control is a technician adjustment and the LOCK-ON SENS control is located on the pilot's control box. Pilot procedure to obtain proper setting of this control is as follows:

1. After air-borne, rotate the control in a clockwise direction until ON-TARGET indication occurs. Radar is now locked "on noise." (Do not adjust the LOCK-ON SENS control when a target is in line with the radar.)

2. Rotate the control in a counterclockwise direction until ON-TARGET indication disappears. Then, rotate the

*Airplanes 135774 through 135852
†Airplanes 141364 and subsequent

control an additional small amount in a counterclockwise direction to prevent radar from locking on spurious noise.

RANGE GATES-OUT SWITCHES. There are two gates-out switches provided to enable the radar to "unlock" from a target and proceed to search in the selected range. When the radar is locked on an undesirable target, and the switch on the control panel is moved to GATES OUT or the switch on the throttle marked "RANGE" is depressed, the radar will reject the target and, when the switch is released, will search and "lock-on" the next farthest target that is within the selected range.

RADAR INDICATORS.

RANGE METERS. A range meter (figure 4-8), located on the instrument panel shroud, sweeps in the absence of targets and stands steady to indicate actual target range when the radar "locks-on" a target. The range meter will oscillate full scale deflections during warm-up, and will come to rest at zero when the set is warmed sufficiently. With AN/APG-30A* radar equipment, the range meter will oscillate full scale deflections during warm-up and when the power switch is in the STDBY-MAN position. When the power switch is turned to the ON position, the range meter will sweep until radar "locks-on" a target indicating actual range.

ON-TARGET INDICATOR LIGHT. A red indicator light (figure 4-8), mounted under the instrument panel shroud, is illuminated when the power switch is ON and the radar system is searching. The light is extinguished when the radar "locks-on" a target, which indicates that range information is being obtained and delivered to the fire control system.

CRYSTAL CURRENT METER. The crystal current meter (figure 4-8), marked "AFC XTAL CURRENT," is located on the center pedestal. The meter sweeps during the radar warm-up period; then if the power switch is left in the STDBY MAN position, the meter returns to zero. When the power switch is positioned at ON, the meter should stand steady between 0.3 and 0.8 on the scale.

*Airplanes 141364 and subsequent

Note

If the current meter sweeps after the warm-up period, when the power switch is ON, the set is not in operational condition.

With AN/APG-30A* radar equipment, the crystal current meter will not oscillate during or after the warm-up period as long as the power switch is in the STDBY-MAN position. After the power switch is turned ON, the crystal current meter will sweep until the lock-in frequency is found and then will remain steady between 0.3 to 0.8 on the scale.

PREFLIGHT CHECK OF RADAR EQUIPMENT (AN/APG-30 OR AN/APG-30A*).

Before all flights where use of the radar ranging equipment is contemplated, the following checks should be performed:

Note

The radar antenna should be beamed at a corner reflector or other suitable "target."

1. Make certain operational check of the equipment has been performed and the receiver-transmitter has been pressurized. The AN/APG-30A* receiver-transmitter does not have to be pressurized.

2. Have external power source connected to the airplane.

3. Push APG-30 (or AN/APG-30A*) circuit breaker in.

4. Place power switch on radar control panel in the STDBY MAN position and allow 3 or 4 minutes for warm-up.

5. See that the crystal current meter and range meter are sweeping during warm-up period. With AN/APG-30A* radar equipment, see that the range meter is sweeping and the crystal current is at zero during the warm-up period.

6. When warm-up period is completed, the meters should come to rest at zero. With AN/APG-30A* radar equipment, the range meter will continue to sweep and the crystal current meter will remain at zero after the warm-up period.

7. Turn max range control to full decrease position to eliminate "lock-on."

8. Move power switch ON.

9. Range meter should sweep to approximately 1300 yards and return to zero in the absence of a target. If a target is within this range, the radar will "lock-on."

10. The on-target light should illuminate and the crystal current meter should stand steady between 0.3 and 0.8 on the scale.

11. Increase range by turning max range control clockwise until radar "locks-on" a target, and check that on-target light is extinguished and range meter stands steady at proper range.

12. Return power switch OFF.

13. Have external power source removed.

IN-FLIGHT CHECK OF RADAR EQUIPMENT (AN/APG-30 OR AN/APG-30A*).

To check operation of radar equipment in flight, proceed as follows:

1. Make certain APG-30 (or AN/APG-30A*) circuit breaker is in.

2. Place power switch on STDBY MAN position, and allow 3 or 4 minutes for warm-up.

3. After warm-up period, see that range meter and crystal current meter are standing steady at zero. With AN/APG-30A radar equipment,* the range meter will continue to sweep and the crystal current meter will remain at zero after the warm-up period.

4. Rotate max range control clockwise to give maximum range.

5. Train antenna away from all targets within range, and move power switch ON.

6. See that the on-target light illuminates and range meter sweeps over the entire range.

7. Check that crystal current meter reads between 0.3 and 0.8.

8. Train antenna on another airplane, or other suitable target, and observe that on-target indicator light is extinguished and range meter stands steady at the proper range. This will indicate that the radar has "locked-on" a target.

9. Move gates-out switch on control panel to GATES OUT position momentarily.

10. See that target is rejected, range meter starts to sweep and the on-target light is illuminated; then radar should "lock-on" the next farthest target.

11. Repeat steps 9. and 10., substituting the range switch on the throttle for the switch on the control panel.

12. When check shows proper operation, move power switch to STDBY MAN position to maintain equipment ready for operation if desired. If instantaneous operation is not desired, move power switch OFF.

AIRCRAFT FIRE CONTROL SYSTEM.

The Mark 16 Mod 5 aircraft fire control system is an automatic lead-computing pilot-operated system which combines the range information furnished by the radar, with other variables and computes a point of aim for the airplane in the fire control of the fixed forward firing guns. The point of aim is indicated to the pilot by means of the gyro reticle image on the reflector plate of the Mark 11 Mod 1 sight unit (figure 4-9). Position of the gyro image is determined by the sight unit gyro, which should be caged at all times except when tracking a target. When using the system, it is necessary to estimate lead and establish an approximate point of aim after the on-target indicator light is extinguished. Then uncage the gyro, and the gyro

*Airplanes 141364 and subsequent

reticle image should move to the target if the lead was correctly estimated. If the image does not settle on the target, correction is necessary and care should be used to prevent overcorrection, as movement of the image will lag behind changes in flight attitude of the airplane. When the gyro reticle image is on the correct point of aim, smooth tracking of the target will permit the fire control system to compute the sight line necessary to score a hit. On some airplanes,* the Mark 25 Mod 0 aural range unit is installed, with an added range limiting feature. It operates in conjunction with the radar system in the air to air mode. It makes the pipper more controllable in getting on target at long range, alerts the pilot when the target is within the preset firing range of the guns or rockets, and gives a breakaway point. Set the fire control system for radar ranging. At long ranges the range unit causes the system to be in the fixed-ranging condition. The system computes according to the range value set on the dial of the control panel, resulting in a more constrained pipper than would be normal while tracking a target at long range; thereby tracking maneuvers are simplified. When the target range equals the value set on the *fixed range* dial on the control box, the fire control system automatically switches out of the fixed range condition, and radar ranging begins. At this same time a ranging tone is heard in the pilot's headset, indicating that the target is within the selected firing range. When the target range diminishes to a minimum distance, the ranging tone ceases, warning the pilot that he should begin his breakaway. It is important to keep the gyro reticle on the target at all times, so that the computer can correctly analyze the problem and end up with an accurate solution. The pilot may fire any time firing conditions are satisfactory after a minimum of 2 seconds smooth tracking. The longer smooth tracking is possible, the greater chances are for a hit. In the event evasive action of the target requires violent maneuvers to keep in range, cage the sight unit gyro to prevent tumbling.

In addition to the pilot-operated controls there is an aircraft velocity switch mounted on the bottom side of the Mark 86 Mod 0 computer. This switch is preset to H, M, or L, as established by the squadron ordnance officer, and these positions represent the expected speed during tracking runs. A Mark 2 Mod 1 plug in ballistics unit furnishes ballistics information, applicable to the Mark 12 20mm guns, to the computer.

MARK 25 MOD 0 RANGE UNIT.† The Mark 25 Mod 0 range unit provides an aural tone to the pilot's headset. This tone becomes audible when the aircraft comes within a preset range of a chosen target and remains audible to a minimum safe range. An IN RANGE volume control is located on the center pedestal just below the AFC XTAL meter (figure 4-8).

AIRCRAFT FIRE CONTROL SYSTEM CONTROLS. All pilot-operated controls for the aircraft fire control system are located on the fire control panel mounted on the left console (figure 4-8), except for the caging switch incorporated in the throttle and the fixed reticle masking knob located on the center pedestal (figure 4-8).

AIRCRAFT FIRE CONTROL SYSTEM CONTROL BOX. The Mark 35 Mod 1 control panel contains a power switch, fixed range dial, fixed and gyro lamp switches, range switch, and a guns-test-rockets selector switch. The Mark 35 Mod 2 control panel‡ does not have the rocket temperature dial installed. Otherwise, the controls and operation are the same as Mark 35 Mod 1 control panel.

POWER SWITCH. The power switch has a selective range from OFF to BRIGHT, and controls the intensity of the reticle images. This switch also controls the 28-volt d-c power to the entire aircraft fire control system. As the switch is moved clockwise from OFF power is supplied to the aircraft fire control system, and the reticle images will be visible when either the fixed or gyro lamp switches are ON.

GYRO LAMP SWITCH. The gyro lamp switch is a three-position (ON-OFF-ON) toggle switch. Each ON position energizes one of the filaments in the dual filament, gyro reticle lamp in the sight unit. Both ON positions provide a-c power supply to the aircraft fire control system. When this switch is ON, the gyro should be running.

FIXED LAMP SWITCH. The fixed lamp switch is also a three-position (ON-OFF-ON) toggle switch, with each ON position energizing one of the filaments in the dual filament fixed reticle lamp in the sight unit.

RANGE SWITCH. The range switch is a two-position toggle switch. It is used to determine which type of range information is being furnished to the aircraft fire control system. Under normal operating conditions, this switch should be in RADAR position for air-to-air firing. In this position, the range information is being furnished by the radar equipment. The FIXED position of this switch is used when the range information is to be determined by the fixed range dial, such as in the case of air-to-ground firing or when the radar equipment is inoperative.

FIXED RANGE DIAL. The fixed range dial determines the range that is being computed by the aircraft

***Airplanes 135913 and subsequent, and airplanes having Service Change No. 111 complied with**
†Airplanes 135813 and subsequent, and airplanes having Service Change No. 111 complied with
‡Airplanes 135787 and subsequent, and airplanes having Service Change No. 85 complied with

fire control system if the range switch is in the FIXED position. Proper operation of this dial consists of estimating the range at which the guns will be fired, turning the dial to this estimated range, and then positioning the range switch to the FIXED position. If the range switch is in the RADAR position, range limiting is possible. The aircraft fire control system computes for the range selected on the dial as in fixed-ranging, until the aircraft is in-range, or at the distance selected on the dial. At this point the fire control system automatically switches to radar ranging, computing the point of aim constantly as the aircraft closes on the target. A ranging tone is heard as long as the aircraft is in-range between the distance selected on the dial and the minimum distance breakaway point.

GUNS-TEST-ROCKETS SWITCH. This switch is a three-position toggle switch, and is used in the GUNS position for normal operation. The ROCKETS and TEST positions are used in some airplanes.* This switch must be returned to the GUNS position after any check procedure for the fire control system to furnish correct information to the sight unit for firing guns.

CAGING SWITCH. The caging switch is incorporated in the throttle, and is actuated by rotating the throttle grip. The purpose of the caging switch is to cage the sight gyro at all times except when tracking. If the gyro is not caged, violent maneuvers or landing shocks will cause the gyro to tumble, and may cause breakage of the sight unit mirror. Proper operation of the gyro requires that it be caged until the radar has "locked-on" a target, and an estimated point of aim has been established. Then when it is uncaged, the gyro reticle image will indicate the proper point of aim. In the event the gyro should tumble or the target should perform evasive tactics that will require considerable correction to re-establish the correct point of aim, momentarily caging the gyro will cause the gyro reticle image to center and reduce the time required for correction. The throttle grip is rotated counterclockwise to uncage the sight unit gyro.

FIXED RETICLE MASKING KNOB. This knob, located on the center pedestal (figure 4-8), is provided so part of the fixed reticle can be masked. Figure 4-9 shows the fixed reticle both masked and full. The fixed reticle is used to denote the line in which the fixed guns are pointing. The full reticle shows a vertical "ladder" with increments of 10 mils, a full circle which indicates 50 mils from the center dot, and a half circle which indicates 100 mils from the center. The fixed reticle is used in the standard rate turn check to determine if the Mark 16 Mod 5 aircraft fire control system is operating properly, and can be used with the gyro reticle image to show difference between line of aim and line of fire.

PREFLIGHT CHECK OF AIRCRAFT FIRE CONTROL SYSTEM.

The fire control system should be checked prior to each flight as follows:

1. Make certain the equipment has been checked for broken, frayed, oil-soaked, or unprotected cables and that the correct gun ballistics unit has been installed on the computer.
2. Have external power source connected to the airplane, and see that the gun sight circuit breaker, on the left console, is in.
3. Move console and floodlights rheostat from the OFF position.
4. Cage the sight unit gyro.
5. Guns-test-rockets switch to GUNS.
6. Fixed lamp and gyro lamp switches OFF.
7. Power switch, marked "OFF-BRIGHT," to OFF position.
8. Fixed range dial to 600 feet.
9. Range switch FIXED.
10. Move fixed lamp switch to forward ON position.
11. Turn OFF-BRIGHT switch from OFF position, and check that fixed reticle image responds to brightness control up to clockwise stop of OFF-BRIGHT switch.
12. Place fixed lamp switch in aft ON position, and repeat step 11.
13. Return fixed lamp switch and power switch to OFF positions.
14. Place gyro lamp switch in forward ON position.
15. Turn OFF-BRIGHT switch from OFF position until gyro reticle image is clearly visible on reflector plate. The gyro motor should be running. The gyro image should be clear and steady, and quickly come to rest. There should be no evidence of blur or fog on any part of the image.
16. Place gyro lamp switch in aft ON position, and repeat step 15.
17. Place fixed reticle lamp switch in aft ON position. Both reticle images should appear, and should both dim or become brighter together as OFF-BRIGHT switch is turned.
18. Move both lamp switches to forward ON positions. Results should be the same as in step 17.
19. Adjust OFF-BRIGHT switch to obtain clear reticle images.
20. Sight on a distant object. The two reticle images should appear to coincide on the distant object regardless of the reticle lamp switching combinations used. Verify this by selecting different switch combinations.
21. Uncage gyro by turning throttle in the direction indicated in figure 4-8.
22. Set fixed range dial to 3000 feet, and see that gyro reticle image moves down 5 (±5) mils.

Note

An error of 5 mils in azimuth may be tolerated under extreme conditions when, on the basis of previous experience and immediate needs, the removal of the computer is not warranted.

***Airplanes 136118 and subsequent**

SIGHT UNIT RETICLE IMAGES

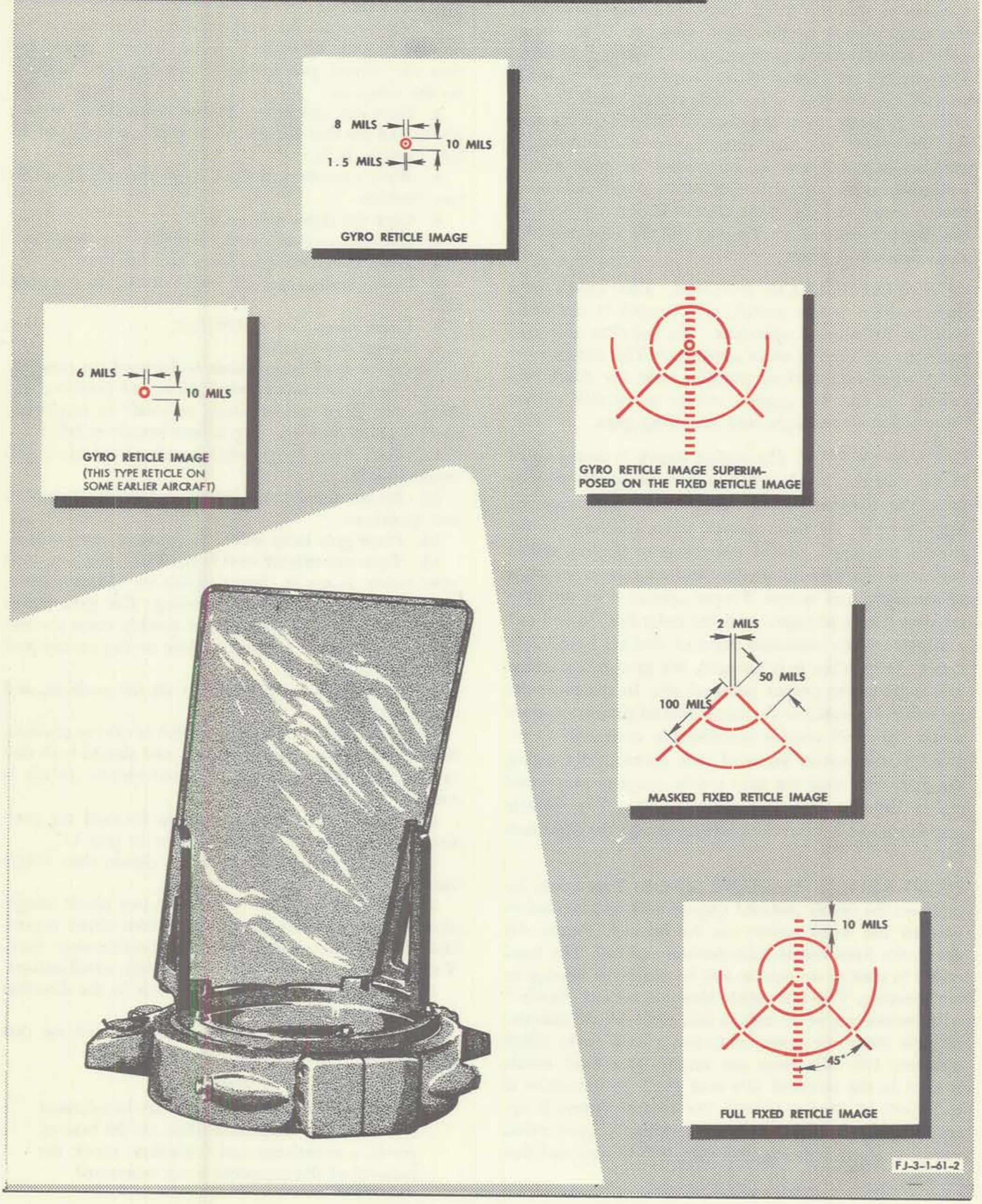


Figure 4-9.

23. Cage gyro.
24. Return gyro lamp switch to OFF position.
25. With fixed lamp switch ON, pull out fixed reticle masking knob, and check that fixed reticle is masked.
26. Push fixed reticle masking knob in; fixed reticle image should be fully visible.
27. Make sure all switches are positioned as shown in steps 4. through 9.
28. Place console and floodlights rheostat OFF.
29. Have external power source removed.

The aircraft fire control system should be turned on with the gyro caged for all flight operations to eliminate possible damage to the gyro in the sight unit.

IN-FLIGHT AIRCRAFT FIRE CONTROL SYSTEM CHECK PROCEDURES.

IN-FLIGHT RANGING CHECK. In-flight ranging check should be performed during flight to the target area, if time permits. This check will ensure correct operation of the ranging function of the system, and is only applicable to aircraft equipped with a radar set.

1. Energize radar set and aircraft fire control system as follows: Advance power switch marked "OFF-BRIGHT" clockwise to desired brilliance. Uncage caging switch, and place fixed lamp toggle to ON. Set range switch on control box to RADAR and adjust fixed range control to 30 hundreds of feet (1000 yards). Allow 3 minutes for the radar equipment to warm up.
2. Close in on a companion aircraft whose range is more than 1500 yards away.
3. As the airplane passes through the preset range of 1000 yards (adjustment made in step 1.), an 800-cycle ranging tone should be heard in the headphones. Adjust the volume control until the tone is at the desired volume. The ranging tone should be continuous down to 200 yards range for guns depending upon the positioning of the guns-test-rockets switch. The setting of the fixed range control determines the maximum range at which the ranging tone will commence as the airplane closes in on target.

The lower range limits at which the tone ceases cannot be adjusted by the fixed range control.

IN-FLIGHT TOTAL LEAD ANGLE CHECK. The total lead angle check provides the pilot with a flight check to test the lead computing functions of the fire control system. This may be accomplished by causing the pipper to be deflected and held at a given offset from the center of the fixed reticle image as the airplane is flown in a timed circular pattern. The amount of time required to complete the circle is measured and should fall within tolerances specified herein. The day selected for the test should have still air. The altitude, bank angle, and aircraft speed must be held constant so that the pipper position will be stabilized at the desired offset. (This test is not affected by the position of the aircraft velocity switch.) This check should proceed as follows:

1. Energize fire control system by turning "OFF-BRIGHT" or power switch to ON position, set fixed range at 3000 feet, place guns-test-rockets switch to GUNS, uncage gyro, turn fixed lamp and gyro lamp switches ON, set range switch to FIXED and unmask fixed reticle. Allow 3 minutes for fire control system to warm up.
2. The total lead angle check is to be conducted under the following conditions: Pressure altitude should be 20,000 (±5000) feet, and the aircraft velocity should be 300 (±50) knots IAS.
3. Fly airplane in a constant rate of turn so that gyro pipper is deflected 50 mils from the center of the fixed image.
4. As the turn is commenced, the pipper will move approximately level with respect to the ground and become relatively stable during a smooth turn.
5. By using the airplane compass or a distant land mark as a position reference, obtain the time required to complete a 360-degree turn while the pipper is stabilized at the 50-mil offset.
6. The time required to complete a 360-degree turn, using the 50-mil offset, should be within 110 to 142 seconds with ballistic element Mark 2 Mod 1. The pipper position should be stabilized throughout the timing cycle.
7. Repeat the check using a 100-mil deflection for the pipper offset. The time required to complete a 360-degree turn with ballistic element Mark 2 Mod 1 should be within 56 to 72 seconds while the pipper position is stabilized.
8. Several passes should be made in right- and left-hand turns with time recorded for each pass to determine the average time required for completing a circle with 50- and 100-mil offsets. The aircraft will be pulling about 1.6 and 2.8 G's respectively for the 50- and 100-mil offsets. If time obtained is not within the limits of 110 to 142 seconds for the 50-mil offset, and 56 to 72 seconds for the 100-mil offset, maintenance should be performed on the system by designated technicians.

IN-FLIGHT ANGLE-OF-ATTACK CHECK. The purpose of this test is to check the alignment of the angle of attack and on some airplanes* the skid compensator. The test is sometimes designated as an "in-flight" angle-of-attack test, and it is important that this alignment be checked occasionally since the accuracy of rocket firing is affected. This alignment has no effect on gun firing.

If it is noticed after several rocket-firing runs that the rockets are consistently passing over or under the target, the aircraft fire control system should be subjected to the angle-of-attack test.

The following steps outline a procedure for conducting the "over-water" angle-of-attack flight check using the horizon as a reference.

1. The pilot should select a day with good horizon visibility for conducting the "over-water" angle-of-attack flight check.
2. Energize the aircraft fire control system as follows: Turn gyro lamp switch to ON and advance "OFF-BRIGHT" control clockwise to desired brilliance. Caging switch should be uncaged on target, fixed lamp switch to ON (use fixed image for reference with gyro), range switch to FIXED, guns-test-rockets switch set in TEST position,

*Airplanes 136118 and subsequent

and the fixed range control set at the desired range. Allow 3 minutes for the aircraft fire control system to warm up.

3. Fly the airplane smoothly, on a straight course, at a constant altitude, and at a speed which approximates that which will be used when tracking and firing rockets.

4. While flying over water, the gyro pipper may be observed with respect to the horizon. At an altitude of 100 feet, with the airplane in level flight, the pipper should rest 3 mils above the horizon.

5. If the center of the movable pipper does not settle in the correct position, the amount of offset may be measured by using the 10-mil ladder markings of the fixed reticle image as a guide. This information should be recorded with notation as to whether the pipper is too high or too low.

6. This procedure should be repeated for five or six times with an increase in airspeed of approximately 25 knots on each pass. This speed should be held within the combat speed range, and the error of pipper displacement should be recorded for each pass. The amount of error should not change with variation in aircraft speeds.

7. After landing, the pilot should average the errors obtained from the five or six passes. The ordnance officer will see that the correct adjustments are made on the angle of attack and skid compensator mounted on the airplane.

8. After this adjustment has been made, a second flight check should be made to determine that the alignment is accurate, and to collect data for additional adjustment if necessary. Thereafter, the position of the gyro pipper should be periodically checked according to this procedure to ensure the stability of the pipper alignment with the flight path. The angle-of-attack check should be very accurate in every detail of the test, since 75 percent of any error between the pipper and the flight path of the airplane will be present in the final rocket solution of the aircraft fire control system.

NORMAL OPERATION OF AERO 10B ARMAMENT CONTROL SYSTEM (AIR-TO-AIR).

While normal operation of the system is possible after the warm-up period required by the radar equipment, accuracy of computation increases with an increase in warm-up time. For the best operation, a minimum warm-up time of 30 minutes is desirable. Therefore, it is recommended that the system be energized immediately from take-off. The following sequence should be carried out for the most effective armament control:

1. Make sure the AN/APG-30 (or AN/APG-30A*) and the gun sight circuit breakers, located on the right console, are in.

2. If illumination of the control panel is desired, move console lights rheostat from OFF position.

3. Place radar power switch in STDBY MAN position, and allow 3 minutes for warm-up.

4. See that crystal current meter and range meter are oscillating during warm-up period. This will indicate that the equipment is operating.

5. Set max range control to the full clockwise position.

Note

> If operation of the armament control system is contemplated below approximately 6000 feet, the radar may "lock-on" the ground. To prevent this, rotate the max range control counterclockwise to decrease the range.

6. Place guns-test-rockets switch in GUNS position.

7. Position range switch in RADAR.

Note

> If radar equipment is inoperative place range switch in FIXED position and align fixed range dial to desired firing range.

8. Turn gyro lamp switch (and fixed lamp switch if fixed reticle is desired) to either ON position.

9. Check that sight unit gyro is caged.

10. When a target is sighted, place radar power switch ON.

11. Make sure gun control switches are in their proper positions.

12. Beam the radar antenna on the target by aiming airplane toward the target.

13. Approach target within the approach angle limits which are determined by target speed. The slower the target, the greater the approach angle can be.

14. When the on-target indicator light goes out, estimate lead and position the airplane so the gyro reticle image is on the estimated aim point. Uncage the gyro and if the lead was correct the pipper will move to the target. If the estimated lead was incorrect, adjust airplane tracking so that image is constantly held on the target.

Note

> Care should be used to prevent over-correction, since the gyro reticle image will lag behind changes in the airplane's flight path.

15. After a minimum of 2 seconds, smooth tracking time, fire at any favorable time. The percentage of hits will be increased by longer tracking time.

16. *Always fire before starting your pull-out.*

CAUTION

> During gun firing TPT will rise and may exceed the engine limitations. Under certain conditions a flame-out may possibly occur.

NORMAL OPERATION OF AERO 10B ARMAMENT CONTROL SYSTEM (AIR-TO-GROUND).

The operation of the system is the same for air-to-ground attacks as described for air-to-air [NORMAL OPERATION OF AERO 10B ARMAMENT CONTROL SYSTEM (AIR-TO-AIR) in this section], with the following exceptions:

*Airplanes 141364 and subsequent

1. Since the use of radar ranging is not practical against most ground targets, fixed range settings will be required.

2. It will not be necessary to estimate the lead before uncaging the gyro, unless there is appreciable target motion.

BOMBING AND ROCKET SYSTEM.

The bomb and rocket system consists of a bomb and rocket control box, four bomb and/or rocket external store stations, four Aero 15A combination bomb-rocket racks and two Aero 65A bomb racks. The four external store stations, equipped with Aero 15A bomb-rocket racks, will accommodate four 500-pound bombs or four Aero 6A-1 rocket pods loaded with seven 2.75-inch FFAR rockets. The Aero 7D rocket pod can be carried only on the two outboard external store stations; if it was carried on the inboard stations, it would interfere with landing gear operation because of its size. The Aero 7D rocket pod carries nineteen 2.75-inch FFAR rockets. Two 1000-pound bombs can be carried on the outboard external store stations using the Aero 65A bomb racks. Mixed bomb loads may be carried, with two 1000-pound bombs carried on the outboard stations and two 500-pound bombs carried on the inboard stations. Each type of rocket requires a different ballistic element; therefore, mixed rocket loads cannot be carried. Bombs can be carried in conjunction with rockets as long as Aero 15A bomb-rocket racks are used for 500-pound bombs and for all rocket configurations.

BOMBING AND ROCKET EQUIPMENT. The four bomb and/or rocket external store stations are located two under the left wing and two under the right wing. Two additional external stations, one under each wing, outboard of the external store stations, will carry a drop tank only. Each external store station is fitted to carry an Aero 15A combination bomb-rocket rack. The two outboard external store stations can carry either an Aero 15A or Aero 65A bomb rack. A bomb and rocket control panel is located on the center pedestal (figure 1-5). This control panel includes a station selector switch, a mode select switch and a bomb arming switch. The Mark 11 Mod 1 sight is used in conjunction with rocket firing. The Mark 3 Mod 1 ballistic element is required for firing the 2.75-inch FFAR rockets.

BOMBING AND ROCKET CONTROLS.

STATION SELECTOR SWITCH. The station selector switch on the bomb and rocket control panel determines how the bombs or rockets will be released. By positioning the switch to the desired station, bombs and rockets may be released singly, in pairs or salvoed. A drop tank position is also included. By positioning the switch to DROP TANK, the two outboard external tank stations will jettison the drop tanks when the bomb-rocket button is depressed.

MODE SELECT SWITCH. The mode select switch on the bomb and rocket control panel has OFF, ROCKETS and BOMBS positions. Select the position desired for the type of external store carried.

BOMB ARMING SWITCH. The bomb arming switch is a three-position switch with NOSE & TAIL, SAFE and TAIL ONLY positions. Positioning the switch to NOSE & TAIL or TAIL ONLY will energize the respective arming solenoids in the Aero 15A or Aero 65A bomb-rocket racks. In the NOSE & TAIL position, both nose and tail arming wire loops are secured so that both arming pins are pulled at bomb departure. With TAIL ONLY selected, the nose arming pin remains with the bomb on release. In SAFE position, neither arming pin is pulled on release and the bombs will be dropped unarmed.

OPERATION OF BOMBING SYSTEM.

To release bombs, all armament circuit breakers must be engaged and the following steps should be performed:

1. Arm master switch to ON.
2. Set the mode select switch to BOMBS.
3. Select either NOSE & TAIL, TAIL ONLY or SAFE on the bomb-arming switch.
4. Select desired station on station selector switch.
5. Depress the bomb-rocket release button on the stick grip.

If bombs are to be released singly, position the station selector to 1 and depress the bomb-rocket release button. When the bomb-rocket release button is released, the station selector switch automatically advances to the next station, until all four bombs are released. Bombs may be released in pairs by selecting 1-4 on the station selector. As the bomb-rocket release button is depressed and released, the station selector switch automatically advances to the 2-3 position. To release all bombs simultaneously, set the station selector switch to SALVO.

Note

- Bombs and tanks may be jettisoned from all underwing stations by either depressing the store and tank jettison switch or by pulling the stores jettison handle.
- To jettison the external stores and retain the drop tanks, select SALVO on the station selector and depress the bomb-rocket button on the stick grip.
- To jettison the tanks and retain the external stores, select DROP TANK on the station selector and depress the bomb-rocket button on the stick grip.
- In the event of electrical failure, the stores jettison handle has a mechanical linkage which will mechanically release the drop tanks and the outboard external store stations when equipped with Aero 65A bomb racks.

OPERATION OF ROCKET SYSTEM.

To fire rockets, all armament circuit breakers must be engaged. The Mark 11 Mod 1 gun sight is used for aiming in rocket firing; therefore, the APG-30 (or AN/APG-30A*) radar and the Mark 16 Mod 5 aircraft fire control system must be turned on to furnish information to the sight. Turn the APG-30 (or AN/APG-30A*)

*Airplanes 141364 and subsequent

radar power switch ON, the AFCS power switch ON and the radar range to RADAR; set the desired range on the fixed range dial and set the guns-test-rockets switch to ROCKETS; turn the gyro and fixed reticle lamp switches to ON and uncage the gyro reticle. In order to fire the rockets, the following steps must be performed:

1. Arm master switch ON.
2. Set the mode selector switch on the bomb and rocket control panel to ROCKETS.
3. Set station selector switch on the bomb and rocket control panel to desired station.
4. Depress the bomb-rocket release button on the stick group.

If rockets are to be fired singly, position the station selector to 1 and depress the bomb-rocket release button. When the bomb-rocket release button is released, the station selector switch automatically advances to the next station until all four stations are expended. Rockets may also be fired in pairs or salvoed by positioning the station selector to station 1-4 or SALVO.

Note

- Rockets and tanks may be jettisoned from all underwing stations by either depressing the store and tank jettison switch or by pulling the stores jettison handle.
- To jettison rockets and retain the drop tanks, select SALVO on the station selector and depress the bomb-rocket button on the stick grip.
- To jettison rocket pods after the rockets are fired, select BOMBS on the station selector and depress the bomb-rocket button on the stick grip.

NORMAL OPERATION OF ROCKET CONTROL SYSTEM (AIR-TO-AIR).

In air-to-air rocket firing, the procedure outlined in the preceding paragraph applies. With the range switch in the RADAR position and the target beyond the range set on the fixed range dial, you have range limiting. The range unit causes the system to be in the fixed ranging condition and computes for the distance set on the fixed range dial. As soon as the target is within range, the range unit automatically switches to radar ranging and computes the problem from that point on until the breakaway. Also, when reaching the preset range, an aural tone is heard in the pilot's headphones indicating that he is in the firing range. The pilot may fire his rockets after smoothly tracking the target for 2 to 4 seconds while in the aural firing range.

NORMAL OPERATION OF ROCKET CONTROL SYSTEM (AIR-TO-GROUND).

In air-to-ground rocket firing, radar ranging is impractical because radar will "lock-on" the ground; therefore, turn the range switch to FIXED and set the fixed range dial to the desired firing range. As the airplane dives at the ground target, it will be unnecessary to provide for an estimated lead before uncaging the gyro unless the target is moving. As the airplane passes through the preselected firing range, the pilot can commence firing. Since the range switch is set at FIXED, no aural tone will be heard and the pilot will have to estimate the range. In air-to-sea attacks on large isolated targets, normal air-to-air procedures may be used.

TIGHT PIP ROCKET SOLUTION.

If the combat situation does not permit the minimum tracking time of 2 to 4 seconds required for rocket firing, the pilot may use a high-speed attack method, generally designated as the tight-pip rocket solution. This procedure is called the tight-pip rocket solution because the gyro remains caged during the tracking and firing run, causing the pipper to become quite stable or "tight." However, even when caged, the pipper is still active since gravity drop, skid and attack-angle inputs for the rocket solution are fed into the sight. With the gyro caged, the pilot must estimate the target lead. In doing this, the wind and relative target motion must be considered to establish a lead angle which will bring hits. With the gyro remaining caged, the pilot should track the target from one-half to one second and then fire. The firing should be accomplished while maintaining the estimated lead. The accuracy of the tight-pip solution is much less than the solution obtained with the gyro uncaged on the target and using a longer target tracking time.

TARGET TOWING.

Many factors are involved while towing targets and each pilot should be aware of the danger involved if precautions are not taken. All pilots know that airplanes fly and stall at a certain airspeed and they must realize that with added drag the normal flying characteristics of a certain airplane are going to change. The pilot should be more concerned with the angle of attack than the power output of the engine. The angle of attack can be changed but the engine will develop only a certain amount of power; keep in mind that jet engines are slow to accelerate. The angle of attack should be decreased for safer climb and likewise decreased for safer glide. It should be remembered that stall speed increases as the angle of bank increases.

TARGET TOWING MECHANISM.

Provisions for towing and releasing aerial gunnery targets are incorporated in the airplane. A cable system originating with the arresting hook and terminating at the tow-ring latch mechanism plus the normal arresting hook cockpit control complete the mechanism. The towring hook is closed by inserting the tow-target ring and pressing it firmly against the forward section of the latch. The hook will close and lock automatically. Release of the tow target is accomplished by lowering the arresting hook.

DRAG TAKE-OFF.

The drag take-off is used with banner targets. The entire length of tow line is laid out in a squat "S" pattern alongside the tow airplane's take-off run. The center leg of the "S," parallel to take-off, and the far forward turn of the "S" are placed opposite the estimated take-off point. This procedure reduces the abrasion of the target before becoming air-borne. Before the take-off the banner target is counterbalanced for either horizontal or vertical towing. Upon return of the tow airplane from a mission, the target and towing gear are jettisoned over the recovery area by lowering the arresting hook.

WARNING

Make no attempt to jettison towing gear over an area where injury to personnel could result.

TARGET TOWING CABLE.

Target towing subjects the cable to severe stresses in addition to damage by gunfire. Frequent inspections are advisable.

MISCELLANEOUS EQUIPMENT.

ANTI-G SUIT PROVISIONS.

The anti-G control valve is located on the left side of the seat. The valve receives air from the engine compressor and meters it to the pilot's anti-G suit when a force of approximately 1.75 G's is applied to the aircraft. A HI and LO control allows for rate of inflation adjustment of the anti-G suit. In the LO range, the valve opens at 1.75 G and allows one psi of air pressure to pass to the suit for every increase of 1 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 manually 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. The suit is connected to the anti-G system at the pilot's quick-disconnect assembly beneath the seat.

UTILITY RECEPTACLE.

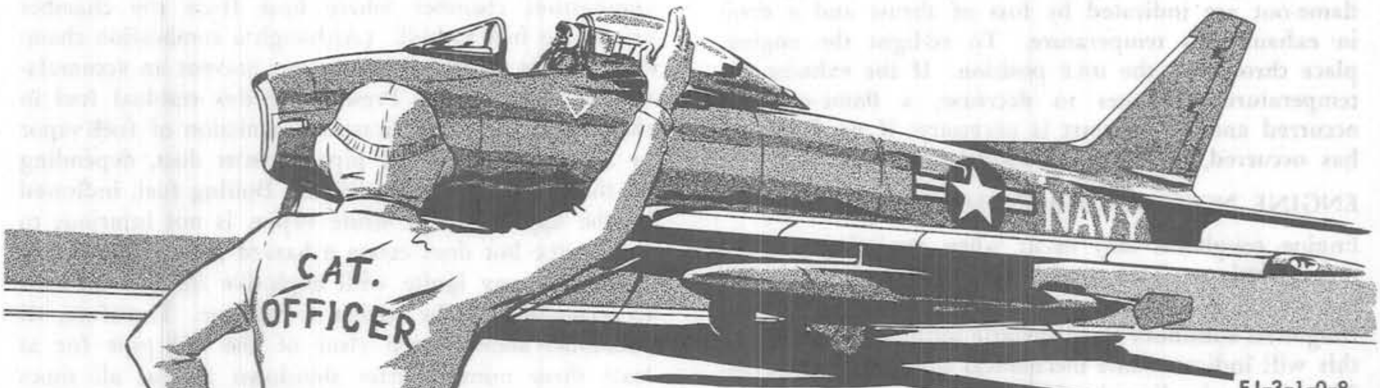
A 28-volt d-c power utility receptacle is provided on the forward portion of the right console.

REARVIEW MIRROR.

The rearview mirror is mounted on the canopy bow just forward and above the pilot. For increased rear vision, two* rearview mirrors are mounted on the canopy bow, one on each side and forward of the pilot.

*Airplanes 139210 and subsequent and airplanes having Service Change No. 329 complied with

SYSTEMS OPERATION section VII



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ENGINE.

ENGINE ACCELERATION AND MAXIMUM SPEED.

Accelerations can be made at all altitudes. Maximum engine speed is limited by the fuel control unit. However, at altitudes above 40,000 feet engine speed may have to be reduced to prevent exhaust gas temperatures from exceeding maximum limits. Idle speeds will gradually increase from 42% rpm at sea level to approximately 82% rpm at 50,000 feet.

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 the 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 chambers 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 pressures 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. Compressor stall may be recognized in flight by one or more of the following characteristics:

1. Loss of thrust and acceleration.
2. Rapid rise of exhaust temperatures.
3. Pulsating, roaring noise accompanied by heavy vibration.
4. Long flame from tail pipe.

High altitude compressor stalls are characterized by one or more sharp "bangs" rather than the "chugging" associated with compressor stall at low altitude or on the ground.

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.

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 drop off approximately 1% between sea level and 30,000 feet. A slight decrease in exhaust gas temperature may accompany this drop-off in rpm. If exhaust gas temperature decreases, it will recover to the maximum limit at approximately 40,000 feet. Above 40,000 feet it may be necessary to reduce engine rpm in order not to exceed the exhaust gas temperature limits.

ACCELERATION AND DECELERATION FLAME-OUTS.

Acceleration and deceleration flame-outs are the result of a fuel control unit malfunction or improper throttle rigging. Rapid movement of the throttle will not cause flame-outs if the fuel control unit is operating normally and the throttle rigging is correct. A malfunction of the fuel control unit can cause acceleration or deceleration flame-outs while improper throttle rigging can cause deceleration flame-outs. An improper throttle rigging may allow the cut-off valve to close when the throttle is retarded to the IDLE position. An acceleration which causes a rich blow-out 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 re-light the engine, place 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 can usually be eliminated by changing the power setting or altitude. If the roughness continues at all throttle settings and altitudes, this will indicate some mechanical failure has occurred. Therefore, a landing should be made as soon as possible.

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 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 the shroud since an attempted start may result in destruction of the starter. If a start must be made when interference is suspected, either an audible check should be made that the engine begins to rotate when the starter is engaged or tachometer indications should be noted. If engine does not begin turning at starter engagement, the stop-start switch must be placed at 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 the ground wind conditions. Boiling fuel, indicated by the appearance of white vapor, is not injurious to the engine but does create a hazard to personnel since the vapor may ignite with explosive force if allowed to accumulate in the engine or fuselage. Therefore, all personnel should keep clear of the tail pipe for at least three 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 immediately. The correct procedure for clearing the engine is given under SMOKE FROM TURBINE DURING SHUTDOWN, in Section III.

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 volume and hence the velocity of the exhaust jet 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, exhaust temperature adjusting segments are added to or removed from the aft end of the tail pipe. These segments correctly adjust the exhaust outlet area to produce as near as possible a stabilized exhaust temperature of 650°C 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 temperature. The initial segments are installed at the bottom of the tail pipe. As additional segments are needed, they are installed as symmetrically as possible, starting from the bottom of the tail pipe. Initial segment installation beginning at the top of the tail pipe is not recommended, because it will reduce the down-tail load. Down-tail loading aids nose-wheel lift-off and is a reaction caused from the tendency of the jet exhaust stream to cling to the upper fairing shelf aft of the tail pipe. Whenever this tendency to cling is spoiled, the normal down-tail load is lost. Whenever this down-tail loading is reduced or lost, nose wheel lift-off speed will increase substantially. Efficient minimum-run take-offs depend upon early nose wheel lift-off; thus, if the tail-pipe segments are improperly located, an excessive ground run will be required during take-off.

FUEL SYSTEM OPERATION.

Fuel sequencing is controlled automatically by float level switches and requires no tank selection by the pilot. If drop tanks and wet leading edge are installed, turn fuel transfer switch to drop tanks immediately after take-off so that if it becomes necessary to jettison the drop tanks, all possible auxiliary fuel will have been used. If drop tanks are not installed, and wet leading edge tanks are full, the fuel transfer switch should be turned to the LEADING EDGE position.

IN-FLIGHT REFUELING SYSTEM.

In-flight refueling is provided for in some airplanes.* A tubular steel boom equipped with a nozzle is mounted under the left-hand inboard wing panel. It extends approximately 70 inches forward of the wet leading edge and makes possible in-flight pressure refueling of the internal fuel cells plus the wet leading edge tanks and the Type II drop tanks with in-flight refueling provisions. The use of in-flight refueling provides the airplane with a greater radius or range and/or a longer period of combat action. With the present oil supply provisions, 5 hours is the maximum flight time with in-flight refueling. Flight test results have shown a negligible drag increase and no loss in maximum speed. The maneuverability and landing qualities are not affected by the addition of the probe.

Note

With the drop tank and leading edge tank switch in the ON position, fuel system air pressure will prevent refueling of these tanks to full capacity.

IN-FLIGHT REFUELING PROCEDURE.

The tanker aircraft is approached from the rear and slightly below the refueling drogue to avoid the slip stream of the tanker at a position approximately 100 feet directly behind and 50 feet below the tanker, the pilot should trim the airplane, stabilize the throttle setting so as to stay in that position and check the throttle friction lock setting. Trim about the pitch axis is not critical as it may require slight retrim as the airplane flies into the tanker slip stream.

Before moving up into contact position, the following items should be turned OFF:

1. Radar system, AN/APG-30.
2. IFF, AN/APX-6.
3. Omni-range receiver, AN/ARN-14E.
4. Direction finder, AN/ARA-25.
5. External lights.

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. Increase rpm slightly to obtain an overtake speed of 5 to 8 knots. It is recommended to close with the drogue slightly above the probe and to lower the right wing just before contact to bring the probe into position to meet the drogue. If engagement is missed, roll out of the wing down attitude and retard throttle for another attempt. After engagement, a slight reduction of rpm may be necessary to prevent overrunning the tanker. During fuel transfer, a slight rpm increase will be necessary to maintain a satisfactory position.

Note

- Rapid rate of closure will move the drogue forward too fast for proper reel-in, thus causing slack in the hose which results in a violent whipping action that could cause structural damage to the probe or drogue. Once contact is made, reduce airspeed to that of the tanker and fly in formation during the refueling operations.
- After contact is made the drogue must be reeled in approximately 10 feet, automatically turning 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 this occurs the amber light will go out. The sequence of these indicator lights is reversed when dropping back to break contact.

The pilot can check progress of the refueling operation by observing the fuel quantity gage. The refueling rate is approximately 190 to 200 gallons per minute.

The total time for in-flight refueling is approximately 4 minutes. The wet leading edge adds approximately 2 minutes to the airplane filling time with Navy fueling pressures [Specification MIL-F-17874 (Aer)].

Note

- Type I drop tanks cannot be refueled during in-flight refueling, but Type II drop tanks can be refueled during in-flight refueling.
- Automatic shutoff of the dual level control valves in the airplane can be detected by an oscillation of the hose caused by the increase in pressure at the instant shutoff occurs and also by no further increase on the fuel quantity gage.

When the fuel transfer is completed, airspeed should be reduced slightly to disengage the probe from the reception coupling in the drogue. At heavy gross weights, a reduction in rpm will usually effect disengagement; however, at light gross weights, idle rpm and speed brake extension may be necessary.

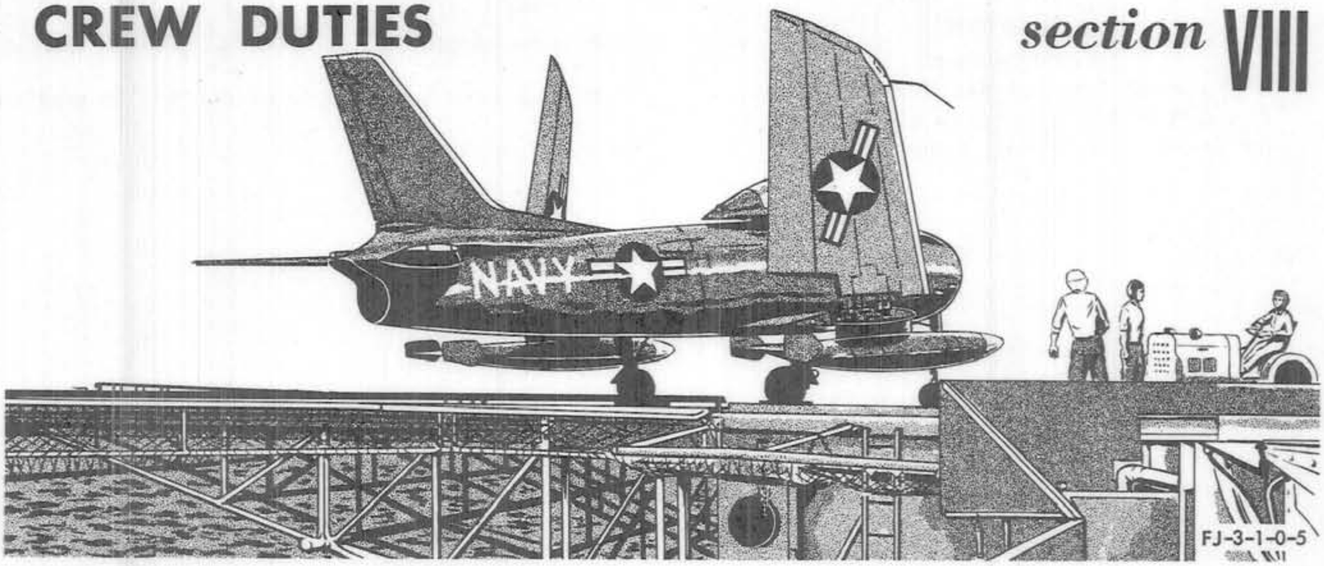
***Airplanes 136118 and subsequent and airplanes having Service Change No. 205 complied with**

CAUTION

High rates of separation when breaking contact should be avoided to preclude sudden loads on the tanker hose braking system.

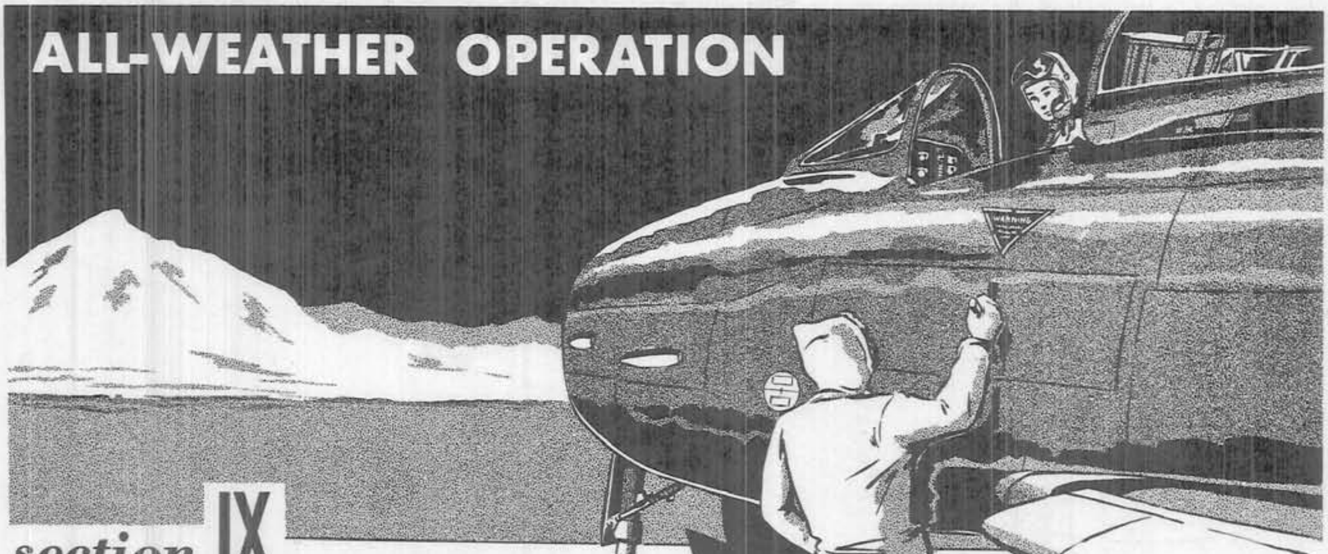
All electrical equipment turned off prior to the refueling operations should be turned on as required. Further information concerning this operation will be supplied when available.

CREW DUTIES section VIII



Not applicable to this airplane.

ALL-WEATHER OPERATION



section IX

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INTRODUCTION.

Except for some repetition necessary for emphasis or continuity of thought, this section contains only those procedures that differ from, or are in addition to, the normal operating procedures in Section II. Particular emphasis should be placed upon the recommendations shown in the instrument flight procedures of this section, because these steps and procedures are the minimum requirements whenever you are operating under Instrument Flight Rules.

NIGHT FLYING.

Night flying should present no unusual problems and cockpit glare has been reduced to a minimum. The following checks and information are in addition to the normal instrument flight procedures in this section:

1. Check and adjust all interior and exterior lights for proper operation.

2. Be sure your personal gear includes a flashlight for emergency lighting.

During night take-offs, it is extremely difficult to distinguish the horizon if conditions are not optimum. If at any time you become disoriented or cannot maintain visual reference with the ground, it is absolutely essential that an immediate transition be made to fly entirely by reference to your flight instruments.

The difference between sunrise/sunset at ground level and at flight altitudes is indicated in figure 9-0A. This information can be useful in flight planning when take-offs or landings are anticipated at sunrise or sunset.

INSTRUMENT FLIGHT PROCEDURES.

Instrument flight should not be undertaken unless you are a qualified instrument pilot and a holder of a Navy *green* or *white* instrument card. You should be thoroughly familiar with existing Navy and CAA regulations, and other publications applicable to all-weather operation. Special attention should be given to the fuel planning phase of the preflight planning of instrument flights.

As certain phases of instrument flying may require delays in departures and additional time for letdown procedures which are often made at low altitudes, the endurance factor is critical. Landing should always be accomplished during the first approach. This strict requirement demands accurate flight planning with special attention to the traffic density and the type of approach at the destination. The FJ-3 has satisfactory stability while being flown on instruments, and its flight handling characteristics during all-weather operation are excellent. The airplane has no wing or tail de-icing equipment. However, no trouble should be encountered while flying through weather except in extreme icing conditions. Flight instruments provide for basic instrument flying and radio navigation equipment will enable the pilot to make successful instrument approaches.

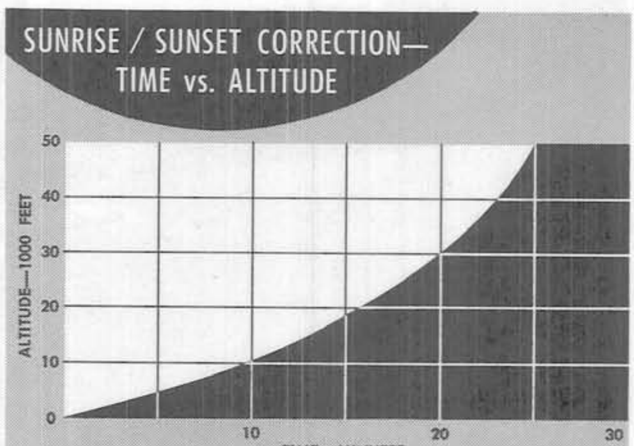


Figure 9-0A.

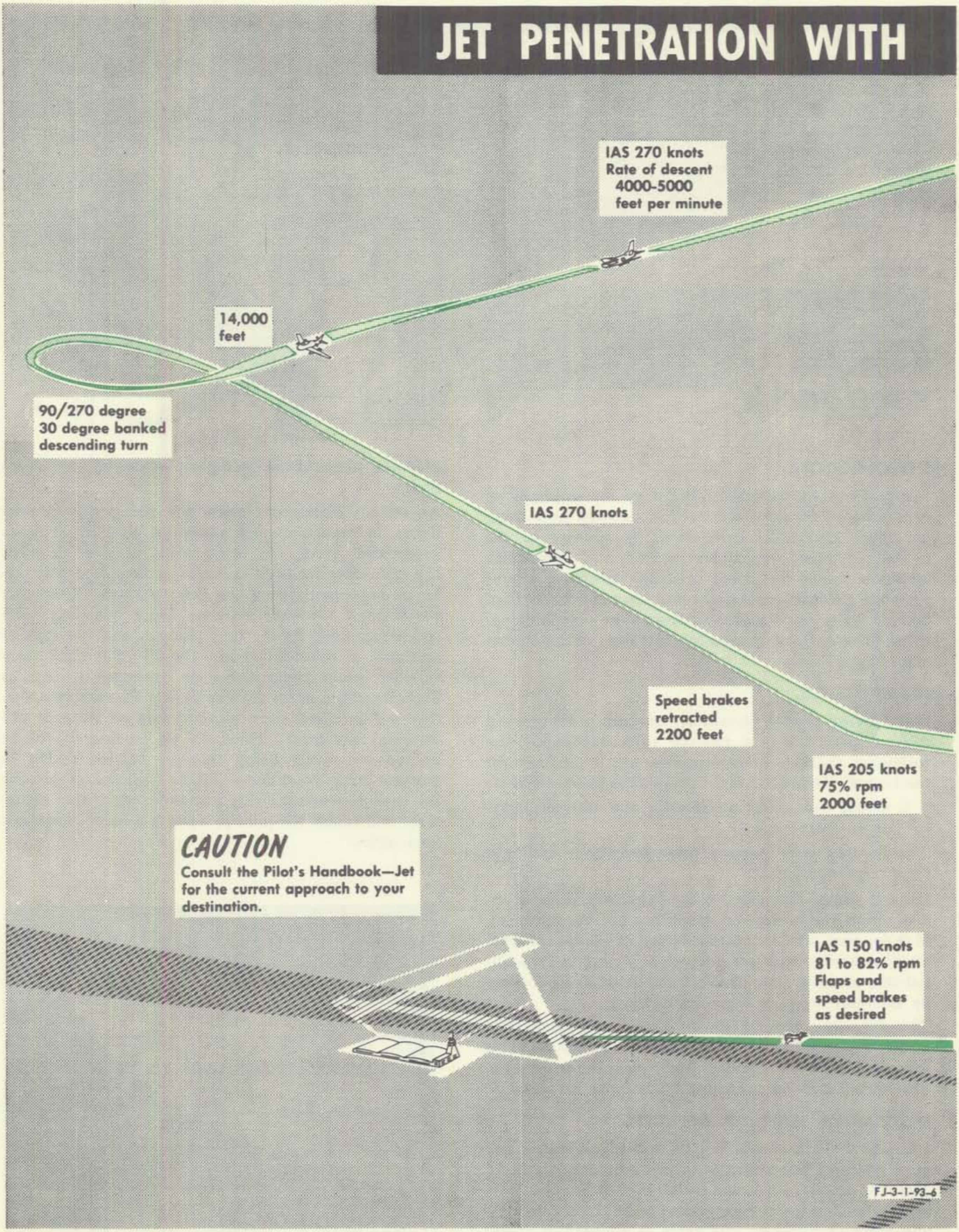


Figure 9-1. (Sheet 1 of 2)

INSTRUMENT APPROACH (TYPICAL)

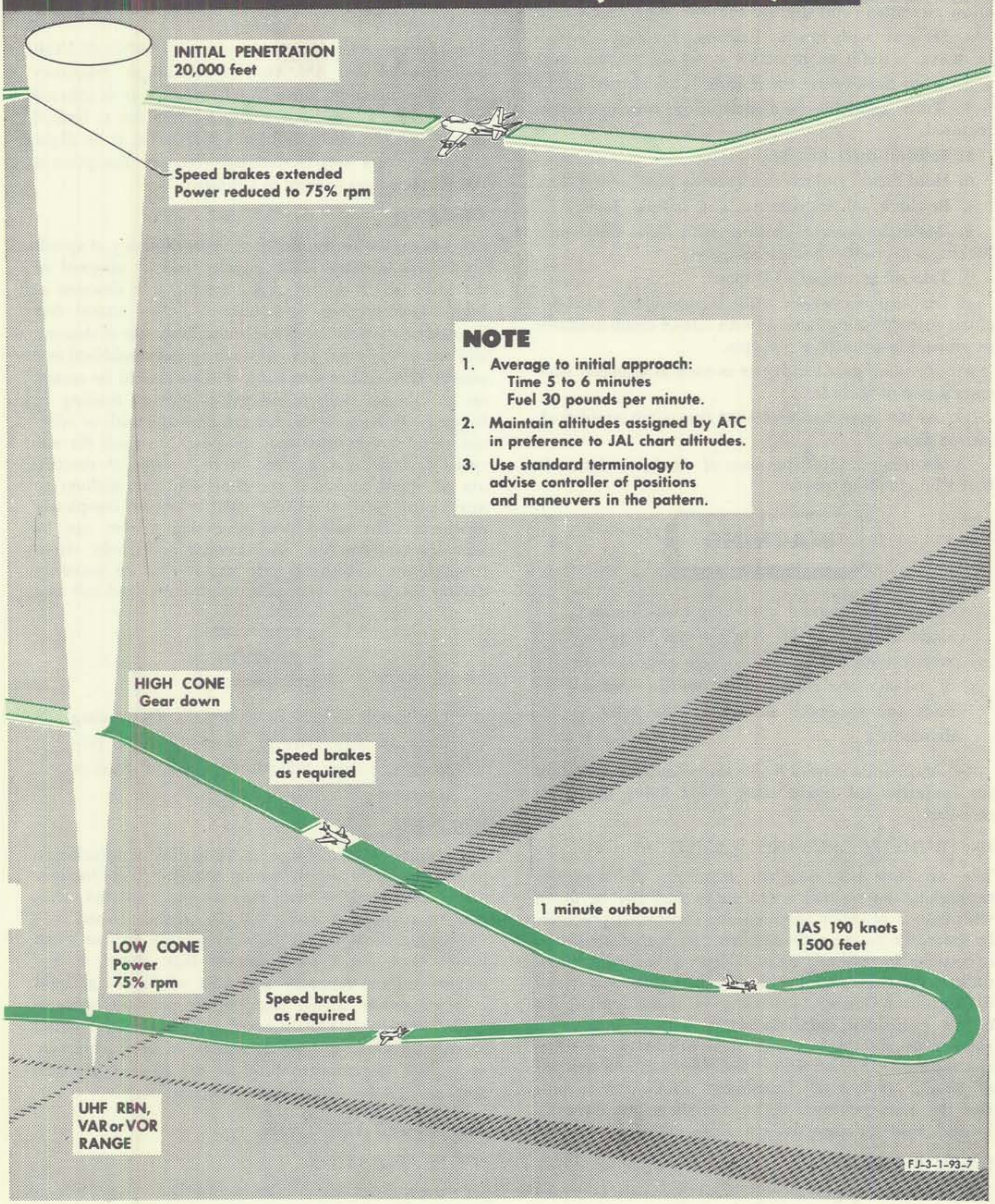


Figure 9-1. (Sheet 2 of 2)

INSTRUMENT TAKE-OFF AND CLIMB.

1. Line up visually with centerline of runway and allow airplane to roll slightly ahead to align nose wheel.

2. Set gyro with runway heading. Place gyro switch in SLAVE. (Refer to GYROSYN COMPASS, Section IV.)

3. Turn pitot heater ON if icing is anticipated.

4. Turn anti-icing and defrosting systems ON as required.

5. Take-off-check-off list.

6. Hold brakes and advance throttle to take-off power.

7. Re-check all instruments and release brakes.

8. Maintain runway heading with light differential braking until rudder becomes effective.

9. Take off at normal VFR speed.

10. As airplane breaks ground immediately establish climb attitude on instruments with rate-of-climb indicator as primary instrument at 500 fpm.

11. Landing gear handle UP as soon as altimeter indicates a gain of altitude.

12. At 160 knots IAS with 1500 fpm climb established, retract flaps.

13. Holding a 1500 fpm rate of climb, accelerate to best VFR climbing speed.

WARNING

Care should be used in making turns, limiting angle of bank to 30 degrees, and beginning accelerations to best climb speeds after take-off by taking into consideration terrain obstructions and minimum altitudes at the point of departure.

14. Maintain a careful watch on tail-pipe temperature for indication of intake icing while flying in visible moisture.

INSTRUMENT CRUISING FLIGHT.

The airplane has excellent handling characteristics throughout its normal speed range and can be flown with ease if properly trimmed and controlled primarily by reference to the attitude gyro. At higher airspeeds, it becomes increasingly more difficult to maintain longitudinal (pitch) control with resultant gains and losses in altitude. During maneuvers at these speeds, use of the horizontal stabilizer for nose-up or nose-down corrections should be kept at a minimum or overcontrolling will result with subsequent altitude changes of 800 or 1000 feet. Instrument installation is such that the more pertinent flight instruments are centrally located, thus reducing the eye strain over long periods.

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.

NAVIGATION EQUIPMENT.

The airplane is equipped with an AN/ARN-14E VOR receiver and an AN/ARA-25 ultra-high frequency automatic direction finder. Neither receiver is affected by atmospheric conditions. While reception is limited to line of sight, this should not be a factor at jet flight altitudes except over mountainous terrain. Reception is possible at ranges as great as 175 miles.

DESCENT.

Descent can be accomplished without difficulty at speeds up to the limiting Mach number and/or airspeed of the airplane. It is not recommended that descents at high Mach number be continued below 10,000 feet because of the very steep angle and high rate of descent, and wing heaviness. On all descents, the windshield and canopy defrost and anti-icing systems should be turned on 10 minutes prior to descent to prevent frosting or fogging. Instrument descent can be made with or without speed brakes extended. However, to limit the airspeed and distance covered at high rates of descent, use of speed brakes is recommended. In medium or heavy rain, forward visibility will be almost completely obscured. The windshield anti-icing system can be used for rain removal. In extremely heavy rain, vision through the windshield side panels may be necessary during the landing approach, touch-down and roll out.

CAUTION

Limit angle of bank to 30 degrees. Descending turns at high rates of descent become progressively more difficult as angle of bank is increased.

HOLDING.

For holding over a range or fix in the race-track-type pattern, maintain approximately 200 knots IAS. Increase this speed slightly if wing slats start to open and maintain an airspeed at which the slats remain closed. The 180-degree turns in the holding pattern require more power than the 2 or 3 minute legs; therefore, for maximum fuel economy and ease of handling, hold constant power setting required to maintain approximately 200 knots IAS in turns. 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 LETDOWNS.

JET PENETRATION.

Jet penetrations have been established to provide a high-speed and high-rate-of-descent letdown from cruising altitude to a point where a VFR approach or an instrument approach such as GCA, VOR or ADF can be made. Penetration procedures for specific fields are given on JAL (jet approach and landing) charts. The "Pilots Handbook-Jet" in two parts for the eastern and western United States, has the JAL charts for all fields where jet penetration procedures have been established. The conditions set up in the JAL charts should be given careful consideration during flight planning. Availability of GCA, alternates, and operational problems in high-density traffic areas should be analyzed. The best penetration airspeed for this airplane is 270 knots using an engine rpm of 75% and speed brakes extended. This combination will produce a rate of descent between 4000 and 5000 fpm, depending on gross weight and airplane configuration. A descent under these conditions provides for a comfortable instrument flight attitude, maintains an airspeed within the range recommended for flight in severely turbulent air, and is considered optimum for a two-plane formation letdown. The fuel consumption to the high station will be approximately 25 pounds per minute and time

to descend will be approximately 5 or 6 minutes. The procedure for conducting a typical jet penetration letdown is shown in figure 9-1.

RADIO RANGE LETDOWN.

The standard low frequency range approach cannot be made with this airplane since no LF equipment is currently installed. Since the airplane is equipped with the VHF AN/ARN-14E receiver it is not susceptible to atmospheric disturbances, precipitation or night effect, VOR ranges can be utilized for range approaches, although very few air fields have published VOR jet penetrations and instrument approaches at this time. VAR ranges (108 to 112 mc) can be utilized with the AN/ARN-14E receiver using the ID-249 vertical needle and the aural feature, although no bearing information is available on the RMI (ID-250).

GROUND CONTROL APPROACH.

The airplane has excellent handling qualities during GCA. On a normal GCA glide path, the airplane is in its approximate landing attitude, and only a small control movement is required for touch-down. The standard GCA pattern will require from 7 to 8 minutes to

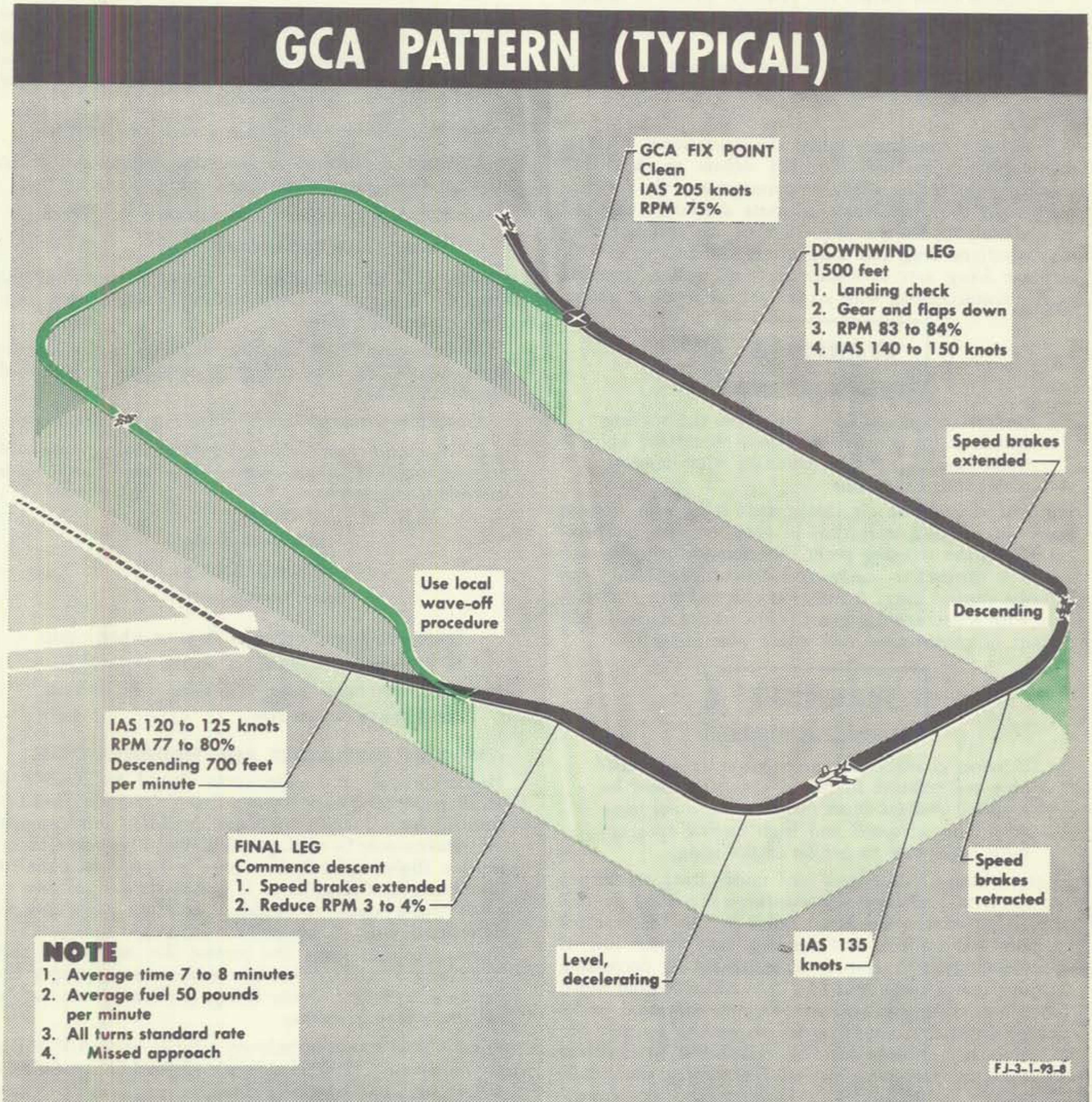


Figure 9-2.

complete, and fuel consumption will average about 50 pounds per minute. A final approach speed between 120 to 125 knots IAS is found to be comfortable and wave-offs can be performed when speed brakes are retracted at the same time throttle is advanced to 100% rpm. Speed brakes are only moderately effective in maintaining the glide path and some throttle adjustments are necessary. For a typical GCA, see figure 9-2.

MISSED APPROACH GO-AROUND.

In case of missed approach, follow this procedure for go-around:

1. Throttle 100% rpm.
2. Speed brake switch IN. (Return switch to neutral position after speed brakes are fully retracted.)
3. Landing gear handle UP.
4. Wing flap lever UP (after reaching 145 knots IAS).

ICING.

Avoid icing conditions whenever operational requirements permit. Ice will normally adhere to the windshield, wing leading edges, empennage, 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 airspeed and to increase power requirements, with a constant reduction in range.

WARNING

Heavy ice accumulation can cause the stalling speed to be greatly increased; 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 with temperatures 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.

WARNING

If icing conditions are encountered and tail-pipe temperature increases, throttle should be retarded and an effort made to leave the icing area. Low airspeed and high engine rpm are most conducive to engine intake icing.

Flight within cloud formations under icing conditions can result in fuel control pressure pickup icing. In this case, icing affects the small holes in the fuel control pressure sensing line and the resultant power loss of approximately 15% rpm is accompanied by decreasing tail-pipe temperature and fuel flow. The recommended procedure to regain normal engine operation is to emerge from the clouds or to descend to warmer air. If course and altitude must be maintained, or if power loss becomes excessive, manual fuel control should be selected in accordance with recommended procedures. (Refer to Section III.) The fuel altitude compensating circuit is thus by-passed and power is regained.

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. 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 defrost switch to DEFROST for desired airflow and release to HOLD.
3. Maintain close watch on tail-pipe temperature.
4. Reduce power and airspeed.

During flight, should icing conditions be encountered 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 as appropriate to avoid 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.

Flight through a thunderstorm should be avoided if at all possible. Thunderstorm flying demands considerable instrument experience and should be intentionally undertaken only by well qualified pilots. However, many routine flight operations require a certain amount of thunderstorm flying, since it is not always possible to avoid storm areas. At night, it is often impossible to detect individual storms and to find a clear area between storms. A pilot using the present day equipment and possessing a combination of common sense, proper experience, and instrument flying proficiency can safely penetrate thunderstorms.

For flight in severe turbulence, refer to Section V of the Supplemental Flight Handbook (NAVAER 01-60JKC-501A) for recommended airspeed range. Throttle setting and pitch attitude are the keys to proper flight technique in turbulent air. The throttle and pitch attitude required for desired penetration airspeed should be established before you enter the frontal area, and if maintained throughout the storm, must result in a constant airspeed, regardless of any false readings of the airspeed indicator and altimeter. Note the following precautions:

BEFORE TAKE-OFF.

1. Make a thorough analysis of the general weather situation to determine thunderstorm areas, and prepare a flight plan which will avoid thunderstorm areas whenever possible.

2. Be certain all flight instruments, navigation equipment, pitot heater, interior lights and de-icing equipment is operating properly before undertaking any instrument flight into thunderstorm areas.

APPROACHING THE STORM.

It is imperative that you prepare the airplane prior to entering the turbulent area. If the storm cannot be seen, its proximity can be detected by lightning flashes. Prepare for penetration as follows:

1. Slow down to best penetration speed and adjust throttle to maintain that speed. [Refer to Section V of the Supplemental Flight Handbook (NAVAER 01-60JKC-501A) for recommended airspeed in severe turbulence.]

2. Pitot heater ON.

3. Safety belt tight and shoulder harness locked.

4. Stow any loose gear.

5. At night, turn cockpit lights full bright to minimize blinding effect of lightning.

CAUTION

Do not lower landing gear or wing flaps, as they decrease the aerodynamic efficiency of the airplane.

IN THE STORM.

While in the thunderstorm, proceed as follows:

1. Devote all attention to flying the airplane.

2. Maintain attitude. Concentrate principally on remaining level by reference to the attitude gyro.

3. Expect turbulence, heavy rain, and lightning. These conditions should cause no undue concern.

4. Maintain original heading. Do not make any turns unless absolutely necessary.

5. Never chase the airspeed indicator, since doing so will result in extreme airplane attitudes. Should a sudden gust be encountered with the airplane in a nose high attitude, a stall may easily result.

6. The altimeter may be unreliable because of differential pressures within the storm. An indicated gain or loss of several thousand feet may be expected.

7. Avoid large or abrupt control movements in order to minimize the stresses imposed on the airplane.

COLD WEATHER PROCEDURES.

While still an important factor for successful cold weather operation, the cold weather postflight preparation is not as critical in jet powered airplanes as in reciprocating-engine airplanes, since there is no need for oil dilution, etc. In order to expedite preflight inspection and ensure satisfactory operation for the next flight, normal operating procedures outlined in Section II should be followed with these exceptions and additions.

BEFORE ENTERING AIRPLANE.

1. Check that all protective covers have been removed.

Note

At temperatures below −26°C (−15°F), it is important that the oil system be preheated to obtain proper oil pressure for starting. Best results are obtained by applying preheat for 10 minutes on both the oil tank and the oil pump.

2. See that the airplane, including surfaces, controls, ducts, shock struts, drains, etc, has been cleared of all ice, snow, and frost.

WARNING

Do not attempt take off with ice, snow or frost on the airplane surfaces. Loss of lift and treacherous stall characteristics will result.

3. Ascertain that the engine is free to rotate.

CAUTION

Any attempt to start engine, if engine is not free will cause starter failure. External heat must be applied to forward section of the engine to remove ice. The engine should be started as soon as possible after preheating to prevent moisture from refreezing.

4. See that wheels are properly chocked and tie-downs secure.

ON ENTERING AIRPLANE.

1. Have external power connected.

2. Check all controls for freedom of movement on ALTERNATE.

3. Check canopy operation, and make certain canopy will fully close.

4. Check for proper operation of electrical and radio equipment.

STARTING ENGINE.

1. Start engine in normal manner. JP-4 fuel has no unusual starting characteristics during low temperature engine starts.

2. If there is no indication of oil pressure after 30 seconds of engine operation at idle, or if oil pressure drops to zero after a few minutes of ground operation, stop engine and have ground crew investigate. Preheat may have to be applied to the oil tank and oil pump.

Note

Oil pressure may be above normal until the oil is warmed by engine heat.

WARM-UP AND GROUND TESTS.

1. Care should be exercised when using full, or near full engine power. Because of low air temperatures the thrust developed at all engine speeds is noticeably greater than normal. Cut throttle at the first sign of airplane slipping.

2. Turn on cockpit heat and defrosting systems as required.

3. Check flight controls, speed brakes, rudder trim and aileron and horizontal tail trim for proper operation.

Note

Cycle flight controls four to six times on both the normal and alternate systems, using switch on left-hand console for change-over. Check hydraulic pressure and control reaction.

4. Check wing flap operation.

CAUTION

Make sure all instruments have warmed-up sufficiently to ensure normal operation. Check flight instruments for sluggishness during taxiing.

TAXIING.

1. Avoid taxiing in deep snow or slush to prevent the possibility of brakes freezing.

2. Use only essential electrical equipment to preserve battery life while taxiing at low engine speeds.

3. Use a greater than normal interval between airplanes while taxiing to permit safe stopping distances and to avoid the slush and snow blown back by the airplane ahead.

BEFORE TAKE-OFF.

1. Make normal full-power check; however, if the field conditions make this impossible, final instrument check must be made during first part of the take-off run.

2. Turn pitot heater switch ON just prior to entering take-off position.

TAKE-OFF.

Since air is more dense in cold weather, thrust and lift will be increased and a shorter take-off run will be required than in normal temperatures.

AFTER TAKE-OFF.

1. After take-off from a wet-snow or slush-covered runway, operate the landing gear and wing flaps through several complete cycles to preclude their freezing in the retracted position.

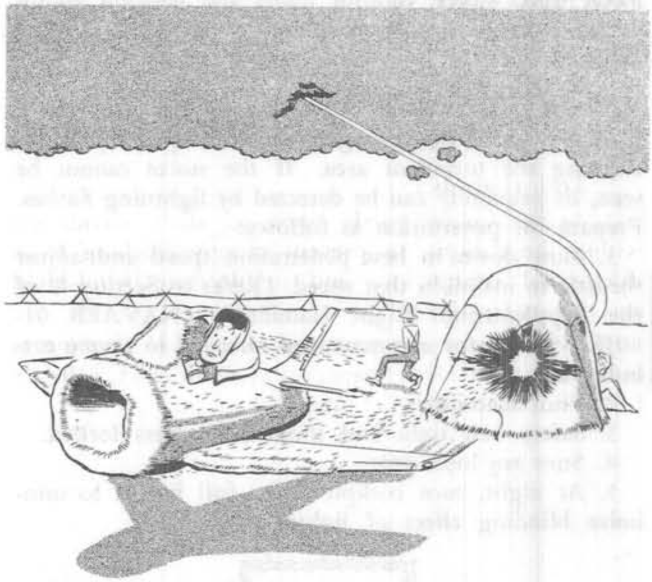
Note

Gear and flap operation may be slowed up considerably in cold weather due to stiffening of all lubricants.

2. Re-check instruments. Many flight instruments, particularly the pressure type may give unreliable indications in extremely low temperatures. In the event of a malfunction flight should be maintained under VFR.

CRUISING FLIGHT.

Cold weather does not affect any flight or normal operational characteristics of the airplane except that the airplane will probably have a higher rate of climb at the lower altitudes.



WARNING:

It is imperative during descents that the altimeter be accurately read, with particular attention given to the 1000 foot and 10,000 foot pointers.

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DESCENT.

1. Prior to rapid descent turn on windshield and canopy defrosting system to prevent fogging and frosting of the windshield.

2. Check engine operating temperatures during descent and in the traffic pattern, as low temperatures are common at low altitudes because of frequent temperature inversions.

APPROACH.

1. Pump brakes several times when on final approach.

2. Make a flatter glide on final to allow for increased thrust; otherwise make a normal pattern and landing.

CAUTION

Cross winds are particularly dangerous when landing on icy runways.

AFTER LANDING.

Note

The best technique for obtaining minimum ground roll on slippery runways is to maintain a high angle of attack, keep flaps down, and apply brakes only after the nose wheel touches down.

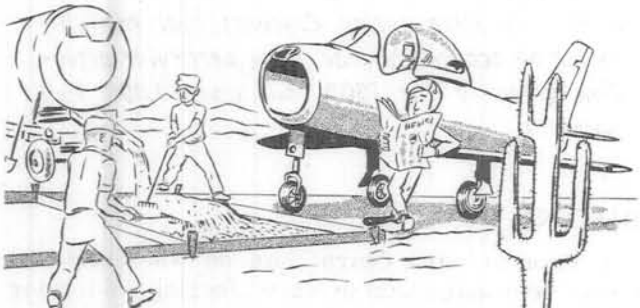
1. Turn pitot heater OFF.
2. Use only essential electrical equipment while taxiing at low engine speed.

STOPPING ENGINE.

The engine is stopped in the normal manner. With JP-4 fuel it is unnecessary to drain the fuel tanks and lines.

BEFORE LEAVING AIRPLANE.

1. Lock controls.
2. Leave canopy partly open to allow circulation within the cockpit, to prevent canopy cracking from differential contraction, and to decrease windshield and canopy frosting.
3. Check that battery is removed when airplane is to be parked outside at temperatures below -29°C (-20°F) for an extended period of time.



CAUTION:

More runway than normal will be required for take-off during desert operations.

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HOT WEATHER AND DESERT PROCEDURES.

In general, hot weather and desert procedures differ from normal procedures mainly in that additional precautions must be taken to protect the airplane from damage due to high temperatures and dust. Extreme care should be taken to prevent the entrance of sand into the various airplane components and systems, such as engine, fuel system, pitot-static system, etc. All filters should be checked more often than normally required. Tires should be checked frequently for signs of blistering, etc.

CAUTION

All metal surfaces exposed to the sun in hot weather become burning hot to touch. Caution should be used when entering the cockpit, particularly, if gloves are not worn.

BEFORE ENTERING AIRPLANE.

1. If operating in sandy country, be sure intake duct is clean.
2. Check for fuel, oil, and hydraulic leaks.

GROUND TESTS.

CAUTION

When airplane is parked in desert or dusty country, do not run up engine to windward of other airplanes, personnel or ground installations.

1. Turn cockpit air temperature control switch to COLDER.
2. Make run-up short as possible.

TAKE-OFF.

1. When taxiing to take-off position, avoid excessive use of brakes.
2. If in desert or dusty country, do not take off in the wake of another airplane.
3. Longer take-off run required due to lower thrust and lift.

AFTER TAKE-OFF.

1. Follow normal flight procedures, being particularly careful to maintain a thrust setting that will keep the exhaust gas temperature within the prescribed limits.
2. Do not climb at less than normal climb speeds when outside air temperatures are extremely high.
3. Expect gusts and turbulence at lower altitudes.

APPROACH AND LANDING.

Because hot air is less dense than cold air, true stalling speed will be greater, although indicated stalling speed will not change. A greater distance will be required for the roll out.

BEFORE LEAVING AIRPLANE.

1. Park cross wind whenever possible.
2. Leave canopy slightly open to permit air circulation within the cockpit, provided blowing sand or dust is not a hazard.

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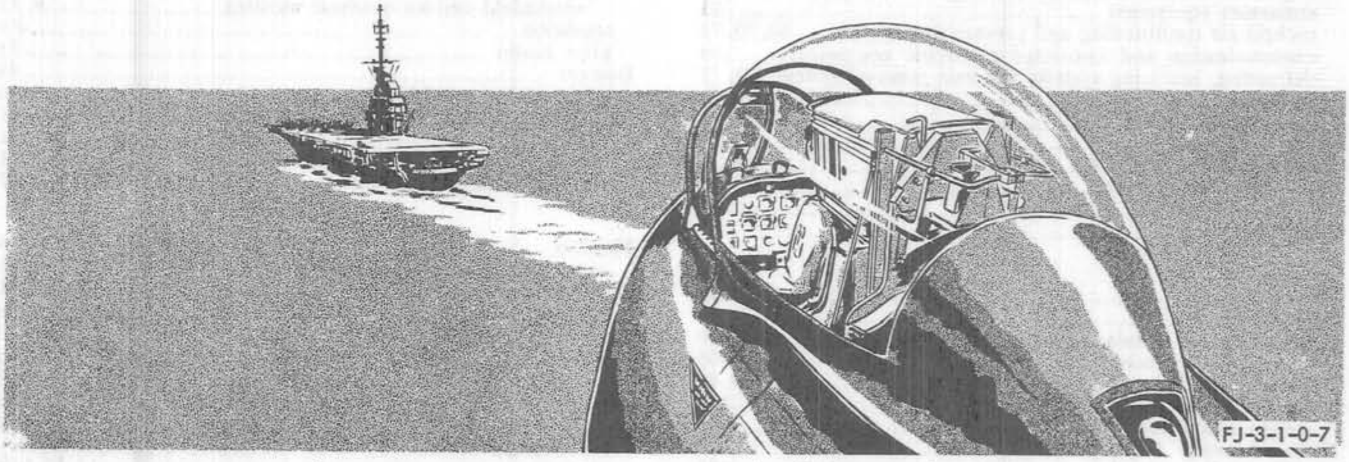

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