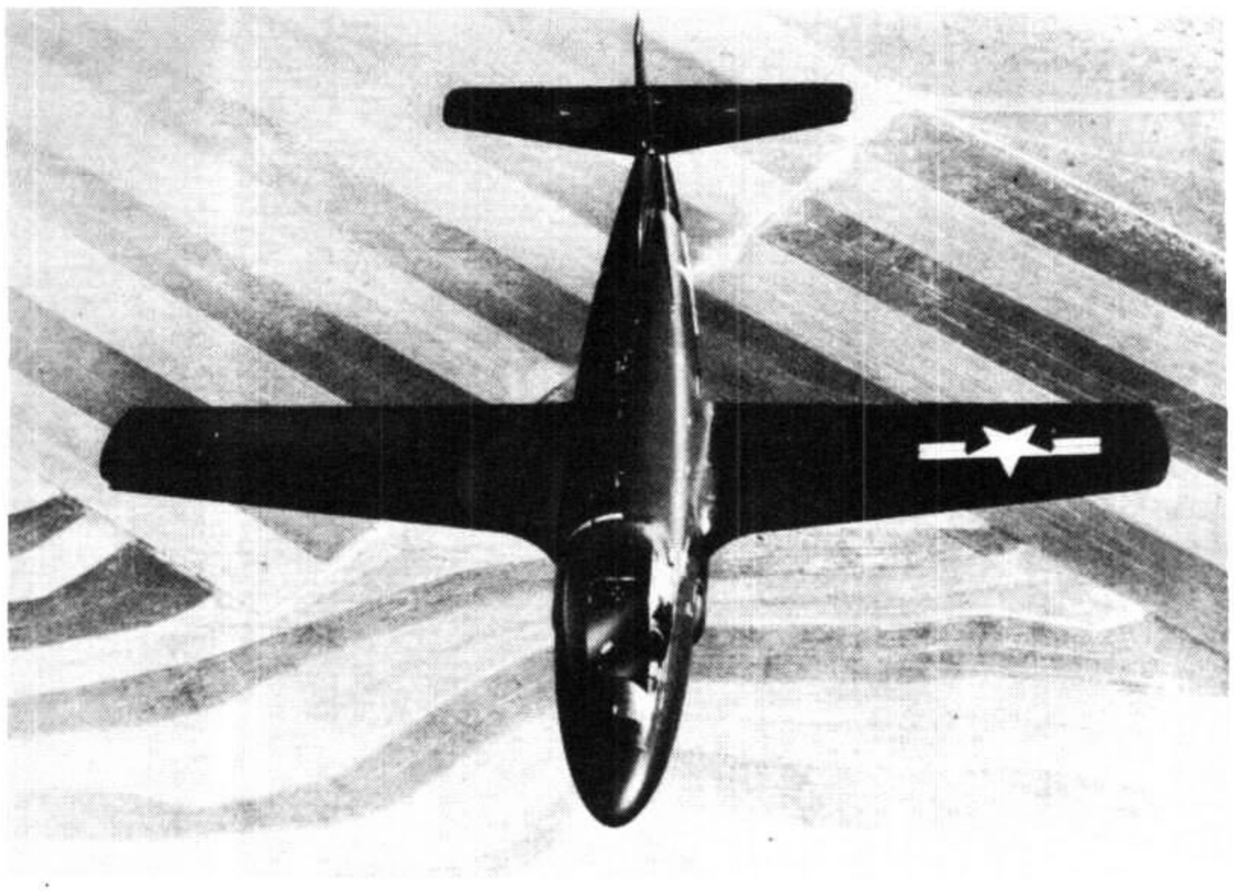
AN 01-40FAB-1

Pilot's Handbook

NAVY MODEL

F3D-2

AIRCRAFT



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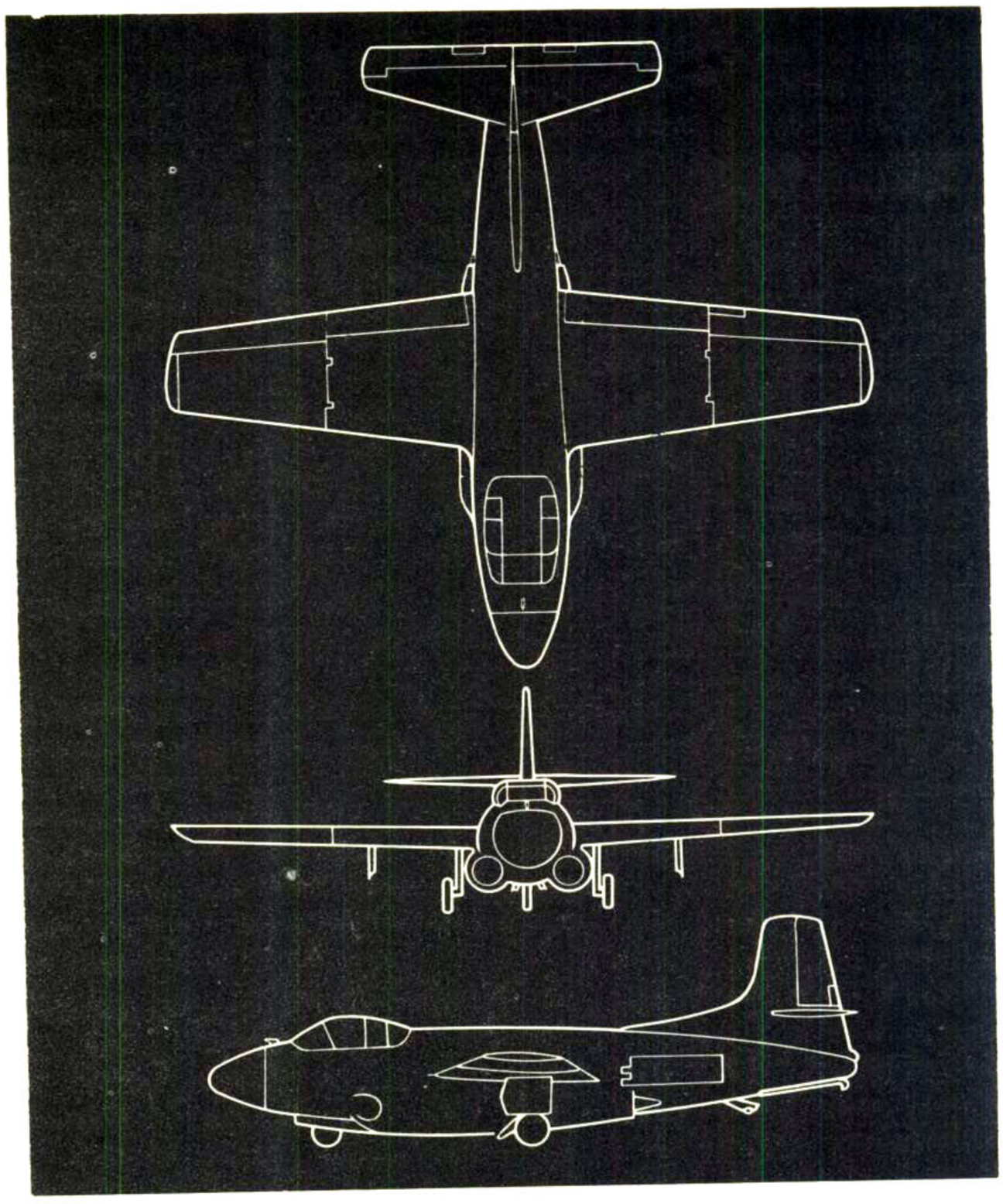
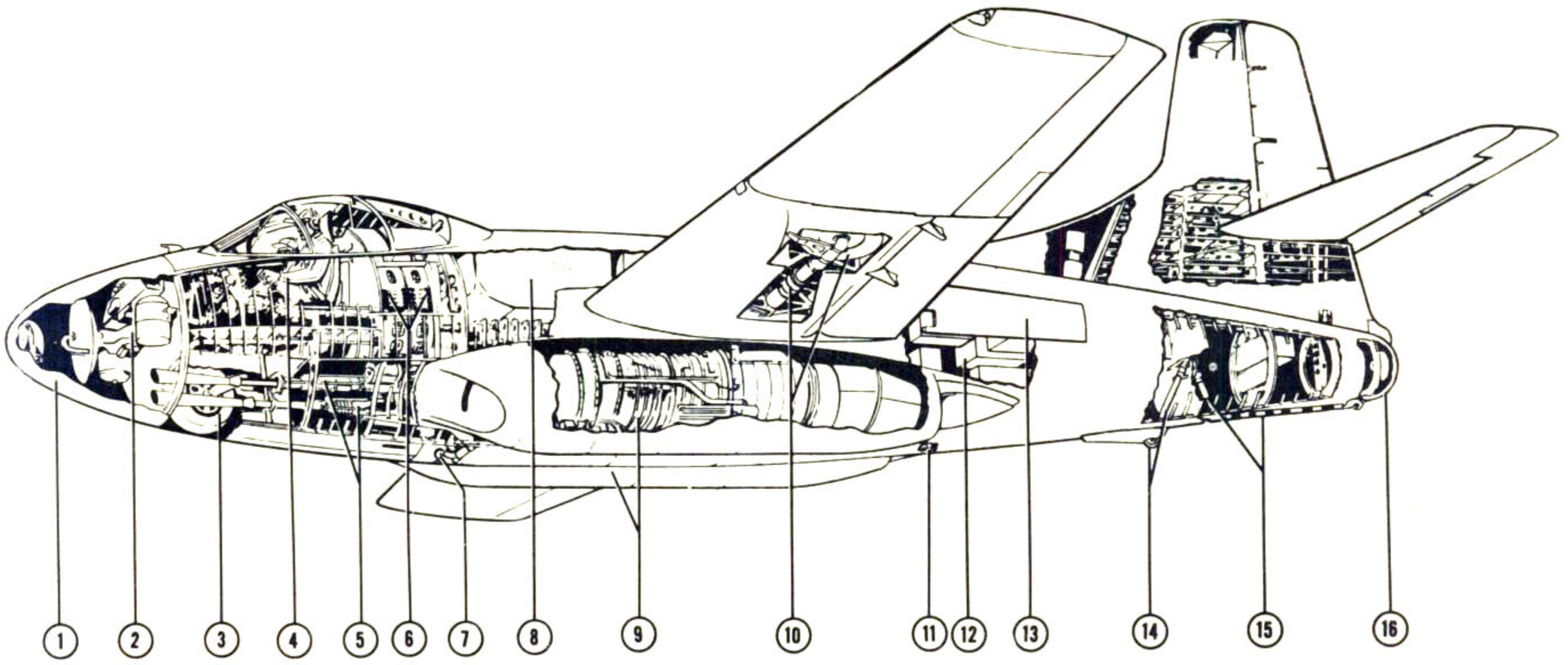


Figure 1-1. Model F3D-2 Airplane



1. Nose radome
2. Radar equipment compartment
3. Nose landing gear
4. Pilot's and radar operator's compartment
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7. Catapult hook (both sides)
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10. Main landing gear
11. Catapult hold back
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Figure 1-2. General Arrangement Diagram

SECTION I

DESCRIPTION

1–1. GENERAL.

1–2. AIRPLANE.

1–3. The model F3D-2 night fighter airplane is a two-place, jet-propelled, all-metal monoplane manufactured by Douglas Aircraft Company, Inc., El Segundo Division. Two J34-WE-36 (24C4E) 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 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. 6¼ in.
Span (wings spread)	50 ft. 0 in.
Span (wings folded)	26 ft. 10 in.
Height (over tail—measured from ground line)	15 ft. 4 in.
Height (over wings—wings folded)	16 ft. 6 in.
Height (maximum during folding)	18 ft. 6 in.
Normal gross weight	
1350 gal. fuel	24,650 lbs.
1650 gal. fuel	26,750 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 32) below the instrument panel.

1–6. GUST LOCK. The GUST LOCK control (figure 1–3, reference 8) 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 and, in airplanes BuNo. 124595 through 124664, operates a switch which opens the electric circuit to the auxiliary hydraulic system pump-motor. This prevents ground check operation of the control surfaces until the gust lock system is unlocked. 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. 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 quadrant slot, must first be pressed inboard.

Note

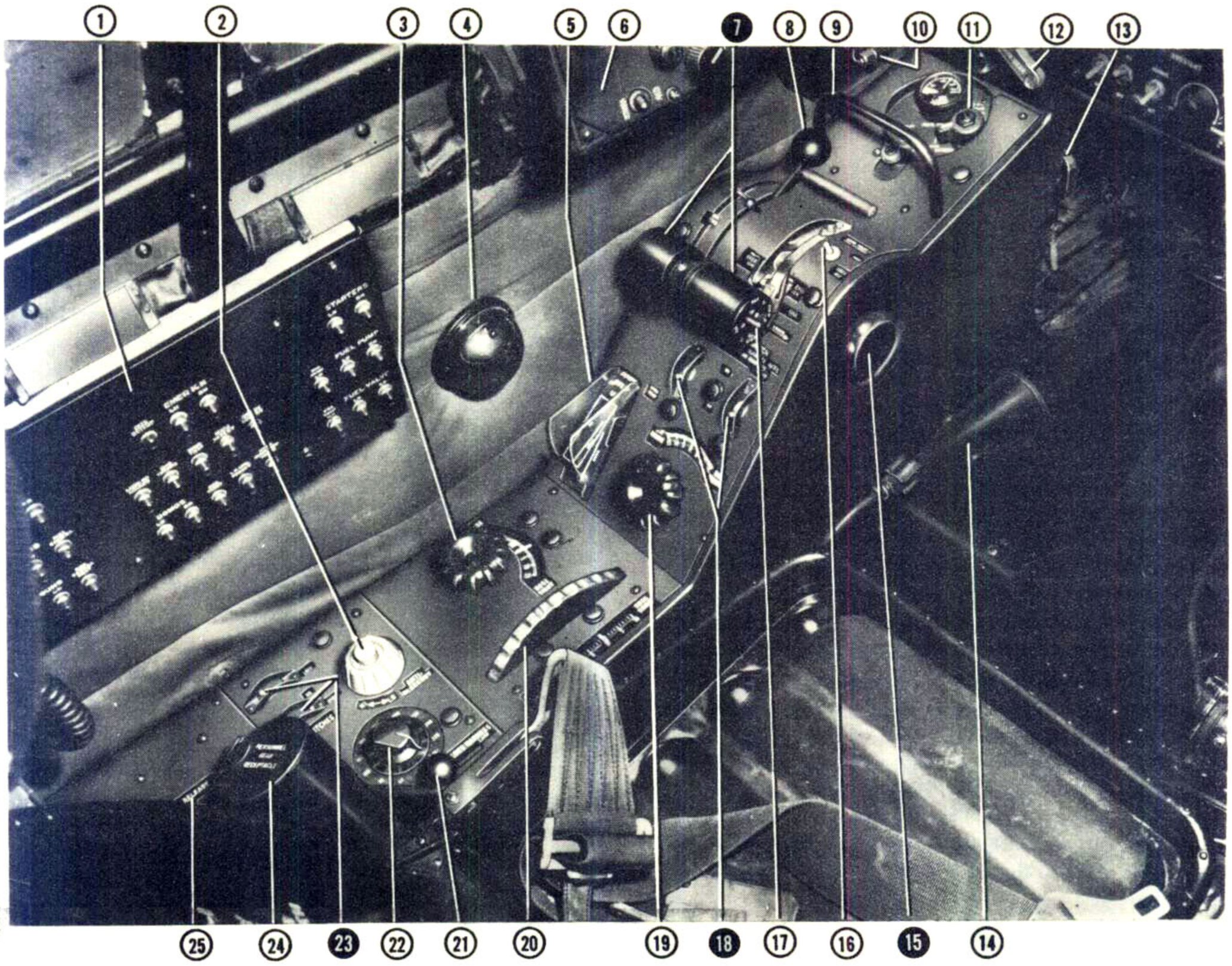
All control surfaces should be in their neutral position before applying the gust lock.

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 3, 19 and 20) 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 5) located on the left-hand console. In airplanes BuNo. 124595 through 124664 if the main system fails, the auxiliary hydraulic control (figure 1–4, reference 23) may be moved to the "EMERGENCY WING FLAP" position to provide hydraulic pressure for wing flap operation. In airplanes BuNo. 125783 and subs. if the main system fails, the emergency flap system control (figure 1–4, reference 23) may be moved to the "EMERG FLAP DOWN" position to provide emergency air pressure for wing flap operation. (Refer to paragraph 3–37.) A combination wing flap and landing gear position indicator (figure 1–4, reference 41) 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 speed-retarder brakes are con-



1. Pilot's circuit breaker panel
2. Pilot's anti-g control
3. Rudder trim tab control
4. Ash tray
5. Wing flaps control
6. AN/ARN-6 radio compass control unit
7. Throttle controls
8. Gust lock control
9. Catapult hand grip
10. Oxygen regulator light
11. Pilot's oxygen regulator
12. Landing gear emergency release handle
13. Landing gear emergency release reset handle
14. Pilot's relief tube
15. Throttle friction control
16. Auto pilot-yaw damper emergency-off switch
17. Radio—ICS transmit switch
18. Master engine switches
19. Aileron trim tab control
20. Elevator trim tab control
21. Pilot's shoulder harness lock control
22. Radio altimeter limit switch
23. Fuel boost pump switches
24. Pilot's personnel gear receptacle
25. External stores emergency release handle

Figure 1-3. Cockpit — Left Side

trolled from a momentary contact type switch on the inboard end of the right throttle control grip. Approximately 3 seconds are required to actuate the speed brakes to the full open (45°) position and approximately 1 to 1½ seconds are required for closing. Any intermediate position can be obtained by releasing the switch when the speed brakes have reached the desired position. The brakes will open only partially if operated while flying at speeds above the blow back speed of 345 knots. After speed has been reduced, the brakes can be opened further by operating the control switch. A speed retarder brake position indicator is installed on a panel at the left-hand side of the pilot's instrument panel on airplanes BuNo. 124646 and subs. The indicator is a tumbling disc type with three positions, "OPEN," "PART OPEN," and "CLO." When electrical power is off, the disc will indicate "PART OPEN" which is the neutral position on the instrument. With electrical power on, the disc will indicate the true position of the dive brakes. Airplanes prior to BuNo. 124646 will be equipped with the indicator by service change.

1–11. AILERON SPOILERS. A spoiler is installed on the upper surface of each wing forward of the wing flap and inboard of the wing fold joint. The spoilers are hydraulically actuated by pressure from the aileron power boost system (see paragraph 1–43). Both spoilers remain closed until the control stick is moved past approximately 8 degrees left or right of neutral. Beyond this position, the left-hand spoiler opens with left wing down and the right-hand spoiler opens with right wing down. Since the boost system pressure is proportional to stick force, the spoiler angle depends on stick force and the aerodynamic hinge moment on the spoiler. Full spoiler opening is obtained with a 30 pound stick force at the maximum indicated airspeed. The spoiler is closed as the control stick passes the 8 degree position on its return toward neutral. Sequence valves are installed in the spoiler system and in the wing fold system to prevent damage from interference between open spoiler and folded wing. The valve system operates to prevent folding of a wing until the respective spoiler is faired, and prevents the spoiler from being opened after the respective wing has been folded.

1–12. AILERON POWER BOOST SYSTEM. An aileron 20:1 ratio power boost system operates from pressure supplied by the auxiliary hydraulic system (refer to paragraph 1–43). The boost system can be mechanically disconnected from the aileron control system by means of the AIL POWER BOOST REL control (figure 4–2, reference 3) which is located adjacent to the pilot's center console. Once disconnected, the boost system cannot be reconnected during flight. A spring-loaded mechanical advantage shifter is installed in airplanes BuNo. 124609, 124621 and subs., and will be installed by service change in all planes prior to those listed above. The shifter is installed in the aileron control cable system to reduce manual forces on the control stick when hydraulic pressure fails. It becomes effective automatically and reduces aileron travel to half the normal travel.

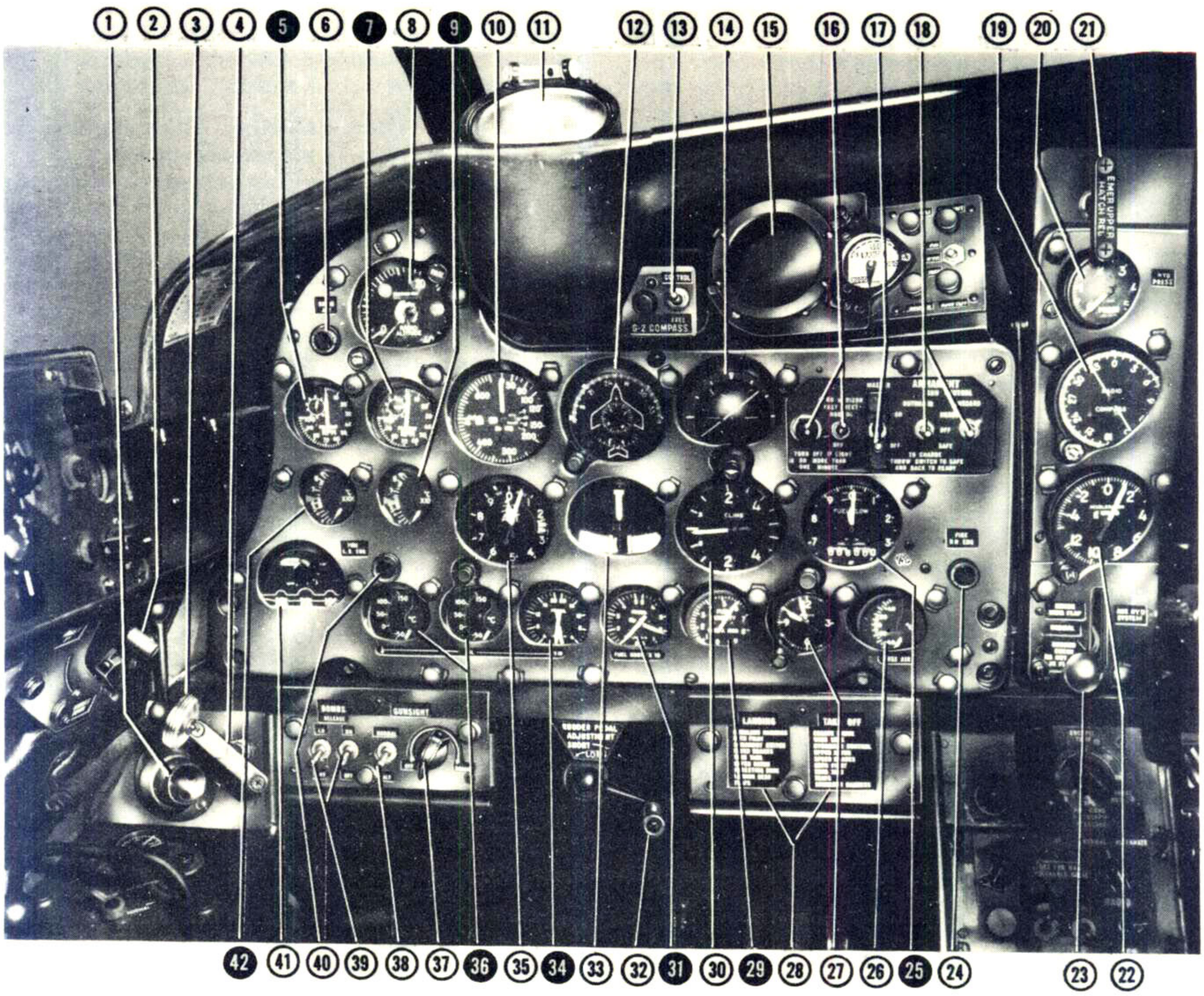
1–13. G-3 AUTOMATIC PILOT CONTROLS. The G-3 automatic pilot is electrically operated and is energized whenever the main inverter is supplying a-c power. The equipment, being continuously synchronized to the airplane's attitude and heading, is ready to take control at any time. The ENGAGE button is on the automatic pilot control panel (figure 1–4A, reference 14) which is located on the center console. The panel also contains the disengage button, the miniature maneuvering control stick which introduces automatically coordinated turns, the controls for trimming the airplane in pitch and yaw, and the switches for controlling constant altitude and return to level flight.

WARNING

After any interruption of the main inverter power, allow seven minutes for auto pilot vertical gyro to stop revolving before re-engaging the main inverter. If this procedure is not followed, engagement of the auto pilot will result in an abrupt displacement of the control surfaces.

1–14. The automatic pilot will maintain the airplane in the same attitude and heading that it had at the time the automatic pilot was engaged unless the airplane is in a bank of over 10 degrees, in which case the airplane will be held in a coordinated turn. Return to level flight may be made by momentarily depressing the RETURN TO LEVEL pushbutton or momentarily displacing the maneuvering stick from its neutral position. The airplane may be flown with the maneuvering stick within the operating limits of ± 70 degrees in pitch and bank, and will continue to fly in an attitude corresponding to the position of the stick. Automatically controlled flight at a specific barometric altitude is accomplished by depressing the ALT CONTROL switch. When the airplane is put into a turn by the maneuvering stick, the selected altitude will be maintained even though the airplane is slightly out of trim. If the airplane is maneuvered into a dive or climb, the altitude control automatically cuts out and cuts in again when the airplane is returned to level flight. The altitude control is disengaged by pulling out on the pushbutton or by disengaging the automatic pilot.

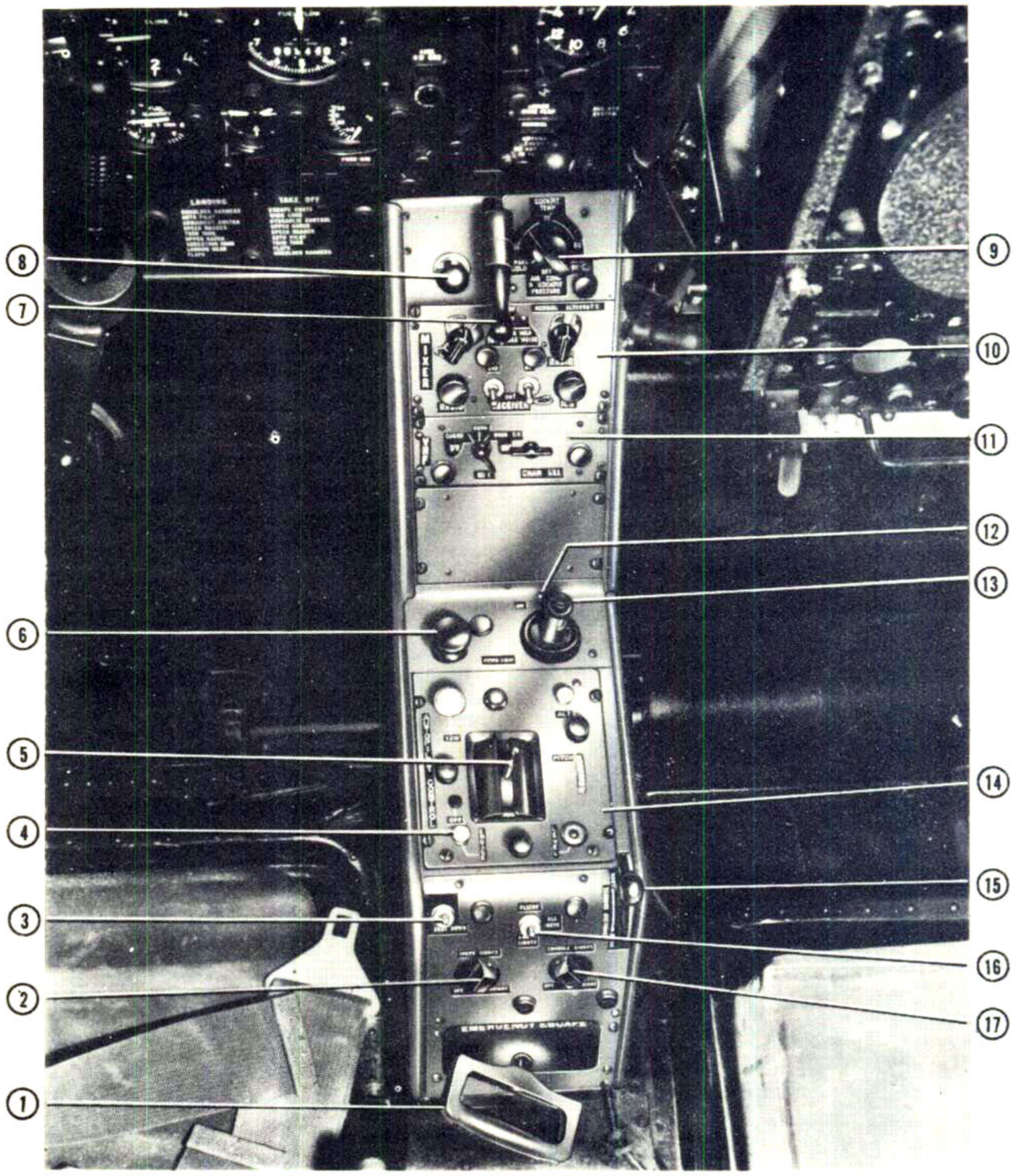
1–15. Automatic yaw damping, through control of the rudder alone, is provided to increase airplane yaw stability during manual flight. During manually controlled turns, the rudder is automatically coordinated by the yaw damper, maintaining ball centered turns up to approximately a 45 degree bank. With banks of more than 45 degrees, some "top" rudder must be held to maintain altitude during a turn with yaw



1. Pilot's ventilating air outlet
2. Landing gear control safety lock
3. Landing gear control
4. Landing gear emergency release handle
5. Left-hand engine tachometer
6. Radio altimeter warning light
7. Right-hand engine tachometer
8. Radio altimeter
9. Right-hand turbine outlet temperature indicator
10. Airspeed indicator
11. Gun sight
12. Master direction indicator—G-2 compass
13. G-2 compass control switch
14. Gyro horizon indicator
15. AN/APG-26 gun aiming radar scope
16. Gyro horizon fast erect warning light and switch
17. Master armament switch
18. Gun control switches
19. AN/ARN-6 radio compass indicator
20. Hydraulic pressure gage
21. Upper hatch emergency release handle
22. Accelerometer
23. Auxiliary hydraulic system control
    Emergency wing flap control*
24. Right-hand engine fire warning light
25. Fuel flow indicator
26. Free air temperature indicator
27. Clock
28. Check-off lists
29. Fuel quantity gage
30. Rate-of-climb indicator
31. Dual fuel boost pressure indicator
32. Rudder pedal adjustment crank
33. Turn and bank indicator
34. Dual oil pressure indicator
35. Altimeter
36. Oil temperature indicator
37. Gunsight light rheostat
38. Gunsight light selector switch
39. Bomb selector switches
40. Left-hand engine fire warning light
41. Wheels and flaps position indicator
42. Left-hand engine turbine outlet temperature indicator

*Airplanes BuNo. 125783 and subsequent.

Figure 1-4. Cockpit—Instrument and Armament Control Panel



1. Lower escape chute door emergency release handle
2. Instrument lights rheostat
3. Pilot's seat adjustment switch
4. Auto pilot engage switch
5. Auto pilot controller
6. Yaw damper engage switch
7. Arresting hook control handle
8. Cigarette lighter
9. Air conditioning and cockpit pressurization control switch
10. Pilot's AN/AIC-4 interphone control panel
11. Pilot's AN/ARC-1 VHF control panel
    AN/ARC-27 UHF control panel*
12. Extension light switch
13. Extension light
14. Auto pilot control panel
15. Radar operator's shoulder harness control lever
16. Instrument lights selector switch
17. Console lights rheostat

*Alternate installation.

Figure 1-4A. Cockpit—Center Console

damper engaged. If an uncoordinated turn, such as a sideslip, is to be made with the yaw damper engaged, the pilot must overpower the rudder. In airplanes BuNo. 124595 through 124648, the yaw damper is automatically disengaged during take-off or landing when the landing gear is extended. In airplanes BuNo. 124649 and subs., however, the yaw damper is automatically disengaged only when the airplane is on the ground. In airplanes BuNo. 125792 and subs., "force links," which permit manual control of the rudder without the need to overpower it even though the yaw damper is engaged, are installed. With force links installed and the yaw damper engaged, rudder control forces are only slightly higher than those normally experienced without the yaw damper engaged.

Note

Until airplanes BuNo. 124649 through 124664, 125783 through 125791 have force links installed by service change, it will be necessary to overpower the yaw damper if rudder control is needed during an approach and landing, unless the yaw damper is disengaged by pulling out the YAW DAMPER switch. Approximately 150 pounds of force on the rudder pedals is needed to overpower the yaw damper.

On airplanes prior to BuNo. 124604, the auto pilot and yaw damping system is inoperative unless the YAW DAMPER PUSH TO ENGAGE switch (figure 1-4A, reference 6) has been incorporated by service change. Airplanes BuNo. 124604 and subs., are equipped with the YAW DAMPER engage switch and the auto pilot and yaw damper systems are fully operative. Depressing the YAW DAMPER switch engages the system and pulling the switch out disengages the system. The YAW DAMPER engage switch should also be depressed during auto pilot operation. The AUTO PILOT & YAW DAMPER control switch (figure 1-3, reference 16) should be left in the "NORM" position at all times except when emergency disengaging of both the yaw damper and automatic pilot systems is necessary.

WARNING

The yaw damper must be disengaged during spins in airplanes which do not have force links installed.

Note

Force links will be installed by service change in airplanes prior to BuNo. 125792. To ascertain whether or not force links have been installed, the following check can be made prior to take-off:

a. Engage auto pilot.
b. Engage yaw damper.
c. Overpower the rudder controls. No force links—approximately 150 pounds of force needed. Force links installed—approximately 35 pounds of force needed.

1-16. G-2 COMPASS CONTROL. The G-2 compass control switch (figure 1-4, reference 13) is located on the instrument panel. Normally, the switch is in the "CONTROL" position. Moving the switch to the "FREE" position disconnects the gyro torque motor from the compass circuit, permitting the compass to operate as a free directional gyro. The "FREE" position is used to prevent the system from becoming erratic due to excessive "dip" of the earth's magnetic field in the polar regions. Refer to paragraph 2-58 for operation of the G-2 compass during flight.

1-17. MAXIMUM ALLOWABLE AIRSPEED INDICATOR. The airspeed indicator (figure 1-4, reference 10) located on the instrument panel, has two pointers. The yellow pointer shows indicated airspeed and the 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.

1-18. POWER PLANT CONTROLS.

1-19. MASTER ENGINE SWITCHES. The master engine switches (figure 1-3, reference 18), 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. 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.

1-19A. ENGINE CRANK SWITCHES. In airplanes BuNo. 124650 and subs., two push-button type momentary contact crank switches which energize the starters are mounted on the left-hand console aft of the throttle levers.

1-20. THROTTLES. Throttle controls (figure 1-3, reference 7), located on the left-hand console, functions as engine starting control when in the bottom (aft) detent position. In airplanes BuNo. 124595 through 124649, outward movement of the spring loaded throttle levers toward "CRANK" will energize the starter if the master engine switch is "ON." Moving the throttle lever to the "IGN" position energizes the ignition coil and starts the 30 second timer. In airplanes BuNo. 124650 and subs., the starters are energized by means of separate switches (refer to paragraph 1-19A). These momentary contact CRANK switches have been incorporated into the airplane to allow for the energizing of the ignition circuits without an advance of the throttle levers and subsequent

premature flow of fuel into the engines. The throttle levers are moved outward at the aft position to "IGNITION" to energize the ignition coil and start the 30 second timer, and are then advanced into "IDLE" to gain the optimum starting fuel flow. Airplanes BuNo. 124595 through 124649 will be modified to incorporate this installation by service change. After a start is made, the throttles operate in a normal manner from the idle stops to full power. A microphone switch and a speed brake switch are 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 must be provided to supply the 1000 amp 29 ± 1 volt d-c constant current required by the starters.

1–21. TURBINE OUTLET TEMPERATURE INDICATORS. These gages (figure 1–4, references 9, 42) 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. Red line turbine outlet temperatures may vary with each engine. Consult the Engine Log Book of the engine to be operated for the correct red line temperature.

1–22. TACHOMETERS. Two tachometers (figure 1–4, references 5, 7) on the instrument panel read in 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)	95.5%

1–23. FUEL SYSTEM CONTROLS.

1–24. GENERAL. The fuel system (see figure 1–5) 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). A combined total of 1650 U.S. gallons (9900 pounds) of fuel may be carried.

1–25. 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 and the electrical system is energized. Fuel from the front and center tanks feeds into the rear tank through a common manifold. The forward lower section of the rear tank is baffled off to form a compartment for housing the booster pumps. A flapper valve at the aft end of the booster pump compartment prevents fuel in the compartment from emptying into the aft tank during a climb, and flapper valves in the supply lines from the front and center tanks prevent return of fuel from the compartment during diving operations. By this means, fuel is supplied to the pumps from the front and center tanks during climbs and from the rear tank during dives. A flapper valve is installed at the top of the booster pump compartment to prevent fuel from returning to the center tank through the vent line during negative "g" operations. Sufficient fuel is contained in the compartment for approximately 30 seconds of negative "g" operation. The booster pumps supply fuel at a pressure of approximately 10 to 30 psi to the engine fuel system.

WARNING

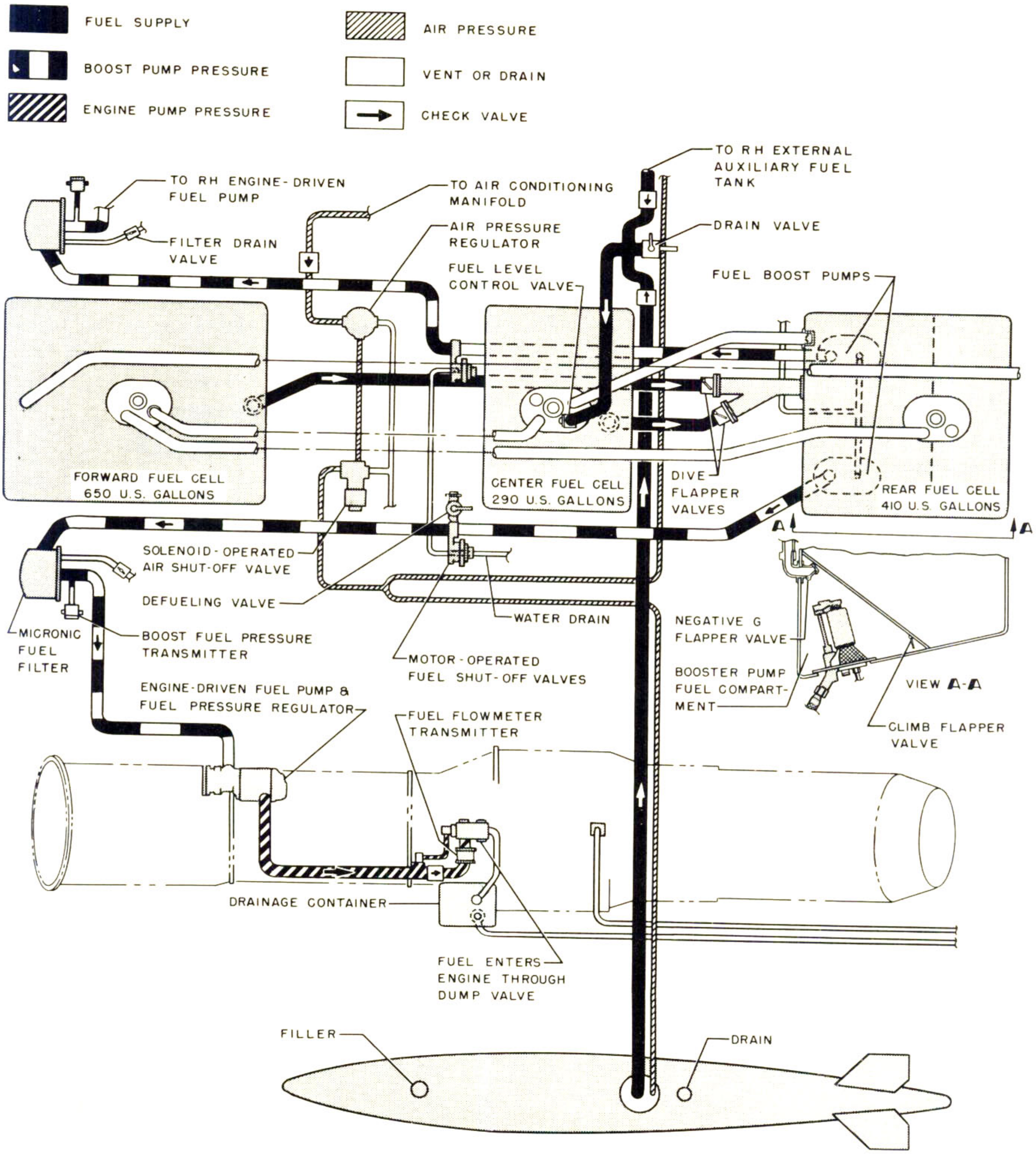
If boost pump pressure falls below the minimum allowable of 10 psi while on the ground, shut down the engine and investigate. If this occurs during flight, power loss will be experienced and engine performance may be restricted with increase in altitude. Furthermore, above 18,000 feet "flame-out" is highly probable.

1–26. ENGINE FUEL SYSTEM. Fuel from the tanks is supplied to the engine fuel system by the booster pumps. This 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.

1–27. 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 cut-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.

1–28. FUEL BOOST PUMP SWITCHES. Two fuel pump switches (figure 1–3, reference 23), are on the left-hand console. These switches control the booster pumps and automatically open the fuel shut-off valves for each engine.

1–28A. FUEL FLOW INDICATOR The fuel flow indicator (figure 1–4, reference 25) provides an indication of the amount of fuel flow in pounds per hour



L H EXTERNAL AUXILIARY FUEL TANK - 150 U.S GALLONS

Figure 1-5. Fuel System

and an indication of the amount, in pounds, of fuel remaining in the airplane. The outer dial and the indicating needle register the current rate of flow, while the smaller four digit indicator at the lower center of the instrument indicates the amount of fuel remaining in the aircraft. An adjustment knob at the lower left-hand corner of the instrument provides for manual setting of the known amount of fuel in the airplane prior to flight.

1–29. FUEL QUANTITY INDICATOR. A fuel indicator (figure 1–4, reference 29) 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.

1–29A. On airplanes BuNo. 125784, 125785, 125788 and subs., a push button switch is installed on the instrument panel below the fuel quantity indicator for use in testing the operation of the fuel quantity indicator. When the test button is pushed in with an external power source connected or with the generators operating, a fuel-tanks-empty impulse is fed to the fuel quantity indicator circuit. The fuel quantity indicator will drop to a zero reading, and then will return to an actual fuel quantity indication when the button is released if the indicator is functioning properly.

1–30. FUEL BOOST PRESSURE INDICATOR. A dual fuel boost pressure indicator (figure 1–4, reference 31) is installed on the instrument panel. This indicator shows the pressure of the fuel being supplied to the engine fuel system.

1–31. DEFUELING VALVE. A defueling valve is installed at 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.

1–32. OIL SYSTEM.

1–33. 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 34) and two oil temperature indicators (figure 1–4, reference 36) are on the instrument panel.

1–34. LANDING GEAR CONTROLS.

1–35. NORMAL CONTROL. The landing gear is locked in the extended position by overcenter mechanical locks. The landing gear control lever (figure 1–4, reference 3) 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 1–4, reference 2) 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.

1–36. 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 1–4, reference 4) 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

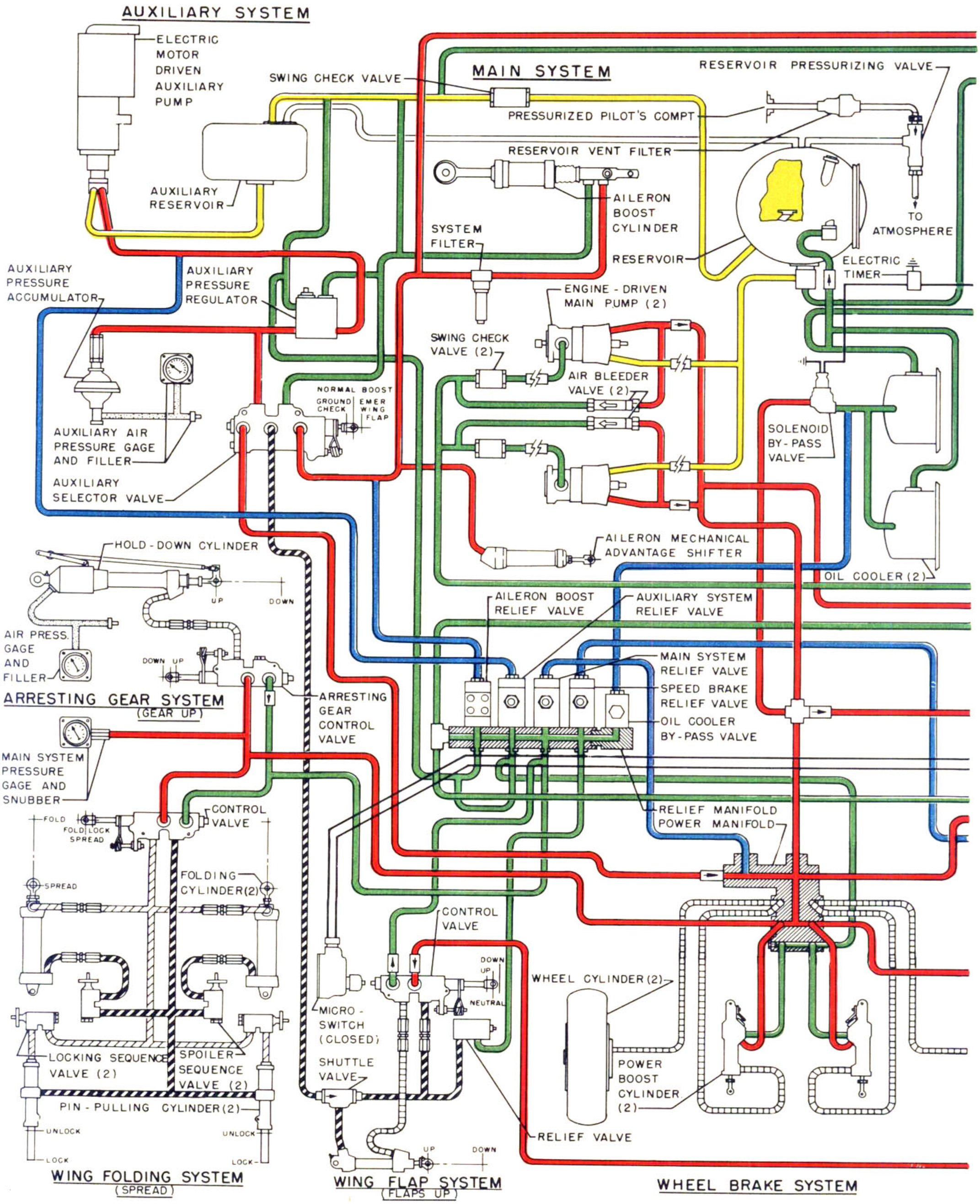
In airplanes BuNo. 124595 through 124664, the release cable is held in the pulled position by a friction lock. To return the cable to its original position, pull friction lock release cable (figure 1–3, reference 13) located below the instrument panel and forward of the left-hand console. The friction lock is not installed in airplanes BuNo. 125783 and subs.

1–37. POSITION INDICATOR. A combination landing gear and wing flap position indicator (figure 1–4, reference 41) is on the instrument panel.

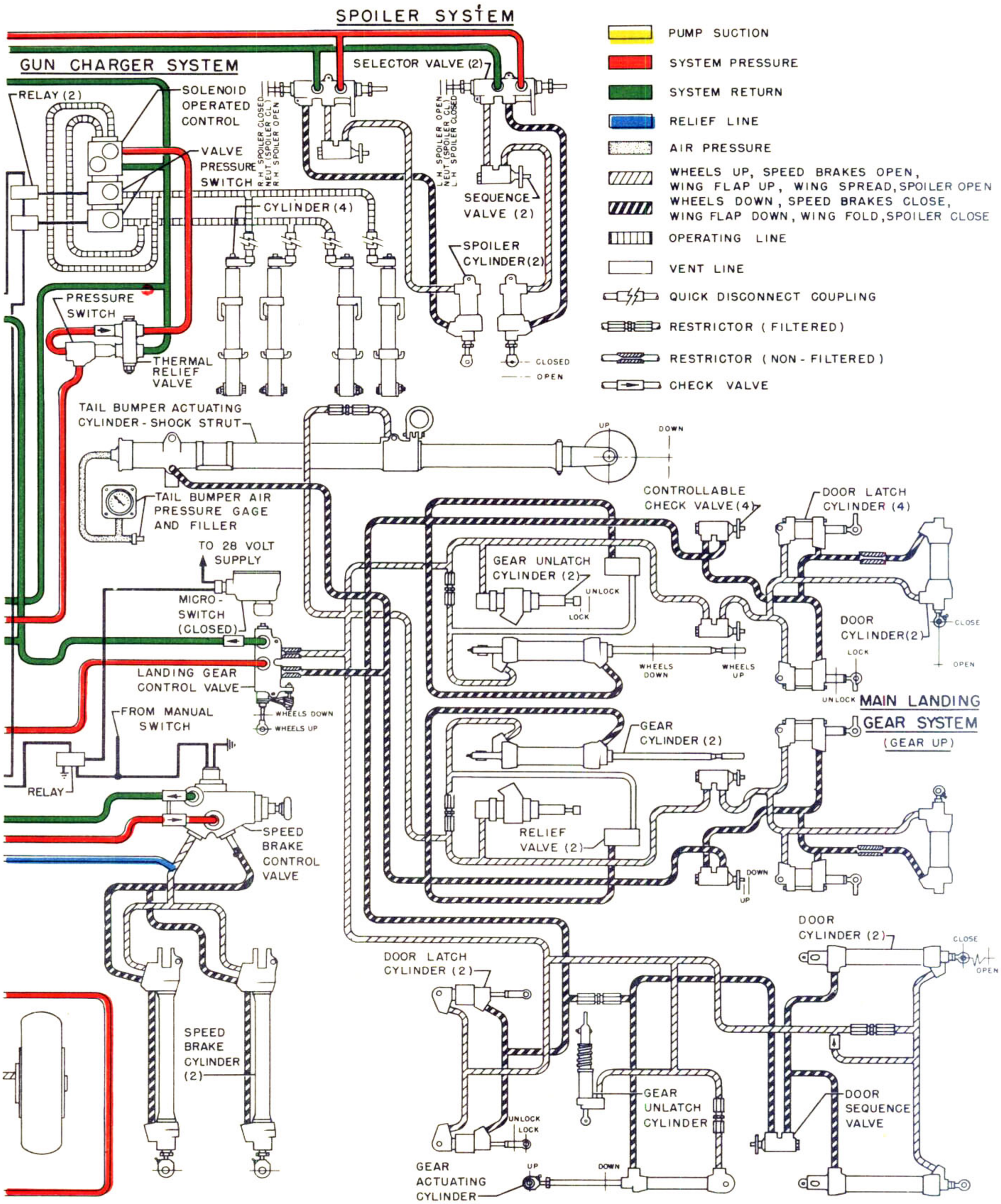
1–38. BRAKES. A power boost brake system operating from the main hydraulic system is provided. The brakes are operated by toe pressure on the rudder pedals. In case of hydraulic system failure, sufficient pressure will be applied for braking by exerting approximately twice the normal force on the rudder pedals.

1–39. ARRESTING GEAR. The arresting hook control (figure 1–4A, reference 7) is located on the center console. The hook is lowered by air pressure independently of the hydraulic system. Retraction of the hook is a 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. On airplanes BuNo. 124629 and subs., a "Failsafe" feature of the arresting hook provides for automatic extension of the arresting hook if the control cable is severed. Airplanes prior to BuNo. 124629 will have this feature incorporated by service change. The approach light operates automatically in conjunction with the hook.

1–39A. A warning light is installed in the arresting hook control handle. When the arresting hook control handle is placed in the "HOOK DOWN" position, the warning light will go on and remain on until the arresting hook is completely extended.



Applicable to airplanes BuNo. 124595 through 124664
Figure 1-6 (Sheet 1 of 4 Sheets). Hydraulic System

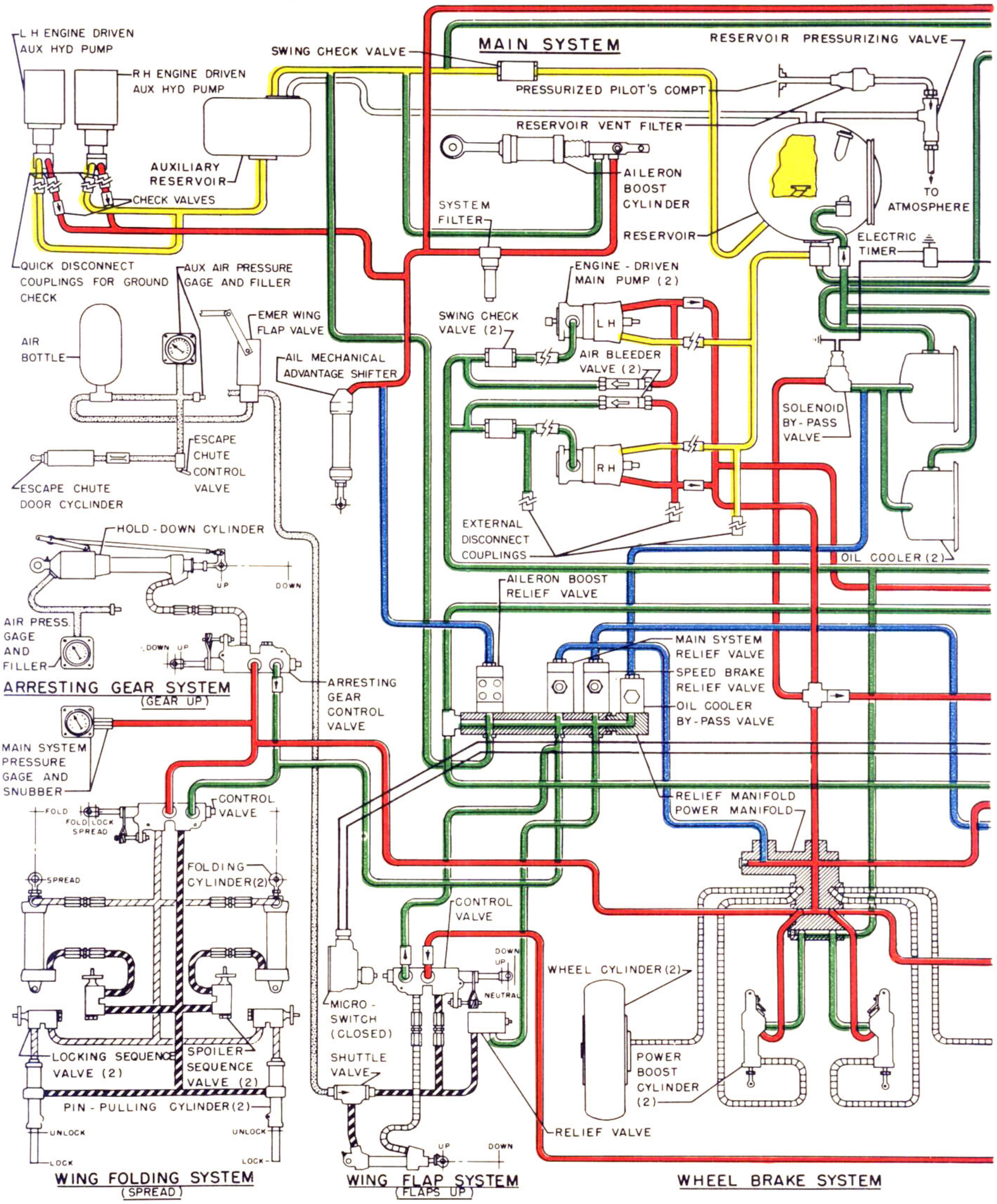


SPEED BRAKE SYSTEM (CLOSED)

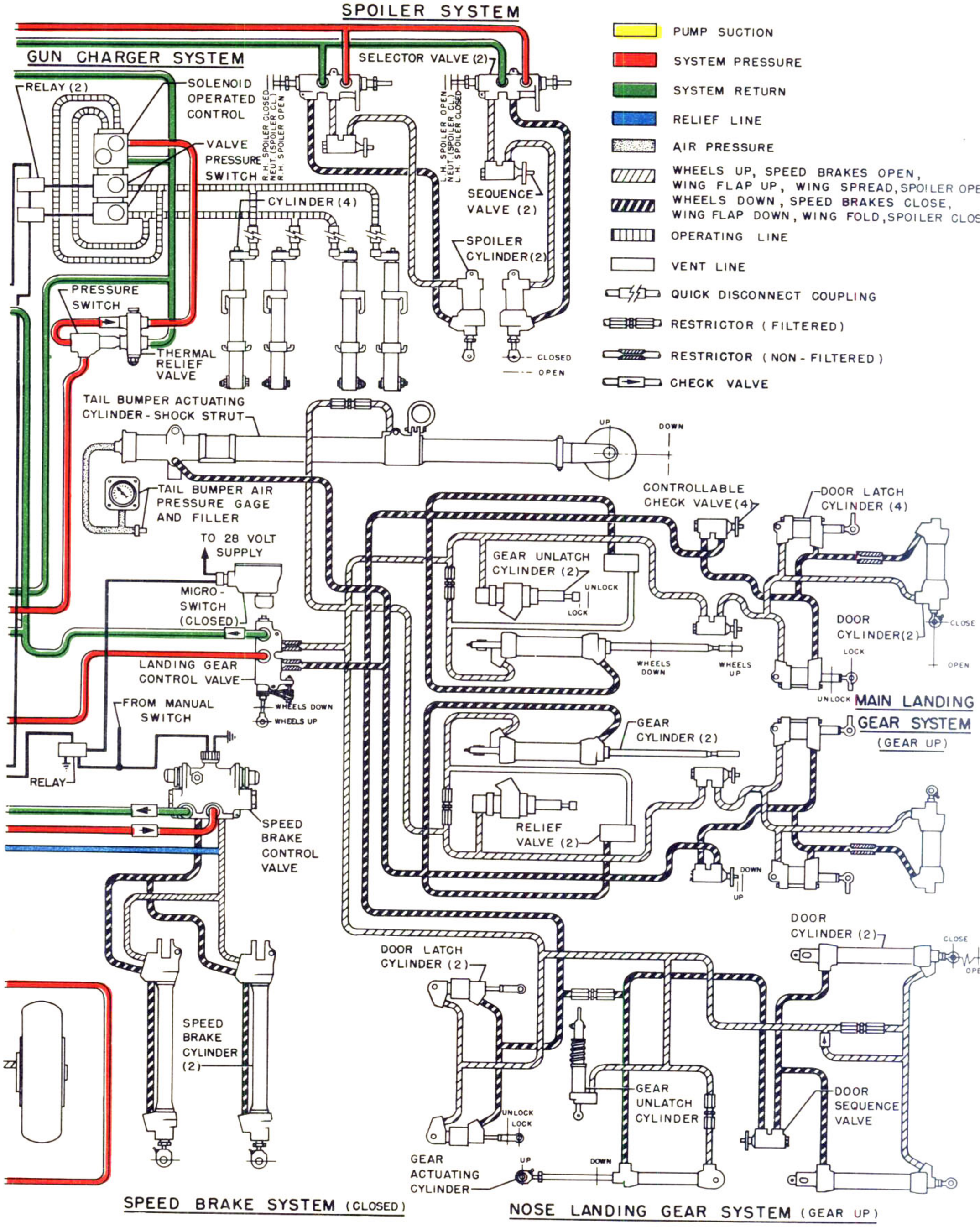
MAIN LANDING GEAR SYSTEM (GEAR UP)

NOSE LANDING GEAR SYSTEM (GEAR UP)

Applicable to airplanes BuNo. 124595 through 124664
Figure 1-6 (Sheet 2 of 4 Sheets). Hydraulic System



Applicable to airplanes BuNo. 125783 and subs.
Figure 1-6 (Sheet 3 of 4 Sheets). Hydraulic System



MAIN LANDING GEAR SYSTEM (GEAR UP)

SPEED BRAKE SYSTEM (CLOSED)

NOSE LANDING GEAR SYSTEM (GEAR UP)

Applicable to airplanes BuNo. 125783 and subs.
Figure 1-6 (Sheet 4 of 4 Sheets). Hydraulic System

1–40. WING FOLDING CONTROL. The "lift-type" wing folding control (figure 4–2, reference 2) 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

1. Wing spoilers must be faired to permit wing folding. Fair spoilers by placing stick in neutral position if auxiliary hydraulic boost pumps are operating. In airplanes prior to BuNo. 125791, spoilers must be closed manually when pumps are inoperative. In airplanes BuNo. 125791 and subs., the spoilers are spring loaded, however, and close automatically whenever the pumps are inoperative.
2. The wing pins are not locked unless the red warning flags on the leading edges of the wings are faired.

1–41. HYDRAULIC SYSTEM CONTROLS.

1–42. MAIN HYDRAULIC SYSTEM. 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 1–6). 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," or the gun control switch to "READY" or "OFF," whichever operation is last. System pressure is continuous whenever the speed brake switch is held in the "OPEN" or "CLOSE" position and will continue for 30 seconds after the speed brake switch is released. 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.

1–43. AUXILIARY HYDRAULIC SYSTEM.

1–43A. In airplanes prior to BuNo. 125783, an auxiliary hydraulic system is provided for aileron power boost and spoiler operation, and may also be used for checking the main hydraulic system on the ground when the engines are shut down (see paragraph 2–25) or for extending the wing flaps during flight in the event of main hydraulic system failure. Power is supplied by an electrically driven pump which is turned on by the battery-generator switch if the gust lock control is in the unlocked position. The auxiliary system operates at pressures between 400 to 2500 psi for aileron boost and spoiler operation and is regulated at 2700 to 3000 psi by the pressure regulator for emergency wing flap and ground check systems. The auxiliary hydraulic system selector valve control (figure 1–4, reference 23) located to the right of the instrument panel, has the following positions:

"EMERGENCY WING FLAP"—In case normal system fails.

"NORMAL"—Normal aileron power boost and spoiler operation.

"GROUND CHECK"—For checking individual components of the main system (see paragraph 2–25). DO NOT USE IN FLIGHT.

1–43B. In airplanes BuNo. 125783 and subs., an auxiliary hydraulic system is provided for aileron power boost and spoiler operation only. Power is supplied by two engine driven pumps which operate at pressures between 400 and 2500 psi. If one of the two auxiliary hydraulic pumps should fail, the resultant reduction of aileron boost would reduce the roll rate of the airplane to approximately 80 percent of normal. In the event of failure of both auxiliary hydraulic pumps, a mechanical advantage shifter is automatically actuated (refer to paragraph 1–12). The complete loss of auxiliary hydraulic pressure would cause the spoilers to be inoperative. Emergency wing flap operation has been changed in these airplanes (refer to paragraph 3–37B), as has the ground check procedure (refer to paragraph 1–43C).

1–43C. EXTERNAL HYDRAULIC QUICK DISCONNECT FITTINGS. For ground check of airplanes BuNo. 125783 and subs., two external hydraulic pressure quick disconnect panels are provided, one for aileron power boost and spoiler operation, and one for operation of the main hydraulic system components. The external hydraulic pressure disconnect fittings are located in the starboard engine accessory section and are accessible through the engine forward cowling access door. The inboard disconnect fittings are connected to the aileron power boost and spoiler system; the outboard disconnect fittings are connected to the main hydraulic system.

1–44. ELECTRICAL SYSTEM CONTROLS.

1–45. GENERAL. The airplane is equipped with a 28-volt direct-current electrical system. Origination of circuits from the various busses is shown on figure 1–7.

1–46. BATTERY. A 24-volt, 34 ampere-hour battery is mounted on the center line of the airplane, just aft of the escape chute. It is accessible from the lower escape chute entrance door. The battery-generator switch (figure 4–2, reference 29) is located at the top of 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 nonessential loads.

1–47. 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 1–46). Generator warning lights (figure 4–2, reference 10) 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.

1–48. CIRCUIT BREAKERS. Circuit breakers for all electrical circuits are provided on two vertical panels (figure 1–3, reference 1 and figure 4–2, reference 16) 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

1–49. 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.

1–50. RADAR POWER SUPPLY INVERTERS. Alternating current is supplied by two single-phase inverters to the IFF and radar equipment (see figure 1–7). Operation is controlled by the three-position a-c inverter control switch (figure 4–2, reference 15) 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, and to the IFF power and control circuit. No indication of inverter failure other than nonfunctioning of equipment is provided.

1–51. INSTRUMENTS POWER SUPPLY INVERTERS. Alternating current is supplied by one of two three-phase inverters. The main inverter is in operation whenever the engines are running or whenever an external d-c power source is connected to the airplane, providing the circuit breaker is closed. Under normal conditions, the main inverter is the only one in operation, supplying power to the automatic pilot, flight and engine instruments, and the CP-63/APG-26 ballistic computer. In the event of failure of the main inverter, an automatic changeover to standby inverter takes place. On airplanes BuNo. 124642 and subs., failure of the main inverter will be indicated by the inverter warning light (figure 4-2, reference 31) on the right-hand console. The light will remain on even though automatic changeover to the standby inverter has taken place. Turning the INSTR INVERT switch (figure 4–2, reference 12) on the right-hand console from "NORM" position to "STBY" will turn the light out if the standby inverter is furnishing power. If the light remains on with the INSTR INVERT switch in the "STBY" position, the standby inverter is not operating. An inverter warning light and INSTR INVERT switch will be added to airplanes prior to BuNo. 124642 by Service Change. The standby inverter will supply power only to essential flight and engine instruments and to the CP-63/APG-26 ballistic computer. The discontinuance of automatic pilot operation will serve as an additional indication of failure of the main inverter.

WARNING

After any interruption of the main inverter power, allow seven minutes for auto pilot vertical gyro to stop revolving before re-engaging the main inverter. If this procedure is not followed, engagement of the auto pilot will result in an abrupt displacement of the control surfaces.

1–52. VOLT-AMMETERS. Combination volt-ammeters (figure 4–2, reference 11) are located on the upper part of the right-hand console panel. 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.

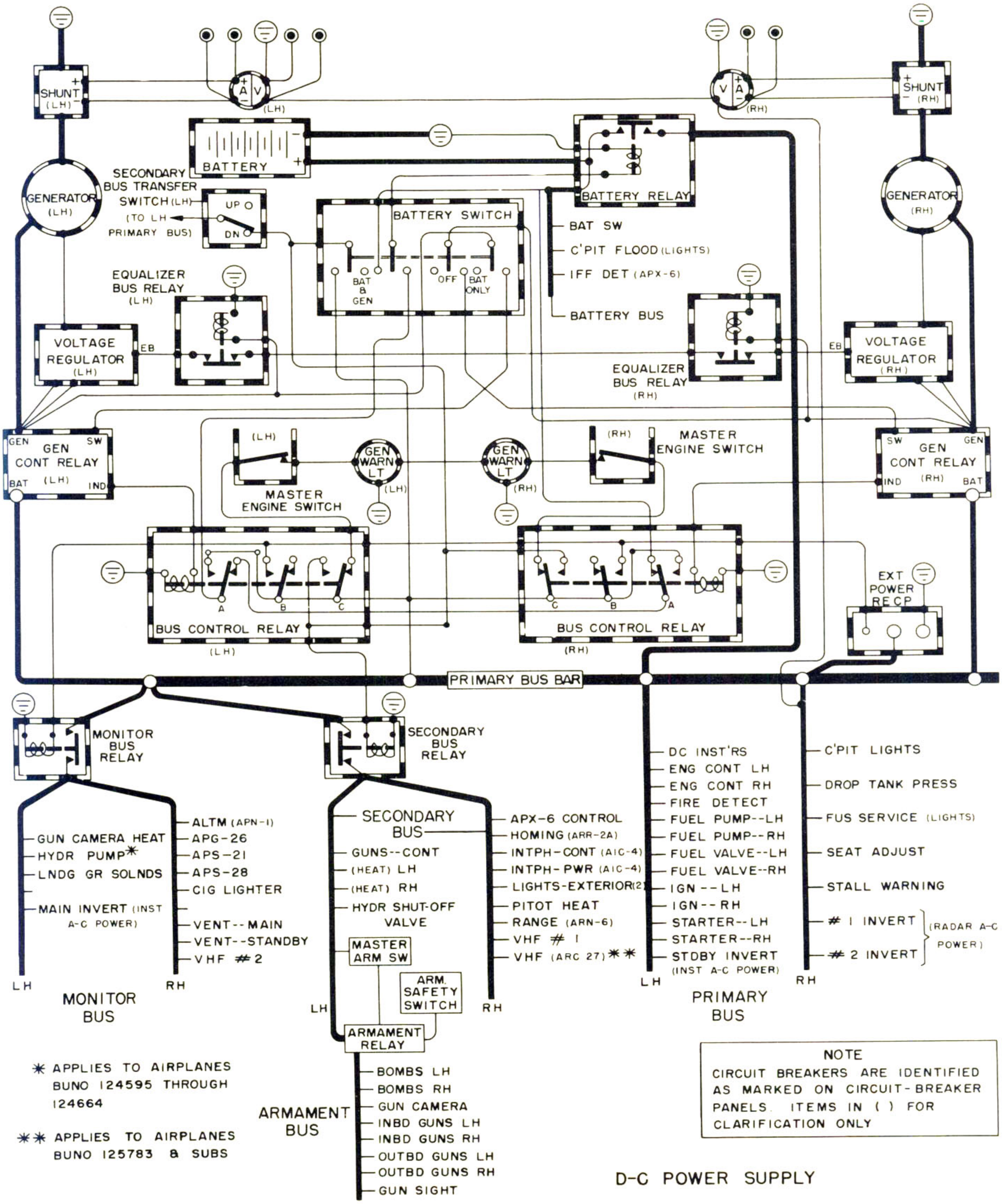


Figure 1-7 (Sheet 1 of 2 Sheets). Electrical System Diagram

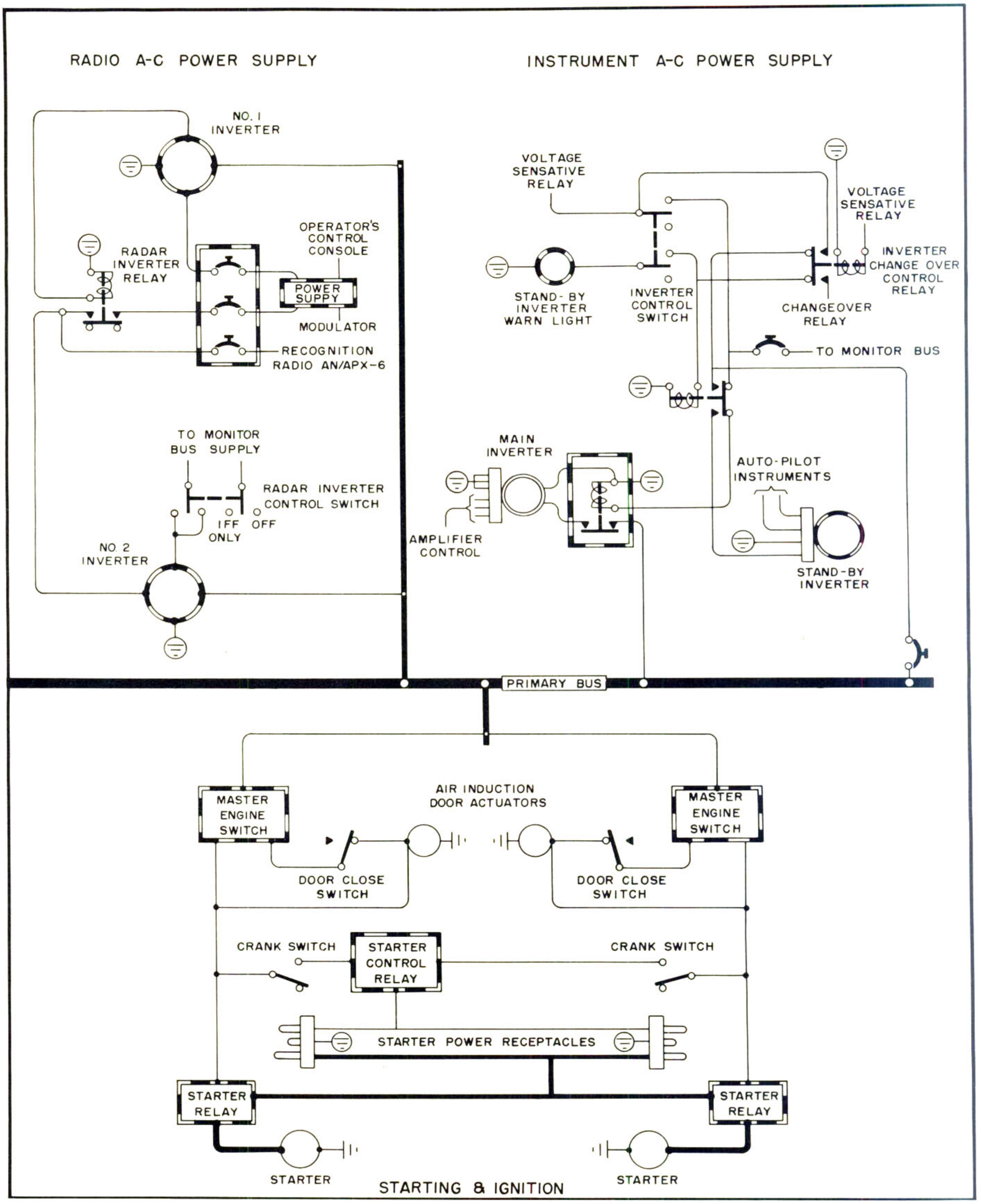


Figure 1-7 (Sheet 2 of 2 Sheets). Electrical System Diagram

1–53. ENGINE FIRE DETECTION SYSTEM.

1–54. GENERAL. The engine fire detection system has detector units installed in each accessory, compressor, burner, and tail section. Warning lights are provided.

1–55. ENGINE FIRE WARNING LIGHTS. Fire warning lights (figure 1–4, references 24 and 40), 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.

1–56. ENGINE FIRE DETECTOR TEST SWITCHES. Detector test switches (figure 4–2, reference 6) 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.

1–57. MISCELLANEOUS.

1–58. SEAT ADJUSTMENT. An electrical actuator is provided for adjusting the pilot's seat up or down and is controlled by a switch (figure 1–4A, 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.

1–59. SHOULDER HARNESS ADJUSTMENT. The pilot and the radar operator are both provided 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 21) on the left-hand console, or the radar operator's handle (figure 1–4A, reference 15) on the center console, forward. 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.

Note

If tension is being held against the shoulder harness, the inertia reel will not release even though the locking lever is moved to the "UNLOCK" position. Under this condition it is not enough to release tension on the shoulder harness, as the "stalock" feature of the inertia reel will keep it locked. Tension on the shoulder straps must be released first, and then the locking lever must be moved to the "UNLOCK" position.

1–60. PERSONNEL GEAR RECEPTACLES. Receptacles for plugging in personnel gear adapters (figure 1–8, 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.

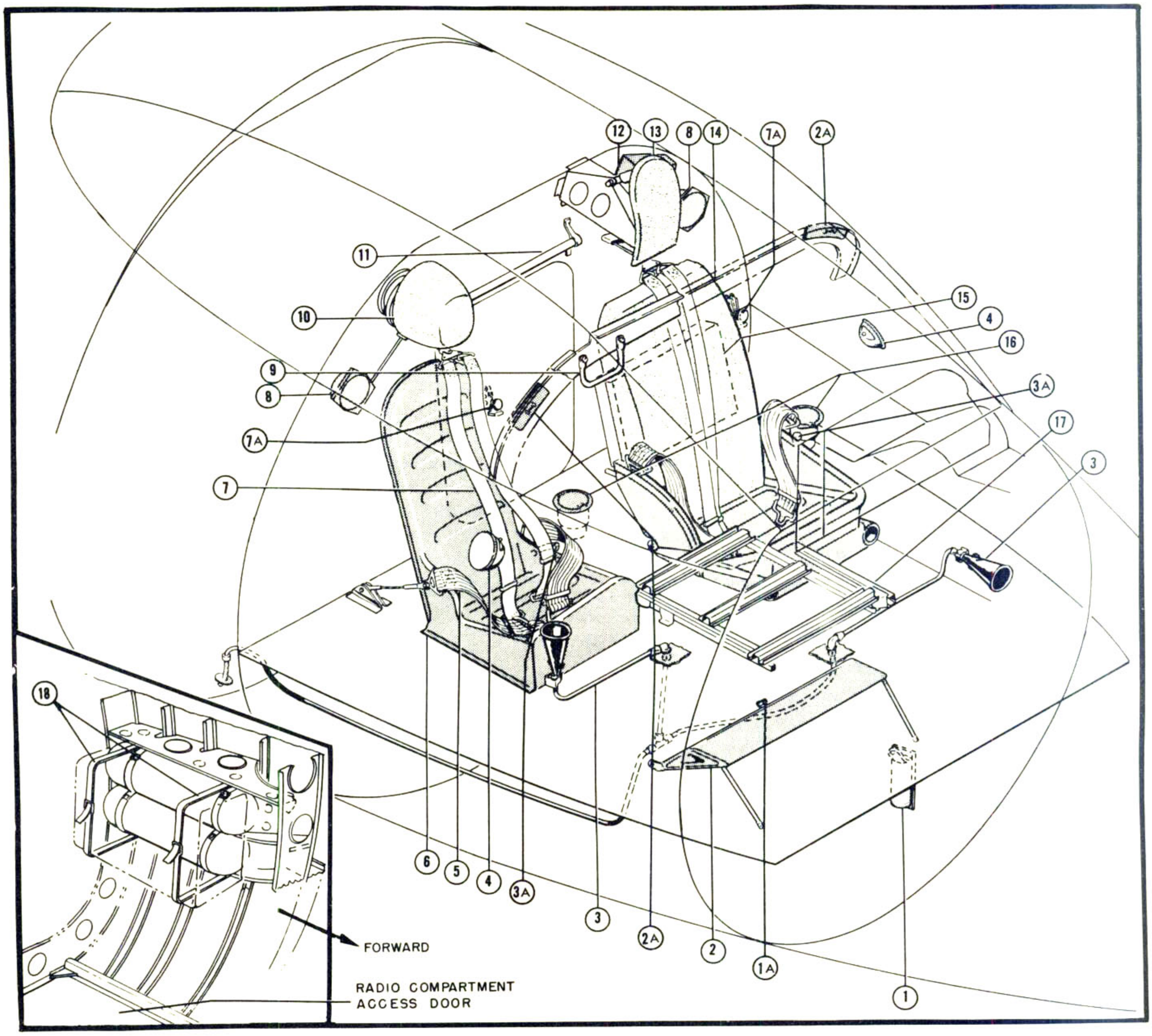
1–60A. Airplanes BuNo. 124625 and subs. are not equipped with personnel gear receptacles as described in paragraph 1–60. A lightweight oxygen tube and connection with incorporated radio connections (figure 4–1, references 10 and 11), is attached to the left-hand side of the pilot's and radar operator's seats. Anti-g connections (figure 4–1, references 12 and 13) are mounted at the lower left-hand side of each seat. Aircraft prior to BuNo. 124625 will be modified to incorporate this installation by service change.

1–61. COCKPIT ENCLOSURE CONTROLS. The cockpit enclosure hatch (ditching 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 an intermediate position. To move the hatch from the intermediate position to the full open position, it is necessary to depress the hinge-type handle on the hatch forward frame. 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 ditching hatch "one-shot" emergency compressed air system, see paragraph 1–62.

Note

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

1–62. COCKPIT ESCAPE CONTROLS. Separate "one-shot" compressed air systems are provided for the upper escape hatch (ditching hatch) and for the



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

*Replaces Item 16 on BuNo. 124625 and subs.

Figure 1-8. Miscellaneous Equipment Diagram

lower escape chute door systems. 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 wheel well. The upper escape hatch release handle (figure 1–4, reference 21) is located on the instrument panel, and the lower escape chute door system emergency release handle (figure 1–4A, reference 61) is located above the floor on the center console. The latter handle is cable connected to a mechanism that jettisons the aft chute door on the bottom of the fuselage, actuates the "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 unlatch and swing out of the way when the handle is pulled. A vaulting bar on rear cabin bulkhead above chute door is provided to expedite escape.

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 lower escape chute door system, reset valve in nose wheel well before closing the windscreen.

1–63. 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.

1–64. GYRO HORIZON FAST ERECTION CONTROL. The fast erection switch and warning light (figure 1–4, reference 16) are located on the instrument panel adjacent to the gyro horizon indicator. When power is turned on to start the instrument, the fast erection electro-magnet is energized. Since the warning light is in series with the magnet, the light burns whenever the magnet is operating. After approximately 20 seconds, a thermal relay opens, disconnecting the d-c from the erecting magnet. If the warning light remains lit for over one minute, it is an indication that power to the magnet was not automatically disconnected due to malfunctioning in the system. The fast erect disconnect switch must then be moved to "OFF" to prevent failure of the gyro horizon.

1–65. 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 RESTRICTIONS ARE TO BE OBSERVED IN OPERATION OF THE MODEL F3D-2 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 and to the speeds given in figure 2–2, except that when carrying 2000-pound bombs a Mach number of 0.74 should not be exceeded.

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 take-off and landing are as follows:

Take-off	27,500 lbs.
Landing on smooth paved runways	24,500 lbs.
Landing on rough runways	20,000 lbs.
Catapulting	26,000 lbs.
Arrested landing	20,000 lbs.

e. The restrictions set forth in paragraph 2–2a are predicated upon flight in smooth air or in relatively light turbulence. When moderate or extreme turbulence is encountered, the possibility of increased accelerations due to gusts should be considered. In order to minimize the possibility of overstressing the airplane due to the combined effects of gusts and maneuvering loads, it is essential that deliberate maneuvers in moderate or extreme turbulence be performed within the limits of airspeed and acceleration shown in figure 2–3.

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

Landing gear	170 knots
Landing flaps	170 knots
Upper escape hatch	310 knots
Speed brakes	Speeds permitted in figure 2–2

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. 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. Plug in personnel gear securely.

c. Release surface controls gust lock.

d. Check surface controls for freedom of movement.

e. Battery-generator switch—"BAT & GEN."

f. Adjust seat and rudder pedals if necessary.

g. Fuel boost pump switches—"OFF."

h. Left-hand circuit breaker panel—all circuit 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.

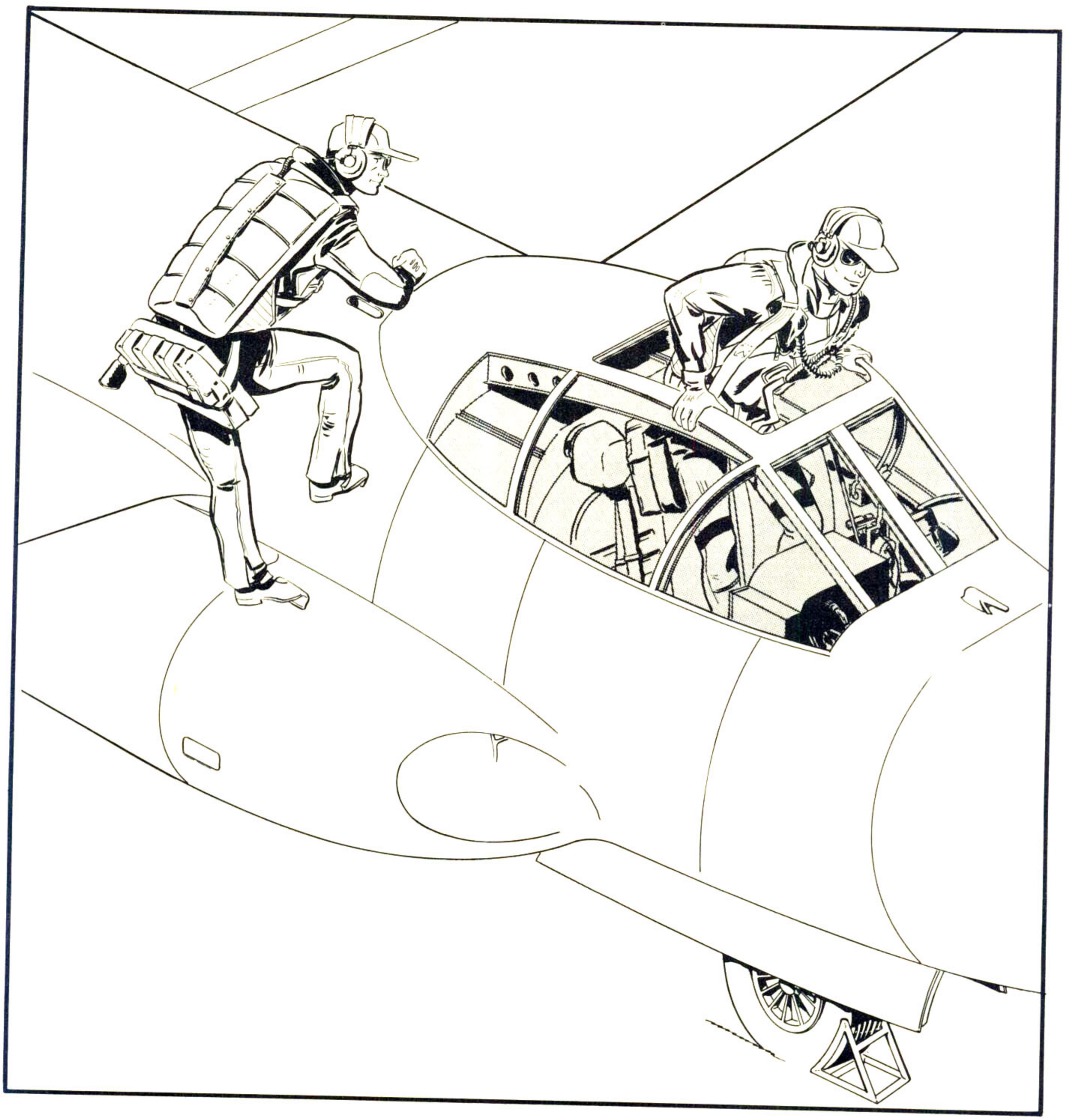
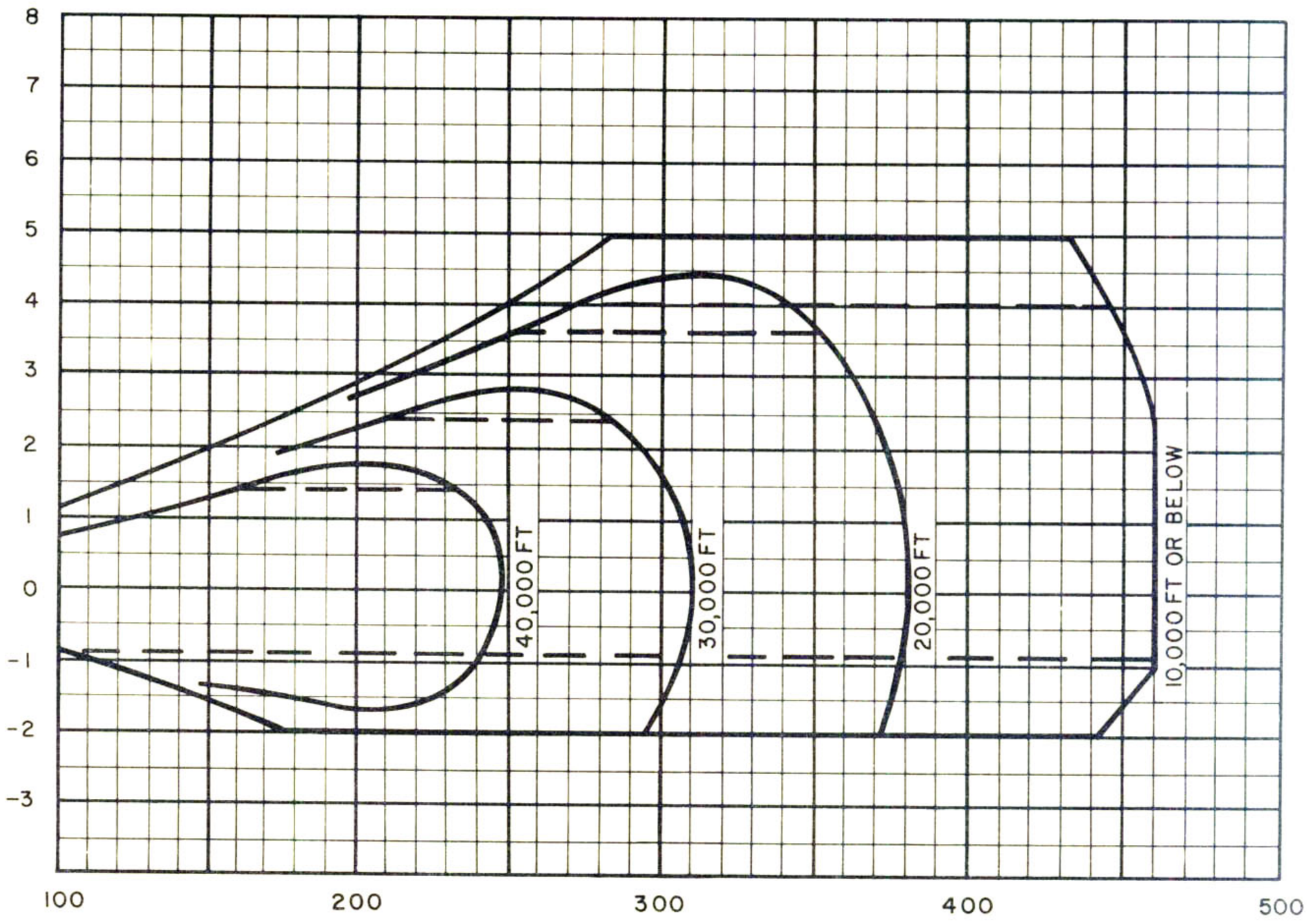


Figure 2-1. Entrance to the Airplane

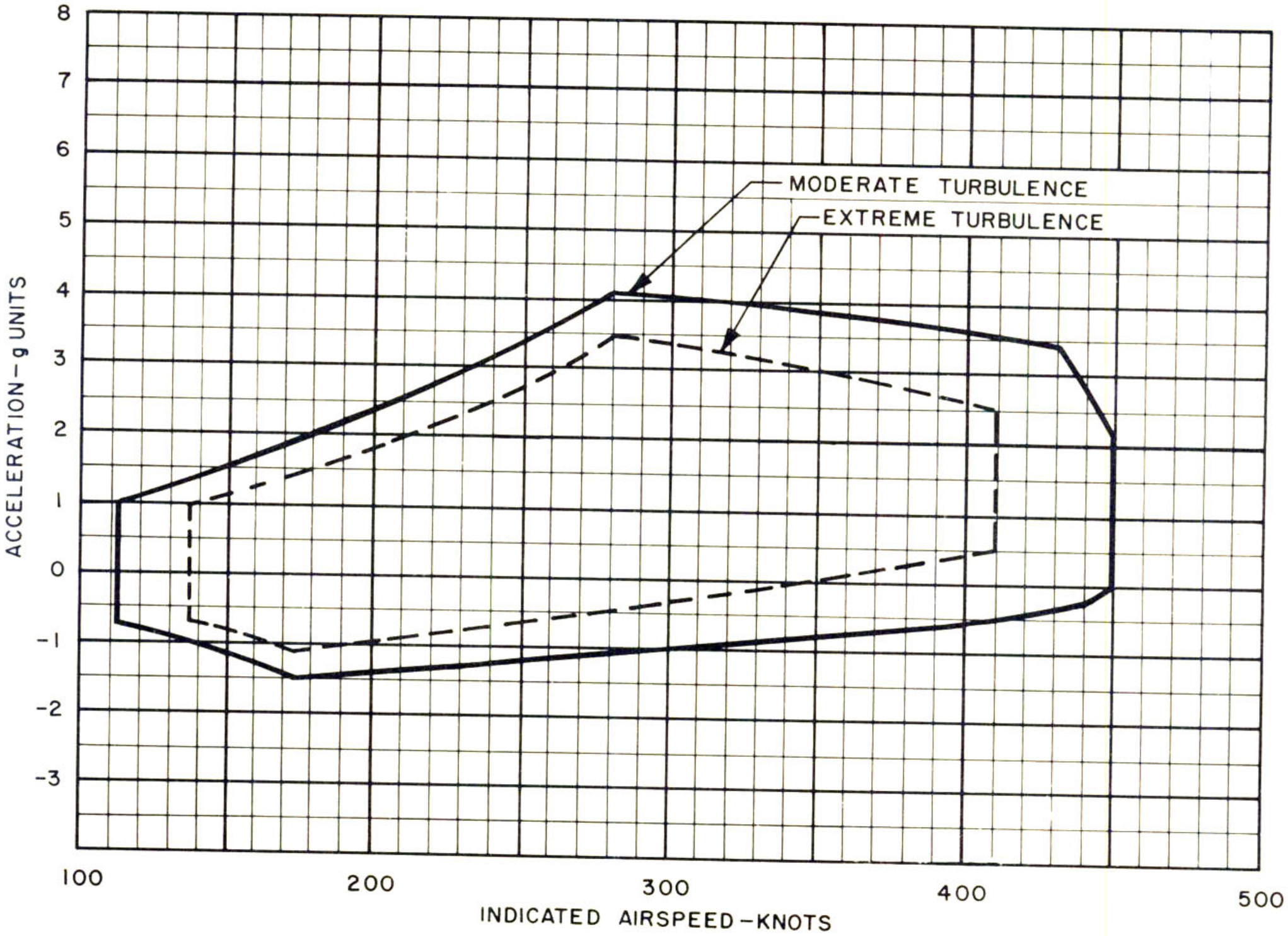
SYMMETRICAL FLIGHT ————————
FULL AILERON DEFLECTION– – –



GROSS WEIGHT 21,000 LBS
WITHOUT EXTERNAL STORES

Figure 2-2. Operating Flight Strength Diagram

1. AT ALTITUDES ABOVE 10,000 FEET, THE LIMITATIONS SHOWN IN FIGURE 2-2 ARE APPLICABLE IN TURBULENT AIR.
2. LARGE OR ABRUPT AILERON DEFLECTIONS SHOULD BE AVOIDED IN TURBULENT AIR.



AT ALTITUDES OF 10,000 FEET AND BELOW
GROSS WEIGHT 21,000 LBS

Figure 2-3. Operating Flight Strength Diagram for Symmetrical Flight in Turbulent Air

q. Gyro instruments—UNCAGED.

r. Armament master switch—"ON."

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

t. Test engine fire detector circuit (see paragraph 1–56).

u. Auxiliary hydraulic system control or, in airplanes BuNo. 125783 and subs., emergency landing flaps control—"NORMAL."

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

w. Auto pilot control switch—"OFF" (button depressed).

x. Check electronic equipment (see paragraph 4–38).

Note

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

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

z. 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 1–5) 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 15 to 20 minutes will be required for completion of the transfer operation at high power 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 BOMB RELEASE handle (figure 1–3, reference 25), 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: The cheapest, most readily available grade of MIL-F-5572.

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

Hydraulic System: Spec. MIL-O-5606 (BuNo. 124595 through 124664).

Spec. MIL-F-7083 (BuNo. 125783 and subs.).

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 "IGNITION" 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.

2–15. 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 exhaust temperature, 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. If the turbine outlet temperature exceeds 815° C. at any time, shut down the engine immediately.

Note

Ground starting the engines should not be attempted at ambient temperatures below −40°C (−40°F).

2–16. 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-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. In airplanes BuNo. 124595 through 124649, initiate the starting cycle by momentarily moving the throttle lever outward to the "CRANK" position. As the engine approaches full cranking speed, 10 to 12 per cent rpm (1250 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. In airplanes BuNo. 124650 and subs., momentarily press the "CRANK" switches. As the engine approaches full cranking speed, 10 to 12 per cent rpm (1250 to 1500 rpm), move the throttle lever outward momentarily at the "IGNITION" position to energize the ignition circuit. Airplanes prior to BuNo. 124650 will be modified by service change to incorporate the latter starting procedure.

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-seconds after cranking operation is begun, open the starter and ignition circuit breakers and investigate to determine the cause of starting failure. The starter may be operated through two consecutive 30-second cycles, after which 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. Swab or drain all excess fuel from the exhaust sections, aft cowl, and fuel dump can before attempting another start.

f. Deleted.

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—log book hot day temperature or lower.

Fuel boost pressure—10 to 30 psi.

Oil pressure—10 to 30 psi.

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

CAUTION

Constantly observe turbine outlet temperatures following starting. Do not exceed maximum limits for engine. Temperature can be controlled by throttle manipulation. Retard the throttle lever slightly to bring about a reduction of outlet temperature.

2–17. 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 2–19) 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 boost pressure—10 to 30 psi.

Oil pressure—60 to 90 psi.

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

2–18. 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.)—log book hot day temperature

(b) Normal rated (maximum continuous) — 635°C (1175°F)

(c) Starting — 815°C (1499°F) maximum not exceeding 5 seconds and 704°C (1299°F) for remainder of starting cycle.

(d) Idle continuous—lower than log book hot day temperature

(e) Acceleration — 760°C (1400°F) maximum

2–19. GROUND TEST.

2–20. 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 at the lateral boundary of the jet, at a distance of 10 to 15 feet aft of the exhaust nozzle.

2–21. 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.

2–22. Check the instrument readings which should be within the following ranges: (Based on sea-level standard conditions.)

Turbine outlet temperature indicator—log book hot day temperature or below.

Fuel boost pressure—10 to 30 psi.

Oil pressure—75 to 155 psi.

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

2–23. The maximum speed setting of the governor stop should correspond to 100 per cent rpm, plus or minus 1 (12,500 rpm, plus or minus 125).

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.

2–24. 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 2–18.

2–24A. FUEL BOOST CHECK. When starting engines, turn fuel boost pumps on one at a time to prevent the possibility of unobserved fuel leakage on the engine yet to be started. Check to see that the proper fuel boost pressure gage is indicating from 10 to 30 psi. This check will also reveal a possible reverse in the electrical or fuel connections.

2–25. HYDRAULIC SYSTEM CHECK.

a. Check operation of the left-hand engine-driven hydraulic pump when starting the left-hand engine. 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 (on airplanes BuNo. 124595 through 124664, the auxiliary hydraulic selector control must be at "NORMAL").

b. To check out the various hydraulically operated units while the engines are inoperative in airplanes BuNo. 124595 through 124664, the auxiliary hydraulic system control must be in the "GROUND CHECK" position. Continuous operation in this position should be limited to 2 minutes in order to prevent over-heating and resultant failure of the pump electric motor. The control must be returned to "NORMAL" when the checks are completed.

c. In airplanes BuNo. 125783 and subs., power for ground check of the hydraulic systems while the engines are inoperative is gained through external hydraulic disconnect fittings which are mounted in the starboard engine accessory section (refer to paragraph 1–43C).

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).

2–26A. In airplanes BuNo. 124595 through 124664, make the following check of the instrument power supply system:

a. Check to see that the MAIN and STANDBY INVERT circuit breakers are pressed in and the INSTR INVERT switch is on "NORM."

b. Pull the MAIN INVERT circuit breaker. After approximately eight seconds the inverter warning light will glow, indicating shutdown of the main inverter.

c. Visually check fuel flow indicator and oil pressure indicator. The proper functioning of these instruments will indicate that automatic changeover to the standby inverter has occurred.

d. Throw INSTR INVERT switch to "STBY." In BuNo. 124595 through 124641 the warning light will go out. In BuNo. 124642 through 124664 the warning light will continue to glow. Operation of the

standby inverter will be revealed by proper functioning of the fuel flow indicator and oil pressure indicator.

e. Press in the MAIN INVERT circuit breaker. The warning light will go out in all cases.

f. Proceed with take-off, leaving INSTR INVERT switch in "STBY" for a minimum of seven minutes.

WARNING

After any interruption of the main inverter, allow seven minutes for auto pilot vertical gyro to stop revolving before re-engaging the main inverter. If this procedure is not followed, engagement of the auto pilot will result in an abrupt displacement of the control surfaces.

g. Throw the INSTR INVERT switch to "NORM." The warning light should remain extinguished, indicating the correct functioning of the main inverter.

2–27. AUTOMATIC PILOT CHECK. Check the operation of the automatic pilot. (See paragraphs 1–13 and 2–55.)

2–28. ELECTRONIC EQUIPMENT CHECK. (See paragraph 4–38.)

2–29. TAXIING. Make certain that the external power sources are disconnected and that the battery-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°. (For catapult take-off tab setting, refer to paragraph 2–32, a.)

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 or emergency landing flap 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—see paragraph 2–18.

r. See that no excessive vibration is present.

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

a. Use elevator tab setting necessary for a trimmed level flight airspeed of 1.15 times power-on stalling speed for the gross weight involved (refer to paragraph 2–32A).

b. Tighten engine control friction adjustment knob.

c. Place headrest in full forward position.

d. Pull catapult hand grip (figure 1–3, reference 9) up into static position.

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

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

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

h. Ease throttles forward and grasp catapult hand grip.

2–32A. POWER-ON STALLING SPEEDS.

TAKE-OFF POWER, FLAPS DOWN 40°, GEAR DOWN

Gross Weight (lbs)	*Approximate Indicated Airspeed (knots)*
18,000	78
21,000	85
24,000	91
27,000	97

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.

2–34A. CATAPULT TAKE-OFF.

a. Flaps full "DOWN."

b. Hold throttle and throttle grip together firmly.

c. Hold stick in neutral elevator position.

d. Fly airplane off bow making slight adjustments, if necessary, of nose position to maintain level flight while accelerating to climbing air speed.

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 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 airspeed for best rate of climb varies with weight, external load, altitude, and power setting.

a. Normal power (95.5 percent rpm). The best climbing airspeed at gross weights between 20,000 and 22,000 pounds is approximately 240 knots (277 mph) calibrated airspeed from sea level to 20,000 feet. From 20,000 feet to service ceiling the best climbing airspeed is approximately 200 knots (231 mph) calibrated airspeed.

b. Military power (100 percent rpm). The best climbing airspeed at gross weights between 20,000 and 22,000 pounds is approximately 270 knots (312 mph) calibrated airspeed from sea level to 20,000 feet. From 20,000 feet to service ceiling the best climbing airspeed is approximately 220 knots (254 mph) calibrated airspeed.

Note

100 percent rpm should not be used for more than 30 minutes continuous operation. If time in climb is anticipated to be more than 30 minutes using 100 per cent rpm, best climb performance will be gained by using 95.5 per cent during the initial phase of the climb.

c. See Figure A–1 for more precise values of best climb speeds at various altitudes and gross weights.

2–41. DURING FLIGHT.

2–42. STABILITY. The airplane possesses positive longitudinal stability in all configurations. 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. Longitudinal trim changes are small. 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 inboard throttle control grip. 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. EFFECTIVENESS OF AILERON SPOILERS. The spoilers are provided to improve the lateral control characteristics of the airplane. The rate of roll is increased by diminishing the lift of the down wing in the turn maneuver. At 450 knots IAS, the rate is raised from 24 degrees per second without spoilers to 54 degrees per second with spoilers. The effectiveness is greatest in the higher speed ranges. However, at approach speeds the lateral control is moderately improved.

2–46. POWER PLANT OPERATION AT LOW ALTITUDE.

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.

2–49. MAXIMUM ENGINE SPEED. The engines should never be operated above 95.5 per cent rpm

(11,930 rpm) for more than 30 minutes in any one run. After 30 minutes of continuous operation above 95.5 per cent power, a cooling period of at least 10 minutes at less than 95.5 per cent rpm must be allowed before higher power is again used. 95.5 per cent rpm (11,930 rpm) is the maximum allowable for continuous operation.

2-50. POWER PLANT OPERATION AT HIGH ALTITUDE.

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 retard the throttle for the affected engine to cut off the fuel flow. When the turbine outlet temperature has reached a safe limit, the throttle may then be slowly advanced until the desired engine rpm has been reached. At high altitudes care must be taken to advance the throttle slowly to avoid compressor stalls.

2-52. SINGLE ENGINE OPERATION. When the duct door is closed on an inoperative engine, a duct rumble will occur at approximately 200 knots I.A.S. This duct rumble will be more pronounced at higher altitudes. No engine or airplane damage will result from this rumble.

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 ON.

a. After the main inverter starts operating, allow approximately two minutes for the gyros to come up to full speed. At this time, a time delay relay will operate, placing the automatic pilot in a state of readiness.

WARNING

After any interruption of the main inverter power, allow seven minutes for auto pilot vertical gyro to stop revolving before re-engaging the main inverter. If this procedure is not followed, engagement of the auto pilot will result in an abrupt displacement of the control surfaces.

b. Before take-off, set the master direction indicator to indicate the same heading as the magnetic compass (see paragraph 2-58).

c. Center the pitch trim and yaw trim controls.

d. Manually trim the airplane for the desired attitude of flight.

e. Engage the automatic pilot by depressing the ENGAGE button.

WARNING

Do not change airspeed appreciably while the automatic pilot is engaged; disengage the automatic pilot before changing speed and re-engage at the new speed. A change in airspeed alters the trim conditions. With disengagement at a speed other than that at which engagement was made, the force required on the manual control stick to prevent the airplane from performing a violent maneuver would be excessive.

Note

If engagement is made within the limits of ± 70 degrees pitch or bank (unlimited azimuth), the attitude and directional heading or rate of turn of the airplane will be maintained under automatic control.

CAUTION

Allow 12 seconds after the conclusion of rapid maneuvers and 60 seconds after looping maneuvers before automatic pilot engagement.

2-57. TO TURN AUTOMATIC PILOT OFF.

a. To return to manual flight, depress the OFF button on the automatic pilot control panel.

b. In an emergency, move the AUTO PILOT & YAW DAMPER switch to the "EMERGENCY OFF" position. This disengages both the automatic pilot and the yaw damper systems.

2-58. G-2 COMPASS. This compass consists of a compass controlled directional gyro indicator (figure 1-4, reference 12), an amplifier and a remote compass transmitter. The gyro should be caged and set to correspond with the indication of the miniature dial in the center of the indicator face prior to take-off. To correctly operate the reset adjustment, depress the knob firmly and rotate the main dial to the desired heading. Keep the knob fully depressed at the new heading for at least two seconds and then release the knob straight out, avoiding any twisting motion. A

switch (figure 1–4, reference 13) which controls the compass system is located on the instrument panel. When the switch is in the "Free" position, the gyro will have to be caged and reset periodically to maintain heading. In this position the gyro is not subject to compass control. When the switch is in the "Control" position, the amplifier will control the gyro so that periodic resetting of the gyro is not necessary. Approximately three minutes are required for the gyro to reach operating speed after the battery switch has been turned on. The gyro will be automatically precessed to correspond with the indication on the miniature compass dial at a rate of approximately 3 degrees per minute when the switch is in the "Control" position. The compass is non-tumbling and does not require caging before or after maneuvers. The miniature dial on the center of the instrument face gives a remote indication of the heading of the compass transmitter. This dial is unstabilized and will be subject to swinging as a result of turns and maneuvers of the airplane. When on "Control" the gyro will be stabilized by the compass transmitter and amplifier and provide a continuous indication of the magnetic heading of the airplane.

2–59. GYRO HORIZON INDICATOR. This instrument (figure 1–4, reference 14) is gyro stabilized and indicates the attitude of the airplane in pitch and bank. The gyro is universal and will not tumble during maneuvers. Since it is universal, the gyro horizon does not require caging. Approximately two minutes are required for the gyro to reach normal operating speed after the battery-generator switch is placed in the "BAT-GEN" or "BAT ONLY" position.

2–60. ELECTRICAL SYSTEM CHECK. The electrical system should be checked in flight periodically.

2–61. STALLS.

2–62. 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. Airplanes BuNo. 124649 and subs., are equipped with a warning device to warn the pilot of impending stalls. A sensing unit mounted in the leading edge of the right wing actuates a small electrical motor on the pilot's control stick, causing it to shake the stick. Warnings are given at percentages of stalling speed above stalling speed. Therefore, a slight shaking of the stick will be experienced at 15 per cent above stalling speed, and a more severe shaking at 5 percent above stalling speed. Stall warning systems will be incorporated into airplanes prior to BuNo. 124649 by service change.

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
27,000	118	105	100

2–63. SPINS.

2–64. 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.

2–65. PERMISSIBLE ACROBATICS.

2–66. GENERAL. Refer to paragraph 2–2 for permissible maneuvers.

2–67. DIVING.

2–68. 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.

2–69. NIGHT FLYING.

2–70. 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.)

2–71. APPROACH.

2–72. DESCENT FROM ALTITUDE. No low altitude engine flame blowout troubles have been encountered with these engines.

2–73. 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."
f. Trim tabs—As desired.

g. Master armament switch—"OFF."
h. Gun selector switches—"OFF."
i. Automatic pilot—"OFF" (button depressed).
j. Upper hatch—Locked "OPEN."

2-74. 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.

2-75. LANDING.

2-76. NORMAL LANDINGS.

2-77. 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.

2-78. 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.

2-79. AFTER LANDING. Raise the wing flaps immediately upon completion of the landing roll.

2-80. SPECIAL LANDINGS.

2-81. 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. Touch down in a normal manner.

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.

2-82. MINIMUM RUN LANDING. The procedure for a minimum run landing is the same as for a normal approach and landing (see paragraphs 2-76 and 2-80) 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.

2-83. EMERGENCY LANDING PROCEDURES. See paragraph 3-19.

2-84. 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.

2-85. STOPPING THE ENGINES.

2-86. 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 to assure a more positive action of the dump valve.

b. Boost pump switch—"OFF."
c. Master engine switch—"OFF."
d. If the engine air inlet duct doors are closed, turn battery-generator switch to "BAT ONLY." Turn master engine switches "ON." The inlet duct doors will open. Next turn the battery-generator switch "OFF" and the master engine switches "OFF" in the sequence given. The inlet duct doors will thus remain open.

CAUTION

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

e. After the proper cooling period, the inlet duct doors can be closed by turning the battery-generator switch to "BAT ONLY" for approximately 40 seconds.

2-87. HYDRAULIC PUMP CHECK. Hydraulic pumps should be checked individually at frequent intervals in the following manner.

a. Stop left-hand engine.

b. The hydraulic pressure gage should read 3,000 psi. (In airplanes BuNo. 124595 through 124664, the auxiliary hydraulic selector control must be at "NORMAL.")

Note

Paragraph 2-25a explains check of the left-hand engine hydraulic pump after starting the left-hand engine. Paragraph 2-87 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.

2–88. 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."

2–89. MOORING.

a. Surface controls lock—"LOCK."
b. Chock wheels.
c. If gusty wind conditions prevail, tie the airplane down (see figure 2–4).

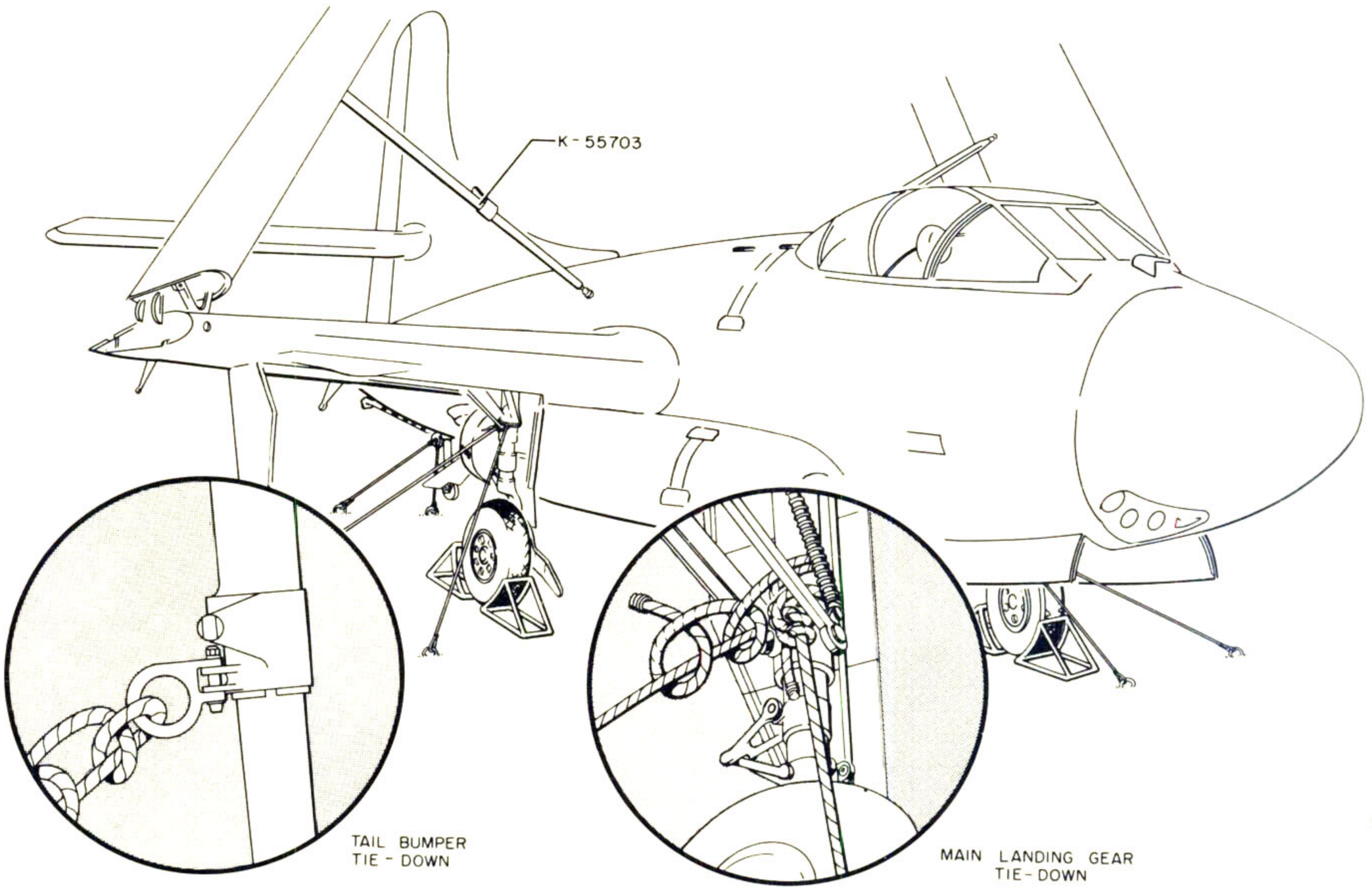


Figure 2-4. Mooring

SECTION III
EMERGENCY OPERATING INSTRUCTIONS

3–1. FIRE.

3–2. FIRE WHILE STARTING ENGINE. If a fire is indicated by a fire detection warning light, 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 the fire continues, request ground crew use CO_2 and continue turning with the starter.

CAUTION

Introduce CO_2 through engine air 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.

3–3. 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." If operating at a gross weight of 21,000 pounds or less, the climb out can be accomplished on a single engine. For gross weights above 21,000 pounds, however, there is not sufficient power to climb on one engine (refer to paragraph 3–10). In either case control is adequate at all speeds above the stall.

3–4. FIRE DURING FLIGHT. If an engine fire occurs during flight, warnings will be given by the fire detection warning lights. The following procedure should be employed:

a. Close the throttle through the cut-off position.
b. Turn booster pump switch "OFF."

Note

It is preferable to extinguish an engine fire by blowing it out with the duct door open. If this method is unsuccessful, the duct door may be shut in an effort to suffocate the fire.

c. If closing of the duct door is desired, turn engine master switch "OFF."
d. Deleted.
e. Cut off all electrical power to the engine by pulling the required circuit breakers.
f. If fire warning light goes out, check circuit by using test switch (refer to paragraph 1–56). The fire itself may destroy the fire warning circuits and thus cause the warning light to go out.

If fire conditions permit, the airplane may be landed with one 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-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-generator 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. With fuselage fires that are uncontrollable by means outlined in paragraphs 3–6 and 3–7, it is left to the pilot's discretion whether to land immediately or to abandon the airplane.

3–9. ENGINE FAILURE.

3–10. ENGINE FAILURE DURING TAKE-OFF. For a normal take-off weight, if single engine failure oc-

curs 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 1–4A, reference 10) 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. 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.

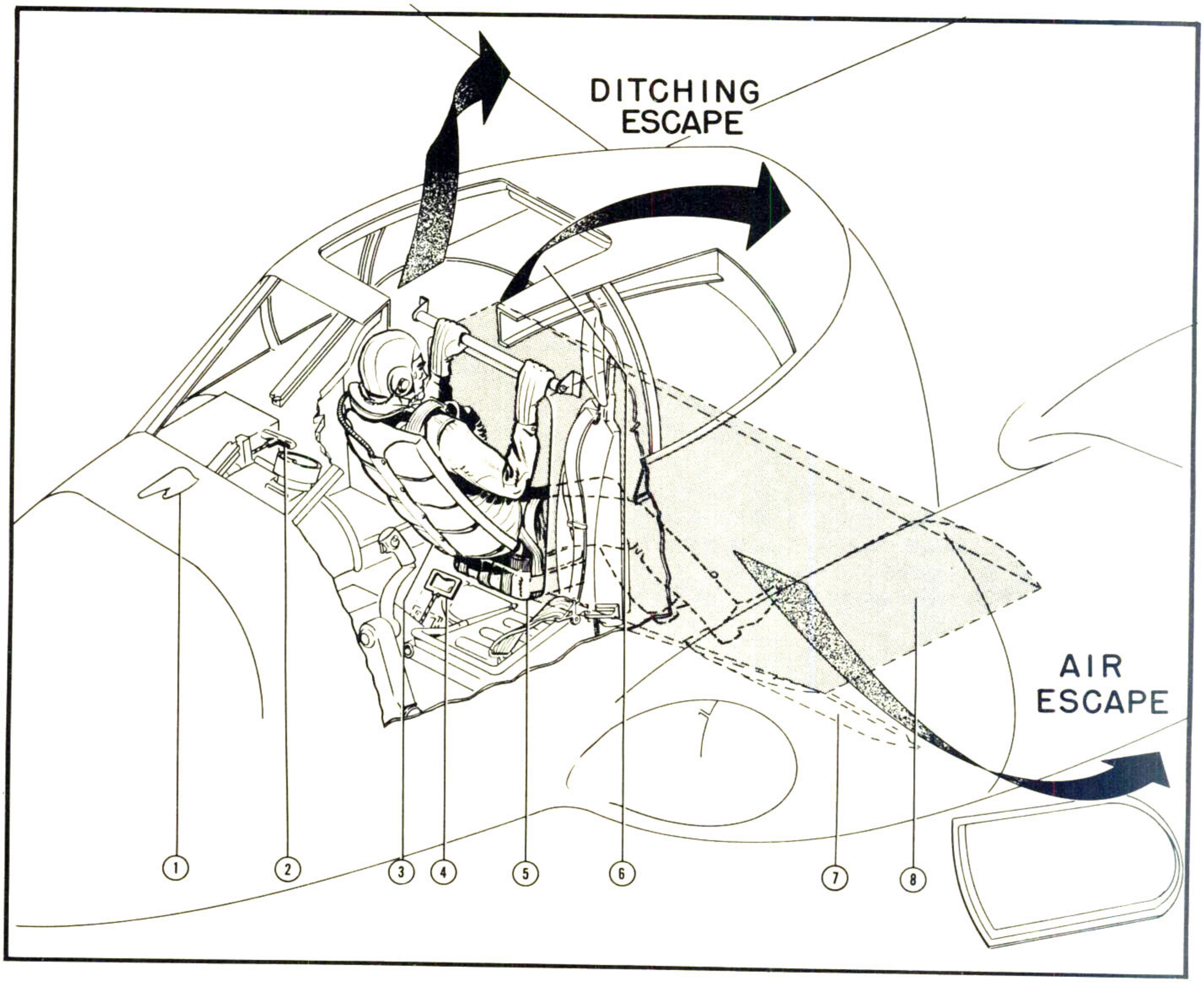
c. Shoulder harness and safety belt locked tight.

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



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. Wind screen
8. Lower escape chute

Figure 3-1. Emergency Equipment and Exits

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 judgment.

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 higher winds, it is recommended that ditching be conducted upwind to take advantage of lowered forward speed. 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 starting at altitude requires close watching of the exhaust temperature in order to determine when light off takes place.

WARNING

If the engine oil temperature falls below −40°C (−40°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.

3–30A. EMERGENCY STOPPING OF ENGINES. Emergency stopping of engines is accomplished by normal shut-down procedure. Variance in the control of the duct door is dependent upon the conditions which make the engine shut-down necessary. For shut-down procedure for engine fire in flight see paragraph 3–4.

3–31. FUEL SYSTEM EMERGENCY OPERATION.

3–32. GENERAL. No emergency provisions are made. If the engine fuel pump fails, proceed with instructions given in paragraph 3–9.

3–33. COURSES OF FUEL FLOW. See figure 1–5.

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 1–4, reference 4) located on the left-hand console panel. 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.

3–37A. In airplanes BuNo. 124595 through 124664, 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

In airplanes BuNo. 124595 through 124664, aileron power boost is off when emergency wing flap hydraulic pressure is used. Reduce airspeed to lower the aileron control forces. After the wing flaps are down, aileron power boost cannot be regained without the loss of emergency flap extension.

3–37B. In airplanes BuNo. 125783 and subs., if the main hydraulic system fails, the wing flaps can be lowered in an emergency by moving the EMERG LANDING FLAP control handle from the upper detent position ("NORMAL") down to the "EMERG FLAP DOWN" position. Returning the EMERG LANDING FLAP control handle to "NORMAL" will allow the flaps to "blow back" to the up position.

Note

In airplanes BuNo. 125783 and subs., the emergency wing flap system is powered from the same compressed air bottle which is used to actuate the lower escape chute. Full flap extension at approach speed can be obtained with full escape chute air bottle charge of 1980 psi unless the escape chute has been actuated.

3–38. AILERON POWER BOOST EMERGENCY RELEASE. If the aileron power boost system fails and excessive aileron forces are present, the boost system may be disconnected by pulling the AILERON POWER BOOST RELEASE handle. Reduce airspeed to lower the aileron control forces. The aileron spoilers will also be inoperative so allowances should be made for the decreased rate of roll.

3–39. EXTERNAL STORES EMERGENCY RELEASE. If electrical release at external stores fails, pull out on the BOMB RELEASE handle (figure 1–3, reference 25).

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 engine, instruments, radio equipment, and fuel boost pumps for approximately ten minutes if both generators are inoperative, providing no other electrical equipment is in use. Furthermore, if all radio equipment and the fuel boost pumps are turned off, the battery contains sufficient charge to operate the engine and instruments for approximately thirty minutes. With fuel boost pumps turned off, however, a power loss, which is increasingly critical at higher altitudes, will be experienced. The battery-generator switch must be moved to the "BAT ONLY" position after all nonessential equipment has been turned off.

WARNING

Turn off fuel boost pumps by pulling the circuit breakers only, as the fuel boost pump switch also controls the fuel shut-off valves. Fuel boost pumps should not be turned off at altitudes above 18,000 feet as "flame-out" is highly probable.

3–41A. CHANGEOVER TO STANDBY INVERTER. If the inverter warning light comes on, indicating failure of the main inverter, changeover to standby inverter is automatic. The INSTR INVERT switch should be moved, however, to the "STANDBY" position to assure positive changeover to standby inverter. The warning light will go out if the standby inverter is functioning properly. If the warning light remains illuminated, no power is available for operation of the essential flight and engine instruments. A landing should be made as soon as possible.

3–42. LANDING GEAR SAFETY SOLENOID. A safety circuit containing a solenoid 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 1–4, reference 2).

3–43. CIRCUIT BREAKERS. For location of circuit breaker panels see figure 1–3, reference 1 and figure 4–2, reference 16.

3–44. RADIO EQUIPMENT EMERGENCY OPERATION.

3–45. AN/APX-6 EQUIPMENT. In case of an impending forced landing or other emergency, the AN/

APX-6 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.

3–46. OXYGEN EQUIPMENT EMERGENCY OPERATION.

3–47. OXYGEN REGULATOR. Should symptoms occur which suggest the onset of anoxia, immediately turn the SAFETY PRESSURE switch located on the regulator to "ON" 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 17) controls the operation of all gunnery and bomb switches. Unless this switch is "ON," no armament circuits can be energized, except the gun charging circuits can be energized 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. Both an illuminated gun sight (figure 1–4, reference 11) and AN/APG-26 gun aiming radar are provided. The Azimuth-Elevation-Range Indicator IP-60/APG-26 (figure 1–4, reference 15) is on the pilot's instrument panel. A gun camera is installed in the right-hand wing inboard of the fold joint.

4–5A. For operation of the AN/APG-26 gun aiming radar, refer to paragraphs 4–84S through 4–84Y.

4–6. GUN SIGHT LIGHT CONTROLS. The gun sight light switch and rheostat are located on the armament panel (figure 1–4, references 37, 38). 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 if the armament master switch is "ON" and either generator is delivering its normal output, if the battery-generator switch is turned on, or if an external power source is connected to the airplane.

4–7. 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; and the combination reticle, used under conditions of reduced target visibility which exist at dawn, twilight, or during overcast periods. The night reticle consists of a center pip partially enclosed on each side by two 90 degree arcs located on a 50 mil radius from the center, and is illuminated through a red-orange filter to protect the pilot's night vision. The day reticle illuminates 50 and 100 mil circles and a "ladder" reference scale arranged in 10 mil graduations for air to air gunnery and for strafing.

4–8. GUN CONTROL SWITCHES. These switches are located on the instrument panel (figure 1–4, reference 18). 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-generator 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 approximately three seconds are required to relieve the hydraulic pressure after the switch has been set at the "READY" position, during which time the guns will not fire. The gun charging electrical circuit is not dependent on the MASTER ARMAMENT switch.

4–12. TO FIRE THE GUNS.

a. Turn on gun sight (if to be used in place of radar sighting).
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 bomb release trigger on the stick is depressed.

4-14. BOMBING EQUIPMENT.

4-15. GENERAL. The airplane has an Aero X-61A supporting rack installed on each wing. The rack is designed for carrying Aero X-1A high speed external store shapes having 20 inch, three point suspension and not exceeding a maximum weight of 2000 pounds.

4-15A. ELECTRICAL BOMB RELEASE SWITCHES. In airplanes BuNo. 124595 through 124664, 125783 through 125807, external stores carried on the racks can be dropped electrically by turning the MASTER ARMAMENT switch "ON" (figure 1-4, reference 17) and throwing the BOMBS RELEASE switches (figure 1-4, reference 39) from "OFF" to "LH" or "RH" as desired and depressing the bomb release trigger on the stick.

4-15B. In airplanes BuNo. 125808 and subs., external stores carried on the bomb racks can be dropped electrically by turning the MASTER ARMAMENT switch "ON" and throwing the BOMBS RELEASE switches from "SAFE" to either "LH" or "RH," or to "TRAIN." The external stores can be released singly by making an individual selection of either "RH" or "LH" with the BOMBS RELEASE switches. Placing the BOMBS RELEASE switches in both the "RH" and "LH" positions will allow the external stores to be salvoed. When the BOMBS RELEASE switches are both placed in "TRAIN," first the left-hand external store and then the right-hand external store will release when the bomb release trigger on the stick is pressed. No intervalometer is provided.

4-15C. BOMB ARMING SWITCH. In airplanes BuNo. 125808 and subs., bombs hung on the external stores racks can be armed by the BOMBS ARMING switch. The BOMBS ARMING switch can be positioned in "SAFE" (centered), "TAIL" (down), or "NOSE-TAIL" (up).

4-15D. MANUAL BOMB RELEASE. In all F3D-2 airplanes the external stores can be released manually by pulling up on the BOMB RELEASE handle (figure 1-3, reference 25) located on 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 (see figure 4-1) 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 11) is on the left-hand console. The radar operator's regulator (figure 4-2, reference 20) 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. Operational flight may be made to an equivalent cabin pressure altitude of 43,000 feet and may be made for short periods of time to 45,000 feet. In addition, sufficient pressure is automatically delivered for emergency descent from 50,000 feet in the event of loss of cabin pressurization. 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 SWITCH. The required positive pressures of oxygen are automatically supplied at 30,000 feet and above, and the use of manually operated safety pressure is unnecessary and may be uncomfortable. Routine use of safety pressure at lower altitudes is not recommended since the use of safety pressure reduces the effectiveness of the air diluter and causes increased oxygen consumption.

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.

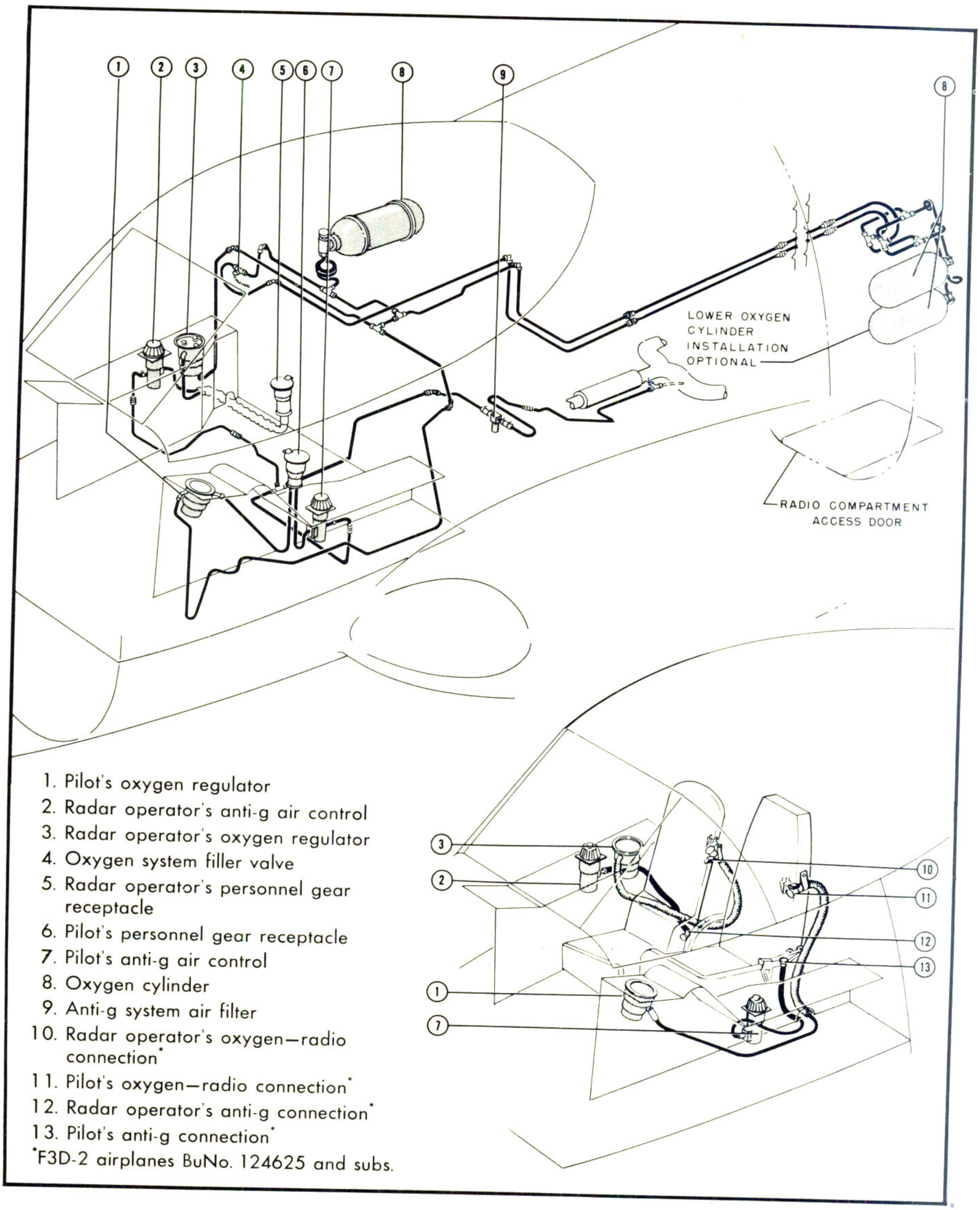
WARNING

If safety pressure is used when the mask is not securely in place, the supply of oxygen may be exhausted.

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 $\pm$ 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



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
10. Radar operator's oxygen—radio connection*
11. Pilot's oxygen—radio connection*
12. Radar operator's anti-g connection*
13. Pilot's anti-g connection*

*F3D-2 airplanes BuNo. 124625 and subs.

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

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. Check mask fit by pulling on the oxygen mask and attaching to the helmet as in flight. Connect the oxygen mask to regulator couplings and turn the manual SAFETY PRESSURE switch to "ON." Take a deep breath and hold. Note the position of the oxygen flow indicator. If flow indicator opens (ie., all black) a leak is indicated. Tighten mask straps until flow indicator closes (ie., white face) indicating a leaktight mask seal has been obtained. Resume breathing and release manual safety pressure. *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 or tube fitting (refer to paragraphs 1–60 and 1–60A).

e. Breathe several times with the regulator air valve in both "NORMAL OXYGEN" and "100% OXYGEN" positions and with the SAFETY PRESSURE switch "ON," 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. In airplanes BuNo. 124595 through 124624, 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. In airplanes BuNo. 124625 and subs., use the alligator-jaw clamp to fasten the breathing tube to the flight suit. In either case it is particularly important that the clip be high on the chest, as otherwise movement of the head would expand or contract the breathing tube. Exhalation after compression of the breathing tube by downward head movement would be difficult due to the increased compensating pressure in the breathing tube.

Note

It is necessary to sew a loop on the pilot's flight suit if the personnel gear adaptor is to be used (refer to paragraphs 1–60 and 1–60A), in order that the breathing tube does not interfere with body movement and to insure safety in bail-out. With the pilot in a sitting position, the lower free end of the disconnect must be snubbed to its shortest workable length.

d. Check mask fit by putting on the oxygen mask and attaching to the helmet as in flight. Connect the oxygen mask to regulator couplings and turn the manual SAFETY PRESSURE switch to "ON." At pressure breathing altitudes the safety pressure need not be depressed. Take a deep breath and hold breath. Note the position of the oxygen flow indicator. If flow indicator opens (ie., all black) a leak is indicated. Tighten mask straps until flow indicator closes (ie., white face) indicating a leak tight mask seal has been obtained. Resume breathing and release manual safety pressure. *Do not use a mask that leaks.*

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 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 (do not exhaust supply below 300 pounds except in emergency).

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

c. Mask fit for leak tightness.

d. Disconnect coupling to insure that it is fully engaged. In event of loss of radio communication on airplanes prior to BuNo. 124625, check the personnel gear receptacle to see that the connector is plugged in (refer to paragraphs 1–60 and 1–60A).

WARNING

Oxygen supply is also dependent on this disconnect.

4–25. EMERGENCY CONDITIONS.

a. Should symptoms occur suggestive of the onset of anoxia or should the regulator become inoperative, immediately turn the SAFETY PRESSURE switch located on the regulator to "ON" 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 "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 fully charged 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 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 valve set to "100% 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 increased 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 2) is located on the left-hand console panel. The radar operator's anti-g air control valve (figure 4–2, reference 17) is located on the right-hand console panel. The controls each have a "HI" and "LO" position.

4–31. ACCELEROMETER. The accelerometer (figure 1–4, reference 22) must be used while becoming accustomed to the suit.

4–32. ANTI-G SUIT CONNECTIONS. On airplanes prior to BuNo. 124625, the anti-g suit connector is plugged into the personnel gear adapter (refer to paragraph 1–60). On airplanes BuNo. 124625 and subs., the anti-g suit connector is plugged into the fitting (figure 4–1, references 12 and 13) at the left-hand side of the pilot's and radar operator's seat.

4–33. OPERATION.

a. Plug the suit connection into the personnel gear adapter or tube fitting (refer to paragraphs 1–60 and 1–60A).

Note

Test the disconnect each time it is plugged in.

b. Turn the anti-g air control valve clockwise to "HI" or counter-clockwise to "LO." 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 "HI" position.

Note

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

c. Watch the accelerometer.

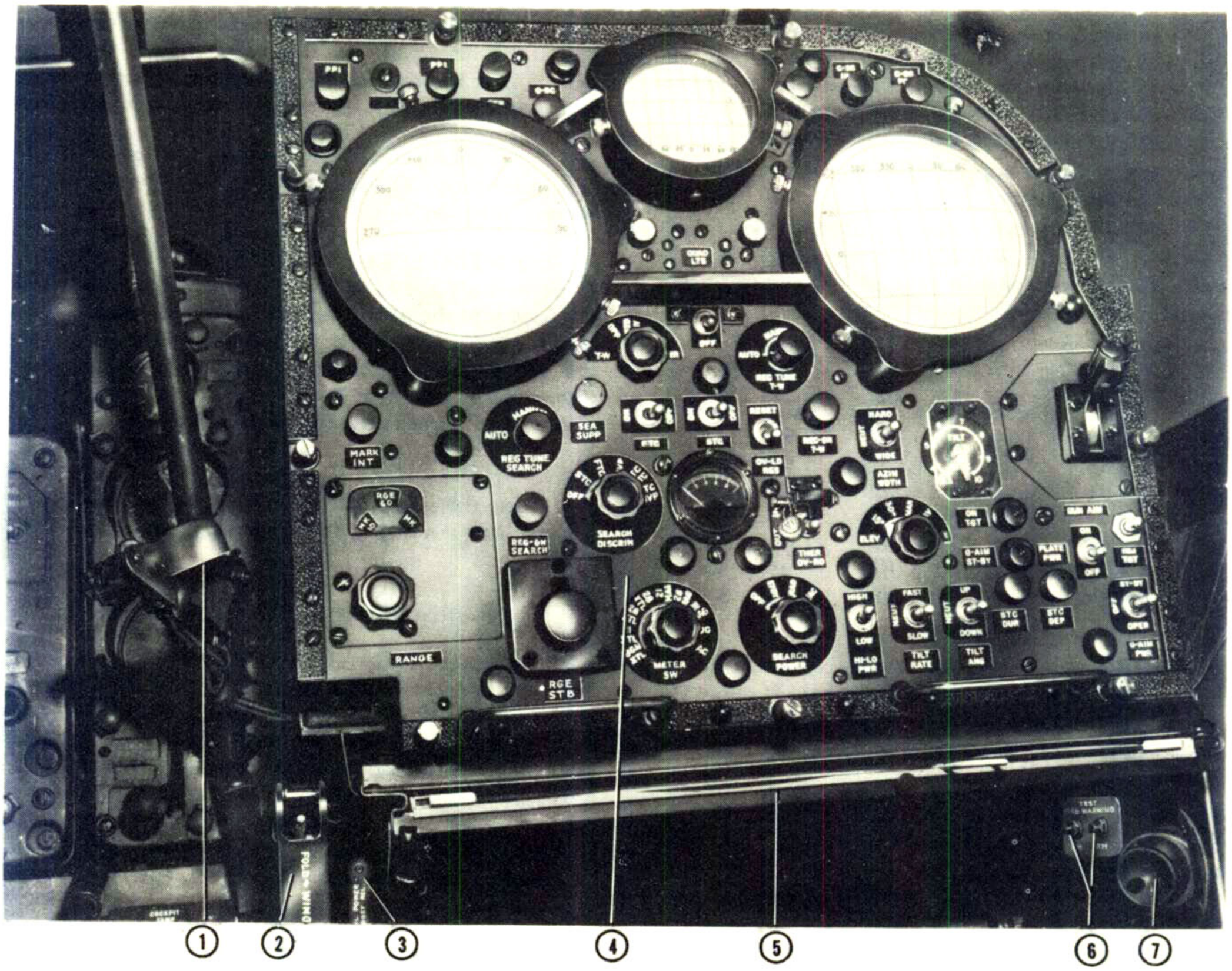
WARNING

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 oral inflation fitting 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

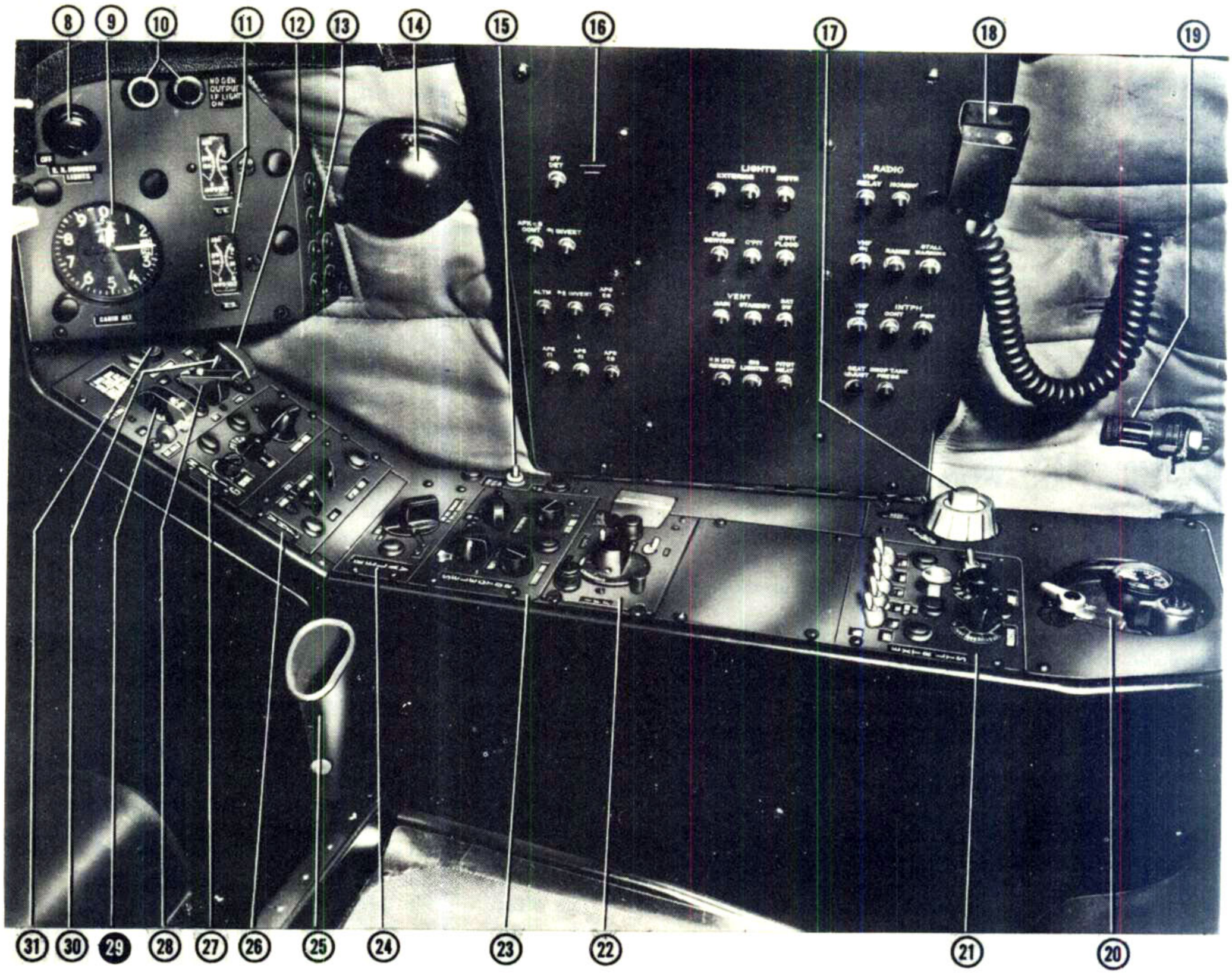
The anti-g suit will not take the place of a life jacket. It will only provide extra buoyancy.



Front View — Right Side

1. Chartboard light
2. Wing fold control
3. Aileron power boost release
4. AN/APQ-35A control panel
5. Chartboard
6. Engine fire detector test switches
7. Radar operator's ventilating air outlet
8. Right-hand console lights rheostat
9. Cabin altimeter
10. Generator warning lights
11. Generator volt-ammeters
12. Inverter control switch
13. Test jack panel
14. Ash tray
15. A-c power selector switch

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



Right-Hand Console

16. Radar operator's circuit breaker panel
17. Radar operator's anti-g control
18. Microphone—headset extension cord
19. Oxygen regulator light
20. Radar operator's oxygen regulator
21. Exterior lights control panel
22. AN/APX-6 IFF control panel
23. Radar operator's ICS-radio selector panel
24. VHF selector control panel
25. Radar operator's relief tube
26. Radar operator's AN/ARC-1 VHF control panel
27. AN/ARR-2A homing radio control panel
28. Master radio switch
29. Battery and generator switch
30. Pitot heat switch
31. Inverter failure warning light

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

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
UHF radio****	AN/ARC-27	*Horizon	4–49A
b. *Navigation*			
VHF homing	AN/ARR-2A	*Horizon	4–58
Radio altimeter	AN/APN-1	0 to 400 feet or 0 to 4000 feet	4–63
Radio compass	AN/ARN-6	200 nautical miles (approx.)	4–69
c. *Radar*			
**Search	AN/APS-21	200 nautical miles (max. land target)	4–80
**Tail warning	AN/APS-28	3 nautical miles	4–80
**Gun aiming	AN/APG-26	4000 yards	4–80
d. *Identification*			
Transponder	AN/APX-6	*Horizon	4–85
***Interrogator-responsor	AN/APX-17	*Horizon	

*These ranges are approximate and depend upon altitude, existing conditions, ground equipment, etc.
**Components of AN/APQ-35 radar.
***Space and weight provisions only.
****Alternate installation for AN/ARC-1.

4–37. MASTER RADIO SWITCH. The MASTER RADIO switch (figure 4–2, reference 28) is on the right-hand console and furnishes power to all communication and navigation equipment with exception of the radio altimeter. Before leaving the airplane, all radio equipment should be secured by turning the switch to "OFF."

4–38. ELECTRONIC EQUIPMENT CHECK.

a. Connect the mask microphone and headset to the personnel gear adapter, or the boom 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 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 at approximately 48 per cent rpm (6000 rpm) or over and the generators are charging, 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 check is 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 VHF CHAN SEL switches (figure 1–4A, reference 11, or figure 4–2, reference 26) to the desired channel settings. Select "VHF 1" or "VHF 2" as desired with the VHF selector knob (figure 4-2, reference 24) on the RELAY control panel. The AN/ARN-6 radio compass is checked by the pilot after the RECEIVER selector switch on the radar operator's SELECTOR panel (figure 4–2, reference 23) is turned to the "COMP" position. From the radar operator's station, the VHF homing equipment can be checked by turning the RECEIVER selector switch to "NAV" and operating the NAVIG panel switches to the desired settings.

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 one station to the other with the transmit switch at a position other than "ICS," to check that "ICS" signals will be heard at both stations regardless of transmit switch settings.

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 megacycles. 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 1–4A, reference 11) is on the cockpit center console and the radar operator's modified C-115/ARC-1 VHF radio control unit (figure 4–2, reference 26 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 preset main channel frequencies. The GUARD-BOTH-MAIN T/R switch permits operation on the guard channel, the selected main channel, or operation on the selected main channel while monitoring the guard channel. 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.

Note

The AN/ARC-28 equipment installed is inoperable and will be removed by service change since its use is considered impractical for this airplane.

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 by acting as an automatic relay 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 24) is on the right-hand console and has a selector switch with positions "OFF," "VHF 1," "VHF 2," and "RELAY." With the selector switch on position "VHF 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 "VHF 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. 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 "VHF 1" or "VHF 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 by lifting upward on the throttle transmit switch (figure 1–3, reference 17).

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

4–49A. UHF RADIO EQUIPMENT.

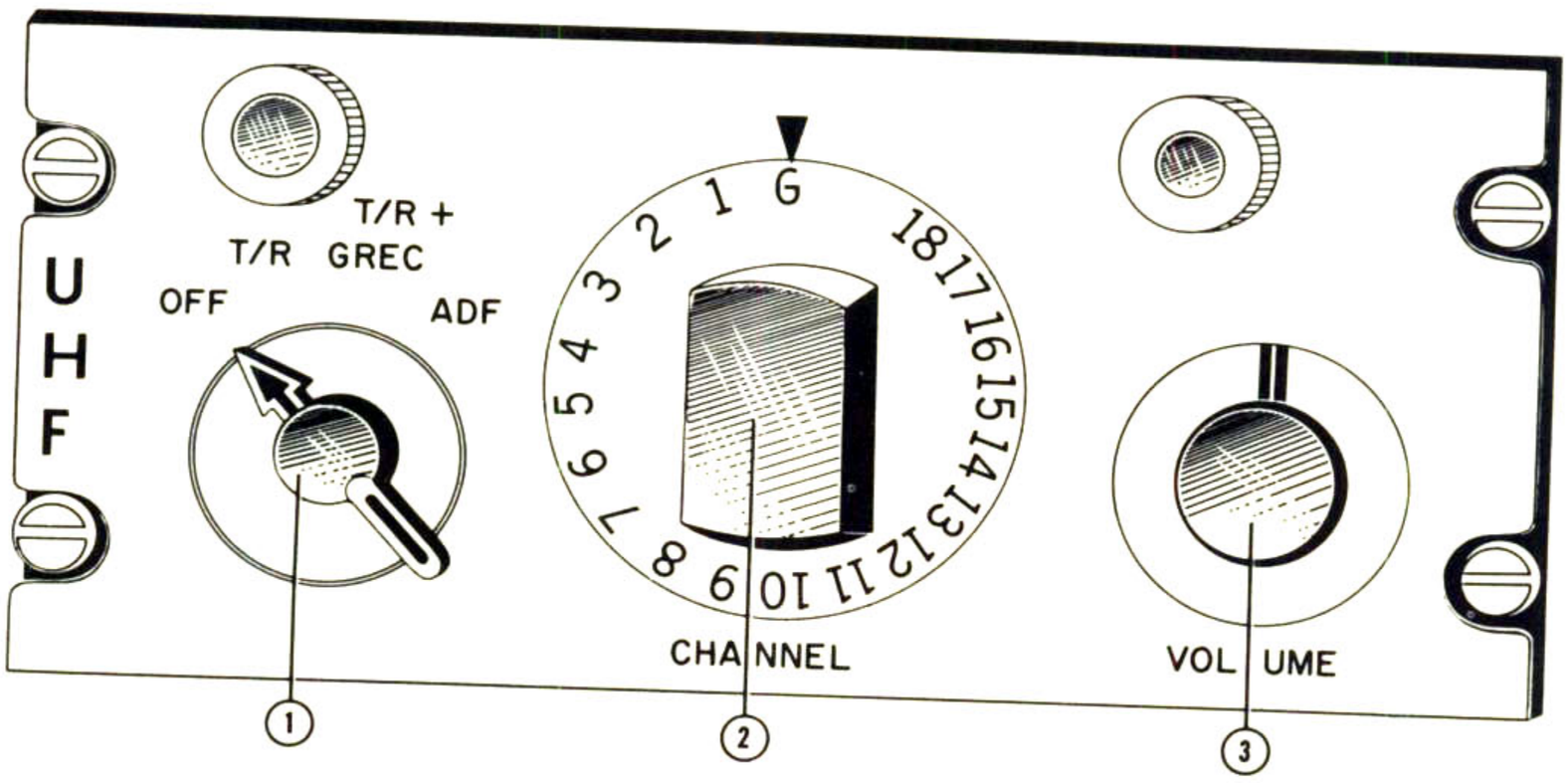
4–49B. GENERAL. The AN/ARC-27 UHF radio is used as an alternate installation for the AN/ARC-1 installation which is normally provided. The AN/ARC-27 UHF radio provides radio telephone communication between aircraft, or between aircraft and surface stations.

4–49C. UHF RADIO TRANSMITTER-RECEIVER. The RT-178/ARC-27 transmitter-receiver installed in the airplane provides radio telephone communication in the frequency range of 225.0 to 399.9 megacycles. Radio set RT-178/ARC-27 provides 1750 frequency channels in the above mentioned range. Provisions have been made for the pilot's remote selection of any one of eighteen preset frequencies or operation on a guard channel frequency. Constant monitoring of the guard channel may be selected. Transmission and reception are on the same frequency and by the same antenna.

4–49D. UHF RADIO CONTROL UNIT. The C-628/ARC-27 control unit is mounted on the center console below the instrument panel. The control unit provides an OFF-T/R-T/R+G REC-ADF switch (figure 4-2B, reference 1) which turns the set on (if MASTER RADIO is "ON" and power is supplied from the battery-generator or an external source). This switch further selects operation on the indicated channel frequency alone when on "T/R," or on indicated channel frequency and guard reception when on "T/R+G REC."

1. Function switch
2. Tuning meter
3. Loop L-R switch
4. Light control
5. Dial
6. Control button (inoperative)
7. Band switch
8. Tuning crank
9. Audio control
10. CW-Voice switch
11. Spare lamp

Figure 4-2A. Radio Compass Control Unit



1. Off—T/R—T/R G Rec—ADF selector switch
2. Channel selector switch
3. Volume control

Figure 4-2B. UHF Radio Control Unit

No ADF operation is provided with this set at this time. The CHANNEL switch (figure 4–2B, reference 2) selects any one of 18 preset frequencies or guard frequency ("G"). A VOLUME control (figure 4–2B, reference 3) is provided to adjust the amplitude of audio signals.

4–49E. OPERATION OF UHF RADIO.

a. Turn OFF-T/R-T/R+G REC-ADF to operation desired.

b. Turn CHANNEL selector to channel number giving frequency desired. If monitoring of guard channel is desired, OFF-T/R-T/R+G REC must be on "T/R+G REC." If transmission on guard frequency is desired, CHANNEL dial must be on "G."

c. Adjust VOLUME to the desired audio level.

d. Transmit (pilot) by switching upward the throttle transmitting switch.

e. Transmit (radar operator) by 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 1–4A, reference 10) 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 HF 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 23) 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 is located on the overturn structure at the left-hand side of the pilot's seat. The radar operator's headset extension jack (figure 4–2, reference 18) is located to the right of the radar operator's seat. Plug-in facilities are provided in the jacks for headset and boom microphone connections.

4–55. THROTTLE TRANSMIT SWITCH. The throttle transmit switch (figure 1–3, reference 17) 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 or UHF 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 is located on the floor forward of the radar operator. The switch is used by the radar operator for either "ICS," "VHF" or "UHF."

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. HOMING RADIO EQUIPMENT.

4–59. GENERAL. The AN/ARR-2A homing radio provides radio telephone or MCW reception for homing purposes.

4–60. 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 frequence 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.

4–61. HOMING RADIO CONTROL PANEL. The modified C-116/ARR-2A homing radio control panel (figure 4–2, reference 27) is located on the cockpit

right-hand console and is marked NAVIG. The panel 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."

4–62. OPERATION OF HOMING RADIO. Operation of the homing radio is entirely under the control of the radar operator. The received signal, however, is fed directly to the pilot's headset, with no switch selection by the pilot required. The pilot must inform the radar operator to select the desired channel, adjust the volume, or change the pitch of the signal. The homing radio is operated as follows:

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.

4–63. RADIO ALTIMETER EQUIPMENT.

4–64. GENERAL. The AN/APN-1 radio altimeter gives an indication of the altitude of the airplane above the surface as an aid in take-offs, navigation, search, attack, and landings.

4–65. RADIO ALTIMETER INDICATOR. The ID-14A/APN-1 radio altimeter indicator (figure 1–4, reference 8) is installed on the cockpit instrument panel. Two control switches are incorporated at the face of the instrument: the power switch which controls the power input to the RT-7A/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.

4–66. RADIO ALTIMETER LIMIT SWITCH. The radio altimeter limit switch (figure 1–3, reference 22) is located on the cockpit left-hand control console. The switch operates in conjunction with the limit indicating light and the range switch on the indicator. The switch can be preset to any altitude in steps of 25 within range of the indicator; the setting determines the altitudes at which the indicating light will function.

4–67. RADIO ALTIMETER LIMIT INDICATING LIGHT. This limit indicating light (figure 1–4, reference 6) 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. The light can be dimmed by turning the cap clockwise.

4–68. 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 AN/APN-1 altimeter cannot be relied upon below 500 feet over water and 600 feet over land. Below these altitudes when on the high range, the indicator will usually read high and may fail to read below 400 feet no matter how close to the terrain the airplane may actually be. Therefore, when flying below 600 feet under conditions of poor visibility, the ID-14A/APN-1 indicator should always be on the low range.

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

4–69. RADIO COMPASS.

4–70. GENERAL. The AN/ARN-6 radio compass is designed 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.

4–71. CONTROLS. The C-149/ARN-6 control unit (figure 1–3, reference 6) is installed on the left-hand side of the cockpit above the throttle quadrant.

4–72. OPERATION OF RADIO COMPASS EQUIPMENT. The equipment is started by turning the function switch (figure 4–2A, reference 1) to "COMP," "ANT" or "LOOP" position.

4–73. HOMING COMPASS OPERATION.

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

b. Rotate the band switch (figure 4–2A, reference 7) to the frequency band in which operation is desired.

c. Turn the TUNING crank (figure 4–2A, reference 8) to the desired station frequency and tune for maximum swing of the tuning meter (figure 4–2A, reference 2). Greater accuracy in tuning may be obtained by placing the CW-VOICE switch (figure 4–2A, reference 10) 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 (figure 4–2A, reference 9) 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 RADIO COMPASS indicator (figure 1–4, reference 19) 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.

4–74. 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 RADIO COMPASS 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.

4–75. 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 RADIO COMPASS 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 (figure 4–2A, reference 3) 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.

4–76. 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 us-

able headset volume and continue to reduce volume as the A-N signals increase in strength.

4–77. 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 to 270 degree position relative to the transmitting station 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.

4–78. 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.

4–79. TO STOP EQUIPMENT. To stop the equipment, turn the function switch to "OFF."

4–80. AN/APQ-35A RADAR EQUIPMENT.

4–81. GENERAL. The radar system AN/APQ-35A is made up of several equipments which may be operated together to provide a system of electronic search, tracking, gun aim, beacon interrogation, and tail warning. The purposes of the AN/APQ-35A are:

a. To search for targets.

b. To compute the course of the airplane with respect to the selected target so that the projectiles from the airplane's guns and the moving target arrive simultaneously at the same point in space.

c. To provide beacon interrogation and display beacon replies.

d. To provide tail warning facilities.

4–82. DESCRIPTION. The AN/APQ-35A is composed of three radar sets whose functional purposes are as follows:

Equipment	*Function*
Radar set AN/APS-21	Airborne long range search, intercept radar, beacon interrogation, and beacon replies.
Radar set AN/APG-26	Airborne gun aiming radar.
Radar set AN/APS-28	Airborne tail warning radar.

4–83. The C-576/APQ-35A control unit and panel (figure 4–2, reference 4), located on the right-hand side of the cockpit and in front of the radar operator contains all the operating controls and cathode ray tube indicators for the AN/APQ-35A radar system except the IP-60/APG-26 pilot's indicator. The operating panel is entirely illuminated for dark adapted vision. The oscilloscope hood is a cone-shaped hood which fastens to the control panel by means of thumb screws. A hood is also provided for the pilot which fastens to the APG-26 indicator. The hoods are stowed above and behind the pilot and radar operator. A metal scope cover is used to cover the three scopes on the panel when the radar system is not in operation.

4–84. OPERATING THE AN/APQ-35A RADAR SYSTEM. The C-576/APQ-35A control unit panel is operated by the radar operator. It controls the entire AN/APQ-35 radar system. The pilot uses his indicator to guide the airplane to gunnery range of the target.

CAUTION

Do not operate the radar system AN/APQ-35A unless the radar modulator MD-103/APQ-35, radar receiver-transmitters RT-167/APS-21, RT-165/APG-26 and RT-168/APS-28 have been pressurized to five pounds above atmospheric pressure at sea level. Do not operate the radar system on the ground unless auxiliary blowers are used to cool the units.

a. Place METER SW in its "DC" position, check the meter on the panel of the control unit. If it indicates 0.93 (28 volts) the equipment may be started. Attach the hood.

b. Place the HI-LO PWR switch in its "HIGH" position and place the PLATE PWR switch in its "ON" position.

c. Move SEARCH POWER switch from "OFF" to "ST-BY." The meter on the control panel should now indicate 0.575 (115 volts) with METER SW in its "AC" position. If no reading is noted, push OV-LD RES switch to "RESET" and release it. This should make the meter indicate.

d. Wait about four minutes and then turn the SEARCH POWER switch to its "RAD" position. Radar set AN/APS-21 is now in operation.

e. Place the G-AIM PWR switch in its ST-BY position. Wait one minute and then move the switch to its "OPER" position. This places radar set AN/APG-26 in alerted standby position. To place in full operation, turn RANGE switch to its extreme counterclockwise position.

f. Turn T-W PWR switch to its "ST-BY" position, wait three minutes and then turn the switch to its "ON" position. This places radar set AN/APS-28 in operation.

g. To stop radar system, reverse the foregoing procedure, place all switches in their "OFF" position. For emergency stops, place PLATE PWR switch in its "OFF" position. This shuts the system off completely.

4–84A. STAND-BY OPERATION.

4–84B. GENERAL. Stand-by operation is used whenever the equipment must be ready for instant use or when maintaining radar silence. Any one of the three Radar Sets may be placed in "stand-by" without affecting the others, except that when Radar Set AN/APS-21 is in stand-by, Radar Set AN/APG-26 is also in stand-by even though the G-AIM PWR switch is in its "OPER" position. Also, Radar Set AN/APG-26 is automatically in "stand-by" at all times except when the RANGE switch is in its "2-25" mile position, and HI-LO PWR switch is in its "HIGH" position. Stand-by operation is obtained as follows:

a. To place Radar Set AN/APS-21 in stand-by, turn the SEARCH POWER switch to "ST-BY." In stand-by, there is no r-f output and Antenna AS-461/APS-21 does not scan.

b. To place Radar Set AN/APG-26 in permanent stand-by operation, (as during search operation) place the G-AIM PWR switch in its "ST-BY" position, HI-LO PWR switch in its "LOW" position, or RANGE switch in some range above 25 miles.

c. To place Radar Set AN/APS-28 in stand-by, place T-W PWR switch in its "STD-BY" position.

4–84C. SEARCH OPERATION.

4–84D. GENERAL. The term—"search operation" as used here refers to AI (Air Intercept) and ASV (surface search) operation by Radar Set AN/APS-21. See also paragraph 4–84Q. The equipment must be placed in operation as directed in paragraph 4–84.

4–84E. AI OPERATION. For AI operation against airborne targets proceed as follows:

a. Place ELEV SCAN switch in its "90°" position. If targets are intercepted, the ELEV SCAN switch may be moved to its "30°" position and the TILT ANG switch operated to position Antenna AS-461/APS-21 so that it scans the 30° sector containing the intercepted target or targets. If interest centers in one target, the ELEV SCAN switch may be moved to its "MAN" position and the TILT ANG switch operated to adjust Antenna AS-461/APS-21 to the proper tilt angle. To easily ascertain this angle, it is advisable to adjust the RGE STB control until the movable range ring intersects the target and it appears on the C-scope. Note the relative elevation angle of the target on the C-scope, and adjust the 30° tilt angle with the TILT ANG switch until the 30° sector centers on the target. Then, when the ELEV SCAN switch is placed in its "MAN" position, the target should still appear on the C-scope. Azimuth bearing is obtained by considering a line as being drawn from the start of the sweep,

through the target, to the azimuth scale. The bearing at the point where the line would strike the scale is the target bearing. Range is estimated by linear interpolation of the radial distance from the start of the sweep to the target against the fixed range markers.

b. If target definition is poor, place the SEARCH DISCRIM switch in its "FTC" position if the range in use is 25 miles or more. If the range is less than 25 miles, use the "HVP" position, and if the range is two miles, operate the FTC ON button on Azimuth-Elevation-Range Indicator IP-60/APG-26 (figure 1–4, reference 15).

c. If targets saturate the PPI-scope at ranges up to six miles, place the SEARCH DISCRIM switch in its "STC," "STC-FTC," or "STC-HVP" positions as required. The "STC" position is used where only a single target or several widely spaced targets are intercepted.

4–84F. ASV OPERATION. ASV scan is used in accordance with the tactical requirement of the mission. For this type of operation, proceed as follows:

a. Place the ELEV SCAN switch in its "ASV" position.

b. Adjust the horizontal scan with the AZIM WDTH control until the antenna beam scans the assigned sector in azimuth.

c. Hold the TILT ANG switch "UP" or "DOWN" until the tilt angle is such as to obtain the greatest surface coverage with the antenna beam. The tilt angle should always be adjusted so that targets can be seen at a minimum range of two miles. This requirement may be altered by tactical considerations. In general, the tilt angle should be adjusted so as to provide as much range coverage as possible.

4–84G. In both AI and ASV operation, the area occupied by the pattern on the PPI-scope may be increased by rotating the DEP CTR control clockwise.

4–84H. Targets may be ranged with the fixed range markers or with the range strobe. The fixed range markers describe arcs on the PPI-scope. The distance in miles between these arcs is indicated in the right or left hand window of the RANGE switch. The calibrated range strobe gives the target range and, when RANGE switch is in its extreme counterclockwise position, selects targets for tracking for Radar Set AN/APG-26. All PPI targets ranged with the range strobe appear on the C-scope. Since only one target can be ranged at a time, only one target appears on the C-scope at any one time.

4–84J. There are two ways the relative azimuth bearing of a target can be obtained. One way is to compare the target's angular position with the radial lines etched on the screen of the PPI-scope. These lines are assigned angular values and from them the azimuth bearing can be estimated. At 0° the target is dead ahead. At other angles, the target is off port or starboard as the case may be.

4–84K. The relative azimuth angle of any selected target can also be obtained with the C-scope. Azimuth bearing is estimated with the horizontal azimuth scale and the target is off port or starboard according to whether it appears on the right or left of the vertical centerline on the C-scope.

4–84L. The relative elevation angle is determined on the C-scope by comparing the target position with the vertical scale. Targets below the horizontal 0° line have a negative angle. Targets above this line have a positive angle.

4–84M. BEACON OPERATION.

4–84N. GENERAL. In beacon operation, Radar Set AN/APS-21 seeks navigational information from one or more beacon transmitters. All ranges, including the 200-mile range, are available for beacon operation. To adjust Radar Set AN/APS-21 for beacon operation, energize Radar Set AN/APQ-35 as directed in paragraph 4–84 (Radar Sets AN/APG-26 and AN/APS-28 may be in stand-by as noted in paragraph 4–84A) and proceed as follows:

a. With SEARCH POWER switch in its "BEAC" position, the aircraft may then be flown in a searching circle with the RANGE switch set to the "200" position. The range should be reduced as the beacon range permits.

b. When such a signal is received, check its coding to ascertain that it is authentic and to identify the beacon station.

c. Fly directly toward the beacon until a directional line through the beacon and the aircraft can be plotted with the aid of the aircraft's compass.

d. Reduce the setting of the RANGE switch to the lowest range on which the beacon signal is visible and carefully measure the range and bearing as directed in paragraph 4–84E, a.

4–84P. For homing, set a flight course that keeps the azimuth bearing of the beacon at 0° plus or minus the wind drift angle.

4–84Q. INTERCEPT OPERATION.

4–84R. GENERAL. Intercept operation is defined to mean all types of operation of Radar Set AN/APS-21 except ASV and beacon operation. Intercept operation is commonly termed AI (air intercept) meaning the location and ranging of airborne targets. After the equipment is placed in operation as directed in paragraph 4–84, proceed as follows:

a. Turn the ELEV SCAN switch to "90°." In 90° AI scan, the beam scans from −30° to +60° and through a horizontal angle adjustable from 30° to 170°. This type of AI scan is used for general search operations. As a rule, the horizontal angle is adjusted to 170°. If weak targets of special interest are observed, the horizontal angle may be reduced to exclude all returns of no immediate interest that brighten the PPI-scope

and make it difficult to distinguish the weak targets. The aircraft must fly a course that keeps the weak targets within the scan field of the antenna beam when the horizontal angle is reduced.

b. Where a more narrow section of altitude is to be searched, the ELEV SCAN switch should be placed in its "30°" position and the tilt angle adjusted with the TILT ANG switch as directed in paragraph 4–84E, a.

c. With the ELEV SCAN switch in its "30°" position, the vertical angle covered by the antenna beam is 30°. By manual control, with the TILT ANG switch, the operator can select any 30° sector between −30° and +60° for scanning. Once a distant target is located in 90° AI scan, the vertical scan angle can be reduced to 30° to exclude targets in which there is no interest. At the same time, the horizontal scan angle may be reduced for targets in the dead ahead position. Reduction in the angle cleans up the PPI-scope of targets and noise that interfere with scope interpretation.

d. Where a particular altitude is to be searched, the ELEV SCAN switch should be placed in its "MAN" position as directed in paragraph 4–84E, a. To avoid losing an intercepted target, its elevation angle must first be measured on the C-scope as directed in paragraph 4–84E, a.

e. In manual (MAN) AI scan, the pencil beam does not tilt automatically but remains at a fixed angle which can be adjusted to any angle between the limits of −30° and +60°. This permits the aircraft to fly at a given altitude and confine its search to any other altitude. The altitude being searched can be selected and changed at any time by means of the TILT ANG switch when the ELEV SCAN switch is in its "MAN" position. The fixed tilt angle is of special value whenever it is desired to observe a weak signal exclusively because all other targets are removed from the PPI-scope.

f. The azimuth angle of scan should be selected by the AZIM WDTH switch to be a width sufficient to include all of the assigned azimuth sector. Generally, it is advisable to start with a 170° angle and narrow it after an interception has been made. With azimuth scan angles of less than 120°, the gun-aim spot will not appear on the C-scope if the azimuth bearing of Antenna AS-459/APG-26 is +60° or −60°. Also the gun-aim spot does not appear if the tilt angle of Antenna AS-459/APG-26 exceeds −30°. Under such conditions, the GUN-AIM control must be adjusted to bring the bearing of Antenna AS-459/APG-26 into the scan angle of Antenna AS-461/APS-21.

g. Targets are ranged and their bearing is obtained as described in paragraph 4–84E. The operator watches for targets and when one appears without IFF or other identification, the RGE STB control is advanced until the range strobe coincides with the target. This transfers the target to the C-scope. In this display, a vertical displacement above or below the reference line represents elevation relative to the flight horizontal axis of the aircraft. Horizontal displacement of the target to the right or left of the vertical reference line represents azimuth bearing relative to the flight axis of the aircraft. The azimuth bearing on the PPI-scope and the azimuth and elevation bearing on the C-scope are orally relayed to the pilot by the radar operator to enable the pilot to set a course that allows the aircraft to come up on the tail of the target. The complete gun-aim operation is described in paragraph 4–84S.

h. Where targets are difficult to distinguish separately in FTC or HVP operation, the RGE STB control should be advanced until the strobing arc is at a range just short of the range of the group of targets. Then the RANGE switch should be moved to its "30TD" position. If the targets are very closely spaced, place the RANGE switch in its "5TD" position. Either of these positions expands the sweep to provide target separation.

4–84S. GUN-AIM OPERATION.

4–84T. GENERAL. With the equipment placed in operation as directed in paragraph 4–84, gun-aim operation begins when the aircraft has been maneuvered into position behind the tail of the target and the range has been closed to 4000 yards. When an enemy target appears on the PPI-scope, proceed as follows:

a. Check to see that the HI-LO PWR switch is in its "HIGH" position.

b. Move the G-AIM PWR switch from its "ST-BY" position to its "OPER" position and adjust the RGE STB control until the range strobe ring passes through the target and the target appears in the C-scope.

c. Adjust the AZIM WDTH and TILT ANG controls to exclude most of the other targets from the PPI-scope. However, the scan angle of Antenna AS-461/APS-21 must always be large enough to preclude the possibility of losing the target.

4–84U. The relative azimuth and elevation on the PPI and C-scopes, together with the range in the RGE window are continuously relayed to the pilot. As the range is reduced, the RANGE switch is turned to a lower range. This process continues until the RANGE switch is in its extreme counterclockwise (2-25) position and the range has closed to 4000 yards. When the RANGE switch is placed in its lowest position, Radar Set AN/APG-26 goes into full operation.

4–84V. When the range closes to 4000 yards, the radar operator adjusts the GUN AIM control until the antenna dot coincides with the target dot on the C-scope and the ON TGT lamp is illuminated. At this range, the normally centered dot on the scope of Azimuth-Elevation-Range Indicator IP-60/APG-26 is unlocked to assume the predicted target position, and the pilot begins observation of the target.

4–84W. The horizontal line on the Azimuth-Elevation-Range Indicator IP-60/APG-26 is the artificial horizon which has been previously adjusted along with the focus and intensity. The target dot is not the actual video pulse from the receiving circuits of Radar Set AN/APG-26 but is a signal produced in Ballistics Computer CP-63/APG-26 that represents the predicted azimuth and elevation of the target. The predicted target range is indicated on a dial beneath the scope which registers a maximum of 2000 yards until the range has closed from a predicted 4000 yards to a prediction of less than 2000 yards. The aircraft is maneuvered to bring the target dot under the crosshairs on the scope screen. As the target is brought into the gun sights, it moves slowly until near the intersection of the crosshairs. In the inside area around the crosshairs, the target movement is large compared to the gun-aim error. If the target dot is not brilliant enough, the DOT INT control should be advanced for the desired brilliance. Keeping the target under the crosshairs, the pilot watches the predicted range dial until the range has closed sufficiently to permit accurate and effective gun fire.

4–84X. If, for any reason, it is necessary to interrupt tracking a particular target, the RED TGT switch may be pressed and the GUN AIM control used to detrain Antenna AS-459/APG-26 from the target.

4–84Y. After the conclusion of firing, Radar Set AN/APG-26 should be returned to stand-by operation and full use of the search capabilities of Radar Set AN/APS-21 resumed.

4–84Z. TAIL WARNING OPERATION.

4–84AA. GENERAL. The tail warning operation is completely unrelated to any of the other types of operations previously described. Radar Set AN/APS-28 maintains close surveillance over the approach of all aircraft coming up on the tail of the aircraft bearing Radar Set AN/APQ-35. The equipment must be started as directed in paragraph 4–84, with the T-W PWR switch in its "ON" position, and the REC-GN T-W adjusted with the SEA SUPP control turned all the way counterclockwise for the normal amount of sea return. The SEA SUPP may then be advanced to suppress sea return to any desired degree.

4–84AB. An aircraft approaching from the rear will be indicated on the O-scope of the AN/APQ-35 control panel in the form of a double-dot display giving azimuth, range and elevation. The azimuth bearing of the target is determined by mentally dropping a line from the left-hand dot to the azimuth scale on the bottom of the O-scope. The left-hand dot also indicates true range as measured against the fixed range markers on the face of the scope. The target elevation or altitude is indicated as being greater than the altitude of the aircraft bearing Radar Set AN/APS-28 if quadrant lamps "1" or "2" are glowing and if the right hand dot is higher than the left hand dot. If the right hand dot is lower than the left hand dot, the target is at an altitude lower than the altitude of the aircraft bearing Radar Set AN/APS-28. It is not advisable to rely completely on quadrant lamps "3" and "4" at low altitudes because they may be illuminated by sea return.

4–84AC. The use made of the warning supplied by Radar Set AN/APS-28 depends upon the tactical situation. It is obvious that one recourse would be to attempt to maneuver the target into position where it can be scanned by Radar Set AN/APS-21 and AN/-APG-26. Under no circumstances should an unidentified target be allowed to approach within a range of 4000 yards.

4–84AD. EMERGENCY FLIGHT ADJUSTMENTS.

4–84AE. GENERAL. The only emergency adjustment that can be made during flight is by means of the THER OV-RD switch. Thermal cut-outs are provided for all major units that are critical as to temperature. If the temperature rise should exceed the rating of these units, the thermal cut-outs operate to remove primary power from the system. Since the cut-outs keep the primary circuits open as long as the temperature is excessive, it is impossible to operate unless the THER OV-RD switch is used. This switch is sealed in the "OUT" position. It must not be used except where the continued use of the equipment is of more value than the equipment itself. Radar Set AN/APS-21 will continue to operate for approximately 30 minutes with the THER OV-RD switch in its "IN" position before permanent damage occurs.

CAUTION

The THER OV-RD switch must not be used except where emergency use of the equipment transcends the damage sure to occur to the equipment.

4–84AF. To operate the THER OV-RD switch, break the seal on the left-hand end of the horizontal rod in the switch lock and remove the seal and seal wire. Then slide the lock assembly to the right to release the switch. With the switch in its "IN" position, operation may be resumed by repeating the starting procedure described in paragraph 4–84.

4–84AG. Two other adjustments that might be considered emergency adjustments are the REC TUNE SEARCH and the REC TUNE T-W. If Radar Set AN/APS-21 or Radar Set AN/APS-28 fail to display any targets on the PPI or O-scope, a defect may have developed in their AFC circuits. If this occurs, normal operation may be restored by resorting to manual tuning over the MANUAL range of the affected tuning control.

4–84AH. ANTI-JAMMING PROCEDURES.

4–84AJ. GENERAL. The procedures described in this paragraph are applicable to enemy jamming and

may also be used to improve poor reception due to natural causes. Circuits that may be selected by the operation of SEARCH DISCRIM switch are the "STC," "FTC," "HVP," and combinations of "STC" and "FTC" or "HVP." These circuits only affect the operation of Radar Set AN/APS-21. On the "0-2" mile range, a pulse jamming signal will be visible but will not be stationary. "STC" is used to allow operation through saturation jamming caused by large nearby targets. "FTC" and "HVP" improve definition so that targets are more easily distinguished from false jamming targets. The "FTC" and "HVP" circuits are also effective against cw jamming. For Radar Set AN/APS-21, the "30TD" and "5TD" expanded sweeps may also be used effectively against jamming. One advantage they provide is to eliminate from the PPI-scope, all signal returns except for those returned from the section of range displayed. Another advantage is that, by providing a large degree of target separation, targets are more easily distinguished from jamming.

4–84AK. The only anti-jamming control for Radar Set AN/APG-26 is the FTC switch on Azimuth-Elevation-Range Indicator IP-60/APG-26. This control is placed in its "ON" position when "HVP" operation is required for Radar Set AN/APS-21.

4–84AL. The anti-jamming controls for Radar Set AN/APS-28 are the STC switch and the FTC switch. These controls are operated by the radar operator as described in the foregoing (see paragraphs 4–84C through 4–84Z).

4–84AM. Occasionally the receiver gain controls can be adjusted to minimize jamming. Only Radar Sets AN/APS-21 and AN/APS-28 have manual receiver gain controls, REC-GN SEARCH and REC-GN T-W.

4–84AN. Another means of minimizing jamming is to manually tune the local oscillators in the receiving systems. Radar Set AN/APS-21 is tuned with REC TUNE SEARCH and Radar Set AN/APS-28 is tuned with REC TUNE T-W. Radar Set AN/APG-26 has no manual tuning control. Ordinarily the tuning controls are placed in their "AUTO" positions but they may be adjusted over their "MANUAL" ranges at any time the radar operator thinks reception might be improved. These controls must also be used if the AFC circuits should become defective.

4–85. AN/APX-6 RADIO EQUIPMENT.

4–86. 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.

4–87. AN/APX-6 IFF CONTROL CONSOLE. The C-544/APX-6 IFF control panel (figure 4–2, reference 22) 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.

4–88. OPERATION OF AN/APX-6 EQUIPMENT.

a. To start equipment 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 "OUT" position.

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

d. To stop equipment rotate the MASTER control to the "OFF" position.

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

4–89. EMERGENCY AND DESTRUCT OPERATIONS.

Refer to paragraph 3–44.

4–90. COCKPIT AIR CONDITIONING AND PRESSURIZING SYSTEM.

4–91. 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,

4–92. CONTROLS. The cockpit air conditioning control (figure 1–4A, reference 9), 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.

4–93. 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.

4–94. Under some conditions of flight in humid climates, the temperature in the cockpit may be below the dew point. 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 In some cases ducting may have become sufficiently cooled so that fog may persist for two to four minutes after the temperature control is moved to the highest setting in the automatic range (80°). A selection in the "AUTO" range should be maintained to provide the most comfortable cockpit temperature compatible with fog elimination.

4–95. 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.

4–96. 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 in airplanes BuNo. 124595 through 124664, the cockpit gradually pressurizes until at 11,750 feet, a maximum pressure differential of 2.75 psi is reached. Above 11,750 feet a constant pressure differential of 2.75 psi above atmospheric pressure is maintained. Above 5000 feet in airplanes BuNo. 125783 and subs., the cockpit gradually pressurizes until at 13,200 feet, a maximum pressure differential of 3.3 psi is reached. Above 13,200 feet a constant pressure differential of 3.3 psi above atmospheric 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.

4–97. LIGHTING EQUIPMENT.

4–98. INTERIOR LIGHTS. The interior lights control panel is located on the cockpit center console. In airplanes BuNo. 124595 through 124664 the switches contained on the panel function as follows:

a. Selector switch (figure 1–4A, reference 16)— Selects "FLIGHT" instrument lights, "ALL INSTR" lights or "EMERG." In the latter position, the cockpit floodlights are turned on.

b. INSTR LIGHTS rheostat (figure 1–4A, reference 2)— Rotated clockwise increases the intensity of the selected instrument lights and the oxygen regulator lights (figure 1–3, reference 10, and figure 4–2, reference 26). Extreme counterclockwise position turns the lights "OFF."

c. CONSOLE LIGHTS rheostat (figure 1–4A, reference 17)— Rotated clockwise increases the intensity of the left-hand and center console lights. Extreme counterclockwise position turns the lights "OFF."

d. R.H. CONSOLE LIGHTS rheostat (figure 4–2, reference 8)—Rotated clockwise increases the intensity of the right-hand console lights. Extreme counterclockwise position turns the lights "OFF."

4–98A. In airplanes BuNo. 125783 and subs., the rheostats contained in the INT LTS panel function as follows:

a. FLT INST rheostat—Rotate clockwise to increase the intensity of the flight instrument and armament panel lights. The extreme counterclockwise position turns the lights "OFF."

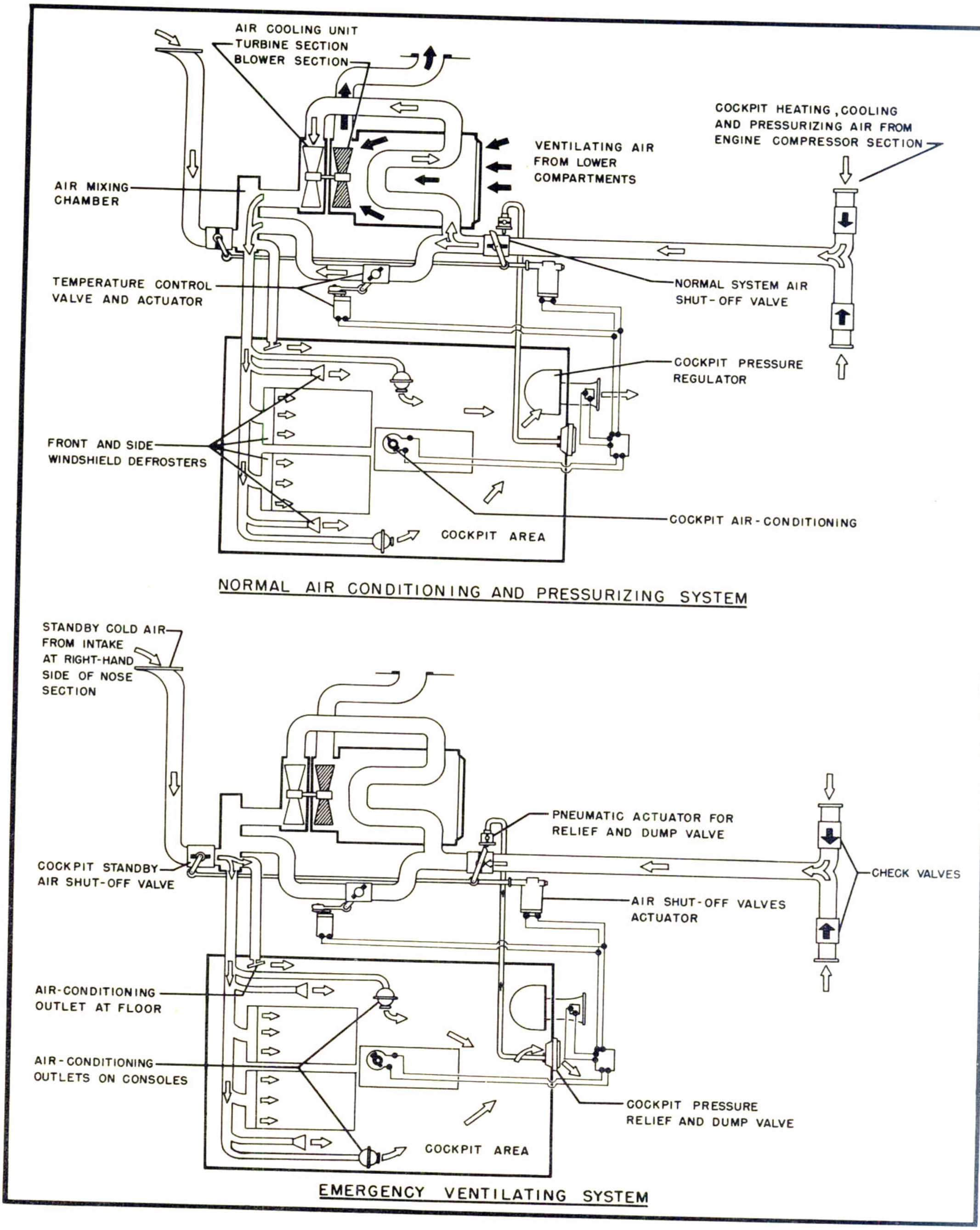


Figure 4-3. Cockpit Air Conditioning and Pressurizing System

b. NON-FLT INST rheostat—Rotate clockwise to increase the intensity of remaining instrument lights The extreme counterclockwise position turns the lights "OFF."

c. CONSOLE rheostat—Rotate clockwise to increase the intensity of the left-hand and center console lights. The extreme counterclockwise position turns the lights "OFF."

d. R.H. CONSOLE LIGHTS rheostat — Rotate clockwise to increase the intensity of the right-hand console lights.

e. EMERG LIGHTS—Switch "ON" to provide emergency cockpit lighting if other interior lighting circuits fail.

4-98B. CHARTBOARD LIGHTS—When the chartboard is pulled out, the chartboard lights switch on automatically. Intensity of the chartboard lights is controlled by the R. H. CONSOLE LIGHTS rheostat.

4-98C. EXTENSION LIGHT. In airplane BuNo. 124595 through 124664, an extension light is installed on the center console (figure 1-4A, reference 13). The switch controlling this extension light is installed forward of and adjacent to the extension light. In airplanes BuNo. 125783 and subs., the extension light is installed on the forward side of the radar operator's seat and the EXTENSION LIGHT switch is on the lower center console.

4-99. EXTERIOR LIGHTS. The EXTR LTS control panel (figure 4-2, reference 21) 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."

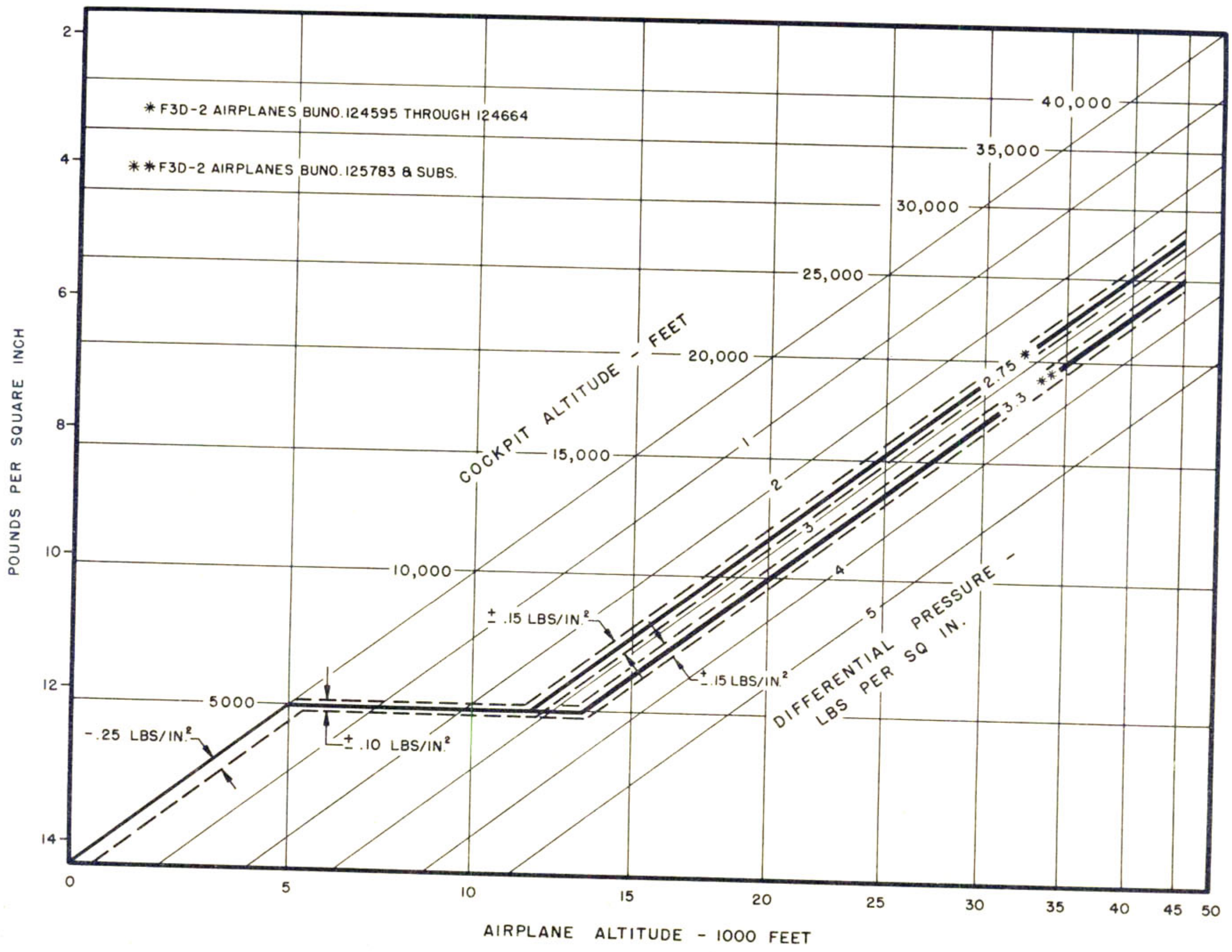


Figure 4-4. Cockpit and Aircraft Altitude Comparison Chart

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 console or the pilot's keying switch on the left-hand side of the cockpit, manually codes the fuselage lights providing the selector switch is in the "FUS OFF FOR KEY" position, and regardless of the MASTER switch position.

4–99A. In airplanes BuNo. 125783 and subs., the switches on the EXT LTS control panel (figure 4–2, reference 21) function as follows:

a. The MASTER switch selects "OFF," "CODE," "FLSH," and "STDY." The "CODE" position allows automatic coding of the fuselage lights. The "FLSH" position gives automatic flashing of the navigation lights. The "STDY" position gives steady illumination of all selected lights.

b. Four selector switches, FUSEL, WING, TAIL, and FORM turn the selected lights to "BRIGHT," "DIM" or "OFF" (switch centered).

c. The FUSEL switch selects the code letter desired for automatic keying of the fuselage lights.

d. The CODE switch can be turned to either "AUTO" or "MAN" for use during automatic keying of fuselage lights, or "MAN" for manual keying of the fuselage lights.

e. The PUSH TO KEY switch is for the use of the radar operator in manually coding the fuselage lights. The MASTER switch must be in the "FLSH" position and the CODE switch must be turned to "MAN."

f. An indicator light on the EXT LTS panel monitors the coding of the fuselage lights whenever the CODE switch is in "MAN."

4–100. APPROACH LIGHT. The approach light for carrier landings is located in the left-hand wing. With the exterior lights MASTER switch in "CODE," "FLASH" or "STEADY," 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

4–100A. In airplanes BuNo. 124648 through 124664, an approach light by-pass switch has been installed in the arresting hook actuating cylinder access well. Switching the approach light by-pass switch "ON" will give steady illumination of the approach light when the wheels are down for use during field carrier landing practice. The approach light by-pass switch must be turned "OFF" for automatic operation of the approach light during normal carrier landings.

4–100B. In airplanes BuNo. 125783 through 125882, 127019 through 127085, a momentary-contact approach light by-pass switch is installed in the nose wheel well. Pushing the approach light by-pass switch to the "ON" position will give steady illumination of the approach light when the wheels are down for use during field carrier landing practice. Turning "OFF" the battery-generator switch will release the by-pass switch control of the approach light circuit and restore normal operation of the approach light.

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 operations, 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 OF 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 in 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. 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

I.A.S. (*Knots*)	*Correction* (*Knots*)
90	Subtract 4
100	Subtract 2
120	0
140	Add 2

FLAPS UP—GEAR UP

I.A.S. (*Knots*)	*Correction* (*Knots*)
110	Subtract 2
150	Add 2
200	Add 2
250	Add 2
300	Add 2
350	Add 2
400	Add 2
450	Add 2

AIRCRAFT MODEL(S)

F3D-2
WITH 2-150 GAL. EXTERNAL DROPPABLE FUEL TANKS (DOUGLAS TYPE EXTERNAL STORES).

TAKE-OFF, CLIMB & LANDING CHART

ENGINE MODEL(S)

WESTINGHOUSE J34-WE-36 (24C4E)

TAKE-OFF DISTANCE FEET

GROSS WEIGHT LB.	HEAD WIND M.P.H.	HEAD WIND KTS.	HARD SURFACE RUNWAY AT SEA LEVEL GROUND RUN	HARD SURFACE RUNWAY AT SEA LEVEL TO CLEAR 50' OBJ.	HARD SURFACE RUNWAY AT 3000 FEET GROUND RUN	HARD SURFACE RUNWAY AT 3000 FEET TO CLEAR 50' OBJ.	HARD SURFACE RUNWAY AT 6000 FEET GROUND RUN	HARD SURFACE RUNWAY AT 6000 FEET TO CLEAR 50' OBJ.	SOD-TURF RUNWAY AT SEA LEVEL GROUND RUN	SOD-TURF RUNWAY AT SEA LEVEL TO CLEAR 50' OBJ.	SOD-TURF RUNWAY AT 3000 FEET GROUND RUN	SOD-TURF RUNWAY AT 3000 FEET TO CLEAR 50' OBJ.	SOD-TURF RUNWAY AT 6000 FEET GROUND RUN	SOD-TURF RUNWAY AT 6000 FEET TO CLEAR 50' OBJ.	SOFT SURFACE RUNWAY AT SEA LEVEL GROUND RUN	SOFT SURFACE RUNWAY AT SEA LEVEL TO CLEAR 50' OBJ.	SOFT SURFACE RUNWAY AT 3000 FEET GROUND RUN	SOFT SURFACE RUNWAY AT 3000 FEET TO CLEAR 50' OBJ.	SOFT SURFACE RUNWAY AT 6000 FEET GROUND RUN	SOFT SURFACE RUNWAY AT 6000 FEET TO CLEAR 50' OBJ.
28,000		0	2800	3400	3450	4200	4280	5280														
		15	2120	2630	2645	3300	3325	4190														
		25	1690	2140	2140	2720	2720	3500														
		35	1310	1710	1680	2190	2170	2860														
26,000		0	2325	2820	2855	3460	3540	4300														
		15	1730	2150	2160	2670	2720	3380														
		25	1370	1740	1710	2160	2205	2790														
		35	1040	1360	1340	1740	1740	2260														
24,000		0	1900	2310	2345	2830	2870	3470														
		15	1390	1730	1750	2160	2175	2890														
		25	1080	1380	1380	1740	1740	2200														
		35	815	1070	1055	1370	1355	1750														

NOTE: DISTANCES SHOWN ARE FOR STANDARD TEMPERATURE 15° C (59° F).
DATA AS OF 3/20/52 BASED ON: PATUXENT FLIGHT TEST & CALCULATIONS

(1) USE 40° FLAPS (FULL DOWN) FOR ALL TAKE-OFFS.

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.	AT SEA LEVEL RATE OF CLIMB F.P.M.	AT SEA LEVEL LBS. OF FUEL USED	AT 10,000 FEET BEST C.A.S. KTS.	AT 10,000 FEET RATE OF CLIMB F.P.M.	AT 10,000 FEET FROM SEA LEVEL LB. OF FUEL USED	AT 10,000 FEET FROM SEA LEVEL DIST. NAUT. MI.	AT 10,000 FEET FROM SEA LEVEL TIME MIN.	AT 20,000 FEET BEST C.A.S. KTS.	AT 20,000 FEET RATE OF CLIMB F.P.M.	AT 20,000 FEET FROM SEA LEVEL LB. OF FUEL USED	AT 20,000 FEET FROM SEA LEVEL DIST. NAUT. MI.	AT 20,000 FEET FROM SEA LEVEL TIME MIN.	AT 30,000 FEET BEST C.A.S. KTS.	AT 30,000 FEET RATE OF CLIMB F.P.M.	AT 30,000 FEET FROM SEA LEVEL LB. OF FUEL USED	AT 30,000 FEET FROM SEA LEVEL DIST. NAUT. MI.	AT 30,000 FEET FROM SEA LEVEL TIME MIN.	AT 35,000 FEET BEST C.A.S. KTS.	AT 35,000 FEET RATE OF CLIMB F.P.M.	AT 35,000 FEET FROM SEA LEVEL LB. OF FUEL USED	AT 35,000 FEET FROM SEA LEVEL DIST. NAUT. MI.	AT 35,000 FEET FROM SEA LEVEL TIME MIN.	AT ___ FEET BEST C.A.S. KTS.	AT ___ FEET RATE OF CLIMB F.P.M.	AT ___ FEET FROM SEA LEVEL LB. OF FUEL USED	AT ___ FEET FROM SEA LEVEL DIST. NAUT. MI.	AT ___ FEET FROM SEA LEVEL TIME MIN.
NORMAL 95.5 % RPM	28,000	250	2250	538	240	1590	1053	23	5.0	225	960	1653	61	13.8	205	280	2621	158	31.5									
	26,000	245	2500	538	235	1800	988	21	4.4	220	1140	1503	53	11.8	200	410	2248	125	25.5									
	24,000	240	2770	538	230	2020	943	18	4.1	215	1320	1398	45	10.1	195	610	1993	103	21.5	185	170	2627	185	36.3					
MILITARY 100% RPM	28,000	280	3130	538	260	2380	958	18	3.5	240	1530	1438	44	9.0	215	580	2138	110	19.3									
	26,000	275	3430	538	260	2650	923	16	3.1	240	1750	1340	40	8.0	215	760	1876	87	16.7	195	250	2423	151	27.4					
	24,000	275	3780	538	260	2940	883	14	2.9	240	2000	1255	36	7.1	210	960	1716	76	14.3	195	430	2090	119	21.9					

POWER PLANT SETTINGS: (DETAILS ON FIG. A-2)
DATA AS OF 3/1/51 BASED ON: CALCULATIONS

FUEL USED: INCLUDES WARM-UP AND TAKE-OFF ALLOWANCE EQUIVALENT TO 5 MINUTES AT NORMAL POWER. (LBS) 588

LANDING DISTANCE FEET

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

DATA AS OF 3/1/51 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.

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

LEGEND

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

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

AIRCRAFT MODEL(S)

F3D-2
NO EXTERNAL LOAD

TAKE-OFF, CLIMB & LANDING CHART

ENGINE MODEL(S)

2 WESTINGHOUSE J34-WE-36
(24C4E)

TAKE-OFF DISTANCE FEET

GROSS WEIGHT LB.	HEAD WIND M.P.H.	HEAD WIND KTS.	HARD SURFACE RUNWAY AT SEA LEVEL GROUND RUN	HARD SURFACE RUNWAY AT SEA LEVEL TO CLEAR 50' OBJ.	HARD SURFACE RUNWAY AT 3000 FEET GROUND RUN	HARD SURFACE RUNWAY AT 3000 FEET TO CLEAR 50' OBJ.	HARD SURFACE RUNWAY AT 6000 FEET GROUND RUN	HARD SURFACE RUNWAY AT 6000 FEET TO CLEAR 50' OBJ.	SOD-TURF RUNWAY AT SEA LEVEL GROUND RUN	SOD-TURF RUNWAY AT SEA LEVEL TO CLEAR 50' OBJ.	SOD-TURF RUNWAY AT 3000 FEET GROUND RUN	SOD-TURF RUNWAY AT 3000 FEET TO CLEAR 50' OBJ.	SOD-TURF RUNWAY AT 6000 FEET GROUND RUN	SOD-TURF RUNWAY AT 6000 FEET TO CLEAR 50' OBJ.	SOFT SURFACE RUNWAY AT SEA LEVEL GROUND RUN	SOFT SURFACE RUNWAY AT SEA LEVEL TO CLEAR 50' OBJ.	SOFT SURFACE RUNWAY AT 3000 FEET GROUND RUN	SOFT SURFACE RUNWAY AT 3000 FEET TO CLEAR 50' OBJ.	SOFT SURFACE RUNWAY AT 6000 FEET GROUND RUN	SOFT SURFACE RUNWAY AT 6000 FEET TO CLEAR 50' OBJ.
24,000		0	1890	2290	2340	2820	2860	3450														
		15	1380	1720	1750	2160	2165	2670														
		25	1075	1370	1375	1740	1740	2190														
		35	805	1060	1050	1360	1350	1740														
22,000		0	1520	1850	1880	2270	2315	2790														
		15	1100	1380	1380	1710	1730	2130														
		25	840	1080	1075	1370	1360	1710														
		35	615	820	805	1050	1040	1340														
20,000		0	1200	1480	1485	1810	1830	2210														
		15	845	1080	1070	1340	1340	1660														
		25	635	830	815	1050	1040	1320														
		35	455	620	600	800	780	1020														

NOTE: DISTANCES SHOWN ARE FOR STANDARD TEMPERATURE 15° C (59° F).
DATA AS OF 3/20/52 BASED ON: PATUXENT FLIGHT TEST & CALCULATIONS

(1) USE 40° FLAPS (FULL DOWN) FOR ALL TAKE-OFFS.

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.	AT SEA LEVEL RATE OF CLIMB F.P.M.	AT SEA LEVEL LBS. OF FUEL USED	AT 10,000 FEET BEST C.A.S. KTS.	AT 10,000 FEET RATE OF CLIMB F.P.M.	AT 10,000 FEET FROM SEA LEVEL LB. OF FUEL USED	AT 10,000 FEET FROM SEA LEVEL DIST. NAUT. MI.	AT 10,000 FEET FROM SEA LEVEL TIME MIN.	AT 20,000 FEET BEST C.A.S. KTS.	AT 20,000 FEET RATE OF CLIMB F.P.M.	AT 20,000 FEET FROM SEA LEVEL LB. OF FUEL USED	AT 20,000 FEET FROM SEA LEVEL DIST. NAUT. MI.	AT 20,000 FEET FROM SEA LEVEL TIME MIN.	AT 30,000 FEET BEST C.A.S. KTS.	AT 30,000 FEET RATE OF CLIMB F.P.M.	AT 30,000 FEET FROM SEA LEVEL LB. OF FUEL USED	AT 30,000 FEET FROM SEA LEVEL DIST. NAUT. MI.	AT 30,000 FEET FROM SEA LEVEL TIME MIN.	AT 35,000 FEET BEST C.A.S. KTS.	AT 35,000 FEET RATE OF CLIMB F.P.M.	AT 35,000 FEET FROM SEA LEVEL LB. OF FUEL USED	AT 35,000 FEET FROM SEA LEVEL DIST. NAUT. MI.	AT 35,000 FEET FROM SEA LEVEL TIME MIN.	AT ___ FEET BEST C.A.S. KTS.	AT ___ FEET RATE OF CLIMB F.P.M.	AT ___ FEET FROM SEA LEVEL LB. OF FUEL USED	AT ___ FEET FROM SEA LEVEL DIST. NAUT. MI.	AT ___ FEET FROM SEA LEVEL TIME MIN.
NORMAL 95.5 % RPM	24,000	255	2910	538	245	2160	923	18	3.8	230	1480	1338	45	9.7	205	740	1858	98	19.8	190	290	2014	157	29.7					
	22,000	255	3240	538	240	2440	880	16	3.2	225	1710	1246	40	8.1	205	950	1678	80	16.3	190	480	1988	122	23.6					
	20,000	250	3640	538	240	2800	850	18	2.9	225	1990	1158	34	7.1	200	1180	1503	69	13.9	190	700	1751	99	19.4	175	230	2181	168	31.2
MILITARY 100 % RPM	24,000	300	4030	538	275	3170	873	14	2.8	250	2190	1218	35	6.6	225	1120	1618	72	12.8	210	570	1932	109	19.0					
	22,000	295	4450	538	270	3820	838	12	2.5	250	2490	1145	32	6.0	225	1370	1503	62	11.3	210	790	1734	91	16.0	185	260	2164	155	26.5
	20,000	290	4950	538	270	3950	800	11	2.2	245	2830	1076	28	5.3	220	1690	1373	54	9.9	205	1020	1564	76	13.7	185	470	1853	119	20.7

(5LBS)

POWER PLANT SETTINGS: (DETAILS ON FIG. A-2)
DATA AS OF 3/1/51 BASED ON: CALCULATIONS

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

LANDING DISTANCE FEET

GROSS WEIGHT LB.	BEST CAS APPROACH POWER OFF M.P.H.	BEST CAS APPROACH POWER OFF KTS.	BEST CAS APPROACH POWER ON M.P.H.	BEST CAS APPROACH POWER ON KTS.	HARD DRY SURFACE AT SEA LEVEL GROUND ROLL	HARD DRY SURFACE AT SEA LEVEL TO CLEAR 50' OBJ.	HARD DRY SURFACE AT 3000 FEET GROUND ROLL	HARD DRY SURFACE AT 3000 FEET TO CLEAR 50' OBJ.	HARD DRY SURFACE AT 6000 FEET GROUND ROLL	HARD DRY SURFACE AT 6000 FEET TO CLEAR 50' OBJ.	FIRM DRY SOD AT SEA LEVEL GROUND ROLL	FIRM DRY SOD AT SEA LEVEL TO CLEAR 50' OBJ.	FIRM DRY SOD AT 3000 FEET GROUND ROLL	FIRM DRY SOD AT 3000 FEET TO CLEAR 50' OBJ.	FIRM DRY SOD AT 6000 FEET GROUND ROLL	FIRM DRY SOD AT 6000 FEET TO CLEAR 50' OBJ.	WET OR SLIPPERY AT SEA LEVEL GROUND ROLL	WET OR SLIPPERY AT SEA LEVEL TO CLEAR 50' OBJ.	WET OR SLIPPERY AT 3000 FEET GROUND ROLL	WET OR SLIPPERY AT 3000 FEET TO CLEAR 50' OBJ.	WET OR SLIPPERY AT 6000 FEET GROUND ROLL	WET OR SLIPPERY AT 6000 FEET TO CLEAR 50' OBJ.
19,000				110	1810	3910	1980	4240	2170	4610												
17,000				105	1620	3530	1770	3830	1940	4160												

DATA AS OF 3/1/51 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.

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

LEGEND

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

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

POWER PLANT CHART

AIRCRAFT MODEL
F3D-2

ENGINE MODEL
WESTINGHOUSE
J34-WE-36 (24C4E)

OPERATING CONDITIONS	ALTITUDE	MAXIMUM ALLOWABLE TURBINE OUT 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 (4)	1260	1176	7065
	5,000	682 (4)	1260	1017	6100
	10,000	682 (4)	1260	868	5210
	15,000	682 (4)	1260	733	4400
	20,000	682 (4)	1260	616	3695
	25,000	682 (4)	1260	522	3130
	30,000	682 (4)	1260	452	2710
	35,000	682 (4)	1260	399	2394
	40,000	682 (4)	1260	358	2150
NORMAL POWER 95.5 PERCENT RPM (MAXIMUM CONTINUOUS) 90% 4100 #/hr at cruise spd 320 K	SEA LEVEL	635	1175	933	5595
	5,000	635	1175	796	4775
	10,000	635	1175	686	4115 5500 #/hr at cruise (375 K) spd
	15,000	635	1175	613	3675
	20,000	635	1175	517	3100
	25,000	635	1175	446	2675
	30,000	635	1175	390	2340
	35,000	635	1175	345	2070
	40,000	635	1175	304	1825

SPECIAL NOTES

(1) FOR MAXIMUM ALLOWABLE TURBINE OUTLET TEMPERATURES TO BE OBSERVED, SEE PARAGRAPH 2-18.

(2) ENGINE FUEL CONSUMPTION AT CONSTANT RPM VARIES WITH AIRSPEED: FUEL CONSUMPTIONS SHOWN ABOVE ARE BASED ON AIRSPEED FOR BEST CLIMB.

(3) BASED ON FUEL WEIGHING 6 POUNDS PER GALLON. (MIL-F-5572 FUEL).

(4) CAUTION: NOTE LOG BOOK ENTRY AND INDICATOR RED LINE.

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

DATA AS OF 7-18-51 BASED ON WESTINGHOUSE ENGINE SPEC. NO. WAGT-24C4E-2A DATED 10-27-50

Figure A-2. Power Plant Chart

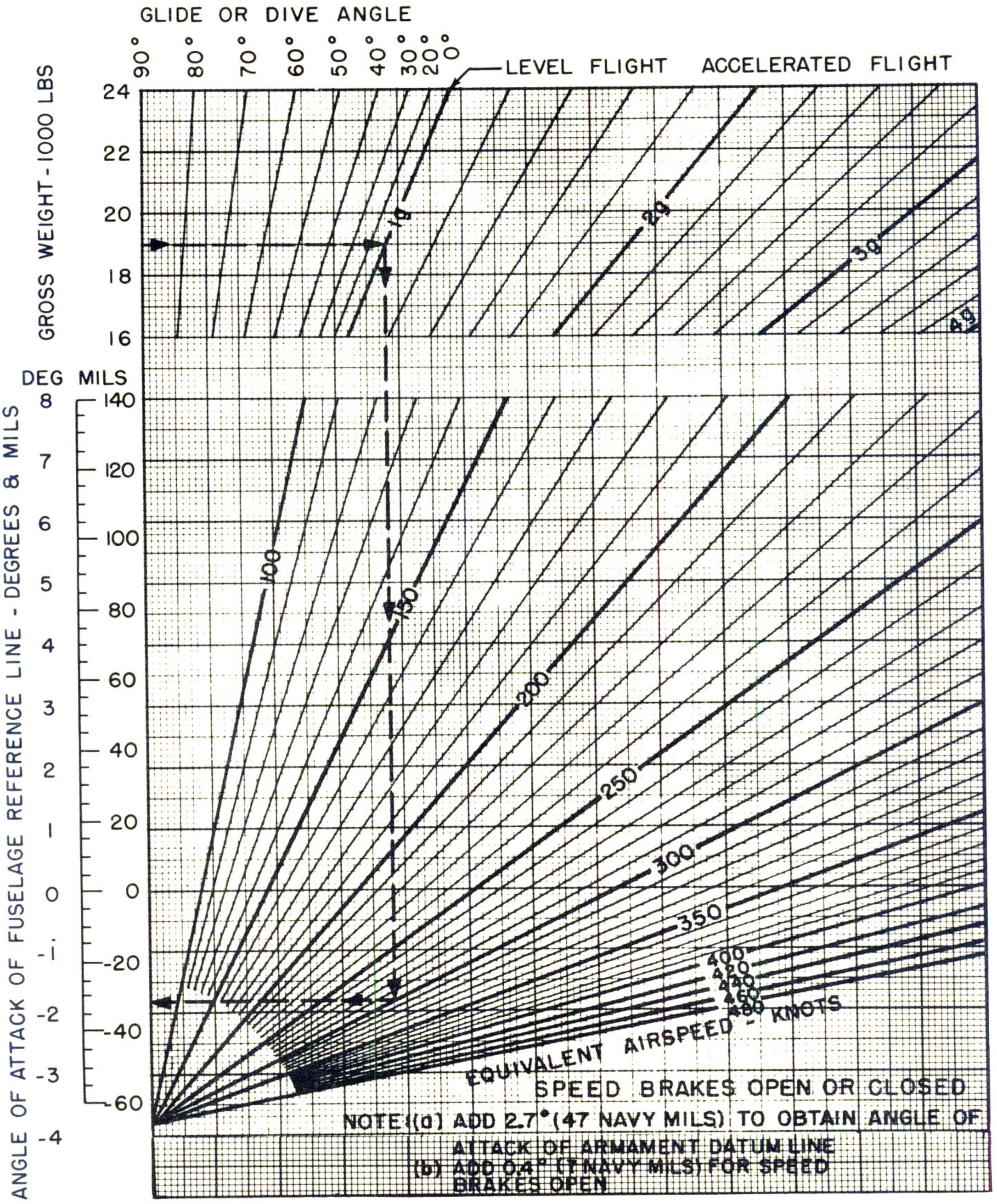


Figure A-3. Angle of Attack Relationship

AIRCRAFT MODEL F3D-2

ENGINES: J34-WE-36 (24C4E)

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 C A S 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
617	536										
540	469	722	627	967	840						
463	402	618	537	829	720	1097	953				
386	335	516	448	691	600	918	794				
347	301	464	403	622	540	822	714				
309	268	412	358	553	480	731	635				
269	234	360	313	484	420	640	556				
231	201	310	269	415	360	548	476				
192	167	258	224	345	300	457	397				
154	134	206	179	276	240	366	318				
115	100	154	134	207	180	274	238				
77	67	104	90	138	120	183	159				
38	33	52	45	69	60	91	79				
95.5		95.5		95.5		95.5					
410		370		324		256					
1226		950		717		509					
7353		5698		4300		3053					

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
709	615										
620	538	813	706	1062	922						
531	461	697	605	911	791	1124	976				
442	384	580	504	759	659	936	813				
398	346	523	454	683	593	843	732				
354	307	464	403	607	527	748	650				
310	269	406	353	521	461	655	569				
265	230	348	302	455	395	562	488				
221	192	290	252	379	329	469	407				
177	154	233	202	304	264	374	325				
132	115	174	151	228	198	281	244				
89	77	116	101	152	132	188	163				
44	38	58	50	76	66	93	81				
USE PERCENT RPM REQUIRED TO MAINTAIN CAS SPECIFIED											
286		276		262		238					
745		601		534		465					
4469		3607		3206		2790					

SINGLE ENGINE CRUISE

875	758										
765	664	924	802								
655	569	791	687								
547	475	660	573								
492	427	593	515								
438	380	527	458								
382	332	462	401								
328	285	396	344								
273	237	329	286								
219	190	264	229								
164	142	198	172								
109	95	132	115								
54	47	66	57								
95.5		95.5									
267		204									
563		412									
2376		2473									

ALTITUDE (FEET)	
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 (95.5% RPM)

NOTES

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

(2) SEE EXAMPLE ON NEXT CHART FOR METHOD OF OBTAINING DISTANCES FOR FUEL QUANTITIES OTHER THAN THOSE SHOWN.

DATA AS OF: 3-15-51 BASED ON: CALCULATIONS

EXAMPLE

GIVEN: A GROSS WEIGHT OF 26,000 LBS. WITH 8800 LBS. (1467 GAL.) OF FUEL.

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

PROCEDURE: DETERMINE FUEL AVAILABLE FOR CRUISE BY SUBTRACTING TAKE-OFF & CLIMB ALLOWANCES (FIG. A-1, 95.5% RPM) & RESERVE FROM INITIAL FUEL: E.G., 8800 - 2249 - 880 = 5671 LBS. (945 GAL.) AVAILABLE. DISTANCE IN CLIMB 125 NAUT. MI. (FIG. A-1), OPPOSITE 5400 LBS. (900 GAL.) UNDER COLUMN FOR TWO ENGINE CRUISE AT 30,000 FEET, READ 822 NAUT. MI. (STAT. MI.) C A S IS 256 KNOTS. TOTAL DISTANCE = 714 + 125 + 839 NAUT MI.

LEGEND

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

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

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

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)

AIRCRAFT MODEL F3D-2

ENGINES: J34-WE-36 (24C4E)

CHART NO. 1

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.

TWO ENGINE CRUISE

MAXIMUM CONTINUOUS POWER

← ALTITUDE (FEET) →	S L		10,000		20,000		30,000		35,000		40,000	
FUEL AVAILABLE FOR CRUISE	STAT	NAUT	STAT	NAUT	STAT	NAUT	STAT	NAUT	STAT	NAUT	STAT	NAUT
US GALLONS / POUNDS												
1650 / 9900												
1600 / 9600												
1400 / 8400												
1200 / 7200	462	401	540	468	630	546	721	625				
1000 / 6000	385	334	450	390	525	455	601	521	692	601	919	798
900 / 5400	347	301	405	351	472	410	541	469	623	541	827	718
800 / 4800	307	267	360	312	420	364	480	417	553	480	735	638
700 / 4200	269	234	315	273	367	319	420	365	484	420	643	558
600 / 3600	231	201	270	234	315	273	360	313	415	360	551	478
500 / 3000	192	167	225	195	262	228	300	260	345	300	459	398
400 / 2400	154	134	180	156	210	182	240	208	276	240	367	318
300 / 1800	115	100	135	117	157	137	180	156	207	180	276	239
200 / 1200	77	67	90	78	105	91	120	104	138	120	184	159
100 / 600	38	33	45	39	52	45	60	52	69	60	92	80
PERCENT RPM	95.5		95.5		95.5		95.5		95.5		95.5	
← CALIBRATED AIRSPEED (KTS) →	411		372		326		266		233			
← FUEL CONSUMPTION (US GAL / HR) →	1229		950		720		518		419			
← FUEL CONSUMPTION (LBS / HR) →	7375		5698		4322		3107		2516			

SINGLE ENGINE CRUISE

MAXIMUM CONTINUOUS POWER

← ALTITUDE (FEET) →	S L		10,000		20,000		30,000		35,000		40,000	
FUEL AVAILABLE FOR CRUISE	STAT	NAUT	STAT	NAUT	STAT	NAUT	STAT	NAUT	STAT	NAUT	STAT	NAUT
US GALLONS / POUNDS												
1650 / 9900	671	583	864	750								
1600 / 9600	650	486	720	625								
1400 / 8400	503	437	647	562								
1200 / 7200	447	388	576	500								
1000 / 6000	392	340	503	437								
900 / 5400	335	291	432	375								
800 / 4800	280	243	359	312								
700 / 4200	223	194	288	250								
600 / 3600	168	146	215	187								
500 / 3000	112	97	144	125								
400 / 2400	56	49	71	62								
300 / 1800	95.5		95.5									
200 / 1200	274		227									
100 / 600	564		421									
PERCENT RPM	3386		2526									
← CALIBRATED AIRSPEED (KTS) →												
← FUEL CONSUMPTION (US GAL / HR) →												
← FUEL CONSUMPTION (LBS / HR) →												

SINGLE ENGINE CRUISE

← ALTITUDE (FEET) →	S L		10,000		20,000		30,000		35,000		40,000	
FUEL AVAILABLE FOR CRUISE	STAT	NAUT	STAT	NAUT	STAT	NAUT	STAT	NAUT	STAT	NAUT	STAT	NAUT
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) →												

LEGEND

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

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

CRUISE DISTANCE FOR A FUEL QUANTITY NOT TABULATED MAY BE OBTAINED BY MULTIPLYING THE RATIO OF THE AVAILABLE FUEL TO THE TABULATED FUEL BY THE TABULATED DISTANCE. HOWEVER, A RAPID METHOD OF INTERPOLATION IS AS FOLLOWS: TAKE THE DIFFERENCE OF THE FUEL AVAILABLE AND THE NEAREST TABULATED FUEL, DIVIDE BY TEN, AND ADD OR SUBTRACT THE RESULT TO THE TABULATED DISTANCE DEPENDING UPON WHETHER THE FUEL AVAILABLE IS GREATER OR LESS, RESPECTIVELY, THAN THE TABULATED FUEL, e.g.:

5671 − 5400 = 271
271 ≅ 27
10
CRUISE DISTANCE = 714 + 27 = 741 N.MI.

NOTES

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

DATA AS OF: 3-15-51 BASED ON: CALCULATIONS

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

AIRCRAFT MODEL F3D-2

ENGINES: J34-WE-36 (24C4E)

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 CALIBRATED AIRSPEED AND PERCENT RPM REQUIRED. SEE EXAMPLE BELOW.

TWO ENGINE CRUISE

MAXIMUM CONTINUOUS POWER

SL STAT	SL NAUT	10,000 STAT	10,000 NAUT	20,000 STAT	20,000 NAUT	30,000 STAT	30,000 NAUT	35,000 STAT	35,000 NAUT	40,000 STAT	40,000 NAUT
479	416	637	553	851	739						
439	381	584	507	780	677	1038	901	195	1038		
400	347	531	461	709	615	943	819	1086	943		
359	312	478	415	638	554	848	737	978	849		
319	277	425	369	567	492	754	655	869	755		
280	243	372	323	496	431	660	573	760	660		
240	208	319	277	425	369	565	491	652	566		
199	173	265	230	355	308	472	410	544	472		
160	139	212	184	283	246	378	328	434	377		
120	104	159	138	213	185	283	246	326	283		
79	69	106	92	142	123	189	164	218	189		
40	35	53	46	71	62	94	82	108	94		
95.5		95.5		95.5		95.5		95.5			
432		387		339		277		238			
1245		968		731		529		434			
7471		5305		4386		3172		2602			

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

SL STAT	SL NAUT	10,000 STAT	10,000 NAUT	20,000 STAT	20,000 NAUT	30,000 STAT	30,000 NAUT	35,000 STAT	35,000 NAUT	40,000 STAT	40,000 NAUT
564	490	754	655	982	853						
517	449	692	601	900	782	1143	993	12[illegible]	1079		
470	408	629	546	819	711	1040	903	11[illegible]	981		
423	367	565	491	737	640	935	813	1017	883		
375	326	503	437	655	569	831	722	904	785		
329	286	440	382	573	498	728	632	791	687		
282	245	378	328	492	427	624	542	678	589		
235	204	314	273	410	356	520	452	565	491		
188	163	251	218	327	284	416	361	451	392		
140	122	189	164	245	213	312	271	339	294		
94	82	126	109	164	142	208	181	226	196		
47	41	63	55	82	71	104	90	113	98		
USE PERCENT RPM REQUIRED TO MAINTAIN CAS SPECIFIED											
292		282		263		234		215			
716		597		498		412		381			
4298		3582		2987		2472		2287			

SINGLE ENGINE CRUISE

704	611	913	793								
645	560	837	727								
586	509	761	661								
527	458	685	595								
469	407	609	529								
410	356	533	463								
351	305	457	397								
292	254	381	331								
235	204	304	264								
175	153	228	198								
117	102	152	132								
59	51	76	66								
95.5		95.5									
290		244									
570		426									
3419		2559									

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)	

734	637	925	803								
672	584	848	736								
611	531	770	669								
550	478	693	602								
489	425	616	535								
428	372	539	468								
367	319	462	401								
306	266	386	335								
244	212	309	268								
183	159	231	201								
122	106	154	134								
61	53	77	67								
USE PERCENT RPM REQUIRED TO MAINTAIN CAS SPECIFIED											
250		229									
471		417									
2825		2377									

NOTES

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

(2) SEE EXAMPLE ON NEXT CHART FOR METHOD OF OBTAINING DISTANCES FOR FUEL QUANTITIES OTHER THAN THOSE SHOWN.

DATA AS OF: 3-15-51 BASED ON: CALCULATIONS

EXAMPLE

GIVEN: A GROSS WEIGHT OF 23,940 LBS. WITH 7100 LBS. (1183 GAL.) OF FUEL.

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

PROCEDURE: DETERMINE FUEL AVAILABLE FOR CRUISE BY SUBTRACTING TAKE-OFF & CLIMB ALLOWANCES (FIG. A-1, 95.5% RPM) & RESERVE FROM INITIAL FUEL: E.G., 7100-1838 -710=4532 LBS. (755 GAL.) AVAILABLE. DISTANCE IN CLIMB=98 NAUT.MI. (FIG. A-1). OPPOSITE 4200 LBS. (700 GAL.) UNDER COLUMN FOR TWO ENGINE CRUISE AT 30,000 FEET, READ 722 NAUT. MI. (726 STAT.MI.). CAS IS 234 KNOTS. TOTAL DISTANCE= 32+98=830 NAUT. MI.

LEGEND

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

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

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

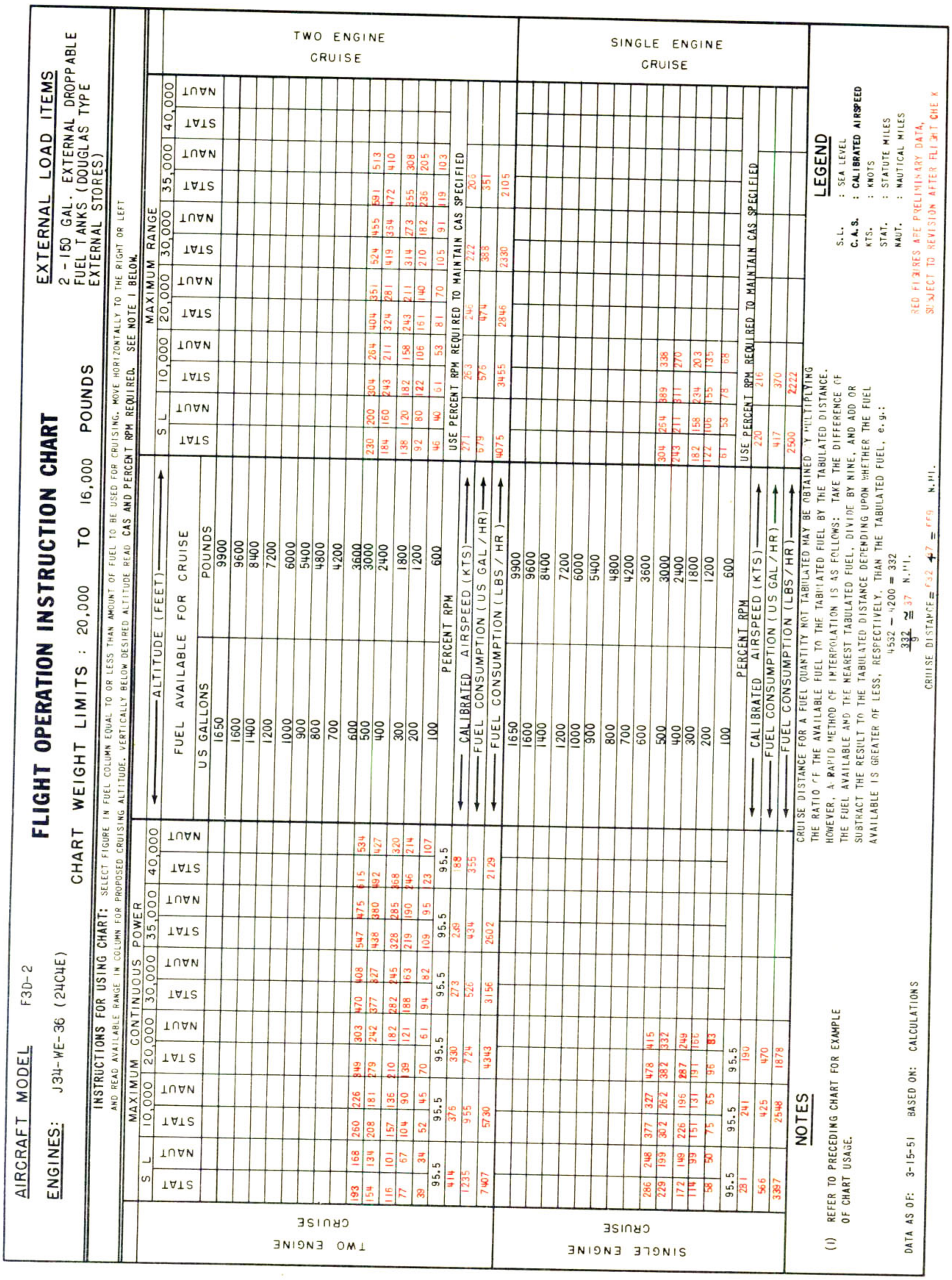


Figure A-4 (Sheet 4 of 8 Sheets). Flight Operation Instruction Chart

Appendix I

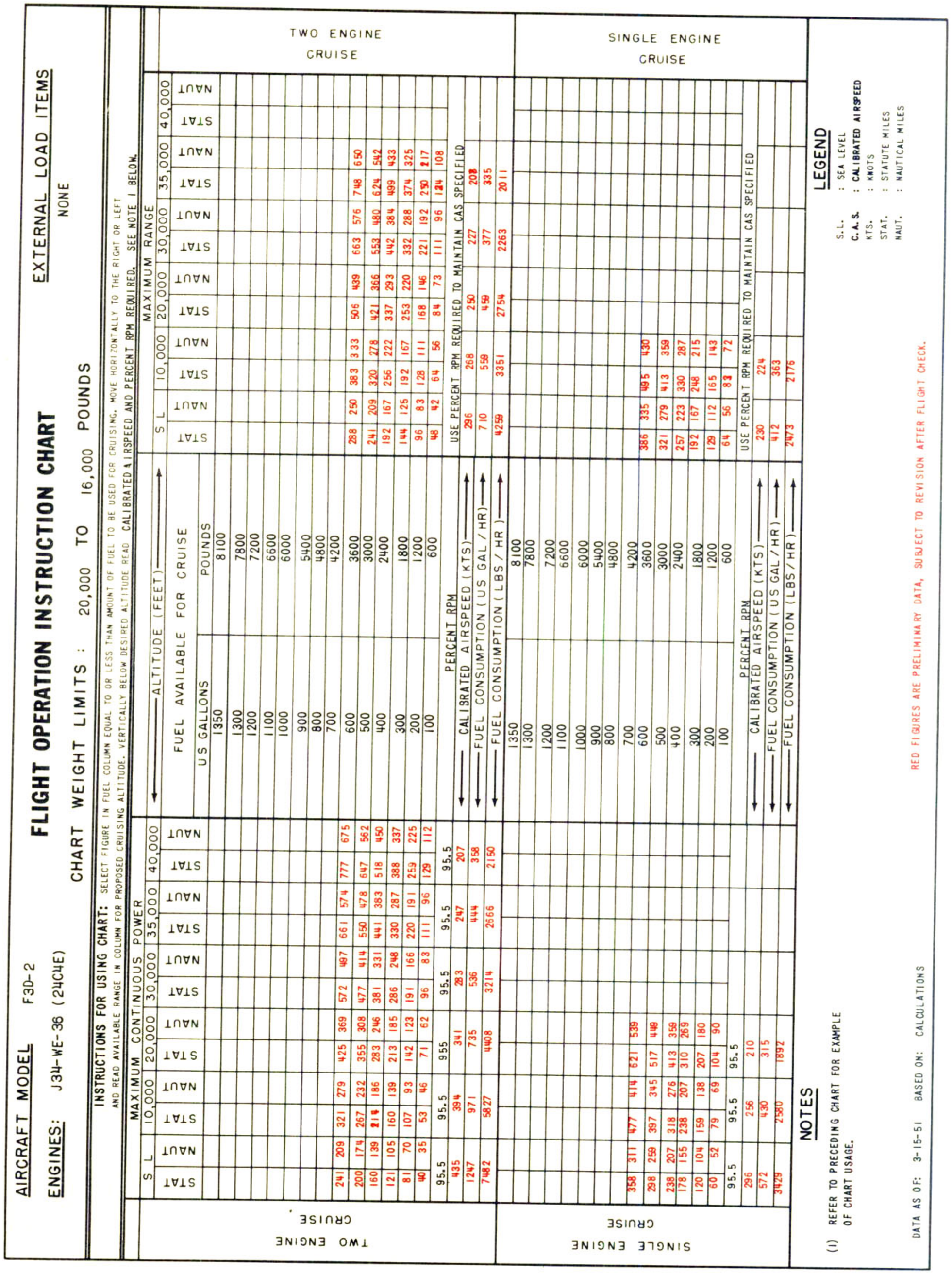


Figure A-4 (Sheet 5 of 8 Sheets). Flight Operation Instruction Chart

AIRCRAFT MODEL F3D-2

ENGINES: J34-WE-36 (24C4E)

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							24,000 TO 20,000 POUNDS						
	S L	10,000	20,000	30,000	35,000	40,000	CHART WEIGHT LIMITS / ALTITUDE (FEET) / FUEL AVAILABLE FOR CRUISE	S L	10,000	20,000	30,000	35,000	40,000	
	HOURS	HOURS	HOURS	HOURS	HOURS	HOURS	US GALLONS / POUNDS	HOURS	HOURS	HOURS	HOURS	HOURS	HOURS	
TWO ENGINE CRUISE							1650 / 9900							TWO ENGINE CRUISE
							1600 / 9600							
							1400 / 8400							
	2.1	2.4	2.7	2.9			1200 / 7200	2.2	2.6	3.0				
	1.7	2.0	2.3	2.4			1000 / 6000	1.8	2.2	2.5	2.7	2.7		
	1.5	1.8	2.1	2.2			900 / 5400	1.6	1.9	2.2	2.4	2.5		
	1.4	1.6	1.8	1.9			800 / 4800	1.4	1.7	2.0	2.2	2.2		
	1.2	1.4	1.6	1.7			700 / 4200	1.3	1.5	1.7	1.9	1.9		
	1.0	1.2	1.4	1.5			600 / 3600	1.1	1.3	1.5	1.6	1.6		
	.9	1.0	1.1	1.2			500 / 3000	.9	1.1	1.2	1.4	1.4		
	.7	.8	.9	1.0			400 / 2400	.7	.9	1.0	1.1	1.1		
	.5	.6	.7	.7			300 / 1800	.5	.6	.7	.8	.8		
	.3	.4	.5	.5			200 / 1200	.4	.4	.5	.5	.5		
	.2	.2	.2	.2			100 / 600	.2	.2	.2	.3	.3		
	USE PERCENT RPM REQUIRED TO MAINTAIN CAS SPECIFIED						PERCENT RPM	USE PERCENT RPM REQUIRED TO MAINTAIN CAS SPECIFIED						
	180	180	180	180			CALIBRATED AIRSPEED (KTS)	170	170	170	170	170		
	585	500	439	411			FUEL CONSUMPTION (US GAL/HR)	552	463	407	369	365		
	3511	3000	2632	2463			FUEL CONSUMPTION (LBS/HR)	3313	2778	2439	2212	2188		
SINGLE ENGINE CRUISE							1650 / 9900							SINGLE ENGINE CRUISE
							1600 / 9600							
							1400 / 8400							
	3.8						1200 / 7200	3.1	3.4					
	3.3						1000 / 6000	2.6	2.8					
	2.8						900 / 5400	2.3	2.5					
	2.3						800 / 4800	2.0	2.3					
	2.1						700 / 4200	1.8	2.0					
	1.9						600 / 3600	1.5	1.7					
	1.6						500 / 3000	1.3	1.4					
	1.4						400 / 2400	1.0	1.1					
	1.2						300 / 1800	.8	.8					
	.9						200 / 1200	.5	.6					
	.7						100 / 600	.3	.3					
	.5						PERCENT RPM	USE PERCENT RPM REQUIRED TO MAINTAIN CAS SPECIFIED						
	.2						CALIBRATED AIRSPEED (KTS)	170	170					
	USE PERCENT RPM REQUIRED TO MAINTAIN CAS SPECIFIED						FUEL CONSUMPTION (US GAL/HR)	392	355					
	180						FUEL CONSUMPTION (LBS/HR)	2353	2132					
	429													
	2571													

NOTES

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

(2) CRUISE TIME FOR A FUEL QUANTITY NOT TABULATED MAY BE OBTAINED BY LINEAR INTERPOLATION OF THE TABULATED TIME VALUES.

DATA AS OF: 3-15-51 BASED ON: CALCULATIONS

EXAMPLE

GIVEN: A GROSS WEIGHT OF 26,000 LBS. WITH 8800 LBS. (1467 GAL.) OF FUEL.

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

PROCEDURE: DETERMINE FUEL AVAILABLE FOR CRUISE BY SUBTRACTING TAKE-OFF & CLIMB ALLOWANCES (FIG. A-1, 95.5% RPM) & RESERVE FROM INITIAL FUEL: E. G., 8800- 2249-880=5671 LBS. (945 GAL.) AVAILABLE. TIME IN CLIMB= 28MIN.= .5 HOURS. OPPOSITE 5400 LBS. (900 GAL.) UNDER COLUMN FOR CHART WEIGHT LIMITS OF 27,000 TO 24,000 LBS. FOR TWO ENGINE CRUISE AT 30,000 FEET, READ 2.2HOURS. CAS IS 180 KNOTS. TOTAL TIME= 2.2 + 5 =2.7 HOURS.

LEGEND

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

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

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

AIRCRAFT MODEL F3D-2

ENGINES: J34-WE-36 (24C4E)

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.

	24,000 TO 20,000 POUNDS							20,000 TO 16,000 POUNDS						
	S L	10,000	20,000	30,000	35,000	40,000	CHART WEIGHT LIMITS →	S L	10,000	20,000	30,000	35,000	40,000	
	HOURS	HOURS	HOURS	HOURS	HOURS	HOURS	ALTITUDE (FEET) →	HOURS	HOURS	HOURS	HOURS	HOURS	HOURS	
TWO ENGINE CRUISE							FUEL AVAILABLE FOR CRUISE: US GALLONS / POUNDS							TWO ENGINE CRUISE
							1650 / 9900							
							1600 / 9600							
							1400 / 8400							
							1200 / 7200							
							1000 / 6000							
							900 / 5400							
							800 / 4800							
							700 / 4200							
							600 / 3600							
							500 / 3000	1.0	1.2	1.4	1.6	1.6	1.6	
							400 / 2400	.8	1.0	1.1	1.2	1.3	1.3	
							300 / 1800	.6	.7	.8	.9	1.0	.9	
							200 / 1200	.4	.5	.6	.6	.6	.6	
							100 / 600	.2	.2	.3	.3	.3	.3	
	USE PERCENT RPM REQUIRED TO MAINTAIN CAS SPECIFIED						PERCENT RPM	USE PERCENT RPM REQUIRED TO MAINTAIN CAS SPECIFIED						
							CALIBRATED AIRSPEED (KTS) →	160	160	160	160	160	160	
							FUEL CONSUMPTION (US GAL / HR) →	508	419	362	322	309	317	
							FUEL CONSUMPTION (LBS / HR) →	3049	2513	2174	1934	1852	1903	
SINGLE ENGINE CRUISE							1650 / 9900							SINGLE ENGINE CRUISE
							1600 / 9600							
							1400 / 8400							
							1200 / 7200							
							1000 / 6000							
							900 / 5400							
							800 / 4800							
							700 / 4200							
							600 / 3600							
							500 / 3000	1.5	1.6	1.7				
							400 / 2400	1.2	1.3	1.4				
							300 / 1800	.9	1.0	1.0				
							200 / 1200	.6	.7	.7				
							100 / 600	.3	.3	.3				
	USE PERCENT RPM REQUIRED TO MAINTAIN CAS SPECIFIED						PERCENT RPM	USE PERCENT RPM REQUIRED TO MAINTAIN CAS SPECIFIED						
							CALIBRATED AIRSPEED (KTS) →	160	160	160				
							FUEL CONSUMPTION (US GAL / HR) →	344	306	286				
							FUEL CONSUMPTION (LBS / HR) →	2062	1838	1718				

NOTES

DATA AS OF: 3-15-51 BASED ON: CALCULATIONS

EXAMPLE

GIVEN: A GROSS WEIGHT OF 23,940LBS. WITH 7100 LBS. (1183 GAL.) OF FUEL.

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

PROCEDURE: DETERMINE FUEL AVAILABLE FOR CRUISE BY SUBTRACTING TAKE-OFF & CLIMB ALLOWANCES (FIG. A-1, 95.5% RPM) & RESERVE FROM INITIAL FUEL: E.G., 7100- 1858-710=4532 LBS. (755 GAL.) AVAILABLE. TIME IN CLIMB=19.8 MIN.= .3 HOURS (FIG. A-1), 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 2.0 HOURS. CAS IS 170 KNOTS. TOTAL TIME=2.0+ .3= 2.3 HOURS.

LEGEND

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

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

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

AIRCRAFT MODEL F3D-2

ENGINES: J34-WE-36 (24C4E)

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.

TWO ENGINE CRUISE

24,000 TO 20,000 POUNDS						CHART WEIGHT LIMITS / ALTITUDE (FEET)		20,000 TO 16,000 POUNDS					
S L	10,000	20,000	30,000	35,000	40,000	FUEL AVAILABLE FOR CRUISE		S L	10,000	20,000	30,000	35,000	40,000
HOURS	HOURS	HOURS	HOURS	HOURS	HOURS	US GALLONS	POUNDS	HOURS	HOURS	HOURS	HOURS	HOURS	HOURS
						1350	8100						
						1300	7800						
2.2	2.6	3.0				1200	7200						
2.0	2.4	2.8	3.1	3.2		1100	6600						
1.8	2.2	2.5	2.8	2.9		1000	6000						
1.7	2.0	2.3	2.5	2.6		900	5400						
1.5	1.8	2.0	2.2	2.3		800	4800						
1.3	1.5	1.8	2.0	2.0		700	4200						
1.1	1.3	1.5	1.7	1.7		600	3600	1.2	1.5	1.7	1.9	2.0	
.9	1.1	1.3	1.4	1.4		500	3000	1.0	1.2	1.4	1.6	1.7	
.7	.9	1.0	1.1	1.2		400	2400	.8	1.0	1.1	1.3	1.3	
.6	.7	.8	.8	.9		300	1800	.6	.7	.8	1.0	1.0	
.4	.4	.5	.6	.6		200	1200	.4	.5	.6	.6	.7	
.2	.2	.3	.3	.3		100	600	.2	.2	.3	.3	.3	
USE PERCENT RPM REQUIRED TO MAINTAIN CAS SPECIFIED						PERCENT RPM		USE PERCENT RPM REQUIRED TO MAINTAIN CAS SPECIFIED					
170	170	170	170	170		CALIBRATED AIRSPEED (KTS)		160	160	160	160	160	
543	452	399	355	347		FUEL CONSUMPTION (US GAL/HR)		511	407	355	315	298	
3257	2710	2392	2132	2083		FUEL CONSUMPTION (LBS/HR)		3067	2439	2128	1890	1786	

SINGLE ENGINE CRUISE

						1350	8100						
						1300	7800						
3.1	3.5					1200	7200						
2.9	3.2					1100	6600						
2.6	3.0					1000	6000						
2.4	2.6					900	5400						
2.1	2.4					800	4800						
1.8	2.1					700	4200						
1.6	1.8					600	3600	1.8	2.0	2.2			
1.3	1.5					500	3000	1.5	1.7	1.8			
1.0	1.2					400	2400	1.2	1.4	1.5			
.8	.9					300	1800	.9	1.0	1.1			
.5	.6					200	1200	.6	.7	.7			
.3	.3					100	600	.3	.3	.4			
USE PERCENT RPM REQUIRED TO MAINTAIN CAS SPECIFIED						PERCENT RPM		USE PERCENT RPM REQUIRED TO MAINTAIN CAS SPECIFIED					
170	170					CALIBRATED AIRSPEED (KTS)		160	160	160			
382	340					FUEL CONSUMPTION (US GAL/HR)		336	295	276			
2294	2040					FUEL CONSUMPTION (LBS/HR)		2016	1770	1653			

NOTES

DATA AS OF: 3-15-51 BASED ON: CALCULATIONS

EXAMPLE

GIVEN: A GROSS WEIGHT OF 23,940 LBS. WITH 7100 LBS. (1183 GAL.) FUEL.

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

PROCEDURE: DETERMINE FUEL AVAILABLE FOR CRUISE BY SUBTRACTING TAKE-OFF & CLIMB ALLOWANCES (FIG. A-1, 95.5% RPM) & RESERVE FROM INITIAL FUEL: E.G., 7100-1858-710=4532 LBS. (755 GAL.) AVAILABLE. TIME IN CLIMB=19.8 MIN.=.3 HOURS (FIG. A-1). 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 2.0 HOURS, CAS IS 170 KNOTS. TOTAL TIME=2.0+.3=2.3 HOURS.

LEGEND

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

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

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