Pilot's Handbook

for

NAVY MODEL

F3D-1
AIRCRAFT

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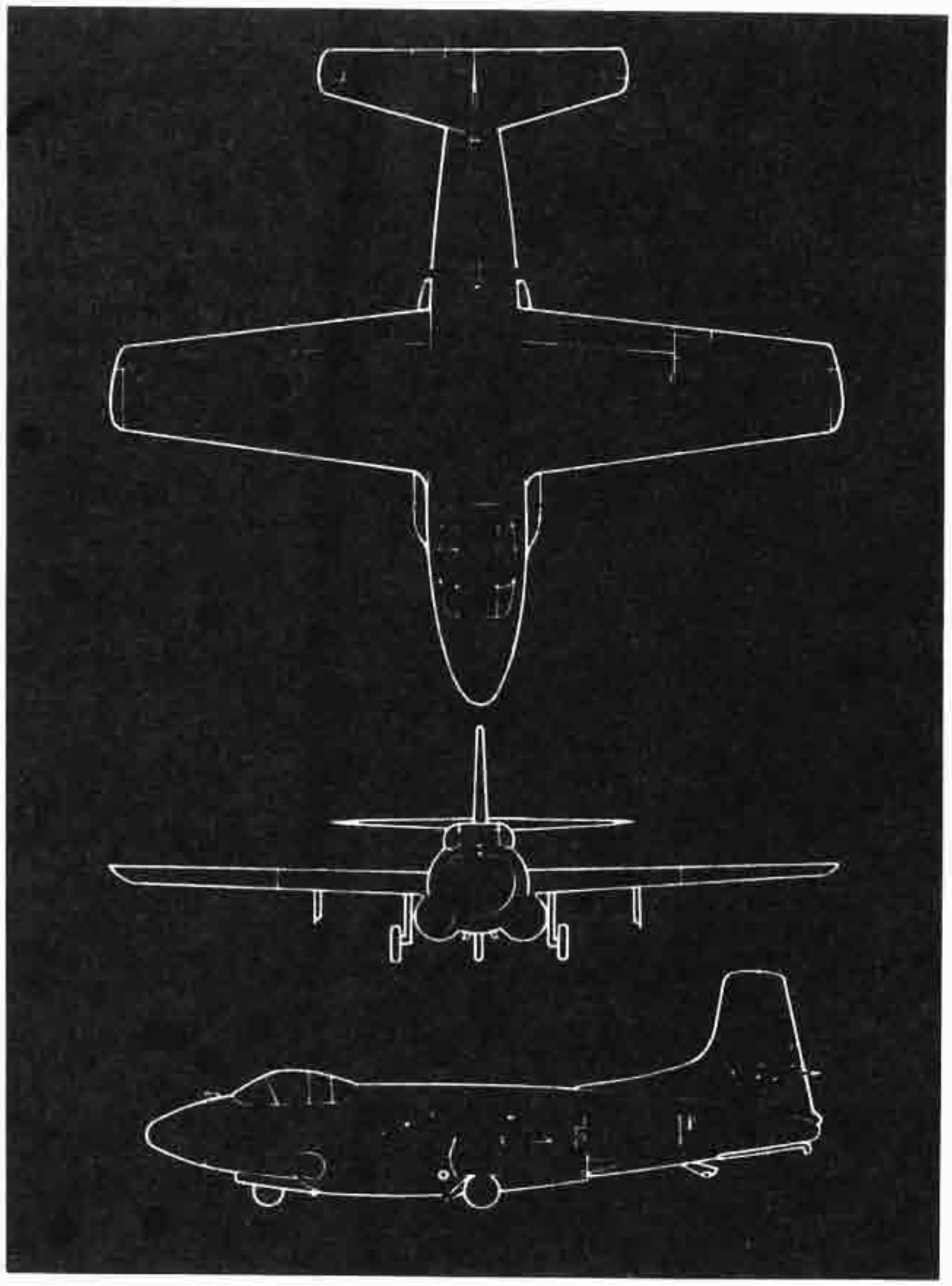
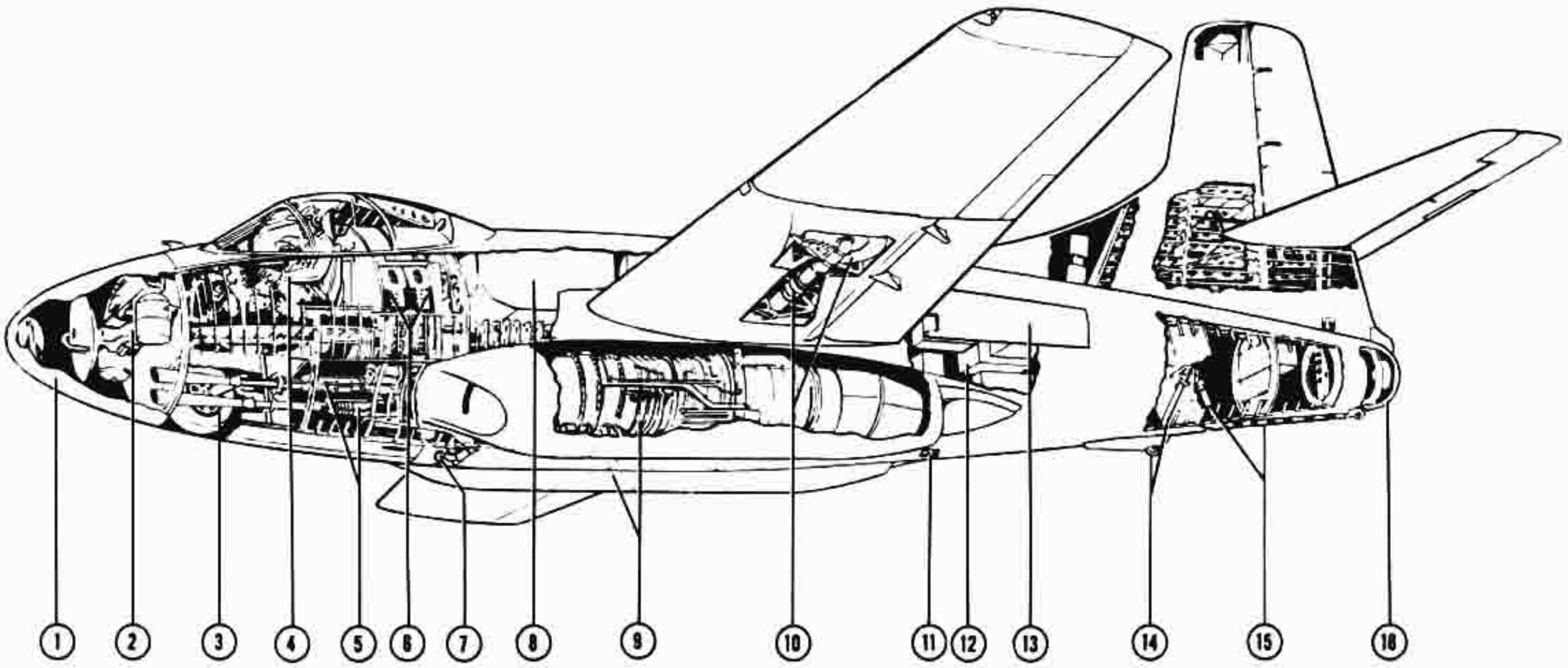


Figure 1-1. Model F3D-1 Airplane



1. Nose radome
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Figure 1-2. General Arrangement Diagram

SECTION I
DESCRIPTION

1–1. GENERAL.

1–2. AIRPLANE.

1–3. The model F3D-1 night fighter airplane is a two-place, jet-propelled, all-metal monoplane manufactured by Douglas Aircraft Company, Inc., El Segundo Division. Two J34-WE-34 Westinghouse engines of the turbo-jet type are installed. An enclosed cockpit accommodates a pilot and a radar operator seated side by side. The entrance door (ditching hatch) is a sliding panel in the upper section of the cockpit enclosure. The forward windshield is flak-resistant glass. The airplane is equipped with tricycle-type landing gear and can take-off from the deck of a carrier with the aid of a catapult, or from a shore base. Landings can be made on an ordinary landing field, or a carrier deck with the aid of arresting gear. Four 20-mm guns are mounted in the lower fuselage nose section, two on each side of the airplane center line. The airplane is equipped with speed brakes, one on each side and one on the bottom of the fuselage. The wings have 3° dihedral and may be folded. The general arrangement of the airplane is shown in figure 1–2. Principal dimensions are as follows:

Length (ground line level)	45 ft. 6 in.
Span (wings spread)	50 ft. 0 in.
Span (wings folded)	26 ft. 10 in.
Height (over tail—measured from ground line)	16 ft. 1 in.
Height (over wings—wings folded)	16 ft. 10 in.
Height (maximum during folding)	18 ft. 6 in.

Normal gross weight

1350 gal. fuel	24,400 lbs.
1650 gal. fuel	26,550 lbs.

1–4. FLIGHT CONTROLS.

1–5. SURFACE CONTROLS. Conventional control stick and rudder pedals are provided for the pilot only. The rudder pedals may be adjusted simultaneously by means of a crank (figure 1–4, reference 31) below the instrument panel.

1–6. GUST LOCK. The GUST LOCK control (figure 1–3, reference 9) is located on the left-hand console outboard of the throttle quadrant. The forward position of the control is "UNLOCK." Moving the lever aft to "LOCK" locks all of the control surfaces in their neutral positions. A take-off with the control surfaces locked is prevented by means of a rod attached to the control lever. This rod engages the forward edges of the throttle levers and prevents their movement from the aft detent positions (engines off) until the gust lock is released. Operation of the aileron boost system when the control surfaces are locked is prevented by an automatic switch connected to the gust lock controls. To move the gust lock control from one position to the other, a locking pin lever, located at the center of the gust lock control slot, must first be pressed inboard.

Note

All control surfaces should be in their neutral positions before applying the gust lock.

1–7. TABS. Controllable trim tabs are located in the rudder, the left-hand aileron, and the elevator. The trim tab controls (figure 1–3, references 5, 24 and 25) are located on the left-hand console.

1–8. HORIZONTAL STABILIZER. The stabilizer is attached with an angle of incidence of 2 degrees 30 minutes nose up.

1–9. WING FLAPS. The wing flaps are hydraulically operated and are controlled by a lever (figure 1–3, reference 6) located on the left-hand console. If the main system fails, the auxiliary hydraulic control (figure 1–4, reference 20) may be moved to the "EMERGENCY WING FLAP" position to provide hydraulic pressure (refer to paragraph 3–37). A combination wing flap and landing gear position indicator (figure 1–4, reference 40) is installed on the instrument panel. If the flaps are down and the speed of the airplane is increased beyond the point where the hydraulic pressure counterbalances the air load on the flaps, the flaps will begin to blow back. In the full down position (40 degrees) blow back will begin at an indicated airspeed of approximately 110 knots (125 mph).

1–10. SPEED RETARDER BRAKES. Hydraulically operated fuselage side and bottom speed retarder brakes controlled by a two-position switch (figure 1–3, reference 22) located on the left-hand console. The operating positions are "OPEN" and "CLOSE." Placing the switch in the "OPEN" position will fully extend the speed brakes at speeds below approximately 358 knots. Above that speed, a blow-back feature operates to decrease speed brake extension with increasing air speed. With the speed brake switch in the "OPEN" position, the speed brakes automatically extend further as air speed is reduced.

1–11. AILERON POWER BOOST SYSTEM. An aileron 20:1 ratio power boost system is provided. An "AIL POWER BOOST REL" control (figure 1–5, reference 13) is located adjacent to the pilot's center console and permits the power boost system to be mechanically disconnected from the aileron control system. Once disconnected, it cannot be reconnected during flight. A spring-loaded mechanical advantage shifter is being

added by Field Modification in the aileron control system to reduce manual forces on the control stick when power boost is inoperative. The shifter then becomes effective automatically and reduces aileron travel to half the normal travel, therefore, required stick forces are halved. Manual forces are further reduced by extending the control stick. The length of the stick can be extended approximately 3 inches by pressing the button below the grip and raising the grip upward to the extended position. The grip will again latch in the extended position. The extending feature is to be eliminated by service change to prevent interferences with the ADF control box when the box is relocated to the cockpit rail above the throttles. The ADF control box relocation will also be accomplished by service change.

1–12. AUTOMATIC PILOT (PIONEER P-1). The electrically powered automatic pilot is equipped with a master direction indicator, a gyro-horizon indicator, and a bank and turn indicator (figure 1–4, references 9, 28 and 30). These instruments indicate the proper trim of the airplane in flight. The automatic pilot when engaged, is operated by the following controls:

a. The automatic pilot receives electrical power from the main three-phase inverter (see paragraph 1–49).

b. A knob attached to the gyro-horizon indicator (figure 1–4, reference 9) provides a means of caging and uncaging the auto-pilot's gyros. The gyros should be caged 15 seconds prior to exceeding 70° dive, 60° climb or 100° bank, and prior to landing, or the gyros may be damaged.

c. A stick-type controller (figure 1–5, reference 18) is used to change the direction of flight and the pitch attitude of the airplane. When the detent button, located on top of the stick, is depressed, the stick can be moved through 360 degrees in azimuth. When the stick is moved laterally, the rudder displacement signal is removed from the system, and a rate-of-turn signal and a bank signal are introduced into the automatic pilot. Operation of the stick controller in a fore and aft direction will cause the airplane to climb or glide. The amount of signal introduced by the controller is dependent upon how far from the neutral position the stick is displaced. The airplane will continue on the signaled operation until the stick is returned to the neutral position. The purpose of the bank-trim and pitch-trim wheels, located on the controller panel, is to introduce signals for trimming the airplane when operating on the automatic pilot.

d. An "AUTO-PILOT" push-pull clutch control (figure 1–5, reference 22) electrically engages and disengages the auto-pilot's servos from the airplane's control system for normal operation.

e. An "AUTO-PILOT" mechanical emergency release handle (figure 1–5, reference 4) manually disengages the auto-pilot servos from the airplane control system in an emergency. Once disconnected, the servos cannot be reconnected in flight.

CAUTION

Do not engage the automatic pilot while in a turn or in climbs, dives, or banks of more than 10°, because to do so may result in insufficient trim being available at the controller to return the airplane to level flight. Do not adjust trim tabs while the automatic pilot is engaged.

1–13. MAXIMUM ALLOWABLE AIRSPEED INDICATOR. The airspeed indicator (figure 1–4, reference 7) located on the instrument panel, has two pointers. The yellow pointer shows indicated airspeed and the red-and-black-striped pointer shows the maximum allowable airspeed, which is a function of flight altitude and the limiting Mach number for the airplane as indicated in the small window located on the right side of the dial. When the two hands meet the airplane is moving at the maximum allowable speed or the critical Mach number. At no time may the yellow pointer be allowed to cross over the striped pointer.

1–14. POWER PLANT CONTROLS.

1–15. MASTER ENGINE SWITCHES. The master engine switches (figure 1–3, reference 23), one for each engine, are located on the left-hand console. Placing the switches in the "ON" position opens the intake air shutters and energizes the starter circuit up to the momentary contact switch which is operated by the throttles. Moving the master engine switches from "ON" to "OFF" does not close the air intake doors unless the throttles are in the throttle closed position.

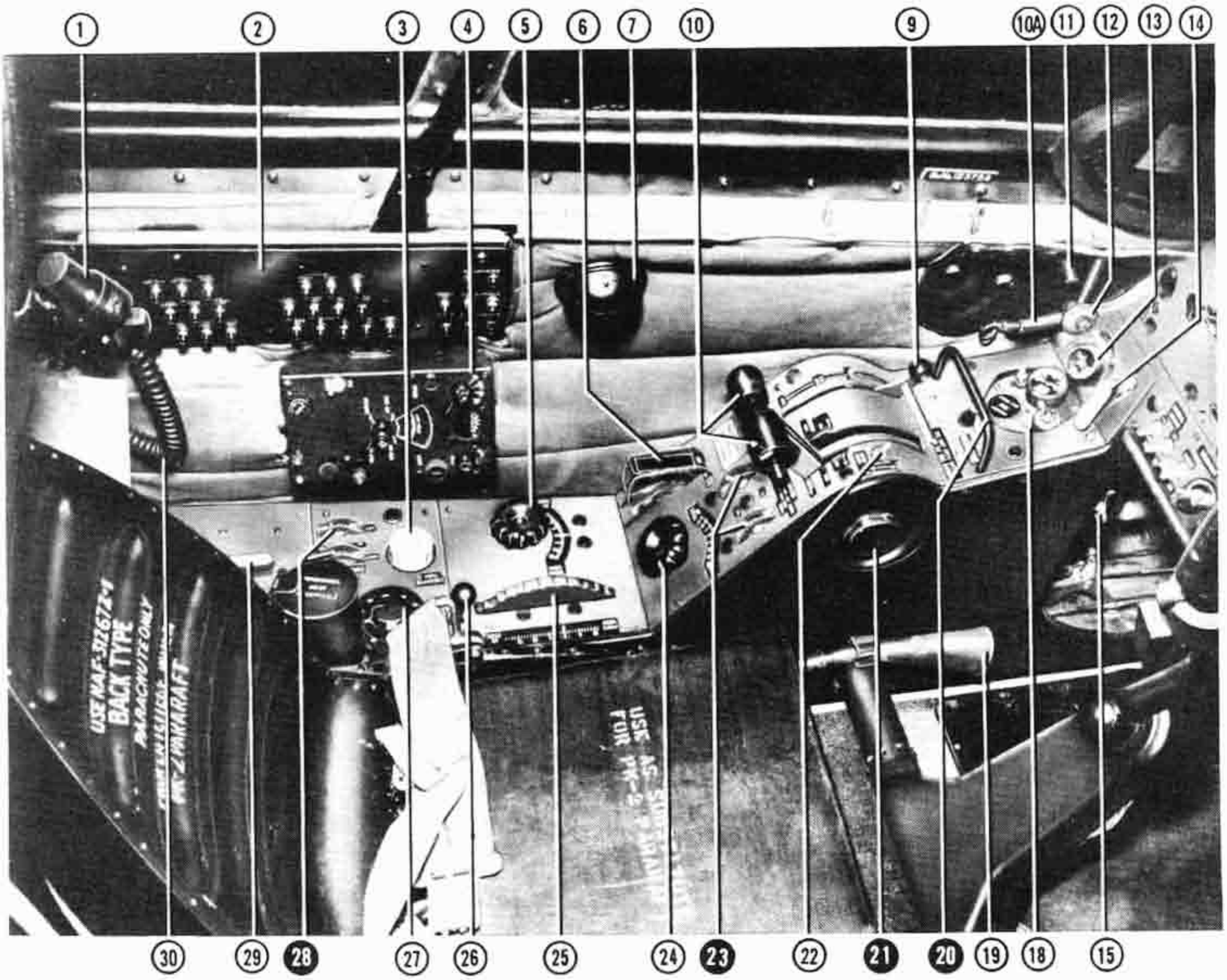
1–16. THROTTLES. Throttle controls (figure 1–3, reference 10), located on the left-hand console, function as the engine starter controls when in the bottom (aft) detent position. If the master engine switch has been turned "ON," outward movement of the spring-loaded throttle lever toward "CRANK" will initiate the starter motor. The "IGN" momentary contact initiates the starting cycle. After a start is made, the throttles operate in a normal manner from the idle stops to full power. A microphone switch is provided on the right-hand engine throttle grip.

Note

Power from the airplane battery cannot be used to operate the engine starters. An external source of power supplying an initial inrush of 1500 amps must be provided for the Westinghouse A-24A-9206 starters.

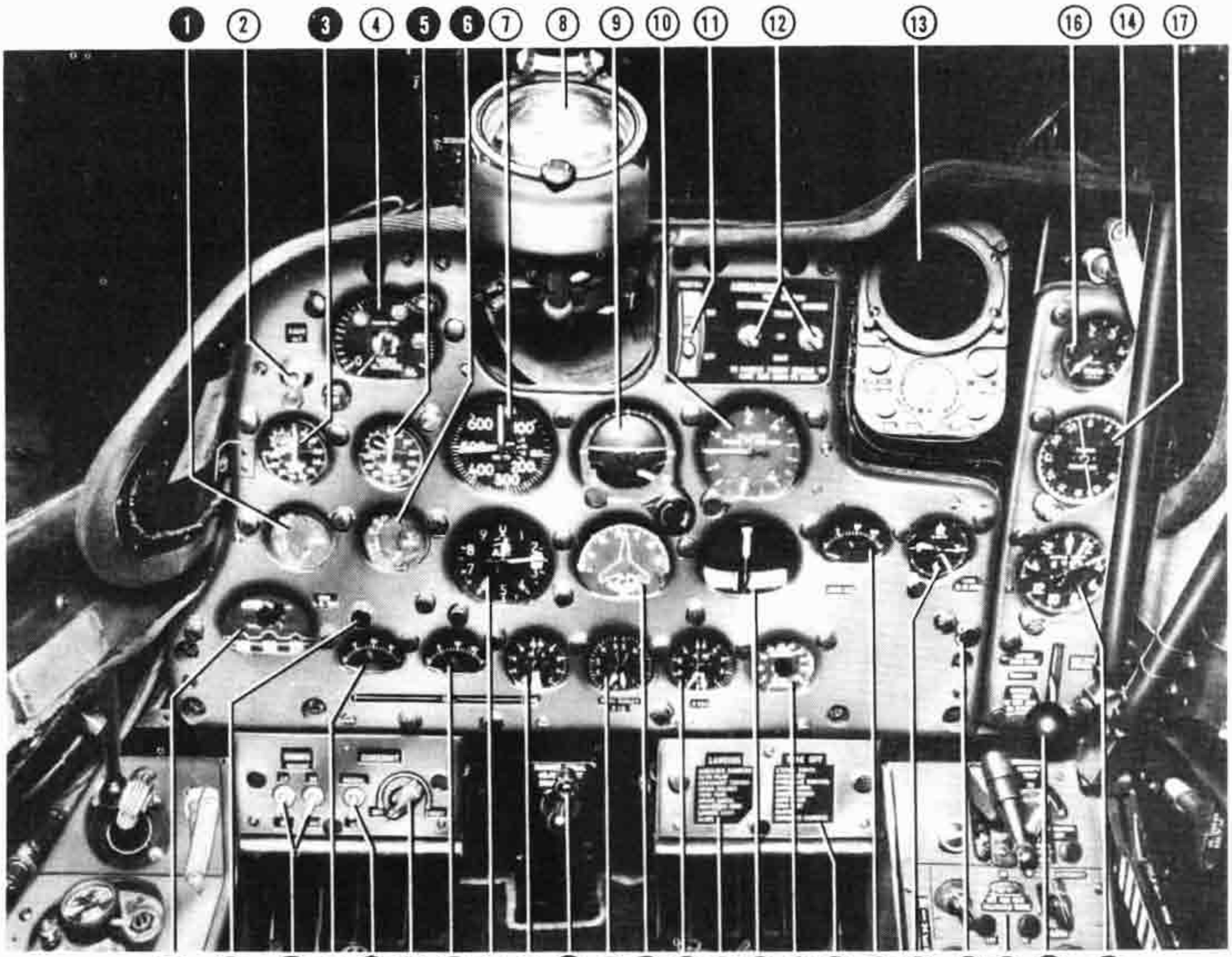
1–17. TURBINE OUTLET TEMPERATURE INDICATORS. These gages (figure 1–4, references 1 and 6) on the instrument panel receive impulses from thermocouples connected in parallel and having matched leadwire resistances. This method is intended to provide an indication of turbine outlet temperature.

1–18. TACHOMETERS. Two tachometers (figure 1–4, references 3 and 5), on the instrument panel, read in



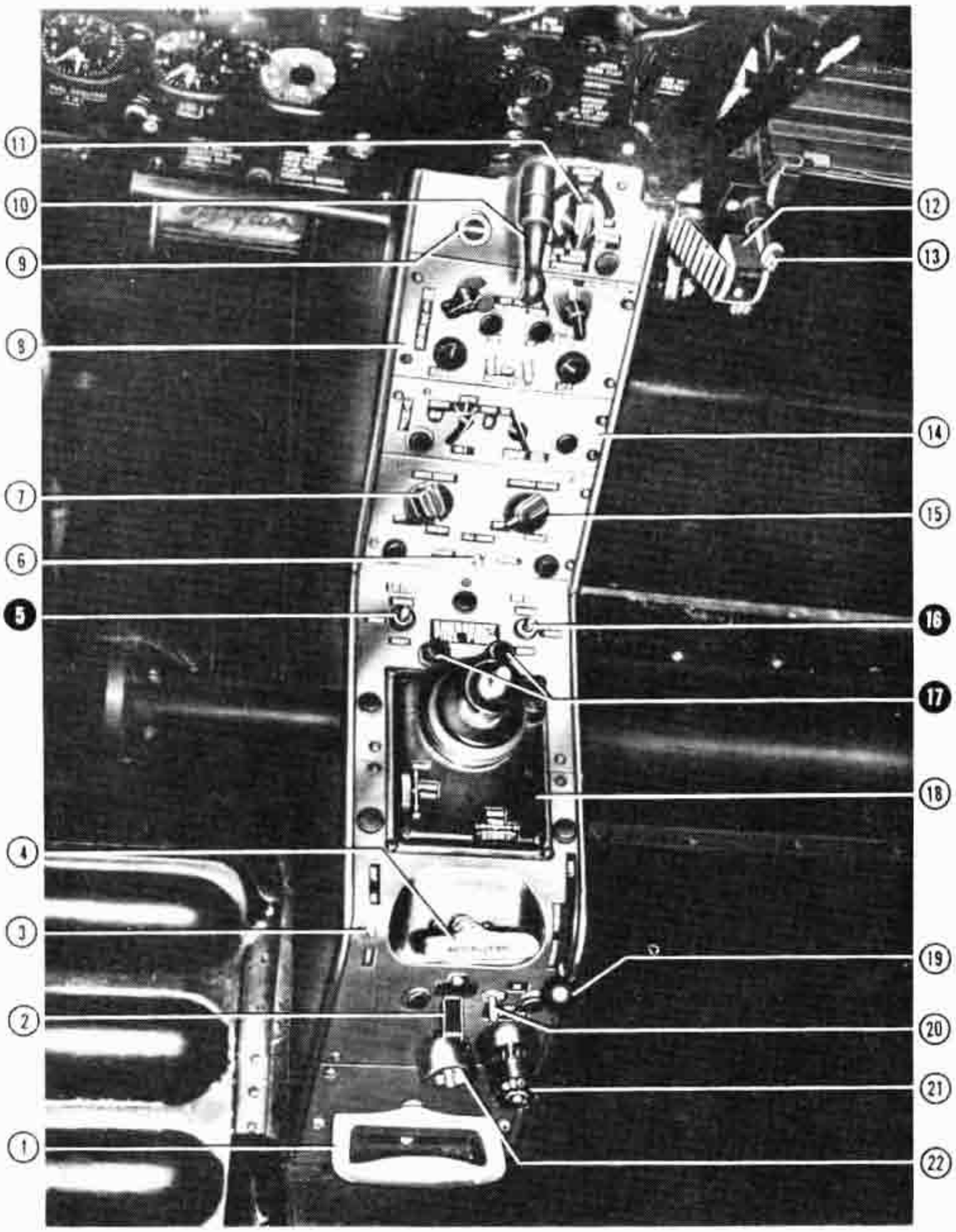
1. Cockpit floodlight
2. Left-hand circuit breaker panel
3. Pilot's anti-g air control
4. AN ARN-6 radio compass control unit
5. Rudder trim tab control
6. Wing flap control
7. Ash tray
8. Deleted
9. Gust lock control
10. Throttle controls and radio–ICS transmit switch
10A. Oxygen regulator panel flood light
11. Landing gear control safety lock
12. Landing gear control
13. Pilot's ventilating air outlet
14. Landing gear emergency release handle
15. Landing gear emergency control reset release
16. Deleted
17. Deleted
18. Pilot's oxygen regulator
19. Pilot's relief tube
20. Throttle control static grip
21. Throttle control friction adjustment
22. Speed brake switch
23. Master engine switches
24. Aileron trim tab control
25. Elevator trim tab control
26. Pilot's shoulder harness control
27. Altitude limit switch
28. Fuel boost pump switches
29. External stores emergency release handle
30. Microphone headset extension cord

Figure 1-3. Cockpit Left-Hand Console



1. Left-hand turbine outlet temperature indicator
2. Radio altimeter warning light
3. Left-hand engine tachometer indicator
4. Radio altimeter indicator
5. Right-hand engine tachometer indicator
6. Right-hand turbine outlet temperature indicator
7. Airspeed indicator
8. Gunsight
9. Gyro horizon indicator—automatic pilot
10. Rate of climb indicator
11. Master armament switch
12. Gun control switches
13. AN APG-26 gun aiming radar scope
14. Upper escape hatch emergency release handle
15. Deleted
16. Hydraulic pressure gage
17. AN ARN-6 radio compass indicator
18. Deleted
19. Accelerometer
20. Auxiliary hydraulic system control
21. Center console (see figure 1–5)
22. Right-hand engine fire warning light
23. Clock
24. Outside air temperature indicator
25. Take-off check-off list
26. Fuel quantity indicator
27. Landing check-off list
28. Turn and bank indicator—automatic pilot
29. Manifold fuel pressure indicator
30. Master direction indicator—automatic pilot
30A. Fuel boost pressure indicator
31. Rudder pedal adjustment control
32. Oil pressure indicator
33. Altimeter
34. Right-hand engine oil temperature indicator
35. Gunsight light rheostat
36. Left-hand engine oil temperature indicator
37. Gunsight light selector switch
38. Bomb selector switches
39. Left-hand engine fire warning light
40. Wheel and flap position indicator

Figure 1-4. Cockpit Instrument and Armament Control Panel



1. Lower escape chute door emergency release handle
2. Approach light switch
3. Pilot's seat adjustment switch
4. Automatic pilot emergency release handle
5. Left-hand engine emergency fuel pump switch
6. Flight and instrument lights selector switch
7. Instrument lights rheostat
8. Pilot's AN AIC-4 interphone control panel
9. Cigarette lighter
10. Arresting hook control
11. Air conditioning and cockpit pressurization control switch
12. Wing folding control
13. Aileron power boost emergency release
14. Pilot's AN ARC-1 VHF radio control panel
15. Left-hand and center console lights rheostat
16. Right-hand engine emergency fuel pump switch
17. Fuel pump warning lights
18. Automatic pilot controller
19. Radar operator's shoulder harness control
20. Extension light switch
21. Extension light
22. Automatic pilot clutch switch

Figure 1-5. Cockpit Center Console

per cent rpm and indicate the percentage of 12,500 rpm which is the maximum allowable. Important settings are as follows:

Take-Off and Military..... 100%
Maximum Continuous (normal rated)....94.4%

1–19. FUEL SYSTEM CONTROLS.

1–20. GENERAL. The fuel system (see figure 1–6) is so designed that the pilot is not required to select manually from tank to tank. The airplane center of gravity is automatically held within allowable limits as fuel is consumed. Three self-sealing fuel tanks are located in the fuselage aft of the cockpit. The forward fuselage tank has a usable capacity of 650 U.S. gallons (3900 pounds), the center fuselage tank, 290 U.S. gallons (1740 pounds), and the aft fuselage tank, 410 U.S. gallons (2460 pounds) of fuel. Provisions are made for suspending an external auxiliary fuel tank from the external stores rack on each wing. The usable capacity of each of these tanks is 150 U.S. gallons (900 pounds). Transfer of fuel to the fuselage center fuel cell is an automatic operation accomplished through pressurization of the auxiliary fuel tanks. The tanks are automatically depressurized when the landing gear is down and locked. A combined total of 1650 U. S. gallons (9900 pounds) of fuel may be carried.

1–21. PRIMARY FUEL SYSTEM. Fuel is drawn from the tanks through the manifold assembly by the booster pumps and impelled on at a pressure of 15 psi through the shut-off valves and filters to the engine-driven primary and emergency fuel pumps. Fuel is metered by the regulator on the primary pump so as to obtain a constant engine rpm for a given throttle position regardless of ambient conditions. Flow from the regulator enters the fuel manifold section via the dump valve.

CAUTION

During engine acceleration in flight using the emergency fuel control, caution must be exercised to advance the throttle slowly so that the turbine outlet temperature limit for acceleration will not be exceeded.

1–22. EMERGENCY FUEL SYSTEM. This system is an enlargement of the primary fuel system. An emergency fuel pump having the same capacity as the primary fuel pump is driven from a separate accessories drive pad. The emergency pump receives its fuel from the common booster system and discharges into the emergency control. Except for military rpm, the emergency fuel control does not have the degree of precise control that is exhibited by the normal fuel regulator. Engine rpm is therefore sensitive to altitude, airspeed and temperature changes and must be controlled directly by the pilot. Engine idling speed must also be regulated by the pilot to prevent engine instability.

1–23. During normal operation of the primary pump, fuel from the emergency pump is by-passed by the emergency fuel control back to the booster pump supply line. A complete failure of the primary fuel system is sensed by the emergency fuel control which automatically effects the changeover from primary to emergency system operation. However, if only partial failure of the system is encountered, a manual switchover must be made. The indications the pilot will have that the primary pump has failed and that the emergency pump is supplying the fuel are by means of the red push-to-test type warning lights (figure 1–5, reference 17) on the center console and by a momentary combustion interruption. The switches for manual selection of the engine emergency fuel systems (figure 1–5, references 5 and 16) are adjacent to their respective warning lights. For normal operation, the switches will be in the "NORM" position. After selecting "EMERG" operation, the momentary contact position "RESET" must be selected to return to normal fuel system operation.

CAUTION

Unlike the normal fuel control, the emergency fuel control has no minimum fuel flow regulation. Therefore, caution must be exercised when decelerating to prevent engine instability or blow out.

1–24. DUMP VALVE. The dump valve is attached to the fuel manifold section of the engine and is normally in the open (shut down) position. In the open position fuel from the fuel manifold is directed to a drain tank. Such flow occurs at shut-down automatically when the throttle is retracted to the "SHUT-OFF" position. Upon starting the engine the dump valve automatically goes to the closed (operating) position which closes the overboard drain opening and permits fuel to flow directly from the governor into the engine.

1–25. FUEL BOOST PUMP SWITCHES. Two switches (figure 1–3, reference 28), are on the left-hand console. These switches operate the booster pumps and automatically open the fuel shut-off valves for each engine. The booster pumps operate at a static pressure of from 10-25 psi.

1–25A. Fuel boost pump pressure indication is provided by means of a pressure transmitter for each engine system and a dual indicator (figure 1–4, reference 30A) on the instrument panel. Normal boost pressure at sea level is 17 to 25 psi. With failure of a boost pump, the respective engine will be operable only below 15,000 feet.

1–26. FUEL QUANTITY INDICATOR. A fuel indicator (figure 1–4, reference 26), installed on the instrument panel, indicates in pounds the total fuel quantity of all three fuselage tanks.

Note

The calibration on the fuel indicator is based on zero degree pitch.

1–27. FUEL PRESSURE INDICATOR. A dual fuel manifold pressure indicator (figure 1–4, reference 29)

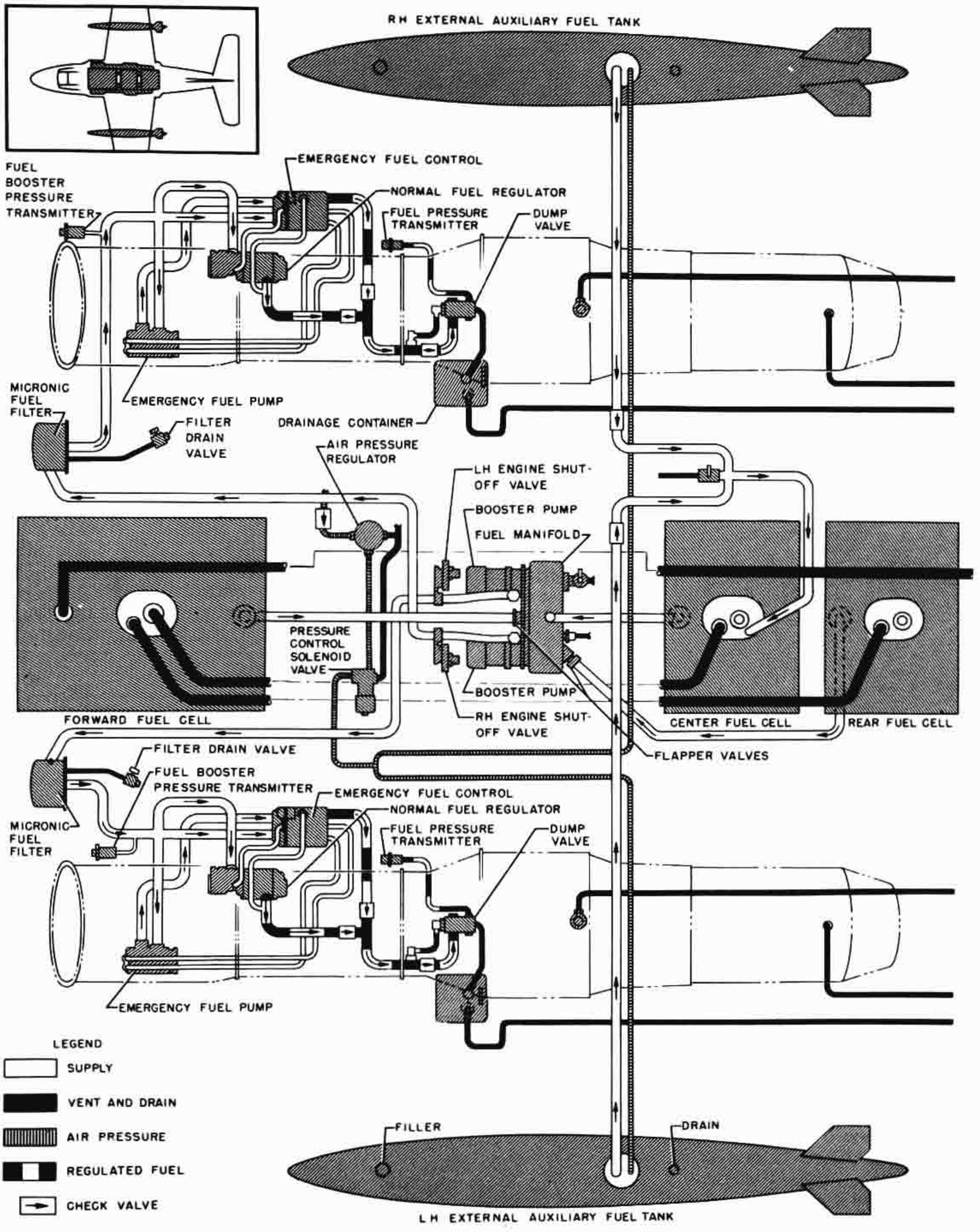


Figure 1-6. Fuel System Diagram

is installed on the instrument panel. This indicator measures the fuel pressure into the engine at the dump valve.

1–28. DEFUELING VALVE. A defueling valve is installed on the bottom of the fuselage between the two engines. It is accessible through an access door and permits defueling at a continuous rate of 50 gallons (300 pounds) per minute.

1–29. OIL SYSTEM.

1–30. GENERAL. An oil tank with a usable capacity of 3.45 U.S. gallons is located outboard of each engine. A dual oil pressure indicator (figure 1–4, reference 32) and two oil temperature indicators (figure 1–4, references 34 and 36) are on the instrument panel.

1–31. LANDING GEAR CONTROLS.

1–32. NORMAL CONTROL. The landing gear is locked in the extended position by overcenter mechanical locks. The landing gear control lever (figure 1–3, reference 12) is located on the left-hand side of the cockpit. With the hydraulic system operating, the main landing gear and the nose gear may be raised or lowered by moving the control to "WHEELS UP" or "WHEELS DOWN." A solenoid safety lock is provided to prevent inadvertent retraction of the gear when the airplane is on the ground. If the control lever cannot be moved to "WHEELS UP" in flight, the safety lock may be released by pushing in on the button (figure 1–3, reference 11) which is adjacent to the landing gear control lever. Hydraulically actuated doors controlled by sequence valves operate automatically in conjunction with the landing gear. The tail bumper gear retracts and extends with the main gear.

1–33. EMERGENCY MAIN GEAR EXTENSION. The landing gear is held in the retracted position by the landing gear door and door latch mechanism. The manual emergency release handle (figure 1–3, reference 14) located on the left-hand console, releases the gear door mechanical latches and permits gravity extension of the gear in emergency, as described in paragraph 3–35.

Note

The release cable is held in the pulled position by a friction lock. To return the cable to its original position, pull friction lock release cable (figure 1–3, reference 15) located below the instrument panel and forward of the left-hand console.

1–34. POSITION INDICATOR. A combination landing gear and wing flap position indicator (figure 1–4, reference 40) is on the instrument panel.

1–35. BRAKES. A power boost brake system operating from the main hydraulic system is provided. The brakes are operated by toe pressure on the rudder pedals. In case of hydraulic system failure, sufficient pressure will be applied for braking by exerting approximately twice the normal force on the rudder pedals.

1–36. ARRESTING GEAR. The arresting hook control (figure 1–5, reference 10) is located on the center console. The hook is lowered by air pressure independently of the hydraulic system. Retraction of the hook is an hydraulic system operation and consequently the hook cannot be raised in flight if hydraulic pressure fails. The hook may be raised manually from the ground with a required force of approximately 125 pounds. The approach light operates automatically in conjunction with the hook.

1–37. WING FOLDING CONTROL. The "lift-type" wing folding control (figure 1–5, reference 12) is located adjacent to the center console. A positive detent on the end of the control lever must be depressed in order to move the lever. The wings are folded by moving the lever directly from "SPREAD" to "FOLD." To spread the wings, the lever is moved from "FOLD" to as far as it will go toward "SPREAD" (approximately half way). At this position, the wings are spread and the locking pins engaged. As soon as this operation is completed (approximately 5 to 7 seconds are required), the lever may be moved to "SPREAD" which locks the locking pins and retracts the warning flags.

Note

The wing pins are not locked unless the red warning flags on the leading edges of the wings are faired.

1–38. HYDRAULIC SYSTEM CONTROLS.

1–39. GENERAL. The main hydraulic system is a 3000 psi demand variable displacement type and operates the landing gear, wing flaps, wing folding, speed retarder brakes, wheel brakes, gun charging, and arresting gear (see figure 1–7). The system is normally depressurized during flight to approximately 400 to 500 psi pressure since the solenoid shut-off valve is energized and hydraulic pressure is by-passed back to the main system reservoir whenever all control valve handles are in their retract positions. Hydraulic pressure becomes available immediately upon moving either the landing gear control to "WHEELS DOWN," the wing flap control to "DOWN," the speed brake switch to "OPEN" or the gun control switch to "SAFE." System pressure will cease 30 seconds after moving the landing gear control to "WHEELS UP," the wing flap control to "UP," the speed brake switch to "CLOSE," or the gun control switch to "OFF," or "READY," whichever operation is last. In the event of electrical system failure, the solenoid by-pass valve becomes de-energized and makes system pressure continually available for operation of all hydraulically controlled units with exception of the speed brakes. Under these conditions, the speed brakes are inoperative. Power is normally supplied to the system by two engine-driven pumps, one on each engine. In addition, an auxiliary hydraulic system is provided for aileron power boost. Power is supplied by an electrically driven pump with a relief valve set at a maximum pressure of 2500 psi. The auxiliary hydraulic system can also be directed to check out the main system on the ground and to extend the wing flaps in the air in the event of main hydraulic system failure. During these operations the pressure is controlled to 3000 psi.

1–40. AUXILIARY HYDRAULIC SYSTEM. The electrically driven hydraulic pump which is provided for operating the aileron power boost system, for emergency wing flap operation, or for checking the individual components of the system on the ground, is operative when the generators are operating and the battery-generator switch is in the "BAT-GEN" position. With the engines inoperative, power must be supplied from an external source to operate the auxiliary hydraulic system. Hydraulic fluid is supplied from the separate auxiliary reservoir. The auxiliary hydraulic system selector valve lever (figure 1–4, reference 20) to the right of the instrument panel has the following positions:

"EMERGENCY WING FLAP"—In case normal system fails.
"NORMAL"—Normal aileron power boost position.
"GROUND CHECK"—For checking individual components of the main system (DO NOT USE IN FLIGHT).

Note

To raise the handle above "NORMAL" into "EMERGENCY WING FLAP," the handle must be deflected to the right to clear a stop in the panel slot.

CAUTION

Do not operate the pump motor continuously in any valve position during ground operation for more than three minutes. Continuous pressure greater than 1200 psi will cause the motor to burn out.

1–41. ESCAPE CONTROLS. Separate "one-shot" compressed air systems are provided for the escape hatch and for the escape chute door system. Air bottles charged to 1980 psi supply the power. Filler valves and gages for the two systems are installed on the right-hand side of the nose gear well. The escape hatch emergency release handle (figure 1–4, reference 14) is located on the instrument panel and the escape chute door system emergency release handle (figure 1–5, reference 1) is located on the center console. The back and inboard side of the pilot's seat are unlatched and swing out of the way when the escape chute door system emergency release handle is pulled.

CAUTION

Do not check emergency air systems on the ground with more than 250 psi in the bottles or damage to the doors may result. After checking the emergency system, reset valve in nose wheel well before closing windscreen.

1–42. ELECTRICAL SYSTEM CONTROLS.

1–43. GENERAL. The airplane is equipped with a 28-volt direct-current electrical system. Origination of circuits from the various busses is shown on figure 1–8.

1–44. BATTERY. A 24-volt, 34 ampere-hour battery is provided on the center line of the airplane, just aft of escape chute. It is accessible from the lower escape chute entrance door. The battery and generator switch (figure 4–2, reference 27) is located on the right-hand console. The switch should be moved to "BAT & GEN" for normal operations and to "OFF" when leaving the airplane. If both generators fail, the switch should be moved to "BAT ONLY" after first turning off all non-essential loads.

1–45. GENERATORS. Two engine-driven generators, one on each engine, are provided. The generators deliver full voltage at an engine speed of approximately 48 per cent rpm (6000 rpm). Both generators are controlled from the battery and generator switch (see paragraph 1–44). Generator warning lights (figure 4–2, reference 7) are on the right-hand console and indicate the lack of generator output. The lights are of the push-to-test type and may be dimmed by rotating the lens clockwise.

1–46. CIRCUIT BREAKERS. Circuit breakers for all electrical circuits are provided on two vertical panels (figure 1–3, reference 2 and figure 4–2, reference 14) above the console panels in the cockpit. If a circuit becomes overloaded, its circuit breaker will automatically spring out. Operation of the circuit may be restored by pushing the breaker in, but it will not remain in until the cause of the overload is remedied. The following circuits are not fused or protected by circuit breakers:

Bus control relay coils (2)
Generator warning lights
Starters
Gun camera relay coils (control)
Monitored bus relay coil
Secondary bus relay coil

1–47. EXTERNAL POWER RECEPTACLES. Three external power receptacles are provided, two for engine starting and one for airplane d-c power supply. The engine starting receptacles are located in the wheel wells on the rear spar. The circuit is connected so that both engines can be started from either receptacle. The airplane d-c power supply receptacle is located in the right-hand wheel well inboard of the engine starting receptacle. All three receptacles are accessible through covers in the lower wing skin.

1–48. RADAR POWER SUPPLY INVERTERS. Alternating current is supplied by two single-phase inverters to the IFF and radar equipment (see figure 1–8). Operation is controlled by the three-position a-c inverter control switch (figure 4–2, reference 13) located on the right-hand console. Moving the switch from "OFF" to the "IFF ONLY" position operates the No. 2 inverter to furnish power to the IFF power and control circuit. Moving the switch from "OFF" to the "APQ-35 & IFF" position operates both inverters, furnishing power to the forward search radar circuit, tail warning radar circuit,

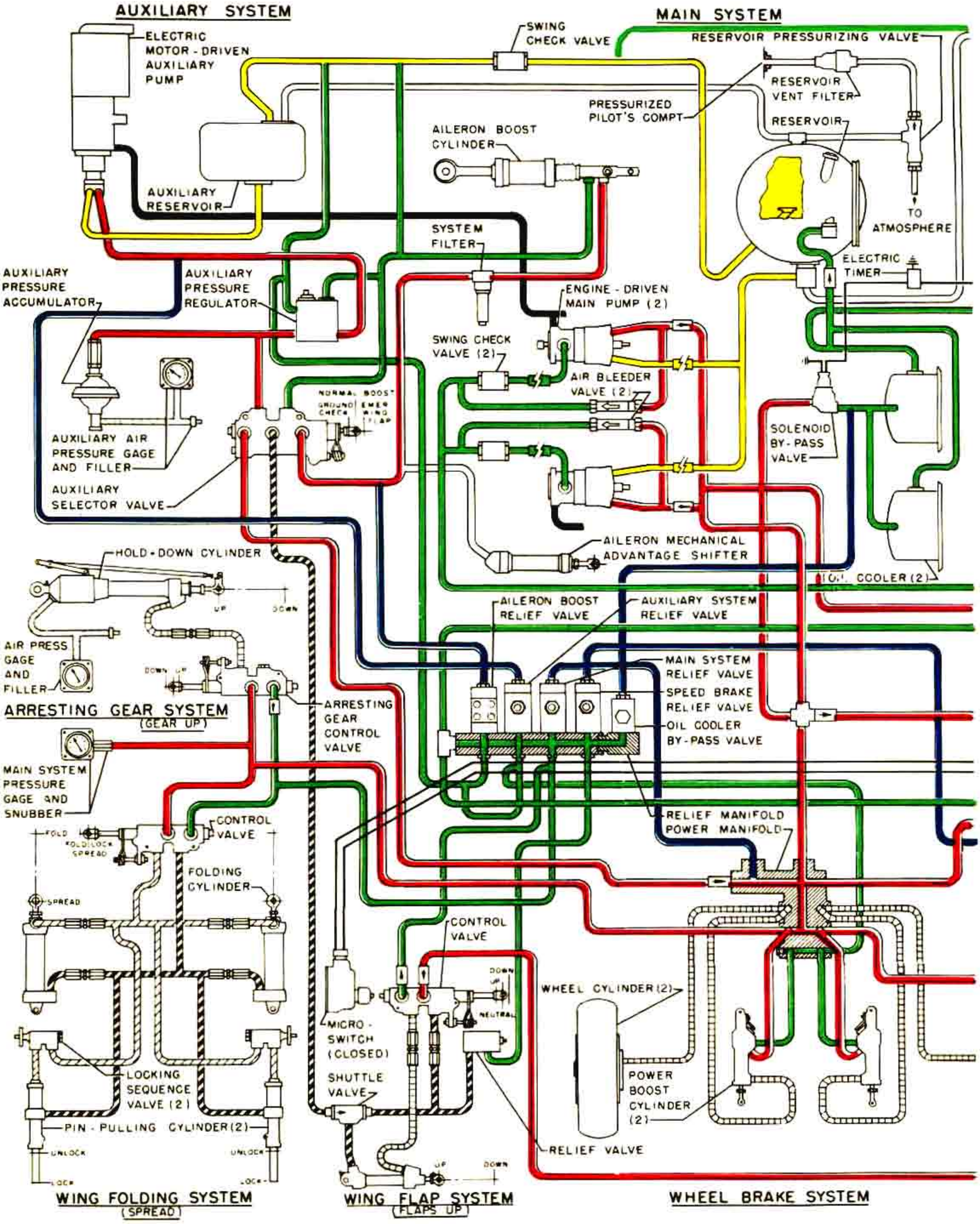


Figure 1-7 (Sheet 1 of 2 Sheets). Hydraulic System Diagram

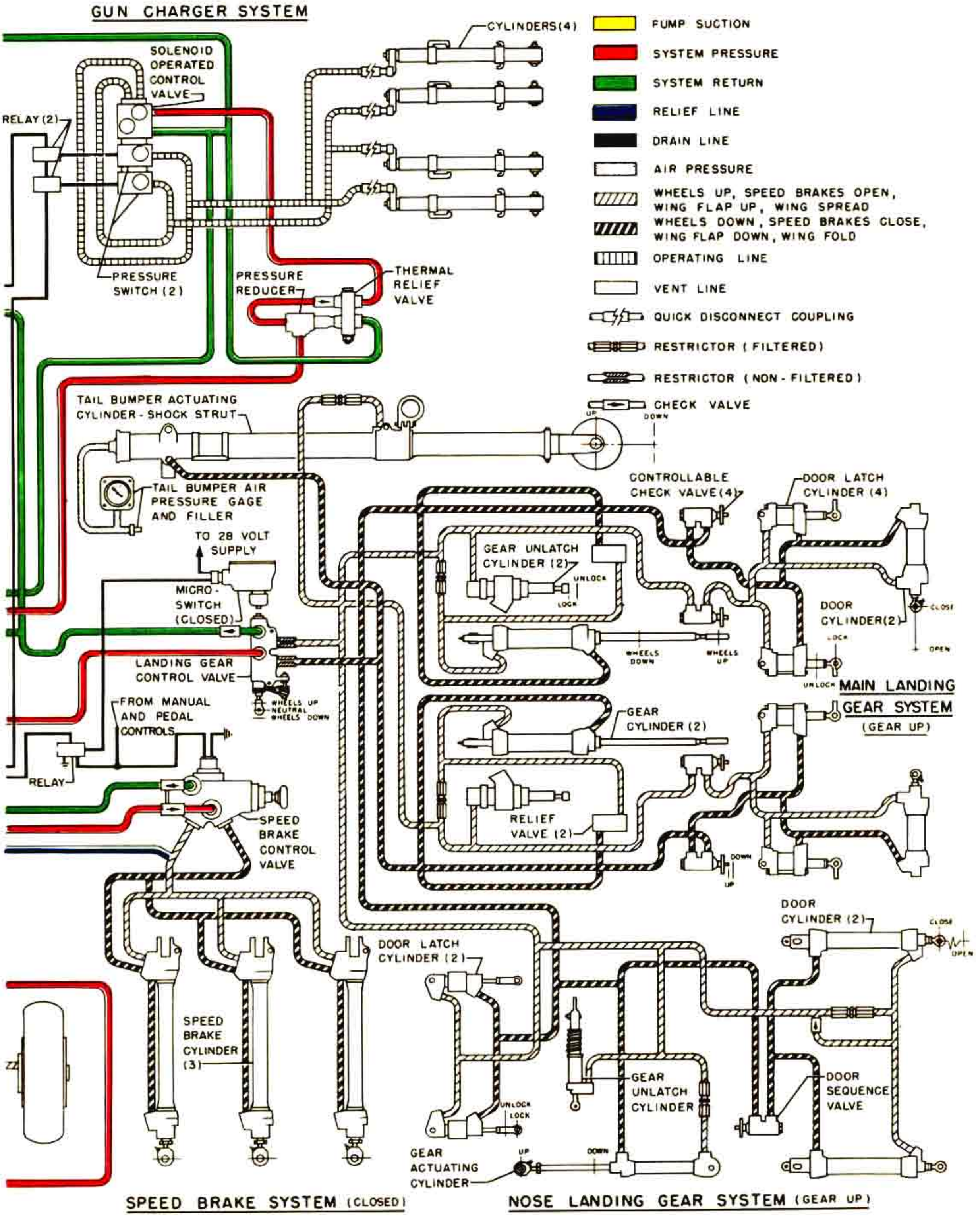


Figure 1-7 (Sheet 2 of 2 Sheets). Hydraulic System Diagram

and to the IFF power and control circuit. No indication of inverter failure other than nonfunctioning of equipment is provided.

1–49. INSTRUMENTS POWER SUPPLY INVERTERS. Alternating current is supplied by two three-phase inverters to the automatic pilot and instrument circuits. Both inverters are in operation whenever the engines are running or whenever an external d-c power source is connected to the airplane, providing the circuit breakers are closed. Under normal conditions, the automatic pilot inverter supplies power to the automatic pilot, radio compass and flight instruments, and the engine instruments inverter supplies power to the engine instruments. In the event of failure of either inverter, an automatic changeover takes place. With exception of the automatic pilot, all equipment will continue to operate from power supplied by the functioning inverter. The discontinuance of automatic pilot operation will serve as an indication of failure of one of the inverters.

1–50. Deleted.

1–51. VOLT-AMMETERS. Combination volt-ammeters (figure 4–2, references 8 and 9), are located on the upper part of the right-hand console. They provide a means of checking the amperage of each generator and voltage of the bus. Voltmeters are connected to a common point on the main bus. Normal indication is approximately 28 volts.

1–52. ENGINE FIRE DETECTION SYSTEM.

1–53. GENERAL. The engine fire detection system has detector units installed in each accessory, compressor, burner, and tail section. Warning lights are provided.

1–54. ENGINE FIRE WARNING LIGHTS. Fire warning lights (figure 1–4, references 22 and 39), one for each engine, are located on the pilot's instrument panel. These lights are the "push-to-test" type for checking bulb failure. When the temperature in the accessory or compressor sections exceeds approximately 232°C (450°F), and the temperature in the burner and tail sections exceeds 385°C (725°F), the fire detector "shorts out," closing the electrical circuit so that the warning lamps are lighted.

1–55. ENGINE FIRE DETECTOR TEST SWITCHES. Detector test switches (figure 4–2, reference 4) one for each engine, are located just forward of the right-hand console. When in the depressed position, an indication is given through the warning light that the respective fire detection circuit is operative.

1–56. MISCELLANEOUS.

1–57. SEAT ADJUSTMENT. An electrical actuator is provided for adjusting the pilot's seat up or down and is controlled by a switch (figure 1–5, reference 3) on the left-hand side of the center console. Seat adjustment can be made with battery switch at "BAT & GEN." The radar operator's seat is not adjustable.

1–58. SHOULDER HARNESS ADJUSTMENT. The pilot and the radar operator are both equipped with shoulder harnesses. The lower two free ends of the shoulder harness fit into the safety belt catch and are held securely as long as the catch is closed. The harness and safety belt are released by opening the safety belt catch. Buckles on the front of the harness permit it to be adjusted. An inertia reel shoulder harness take-up mechanism is provided with each harness. Each harness may be locked in position by pushing the pilot's handle (figure 1–3, reference 26) on the left-hand console, or the radar operator's handle (figure 1–5, reference 19) on the center console, forward. When unlocking the harness, it may be necessary to move the lever from one position to the other several times to obtain disengagement within the reel. In the unlocked position, the reels are automatically locked when subjected to a deceleration along the thrust line of the airplane (as in a head-on crash) in excess of 2.5g.

1–59. PERSONNEL GEAR RECEPTACLES. Receptacles for plugging in personnel gear adapters (figure 1–9, reference 16) are located on the outboard side of the pilot's seat and behind the inboard corner of the radar operator's seat. Both receptacles are flexibly mounted to facilitate disconnection of the adapter from the receptacle in the event of an emergency escape. The receptacles have provisions for connecting simultaneously, the oxygen mask, anti-g suit, suit heat, headphones, and microphone cord.

WARNING

This system is designed so that radio reception is cut off before the oxygen supply is disconnected. Thus, a loss of radio reception serves as an immediate warning of a loose or disconnected personnel gear adapter.

1–60. COCKPIT ENCLOSURE CONTROLS. The cockpit enclosure hatch is manually operated and is controlled from within the cockpit by a handle located on the leading edge of the hatch. Pulling aft on the handle unlatches the safety lock and permits movement of the hatch to the aft locked position. To close the hatch, a spring loaded lever in the forward recess of the hatch must first be depressed. After the hatch has been moved forward, the handle may be used to close the hatch and when pushed to its extreme forward position, the hatch will be secured and locked. Entrance may be gained from the outside of the airplane by means of a "dog-eared" handle located in the center of the cockpit enclosure hatch. Turning the handle will release the locking mechanism and pulling aft on the handle will open the hatch. For operation of the emergency compressed air "one-shot" system, see paragraph 3–18.

Note

The upper escape hatch must be kept closed at speeds above 310 knots or extreme buffeting will occur within the cockpit.

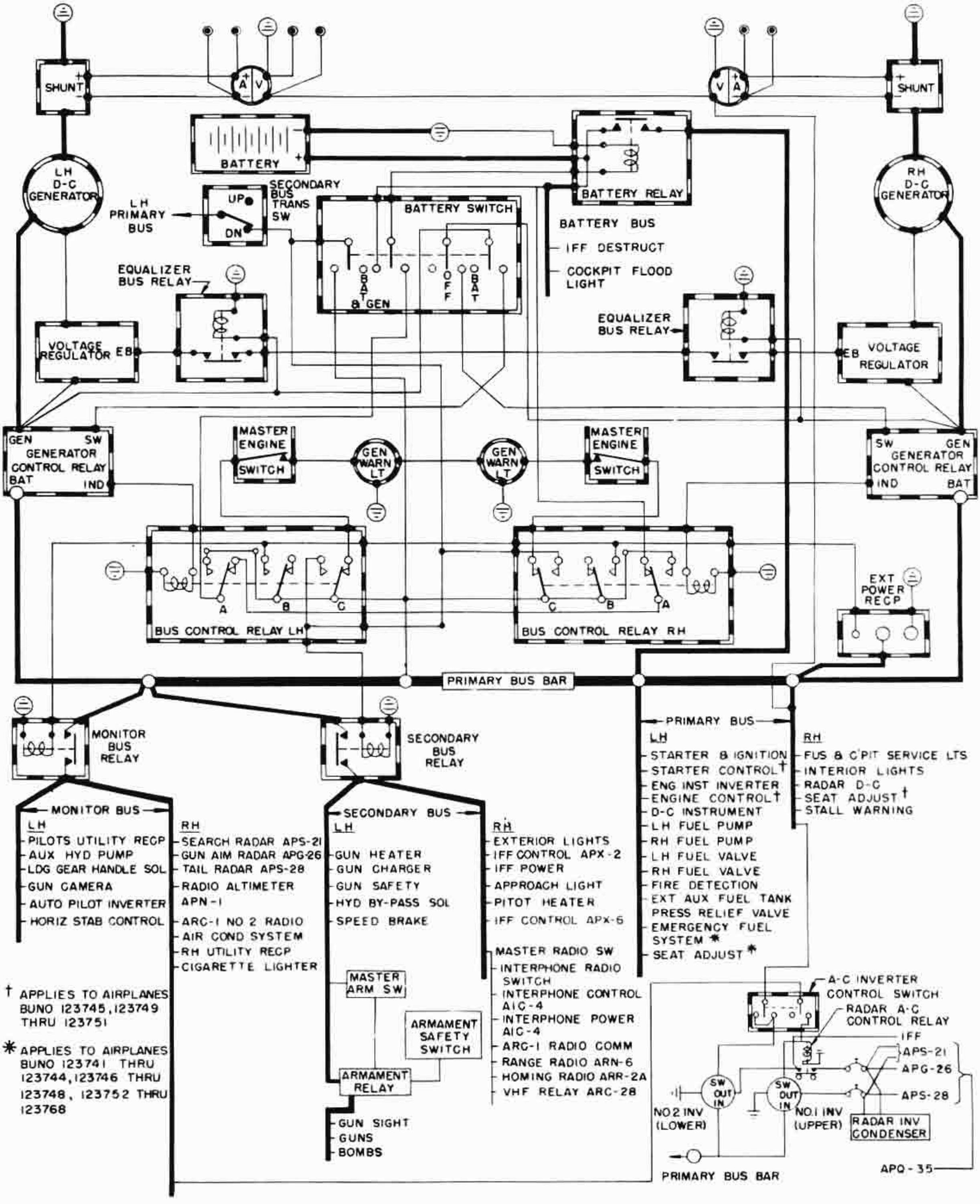
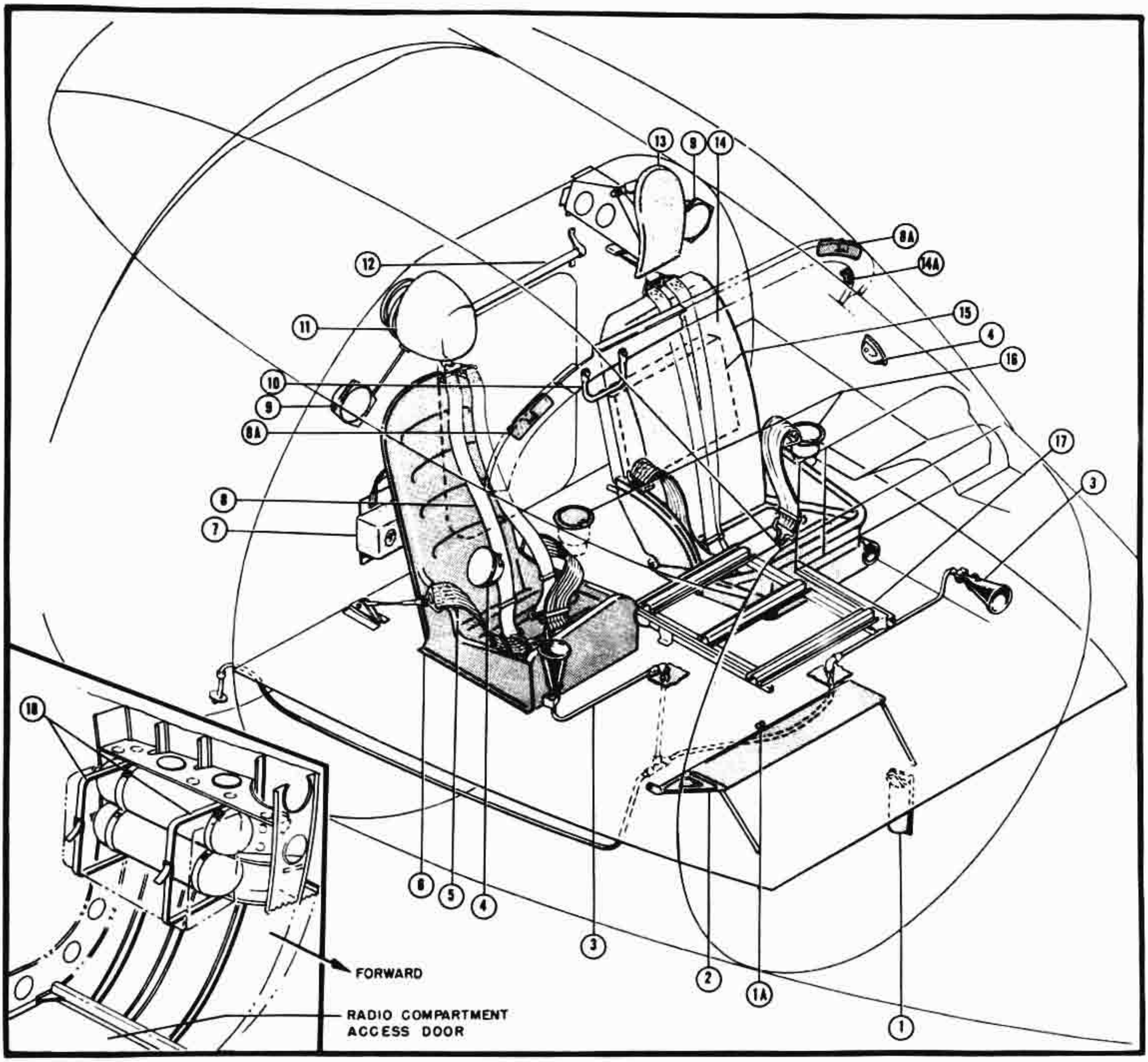


Figure 1-8. Electrical Bus System Diagram



1. Airplane jack pad stowage
1A. Radar Operator's foot transmit switch
2. Radar operator's foot rest
3. Relief tube
4. Ash tray
5. Lap harness
6. Radar operator's seat
7. First-aid kit
8. Shoulder harness
9. Shoulder harness inertia reel
10. Radar operator's assist handle
11. Radar operator's head rest
12. Cockpit aft escape hand rail
13. Pilot's head rest
14. Pilot's seat
14A. Keying switch
15. Map and oxygen mask stowage
16. Personnel gear receptacle
16A. Rear-view mirrors
17. Radar operator's chartboard
18. Baggage stowage

Figure 1-9. Miscellaneous Equipment Diagram

1–61. COCKPIT CANOPY RAIN REPELLENT. A rain repellent compound in accordance with Specification MIL-K-6882 is recommended for application on the canopy panels. The compound is effective for approximately two hours in rain or for one week if not subjected to cleaning, de-icing or degreasing fluids, or salt sprays. Re-applications should be made at weekly intervals or whenever the compound may have been removed by any of the physical causes noted above.

Note

Retouching is not acceptable since it causes smudging.

1–62. COCKPIT ESCAPE CHUTE CONTROLS. The lower escape chute door emergency release handle (figure 1-5, reference 1) on the center console, is cable connected to a mechanism that jettisons the aft chute door on the bottom of the fuselage, actuates a one-shot air pressure system that opens the lower windscreen door, and opens the chute entrance door in the aft wall of the cockpit, between the pilot's and radar operator's seats. The back and inboard side of the pilot's seat unlatches and swings out of the way when the handle is pulled. A vaulting bar on rear cabin bulkhead above chute door is provided to expedite escape.

1–63. OPERATIONAL EQUIPMENT. See Section IV for operation of the armament, oxygen, communications, electronic, heating, ventilating, pressurizing and lighting equipment.

SECTION II
NORMAL OPERATING INSTRUCTIONS

2–1. BEFORE ENTERING THE COCKPIT.

2–2. THE FOLLOWING TEMPORARY RESTRICTIONS ARE TO BE OBSERVED IN OPERATION OF THE MODEL F3D-1 SERIES AIRPLANES. THESE LIMITATIONS AND RESTRICTIONS ARE SUBJECT TO CHANGE AND LATEST SERVICE DIRECTIVES AND ORDERS MUST BE CONSULTED.

a. The maximum permissible combinations of airspeed and acceleration are given in figure 2–2 for flight at a gross weight of 21,000 pounds without external stores. At other gross weights, the permissible accelerations are such as to maintain a constant product of gross weight and acceleration, except that +6.0g and —2.5g shall not be exceeded even at very low gross weights.

b. When carrying external load items, the airplane is restricted to normal flying.

c. The following maneuvers are permitted when not carrying external load items:

Vertical turn	Loop
Wing over	Chandelle
Aileron roll	Immelman turn
Inverted flight (only for entering a dive)	Normal spin (not over two turns)

d. The maximum recommended gross weights for landing are as follows:

Landing on smooth paved runways	24,500 lbs.
Landing on rough runways	20,000 lbs.

e. CATAPULTING AND ARRESTED LANDINGS ARE NOT PERMITTED UNTIL AUTHORIZED BY THE BUREAU OF AERONAUTICS.

f. The maximum permissible indicated airspeeds for operating various devices or for flying with these devices displaced are as follows:

Landing gear	160 knots
Landing flaps	169 knots
Upper escape hatch	310 knots
Speed brakes	Speeds permitted in figure 2–2

g. To provide reduced aileron control forces with aileron boost off, the control stick may be extended an additional 3 inches over the normal configuration. To prevent overloading the control system, this stick extension must only be used when the aileron power boost is off. Flight with the control stick extended shall be limited to normal flying.

2–3. Determine the take-off weight and center of gravity for any loading condition and the anticipated loading for landing. Loading data are furnished in the Handbook of Weight and Balance, AN01-1B-40.

2–4. Check the exterior of the airplane for the following:

a. General condition and cleanliness.

b. Proper inflation of tires and struts.

c. Arresting hook latched up.

d. Security of access door and cover plates.

e. All external covers and any external locks or surface control battens removed.

f. Clear ground 15 feet in front, and 5 feet to the sides and aft of the engine air intake ducts.

g. Check quantity of hydraulic fluid, engine oil, fuel, and ammunition on board.

h. See that external d-c power supplies are plugged into one of the engine starting power receptacles and into the airplane power supply system receptacle.

i. Condition of airspeed static plates.

j. Engine inlet ducts and boundary layer bleeds for stray objects.

k. Emergency escape system air bottles pressure—1980 ± 50 psi (nosewheel well).

l. Hydraulic accumulator pressure—1980 ± 50 psi (nosewheel well).

m. Lower escape chute doors closed and latched.

n. 100 pound CO_2 fire extinguishers are placed 10 feet from engine air intake duct and exhaust exit.

2–5. ON ENTERING THE COCKPIT.

a. Check the interior of the cockpit for general condition and for any loose items.

b. Adjust seat and rudder pedals if necessary.

c. Plug in personnel gear adapter securely.

d. Release surface controls gust lock.

e. Check surface controls for freedom of movement.

f. Battery-generator switch—"OFF."

g. Fuel boost pump switches—"OFF."

h. Left-hand circuit breaker panel—all circut breakers closed.

i. Trim tabs—0°.

j. Wing flaps—"UP."

k. Master engine switches—"OFF."

l. Throttles in aft-detent positions.

m. Speed brake—"CLOSE."

n. Check oxygen system (see paragraph 4–22).

o. Landing gear—"WHEELS DOWN."

p. Set altimeter and clock.

q. Gyro instruments—UNCAGED.

r. Armament master switch—"ON."

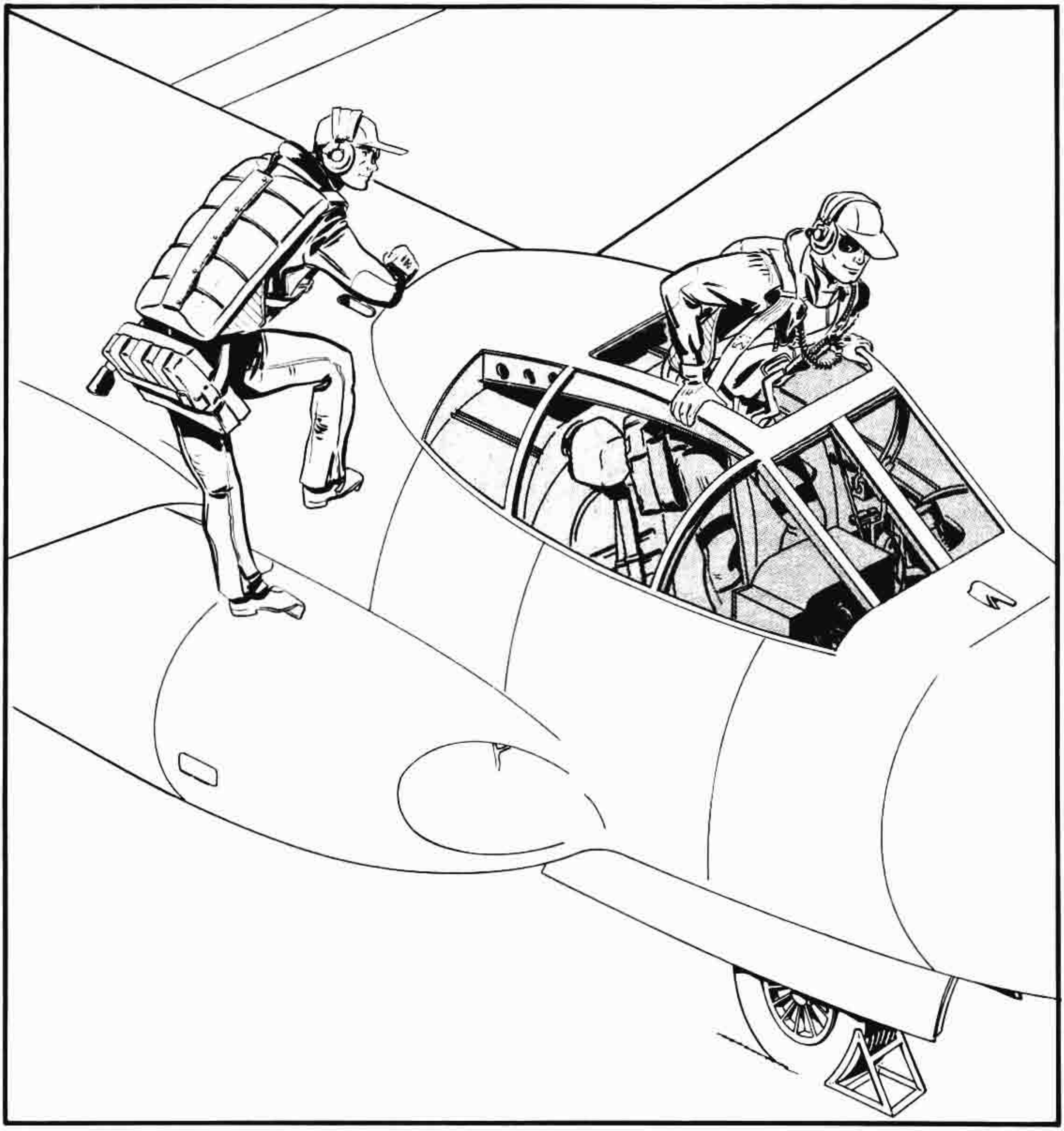


Figure 2-1. Entrance to the Airplane

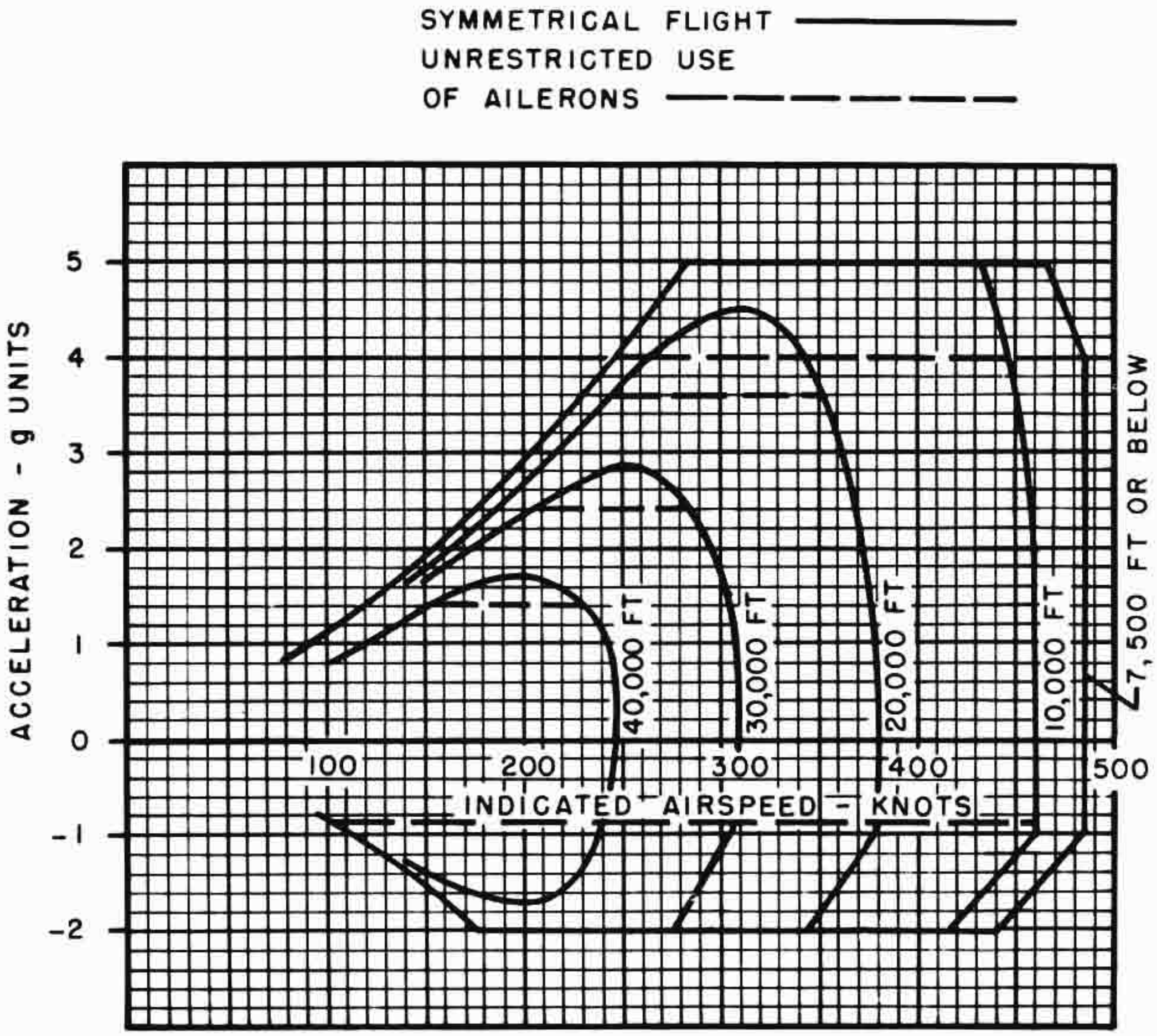


Figure 2-2. Operating Flight Strength Diagram

s. Check gunsight light, then turn armament master switch "OFF."

t. Test engine fire detector circuit (see paragraph 1–55).

u. Auxiliary hydraulic system control—"NORMAL."

v. Escape chute door in cockpit aft bulkhead CLOSED and LOCKED.

w. Emergency fuel pump switches—"NORM" (lights out).

x. Auto pilot clutch control—"OFF." (Out)

y. Check electronic equipment (see paragraph 4–37).

Note

Special electronic equipment should be checked only when an engine is running or with external power.

z. Right-hand circuit breaker panel—all circuit breakers closed.

aa. Check seat belt, shoulder harness and harness lock.

2–6. CHECK FOR NIGHT FLIGHTS. Check the operation of all interior and exterior lights. Spare light bulbs are carried in a container at the forward end of the right-hand side of the center console.

Note

If the exterior lights master switch is placed in either the "CODE," "FLASH" or "STEADY" position, the approach light may be checked by lowering the arresting hook.

2–7. FUEL SYSTEM MANAGEMENT.

2–8. FUEL FLOW. The fuel system (see figure 1–6) is so arranged that the airplane center of gravity is automatically held within allowable limits as fuel is consumed and no manual selection of tanks is required. The fuel boost pump switches must be on during all engine operations since the fuel boost pump switches also control the fuel shut-off valves.

2–9. FUEL TRANSFER. Under certain conditions, it is possible for the total engine fuel consumption to exceed the drop tank fuel transfer rate. Therefore, a drop in fuel quantity in the main tank system is not always a true indication that the drop tanks are empty. After the landing gear is retracted, approximately 8 to 10 minutes will be required for completion of the transfer operation. Such a time interval should be allowed to elapse before accepting a drop in fuel quantity as definite indication of empty drop tanks.

2–10. JETTISONING FUEL DROP TANKS. The drop tanks can be jettisoned manually by means of the external stores release handle (figure 1–3, reference 29), or by means of the electrical release system as follows:

a. BOMB RELEASE switches—"LH" and "RH."

b. MASTER armament switch—"ON."

c. Depress bomb trigger on stick.

d. MASTER armament switch—"OFF."

e. BOMB RELEASE switches—"OFF."

2–11. SERVICING INSTRUCTION.

2–12. Service the airplane with the following:

Fuel: Spec. MIL-F-5572; the cheapest, most readily available grade.

Oil: Spec. MIL-O-6081. Grade 1010.

Hydraulic System: Spec. MIL-O-5606.

2–13. ENGINE STARTING.

2–14. GENERAL. A control timer is provided in the ignition circuit to de-energize the ignition coils after 30 seconds of operation. The timing action is initiated when the throttle lever is moved to the "IGNITE" position. If an engine start is obtained during the 30-second cycle, the starter is shut off automatically by the undercurrent relay as the engine begins to support itself, but the ignition continues until the timing cycle has elapsed. In the event of non-ignition during the 30-second period, the starter should be turned off manually by opening the circuit breaker. After turning off the other engine controls, an investigation should be made to determine the cause for failure of the engine to start.

2–14A. ABNORMAL STARTS. A "hot start" is one during which abnormally high turbine outlet temperatures are experienced at relatively low engine rpm. It may be caused by excessive fuel in the combustion chamber due to a previous false start, late or faulty ignition, or by oil from leaky bearing seals. If a "hot start" occurs, as indicated by flame aft of the turbine and sluggish acceleration, the engine rpm should be increased immediately to approximately 56 per cent rpm (7000 rpm) rather than remaining in the idle range. This brings the engine to its coolest operating condition and the excess fuel can be burned with the least risk of exceeding the temperature limits at the turbine blades.

CAUTION

"Hot starts" cause abnormal turbine blade growth and combustion chamber deterioration. If the above action does not reduce the temperatures immediately, shut down the engine and investigate.

Note

Starting the engines should not be attempted at ambient temperatures below —29°C (—20°F).

2–15. STARTING PROCEDURE. The following steps are arranged in the order recommended for starting the engine. Although either engine can be started first, the normal procedure is to start first the left-hand and then the right-hand engine.

a. Throttle in aft (cut-off) position.

b. Battery and generator switch—"BAT & GEN."

c. Master engine switch—"ON." Check for open position of entrance duct door.

CAUTION

The engine duct door must be open before an engine start is attempted.

d. Fuel boost pump switch—"ON."

e. Initiate the starting cycle by momentarily moving the throttle lever outward to the "CRANK" position. As the engine approaches full cranking speed, 8 to 12 per cent rpm (1000 to 1500 rpm), advance the throttle lever into the "IDLE" range and move the lever outward to the "IGN" position to energize the ignition circuit.

Note

Indication of a start is an increase in turbine outlet temperature with an increase in engine rpm.

CAUTION

If the engine does not start during the first 30-second ignition period, open the starter circuit breaker and investigate to determine the cause of starting failure. The starter may be operated through three consecutive 30-second cycles, after which 20 to 30 minutes must be allowed for cooling of the starter motor and ignition coils. The engine air inlet duct door must be open during the cooling period (see paragraph 2–84). Swab or drain all excess fuel from the exhaust sections and fuel dump can before attempting another start.

f. On warm days particularly, the turbine outlet temperature may rise abnormally fast immediately following "light-off." If the temperature reaches between 750° and 800°C (1380° and 1470°F), retard the throttle lever slightly to reduce the temperature to between 700° and 750°C (1290° and 1380°F). After 16 to 17.5 per cent rpm (2000 to 2200 rpm) is reached, the normal procedure can be resumed.

g. Advance the throttle lever to obtain 32 to 35 per cent rpm (4000 to 4375 rpm). At this point, instrument readings should be within the following ranges:

Turbine outlet temperature—682°C (1260°F) or lower.

Fuel pressure—5 to 30 psi.

Oil pressure—5 to 28 psi.

Oil temperature—32° to 71°C (90° to 160°F).

2–16. RUN-UP. Although a warm-up period is not required for jet engines, a run-up period is necessary for the purpose of checking instruments and engine operation prior to flight. Large quantities of fuel will be used if prolonged run-up is used. Running time from start to take-off should be held to a practicable minimum. When satisfied that engine operation is normal at 34 per cent rpm (4200 rpm), increase engine speed to 64 per cent rpm (8000 rpm). Maintain this speed while making the ground test (see paragraph 2–18) and an instrument check which should range as follows: (Based on sea-level standard conditions.)

Turbine outlet temperature 510° to 565°C (950° to 1050°F).

Fuel pressure gage 30 to 60 psi.

Oil pressure gage 44 to 70 psi.

Oil cooler out temperature gage 32° to 71°C (90° to 160°F).

2–17. Make a constant inspection for fluctuation of rpm and oil pressure.

Note

The following maximum allowable turbine outlet temperatures must be observed.

(a) Take-off and military (30 min.)—682°C (1260°F)

(b) Normal rated (maximum continuous)—635°C (1174°F)

(c) Starting 5 seconds—960°C (1760°F), remainder of starting time—849°C (1560°F)

(d) Idle continuous—lower than 682°C (1260°F)

(e) Acceleration 5 seconds—849°C (1560°F), remainder of acceleration—793°C (1460°F)

2–18. GROUND TEST.

2–19. ENGINE CHECK. If erratic combustion is indicated by high turbine outlet temperatures or "afterburning," shut down the engine and investigate for cause.

WARNING

Personnel should not attempt to walk at a distance of less than 10 feet in front of the intake jet or at a distance of less than 40 feet aft of the exhaust nozzle. An observer can check the turbine for hot spots when standing just at the lateral boundary of the jet, at a distance of 10 to 15 feet aft of the exhaust nozzle.

2–20. If combustion and general engine operation are satisfactory check the governor high-speed stop as follows: Advance the throttle lever slowly until the engine reaches a speed of 100 per cent rpm (12,500 rpm).

CAUTION

Do not exceed the maximum turbine outlet temperature of the engine.

2–21. Check the instrument readings which should be within the following ranges: (Based on sea-level standard conditions.)

Turbine outlet temperature indicator to 682°C + 0, — 16°C (1260°F + 0 —29°F).

Fuel manifold pressure gage 160 to 220 psi.

Oil pressure gage 65 to 90 psi.

Oil temperature gage 32° to 90°C (90° to 194°F).

2–22. The maximum speed setting of the governor stop should correspond to 100 per cent rpm, plus 1, minus 2 (12,500 rpm, plus 125, minus 250).

CAUTION

The limitations at military power are 100 per cent rpm, plus 1 (12,500 rpm, plus 125) or limiting turbine outlet temperature whichever occurs first.

2–23. Accelerate and decelerate the engine between 34 per cent rpm (4200 rpm) and 100 per cent rpm (12,500 rpm) with sufficiently rapid throttle motion to check the governor acceleration control. The engine should accelerate from idle to 100 per cent rpm in from 12 to 15 seconds. Maximum allowable turbine outlet temperature limits for transient state (while accelerating) are noted in paragraph 2–17.

2–24. Check the emergency fuel regulator and pump at 64 per cent rpm (8000 rpm) by moving the EMERGENCY FUEL PUMP switch momentarily from "NORM" to "EMERG." Emergency operation is indicated by a lighted warning light and a change in engine instrument readings. Within 3 seconds, constant rpm should be 58 to 82 per cent (7250 to 10,250 rpm). Return to normal operation by moving the switch momentarily from "NORM" to "RESET." If it is desired to continue operation, reduce engine speed to approximately 34 per cent rpm (4200 rpm) for idling.

2–25. HYDRAULIC SYSTEM CHECK.

a. Check operation of the left-hand engine-driven hydraulic pump when starting the left-hand engine. With the auxiliary hydraulic selector control at "NORMAL," the hydraulic pressure gage should read 3000 psi since the hydraulic system remains pressurized as long as the landing gear is extended and the engine is running.

b. To check out the various hydraulically operated units while the engines are inoperative, the auxiliary hydraulic system control must be in the "GROUND CHECK" position. Continuous operation in this position should be limited to 3 minutes in order to prevent overheating and resultant failure of the pump electric motor. The control must be returned to "NORMAL" when the checks are completed.

2–26. ELECTRICAL SYSTEM CHECK.

a. Disconnect the external power sources.

b. Increase the engine speed gradually until the voltmeter reads approximately 27 volts. If the generator warning light goes out, it is an indication that the reverse-current relay is functioning properly.

c. Increase the engine speed and check the voltmeter. The voltmeter reading should not increase beyond 28 volts and should remain at that reading regardless of any further increase in engine speed.

d. A take-off should not be made if the generator warning lights are on or if the voltmeter reading is too high (above 28.5 volts).

2–27. AUTOMATIC PILOT CHECK. Check the operation of the automatic pilot. (See paragraphs 1–12 and 2–55.)

2–28. ELECTRONIC EQUIPMENT CHECK. (See paragraph 4–35.)

2–29. TAXIING. Make certain that the external power sources are disconnected and that the battery and generator switch is at "BAT & GEN."

2–30. The airplane is equipped with a tricycle type landing gear and standard taxiing procedures for airplanes equipped with this type of gear should be followed. The brakes are operated by toe pressure on the rudder pedals. Approximately 4 gallons (24 pounds) of fuel are consumed per minute while taxiing under normal conditions.

2–31. BEFORE TAKE-OFF.

a. Shoulder harness and safety belt secured and locked.

b. Aileron tab—0°.

c. Rudder tab—0°.

d. Elevator tab—0°.

e. Wing flaps full down for carrier take-off, one half down for airfield take-off.

f. Speed retarder brakes—"CLOSE."

g. Landing gear—"WHEELS DOWN."

h. Check all instruments for indications within the required limits.

i. Check fuel and oil pressures at idling rpm.

j. Check hydraulic pressure, generator warning, and fire warning lights.

k. Auxiliary hydraulic system control–"NORMAL."

l. Cockpit air conditioning control—"OFF."

Note

Fog and steam can be introduced into the cockpit through the air conditioning system if water is splashed into the engine air intakes during take-offs. To preclude this possibility, the control should be at "OFF" until airborne.

m. Unfold wings and see that control is left in "SPREAD" position. Also, check to see that the red

warning flags at wing leading edge are faired with wings, indicating that the locking pins are engaged.

n. Operate the ailerons to make certain that the aileron boost system is operating.

o. Upper escape hatch—"OPEN."

p. Gradually open the throttles to 100 per cent rpm (12,500 rpm).

q. Check the turbine outlet temperatures, 682°C (1260°F) maximum.

r. See that no excessive vibration is present.

2–32. CATAPULT CHECK. In addition to the preceding checks, the following should be accomplished:

a. Tighten engine control friction adjustment knob.

b. Pull catapult hand grip (figure 1–3, reference 20) up into static position.

c. Place back and head firmly against back pad and headrest.

d. The pilot should place his feet against rudder pedals with legs stiff. The radar operator should brace his feet against the footrest.

e. The pilot should brace his right arm. The radar operator should brace both arms.

f. Ease throttles forward and grasp catapult hand grip.

2–33. TAKE-OFF.

2–34. NORMAL TAKE-OFF. (FROM AIRFIELD).

a. Flaps half "DOWN."

b. Indicated air speed for take-off is approximately 121 knots (139 mph) at 24,000 lbs. gross weight and 110 knots (127 mph) at 20,000 lbs.

c. The airplane has no unusual take-off characteristics.

d. See figure A–1 for take-off performance data.

e. See paragraph 2–2 for gross weight and loading restrictions.

2–35. MINIMUM RUN TAKE-OFF. For a minimum run take-off, the controls should be set in the same position as for a normal take-off, except the flaps should be 40° (full down) and the airplane may be pulled off at an IAS varying from 99 knots (114 mph) at 24,000 lbs. gross weight to 91 knots (105 mph) at 20,000 lbs.

2–36. ENGINE FAILURE DURING TAKE-OFF. Refer to paragraph 3–10 for procedure to be followed in case of engine failure during take-off.

2–37. AFTER TAKE-OFF.

a. Use brakes lightly to stop wheels from spinning.

b. Retract the landing gear as soon as the airplane reaches a point beyond which a safe landing cannot be made in the field or in any level space available beyond the field.

Note

The landing gear will retract in a maximum time of six and one-half seconds.

c. Retract the wing flaps. The wing flaps actuating system is designed to allow blow back of the wing flaps before structural damage occurs. However, it is recommended that the flaps be retracted at 140 knots (162 mph) since little or no trim change is necessary at this speed.

d. Close upper escape hatch.

2–38. CLIMB.

2–39. The characteristics of the airplane in a climb are normal.

2–40. The best climbing airspeed with 94.4% rpm is approximately 220 knots (254 mph) calibrated airspeed from sea level to 20,000 feet and 190 knots calibrated airspeed from 20,000 feet to service ceiling. Use of 100% rpm will increase these speeds approximately 20 to 30 knots calibrated airspeed. See figure A–1 for more precise values of the best CAS at various altitudes.

2–41. DURING FLIGHT.

2–42. STABILITY. The airplane possesses positive longitudinal stability in all configurations. However, in the power approach configuration, a pull force of approximately 8 pounds, which is the result of the elevator down-spring, is required to stall the airplane from a trim speed of 1.2 V_{SL}.

2–43. TRIM CHANGES. Trim changes are small except when lowering the wing flaps. Asymmetric power trim change is small except at low speeds and large asymmetric power. A slight lateral and longitudinal trim is necessary at high Mach number due to left wing heaviness and slight "tuck under" tendencies.

2–44. USE OF SPEED RETARDER BRAKES. The speed brakes are operated by the switch on the left-hand console. To eliminate a potential nose-up condition when the speed brakes and/or landing flaps are open, an elevator down-spring is incorporated in the elevator control system.

2–45. POWER PLANT OPERATION.

2–46. LOW ALTITUDE OPERATION.

2–47. GENERAL. Operation at low altitude is not appreciably different from operation on the ground.

2–48. TURBINE OUTLET TEMPERATURES. If the turbine outlet temperatures exceed the limits, the engine speeds should be reduced.

CAUTION

Critical vibratory stresses are encountered in the rpm range from 68 to 76 per cent. Prolonged engine operation in this range should be avoided. Short periods of operation at this rpm, however, are not considered to be detrimental.

2–49. MAXIMUM ENGINE SPEED. The engines should never be operated above 94.4 per cent rpm (11,800 rpm) for more than 30 minutes in any one run.

After 30 minutes of continuous operation above 94.4 per cent power, a cooling period of at least 10 minutes at less than 94.4 per cent rpm must be allowed before higher power is again used. 94.4 per cent rpm (11,800 rpm) is the maximum allowable for continuous operation.

2–50. HIGH ALTITUDE OPERATION.

2–51. COMPRESSOR STALL. At altitudes above 30,000 feet, abrupt increases in engine speed or decreases in airspeed can result in compressor stall. This is a condition of compressor pulsation accompanied by fluctuations of engine rpm and turbine outlet temperatures. It can be eliminated, if recognized immediately, either by increasing airspeed, decreasing engine rpm, or both. If allowed to continue, this condition of compressor instability can result in "dead band" operation, whereby turbine outlet temperatures increase beyond limits, with resultant loss of control of engine rpm and turbine outlet temperature. In extreme cases, where turbine outlet temperature has exceeded the limits, it will be necessary to shut off fuel flow to the affected engine in order to control the temperature. Engine accelerations at high altitudes are extremely critical and care must be taken to advance the throttles very slowly to avoid compressor stalls.

2–52. COMPRESSOR PULSATION. At higher altitudes a phenomenon known as compressor pulsation may be encountered on accelerations, and at low IAS with high engine rpm. The pilot can recognize it by loss of rpm and engine vibration.

2–53. CHANGING POWER CONDITIONS DURING FLIGHT. Advance or retard the throttles as necessary but maintain allowable instrument limits.

2–54. RESTARTING AT ALTITUDE. See paragraph 3–28.

2–55. USE OF AUTOMATIC PILOT.

2–56. TO TURN AUTOMATIC PILOT EQUIPMENT ON.

a. Erect the gyros (compass transmitter and gyro-horizon indicator) by first caging, then uncaging the knob on the gyro-horizon indicator.

Note

1. As soon as the airplane's electrical power is on, the bank and turn indicator and the gyro-horizon indicator become operative and provide conventional flight indications. The gyros may, however, not be in a vertical position when the system is engaged. The preceding procedure is therefore necessary.
2. Caging or uncaging the gyros controls the operation of the clutch switch solenoid which not only disengages the automatic pilot whenever the caging cycle starts but also prevents re-engagement until the gyros are uncaged.

b. Allow two minutes for the amplifier to warm up.

c. Move the stick-type control to its neutral detent position; also center the pitch-trim and bank-trim wheels on the controller panel.

d. Trim the airplane in the desired attitude of flight.

e. Engage the automatic pilot by pushing the clutch control switch in.

CAUTION

Do not engage the automatic pilot while in a turn, or in climbs, dives, or banks of more than 10 degrees.

2–57. TO TURN AUTOMATIC PILOT EQUIPMENT OFF.

a. To return to manual flight, pull the auto-pilot clutch control out to the off position.

b. In an emergency, disengage the system by pulling the emergency mechanical release handle, which operates the servo disconnects.

Note

After the emergency release handle has been pulled, the automatic pilot cannot be re-engaged while in flight.

2–58. ELECTRICAL SYSTEM CHECK. The electrical system should be checked in flight periodically.

2–59. STALLS.

2–60. GENERAL. The stalling characteristics are normal and the airplane has very little tendency to roll at the stall. The ailerons remain effective and will provide lateral control through the stall. Although a mild stall warning in the form of general airplane and tail buffeting is present, the warning occurs too close to the stall (from one knot to four knots above stall) to be considered a reliable warning. This is especially true in the power approach configuration where the very low control force stability tends to aggravate the possibility of inadvertent stalling. During flaps up stalls, some warning is present in the form of general buffeting. However, only a minor amount of warning exists in the landing condition.

POWER-OFF STALLING SPEEDS

APPROXIMATE INDICATED STALLING SPEEDS (knots)			
Gross Weight	Flaps Up Gear Up	Flaps Down 25° Gear Down	Flaps Down 40° Gear Down
15,000	88	78	74
18,000	96	86	82
21,000	103	92	88
24,000	111	99	94

2–61. SPINS.

2–62. GENERAL. Spin tests show that the airplane is markedly resistant to entering a spin, particularly with any power above idle. The spin itself is very steep with the airplane axis 60 degrees to 80 degrees nose down. Recovery is easily accomplished by application of opposite rudder followed by use of down elevator. If flaps or speed brakes are in use, they should be retracted before spin recovery is attempted.

2–63. PERMISSIBLE ACROBATICS.

2–64. GENERAL. Refer to paragraph 2–2 for permissible maneuvers.

2–65. DIVING.

2–66. GENERAL. Refer to figure 2–2 for dive restrictions.

WARNING

Do not use snap pull-outs in recovering from dives. Do not move the controls abruptly in any maneuvers at high speeds.

2–67. NIGHT FLYING.

2–68. Lights should be used as required. The proper use of oxygen during night flights is of particular importance. Oxygen should be used on all flights with cockpit altitude above 5,000 feet. (See paragraph 4–17.)

2–69. APPROACH.

2–70. DESCENT FROM ALTITUDE. No low altitude engine flame blowout troubles have been encountered with these engines. There is, however, an engine rpm below which the engine cannot be accelerated with safe exhaust temperature. This minimum rpm increases with altitude which means that low power operation may not be possible at high altitude. Specific information on minimum rpm vs. altitude will be added when available.

2–71. DESCENT CHECK LIST.

a. Landing gross weight—See paragraph 2–2d.
b. Shoulder harness and safety belt—Locked.
c. Wing flaps—As desired.
d. Landing gear—"WHEELS DOWN."
e. Speed retarder brakes—"CLOSE."

CAUTION

Speed brakes must be closed for landing or lower brake will be damaged.

f. Trim tabs—As desired.
g. Master armament switch—"OFF."
h. Gun selector switches—"OFF."
i. Automatic pilot—"OFF."
j. Upper hatch—Locked "OPEN."

2–72. FINAL APPROACH. The choice of engine speed for a landing approach must be a compromise between minimum thrust and time required to regain maximum thrust. Experience will dictate the most desirable speed to be used. The recommended approach speed is 110 knots (128 mph) IAS.

2–73. LANDING.

2–74. NORMAL LANDINGS.

2–75. SHORE LANDINGS. Use flaps as desired. Full flaps (40°) should normally be used. Lesser flap settings will result in increased landing speed, and hence increased ground run.

2–76. CARRIER LANDINGS. Full flaps (40°) should be used for all carrier landings. Lower the arresting hook and make a standard carrier approach.

WARNING

Contact the deck as in a normal tricycle gear landing, but with the nose wheel well off to clear the cables. Do not return the arresting hook control to the "HOOK UP" position until the airplane has come to rest on deck.

2–77. AFTER LANDING. Raise the wing flaps immediately upon completion of the landing roll.

2–78. SPECIAL LANDINGS.

2–79. CROSS WIND LANDINGS.

a. Make a longer and lower approach than normal to allow sufficient time to establish a course that will result in a ground track parallel to the runway.

b. Use a combination of crabbing and wing low method. No skidding is necessary.

c. Just prior to ground contact, change the airplane's heading to that of the runway and place the wheels on the ground.

Note

The above procedure will minimize side loads on the nose wheel, and make it easier to keep the airplane from turning into the wind.

2–80. MINIMUM RUN LANDING. The procedure for a minimum run landing is the same as for a normal approach and landing (see paragraphs 2–74 and 2–78) except for the following differences:

a. Hold the nose wheel off the ground as long as possible to increase the drag.

b. Do not raise the wing flaps until the airplane has sufficiently slowed down so that a stop is assured.

2–81. EMERGENCY LANDING PROCEDURES. See paragraph 3–19.

2–82. TAKE-OFF IF LANDING IS NOT COMPLETED.

a. Open the throttles smoothly.
b. Raise the landing gear.
c. Raise the landing flaps after a minimum safe altitude has been obtained.
d. Reduce power as required.

2–83. STOPPING THE ENGINES.

2–84. GENERAL. Each engine may be stopped as follows:

a. Set 60 per cent rpm (7500 rpm) and allow turbine outlet temperature to stabilize. Then close the throttle rapidly so as to produce a quick drop in dump valve actuating pressure and assure a more positive action of the dump valve.

b. Boost pump switch—"OFF."

c. Master engine switch—"OFF."

Note

To permit better cooling of the engine, the air inlet duct doors should be left open for a period of 20 minutes following ground shutdown.

d. If the engine air inlet duct doors are closed, turn the master engine switches "ON," move the throttle levers slightly forward out of the extreme cut-off position, and then turn the master engine switches "OFF."

CAUTION

Do not leave the airplane unattended with the inlet duct doors open.

e. After the proper cooling period, the inlet duct doors are closed by moving the throttle levers to the extreme aft position.

2–85. HYDRAULIC PUMP CHECK. Hydraulic pumps should be checked individually at frequent intervals in the following manner.

a. Stop left-hand engine.

b. With the auxiliary hydraulic selector control at "NORMAL" the hydraulic pressure gage should read 3,000 psi.

Note

Paragraph 2–25a explains check of the left-hand engine hydraulic pump after starting the left-hand engine. Paragraph 2–85 should now be applied, stopping the left-hand engine first to allow for checking the right-hand engine hydraulic pump. Both hydraulic pumps have thus been checked without resorting to extra operations.

2–86. BEFORE LEAVING THE AIRPLANE.

a. See that throttles are fully closed.

b. Turn off all electrical switches.

c. Uncage the gyro instruments.

d. Landing gear—"WHEELS DOWN."

e. Wing flaps—"UP" (0°).

f. Speed retarder brakes—"CLOSE."

2–87. MOORING.

a. Surface controls lock—"LOCK."

b. Chock wheels.

c. If gusty wind conditions prevail, tie the airplane down (see figure 2–3).

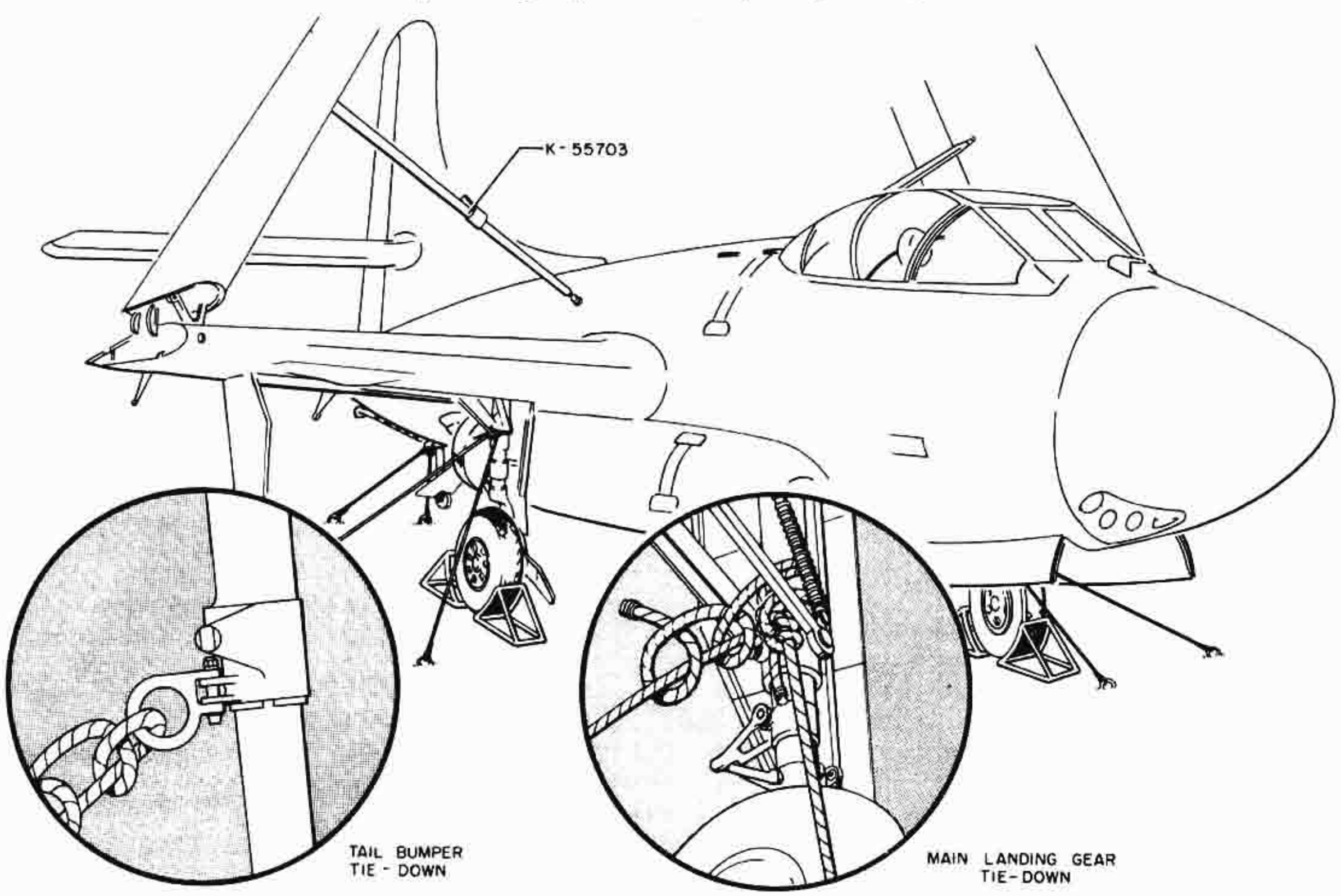


Figure 2-3. Mooring

SECTION III
EMERGENCY OPERATING INSTRUCTIONS

3–1. FIRE.

3–2. FIRE WHILE STARTING ENGINE. If a fire within the engine proper is indicated by high temperatures on the turbine outlet temperature indicators, shut down the engine afire by closing the throttle and turning the fuel boost pump switch "OFF." Turning the engine with the starter will normally blow the fire out. However, if fire continues, request ground crew use CO_2 and continue turning with the starter.

CAUTION

CO_2 should be applied in inlet ducts and boundary layer bleed ducts. It should not be applied through exhaust exit if fire is controllable by other procedures. Application of cold CO_2 to hot turbine blades may result in engine damage.

3–2A. The fire detection warning lights indicate fires in the accessory and aft cowl sections. In the event of a fire in these sections, shut down the engine afire by closing the throttle and turning the fuel boost pump switch "OFF." Turning the engine over with the starter will not aid in putting out this type of fire. CO_2 should be applied into boundary layer bleed ducts.

3–3. FIRE DURING TAKE-OFF. If a fire is indicated during take-off, shut-down the engine afire by closing the throttle and turning the fuel boost pump switch "OFF," and land immediately. If operating at normal gross weights, the climb out can be accomplished on single engine. Single engine control is adequate at all speeds above the stall.

3–4. FIRE DURING FLIGHT. If a fire occurs during flight, warning will be given by the fire detection warning light. Close the throttle and turn the fuel boost pump switch and master engine switch "OFF." Do not attempt to restart the engine. If conditions permit, the airplane may be landed with the other engine operative. However, it is left to the pilot's discretion whether to attempt a landing or to bail out.

3–5. FIRE WHILE STOPPING ENGINE. If fire persists in the burner or turbine section after closing the throttle, and CO_2 is not immediately available, continue engine operation until CO_2 is obtained. If, after stopping the engine, fire is noted to continue within the engine, leave fuel shut off, request external electrical power source be connected to receptacle if not already attached, and turn the engine with the starter. Normally, this will blow the fire out but if fire continues, request ground crew use CO_2. Continue turning with the starter.

CAUTION

Introduce CO_2 through engine intake duct or between the exhaust tail pipe and cowling. Do not shoot cold CO_2 directly into engine exhaust or damage to engine may result.

3–6. ELECTRICAL FIRES. In the event of a fire in the electrical system, the following procedure should be applied:

a. Turn off the battery and generator switch.

b. Turn off all electrical equipment except engine switches.

c. If the fire is extinguished and certain circuits are needed for the operation of the airplane, turn the circuits on one at a time, starting with the battery switch and watch for the one that caused the fire.

3–7. WING FIRE.

a. If a wing fire occurs during night flight operation, turn the switches which control all the lights within the wing "OFF."

b. Attempt to extinguish the fire by side-slipping the airplane away from the wing fire.

3–8. FUSELAGE FIRE. If a fuselage fire develops it is not possible to cut off the fuel supply from any one tank as no fuel selection is incorporated in this airplane due to the gravity feed system.

3–9. ENGINE FAILURE.

3–10. ENGINE FAILURE DURING TAKE-OFF. For a normal take-off weight, if single engine failure occurs before both flaps and gear are up, there is not sufficient power to climb. However, the control characteristics are satisfactory for all speeds above the stall. LAND STRAIGHT AHEAD. As many as possible of the following operations should be accomplished in the order given:

a. Landing gear—"WHEELS UP" unless sufficient runway is available STRAIGHT AHEAD for a landing in the normal ("WHEELS DOWN") position.

b. Wing flaps—FULL "DOWN" (40°).

c. Lower the seat.

d. Fuel boost switches and battery-generator switch—"OFF."

3–11. ONE ENGINE FAILURE IN FLIGHT.

3–12. If one engine fails during flight after flaps and gear are up, proceed as follows:

a. Increase operative engine to 100 per cent rpm (12,500 rpm).

b. Shut down inoperative engine completely. Make certain the master engine switch is turned off to permit closing of the inlet air shutter door.

c. Trim the airplane to fly directionally straight.

d. If prolonged single-engine flight is to be maintained, readjust the operative engine for a single-engine flight in accordance with figure A–4.

3–13. LANDING WITH ONE ENGINE INOPERATIVE. Make a normal approach and landing at airspeeds approximately 5 knots higher than usual.

3–14. LANDING WITH BOTH ENGINES INOPERATIVE. The maximum gliding ratio (gear and flaps up) with no power is 15 to 1 at approximately 150 knots (173 mph) IAS.

3–15. ESCAPE FROM AIRPLANE.

3–16. COCKPIT FLOODLIGHTS. The floodlights are turned on by the "EMERG" position of the flight and instrument lights selector switch (figure 1–5, reference 6) on the center console. The floodlights are turned on prior to an emergency escape at night to provide extensive lighting for the escape operation. Floodlights are installed at each side and on the aft bulkhead of the cockpit.

3–17. TO RELEASE THE ESCAPE CHUTE DOOR. Pull the escape chute door emergency release handle (figure 3–1, reference 4) located on the center console and leave the airplane as shown on figure 3–1.

WARNING

Use lower escape chute for emergency escapes in the air. At speeds above 175 knots, the upper escape hatch must be closed or the differential pressure will hold the lower escape chute doors closed. Speed brakes must be closed before bailing out. It is recommended that a feet first facing aft escape be employed. Although it is possible to escape through the chute head first, it is much less desirable.

3–18. TO OPEN THE UPPER ESCAPE HATCH. Pull the upper escape hatch emergency release handle (figure 3–1, reference 2) located on the instrument panel and leave the airplane as shown in figure 3–1.

3–19. FORCED LANDING.

3–20. GENERAL. The customary precautions should be observed when making a forced landing. It will be left up to the discretion of the pilot as to whether to make a landing with the wheels up or down. In case of a belly landing, the following should be accomplished:

a. Landing gear control—"WHEELS UP."
b. Wing flaps control—full "DOWN."
c. Shoulder harness and safety belt locked tight.
d. Open upper escape hatch.
e. Fuel boost switches—"OFF."
f. Engine master switches—"OFF."
g. Jettison external tanks, if carried.
h. Battery-generator switch—"OFF."

3–21. DITCHING.

3–22. PREPARATION FOR DITCHING.

a. Open upper emergency escape hatch.
b. Jettison loose equipment.

CAUTION

Do not open lower escape chute door to jettison equipment.

c. Shoulder harness and safety belt locked tight.

3–23. HANDLING THE AIRPLANE. Experience gained in ditching similar airplanes has shown that best results are obtained by following the procedure listed below.

a. If possible use up most of the fuel supply to lighten the airplane and reduce stalling speed. Empty tanks are also a contribution to flotation.

b. Ditch while power is available. Power will allow the pilot to choose the spot for ditching to obtain best possible sea conditions and most favorable landing position and attitude.

c. Ditch at lowest possible forward speed. At time of contact, attempt to have the lowest possible forward speed consistent with safe control of the airplane; this will reduce the landing impact. Under no circumstances should the airplane be stalled in as this will result in severe impact, and cause the airplane to nose into the sea.

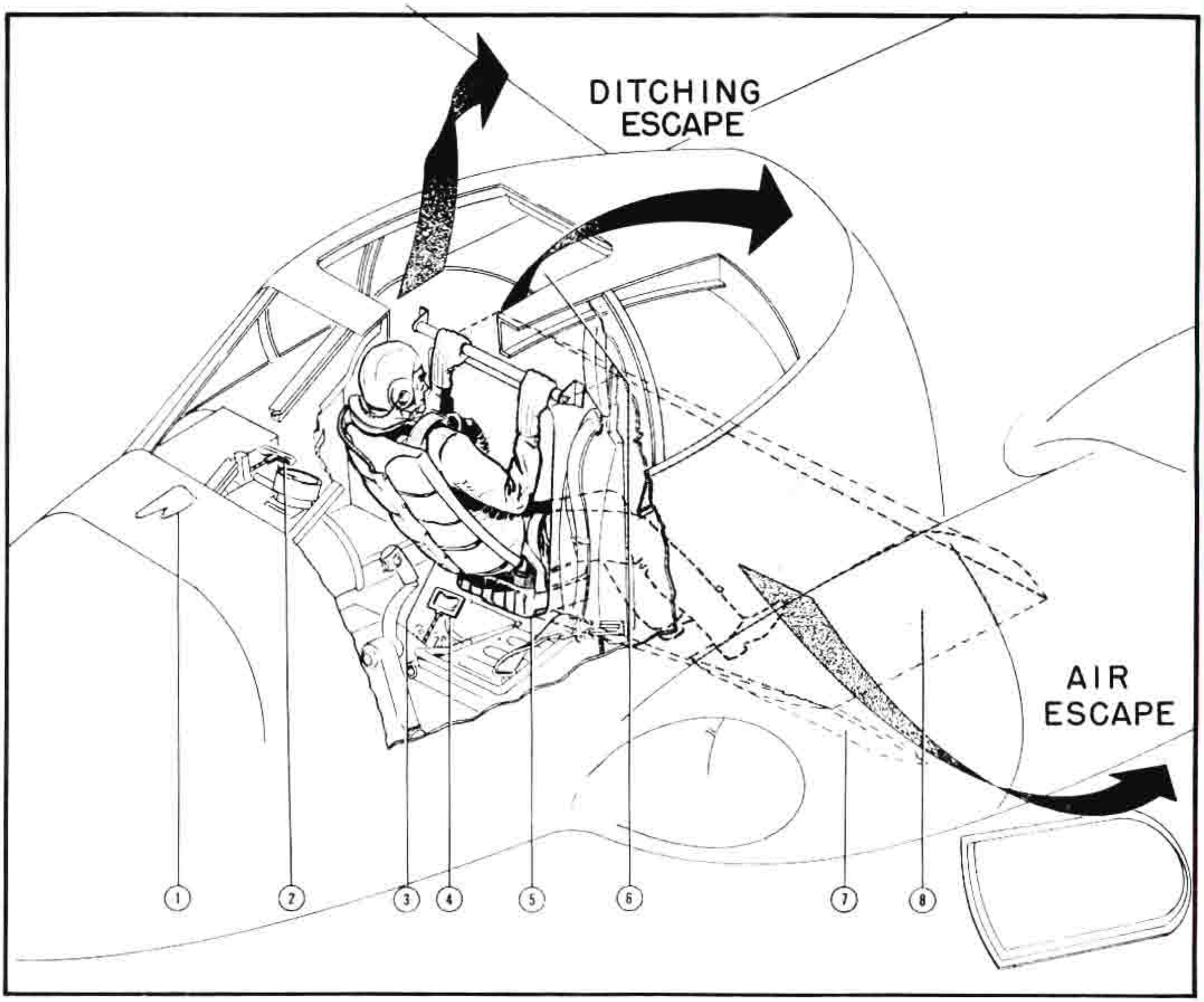
d. Ditch at the lowest possible rate of descent—100 feet per minute is recommended.

e. Ditch the airplane 5° nose high. This attitude gives best distribution of landing shock over the fuselage.

f. Ditch with the landing gear up and use flap setting of 20°. This flap setting should be used in most cases; however, it is left to the pilot's discretion for final judgement.

g. Avoid bouncing since bouncing will cause loss of control.

h. In daylight it is recommended that the airplane be ditched along the top of the swell, parallel to the row of swells if the wind does not exceed 35 knots. In high winds, it is recommended that ditching be conducted upwind to take advantage of lowered forward speed.



1. Pitot tube—barrier crash hook
2. Upper escape hatch emergency release handle
3. Back-type parachute
4. Lower escape chute emergency release handle
5. Pararaft kit
6. Upper escape hatch
7. Windscreen
8. Lower escape chute

Figure 3-1. Emergency Equipment and Exits

However, it must be remembered that the possibility of ramming nose-on into a wave is increased, as is the possibility of striking the tail on a wave crest and nosing in.

3–24. DITCHING WITH PARTIAL POWER FAILURE. On let-down with one engine inoperative, it is advisable to hold speed well above stalling speed until flare-out, at which time speed will be reduced to just above stalling and airplane set up for 5° nose high landing.

3–25. CROSSWIND DITCHING. The basic rules for ditching listed in paragraph 3–23 will still apply in addition to those listed below:

a. Crab the airplane to kill drift.
b. Land on downwind side of the swell or wave.

3–26. UP-WIND DITCHING. The basic rules for ditching listed in paragraph 3–23 will still apply in addition to those listed below:

a. Maintain nose up condition—avoid nose striking wave face.
b. Touch down immediately before the crest of a rising wave.
c. Hold nose up after first impact.

3–27. NIGHT DITCHING. Make an instrument let-down holding airspeed well above stalling speed, and at the lowest possible rate of descent. Landing attitude should be 5° nose high, with 20° flap.

3–28. EMERGENCY AIR STARTING OF ENGINES.

3–29. GENERAL. If an engine stops in flight and airplane performance is adequate on the operative engine, or if sufficient altitude is available if both engines are dead, an attempt may be made to restart either or both engines. The technique of ignition at altitude requires close watching of the exhaust temperature in order to determine when ignition takes place.

WARNING

If the engine oil temperature falls below —29°C (—20°F) while the engine is stopped, do not attempt a restart as serious damage to the engine may result. Descend to a warmer altitude, allow oil temperature to rise, and restart.

3–30. Nose the airplane down, or if one engine is operative, fly at such a speed that will permit the dead engine to windmill at least 12 per cent rpm (1500 rpm). With the fuel boost and master engine switches turned "ON," manipulate the throttle in the same manner as for a normal start. Above 30,000 feet engine windmilling rpm as much as 28 per cent (3500 rpm) may be necessary for air starts.

CAUTION

Do not windmill engine without fuel supplied to the fuel pump inlet as fuel is needed to lubricate the pump.

Note

Since the engine is windmilling above the maximum starter cranking speed, only the 30-second cycle of the ignition system is needed for an air start.

CAUTION

During engine acceleration in flight using the emergency fuel control, caution must be exercised to advance the throttle slowly so that the turbine outlet temperature limit for acceleration will not be exceeded. Unlike the normal fuel control, the emergency fuel control has no minimum fuel flow regulation. Therefore, caution must be exercised when decelerating to prevent engine instability or blow out.

3–31. FUEL SYSTEM EMERGENCY OPERATION.

3–32. GENERAL. Although both the primary and emergency fuel pumps are operating whenever the engine is running, only the primary pump normally supplies fuel to the system. With failure of the primary pump, the emergency pump automatically furnishes fuel pressure. However, should the fuel pressure start to drop with the normal system operating, the pilot can manually select the emergency system by momentarily moving the switch (figure 1–5, reference 5 or 16) on the center console to the "EMERG" position. A return to primary pump pressure is accomplished by momentarily moving the switch to "RESET."

3–33. COURSES OF FUEL FLOW. See figure 1–6.

3–34. SYSTEMS AND CONTROLS EMERGENCY OPERATION.

3–35. LANDING GEAR EMERGENCY EXTENSION. Slow the airplane down to 120 knots (139 mph). Move landing gear control lever to "WHEELS DOWN" position. Pull the emergency release handle (figure 1–3, reference 14) located on the left-hand console. This releases the gear door mechanical latches, permitting the landing gear to extend and open the landing gear doors by gravity.

3–36. EMERGENCY BRAKE OPERATION. If hydraulic system brake failure occurs, exert approximately twice the normal force on the rudder brake pedals. Allowance for extra run should be made.

3–37. WING FLAP EMERGENCY OPERATION. If the main hydraulic system fails and it is desired to extend the wing flaps in an emergency, move the auxiliary hydraulic system control to the "EMERGENCY WING FLAP" position to provide hydraulic pressure. Move the wing flap control to the "DOWN" position.

Note

Aileron power boost is off when emergency wing flap hydraulic pressure is used. Reduce airspeed and extend stick to lower the aileron control forces. After the wing flaps are down, aileron power boost can be regained by moving the wing flap control to the neutral position and then returning the auxiliary hydraulic system control to "NORMAL," thereby eliminating the necessity for stick extension.

3–38. AILERON POWER BOOST EMERGENCY RELEASE. In case of hydraulic system failure and excessive aileron forces are present, the aileron power boost system may be disconnected by pulling the emergency release handle (figure 1–5, reference 13). Reduce airspeed and extend stick to lower the aileron control forces.

3–39. EXTERNAL STORES EMERGENCY RELEASE. If electrical release at external stores fails, pull out on the emergency release handle (figure 1–3, reference 29).

3–40. ELECTRICAL SYSTEM EMERGENCY OPERATION.

3–41. GENERAL. If a generator warning light comes on, it is an indication that the reverse current relay for that generator is open thereby leaving only one generator connected into the electrical system. In such a condition the electrical load on the remaining generator should be maintained below 400 amperes. If both generator warning lights are ON the electrical system becomes dependent upon the battery. The battery contains sufficient charge to operate the instruments, radio equipment, and fuel boost pumps for approximately ten minutes if both generators are inoperative, providing no other electrical equipment is in use. The battery-generator switch must be moved to the "BAT ONLY" position after all non-essential equipment has been turned off.

3–42. LANDING GEAR SAFETY SOLENOID. A safety circuit containing a solenoid for the landing gear prevents the control lever from being moved to the "WHEELS UP" position when the landing gear is extended and the weight of the airplane is on the shock struts (struts compressed). If the circuit fails and it is desired to raise the gear, the solenoid locks may be released by operating the control safety lock button (figure 1–3, reference 11).

3–43. CIRCUIT BREAKERS. For location of circuit breaker panels see figure 1–3, reference 2 and figure 4–2, reference 14.

3–44. RADIO EQUIPMENT EMERGENCY OPERATION.

3–45. AN APX-2 EQUIPMENT. In case of an impending forced landing or other emergency, the AN APX-2 master switch should be placed in the EMERGENCY position by pushing the stop and turning the switch to the extreme clockwise position. This causes the transponder to send out a special emergency or distress signal. In case of a forced landing in questionable territory, the equipment should be destroyed after landing by raising the guard and closing the destructor switch. In case of a crash landing, an impact switch automatically sets off the destructor circuit, however, as an additional precaution, the destructor switch should be closed if time permits.

3–45A. AN APX-6 EQUIPMENT (same as AN APX-2).

3–46. OXYGEN EQUIPMENT EMERGENCY OPERATION.

3–47. OXYGEN REGULATOR. Should symptoms occur which suggest the onset of anoxia, immediately depress the "SAFETY PRESSURE" button located on the regulator and descend below 10,000 feet cockpit altitude. If for any reason the regulator should become inoperative and a constant flow of oxygen is not obtained by use of safety pressure, activate the oxygen bailout equipment and descend below 10,000 feet cockpit altitude.

3–48. MISCELLANEOUS EMERGENCY EQUIPMENT.

3–49. PARARAFT KIT. Each seat is designed to accommodate a seat-type pararaft kit and back-type parachute (figure 3–1, references 3 and 5). The parachute is operated in the usual manner by pulling the rip cord handle on the left retainer strap. After descending to land or into water, the pararaft kit should be separated from the harness by removing the release link on the container and pulling out the kit by the handle provided for that purpose.

Note

The pararaft should be attached to the life vest or belt by means of the lanyard provided. The pararaft may be lost after the parachute harness is removed if this attachment is not correctly made.

SECTION IV
OPERATIONAL EQUIPMENT

4–1. ARMAMENT EQUIPMENT.

4–2. GENERAL. The airplane is designed to carry four 20-mm guns. A Mk 20 Mod 0 gun sight is installed.

4–3. ARMAMENT MASTER SWITCH. The armament master switch (figure 1–4, reference 11) controls the operation of all gunnery and bomb switches. Unless this switch is "ON," no armament circuits can be energized, except the guns which can be charged if the arresting hook is up. The master armament circuit is automatically opened when the arresting hook is extended.

4–4. GUNNERY EQUIPMENT.

4–5. DESCRIPTION. Four forward firing 20-mm guns are mounted in the lower fuselage nose section, two on each side of the center line of the airplane. A gun sight (figure 1–4, reference 8) is provided. A gun camera is installed in the right-hand wing inboard of the fold joint.

4–6. GUNNERY CONTROLS.

4–7. GUN SIGHT LIGHT CONTROLS. The gun sight light switch and rheostat are located on the armament panel (figure 1–4, references 35 and 37). The upper "NORMAL" position of the switch selects the normal filament in the gun sight light while the lower "ALT" position selects the alternate (spare) filament. The rheostat controls the light intensity and also has an "OFF" position. The gun sight light is operative whenever the armament master switch is "ON" and either generator is delivering its normal output, or the battery-generator switch is turned to "BAT-GEN" or "BAT ONLY," or an external power source is connected to the airplane.

4–7A. GUN SIGHT RETICLE CONTROLS. Reticle selection is accomplished by rotating the reticle control knob located directly above the crash pad at the rear of the sight. Three reticles are available: the night reticle, intended for use where visibility of the target is extremely low; the day reticle, used for better image visibility against light backgrounds, contains detailed markings as the 50- and 100-mil circles for deflection firing in air to air gunnery, and the "ladder" reference points arranged in 10-mil graduations for air to ground rocket firing and low altitude bombing; and the combination reticle, used under conditions of reduced target visibility which exist at dawn, twilight, or during overcast periods.

4–8. GUN CONTROL SWITCHES. These switches are located on the instrument panel (figure 1–4, reference 12). The left-hand switch charges the outboard pair of guns and the right-hand switch charges the inboard pair of guns. The positions are "READY," "OFF" and "SAFE."

4–9. OPERATION OF GUNNERY EQUIPMENT.

4–10. TO OPERATE THE GUN SIGHT.

a. Battery switch "BAT & GEN."
b. Armament master switch—"ON."
c. Gun sight light switch—"NORMAL."
d. Adjust rheostat to desired brilliance.
e. Rotate the reticle control knob until the desired reticle pattern is visible on the windshield.
f. If light burns out or is inoperative, move the gun sight switch to "ALT."

4–11. TO CHARGE THE GUNS. The guns are charged by moving the gun control switches from "OFF" to "SAFE" and then to "READY." Several seconds are required for charging the guns and several seconds are required to relieve the hydraulic pressure after the switch has been set to the "READY" position. The gun charging electrical circuit is not dependent on the "MASTER ARMAMENT" switch.

4–12. TO FIRE THE GUNS.

a. Turn on gun sight.
b. Charge guns.
c. Squeeze trigger on control stick.

CAUTION

DO NOT fire guns with engines running while the airplane is on the ground without intake duct screens in place as ejected shells may rebound from the ground and be sucked into air intake scoop.

4–13. TO OPERATE THE GUN CAMERA. To operate the gun camera, the armament master switch must be in the "ON" position. The gun camera will operate when either the gun trigger or the emergency stores trigger on the stick is depressed.

4–14. BOMBING EQUIPMENT.

4–15. GENERAL. An Aero X-61A supporting rack is installed on each wing. The rack is designed for carrying Aero X-1A high speed external store shapes having three point suspension and not exceeding a maximum weight of 2000 pounds. External stores carried on the racks can be dropped normally by moving the BOMB RELEASE switches (figure 1–4, reference 38) from "OFF" to "LH" or "RH" as desired and depressing bomb trigger on stick. In an emergency, the external stores can be released by pulling out on the release handle (figure 1–3, reference 29) located at the aft end of the left-hand console.

4–16. OXYGEN AND ANTI-G SYSTEM EQUIPMENT.

4–17. OXYGEN SYSTEM.

4–18. GENERAL. An automatic positive pressure diluter-demand oxygen system is provided with oxygen

from three 514 cubic inch capacity oxygen cylinders. The oxygen system refill valve is located on the cockpit rear bulkhead. The pilot's regulator (figure 1–3, reference 18) is on the left-hand console. The radar operator's regulator (figure 4–2, reference 17) is on the right-hand console. The amount of air admitted through the air admission valve on the regulator is dependent upon the altitude up to approximately 30,000 feet, beyond which 100 per cent oxygen is automatically delivered. Above 30,000 feet, an automatic pressure breathing mechanism operates allowing internally regulated pressure to rise progressively to 10 inches of water or .36 psi at 43,000 feet altitude. A blinker flow indicator and oxygen system pressure gage is provided on each regulator console panel.

4–19. OXYGEN REGULATOR CONTROLS.

4–20. AIR VALVE KNOB. In the "NORMAL OXYGEN" position of the air valve knob, diluted oxygen is supplied upon demand. The amount of dilution depends upon cabin altitude up to 30,000 feet, above which 100% oxygen is supplied. Turning the control to "100% OXYGEN" supplies undiluted oxygen upon demand regardless of altitude.

4–21. SAFETY PRESSURE BUTTON. This button is pulled out for normal operation and pushed in to override the air valve knob. When pushed in undiluted oxygen is supplied upon demand but at a moderately higher pressure than that supplied by the air valve control.

CAUTION

In order to utilize the safety pressure feature of this type oxygen regulator, it is necessary to use the type A-13 or A-13A pressure breathing oxygen mask.

WARNING

In order to utilize the safety pressure feature of not securely in place, the supply of oxygen may be exhausted. A guard is provided to reduce the possibility of inadvertently engaging safety pressure.

4–22. PRE-FLIGHT CHECK. The following items should be checked at regular intervals when the airplane is on the ground, and whenever possible before flights in which oxygen is likely to be used, to assure proper functioning of the system:

a. Pressure gage should read 1800 ± 50 psi if the cylinder is fully charged.

b. Test the breathing tube couplings, regulator diaphragm and diluter check valve for leakage by inserting a spare mask tube quick disconnect fitting AN 6043, into the open end of the disconnect. Blow into the open 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 five seconds the leakage is within acceptable limits. If leakage exists check the coupling, outlet elbow, and breathing tube clamps for tightness.

c. Put on the mask. Check the mask fit by placing the thumb over the disconnect at the end of the mask tube and inhale lightly. If there is no leakage, the mask should adhere tightly to the face and definite resistance to inhalation should be encountered. If the mask leaks, tighten the mask suspension straps. DO NOT USE A MASK THAT LEAKS.

d. Fully engage the mating portions of the disconnect coupling to connect the mask to the personnel gear adapter.

e. Breathe several times with the regulator air valve in both "NORMAL OXYGEN" and "100 PER CENT OXYGEN" positions and with the "SAFETY PRESSURE" valve depressed, to check regulator operation and observe the flow indicator for "blink" verifying the positive flow of oxygen.

4–23. OPERATING INSTRUCTIONS. Oxygen shall be used constantly during day flights when above 10,000 feet. Oxygen shall be used constantly during night flight when above 5,000 feet when on combat or training flights. The following procedures should be followed when oxygen is used during flight:

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

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

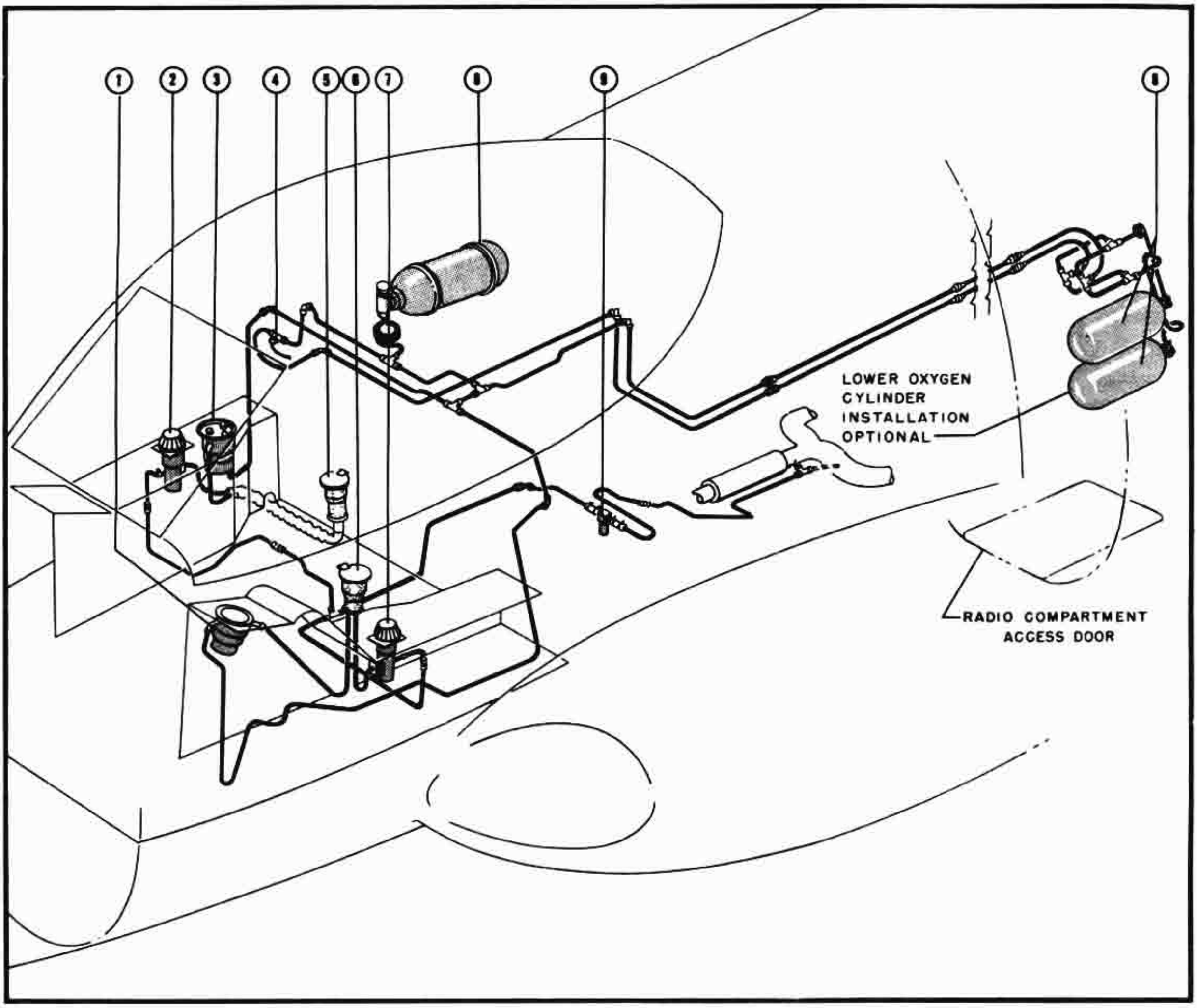
c. Put the mask on. Fully engage the mating portions of the disconnect couplings to connect the mask to the oxygen system. Attach the ring to a snap clip sewed to the flight suit sufficiently high on the chest to permit free movement of the breathing tube. It is particularly important that the clip be high on the chest when the Erie bailout connector is used, as otherwise movement of the head expands and contracts the breathing tube. Exhalation after compression of the breathing tube by downward head movement will be difficult due to the increased compensating pressure in the breathing tube.

Note

In order that the breathing tube does not interfere with body movement and to insure safety in bail-out, it is necessary to sew a loop on the pilot's flight suit, so that in a sitting position the lower free end of the disconnect will be snubbed to its shortest workable length.

d. To check the mask fit, squeeze the mask tube and inhale lightly. If there is no leakage, the mask should adhere tightly to the face and definite resistance to inhalation should be encountered. If the mask leaks, tighten the suspension straps.

e. The oxygen flow indicator blinks upon the intermittent application of from 5″ to 7″ of water pressure created by the flow of oxygen. The automatic pressure breathing oxygen regulator delivers a pressure of



1. Pilot's oxygen regulator
2. Radar operator's anti-g air control
3. Radar operator's oxygen regulator
4. Oxygen system filler valve
5. Radar operator's personnel gear receptacle
6. Pilot's personnel gear receptacle
7. Pilot's anti-g air control
8. Oxygen cylinder
9. Anti-g system air filter

Figure 4-1. Oxygen and Anti-G System Diagram

5" to 7" of water to the mask at approximately 41,000 feet and 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.

4–24. The following should be checked frequently while on oxygen:

a. Cylinder pressure gage for oxygen supply.

b. Oxygen flow indicator for flow of oxygen through regulator.

c. Mask fit for leak tightness.

d. In event of loss of radio communication, check the personnel gear receptacle to see that the connector is plugged in.

WARNING

Oxygen supply is also dependent on this disconnect.

4–25. EMERGENCY CONDITIONS.

a. Should symptoms occur suggestive of the onset of hypoxia or the regulator becomes inoperative, immediately depress the "SAFETY PRESSURE" button located on the regulator and descend below 10,000 feet cockpit altitude. If for any reason the regulator should become inoperative and a constant flow of oxygen is not obtained by use of safety pressure, activate the oxygen bail-out equipment and descend below 10,000 feet cockpit altitude.

b. Whenever excessive carbon monoxide or other noxious or irritating gas is present or suspected, regardless of altitude, the air valve should be turned to "OFF" or "100% OXYGEN," and undiluted oxygen used until the danger is passed or the flight is completed.

c. Do not exhaust supply cylinder below 300 psi except in an emergency.

d. The following table may be used to determine the number of man hours of oxygen available at various altitudes with three oxygen cylinders installed in the airplane:

Cabin Not Pressurized			Cabin Pressurized		
Airplane Altitude	Air Valve "ON" (Normal Oxygen)	Air Valve "OFF" (100% Oxygen)	Cabin Altitude	Air Valve "ON" (Normal Oxygen)	Air Valve "OFF" (100% Oxygen)
10,000	26.46	3.39	5,000	22.95	2.70
15,000	24.90	4.29	7,750	25.50	3.09
20,000	20.01	5.46	11,600	26.40	3.66
25,000	12.45	6.96	16,000	24.15	4.50
30,000	9.30	9.09	18,700	21.60	5.10
35,000	12.51	12.51	22,000	17.25	6.00
40,000	12.51	12.51	25,000	12.45	6.96

Note

Installation of the lower oxygen cylinder in the radio equipment compartment is optional. If only two cylinders are installed, the man hours in the above table should be reduced by one-third.

4–26. Should brief removal of the mask from the face be necessary at high altitude, the following procedure should be used.

a. Take three or four deep breaths of 100 per cent oxygen (air value set to "OFF" or "100 PER CENT OXYGEN").

b. Hold breath and remove mask from face.

c. As soon as practicable, replace mask to face and take three or four deep breaths of 100 per cent oxygen.

d. Reset the air valve lever to the normal operating position.

4–27. ANTI-G SYSTEM.

4–28. GENERAL. The use of an anti-g suit will increase the ability to withstand blackout. It also decreases the amount of fatigue resulting from continued dives, pullouts and acrobatics. The control valve will automatically open at 1¾ "g's" and allow increased inflation of the suit as the applied "g" increases. The air pressure in the suit increases at approximately one psi per "g" when the control is set to "LO" and approximately 1.5 psi per "g" when the control is set to "HI." The valve adjusts itself to the "g" applied and will rapidly reduce the pressure as level flight is attained. The suit should fit comfortably during level flight. If worn too loose, inflation time will be reduced and the protection against "g" will be of a less degree. If forced down at sea the suit can be used as accessory flotation gear. (See paragraph 4–34.)

4–29. CONTROLS.

4–30. ANTI-G AIR CONTROL VALVES. The pilot's anti-g air control valve (figure 1–3, reference 3) is located on the left-hand console panel. The radar operator's anti-g air control valve (figure 4–2, reference 15) is located on the right-hand console panel. The controls each have a "HIGH" and "LOW" position.

4–31. ACCELEROMETER. The accelerometer (figure 1–4, reference 19) must be used while becoming accustomed to the suit.

4–32. PERSONNEL GEAR ADAPTER. The anti-g suit connector is plugged into the fitting at the lower end of the personnel gear adapter. The anti-g pressure system is operable during flight if the adapter fitting is plugged into the personnel gear receptacle (see paragraph 1–59).

4–33. OPERATION.

a. Plug the suit connection in the personnel gear adapter.

Note

Test the disconnect each time it is plugged in.

b. Turn the anti-g air control valve to "HIGH" or "LOW." If the ability to withstand "g" forces is lower than average, there may be a tendency to "grey," even with the suit on. If this is the case or for added protection turn the control to the "HIGH" position.

Note

If a tendency to "grey" is present, tensing the abdominal muscles will help in this circumstance.

c. Watch the accelerometer.

WARNING

The limiting load factor shown in figure 2–2 must be observed during all maneuvers even though anti-g equipment is being used.

4–34. ACCESSORY FLOTATION GEAR. If forced down at sea the anti-g equipment may be used as accessory flotation gear. Unzip both legs of suit by jerking upward on the quick release zipper fastenings at the top, and pull the zippers apart. Fasten the unzipped legs behind, using the snaps on the pockets. Take the plug stowed in the left breast pocket, plug it into the disconnect, and inflate the suit. The oral valve must be unscrewed before it can be blown through.

WARNING

The anti-g suit will not take the place of a life jacket. It will only provide extra buoyancy.

4–35. ELECTRONIC EQUIPMENT.

4–36. GENERAL. The electronic installations in the airplane are of four types, each of which is listed below with its components of equipment:

Equipment	*Designation*	*Range*	*Paragraph*
a. *Communication*			
VHF radio	AN/ARC-1	*Horizon	4–39
VHF radio relay	AN/ARC-28	*Horizon	4–43
Interphone	AN/AIC-4		4–50
b. *Navigation*			
VHF homing	AN/ARR-2A	*Horizon	4–60
Radio altimeter	AN/APN-1	0 to 400 feet or 0 to 4000 feet	4–65
Radio compass	AN/ARN-6	200 nautical miles (approx.)	4–71
c. *Radar*			
**Search	AN/APS-21	200 nautical miles (max. land target)	4–83
**Tail warning	AN/APS-28	3 nautical miles	4–83
**Gun aiming	AN/APG-26	4000 yards	4–83
d. *Identification*			
Transponder-interrogator-responsor	AN/APX-2 or AN/APX-2A	*Horizon *Horizon	4–84
Transponder	AN/APX-6	*Horizon	4–95
***Interrogator-responsor	AN/APX-7	*Horizon	

*These ranges are approximate and depend upon altitude, existing conditions, ground equipment, etc.

**Components of AN/APQ-35 radar.

***Space provisions only.

4–37. MASTER RADIO SWITCH. The "MASTER RADIO" switch (figure 4–2, reference 26) is on the right-hand console and furnishes power to all communication and navigation equipment with exception of the radio altimeter.

4–38. ELECTRONIC EQUIPMENT CHECK.

a. Connect the mask microphone and headset to the personnel gear adapter, or the hand microphone and headset to the extension cord jack.

b. Check operation of console lights by turning the CONSOLE LIGHTS rheostat and the R.H. CONSOLE LIGHTS rheostat clockwise. The GFE panels for electronic equipment control have been modified to incorporate the indirect red lighting used on all other console control panels.

c. After the engines are running and the generators are charging approximately 48 per cent rpm (6000 rpm) or over, or with an external power source connected, turn the "MASTER RADIO" switch to "ON." Allow approximately one minute for the equipment to warm up. Adjust the volume control on the applicable interphone control panel for power output. The preflight inspection required is an operational check as follows:

d. Turn on all radio equipment that operates in conjunction with the interphone.

e. The VHF receiver channels may be checked on the pilot's and radar operator's control panels by operating the radio switches to their respective settings after first setting the knob on the radar operator's RELAY panel to the desired VHF receiver. From the pilot's station, the navigation receiver and the range receiver must be checked individually as no switch selection is provided for their reception. From the radar operator's station, navigation and range receivers can be selected from the SELECTOR panel.

f. The transmitters should be checked by setting the "TRANSMIT" and "RECEIVER" switches to "VHF" on the pilot's MIXER panel and on the radar operator's "SELECTOR" panel, and talking into the microphone with the transmit switch operated.

g. The interphone system should be checked for reception from each station to the other.

Note

Transmission instructions for electronic equipment are subject to local limitations regarding radio silence.

4–39. VHF RADIO EQUIPMENT.

4-40. GENERAL. The AN/ARC-1 VHF radio provides radio telephone communication between aircraft, or between aircraft and ground stations.

4–41. VHF RADIO TRANSMITTER - RECEIVERS. Each of the two RT-18/ARC-1 transmitter-receivers installed in the airplane provides radio telephone communication in the frequency range of 100 to 156 mega-

cycles. A pair of frequencies, consisting of one frequency for transmitting and receiving on one transmitter-receiver, and a second frequency for receiving and transmitting on the second transmitter-receiver, are selected from the two operators' control units. A relay cuts out the receiver section and cuts in the transmitter section when the pilot's or radar operator's transmit switch is depressed.

4–42. VHF RADIO CONTROL UNITS. The pilot's modified C-115/ARC-1 VHF radio control unit (figure 1–5, reference 14) is on the cockpit center console and the radar operator's modified C-115/ARC-1 VHF radio control unit (figure 4–2, reference 23) is on the right-hand console. Each unit provides a nine-position rotary switch marked "CHAN SEL" and a three-position rotary switch marked "GUARD-BOTH-MAIN T/R." The switch marked "CHAN SEL" provides for the selection of any one of the nine pre-selected main channel frequencies. The "GUARD-BOTH-MAIN T/R" switch permits operation on the guard channel, the selected main channel or both channels simultaneously. Both the pilot's and the radar operator's VHF control units are subject to control of the C-390/ARC-28 VHF relay control unit.

4–43. VHF RELAY EQUIPMENT.

4–44. GENERAL. The AN/ARC-28 VHF relay equipment in this aircraft may be used to extend the operating range of two-way VHF radio communication with modulated signals of other aircraft or ground stations, by acting as an automatic relay between them, as for example, between a ground station or ship and a second aircraft in flight. By this method the equipment is capable of extending consistent VHF communication far beyond ordinary horizon limitation. This equipment does not, however, have any direct effect on the range to be expected from the VHF radio installed in this aircraft. The AN/ARC-28 equipment is made up of the two RT-18/ARC-1 VHF radio transmitter-receivers interconnected by a RE-51/ARC-28 relay unit, the two C-115/ARC-1 control units, and a C-390/ARC-28 control unit. Normally, a modulated radio signal received from either terminal station of the radio circuit is retransmitted automatically to the other terminal station.

4–45. RELAY CONTROL UNIT. The modified C-390/ARC-28 "RELAY" control unit (figure 4–2, reference 22) is on the right-hand console and has a selector switch with positions "OFF," "1," "2," and "RELAY." With the selector switch on position "1," both the pilot and the radar operator may transmit and receive on the No. 1 VHF with channel selection in control of the pilot. On switch position "2," both the pilot and the radar operator may transmit and receive on the No. 2 VHF with channel selection in control of the radar operator. With the switch at "RELAY," the RE-51/ARC-28 relay is turned on as well as the two RT-18/ARC-1 transmitter-receivers. In this position the pilot and operator can only monitor the relayed transmissions of the stations utilizing the relay system.

Note

When the C-390/ARC-28 control unit is turned to "OFF," both RT-18/ARC-1 transmitter-receivers will be off.

4–46. No local transmitter-receiver control during relay operation is available.

4–47. OPERATION OF RELAY AND VHF RADIO.

CAUTION

Each time the equipment is turned on, allow at least 20 seconds for the vacuum tubes to reach operating temperature before using the equipment for relay operation, or before operating the transmit switches if local control is desired.

4–48. AUTOMATIC RELAY OPERATION.

a. Rotate the knob on the radar operator's relay panel (control unit C-390/ARC-28) to "RELAY," then rotate CHAN SEL switches at the pilot's and radar operator's VHF panels (control units C-115/ARC-1) to the two frequency channels selected for relay operation, giving the desired frequency combination. The equipment will be ready for automatic relay operation as soon as the vacuum tubes reach operating temperature.

b. To change the frequency combination of the system, rotate the CHAN SEL switches of each VHF panel (C-115/ARC-1 control unit) to the two desired frequency channels.

c. Monitoring will give an indication that the equipment is operating properly.

4–49. OPERATION OF VHF RADIO.

a. RELAY control unit (see paragraph 4–45), set to "1" or "2" depending upon whether the pilot ("1") or radar operator ("2") is to have control.

b. On selected VHF control panel, set "GUARD-BOTH-MAIN T/R" switch and "CHAN SEL" switch to channels desired.

c. RECEIVER switch on MIXER and SELECTOR panels—set to "VHF" if reception is desired.

d. The pilot transmits on "1" transmitter-receiver by lifting upward on the throttle transmit switch.

e. The radar operator transmits on "2" transmitter-receiver by selecting "VHF" on the TRANSMIT switch and then depressing the foot transmit switch.

4–50. RADIO INTERPHONE EQUIPMENT.

4–51. GENERAL. The AN/AIC-4 radio interphone provides communication between the pilot and the radar operator.

4–52. PILOT'S MIXER CONTROL PANEL. The modified C-242/AIC-4 pilot's MIXER control panel (figure 1–5, reference 8) is on the center console. The panel contains the "RADIO" and "ICS" volume controls, the VHF receiver selector toggle switch, and the "RADIO" selector switch which has two positions,

"NORMAL" and "ALTERNATE." Under normal conditions, the "NORMAL" position is used, amplifying all radio receiver outputs through the AM-40/AIC interphone amplifier. If the amplifier becomes inoperative, the switch is moved to "ALTERNATE," in which position the amplifier circuit is by-passed. In this position, any radio receiver output selected by the pilot will also appear in the radar operator's headphones, and accordingly may interfere with other radio reception by the radar operator. The HF receiver selector toggle switch and sensitivity control, and the transmission selector switch are not used in this system.

4–53. RADAR OPERATOR'S SELECTOR CONTROL PANEL. The modified C-387/AIC-4 radar operator's selector control panel (figure 4–2, reference 21) is on the right-hand console. The panel contains the "RADIO VOL" and "ICS VOL" controls, the TRANSMIT switch with "VHF" and "ICS" positions, and the RECEIVER selector switch with "OUT," "VHF," "NAV" and "COMP" positions.

4–54. MICROPHONE HEADSET EXTENSIONS. The pilot's headset extension jack (figure 1–3, reference 30) is located adjacent to the pilot's circuit breaker panel. The radar operator's headset extension jack (figure 4–2, reference 15A) is located adjacent to the radar operator's circuit breaker panel. Plug-in facilities are provided in the jacks for headset and mask microphone connections.

4–55. THROTTLE TRANSMIT SWITCH. The throttle transmit switch (figure 1–3, reference 10) is on the inboard throttle control lever. The switch is a two-position switch, upward for "RADIO" transmission and downward for "ICS." Use of the switch in the "RADIO" position energizes relays in the VHF transmitter-receiver which causes the transmitter section to become operative and the receiver section to become inoperative.

4–56. FOOT TRANSMIT SWITCH. The foot transmit switch (figure 1–9, reference 1A) is located on the floor forward of the radar operator. The switch is used by the radar operator for both "ICS" and "VHF."

4–57. OPERATION OF INTERPHONE EQUIPMENT.

a. MASTER radio switch—"ON."

b. Radar operator's TRANSMIT switch—"ICS."

c. Pilot's "ICS" volume control—set for desired audio level.

d. Radar operator's "ICS VOL" control—set for desired audio level.

e. To transmit—pilot's throttle switch to "ICS" (down) or radar operator's foot switch depressed. If hand microphone is connected to jack, press microphone switch.

Note

Interphone reception is at either station regardless of position selected on the receiver selector switches.

4–58. Deleted.

4–59. Deleted.

4–60. HOMING RADIO EQUIPMENT.

4–61. GENERAL. The AN/ARR-2A homing radio provides radio telephone or MCW reception for homing purposes.

4–62. HOMING RADIO RECEIVER. The R-4A/ARR-2 homing radio receiver receives either navigation (MCW) or voice signals. In either case, the original signal (at the transmitter) is impressed on another signal in the frequency band between 540 and 830 kilocycles (called the modulation frequency). This in turn modulates a carrier frequency between 234 and 258 megacycles to produce the radiated signal. The receiver de-modulates the signal in reverse order. Six preset frequency modulated channels are available and may be selected by remote control. When the receiver is used for navigation, a beat oscillator produces an audible beat note. When used for reception of voice modulation, the beat note oscillator is cut out. The desired operating condition (NAV or VOICE) is selected by the switch on the remote control unit.

4–63. HOMING RADIO CONTROL CONSOLE. The modified C-116/ARR-2A homing radio control console (figure 4–2, reference 25) is located on the cockpit right-hand control console and is marked "NAVIG." The console contains the sensitivity control marked "SENS," the selector control marked "PITCH" and the channel selector marked "CHAN SEL." The "SENS" control with the indicated position "INCREASE OUTPUT" adjusts the sensitivity of the receiver by varying the R-F gain. The "PITCH" control is used to connect a beat frequency oscillator into the circuit for code reception when the switch is set to "NAV," and to disconnect it from the circuit when the switch is set to "VOICE." The control when set to "NAV" also varies the tone of the beat frequency oscillator. The "CHAN SEL" control is used to select one of the six preset frequencies indicated by the positions marked "1" to "6."

4–64. OPERATION OF HOMING RADIO.

a. Radio master switch—"ON."

b. Turn "CHAN SEL" control on the "NAVIG" panel to the assigned channel number.

c. Turn "PITCH" control to "NAV."

d. Adjust the "SENS" control to produce a usable weak signal, or if the desired signal cannot be heard, to a fairly strong background hiss.

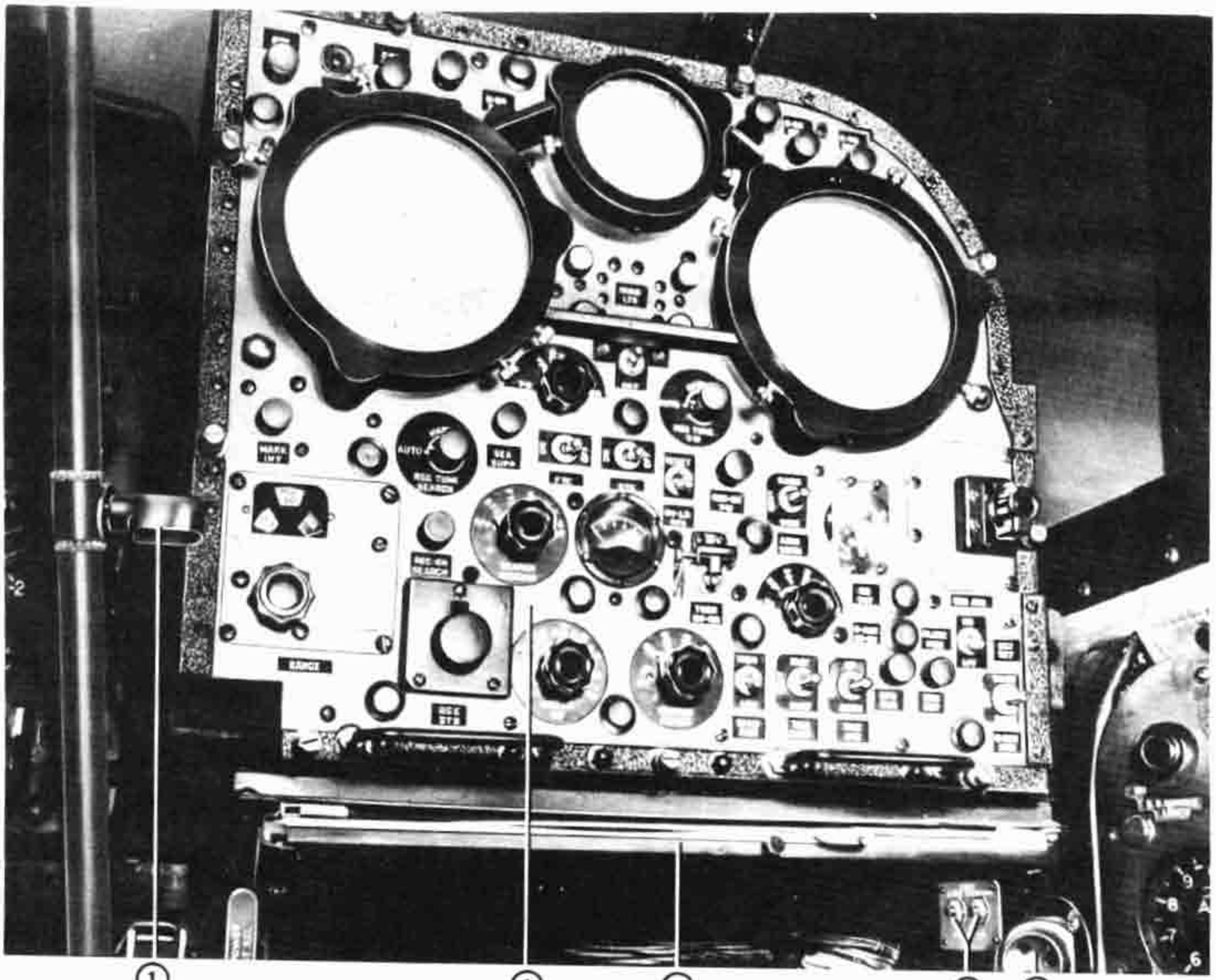
e. If a signal is present, adjust the "PITCH" control to produce a pleasing audible tone.

f. Readjust the "SENS" control to keep the signal at the lowest usable level to avoid wrong course indications.

4–65. RADIO ALTIMETER EQUIPMENT.

4–66. GENERAL. The AN/APN-1 radio altimeter gives indication of the altitude above the terrain, for navigational purposes.

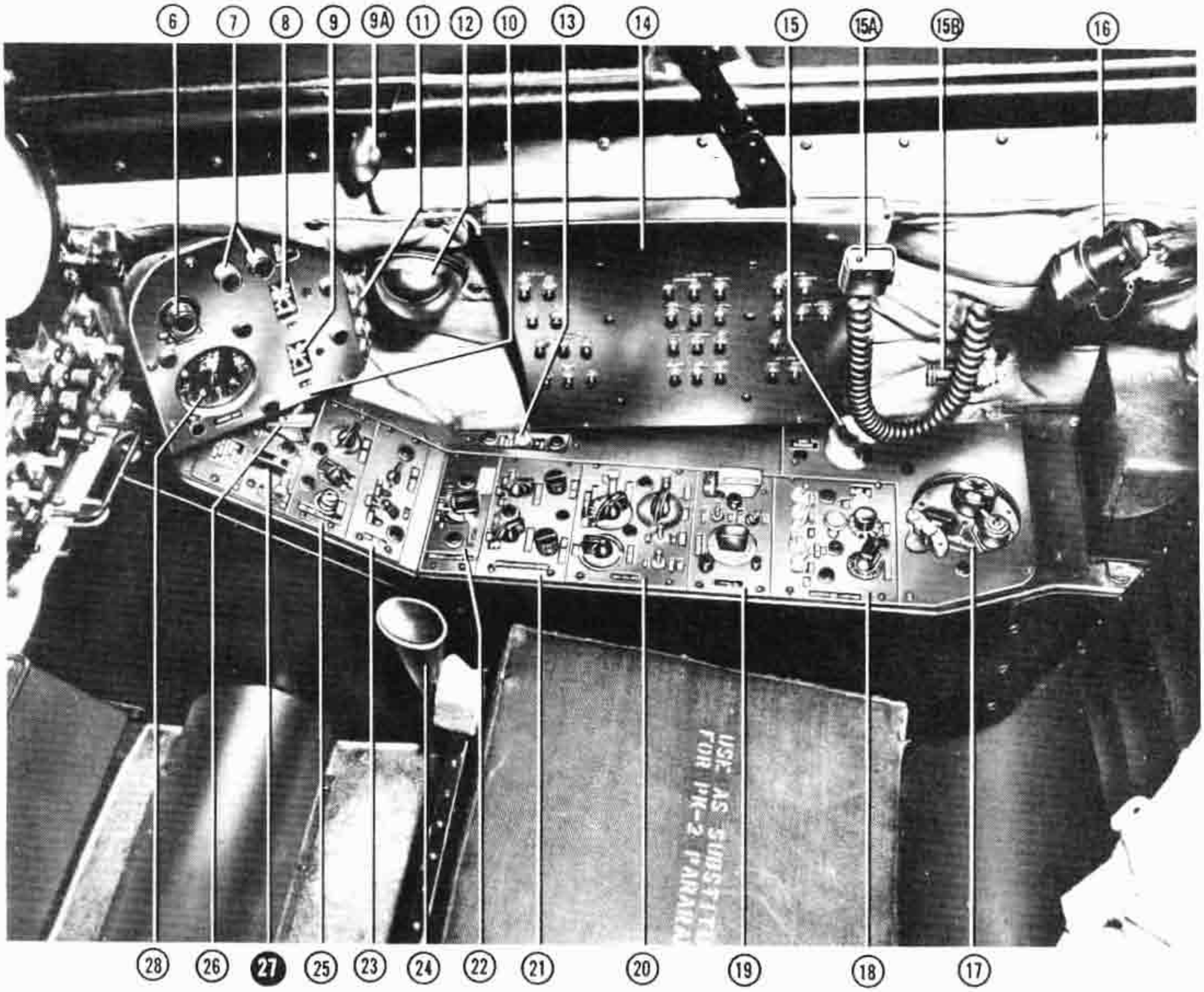
4–67. RADIO ALTIMETER INDICATOR. The ID-14A/APN-1 radio altimeter indicator (figure 1–4, reference 4) is installed on the cockpit instrument panel. Two control switches are incorporated at the face of



Front View—Right Side

1. Chartboard light
2. AN/APQ-35 radar control panel
3. Chartboard
4. Fire warning test switches
5. Radar operator's ventilating air outlet
6. Right-hand console lights rheostat
7. Generator warning lights
8. Left-hand generator volt-ammeter
9. Right-hand generator volt-ammeter
9A. Chartboard light
10. Pitot heat switch
11. Test jack panel
12. Ash tray
13. A-c power selector switch
14. Right-hand circuit breaker panel
15. Radar operator's anti-g air control
15A. Microphone headset extension cord
15B. Oxygen regulator panel flood light

Figure 4-2 (Sheet 1 of 2 Sheets). Radar Operator's Equipment



Right-Hand Console

16. Cockpit floodlight
17. Radar operator's oxygen regulator
18. Exterior lights control panel
19. AN/APX-6 IFF radio control panel
20. AN/APX-2 IFF radio control panel
21. Radar operator's AN/AIC-4 interphone control panel
22. AN/ARC-28 VHF radio relay control panel
23. Radar operator's AN/ARC-1 VHF radio control panel
24. Radar operator's relief tube
25. AN/ARR-2A VHF homing radio control panel
26. Master radio switch
27. Battery and generator switch
28. Cabin altimeter
29. Deleted
30. Deleted

Figure 4-2 (Sheet 2 of 2 Sheets). Radar Operator's Equipment

the instrument: the power switch which controls the power input to the RT-7/APN-1 radio altimeter transmitter-receiver; and a range switch which selects the desired altitude (low or high) range. The numerals 1, 2, 3 and 4, indicating the altitude for the low range in hundreds of feet, and 10, 20, 30 and 40, also in hundreds of feet for the high range, are visible through four windows on the face of the instrument. Therefore, the full scale reading for the low range is 400 feet and the full scale reading for the high range is 4000 feet.

4–68. RADIO ALTIMETER LIMIT SWITCH. The radio altimeter limit switch (figure 1–3, reference 27) is located on the cockpit left-hand console. The switch operates in conjunction with the limit indicating light and the range switch on the indicator. The switch is preset to any altitude within range of the indicator; the setting determines the altitudes at which the indicating light will function.

4–69. RADIO ALTIMETER LIMIT INDICATING LIGHT. This limit indicating light (figure 1–4, reference 2) is installed on the left-hand side of the instrument panel. This red light illuminates when the airplane is at a lower altitude than that preset on the limit switch.

4–70. OPERATION OF RADIO ALTIMETER EQUIPMENT.

a. Turn power control switch clockwise.

b. Allow one minute for tubes to heat and observe that the indicator has moved from its sub-zero stop position to some other position indicating that the equipment is energized.

CAUTION

When the airplane is resting on the ground, the indicator pointer may not indicate zero altitude.

c. Set the range switch on the indicator to show the desired altitude range.

d. Set the limit switch for the altitude at which the limit indicator light will light.

WARNING

The HIGH RANGE of the altimeter must never be used when flying at altitudes within the LOW RANGE or when landing.

e. To shut off the radio altimeter equipment, turn the power control switch on the altitude indicator fully counterclockwise.

4–71. RADIO COMPASS.

4–72. GENERAL. The AN/ARN-6 radio compass is designated to guide the aircraft to a transmitting station at its destination or to take bearings on transmitting stations as an aid to navigation. It may also be used as a radio communication receiver. The equipment has a frequency range of 100 to 1750 kilocycles.

4–73. CONTROLS. The C-149/ARN-6 control box (figure 1–3, reference 4) is installed on the left-hand side of the cockpit below the circuit breaker panel.

4–74. OPERATION.

4–75. TO START EQUIPMENT. The equipment is started by turning the functioning switch to "COMP," "ANT" or "LOOP" position.

4–76. HOMING COMPASS OPERATION.

a. Turn the function switch to "COMP" position.

b. Rotate the band switch to the frequency band in which operation is desired.

c. Turn the "TUNING" crank to the desired station frequency and tune for maximum swing of the tuning meter. Greater accuracy in tuning may be obtained by placing the "CW-VOICE" switch in "CW" position. A 900-cycle tone will be heard along with the station modulation. This will aid in accurate tuning. After tuning return the "CW-VOICE" switch to "VOICE" to eliminate the 900-cycle tone.

d. Adjust "AUDIO" control for desired headset level.

e. Listen for station identification to be sure that the correct station is being received.

f. Turn the "VAR" knob on the indicator until the azimuth zero is at the index.

g. The indicator pointer will now show the bearing of the station relative to aircraft heading. For example, if the pointer is to the left of zero the station is on your left. Turn your aircraft to the left until the pointer is at zero. If the aircraft heading is held at zero degrees on the radio compass indicator, you will ultimately fly over the radio station antenna. Cross winds, however, will cause the flight path to be a curved line. Direction of wind drift may be determined by noting any change in magnetic bearing while homing with the radio compass. An increasing magnetic bearing indicates a wind from the right while a decreasing magnetic bearing indicates a wind from the left. Compensate for wind drift by offsetting the aircraft heading until there is a minimum rate of change of the magnetic compass reading. The radio compass indicator now shows directly in degrees the relative aircraft to station heading necessary to correct for wind drift.

4–77. POSITION FINDING–AUTOMATIC METHOD.

a. Select three stations whose geographical locations are spaced at approximately equal intervals about the aircraft.

b. Tune in the stations, identify them and log their dial readings.

c. Adjust "VAR" knob on the indicator until its bearing scale at the index is the same as the *true* magnetic heading of the aircraft.

d. Set the function switch knob to "COMP."

e. Tune in one of the selected stations, and record the bearing as indicated by the *tail* of the indicator pointer.

f. Repeat step e for the other stations, in rapid succession, while flying with a steady level heading.

Note

Because of the plane's motion, the less time taken for observations, the greater the accuracy of the fix.

g. The recorded bearings will be the station to aircraft bearing from north. Project lines from the stations at the recorded bearings. The aircraft position will be within the vicinity of the small triangle made by the intersection of the projected lines.

4–78. POSITION FINDING–AURAL-NULL METHOD.

a. Select three stations whose geographical locations are spaced at approximately equal intervals about the aircraft.

b. Tune in the stations, identify them and log their dial readings.

c. Adjust the "VAR" knob on the indicator until its bearing scale at the index is the same as the *true* magnetic heading of the aircraft.

d. Set the function switch knob to "LOOP" position.

e. Tune in the desired station. To obtain good signal strength for station identification it may be necessary to rotate the loop by means of the "LOOP L-R" switch knob for maximum signal. Direction and speed of the loop's rotation are controlled by direction and amount of "LOOP L-R" switch rotation, respectively.

f. Use the "LOOP L-R" switch knob, as in step e, and rotate loop for minimum headset volume. Record the bearings shown by the indicator pointer. Better definition of the null may be obtained by turning the "AUDIO" control fully clockwise and locating the null by either listening for minimum audio signal or noting a counterclockwise dip of the tuning meter pointer. The use of "CW" operation also improves the definition of the null. To obtain "CW" operation throw the "CW-VOICE" switch to "CW" position.

g. Position finding in "LOOP" operation is subject to a 180 degree error since there are two null points in a 360 degree rotation of the loop. This ambiguity is overcome by keeping aware of the general geographical location and selecting stations located well to the left and right of the course.

4–79. RECEIVER OPERATION–ANTENNA RECEPTION.

a. Turn the function switch to "ANT" position.

b. Turn band switch to desired frequency band.

c. Throw "CW-VOICE" switch to "CW" position for aural reception of unmodulated signals.

d. Use the "TUNING" crank and tune in the desired station.

e. Adjust "AUDIO" control for desired headset volume.

Note

For best definition of radio range stations adjust the "AUDIO" control for the lowest usable headset volume and continue to reduce volume as the A-N signals increase in strength.

4–80. RECEIVER OPERATION–LOOP RECEPTION. If reception on "ANT" is noisy due to precipitation static, commonly known as rain or snow static, better results may be obtained by operating in "LOOP" position as follows:

a. Turn function switch to "LOOP" position.

b. Turn band switch to desired frequency band.

c. If station is unmodulated, place "CW-VOICE" switch in "CW" position.

d. Tune in desired station.

e. Rotate loop with the "LOOP L-R" switch until maximum signal is obtained. If flight course is not straight, readjustments may be necessary.

f. Adjust "AUDIO" control for desired headset volume.

g. For best definition of radio range A-N signals on "LOOP," it is necessary to maintain the loop near the 90 or 270 degree position and adjust the "AUDIO" control for lowest usable headset volume.

Note

Cone of silence indications are not always reliable while receiving on "LOOP." In some cases, an increase instead of a decrease in signal may be noted.

4–81. SUMMARY OF PRECAUTIONS DURING OPERATION.

a. Select radio stations that provide stable bearings. Do not use a station for bearing unless it can be identified by headset signal on "COMP" operation. High-powered, clear-channel stations should be used when possible. Any interference from other stations will cause an error in bearing. Tune equipment accurately. Station identification must be checked, especially stations broadcasting network programs. Avoid taking bearings on synchronized stations except when close to desired station. If station stops transmitting or fades, bearings may change to other stations of the same frequency thus causing errors. This is especially true of code stations operating in a network.

b. Night effect or reflection of radio waves from the sky may be recognized by fluctuations in bearings. Night effect is worst at sunrise and sunset. The higher the frequency of operation the greater the night effect. It may be present at distances over 20 miles when receiving 850 to 1750 kilocycle stations, however with 100 to 450 kilocycle stations reliable bearings above 200 miles can be taken even when night effect is present. The remedies for night effect are to increase altitude, thereby increasing signal strength of direct waves, to use stations operating on lower frequency, and to take an average of the fluctuations.

c. Mountain effect is considered to be the reflection of radio waves from mountain surfaces. It is known to exist around Salt Lake City and Pittsburgh. Do not rely fully on bearings taken in such areas.

d. For aural reception of A-N signals operate equipment on "ANT" or "LOOP" instead of "COMP" since the action of AVC in "COMP" position will cause broad

course indications. Always operate the equipment with "AUDIO" control set at lowest usable headset volume and reduce it as the A-N signal strength increases. Cone of silence indications are not always reliable when operating the equipment on "LOOP." Use equipment on "ANT" for cone of silence indication.

e. This equipment should provide compass bearings during conditions of moderate precipitation static which interrupt normal reception. When static becomes too severe it will be necessary to operate on "LOOP" position. In this position, satisfactory aural reception and aural-null direction finding will be possible most of the time.

f. Do not depend on two stations for a fix of location; use at least three stations with bearings spaced at approximately equal intervals throughout 360 degrees for greatest accuracy.

g. While taking bearings always keep aircraft on a steady level heading.

h. When homing or direction finding on "LOOP" operation there is a 180 degree ambiguity and station bearings may be 180 degrees from the null obtained. Use stations with good signal strength for sharply defined nulls. Width of null may be controlled by position of "AUDIO" control. The tuning meter may be used as a visual-null indicator.

4–82. TO STOP EQUIPMENT. To stop the equipment, turn the function to "OFF."

4–83. RADAR EQUIPMENT. Information on components of the AN/APQ-35 radar equipment will be added when available.

4–84. AN/APX-2 RADIO EQUIPMENT.

4–85. GENERAL. The AN/APX-2 IFF radio provides a means of receiving interrogation signals and automatically responding or transmitting in answer to the interrogation coded identification signals. In conjunction with the radar equipment installed in the airplane, it provides a means of interrogating other aircraft. A destructor circuit is contained in the IFF unit.

4–86. CONTROLS. The modified C-241/APX "IFF" radio control console (figure 4–2, reference 20) is on the right-hand console panel. The master control switch places the equipment in operation when turned clockwise from "OFF" to "NORM," "INT ONLY," "ROOSTER," or "EMERGENCY." The interrogation switch marked "INT" is normally left in the "OUT" position. It is moved to "CONT" or held at "TMPRY" when the pilot wishes to interrogate unidentified craft whose presence he suspects or which has been detected by radar. The "G-BAND" switch is also normally in the "OUT" position. It may be thrown to "CONT" in conformity with specific orders governing the use of the "G-BAND" transponder. The switch marked "CODE" selects one of the six code combinations for transmission. A guard latch adjacent to the "CODE" switch is pushed in order to rotate the switch to "DESTRUCT" for destruction of the unit to prevent the equipment's falling into enemy hands.

4–87. OPERATION OF AN/APX-2 IFF EQUIPMENT.

4–88. TO START IFF EQUIPMENT. Rotate the master control switch on the "IFF" console clockwise away from the "OFF" position and set it in the desired operating position.

4–89. TO SET SELECTOR SWITCH. Rotate the "CODE" switch to the position designated by a competent authority. Unless otherwise designated, it is set and left in the position "1."

4–90. FOR G-BAND OPERATION. Throw the "G-BAND" switch to the "ON" position.

4–91. FOR INT OPERATION. Throw the "INT" switch to "CONT" or hold it momentarily in the "TMPRY" position.

4–92. FOR ROO OPERATION. Rotate the master control switch to the "ROOSTER" position. (This should be done only by specific direction of the Commanding Officer and only if a specified ROO adjustment has been made inside the transmitter-receiver unit by a maintenance crew.)

4–93. TO INDICATE DISTRESS. (See paragraph 3–45.)

4–94. TO DESTROY THE TRANSMITTER-RECEIVER UNIT. (See paragraph 3–45.)

4–95. AN/APX-6 RADIO EQUIPMENT.

4–95A. GENERAL. The primary purpose of the AN/APX-6 transponder equipment is to enable the airplane in which it is installed to identify itself automatically as friendly whenever it is properly challenged by suitably equipped friendly surface and airborne radar.

4–95B. AN/APX-6 IFF CONTROL CONSOLE. The C-544/APX-6 IFF control panel (figure 1–6, reference 13) is on the right-hand console. The MASTER control is a five-position rotary switch and permits selection of the operational characteristics "OFF," "STDBY," "LOW," "NORM" and "EMERGENCY." The MODE 2 control is a three-position toggle switch which permits selection of "MODE 2," "OUT" and "I/P" positions. The MODE 3 control is a two-position toggle switch with "MODE 3" and "OUT" positions. The DESTRUCT switch is a two-position toggle switch protected against accidental operation by a guard cover. In the "ON" position, voltage is applied to the destructor fire circuit. In the "OFF" position, no voltage is applied unless the impact switch is tripped.

4–95C. OPERATION OF AN/APX-6 EQUIPMENT.

4–95D. TO START EQUIPMENT.

a. Rotate the MASTER control to "STDBY," "LOW" or "NORM" as required. Unless instructed otherwise, set the control in the "NORM" position.

b. Set the MODE 2 control to required position. Unless instructed otherwise, set the control in the "I/P" position.

c. Set the MODE 3 control to required position. Unless instructed otherwise, set the control in the "OUT" position.

4–95E. EMERGENCY AND DESTRUCT OPERATIONS. Refer to paragraph 3–44.

4–95F. TO STOP EQUIPMENT.

a. Rotate the MASTER control to the "OFF" position.

b. If the DESTRUCT control was operated during flight, report this fact immediately upon landing so that a new receiver-transmitter may be installed.

4–96. AFTER LANDING. Before leaving the airplane, all radio equipment should be secured by turning the master radio switch to "OFF."

4–97. COCKPIT AIR CONDITIONING AND PRESSURIZING SYSTEM.

4–98. GENERAL. An interconnected air conditioning and pressurizing system heats, cools, ventilates and pressurizes the cockpit as required to maintain efficient operating conditions for the crew members (see figure 4–3). Heated compressed air, which is bled from the last stage of the engine compressor, may be passed through the refrigeration unit or diverted around the unit as required by cockpit temperature conditions. Air passing through the refrigeration unit operates the unit and is passed to the mixing chamber as cooled air. This air, proportionately mixed in the chamber with the heated air which by-passes the refrigeration unit, is delivered to the cockpit for heating or cooling, and serves also to ventilate and pressurize the cockpit.

4–99. CONTROLS. The cockpit air conditioning control (figure 1–5, reference 11), on the center console, makes possible manual or automatic selection of cockpit temperature, or manual selection of the emergency ventilating system. The rheostat portion of the control is in the temperature control bridge circuit and provides for selection of cockpit temperatures from 60°F to 80°F (15.5°C to 26.6°C). The other positions of the control are "OFF," "MANUAL HOT" and "MANUAL COLD." The "OFF" position also turns on emergency ventilation air and depressurizes cockpit. Since cabin pressurization and windshield defogging are completely automatic, no controls are required.

4–100. OPERATION OF AIR CONDITIONING SYSTEM. Provision is made to supply full hot or full cold air to the cockpit by manually holding the cockpit air conditioning control respectively to "MANUAL HOT" or "MANUAL COLD." When the control is placed in either of these positions, the hot-air by-pass valve actuator moves the valve in the corresponding direction so long as the control position is held. When the control is released, it returns to a "neutral" position and the by-pass valve setting remains at the position in which the actuator stopped. In "MANUAL HOT," a temperature high limit control is provided in the circuit to prevent overheating of the windshield. In addition, a high limit safety element overrides all other circuits to operate on emergency ventilation if the defogging air becomes hot enough to threaten safety of the windshield. If this occurs, cockpit pressure is lost and cannot be regained until the fusable element is replaced after landing.

4–101. Under some conditions of flight in humid climates, the temperature in the cockpit may be below the dew point of the atmospheric air. In such cases condensed water droplets (fog) may form in the cockpit. The fog will have the appearance of grey smoke and will appear to be issuing from the air conditioning outlets. This fog condition may be alleviated by operating the cockpit air conditioning control so as to increase the temperature of the air in the cockpit.

4–102. EMERGENCY VENTILATION. When the cockpit air conditioning control is moved to "OFF," the normal air conditioning system shut-off valve is closed, and the emergency ventilating and cockpit pressure relief valves are opened, thus permitting free circulation of outside air throughout the cockpit without cockpit pressurization.

4–103. COCKPIT PRESSURIZATION. When the normal air conditioning system is in operation, the air provided for heating, cooling, and ventilating also pressurizes the cockpit. The pressure in the cabin is automatically maintained on a predetermined schedule with regard to altitude by the pressure-regulating valve located just behind the radar operator's head. This pressure schedule is as follows: From sea-level to 5,000 feet altitude the cockpit pressure remains equal to atmospheric pressure. Above 5,000 feet the cockpit gradually pressurizes until at 11,750 altitude, a maximum pressure differential of 2.75 psi is reached. Above 11,750 feet a constant pressure differential of 2.75 psi above atmosphere pressure is maintained. This information is shown graphically in figure 4–4, Cockpit and Aircraft Altitude Comparison Chart. In the event of failure of the cockpit pressure regulating valve to function properly, the cockpit pressure relief valve prevents excessive positive pressure differentials. Also in the event of fast dives or other such maneuvers, it prevents an excessive negative differential which might eventually damage the cockpit. This valve opens at pressure differentials of plus 3.0 psi and minus 0.1 psi. As previously mentioned, it also opens when the cockpit air conditioning control is moved to the "OFF" position.

Note

Due to the design service ceiling of the airplane and the above-mentioned maximum cockpit pressure differential, there is no danger of explosive decompression.

4–104. LIGHTING EQUIPMENT.

4–105. INTERIOR LIGHTS. The interior lights control panel is located on the cockpit center console. The switches contained on the console function as follows:

a. Selector switch (figure 1–5, reference 6)—Selects "FLIGHT" instrument lights, "ALL INSTR" lights or "EMERG." In the latter position, the cockpit floodlights are turned on.

b. "INSTR LIGHTS" rheostat (figure 1–5, reference 7)—Rotated clockwise increases the intensity of the selected instrument lights. Extreme counterclockwise position turns the lights "OFF."

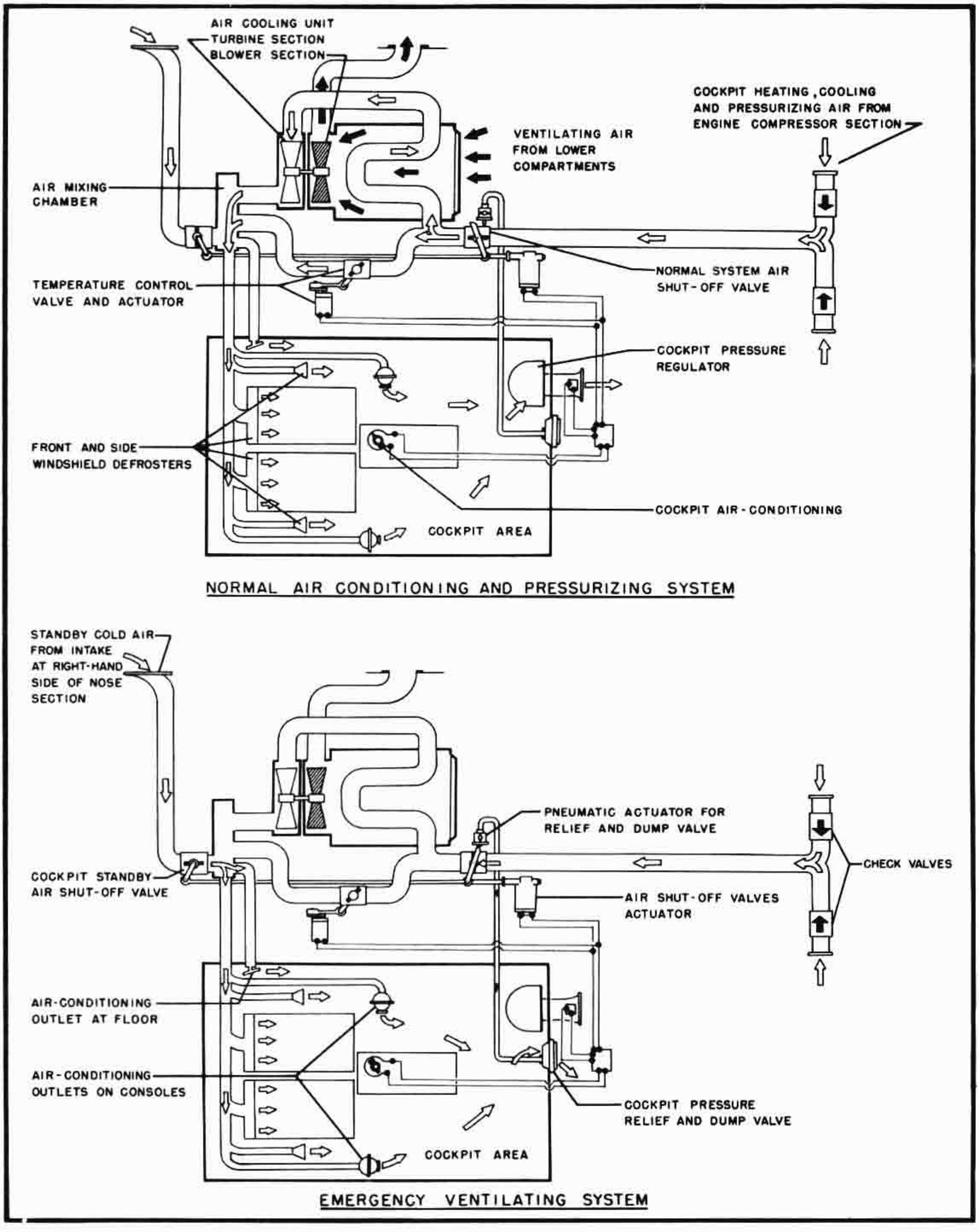


Figure 4-3. Cockpit Air Conditioning and Pressurizing System

c. "CONSOLE LIGHTS" rheostat (figure 1–5, reference 15)—Rotated clockwise increases the intensity of the left-hand and center console lights, and the pilot's oxygen regulator panel light (figure 1–3, reference 10A). Extreme counterclockwise position turns the lights "OFF."

d. "R.H. CONSOLE LIGHTS" rheostat (figure 4–2, reference 6)—Rotated clockwise increases the intensity of the right-hand console lights and the radar operator's oxygen regulator panel light (figure 4–2, reference 15B). Extreme counterclockwise position turns the lights "OFF."

4–106. EXTERIOR LIGHTS. The exterior lights control panel (figure 4–2, reference 18) is on the right-hand console. The switches contained on the console function as follows:

a. Five selector switches, "WING," "FUS," "TAIL," "FORM" and "FLOOD," turn the selected lights "ON" or "OFF."

b. A switch marked "ALL" controls the intensity of the lights selected. Positions are "BRT," "MED" and "DIM."

c. The "MASTER" switch selects "OFF," "CODE," "FLASH" and "STDY." The "CODE" position applies to the upper and lower fuselage lights only, and other lights will burn steadily if on. The "FLASH" position applies to wing and tail lights only and fuselage lights will burn steadily if on. The "STDY" position applies to all lights which will burn steadily if on.

d. The "CODE" switch selects the desired signal letter. The "MASTER" switch must be in the "CODE" position.

e. The radar operator's keying switch on the exterior lights panel or the pilot's keying switch (figure 1–9, reference 14A) on the left-hand side of the cockpit, manually code the fuselage lights providing the selector switch is in the "FUS OFF FOR KEY" position, and regardless of the "MASTER" switch position.

4–107. APPROACH LIGHT. The approach light in the left-hand wing is controlled by the permanently guarded switch (figure 1–5, reference 2) on the cockpit center console. The "ON" position, obtained by removing the guard, is used to manually obtain a steady light for simulated carrier landings, which do not make use of the

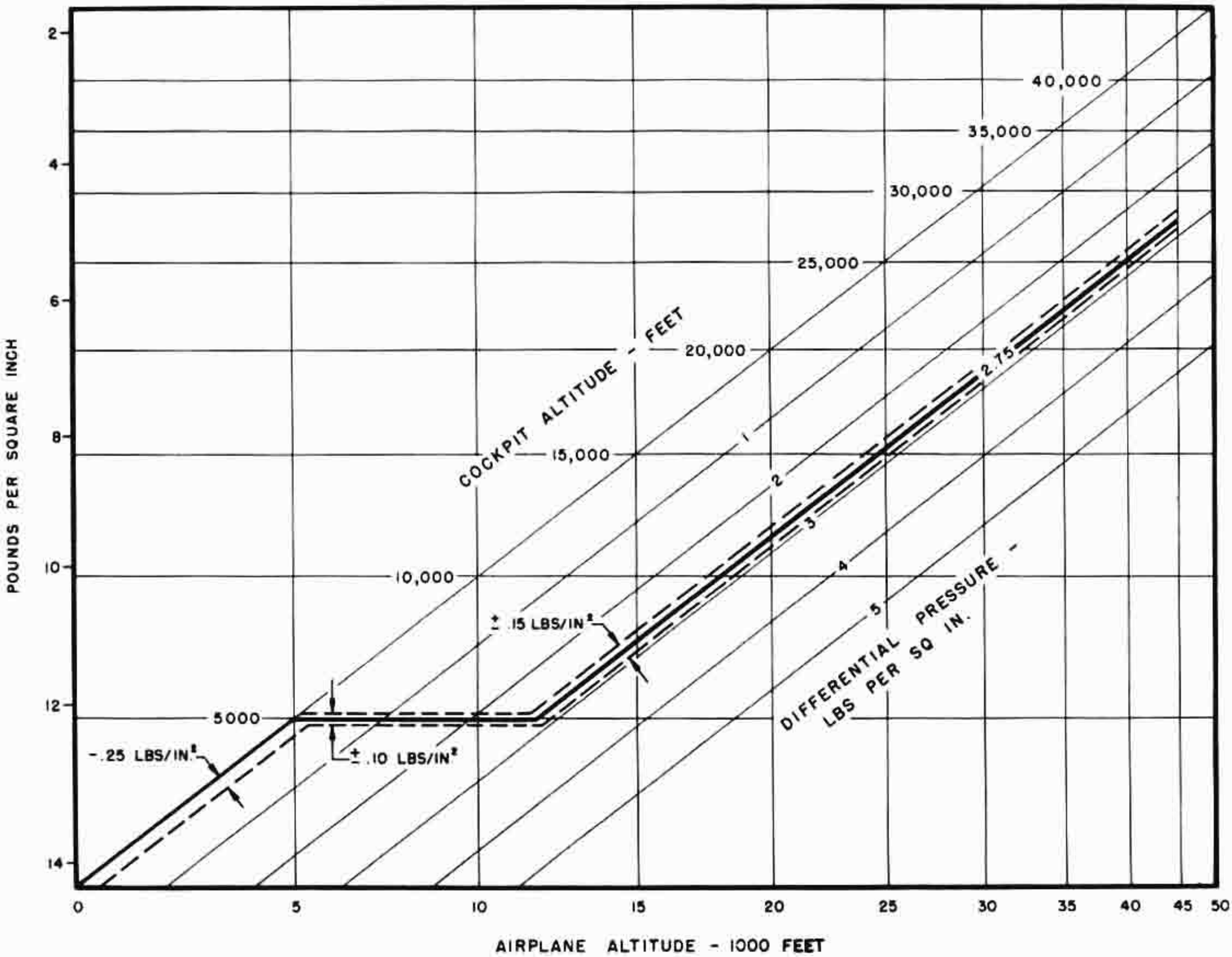


Figure 4-4. Cockpit and Aircraft Altitude Comparison Chart

arresting hook. The normal "OFF" position is for automatic operation of the light for carrier landings. With the exterior lights MASTER switch in "CODE," "FLASH" or "STEADY" and the approach light switch "OFF," the light will operate as follows:

Landing Wheels	*Arresting Hook*	*Approach Light*
Not locked down	Any position	Off
Locked down	Not down	Flash
Locked down	Down	Steady

APPENDIX I
OPERATING CHARTS

A–1. FLIGHT PLANNING.

A–2. FLIGHT OPERATION CHARTS. The following pages contain charts to be used as a guide to the planning of operations. Charts provided are a Take-Off, Climb, and Landing Chart and a set of Flight Operation Instruction Charts which covers the probable gross weight range for the stated configuration.

A–3. GENERAL.

a. The methods of computing flight time, fuel requirements, and range vary, depending on the type of operation and mission planned. These instructions cannot possibly cover all the types of possible operation, but they do cover the more common types likely to be encountered, as for example, simple continuous flight at fairly constant power or a bombing mission with allowances for combat operation.

b. The Flight Operation Instruction Charts have been set up so that ranges in columns at the left-hand side of the chart are for Maximum Continuous (Normal Rated) Operation, which gives the maximum airspeed possible with an indefinite time limit on the engine. Maximum range figures, obtained from columns at the right-hand side of the chart, require a corresponding decrease in airspeed but give an increase in fuel economy.

c. The charts indicate two features which are characteristic of jet engine aircraft. First, the range attainable with a given amount of fuel increases rapidly with an increase in cruising altitude. Second, the speed for maximum range occurs very close to the high speed with normal rated thrust. A study of the chart will show that it is more important to choose a high cruising altitude than to reduce the speed at a lower altitude.

d. If cruise at low altitude is required, a considerable increase in range can be realized by using only one engine. However, the range is still not as great as if two engines are used at higher altitude.

A–4. MAXIMUM ENDURANCE OPERATION. If it is desired to operate the airplane at the conditions for minimum fuel consumption (maximum endurance), the airplane should be flown at an indicated airspeed of approximately 170 knots for a gross weight of 24,000 lbs. and approximately 160 knots for 20,000 lbs. For two engine operation, minimum fuel flow is obtained by flying at 30,000 to 35,000 feet. On single engine, minimum fuel flow occurs at 10,000 to 15,000 feet. It can be seen from the maximum endurance chart that the fuel flow is as low for single engine operation at 10,000 feet as it is for the two engine case at its best altitude (30,000 to 35,000 feet). It is therefore not necessary to climb to high altitude to obtain the best endurance in the airplane if single engine operation is used.

A–5. USE OF THE CHARTS. The simplest type of mission to plan is one in which the flight is continuous at constant altitude, and the desired cruising power and airspeed are reasonably constant. This is known as a "single stage flight." An example of the use of the charts for this type of mission appears at the bottom of the first Flight Operation Instruction Chart; however, the following general information may be of value.

a. Assuming the range to be flown is known, choose the altitude at which the flight is to be made. The main factors in the choice of altitude are weather conditions, oxygen requirements, and the approximate true airspeed desired.

b. Enter the Climb Data Chart (figure A–1) at the chosen altitude and the approximate gross weight of the airplane before take-off, and read the fuel used in climb to this operating altitude.

Note

Allowances have been made in the Climb Data Chart for run-up and take-off as well as fuel used in climb.

c. Determine the fuel reserve desired and add this to the climb allowance. *No allowances have been made in the Flight Operation Instruction Charts for wind, navigational error, or other contingencies. No allowance has been made for combat or formation flight. The allowances to be made for each of these items will be dictated by local doctrine.*

d. Add allowances made in (b) and (c), and subtract this total allowance from the fuel available in the airplane before starting the engines. The result is the value to be used in entering the chart.

e. Select the appropriate Flight Operation Instruction Chart (figure A–4) corresponding to the approximate gross weight of the airplane before take-off.

f. Find the figure in the fuel column of the chart equal to (or slightly less than) the amount of fuel determined in (d) to be available for flight.

g. Read horizontally to the right or left and read the available range in the column for proposed cruising altitude.

h. Move vertically down the desired altitude column, and read the RPM and indicated airspeed settings required.

A–6. A little more complex, but very common, type of operation is one for which the airplane gross weight is considerably higher when cruising out than when cruising back. This is because of bombs dropped, empty drop

tanks released, and the large weight of fuel consumed during cruise out on long missions. In such a problem, the following general comments may be helpful:

a. The appropriate Flight Operation Instruction Chart corresponding to the approximate gross weight for each phase of the mission (cruise out and cruise back) should be for that phase.

b. In making a fuel allowance for climb to cruise back, the value taken from the Climb Chart of the cruise back altitude may be decreased by 480 lbs., the amount of the run-up and take-off allowance.

c. Fuel used in climb from one altitude to another may be obtained by subtracting the "fuel used" entries in the Climb Chart for the two altitudes and at the approximate gross weight.

A–7. AIRSPEED CALIBRATION.

A–8. The following calibrations represent the airspeed position error and give the corrected indicated airspeeds for a given reading of the cockpit airspeed indicator, assuming zero scale error for the instrument itself:

FLAPS DOWN—GEAR DOWN		FLAPS UP—GEAR UP	
I.A.S. (Knots)	*Correction (Knots)*	*I.A.S. (Knots)*	*Correction (Knots)*
90	Subtract 4	110	Subtract 2
100	Subtract 2	150	Add 2
120	0	200	Add 2
140	Add 2	250	Add 2
		300	Add 2
		350	Add 2
		400	Add 2
		450	Add 2

TAKE-OFF, CLIMB & LANDING CHART

AIRCRAFT MODEL (S)
F3D-1
WITH 2-150 GAL EXTERNAL DROPPABLE FUEL TANKS (DOUGLAS TYPE EXTERNAL STORES)

ENGINE MODEL (S)
WESTINGHOUSE
J34-WE-34 (24C4D)

TAKE-OFF DISTANCE FEET

GROSS WEIGHT LB.	HEAD WIND M.P.H.	HEAD WIND KTS	HARD SURFACE RUNWAY AT SEA LEVEL GROUND RUN	TO CLEAR 50' OBJ.	AT 3000 FEET GROUND RUN	TO CLEAR 50' OBJ.	AT 6000 FEET GROUND RUN	TO CLEAR 50' OBJ.	SOD-TURF RUNWAY AT SEA LEVEL GROUND RUN	TO CLEAR 50' OBJ.	AT 3000 FEET GROUND RUN	TO CLEAR 50' OBJ.	AT 6000 FEET GROUND RUN	TO CLEAR 50' OBJ.	SOFT SURFACE RUNWAY AT SEA LEVEL GROUND RUN	TO CLEAR 50' OBJ.	AT 3000 FEET GROUND RUN	TO CLEAR 50' OBJ.	AT 6000 FEET GROUND RUN	TO CLEAR 50' OBJ.
28,000		0	3745	6220	4560	7580	5650	9600												
		15	2880	5070	3550	6240	4450	8180												
		25	2335	4330	2910	5370	3690	7130												
		35	1840	3840	2325	4550	2995	6120												
26,000		0	3160	5190	3785	6200	4880	7770												
		15	2405	4130	2920	5060	3630	6390												
		25	1930	3560	2370	4320	2995	5520												
		35	1505	2950	1870	3630	2400	4680												
24,000		0	2505	4280	3115	5110	3930	6250												
		15	1955	3430	2370	4130	2960	5110												
		25	1535	2880	1900	3500	2405	4370												
		35	1190	2370	1485	29[illegible]	1905	3670												

NOTE: DISTANCES SHOWN ARE FOR STANDARD TEMPERATURE 15°C (59°F)
DATA AS OF 2-5-51 BASED ON: CALCULATIONS

(1) USE 40° FLAPS (FULL DOWN) FOR MINIMUM GROUND RUN (CARRIER TYPE) TAKE-OFF
(2) USE 25° FLAPS FOR TAKE-OFF OVER OBSTACLE

NORMAL TAKE-OFF WITH 100 PERCENT RPM IS 100% OF CHART VALUES

CLIMB DATA

	GROSS WEIGHT LB.	AT SEA LEVEL BEST C.A.S. KTS	RATE OF CLIMB F.P.M.	LBS. OF FUEL USED	AT 10,000 FEET BEST C.A.S. KTS	RATE OF CLIMB F.P.M.	FROM SEA LEVEL LB OF FUEL USED	DIST NAUT MI.	TIME MIN	AT 20,000 FEET BEST C.A.S. KTS	RATE OF CLIMB F.P.M.	FROM SEA LEVEL LB OF FUEL USED	DIST NAUT MI.	TIME MIN	AT 30,000 FEET BEST C.A.S. KTS	RATE OF CLIMB F.P.M.	FROM SEA LEVEL LB OF FUEL USED	DIST NAUT MI.	TIME MIN	AT 35,000 FEET BEST C.A.S. KTS	RATE OF CLIMB F.P.M.	FROM SEA LEVEL LB OF FUEL USED	DIST NAUT MI.	TIME MIN	AT FEET BEST C.A.S. KTS	RATE OF CLIMB F.P.M.	FROM SEA LEVEL LB OF FUEL USED	DIST NAUT MI.	TIME MIN
NORMAL 94.4% RPM	28,000	235	1790	445	225	1200	985	26	7.0	210	610	1655	87	17.5															
	26,000	235	2010	445	220	1370	920	22	6.1	210	770	1485	73	15.2	195	180	2555	194	40.2										
	24,000	230	2250	445	220	1580	885	20	5.2	205	960	1340	61	13.2	195	340	2070	145	30.2										
MILITARY 100% RPM	28,000	276	2740	445	[illegible]	[illegible]	868	19	4.0	23[illegible]	1270	1305	50	13.5	200	480	1980	129	23.7										
	26,000	264	3000	445	[illegible]	2240	650	9	2.6	230	1670	1220	44	9.3	200	570	1735	101	19.8										
	24,000	265	3310	445	245	2550	790	16	3.2	225	1890	1130	40	8.4	200	760	1570	84	16.7	190	240	2005	146	27.7					

POWER PLANT SETTINGS: (DETAILS ON FIG. A-3)
DATA AS OF 7-16-51 BASED ON: PATUXENT FLIGHT TEST & CALCULATIONS

FUEL USED: INCLUDES WARM-UP AND TAKE-OFF ALLOWANCE EQUIVALENT TO 5 MINUTES AT NORMAL POWER. (445 LBS.)

LANDING DISTANCE FEET

GROSS WEIGHT LB.	BEST CAS APPROACH POWER OFF M.P.H.	POWER OFF KTS.	POWER ON M.P.H.	POWER ON KTS.	HARD DRY SURFACE AT SEA LEVEL GROUND ROLL	TO CLEAR 50' OBJ.	AT 3000 FEET GROUND ROLL	TO CLEAR 50' OBJ.	AT 6000 FEET GROUND ROLL	TO CLEAR 50' OBJ.	FIRM DRY SOD AT SEA LEVEL GROUND ROLL	TO CLEAR 50' OBJ.	AT 3000 FEET GROUND ROLL	TO CLEAR 50' OBJ.	AT 6000 FEET GROUND ROLL	TO CLEAR 50' OBJ.	WET OR SLIPPERY AT SEA LEVEL GROUND ROLL	TO CLEAR 50' OBJ.	AT 3000 FEET GROUND ROLL	TO CLEAR 50' OBJ.	AT 6000 FEET GROUND ROLL	TO CLEAR 50' OBJ.
	ENTER FOLLOWING CHART AT CORRECT GROSS WEIGHT FOR LANDING DISTANCES. NO CHANGE DUE TO ADDITION OF EXTERNAL TANKS																					

DATA AS OF 2-5-51 BASED ON: CALCULATIONS

CHART VALUES ARE 100% OF NORMAL CAPABILITIES.

NOTE: TO DETERMINE FUEL CONSUMPTION IN U.S. GALLONS, DIVIDE FUEL IN POUNDS BY 6 FOR AN-F-48 FUEL, FOR AN-F-58 (JP-3) FUEL DIVIDE BY 6.5.

LEGEND
C.A.S. : CALIBRATED AIRSPEED
KTS. : KNOTS
F.P.M. : FEET PER MINUTE

RED FIGURES ARE PRELIMINARY DATA, SUBJECT TO REVISION AFTER FLIGHT CHECK.

Figure A-1 (Sheet 1 of 2 Sheets). Take-Off, Climb & Landing Chart

AIRCRAFT MODEL (S)
F3D-1
NO EXTERNAL LOAD

TAKE-OFF, CLIMB & LANDING CHART

ENGINE MODEL (S)
WESTINGHOUSE J34 - WE -34
(24C4D)

TAKE - OFF DISTANCE FEET

GROSS WEIGHT LB.	HEAD WIND M.P.H.	HEAD WIND KTS	HARD SURFACE RUNWAY AT SEA LEVEL GROUND RUN	AT SEA LEVEL TO CLEAR 50' OBJ	AT 3000 FEET GROUND RUN	AT 3000 FEET TO CLEAR 50' OBJ.	AT 6000 FEET GROUND RUN	AT 6000 FEET TO CLEAR 50' OBJ
24,000		0	2605	4250	3110	5060	3800	6110
		15	1955	3400	2370	4[illegible]0	2935	5070
		25	1551	2860	1900	3460	2580	4540
		35	1190	2380	1485	2900	1890	3650
22,000		0	2125	3475	2550	4140	3080	5080
		15	1570	2740	1910	3320	2345	4070
		25	1225	2280	1520	2790	1890	3460
		35	930	1860	1170	2300	1470	2870
20,000		0	1700	2780	2045	3340	2475	4030
		15	1280	2180	1510	2640	1860	3220
		25	950	1790	1160	2190	1475	2710
		35	705	1440	885	1890	1155	2220

GROSS WEIGHT LB.	SOD-TURF RUNWAY AT SEA LEVEL GROUND RUN	AT SEA LEVEL TO CLEAR 50' OBJ.	AT 3000 FEET GROUND RUN	AT 3000 FEET TO CLEAR 50' OBJ.	AT 6000 FEET GROUND RUN	AT 6000 FEET TO CLEAR 50' OBJ.	SOFT SURFACE RUNWAY AT SEA LEVEL GROUND RUN	AT SEA LEVEL TO CLEAR 50' OBJ.	AT 3000 FEET GROUND RUN	AT 3000 FEET TO CLEAR 50' OBJ.	AT 6000 FEET GROUND RUN	AT 6000 FEET TO CLEAR 50' OBJ.
24,000												
22,000												
20,000												

NOTE: DISTANCES SHOWN ARE FOR STANDARD TEMPERATURE 15°C (59°F)
DATA AS OF 2-5-51 BASED ON: CALCULATIONS
(1) USE 40° FLAPS (FULL DOWN) FOR MINIMUM GROUND RUN (CARRIER TYPE) TAKE-OFF
(2) USE 25° FLAPS FOR TAKE-OFF OVER OBSTACLE
NORMAL TAKE-OFF WITH 100 PERCENT RPM IS 100% OF CHART VALUES.

CLIMB DATA

GROSS WEIGHT LB.	AT SEA LEVEL BEST C.A.S. KTS.	RATE OF CLIMB F.P.M.	LBS. OF FUEL USED	AT 10,000 FEET BEST C.A.S. KTS	RATE OF CLIMB F.P.M.	FROM SEA LEVEL LB OF FUEL USED	DIST NAUT MI	TIME MIN
NORMAL 94.4% RPM 24,000	245	2590	448	230	1710	839	2[illegible]	4.8
NORMAL 22,000	240	2875	448	225	1950	788	9	4.5
NORMAL 20,000	240	3020	448	225	2250	760	17	3.8
MILITARY 100% RPM 24,000	265	3530	448	245	2770	770	16	3.2
MILITARY 22,000	260	3920	448	265	3[illegible]	735	9	2.9
MILITARY 20,000	[illegible]	[illegible]	448	[illegible]	[illegible]	700	12	2.6

GROSS WEIGHT LB.	AT 20,000 FEET BEST C.A.S. KTS	RATE OF CLIMB F.P.M.	FROM SEA LEVEL LB OF FUEL USED	DIST NAUT MI	TIME MIN	AT 30,000 FEET BEST C.A.S. KTS	RATE OF CLIMB F.P.M.	FROM SEA LEVEL LB OF FUEL USED	DIST NAUT MI	TIME MIN
NORMAL 24,000	215	1080	1275	56	12.5	200	450	1885	123	25.2
NORMAL 22,000	210	1710	1170	47	10.8	200	670	1660	105	21.4
NORMAL 20,000	218	1920	1070	41	9.4	200	8[illegible]	1460	86	14.7
MILITARY 24,000	240	1850	1088	40	7.6	220	9[illegible]	1478	81	15.[illegible]
MILITARY 22,000	240	2[illegible]	1015	55	6.3	215	1130	1348	70	13.[illegible]
MILITARY 20,000	2[illegible]8	2[illegible]	848	[illegible]	4.7	215	1[illegible]	1288	60	[illegible]

GROSS WEIGHT LB.	AT 35,000 FEET BEST C.A.S. KTS	RATE OF CLIMB F.P.M.	FROM SEA LEVEL LB OF FUEL USED	DIST NAUT MI	TIME MIN	AT ___ FEET BEST C.A.S. KTS.	RATE OF CLIMB F.P.M.	FROM SEA LEVEL LB OF FUEL USED	DIST NAUT MI	TIME MIN.
NORMAL 24,000										
NORMAL 22,000	191	[illegible]	2145	16[illegible]	44[illegible]					
NORMAL 20,000	190	670	1780	175	26.9					
MILITARY 24,000	210	550	1820	150	21.2					
MILITARY 22,000	[illegible]	[illegible]	1696	[illegible]	[illegible]					
MILITARY 20,000	220	[illegible]	1415	[illegible]	[illegible]	[illegible]	[illegible]	1770	[illegible]	[illegible]

POWER PLANT SETTINGS: (DETAILS ON FIG A-3)
DATA AS OF 7-16-51 BASED ON: PATUXENT FLIGHT TEST & CALCULATIONS
FUEL USED: INCLUDES WARM-UP AND TAKE-OFF ALLOWANCE EQUIVALENT TO 5 MINUTES AT NORMAL POWER. (445 LBS)

LANDING DISTANCE FEET

GROSS WEIGHT LB.	BEST CAS APPROACH POWER OFF M.P.H.	POWER OFF KTS	POWER ON M.P.H.	POWER ON KTS	HARD DRY SURFACE AT SEA LEVEL GROUND ROLL	AT SEA LEVEL TO CLEAR 50' OBJ.	AT 3000 FEET GROUND ROLL	AT 3000 FEET TO CLEAR 50' OBJ	AT 6000 FEET GROUND ROLL	AT 6000 FEET TO CLEAR 50' OBJ.
19,000					[illegible]2	3910	1980	4240	2[illegible]	[illegible]
17,000				[illegible]	1620	3530	1770	3630	[illegible]	

GROSS WEIGHT LB.	FIRM DRY SOD AT SEA LEVEL GROUND ROLL	AT SEA LEVEL TO CLEAR 50' OBJ	AT 3000 FEET GROUND ROLL	AT 3000 FEET TO CLEAR 50' OBJ.	AT 6000 FEET GROUND ROLL	AT 6000 FEET TO CLEAR 50' OBJ	WET OR SLIPPERY AT SEA LEVEL GROUND ROLL	AT SEA LEVEL TO CLEAR 50' OBJ	AT 3000 FEET GROUND ROLL	AT 3000 FEET TO CLEAR 50' OBJ	AT 6000 FEET GROUND ROLL	AT 6000 FEET TO CLEAR 50' OBJ
19,000												
17,000												

DATA AS OF 2-5-51 BASED ON: CALCULATIONS
CHART VALUES ARE 100% OF NORMAL CAPABILITIES.

NOTE: TO DETERMINE FUEL CONSUMPTION IN U.S. GALLONS, DIVIDE FUEL IN POUNDS BY 6 FOR AN-F-48 FUEL, FOR AN-F-58 (JP-3) FUEL DIVIDE BY 6.5

LEGEND
C.A.S. : CALIBRATED AIRSPEED
KTS. : KNOTS
F.P.M. : FEET PER MINUTE

RED FIGURES ARE [illegible] AFTER FLIGHT CHECK

Figure A-1 (Sheet 2 of 2 Sheets). Take-Off, Climb & Landing Chart

POWER PLANT CHART

AIRCRAFT MODEL
F3D - 1

ENGINE MODEL
WESTINGHOUSE
J34 - WE - 34 (24C4D)

OPERATING CONDITIONS	ALTITUDE	MAXIMUM ALLOWABLE GAS TEMPERATURE (1)		TWO ENGINE FUEL CONSUMPTION(2)	
		°C	°F	GAL/HR (3)	LB / HR
MILITARY POWER 100 PERCENT RPM (30 MIN. MAXIMUM)	SEA LEVEL	682	1260	1318	7905
	5,000	682	1260	1134	6805
	10,000	682	1260	964	5785
	15,000	682	1260	814	4885
	20,000	682	1260	688	4125
	25,000	682	1260	586	3520
	30,000	682	1260	499	2995
	35,000	682	1260	416	2500
	40,000	682	1260	341	2050
NORMAL POWER 94.4 PERCENT RPM (MAXIMUM CONTINUOUS)	SEA LEVEL	635	1175	997	5985
	5,000	635	1175	868	5210
	10,000	635	1175	752	4515
	15,000	635	1175	651	3905
	20,000	635	1175	563	3380
	25,000	635	1175	485	2910
	30,000	635	1175	413	2480
	35,000	635	1175	352	2110
	40,000	635	1175	297	1785

SPECIAL NOTES

(1) FOR MAXIMUM ALLOWABLE TURBINE OUTLET TEMPERATURES TO BE OBSERVED, SEE PARAGRAPH 2-17.

(2) ENGINE FUEL CONSUMPTION CORRESPONDS TO SPEED FOR LEVEL FLIGHT.

(3) BASED ON FUEL WEIGHING 6 POUNDS PER GALLON.

(4) FUEL CONSUMPTION FIGURES INCREASED 5% DUE TO INCOMPLETE FLIGHT TEST INFORMATION.

DATA AS OF: 7-16-51 BASED ON: PATUXENT FLIGHT TEST (BUNO. 123743)

Figure A-2. Power Plant Chart

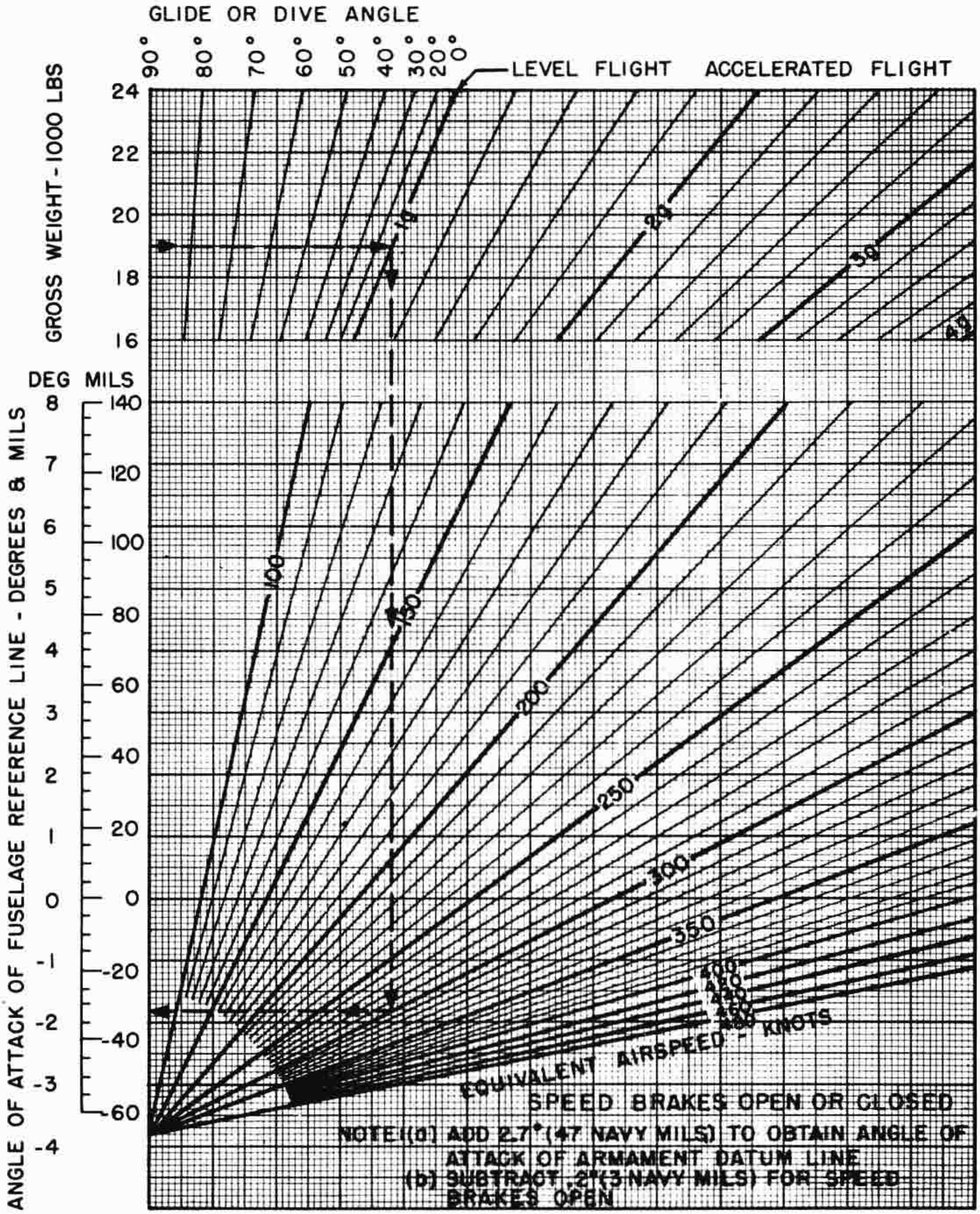


Figure A-3. Angle of Attack Relationship

AIRCRAFT MODEL F3D-1

ENGINES: WESTINGHOUSE J34-WE-34 (24C4D)

FLIGHT OPERATION INSTRUCTION CHART

CHART WEIGHT LIMITS : 27,000 TO 24,000 POUNDS

EXTERNAL LOAD ITEMS
2-150 GAL. EXTERNAL DROPPABLE FUEL TANKS (DOUGLAS TYPE EXTERNAL STORES)

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING. MOVE HORIZONTALLY TO THE RIGHT OR LEFT AND READ AVAILABLE RANGE IN COLUMN FOR PROPOSED CRUISING ALTITUDE. VERTICALLY BELOW DESIRED ALTITUDE READ CAS AND PERCENT RPM REQUIRED. SEE EXAMPLE BELOW.

	MAXIMUM CONTINUOUS POWER													MAXIMUM RANGE												
	S L		10,000		20,000		30,000		35,000		40,000		← ALTITUDE (FEET) →	S L		10,000		20,000		30,000		35,000		40,000		
	STAT	NAUT	STAT	NAUT	STAT	NAUT	STAT	NAUT	STAT	NAUT	STAT	NAUT	FUEL AVAILABLE FOR CRUISE	STAT	NAUT	STAT	NAUT	STAT	NAUT	STAT	NAUT	STAT	NAUT	STAT	NAUT	
													US GALLONS / POUNDS													
TWO ENGINE CRUISE													1650 / 9900													TWO ENGINE CRUISE
													1600 / 9600													
	585	508	786	683	1072	930							1400 / 8400	639	555	823	715									
	502	436	674	585	917	797	1140	990					1200 / 7200	547	475	706	613									
	418	363	562	488	764	664	950	825					1000 / 6000	456	396	589	511									
	377	327	506	439	689	598	856	743					900 / 5400	411	357	530	460									
	334	290	449	390	611	531	760	660					800 / 4800	365	317	471	409									
	293	254	394	342	535	465	666	578					700 / 4200	319	277	412	358									
	251	218	338	293	459	398	570	495					600 / 3600	274	238	354	307									
	210	182	281	244	382	332	476	413					500 / 3000	228	198	295	256									
	168	146	225	195	306	266	380	330					400 / 2400	182	158	235	204									
	126	109	168	146	229	199	286	248					300 / 1800	137	119	176	153									
	84	73	113	98	152	133	190	165					200 / 1200	91	79	117	102									
	41	36	56	49	76	66	96	83					100 / 600	46	40	59	51									
	94.4		94.4		94.4		94.4						PERCENT RPM	87.8		88.5										
	369		320		278		212						← CALIBRATED AIRSPEED (KTS) →	308		271										
	1015		757		561		410						← FUEL CONSUMPTION (US GAL/HR) →	777		613										
	6090		4540		3365		2460						← FUEL CONSUMPTION (LBS/HR) →	4660		3685										
SINGLE ENGINE CRUISE													1650 / 9900													SINGLE ENGINE CRUISE
													1600 / 9600													
	728	632											1400 / 8400													
	624	541											1200 / 7200													
	520	461											1000 / 6000													
	468	406											900 / 5400													
	416	361											800 / 4800													
	364	316											700 / 4200													
	312	271											600 / 3600													
	260	226											500 / 3000													
	208	180											400 / 2400													
	156	135											300 / 1800													
	104	90											200 / 1200													
	52	45											100 / 600													
	94.4												PERCENT RPM													
	235												← CALIBRATED AIRSPEED (KTS) →													
	520												← FUEL CONSUMPTION (US GAL/HR) →													
	3120												← FUEL CONSUMPTION (LBS/HR) →													

FOR SINGLE ENGINE CRUISE FLY MAXIMUM CONTINUOUS POWER (94.4 PERCENT RPM).

NOTES

(1) USE OPERATING CONDITIONS OF NEXT CHART IF WEIGHT DIMINISHES BELOW LIMITS OF THIS CHART.

(2) FUEL CONSUMPTION FIGURES INCREASED 5% DUE TO INCOMPLETE FLIGHT TEST INFORMATION.

PATUXENT FLIGHT TEST

DATA AS OF : 7-16-51 BASED ON: 8 CALCULATIONS

EXAMPLE

GIVEN: A GROSS WEIGHT OF 21,257 LBS. WITH 8900 LBS. (1483 GAL.) OF FUEL.

DESIRED: MAXIMUM RANGE AT 20,000 FEET WITH 30% RESERVE.

PROCEDURE: DETERMINE FUEL AVAILABLE FOR CRUISE BY SUBTRACTING TAKE-OFF AND CLIMB ALLOWANCES (FIGURE A-1, 94.4% RPM) AND RESERVE FROM INITIAL FUEL: I.E., 8900-1485-690 = 6525 LBS. (1088 GAL.) AVAILABLE. DISTANCE IN CLIMB = 93 NAUT. MI. (FIGURE A-9, 94.4% RPM)

OPPOSITE 6000 LBS. (1000 GAL.) UNDER COLUMN FOR TWO ENGINE CRUISE AT 20,000 FEET, READ 656 NAUT. MI. (755 STAT. MI.), CAS IS 257 KNOTS. TOTAL RANGE = 93 + 656 = 749 NAUT. MI.

LEGEND

S.L. : SEA LEVEL
C.A.S. : CALIBRATED AIRSPEED
KTS. : KNOTS
STAT. : STATUTE MILES
NAUT. : NAUTICAL MILES

Figure A-4 (Sheet 1 of 8 Sheets). Flight Operation Instruction Chart

AIRCRAFT MODEL F3D-1

ENGINES: WESTINGHOUSE J34-WE-34 (24C4D)

FLIGHT OPERATION INSTRUCTION CHART

CHART WEIGHT LIMITS : 24,000 TO 20,000 POUNDS

EXTERNAL LOAD ITEMS
2-150 GAL. EXTERNAL DROPPABLE FUEL TANKS
(DOUGLAS TYPE EXTERNAL STORES)

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING. MOVE HORIZONTALLY TO THE RIGHT OR LEFT AND READ AVAILABLE RANGE IN COLUMN FOR PROPOSED CRUISING ALTITUDE. VERTICALLY BELOW DESIRED ALTITUDE READ CAS AND PERCENT RPM REQUIRED. SEE NOTE 2 BELOW

TWO ENGINE CRUISE

MAXIMUM CONTINUOUS POWER

S L		10,000		20,000		30,000		35,000		40,000	
STAT	NAUT	STAT	NAUT	STAT	NAUT	STAT	NAUT	STAT	NAUT	STAT	NAUT
504	438	681	591	928	806	1165	1012				
420	365	568	493	773	671	972	844				
379	329	510	443	696	604	874	759				
336	292	454	394	618	537	777	675				
295	256	397	345	541	470	681	591				
252	219	341	296	464	403	583	506				
211	183	285	246	387	336	486	422				
168	146	227	197	310	269	388	337				
127	110	170	148	231	201	291	253				
84	73	114	99	154	134	195	169				
43	37	56	49	77	67	97	84				
94.4		94.4		94.4		94.4					
371		324		284		220					
1018		757		567		417					
6110		4540		3400		2500					

ALTITUDE (FEET)	
FUEL AVAILABLE FOR CRUISE	
US GALLONS	POUNDS
1650	9900
1600	9600
1400	8400
1200	7200
1000	6000
900	5400
800	4800
700	4200
600	3600
500	3000
400	2400
300	1800
200	1200
100	600
PERCENT RPM	
CALIBRATED AIRSPEED (KTS)	
FUEL CONSUMPTION (US GAL/HR)	
FUEL CONSUMPTION (LBS/HR)	

MAXIMUM RANGE

S L		10,000		20,000		30,000		35,000		40,000	
STAT	NAUT	STAT	NAUT	STAT	NAUT	STAT	NAUT	STAT	NAUT	STAT	NAUT
558	485	638	554	947	822						
465	404	531	461	789	685						
418	363	478	415	709	616						
372	323	425	369	631	548						
328	283	372	323	552	479						
279	242	319	277	473	411						
235	202	266	231	394	342						
187	162	213	185	316	274						
139	121	159	138	236	205						
93	81	106	92	158	137						
46	40	53	46	78	68						
87.3		87.8		90.8							
306		269		254							
758		588		498							
4550		3530		2990							

TWO ENGINE CRUISE

SINGLE ENGINE CRUISE

649	563
540	469
486	422
432	376
378	328
324	282
270	235
216	188
162	141
108	94
54	47
94.4	
243	
518	
3106	

1650	9900
1600	9600
1400	8400
1200	7200
1000	6000
900	5400
800	4800
700	4200
600	3600
500	3000
400	2400
300	1800
200	1200
100	600
PERCENT RPM	
CALIBRATED AIRSPEED (KTS)	
FUEL CONSUMPTION (US GAL/HR)	
FUEL CONSUMPTION (LBS/HR)	

FOR SINGLE ENGINE CRUISE FLY MAXIMUM CONTINUOUS POWER (94.4 PERCENT RPM).

SINGLE ENGINE CRUISE

NOTES

(1) USE OPERATING CONDITIONS OF HEAT CHART IF WEIGHT DIMINISHES BELOW LIMITS OF THIS CHART.
(2) REFER TO PRECEDING CHART FOR EXAMPLE OF CHART USAGE.

DATA AS OF: 7-16-51 BASED ON: PATUXENT FLIGHT TEST & CALCULATIONS

LEGEND

S.L. : SEA LEVEL
C.A.S. : CALIBRATED AIRSPEED
KTS. : KNOTS
STAT. : STATUTE MILES
NAUT. : NAUTICAL MILES

Figure A-4 (Sheet 2 of 8 Sheets). Flight Operation Instruction Chart

AIRCRAFT MODEL F3D-1

ENGINES: WESTINGHOUSE J34-WE-34 (24C4D)

FLIGHT OPERATION INSTRUCTION CHART

CHART WEIGHT LIMITS : 24,000 TO 20,000 POUNDS

EXTERNAL LOAD ITEMS

NONE

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING. MOVE HORIZONTALLY TO THE RIGHT OR LEFT AND READ AVAILABLE RANGE IN COLUMN FOR PROPOSED CRUISING ALTITUDE. VERTICALLY BELOW DESIRED ALTITUDE READ CAS AND PERCENT RPM REQUIRED. SEE EXAMPLE BELOW

TWO ENGINE CRUISE

MAXIMUM CONTINUOUS POWER

S L		10,000		20,000		30,000		35,000		40,000	
STAT	NAUT	STAT	NAUT	STAT	NAUT	STAT	NAUT	STAT	NAUT	STAT	NAUT
584	507										
539	468	714	620								
494	429	654	568	886	769	1130	981				
449	390	594	516	805	699	1027	892	1155	1003		
404	351	535	465	724	629	929	803	1040	903		
359	312	476	413	644	559	822	714	924	802		
314	273	416	361	563	489	720	625	808	702		
270	234	357	310	484	420	616	535	692	601		
225	195	297	258	403	350	514	446	577	501		
180	156	237	206	322	280	411	357	462	401		
135	117	178	155	242	210	309	268	347	301		
90	78	119	103	161	140	205	178	230	200		
45	39	60	52	81	70	102	89	115	100		
94.4		94.4		94.4		94.4		94.4			
380		332		291		230		192			
975		740		557		409		334			
5850		4440		3340		2455		2005			

ALTITUDE (FEET)	
FUEL AVAILABLE FOR CRUISE	
US GALLONS	POUNDS
1350	8100
1300	7800
1200	7200
1100	6600
1000	6000
900	5400
800	4800
700	4200
600	3600
500	3000
400	2400
300	1800
200	1200
100	600
PERCENT RPM	
CALIBRATED AIRSPEED (KTS)	
FUEL CONSUMPTION (US GAL/HR)	
FUEL CONSUMPTION (LBS/HR)	

MAXIMUM RANGE

S L		10,000		20,000		30,000		35,000		40,000	
STAT	NAUT	STAT	NAUT	STAT	NAUT	STAT	NAUT	STAT	NAUT	STAT	NAUT
626	544										
579	503	765	664								
531	461	701	609	910	790						
483	419	637	553	827	718						
434	377	573	498	744	646						
386	335	510	443	661	574						
337	293	447	388	578	502						
290	252	382	332	496	431						
242	210	319	277	414	359						
193	168	255	221	331	287						
145	126	191	166	249	216						
97	84	128	111	166	144						
48	42	63	55	83	72						
86.5		87.1		90.3							
305		272		260							
728		568		486							
4370		3410		2916							

SINGLE ENGINE CRUISE

736	640
680	591
624	541
567	492
510	443
454	394
397	345
340	296
284	246
227	197
170	148
113	99
57	49
94.4	
248	
503	
3020	

1350 / 8100
1300 / 7800
1200 / 7200
1100 / 6600
1000 / 6000
900 / 5400
800 / 4800
700 / 4200
600 / 3600
500 / 3000
400 / 2400
300 / 1800
200 / 1200
100 / 600
PERCENT RPM
CALIBRATED AIRSPEED (KTS)
FUEL CONSUMPTION (US GAL/HR)
FUEL CONSUMPTION (LBS/HR)

FOR SINGLE ENGINE CRUISE FLY MAXIMUM CONTINUOUS POWER (94.4 PERCENT RPM).

NOTES

(1) USE OPERATING CONDITIONS OF NEXT CHART IF WEIGHT DIMINISHES BELOW LIMITS OF THIS CHART.

PATUXENT FLIGHT TEST

DATA AS OF: 7-16-51 BASED ON: B CALCULATIONS

EXAMPLE

GIVEN: A GROSS WEIGHT OF 23,486 LBS. WITH 7100 LBS. (1181 GAL.) OF FUEL.

DESIRED: MAXIMUM RANGE AT 30,000 FEET WITH 10% RESERVE.

PROCEDURE: DETERMINE FUEL AVAILABLE FOR CRUISE BY SUBTRACTING TAKE-OFF AND CLIMB ALLOWANCES (FIGURE A-3, 94.4% RPM) AND RESERVE FROM INITIAL FUEL: i.e., 7100-1895-710 = 4495 (749 GAL.) AVAILABLE. DISTANCE IN CLIMB = 129 NAUT. MI. (FIGURE A-3, 94.4% RPM)

OPPOSITE 4200 LBS. (700 GAL.) UNDER COLUMN FOR TWO ENGINE CRUISE AT 30,000 FEET, READ 625 NAUT. MI. (720 STAT. MI.) CAS IS 230 KNOTS. TOTAL RANGE = 129 + 625 = 754 NAUT. MI.

LEGEND

S.L. : SEA LEVEL
C.A.S. : CALIBRATED AIRSPEED
KTS. : KNOTS
STAT. : STATUTE MILES
NAUT. : NAUTICAL MILES

Figure A-4 (Sheet 3 of 8 Sheets). Flight Operation Instruction Chart

AIRCRAFT MODEL F3D-1

ENGINES: WESTINGHOUSE J34-WE-34 (24C4D)

FLIGHT OPERATION INSTRUCTION CHART

CHART WEIGHT LIMITS : 20,000 TO 16,000 POUNDS

EXTERNAL LOAD ITEMS
2-150 GAL. EXTERNAL DROPPABLE FUEL TANKS (DOUGLAS TYPE EXTERNAL STORES)

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING. MOVE HORIZONTALLY TO THE RIGHT OR LEFT AND READ AVAILABLE RANGE IN COLUMN FOR PROPOSED CRUISING ALTITUDE. VERTICALLY BELOW DESIRED ALTITUDE READ CAS AND PERCENT RPM REQUIRED. SEE NOTE 1 BELOW.

	MAXIMUM CONTINUOUS POWER											
	S L		10,000		20,000		30,000		35,000		40,000	
	STAT	NAUT	STAT	NAUT	STAT	NAUT	STAT	NAUT	STAT	NAUT	STAT	NAUT
TWO ENGINE CRUISE												
	213	185	284	247	390	339	499	433	575	499		
	170	148	228	198	312	271	398	346	460	399		
	128	111	170	148	234	203	298	259	344	299		
	85	74	114	99	157	136	199	173	229	199		
	43	37	56	49	78	68	99	86	115	100		
	94.4		94.4		94.4		94.4		94.4			
	375		328		288		232		204			
	1016		765		570		427		337			
	6094		4589		3417		2559		2141			
SINGLE ENGINE CRUISE												
	280	244	365	317								
	224	195	292	254								
	168	146	219	190								
	112	97	146	127								
	56	49	73	65								
	94.4		94.4									
	252		191									
	518		350									
	3105		2100									

← ALTITUDE (FEET) →		MAXIMUM RANGE											
FUEL AVAILABLE FOR CRUISE		S L		10,000		20,000		30,000		35,000		40,000	
US GALLONS	POUNDS	STAT	NAUT	STAT	NAUT	STAT	NAUT	STAT	NAUT	STAT	NAUT	STAT	NAUT
1650	9900												
1600	9600												
1400	8400												
1200	7200												
1000	6000												
900	5400												
800	4800												
700	4200												
600	3600												
500	3000	237	206	316	274	416	362	516	448				
400	2400	190	165	252	219	333	289	412	358				
300	1800	142	123	189	164	250	217	310	269				
200	1200	94	82	126	109	166	144	206	179				
100	600	47	41	63	55	83	72	104	90				
PERCENT RPM		86.6		86.5		88.4		93.7					
← CALIBRATED AIRSPEED (KTS) →		304		262		237		227					
← FUEL CONSUMPTION (US GAL/HR) →		739		553		442		404					
← FUEL CONSUMPTION (LBS/HR) →		4431		3319		2654		2422			
1650	9900												
1600	9600												
1400	8400												
1200	7200												
1000	6000												
900	5400												
800	4800												
700	4200												
600	3600												
500	3000	285	247										
400	2400	228	198										
300	1800	171	148										
200	1200	114	99										
100	600	57	49										
PERCENT RPM		89.2											
← CALIBRATED AIRSPEED (KTS) →		215											
← FUEL CONSUMPTION (US GAL/HR) →		434											
← FUEL CONSUMPTION (LBS/HR) →		2604											

TWO ENGINE CRUISE

SINGLE ENGINE CRUISE

NOTES

(1) REFER TO PRECEDING CHART FOR EXAMPLE OF CHART USAGE.

LEGEND

S.L. : SEA LEVEL
C.A.S. : CALIBRATED AIRSPEED
KTS. : KNOTS
STAT. : STATUTE MILES
NAUT. : NAUTICAL MILES

DATA AS OF: 7-16-51 BASED ON: PATUXENT FLIGHT TEST & CALCULATIONS

Figure A-4 (Sheet 4 of 8 Sheets). Flight Operation Instruction Chart

AIRCRAFT MODEL F3D-1

ENGINES: WESTINGHOUSE J34-WE-34 (24C4D)

FLIGHT OPERATION INSTRUCTION CHART

CHART WEIGHT LIMITS : 20,000 TO 16,000 POUNDS

EXTERNAL LOAD ITEMS

NONE

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING. MOVE HORIZONTALLY TO THE RIGHT OR LEFT AND READ AVAILABLE RANGE IN COLUMN FOR PROPOSED CRUISING ALTITUDE. VERTICALLY BELOW DESIRED ALTITUDE READ C.A.S. AND PERCENT RPM REQUIRED. SEE NOTE 1 BELOW.

	MAXIMUM CONTINUOUS POWER													MAXIMUM RANGE												
	S L		10,000		20,000		30,000		35,000		40,000		← ALTITUDE (FEET) →	S L		10,000		20,000		30,000		35,000		40,000		
	STAT	NAUT	STAT	NAUT	STAT	NAUT	STAT	NAUT	STAT	NAUT	STAT	NAUT	FUEL AVAILABLE FOR CRUISE	STAT	NAUT	STAT	NAUT	STAT	NAUT	STAT	NAUT	STAT	NAUT	STAT	NAUT	
													US GALLONS / POUNDS													
TWO ENGINE CRUISE													1350 / 8100													TWO ENGINE CRUISE
													1300 / 7800													
													1200 / 7200													
													1100 / 6600													
													1000 / 6000													
													900 / 5400													
													800 / 4800													
													700 / 4200													
	270	234	358	311	487	422	629	545	727	631			600 / 3600	295	256	396	343	518	451	630	546					
	225	195	298	259	406	352	524	454	606	526			500 / 3000	246	213	330	286	432	376	525	455					
	180	156	238	207	325	282	419	363	485	421			400 / 2400	196	170	264	229	346	301	419	364					
	135	117	178	155	243	211	314	272	364	316			300 / 1800	147	128	198	172	260	226	314	273					
	90	78	119	103	162	141	209	181	243	211			200 / 1200	98	85	131	114	173	150	210	182					
	45	39	60	52	81	70	105	91	121	105			100 / 600	49	43	66	57	86	75	105	91					
	94.4		94.4		94.4		94.4		94.4				PERCENT RPM	86.1		85.9		88.9		92.9						
	382		333		295		237		214				← CALIBRATED AIRSPEED (KTS) →	303		264		249		230						
	977		740		555		413		353				← FUEL CONSUMPTION (US GAL / HR) →	712		533		445		400						
	5860		4440		3330		2495		2120				← FUEL CONSUMPTION (LBS / HR) →	4270		3200		2670		2400						
SINGLE ENGINE CRUISE													1350 / 8100													SINGLE ENGINE CRUISE
													1300 / 7800													
													1200 / 7200													
													1100 / 6600													
													1000 / 6000													
													900 / 5400													
													800 / 4800													
													700 / 4200													
	358	311	450	390									600 / 3600	384	316											
	298	259	375	325									500 / 3000	303	263											
	238	207	300	260									400 / 2400	242	210											
	179	155	224	194									300 / 1800	182	158											
	119	103	150	130									200 / 1200	121	105											
	60	52	75	65									100 / 600	61	53											
	94.4		94.4										PERCENT RPM	89.0												
	256		204										← CALIBRATED AIRSPEED (KTS) →	220												
	495		365										← FUEL CONSUMPTION (US GAL / HR) →	418												
	2970		2190										← FUEL CONSUMPTION (LBS / HR) →	2510												

NOTES

(1) REFER TO PRECEDING CHART FOR EXAMPLE OF CHART USAGE.

LEGEND

S.L. : SEA LEVEL
C.A.S. : CALIBRATED AIR SPEED
KTS. : KNOTS
STAT. : STATUTE MILES
NAUT. : NAUTICAL MILES

DATA AS OF: 7-16-51 BASED ON: PATUXENT FLIGHT TEST & CALCULATIONS

Figure A-4 (Sheet 5 of 8 Sheets). Flight Operation Instruction Chart

AIRCRAFT MODEL F3D-1

ENGINES: WESTINGHOUSE J34-WE-34 (24C4D)

FLIGHT OPERATION INSTRUCTION CHART

MAXIMUM ENDURANCE

EXTERNAL LOAD ITEMS

2-150 GAL. EXTERNAL DROPPABLE FUEL TANKS (DOUGLAS TYPE EXTERNAL STORES)

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING. MOVE HORIZONTALLY TO THE RIGHT OR LEFT AND READ AVAILABLE ENDURANCE IN COLUMN FOR EXPECTED CRUISE WEIGHT & PROPOSED CRUISING ALTITUDE. VERTICALLY BELOW DESIRED ALTITUDE READ C.A.S. & PERCENT RPM REQUIRED SEE EXAMPLE BELOW

	27,000 TO 24,000 POUNDS						← CHART WEIGHT LIMITS →		27,000 TO 24,000 POUNDS						
	S L	10,000	20,000	30,000	35,000	40,000	← ALTITUDE (FEET) →		S L	10,000	20,000	30,000	35,000	40,000	
	HOURS	HOURS	HOURS	HOURS	HOURS	HOURS	FUEL AVAILABLE FOR CRUISE		HOURS	HOURS	HOURS	HOURS	HOURS	HOURS	
							US GALLONS	POUNDS							
							1650	9900							
							1600	9600							
	24	29	32				1400	8400							
	21	25	27	27			1200	7200							
	17	21	23	23			1000	6000							
	16	18	20	20			900	5400							
	14	16	18	18			800	4800							
	12	14	15	16			700	4200							
	10	12	14	14			600	3600							
	9	10	11	12			500	3000							
	7	8	9	9			400	2400							
	5	6	7	7			300	1800							
	3	4	5	5			200	1200							
	2	2	2	2			100	600							
TWO ENGINE CRUISE	75.0	79.5	84.9	91.9			PERCENT RPM								TWO ENGINE CRUISE
	190	190	190	190			← CALIBRATED AIRSPEED (KTS) →								
	577	488	443	435			← FUEL CONSUMPTION (US GAL/HR) →								
	3460	2925	2660	2610			← FUEL CONSUMPTION (LBS/HR) →								
							1650	9900							
							1600	9600							
	31						1400	8400							
	27						1200	7200							
	22						1000	6000							
	20						900	5400							
	18						800	4800							
	16						700	4200							
	13						600	3600							
	11						500	3000							
	9						400	2400							
	7						300	1800							
	4						200	1200							
	2						100	600							
SINGLE ENGINE CRUISE	88.8						PERCENT RPM								SINGLE ENGINE CRUISE
	190						← CALIBRATED AIRSPEED (KTS) →								
	448						← FUEL CONSUMPTION (US GAL/HR) →								
	2686						← FUEL CONSUMPTION (LBS/HR) →								

NOTES

(1) USE OPERATING CONDITIONS OF NEXT CHART IF WEIGHT DIMINISHES BELOW LIMITS OF THIS CHART.

DATA AS OF: 7-16-51 BASED ON: PATUXENT FLIGHT TEST & CALCULATIONS

EXAMPLE

GIVEN: A GROSS WEIGHT OF 25,627 LBS. WITH 9900 LBS. (1483 GAL.) OF FUEL.

DESIRED: MAXIMUM ENDURANCE AT 20,000 FEET WITH 10% RESERVE.

PROCEDURE: DETERMINE FUEL AVAILABLE FOR CRUISE BY SUBTRACTING TAKE-OFF AND CLIMB ALLOWANCES (FIGURE A-3, 94.4% RPM) AND RESERVE FROM INITIAL FUEL i.e., 9900-1485-990 = 6525 LBS. (1088 GAL.) AVAILABLE. TIME IN CLIMB = .3 HRS. (FIGURE A-3, 94.4% RPM)

OPPOSITE 6000 LBS. (1000 GAL.) UNDER COLUMN FOR CHART WEIGHT LIMITS OF 27,000 TO 24,000 LBS. FOR TWO ENGINE CRUISE AT 20,000 FEET, READ 2.3 HRS. CAS IS 190 KNOTS. ENDURANCE = 2.3 + .3 = 2.6 HRS.

LEGEND

S.L. : SEA LEVEL
C.A.S. : CALIBRATED AIRSPEED
KTS. : KNOTS
STAT. : STATUTE MILES
NAUT. : NAUTICAL MILES

Figure A-4 (Sheet 6 of 8 Sheets). Flight Operation Instruction Chart

AIRCRAFT MODEL F3D-1

ENGINES: WESTINGHOUSE J34-WE-34 (24C4D)

FLIGHT OPERATION INSTRUCTION CHART

MAXIMUM ENDURANCE

EXTERNAL LOAD ITEMS

2-150 GAL. EXTERNAL DROPPABLE FUEL TANKS (DOUGLAS TYPE EXTERNAL STORES)

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING. MOVE HORIZONTALLY TO THE RIGHT OR LEFT AND READ AVAILABLE ENDURANCE IN COLUMN FOR EXPECTED CRUISE WEIGHT & PROPOSED CRUISING ALTITUDE. VERTICALLY BELOW DESIRED ALTITUDE READ CAS & PERCENT RPM REQUIRED. SEE NOTE 1 BELOW

	24,000 TO 20,000 POUNDS						← CHART WEIGHT LIMITS →		20,000 TO 16,000 POUNDS						
	S L	10,000	20,000	30,000	35,000	40,000	← ALTITUDE (FEET) →		S L	10,000	20,000	30,000	35,000	40,000	
	HOURS	HOURS	HOURS	HOURS	HOURS	HOURS	FUEL AVAILABLE FOR CRUISE		HOURS	HOURS	HOURS	HOURS	HOURS	HOURS	
							US GALLONS	POUNDS							
TWO ENGINE CRUISE							1650	9900							TWO ENGINE CRUISE
							1600	9600							
							1400	8400							
	2.2	2.6	2.9	3.0			1200	7200							
	1.8	2.2	2.4	2.5			1000	6000							
	1.6	2.0	2.2	2.3			900	5400							
	1.4	1.7	1.9	2.0			800	4800							
	1.3	1.5	1.7	1.8			700	4200							
	1.1	1.3	1.5	1.5			600	3600							
	.9	1.1	1.2	1.3			500	3000	1.0	1.2	1.4	1.4	1.5		
	.7	.9	1.0	1.0			400	2400	.8	1.0	1.1	1.1	1.2		
	.5	.7	.7	.8			300	1800	.6	.7	.8	.9	.9		
	.4	.4	.5	.5			200	1200	.4	.5	.5	.6	.6		
	.2	.2	.2	.3			100	600	.2	.2	.3	.3	.3		
	74.7	79.2	84.2	90.5			PERCENT RPM		74.3	78.8	83.9	88.7	93.0		
	190	190	190	190			← CALIBRATED AIRSPEED (KTS) →		190	190	190	190	190		
	556	458	412	398			← FUEL CONSUMPTION (US GAL/HR) →		508	413	367	349	340		
	3335	2745	2470	2390			← FUEL CONSUMPTION (LBS/HR) →		3050	2480	2200	2095	2040		
SINGLE ENGINE CRUISE							1650	9900							SINGLE ENGINE CRUISE
							1600	9600							
							1400	8400							
	2.9						1200	7200							
	2.4						1000	6000							
	2.2						900	5400							
	1.9						800	4800							
	1.7						700	4200							
	1.4						600	3600							
	1.2						500	3000	1.4	1.7					
	1.0						400	2400	1.1	1.2					
	.7						300	1800	.8	.9					
	.5						200	1200	.5	.6					
	.2						100	600	.3	.3					
	87.8						PERCENT RPM		86.0	94.4					
	190						← CALIBRATED AIRSPEED (KTS) →		190	190					
	416						← FUEL CONSUMPTION (US GAL/HR) →		364	341					
	2494						← FUEL CONSUMPTION (LBS/HR) →		2184	2044					

NOTES

(1) REFER TO PRECEDING CHART FOR EXAMPLE OF CHART USAGE

DATA AS OF: 7-16-51 BASED ON: PATUXENT FLIGHT TEST & CALCULATIONS

LEGEND

S.L. : SEA LEVEL
C.A.S. : CALIBRATED AIRSPEED
KTS. : KNOTS
STAT. : STATUTE MILES
NAUT. : NAUTICAL MILES

Figure A-4 (Sheet 7 of 8 Sheets). Flight Operation Instruction Chart

AIRCRAFT MODEL F3D-1

ENGINES: WESTINGHOUSE J34-WE-34 (24C4D)

FLIGHT OPERATION INSTRUCTION CHART

MAXIMUM ENDURANCE

EXTERNAL LOAD ITEMS

NONE

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING. MOVE HORIZONTALLY TO THE RIGHT OR LEFT AND READ AVAILABLE ENDURANCE IN COLUMN FOR EXPECTED CRUISE WEIGHT & PROPOSED CRUISING ALTITUDE. VERTICALLY BELOW DESIRED ALTITUDE READ C A S & PERCENT RPM REQUIRED. SEE EXAMPLE BELOW.

	24,000 TO 20,000 POUNDS						← CHART WEIGHT LIMITS →		20,000 TO 16,000 POUNDS						
	S L	10,000	20,000	30,000	35,000	40,000	← ALTITUDE (FEET) →		S L	10,000	20,000	30,000	35,000	40,000	
	HOURS	HOURS	HOURS	HOURS	HOURS	HOURS	FUEL AVAILABLE FOR CRUISE		HOURS	HOURS	HOURS	HOURS	HOURS	HOURS	
							US GALLONS	POUNDS							
							1350	8100							
	2 4						1300	7800							
	2 2	2 7					1200	7200							
	2 0	2 5	2 7	2 9			1100	6600							
	1 8	2 2	2 4	2 6	2 7		1000	6000							
	1 7	2 0	2 2	2 3	2 4		900	5400							
	1 5	1 8	2 0	2 1	2 1		800	4800							
	1 3	1 6	1 7	1 8	1 9		700	4200							
	1 1	1 3	1 5	1 6	1 6		600	3600	1 2	1 5	1 6	1 7	1 8		
	9	1 1	1 2	1 3	1 3		500	3000	1 0	1 2	1 3	1 3	1 3		
	7	9	1 0	1 0	1 1		400	2400	8	1 0	1 1	1 2	1 2		
	6	7	7	8	8		300	1800	6	7	8	9	9		
	4	4	5	5	5		200	1200	4	5	5	6	6		
	2	2	2	3	3		100	600	2	2	3	3	3		
	75.0	78.2	83.4	88.8	94.4		PERCENT RPM		74.8	78.0	85.0	88.0	92.0		
	190	190	190	190	190		← CALIBRATED AIRSPEED (KTS) →		190	190	190	190	190		
	545	448	410	383	374		← FUEL CONSUMPTION (US GAL/HR) →		510	413	372	362	326		
	3270	2690	2460	2300	2246		← FUEL CONSUMPTION (LBS/HR) →		3060	2475	2230	2070	1955		
SINGLE ENGINE CRUISE							1350	8100							SINGLE ENGINE CRUISE
	3 2						1300	7800							
	2 5						1200	7200							
	2 7						1100	6600							
	2 4						1000	6000							
	2 2						900	5400							
	2 0						800	4800							
	1 7						700	4200							
	1 5						600	3600	1 7	1 7					
	1 2						500	3000	1 4	1 5					
	1 0						400	2400	1 1	1 2					
	7						300	1800	8	9					
	4						200	1200	5	6					
	2						100	600	3	3					
	86.6						PERCENT RPM		85.4	92.1					
	190						← CALIBRATED AIRSPEED (KTS) →		190	190					
	409						← FUEL CONSUMPTION (US GAL/HR) →		363	344					
	2455						← FUEL CONSUMPTION (LBS/HR) →		2180	2065					

TWO ENGINE CRUISE

TWO ENGINE CRUISE

NOTES

(1) FUEL CONSUMPTION FIGURES INCREASED 5% DUE TO INCOMPLETE FLIGHT TEST INFORMATION.

PATUXENT FLIGHT TEST

DATA AS OF: 7-16-51 BASED ON: & CALCULATIONS

EXAMPLE

GIVEN: A GROSS WEIGHT OF 23,498 LBS. WITH 7100 LBS. (1182 GAL.) OF FUEL.

DESIRED: MAXIMUM ENDURANCE AT 30,000 FEET WITH 10% RESERVE.

PROCEDURE: DETERMINE FUEL AVAILABLE FOR CRUISE BY SUBTRACTING TAKE-OFF AND CLIMB ALLOWANCES (FIGURE A-1, 94.4% RPM) AND RESERVE FROM INITIAL FUEL: i.e., 7100-1895-710 = 4495 LBS. (749 GAL.) AVAILABLE. TIME IN CLIMB = .4 HRS. (FIGURE A-1, 94.4% RPM)

OPPOSITE 4200 LBS. (700 GAL.) UNDER COLUMN FOR CHART WEIGHT LIMITS OF 24,000 TO 20,000 LBS. FOR TWO ENGINE CRUISE AT 30,000 FEET, READ 3.0 HRS. CAS IS 190 KNOTS. ENDURANCE = 3.0 + .4 = 3.4 HRS.

LEGEND

S.L. : SEA LEVEL
C.A.S : CALIBRATED AIRSPEED
KTS. : KNOTS
STAT. : STATUTE MILES
NAUT. : NAUTICAL MILES

Figure A-4 (Sheet 8 of 8 Sheets). Flight Operation Instruction Chart