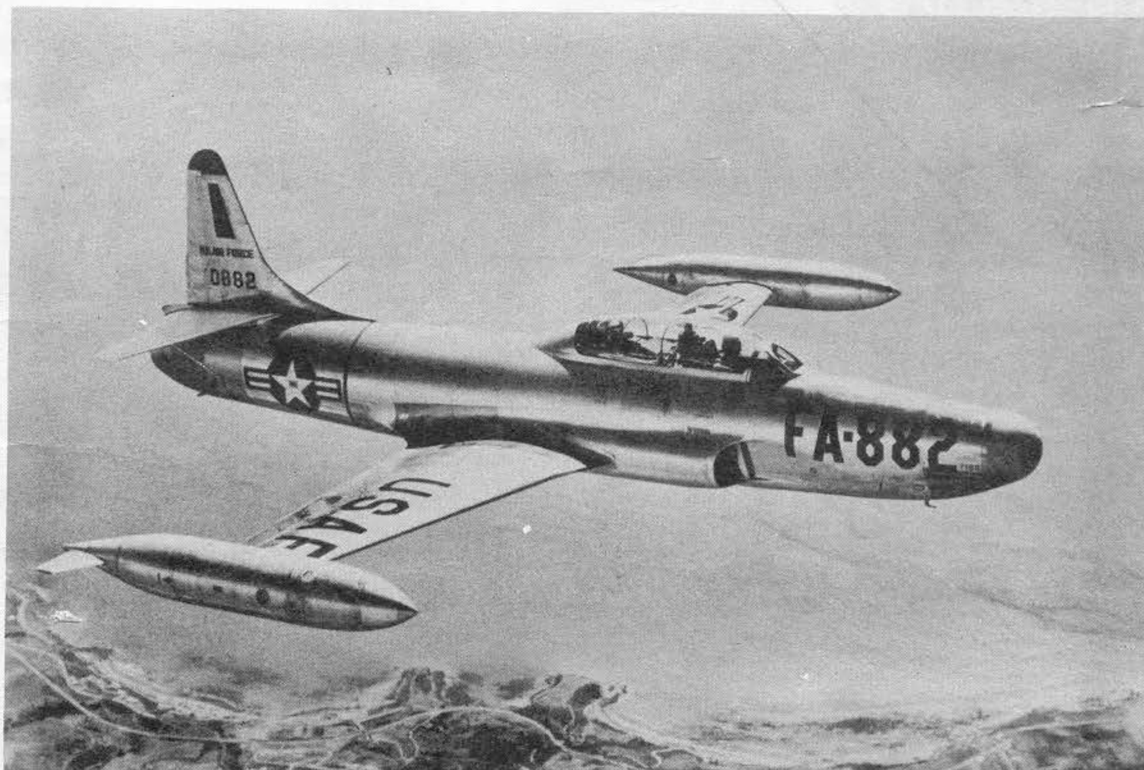
AN 01-75FAB-1

HANDBOOK
FLIGHT OPERATING INSTRUCTIONS
USAF SERIES
F-94B
AIRCRAFT



AB 3235

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AIRPLANE SERIAL NUMBER CODE

Group (1)	AF Serial Nos. 50-805 thru 50-841
Group (2)	AF Serial Nos. 50-842 and Up
Group (3)	AF Serial Nos. 50-805 thru 50-868
Group (4)	AF Serial Nos. 50-805 thru 50-904
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FOREWORD

This Handbook contains the information necessary for safe and efficient operation of the F-94B Airplane. The instructions and descriptions will provide the pilot and radar operator with a general and specific knowledge of the airplane, its systems, flight characteristics, and emergency procedures.

Information contained in this Handbook is kept current by frequent revisions, but as the incorporation of revised information takes an appreciable length of time it is imperative that flight crews keep up-to-date on short technical orders of the 01-75FAB series which frequently cover critical flight restrictions or new techniques which have not yet been incorporated in the Handbook of Flight Operating Instructions.

The data and instructions contained in this Handbook are the result of engineering tests and flight observations made to assure safe completion of flight missions under all conditions. Read the complete book, then use it as a reference manual to answer specific questions. The Handbook is divided into eight sections and an appendix as follows:

SECTION I, DESCRIPTION—This section contains a description of the airplane, its controls, systems, and power plant. All emergency and miscellaneous equipment which is not part of the operational equipment is also discussed.

SECTION II, NORMAL OPERATING INSTRUCTIONS—Complete operating instructions are given and arranged in proper sequence from the time the airplane is approached by the flight crew until it is parked on the ramp after the completion of a routine flight.

SECTION III, EMERGENCY OPERATING INSTRUCTIONS—Procedures to be followed in the event of partial or complete failure of any mechanism for which emergency means of operation is provided are described.

SECTION IV, OPERATIONAL EQUIPMENT—Descriptions, normal operating instructions, and emergency operating instructions are given in this section for all equipment that is not essential to fly the airplane. Additional equipment such as armament, cockpit pressurization, heating, and ventilation is discussed.

SECTION V, CREW DUTIES—Information covering the responsibilities of pilot and radar operator and primary and alternate functions of each will be furnished when available.

SECTION VI, EXTREME WEATHER OPERATION — The proper techniques and procedures to be followed under conditions of cold weather, hot weather, and desert operation are given. This section provides information supplemental to Section II.

SECTION VII, OPERATING LIMITATIONS—Airplane and engine operating limitations and restrictions are detailed in this section.

SECTION VIII, FLIGHT CHARACTERISTICS—General and specific flight characteristics are discussed in this section.

APPENDIX I, OPERATING CHARTS — All operating data charts for efficient flight planning are contained in this section. Complete data are supplied for best climb and descent air speeds and necessary cruise control information with and without external loads. Take-off and landing charts for various gross weights are also included.

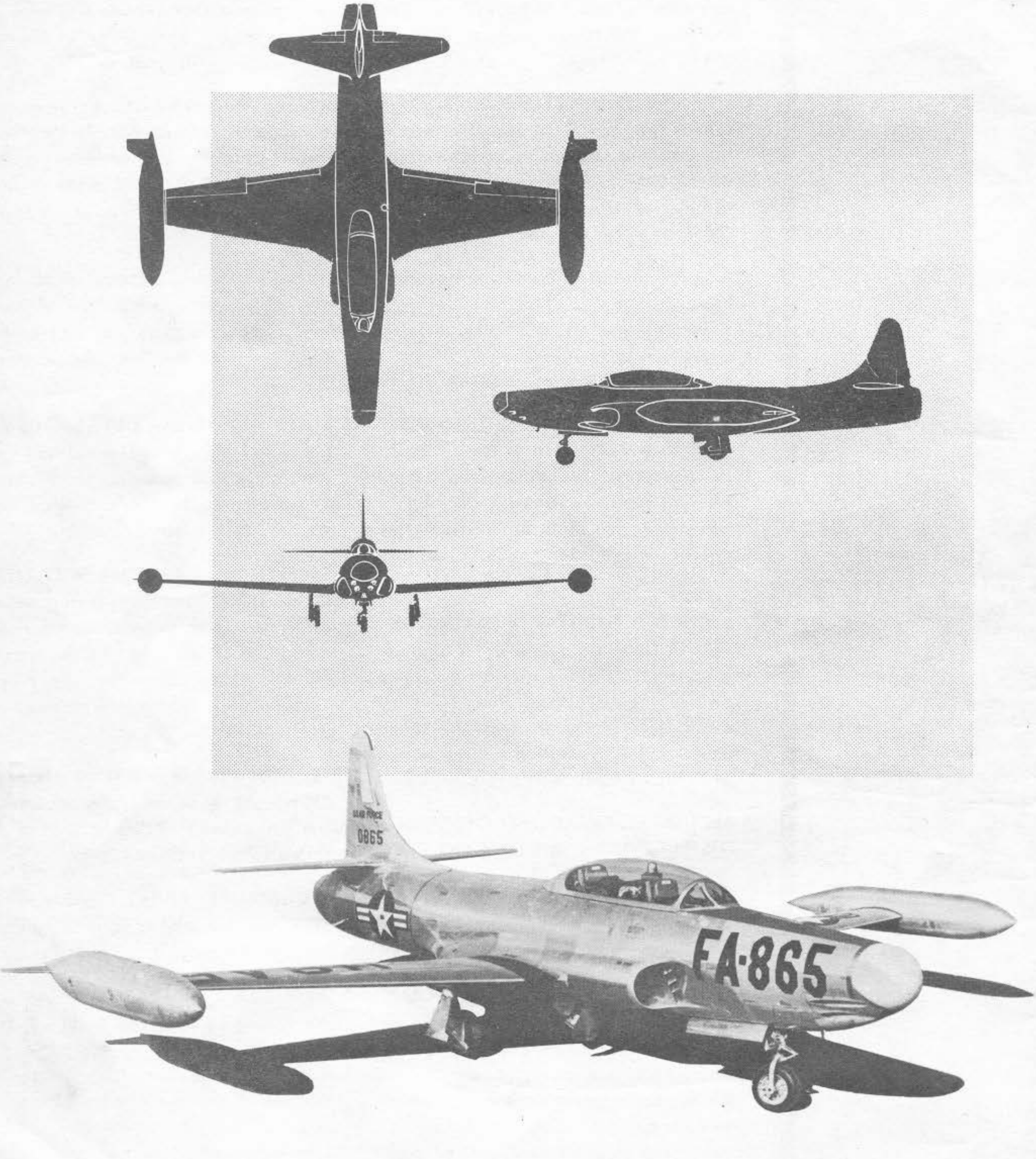

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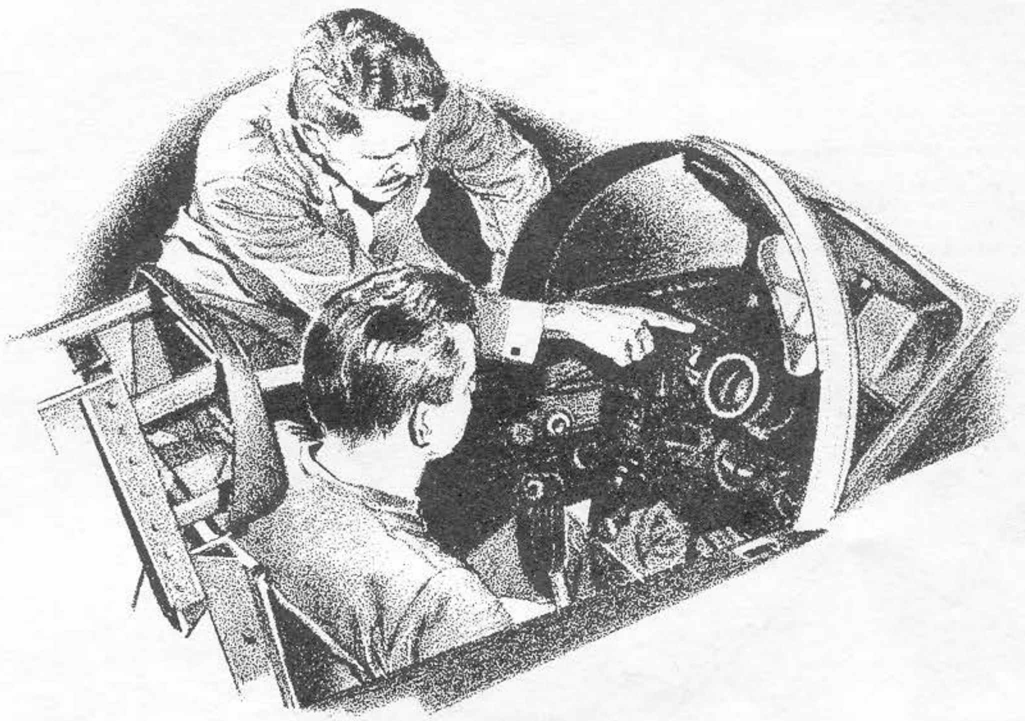
Figure 1 — The Airplane



SECTION I

DESCRIPTION

1-1. THE AIRPLANE.

1-2. GENERAL.

1-3. The F-94B is a two-place jet-propelled interceptor with stations for a pilot in the front seat and a radar operator in the rear seat. The airplane is designed primarily for all-weather interception, utilizing radar for search and tracking. Armament consists of four .50 caliber machine guns mounted in the lower fuselage nose.

1-4. DIMENSIONS. The overall dimensions of the airplane are as follows:

Wing span (less tip tanks) .... 37.6 feet
Wing span (with tip tanks) .... 42.9 feet
Fuselage length .... 40.1 feet
Height (to top of rudder) .... 12.7 feet

1-5. GROSS WEIGHT. The normal take-off gross weight (full useful load without tip tanks) is approximately 13,400 pounds. The alternate take-off gross weight (full useful load and full tip tanks) is approximately 16,775 pounds.

1-6. MAIN DIFFERENCE TABLE

F-94A	F-94B
LOW PRESSURE OXYGEN SYSTEM 165 GALLON UNDERSLUNG TIP TANKS 1000-PSI HYDRAULIC SYSTEM	HIGH PRESSURE OXYGEN SYSTEM 230 GALLON CENTER-LINE TIP TANKS 1500-PSI HYDRAULIC SYSTEM WINDSHIELD DE-ICING ZERO READER GLIDE SLOPE RECEIVER LOCALIZER RECEIVER PNEUMATIC GUN CHARGER 5-PSI COCKPIT PRESSURIZATION AUTOMATIC COCKPIT TEMPERATURE REGULATION

FLUID SPECIFICATIONS

(1) FUEL — MIL-F-5624 (JP-3)
ALTERNATE FUELS —
GASOLINE — MIL-F-5572 GRADE 100/130
MIL-F-5616 (JP-1)
(2) ENGINE OIL — MIL-O-6081 GRADE 1010
(3) HYDRAULIC OIL — MIL-O-5606
(4) DE-ICER FLUID — MIL-A-6091

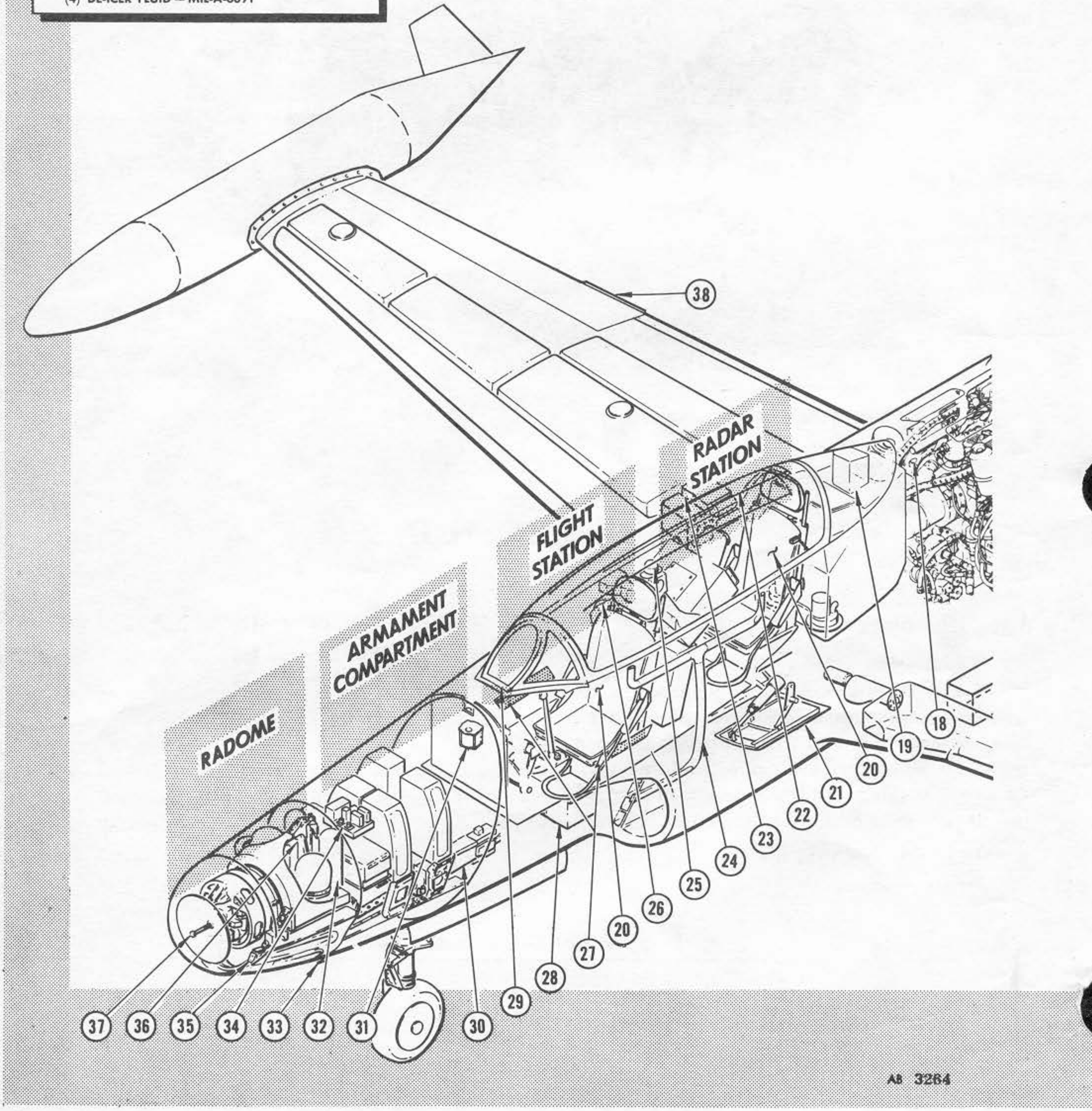
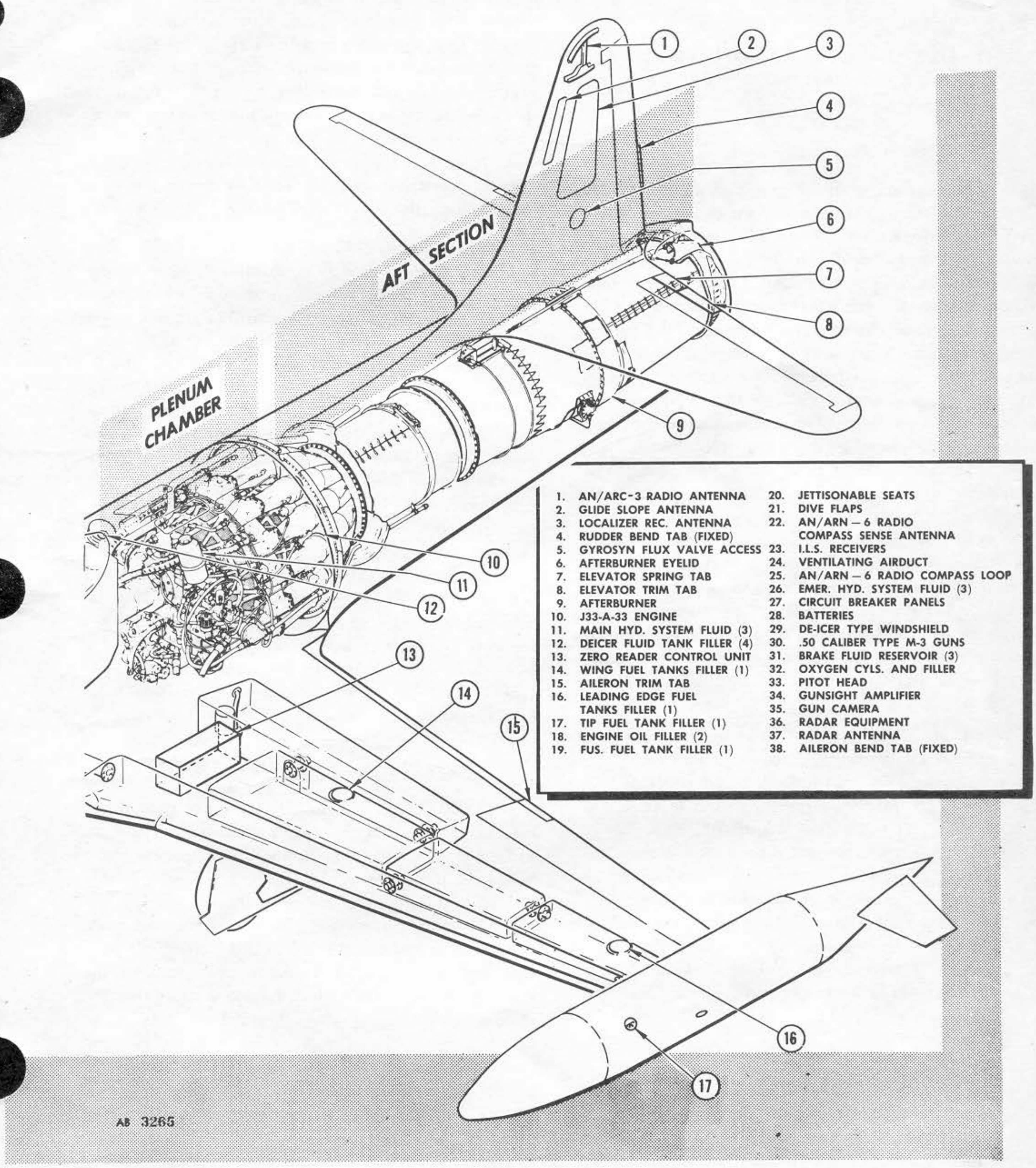


Figure 2 (Sheet 1 of 2 Sheets) — General Arrangement



1. AN/ARC-3 RADIO ANTENNA
2. GLIDE SLOPE ANTENNA
3. LOCALIZER REC. ANTENNA
4. RUDDER BEND TAB (FIXED)
5. GYROSYN FLUX VALVE ACCESS
6. AFTERBURNER EYELID
7. ELEVATOR SPRING TAB
8. ELEVATOR TRIM TAB
9. AFTERBURNER
10. J33-A-33 ENGINE
11. MAIN HYD. SYSTEM FLUID (3)
12. DEICER FLUID TANK FILLER (4)
13. ZERO READER CONTROL UNIT
14. WING FUEL TANKS FILLER (1)
15. AILERON TRIM TAB
16. LEADING EDGE FUEL TANKS FILLER (1)
17. TIP FUEL TANK FILLER (1)
18. ENGINE OIL FILLER (2)
19. FUS. FUEL TANK FILLER (1)
20. JETTISONABLE SEATS
21. DIVE FLAPS
22. AN/ARN – 6 RADIO COMPASS SENSE ANTENNA
23. I.L.S. RECEIVERS
24. VENTILATING AIRDUCT
25. AN/ARN – 6 RADIO COMPASS LOOP
26. EMER. HYD. SYSTEM FLUID (3)
27. CIRCUIT BREAKER PANELS
28. BATTERIES
29. DE-ICER TYPE WINDSHIELD
30. .50 CALIBER TYPE M-3 GUNS
31. BRAKE FLUID RESERVOIR (3)
32. OXYGEN CYLS. AND FILLER
33. PITOT HEAD
34. GUNSIGHT AMPLIFIER
35. GUN CAMERA
36. RADAR EQUIPMENT
37. RADAR ANTENNA
38. AILERON BEND TAB (FIXED)

Figure 2 (Sheet 2 of 2 Sheets) — General Arrangement

1–7. ENGINE.

1–8. GENERAL.

1–9. The J33-A-33 jet engine (10, figure 2) is a centrifugal compressor type designed for use with an afterburner for thrust augmentation.

1–10. ENGINE FUEL SYSTEM.

1–11. The function of the engine fuel control system (figure 3) is equivalent to that of the carburetor system used with reciprocating engines. The J-33 engine incorporates two independent fuel control systems fed by a dual engine-driven gear-type pump. One side of the dual pump supplies the main fuel control (Bendix), while the other supplies the emergency fuel control (Rochester). The pump is so designed that, in the event of failure of the main pump gears, the emergency gears can maintain the fuel supply through the emergency fuel control unit. Fuel from the emergency side of the pump is normally by-passed to the pump inlet, but is available in case of failure of main pump pressure. Changeover from main to emergency fuel control system is accomplished automatically through the action of a pressure switch in the main fuel control system, provided the cockpit emergency fuel switch is in the "TAKE-OFF & LAND" position. However, changeover can be accomplished manually by placing the emergency fuel switch in the "EMERGENCY" position. The throttle linkage is connected to both the main and the emergency fuel control units.

Note

Fuel MIL-5616 (JP-1) can be used in this airplane in an emergency but the functioning of the main fuel control will be adversely affected. The maximum rpm stop must be readjusted so the engine will attain 100% rpm. In addition, engine rpm will drop several percent at the full throttle setting as the altitude is increased, the engine acceleration temperature may be over the limit, and the altitude idling speeds will be lower and may result in flameouts or damage to the turbine blades. The throttle must be used to keep the tail pipe temperature above 400° C which is the low limit with JP-1 fuel.

1–12. MAIN FUEL CONTROL UNIT. The main fuel control unit is a wide range governor operated by the throttle. The unit is compensated to limit maximum engine speed, maintain approximately constant rpm regardless of airspeed or altitude, limit acceleration temperature, and to limit the engine deceleration to that required to maintain combustion. It also controls the amount of fuel delivered to the combustion chambers, by-passing any fuel in excess of that required for the throttle setting, engine speed, altitude, and airspeed. Starting fuel sequence control is included in the main fuel control unit for automatic starting. For simplified engine starting and controlled acceleration to idling speed during starting, the starting fuel sequence control directs fuel to two burners for ignition and then to all other burners as fuel pressure builds up. This provides a more accurately controlled fuel flow during the start, thus reducing the danger of incurring a "hot start."

1–13. EMERGENCY FUEL CONTROL UNIT. The emergency fuel control is mechanically linked to the throttle and to the main fuel control. This unit provides an alternate means of manually controlling engine power in the event of failure of the main side of the engine-driven pump or of the main fuel control system. It consists of a throttle valve, an altitude-compensated relief valve (or Barometric), and a solenoid-operated by-pass valve (normally open). The relief valve is adjusted to provide 100% engine rpm on the ground on a 100°F day. Available full throttle rpm will vary with free air temperature and altitude. The altitude compensator attempts to maintain constant engine rpm for a given throttle setting regardless of air speed and altitude. However, in flight, engine overspeeding is possible and your attention will be required to prevent exceeding the maximum allowable rpm when operating on emergency fuel control system. The solenoid-operated by-pass valve is normally open. Hence, in the event of an electrical failure, it will be impossible to close this valve. Therefore, the emergency fuel control system will not be available.

1–14. ENGINE FUEL SYSTEM CONTROLS.

1–15. THROTTLE. The throttle (8, figure 5) regulates the fuel pressure to the engine combustion chambers and the resulting fuel flow determines the engine speed. When the throttle is in the "OFF" (full aft) position, all fuel to the engine is shut off unless the starting fuel sequence control is energized as it is during automatic starting. When advanced to the "FULL" (forward) position and pushed outboard, the throttle operates the afterburner microswitch which is inoperative unless the afterburner emergency shut-off switch is "ON." The dive flap switch, the gunsight caging ring, the gunsight manual ranging control (twist-grip), and the microphone button are installed on the throttle. Throttle friction may be adjusted as desired by turning the friction lock (16, figure 6). The throttle slot is staggered to provide straight fore and aft motion in the operating range between "IDLE" and "FULL," while outboard and aft motion is required when moving from the "IDLE" to the "OFF" position.

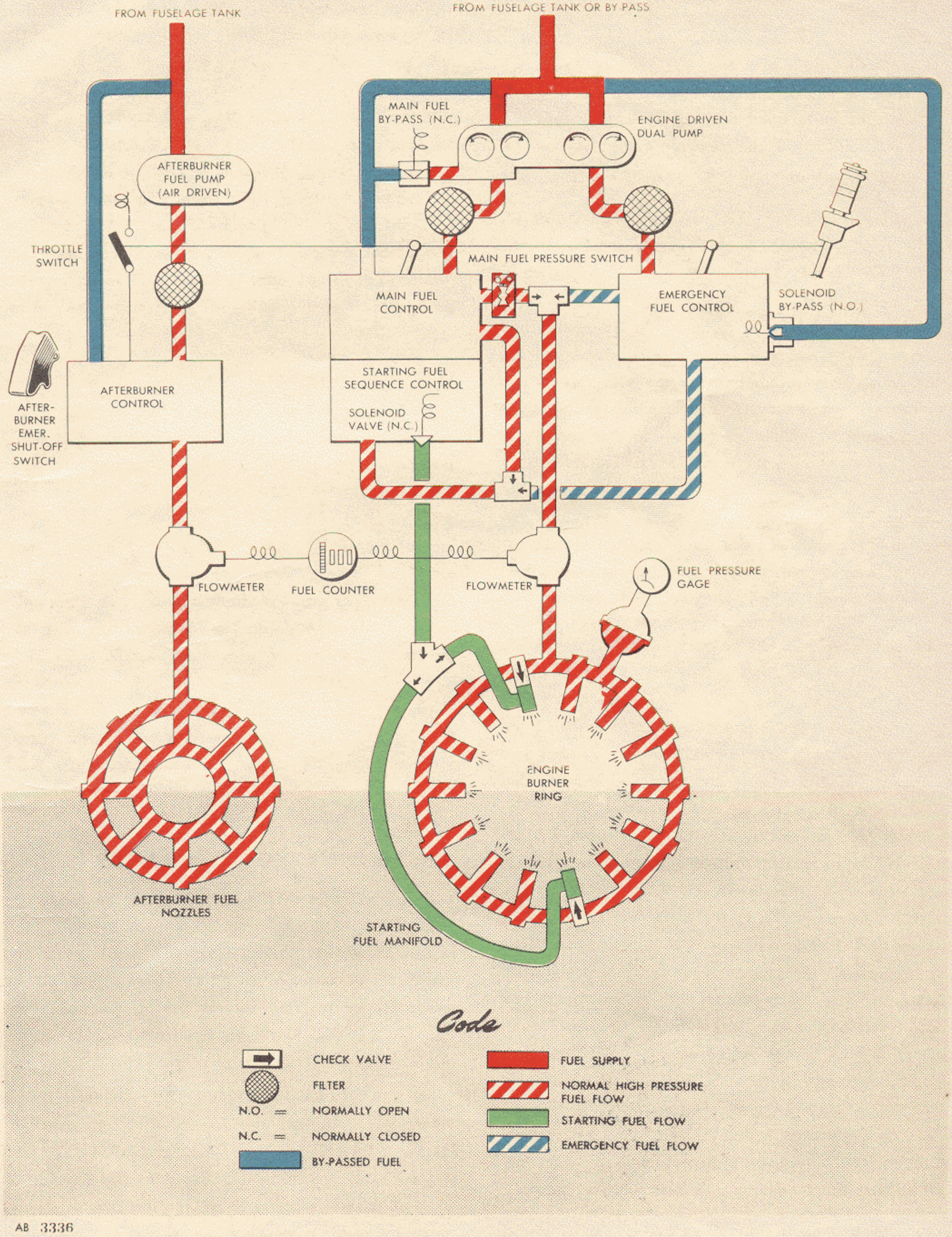


Figure 3 — Engine Fuel Control System Diagram

CAUTION

If the throttle is left out of the "OFF" position when the engine is static or coasting, fuel will drain or be pumped through the engine into the tailpipe or out the manifold drain onto the ground. This can create a fire hazard.

1-16. EMERGENCY FUEL SWITCH. This switch (3, figure 9) is a three-positioned toggle switch. In the "TAKE-OFF & LAND" position, the pressure switch in the main fuel control unit is energized so that in the event of failure of main system pressure, the emergency fuel solenoid by-pass valve is automatically closed and the emergency system supplies the engine with fuel. When the emergency fuel switch is in the "OFF" position, the pressure switch is not energized and the emergency system by-pass valve will remain open regardless of pressure drop in the main system. When placed in the "EMERGENCY" position, the emergency system by-pass valve is closed and the main fuel control unit by-pass valve is opened, thereby transferring engine fuel control to the emergency system.

1-17. EMERGENCY FUEL CHECK-OUT SWITCH. The emergency fuel check-out switch (1, figure 12) is provided to permit ground checking the emergency fuel system and the automatic changeover function of the main fuel control system pressure switch. It has two positions, "NORMAL" (off) and a spring-loaded "EMERG FUEL CHECK-OUT" position. When the switch is held in the "CHECK-OUT" position, a relay energizes the main fuel control pressure switch (emergency fuel switch must be in the "OFF" position) and opens the by-pass valve in the main fuel control, thus simulating failure of the main fuel control system. The pressure switch will sense the pressure drop in the main system and close the by-pass valve in the emergency fuel control system and thus automatically transfer control of engine fuel to the emergency system. The switch should be moved to the "CHECK-OUT" position at 40% - 60% rpm and should be returned to "NORMAL" while rapidly retarding the throttle. Rapid movement of the throttle positions the valves in the main fuel control so that the transition will be smooth as possible.

1-18. EMERGENCY FUEL SYSTEM INDICATOR LIGHTS. Red, green, and amber emergency fuel system indicator lights (30, figure 10) are located on the instrument panel. The red light is wired to glow when the nose gear uplock is unlocked while the emergency fuel switch is in the "OFF" position. This indication is intended to remind you that the emergency fuel switch has not been placed in the "TAKE-OFF & LAND" position (main fuel pressure switch energized) prior to take-off or landing. The green light glows when the emergency fuel switch is in the "TAKE-OFF & LAND" position. The amber light comes on whenever the emergency fuel control by-pass valve is closed, thus indicating that the engine is operating on the emergency fuel control system.

1-19. IGNITION SYSTEM.

1-20. Ignition is used only for initial starting of the engine and afterburner, but not for sustaining combustion as in a reciprocating engine. The system consists of an ignition control unit, four ignition coils, and four spark plugs. Two of the spark plugs are used for initiating combustion in engine combustion chambers 7 (bottom) and 14 (top), while the other two are located in the afterburner grid for afterburner starting. Ignition is automatically supplied during engine starting whenever the starter is energized, provided the ignition switch is in the "NORMAL" position. The ignition system and starting motor are energized for the proper duration by a relay which senses starter current drain. As the engine speed increases, the starter current decreases to a value which causes the relay to disconnect the starting motor and ignition system.

1-21. IGNITION SYSTEM CONTROLS.

1-22. IGNITION SWITCH. This switch (2, figure 12) is provided for ground testing only and should be left in the "NORMAL" position at all other times. When the switch is placed in the "OFF" position, the starter motor can be operated without having automatic ignition. Neither the engine nor afterburner can be started if this switch is "OFF."

1-23. AIR START IGNITION SWITCH. This switch (5, figure 7) has two positions, "OFF" and a spring-loaded "START" position. When pushed to "START" and released, ignition will be provided for a period of 45 to 60 seconds whether or not the starter is used, provided the ignition switch is in the "NORMAL" position.

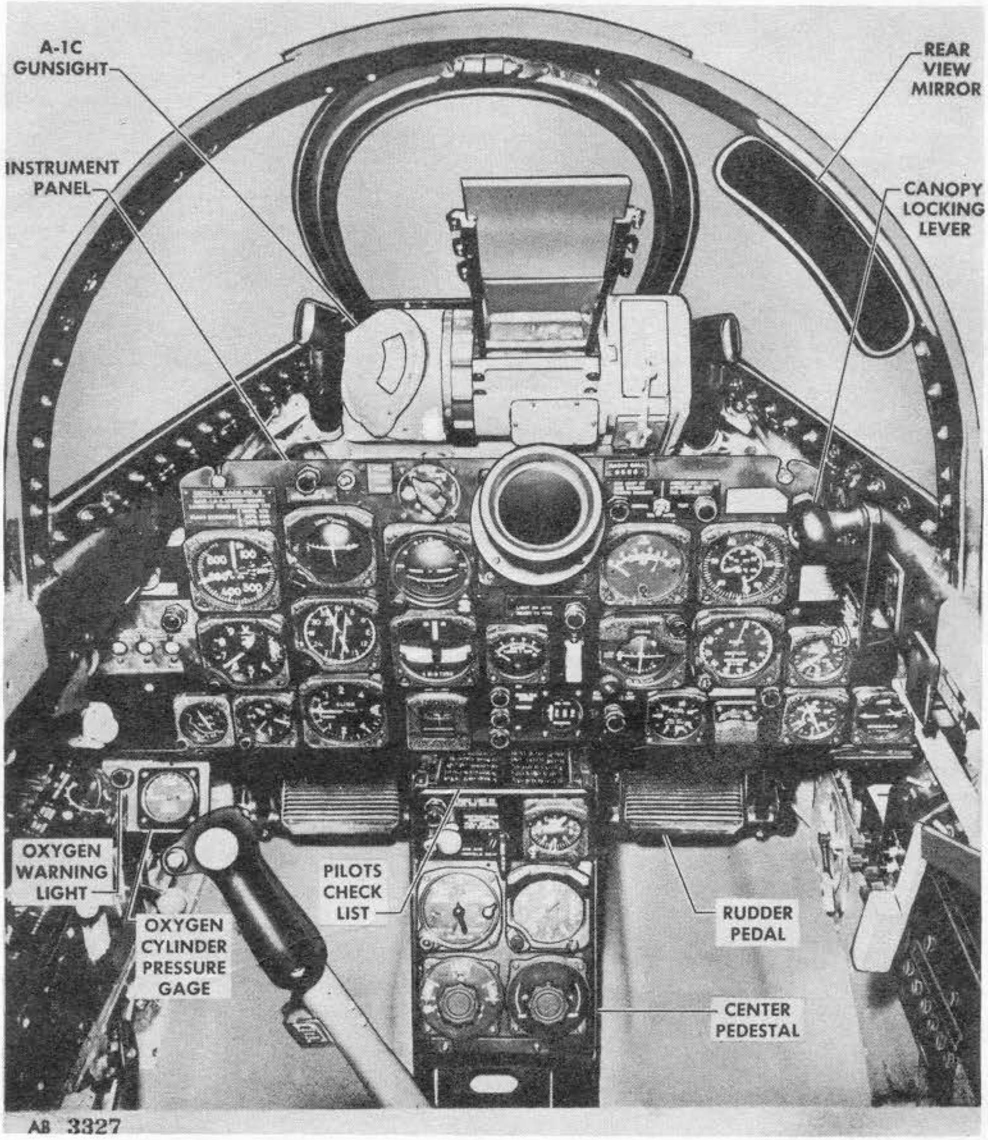


Figure 4 — Pilot's Cockpit, Forward View

1-24. STARTING SYSTEMS.

1-25. ENGINE STARTING SYSTEM.

1-26. The airplane battery is capable of starting the engine; however, to insure that satisfactory starts will be obtained, an external power source should normally be used.

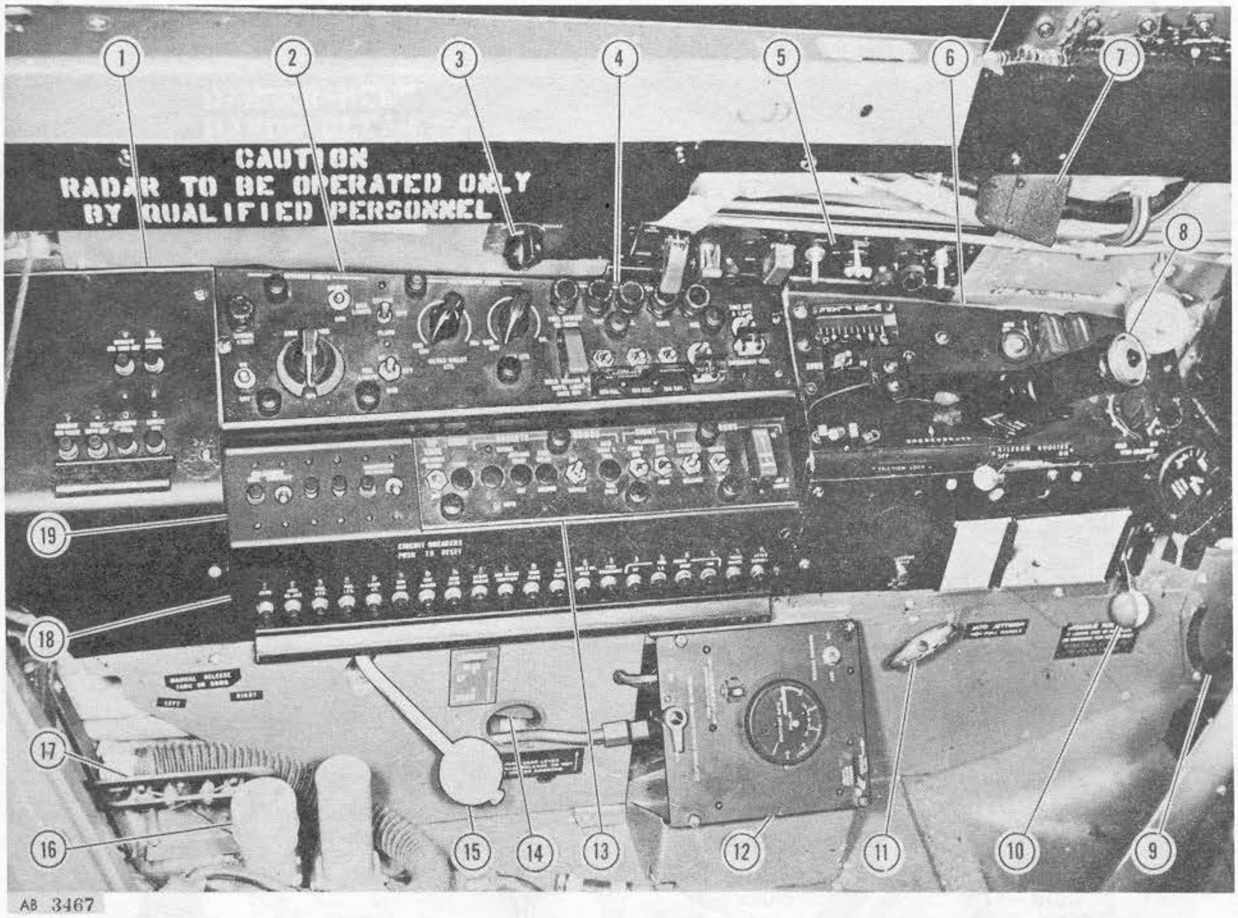
1-27. STARTER SWITCH. This switch (3, figure 12) has two spring-loaded positions and a center neutral position. When pushed to "START" and held for three seconds, it energizes the starting motor and ignition system until engine speed increases to about 20% rpm; at this point a relay opens, automatically disconnecting both the starter and ignition system. The "STOP-START" position is provided to permit stopping the starting cycle immediately, if necessary, by overriding the automatic relay. You need only hold the switch in this position momentarily.

1-28. STARTING FUEL SYSTEM.

1-29. Two starting fuel control systems (automatic and manual) are provided. The automatic system provides better combustion and controlled acceleration during the initial starting phase and should be used for the standard starting procedure in preference to the manual system.

1-30. STARTING FUEL SWITCH.

1-31. This switch (4, figure 7) has three positions: "OFF," "AUTO," and "MAN." It is guarded to the



1. Circuit Breaker Panel
2. Lighting Control Panel
3. Side Panel Light Control
4. Fuel Control Panel
5. Left Side Upper Panel
6. Left Side Forward Panel
7. Ultra-violet Panel Light
8. Throttle
9. Pressure Air Inlet Grill
10. Hydrofuse Reset Lever
11. JATO Unit Jettison Handle
12. Oxygen Regulator
13. Armament Control Panel
14. Landing Gear Control Lever Solenoid Lock Release
15. Landing Gear Selector Lever
16. Anti-G Suit Valve
17. Manual Release—Tank or Bomb
18. Left Side Circuit Breaker Panel
19. Circuit Breaker and Switches

Figure 5 — Pilot's Cockpit, Left Side

"OFF" position and must be left in this position at all times except during the actual starting operation.

1-32. "AUTO" POSITION. When the starting fuel switch is placed in the "AUTO" position with the throttle "OFF," the starting fuel sequence control is energized and the emergency fuel control by-pass valve is closed. Thus both the main and emergency sides of the pump are supplying fuel to the starting fuel control which routes fuel through the starting manifold to combustion chambers No. 7 and 14. As fuel pressure increases, fuel is supplied to all burners and the engine will accelerate to approximately 35% rpm. The starting fuel sequence control remains energized until the throttle is moved out of the "OFF" position, or the starting fuel switch is placed in the "OFF" position. If the starting fuel switch it left in the "AUTO" position, the automatic starting system will become energized whenever the throttle is placed in the "OFF" position.

CAUTION

If the starting fuel switch is left "ON" when the engine is static or coasting and the electrical system is energized, fuel will drain or be pumped through the engine into the tailpipe or out of the manifold drain onto the ground. This can create a fire hazard.

1-33. "MAN." POSITION. When the starting fuel switch is placed in the manual position, the starting fuel sequence control is not energized, but the emergency and main fuel by-pass valves are closed and fuel is fed to all of the burners. Movement of the throttle to the "IDLE" position has no effect on electrical sequencing because the starting fuel sequence control is not used for manual starts. If the switch is left in the "MAN." position, both the normal and emergency fuel systems would be supplying fuel. Under these conditions, since there is no governor protection, overspeeding is very likely to occur; also the idling speed will be excessively high.

1–34. OIL SYSTEM.

1–35. The engine oil system is automatic and requires no controls. A pressure gage is located on the instrument panel (18, figure 10). The system is an integral wet sump type with pressure and splash lubrication. The oil supply is contained in the accessory drive gear housing. Oil level in the reservoir may be determined by a bayonet gage located on the right side of the accessory gear casing. The reservoir, when full, holds 12 quarts of oil. See figure 2 for oil grade and specification.

1–36. AFTERBURNER.

1–37. GENERAL.

1–38. Afterburning, in general, consists of utilizing the unburned oxygen in the jet exhaust to burn additional fuel in the tailpipe, thereby increasing the thrust normally available by approximately 30%. Afterburning may be used for take-off and climb, or level flight acceleration for periods not to exceed 15 minutes. Electrical power for control of the afterburner is supplied by the 28-volt d.c. system.

1–39. DESCRIPTION. The afterburner consists of a large diameter tailpipe incorporating a burner grid, two spark plugs for starting ignition, and two "eyelids" actuated by air cylinders. The "eyelids" serve to reduce the exit nozzle area during operation without the afterburner and to increase the exit nozzle area during afterburner operation.

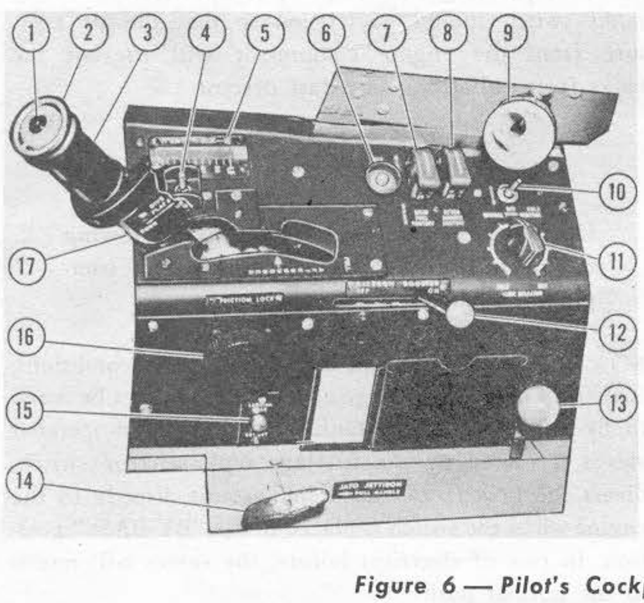
1–40. AFTERBURNER FUEL SYSTEM. This fuel system is separate and independent of the engine fuel system. Fuel is supplied from the fuselage tank through a separate boost pump to the afterburner fuel pump which is driven by air from the engine compressor. A flowmeter in the supply line records the fuel used on the cockpit fuel counter. The afterburner control unit automatically controls fuel and ignition for starting, operates the "eyelids," and regulates fuel pressure to compensate for change in altitude. In case of over-temperature, or any other malfunction of the control system, the afterburner must be shut off immediately by removing the throttle from the forward slotted position or by turning the afterburner emergency shut-off switch "OFF."

1–41. AFTERBURNER CONTROLS.

1–42. THROTTLE OPERATION. The primary afterburner control is the throttle. When it is moved outboard into the slot at the forward end of its travel a microswitch is actuated which, through the afterburner control unit, turns on fuel and ignition, thus resulting in the starting of the afterburner. As the afterburner starts, the tailpipe pressure change operates a pressure switch which turns off the ignition and through relays opens the "eyelids" and turns on the "EYELID OPEN" light.

1–43. AFTERBURNER SHUT-OFF SWITCH. The afterburner shut-off switch (8, figure 6) is installed to permit turning the afterburner off in the event of failure of the microswitch in the throttle linkage. This switch is normally left in the "ON" position.

1–44. EYELIDS CONTROL SWITCH. The afterburner "eyelids" switch (8, figure 7) has two positions, "AUTO"



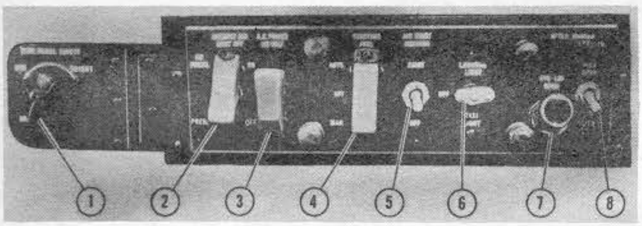
1. Microphone Button
2. Gunsight Gyro-caging Ring
3. Gunsight Manual Ranging Control
4. Wing Flaps Switch
5. Wing Flaps Position Indicator (Group (1) Airplanes)
6. JATO Firing Switch Button
7. Main Fuel Shut-off Valves Switch
8. Afterburner Shut-off Switch
9. Cockpit Ventilating Duct
10. Manual Temperature Control Switch
11. Temperature Selector
12. Aileron Booster Lever
13. Hydrofuse Reset Lever
14. JATO Jettison Handle
15. Landing Gear Warning Horn Cutout Button
16. Throttle Friction Control Knob
17. Dive Flaps Switch

Figure 6 — Pilot's Cockpit, Left Side Forward Panel

and "MAN. OPEN." When placed in the "AUTO" position, the "eyelids" are controlled by the automatic relays. In the "MAN. OPEN" position, the automatic relays are overridden and the "eyelids" are opened. In addition, the afterburner pressure switch that under normal conditions automatically turns the ignition off, is overridden.

1–45. EYELIDS "OPEN" INDICATOR LIGHT.

1–46. The "eyelids" "OPEN" indicator light (7, figure 7) glows whenever the "eyelids" are fully open.



1. Side Panel Red Light Control
2. Cockpit Air Valves Shut-off Switch
3. 115-Volt A.C. Switch
4. Starting Fuel Switch
5. Air Start Ignition Switch
6. Landing and Taxi Lights Switch
7. Eyelids "OPEN" Indicator Light
8. Eyelid Control Switch

Figure 7 — Pilot's Cockpit, Left Side Upper Panel

1–47. JATO.

1–48. GENERAL.

1–49. Provisions are included for mounting two JATO (jet assisted take-off) units on the bottom of the fuselage. The JATO units add about one thousand pounds of thrust each for approximately twelve seconds duration, and will materially improve the airplane's take-off performance. (See Appendix I.) If JATO units are installed, they must be used on the first take-off, or be jettisoned, as they will not be safe after being subjected to low temperatures.

1–50. JATO CONTROLS.

1–51. JATO ARMING SWITCH. This switch (26, figure 10), located on the instrument panel, when placed in the "ARM" position, arms the electrical firing circuit.

1–52. JATO FIRING SWITCH. The JATO units are fired electrically by the push-button switch (6, figure 6), located on the pilot's left side forward panel, after the arming switch has been placed in the "ARM" position.

1–53. JATO JETTISON HANDLE. After JATO thrust is exhausted, the units are jettisoned by pulling the manual release handle (11, figure 5)) on the pilot's left side panel.

1–54. JATO "READY" INDICATOR LIGHT.

1–55. This light (28, figure 10), located on the instrument panel, glows when the JATO firing circuit is armed and ready for firing.

1–56. AIRPLANE FUEL SYSTEM.

1–57. GENERAL.

1–58. Fuel is carried in four groups of tanks as shown on figure 8. Tip (droppable) tanks may be carried on attachments at the wing tips when desired. Under normal operating conditions, all fuel is transferred to the fuselage tank before being fed to the engine. Fuel transfer is automatically controlled by float valves within the fuselage tank. The leading edge and wing tank float valves are located one and two inches respectively below the level of the tip tank float valve. Thus the locations of these valves determine that fuel from the tip tanks will be used first, from the leading edge tanks second, and the wing tanks last. When the fuel level in the fuselage tank drops below any of the float valves, the valve will open admitting fuel from the respective tank group, provided, of course, that the respective tank selector switch is turned "ON." The fuselage tank level is maintained at each float valve level until that tank group is empty. A pressure switch is incorporated in the supply line from each tank group. When the tank group empties, the pressure drop causes a red indicator light, located above the tank switch, to glow, thus indicating that the tank switch may be turned off. Turning the tank switch off also turns the corresponding booster pump off. However, the tip tanks switch should be left on so that the air pressure from the engine compressor will prevent the tanks from collapsing in a fast descent.

CAUTION

Open the tip tank filler caps slowly allowing the pressure to gradually escape before completely removing the cap.

1–59. BY-PASS SYSTEM. Under emergency conditions, fuel from the leading edge and wing tanks can be made to by-pass the fuselage tank. Three solenoid-operated valves, actuated by the fuselage tank selector switch, divert the flow from these tank groups directly to the engine when the switch is placed in the "BY-PASS" position. In case of electrical failure, the valves wil! return to the normal position.

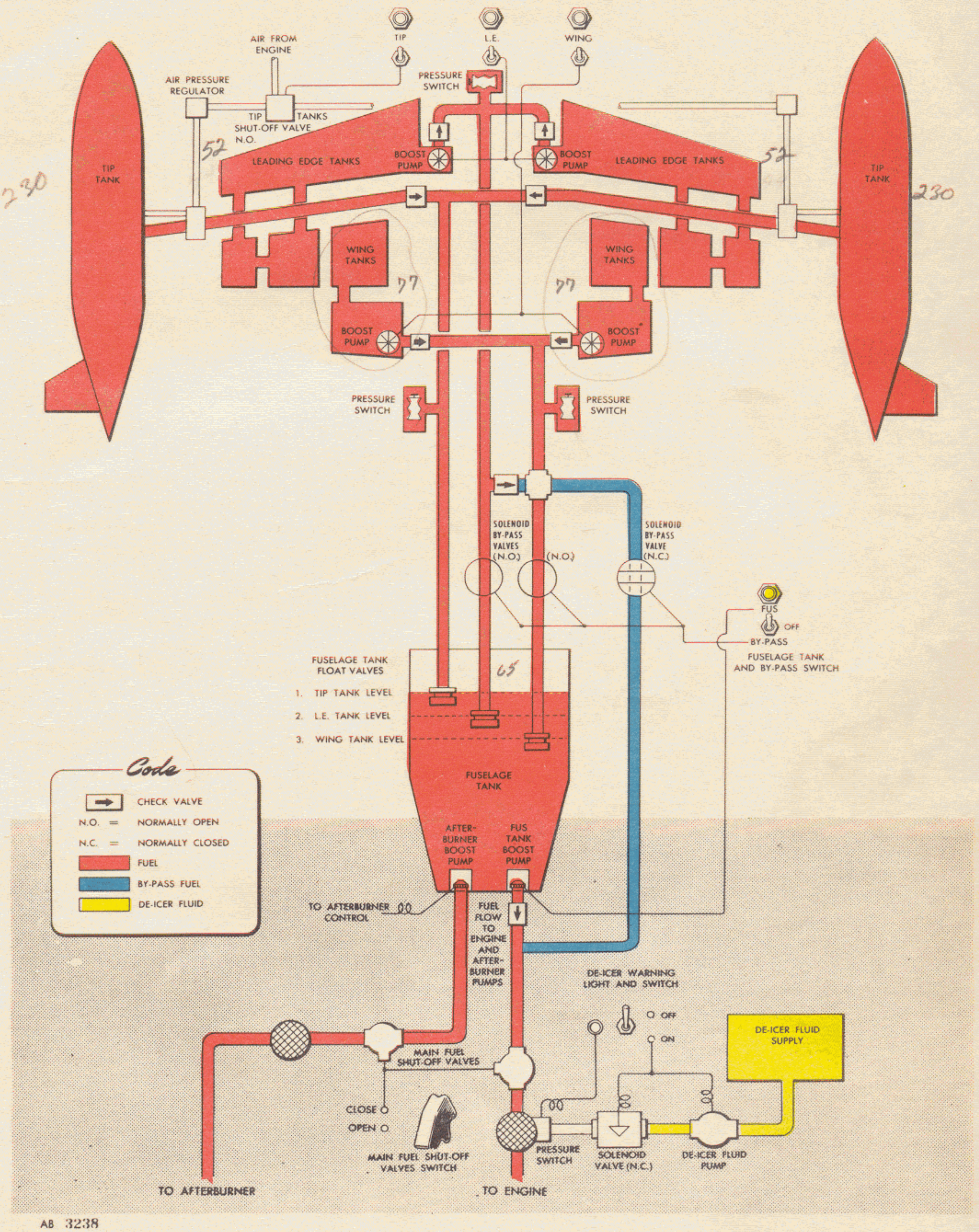
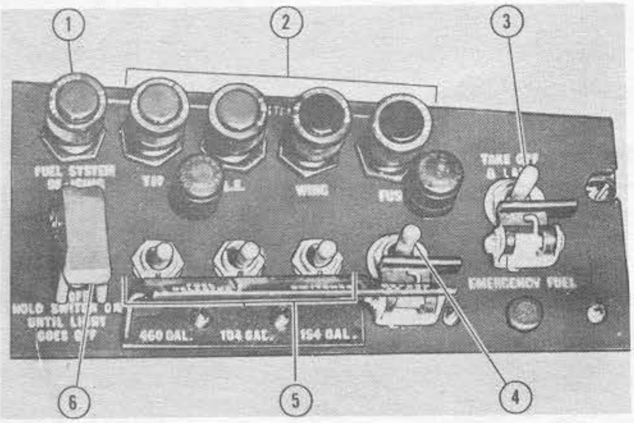


Figure 8 — Airplane Fuel System Diagram



1. Fuel Filter De-Icer Warning Light
2. Fuel Tank Indicator Lights
3. Emergency Fuel Switch
4. Fuselage Tank and By-Pass Switch
5. Tip, Leading Edge, and Wing Tank Switches
6. Fuel Filter De-Icer Switch

Figure 9 — Pilot's Cockpit, Fuel Control Panel

1-60. FUEL QUANTITY DATA (U.S. GALLONS)

TANKS	NO. TANKS	USABLE FUEL (EA.)	USABLE EXPANSION SPACE (EA.)	TRAPPED FUEL (EA.) LEVEL FLIGHT	TOTAL VOLUME (EA.)
TIP	2	230	0(1)	0.5	(3)
LEADING EDGE	2	52	0(1)	(2)	(2)
WING	2	77	0(1)	(2)	(2)
FUSELAGE	1	65	0(1)	(2)	(2)
TOTAL AIRPLANE		783	0(1)	12.6	(3)

(1) ALL TANKS HAVE THE USUAL EXPANSION SPACE; HOWEVER, THIS IS NOT AVAILABLE FOR "STUFFING" PURPOSES SINCE FUEL IN THIS SPACE DRAINS OVERBOARD
(2) NOT DETERMINED FOR SEPARATE TANK GROUPS
(3) NOT DETERMINED

1–61. FUEL FILTER DE-ICING. Provisions are included for de-icing the low pressure fuel filter. For a description of this system refer to Section IV.

1–62. FUEL SYSTEM CONTROLS.

1–63. TIP FUEL TANK SWITCH. The tip fuel tank switch (5, figure 9) has two positions. When it is up, it operates a solenoid valve which admits air pressure from the engine compressor into the tip tanks. The air pressure forces fuel from the tip tanks into the fuselage tank when the tip tank float valve is open. In case of electrical failure, the solenoid valve will automatically open and fuel will be fed from the tip tanks to the fuselage tank. In the down (Off) position this solenoid valve is closed.

1–64. LEADING EDGE FUEL TANK SWITCH. The leading edge fuel tank switch (5, figure 9) has two positions. In the up (On) position, it turns on a booster pump in each leading edge tank. These pumps transfer fuel into the fuselage tank when the leading edge tank float valve is open. They also force fuel to the engine pump when the by-pass valves are open. When in the down (Off) position, the booster pumps are inoperative.

1–65. WING FUEL TANK SWITCH. The wing fuel tank switch (5, figure 9) is a two-positioned switch. When in the up (On) position, a booster pump in each wing tank forces fuel into the fuselage tank if the wing tank float valve is open. They also force fuel to the engine pump when the by-pass valves are open. In the down (Off) position, the booster pumps are turned off.

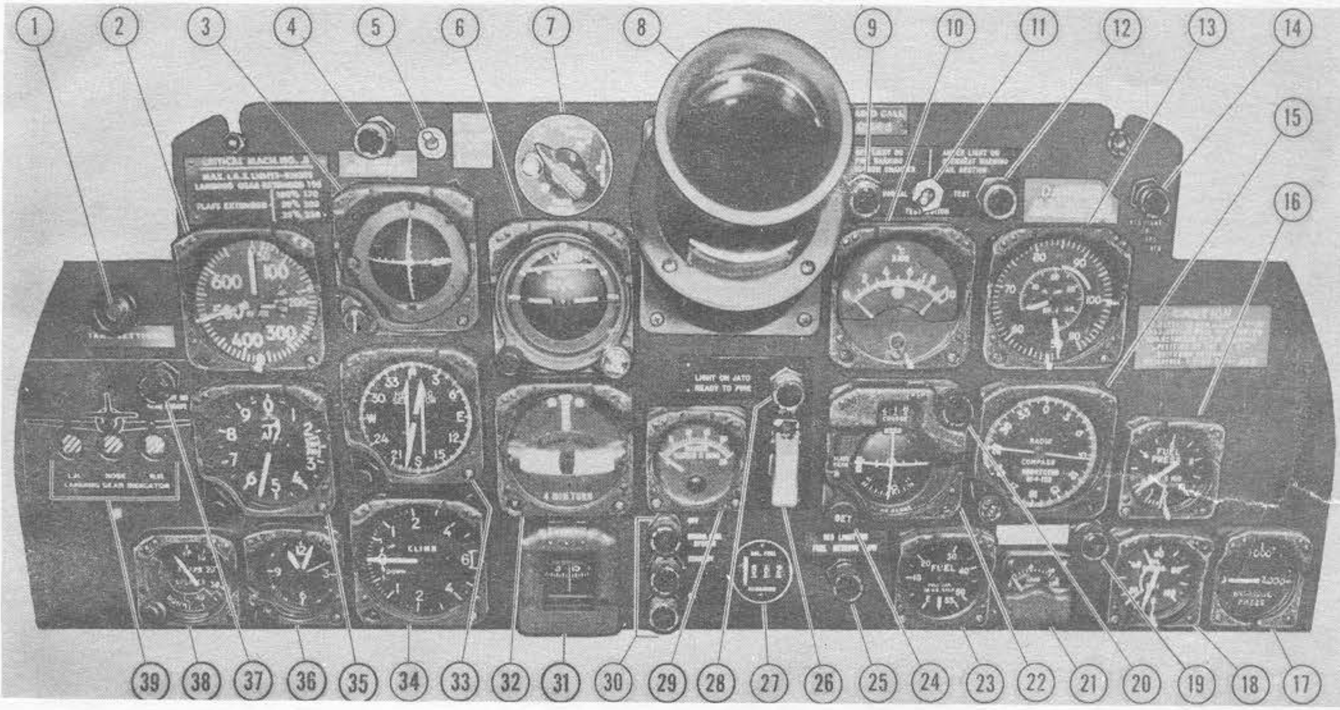
1–66. FUSELAGE TANK AND BY-PASS SWITCH. The fuselage tank and by-pass switch (4, figure 9) has three positions: "FUS," "BY-PASS," and Off. In the "FUS" position, the fuselage tank booster pump is turned on to supply fuel under pressure to the engine-driven fuel pump. In the downward "BY-PASS" position, the fuselage tank booster pump is shut off and the electrically operated by-pass valves are reset, causing fuel in the wing tanks and leading edge tanks to by-pass the fuselage tank. In the center (Off) position, the fuselage tank by-pass valves are set for normal operation but the fuselage tank booster pump is off.

1–67. MAIN FUEL SHUT-OFF VALVES SWITCH. (7, figure 6). This is a guarded two-position "OPEN"-"CLOSE" emergency switch used to shut off all fuel to the engine and afterburner in an emergency.

1–68. FUEL SYSTEM INDICATORS.

1–69. FUEL TANK INDICATOR LIGHTS. An indicator light (2, figure 9) for each group of tanks is located on the pilot's fuel control panel just above each tank switch. The tip tanks, leading edge tanks, and the wing tanks indicator lights are red and glow whenever the respective switches are On and the fuel pressure in the lines is below 5 psi. The fuselage tank (amber) indicator light glows whenever the fuselage tank booster pump is in operation. On Group 3 airplanes that have not been modified, the tip fuel tank indicator light has been rendered inoperative and is so placarded.

1-70. FUEL QUANTITY INDICATORS. The float-type fuel gage indicates the quantity of fuel in the fuselage tank only (23, figure 10). A low-level warning light (25, figure 10) glows when the quantity of fuel remaining in the fuselage tank drops about 10 gallons below full.



1. Tip Tank Jettison Switch Button
2. Airspeed Indicator
3. Zero Reader Indicator
4. Instrument Power "OFF" Warning Light
5. Instrument Power Switch
6. J-8 Attitude Indicator
7. Radar Control
8. Radar Scope
9. Plenum Chamber Fire Warning Light
10. Tailpipe Temperature Indicator
11. Fire and Overheat Warning Circuit Test Switch
12. Tailpipe Overheat Warning Light
13. Tachometer
14. Canopy "Unlatched" Warning Light
15. Radio Compass Azimuth Indicator
16. Fuel Pressure Gage
17. Hydraulic Pressure Gage
18. Oil Pressure Gage
19. Generator "Out" Warning Light
20. Marker Beacon Indicator Light (inoperative)
21. Loadmeter
22. ILS Deviation Indicator (Cross-Pointer)
23. Fuselage Fuel Tank Quantity Gage
24. Course Setting Knob ILS
25. Fuselage Fuel Tank Low-Level Warning Light
26. JATO Arming Switch
27. Fuel Quantity Counter
28. JATO "Ready" Indicator Light
29. Target Range Indicator
30. Emergency Fuel System Indicator Lights
31. Standby Compass
32. Turn and Bank Indicator
33. Heading Selector—(Zero Reader and Gyrosyn Compass)
34. Rate of Climb Indicator
35. Altimeter
36. Clock
37. Landing Gear "Unsafe" Warning Light
38. Wing Flaps Position Indicator (Group (2) Airplanes)
39. Landing Gear Position Indicators

Figure 10 — Pilot's Instrument Panel

1–71. FUEL QUANTITY COUNTER. The fuel quantity counter (27, figure 10) records fuel flow from two flowmeters, one in the engine fuel system and one in the afterburner fuel system (figure 3). The counter dial must be set to read the amount of usable fuel in the airplane each time the tanks are filled. The reading on the counter dial is in gallons of fuel remaining in the airplane and will be accurate except under the following conditions:

a. Any fuel which is released when the tip tanks are jettisoned will not be counted.

b. Any fuel leaking from the tank vent or a fuel line upstream of the flowmeter will not be counted.

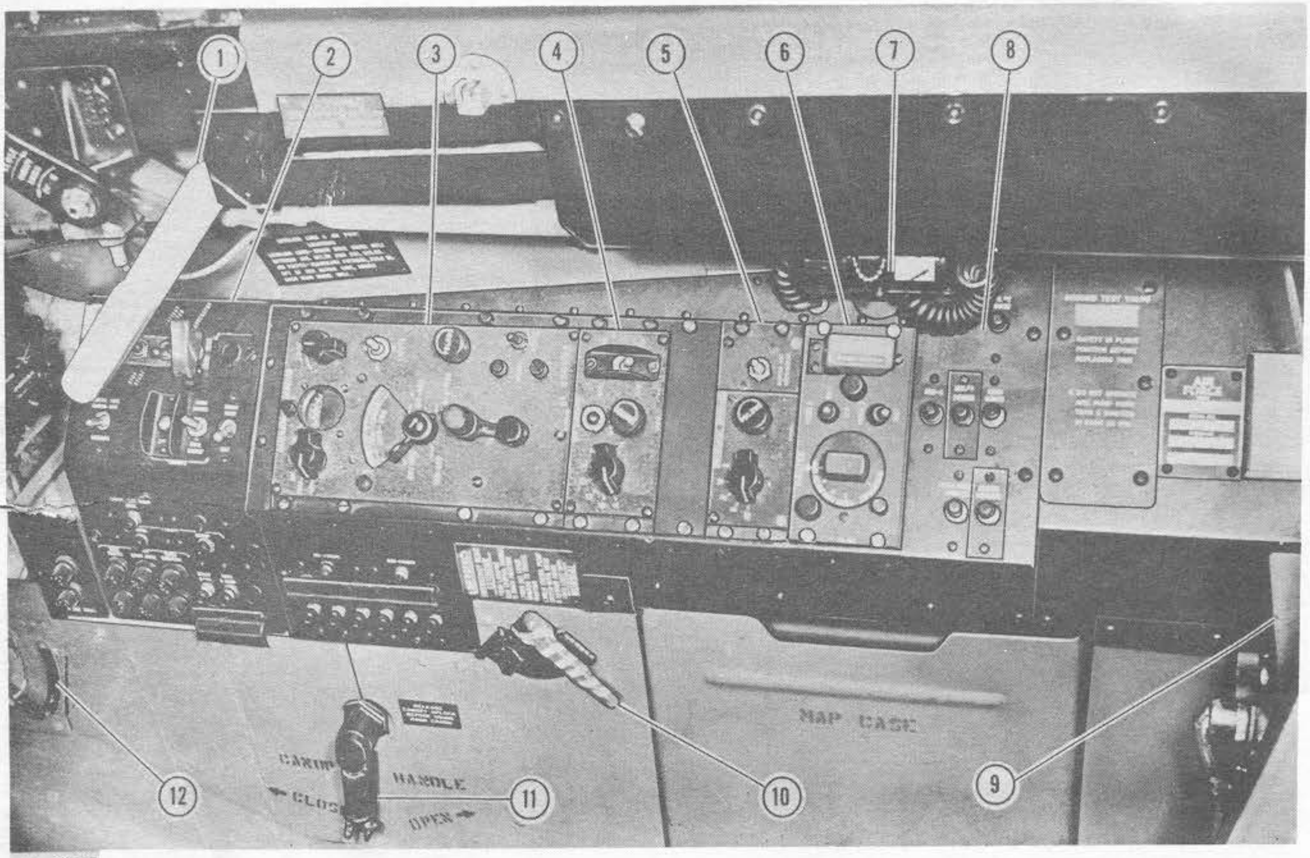
c. Any fuel going through the automatic starting control will not be counted; this usually amounts to about a gallon for an automatic ground start.

1–72, In addition to the fuel losses mentioned in paragraph 1–71 preceding, additional fuel will be lost as a result of vaporization and/or boiling in the tanks. Normally this loss is small but can become quite large if aggravated by the following conditions:

a. Warm or hot fuel at the time of take-off.

b. High rate of climb (particularly when the afterburner is being used.

c. High cruising altitude.



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1. Canopy Jettison Lever
2. Right Side Forward Panel
3. AN/ARN-6 Radio Compass Control Panel
4. AN/ARC-3 Radio Control Panel (VHF)
5. Instrument Approach (ILS) Radio Control Panel
6. AN/APX-6 IFF Radio Control Panel
7. Type C-4 Spotlight
8. Right Side Aft Circuit Breaker Panel
9. AN AIC-2A Interphone Equipment
10. Emergency Hydraulic System Selector Lever
11. Canopy Handcrank
12. Pressure Air Inlet Grill

Figure 11 — Pilot's Cockpit, Right Side

Each of the items listed above is a factor through which loss of fuel will result. Any one, or a combination of these factors may exist; therefore, the fuselage fuel tank quantity indicator or fuselage fuel tank low level warning light may indicate that the actual fuel load is less, toward the end of a flight, than the indication given by the counter. The loss of fuel from vaporization and/or boiling is greater with MIL-F-5624 (JP-3) fuel than with any other fuel approved for use in jet engines. The preceding information must be taken into account in planning a long flight at high altitude when the fuel reserve for landing will be marginal.

1-73. TIP TANK RELEASE CONTROLS.

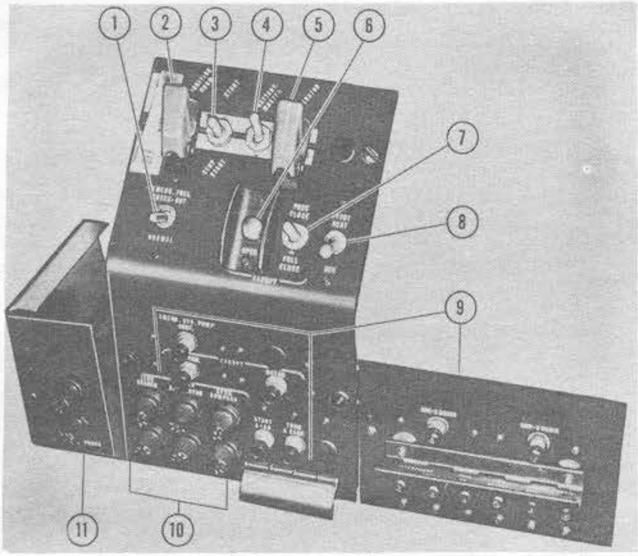
1-74. TIP TANK JETTISON SWITCH. This button (1, figure 10), located on the instrument panel, when pushed, both tanks will be released simultaneously. The circuit is connected directly to the battery and therefore is always "hot."

1-75, BOMBS SELECTOR SWITCH. This switch (figure 54) located on the armament control panel, is inoperative.

1-76. TIP TANK JETTISON "READY" SWITCH. This switch (figure 54) has two positions, "READY" and "OFF." When in the "READY" position, the circuit is armed so that the tanks may be released together by pushing the bomb release button on the control stick.

1-77. BOMB RELEASE BUTTON. This button, located on the control stick grip, (figure 17) when pressed, will release the tip tanks provided the tip tank jettison "ready" switch is in the "READY" position.

1-78. MANUAL RELEASE—TANK OR BOMB. The manual release handle (17, figure 5) when pulled will release both tanks mechanically. This control is provided so that the tanks may be released in the event of an electrical failure.



1. Emergency Fuel Check-Out Switch
2. Ignition Switch
3. Starter Switch
4. Battery Master Switch
5. Generator Switch
6. Canopy "Open" Switch
7. Canopy Close Switch
8. Pitot Heat Switch
9. Circuit Breakers
10. Fuses
11. Spare Fuses

Figure 12 — Pilot's Cockpit, Right Side Forward Panel

1–79. ELECTRICAL SYSTEM.

1–80. GENERAL.

1–81. The direct current electrical system is a 28-volt, single wire, grounded circuit. Power is furnished by one 400-ampere engine-driven generator in parallel with two 12-volt storage batteries which are connected in series. Alternating current is supplied by four rotary inverters that operate from the 28-volt d.c. system. The power supplied by these inverters operates the autosyn pressure instruments, gyro flight instruments, gunsight, and radar equipment. Electrical power distribution is shown on figure 13.

1–82. D.-C. SYSTEM.

1–83. GENERAL.

1–84. Two 12-volt storage batteries, connected in series for 24-volt operation, are paralleled with one 400-ampere engine-driven generator. A voltage regulator and a reverse current relay are used for protection and control of the system. The generator feeder is fused at the engine for overload and feeder protection.

1–85. EXTERNAL POWER RECEPTACLE. For ground operation, two cart receptacles are provided. These are connected in parallel for operation singly or together, with a 5 minute current rating of 400 amperes each or 800 amperes together. No manual switching is provided in the airplane for controlling the ground cart circuit. The ground cart contactor in the airplane will automatically close and connect the cart to the d.c. bus whenever a cart is plugged into either receptacle and turned on.

CAUTION

Do not turn the battery master switch "ON" or operate the exterior canopy control switches when a ground cart is connected to the airplane. Refer to paragraph 1–88.

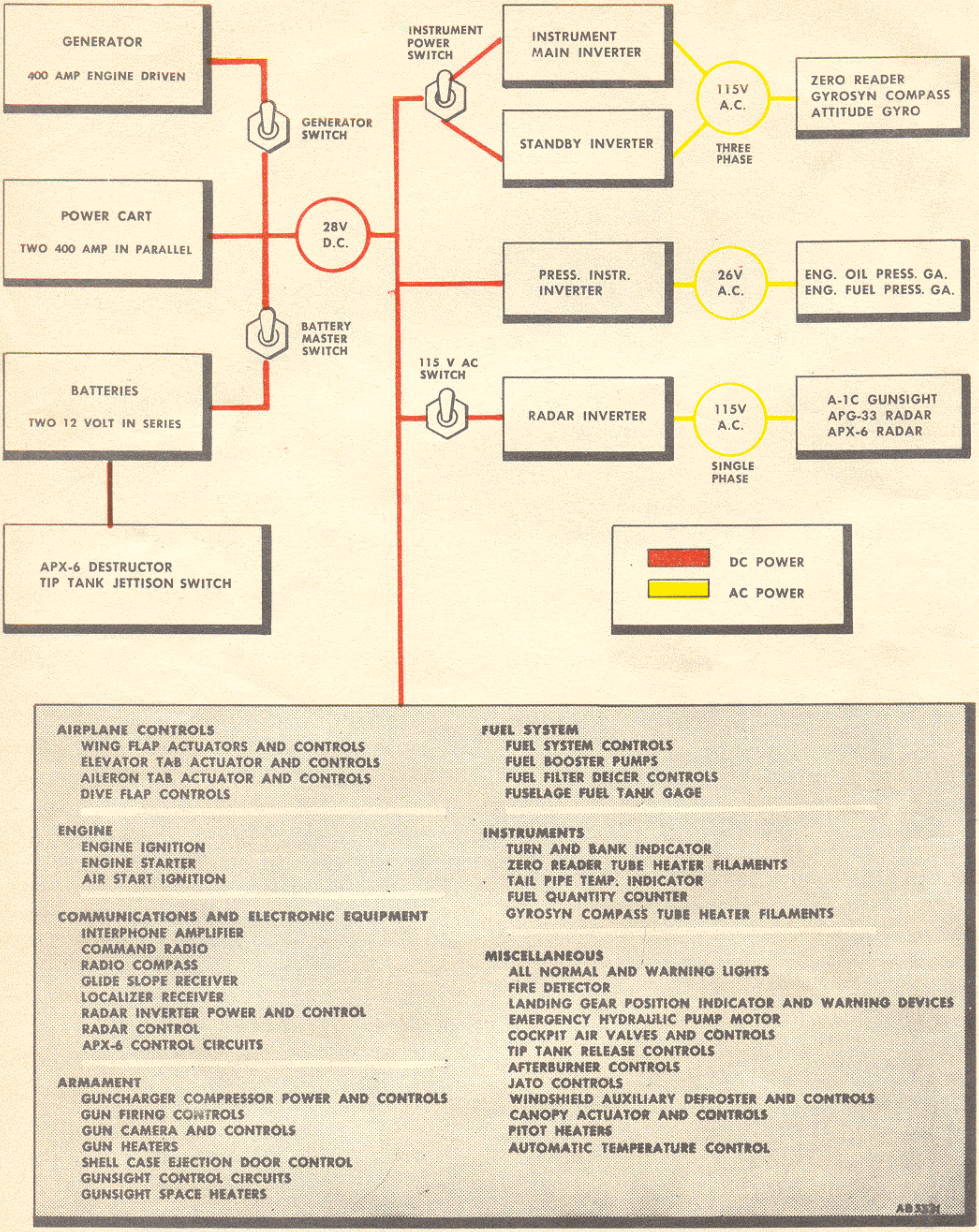


Figure 13 — Electrical Power Distribution Diagram

1–86. When using ground carts, care must be taken to avoid interruption of the cart load current at the cart receptacle when plugging or unplugging the ground carts.

CAUTION

Turn off ground carts before connecting or disconnecting from airplane. This must be done to avoid burning the contact pins.

1–87. D.C. SYSTEM CONTROLS.

1–88. BATTERY MASTER SWITCH. The battery master switch (4, figure 12) has two positions: "ON" and "OFF." When "ON" it connects the airplane's batteries to the d.c. bus. It is possible to place the airplane batteries in parallel with the external power supply by turning the battery switch "ON" or by operating either of the external canopy switches when the cart is connected and on. This practice is prohibited because damage to the airplane's batteries will result.

1–89. GENERATOR SWITCH. The generator switch (5, figure 12), located in the front cockpit, has two positions "ON" and "OFF." In the "ON" position it connects the generator to the d.c. bus, and is normally left in this position at all times as a reverse current relay in the circuit automatically protects the generator.

1–90. GENERATOR VOLTAGE ADJUSTMENT RHEOSTAT. This rheostat (5, figure 50), located in the rear cockpit, provides a means of adjusting generator voltage while in flight.

CAUTION

Never adjust the system for more than 28.5 volts. If adjustment is necessary before the system has warmed up (30 minutes operation), continue rechecking the adjustment periodically until the warm-up is complete.

1–91. D.C. SYSTEM INDICATORS.

1–92. GENERATOR "OUT" WARNING LIGHT. This warning light (19, figure 10) glows whenever the generator is inoperative and the d.c. bus is energized.

1–93. VOLTMETER. A voltmeter (7, figure 50) is located in the rear cockpit.

1–94. AMMETER. An ammeter (9, figure 50) is installed in the rear cockpit for indicating generator current.

1–95. LOADMETER. The pilot's cockpit contains a loadmeter (21, figure 10). This instrument is an ammeter, the scale of which has been calibrated to read from −0.1 to +1.25 times the generator rated output.

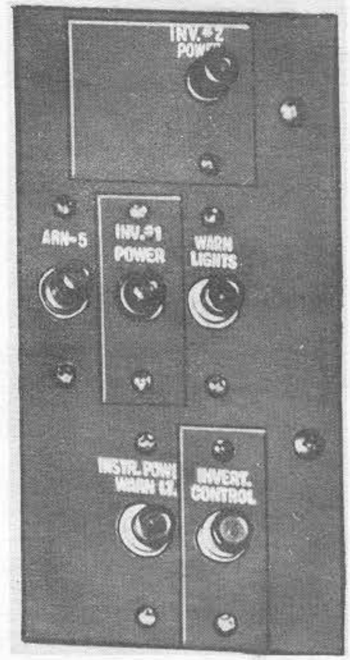


Figure 14 — Pilot's Cockpit, Right Side Circuit Breaker Panel

1–96. A.C. SYSTEM.

1–97. GENERAL. Three independent and functionally separate inverter systems provide 400-cycle a.c. power to the gyro instruments, pressure instruments, and radar equipment. Power for these inverters is supplied by the airplane d.c. system as shown in figure 13.

1–98. INSTRUMENT INVERTERS.

1–99. The gyrosyn compass, zero reader, and attitude gyro are supplied with 115-volt, 3-phase, 400-cycle a.c. power from one of two 100 v.a. inverters. The other inverter serves as a spare. Either inverter can be selected by means of a two-position switch. It is good practice to use one inverter continuously until it fails rather than dividing the operating time equally between the two inverters. Therefore, if a failure occurs during a flight and the spare inverter has had very little operating time, it can be expected to function satisfactorily.

1–100. INSTRUMENT POWER SWITCH. This switch (5, figure 10) has two positions: "NORMAL" and "STANDBY," and is used to select the inverter to be used. Since there is no off position, the inverter selected will operate whenever the d.c. bus is energized.

1–101. INSTRUMENT POWER "OFF" WARNING LIGHT. This light (4, figure 10) glows when the inverter selected by the instrument power switch has failed.

1–102. INVERTER TEST. With the d.c. bus energized, the inverters can be tested by means of the inverter switch and the instrument power "OFF" warning light. If the warning light glows, the inverter selected by the inverter switch is not operating; if the light does not glow, the inverter is operating.

1–103. PRESSURE INSTRUMENTS INVERTER. The engine oil pressure and engine fuel pressure instruments are powered by a 26-volt single-phase 6 v.a. inverter. No control switch is provided. Thus, inverter power is supplied to these instruments whenever the d.c. bus is energized.

1–104. RADAR INVERTER.

1–105. The radar inverter furnishes 115-volt, single-phase, 400-cycle power and is rated at 2.5 k.v.a. The equipment supplied by this inverter is listed on figure 13. Twenty-eight volt, 3-phase a.c. power to the computer gyros in the A-1C gunsight is furnished by an accurate frequency source, the type D-2 electronic inverter. This inverter requires 28 volts d.c. from the airplane's d.c. bus, and 300 volts d.c. power from the APG-33 radar power supply. Another source of 28-volt, 3-phase a.c. power is obtained from a phase adapter and transformer operating from the radar inverter and is used to supply power to the APG-33 vertical gyro and the microsyn position transmitter signal circuits in both the A-1C sight and the APG-33 radar.

1–106. 115-VOLT A.C. SWITCH. This switch (3, figure 7) is a two-position "ON-OFF" switch located on the pilot's left shelf and is provided with a guard to keep it in the "ON" (normal) position. When the switch is in the "OFF" position, the radar inverter is disconnected from its power source and the radar and gunsight will be inoperative.

1–107. HYDRAULIC SYSTEM.

108– GENERAL.

1–109. The hydraulic power system (figure 16) operates the aileron booster, landing gear, shell case ejection doors, and dive flaps. This system is a constant pressure type, incorporating accumulators and a self-regulating engine-driven pump. Air charged accumulators store pressure for peak demands and hence, reduce fluctuation in pump loading while the system relief valve functions as a safety device to by-pass any excessive system pressure. Air from the engine compressor is used to pressurize the reservoir.

1–110. HYDROFUSE.

1–111. The hydrofuse is a device which automatically shuts off hydraulic pressure to the dive flaps and landing gear but not to the aileron booster or shell case ejection door, in the event of leakage in the system.

1–112. HYDROFUSE RESET LEVER. The hydrofuse reset lever (10, figure 5) permits manual resetting of the hydrofuse to override it in an emergency or in case the hydrofuse malfunctions. However, the hydrofuse is safetied in the reset position when the airplane leaves the factory.

1–113. EMERGENCY PUMP.

1–114. An electrically-driven pump and a reservoir are provided for extension of the landing gear only in the event of failure of the main system. The gear cannot be raised by pressure from the emergency pump. No other emergency hydraulic system is provided.

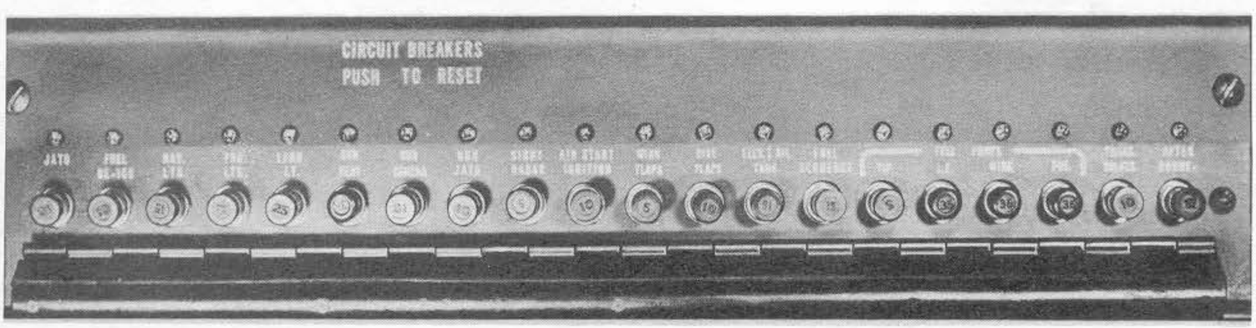


Figure 15 — Pilot's Cockpit, Left Side Circuit Breaker Panel

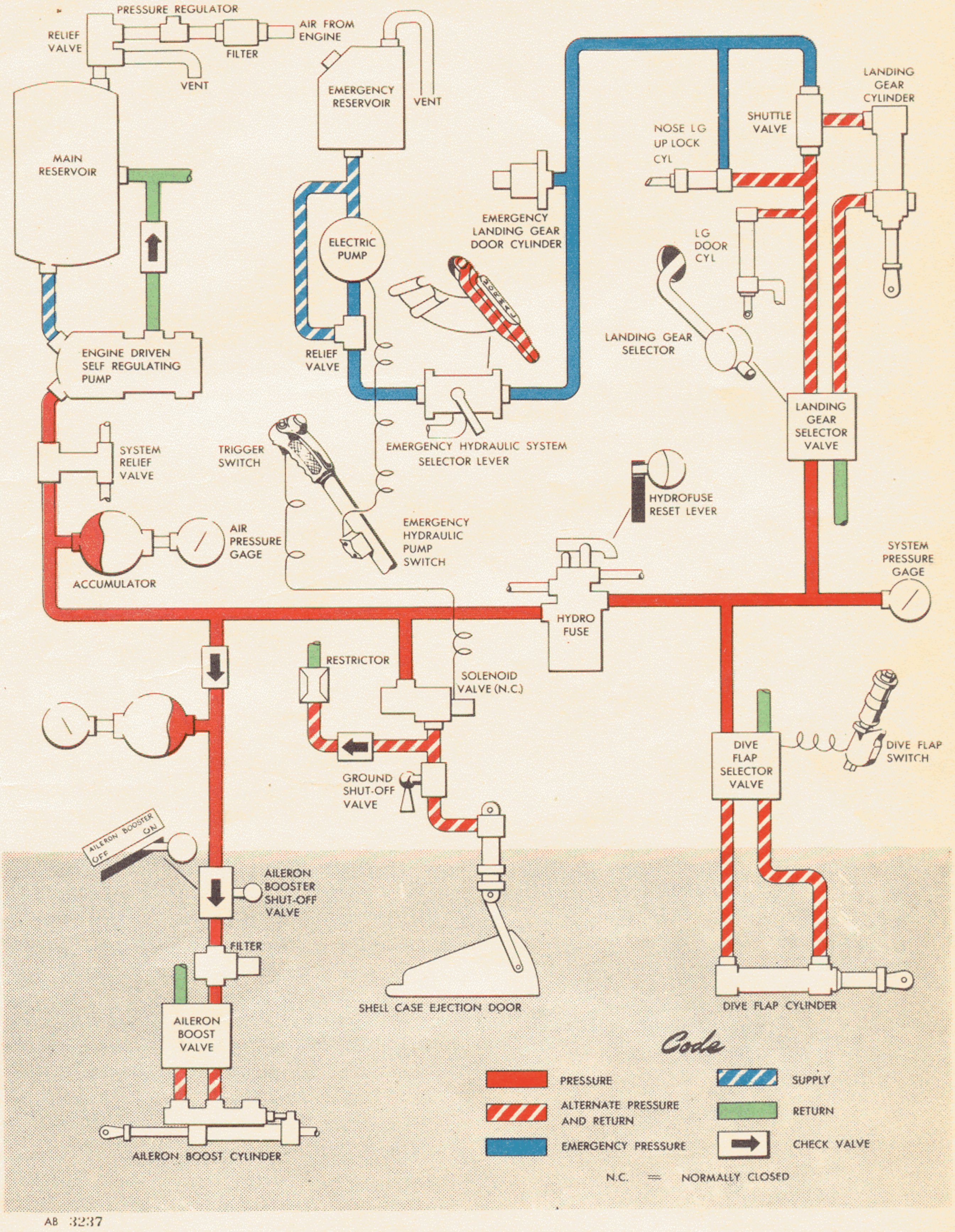


Figure 16 — Hydraulic System Diagram

1–115. EMERGENCY HYDRAULIC PUMP SWITCH. The emergency hydraulic pump switch (figure 17) is located on the control stick just below the grip. It is spring-loaded to Off and when pressed, turns on the emergency pump.

1–116. HYDRAULIC PRESSURE GAGE. This gage (17, figure 10) indicates hydraulic system pressure.

1–117. FLIGHT CONTROL SYSTEM.

1–118. GENERAL.

1–119. Primary flight controls are the conventional stick and rudder pedals. Aileron control is augmented by a hydraulically-powered booster. The elevator stick forces are reduced by means of two servo-acting spring tabs in addition to the servo action of the two trim tabs.

1–120. CONTROL STICK. The control stick (figure 17) mounts the gun trigger switch, the elevator and aileron trim tab switch, the bomb release button, and the emergency hydraulic pump switch.

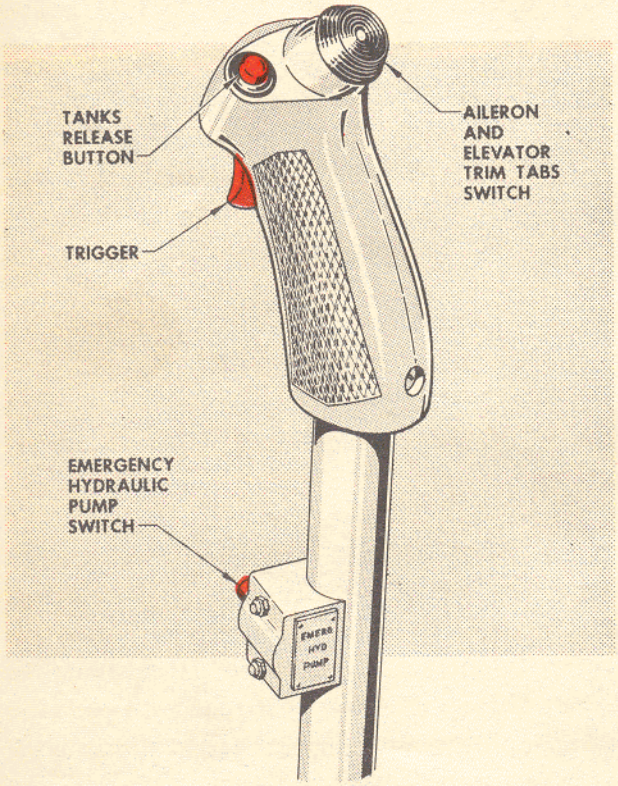


Figure 17 — Control Stick

1–21. SURFACE CONTROL LOCK. The surface control lock consists of a tubular bracket (figure 18) which can be attached to the rudder pedals and the control stick by a thumbscrew. When not in use it is stowed in clips on the floor to the right of the pilot's seat.

1–122. AILERON CONTROL SYSTEM.

1–123. AILERON BOOST SYSTEM.

1–124. The hydraulic aileron booster unit reduces aileron control forces without destroying the feel of the control, as the pilot must supply about one-fifteenth of the total force required. The control force reduction is effective after the control stick is moved about two degrees from the neutral position. The booster unit is powered by the hydraulic system and is normally in operation whenever the engine is running. A separate accumulator is installed to provide full pressure during peak loads. The booster unit incorporates an automatic by-pass valve to permit manual operation of the ailerons in the event of a hydraulic system failure.

1–125. AILERON BOOSTER LEVER. The aileron booster lever (12, figure 6) is provided to permit shutting off hydraulic pressure to the booster unit in an emergency.

1–126. Inasmuch as you only supply one-fifteenth of the force required to control the ailerons when the booster is operating, you will find the ailerons very stiff when the booster is off.

1–127. AILERON TABS.

1–128. The tab on the left aileron is operated by an electric actuator and serves to trim the airplane laterally. The tab on the right aileron is ground adjustable only.

1–129. AILERON AND ELEVATOR TRIM TABS SWITCH. The trim tab on the left aileron and the tabs on the elevators are electrically operated and are controlled by the same thumb switch (figure 17) at the top of the control stick. Pushing the tab switch forward (nose down) or aft (nose up) operates the elevator tabs, and moving the switch to the left (left wing down) or to the right (right wing down) operates the aileron tab. The position of the aileron tabs can be seen from the cockpit.

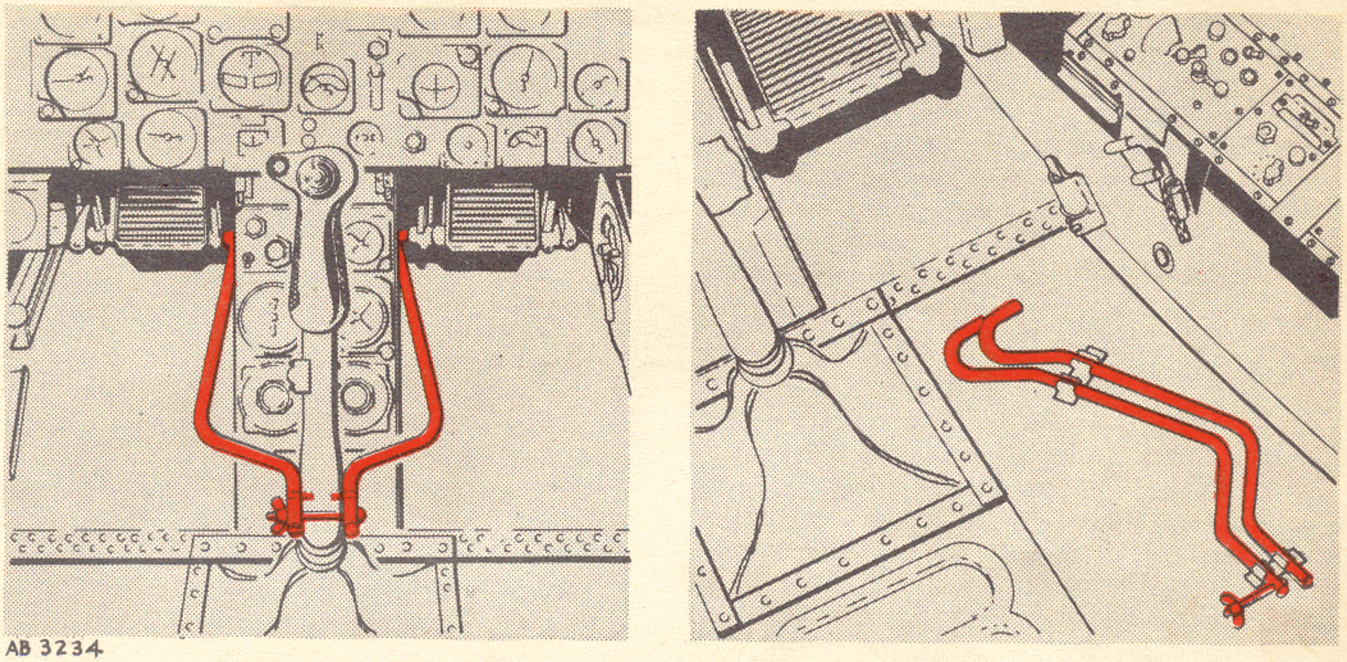


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Figure 18 — Surface Control Lock

1-130. ELEVATOR CONTROL SYSTEM.

1-131, The elevator control system includes a bungee spring and a pair of spring tabs in addition to the conventional trim tabs. The bungee spring holds the elevators in the up position when the surface is raised about 20 degrees above the neutral position, and holds them in the down position when the surface is moved below neutral. You will notice that this action gives a peculiar feel to the control on the ground but it is not noticeable in flight.

1-132. SPRING TABS. These tabs, which are located on the inboard corners of the elevator, reduce the elevator stick forces. They deflect in proportion to the force exerted on the control stick until the maximum deflection is obtained. At low stick forces, there is no force applied directly to the elevators as the spring tabs, because of their deflected position, displace the elevators. At higher stick forces, they remain fully deflected (thus reducing the forces required) and the stick force is then applied directly to the elevator through the horn assembly and torque tube.

1-133. ELEVATOR TRIM TABS.

1-134. The elevator trim tabs are located outboard of the spring tabs and are operated by an electric actuator. In addition to electric operation, automatic servo operation is incorporated to aid in reducing elevator stick forces.

1-135. AILERON AND ELEVATOR TRIM TABS SWITCH. Refer to paragraph 1-129.

1-136. ELEVATOR TABS "NEUTRAL" INDICATOR LIGHT. (1, figure 19). A green light on the center pedestal glows when the elevator tabs are in the neutral position.

1-137. RUDDER CONTROL SYSTEM.

1-138. RUDDER. The rudder and its controls are entirely conventional.

1-139. RUDDER PEDALS. The rudder pedals may be adjusted fore and aft by releasing the adjustment lock levers. When the adjustment lock levers are moved outboard spring action moves the rudder pedals toward the pilot. By holding the levers in the unlocked positions, slight foot pressure will adjust the rudder pedals to the desired leg length.

1-140. RUDDER TAB. A bend tab is installed on the rudder and is ground adjustable only.

1–141. WING FLAPS.

1–142. GENERAL.

1–143. The wing flaps are actuated by two electric motors mechanically interconnected by a flexible shaft so that if one motor fails the remaining motor will actuate the flaps with equal extension assured. Retraction and extension time will be slightly increased when only one motor is operative. There is no emergency method of operating the flaps.

1–144. WING FLAPS SWITCH.

1–145. The wing flaps are controlled by the switch (4, figure 6) on the pilot's left shelf. It has three positions: "UP," center Off, and "DOWN." The flaps may be stopped in any intermediate position by moving the switch to the center position.

1–146. WING FLAPS POSITION INDICATOR.

1–147. The wing flaps position indicator is located on the pilot's left side forward panel (5, figure 6) on Group (1) airplanes. It shows the position of the flaps in percentage of travel from 0% to 100%. At full flap extension the instrument will indicate 100%. The wing flap position indicator on Group (2) airplanes is located on the pilot's instrument panel (38, figure 10) and shows flap position in degrees from 0° to 45°. The instrument will indicate 45° when the flaps are fully extended. The seventy percent flaps setting used for take-off on Group (1) airplanes is 31.5° on Group (2) airplanes.

1–148. DIVE FLAPS.

1–149. GENERAL.

1–150. The dive flaps are a drag increasing device used for reducing speed in a dive or any other flight attitude where reduction of speed is desired. No partial or intermediate extension of the flaps is possible; they must be full up or full down (60°). However, their direction of travel may be reversed at any time. The dive flaps are mechanically interconnected and are actuated hydraulically by separate cylinders. The pin connecting each actuating cylinder piston to the flap is quickly removable to permit safe access to the lower fuselage for ground operations. The dive flaps may be fully extended at any speed. They will be found useful in maintaining position in formation, in slow flying, in preventing floating before touchdown on landing, and in recovering from dives by inducing a nose-up pitching moment. You will note that this nosing-up tendency occurs whenever the dive flaps are extended and must be compensated for by the use of elevator tab or forward stick.

1–51. DIVE FLAPS SWITCH.

1–152. The dive flaps are controlled electrically by a sliding switch (17, figure 6) mounted on the throttle. The switch is moved aft to extend the flaps and forward to retract the flaps.

1–153. LANDING GEAR.

1–154. GENERAL.

1–155. The tricycle landing gear and wheel well doors are hydraulically actuated and are controlled by a selector valve on the left side of the pilot's cockpit. The main gears retract inboard and the nose gear retracts aft. All gears are provided with uplocks and downlocks. The nose wheel is equipped with a shimmy damper and is non-steerable. An electrically operated indicator and warning system is provided. Movement of the gear selector lever to the "UP" position while the weight of the airplane is on the gear is prevented by the control lever solenoid lock. In addition, an independent hydraulic system is provided to extend the gear in case of failure of the main hydraulic system.

1–156. EMERGENCY EXTENSION SYSTEM. The emergency extension system consists basically of an electrically-driven hydraulic pump, a separate reservoir, a selector valve and a set of "down" lines to the gear actuating cylinders. As no "up" or return lines are provided, the landing gear cannot be retracted by the emergency system and because of the limited fluid supply, only one complete extension of the gear is possible.

1–157. LANDING GEAR SAFETY CLIPS. To prevent accidental folding of the landing gear drag struts while the airplane is parked with little or no hydraulic pressure, safety clips are installed on the spring-loaded downlock cartridges. These safety clips have long red streamers attached, to prevent their being unnoticed in the pre-flight check.

1–158. LANDING GEAR CONTROLS.

1–159. LANDING GEAR SELECTOR LEVER.

1–160. The landing gear is controlled by the lever (15, fig. 5) located on the pilot's left side panel. The lever is held in either the "UP" or "DOWN" position by a spring-loaded lock which, for movement of the lever, can be released by pressure on the button on the end of the lever. This lever must be in the "DOWN" position before the gear can be extended by the emergency system. A solenoid lock, operated by a scissors switch on the left main gear strut, prevents movement of the landing gear selector lever to the "UP" position while the weight of the airplane is on the gear.

1-161. LANDING GEAR CONTROL LEVER SOLENOID LOCK RELEASE. The landing gear control lever solenoid lock (14, fig. 5) may be released if necessary by lifting the release lever.

1-162. EMERGENCY HYDRAULIC SYSTEM SELECTOR LEVER. The emergency selector lever (10, fig. 11) mechanically operates the valve that directs emergency hydraulic system pressure to the landing gear control valve. This lever has two positions: "NORMAL" and "EMERGENCY." In the "NORMAL" position the emergency pump pressure line to the landing gear control valve is shut off. When the lever is in the "EMERGENCY" position, the emergency pump pressure line is open.

1-163. EMERGENCY HYDRAULIC PUMP SWITCH. This switch, located on the side of the control stick, is spring-loaded to off, and when pushed, turns on the emergency hydraulic pump electric motor.

1-164. LANDING GEAR POSITION INDICATORS AND WARNING SYSTEM.

1-165. LANDING GEAR POSITION INDICATOR. The landing gear position indicator (39, fig. 10), on the pilot's instrument panel, shows the position of each individual landing gear. When the d.c. bus is not energized, diagonal stripes appear in each window. If the d.c. bus is energized, a wheel appears in each window for each gear that is down and locked, and the word "UP" appears in the window for each gear that is up and locked. With the gear at any intermediate position, diagonal stripes are displayed.

1-166. LANDING GEAR UNSAFE WARNING LIGHT AND WARNING HORN. The gear unsafe warning light (37, fig. 10) glows whenever the landing gear is not down and locked or up and locked. The warning horn sounds whenever power is reduced below 65% (±5%) rpm and the landing gear is not down and locked. The landing gear warning horn cut-out button (15, fig. 6) is provided, on the pilot's left side panel, to silence the horn when desired; however, the throttle switch will be automatically reset the next time the throttle is advanced.

1-167. BRAKES.

1-168. GENERAL.

1-169. The brake system is an independent, manually operated hydraulic system. The brakes are operated by the conventional toe pedals. No emergency braking provisions are included.

1-170. PARKING BRAKE HANDLE.

1-171. The parking brake handle (7, fig. 19) is provided to set the brakes for extended periods. When applying the parking brakes it is necessary to apply toe pressure first and then pull out the handle to set the brakes. If the handle is pulled out and toe pressure is then applied, damage to the brake piston seal will result. Brakes are released by applying toe pressure momentarily to both pedals and releasing.

1. Elevator Tab "Neutral" Indicator Light
2. Defrosting Control
3. Windshield De-Icer Switch
4. Zero Reader Control
5. Rocket Setting Unit (Inoperative)
6. Accelerometer
7. Parking Brake Handle
8. Cabin Altimeter
9. Gunsight Reticle Dimmer Rheostat

Figure 19 — Pilot's Cockpit, Center Pedestal

1-172. INSTRUMENTS.

1-173. GYROSYN COMPASS.

1-174. The J-2 gyrosyn compass consists fundamentally of a heading selector (33, fig. 10) electrically connected to a transmitter which serves as a magnetic compass. The compass heading is indicated by the single needle of the heading selector. The compass is connected to the d.c. bus and is on whenever the battery master switch is "ON." Three minutes are required for the gyro to come up to speed after the battery master switch has been turned on.

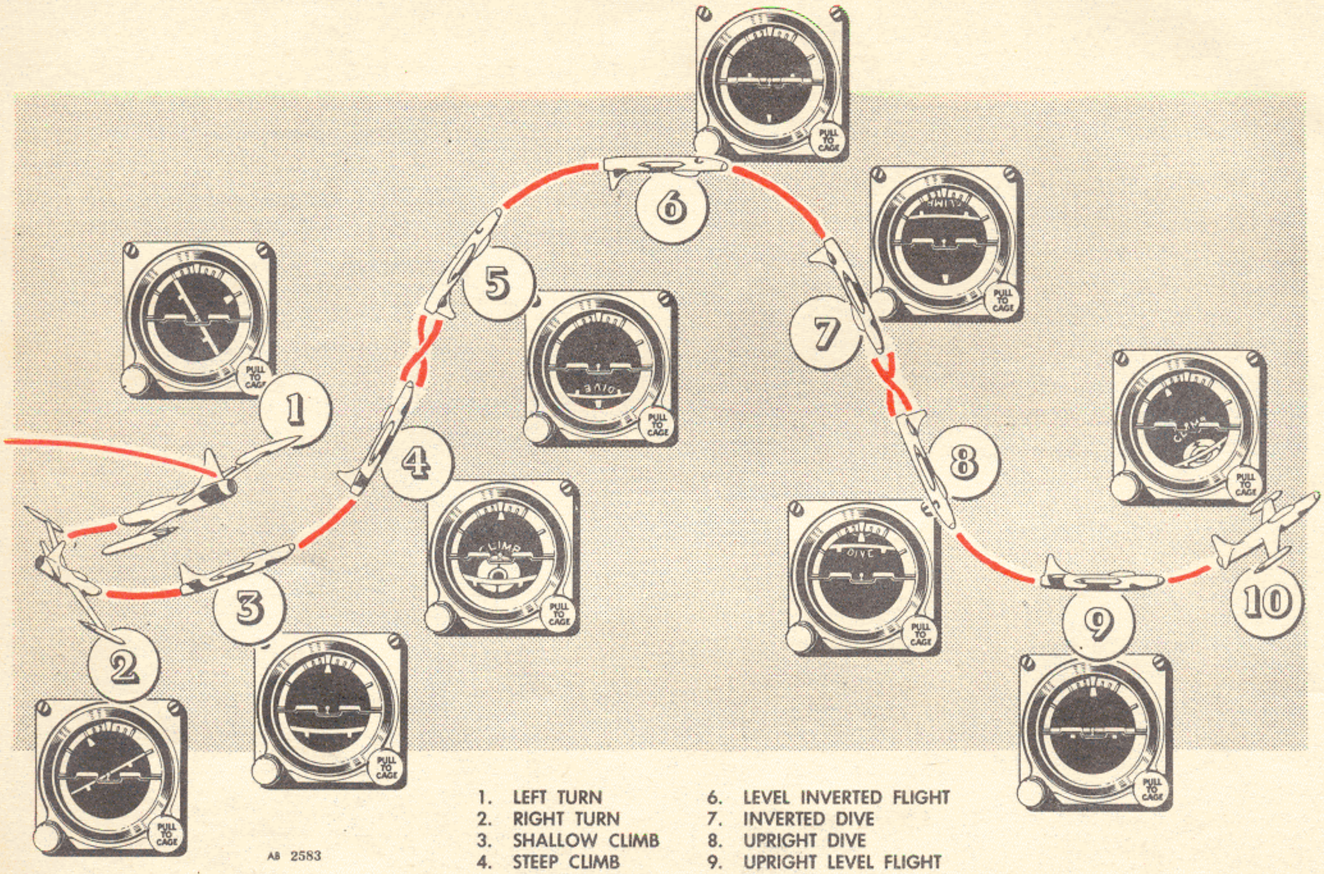

Figure 20 — Type J-8 Attitude Indicator Positions

1–175. After the gyro has attained operating speed, the indicator must be checked against the stand-by compass to see that the indicator does not show a 180° ambiguity. If a 180° ambiguity is present, the gyrosyn compass is not functioning properly.

1–176. ATTITUDE GYRO. A type J-8 attitude gyro (6, fig. 10) is installed on the pilot's instrument panel. This instrument is free in 360° of roll and tumbles at ±85° in pitch. The knob in the lower left corner may be used to adjust the miniature airplane for the pitch trim attitude of the airplane. The "PULL TO CAGE" knob in the lower right corner of the instrument is provided to erect the gyro after it has tumbled or when it is first started. Erecting is accomplished by pulling the knob out hard and releasing. Approximately 12 seconds are required for the gyros to come up to speed after power is on and about 2 minutes is required for the instrument to become fully operative after the gyros have been erected by pulling the "PULL TO CAGE" knob. If the caging knob is not pulled, about 15 minutes are required for the gyros to erect themselves. This instrument operates on power supplied by the instrument inverter. Typical attitude positions are illustrated in figure 20.

1–177. ZERO READER.

1–178. The Zero Reader is an automatic flight instrument that combines all of the information required to fly the airplane on a predetermined flight plan in a safe manner and presents it to the pilot visually on the Zero Reader indicator. Displacement of the bars on the indicator shows the pilot the corrective action he must take to return the airplane to the desired flight path. When the bars are zeroed (centered), the airplane is either on course or in an attitude that will bring it to the desired flight path. The Zero Reader may be used for instrument flying or for making instrument approaches. When it is being used, the other flight instruments need only be used for reference. Briefly stated, the Zero Reader can be compared to an auto pilot in which the human pilot replaces the servos, since all that is required of him is the proper response to its indications without the necessity of making any mental computations.

1–179. Power for the Zero Reader is supplied by the 28 volt d.c. bus and the 115-volts a.c. instrument inverter. Hence, it is on whenever the battery master switch is on or a battery cart is connected and on.

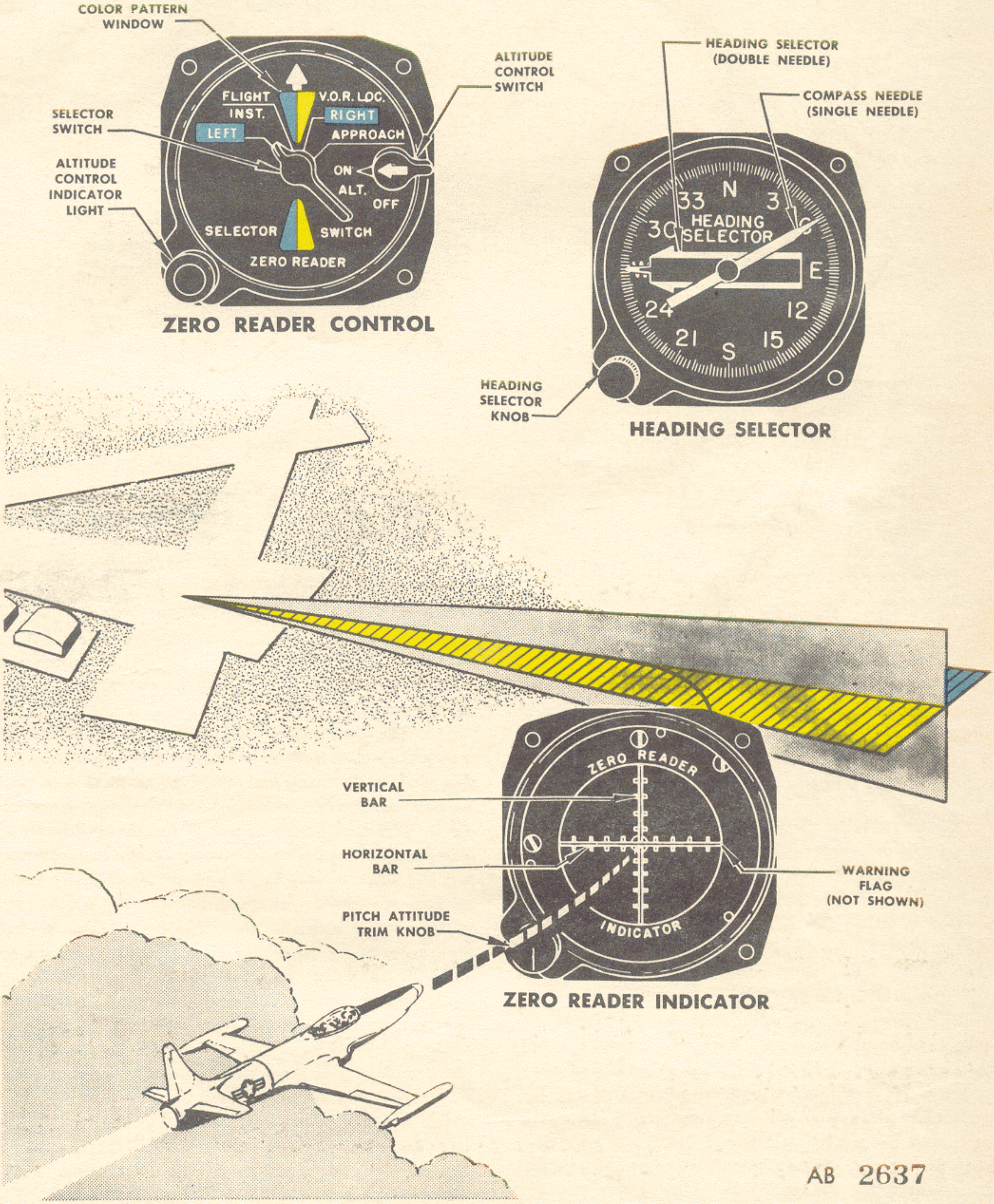

Figure 21 — Zero Reader Controls and Indicators

1–180. ZERO READER CONTROLS.

1–181. HEADING SELECTOR.

1–182. The heading selector (Fig. 21) is a gyrosyn compass indicator that incorporates two needles. The single needle shows the magnetic heading of the airplane while the double needle indicates the heading that has been selected and set into the Zero Reader.

1–183. HEADING SELECTOR KNOB. The desired heading is chosen by means of the selector knob located on the lower left corner of the heading selector. Signals are fed to the Zero Reader that cause the vertical bar of the deviation indicator to inform the pilot how the airplane must be maneuvered to attain the desired heading.

1–184. ZERO READER CONTROL.

1–185. This control (Fig. 21) incorporates the selector switch, altitude control switch, and altitude control indicator light.

1–186. SELECTOR SWITCH. The selector switch has four positions: (Blue) "LEFT," "FLIGHT INST.," "V.O.R. LOC. (Blue) RIGHT," and "APPROACH."

1–187. When the selector switch is in the (Blue) "LEFT" position, localizer signals are fed to the Zero Reader. This position is used whenever the reciprocal of the localizer final approach heading is being flown, regardless of whether proceeding inbound or outbound.

1–188. The "FLIGHT INST." position is used for all flying when radio navigation is not required. No radio signals (compass signals only) are fed to the Zero Reader when the selector switch is in this position.

1–189. When in the "V.O.R. LOC. (Blue) RIGHT" position, localizer signals are supplied to the Zero Reader. This position is used whenever the localizer final approach heading is being flown, regardless of whether proceeding inbound or outbound. The radio signals fed to the Zero Reader, when the switch is in this position, are the same as those fed to it when the switch is in the (Blue) "LEFT" position, except that the vertical bar is displaced in the opposite direction, so that it will always be necessary to fly toward the bar to zero the needle.

1–190. Moving the selector switch to "APPROACH" provides the Zero Reader with glide slope signals in addition to the localizer signals. The installation in this airplane is adjusted so that when the Zero Reader indicator bars are zeroed, the ILS cross-pointer horizontal bar will give a zero to one dot increment fly-down indication. This adjustment has been made so that you will fly in the upper half of the glide slope beam and thus be automatically provided with a safe margin of obstruction clearance.

1–191. ALTITUDE CONTROL SWITCH. This switch has an "ON" and an "OFF" position. When in the "ON" position, barometric signals are supplied to the horizontal bar which will inform the pilot how to fly to maintain a constant altitude. The altitude control switch is mechanically interconnected with the selector switch so that the selector switch, when turned to "APPROACH," also turns the altitude control switch "OFF." When maintaining a constant altitude is not desired, the altitude control switch must be left "OFF."

1–192. ALTITUDE CONTROL INDICATOR LIGHT. This light, located in the lower left corner of the Zero Reader control, is green and glows whenever the altitude control switch is "OFF."

1–193. ZERO READER INDICATORS.

1–194. ZERO READER INDICATOR. The Zero Reader indicator (Fig. 21) shows the pilot how the airplane must be maneuvered to begin and maintain a pre-selected flight plan. The indications are presented by a vertical and a horizontal bar superimposed on a spherical background, which is stabilized by a non-tumbling vertical gyro. This gyro is free in 360° of roll and 85° of pitch. The sphere represents the earth and carries vertical and horizontal markings with a dot at their intersection which represents the airplane. When maneuvering the airplane to follow the indications of the Zero Reader, the dot must be flown toward the vertical and horizontal bars. The bars respond instantly to any attitude change even though it is only one degree. Airplane attitude changes that are required to produce full deflection of the bars are well within safe limits under all flying conditions. These limits are 30° $\pm$3° in bank and 10° nose-up or 6° nose-down with the altitude control on ($\pm$5° with selector switch in "APPROACH") in pitch. For example, regardless of how far off the desired heading the airplane may be, the maximum bank required to return the airplane to the desired heading will be 30°. If the airplane is banked more than 30°, the vertical bar will move to the other side of zero, thus indicating to the pilot that he should reduce the angle of bank. Maximum attitude changes are only required to return the bars to zero when they are fully deflected; for example, a heading change of more than 20° will require the full 30° of bank to zero the needle, whereas a heading change of 8° will only require a bank of 15°. A red "OFF" (warning) flag is installed, and when displayed, indicates that power is not being supplied to the equipment. Normally it disappears one minute after power is on, thus indicating the equipment is ready for use.

1–195. PITCH ATTITUDE TRIM KNOB. The pitch attitude trim knob, located on the lower left corner of the indicator, permits the manual lowering or raising of the horizontal bar, to adjust for normal variations in the pitch trim of the airplane and to allow setting the bar for climb or descent. The maximum pitch changes possible with full deflection of the bar are: 20° nose-up, and 10° nose-down. Movement of the knob one full turn in either direction produces full scale deflection of the horizontal bar. The arrow on the knob is for reference only.

1–196. ILS DEVIATION INDICATOR (CROSS-POINTER).

1–197. The deviation indicator (22, fig. 10) is used as a conventional ILS cross-pointer meter. The vertical bar accepts signals from the localizer receiver and the horizontal bar accepts signals from the glide slope receiver. The bars move vertically and horizontally so that the right angle relationship between them is maintained throughout their full range of deflection. The course indicator and course set knob are for use with omnirange facilities and as this airplane has no omni-range receiver, they are inoperative. An "OFF" flag is installed for each bar to indicate when either receiver is not functioning.

1–198. MARKER BEACON LIGHT. This light is located in the upper right corner of the deviation indicator. It is inoperative since no marker beacon receiver is installed.

1–199. ACCELEROMETER. The accelerometer (6, fig. 19) indicates the G's being pulled at any given instant. The indicating needle moves clockwise to show positive G's only. The "TURN TO SET" knob on the lower left corner of the instrument rotates the preselector needle to any desired position.

1–200. MISCELLANEOUS EQUIPMENT.

1–201. GENERAL.

1–202. CHECK LIST. The pilot's check list (figure 4) is mounted directly beneath the center of the instrument panel. It may be pulled out of its clips to read the information printed on the back.

1–203. MAP CASE. The map case (fig. 11) is installed in the right side panel of the front cockpit. It is hinged at the bottom and is pulled out from the top.

1–204. DATA CASE. The standard size data case is installed on the inside of the right armament door.

1–205. CANOPY.

1–206. A single bubble-type canopy is used to cover both the pilot's and radar operator's stations. The canopy is not the sliding type but is hinged at the aft end and is raised or lowered by an electrically actuated jack shaft located between the seats. Upon closing, the canopy seal receptacle is mated with the engine air pressure line and inflated to seal the canopy frame against the cockpit sill and windshield. A jettison catapult is provided to remove the canopy quickly if the occasion arises. While on the ground, a safety pin is installed to prevent inadvertent firing of the catapult. The safety pin must be removed before flight.

Caution

TURN OFF OR DISCONNECT POWER CART BEFORE OPERATING CANOPY SWITCHES

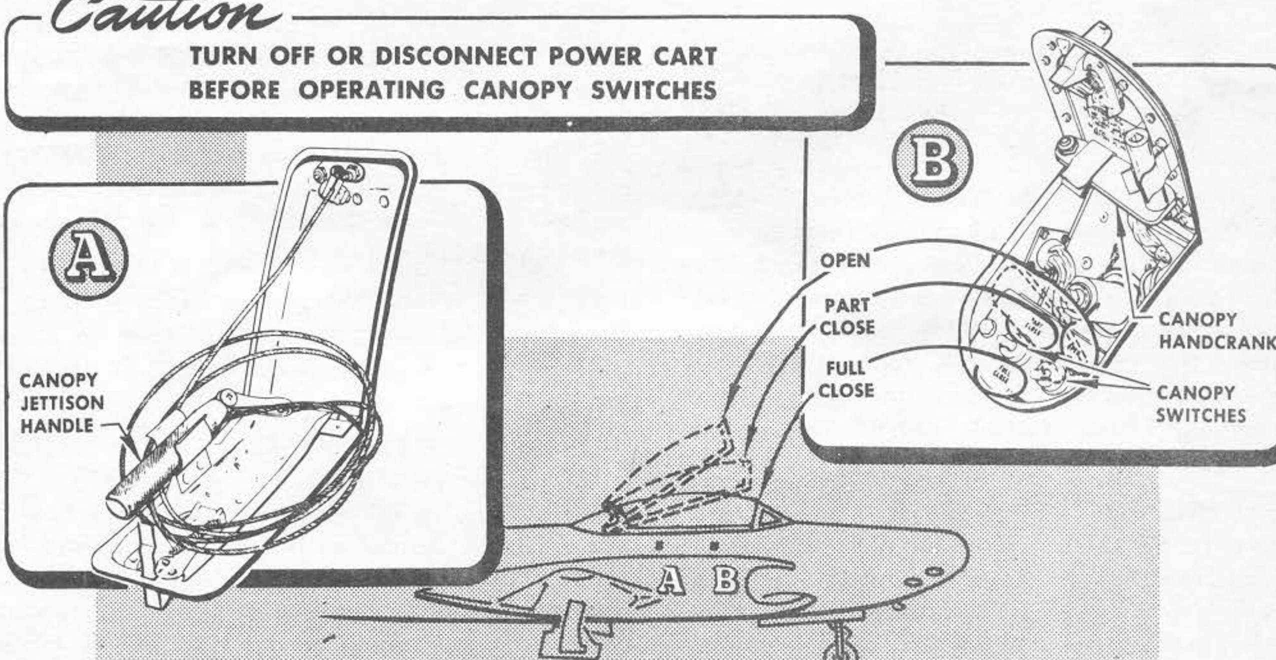

Figure 22 — External Canopy Controls

1–207. CANOPY CONTROLS.

1–208. CANOPY "OPEN" SWITCH. Canopy "OPEN" switches (6, fig. 12, 10, fig. 52 and fig. 22) are located on the right shelf in both cockpits and in the external well on the right side of the fuselage. The external switch, in addition to opening the canopy, is wired in such a way that it performs the same function as the battery master switch, hence, when it is in "OPEN" position it energizes the direct current bus. If an external power supply is connected and turned on when the switch is in this position, it will place the airplane batteries in parallel with the external power supply, a practice which is prohibited. This can be avoided by turning the cart off before operating the external canopy switches.

1–209. CANOPY "CLOSE" SWITCHES. Canopy close switches (7, fig. 12; 9, fig. 52 and fig. 22) are located next to the "OPEN" switches in each cockpit and in the external well. Each switch has three positions: "PART CLOSE," center Off, and "FULL CLOSE." The canopy must be lowered or partly closed before it can be fully closed in order to prevent fully closing the canopy before the other crew member is clear. However, caution must be exercised before operating the canopy to see that the cockpit sills are clear. After the canopy reaches the partly closed position, it may be fully closed by moving the switch to the "FULL CLOSE" position. The external "PART CLOSE"-"FULL CLOSE" switch will also connect the airplane batteries to the d.c. bus and will parallel the external power supply and the airplane batteries whenever it is placed in the "PART CLOSE" or "FULL CLOSE" positions.

1–210. CANOPY HANDCRANK. A handcrank for manual operation of the canopy is provided on the right side of the front cockpit and in the external well (Fig. 22).

1–211. CANOPY LOCK HANDLE. A canopy locking handle (fig. 4) is provided on the right side of each cockpit to lock the canopy closed during flight. The handle is pulled aft to lock and pushed forward to unlock. It is not necessary to unlock the canopy before jettisoning. The lock handle in the rear cockpit is normally stowed on the lower right canopy frame and must be removed and installed on the canopy locking handle drive when it is to be used.

1–212. CANOPY JETTISON LEVER. A canopy jettison lever (1, fig. 11) located on the right side of each cockpit, when pulled aft, jettisons the canopy by igniting a powder charge provided the safety pin has been removed. A handle attached to a coiled cable is stowed in the exterior well on the right side of the airplane for emergency jettisonning of the canopy when the airplane is on the ground. The cable is provided to permit operation from a safe distance.

1–213. CANOPY "UNLATCHED" WARNING LIGHT. A red light on the front cockpit instrument panel (14, fig. 10) glows when the canopy is unlocked, and is off when the canopy is locked.

1–214. EMERGENCY EQUIPMENT.

1–215. GENERAL.

1–216. EJECTION SEATS.

1–217. The pilot's and radar operator's bucket seats are the ejection type. They are non adjustable on Group (4) airplanes while the pilot's seat (only) is adjustable vertically on Group (5) airplanes. They are equipped with safety belts and inertia reel type shoulder harnesses. A multiple unit quick-disconnect fitting is provided on the front of the seats to automatically disconnect oxygen, radio and G suit lines when the seats are ejected. One safety pin (Fig. 24) is installed in each seat to prevent inadvertent ejection while on the ground. These pins must be removed prior to flight. An interlock mechanism between the canopy and seat ejection systems is installed to prevent the seats from being ejected before the canopy has been jettisoned.

1–218. EJECTION SEAT CONTROLS.

1–219. RIGHT ARM REST.

1–220. The right arm rest is hinged at the aft end and is folded down as shown on figure 23 when in the normal position. Raising this arm rest to the horizontal position arms the ejection mechanism.

1–221. EJECTION TRIGGER. The ejection seat trigger (Fig. 23) is located on the forward end of the right arm rest. After the arm rest is raised to the horizontal position, squeezing the trigger ejects the seat, provided that the canopy has been released and the seat catapult safety pin has been removed. The trigger is inoperative when the arm rest is in the normal position.

1–222. LEFT ARM REST. This arm rest is normally stowed in the folded position shown on figure 23. When raised to the horizontal position, it locks the shoulder harness.

1–223. SHOULDER HARNESS INERTIA REEL LOCK. A two-position (locked-unlocked) shoulder harness inertia reel lock (Fig. 23) is located on the left side of each seat. A latch is provided for positively retaining the lock handle at either position on the quadrant. By pressing down on the top of the control handle, the latch is released and the control handle may then be moved freely from one position to the other. When the control is in the unlocked position, the reel harness cable will extend to allow the occupant to lean forward in the cockpit, however, the reel will automatically lock when the airplane encounters an impact force of 2 to 3 G's. When the reel is locked in this manner, it will remain locked until the control handle is moved to the locked and then returned to the unlocked position. When the control is in the locked position, the reel harness cable is manually locked so that the occupant is prevented from bending forward. The locked position is used only when a crash landing is anticipated. This position provides an added safety precaution over and above that of the automatic safety lock.

1-224. OVERHEAT AND FIRE WARNING LIGHTS.

1-225. A tail section overheat warning light and plenum chamber fire warning light (12, fig. 10) (9, fig. 10) are located near the top center of the instrument panel. The overheat light may be operated by any one of several thermoswitches located in the tailpipe section. Operation of the light is an overtemperature warning which may indicate a fire, or may be caused by exhaust leakage at the tailpipe clamp, improper adjustment of the thermoswitch or a "short" in the circuit. The fire warning light is operated by thermoswitches in the plenum chamber (engine accessory section) and any overtemperature in this compartment would probably indicate a fire.

2-226. FIRE AND OVERHEAT WARNING CIRCUIT TEST SWITCH. The circuit test switch (11, fig. 10) is provided to permit testing the entire overheat and fire warning wiring up to, but not including, the thermoswitches. The switch has two positions: "NORMAL" and "TEST." When pushed to the "TEST" position, both warning lights should come on, indicating that the wiring is operative. The light filaments are checked by the standard push-to-test procedure.

1-227. AUXILIARY EQUIPMENT.

1-228. GENERAL.

1-229. Operational equipment, including cockpit heating and pressurization, oxygen, armament, lighting, and electronics is described in Section IV.

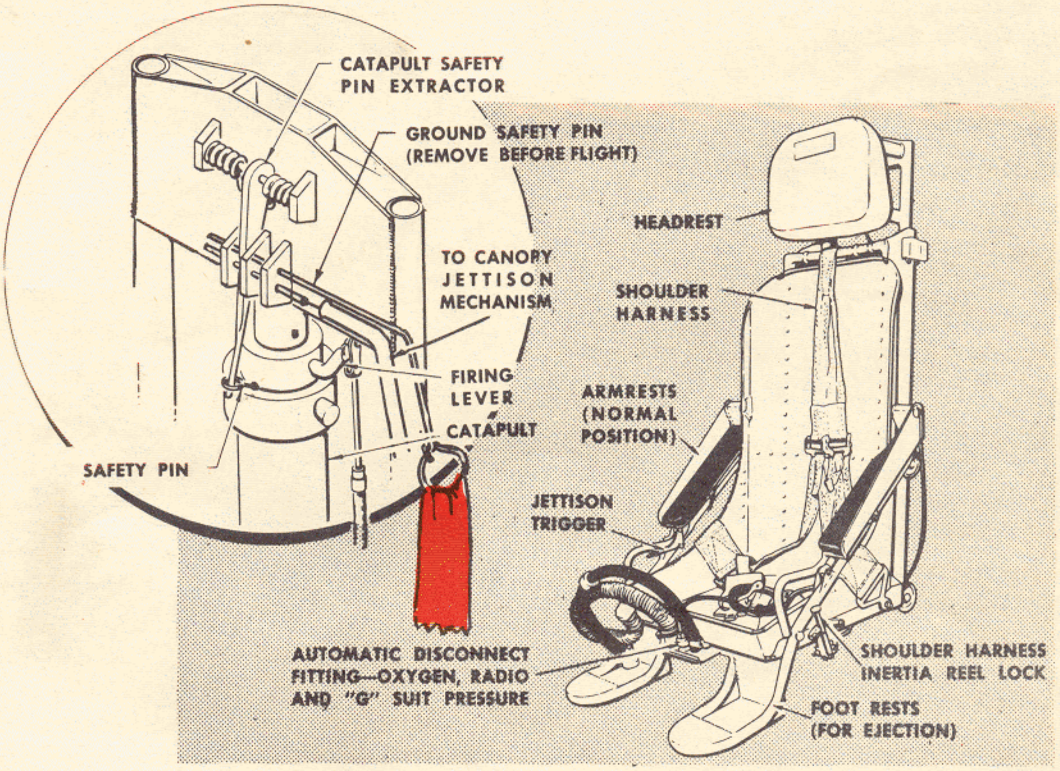

Figure 23 — Ejection Seat Controls


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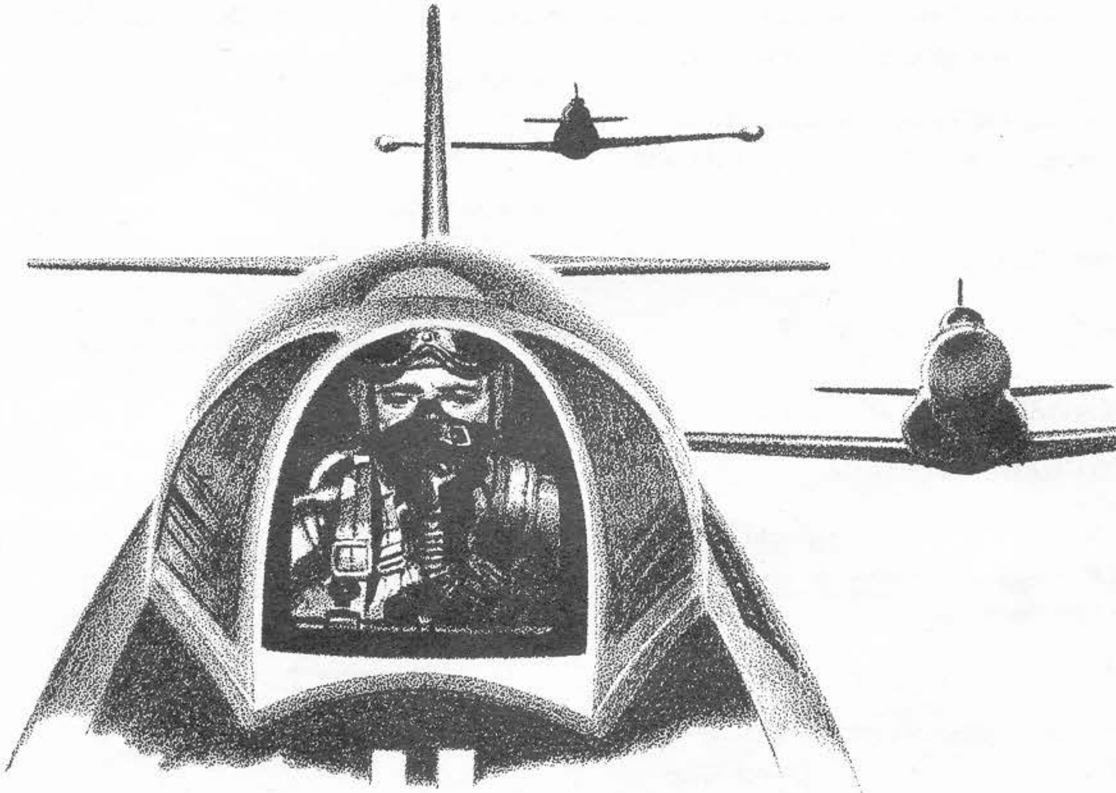


SECTION II

NORMAL OPERATING INSTRUCTIONS

2–1. BEFORE ENTERING THE AIRPLANE.

2–2. FLIGHT RESTRICTIONS.

2–3. Refer to Section VII for all operating limitations.

2–4. WEIGHT AND BALANCE.

2–5. See Handbook of Weight and Balance, AN 01-1B-40, and figure 56. The normal take-off gross weight with full load of ammunition is approximately 13,400 lbs. The maximum gross weight, with ammunition and full tip tanks, is approximately 16,775 lbs. The following ballast requirements are posted on the underside of the left armament door.

1. DROPPABLE WING TIP FUEL. A minimum of 150 rounds of expendable ammunition, or 50 pounds of ballast in the nose ammunition boxes is required when fuel is carried in the wing tip tanks.

2. MACHINE GUNS. For each machine gun removed from the nose, place 75 pounds of ballast in the ammunition box which fed the removed gun.

3. RADAR OPERATOR. When aft cockpit is unoccupied place 230 pounds of ballast in radar operator's seat or 60 pounds of ballast in nose ammunition boxes.

2–6. PRE-INSPECTION CHECK.

2–7. Check the following:

a. Form 1 for engineering status and make sure the airplane has been serviced with the required amount of ammunition, fuel, oil, hydraulic fluid, and oxygen.

b. That the weight and balance clearance (Form F) is satisfactory. Refer to AN 01-1B-40 for weight and balance data.

2–8. EXTERIOR CHECK.

2–9. Make this check as shown on figure 24.

2–10. ON ENTERING THE AIRPLANE.

2–11. HOW TO GAIN ENTRANCE.

2–12. If a ladder is not available, climb onto the right wing over the leading edge. Operate the canopy switch (figure 22) to raise the canopy.

DO NOT OPERATE CANOPY SWITCH WHILE EXTERNAL POWER CART IS TURNED ON OR THE AIRPLANE BATTERIES MAY BE DAMAGED!

2–13. INTERIOR CHECK (ALL FLIGHTS).

2–14. FRONT COCKPIT.

a. If the flight is to be solo, check rear cockpit for oxygen "OFF" and for security of all loose equipment such as seat belt, harness, and connectors for oxygen, anti-G suit, and radio.

b. Power cart—connected and "OFF."

c. Battery master switch—"OFF."

d. Shoulder harness and safety belt secured and shoulder harness inertia reel lock —unlocked.

e. Adjust seat height. (Group (5) airplanes only).

f. Surface control lock—remove and stow.

g. Rudder pedals—adjust to suit leg length.

h. Parking brake—set.

TO APPLY PARKING BRAKE, ALWAYS APPLY TOE PEDAL PRESSURE FIRST, THEN PULL OUT PARKING BRAKE HANDLE. APPLYING TOE PRESSURE WITH THE BRAKE HANDLE PULLED OUT, OR PARTIALLY PULLED OUT, WILL DAMAGE BRAKE PISTON SEAL!

i. Landing gear selector—"DOWN."

j. Oxygen regulator diluter lever—"NORMAL OXYGEN."

k. Oxygen cylinder pressure gage — approximately 1800 psi.

l. Oxygen warning system switch—"ON."

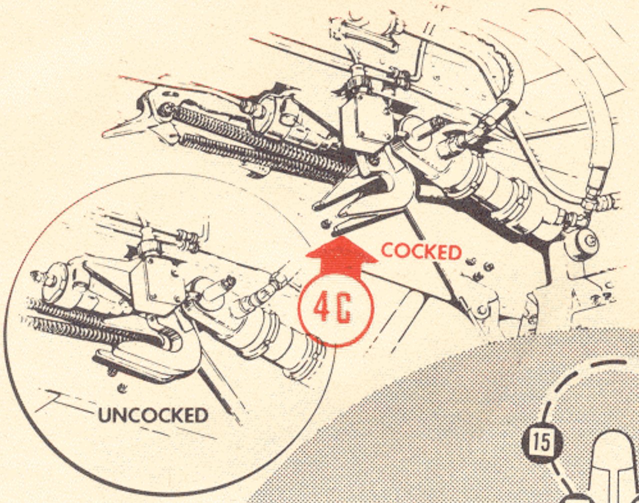
m. Regulator supply valve lever—"OFF."

n. Remove caution tag and pin assembly from the H-2 oxygen cylinder.

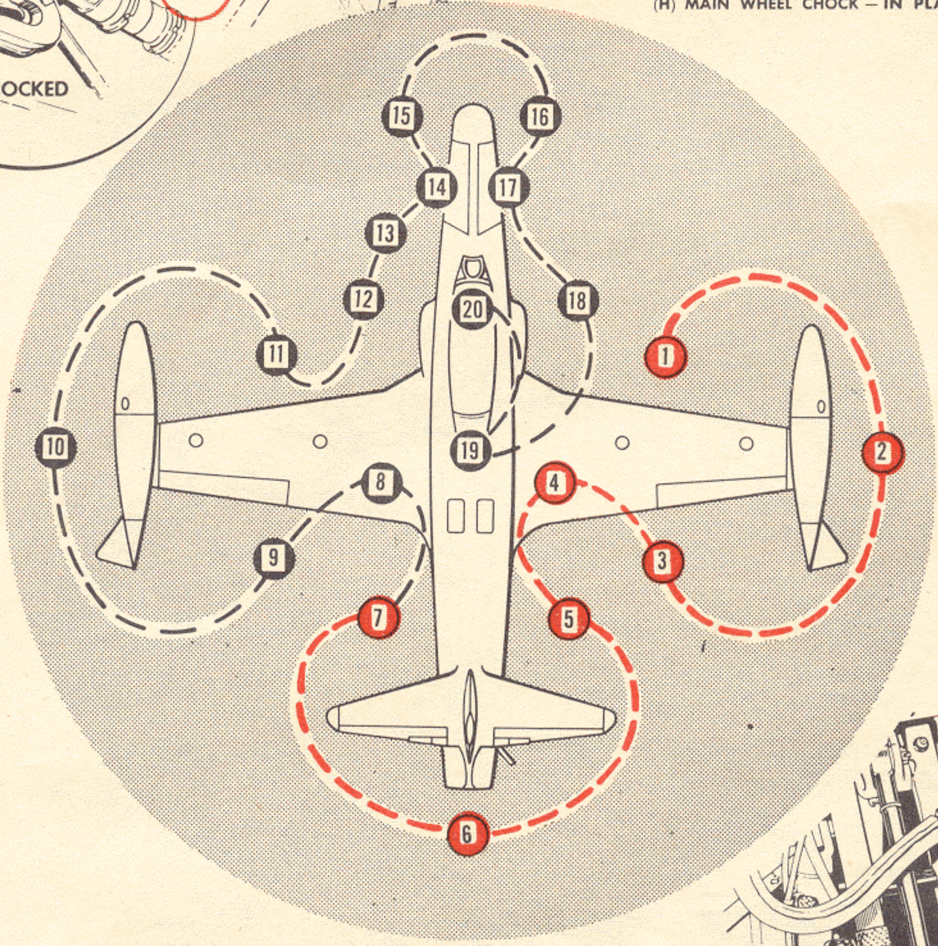
o. Left circuit breakers—check (in).

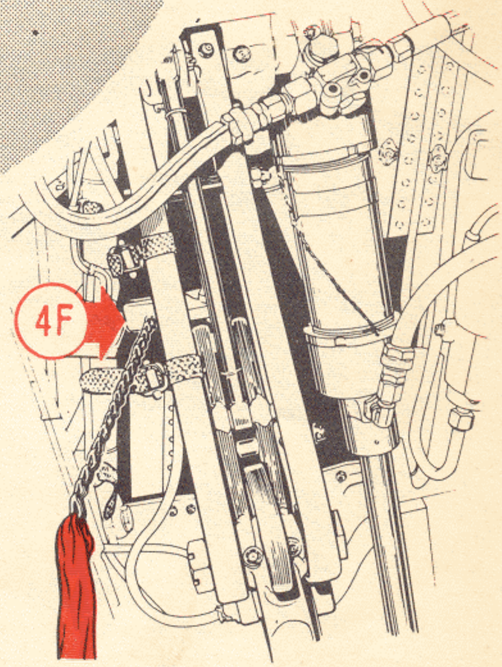
p. Armament switches—"OFF."

q. Fuel tank switches—"OFF."



1. WING FUEL TANK FILLER CAPS — SECURED
2. (A) TIP TANK AND FAIRING — SECURED
   (B) TIP TANK FILLER CAP — SECURED
   (C) POSITION LIGHT — CONDITION
3. WING, AILERON, TAB AND FLAPS — CONDITION
4. (A) LANDING GEAR WHEEL AND DIVE FLAPS — CONDITION (FUEL LEAKS RIGHT WHEEL WELL)
   (B) JATO BOTTLES — SECURED AND NOZZLES CLEAR
   (C) LANDING GEAR WHEEL WELL DOOR UPLOCK — COCKED
   (D) LANDING GEAR SHOCK STRUT — INFLATION
   (E) LANDING GEAR TIRE — INFLATION
   (F) SAFETY CLIP — REMOVED
   (G) DIVE FLAP HYDRAULIC CYLINDER PIN — INSTALLED
   (H) MAIN WHEEL CHOCK — IN PLACE





5. ENGINE ACCESS DOORS — SECURED
6. (A) AFTERBURNER, EYELIDS, AND TAILPIPE — CONDITION (CRACKS AND WRINKLES)
   (B) ELEVATOR TABS — CHECK FOR EXCESSIVE PLAY
   (C) RUDDER BEND TAB — CONDITION
   (D) FUEL TANK VENT — CLEAR
   (E) EMPENNAGE — CONDITION
7. ENGINE ACCESS DOORS — SECURED

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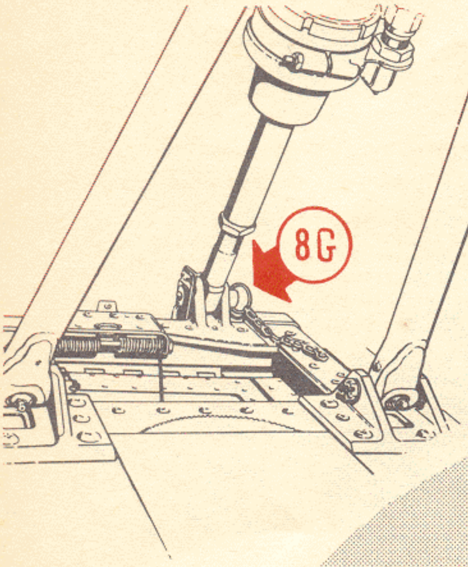
Figure 24 (Sheet 1 of 3 Sheets) — Exterior Inspection Diagram

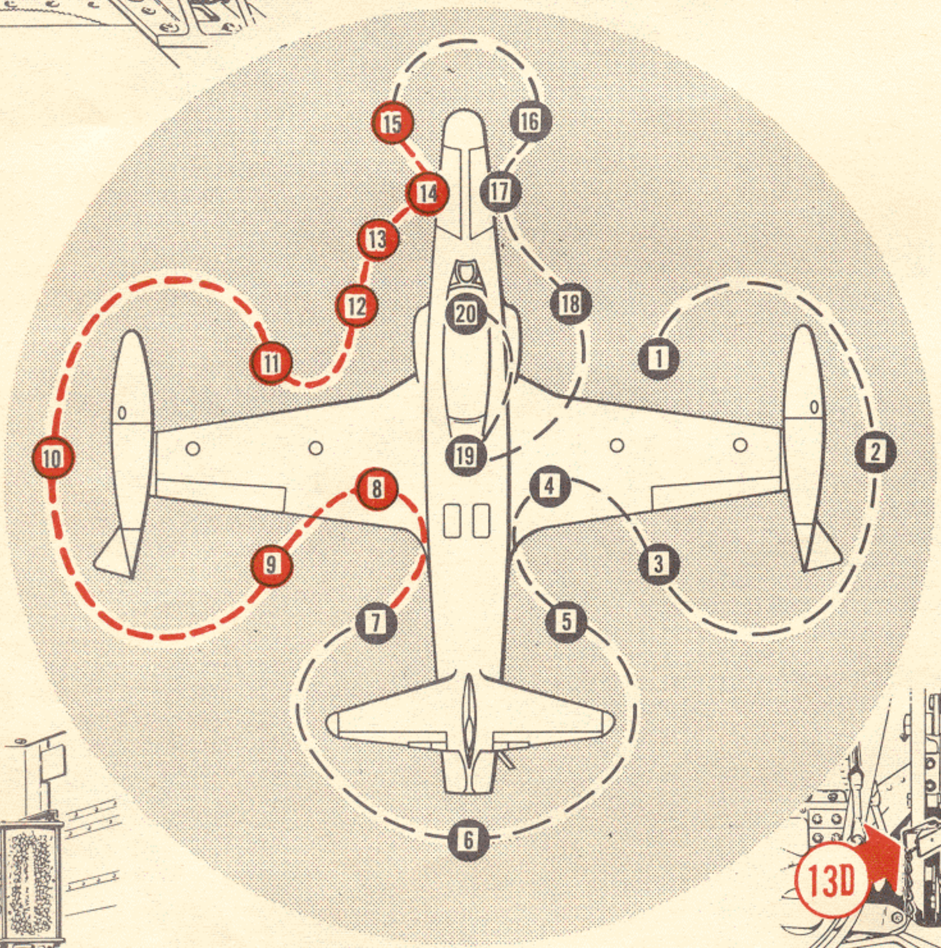


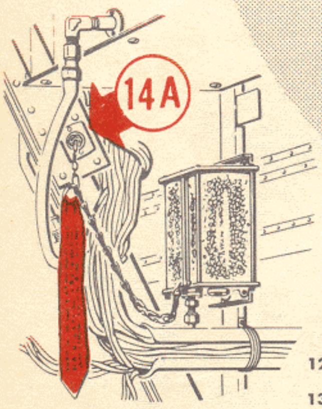
8. (A) LANDING GEAR WHEEL AND DIVE FLAPS—CONDITION
(B) JATO BOTTLES—SECURED AND NOZZLES CLEAR
(C) LANDING GEAR WHEEL WELL DOOR UPLOCK—COCKED
(D) LANDING GEAR SHOCK STRUT—INFLATION
(E) LANDING GEAR TIRE—INFLATION
(F) SAFETY CLIP—REMOVED
(G) DIVE FLAP HYDRAULIC CYLINDER PIN—INSTALLED
(H) MAIN WHEEL CHOCK—IN PLACE

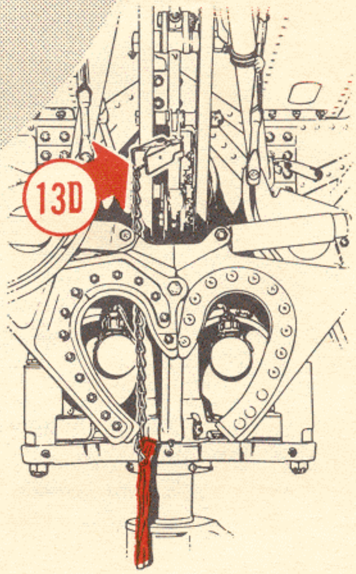
9. WING, AILERON, TAB AND FLAPS—CONDITION

10. (A) TIP TANK AND FAIRING— SECURED
(B) TIP TANK FILLER CAP— SECURED
(C) POSITION LIGHT—CONDITION

11. WING FUEL TANK FILLER CAPS— SECURED







12. AIR INTAKE DUCT—COVER REMOVED

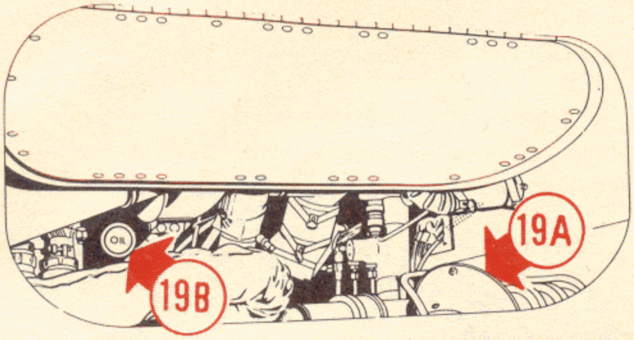
13. (A) NOSE WHEEL WELL—CONDITION
(B) NOSE WHEEL SHOCK STRUT—INFLATION
(C) NOSE WHEEL TIRE—INFLATION AND SLIPPAGE
(D) NOSE WHEEL SAFETY CLIPS—REMOVED

14. (A) RADAR DESSICATOR PLUG—REMOVED AND STOWED
(B) ARMAMENT COMPARTMENT—CONDITION AND HOOD SECURED

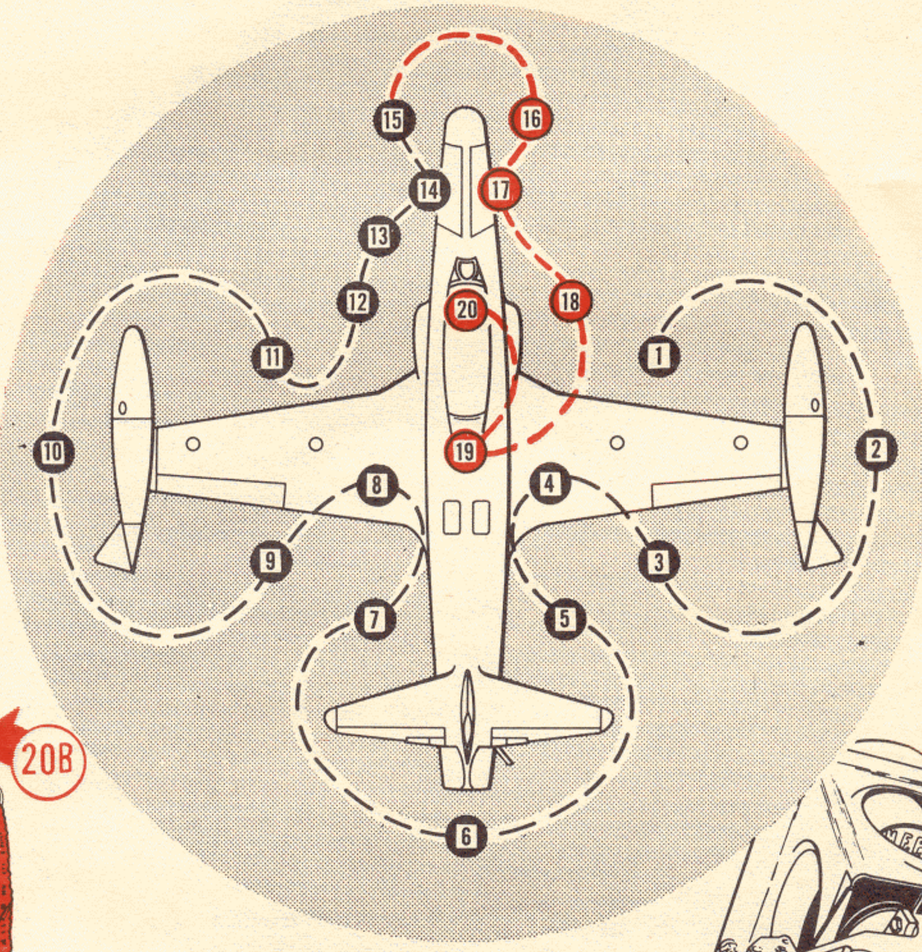
15. (A) STATIC SOURCES—CLEAR
(B) PITOT COVER—REMOVED

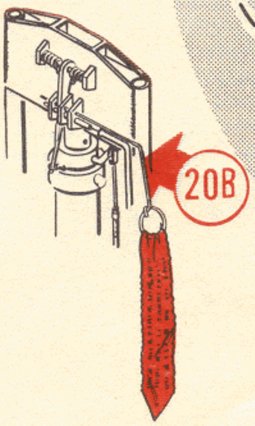
AB 2816

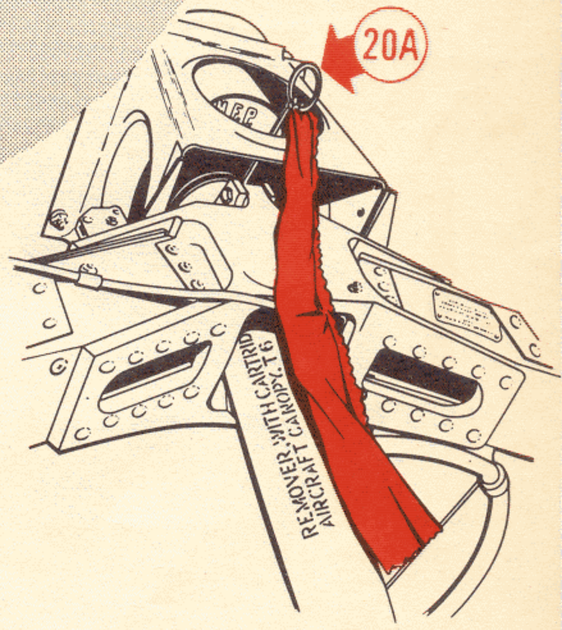
Figure 24 (Sheet 2 of 3 Sheets) — Exterior Inspection Diagram



16. STATIC SOURCES — CLEAR
17. ARMAMENT COMPARTMENT — CONDITION AND HOOD SECURED
18. AIR INTAKE DUCT — COVER REMOVED







19. FUSELAGE FUEL TANK FILLER CAP — SECURED
PUSH OPEN THE SPRING LOADED ENGINE COMPARTMENT DOORS
(A) ALCOHOL TANK FILLER CAP — SECURED
(B) ENGINE OIL TANK FILLER CAP — DIP STICK — SECURED
(C) HYDRAULIC OIL RESERVOIR CAP — SECURED
(D) ENGINE COMPARTMENT — CONDITION

20. (A) CANOPY GROUND SAFETY PIN — REMOVED
(B) EJECTION SEAT SAFETY PINS — REMOVED

AB 2817

Figure 24 (Sheet 3 of 3 Sheets) — Exterior Inspection Diagram

r. Cockpit air valves shut-off switch—"PRESSURE."

s. 115 volt a.c. switch—"OFF."

Note

This must be done to avoid overloading the battery cart.

t. Afterburner "eyelid" control switch—"AUTO."

u. Afterburner shut-off switch—"ON."

v. Main fuel shut-off valves switch—"OPEN."

w. Wing flaps switch—"UP."

x. Aileron booster lever—"ON."

y. Hydrofuse reset lever—check.

z. Alternator switch—"OFF" (on airplanes equipped with de-icer boots).

aa. Wing heat switch—"OFF" (on airplanes equipped with de-icer boots).

ab. Clock—set.

ac. Altimeters—set.

ad. Instrument power switch—"NORMAL."

ae. Fuel quantity counter—check that it is set to the amount of fuel on board.

af. JATO arming switch—"OFF."

ag. Battery master switch—check "OFF."

ah. Generator switch—check (normally "ON" at all times).

ai. Pitot heat switch—"OFF."

aj. Radar and radio switches—"OFF."

ak. Right circuit breakers—check (in).

al. Emergency hydraulic system selector lever — "NORMAL."

am. External power cart—"ON."

an. All warning and indicator lights—push to test lamps.

ao. Flashlights—stowed.

ap. Zero Reader Checks.

1. Check that the heading selector compass needle reading corresponds to approximately the same reading as the standby magnetic compass.

2. Set the selector switch to the "FLIGHT INST." position.

3. By means of the heading selector knob on the heading selector, align the heading selector (double needle) with the compass needle. When the flags disappear, indicating that the quick erector had completed its cycle, the vertical bar on the Zero Reader indicator should read zero.

4. Set the altitude control switch to the "OFF" position; the green light at the lower left corner should glow. Leave the altitude control switch "OFF."

5. Set the heading selector (double needle) to a heading 10 degrees to the right of the adjustment made in step 3. Note the amount of deflection on the vertical bar of the Zero Reader indicator. Set the heading selector (double needle) 10 degrees to the left and note that the vertical bar deflects a comparable amount to the left. Again set the heading selector (double needle) to the heading called for in step 3.

6. Zero the horizontal bar of the Zero Reader indicator by manipulating the pitch attitude trim knob on the lower left corner of the indicator. This is a check to determine that the pitch attitude trim potentiometer is functioning.

7. Turn instrument approach receiver selector switch to the channel of the localizer on the field and set the Zero reader selector switch to "APPROACH." This will cause the vertical bars of both the ILS deviation (crosspointer) indicator and the Zero Reader indicator to deflect left or right, depending upon the location of the airplane with relation to the beam.

2-15. REAR COCKPIT.

a. Shoulder harness and safety belt secured and shoulder harness inertia reel lock—unlocked.

b. Oxygen regulator diluter lever—"NORMAL OXYGEN."

c. Oxygen cylinder pressure gage—approximately 1800 psi.

d. Oxygen warning system switch—"ON."

e. Regulator supply valve lever—"OFF."

f. Remove caution tag and pin assembly from H-2 oxygen cylinder.

g. Radar controls—as required.

2–16. INTERIOR CHECK (NIGHT FLIGHTS).

a. Landing and taxi lights switch—test (five seconds maximum for test).

b. Ultraviolet and red lights—test.

c. Navigation lights—test.

d. Fuselage lights—test.

e. Instrument panel lights—test.

f. Side panel lights—test.

2–17. STARTING THE ENGINE.

WARNING

After any ten hot starts, the J33-A-33 engine shall be inspected. A hot start is one in which the exhaust temperature exceeds 1000° C (1832° F). Ten hot starts constitute an inspection requirement regardless of the time lapse between the starts and, therefore all over-temperature operation must be entered in the Form 1.

WARNING

If the exhaust tail pipe temperature reaches 900° C and stays there for 5 seconds shut down the engine. If the cause of the high temperature start is known, correct it, otherwise repeat the start. If 900° C, 5 second limit is exceeded on the second start, shut down the engine. The engine should be checked for malfunction before attempting another start.

a. Throttle—"OFF."

b. Main fuel shut-off valves switch—"OPEN" (guard down).

c. Ignition switch—check "NORMAL."

d. Fuel tank switches—On (up). (See paragraphs 2–45—2–48.)

WARNING

Be sure the areas shown on figure 25 are clear of personnel and equipment before starting.

2–18. AUTOMATIC START.

a. Starter switch—"START" (hold for 3 seconds, then release).

CAUTION

The starting motor should bring the engine up to about 10% rpm. Do not attempt to start the engine below 9% rpm as a hot start will result. If 9% rpm cannot be obtained, push the starter switch to the "STOP-START" position and release. Then secure an adequate source of auxiliary power prior to attempting a restart.

b. Starting fuel switch—"AUTO" at not less than 9% rpm. The engine should start and accelerate automatically to a stabilized speed of approximately 30-35% rpm. If ignition does not occur within ten seconds after the starting fuel switch is turned to the "AUTO" position, turn starting fuel switch to "OFF" and push starter switch to "STOP-START" and allow the engine to stop turning. Before attempting another start accomplish the following:

1. Wait until all fuel has drained out of the tailpipe drain. Do not pull the tail down as this will cause fuel to collect in the afterburner section.

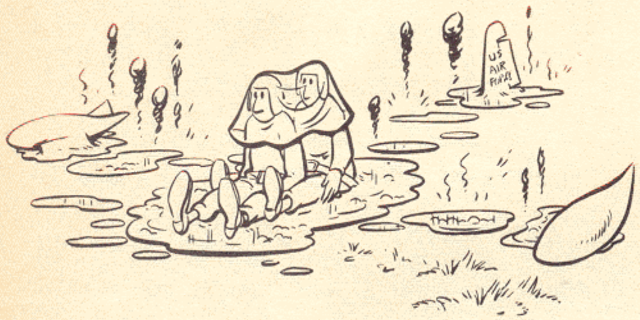
2. Turn ignition switch "OFF" and clear out vapor by turning the engine with the starter.

3. Check ignition before restarting.

CAUTION

These steps are necessary to prevent the possibility of an inadvertent explosion in the tailpipe.

WARNING



If exhaust temperature reaches 1000°C and stays there for more than 3 seconds, turn the starting fuel switch to "OFF" immediately and push the starter switch to the "STOP-START" position.

c. Throttle—"IDLE" (at 30-35% rpm). This automatically transfers engine fuel operation from the automatic starting system to the main system.

d. Starting fuel switch—"OFF" (push guard down).

2-19. MANUAL START.

2-20. GENERAL. Both engine-driven pumps are required to supply sufficient fuel during manual starting procedure. Since the main fuel control has very erratic metering characteristics in the low engine speed range from 9 to 23% rpm, it is imperative that the main fuel control be by-passed as soon as the engine has started by turning "OFF" the starting fuel switch with the emergency fuel switch in "EMER" position.

2-21. PROCEDURE.

a. Emergency fuel switch—"EMERGENCY."

b. Starter switch—"START" (hold 3 seconds, then release).

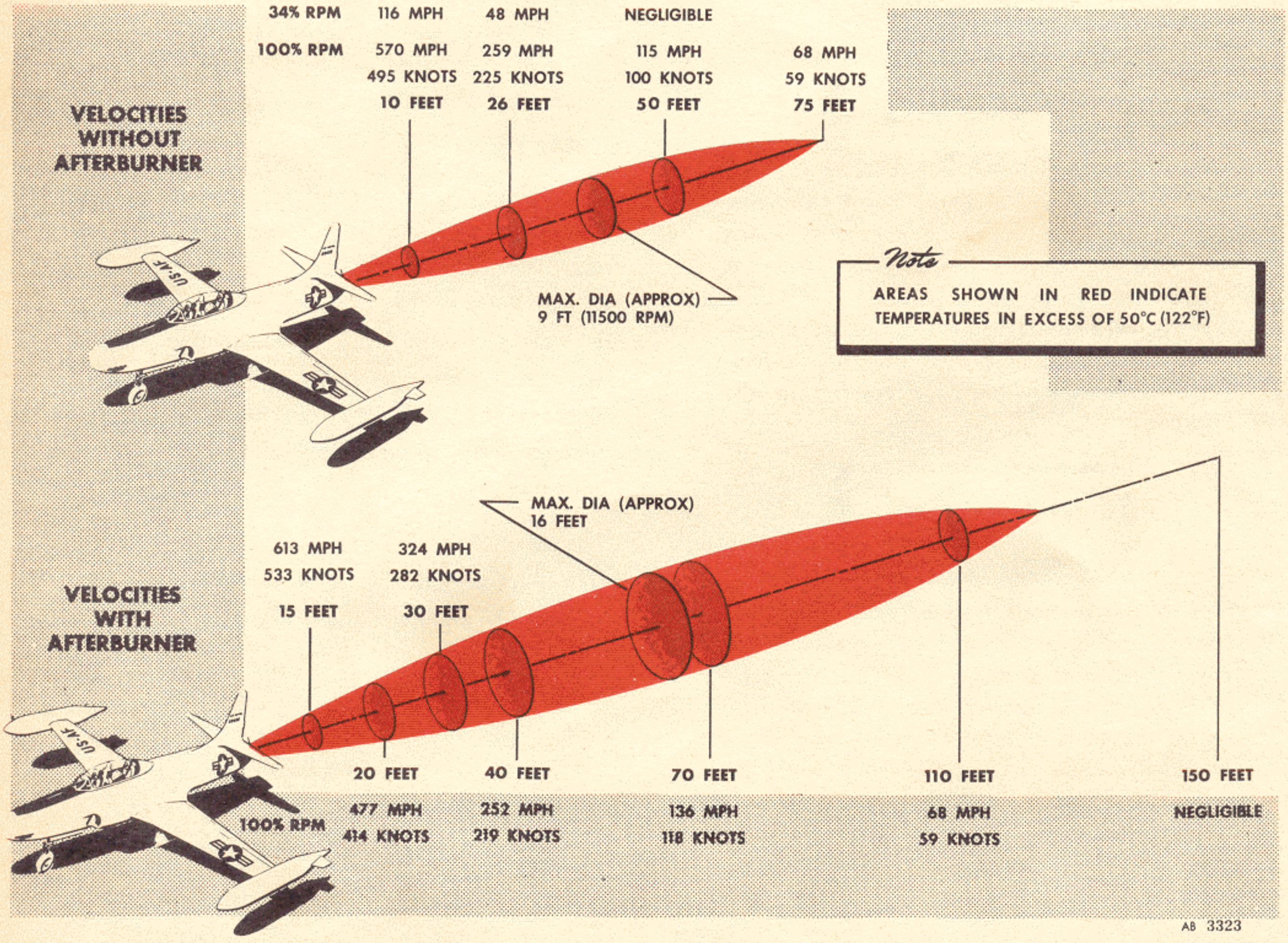


Figure 25 — Danger Areas

c. Starting fuel switch—"MANUAL."

d. At maximum attainable rpm (not less than 9%), move throttle to the "FULL" open position, and as soon as fuel pressure starts to build up, retard the throttle quickly to the "IDLE" position to prevent the tailpipe temperature from exceeding the limit.

e. As soon as the combustion rumble is heard or exhaust temperature begins to rise, turn the starting fuel switch "OFF."

Note

It is recommended that the starting fuel switch be turned "OFF" by pushing the guard down. This avoids the possibility of accidentally turning to the "AUTO" position.

f. If ignition does not occur within 3 seconds after the throttle is opened, return the throttle to "OFF" and push the starter switch to the "STOP-START position.

g. After the engine starts, adjust throttle as required to hold the temperature below 900°C. Try to hold the temperature between 800° and 900°C until the engine reaches idle rpm. It may be necessary to pull the throttle back slightly beyond the "IDLE" position to keep from overheating during the start; however, use care to prevent going to the full "OFF" position.

h. Accelerate the engine to about 80% rpm.

i. Retard the throttle rapidly, and at the same time turn the emergency fuel switch "OFF" to return the engine to the main fuel system. This will accomplish the changeover smoothly. Check that the red emergency warning light comes on and that the amber light goes off.

Note

Do not disconnect the external power supply until the emergency fuel switch is in the "OFF" position. The premature interruption of current to the solenoid-operated main and emergency by-pass valves will admit excessive fuel to the engine with the possibility of a tail-pipe temperature surge occurring.

2–22. AT IDLING SPEED (34% rpm) ACCOMPLISH OR CHECK THE FOLLOWING:

a. External power supply—disconnect.

b. Battery master switch—"ON."

c. 115 volt a.c. switch—"ON."

d. Fuel pressure—within normal operating range.

e. Oil pressure—2 psi minimum.

f. Generator loadmeter—indicating.

2–23. INSTRUCTIONS IN CASE OF FIRE.

2–24. Refer to paragraph 3–20.

2–25. GROUND TESTS.

Note

No warm-up is required. If oil pressure is up and 100% rpm can be obtained, the engine is ready for take-off.

2–26. EMERGENCY FUEL SYSTEM CHECK.

a. Emergency fuel switch—"OFF."

b. Run the engine up to 40-60% rpm.

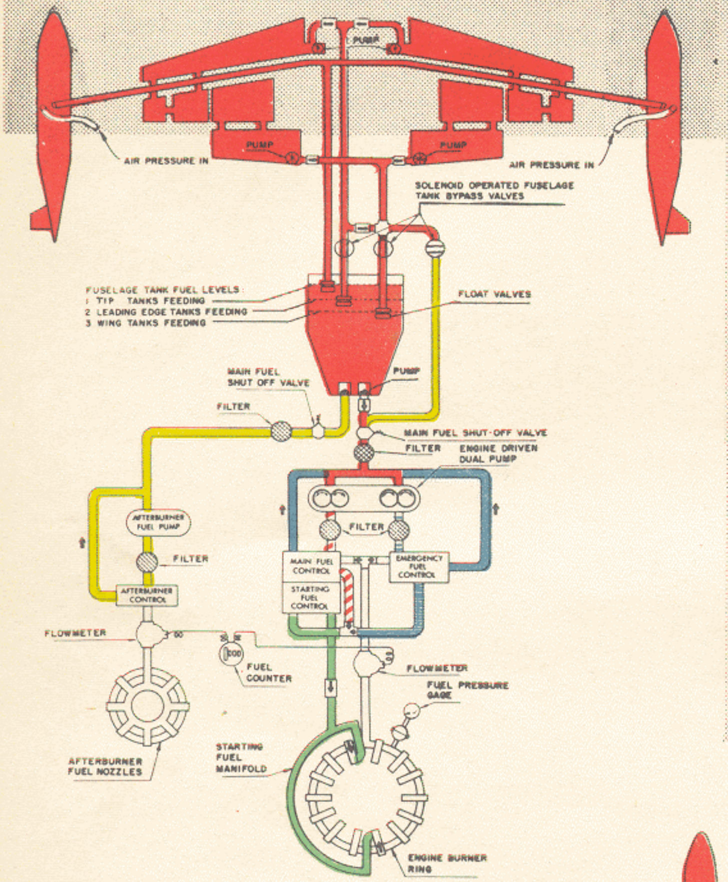
c. Stop movement of the throttle in this range.

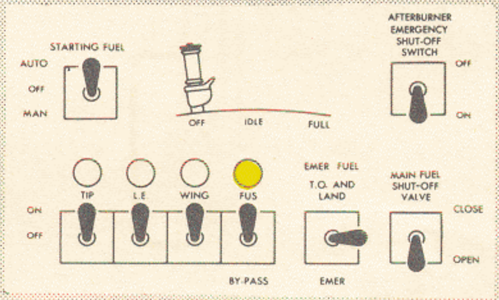
d. Move the emergency fuel system check-out switch and hold. When the engine changes over to the emergency fuel system, the green and amber emergency fuel indicator lights will come on. The red emergency fuel indicator light will stay on.

Note

At this point you can either return to the normal fuel system as explained in paragraph e. following, or advance the throttle to determine the maximum power available if you so desire. However, the tailpipe temperature must be maintained within limits by means of the throttle as the main fuel control unit is not operating.

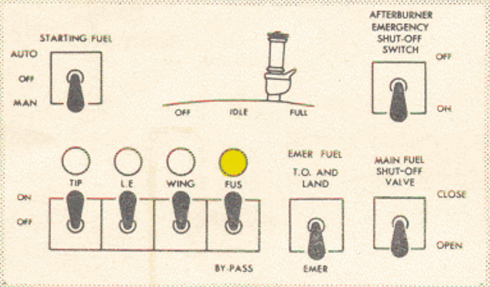
e. Release the emergency fuel check-out switch while rapidly retarding the throttle from about 80% rpm. This must be done to return the engine to the main fuel system. When the engine returns to the main fuel system, the green and amber lights will go out and the red light will stay on.





STARTING FUEL FLOW — (AUTOMATIC)

Starting fuel switch to *"AUTO"* at 9-10% rpm. Fuel is directed to burners number 7 and 14 until ignited and then to all burners automatically by the starting fuel control. Starting fuel switch *"OFF"* after throttle is moved to *"IDLE"* at 30-35% rpm.



STARTING FUEL FLOW — (MANUAL)

Fuel is directed to all burners from main and emergency fuel control when throttle is opened (3/4). Starting fuel switch *"OFF"* as soon as ignition is heard. Engine is accelerated on emergency fuel control.

- NORMAL FUEL SUPPLY
- BY-PASS FUEL
- MAIN PUMP FUEL FLOW
- EMERGENCY PUMP FUEL FLOW
- STARTING FUEL FLOW
- STATIC FUEL

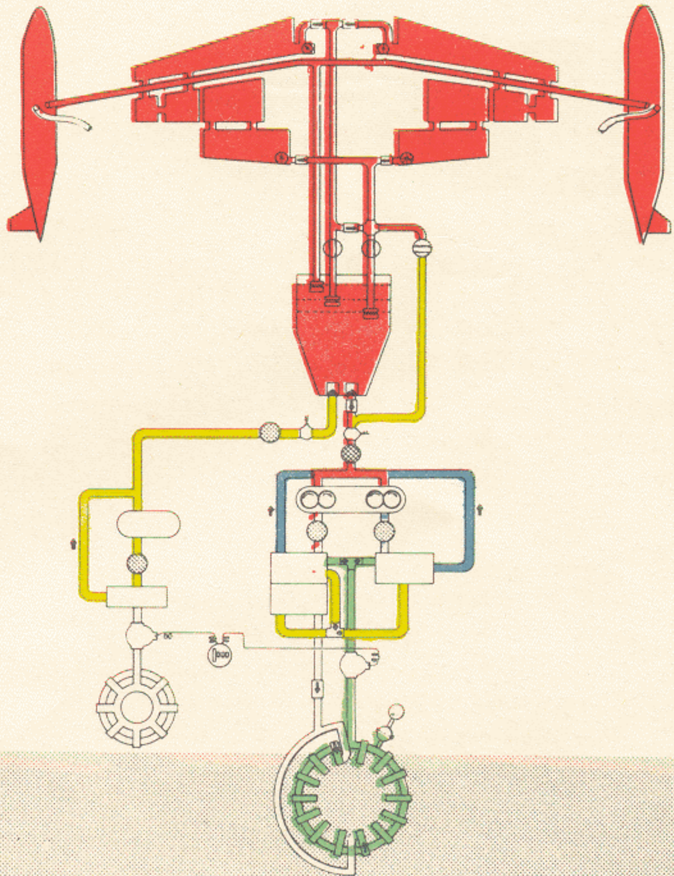
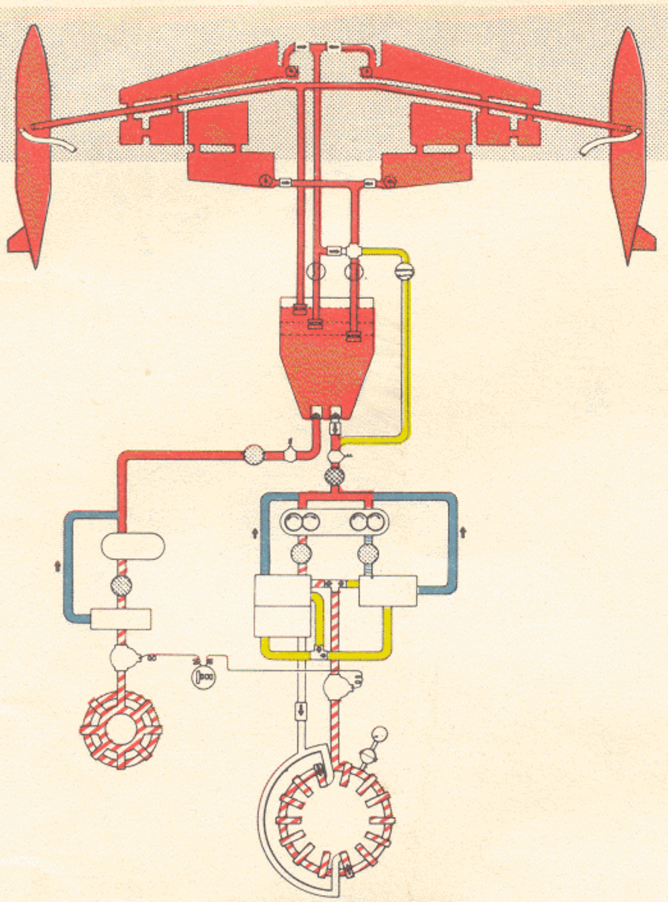
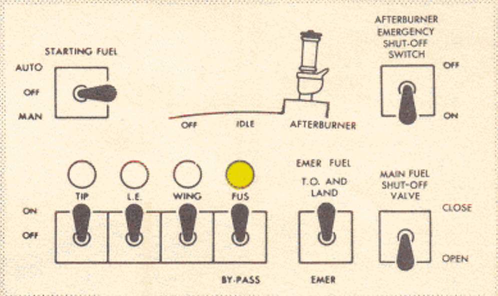


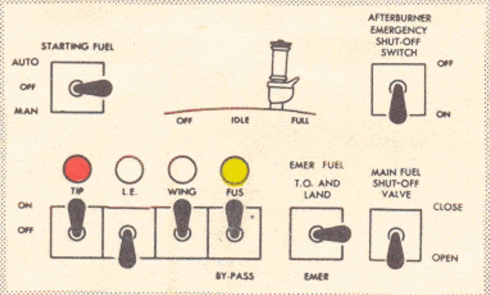
Figure 26 (Sheet 1 of 2 Sheets) — Courses of Fuel Flow





TAKE-OFF FUEL FLOW

Fuel flow thru main pump and afterburner pump to burner rings. Emergency pump output is by-passed. Emergency fuel pressure switch is energized, as safeguard against main pump failure.



CRUISE AND LANDING FUEL FLOW

As fuselage tank level drops the upper float valve opens until each succeeding tank group is empty. Turn each tank group switch *"OFF"* (except tip tank and fuselage tank switches which remain on throughout flight) as indicator light above comes on. Emergency fuel switch in *"T.O. AND LANDING"* position for landing.

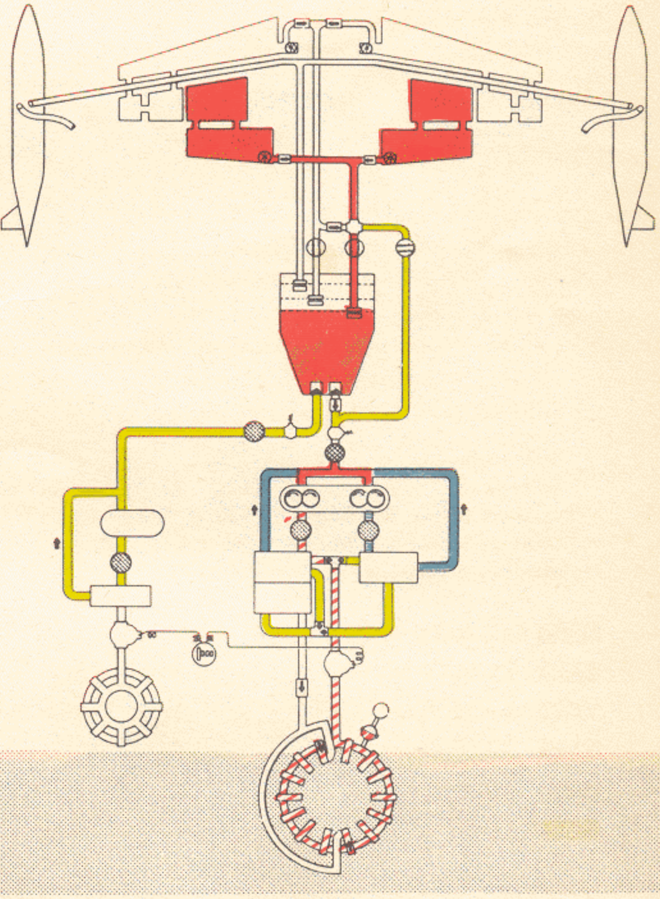


Figure 26 (Sheet 2 of 2 Sheets) — Courses of Fuel Flow

2-27. OTHER GROUND CHECKS.

a. Aileron and elevator tabs.—Check operation and set in neutral position.

b. Dive flaps.—Check operation (be sure ground crew is clear of the flaps) and return to the up position.

c. Wing flaps.—Check operation and set 70% (31.5°).

d. Instrument inverters.—Check that the warning light does not light when the instrument power switch is in either the "NORMAL" or "STANDBY." Return switch to "NORMAL."

e. Cockpit air shut-off valves switch.—"PRESSURE."

f. Radar.—Check as required and leave "ON."

g. Guns-camera switch.—"SIGHT and CAMERA" and check operation of gunsight.

h. Communication equipment.—Check.

i. Put on oxygen mask and turn oxygen regulator supply valve lever "ON." Push down "EMERGENCY" button to test mask.

2-28. TAXIING INSTRUCTIONS.

2-29. GENERAL.

2-30. After the brakes are released the airplane will start to move when the engine speed is increased to about 55% rpm. Forward movement should be maintained if on soft ground or when making turns of short radius since it is difficult to start moving under these conditions. Brakes must be used for steering.

2-31. Taxi time should be cut to the absolute minimum. A good rule to remember is: Every minute spent on the ground taxiing requires between 3 and 4 gallons of fuel or subtracts about 7 miles from the cruising range of the airplane.

2-32. For taxiing at night, place the landing-taxi lights switch in the "TAXI" position. For take-off and landing place this switch in the "LANDING LIGHT" position. Be sure to turn the lights "OFF" as soon as the gear is retracted to prevent their burning out.

CAUTION

Don't leave landing lights on longer than 5 minutes while on ground.

EVERY MINUTE SPENT ON THE GROUND SUBTRACTS 7 MILES FROM YOUR CRUISING RANGE AT ALTITUDE!

2-33. BEFORE TAKE-OFF.

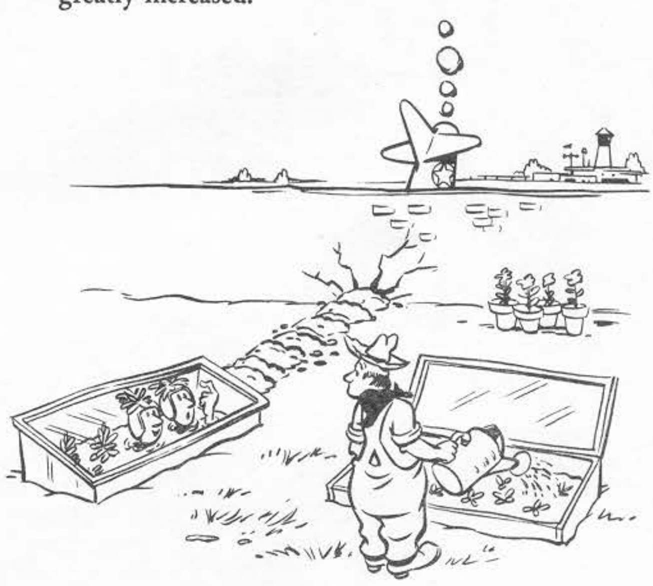
2-34. CHECK THE FOLLOWING:

a. Shoulder harness and safety belt—Tight. Inertia reel lock control—Unlocked.

b. Wing flaps—Check setting at 70%. (31.5°)

WARNING

Never take off with the wing flaps retracted as the required take-off run and airspeed are greatly increased.



CHECK RUNWAY LENGTHS IN APPENDIX I !

c. See Appendix I for take-off distances.

d. It is advisable to use neutral elevator tab if full tip tanks are carried. Use nose up tab if the tip tanks are off or empty.

e. Canopy—Close and lock as follows:

1. Notify the other crew member that the canopy is to be closed and wait for confirmation that he is clear before closing.

CHECK BOTH COCKPIT SILLS BEFORE CLOSING CANOPY!

2. Check that both cockpit sills are clear of foreign objects.

3. Hold the canopy close switch in the "PART CLOSE" position until canopy stops moving.

4. Check that the crew is clear and move the switch to the "CLOSE" position.

5. After the canopy is closed, pull the locking lever aft and see that the red warning light goes out.

f. Surface controls—Check for freedom of operation and proper direction of movement.

g. Taxi a few feet straight down the runway so that the nose wheel will be centered when the brakes are completely released.

h. Emergency fuel switch—"TAKE-OFF & LAND."

WARNING

Check that the emergency fuel system green indicator light is on and that the red and amber lights are out.

i. JATO arming switch—"up" (if JATO is to be used), and check that JATO ready indicator light glows.

j. Tip tank jettison "ready" switch—"READY."

k. Hold the brakes.

l. Throttle—Open. Observe the tailpipe temperature and check to see that the instruments are in the desired ranges and that the loadmeter is indicating.

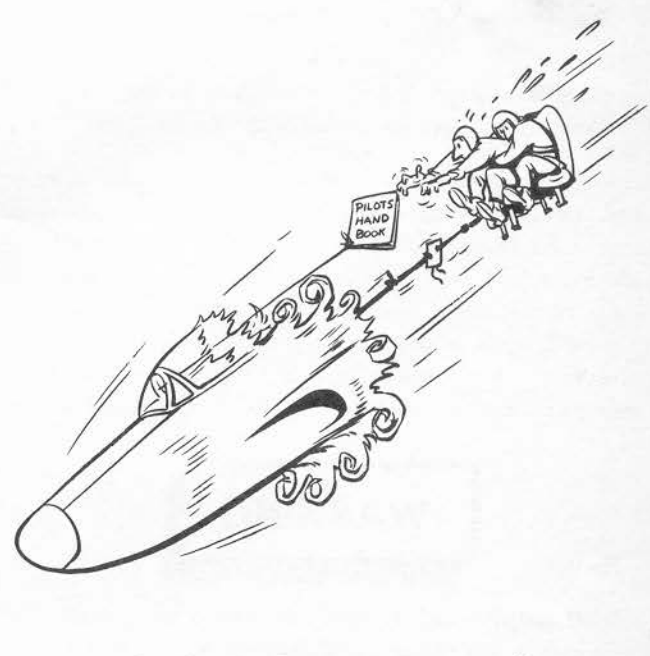
Note

Because of the tolerance allowed in the governor, the engine may turn up between 98.5 and 101.5% rpm. Although 100% is the normal full throttle maximum, any value between 98.5 and 101.5% is acceptable for take-off so long as the stable tailpipe temperature does not exceed 720°C maximum.

WARNING

If the engine controls allow the preceding limits to be exceeded, the pilot should retard the throttle as necessary. Exceeding these limits will adversely affect engine strength and general safety.

1. If afterburning is to be used for take-off, a minimum of 98% rpm must first be obtained to assure a



DO NOT OVERSPEED THE ENGINE!

smooth afterburner start. Since the engine rpm will lag behind the throttle movement if the throttle is advanced rapidly, it is recommended that 98% rpm be attained before the throttle is pushed into the afterburner slot.

2–35. TAKE-OFF.

2–36. JATO TECHNIQUE.

Note

Before using JATO you should check the weight and balance to make sure that the static loading limits are not exceeded. Remember that the JATO bottles move the c.g. 2% aft. Have the c.g. as far forward as practical because the low thrust line of the JATO power shifts the "effective" c.g. farther aft. This means that the stick forces will be very light and that the "nosing up" tendency at the instant of take-off will be more pronounced. You must take prompt corrective action to prevent the tail from striking the runway or to prevent a possible stall, but be careful not to overcontrol because of the light stick forces.

2–37. Take-off performance will depend somewhat upon the JATO firing point (See Appendix I for take-off distances and JATO firing points). Minimum ground roll will be obtained when the units are fired shortly after the start of the take-off run, but best performance in clearing a 50-foot obstacle will be obtained by firing the units later in the take-off run.

2–38. PROCEDURE.

Note

See paragraph 3–8 for procedure in event of engine failure during take-off.

a. If the afterburner is to be used, open the throttle and, when the engine speed reaches 98 to 100% rpm, move the throttle outboard into the slot to start the afterburner. Check that the "eyelids" open indicator light comes on. A momentary drop of approximately 3 to 6% rpm is one of the best indications that the afterburner has lighted. If a non-afterburner take-off is being made, check that the "eyelids" open light is Off.

WARNING

If tailpipe temperature goes down to approximately 600°C or up to approximately 800°C, and stays for more than one or two seconds, the afterburner control system is not operating properly and the afterburner should be shut off. For safe and proper operation, tailpipe temperature should be 690° to 720°C with engine at 100% rpm.

BEST PERFORMANCE IN CLEARING AN OBSTACLE WILL BE OBTAINED BY FIRING THE JATO BOTTLES LATER IN THE TAKE-OFF RUN!

b. Release the brakes.

c. Maintain directional control by minimum use of the brakes until the rudder becomes effective (at about 65 knots IAS).

d. The nose wheel may either be left on the ground until take-off speed is reached as shown in table below, or it may be raised slightly at 90 to 100 knots IAS.

Configuration	*With Afterburner*	*Without Afterburner*
No tip tanks	110 knots IAS	115 knots IAS
Tip tanks full	120 knots IAS	125 knots IAS

e. At the instant the main wheels break ground, there is a tendency for the airplane to nose up. This must be checked by a slight relaxation of the back pressure on the stick.

CAUTION

Although it is possible to take off about 10 knots IAS slower than noted above, taking off at too low an airspeed may cause the airplane to settle back onto the ground. It must be remembered that sufficient airspeed is important when taking off in this airplane because there is no propeller slipstream to increase the lift of the wing.

f. Landing gear—"UP."

g. JATO bottles—jettison (over a clear area).

h. Wing flaps—"UP" between 140 and 175 knots IAS. Return the switch to neutral position after flaps are up.

i. Climb at about 175-215 knots IAS to a safe altitude, then gradually accelerate to the best climbing speed for the remainder of the climb. With afterburner take-off, maintain some climb while accelerating to the best climbing speed. Plan to reach climb schedule between 5,000-8,000 feet.

j. Emergency fuel switch—"OFF" (at safe altitude).

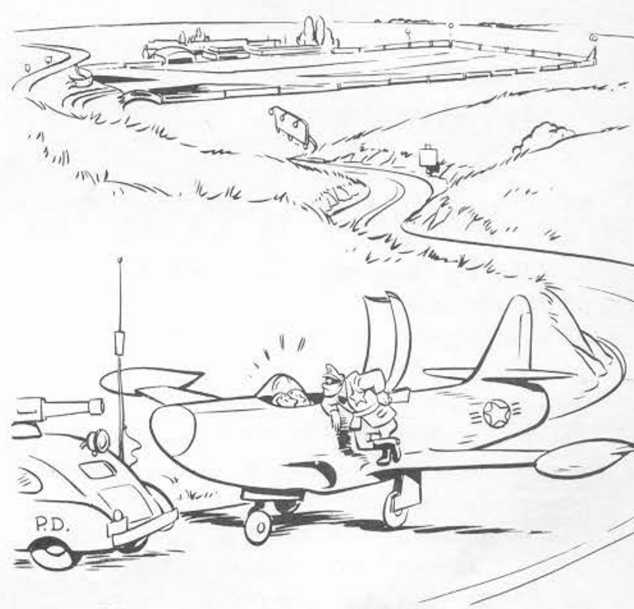
WARNING

Before turning the emergency fuel switch "OFF," check to see that the amber emergency fuel indicator light is off. If the amber light is on, the main fuel system has failed and the engine is running on the emergency fuel system. If such is the case, leave the emergency fuel switch in the "TAKE-OFF & LAND" position, circle the field, and land.

k. Tip tank jettison "ready" switch—"OFF."

2-39. INSTRUMENT TAKE-OFF WITH ZERO READER. Proceed as shown on figure 27.

WARNING



Do Not Attempt Take-Off with the Wing Flaps Retracted because the Runway Length and Speed Required will be Greatly Increased!

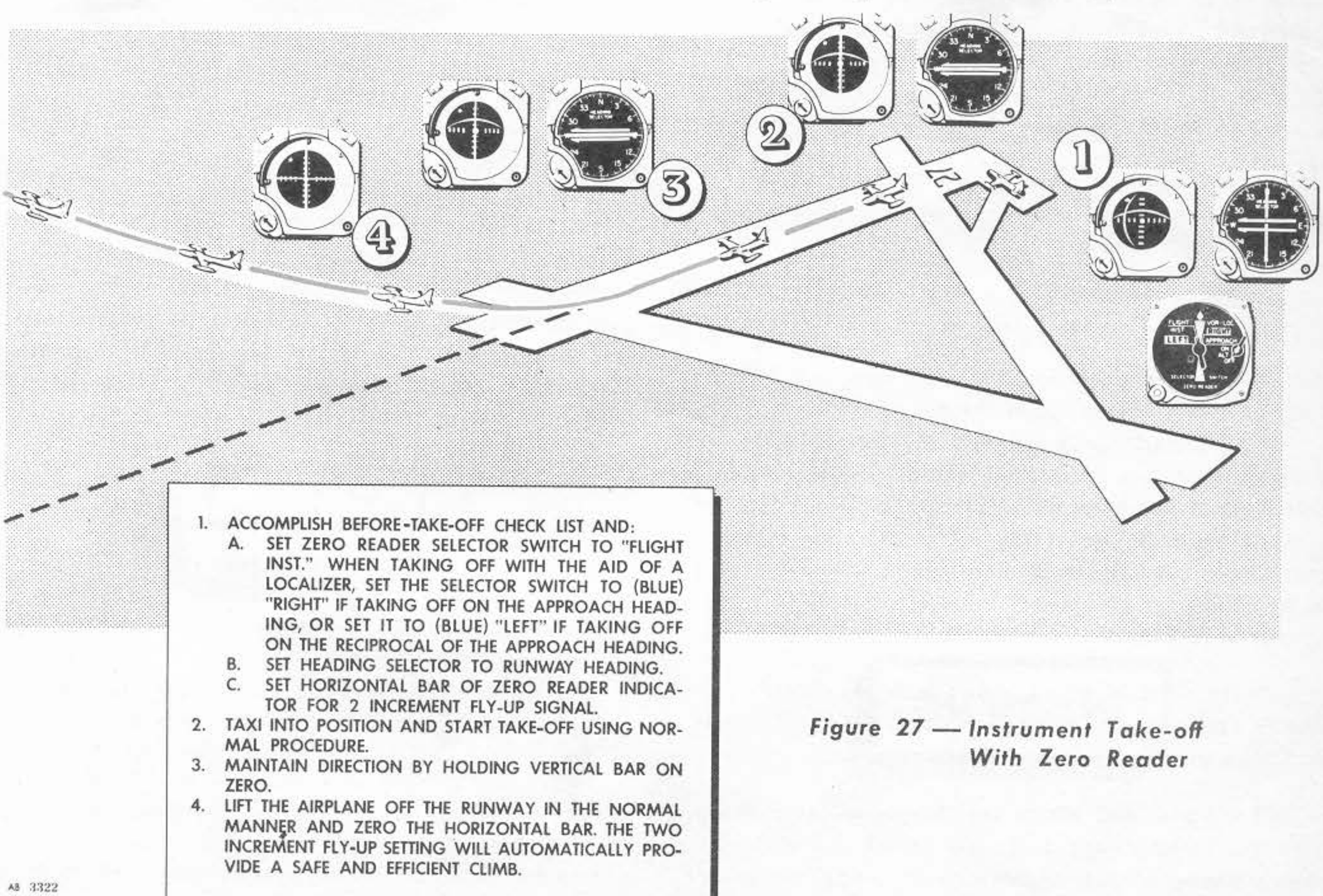


Figure 27 — Instrument Take-off With Zero Reader

2–40. CLIMB.

2–41. GENERAL.

2–42. The recommended climbing speeds are given in the Climb Chart, Appendix I. The best rate of climb can be obtained at 100% rpm with afterburning. Do not operate the engine for more than 30 minutes at 100% rpm or the afterburner for more than 15 minutes at any one time.

2–43. ENGINE OPERATION IN FLIGHT.

2–44. GENERAL.

2–45. Maximum continuous operation of the J33 engine is limited to 96% rpm. Refer to Appendix I for selection of power settings for optimum cruise.

2–46. FUEL SYSTEM OPERATION IN FLIGHT.

2–47. GENERAL.

2–48. Normally the fuel system is operated with all tank switches placed in the On position. Thus, the sequence of fuel tank selection is automatically controlled by the float valves in the fuselage tank. The leading edge and wing tank switches must be turned off as the indicator light comes on.

CAUTION

Do not turn the tip tank switch Off when its light comes on, since the tanks may be collapsed by differential air pressure during a rapid descent.

2–49. The vaporization and slugging losses of MIL-F-5624 (GRADE JP-3) fuel are greater than those for MIL-F-5616 (GRADE JP-1) fuel. These losses are difficult to predict and as they are not recorded by the fuel quantity counter, the actual quantity of fuel remaining in the airplane is uncertain. The following procedure can be used when slugging losses are expected to be high (paragraph 1–72) and is recommended to give the pilot an indication when approximately 150 gallons of fuel remain in the airplane:

a. Leave the leading edge fuel tank switch Off until the tip and wing tanks are empty and the red fuselage fuel tank low level warning light comes on.

b. Anticipate and watch for the light. Immediately turn the leading edge fuel tank switch On and plan the remainder of your flight for the 150 gallons of remaining fuel.

Note

If the fuselage tank by-pass system has been used, the foregoing procedure should not be relied upon since an undetermined amount of fuel may have been drawn from the leading edge tanks.

2–50. AFTERBURNER OPERATION IN FLIGHT.

2–51. GENERAL.

2–52. After the throttle is pushed outboard to start the afterburner, malfunctioning of the "eyelids" and afterburner pressure switch may be recognized as follows:

a. If the tailpipe temperature remains unchanged and the "eyelids" open light stays off, the probable causes are: The afterburner emergency switch is off; the afterburner circuit breaker may be out; the afterburner pressure switch is not working. In any of these cases, the afterburner should be shut off by moving the throttle inboard until the malfunction is corrected.

b. If the "eyelids" open light comes on and the tailpipe temperature goes down to approximately 600°C, it means that the afterburner did not light but the "eyelids" opened and afterburner ignition stopped. The probable cause is malfunctioning of the afterburner pressure switch. If one or two additional attempts produce the same result, pull the throttle inboard to stop afterburner operation. The additional thrust when the afterburner is operating is immediately apparent to the pilot.

c. If the tailpipe temperature indicator goes up to about 800°C and remains there, and the "eyelids" open light stays off, the afterburner is operating but the "eyelids" have not opened. Shut off the afterburner by moving throttle lever inboard or turn afterburner emergency shut-off switch to "OFF." This condition is probably caused by the improper working of the afterburner pressure switch or the "eyelids" actuator.

WARNING

Do not allow afterburner to operate at 800° C longer than three seconds.

d. The afterburner is normally started with the "eyelids" closed and the pressure switch operates the air valves which open the "eyelids" and shuts off the afterburner ignition. If the "eyelids" are opened manually prior to starting the afterburner, it is unlikely that the afterburner will start consistently, particularly at high altitude.

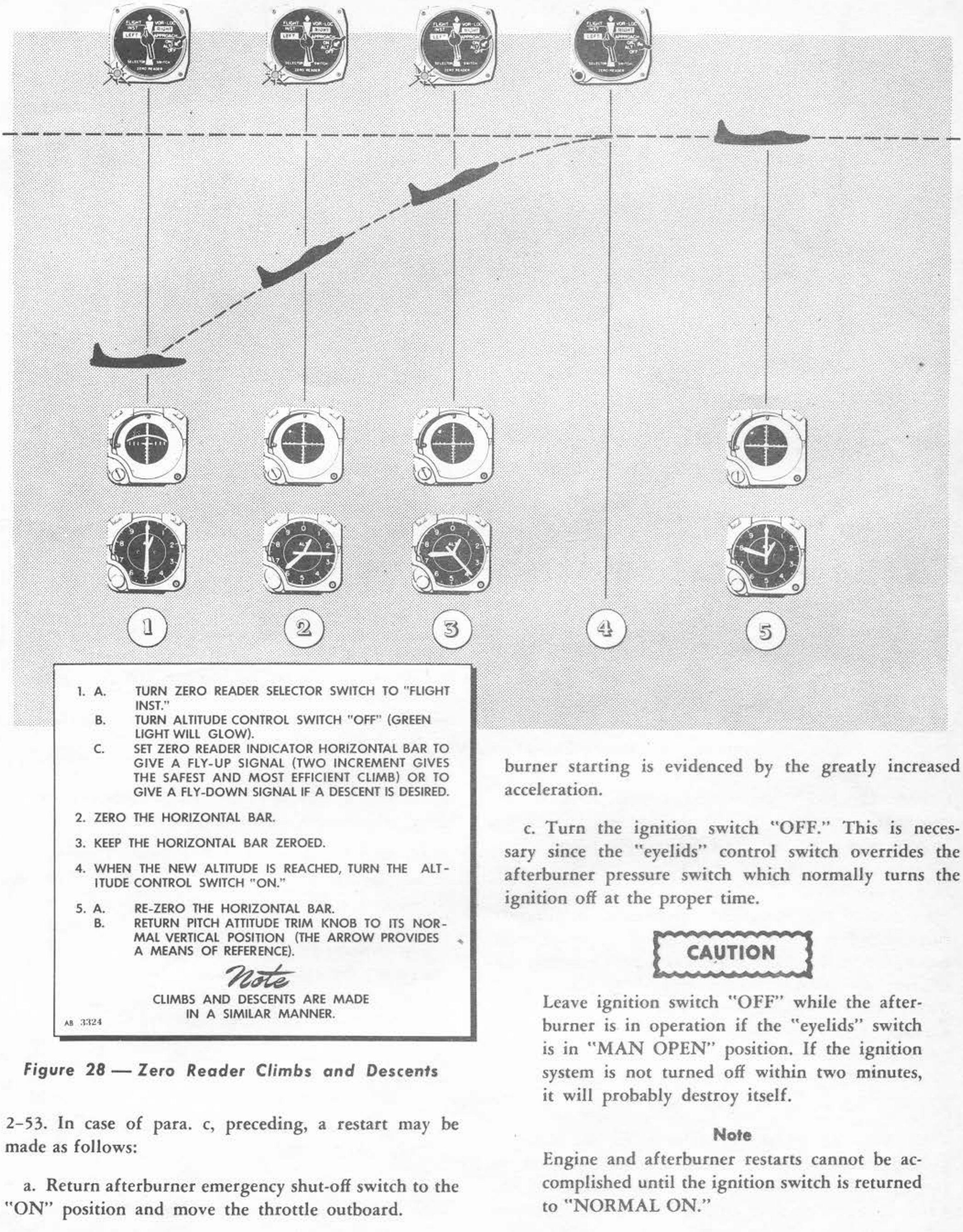


Figure 28 — Zero Reader Climbs and Descents

2–53. In case of para. c, preceding, a restart may be made as follows:

a. Return afterburner emergency shut-off switch to the "ON" position and move the throttle outboard.

b. When the afterburner starts, place the afterburner "eyelids" switch in the "MAN OPEN" position. Afterburner starting is evidenced by the greatly increased acceleration.

c. Turn the ignition switch "OFF." This is necessary since the "eyelids" control switch overrides the afterburner pressure switch which normally turns the ignition off at the proper time.

CAUTION

Leave ignition switch "OFF" while the afterburner is in operation if the "eyelids" switch is in "MAN OPEN" position. If the ignition system is not turned off within two minutes, it will probably destroy itself.

Note

Engine and afterburner restarts cannot be accomplished until the ignition switch is returned to "NORMAL ON."

2–54. The afterburner "eyelids" switch will operate the "eyelids" at any time, but open "eyelids" with the

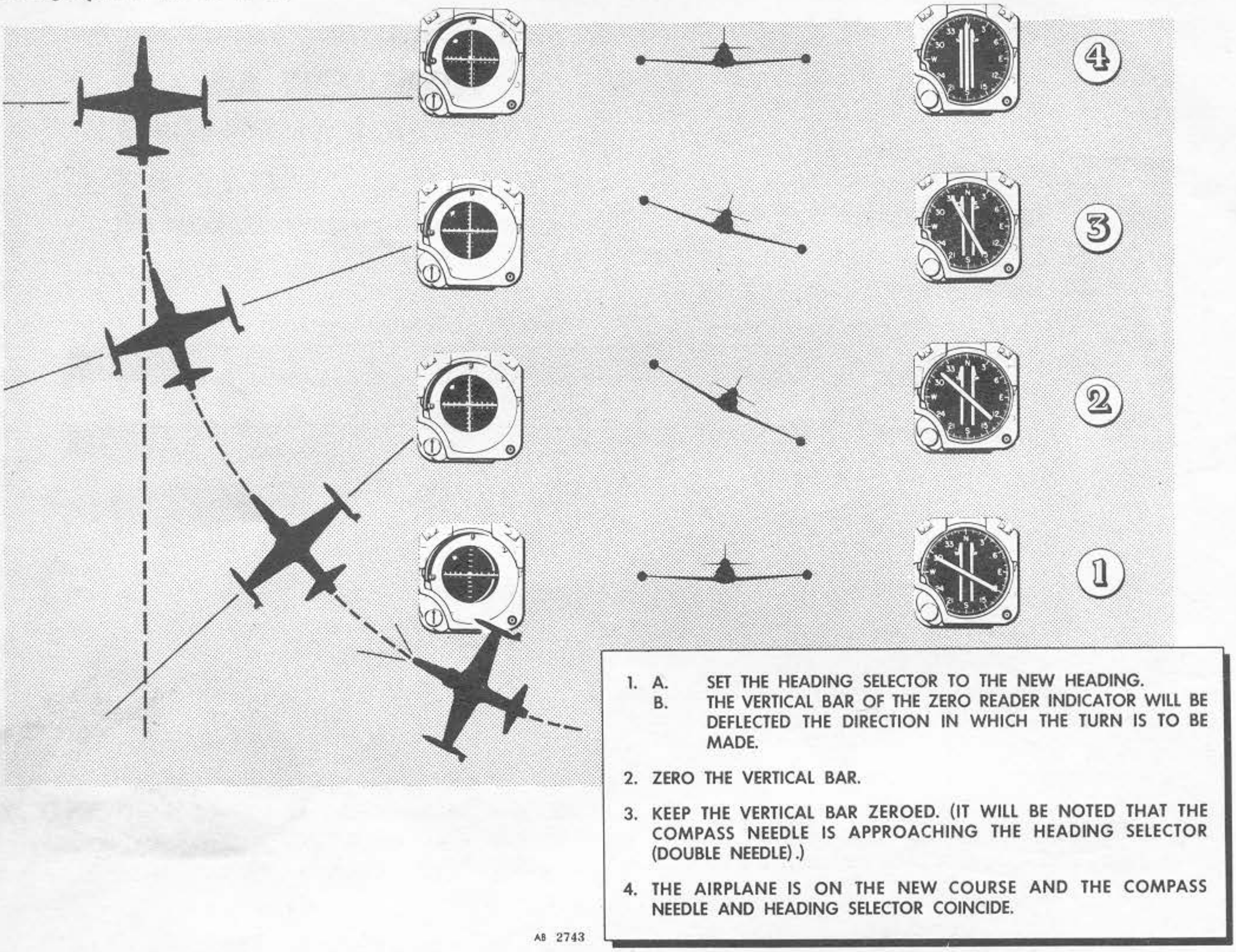


Figure 29 — Turns With Zero Reader

afterburner off will reduce the normal thrust to approximately 70-75%. This is also accompanied by an increase in specific fuel consumption. The tailpipe temperature with afterburner on and "eyelids" open should be between 690° and 720°C at 100% rpm. Temperatures outside this range indicate that the afterburner fuel control system is malfunctioning. A temperature below 690° C produces poor thrust and generally inefficient operation. Temperatures above 720°C will damage the engine and the afterburner and if the temperature cannot be brought down to 720°C by slightly reducing the throttle setting, the afterburner should be shut off. The throttle has a range of approximately 95-100% rpm in the afterburner slot.

2–55. Air starts of the afterburner are the same as ground starts; however, successful starting at 40,000 feet or higher is unlikely if the air speed is less than 220 knots. If the afterburner fails to start or goes out after it has been operating, a fuel trail will probably be visible to the pilot in the rear-view mirror. This fuel trail is not dangerous but extremely wasteful. During afterburner operation, if extreme combustion roughness is encountered, it is recommended that the afterburner be shut off.

2–56. Stopping the afterburner is normally accomplished by moving the throttle inboard. If this does not stop the operation of the afterburner, it is probable that the microswitch on the throttle has failed and afterburner operation should be stopped by moving the afterburner emergency shut-off switch to the "OFF" position.

2–57. FLIGHT CHARACTERISTICS.

2–58. See Section VIII for flight characteristic information.

2–59. OPERATION OF OTHER SYSTEMS IN FLIGHT.

2–60. INSTRUMENT FLIGHT WITH ZERO READER. The Zero Reader may be used as a pure flight instrument (without radio navigation signals). When it is being used in this manner, only occasional reference to the other flight instruments is necessary.

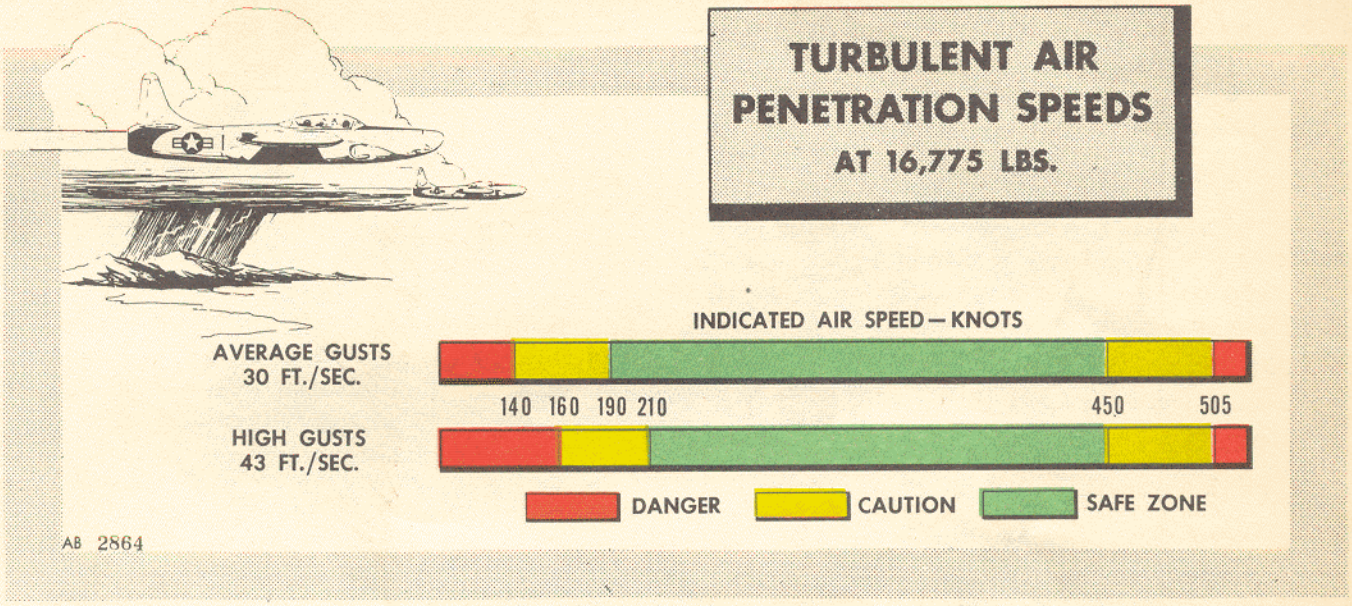


Figure 30 — Turbulent Air Penetration Speeds

The procedure for climbs and descents is shown on figure 28, and for making turns on figure 29. These procedures can be combined to produce climbing turns and diving turns.

2–61. TURBULENT AIR AND THUNDERSTORM FLYING.

CAUTION

Thunderstorm flying demands considerable instrument experience and should be intentionally undertaken only by pilots able to qualify for the AF Form 8A (Green) instrument card. However, many routine flight operations require a certain amount of thunderstorm flying since it is often impossible to detect individual storms and find the in-between clear areas. A pilot, using modern equipment and possessing a combination of proper experience, common sense, and instrument flying proficiency, can safely fly through thunderstorms.

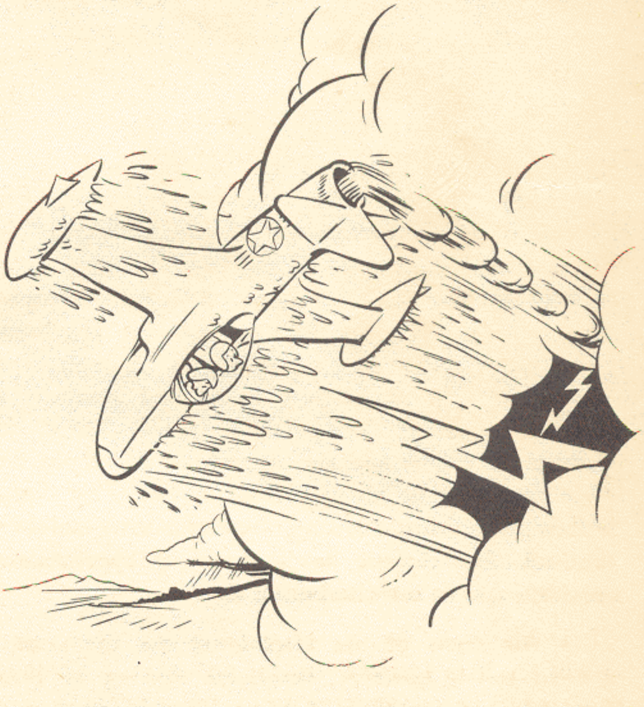
2–62. GENERAL.

2–63. Power setting and pitch attitude required for desired penetration air speed should be established before entering the storm. This power setting and pitch attitude, if maintained throughout the storm, will result in approximately a constant average air speed, regardless of any false readings of the air-speed indicator. Specific instructions for thunderstorm flying are given in paragraph 2–64 through 2–67.

2–64. BEFORE TAKE-OFF.

a. Check Turbulent Air Penetration Speed Chart (figure 30) for best penetration speed.

b. Make a thorough analysis of the general weather situation to determine thunderstorm areas and prepare a flight plan which will require the least possible exposure of the airplane to regions of possible thunder-



A Pilot Using Modern Equipment And Possessing A Combination Of Proper Experience, Common Sense, And Instrument Flying Proficiency, Can Safely Fly Through Thunderstorms.

c. Be sure to check proper operation of all flight instruments, navigation equipment, pitot heater, and instrument panel lights before undertaking any instrument flight and also before attempting flight into thunderstorm areas.

2-65. APPROACHING THE STORM.

2-66. GENERAL. It is imperative that you prepare the airplane prior to entering a zone of turbulent air. If the storm cannot be seen, its proximity can be detected by radio crash static. Prepare the airplane as follows:

a. Adjust power controls as necessary to obtain safe penetration speed. See figure 30.

b. Pitot heater switch—"ON."

c. Check gyro instruments for proper settings.

d. Turn altitude control switch "OFF."

e. Safety belt and shoulder harness fastened.

f. Turn off any radio equipment rendered useless by static.

g. At night, turn cockpit lights full bright or use dark glasses to minimize blinding effect of lightning.

CAUTION

Do not lower gear and flaps as they merely decrease the aerodynamic efficiency of the airplane.

2-67. IN THE STORM.

a. Maintain power setting and pitch attitude (established before entering the storm) throughout the storm. Hold these constant and your air speed will remain approximately constant regardless of the air-speed indicator.

b. Devote your full attention to flying the airplane.

c. Expect turbulence, precipitation, and lightning. Don't allow these conditions to cause undue concern.

d. Maintain attitude. Concentrate principally on holding a level attitude by reference to the attitude gyro. The Zero Reader may be used if desired as a flight instrument.

e. Maintain original heading. Do not make any turns unless absolutely necessary.

f. Don't chase the air-speed indicator, since doing so will result in extreme airplane attitudes. If a sudden gust should be encountered while the airplane is in a nose high attitude, a stall might easily result. A heavy rain, by partial blocking of the pitot tube pressure head, may decrease the indicated air speed reading considerably.

g. Use as little elevator control as possible to maintain airplane attitude in order to minimize the stresses imposed on the airplane.

h. The altimeter may be unreliable in thunderstorms because of differential barometric pressure within the storm. A gain or loss of several thousand feet may be expected. Make allowance for this error in determining minimum safe altitude.

Note

Altitudes between 10,000 and 20,000 feet are usually the most turbulent areas in a thunderstorm. The least turbulent areas will be above 30,000 feet. Therefore, altitudes in excess of 30,000 feet are recommended for thunderstorm penetration.

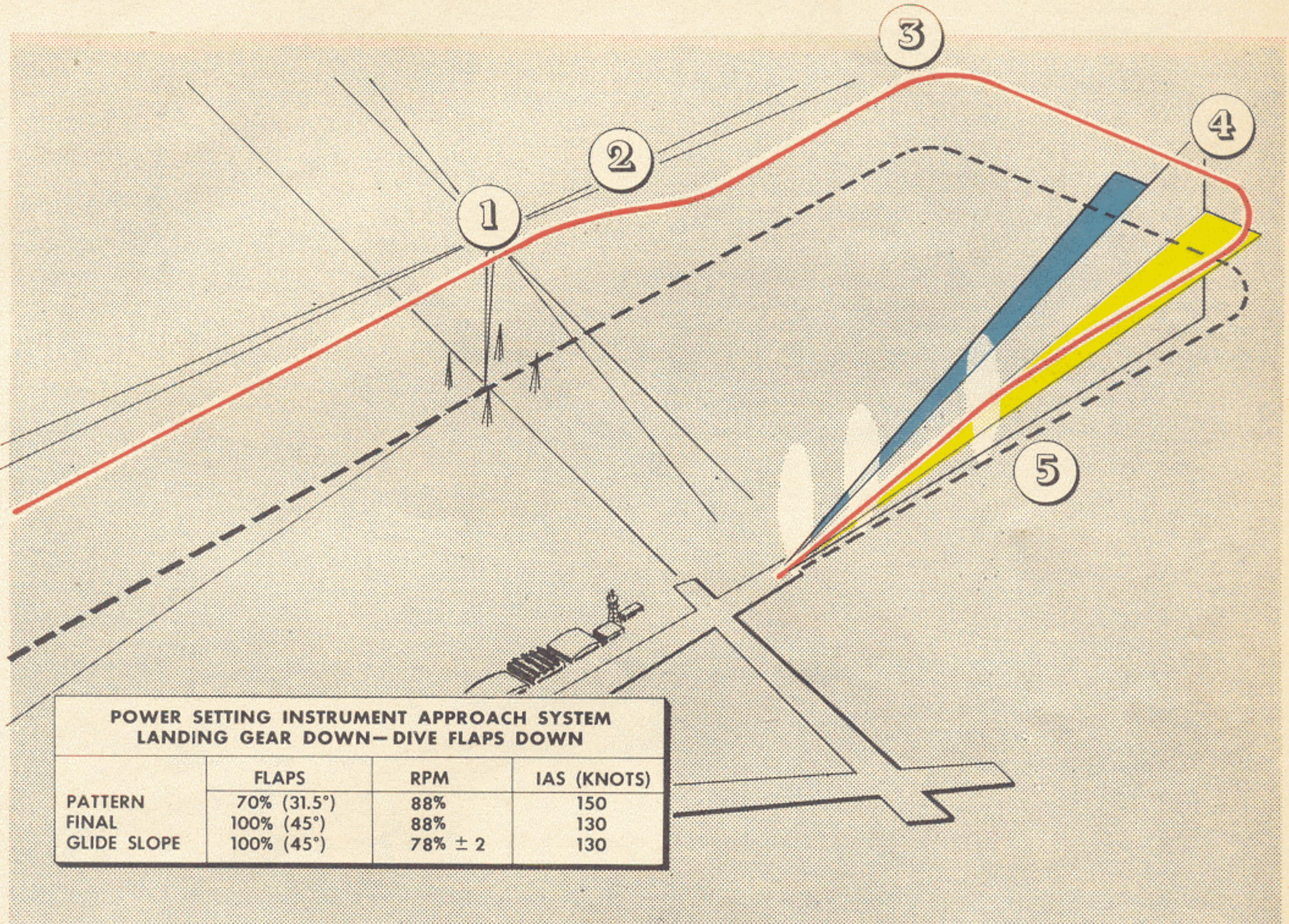
2-68. APPROACH.

2-69. GENERAL.

2-70. Keep the engine speed at 60% rpm or above during the approach so that power may be applied more quickly if required. Maintain a shallow glide path during the last part of the final approach. Approximately 25-30 gallons of fuel will be required for a tight pattern go-around if the landing cannot be made.

2-71. The approach speed should be increased 5 knots IAS for each 10 knots of reported headwind, because of possible gust conditions. This increase in speed should be obtained by application of power. Such a procedure will result in a flatter approach angle, and thereby reduce gust effects.

MAINTAIN ADEQUATE SPEED ON APPROACH, JET PLANES DON'T ACCELERATE AS RAPIDLY AS THOSE WITH PROPELLERS!



POWER SETTING INSTRUMENT APPROACH SYSTEM
LANDING GEAR DOWN—DIVE FLAPS DOWN

	FLAPS	RPM	IAS (KNOTS)
PATTERN	70% (31.5°)	88%	150
FINAL	100% (45°)	88%	130
GLIDE SLOPE	100% (45°)	78% ± 2	130

Note Since the Zero Reader is not connected to a range receiver, the Zero Reader selector switch will be in "FLIGHT INST." for instrument flying.

1. Orient yourself and fly the ILS approach pattern established for the particular field, with the aid of the Zero Reader. When using the Zero Reader, the approach to the localizer must be:
   a. At an angle less than 90°,
   b. and where possible, at least 5 miles outbound from the outer marker.

   Turn ILS receiver selector to the proper channel.
2. Descend to the desired approach altitude as shown on figure 28 .
3. Make turn as shown on figure 29 .
4. When the ILS cross-pointer vertical bar first begins to move off the peg:
   a. Turn the Zero Reader selector switch to (BLUE) "RIGHT." This will cause the Zero Reader indicator vertical bar to deflect.
   b. Set the heading selector to the localizer heading.
   c. Zero the vertical indicator bar. This will bring you on to the localizer beam in a smooth curve.
   d. By keeping the vertical bar zeroed, the airplane will follow the localizer beam.
   e. Frequent reference to the ILS cross-pointer indicator will show the position of the airplane with relation to localizer beam.
5. a. When the ILS cross-pointer horizontal bar reaches center (indicating you are on the glide slope), turn the selector switch to "APPROACH." This feeds glide slope receiver signals to the Zero Reader indicator horizontal bar.
   b. Keep the deviation indicator bars zeroed and you will follow the localizer and glide slope beams accurately and without oscillating (bracketing is unnecessary).
   c. Set the pitch trim knob to give a fly-up signal in case a go-around is necessary. This will have no effect on the horizontal bar until the selector switch is moved out of "APPROACH."
   d. To go around in the event of a missed approach, simply turn the selector switch to "FLIGHT INST." By continuing to zero the bars you will assume a safe climbing attitude. Then follow local procedure.
   e. If a cross-wind is present, it will be evidenced by a divergence between the compass needle and the heading selector (double needle). Let this condition stabilize for at least 30 seconds and, if it persists, set the heading selector (double needle) to coincide with compass needle. However, don't make too many corrections at the last minute. If no correction is made you will be brought into the runway but on the downwind side.

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Figure 31 — Instrument Approach with Zero Reader

1. AFTER ORIENTATION, INTERCEPT THE LOCALIZER BEAM AT ALTITUDE 25 MILES OUTBOUND FROM THE OUTER MARKER AND TURN ZERO READER SELECTOR SWITCH TO (BLUE) "RIGHT."

2. EXTEND DIVE FLAPS AND DESCEND (INBOUND) ON THE LOCALIZER BEAM, WITH THE ENGINE IDLING, AT ABOUT 20 KNOTS LESS THAN .8 MACH NO. (20 KNOTS LESS THAN THE RED NEEDLE).

3. START ROUNDING OUT OF THE DIVE AT 10,000 FEET.

4. DURING THE PULL-OUT, TURN "ON" THE ZERO READER ALTITUDE CONTROL WHEN THE APPROACH ALTITUDE IS REACHED.

5. MAINTAIN THIS ALTITUDE, WITH THE ENGINE IDLING, UNTIL THE AIR SPEED HAS DROPPED TO THE POINT WHERE THE GEAR CAN BE EXTENDED, THEN EXTEND FLAPS TO 70% (31.5°).

6. PROCEED AS SHOWN IN STEP 5 OF THE ZERO READER APPROACH DIAGRAM.

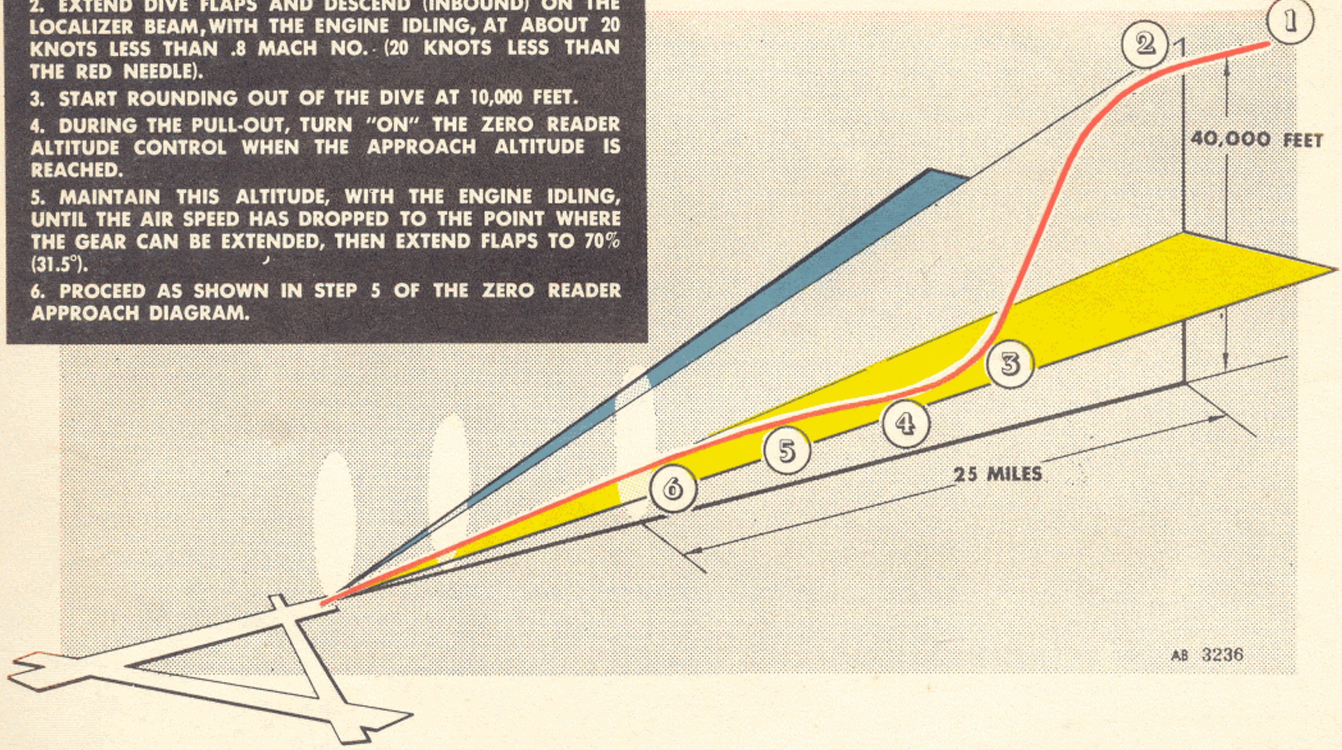
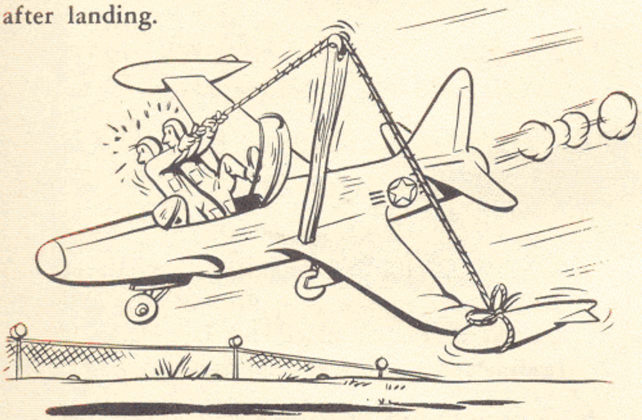


Figure 32 — Rapid Descent Approach With Zero Reader

2-72. With the landing gear down and wing flaps 100% (45°) extended, start the final turn at about 140 knots IAS (100 gallons of fuel remaining) and pass over the end of the runway at about 115 knots.

2-73. Dive flaps may be used as desired during the approach and landing. Their use will increase the glide angle, reduce floating, and reduce the length of roll after landing.



DO NOT ATTEMPT TO LAND WITH ONE TIP TANK FULL AND ONE EMPTY, AS THE WING WITH THE FULL TANK WILL BE VERY HEAVY AND EXTREMELY DIFFICULT TO HOLD UP AT LOW AIRSPEED. DROP THE TANKS!

2-74. INSTRUMENT APPROACH WITH ZERO READER. Follow the procedure given on figure 31.

2-75. RAPID DESCENT APPROACH WITH ZERO READER. There are times when, because of a low fuel supply, it is advisable to orient yourself at altitude where the remaining fuel will yield the greatest range and then let down at a high rate of descent. This procedure is shown on figure 32.

2-76. GROUND CONTROLLED APPROACH. Proceed as shown on figure 33.

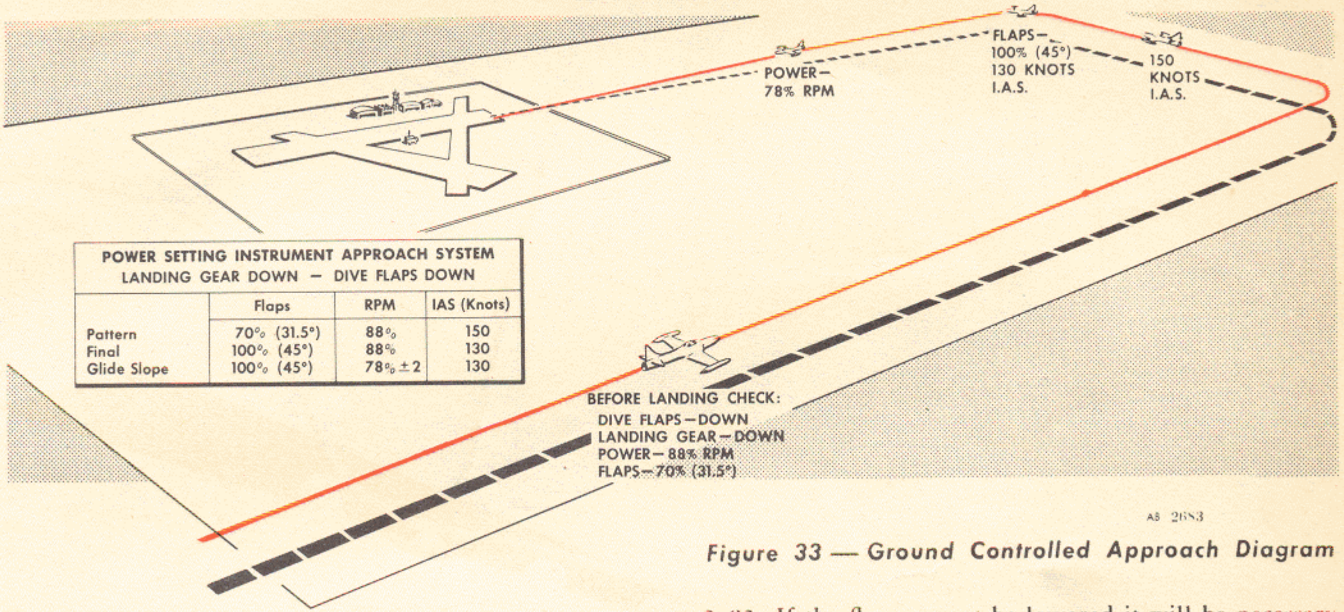
Note

The Zero Reader may be used to simplify the mechanics of instrument flying during ground controlled approaches.

2-77. LANDING.

2-78. GENERAL.

2-79. The landing technique is similar to that of conventional tricycle landing gear airplanes, and the landing attitude is about the same; that is, main wheels first, tail slightly down. For speeds, see figure 34.



POWER SETTING INSTRUMENT APPROACH SYSTEM LANDING GEAR DOWN — DIVE FLAPS DOWN			
	Flaps	RPM	IAS (Knots)
Pattern	70% (31.5°)	88%	150
Final	100% (45°)	88%	130
Glide Slope	100% (45°)	78% ± 2	130

Figure 33 — Ground Controlled Approach Diagram

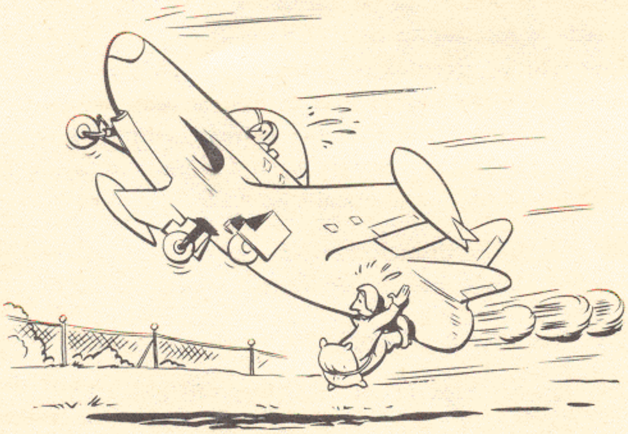
Note

Care should be exercised to avoid extreme tail-low attitudes which will cause the tail to drag on the runway.

2–80. When landing in headwinds, the final approach speed should be increased 5 knots IAS for each 10 knots of reported wind. This will result in a flatter final approach angle, and reduce gust effects. Power should be used to obtain this speed increase rather than lowering the nose.

2–81. Have some power on as the flare-out is started. Do not remove power too soon as the ship may "drop-in" during the flare-out. If the landing is being made with an appreciable load of fuel or ammunition, the over-the-fence air speed should be increased about 3 knots for each 100 gallons of fuel remaining.

CAUTION



When Landing, Particularly Without Flaps, Extra Care Must Be Used To Avoid Dragging The Tail On The Runway!

2–82. If the flaps cannot be lowered it will be necessary to increase approach speed about 15 knots above normal and allow for a flatter approach. If the only available runway is short or has a bad approach it will probably be best to land with the gear Up.

2–83. NORMAL LANDING.

a. Guns-camera switch—"OFF."

b. Landing gear—"DOWN" (check indicator).

c. Emergency fuel switch—"TAKE-OFF & LAND."

Note

Side slips and "S" turns may be used as desired. These maneuvers should be practiced in normal landings so that they may be used more effectively in case of an emergency "dead-engine" landing.

d. Wing flaps—"DOWN."

e. Dive flaps—"DOWN" (if desired).

f. Engine speed—60% rpm (or more).

2–84. AFTER TOUCH-DOWN.

a. Wing and dive flaps—"UP."

Note

By retracting the flaps immediately after touch-down, more weight is applied to the wheels and the brakes are more effective. Hence, the landing roll is shortened appreciably.

b. Emergency fuel switch—"OFF."

CAUTION

Braked landings should not be made more often than once every 15 minutes. Heat generated by too much braking will cause tire failure.

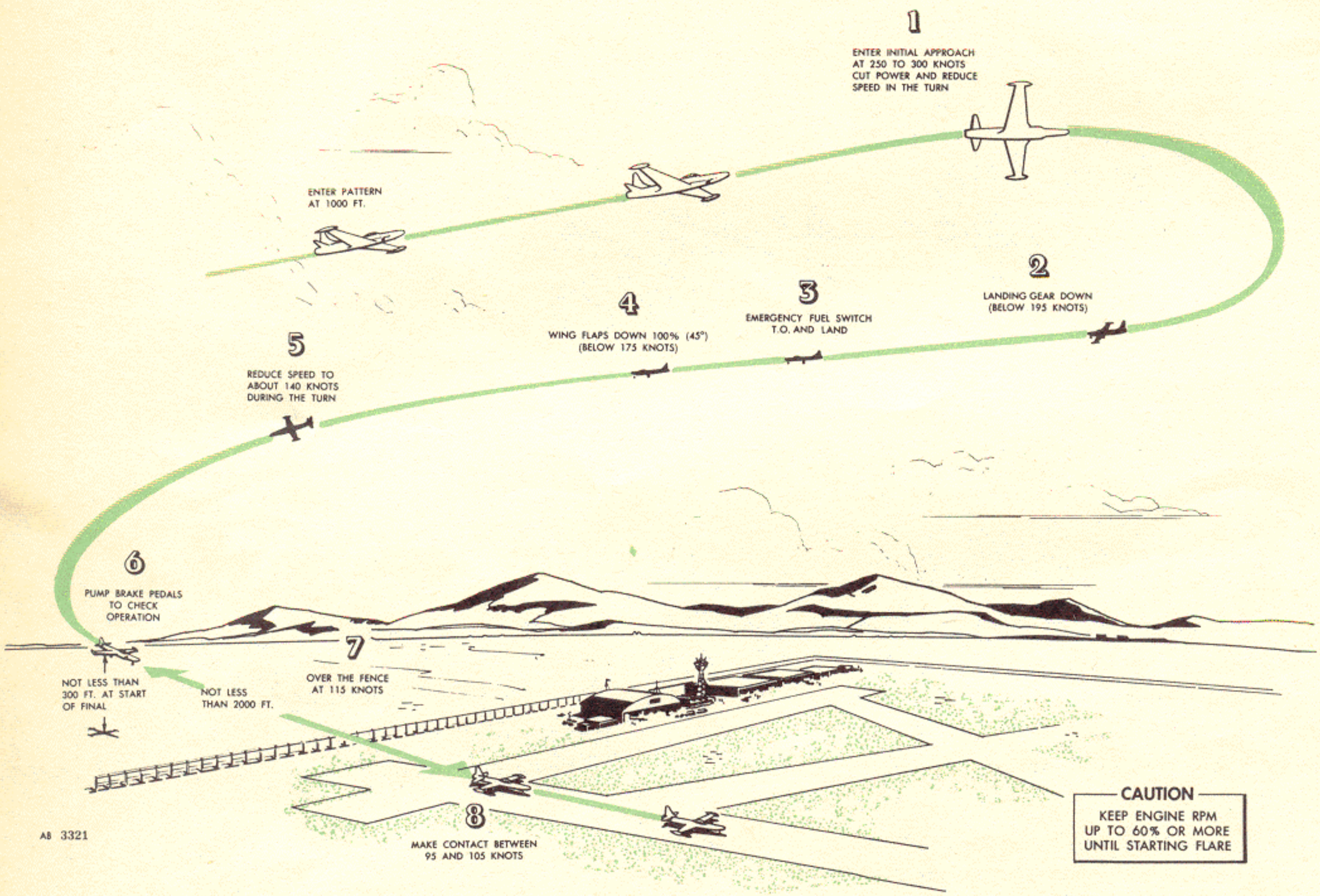


Figure 34 — Landing Approach Diagram

2-85. CROSS WIND LANDING.

2-86. The procedure is the same as for a normal landing. However, if the drift appears excessive use a crabbing approach until just before contact.

2-87. MINIMUM RUN LANDING.

2-88. Follow normal landing procedure and try to land as close to the edge of the field as possible. Go over the fence low and use dive flaps in addition to the wing flaps. The wing flaps may be started up just before contact or about three feet above the ground. After contact, use the brakes as much as possible without sliding the tires.

2-89. EMERGENCY LANDING.

2-90. See paragraph 3-27.

2-91. GO-AROUND.

2-92. The ability of jet airplanes to accelerate at low speeds is inferior to that of propeller-driven airplanes. This will be accentuated if the engine rpm is less than 60%, since the engine acceleration is poor below this speed. In the event that the landing cannot be completed, the decision to go around should be made as soon as possible, and should be made as follows:

a. Open the throttle to 100% rpm and, if necessary, use the afterburner for additional thrust.

b. Retract the landing gear as soon as possible.

c. Retract flaps at not less than 140 knots IAS.

d. Accelerate to approximately 145 knots IAS before starting to climb.

2–93. STOPPING THE ENGINE.

Note

Whenever it is expected that inspection or maintenance work will be done on the airplane, extend the dive flaps before shutting the engine down, since hydraulic pressure will not be available after engine shut-down.

2-94. STOP THE ENGINE as follows:

a. Set parking brakes.

b. Throttle—"OFF."

c. Turn all switches "OFF" except generator switch, ignition switch, and afterburner emergency shut-off switch.

2–95. BEFORE LEAVING THE AIRPLANE.

2–96 Accomplish the following:

a. Lock the surface controls.

b. Fill out Form 1.

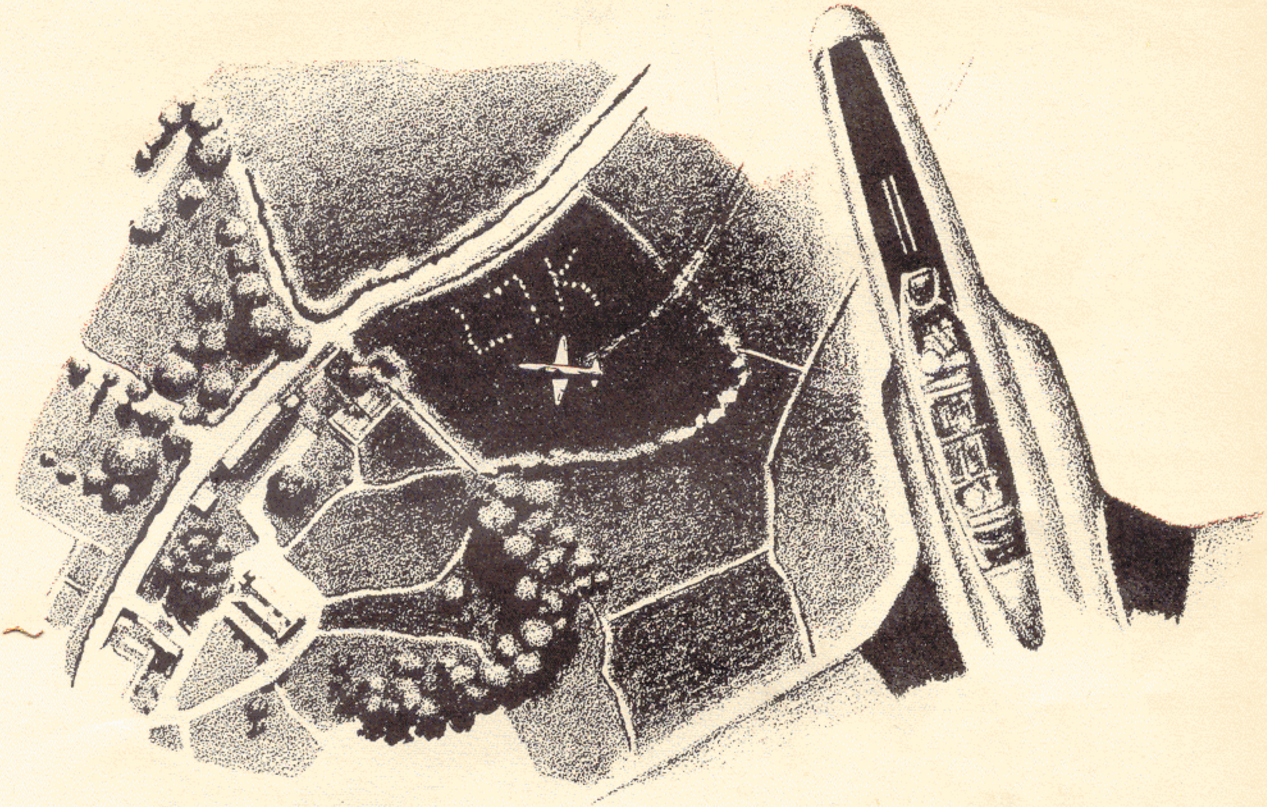
c. Release the parking brakes after chocks are in place.

d. Install canopy ground safety pin.

e. Install seat safety pins.

f. Close the canopy.

g. Install landing gear safety clips.



SECTION III

EMERGENCY OPERATING INSTRUCTIONS

3-1. ENGINE FAILURE.

3-2. GENERAL.

3-3. The most prevalent cause of engine failure is the stoppage of fuel flow to the engine. A complete understanding of the fuel system will reduce apparent engine failures to a minimum.

3-4. FLIGHT CHARACTERISTICS.

3-5. The flight characteristics of this airplane with a dead engine are normal and rapid trim revisions are not necessary. The glide speed that gives the greatest distance for the least loss of altitude (figure 35) is about 170 knots IAS (gear and flaps up). The hydraulic pump will supply sufficient pressure to operate all services when the engine is windmilling; however, operating time will be slightly longer.

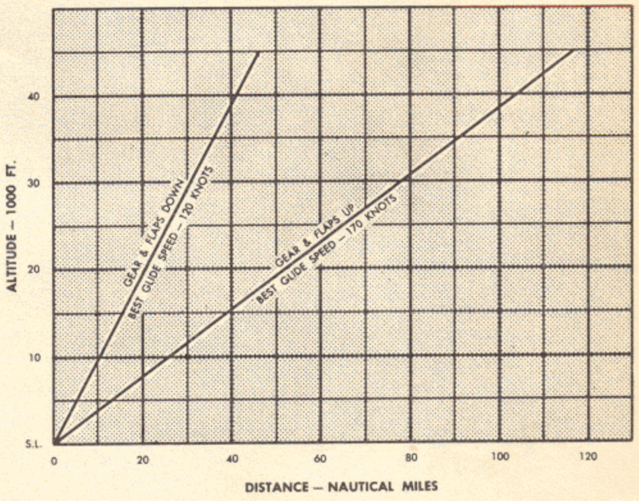


Figure 35 — Gliding Distances (Dead Engine)

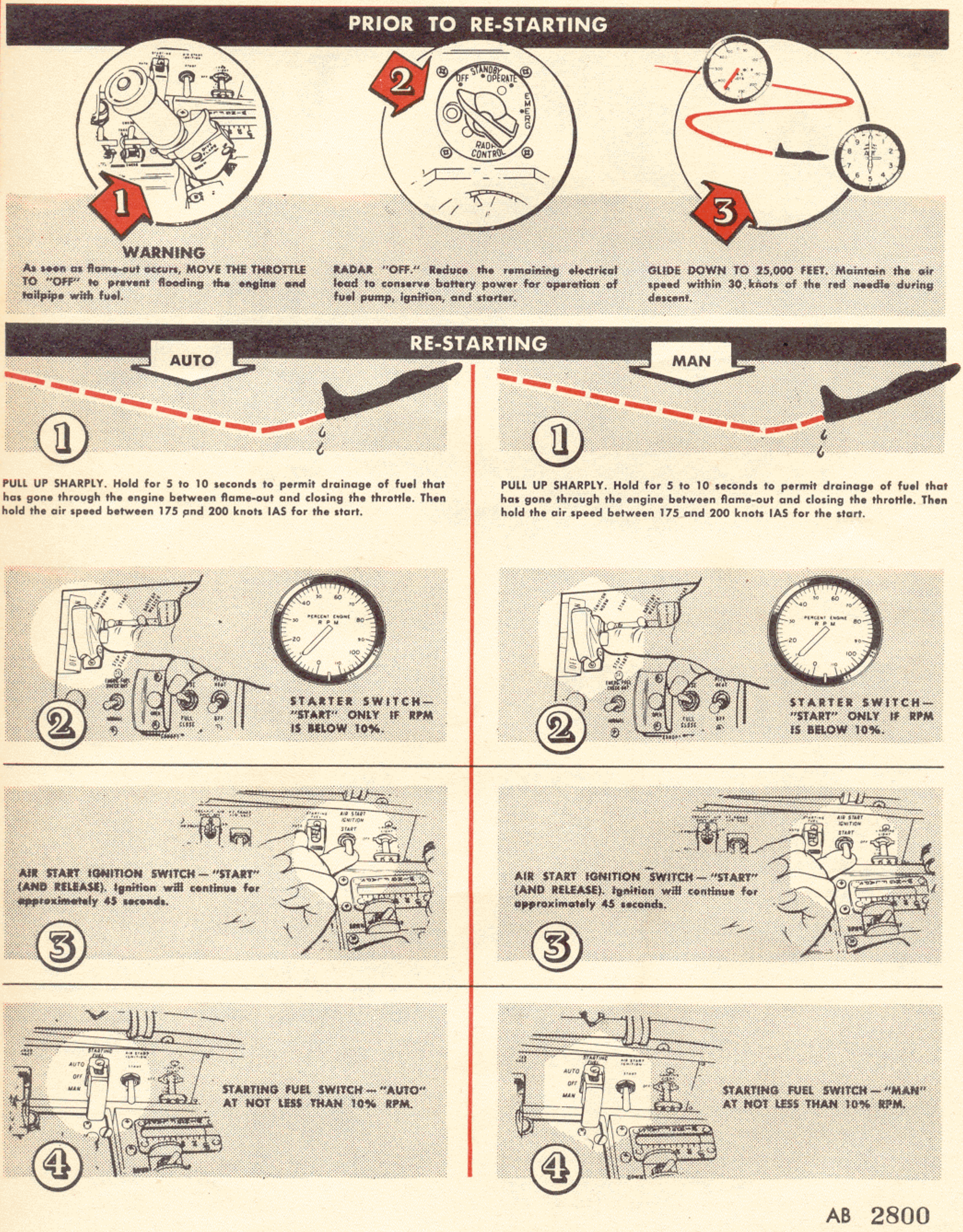
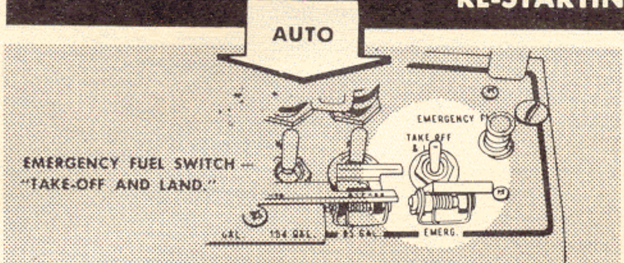


Figure 36 (Sheet 1 of 2 Sheets)—Air Starting Procedure

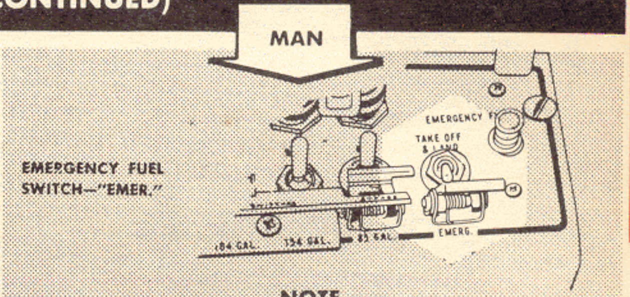
RE-STARTING (CONTINUED)



NOTE

The emergency fuel switch must be placed in "TAKE-OFF AND LAND" so the engine will start on the emergency fuel system if the main fuel system is malfunctioning.

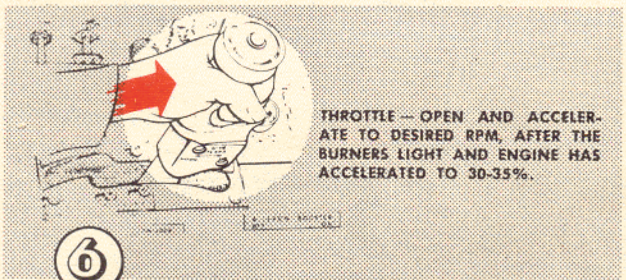
5



NOTE

Engine speed control at low rpm is more sensitive when using the emergency fuel control unit.

5



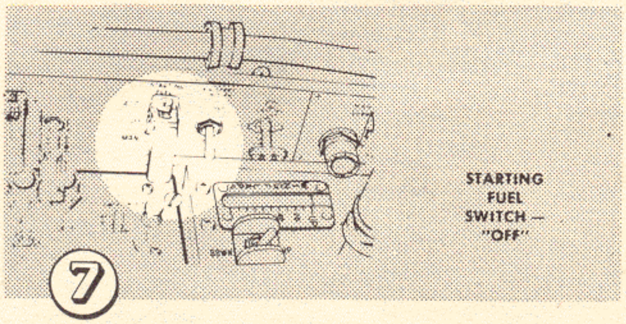
6

WARNING

If the tailpipe temperature reaches 1,000°C and stays there for more than 3 seconds, move the throttle and starting fuel switch to "OFF" immediately.

WARNING

If the amber emergency fuel indicator light remains on after the throttle is opened, the engine is running on the emergency fuel system. Therefore, leave the emergency fuel switch in the "TAKE-OFF & LAND" position until the airplane is landed. Use care to prevent engine over-speeding since there is no governor in the emergency fuel system. If the amber light is out, the emergency fuel switch may be returned to the "OFF" position after the throttle has been opened.



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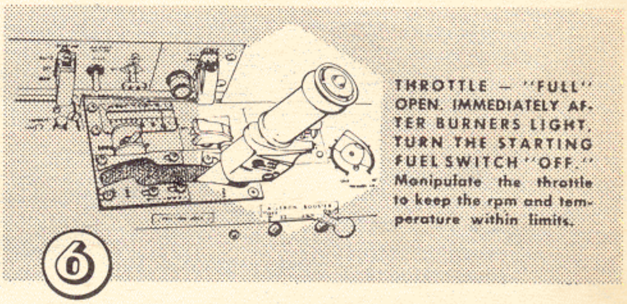

6

WARNING

If the tailpipe temperature reaches 1,000°C and stays there for more than 3 seconds, move the throttle to "OFF" immediately.

WARNING

Since the engine is operating on the emergency system, use care to prevent overspeeding and excessive tailpipe temperature as there is no governor in the emergency fuel system.

NOTE

If engine flame-out was not caused by failure of the main engine fuel pump or main fuel control, engine operation may be returned to the main system by increasing the rpm to about 70% and then retarding the throttle (quite rapidly) and at the same time, move the emergency fuel switch to the "OFF" position. The foregoing procedure must be followed to assure a smooth changeover to the main fuel system.

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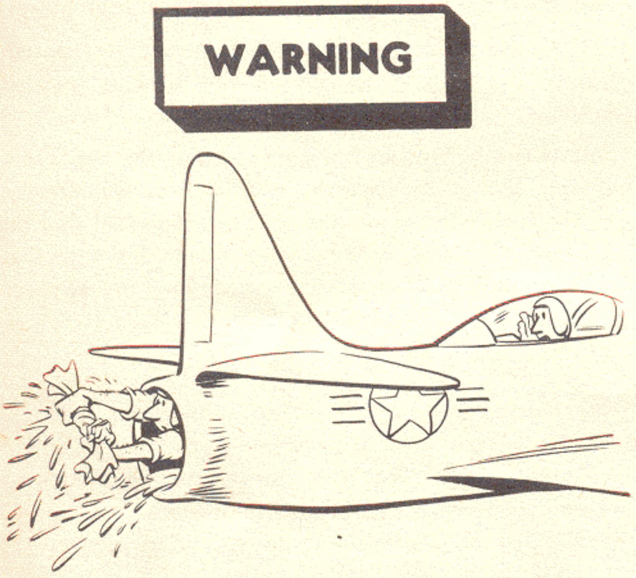
Figure 36 (Sheet 2 of 2 Sheets) — Air Starting Procedure

3-6. PROCEDURE.

3-7. The normal procedure to follow in case of an engine failure is as follows:

a. Throttle—"OFF" immediately to prevent flooding the engine and tailpipe with fuel.



As Soon As Flame-out Occurs Move The Throttle To "Off" To Prevent Flooding The Engine And Tailpipe With Fuel!

b. Radar equipment—"OFF."

c. Reduce the electrical load as much as possible to conserve battery power for operation of fuel pumps, ignition and starter.

3-8. ENGINE FAILURE DURING TAKE-OFF.

3-9. TOTAL POWER FAILURE BEFORE LEAVING THE GROUND. If total power failure occurs before leaving the ground, accomplish the following:

a. Throttle—"OFF" immediately.

b. Use the brakes as much as possible without sliding the tires, since rolling friction is more effective than sliding friction.

c. Release the tip tanks if it is necessary to retract the gear.

d. Landing gear—UP, if there is insufficient runway.

Note

If the airplane is still on the ground, it will be necessary to release the landing gear lever solenoid lock by depressing the lock release lever.

e. Battery master and generator switches—"OFF."

3-10. TOTAL POWER FAILURE AFTER LEAVING THE GROUND. If total power failure occurs soon after leaving the ground, accomplish as much of the following as conditions permit:

a. Maintain flying speed.

b. Throttle—"OFF."

c. Tip tanks—Release.

d. Prepare to land straight ahead.

e. Landing gear—Up, if it is impossible to land on the runway.

f. Wing flaps—Leave extended.

g. Main fuel shut-off valves—"CLOSE" (guard up).

h. Battery and generator switches — "OFF" before ground contact.

3-11. PARTIAL POWER LOSS AFTER LEAVING THE GROUND. If the airplane is already airborne and partial power failure occurs accomplish the following:

a. Afterburner—On.

b. Tip tanks—Release.

c. Landing gear—Up.

d. If rpm is less than 95%, move the emergency fuel switch to "EMERGENCY."

e. Try to attain an air speed of at least 130 knots. If necessary, lower the nose.

f. Wing flaps—Up (at 130 knots IAS).

g. When sufficient speed and altitude have been attained, return to the field and land.

3-12. ENGINE FAILURE DURING FLIGHT.

3-13. FLAME-OUT CAUSES. Engine flame-out in flight is usually caused by one of the following conditions:

a. Failure of fuel to feed because of negative acceleration.

b. Fuselage tank running out of fuel.

c. Failure of one of the fuel system units.

d. Wing tanks running out of fuel while the fuselage tank is being by-passed.

e. Inability of the filter to pass fuel because of stoppage by ice accumulation.

3-14. In the cases of flame-out given in paragraph 3-13, a re-start may be accomplished. However, prior to restarting, accomplish the following:

a. If there is no fuel in the fuselage tank, start transferring from the wing and tip tanks if fuel is available from these sources.

b. Place fuselage tank switch in the "FUS" position.

c. Remove the ice from the fuel filter by use of fuel filter de-icer switch.

3–15. RESTARTING ENGINE DURING FLIGHT. (See figure 36.)

3–16. Poor flame propagation makes air starts uncertain at higher altitudes, hence, it will be necessary to glide down to 25,000 feet, or less, before attempting an air start. If circumstances permit, keep the engine windmilling at 10% rpm or above. The engine speed should stay above 10% rpm if the air speed is maintained within about 30 knots of the red needle. Normally air starts will be made by using the automatic fuel starting system. The manual system should be used only in case of failure of the automatic system. If circumstances make a fast descent impractical, it may be necessary to use the starter as shown in step 2, figure 36.

Note

If you have forgotten the recommended air starting procedure, the normal ground starting procedure will work, provided the flameout resulted from something other than failure of the main engine-driven fuel pump or the main fuel control unit.

3–17. LANDING WITH ENGINE INOPERATIVE.

3–18. Final approach with dead engine should be about 10–15 knots faster than normal. If you are in a position to land on a prepared runway of adequate length, and if you are sufficiently experienced in the airplane to accomplish a dead engine landing safely with the gear down, the gear should be extended by means of the emergency system.

3–19. In cases where the runway length is marginal, and/or you are inexperienced in the airplane, the landing should be made with the gear retracted. This is substantiated by the following:

a. In cases of overshooting the desired touchdown point or coming in with excessive speed, the airplane can be forced onto the runway and will slide to a stop in a much shorter distance than if the wheels were extended. In addition, if the airplane does slide off the end of the runway, you will have a much better chance of survival if the landing gear is retracted.

b. If the runway is undershot, you will have a much better chance of survival if the landing gear is retracted.

c. If the landing is overshot or undershot, and the landing gear has been extended, you will be unable to retract the landing gear if the need arises.

3–20. FIRE.

3–21. GENERAL.

3–22. There is no fire extinguishing system on this airplane. If the overheat warning light comes on, it probably indicates an overheat condition in the tailpipe. Reduce power to see if the warning light will go out, especially if the engine has been operating at high power.

3–23. If the light goes out, when power is reduced, continue the flight with caution and land as soon as possible.

3–24. If the light does not go out, or if the fire warning light comes on, shut the engine down completely, turn the fuel switches off, and turn the main fuel shut-off valves switch to "CLOSE." Make reasonably sure that fire is actually present before abandoning the airplane as described in paragraph 3–36.

3–25. COCKPIT SMOKE REMOVAL.

3–26. During certain atmospheric conditions, the air cooler will create a vapor condition in the cockpit which resembles smoke. This can usually be eliminated by temporarily moving the cockpit temperature selector to the full "HOT" position. If the condition persists:

a. Shut off the pressurization air by moving the cockpit air valves switch to "NO PRESSURE."

b. Turn "OFF" the battery master and generator switches until it is determined that the smoke is not caused by a short in the electrical wiring.

c. Extend the dive flaps. Extension of the dive flaps will facilitate cockpit smoke removal because the cockpit pressure outflow valve empties into the dive flap area.

d. The oxygen regulator diluter lever may be turned to "100% OXYGEN" if necessary.

3–27. CRASH LANDING.

CAUTION

If any gear cannot be extended, land with all gears retracted.

3–28. GENERAL.

3–29. For a belly landing, notify the radar operator then proceed as follows:

a. Release the tip tanks by pushing tip tank jettison switch.

b. Unlock the canopy or jettison it.

c. Make certain your parachute is unbuckled and your shoulder harness and safety belt are locked.

d. Extend the wing flaps 100%. Fully extended flaps will prevent a wing tip from digging into the ground and the resulting ground loop.

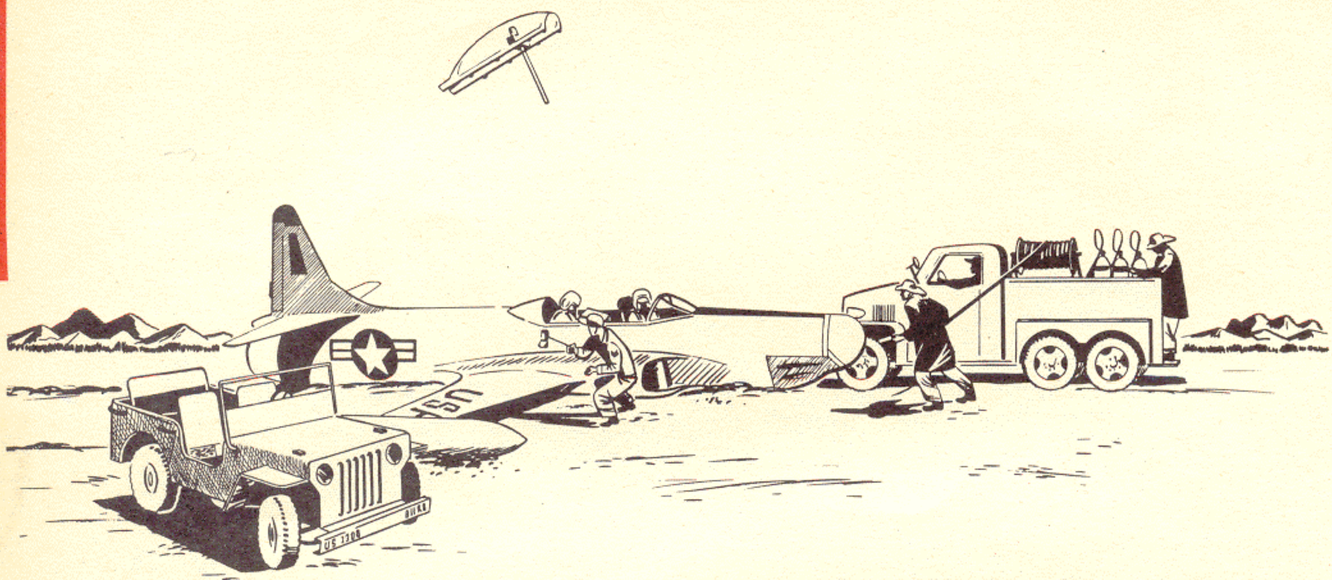


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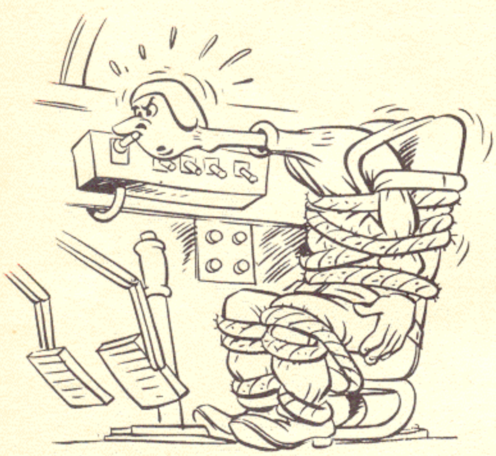
Figure 37 — Emergency Entrance



YOU ARE PREVENTED FROM BENDING FORWARD WHEN THE HARNESS IS LOCKED; THEREFORE, ALL SWITCHES NOT READILY ACCESSIBLE SHOULD BE "CUT" BEFORE LOCKING THE SHOULDER HARNESS!

e. Just before contact with the ground, move the throttle to "OFF," turn the generator and battery master switches "OFF" and turn the main fuel shut-off valves switch to "CLOSE."

f. Make a normal approach and let the airplane touch the ground slightly before the stall is reached. If the engine is dead, use higher than normal (9 – 13 knots IAS) over-the-fence speed.

3-30. EMERGENCY ENTRANCE ON THE GROUND.
Refer to figure 37.

3-31. DITCHING.

3-32. GENERAL.

3-33. This airplane should never be ditched if there is sufficient altitude for a safe bail-out. Ditching is not recommended because, when contact is made with the water, the deceleration will be extremely high and the chances of survival will be slight. If the fuel supply is nearing depletion, stay at altitude until it is exhausted because the remaining fuel will yield much greater range at altitude than near the surface. After the fuel is exhausted glide down below 10,000 feet and bail out.

3-34. PROCEDURE.

3-35. If there is insufficient altitude for a safe bail-out, notify the radar operator, then ditch as follows:

a. Turn IFF selector switch to "EMERGENCY."

b. Release the tip tanks unless the sea is calm and the tanks are nearly empty.

Note

Empty or nearly empty tip tanks will hold the engine air intake ducts out of water until the initial speed is lost and will also provide additional buoyancy.

c. Jettison the cockpit canopy.

d. Make sure the landing gear lever is "UP."

WARNING

Do not attempt a water landing with the landing gear extended.

e. Unbuckle your parachute harness.

f. Make sure your shoulder harness is locked and the safety belt is fastened.

g. Dive flaps "DOWN," wing flaps 50% to 66% (22.5°—30°). (The wing and dive flaps will not cause the airplane to dive. Open dive flaps will aid in keeping the engine air intake ducts above the water).

h. Throttle—"OFF."

i. Select a heading parallel to the wave crests if possible. Aim to touch down on the down side of a crest or on the falling side of a wave, never on the rising side.

j. After the airplane comes to rest, get out of the cockpit immediately and don't forget your life raft.

BAIL OUT RATHER THAN ATTEMPT A WATER LANDING!

3-36. BAIL-OUT.

3-37. GENERAL.

3-38. If sufficient altitude is available, bailing out is preferable to ditching in this airplane. At night or with poor visibility, and with sufficient altitude it is also preferable to bail out rather than crash land even if over open country. With good visibility in the daytime over open country, it is probably advisable to crash land the airplane, except in case of fire.

3-39. In all cases of emergency exit in flight, escape should be made by jettisoning the seats.

3-40. PREPARATION.

a. Inform the radar operator as far in advance as possible that it will be necessary to bail out.

b. If the airplane is still controllable, reduce speed to less than 175 knots IAS.

c. Turn IFF selector switch to "EMERGENCY."

3-41. PROCEDURE (PILOT).
See figure 38 for bail-out procedures.

3-42. PROCEDURE (RADAR OPERATOR). The radar operator's procedure is the same as the pilot's except that he must raise his console to the vertical position before jettisoning his seat. The radar operator should leave the airplane before the pilot, immediately after the canopy is jettisoned, unless advised otherwise by the pilot.

Note

The radar console can be raised, with the canopy off, at any airspeed.

3-43. After ejection, release harness and kick free of the seat. Delay opening of the parachute if possible until reaching 15,000 feet.

3-44. AIRCRAFT SYSTEMS.

3-45. FUEL SYSTEM.

4-36. ENGINE FUEL SYSTEM.

3-47. If the engine fails for no apparent reason, it is probable that one of the engine fuel system units has failed. In this case, the engine should run on the emergency fuel system (see figure 39) after a normal air start.

3-48. BOOSTER PUMP FAILURE. If a wing or leading edge tank booster pump fails, fuel cannot be drawn from that tank by the engine-driven pump except under the most ideal conditions. However fuel will be fed normally from the corresponding tank on the opposite side of the airplane if its booster pump is operating. Fuel may be drawn out of the fuselage tank by the engine-driven pump without the aid of the booster pump at a rate in excess of that necessary to provide 100% rpm up to an altitude of at least 8,000 feet.

3-49. LEAKING FUEL TANKS. If a serious fuel leak is suspected, use the fuel from the leaking tank as rapidly as possible (by turning all other tank switches off). If the leak is in the fuselage tank, first turn the wing tank and leading edge tank switches off and consume the fuel in the tip tanks and the fuselage tank. Then turn the fuselage tank switch to "BY-PASS" and the wing tank and leading edge tank switches on.

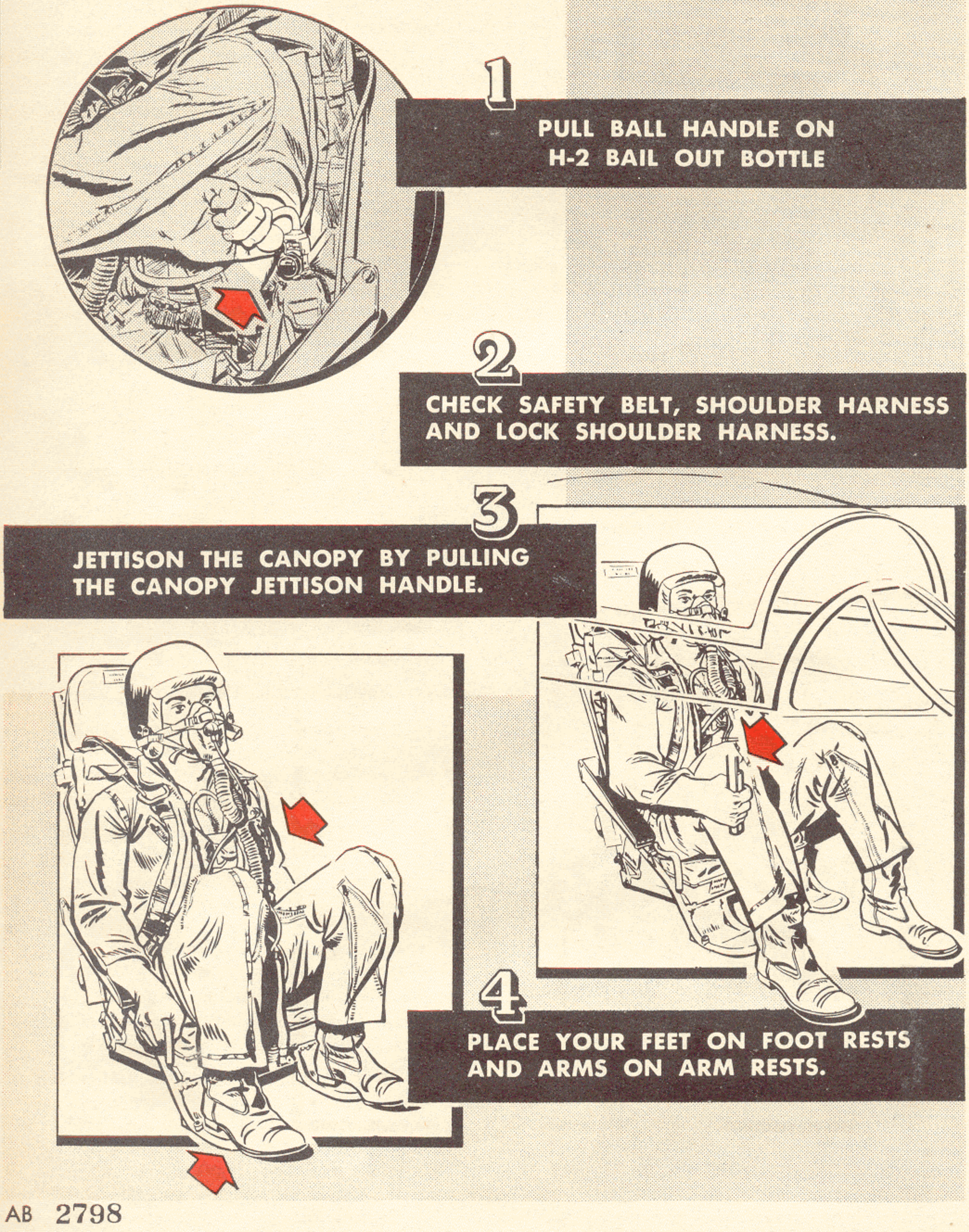
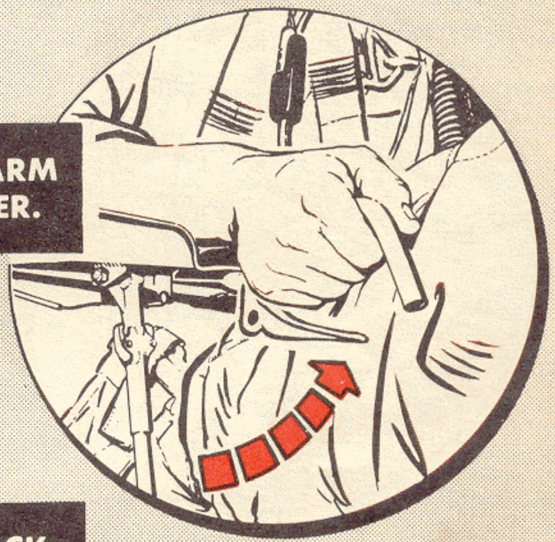


Figure 38 (Sheet 1 of 2 Sheets) — Bail-out Procedure

5

RAISE BOTH ARM RESTS. THE RIGHT ARM REST COCKS THE SEAT EJECTION TRIGGER.



6

SIT ERECT WITH YOUR HEAD HARD BACK AND CHIN TUCKED IN.

7

SQUEEZE THE TRIGGER.

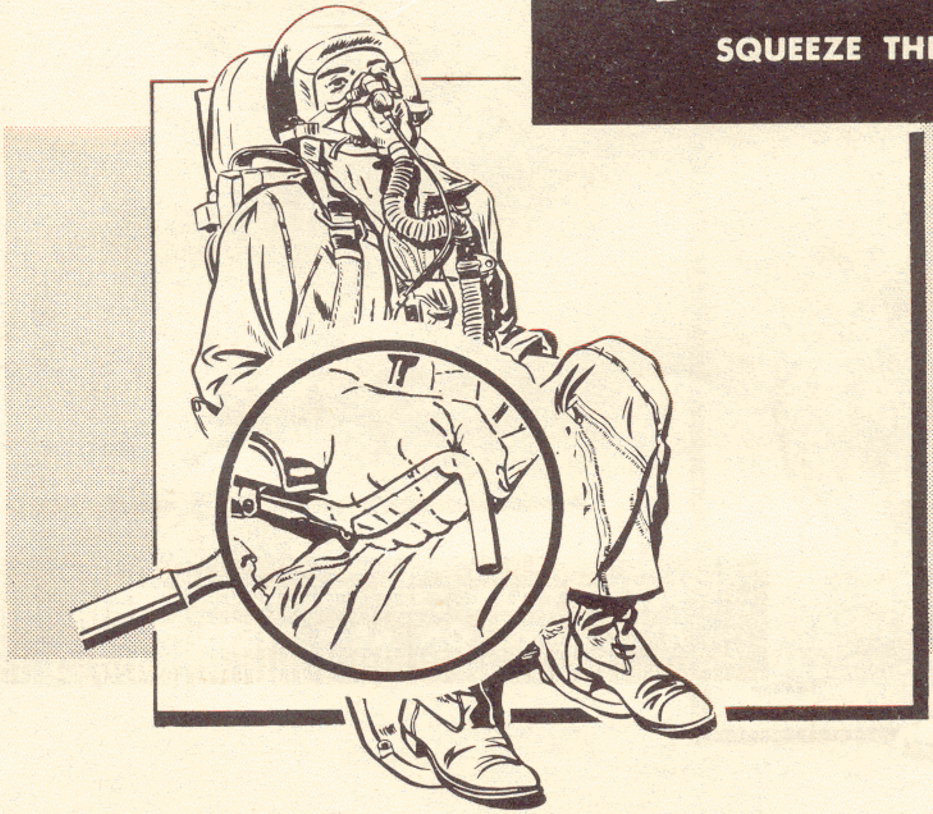


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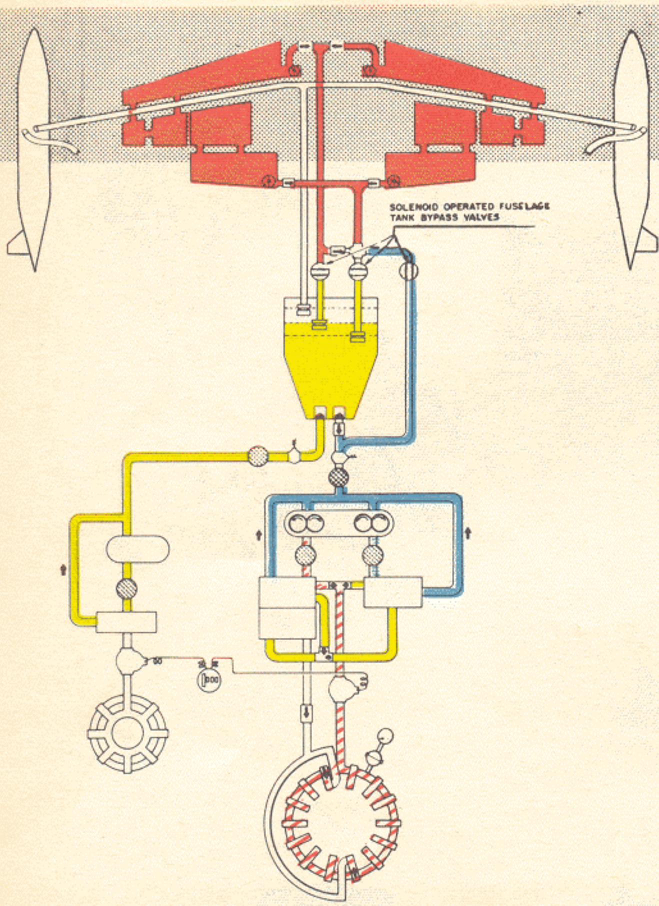
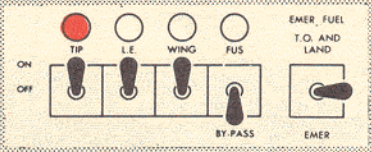
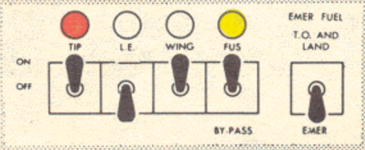
Figure 38 (Sheet 2 of 2 Sheets) — Bail-out Procedure





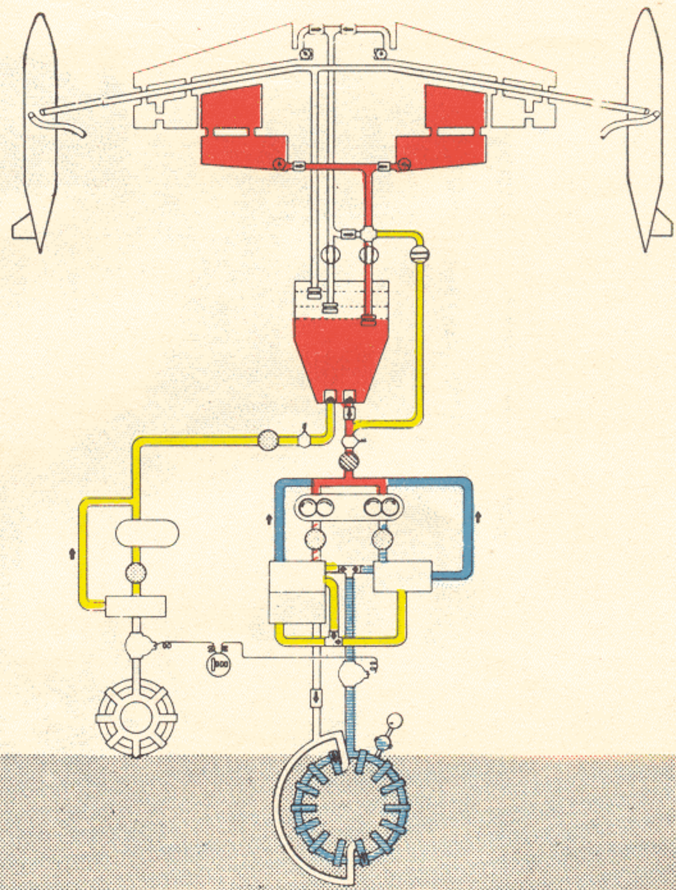
FUSELAGE TANK BY-PASS OPERATION

Fuel from the leading edge and wing tanks is routed to by-pass the fuselage tank with switches set as above.



EMERGENCY FUEL FLOW

With the emergency fuel switch in *"EMER"* the main fuel pump is by-passed and fuel flow is thru the emergency pump and fuel control.



- NORMAL FUEL SUPPLY
- BY-PASS FUEL FLOW
- MAIN PUMP FUEL FLOW
- EMERGENCY PUMP FUEL FLOW
- STATIC FUEL

Figure 39 — Emergency Courses of Fuel Flow

3-50. ELECTRICAL SYSTEM.

3-51. COMPLETE FAILURE. If the electrical system should fail completely, fuel will be available only from the tip tanks and the fuselage tank. Wing flap, dive flap, and trim tab operation will not be available. With the exception of the gyro instruments and the fuel quantity counter, none of the pointers of the electrically operated instruments will remain in their operating ranges in the event of electrical failure. The gyro instruments will give more and more erratic readings as the gyros slow down while the fuel quantity counter reading will remain as it was when the power failed. The tachometer and tail pipe temperature indicator are self generating instruments and therefore will not be affected by electrical power failure.

3-52. GENERATOR FAILURE. If only the generator fails and battery power is still available turn off all non-essential electrical equipment. Turn off the leading edge and wing tanks, and allow fuel to transfer from the tip tanks. When the tip tanks are empty, turn the leading edge tanks on until the fuselage tank quantity gage shows nearly full. Then turn the leading edge tanks on intermittently to maintain this level until the leading edge tanks are emptied. Repeat this manual transfer from the wing tanks.

WARNING

If the generator "OUT" warning light comes on, turn 115-volt a.c. and radar switches "OFF" immediately.

3-53. HYDRAULIC SYSTEM.

3-54. GENERAL. The emergency hydraulic system supplies pressure for extension of the landing gear only. Refer to paragraphs 3-60 through 3-62.

3-55. HYDROFUSE. The hydrofuse was rendered inoperative by safety wiring in the "RESET" position before the airplane left the factory. However, if the safety wire should be removed, it will function normally. The lever is provided to permit resetting the hydrofuse in an emergency if it has shut off pressure as the result of leakage in the landing gear or dive flap systems, or malfunctioning of the fuse. The hydrofuse cannot shut off pressure to the shell case ejection door or to the aileron booster.

3-56. FLIGHT CONTROLS.

3-57. AILERON BOOST. In the event of aileron boost failure, move the aileron booster shut-off lever to "OFF."

3-58. WING FLAPS.

3-59. There is no emergency means of extending the wing flaps. (See paragraph 2-82.)

3-60. LANDING GEAR.

3-61. The emergency hydraulic system should be used for extension of the landing gear, only in case of failure of the normal system. After the gear has been extended by the emergency system, fluid must be removed from the main system reservoir before the gear can be retracted again. This is necessary because the fluid in the "up" sides of the cylinders is returned to the main reservoir during emergency gear extension. If fluid is not removed, the main reservoir will overflow into the plenum chamber if the gear is retracted and cause a serious fire hazard. The gear cannot be shaken down by yawing or sharp pull-ups.

WARNING

The emergency hydraulic system is for emergency extension of the gear only, and no means of retracting is provided by the emergency system.

3-62. LANDING GEAR EMERGENCY EXTENSION. Emergency extension of the landing gear is accomplished as shown in figure 40. If no action results from this procedure it still may be possible to extend the gear if the hydrofuse is not safety-wired in the "RESET" position as it was when the airplane left the factory.

a. Return the emergency hydraulic system selector lever to the "NORMAL" position.

b. Check that the landing gear lever is in the "DOWN" position.

c. Hold the hydrofuse reset lever in "RESET" until the gear is down and locked as shown by the landing gear position indicator or until all the hydraulic fluid is pumped overboard as indicated by failure of the aileron booster.

d. If the landing gear has still failed to extend and lock, try the emergency system again before bailing out or making a belly landing.

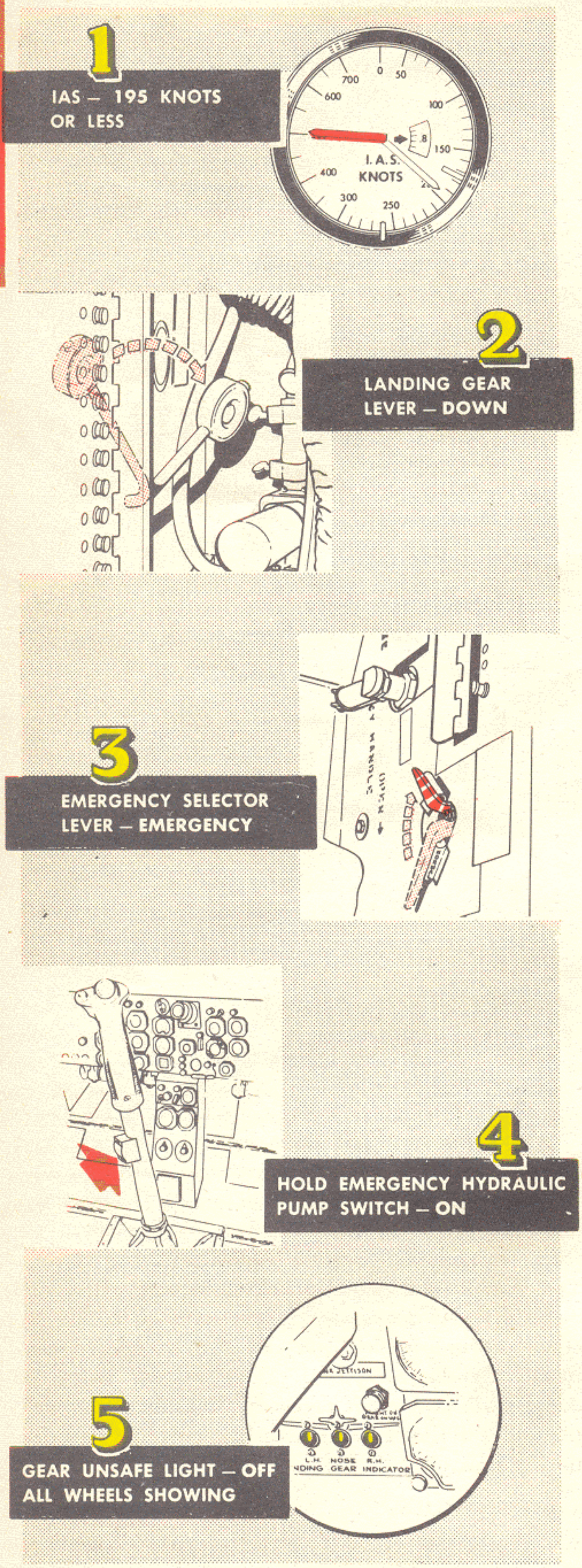


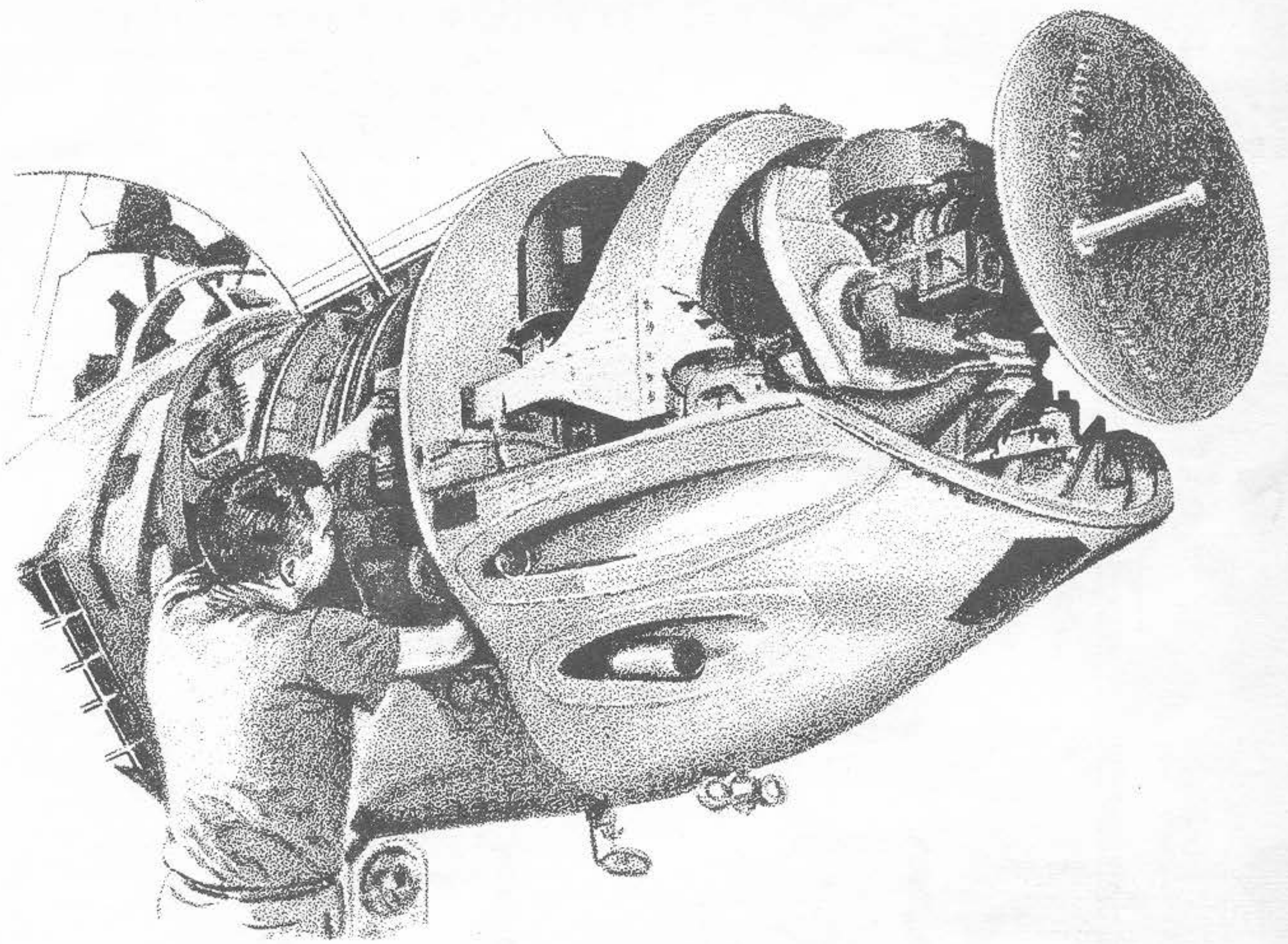
Figure 40 — Emergency Landing Gear Extension

3-63. TIP TANKS EMERGENCY JETTISON. Normally there is no reason to jettison empty tip tanks. However if for some reason it is necessary to land with one full and one empty tip tank you should attempt to transfer fuel from the heavy tank and land with the tanks on the airplane. If this is impossible jettison the tanks at an airspeed of 250 knots or more as the light tank at low airspeed has a tendency to roll up on the top side of the wing if released at a lower speed.

a. Tip Tank Jettison switch—PUSH.

b. In case of failure of the electrical controls:

Manual Release, Tank or Bomb—PULL.



SECTION IV

DESCRIPTION AND OPERATION OF AUXILIARY EQUIPMENT

4–1. PRESSURIZATION, HEATING AND VENTILATING SYSTEM.

4–2. GENERAL.

4–3. Pressurization, heating, and ventilating are combined into an air conditioning system (fig. 41) on this airplane. When the canopy is closed, the cabin is sealed by an automatically inflated rubber seal. Air for pressurization, heating, ventilating and canopy seal inflation is obtained from the engine compressor. Cabin temperature is controlled by diverting a portion of the hot air from the engine compressor through the turbo-refrigerator for cooling before it enters the cabin. Air enters the cabin through four inlet grilles (two in each cockpit) and the windshield defroster ducts. Pressurization is maintained automatically by the pressure regulator which releases air from the cockpit at a variable rate calculated to maintain the proper pressure differential and rate of change of cockpit air. From sea level to 12,500 feet altitude the cabin is unpressurized; above 12,500 feet, cabin pressure is gradually increased until the differential above outside air pressure reaches five psi. The cabin altimeter (8, fig. 19) located in the pilot's cockpit, indicates the equivalent cabin altitude. The combination pressure relief, vacuum relief and dump valve unit operates automatically to relieve excessive cabin pressure, and can also be opened electrically by the cockpit air valve shut-off switch to dump cabin pressure if necessary. Outside air for ventilating is available to each cockpit only if pressurization is shut off.

4–4. CONTROLS.

4–5. COCKPIT AIR VALVES SHUT-OFF SWITCH. This switch (2, fig. 7) controls the air shut-off valve, the relief and dump valve, and the solenoid valve in

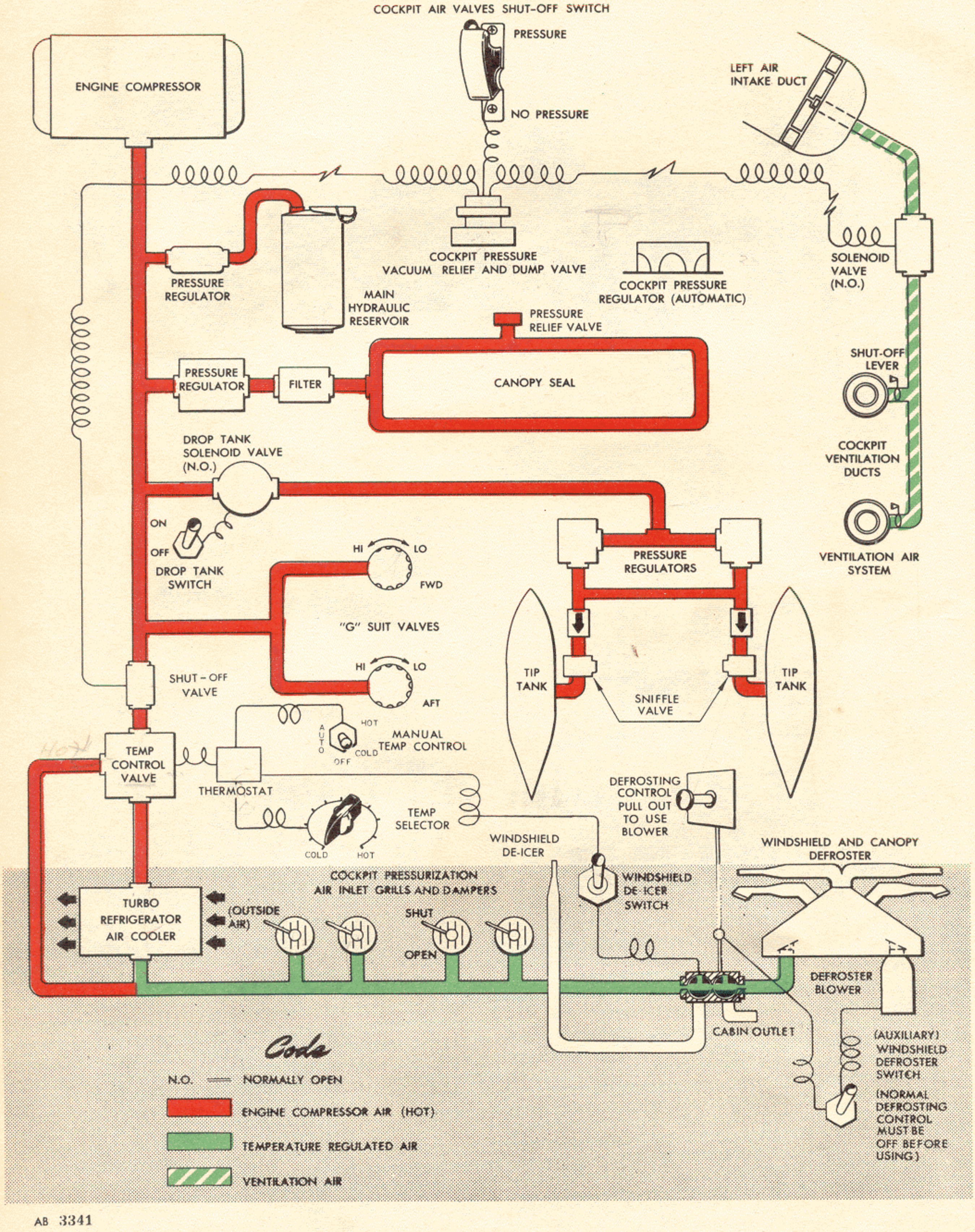


Figure 41 — Pressurization, Heating and Ventilating System Diagram

the ventilation air duct. When the switch is in the "PRESSURE" (normal) position, the solenoid valve is closed, the relief and dump valve is closed, and the compressor air shut-off valve is open; thus providing cabin pressure. When the switch is in the "NO PRESSURE" position, the positions of the valves are reversed and cabin pressurization is shut off.

4–6. TEMPERATURE SELECTOR. This control (11, fig. 6) located on the pilot's left side forward panel, permits the presetting of a thermostat which varies the position of the temperature control valve to maintain the desired cockpit temperature.

4–7. MANUAL TEMPERATURE CONTROL SWITCH. This switch (10, fig. 6), located on the pilot's left side panel, is provided to permit overriding the thermostatic control if necessary. The switch has four positions: "AUTO," "OFF," "COLD," and "HOT." When the switch is in the "AUTO" (normal) position, the thermostatic control is operative and the selected temperature will be maintained. When the switch is held in the "COLD" position, the thermostat is inoperative, and the temperature control valve is moved toward the full cold position until the switch is released. When the switch is held in the "HOT" position, the thermostat is inoperative and the temperature control valve is moved toward the full hot position. Placing the switch in "OFF" renders the thermostat inoperative and stops the movement of the valve.

4–8. PRESSURE AIR INLET DAMPERS. Each of the four inlet grilles is provided with a damper (8, fig. 5, and 8, fig. 52) which permits individual regulation of inflowing air. If the dampers on all inlet grilles are closed, all of the inflowing air will be directed to the windshield defroster ducts on windshield de-icer.

4–9. VENTILATION DUCT SHUT-OFF LEVERS. Ventilating air is supplied to the cabin when the cockpit air valves switch is in the "NO PRESSURE" position. The quantity of ventilating air entering each cockpit is individually controlled by a shut-off lever in the cockpit ventilating duct outlet (9, fig. 6).

4–10. WINDSHIELD AND CANOPY DEFROSTING.

4–11. GENERAL.

4–12. Hot air for defrosting the windshield and canopy is taken from the cabin pressurization system and distributed by ducts at the interior base of the windshield. The temperature of this air is dependent upon the position of the temperature selector and the quantity is dependent upon the positions of the cockpit pressure air inlet grille dampers.

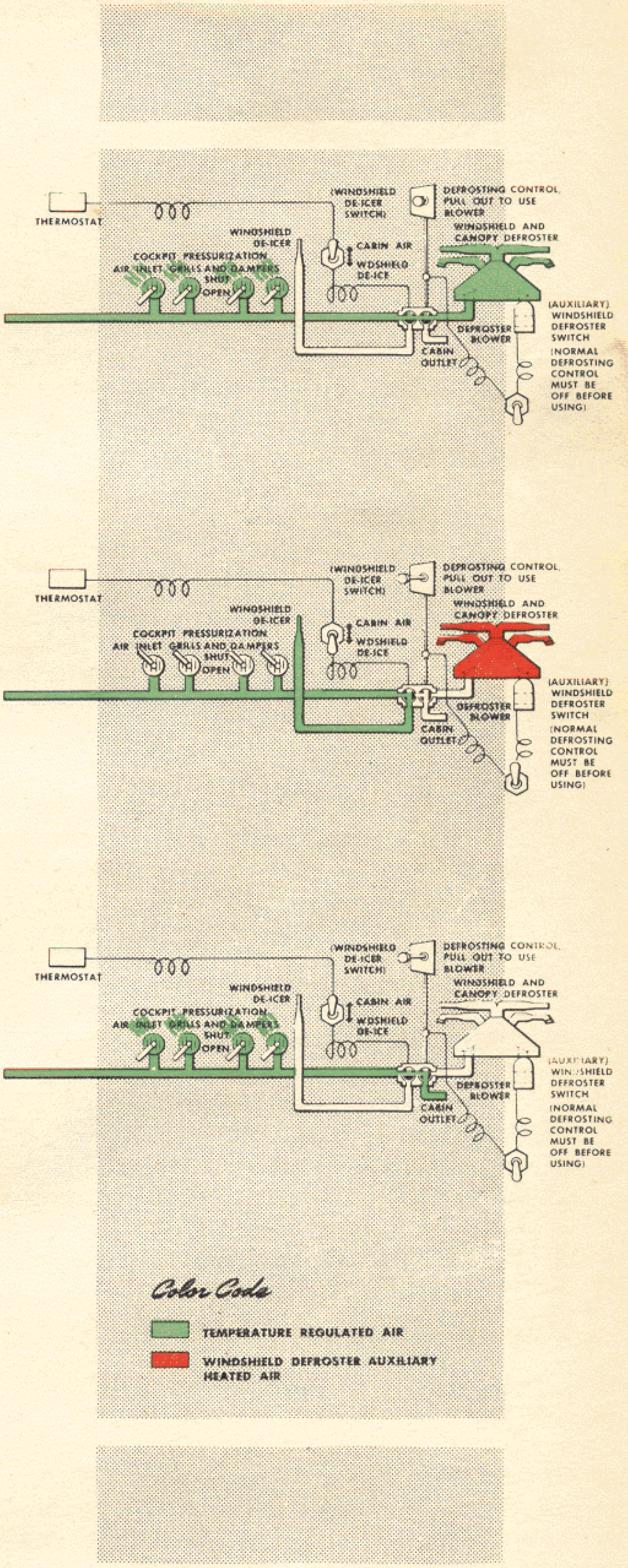


Figure 42 — De-icer and Defroster Valve Positions

4-13. (AUXILIARY) WINDSHIELD AND CANOPY DEFROSTING SYSTEM. An electric fan and heater unit provides an alternate source of heated air for defrosting while descending from altitude with the engine inoperative, at low engine rpm, or while heated air from the cabin pressurization system is being diverted for windshield de-icing.

4-14. CONTROLS. (See Fig. 42.)

4-15. DEFROSTING CONTROL. This control (2, fig. 19) located on the pilot's pedestal, mechanically positions the defroster valve. The control is pushed in to defrost and pulled out to shut off defrosting air. Defrosting air is not available from the cabin pressurization system when the windshield de-icer is turned on.

4-16. (AUXILIARY) WINDSHIELD DEFROSTER SWITCH. This switch (Fig. 54), located on the armament control panel, has two positions, On (up) and Off (down). When the switch is on, the electric fan and heater unit supplies hot air to the interior windshield defroster duct, provided the defrosting control is pulled out (shut off).

4–17. WINDSHIELD DE-ICING.

4-18. GENERAL.

4-19. Ice may be removed from the windshield by diverting heated air from the defroster ducts to the space between the two layers of glass in the center windshield panel. The quantity of air depends upon the position of the pressure air inlet grille dampers.

4-20. WINDSHIELD DE-ICER SWITCH. This switch (3, fig. 19), on the pilot's center panel, has two positions: "WDSHIELD DE-ICE," and "CABIN AIR." When placed in the "WDSHIELD DE-ICE" position, hot air is directed to the center windshield panel. When the switch is placed in the "CABIN AIR" position, the valve position is reversed and air is available for defrosting.

4–21. WING AND STABILIZER DE-ICING SYSTEM.

4-22. GENERAL.

4-23. If rubber de-icer boots are installed on the leading edges of the wing and horizontal stabilizer, they are electrically operated and powered by a 30 k.v.a. engine-driven alternator. High resistance wires are embedded in the rubber de-icer boots to convert the electrical energy to heat energy. These integral wires are arranged so that when the system is operating, a "burn-out" section approximately one and one-half inches wide along the leading edge of each boot is hot continuously and the remainder of the boots are alternately heated in narrow span-wise sections that progress aft from the "burn-out" section. The spanwise sections are automatically selected by a cyclic timer operated by the 28-volt d.c. electrical system. Each section is heated ten out of every 100 seconds. A cut-out switch is installed on the landing gear scissor to prevent inadvertent operation of the de-icers when the airplane is on the ground.

Note

The landing gear microswitch should not be relied upon to shut off the de-icer when landing. The wing heat switch and alternator should be turned off.

WARNING

Under certain load conditions, the installation of this de-icer system may cause a rearward c.g. loading, requiring the addition of ballast. Refer to Technical Order AN 01-1B-40.

4-24. DE-ICING CONTROLS.

4-25. ALTERNATOR SWITCH. This switch, located on the left side of the pilot's cockpit below the aileron booster shut-off lever, has two positions: "ON" and "OFF." When in the "ON" position, 28-volt d.c. current closes a solenoid-operated contact and completes the exciter field current circuit of the 30 k.v.a. alternator.

4-26. WING HEAT SWITCH. This switch controls the wing and stabilizer de-icer electrical circuit and is located adjacent to the alternator switch on the left side of the pilot's cockpit. The switch has two positions: "ON" and "OFF." When the switch is "ON," the 28-volt d.c. circuit to the cyclic timer is completed and the de-icing system is placed in operation (provided that the alternator has been turned on and the airplane is airborne).

4-27. ALTERNATOR VOLTAGE ADJUSTMENT RHEOSTAT. A voltage adjustment rheostat is located beneath a cover box forward of the a.c. voltmeter in the radar operator's cockpit to provide control for the output of the 30 k.v.a. alternator. The rheostat should be set for 115 volts output under full load when the engine is operating at normal cruising rpm.

4-28. DE-ICER INDICATORS.

4-29. ALTERNATOR VOLTMETER. An a.c. voltmeter is located on the left side of the radar operator's cockpit and indicates the output of the alternator.

4-30. WING HEAT INDICATOR LIGHT. A green light is located forward of the "WING HEAT" switch to indicate to the pilot when the system is operating.

4-31. DE-ICING OPERATION.

CAUTION

Do not attempt to operate the de-icers on the ground since 8½ seconds of ground operation will destroy the boots.

4-32. The system should be activated before icing conditions are encountered. However, if it is turned on as soon as ice begins to form, it will properly de-ice. If a great amount of ice is allowed to bridge over the leading edge due to delay in turning on the system, operation will be seriously affected. The system is placed in operation as follows:

a. Alternator switch—"ON."

b. Wing heat switch—"ON."

4-33. FUEL FILTER DE-ICER SYSTEM.

4-34. GENERAL.

4-35. This system (Fig. 8) is provided to remove ice accumulation from the low pressure fuel filter. It consists of a five gallon alcohol supply tank, an electrically-driven pump, a differential pressure switch and a warning light. The tank is connected through the fluid pump and a solenoid shut-off valve to the low pressure fuel filter. The alcohol supply is sufficient for about twenty applications of 15 seconds each.

4-36. FUEL FILTER DE-ICER SWITCH.

4-37. This toggle switch, located on the pilot's left side upper panel (6, fig. 9), has two positions: "ON" and "OFF." Holding the switch in the "ON" position turns on the pump and opens the solenoid valve so that alcohol is delivered to the filter. If the filter is iced, the alcohol will dissolve the ice accumulation, which reduces the pressure drop and thus extinguishes the warning light.

4-38. FUEL FILTER DE-ICER WARNING LIGHT.

4-39. The red warning light, located on the pilot's left side upper panel (1, fig. 9), is connected to the differential pressure switch which senses fuel pressure drop across the low pressure filter. If the pressure drop reaches approximately 2 psi, the warning light glows, indicating the possibility of icing.

WARNING

If the filter icing warning light comes on, hold the de-icing switch in the "ON" position until the warning light goes out. If the warning light does not go out after holding the de-icing switch on for from 20 to 30 seconds, the flight should be discontinued.

4-40. LIGHTING EQUIPMENT.

4-41. LANDING AND TAXI LIGHTS.

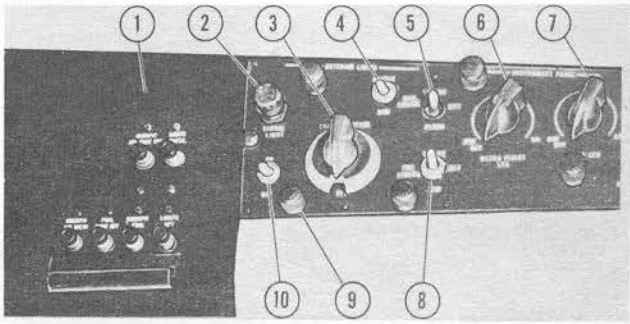
4-42. Two non-adjustable landing and taxi lights are mounted on the nose gear and turn with the gear. The switch, located on the pilot's left side upper panel (6, fig. 7), has three positions: "LANDING LIGHTS," "OFF," and "TAXI LIGHT." When the switch is in the "LANDING LIGHTS" position, both lights are on. In the "TAXI LIGHT" position, only the left light is on.

CAUTION

Do not leave landing lights on more than five minutes on the ground.

4-43. NAVIGATION LIGHTS.

4-44. Conventional navigation lights are installed on each wing tip and on the empennage. In addition, navigation lights are installed on each wing tip fuel tank to replace the normal lights when tip tanks are carried. An automatic switching arrangement is provided to energize the normal lights if the tip tanks are dropped, when the navigation lights are turned on.



1. Circuit Breakers
2. Signal Light Indicator Light
3. Code Selector
4. Navigation Lights Dimmer Switch
5. Navigation Lights Steady Flash Switch
6. Ultra-violet Lights Rheostat
7. Instrument Panel Red Light Rheostat
8. Fuselage Lights Switch
9. Indirect Panel Light (typical)
10. Signal Lights Switch

Figure 43 — Lighting Control Panel, Pilot's Cockpit

The switches are located on the pilot's lighting control panel (4 and 5, fig. 43). The lights are turned on or off, or connected through the flasher-coder by the "STEADY"-"FLASH" switch. When in the "FLASH" position, the navigation lights will flash the code character chosen by the code selector. Brilliance is controlled by the "DIM"-"BRIGHT" switch.

4–45. FUSELAGE LIGHTS.

4–46. One 6-watt fuselage light and one 100-watt signal light are installed on the top and bottom of the fuselage. The fuselage lights may be dimmed, but not flashed, and the signal lights may be flashed by means of the code selector. The fuselage light switch, located on the pilot's left side panel (8, fig. 43), controls the 6-watt fuselage light and has three positions: "DIM," Off (center), and "BRIGHT."

4–47. SIGNAL LIGHTS.

4-48. The signal lights switch, located on the pilot's lighting control panel (10, fig. 43), controls the 100-watt signal lights and has two positions: "ON" and "OFF." The white indicator light on the pilot's left side panel (2, fig. 43) glows when the signal lights are on, and flashes the code character determined by the code selector.

4–49. CODE SELECTOR.

4–50. This selector, located on the pilot's lighting control panel (3, fig. 43), has a position for each code letter and an "OFF" position. It will flash the code character selected on the navigation lights and the signal lights.

4–51. COCKPIT LIGHTING.

4–52. PILOT'S COCKPIT. The pilot's instruments are individually edge lighted and shielded, and the left shelf is indirectly lighted through a translucent panel. In addition, one C-4 spot, two ultra-violet spots, and two red floodlights are provided. Each group of lights is individually controlled by a separate rheostat (figures 43 and 45).

4–53. REAR COCKPIT. The rear cockpit contains two red floodlights, one ultra-violet spot, and one C-4 spot. The red floodlights and ultra-violet light are individually controlled by rheostats (6 and 8, fig. 50). The control for the C-4 spotlight is incorporated in the light assembly.

4–54. COMMUNICATIONS AND ASSOCIATED ELECTRONIC EQUIPMENT.

TABLE OF COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT

TYPE	DESIGNATION	USE	OPERATOR	ILLUSTRATION
INTERPHONE	AN/AIC-2A	INTERCREW COMMUNICATION	PILOT AND RADAR OPERATOR	FIG. 44
VHF COMMAND	AN/ARC-3	TWO-WAY VOICE OR CODE COMMUNICATIONS	PILOT	FIG. 46
RADIO COMPASS	AN/ARN-6	NAVIGATION, VOICE OR CODE RECEPTION	PILOT	FIG. 47
GLIDE SLOPE RECEIVER	AN/ARN-5B	ILS APPROACH	PILOT	FIG. 48
LOCALIZER RECEIVER	RC-103-D	ILS APPROACH	PILOT	FIG. 48
RADAR	AN/APG-33	SEARCH AND TRACKING	PILOT AND RADAR OPERATOR	FIG. 2, 10 & 52
IFF	AN/APX-6	IDENTIFICATION	PILOT	FIG. 11

AB 3332

4–55. AN/AIC-2A INTERPHONE.

4–56. The interphone amplifier is on whenever the battery switch is "ON." Both microphones are always on interphone except when one of the microphone buttons is held down. Holding either microphone button (1, fig. 6; or 2, fig. 50) down connects the microphone to the AN/ARC-3 transmitter.

4–57. INTERPHONE (RADIO RECEIVER CUT-OUT) SWITCH. The interphone receiver cut-out switch (16, fig. 50) is located on the floor of the radar operator's cockpit and permits the radar operator to cut out AN/ARC-3 or AN/ARN-6 audio reception when it interferes with his interphone reception. The switch is a spring-loaded button type, which, when held down by toe pressure, cuts out receiver reception. When the button is released, both receiver and interphone reception are available.

4–58. INTERPHONE ALTITUDE GAIN CONTROL. This control is located on the interphone amplifier (Fig. 44) just aft and to the right of the pilot's seat. Adjust the control to give the desired interphone performance at the altitude at which you are flying. The suggested settings are as follows:

Altitude–Ft.	Control Setting
0 — 10,000	1
10,000 — 20,000	2
20,000 — 30,000	3
above 30,000	4

Figure 44 — AN/AIC-2A Interphone Amplifier

When turned fully counter-clockwise, the altitude control will be set at No. 1 and when turned fully clockwise it will be set at No. 4. Detents are provided to indicate settings No. 2 and 3.

4–59. HEADSET VOLUME CONTROL. A headset volume control is provided on the left side panel in the rear cockpit (4, fig. 50), and on the right side of the pilot's cockpit (Fig. 45).

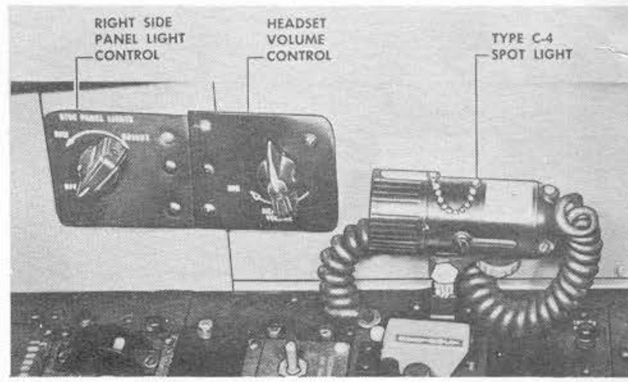
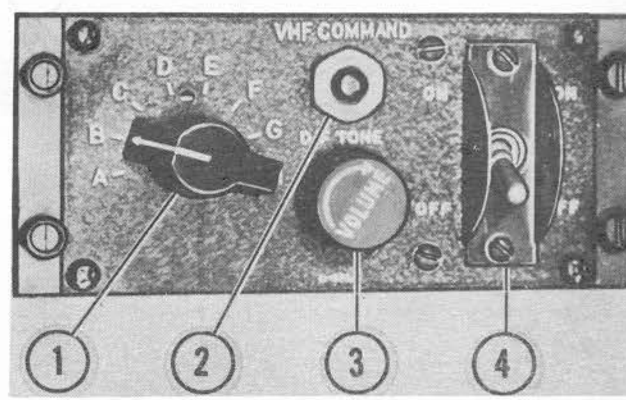


Figure 45 — Light and Headset Volume Control, Pilot's Right Side

4–60. AN/ARC-3 VHF COMMAND RADIO.

4–61. This set consists of a very high frequency transmitter and receiver, power for which is supplied by the direct-current bus. When the set is turned on, transmission is controlled by the microphone button on the throttle, or the switch button (2, fig. 50) on the radar operator's left side panel. Reception on this set may be interrupted any time the radar operator presses the cut-out switch (16, fig. 50).



1. Channel Selector Switch
2. DF Tone Control
3. Volume Control
4. "ON-OFF" Switch

Figure 46 — AN/ARC-3 VHF Command Radio Controls

4–62. "ON-OFF" SWITCH. This switch (4, fig. 46) turns the set on or off.

4–63. CHANNEL SELECTOR SWITCH. This switch (1, fig. 46) has positions "A," "B," "C," "D," "E," "F," "G," and "H." The set transmits and receives on the channel to which the selector switch is set.

4–64. VOLUME CONTROL. (3, fig. 46) The volume control may be turned clockwise to increase the volume and counter-clockwise to decrease the volume.

4–65. D/F TONE CONTROL. By keying this control (2, fig. 46) code may be transmitted, and by holding it depressed, a continuous signal can be transmitted on which a fix can be obtained by a ground direction finder station.

4–66. AN/ARN-6 RADIO COMPASS.

4–67. The AN/ARN-6 radio compass provides navigational aid as well as aural reception. The control panel is located on the pilot's right side panel (3, fig. 11), and the azimuth indicator (15, fig. 10) is located on the instrument panel.

4–68. FUNCTION SWITCH. The function switch (1, fig. 47) is used to turn the set on and select the type of operation. In the "COMP" position, the set functions as an automatic direction finder. In the "ANT" position, the antenna is switched from the loop to the sense antenna. In the "LOOP" position, the loop can be manually rotated by the use of the loop left-right switch. The "CONT" position has no function on this airplane and hence is inoperative.

4–69. LOOP L-R SWITCH. This switch (3, fig. 47) is provided to permit manual control of the loop when the function switch is in the "LOOP" position.

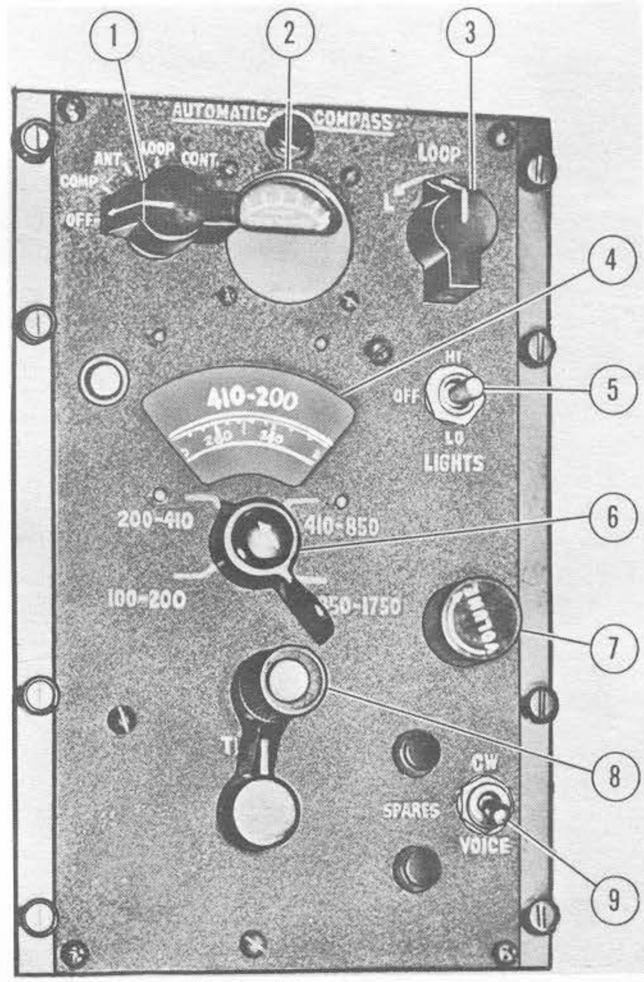
4–70. VOLUME CONTROL. This knob (7, fig. 47) provides selection of the desired level of audio reception.

4–71. VOICE-CW SWITCH. This switch (9, fig. 47) provides selection of continuous wave or voice reception.

4–72. BAND SWITCH. This switch (6, fig. 47) provides selection of any one of four frequency bands.

4–73. LIGHT SWITCH. This switch (5, fig. 47) controls the AN/ARN-6 panel lighting and has three positions: "OFF," "HIGH," and "LOW."

4–74. TUNING CRANK. The tuning crank (8, fig. 47) is used to tune the desired station for maximum signal strength as indicated on the tuning meter.



1. Function Switch
2. Tuning Meter
3. Loop L-R Switch
4. Tuning Dial
5. Light Switch
6. Band Switch
7. Volume Control
8. Tuning Crank
9. Voice-CW Switch

Figure 47 — AN/ARN-6 Radio Compass Control Panel, Pilot's Right Side

4–75. TUNING METER. This meter (2, fig. 47) indicates relative signal strength and tuning accuracy.

4–76. OPERATION. Turn the set on by turning the function switch to "COMP," "ANT," or "LOOP." Turn the set off by turning the function switch to "OFF."

CAUTION

Erratic operation of the compass can be expected when the airplane is in a bank of 45 degrees or more as manifested by any one of the following:

a. The compass indicator may slow down so that there is considerable lag between the beaming indication and the airplane heading.

b. The indicator may stop altogether or move in jerks.

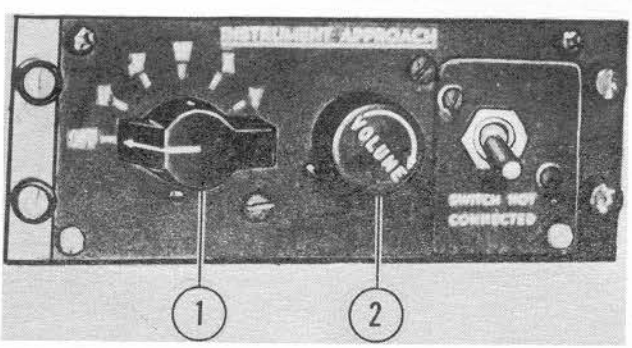
c. The indicator may start moving to the direction opposite from the turn, later change direction but still lag the airplane heading considerably.

d. The indicator may oscillate violently. Since the erartic operation occurs only during a turn, it will not affect the use of the radio compass in normal flight.

4–77. INSTRUMENT APPROACH (ILS) RECEIVERS.

4–78. The ILS receivers consist of the AN/ARN-5B glide slope receiver and the RC-103-D localizer receiver (23, fig. 2). Both receivers are used in conjunction with the Zero Reader and the instrument (ILS) approach system described in paragraphs 1–177 - 1–196. The glide slope receiver supplies signals to actuate the horizontal bars of the Zero Reader indicator and the deviation (cross-pointer) indicator when the Zero Reader selector is in the "APPROACH" position. The localizer receiver supplies signals to actuate the vertical bars on the Zero Reader indicator and the deviation (cross-pointer) indicator when the Zero Reader selector is in the "LEFT," "APPROACH," or "RIGHT" position. Audio reception is also provided on the localizer receiver.

4–79. VOLUME CONTROL. The volume control (2, fig. 48), located on the pilot's right side panel, provides control of the audio level of ILS identification signals but has no effect on the strength of signals supplied to the indicating equipment.



1. Channel Selector and "OFF" Switch
2. Volume Control

Figure 48 — ILS Control Panel

4–80. CHANNEL SELECTOR SWITCH. The channel selector switch (1, fig. 48) located on the pilot's right side panel, turns on and selects the frequencies for both ILS receivers. Operating frequencies for each channel are as follows:

FREQUENCY (MEGACYCLES)

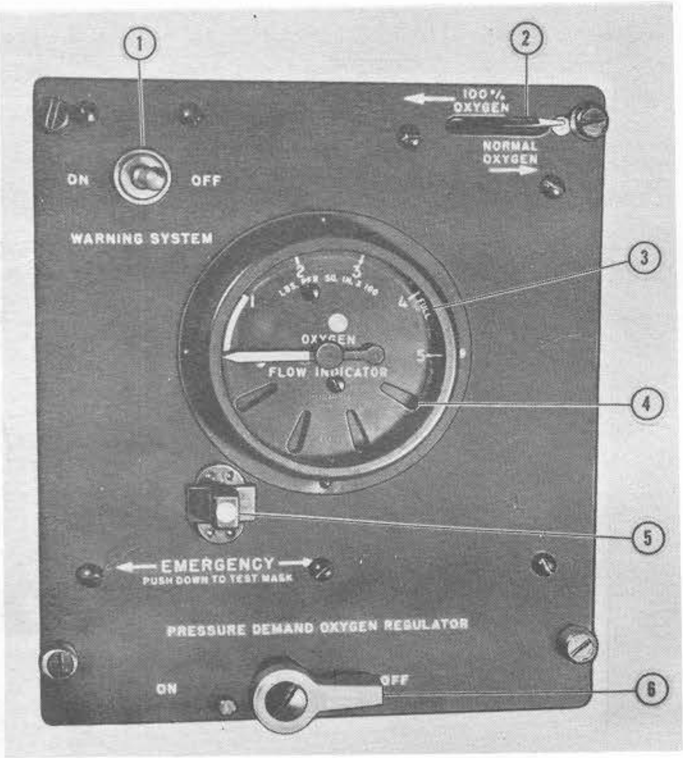
SWITCH POSITION	LOCALIZER RECEIVER RC-103-D	GLIDE SLOPE RECEIVER AN/ARN-5B
U	108.3	332.6
V	108.7	333.8
W	109.1	335.0
X	109.5	332.6
Y	109.9	333.8
Z	110.3	335.0

4–81. OXYGEN SYSTEM.

4–82. GENERAL.

4–83. A high pressure oxygen system, supplied by two Type AN 6025/AX295 oxygen cylinders, properly check-valved for combat safety, is installed in the airplane. The oxygen cylinders (32, fig. 2) are installed in the forward part of the nose compartment and may be recharged through a single filler valve located inside the nose compartment on the forward left side. Only a pressure breathing demand oxygen mask will be used.

4–84. REGULATOR. An automatic pressure breathing diluter demand oxygen regulator is installed in each cockpit (12, fig. 5, and 1, fig. 50). The regulator automatically supplies the proper mixture of air and oxygen at all altitudes. At high altitudes the regulator automatically supplies positive pressure breathing.



1. Warning System Switch
2. Diluter Lever
3. Low Pressure Gauge
4. Flow Indicator Windows
5. Emergency Toggle Lever
6. Supply Valve Lever

Figure 49 — Oxygen Regulator Panel

4-85. CONTROLS.

4-86. REGULATOR DILUTER LEVER. A diluter lever (2, fig. 49) is provided on each regulator. The lever in the "NORMAL OXYGEN" position opens the air inlet valve so that the regulator automatically supplies a proper mixture of air and oxygen to the mask at all altitudes. The lever, at the "100% OXYGEN" position closes the air inlet valve so that the regulator supplies 100% oxygen to the mask for emergency use.

4-87. REGULATOR SUPPLY VALVE LEVER. The oxygen supply valve lever (6, fig. 49) is located at the bottom of the regulator panel. When turned to the "ON" position, it opens the oxygen supply to the regulator. The lever, when turned to the "OFF" position, cuts off the oxygen supply.

CAUTION

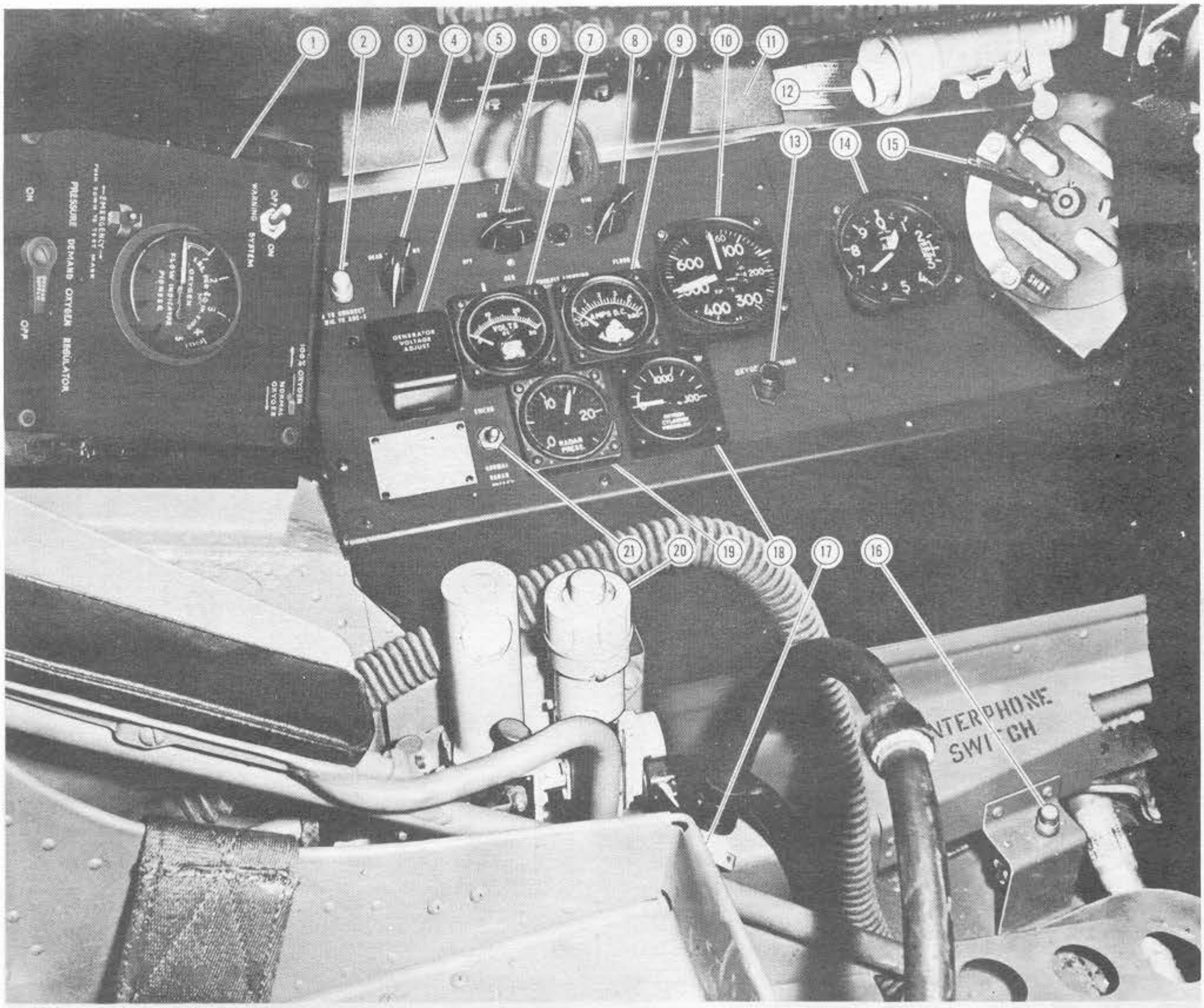
If the oxygen supply valve is left turned on at an unused station, oxygen will be lost.

4-88. REGULATOR EMERGENCY TOGGLE LEVER. The emergency toggle lever (5, fig. 49) on the regulator provides a means of manually supplying positive pressure to the mask for emergency use. Pushing the lever gives a positive pressure to the mask which is automatically stopped when the lever is released. Pushing the lever to either side (right or left) locks the lever to give continuous positive pressure to the oxygen mask.

Note

The oxygen mask fit may be tested at any altitude by pushing the "EMERGENCY" toggle lever.

4-89. REGULATOR WARNING SYSTEM SWITCH. A toggle switch (1, fig. 49) for operating the warning light circuit is provided on each regulator panel. The toggle switch turns on the warning light circuit and should be in the "ON" position when the regulator is in use. It should be in the "OFF" position when the regulator is not in use.



A3 2649

1. Oxygen Regulator
2. Microphone Button
3. Ultra-violet Flood Light
4. Head Set Volume Control
5. Generator Voltage Adjustment Rheostat
6. Red Light Control Rheostat
7. Voltmeter
8. Ultra-violet Light Control Rheostat
9. Ammeter
10. Airspeed Indicator
11. Ultra-violet Flood Light
12. Ventilation Duct Outlet
13. Oxygen Warning Light
14. Altimeter
15. Pressure Air Inlet Damper and Grill
16. Radio Receiver Cut-out Switch
17. Radar Operator's Ejection Seat
18. Oxygen Cylinder Pressure Gage
19. Radar Pressure Gage
20. Anti-G Suit Valve
21. Radar Pressure Selector Switch

Figure 50 — Radar Operator's Cockpit, Left Side

2 CREW MEMBERS	CREW MEMBER OXYGEN DURATION—HOURS								2 TYPE AN6025 AX295 CYLINDERS
CABIN ALTITUDE FEET	GAGE PRESSURE — P.S.I.								
	1800	1600	1400	1200	1000	800	600	400	BELOW 400
40,000	4.0 4.0	3.5 3.5	3.0 3.0	2.5 2.5	2.0 2.0	1.5 1.5	1.0 1.0	0.5 0.5	EMERGENCY DESCEND TO ALTITUDE NOT REQUIRING OXYGEN
35,000	4.0 4.0	3.5 3.5	3.0 3.0	2.5 2.5	2.0 2.0	1.5 1.5	1.0 1.0	0.5 0.5	
30,000	2.9 3.0	2.5 2.6	2.2 2.2	1.8 1.9	1.5 1.5	1.1 1.1	0.7 0.7	0.4 0.4	
25,000	2.2 2.8	2.0 2.5	1.7 2.1	1.4 1.8	1.1 1.4	0.8 1.1	0.6 0.7	0.3 0.4	
20,000	1.7 3.2	1.5 2.8	1.3 2.4	1.1 2.0	0.9 1.6	0.6 1.2	0.4 0.8	0.2 0.4	
15,000	1.4 3.9	1.2 3.4	1.0 2.9	0.9 2.4	0.7 1.9	0.5 1.5	0.3 1.0	0.2 0.5	
10,000	1.1 5.1	1.0 4.5	0.8 3.8	0.7 3.2	0.5 2.6	0.4 1.9	0.3 1.3	0.1 0.6	

BLACK FIGURES INDICATE DILUTER LEVER "NORMAL"
RED FIGURES INDICATE DILUTER LEVER "100%"

Figure 51 — Oxygen Duration Chart

4-90. INDICATORS.

4-91. PRESSURE GAGE. The pilot's oxygen cylinder pressure gage is located on the lower left corner of the instrument panel (fig. 4). The radar operator's oxygen cylinder pressure gage (18 fig. 50) is located on the left side panel. These gages indicate the pressure in the oxygen system and are used to determine oxygen duration.

CAUTION

The pressure gage on the regulator indicates pressure delivered to the regulator and not the pressure in the oxygen cylinders. The high pressure oxygen cylinder pressure gages are used to determine duration.

4-92. FLOW INDICATOR. A flow indicator (4, fig. 49) is incorporated in the oxygen regulator. The flow indicator indicates that oxygen is flowing through the regulator.

4-93. WARNING LIGHTS. An oxygen warning light is provided on the panel at the pilot's station (fig. 4) and at the radar operator's station (13, fig. 50). The warning circuit for each station is turned on by having the warning system switch on the oxygen regulator turned on. With the regulator operating normally, a filament glow in the bulb will indicate that the circuit is on and that operation is normal. When the oxygen is not flowing through the regulator, or if a continuous stream is flowing through the regulator, the warning light will come on indicating an inoperative or malfunctioning oxygen regulator. The following conditions will cause the oxygen warning light to come on:

a. Oxygen supply valve lever "OFF."

b. Oxygen supply depleted.

c. Breaking of disconnect between mask and mask-to-regulator tube or any large leak between the regulator and the crew member.

4-94. NORMAL OPERATION.

4-95. The oxygen system is placed in operation as follows:

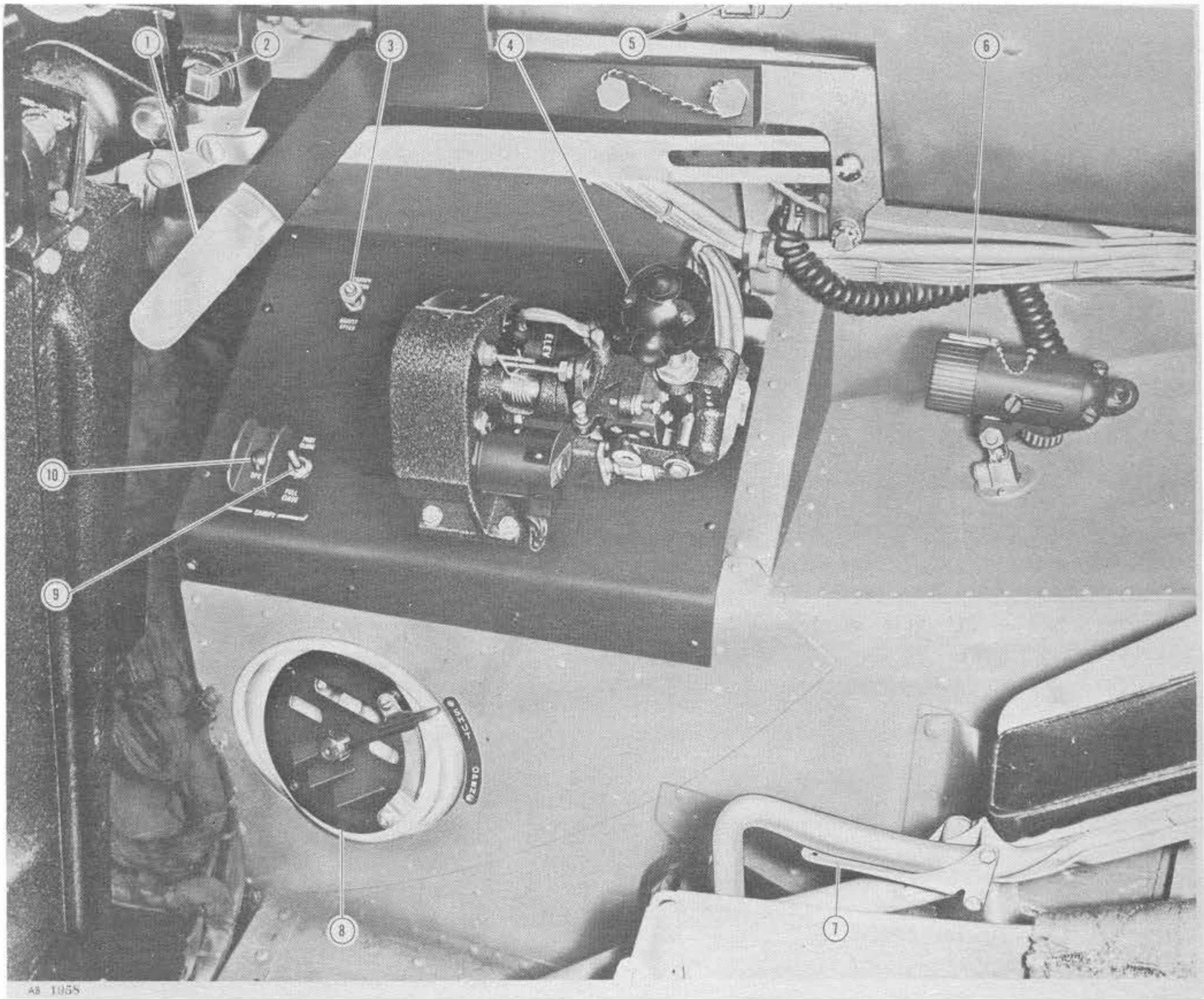
a. Regulator diluter lever—"NORMAL OXYGEN."

b. Regulator supply valve lever—"ON."

c. Regulator warning system switch—"ON."

Note

The oxygen warning light should have a filament glow in the bulb.



1. Canopy Jettison Lever
2. Canopy Locking Lever Connection
3. Canopy Motor Speed Adjustment
4. Radar Antenna Control Unit
5. Cockpit Spot Light Mount
6. C-4 Spot Light
7. Ejection Seat Trigger
8. Pressure Air Inlet Damper
9. Canopy Close Switch
10. Canopy Open Switch

Figure 52 — Radar Operator's Cockpit, Right Side

4–96. EMERGENCY OPERATION.

4–97. If symptoms of anoxia occur or if smoke or fuel fumes should enter the cabin, set the diluter lever of the regulator to "100% OXYGEN" and push "EMERGENCY" toggle lever to either the right or left.

CAUTION

When it becomes necessary for the radar operator to use "100% OXYGEN" or "EMERGENCY" the pilot must be informed of this action. Use of "100% OXYGEN" or "EMERGENCY" will reduce oxygen duration of the airplane. After the emergency is over, set the diluter lever to "NORMAL OXYGEN" and push the "EMERGENCY" toggle lever to the center position.

4–98. If the regulator should become inoperative or if the oxygen warning light should turn on, pull the cord of the H-2 emergency oxygen cylinder.

WARNING

If it becomes necessary for the radar operator to use the H-2 emergency oxygen cylinder, the pilot must be informed of this action, so that he can immediately descend to an altitude at which oxygen is not required.

4–99. GUNNERY EQUIPMENT.

4–100. GENERAL.

4–101. Four .50 caliber machine guns with ammunition boxes carrying up to 300 rounds each are located in the nose armament compartment. Each gun is equipped with a pneumatic charger. A gun camera, mounted in the fuselage nose between the two lower guns, operates with the guns or separately. The type A-1C gunsight is mounted above the pilot's instrument panel.

4–102. A-1C GUNSIGHT.

4–103. GENERAL.

4–104. The type A-1C gunsight (figs. 4 and 53) is located above the instrument panel and may be used as a fixed gunsight, a computing sight with manual ranging, or an automatic computing sight with radar ranging. Under normal conditions, the sight operates automatically and requires only that the center dot be kept on the target and that the target be tracked smoothly. The sight reticle image, which consists of a circle and central dot, is projected onto a small reflector mounted on the sight. The sight is operable from sea level to 40,000 feet; however, due to the limitations of the radar ranging unit, manual ranging must be used below 15,000 feet.

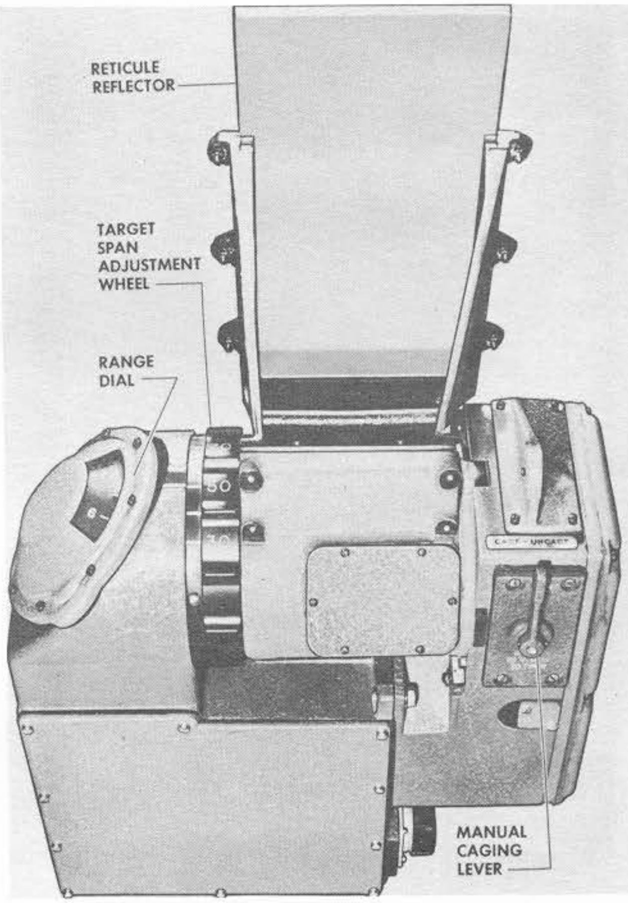


Figure 53 — A-1C Gunsight

4–105. CONTROLS.

4–106. RETICLE DIMMER RHEOSTAT. The brilliance of reticle illumination may be adjusted by means of the reticle dimmer rheostat located on pilot's center pedestal (9, fig. 19). When the sight is not in use, the rheostat should be turned to "DIM."

4–107. FILAMENT SELECTORS. Two filament selector switches allow selection of alternate filaments in the lamps which illuminate the reticle dot and circle, if the normal filaments burn out. These switches are located on the pilot's armament control panel (fig. 54).

4–108. GYRO-CAGING RING. An electrical gyro-caging ring is provided on the throttle grip (2, fig. 6) to stabilize the reticle image prior to making an attack.

4–109. GYRO-CAGING LEVER. A manual caging lever, located on the right side of the sight (fig. 53) is moved left to "CAGE," and right to "UNCAGE." In the event of sight failure, the caging lever may be placed in "CAGE" and the reticle can then be used as a fixed sight.

4–110. TARGET SPAN ADJUSTMENT WHEEL. This wheel is used in connection with the manual ranging system during gunnery operation. The target span adjustment wheel on the sight (fig. 53) is set to correspond to the span of the target airplane.

4–111. MANUAL RANGING CONTROL. Normally for gunnery operation, the radar set provides range information to the gunsight; however, against overland targets difficulty may be encountered in maintaining range lock-on at low altitudes. When this condition exists, manual ranging is required using the twist-grip incorporated in the throttle lever (3, fig. 6). Clockwise rotation of the twist-grip reduces the range (increases reticle size). This manual ranging control is spring-loaded to the full counterclockwise position where it must be for operation with the radar ranging system. When the grip is twisted out of the full clock-wise position, manual range information is provided to the sight.

4–112. RANGE DIAL. This dial (fig. 53) located on the left side of the sight head, indicates the target range in hundreds of feet as determined by the ranging circuits, from either radar or manual range data.

4–113. GUNSIGHT OPERATION.

4–114. RADAR RANGING.

a. 115-volt a.c. switch—"ON."

b. Radar switch—"OPERATE."

c. Guns-camera switch—"GUNS" or "SIGHT AND CAMERA."

CAUTION

The foregoing switching sequence must be used to prevent damaging the D-2 electronic inverter.

d. Caging lever—"UNCAGE."

e. Reticle dimmer—position to give satisfactory reticle illumination.

f. Fly the airplane so that the reticle image is continuously and accurately centered on the target. After the target is within range and has been tracked smoothly, without slipping or skidding, for approximately one second, fire the guns.

4–115. MANUAL RANGING. Operation of the sight with manual ranging is essentially the same as with radar ranging except that the pilot performs the function of the radar ranging by twisting the throttle grip and setting the span of the target on the target span adjustment wheel. The grip should be turned so that the circle continuously and accurately encloses the target. The radar switch must be on either "STANDBY" or "OPERATE" position.

4–116. FIXED SIGHT. The sight may be used as a fixed sight by placing the caging lever located on the sight head at "CAGE."

4–117. GUN AND CAMERA CONTROLS.

4–118. GUNS-CAMERA SWITCH. The guns-camera switch (fig. 54) located on the pilot's armament control panel, has three positions: "SIGHT & CAMERA," "OFF," and "GUNS." When the switch is in the "SIGHT & CAMERA" position, only the gunsight and the gun camera are operable. When the switch is in the "GUNS" position, the gunsight, gun camera, and the machine guns are operable. The guns and camera are operated by squeezing the control stick trigger.

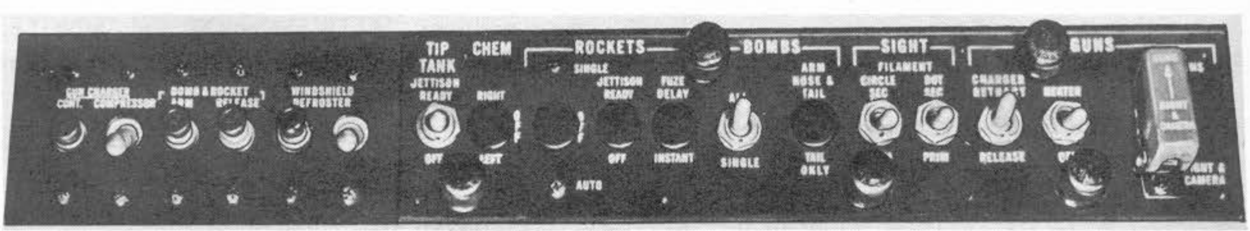


Figure 54 — Armament Control Panel, Pilot's Cockpit, Left Side

CAUTION

Do not turn the gunsight on (guns-camera switch to "GUNS" or "SIGHT & CAMERA") unless the 115 volt a.c. switch is "ON" and the APG-33 radar control is on and operating, or the D-2 electronic inverter will be damaged.

4–119. GUN HEATERS SWITCH. The gun heaters, one attached to each gun, are turned on or off by the gun heater switch (fig. 54). They may be turned on prior to take-off if use of the guns is contemplated during the flight, especially if the flight is to be at high altitude.

4–120. AUTOMATIC (PNEUMATIC) GUN CHARGERS.

4–121. GENERAL.

4–122. The chargers can be operated by remote electrical control, local manual control, or automatically, and can be used for:

a. Charging the guns by remote electrical or manual control.

b. Holding the gun breech in retracted position for purposes of safety and to permit cooling of the gun barrel.

c. Automatically charging the gun during gunfire when the gun misfires.

d. Firing the gun by use of an electropneumatic sear actuator contained in the charger. This replaces the usual gun-firing solenoid.

4–123. The chargers are powered by an electrically-driven air compressor which charges a storage bottle located in the nose armament compartment. An automatic pressure switch turns the compressor on whenever the pressure in the storage bottle falls below the operating value, provided the compressor switch on the pilot's left side panel is in the "COMPRESSOR" position.

4–124. GUN CHARGER CONTROLS.

4–125. GUN CHARGER SWITCH. The gun charger switch located on the pilot's left side panel (fig. 54) has three positions: "RETRACT," center (off), and "RELEASE." When the switch is placed in the "RETRACT" position (gun-camera switch in "GUNS" position), all of the gun bolts are retracted. When the switch is pushed to the "RELEASE" position the bolts are released, and a round is placed in each firing chamber ready for firing.

4–126. GUN CHARGER COMPRESSOR SWITCH. This switch, located on the pilot's armament control panel, has two positions: "COMPRESSOR," and Off. When the switch is placed in the "COMPRESSOR" position, the compressor will charge the storage bottle until operating pressure is reached at which point the automatic pressure switch will control the compressor to maintain operating pressure.

4–127. OPERATION CHECK. The pilot or the armorer must make the following check each time the ammunition boxes are loaded:

a. Battery master "ON" or battery cart connected and On.

b. Gun charger compressor switch—"COMPRESSOR."

c. 115-volt a.c. switch—"ON."

d. Radar switch—"STANDBY" or "OPERATE."

e. Place the guns-camera switch in the "GUNS" position.

f. Then while someone is watching the feed chutes and feedways, push the charger switch to "RETRACT" and see that a round is placed in each feedway.

g. Push the charger switch to "RELEASE." The guns are now charged and ready for action with the first round about to enter the firing chamber.

h. Turn all switches "OFF."

4–128. BOMBING EQUIPMENT.

4–129. GENERAL.

4–130. Wing tip fuel tanks are carried in place of bombs on this airplane, and the bomb controls are used to release or jettison the tanks.

4–131. BOMB CONTROLS.

4–132. BOMBS SELECTOR SWITCH. This switch (fig. 54), located on the pilot's armament control panel, has three positions: "ALL," center Off, and "SINGLE." Its normal purpose is to arm the bombs release circuits. It is inoperative on this airplane.

4–133. PITOT HEAT.

4–134. PITOT HEAT SWITCH.

4–135. The pitot heater is controlled by the switch (8, fig. 12) located on the pilot's right side forward panel.

4–136. ANTI-G SUIT VALVE.

4–137. GENERAL.

4–138. An anti-G suit valve is installed on the left side of each cockpit at floor level (16, fig. 5) and (20, fig. 50). The valve receives air under pressure from the engine compressor and automatically meters it to the pneumatic suit during positive G accelerations. At the high setting, suit pressurization begins at approximately 1.75 G and increases at the rate of 1.4 psi per G. At the low setting, suit pressurization begins at approximately 1.75 G and increases at the rate of one psi per G. A button on top of the valve can be manually depressed to inflate the suit momentarily when desired. This inflation may be used to lessen fatigue during a long flight. The suit is connected to the valve through a quick disconnect fitting attached to the seat.

4–139. RADAR OPERATOR'S BLACKOUT CURTAIN.

A blackout curtain is provided in the radar operator's cockpit to shut out extraneous light during use of the radar scope.


FA-877

SECTION V

CREW DUTIES

Information in this section will be furnished at a later date.

SECTION VI

EXTREME WEATHER OPERATION

6–1. COLD WEATHER OPERATION.

6–2. GENERAL.

6–3. The success of low temperature operation depends primarily upon the preparations made during the post-flight inspection, in anticipation of the requirements for operation on the following day. The procedures outlined in paragraph 6–30 must be followed to expedite the pre-flight inspection and to insure satisfactory operation of the airplane and its systems during the next flight.

6–4. BEFORE ENTERING THE AIRPLANE.

a. Remove all protective covers and dust plugs.

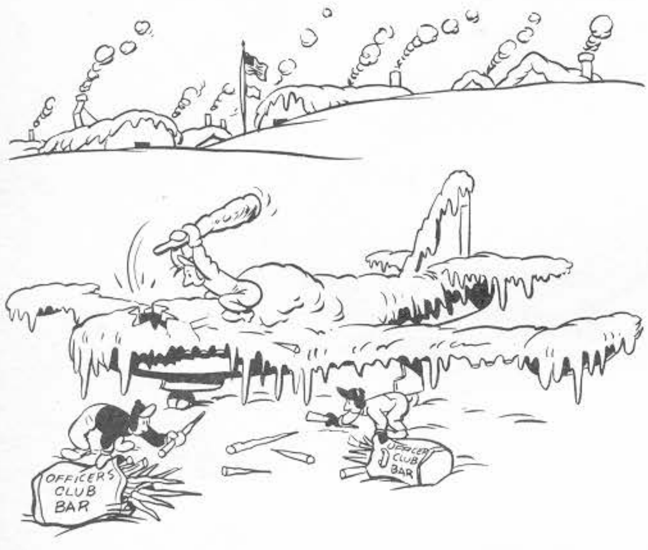
b. Check the entire airplane for freedom from frost, snow and ice. Brush off all light snow and frost. Remove all ice by a direct flow of air from a portable ground heater. Do not chip or scrape ice away as this may cause damage to the airplane. The collection of frost, snow and ice on aircraft surfaces constitutes one of the major flight hazards and will cause loss of lift and treacherous stalling characteristics.

c. At temperatures below —26° C (—15° F), preheat cockpit, instrument panel, and canopy Plexiglas.

d. Check that the fuel tank vents, fuel filter and drain cocks are free from ice and drain condensate.

e. Check shock struts and actuating cylinders for dirt and ice; clean with a rag soaked in hydraulic fluid. Check shock struts for proper inflation.

f. No preheat or oil dilution is required to insure crankability or proper lubrication down to —54° C (—65° F); however, if a start is necessary with an inadequate power unit, preheating the accessory section and the oil sump will facilitate the start by decreasing starter loads.



DON'T CHIP AWAY ICE AS IT MAY CAUSE DAMAGE TO THE AIRPLANE!

g. Check that the fuel filter de-icing system has been serviced.

h. When JATO units are to be used, install units just prior to engine start to minimize cooling period before use.

6–5. ON ENTERING THE AIRPLANE.

a. Check flight controls for proper operation.

b. Insure that canopy can be closed and locked.

c. Use an external power source to operate and check electrical and radio equipment.

6–6. BEFORE STARTING ENGINE.

6–7. A C-22 power unit or its equivalent is required for starting. If minimum starting rpm (9%) cannot be obtained, shut down the engine and connect an adequate power unit. Preheat through the intake ducts if a start is necessary with an inadequate power source.

6–8. STARTING ENGINE.

a. Start the engine using the normal starting procedure outlined in Section II.

b. If there is no indication of oil pressure after 30 seconds of engine operation, or if the pressure drops to 0 after a few minutes of ground running, stop the engine and investigate.

Note

No warm-up is required if the oil pressure remains below 100 psi at full throttle. A temporary high oil pressure (above 100 psi) is not dangerous but take-off should be delayed until the pressure drops below 100 psi. If the oil pressure remains above 100 psi, an oil system malfunction is indicated and the airplane should not be flown.

6–9. WARM-UP AND GROUND CHECK.

a. Turn on cabin heat and windshield defrosting system, as required, immediately after engine start.

b. Check surface controls, dive flaps and aileron and trim tabs for proper operation.

c. Check wing flap and flap indicator operation. If questionable readings result, cycle flaps three to four times to correct indicator action.

d. Check the fuel filter de-icing system operation by energizing the system and checking the electric loadmeter for an increased load reading.

e. Check instruments for proper operation. Electric gyro instruments will require approximately two minutes to warm-up after battery is switched on.

Note

Because of low ambient temperatures, the thrust developed at all engine speeds is noticeably greater than normal.

WARNING

Use firmly anchored wheel chocks for all engine run-ups. The aircraft should be tied down securely before attempting a full power run-up.

6–10. TAXIING INSTRUCTIONS.

a. Avoid taxiing in deep snow as taxiing and steering are extremely difficult and frozen brakes may result.

b. Use only essential electrical equipment to preserve battery life when taxiing at low engine speeds.

c. Increase the taxi interval at sub-freezing temperatures to insure safe stopping distance and to prevent icing of airplane surfaces by melted snow and ice in the jet blast of a preceding airplane.

d. Minimize taxi time to conserve fuel and to reduce the amount of ice fog generated by jet engines.

6–11. BEFORE TAKE-OFF.

a. Energize the fuel filter de-icing system for 15 seconds to preclude the possibility of engine failure during take-off.

b. Check that canopy is locked.

c. Turn gun heat switch "ON."

d. Turn pitot heat switch "ON."

e. Make final instrument check during the first part of the take-off roll as the brakes will not hold the airplane on snow-covered or icy runways at full throttle.

6–12. TAKE-OFF.

CAUTION

In case of severe cockpit fog developing, turn temperature selector to "HOT." Adjust selector as necessary after becoming airborne.

6–13. Throttle—"FULL." Maximum engine speed of 100% will not be available at low ambient temperatures because of increased air density. However, the governor control should not be reset to 100% rpm as the rated output and design strength of the engine may be exceeded. Although take-off thrust can be obtained at less than maximum engine speed (88% rpm at —65°F), do not take off unless at least 95% rpm is available at full throttle.

6–14. AFTER TAKE-OFF.

6–15. After take-off from a wet snow or slush-covered runway, operate the landing gear and flaps through several complete cycles to prevent their freezing.

6–16. CLIMB.

6–17. Climb performance will be improved during cold weather operation at lower altitudes. Follow recommended climb speeds as given in the Climb Chart, Appendix I.

6–18. ENGINE OPERATION IN FLIGHT.

6–19. Engine operation during flight in cold weather should be governed by normal procedures (with the exception of operation of the fuel filter de-icing system as directed in paragraph 6–21, following).

6–20. OPERATION OF THE AIRCRAFT SYSTEMS DURING FLIGHT.

6–21. If wing and stabilizer de-icers are installed and icing conditions are anticipated, place the de-icing system in operation as follows:

a. Alternator switch—"ON."

b. Wing heat switch—"ON."

c. Use cockpit heat, windshield de-icer, or defroster as required. Adjust cockpit temperature to a comfortable level.

d. Operate the fuel filter de-icing system when required. After clearing the first ice accumulation from the filter, energize the de-icing system for 15 seconds every 30 minutes for the duration of the flight to keep the filter clear of ice.

6–22. DESCENT.

a. Operate auxiliary defroster, if necessary, to clear windshield of frost usually formed during a rapid descent from altitude.

b. Check engine operating temperatures during descents and in the landing pattern as lower temperatures are common at low altitudes because of frequent temperature inversions.

6–23. APPROACH.

a. Operate fuel filter de-icing system for 15 seconds before entering pattern.

b. Turn off all non-essential electrical equipment at least one minute before final approach to reduce battery load when generator cuts out.

c. Make normal patterns and landings but allow for a flatter glide because of increased thrust.

d. Pump brakes to check operation.

6–24. LANDING.

6–25. Landing speeds and technique are normal with the usual care being exercised in the use of the brakes on snow-covered or slippery runways.

6–26. AFTER TOUCH-DOWN.

6–27. If wing and stabilizer de-icers are installed and the system is in operation, turn it off as follows:

a. Alternator switch—"OFF."

b. Wing heat switch—"OFF."

CAUTION

Ground operation of the wing and stabilizer system for 8½ seconds will destroy the boots.

c. Pitot heat switch—"OFF."

6–28. STOPPING THE ENGINE.

6–29. The engine is stopped in the normal manner.

6–30. BEFORE LEAVING AIRPLANE.

a. Release brakes after wheels are chocked.

b. Leave canopy partly open to allow circulation within the cockpit to prevent canopy cracking from contraction and to reduce windshield and canopy frosting.

c. Inspect shock struts and actuating cylinders and wipe with a rag soaked in hydraulic fluid. It is advisable to keep shock struts exceptionally clean as any scarring of the seals will result in excessive leakage.

d. Drain the fuel pumps within 30 minutes after stoping engine.

e. Whenever possible, leave the airplanes parked with full fuel tanks. Every effort should be made, during servicing, to prevent moisture from entering the fuel system.

f. Install protective covers and dust plugs.

g. Remove batteries when the aircraft is to be parked at temperatures below —29°C (—20°F) for more than four hours.

6–31. HOT WEATHER OPERATION.

6–32. BEFORE ENTERING THE AIRPLANE.

a. All metal surfaces exposed to the sun are burning hot to the touch. Gloves should be worn to prevent burns. (Tape, cord or cloth muffs around the control stick, etc. are advisable.)

b. Check tires for proper inflation and for evidence of blisters or other deterioration.

c. Check particularly for hydraulic system leaks as heat and moisture may cause valves and packings to swell.

d. Note particularly electrical wiring and equipment for evidence of corrosion.

6–33. ON ENTERING THE AIRPLANE.

6–34. Care should be exercised in allowing foreign objects to come in contact with the canopy, since it is possible to damage the plexiglas in extremely hot weather.

6–35. STARTING THE ENGINE.

6–36. Normal starting procedures are used in hot weather. Temperatures will probably be on the high side of operating ranges.

6–37. WARM-UP AND GROUND TEST.

6–38. Ground testing should be complete but accomplished as rapidly as possible.

6–39. TAXIING INSTRUCTIONS.

a. Brakes should be used as little as possible to prevent their overheating.

b. The airplane may be taxied with the canopy partially open if necessary.

6–40. BEFORE TAKE-OFF.

6–41. Be sure that take-off distances have been checked in Appendix I.

6–42. TAKE-OFF.

6–43. During take-off the airplane will accelerate slowly and ground run will be longer because the air is less dense in hot weather. Ground speed will be increased for the same indicated airspeed.

6–44. CLIMB.

6–45. Rate of climb should be held as low as practicable because of the fact that the fuel in the tanks is warm and more susceptible to vaporization losses with rapid climbs to altitude.

6–46. ENGINE OPERATION IN FLIGHT.

6–47. Engine operation in flight should not be affected at normal altitudes. At low altitudes temperatures may be in the high ranges.

6–48. LANDING.

a. Hot weather operation requires the pilot to be more cautious of stalling speeds.

b. Landing ground rolls are longer than those in normal temperature.

6–49. BEFORE LEAVING THE AIRPLANE.

a. The canopy may be left partially open if the location is not subject to blowing sand or dust.

b. In locations with high humidity and excessive temperature changes from day to night, it is probably preferable to leave the canopy slightly open and cockpit ventilation duct shut-off levers open.

6–50. DESERT OPERATION.

6–51. GENERAL.

6–52. Most hot weather procedures are also applicable to desert operation. Blowing dust and sand is the main enemy of desert operation.

6–53. BEFORE ENTERING THE AIRPLANE.

a. Check that fuel filters have been serviced and cleaned.

b. Check that airplane is clear of other airplanes prior to starting engine.

6–54. TAXIING INSTRUCTIONS.

a. Taxi carefully with minimum power to minimize the blowing of dust and sand onto other aircraft.

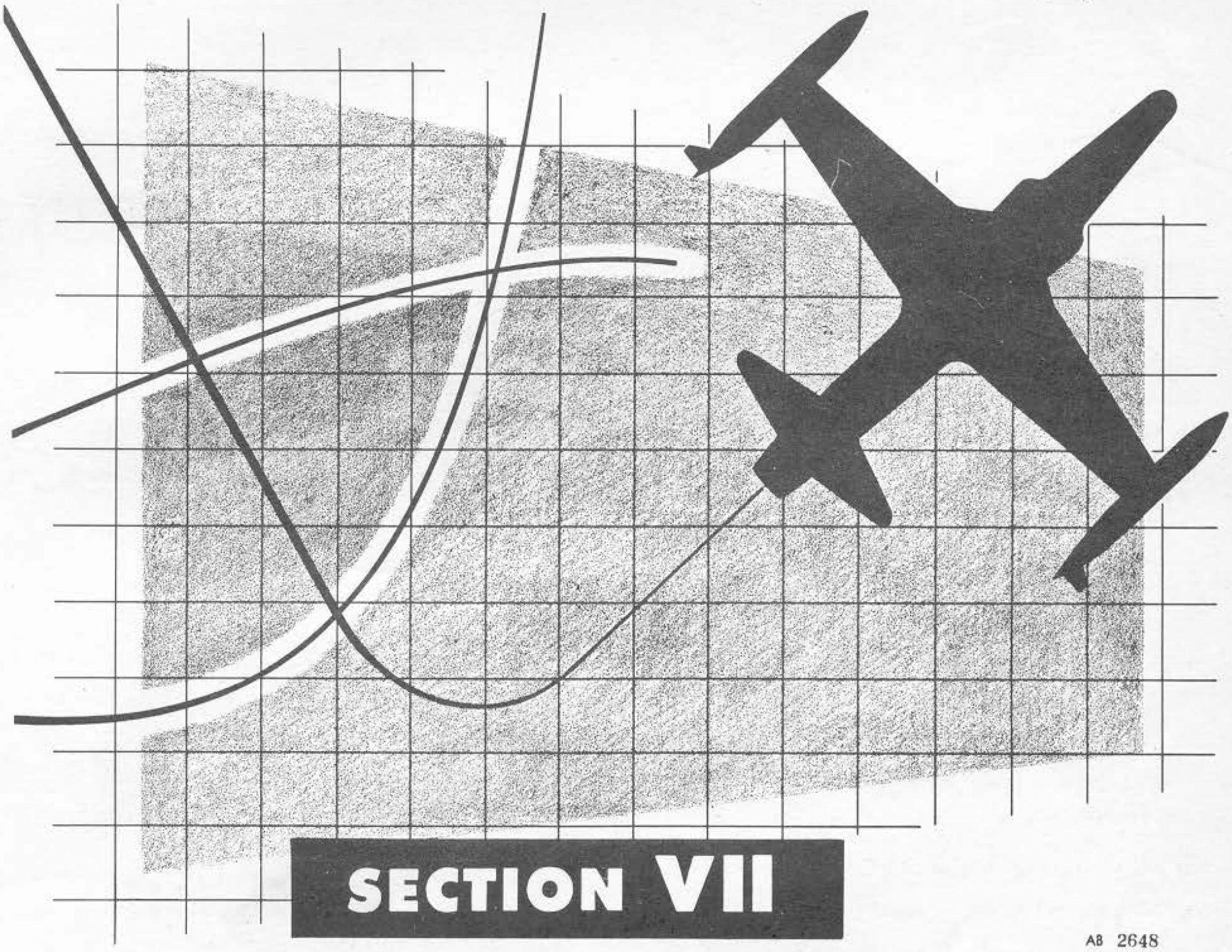
b. Keep adequate distance from any taxiing airplanes ahead of you.

6–55. TAKE-OFF.

6–56. Be prepared for sudden gusts of wind during take-off run.

6–57. BEFORE LEAVING THE AIRPLANE.

6–58. Cover all ducts and air intakes as soon as possible to prevent the entrance of blowing sand.



AB 2648

OPERATING LIMITATIONS

7-1. MINIMUM CREW REQUIREMENT.

7-2. The minimum crew requirement for this airplane is one pilot in the front cockpit. Additional crew member as required to accomplish special missions will be added at the discretion of the Commanding Officer.

7-3. GENERAL FLIGHT RESTRICTIONS.

7-4. AIRPLANE RESTRICTIONS.

a. Spins are prohibited.

b. Vertical stalls are prohibited.

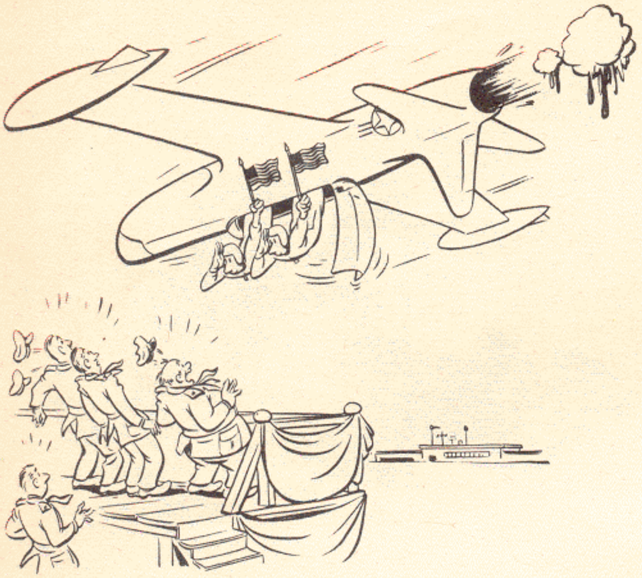
c. Never unlock the canopy in flight.

d. Inverted flying or any maneuver resulting in extended negative acceleration will result in engine flame-out. There is no means of insuring a continuous flow of fuel or of maintaining oil pressure for more than ten seconds in this attitude.

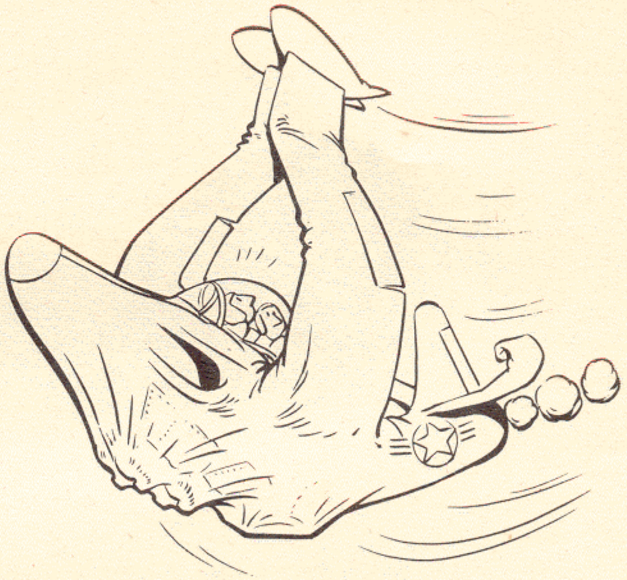
e. Do not attempt to land with one tip tank full and the other empty as the wing with the full tank will be very heavy and extremely difficult to hold up at low airspeeds. Drop the tip tanks.

7-5. AIRSPEED LIMITATIONS (INDICATED). If aileron compressibility buzz occurs, limit the speed to

VERTICAL STALLS ARE PROHIBITED!



Inverted Flight Or Any Maneuver Resulting In Extended Negative Acceleration Will Result In Engine Flame-out!



Never Exceed 7.33 G's!

that at which buzz occurs. At lower speeds observe the following limitations:

Wing flaps extended 50% (22.5°)—200 knots IAS.

Wing flaps extended 25% (11.3°)—230 knots IAS.

Landing gear extended—195 knots IAS.

Note

The restrictions in the paragraph above are based on structural limitations and damage may occur if these limits are exceeded.

7-6. The airplane is limited to a Mach number of .80 or 505 knots, whichever is less. Compressibility effects cause shaking, tucking, and aileron buzz above this .80 Mach number limit. This applies above 4,000 feet, the altitude at which .80 Mach number equals the airplane structural strength limit speed of 505 knots IAS. Below

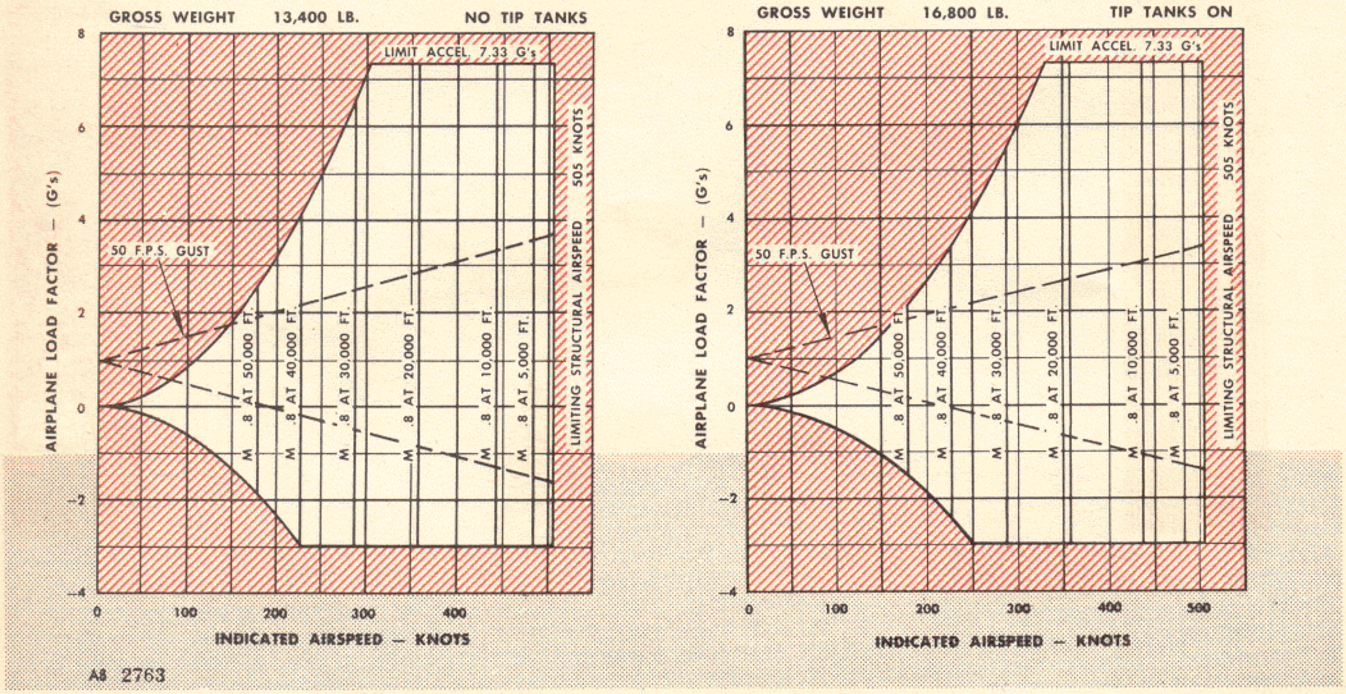


Figure 55 — V-G Diagram

this altitude flight at .80 Mach number would give speeds greater than 505 knots IAS, resulting in excessive structural loads on the airplane. Therefore, at altitudes from 4,000 feet down to sea level the red limit hand on the airspeed indicator will remain at 505 knots. At any altitude above 4,000 feet, the red limit hand of the airspeed indicator points to the airspeed corresponding to .80 Mach number at the flight altitude.

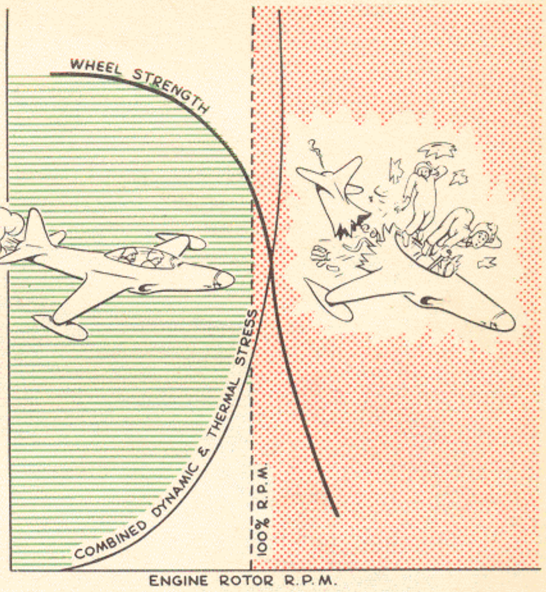
7-7. ENGINE RESTRICTIONS.

7-8. Maximum permissible rpm of 100% (30 Min. duration) and tailpipe temperature of 720°C must not be exceeded since the turbine wheel will be weakened and failure may result. A small increase in rpm above 100% and/or increase in tailpipe temperature above 720°C results in a large increase of turbine wheel stress and rapid decrease of turbine wheel strength. Thus, slight increases of rpm or tailpipe temperatures above 100% or 720° C respectively, rapidly increase the probability of turbine wheel failure.

a. Overspeeding in excess of 110% rpm will require removal of engine for overhaul.

b. Overspeeding from 105 to 110% rpm will require a 25-hour inspection to determine engine serviceability.

c. Overspeeding from 101.5 to 105% rpm for more than 15 seconds will require a 25-hour inspection to determine engine serviceability.

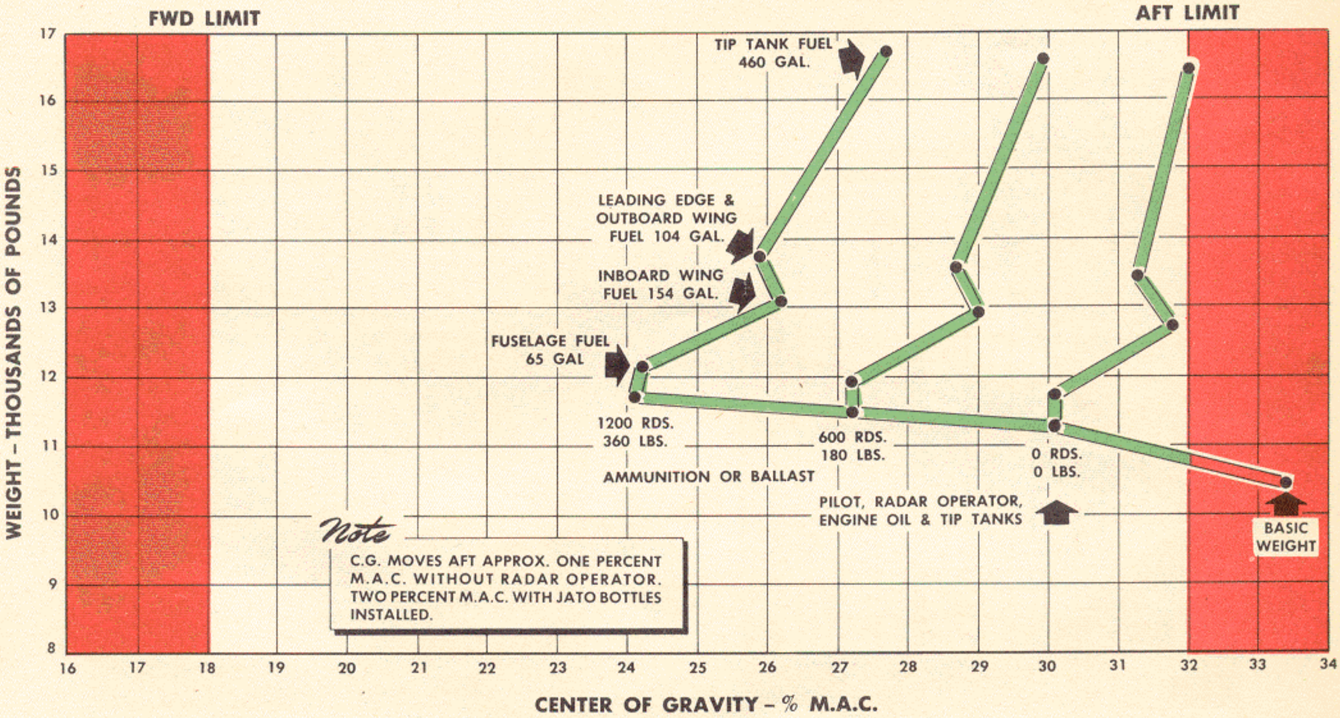


d. Overspeeding from 101.5 to 105% for less than 15 seconds will require normal pre-flight inspection to determine engine serviceability.

e. When overspeeding is encountered beyond 101.5% and not in excess of 110% rpm, the cause for overspeeding will be corrected prior to further flight.

Note

These limitations and restrictions are subject to change and latest service directives and orders must be consulted.



This curve shows the c.g. travel and weight change as fuel and/or ammunition are added or consumed. Starting with the basic weight condition the c.g. moves forward (to 30.1 MAC) with the addition of pilot, radar operator, engine oil and empty tip tanks. The most forward c.g. is obtained with full ammunition and no fuel, while the most rearward is obtained with full fuel and no ammunition. Extension of the landing gear causes a negligible change in c.g. position as does dropping the empty tip tanks. Airplane flight characteristics are very slightly affected by movements of the c.g. within the limits shown. The effect is manifest by a slightly lighter elevator stick feel with an extreme rearward c.g.

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Figure 56 — Diagram of CG Travel

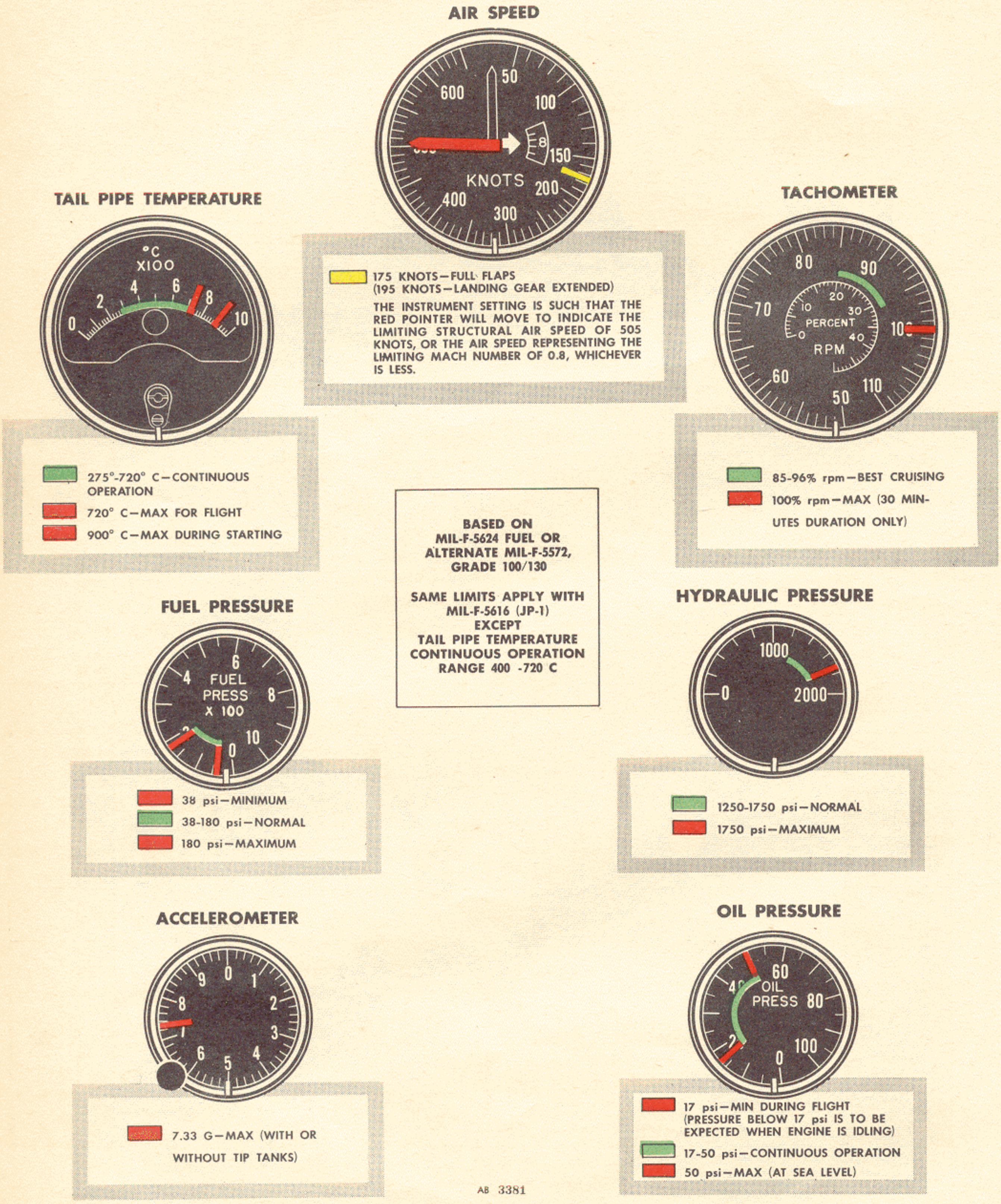
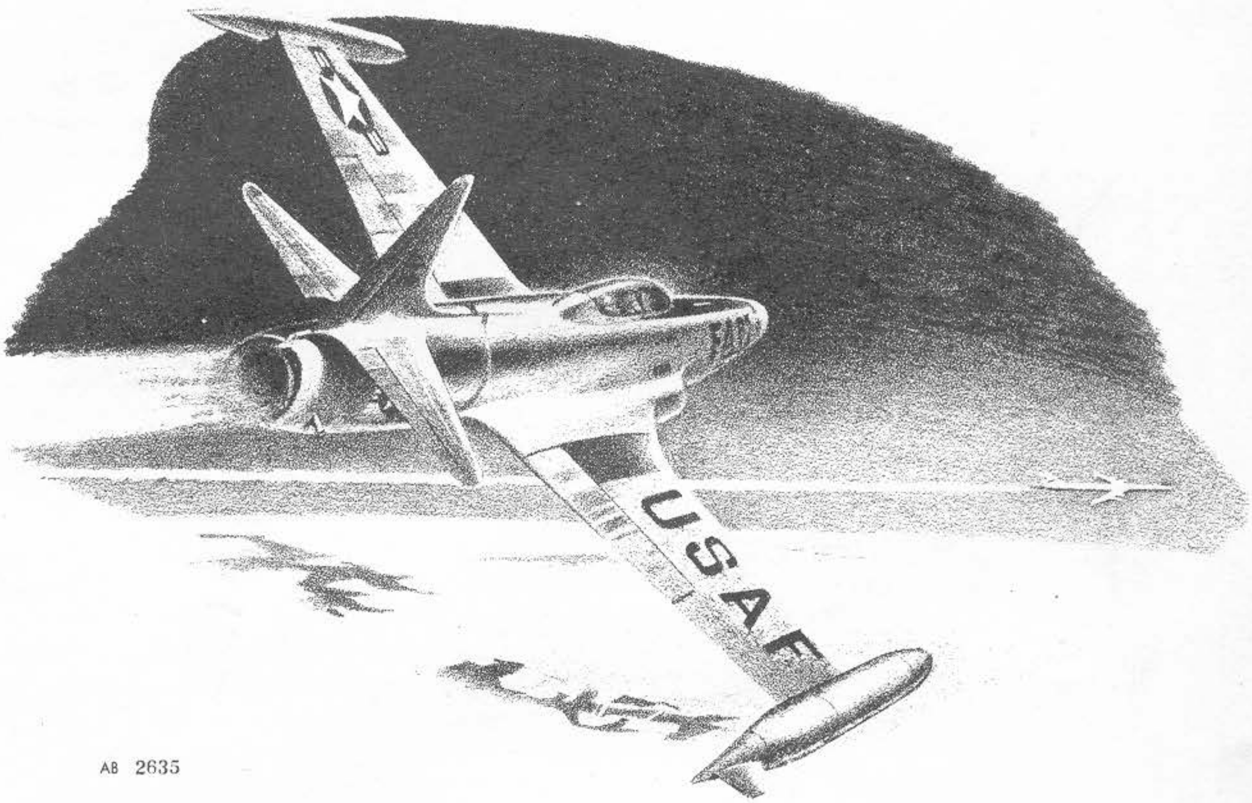


Figure 57 — Instrument Markings Diagram



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SECTION VIII

FLIGHT CHARACTERISTICS

8–1. GENERAL.

8–2. The flight characteristics of jet aircraft are somewhat different from those of conventional propeller-driven aircraft. Level flight and dive speeds are higher, and climb speeds are greater, while take-off performance is inferior to that of a propeller-driven airplane. At the same time, engine controls are simplified and torque is eliminated. However, maximum overall performance and tactical value are not attained automatically in jet aircraft. In order to secure the best results the pilot must be willing to apply techniques different from those he would use under similar circumstances in propeller-driven aircraft. He must have somewhat more training, particularly in basic theory, and he must think further ahead.

8–3. The performance characteristics peculiar to jet aircraft, i.e., high level flight speeds, high climb speeds, and inferior take-off, result from the thrust characteristics of the jet engine. At this point it is necessary to distinguish between thrust and power. Thrust is a force, and it is this force or thrust that is delivered by the engine. Power, however, is the time rate of doing work. It is equal to force (or thrust) times distance divided by time. Since the distance divided by time is equivalent to speed, you can see that power is a combination of thrust AND speed. The jet engine characteristic which determines the unique flight characteristics of the jet airplane is this: at a fixed throttle setting the thrust remains approximately constant regardless of the airplane speed. Therefore, since power is the product of thrust and speed, you can see that the power available is directly proportional to speed, being low at low speed and attaining its greatest value at maximum speed. This dependence of power on speed explains the inferior take-off characteristics of jet aircraft.

8–4. Another jet aircraft flight characteristic explained by the speed-power relationship is the high climb speed. Maximum rate of climb occurs at the speed for maximum excess power, excess power being the difference between power available and power required. Figure 58 shows representative power available curves for a jet airplane and for a propeller-driven airplane of the same maximum speed. Also shown is a representative power required curve. Maximum excess power for the propeller-driven airplane is shown at "A." The corresponding speed is the best climb speed for the propeller-driven airplane. Since the best climb speed is comparatively low, the angle of climb will be rather high, and pilots trained in this type of aircraft instinctively tend to climb at steep angles.

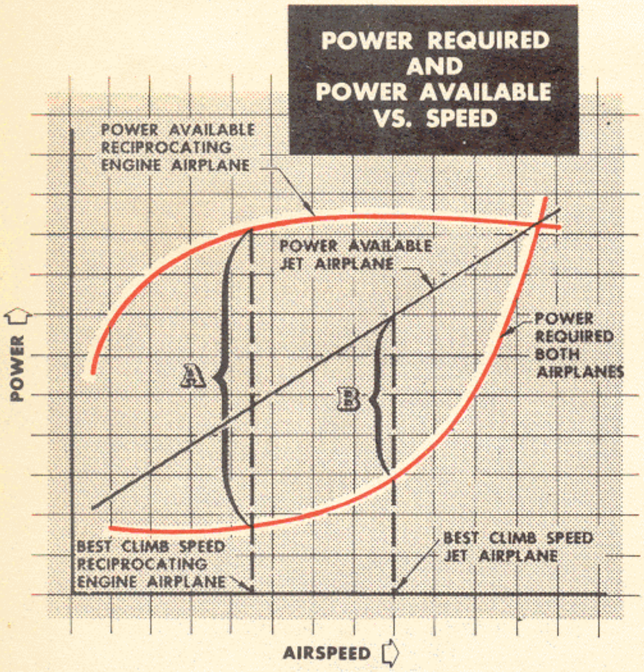

Figure 58 — Representative Speed-Power Curve

8–5. The situation in the jet airplane is totally different. You can see at "B" on figure 58 that the speed for maximum excess power is quite high. The best climb speed for a jet airplane is correspondingly high—much higher than it is for the propeller-driven airplane—and consequently the climb angle is much lower. You should maintain the recommended speed when climbing even though you have a strong tendency to reduce air speed because, at low speed, you suffer a great loss of power and thereby sacrifice climb performance. During combat climbs it is particularly important to keep the speed up because climb performance and power must be kept at top levels if tactical advantage is to be maintained.

8–6. Another phenomenon that you may encounter while flying at cruise conditions in jet aircraft is that it appears to be possible to fly at different speeds in level flight without any change in throttle setting. This is also a result of the speed-power characteristics of the jet airplane. At some cruise conditions, particularly in the lower or middle speed range at high altitude, the power available and power required vary in such a manner that, as the speed increases (at fixed throttle), the power available also increases just about enough to keep up with the power required. This makes it advisable to either dive into the cruising altitude from a higher altitude or to increase the throttle setting until the speed builds up and then return to the cruise throttle setting.

8–7. There is another flight characteristic which should be discussed here even though it is not peculiar to jet aircraft alone. This phenomenon, which affects all airplanes, is known as flying on the "wrong" side of the speed-power curve. It is best explained by showing how total drag and power are interrelated throughout the speed range of the airplane. Total drag—the resistance to motion which must be overcome by the engine—consists of two parts—parasite drag and induced drag. Parasite (or form) drag is the resistance offered by a fluid (such as air) in the form of external viscous forces. Parasite drag varies with the airspeed, being low at low speed and becoming very high at high speed. Induced drag is a component of the backward leaning lift line. It may therefore be considered to be the drag induced by the production of lift. It is low at high speed and high at low speed.

8–8. Now refer to figure 58 and imagine an airplane flying at maximum level flight speed. At this point the power required and the power available are both at a maximum. The angle of attack of the wing is low, the induced drag is low, and the parasite drag is high. If the throttle is now retarded to, say, maximum cruise setting, the airplane will slow down until the power required is equivalent to the power available at the new throttle setting. Notice that the power required is less than it was at high speed. The parasite drag will be less and the induced drag will be greater, but the sum of the two will be such that the power required will be less than it was at high speed. The nose of the airplane will be up a little bit because the angle of attack has to be greater in order to provide the same lift at lower speed. This situation, i.e., less power required with lower speed, prevails until the airplane has slowed to the speed corresponding to the lowest point on the power required curve.

8-9. If the speed is reduced below that for minimum power required, the situation changes. No longer is the power required decreased because of the lower speed. On the contrary, the power must be increased if level flight is to be maintained. The reason for this is that the induced drag has now increased so much that it overbalances the effect of lower speed. The airplane is now flying on the "wrong" side of the power curve and any further reduction in speed must be accompanied by increased power.

8-10. Flying on the "wrong" side of the speed-power curve is not a stable condition. The angle of attack is high and the airplane is near the stalled condition; level flight at fixed throttle is difficult, if not impossible. The best solution is to put the nose down and sacrifice altitude to regain speed.

8-11. CLIMB.

8-12. Optimum climb performance will be attained by following the climb speeds given in the Climb Chart, Appendix I. Small variations from these recommended speeds will not seriously affect the climb performance at low altitudes; however, when above 30,000 feet, is is necessary to adhere closely to the proper climb speed in order to avoid a large reduction in rate of climb. Also, if turns are required, it is best to make these at an altitude below 25,000 feet. This is more important in non-afterburning climbs, especially at the higher gross weights.

8-13. The use of the afterburner in a climb will be dependent upon the mission to be performed. If minimum time-to-climb is of primary importance, use the afterburner all the way. If long range is important, do not use the afterburner at all unless it is necessary for take-off.

8-14. CRUISE PERFORMANCE.

8-15. When setting up the cruise conditions given in the Cruise Charts, Appendix I, approach the speed condition from the high side. At high altitudes the speed must be kept up to the values given in the Cruise Charts in order to attain the ranges listed. Although the fuel economy is practically constant for a wide range of speeds at altitudes below 30,000 feet, the speed range for best fuel economy becomes quite narrow at altitudes above 30,000 feet because of compressibility and induced drag effects. At altitudes above 30,000 feet, small deviations from the recommended speeds will result in a serious reduction in range.

8-16. Best cruising performance is realized when the air is smooth. Rough air and turbulence will require more power to hold the desired air speed. This results in increased fuel consumption and less range.

8-17. AFTERBURNER OPERATION. The afterburner should not be used for cruising operations.

8-18. If the afterburner fuel control setting is too low, insufficient flow of fuel to the afterburner will result. In this event it is possible for the thrust with afterburner to be less than that of the engine alone at altitudes above 35,000 feet. A tailpipe temperature of approximately 600°C is indicative of this condition existing.

8-19. SLOW FLYING.

8-20. Slow flying is of very little value with this airplane since operation at speeds below the normal cruising range results in a waste of fuel and actually decreases the range and endurance. However, if slow flying is necessary, it should be done whenever possible in the clean configuration (gear, wing flaps and dive flaps retracted), because the engine can be accelerated faster than the airplane can be cleaned up and also because the fuel consumption will be increased with gear and flaps extended. If it is necessary to lose altitude while slow flying, the gear, wing flaps, and dive flaps should be extended to increase drag since the airplane will accelerate quite rapidly in the clean configuration when the nose is lowered.

8-21. The slow flight characteristics of this airplane are normal. All controls are effective down to the stall. Slow flight should be practiced at a safe altitude. Reduce the air speed by retarding the throttle to "IDLE" and maintain altitude by holding the nose up. When the desired air speed has been attained, it can be maintained by applying power. When descending at low air speeds, reduce the power by retarding the throttle to "IDLE" and decelerate to speeds at which the landing gear and wing flaps may be extended. After the gear and wing flaps have been extended, set up the desired rate of descent by adjustment of power.

8-22. TRIM CHANGES.

8-23. Since there is no torque effect from the power plant in this airplane, the rudder trim does not change with changes in speed and power if the rudder tab has been correctly adjusted on the ground.

8-24. The elevator tab becomes fairly sensitive at high speeds. If the tab mechanism should fail, causing the

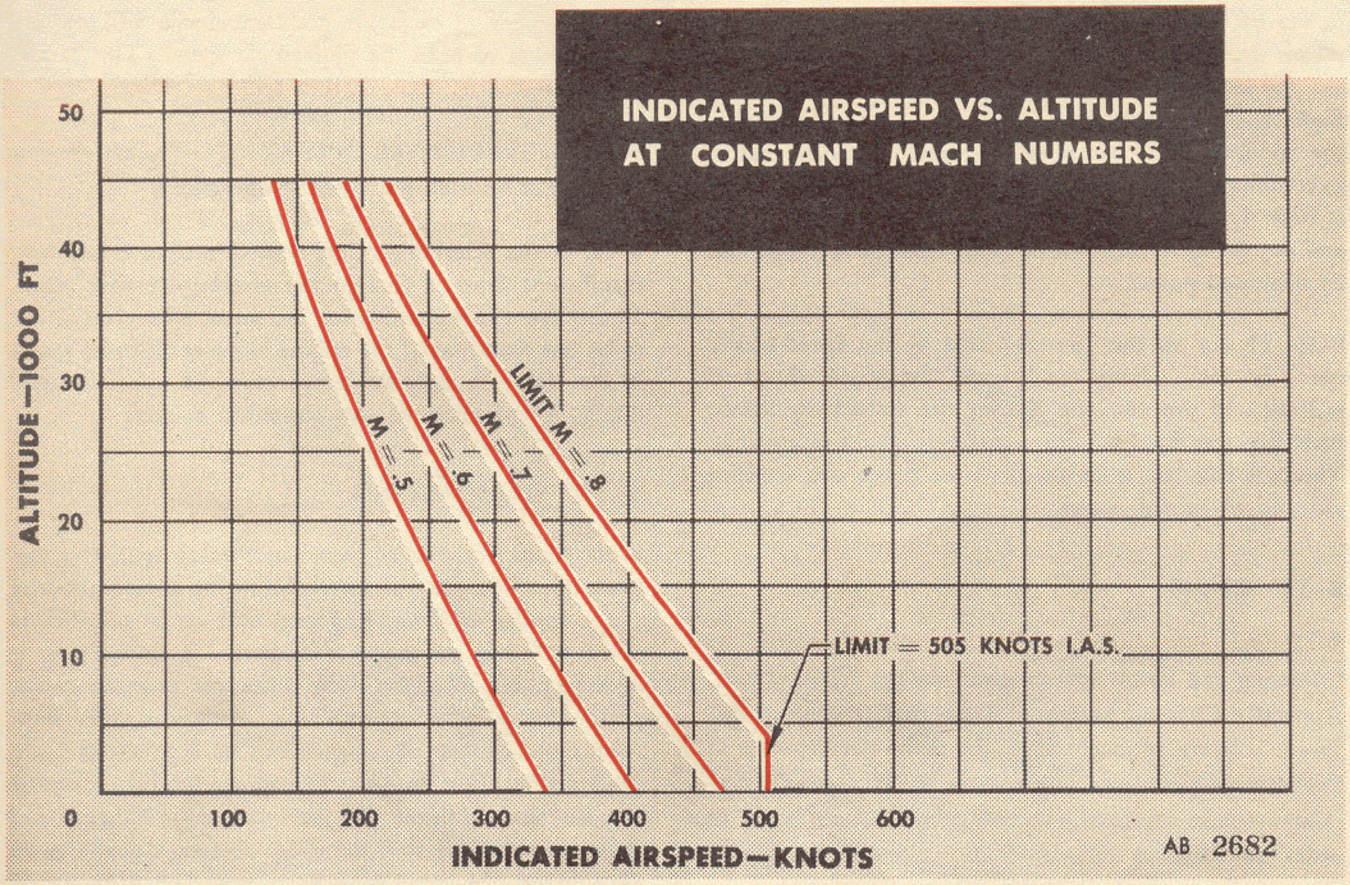

Figure 59 — Mach Number Chart

tab to travel to the fully deflected position, the sudden stick force could be excessive. However, this condition can easily be overpowered if speed is reduced.

8–25. The pitch change for the extremes of flight speed is considerable in a jet airplane because of the extremely wide speed range. Since there is so much difference in cruising pitch attitudes, it is necessary to zero the attitude gyro and Zero Reader for the cruise condition after stable flight conditions have been established.

8–26. MACH NUMBER.

8–27. Mach number represents a percentage of the speed of sound. For example, if you are flying at .50 Mach number, your speed is 50% of the speed of sound. The speed of sound, being a function of air temperature only, decreases as you climb since the air temperature decreases with altitude. For example, the speed of sound is approximately 660 knots at sea level, 614 knots at 20,000 feet, and 575 knots at 40,000 feet. So if you were flying at .50 Mach number, your true speed would be 330 knots at sea level, 307 knots at 20,000 feet, and 287.5 knots at 40,000 feet. The Mach number for any altitude and indicated airspeed condition may be found from figure 59.

8–28. AILERON BOOST.

8–29. While there is usually no reason for turning aileron boost off in flight, it can be turned on or off at any time. If the airplane is not trimmed and/or the stick is off center when the boost is turned on, an abrupt maneuver may occur because the airplane will react more quickly than the pilot. For practice purposes, it is recommended that the aileron boost be turned off in low speed flight to obtain first-hand information on the control forces required. In the event of boost system failure, it is best to reduce speed to obtain lighter aileron control forces, since these forces increase with airspeed. Manual aileron control may be supplemented by the use of aileron tab to obtain a fairly high rate of roll at high speed, but it is not considered good technique to depend on the tab for the fine control required, such as in formation or other precision flying.

8-30. DIVE FLAPS.

8-31. The dive flaps are effective in many ways, principally as a drag producing device to slow the airplane down. These flaps can be extended or retracted at any speed or in any flight attitude as long as hydraulic pressure is available. It is recommended that suitable elevator trim be used during operation of the flaps to keep the stick forces in a comfortable range, since there is a definite pitch change when the flaps are operated. The extension of the flaps will be accompanied by a nose-up tendency, whereas retraction of the flaps will give the opposite effect. The force required to counteract this pitch change varies with speed, being very light at the lower airspeeds but quite high at maximum airspeed. In view of this characteristic, the pilot must be alerted to this change, particularly when retracting the flaps near the ground at high speeds. The pitching moment that accompanies operation of the flaps, however, is never strong enough to cause damage to any part of the airplane at any permissible speed nor is it strong enough to prevent the pilot from overcoming the pitching moment without use of the elevator trim tab.

8-32. The dive flaps are effectively used in formation flying, since they have a noticeable effect upon the turning radius. This is primarily a result of slowing the airplane down. They will permit a more rapid descent without exceeding the Mach number limit and also, because of the nose-up pitching moment, they tend to counteract the "tucking under" tendency of the airplane if it is permitted to exceed this limit.

8-33. Considerable noise and roughness can be anticipated when flying at high speeds with the flaps extended. Use of the flaps below 12,000 feet will sometimes affect the pilot's ears because of the change in cabin pressure. Below 12,000 feet, the cabin is not pressurized and the cabin air outflow valve is open. This valve is in the dive flap area, and since opening the dive flaps lowers the pressure behind them, the cabin pressure is also lowered. Above 12,000 feet, however, the cabin is pressurized and the pressure regulator reacts with sufficient speed to eliminate this effect.

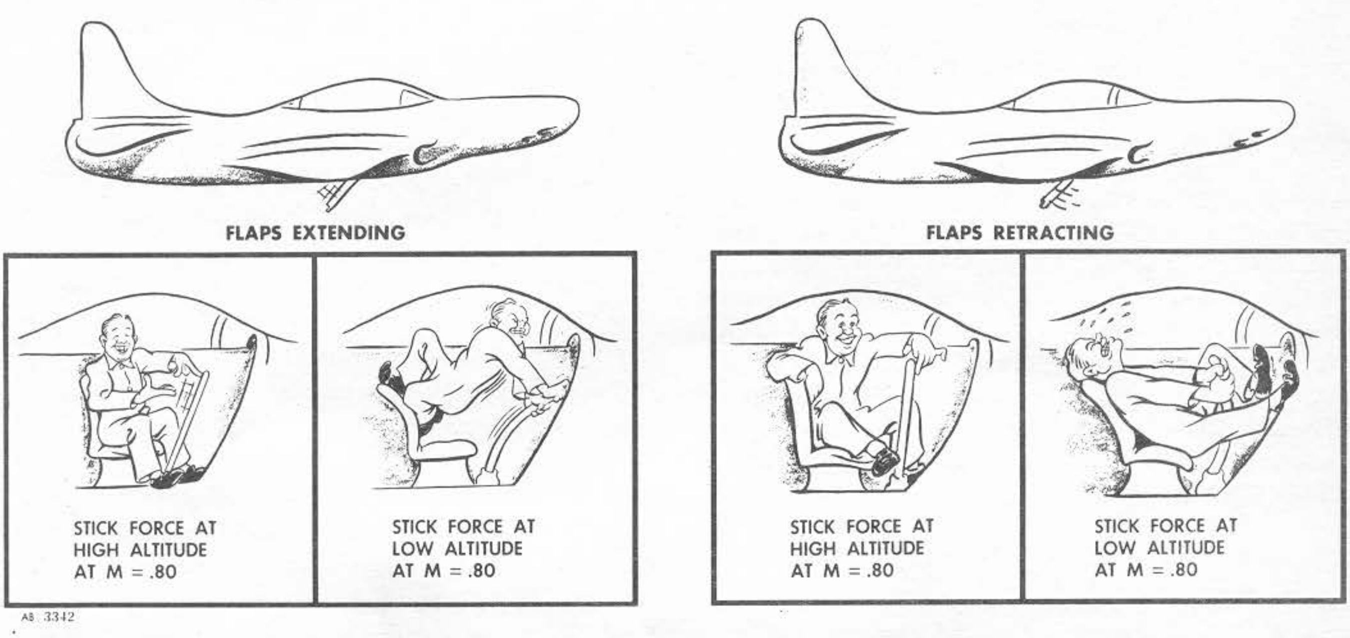

Figure 60 — Effect of Altitude on the Stick Force Required to Compensate for Dive Flap Operation at Limit Mach Number of .80

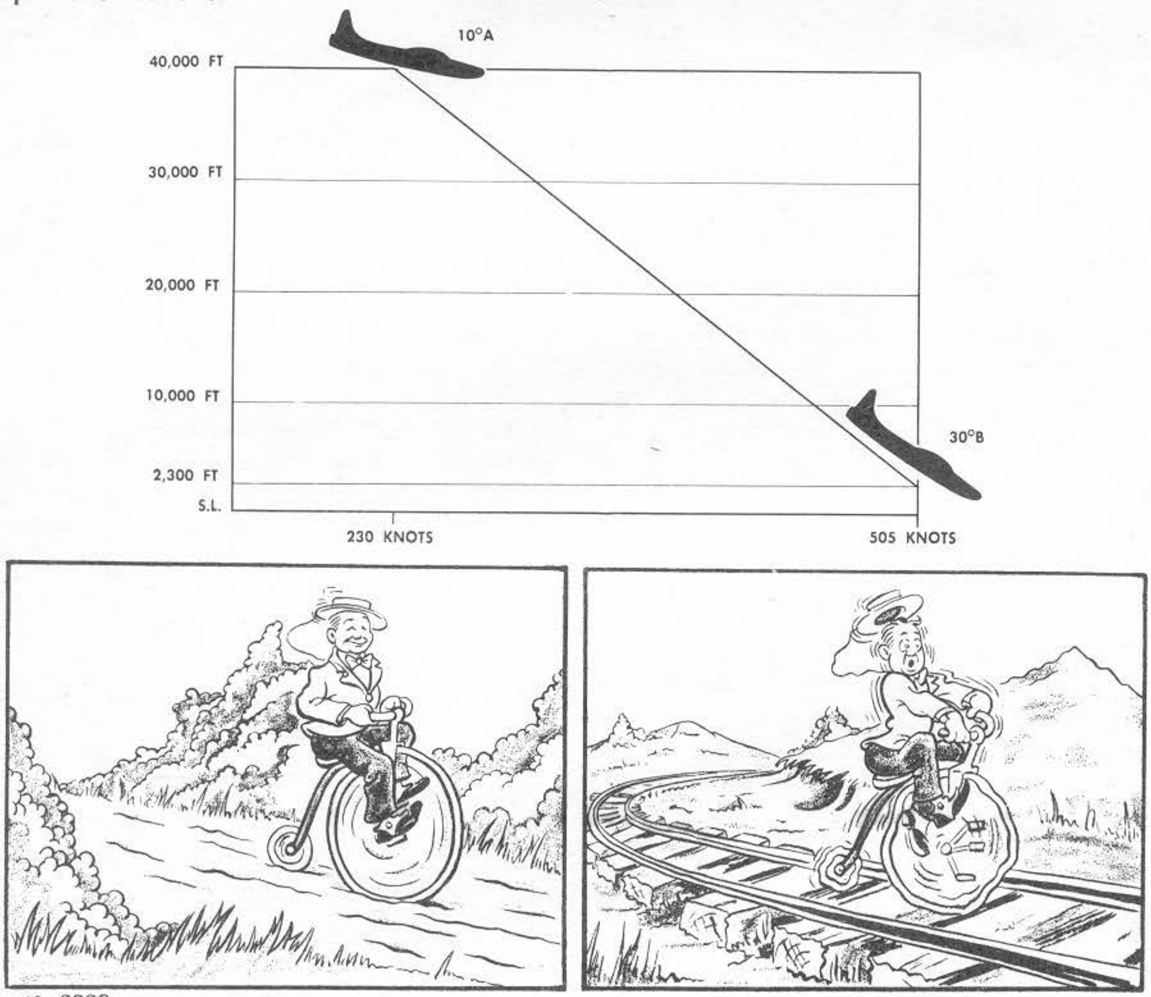

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Figure 61 — Effect of Altitude on Buffet Severity at .80 Mach Number

8–34. DIVES.

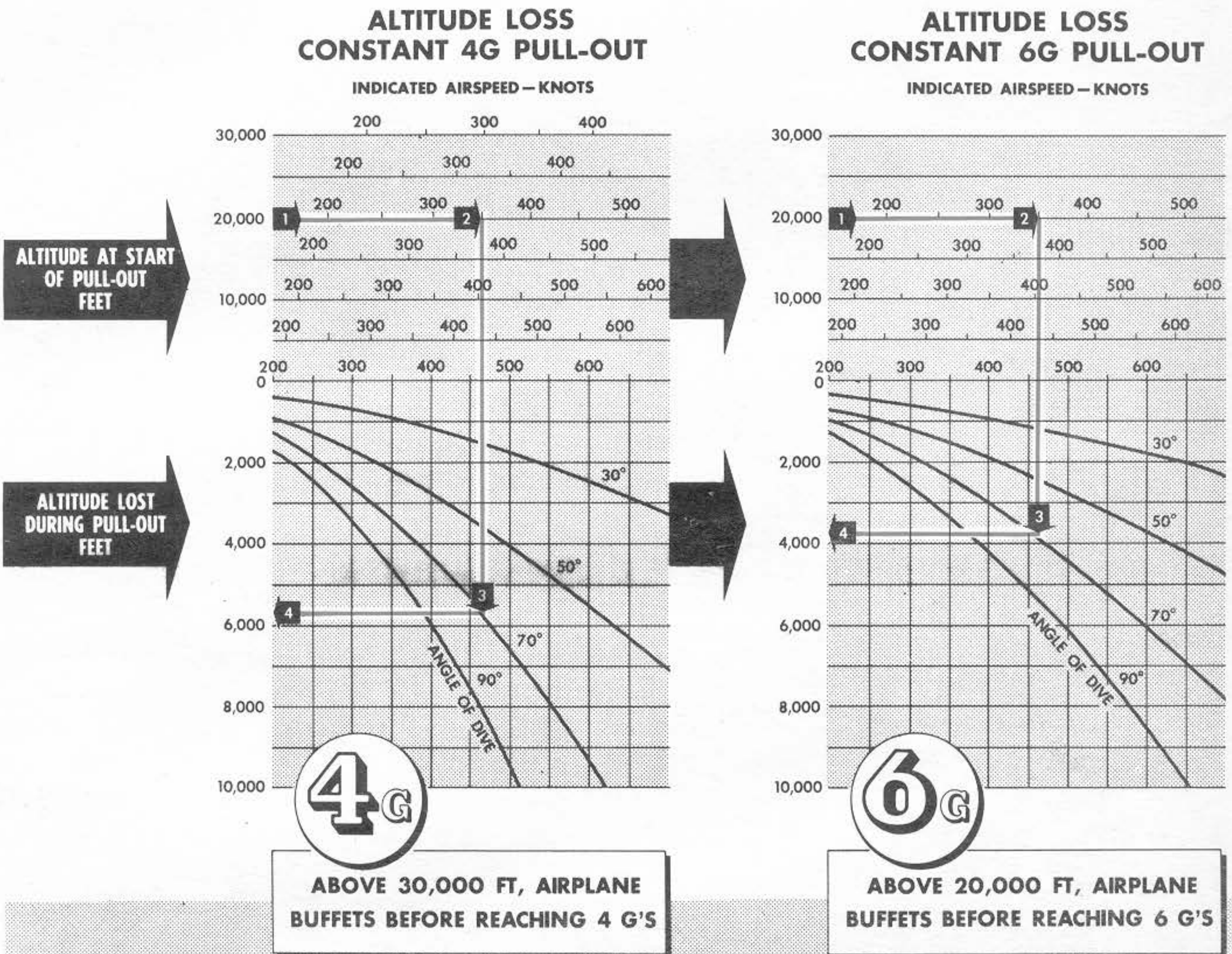
8–35. This airplane has a limit of .80 Mach number or 505 knots IAS, whichever is less. Up to this limit it is readily and safely controllable. Above .80 Mach number the airplane's lateral stability decreases rapidly because of the airflow separation over the wing. This will also cause the ailerons to buzz with a resultant stick vibration, particularly if tip tanks are installed. During accelerated flight, such as in pull-outs, turns, etc., aileron buzz can be anticipated at speeds less than .80 Mach number.

CAUTION

Speeds within the buzz range should be avoided as lateral control becomes difficult and prolonged operation within this range will eventually cause structural fatigue.

8–36. Longitudinally, although the airplane will still be stable, a "tucking under" tendency becomes apparent as the Mach number limit is exceeded. At these higher speeds, the airplane will buffet as a result of the flow separation mentioned before. This buffet will not be pronounced at the limit Mach number at high altitudes because of the low indicated airspeed required to obtain this limit. At low altitudes, however, the buffeting is much more pronounced since the indicated airspeed corresponding to .80 Mach number is considerably higher and the resulting air loads are accordingly increased.

8–37. During a dive, the airplane may have some tendency to snake, especially if the engine is idling. Snaking can be described as a directional oscillation with the nose swinging a few degrees to the left and then to the right, usually in a definite period. It is caused by air spilling out of the engine inlet ducts. This snaking is not excessive or dangerous in any respect and is controllable. During a high speed dive, or a pull-out from a dive, a rumbling noise may be heard if the throttle is retarded. This rumbling is caused by turbulence in the air ducts and is no cause for alarm.



HOW TO USE CHARTS:

SELECT APPROPRIATE CHART, DEPENDING UPON ACCELERATION (4G OR 6G) TO BE HELD IN PULL OUT; THEN—

1. ENTER CHART AT ALTITUDE LINE NEAREST ACTUAL ALTITUDE AT START OF PULL-OUT. (FOR EXAMPLE, 20,000 FT.)
2. ON SCALE ALONG ALTITUDE LINE, SELECT POINT NEAREST THE IAS AT WHICH PULL-OUT IS STARTED (350 KNOTS IAS).
3. SIGHT VERTICALLY DOWN TO POINT ON CURVE OF DIVE ANGLE (70°) DIRECTLY BELOW AIRSPEED.
4. SIGHT BACK HORIZONTALLY TO SCALE AT LEFT TO READ ALTITUDE LOST DURING PULL-OUT. (CONSTANT 4G PULL-OUT—5700 FT; CONSTANT 6G PULL-OUT—3800 FT.)

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Figure 62 — Altitude Losses in Dive Recovery

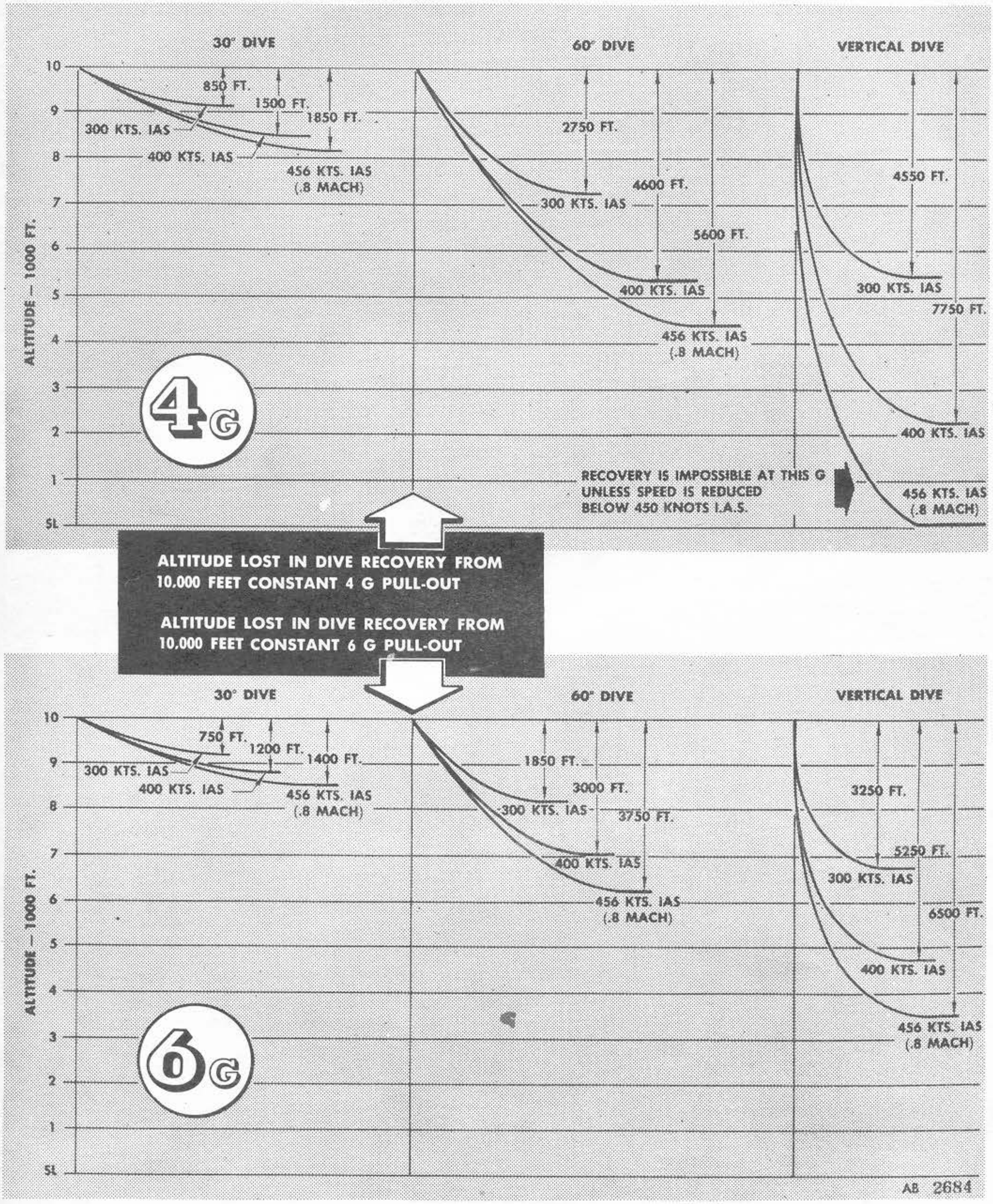


Figure 63 — Typical Dive Recoveries from 10,000 Feet

8-38. STALLS.

8-39. 1 G STALLS. The airplane stalls normally with plenty of warning; it mushes noticeably and begins to shake and buffet about 10 knots above the stall speed. During a complete stall, a wing may drop. Stalls should be entered by slowly raising the nose and gradually easing into the stall. Abrupt nose-high stalls with power off and gear and flaps up should be avoided, especially, at rearward center-of-gravity positions because the airplane may flip over on its back. Practice stalls should be made above 15,000 feet. Stalling speeds are shown on the accompanying table.

8-40. Stall recovery is quick and easy; the ailerons are effective throughout. The rudder should not be used to raise a dropping wing because it is ineffective.

8-41. Tip tanks have no effect on normal 1 G stalls except that in the case of a dropping wing the rudder effect is reversed, i.e., attempting to raise the wing with rudder action will drop the wing further.

8-42. ACCELERATED STALLS. Accelerated stalls are preceded by buffeting. The airplane will normally shake and mush straight ahead or in the direction of the maneuver. The stall characteristics are similar with or without tip tanks. Recovery from accelerated stalls is made by relaxing stick pressure.

8-43. SPINS.

8-44. GENERAL.

8-45. Intentional spins in this airplane are prohibited. Complete spin tests have not been conducted; however, sufficient spins have been made to indicate that the spinning characteristics are violent and erratic during the first part of the spin and that considerable altitude is lost before it is possible to accomplish a recovery.

8-46. NORMAL SPINS.

8-47. CHARACTERISTICS. The spin, particularly during the first two or three turns, is rather violent and erratic and may tend to reverse direction. A definite pause between turns can be anticipated and may be accompanied by a whipping action and buffeting. Model tests indicate that the center-of-gravity position and the position of the wing flaps, dive flaps, and landing gear have little effect upon either the spin characteristics or the recovery procedures.

8-48. RECOVERY. The most important point in the spin recovery is to get the nose down as far as possible. If no confusion exists regarding the direction of rotation of the airplane in the spin, recovery should be made by holding the rudder against the spin and the elevator in a position to increase the nose-down attitude of the airplane. The ailerons should be neutralized. Opposite aileron should not be used since this may cause an inverted spin. If confusion exists regarding the direction of rotation, all surfaces should be neutralized to effect recovery. As the airspeed increases and the rotation stops, a gradual pull-out should be accomplished, but care must be exercised not to restall the airplane during this pull-out because of the possibility of re-entering the spin.

8-49. INVERTED SPINS.

8-50. CHARACTERISTICS. Inverted spin characteristics, so far as is known, are similar to those of the

STALL SPEED TABLE — I. A. S. (KNOTS)

GROSS WEIGHT (LB.)	12000			13600			16775		
APPROXIMATE FUEL REMAINING (GAL.)	50			300			703		
ANGLE OF BANK	0°	30°	60°	0°	30°	60°	0°	30°	60°
FLAPS AND GEAR UP	113	121	160	120	129	169	133	143	188
FLAPS AND GEAR DOWN	96	103	136	102	109	144	113	121	159
70% FLAPS AND GEAR DOWN (31.5°)	99	106	140	105	112	148	116	124	164

normal spin except that flame-out will occur because of the inverted attitude. Model tests indicate that the spin will tend to revert to a normal spin if recovery is not effected before several turns.

8–51. RECOVERY. In an inverted spin, the recommended recovery procedure is to neutralize all controls. Recovery will probably occur sooner if the rudder is held against the spin and elevator applied in a direction to force the nose down and increase the airspeed. Opposite aileron should not be used since model tests indicate that such a practice will result in more pronounced and erratic oscillations. When the airspeed has increased and the rotation has stopped, half roll to the normal attitude and pull out, using care to avoid an accelerated stall.

8–52. PERMISSIBLE ACROBATICS.

8–53. All acrobatics, except intentional spins and acrobatics requiring extended negative acceleration, are permissible. During negative accelerations the engine oil pressure will drop almost immediately and a flame-out will occur if the inverted condition is maintained for more than approximately 10 seconds since fuel will not be fed to the engine. Negative acceleration greater than 1 G may cause immediate flame-out.

8–54. At least 10 quarts of oil are required in the engine reservoir to provide sufficient lubrication during acrobatics.

8–55. The pilot is cautioned to use extreme care in maneuvers which require a downward recovery as the loss of altitude in such a recovery is very rapid. In general, acrobatics should not be attempted below 10,000 feet until the pilot becomes familiar with the speed at which the airplane can gain and lose altitude.

8–56. FLYING WITH EXTERNAL LOAD.

8–57. The tip tanks have very little effect on the airplane's flying characteristics. Uneven transfer of fuel from the tip tanks causes wing heaviness but this can usually be trimmed out with the aileron tab. However, if the fuel differential is more than 150 gallons, you will not be able to keep the wings level for landings and the tip tanks should be dropped. If uneven feeding of the tanks is suspected, the airplane should be stalled (at about 15,000 feet) to determine whether or not it is safe to land. If in doubt, jettison the tip tanks.

8–58. STABILITY.

8–59. GENERAL.

8–60. The airplane is directionally and longitudinally stable at all approved center-of-gravity positions. Laterally the airplane is neutrally stable. This condition does not require any special technique other than frequent reference to the lateral attitude.

8–61. EFFECT OF CG. The external and internal loading of the airplane affects the CG. Full ammunition or equivalent ballast moves the CG forward 5 to 6½% depending on the fuel load. Tip tank fuel loading moves the CG aft about 1½%.

8–62. In the aft CG range the stick forces are lighter. The airplane is quite sensitive to elevator trim at CG's aft of 29% but the stick forces and the stability remain positive.

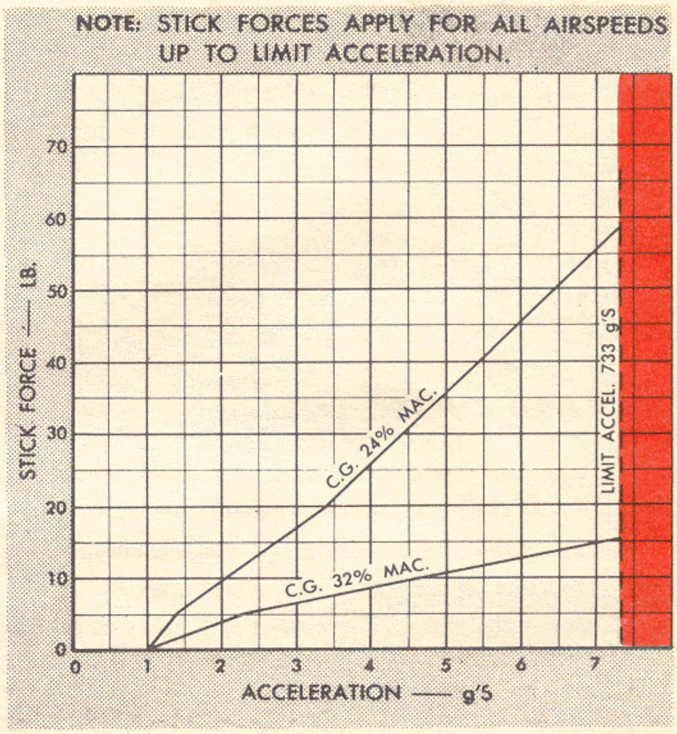


Figure 64 — Stick Force Diagram

8–63. MANEUVERING LOADS.

8-64. Maneuvering loads are incurred when an airplane is turned, rolled, yawed, pulled out of a dive, or accelerated in some manner. It is the pilot's responsibility to prevent these loads from becoming excessive by restricting the maneuvers to the specified acceleration limits. For this purpose he relies on the accelerometer, an instrument designed to detect the acceleration loads placed upon the airplane. Although the accelerometer is generally reliable, it has limitations which can, under some circumstances, mislead the pilot into believing that he is executing a safe maneuver, whereas in reality he may be dangerously overstressing the airplane. The limitations of the accelerometer are (1) it reads only the accelerations in a vertical plane, and (2) it is located on the pilot's instrument panel and cannot accurately detect accelerations of the airplane tail assembly.

8–65. As an example, during maneuvers such as yaws and skids, the accelerometer will read approximately 1 G. At the same time fairly large loads are being imposed on the vertical tail assembly of the airplane. Actually, the steady loads that are applied during these maneuvers are usually not excessive and are almost directly proportional to the rudder pedal force being applied. Of more importance is the rate of application or particularly the rate of release of these forces. During rapid application and/or rapid release of large control forces, very high loads can be imposed on the airplane structure. This is not meant to imply that the pilot should apply control forces gradually in order to avoid excessive loads, it is merely a caution that very rapid application or release of forces can, at moderate to high airspeeds, result in structural damage to the airplane.

8–66. APPROACH AND LANDING.

8–67. At approach speeds this airplane handles somewhat differently than the F-80 or T-33 airplanes because of the longer nose, larger aft fuselage, and the heavier weight. This means that somewhat more attention is required during the approach leg. This is mostly noticeable if the nose is raised at a slow airspeed, because the drag increases very rapidly and, as a result, the airspeed will drop off unless power is applied immediately. Because of the slow acceleration of jet engines from low engine speeds, it is desirable from the standpoint of safety, to keep at least 60% rpm until you are quite close to the runway; then, if power is needed for any reason the response will be much faster. If the runway length is short enough to be marginal, the approach speed must be closely controlled—5 knots too fast can mean a touchdown too far down the runway to stop or to go around; five knots too slow can mean a hard landing, possibly short of the runway. If the runway is of adequate length for high performance jet type aircraft, it will not be necessary to approach as slow as for a marginal field. With a gliding approach, the proper airspeed using 60% rpm, the airplane can be flared normally to touchdown. If a level power-on drag approach is made, it is necessary that more power be kept on until a few feet away from the runway. The airplane may drop suddenly if the power is pulled off too abruptly. If the speed during final approach is excessive, it should be reduced by slipping and/or extension of the dive flaps. Fishtailing is not recommended. Touchdown should be made in a slightly nose-high attitude on the main wheels. Do not get the nose so high that the tail will drag. Also avoid landing on the nose wheel. As soon as the wheels touch you can retract the wing flaps to get better braking and, if the airplane has any tendency to float, the flaps can be retracted just before touchdown to eliminate this tendency. When landing in a crosswind, it is advisable to make a crabbing approach rather than by holding a wing down. The tricycle gear will straighten the roll after touchdown. Dead-stick landings should be made about ten knots IAS higher because of the reduced flare with power off.

8–68. ABORTED LANDINGS OR GO-AROUNDS.

8–69. The importance of holding at least 60% rpm becomes apparent if the landing approach is short or if it is necessary for any reason to go around. The throttle should immediately be advanced to full open and the landing gear and flaps raised as soon as you are sure the airplane won't touch the runway. The gear and flaps should be retracted to eliminate their drag and thus enable the airplane to accelerate more rapidly. If the engine speed is at approximately 60% rpm, it will require only about 4 seconds for the engine to accelerate to 100% rpm; however, if the engine is operating at idling speed, it will require approximately

10 seconds to accelerate and the thrust available will be small during the first six seconds of this engine acceleration.

8–70. PORPOISING.

8-71. If, during a landing, the pilot allows the nose wheel to touch the runway first, it is possible that a porpoising oscillation may result. This oscillation results from the nose wheel bouncing off the runway and may be mild at first; however, it will probably be difficult to dampen out with the elevator because of the inertia effects. Holding the stick all the way back may help more than trying to correct the zoom. However, in all cases where the airplane hits the nose wheel first, bounces, and then hits on the main wheels, it is recommended that a go-around be started immediately if sufficient runway and fuel are available. If it is necessary to land with excessive speed such that the nose wheel would normally contact the runway first, the wing flaps should be retracted while the airplane is still a few feet off the runway. This will give the airplane a nose-up attitude and a normal landing can be executed.

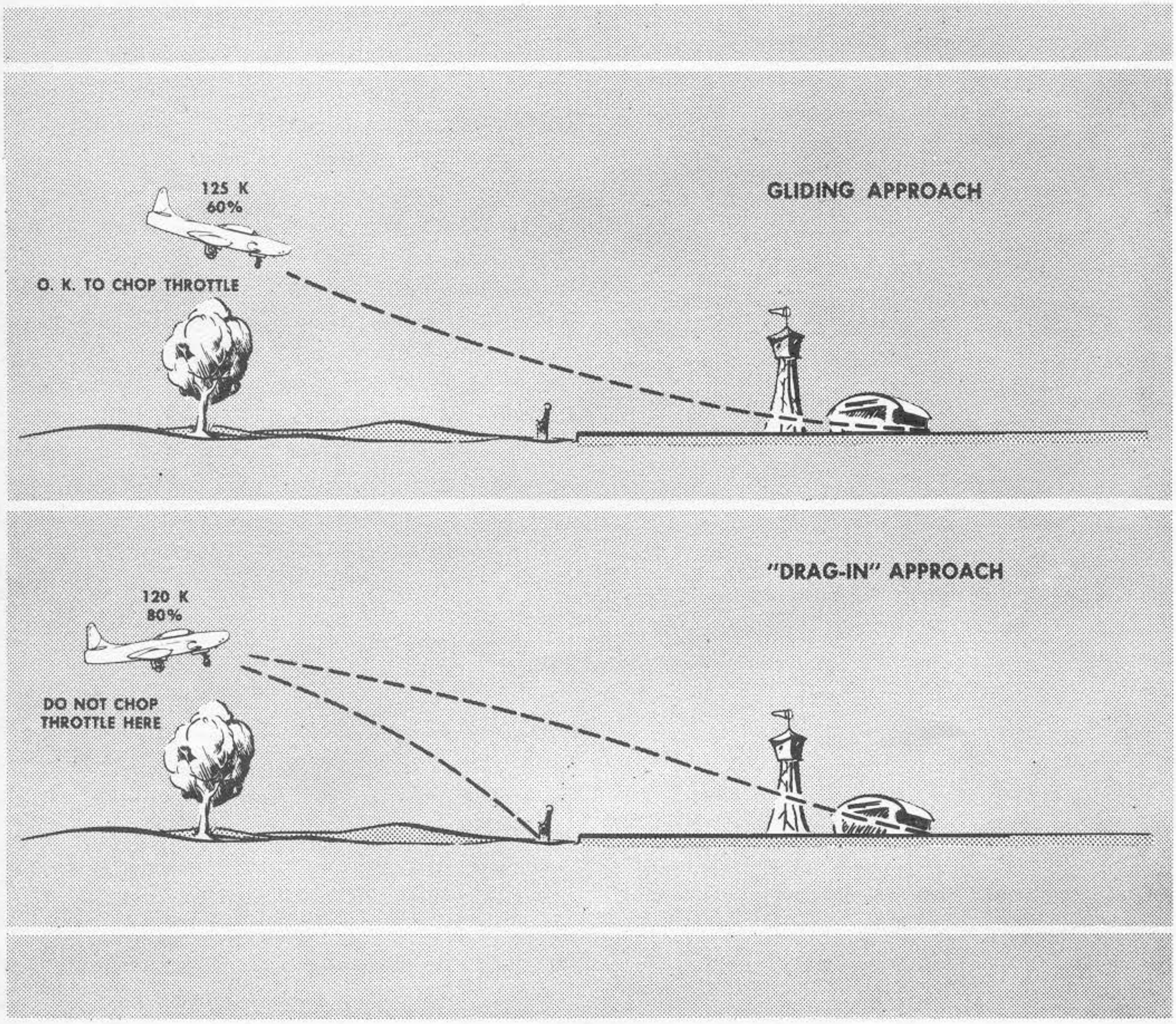
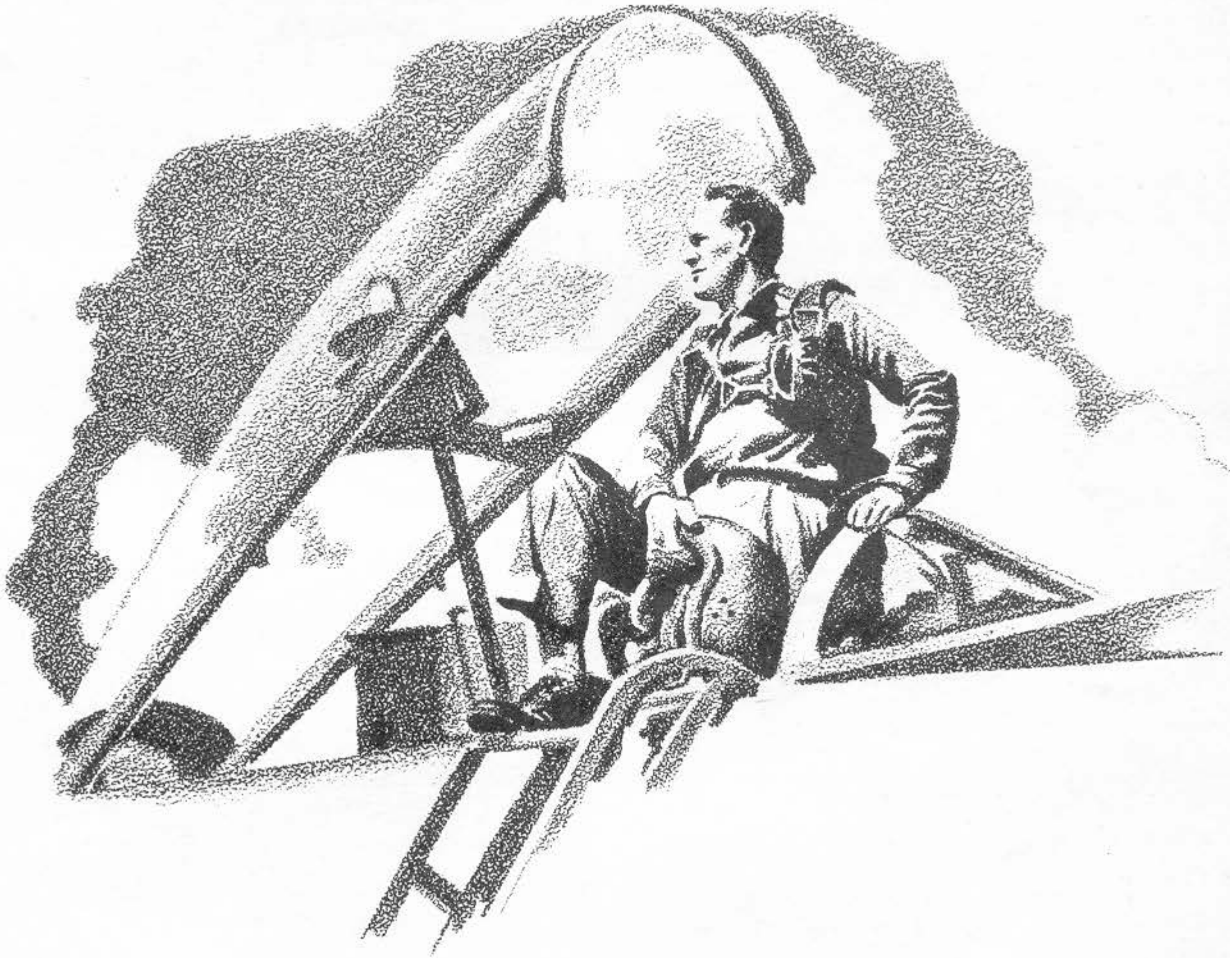


Figure 65 — Final Approach Diagram



APPENDIX I

FLIGHT OPERATIONAL DATA

A–1. INTRODUCTION.

A–2. AIRSPEED CORRECTION CHARTS.

A–3. An airspeed Installation Correction Chart is shown in figure A-7 and an Airspeed Compressibility Chart in figure A-8. By use of these charts, airspeed instrument readings can be corrected to calibrated airspeed and equivalent airspeed values.

A–4. EXAMPLE OF USE OF AIRSPEED CORRECTION CHARTS.

Flight Altitude	35,000 ft.
Airspeed indicator reading (IAS)	260 knots
Correction for installation error, figure A-7	−3 knots
Calibrated airspeed (CAS)	257 knots
Correction for compressibility, figure A-8	−13 knots
Equivalent airspeed (EAS)	244 knots

A-5. TAKE-OFF CHART.

A-6. The Take-off Chart, figure A-9, lists take-off distances for various pressure altitudes and air temperatures. Engine thrust reduces as altitude or free air temperature increases. Consequently, greater take-off distances are required at higher altitudes and on warm days. Representative performance showing the effects of altitude and air temperature are shown in figure A-1. Note that both ground roll distance and air distance are increased at higher free air temperatures and altitudes.

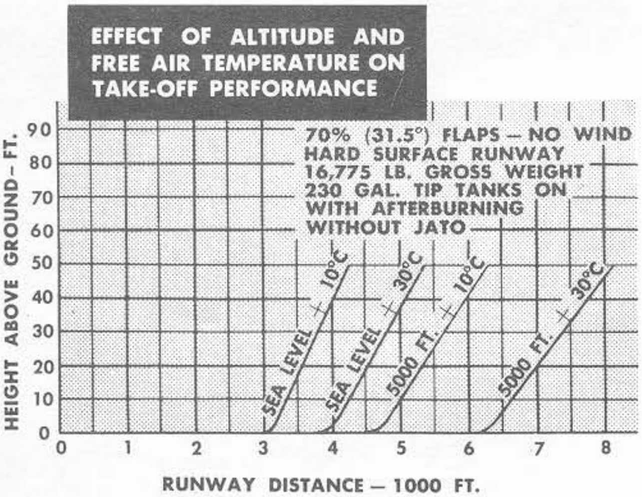


Figure A-1 — Effect of Altitude and Free Air Temperature on Take-off Performance

A-7. To use the Take-off Chart, figure A-9, set airplane altimeter to 29.92 and read pressure altitude. With air temperature obtained from the field weather station and pressure altitude, enter chart and determine the take-off distance that will be required when the normal take-off technique outlined in Section II is followed.

A-8. The Take-off Chart includes no conservatism factor.

A-9. JATO TAKE-OFF DISTANCES. Take-off distances with two 1000-pound JATO units are also included in the Take-off Chart. The ground roll distances given are minimum values that can be attained by firing the JATO units according to the schedule shown under "JATO Firing Data for Minimum Ground Roll" at the bottom of figure A-9. Firing the JATO units by this schedule will result in their being expended at about the time the airplane leaves the ground. Consequently, this procedure should be followed only when there are no obstacles near the end of the runway.

A-10. When there are obstacles near the end of the runway, the JATO units should be fired according to the schedule "JATO Firing Data For Minimum Distance To 50′ Obstacle." This procedure will result in the JATO units being expended near the 50′ high point and, consequently, will result in the minimum total distance to this point. The distance given to clear 50 feet is based upon this technique. The corresponding ground roll distance to the take-off point will be greater than the ground roll value shown. The ground roll distance is based upon an earlier JATO firing point as discussed in the preceding paragraph.

A-11. CLIMB CHART.

A-12. Standard day performance is presented in the Climb Chart, figure A-10, with and without afterburning. Rate of climb, distance, time and fuel used to climb to altitude are shown based upon use of optimum climbing speed schedules shown.

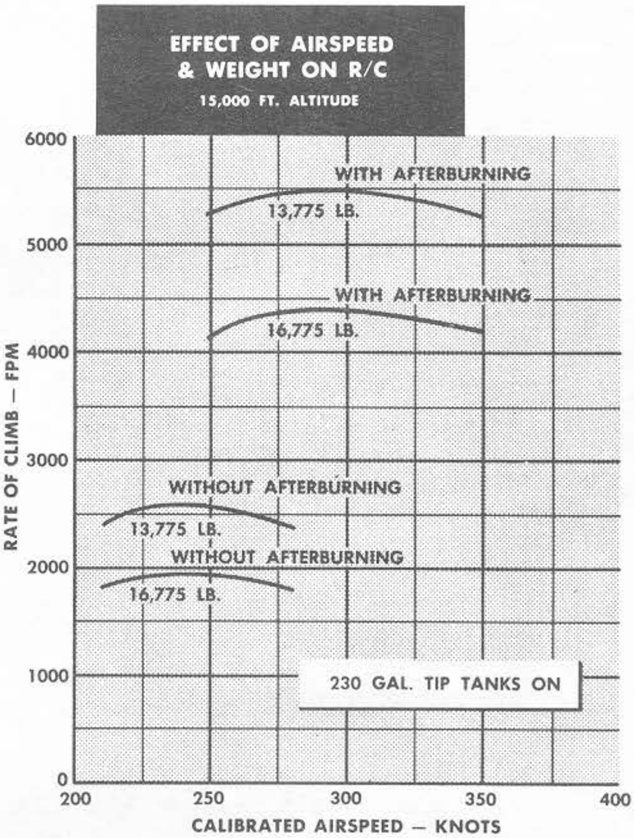


Figure A-2 — Effect of Airspeed and Weight on Rate of Climb

A-13. Use of climb speed schedules other than shown on the Climb Chart will result in reduced rates of climb at all altitudes. Consequently, fuel used and time required to reach altitude will be greater than shown on the Climb Chart. The variation of rate of climb with airspeed and gross weight is shown in figure A-2. Rate of climb is proportional to excess thrust horsepower; therefore, the maximum rate of climb will be attained at the airspeed for which excess thrust horsepower is a maximum. Power required to maintain airspeed and power available from engine output are shown versus airspeed in the upper part of figure A-3.

The difference between these two quantities is excess thrust horsepower. The speed at which the difference is a maximum is the speed for maximum rate of climb. The relationship of thrust required and thrust available is shown in the lower part of figure A-3 for comparison.

DETERMINATION OF OPTIMUM CLIMB SPEED

15,000 FT. ALTITUDE

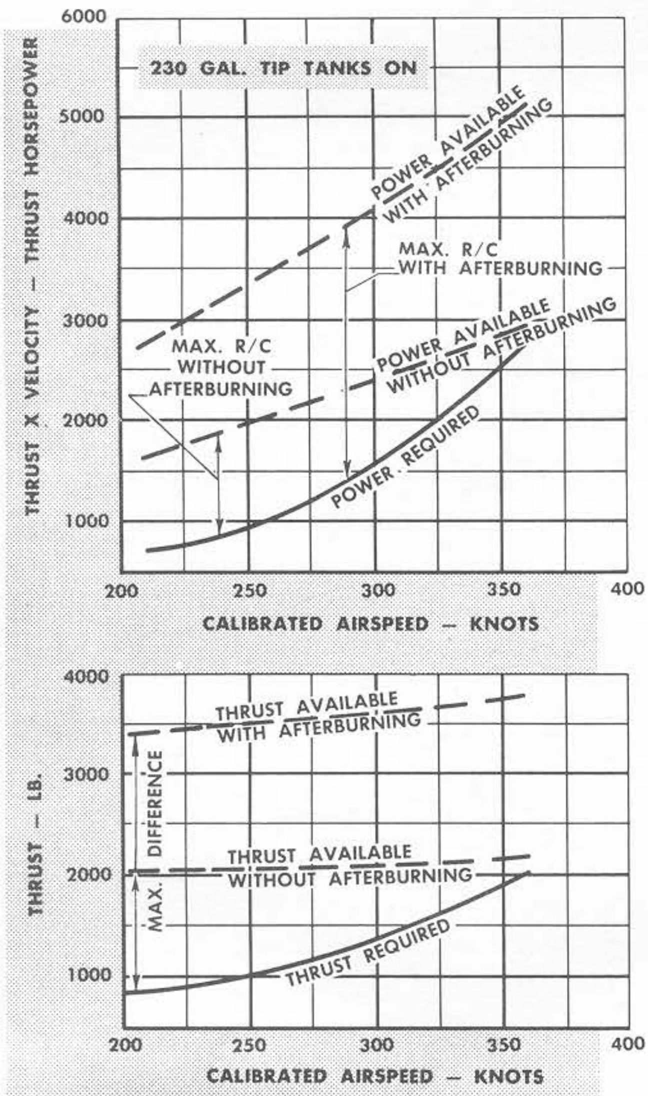


Figure A-3 — Determination of Optimum Climb Speed

A-14. The rate of climb will be reduced on warm days due to lower engine thrust. This will result in increased time and distance required to reach altitude. These factors, in combination with the effect of temperature on fuel flow, will result in a somewhat greater quantity of fuel required to reach altitude. A typical variation of rate of climb and time to climb versus altitude is shown in figures A-4 and A-5 for two days with differing free air temperatures.

A-15. DESCENT CHART.

A-16. Distance, time and fuel required to descend from altitude with idle rpm are given in the Descent Chart, figure A-11. These data are based upon maintaining constant 0-6 Mach number. Maximum range will be attained by following this schedule. Gear, landing flaps and dive flaps should be in the retracted position except that on scme airplanes the idle rpm at altitudes above 35,000 feet may be sufficiently high that the rate of descent is quite low at 0.6 Mach number. When this occurs, the dive flaps should be used down to 35,000 feet altitude. Decreasing the airspeed below the schedule shown will decrease the rate of descent. Either change will decrease the total range of the airplane. In case of engine failure when it is necessary to extend the glide as far as possible, the airspeed shown in Section III should be used.

A-17. LANDING DISTANCE CHART.

A-18. Figure A-12 shows landing distances required when using the normal landing technique recommended in Section II. The distances include no conservatism factor.

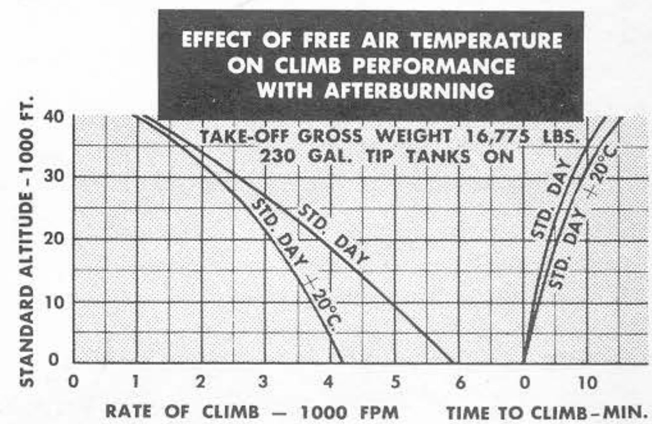


Figure A-4 — Effect of Free Air Temperature on Climb Performance With Afterburning

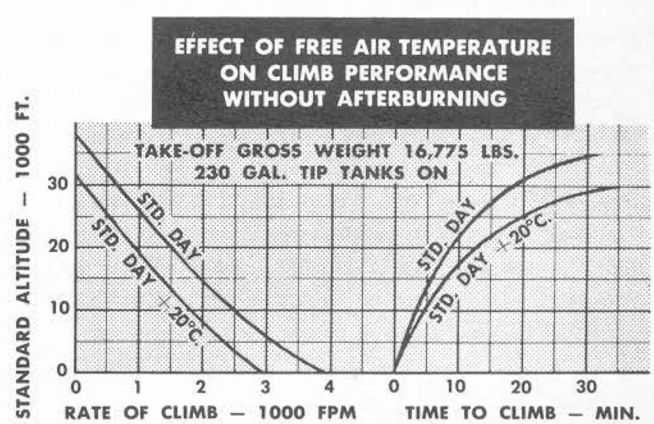


Figure A-5 — Effect of Free Air Temperature on Climb Performance Without Afterburning

A-19. MAXIMUM ENDURANCE CHART.

A-20. Maximum endurance is obtained at a given altitude by flying at the condition which will give the lowest rate of fuel consumption at that altitude. This condition will be obtained by flying at the speeds shown in the Maximum Endurance Chart, figure A-13.

A-21. FLIGHT OPERATION INSTRUCTION CHARTS.

A-22. GENERAL.

A-23. The Flight Operation Instruction Charts, figures A-16, A-17 and A-18, show the maximum range available with the fuel remaining in the airplane, and the procedure required to obtain this range. The effects of the main vairiables on range are shown in a manner to give the most usable and most accurate information consistent with simplicity.

A-24. The chart may be used at any point in flight or for pre-flight planning. The initial conditions are the airplane configuration and gross weight, the actual altitude of the airplane and the fuel remaining on board. In the Flight Operation Instruction Chart, the five main columns across the top are initial altitude conditions. On the line opposite fuel quantities, maximum ranges are shown for each initial altitude. In general, two range values are given for each altitude and fuel quantity, one for level flight at that altitude, and one for the maximum range obtainable by climbing to a higher altitude. Distances covered in let-down are included, and for range figures indicating a cruise at higher altitude, climb distance is included. Ranges quoted do not include any landing reserve.

A-25. In the lower half of the Flight Operation Instruction Chart the cruising instructions are given. Note that the values of rpm, fuel consumption, ground speed, range factor and let-down distance are listed as approximate. With the exception of ground speed, these items are to be varied as airplane weight reduces (within the weight limits of the particular chart) so that calibrated airspeed is maintained constant. Maximum range is attained by flying as close as possible to the recommended calibrated airspeed. Values of ground speed are based upon standard day conditions and will vary slightly when air temperature is not standard.

A-26. FUEL QUANTITIES. Fuel quantities tabulated on the chart represent fuel that is available for cruising. Allowances must be made for extra items such as combat, landing and endurance reserves. Additional allowances must be made for evaporation losses and for fuel "slugging" losses particularly when using JP-3 fuel under adverse conditions. During fuel "slugging," large quantities of liquid fuel are carried overboard through the vent system by violent foaming of the fuel. The fuel quantities to allow for these losses cannot be simply presented as they vary from zero to considerable amounts depending upon atmospheric temperature, fuel temperature at take-off individual fuel shipments, the length of time since the fuel was refined (amount of weathering) and the rate of change of altitude during flight.

A-27. WIND. Under different wind conditions, ranges are varied by the effect of wind on ground speed. Let-down distances are affected for the same reason. Recommended calibrated airspeed to obtain long range may also change with different headwinds in order to maintain the most favorable miles-per-gallon ratio. The lower half of the Flight Operation Instruction Chart contains operating instructions for different wind conditions. These cruising data are presented for the same altitudes that head the upper half of the chart.

A-28. Since the wind may be from any direction with respect to the airplane course, some question may arise as to the method of handling winds other than direct headwinds or tailwinds. A wind at any angle to the airplane course affects the airplane's ground speed along the course. For purposes of cruise control, all winds may be expressed as effective winds. This reduces the wind to one which would have the same net effect on the airplane's ground speed as if it were a direct headwind or tailwind.

A-29. FREE AIR TEMPERATURE. All data in the Flight Operation Instruction Charts are for standard day conditions. On days when the free air temperature is other than standard, range performances will be slightly different from the values given. Climb performance is reduced but miles-per-gallon in level flight increases on days hotter than standard. Typical flights on days with different free air temperatures are illustrated in figure A-6 showing the magnitude of the air temperature effects.

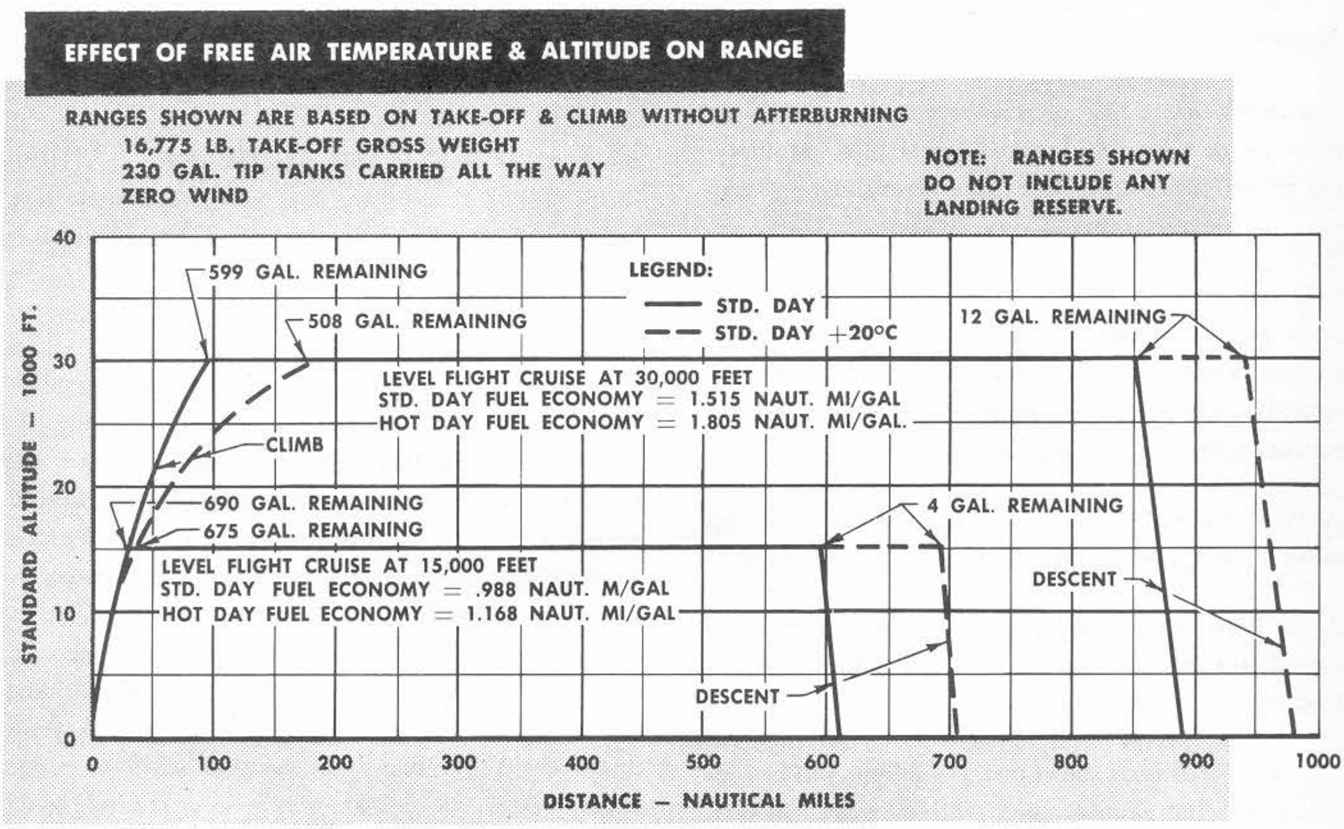
A-30. USE OF THE FLIGHT OPERATION INSTRUCTION CHARTS.

A-31. To use the charts in flight, refer to the upper half, and under the present altitude column read range opposite fuel quantity. For cruising at that altitude the operating instructions are listed directly below. Enter on the line according to effective wind and read the calibrated airspeed. Approximate values of cruising rpm, gallons per hour, range factor, let-down distance, and nautical ground miles per hour are given for reference. Multiplying still air range by the range factor results in nautical ground miles that can be flown.

A-32. If it is desirable to increase range, enter the same altitude column as before. Under the second and third sub-headings are shown the optimum altitude to which a climb should be made to obtain best range, and the range at that optimum altitude. To obtain this range, climb immediately (according to the recommended climb procedure) to the altitude shown. For cruising instructions refer to the lower half of the chart in the column according to the new altitude. Calculation of range in a wind and cruising procedure are as described above for the level flight cruise.

Note

At any time during the flight the pilot may refer to the chart with actual conditions of altitude and fuel to obtain range remaining in the same manner as previously discussed.



AB 2923

Figure A-6 — Effect of Free Air Temperature and Attitude on Range

A-33. EXAMPLE OF USE OF CHARTS IN PREFLIGHT PLANNING.

A-34. MAXIMUM RANGE ON INTERNAL FUEL (323 gallons). The airplane is to cruise at 35,000 feet altitude against an 80 knot headwind. The take-off weight is 13,400 pounds:

a. From the climb chart it is seen that the take-off and climb to altitude without afterburner will use 133 gallons of fuel. The still air range covered in climb will be about 80 nautical miles. The fuel remaining at 35,000 feet will be 190 gallons (323 — 133).

b. By referring to the 35,000-foot section of the Flight Operation Instruction Chart (figure A-16, sheet 2) between 160 and 200 gallons, it can be seen that 344 additional still air nautical miles can be flown using straight line interpolation, including allowances for let-down. The total still air range is then 80 plus 344 or 424 nautical miles.

c. In the lower half of the chart it is seen that the range factor for an 80 knot headwind is .8. Multiplying the still air range by this factor gives about 339 nautical miles actual range.

d. Cruising at 35,000 feet with a headwind of 80 knots, according to the lower half of the Flight Operating Instruction Chart, is at a calibrated airspeed of 227 knots at approximately 90% rpm and the let-down is begun 55 nautical miles from the destination.

A-35. MAXIMUM FERRY RANGE. Take-off with tip tanks = 783 gallons. Tip tanks to be carried all the way.

A-36. Reference to figure A-18 shows that the optimum altitude for any fuel quantity over 400 gallons is 35,000 feet.

a. The climb chart shows that 243 gallons will be consumed and 166 nautical miles will be covered in taxi, take-off and climb to 35,000 feet without afterburning.

b. After 35,000 feet is reached, 783 — 243 = 540 gallons will be available for level flight and let-down.

c. For 540 gallons at 35,000 feet about 790 nautical miles are available.

d. With the 166 nautical miles covered in climb, a total flight of 790 + 166 = 956 nautical miles can be made.

A-37. If it is desired to drop the tip tanks when empty, reference to figure A-17, sheet 2, shows that at 35,000 feet, 540 gallons of fuel will permit a flight of 857 nautical miles. The operating data from the same figure, for the portion of the flight with tip tanks, are 219 knots calibrated airspeed at 35,000 feet at about 95% rpm. Figure A-17 is to be used for operating data only while carrying the tip tanks. When the tip tanks are dropped, the operating data must be obtained from figure A-16, sheet 2. Figure A-16, sheet 2, shows that the optimum altitude for any fuel quantity over 80 gallons is 40,000 feet. Therefore, a climb to 40,000 feet must be made when the tip tanks are dropped in order to attain the range of 857 nautical miles. At 40,000 feet, cruise at 202 knots calibrated airspeed at approximately 91% rpm and begin let-down 85 miles from destination. With the 166 nautical miles covered in climb, the total range for the flight is 857 + 166 = 1023 nautical miles.

A-38. EXAMPLE OF THE USE OF CHARTS WHILE IN FLIGHT. The airplane is at 5,000 feet altitude with 280 gallons of fuel (no tip tanks) and distance to destination is 380 nautical miles.

a. Reference to the 5,000-foot column of the Flight Operation Instruction Chart opposite 280 gallons shows that by cruising at 5,000 feet the range will be only 190 nautical miles. By climbing to 40,000 feet, a flight of 440 nautical miles can be made. In order to fly 380 nautical miles it is evident that it is necessary to climb and cruise at an altitude higher than 5,000 feet, but not necessarily as high as 40,000 feet. A linear interpolation (which in all cases will be close to the actual values) between the difference in range (440 — 190 = 250) and altitude (40,000 — 5,000 feet = 35,000) provides a quick guess that for the 190 additional nautical miles of range needed 380 — 190 = 190 an increase of at least 30,000 feet of altitude will be necessary (or a minimum cruising altitude of 35,000 feet). The 380 nautical miles are available by climbing and cruising at 35,000 feet.

b. For purposes of checking the estimate, detailed calculations are shown. A distance of 75 nautical miles will be covered with an expenditure of 98 gallons of fuel in climbing from 5,000 feet to 35,000 feet. This means that there are only 380 — 75 or 305 nautical miles to go from that point and 182 gallons are available. With these as the initial conditions, enter the Flight Operation Instruction Chart in the 35,000-foot column. The distance which can be flown at 35,000 feet with 182 gallons is 331 nautical miles. This shows that a climb to 35,000 feet will provide sufficient range to reach destination. (Cruising speed at 35,000 feet is 226 knots calibrated airspeed at approximately 90%rpm.)

AIRSPEED INSTALLATION CORRECTION TABLE

(WITH OR WITHOUT TIP TANKS)

AIRPLANE MODEL: F-94B **ENGINE MODEL: J33-A-33**

GEAR AND FLAPS UP ADD CORRECTION TO CORRECTED INSTRUMENT READING TO OBTAIN CAS		GEAR AND FLAPS DOWN ADD CORRECTION TO CORRECTED INSTRUMENT READING TO OBTAIN CAS	
IAS (Knots)	CORRECTION (Knots)	IAS (Knots)	CORRECTION (Knots)
175	−2	100	+2
200	−2	125	+2
225	−3	150	+2
250	−3	175	+2
275	−4		
300	−5		
325	−6		
350	−7		
375	−7		
400	−8		
425	−8		
450	−9		
475	−9		
500	−9		

REMARKS: MULTIPLY NAUTICAL UNITS BY 1.15 FOR CONVERSION TO STATUTE UNITS.

DATA AS OF: 12-1-50

DATA BASIS: FLIGHT TEST

IAS — INDICATED AIRSPEED

CAS — CALIBRATED AIRSPEED

Figure A-7 — Airspeed Installation Correction Table

COMPRESSIBILITY CORRECTION TABLE

Add correction to calibrated airspeed to obtain equivalent airspeed.

Pressure Altitude	CAS — KNOTS									
	150	200	250	300	350	400	450	500	550	600
5,000	0	0	—1	—2	—2	—3	—4	—6	—8	—10
10,000	0	—1	—2	—3	—5	—7	—10	—13	—17	—21
15,000	—1	—2	—3	—6	—8	—12	—16	—21	—27	
20,000	—1	—3	—5	—8	—12	—17	—23	—31		
25,000	—2	—4	—7	—11	—17	—24	—32			
30,000	—2	—5	—9	—15	—23	—32				
35,000	—3	—7	—12	—20	—29					
40,000	—4	—9	—16	—25						

REMARKS: MULTIPLY NAUTICAL UNITS BY 1.15 FOR CONVERSION TO STATUTE UNITS.

CAS — CALIBRATED AIRSPEED

Figure A-8 — Compressibility Correction Table

AIRPLANE MODEL F-94B	TAKE-OFF DISTANCES—FEET NO TIP TANKS 70% FLAPS — HARD SURFACE RUNWAY — NO WIND	ENGINE MODEL J33-A-33

CONFIGURATION AND GROSS WEIGHT	PRESS. ALT. FT.	−10°C		+10°C		+30°C		+50°C	
		GROUND ROLL	CLEAR 50′	GROUND ROLL	CLEAR 50′	GROUND ROLL	CLEAR 50′	GROUND ROLL	CLEAR 50′
NO TIP TANKS	5000	2925	4150	3775	5500	4975	7250	6350	9425
13,400 LB.	4000	2675	3850	3450	5050	4550	6625	5800	8650
WITHOUT	3000	2450	3550	3175	4625	4150	6050	5250	7800
AFTERBURNER	2000	2225	3300	2900	4250	3775	5525	4800	7100
WITHOUT	1000	2025	3050	2650	3875	3450	5050	4375	6475
JATO	S.L.	1875	2800	2450	3550	3125	4600	3975	5875
NO TIP TANKS	5000	2300	3275	2800	3875	3550	4850	4550	6150
13,400 LB.	4000	2150	3050	2625	3600	3225	4525	4225	5700
WITH	3000	1950	2825	2350	3325	3025	4200	3875	5300
AFTERBURNER	2000	1825	2600	2175	3100	2800	3900	3600	4950
WITHOUT	1000	1675	2400	2000	2875	2550	3600	3300	4550
JATO	S.L.	1525	2225	1850	2675	2350	3350	3050	4250
NO TIP TANKS	5000	1950[4]	2900[5]	2375[4]	3500[5]	2925[4]	4275[5]	3550[4]	5175[5]
13,400 LB.	4000	1850[4]	2700[5]	2200[4]	3225[5]	2675[4]	3950[5]	3225[4]	4775[5]
WITHOUT	3000	1625[4]	2500[5]	2025[4]	3000[5]	2475[4]	3650[5]	2975[4]	4375[5]
AFTERBURNER	2000	1550[4]	2325[5]	1875[4]	2775[5]	2275[4]	3350[5]	2725[4]	4050[5]
WITH	1000	1425[4]	2150[5]	1725[4]	2550[5]	2100[4]	3125[5]	2550[4]	3750[5]
JATO	S.L.	1325[4]	2000[5]	1600[4]	2375[5]	1950[4]	2900[5]	2350[4]	3475[5]
NO TIP TANKS	5000	1500[4]	2150[5]	1775[4]	2450[5]	2175[4]	3100[5]	2725[4]	3800[5]
13,400 LB.	4000	1400[4]	2000[5]	1650[4]	2275[5]	2050[4]	2900[5]	2550[4]	3550[5]
WITH	3000	1275[4]	1850[5]	1525[4]	2125[5]	1900[4]	2675[5]	2350[4]	3300[5]
AFTERBURNER	2000	1175[4]	1725[5]	1400[4]	1975[5]	1750[4]	2525[5]	2175[4]	3100[5]
WITH	1000	1075[4]	1575[5]	1300[4]	1825[5]	1625[4]	2325[5]	2025[4]	2875[5]
JATO	S.L.	1000[4]	1450[5]	1200[4]	1700[5]	1500[4]	2150[5]	1875[4]	2675[5]

NOTES: (1) FOR HEADWINDS: DECREASE TAKE-OFF DISTANCES 1% FOR EACH 1.0 KNOT INCREASE IN WIND VELOCITY.
(2) TAKE-OFF DISTANCES AND JATO FIRING POINTS INCLUDE NO CONSERVATISM FACTOR.
(3) DURATION OF JATO ASSIST 12 SECONDS.
(4) BASED ON JATO FIRING FOR MINIMUM GROUND ROLL.
(5) BASED ON JATO FIRING FOR MINIMUM DISTANCE OVER 50′ OBSTACLES.

JATO FIRING DATA FOR MINIMUM GROUND ROLL

13,400 LB. :: NO TIP TANKS :: WITHOUT AFTERBURNER

JATO FIRING PT. (FT.) FROM START OF ROLL

ALT.	TEMP. −10°C	+10°C	+30°C	+50°C
5000′	275	575	950	1425
4000′	200	475	800	1225
3000′	150	375	650	1000
2000′	125	300	525	825
1000′	75	250	425	675
S. L.	50	175	350	550

JATO FIRING DATA FOR MINIMUM GROUND ROLL

13,400 LB. :: NO TIP TANKS :: WITH AFTERBURNER

JATO FIRING PT. (FT.) FROM START OF ROLL

ALT.	TEMP. −10°C	+10°C	+30°C	+50°C
5000′	50	175	375	725
4000′	25	125	300	600
3000′	0	75	225	475
2000′	0	50	175	375
1000′	0	25	125	300
S. L.	0	0	75	225

JATO FIRING DATA FOR MIN. DIST. TO 50′ OBSTACLE

13,400 LB. :: NO TIP TANKS :: WITHOUT AFTERBURNER

JATO FIRING PT. (FT.) FROM START OF ROLL

ALT.	TEMP. −10°C	+10°C	+30°C	+50°C
5000′	775	1225	1825	2550
4000′	650	1025	1550	2225
3000′	525	850	1325	1900
2000′	425	700	1125	1625
1000′	350	575	950	1400
S. L.	275	475	800	1200

JATO FIRING DATA FOR MIN. DIST. TO 50′ OBSTACLE

13,400 LB. :: NO TIP TANKS :: WITH AFTERBURNER

JATO FIRING PT. (FT.) FROM START OF ROLL

ALT.	TEMP. −10°C	+10°C	+30°C	+50°C
5000′	250	500	975	1375
4000′	175	400	725	1200
3000′	125	300	600	1000
2000′	100	225	475	850
1000′	75	150	350	700
S. L.	25	100	275	575

DATA AS OF: 12-1-50
BASED ON: CALCULATION

BASED ON MIL-F-5624 (JP-3) FUEL
RED FIGURES HAVE NOT BEEN FLIGHT CHECKED

Figure A-9 (Sheet 1 of 2 Sheets) — Take-off Distances

AIRPLANE MODEL F-94B	TAKE-OFF DISTANCES—FEET 2 — 230 GAL. TIP TANKS 70% FLAPS — HARD SURFACE RUNWAY — NO WIND	ENGINE MODEL J33-A-33

CONFIGURATION AND GROSS WEIGHT	PRESS. ALT. FT.	−10°C		+10°C		+30°C		+50°C	
		GROUND ROLL	CLEAR 50′	GROUND ROLL	CLEAR 50′	GROUND ROLL	CLEAR 50′	GROUND ROLL	CLEAR 50′
TIP TANKS	5000	4350	6575	5650	8625	7375	11250	9475	14600
16,775 LB.	4000	4050	6075	5200	7900	6750	10350	8625	13325
WITHOUT	3000	3750	5575	4775	7225	6160	9425	7850	12100
AFTERBURNER	2000	3425	5100	4350	6625	5625	8625	7150	10975
WITHOUT	1000	3125	4650	4000	6100	5150	7850	6500	9975
JATO	S.L.	2850	4225	3650	5575	4700	7150	5925	9275
TIP TANKS	5000	3825	5175	4650	6275	6175	8150	8175	10575
16,775 LB.	4000	3475	4750	4225	5750	5625	7450	7475	9700
WITH	3000	3200	4375	3900	5325	5125	6850	6800	8900
AFTERBURNER	2000	2925	4075	3575	4925	4700	6325	6200	8150
WITHOUT	1000	2700	3775	3300	4550	4275	5825	5675	7525
JATO	S.L.	2500	3500	3025	4225	3925	5350	5175	6925
TIP TANKS	5000	3700[4]	5450[5]	4600[4]	6600[5]	5775[4]	8325[5]	7025[4]	10250[5]
16,775 LB.	4000	3375[4]	5050[5]	4225[4]	6050[5]	5275[4]	7575[5]	6450[4]	9300[5]
WITHOUT	3000	3050[4]	4600[5]	3840[4]	5550[5]	4825[4]	6925[5]	5900[4]	8525[5]
AFTERBURNER	2000	2775[4]	4175[5]	3500[4]	5075[5]	4400[4]	6350[5]	5425[4]	7800[5]
WITH	1000	2525[4]	3775[5]	3175[4]	4650[5]	4025[4]	5800[5]	4950[4]	7125[5]
JATO	S.L.	2325[4]	3450[5]	2900[4]	4250[5]	3650[4]	5300[5]	4550[4]	6450[5]
TIP TANKS	5000	2600[4]	3650[5]	3125[4]	4250[5]	3950[4]	5175[5]	4950[4]	6275[5]
16,775 LB.	4000	2400[4]	3375[5]	2900[4]	3975[5]	3650[4]	4850[5]	4600[4]	5850[5]
WITH	3000	2225[4]	3125[5]	2675[4]	3700[5]	3350[4]	4525[5]	4225[4]	5475[5]
AFTERBURNER	2000	2050[4]	2875[5]	2450[4]	3450[5]	3100[4]	4225[5]	3900[4]	5125[5]
WITH	1000	1875[4]	2650[5]	2275[4]	3200[5]	2850[4]	3950[5]	3600[4]	4800[5]
JATO	S.L.	1750[4]	2475[5]	2100[4]	2975[5]	2625[4]	3675[5]	3325[4]	4500[5]

NOTES: (1) FOR HEADWINDS: DECREASE TAKE-OFF DISTANCES 1% FOR EACH 1.0 KNOT INCREASE IN WIND VELOCITY.
(2) TAKE-OFF DISTANCES AND JATO FIRING POINTS INCLUDE NO CONSERVATISM FACTOR.
(3) DURATION OF JATO ASSIST 12 SECONDS.
(4) BASED ON JATO FIRING FOR MINIMUM GROUND ROLL.
(5) BASED ON JATO FIRING FOR MINIMUM DISTANCE OVER 50′ OBSTACLES.

JATO FIRING DATA FOR MINIMUM GROUND ROLL

16,775 LB. :: TIP TANKS :: WITHOUT AFTERBURNER

JATO FIRING PT. (FT.) FROM START OF ROLL

ALT.	TEMP. −10°C	+10°C	+30°C	+50°C
5000′	1600	2400	3400	4475
4000′	1350	2050	2950	4000
3000′	1125	1750	2550	3525
2000′	900	1475	2200	3075
1000′	725	1225	1875	2700
S. L.	575	1025	1600	2325

JATO FIRING DATA FOR MIN. DIST. TO 50′ OBSTACLE

16,775 LB. :: TIP TANKS :: WITHOUT AFTERBURNER

JATO FIRING PT. (FT.) FROM START OF ROLL

ALT.	TEMP. −10°C	+10°C	+30°C	+50°C
5000′	2825	4000	5480	7025
4000′	2450	3500	4825	6275
3000′	2100	3025	4275	5650
2000′	1800	2600	3725	5000
1000′	1525	2250	3225	4425
S. L.	1250	1925	2825	3900

JATO FIRING DATA FOR MINIMUM GROUND ROLL

16,775 LB. :: TIP TANKS :: WITH AFTERBURNER

JATO FIRING PT. (FT.) FROM START OF ROLL

ALT.	TEMP. −10°C	+10°C	+30°C	+50°C
5000′	675	1075	1725	2550
4000′	525	900	1475	2250
3000′	425	750	1225	1950
2000′	325	600	1050	1675
1000′	225	475	875	1450
S. L.	150	375	725	1225

JATO FIRING DATA FOR MIN. DIST. TO 50′ OBSTACLE

16,775 LB. :: TIP TANKS :: WITH AFTERBURNER

JATO FIRING PT. (FT.) FROM START OF ROLL

ALT.	TEMP. −10°C	+10°C	+30°C	+50°C
5000′	1300	1900	2800	3950
4000′	1100	1625	2450	3525
3000′	925	1400	2125	3125
2000′	750	1200	1850	2725
1000′	625	1000	1600	2400
S. L.	525	850	1350	2100

DATA AS OF: 12-1-50
BASED ON: CALCULATION

BASED ON MIL-F-5624 (JP-3) FUEL
RED FIGURES HAVE NOT BEEN FLIGHT CHECKED

Figure A-9 (Sheet 2 of 2 Sheets) — Take-off Distances

AIRPLANE MODEL
F-94B

CLIMB CHART

NACA STANDARD DAY

ENGINE MODEL
J33-A-33

100% RPM					PRESS. ALT. FT.	100% RPM				
	APPROXIMATE			CAS KNOTS		CAS KNOTS	APPROXIMATE			
	FROM SEA LEVEL						FROM SEA LEVEL			
RATE OF CLIMB	DISTANCE	TIME	FUEL				FUEL	TIME	DISTANCE	RATE OF CLIMB
AIRPLANE CONFIGURATION & GROSS WEIGHT										
CLEAN CONFIGURATION WITH AFTERBURNER 11,400 LB.						2 - 230 GAL. TIP TANKS WITH AFTERBURNER 13,775 LB.				
9250	0	0	70 (1)	310	SEA LEVEL	305	80 (1)	0	0	7250
8550	3	0.5	93	305	5,000	300	108	0.5	4	6650
7850	6	1.0	114	300	10,000	295	135	1.5	9	6100
7100	10	2.0	134	295	15,000	290	161	2.5	13	5500
6350	15	2.5	154	290	20,000	285	186	3.5	19	4850
5550	20	3.5	173	270	25,000	265	210	4.5	26	4200
4650	27	4.5	191	250	30,000	245	234	6.0	35	3500
3650	35	5.5	210	230	35,000	225	259	7.5	45	2650
2650	45	7.0	228	205	40,000	200	285	9.5	60	1800
AIRPLANE CONFIGURATION & GROSS WEIGHT										
CLEAN CONFIGURATION WITH AFTERBURNER 13,400 LB.						2 - 230 GAL. TIP TANKS WITH AFTERBURNER 16,775 LB.				
7800	0	0	70 (1)	310	SEA LEVEL	305	80 (1)	0	0	5950
7200	3	0.5	97	305	5,000	300	115	1.0	5	5450
6600	8	1.5	124	300	10,000	295	147	2.0	10	4950
6000	12	2.0	147	295	15,000	290	179	3.0	16	4400
5300	18	3.0	171	290	20,000	285	210	4.0	24	3850
4600	24	4.0	192	270	25,000	265	241	5.5	33	3300
3800	32	5.5	215	250	30,000	245	270	7.0	43	2600
2950	43	7.0	237	230	35,000	225	305	9.5	58	1850
2050	55	9.0	260	205	40,000	200	345	13.0	80	1100
AIRPLANE CONFIGURATION & GROSS WEIGHT										
CLEAN CONFIGURATION WITHOUT AFTERBURNER 11,400 LB.						2 - 230 GAL. TIP TANKS WITHOUT AFTERBURNER 13,775 LB.				
6000	0	0	20 (1)	275	SEA LEVEL	270	30 (1)	0	0	4850
5200	4	1.0	32	265	5,000	260	46	1.0	5	3900
4450	9	2.0	43	255	10,000	250	62	2.5	12	3200
3750	15	3.0	56	245	15,000	240	78	4.5	20	2600
3100	23	4.5	68	235	20,000	230	97	6.5	31	2050
2500	33	6.5	81	225	25,000	220	117	9.0	46	1550
1950	45	8.5	95	215	30,000	210	140	13.0	67	1050
1400	62	11.5	109	205	35,000	200	169	19.0	100	600
800	90	16.0	128	195	40,000	190	219	31.5	170	200
AIRPLANE CONFIGURATION & GROSS WEIGHT										
CLEAN CONFIGURATION WITHOUT AFTERBURNER 13,400 LB.						2 - 230 GAL. TIP TANKS WITHOUT AFTERBURNER 16,775 LB.				
5050	0	0	20 (1)	275	SEA LEVEL	270	30 (1)	0	0	3850
4300	5	1.0	35	265	5,000	260	50	1.5	7	3050
3600	11	2.5	49	255	10,000	250	70	3.5	15	2450
3000	19	4.0	64	245	15,000	240	93	5.5	26	1950
2450	28	5.5	79	235	20,000	230	118	8.5	41	1500
1950	40	8.0	96	225	25,000	220	146	12.5	62	1050
1450	57	11.0	112	215	30,000	210	184	18.5	95	600
950	80	15.0	133	205	35,000	200	243	31.0	166	200
400	125	22.0	163	195	40,000	—	—	—	—	—

MULTIPLY NAUTICAL UNITS BY 1.15 FOR CONVERSION TO STATUTE UNITS

NOTES: (1) FUEL ALLOWANCE FOR TAXI AND TAKE-OFF
(2) FUEL CONSUMPTION IS 5% CONSERVATIVE TO ALLOW FOR VARIATIONS IN SERVICE AIRCRAFT AND OPERATING TECHNIQUES
(3) FUEL DENSITY 6.5 LB./GAL.

LEGEND
FUEL — U.S. GALLONS
DISTANCE — NAUTICAL MILES
TIME — MINUTES
RATE OF CLIMB — FEET PER MINUTE
CAS — CALIBRATED AIRSPEED

DATA AS OF: 12-1-50

BASED ON: CALCULATION

BASED ON MIL-F-5624 (JP-3) FUEL

RED FIGURES HAVE NOT BEEN FLIGHT CHECKED

Figure A-10 — Climb Chart

AIRPLANE MODEL F-94B

DESCENT CHART

ENGINE MODEL J33-A-33

NACA STANDARD DAY

NOTES: (1) DESCEND AT .6 MACH NUMBER
(2) USE DIVE FLAPS DOWN TO 35,000′ IF IDLE RPM IS TOO GREAT TO ALLOW DESCENT AT .6 MACH NUMBER
(3) DISTANCES AND SPEEDS IN NAUTICAL UNITS
(4) FUEL CONSUMPTION IS 5% CONSERVATIVE TO ALLOW FOR VARIATIONS IN SERVICE AIRCRAFT AND OPERATING TECHNIQUES

Airplane Configuration & Gross Wt. 2 — 230 Gal. Tip Tanks 11,600 Lb. Gross Weight					PRESSURE ALTITUDE (FEET)	Airplane Configuration & Gross Wt. Clean Configuration 11,300 Lb. Gross Weight				
APPROXIMATE				CAS KNOTS		CAS KNOTS	APPROXIMATE			
RATE OF DESCENT	TO SEA LEVEL						TO SEA LEVEL			RATE OF DESCENT
	DISTANCE	TIME	FUEL				FUEL	TIME	DISTANCE	
1200	74	12.5	20	175	40,000	175	27	15.2	85	1000
1700	55	8.7	15	200	35,000	200	21	9.6	61	1500
2400	40	6.4	12	225	30,000	225	16	7.0	44	2150
3200	30	4.7	8	250	25,000	250	12	5.2	32	2850
4100	21	3.3	6	275	20,000	275	8	3.7	24	3700
5150	14	2.2	4	305	15,000	305	6	2.5	16	4650
6300	8	1.4	3	335	10,000	335	3	1.5	10	5750
7550	3	0.6	1	365	5,000	365	2	0.8	4	6850
8900	0	0	0	395	Sea Level	395	0	0	0	8050

REMARKS: MULTIPLY NAUTICAL UNITS BY 1.15 FOR CONVERSION TO STATUTE UNITS
DATA AS OF: 12-1-50
BASED ON: CALCULATION
BASED ON: MIL-F-5624 (JP-3) FUEL
FUEL DENSITY 6.5 LB/GAL
RED FIGURES HAVE NOT BEEN FLIGHT CHECKED

LEGEND:
FUEL — U.S. GALLONS
DISTANCE — NAUTICAL MILES
TIME — MINUTES
RATE OF DESCENT — FT PER MIN
CAS — CALIBRATED AIRSPEED

Figure A-11 — Descent Chart

AIRPLANE MODEL
F-94B

LANDING DISTANCE

ENGINE MODEL
J33-A-33

FEET

NACA STANDARD DAY

GROSS WEIGHT LB.	BEST CAS APPROACH		HARD SURFACE — NO WIND							
	POWER OFF	POWER ON	AT SEA LEVEL		AT 2000′		AT 4000′		AT 6000′	
	KNOTS	KNOTS	GROUND ROLL	CLEAR 50′	GROUND ROLL	CLEAR 50′	GROUND ROLL	CLEAR 50′	GROUND ROLL	CLEAR 50′
11,000	105	105	2575	3550	2725	3725	2900	3925	3075	4150
13,400	125	125	3150	4225	3325	4425	3525	4675	3750	4950

NOTES: (1) SPEEDS ARE IN NAUTICAL UNITS
(2) LANDING DISTANCES INCLUDE NO CONSERVATISM FACTOR
(3) CONFIGURATION:
GEAR DOWN
WING FLAPS 100% (DOWN)
DIVE FLAPS UP
TIP TANKS ON OR OFF

LEGEND:
CAS — CALIBRATED AIRSPEED

DATA AS OF: 12-1-50
BASED ON: CALCULATION

BASED ON MIL-F-5624 (JP-3) FUEL

RED FIGURES HAVE NOT BEEN FLIGHT CHECKED

Figure A-12 — Landing Distance

AIRPLANE MODEL
F-94B

MAXIMUM ENDURANCE CHART

NACA STANDARD DAY

ENGINE MODEL
J33-A-33

NOTES: (1) SPEEDS IN NAUTICAL UNITS
(2) FUEL CONSUMPTION IS 5% CONSERVATIVE TO ALLOW FOR VARIATIONS IN SERVICE AIRCRAFT AND OPERATING TECHNIQUES

AIRPLANE CONFIGURATION & GROSS WEIGHT 2 — 230 GAL. TIP TANKS — 11,600 LB.		PRESSURE ALTITUDE FT.	AIRPLANE CONFIGURATION & GROSS WEIGHT CLEAN: 11,300 LB.	
APPROX. FUEL FLOW GPM	CAS KNOTS		CAS KNOTS	APPROX. FUEL FLOW GPM
3	160	40,000	160	2
3	160	35,000	160	3
3	160	30,000	160	3
3	160	25,000	160	3
4	160	20,000	160	3
4	160	15,000	160	4
4	160	10,000	160	4
5	160	5,000	160	5
6	160	Sea Level	160	5

REMARKS: MULTIPLY NAUTICAL UNITS BY 1.15 FOR CONVERSION TO STATUTE UNITS

DATA AS OF: 12-1-50

BASED ON: CALCULATION

BASED ON: MIL-F-5624 (JP-3) FUEL

FUEL DENSITY 6.5 LB/GAL

RED FIGURES HAVE NOT BEEN FLIGHT CHECKED

LEGEND:
FUEL — U.S. GALLONS
FUEL FLOW — GAL PER MIN
CAS — CALIBRATED AIRSPEED

Figure A-13 — Maximum Endurance Chart

COMBAT ALLOWANCE CHART

WITHOUT TIP TANKS
NACA STANDARD DAY

AIRPLANE MODEL
F-94B

ENGINE MODEL
J33-A-33

AT ALTITUDE (FEET)	FUEL REQUIRED: U. S. GAL. PER MINUTE		
	96% RPM (Normal Power) Max. Continuous	100 %RPM (Military Power) 30 Minute Limit	100% RPM With Afterburner 3 Minute Limit Below 5000 Ft.
40,000	4	4	14
35,000	4	6	17
30,000	5	7	19
25,000	6	8	21
20,000	7	9	23
15,000	8	11	26
10,000	10	13	29
5,000	12	14	32
Sea Level	13	15	36

REMARKS: (1) FUEL CONSUMPTION IS 5% CONSERVATIVE TO ALLOW FOR VARIATIONS IN SERVICE AIRCRAFT AND OPERATING TECHNIQUES

(2) LIMIT TAILPIPE TEMPERATURE 720 DEGREES CENTIGRADE

DATA AS OF: 12-1-50

BASED ON: CALCULATION

BASED ON: MIL-F-5624 (JP-3) FUEL

FUEL DENSITY 6.5 LB./GAL.

RED FIGURES HAVE NOT BEEN FLIGHT CHECKED

Figure A-14 — Combat Allowance Chart

MAXIMUM CONTINUOUS POWER

NACA STANDARD DAY

AIRPLANE MODEL
F-94B

ENGINE MODEL
J33-A-33

CONFIGURATION: 2 — 230 GAL. TIP TANKS
WEIGHT: 16,775 LB.

Altitude	% RPM	Approximate		
		CAS-Knots	TAS-Knots	Gal. Hr.
Sea Level	96	410	410	795
5,000	96	390	415	690
10,000	96	370	425	590
15,000	96	345	425	495
20,000	96	320	425	410
25,000	96	295	425	335
30,000	96	265	415	285
35,000	96	235	405	250
40,000	96	200	385	215

CONFIGURATION: CLEAN
WEIGHT: 13,400 LB.

Altitude	% RPM	Approximate		
		CAS-Knots	TAS-Knots	Gal. Hr.
Sea Level	96	435	435	795
5,000	96	415	440	690
10,000	96	390	445	590
15,000	96	360	445	495
20,000	96	335	445	410
25,000	96	310	445	335
30,000	96	280	440	285
35,000	96	250	430	250
40,000	96	215	410	215

REMARKS: (1) MULTIPLY NAUTICAL UNITS BY 1.15 TO OBTAIN STATUTE UNITS.
(2) FUEL CONSUMPTION IS 5% CONSERVATIVE TO ALLOW FOR VARIATIONS IN SERVICE AIRCRAFT AND OPERATING TECHNIQUES.

DATA AS OF: 12-1-50
BASED ON: CALCULATION
BASED ON: MIL-F-5624 (JP-3) FUEL
FUEL DENSITY 6.5 LB. GAL.
RED FIGURES HAVE NOT BEEN FLIGHT CHECKED.

LEGEND:
CAS — CALIBRATED AIRSPEED - KNOTS
TAS — TRUE AIRSPEED - KNOTS

Figure A-15 — Maximum Continuous Power

AIRPLANE MODEL(S) F-94B
ENGINE(S) J33-A-33

FLIGHT OPERATION INSTRUCTION CHART

CHART WEIGHT LIMITS 13,400 TO 10,900 POUNDS

EXTERNAL LOAD ITEMS NONE
NUMBER OF ENGINES OPERATING: ONE

INSTRUCTIONS FOR USING CHART: (A) IN FLIGHT — Select figure in fuel column equal to or less than fuel available for cruise (fuel on board minus allowances for reserve, combat, navigational errors, formation flight, etc.). Move horizontally right or left to section according to present altitude and read total range available (no wind) by cruising at that altitude or by climbing to another altitude of maximum range. For a flight at initial altitude, operating instructions are given directly below. For a flight at higher altitude, climb immediately to desired altitude and read cruising instructions in appropriate cruising altitude section. (B) FLIGHT PLANNING — From initial fuel on board subtract fuel required for take-off and climb to desired cruising altitude and all other necessary allowances. Then use chart as for IN FLIGHT above, adding initial climb distances to range values.

NOTES: Ranges shown at optimum altitudes are maximum. In order to obtain maximum range on flights requiring more than one chart (due to external configuration or gross weight change), it is necessary to observe the optimum cruising altitude on each chart; i.e., when changing charts a climb may be required to obtain a maximum range. All range values include allowances for descent distance and fuel. Climb distance and fuel are included where climbs are indicated.

DATA BELOW CONTAIN NO FUEL RESERVE FOR LANDING

NACA STANDARD DAY

LOW ALTITUDE

(RANGE FIGURES INCLUDE ALLOWANCES FOR PRESCRIBED CLIMB AND DESCENT TO SEA LEVEL)

IF YOU ARE AT S. L. — RANGE IN AIRMILES: BY CRUISING AT S. L.	OPT. ALT. 1000 FT.	BY CRUISING AT OPT. ALT.	FUEL U. S. GAL.	IF YOU ARE AT 5000' — RANGE IN AIRMILES: BY CRUISING AT 5000'	OPT. ALT. 1000 FT.	BY CRUISING AT OPT. ALT.	IF YOU ARE AT 10,000' — RANGE IN AIRMILES: BY CRUISING AT 10,000'	OPT. ALT. 1000 FT.	BY CRUISING AT OPT. ALT.	IF YOU ARE AT 15,000' — RANGE IN AIRMILES: BY CRUISING AT 15,000'	OPT. ALT. 1000 FT.	BY CRUISING AT OPT. ALT.	FUEL U. S. GAL.	IF YOU ARE AT 20,000' — RANGE IN AIRMILES: BY CRUISING AT 20,000'	OPT. ALT. 1000 FT.	BY CRUISING AT OPT. ALT.
(180)	40	(500)	323	(215)	40	(520)	(260)	40	(540)	(315)	40	(560)	323	(370)	40	(580)
(180)	40	(495)	320	(215)	40	(515)	(260)	40	(535)	(310)	40	(555)	320	(365)	40	(575)
155	40	420	280	190	40	440	(230)	40	(465)	(270)	40	(480)	280	(320)	40	(500)
135	40	345	240	165	40	365	195	40	390	235	40	405	240	(280)	40	(425)
115	40	270	200	135	40	290	165	40	315	195	40	330	200	235	40	355
90	40	195	160	110	40	215	135	40	240	160	40	255	160	190	40	280
70	30	115	120	85	35	140	100	40	160	120	40	180	120	145	40	200
45	15	60	80	55	15	70	70	30	90	85	30	105	80	100	35	125

EFFECTIVE WIND	CRUISING AT S.L.: CAS	% RPM	GPH	G.S.	RANGE FACTOR	Let Down Dist.	CRUISING AT 5000': CAS	% RPM	GPH	G.S.	RANGE FACTOR	Let Down Dist.	CRUISING AT 10,000': CAS	% RPM	GPH	G.S.	RANGE FACTOR	Let Down Dist.
120 HW																		
80 HW													334	89	439	314	.8	8
40 HW	328	88	505	294	.9	0	318	86	451	306	.9	4	309	86	391	321	.9	9
0	309	86	472	309	1.0	0	299	84	414	321	1.0	4	289	84	356	332	1.0	10
40 TW	298	83	434	323	1.1	0	293	81	398	349	1.1	4	273	81	330	350	1.1	10
80 TW													260	78	292	370	1.2	11
120 TW																		

EFFECTIVE WIND	CRUISING AT 15,000': CAS	% RPM	GPH	G.S.	RANGE FACTOR	Let Down Dist.	CRUISING AT 20,000': CAS	% RPM	GPH	G.S.	RANGE FACTOR	Let Down Dist.
120 HW							297	91	324	292	.7	20
80 HW	321	91	384	327	.8	13	291	89	312	320	.8	21
40 HW	299	88	346	336	.9	15	280	88	289	340	.9	22
0	278	85	312	344	1.0	16	266	86	272	356	1.0	23
40 TW	255	82	278	352	1.1	16	253	85	256	374	1.1	23
80 TW	238	80	255	366	1.2	17	246	84	245	401	1.2	24
120 TW							241	83	236	445	1.3	26

Figure A-16 (Sheet 1 of 2 Sheets) — Flight Operation Instruction Charts

HIGH ALTITUDE

AIRPLANE MODEL F-94B ENGINE J33-A-33 CHART WEIGHTS LIMITS: 13,400 TO 10,900 LB. EXT. LOAD: NONE NUMBER OF ENGINES OPERATING: ONE

(RANGE FIGURES INCLUDE ALLOWANCES FOR PRESCRIBED CLIMB AND DESCENT TO SEA LEVEL)

IF YOU ARE AT 25,000′ — RANGE IN AIRMILES: BY CRUISING AT 25,000′	OPT. ALT. 1000 FT.	BY CRUISING AT OPT. ALT.	FUEL U.S. GAL.	IF YOU ARE AT 30,000′ — RANGE IN AIRMILES: BY CRUISING AT 30,000′	OPT. ALT. 1000 FT.	BY CRUISING AT OPT. ALT.	IF YOU ARE AT 35,000′ — RANGE IN AIRMILES: BY CRUISING AT 35,000′	OPT. ALT. 1000 FT.	BY CRUISING AT OPT. ALT.	IF YOU ARE AT 40,000′ — RANGE IN AIRMILES: BY CRUISING AT 40,000′	OPT. ALT. 1000 FT.	BY CRUISING AT OPT. ALT.	FUEL U.S. GAL.	IF YOU ARE AT 45,000′ — RANGE IN AIRMILES: BY CRUISING AT 45,000′	OPT. ALT. 1000 FT.	BY CRUISING AT OPT. ALT.
(435)	40	(595)	323	(500)	40	(605)	(565)	40	(615)	(625)			323			
(430)	40	(590)	320	(495)	40	(600)	(560)	40	(610)	(620)			320			
(375)	40	(515)	280	(435)	40	(530)	(495)	40	(540)	(545)			280			
(325)	40	(445)	240	(375)	40	(455)	(430)	40	(465)	(475)			240			
275	40	370	200	315	40	380	(360)	40	(390)	(405)			200			
225	40	295	160	260	40	305	295	40	315	330			160			
170	40	220	120	200	40	230	225	40	245	255			120			
120	40	140	80	135	40	160	155	40	165	180			80			

CRUISING AT 25,000′ (APPROXIMATE)

CAS	% RPM	GPH	G.S.	RANGE FACTOR	Let Down Dist.	EFFECTIVE WIND
274	90	268	291	.7	28	120 HW
264	89	257	314	.8	29	80 HW
260	88	247	343	.9	30	40 HW
253	87	241	368	1.0	32	0
253	87	241	402	1.1	34	40 TW
253	87	241	437	1.2	35	80 TW
244	86	231	460	1.3	36	120 TW

CRUISING AT 30,000′ (APPROXIMATE)

EFFECTIVE WIND	CAS	% RPM	GPH	G.S.	RANGE FACTOR	Let Down Dist.
120 HW	252	91	229	292	.7	37
80 HW	246	90	222	318	.8	40
40 HW	244	89	217	349	.9	42
0	240	89	215	380	1.0	44
40 TW	240	89	215	415	1.1	46
80 TW	238	88	209	445	1.2	48
120 TW	230	88	205	469	1.3	49

CRUISING AT 35,000′ (APPROXIMATE)

EFFECTIVE WIND	CAS	% RPM	GPH	G.S.	RANGE FACTOR	Let Down Dist.
120 HW	240	91	200	309	.7	52
80 HW	227	90	195	323	.8	55
40 HW	227	90	195	357	.9	57
0	226	90	195	390	1.0	61
40 TW	226	90	195	425	1.1	63
80 TW	219	89	185	447	1.2	66
120 TW	218	89	185	480	1.3	68

CRUISING AT 40,000′ (APPROXIMATE)

CAS	% RPM	GPH	G.S.	RANGE FACTOR	Let Down Dist.	EFFECTIVE WIND
210	92	186	300	.7	72	120 HW
208	92	186	332	.8	76	80 HW
203	91	176	358	.9	81	40 HW
202	91	176	391	1.0	85	0
201	91	176	424	1.1	89	40 TW
200	91	176	455	1.2	94	80 TW
196	90	171	485	1.3	98	120 TW

CRUISING AT 45,000′ (APPROXIMATE)

EFFECTIVE WIND	CAS	% RPM	GPH	G.S.	RANGE FACTOR	Let Down Dist.
120 HW						
80 HW						
40 HW						
0						
40 TW						
80 TW						
120 TW						

SPECIAL NOTES

1. Climb at 100% RPM — Without Afterburning.
2. Multiply nautical units by 1.15 to obtain statute units.
3. Range and fuel consumption are 5% conservative to allow for variations in service aircraft and operating techniques.
4. Read lower half of chart opposite effective wind only.
5. Make additional allowances for landing, navigational errors, combat, formation flight etc. as required.
6. Multiply range by .92 when using gasoline.

DATA AS OF: 12-1-50 BASED ON: CALCULATION

EXAMPLE

If you are at S.L. with 320 gallons of available fuel, you can fly 180 airmiles by holding 309 CAS. However, you can fly 495 airmiles by immediately climbing to 40,000 feet using 100% RPM. At 40,000 feet cruise at 202 CAS and start letdown 85 airmiles from destination. With a 40 knot headwind the range at 40,000 feet will be 495 x .9 or 445 airmiles. Cruise at 203 CAS with this wind and start letdown 81 airmiles from destination.

BASED ON MIL-F-5624 FUEL (JP-3)

RED FIGURES HAVE NOT BEEN FLIGHT CHECKED

LEGEND

EFFECTIVE WIND — HW, Headwind; TW, Tailwind — Knots

RANGE FACTOR = GROUND DISTANCE (Effective Wind) / RANGE IN AIRMILES (Zero Wind)

G.S. — GROUND SPEED IN KNOTS

CAS — CALIBRATED AIRSPEED IN KNOTS

GPH — TOTAL FUEL CONSUMPTION — U.S. GAL. PER HR.

RANGE — NAUTICAL MILES

( ) POSSIBLE ONLY IF TIP TANKS DROPPED IN FLIGHT

Figure A-16 (Sheet 2 of 2 Sheets) — Flight Operation Instruction Charts

AIRPLANE MODEL(S) F-94B
ENGINE(S) J33-A-33

FLIGHT OPERATION INSTRUCTION CHART

CHART WEIGHT LIMITS 16,580 TO 13,400 POUNDS

EXTERNAL LOAD ITEMS
2 - 230 Gallon External Tip Tanks
Dropped When Empty.
NUMBER OF ENGINES OPERATING: ONE

INSTRUCTIONS FOR USING CHART: (A) IN FLIGHT — Select figure in fuel column equal to or less than fuel available for cruise (fuel on board minus allowances for reserve, combat, navigational errors, formation flight, etc.). Move horizontally right or left to section according to present altitude and read total range available (no wind) by cruising at that altitude or by climbing to another altitude of maximum range. For a flight at initial altitude, operating instructions are given directly below. For a flight at higher altitude, climb immediately to desired altitude and read cruising instructions in appropriate cruising altitude section. (B) FLIGHT PLANNING — From initial fuel on board subtract fuel required for take-off and climb to desired cruising altitude and all other necessary allowances. Then use chart as for IN FLIGHT above, adding initial climb distances to range values.

NOTES: Ranges shown at optimum altitudes are maximum. In order to obtain maximum range on flights requiring more than one chart (due to external configuration or gross weight change), it is necessary to observe the optimum cruising altitude on each chart; i.e., when changing charts a climb may be required to obtain a maximum range. All range values include allowances for descent distance and fuel. Climb distance and fuel are included where climbs are indicated.

DATA BELOW CONTAIN NO FUEL RESERVE FOR LANDING

NACA STANDARD DAY

LOW ALTITUDE

IF YOU ARE AT S. L.			FUEL U. S. GAL.	IF YOU ARE AT 5000′			IF YOU ARE AT 10,000′			IF YOU ARE AT 15,000′			FUEL U. S. GAL.	IF YOU ARE AT 20,000′		
RANGE IN AIRMILES				RANGE IN AIRMILES			RANGE IN AIRMILES			RANGE IN AIRMILES				RANGE IN AIRMILES		
BY CRUISING AT S. L.	OPT. ALT. 1000 FT.	BY CRUISING AT OPT. ALT.		BY CRUISING AT 5000′	OPT. ALT. 1000 FT.	BY CRUISING AT OPT. ALT.	BY CRUISING AT 10,000′	OPT. ALT. 1000 FT.	BY CRUISING AT OPT. ALT.	BY CRUISING AT 15,000′	OPT. ALT. 1000 FT.	BY CRUISING AT OPT. ALT.		BY CRUISING AT 20,000′	OPT. ALT. 1000 FT.	BY CRUISING AT OPT. ALT.
				(RANGE FIGURES INCLUDE ALLOWANCES FOR PRESCRIBED CLIMB AND DESCENT TO SEA LEVEL)												
(400)	35	(1020)	783	(485)	35	(1035)	(590)	35	(1055)	(675)	35	(1085)	783	(830)	35	(1120)
385	35	970	750	(465)	35	(990)	(565)	35	(1010)	(650)	35	(1040)	750	(795)	35	(1075)
360	35	895	700	435	35	920	530	35	945	(610)	35	(970)	700	(745)	35	(1005)
335	35	830	650	405	35	850	495	35	875	570	35	905	650	695	35	935
310	35	760	600	375	35	785	460	35	810	530	35	830	600	645	35	870
285	35	690	550	345	35	715	420	35	740	485	35	760	550	595	35	800
265	35	635	500	315	35	655	385	35	670	445	35	695	500	545	35	735
240	35	575	450	285	35	600	350	35	605	405	35	635	450	495	35	665
215	35	520	400	255	35	540	315	35	550	365	35	575	400	445	35	590
195	35	445	350	230	35	475	280	35	495	325	35	515	350	395	35	530

CRUISING AT S.L.

EFFECTIVE WIND	CAS	APPROXIMATE % RPM	GPH	G.S.	RANGE FACTOR	Let Down Dist.
120 HW						
80 HW						
40 HW	327	91	590	292	.9	0
0	297	88	526	297	1.0	0
40 TW	274	85	479	308	1.1	0
80 TW						
120 TW						

CRUISING AT 5000′

EFFECTIVE WIND	CAS	APPROXIMATE % RPM	GPH	G.S.	RANGE FACTOR	Let Down Dist.
120 HW						
80 HW						
40 HW	297	87	480	284	.9	(7)
0	287	86	450	308	1.0	
40 TW	280	84	423	335	1.1	
80 TW						
120 TW						

CRUISING AT 10,000′

EFFECTIVE WIND	CAS	APPROXIMATE % RPM	GPH	G.S.	RANGE FACTOR	Let Down Dist.
120 HW						
80 HW	306	90	457	283	.8	(7)
40 HW	287	88	400	296	.9	
0	278	87	384	319	1.0	
40 TW	266	85	356	340	1.1	
80 TW	251	84	343	359	1.2	
120 TW						

CRUISING AT 15,000′

EFFECTIVE WIND	CAS	APPROXIMATE % RPM	GPH	G.S.	RANGE FACTOR	Let Down Dist.
120 HW						
80 HW	297	92	388	293	.8	(7)
40 HW	276	90	359	307	.9	
0	267	89	344	332	1.0	
40 TW	251	87	314	346	1.1	
80 TW	244	86	305	372	1.2	
120 TW						

CRUISING AT 20,000′

EFFECTIVE WIND	CAS	APPROXIMATE % RPM	GPH	G.S.	RANGE FACTOR	Let Down Dist.
120 HW	274	93	334	262	.7	
80 HW	270	92	319	293	.8	(7)
40 HW	260	91	300	314	.9	
0	255	90	294	343	1.0	
40 TW	242	89	274	362	1.1	
80 TW	232	88	262	381	1.2	
120 TW	225	88	253	408	1.3	

Figure A-17 (Sheet 1 of 2 Sheets) — Flight Operation Instruction Charts

HIGH ALTITUDE

AIRPLANE MODEL F-94B   ENGINE J33-A-33   CHART WEIGHT LIMITS: 16,580 TO 13,400 LB. EXT. LOAD: 2 - 230 GAL. TIP TANKS DROPPED WHEN EMPTY   NUMBER OF ENGINES OPERATING: ONE

IF YOU ARE AT 25,000'			FUEL U. S. GAL.	IF YOU ARE AT 30,000'			IF YOU ARE AT 35,000'			IF YOU ARE AT 40,000'			FUEL U. S. GAL.	IF YOU ARE AT 45,000'		
RANGE IN AIRMILES				RANGE IN AIRMILES			RANGE IN AIRMILES			RANGE IN AIRMILES				RANGE IN AIRMILES		
BY CRUISING AT 25,000'	OPT. ALT. 1000 FT.	BY CRUISING AT OPT. ALT.		BY CRUISING AT 30,000'	OPT. ALT. 1000 FT.	BY CRUISING AT OPT. ALT.	BY CRUISING AT 35,000'	OPT. ALT. 1000 FT.	BY CRUISING AT OPT. ALT.	BY CRUISING AT 40,000'	OPT. ALT. 1000 FT.	BY CRUISING AT OPT. ALT.		BY CRUISING AT 45,000'	OPT. ALT. 1000 FT.	BY CRUISING AT OPT. ALT.
				(RANGE FIGURES INCLUDE ALLOWANCES FOR PRESCRIBED CLIMB AND DESCENT TO SEA LEVEL)												
(940)	35	(1140)	783	(1080)	35	(1165)	(1195)						783			
(905)	35	(1095)	750	(1040)	35	(1120)	(1150)						750			
(850)	35	(1025)	700	(975)	35	(1050)	(1080)						700			
(795)	35	(955)	650	(910)	35	(980)	(1010)						650			
740	35	885	600	(845)	35	(910)	(940)						600			
685	35	820	550	780	35	840	870						550			
625	35	750	500	720	35	770	805						500			
570	35	680	450	655	35	700	735						450			
515	35	620	400	595	35	635	665						400			
460	35	555	350	530	35	570	600						350			

CRUISING AT 25,000'						EFFEC-TIVE WIND	CRUISING AT 30,000'						CRUISING AT 35,000'						CRUISING AT 40,000'						EFFEC-TIVE WIND	CRUISING AT 45,000'					
	APPROXIMATE							APPROXIMATE						APPROXIMATE						APPROXIMATE							APPROXIMATE				
CAS	% RPM	GPH	G.S.	RANGE FACTOR	Let Down Dist.		CAS	% RPM	GPH	G.S.	RANGE FACTOR	Let Down Dist.	CAS	% RPM	GPH	G.S.	RANGE FACTOR	Let Down Dist.	CAS	% RPM	GPH	G.S.	RANGE FACTOR	Let Down Dist.		CAS	% RPM	GPH	G.S.	RANGE FACTOR	Let Down Dist.
260	93	295	274	.7		120 HW	248	96	277	288	.7		228	96	250	288	.7								120 HW						
253	92	283	299	.8	(7)	80 HW	244	95	266	316	.8	(7)	228	96	250	323	.8	(7)							80 HW						
244	91	272	321	.9		40 HW	239	94	254	346	.9		228	96	250	358	.9								40 HW						
243	91	272	355	1.0		0	231	93	247	366	1.0		219	95	234	378	1.0								0						
233	90	260	376	1.1		40 TW	224	92	238	390	1.1		211	94	226	403	1.1								40 TW						
221	89	242	393	1.2		80 TW	218	92	228	416	1.2		208	94	226	439	1.2								80 TW						
220	89	242	427	1.3		120 TW	213	91	224	441	1.3		205	93	218	460	1.3								120 TW						

SPECIAL NOTES

1. Climb at 100% RPM — Without Afterburning.
2. Multiply nautical units by 1.15 to obtain statute units.
3. Range and fuel consumption are 5% conservative to allow for variations in service aircraft and operating techniques.
4. Read lower half of chart opposite effective wind only.
5. Make additional allowances for landing, navigational errors, combat, formation flight etc. as required.
6. Multiply range by .92 when using gasoline.
7. Refer to Figure A-16 for letdown without tip tanks.

DATA AS OF: 12-1-50   BASED ON: CALCULATION

EXAMPLE

If you are at S.L. with 750 gallons of available fuel, you can fly 385 airmiles by holding 297 CAS. However, you can fly 970 airmiles by immediately climbing to 35,000 feet using 100% RPM. At 35,000 feet cruise at 219 CAS. Drop tip tanks when empty and refer to Figure A-16 for cruising RPM and letdown distances.

BASED ON MIL-F-5624 FUEL (JP-3)

RED FIGURES HAVE NOT BEEN FLIGHT CHECKED

LEGEND

EFFECTIVE WIND — HW, Headwind; TW, Tailwind — Knots

RANGE FACTOR = GROUND DISTANCE (Effective Wind) / RANGE IN AIRMILES (Zero Wind)

G.S. — GROUND SPEED IN KNOTS

CAS — CALIBRATED AIRSPEED IN KNOTS

GPH — TOTAL FUEL CONSUMPTION — U.S. GAL. PER HR.

RANGE — NAUTICAL MILES

( ) RANGE FIGURES QUOTED FOR PURPOSES OF INTERPOLATION ONLY

Figure A-17 (Sheet 2 of 2 Sheets) — Flight Operation Instruction Charts

AIRPLANE MODEL(S) F-94B

ENGINE(S) J33-A-33

FLIGHT OPERATION INSTRUCTION CHART

CHART WEIGHT LIMITS 16,580 TO 11,200 POUNDS

EXTERNAL LOAD ITEMS
2 - 230 Gallon External Tip Tanks
Carried All The Way.
NUMBER OF ENGINES OPERATING: ONE

INSTRUCTIONS FOR USING CHART: (A) IN FLIGHT — Select figure in fuel column equal to or less than fuel available for cruise (fuel on board minus allowances for reserve, combat, navigational errors, formation flight, etc.). Move horizontally right or left to section according to present altitude and read total range available (no wind) by cruising at that altitude or by climbing to another altitude of maximum range. For a flight at initial altitude, operating instructions are given directly below. For a flight at higher altitude, climb immediately to desired altitude and read cruising instructions in appropriate cruising altitude section. (B) FLIGHT PLANNING — From initial fuel on board subtract fuel required for take-off and climb to desired cruising altitude and all other necessary allowances. Then use chart as for IN FLIGHT above, adding initial climb distances to range values.

NOTES: Ranges shown at optimum altitudes are maximum. In order to obtain maximum range on flights requiring more than one chart (due to external configuration or gross weight change), it is necessary to observe the optimum cruising altitude on each chart; i.e., when changing charts a climb may be required to obtain a maximum range. All range values include allowances for descent distance and fuel. Climb distance and fuel are included where climbs are indicated.

DATA BELOW CONTAIN NO FUEL RESERVE FOR LANDING

NACA STANDARD DAY

LOW ALTITUDE

(RANGE FIGURES INCLUDE ALLOWANCES FOR PRESCRIBED CLIMB AND DESCENT TO SEA LEVEL)

IF YOU ARE AT S. L. — RANGE IN AIRMILES: BY CRUISING AT S. L.	OPT. ALT. 1000 FT.	BY CRUISING AT OPT. ALT.	FUEL U. S. GAL.	IF YOU ARE AT 5000' — RANGE IN AIRMILES: BY CRUISING AT 5000'	OPT. ALT. 1000 FT.	BY CRUISING AT OPT. ALT.	IF YOU ARE AT 10,000' — RANGE IN AIRMILES: BY CRUISING AT 10,000'	OPT. ALT. 1000 FT.	BY CRUISING AT OPT. ALT.	IF YOU ARE AT 15,000' — RANGE IN AIRMILES: BY CRUISING AT 15,000'	OPT. ALT. 1000 FT.	BY CRUISING AT OPT. ALT.	FUEL U. S. GAL.	IF YOU ARE AT 20,000' — RANGE IN AIRMILES: BY CRUISING AT 20,000'	OPT. ALT. 1000 FT.	BY CRUISING AT OPT. ALT.
(385)	35	(940)	783	(480)	35	(965)	(570)	35	(990)	(670)	35	(1015)	783	(795)	35	(1040)
370	35	895	750	(455)	35	(920)	(545)	35	(945)	(640)	35	(970)	750	(760)	35	(995)
345	35	825	700	420	35	850	510	35	875	(595)	35	(900)	700	(710)	35	(925)
320	35	755	650	390	35	725	470	35	805	550	35	830	650	660	35	855
295	35	685	600	360	35	705	435	35	735	510	35	760	600	605	35	785
270	35	615	550	330	35	635	405	35	660	470	35	690	550	555	35	712
245	35	540	500	300	35	565	365	35	590	425	35	620	500	510	35	640
220	35	470	450	270	35	495	330	35	520	385	35	550	450	460	35	570
195	35	400	400	240	35	425	295	35	450	345	35	475	400	410	35	500
175	30	330	350	210	35	355	260	35	380	300	35	405	350	360	35	430
150	30	270	300	180	30	290	220	30	310	260	35	335	300	310	35	360
125	25	210	250	150	25	225	185	30	250	215	30	270	250	260	35	285
100	20	150	200	120	25	175	150	25	190	175	25	205	200	210	30	230
75	15	100	150	90	20	115	115	20	130	130	25	150	150	160	25	165
50	10	60	100	60	10	70	80	15	80	90	20	100	100	110	—	—

CRUISING AT S.L. — APPROXIMATE: CAS	% RPM	GPH	G.S.	RANGE FACTOR	Let Down Dist.	EFFECTIVE WIND	CRUISING AT 5000' — APPROXIMATE: CAS	% RPM	GPH	G.S.	RANGE FACTOR	Let Down Dist.	CRUISING AT 10,000' — APPROXIMATE: CAS	% RPM	GPH	G.S.	RANGE FACTOR	Let Down Dist.
						120 HW												
						80 HW							294	90	410	268	.8	7
309	88	533	274	.9	0	40 HW	303	88	442	280	.9	3	284	89	382	292	.9	8
297	87	513	297	1.0	0	0	287	87	437	308	1.0	3	278	88	377	320	1.0	8
284	86	493	318	1.1	0	40 TW	273	86	427	329	1.1	3	266	87	370	344	1.1	9
						80 TW							263	86	352	372	1.2	9
						120 TW												

CRUISING AT 15,000' — APPROXIMATE: CAS	% RPM	GPH	G.S.	RANGE FACTOR	Let Down Dist.	EFFECTIVE WIND	CRUISING AT 20,000' — APPROXIMATE: CAS	% RPM	GPH	G.S.	RANGE FACTOR	Let Down Dist.
						120 HW	274	93	321	264	.7	17
281	91	364	279	.8	12	80 HW	266	92	311	288	.8	18
275	90	347	306	.9	13	40 HW	262	91	301	318	.9	19
267	89	336	332	1.0	14	0	255	90	292	343	1.0	21
260	88	325	359	1.1	14	40 TW	249	89	284	369	1.1	22
255	87	314	386	1.2	15	80 TW	245	89	278	399	1.2	23
						120 TW	232	88	273	428	1.3	23

Figure A-18 (Sheet 1 of 2 Sheets) — Flight Operation Instruction Charts

HIGH ALTITUDE

AIRPLANE MODEL F-94B ENGINE J33-A-33

CHART WEIGHT LIMITS: 16,580 TO 11,200 LB.
EXT. LOAD: 2 - 230 GAL. TIP TANKS CARRIED ALL THE WAY

NUMBER OF ENGINES OPERATING: ONE

IF YOU ARE AT 25,000'			FUEL U. S. GAL.	IF YOU ARE AT 30,000'			IF YOU ARE AT 35,000'			IF YOU ARE AT 40,000'			FUEL U. S. GAL.	IF YOU ARE AT 45,000'		
RANGE IN AIRMILES				RANGE IN AIRMILES			RANGE IN AIRMILES			RANGE IN AIRMILES				RANGE IN AIRMILES		
BY CRUISING AT 25,000'	OPT. ALT. 1000 FT.	BY CRUISING AT OPT. ALT.		BY CRUISING AT 30,000'	OPT. ALT. 1000 FT.	BY CRUISING AT OPT. ALT.	BY CRUISING AT 35,000'	OPT. ALT. 1000 FT.	BY CRUISING AT OPT. ALT.	BY CRUISING AT 40,000'	OPT. ALT. 1000 FT.	BY CRUISING AT OPT. ALT.		BY CRUISING AT 45,000'	OPT. ALT. 1000 FT.	BY CRUISING AT OPT. ALT.
				(RANGE FIGURES INCLUDE ALLOWANCES FOR PRESCRIBED CLIMB AND DESCENT TO SEA LEVEL)												
(905)	35	(1060)	783	(1025)	35	(1100)	(1155)						783			
(865)	35	(1015)	750	(980)	25	(1055)	(1105)						750			
(805)	35	(945)	700	(915)	35	(985)	(1030)						700			
(745)	35	(875)	650	(850)	35	(915)	(955)						650			
690	35	810	600	(785)	35	(845)	(880)						600			
635	35	740	550	720	35	770	(805)						550			
575	35	665	500	655	35	700	730						500			
525	35	595	450	595	35	630	660						450			
465	35	525	400	530	35	555	590						400			
410	35	455	350	465	35	485	520						350			
355	35	385	300	405	35	415	450						300			
300	35	315	250	340	35	345	380						250			
240	30	250	200	275	—	—	310						200			
185	—	—	150	210	—	—	235						150			
130	—	—	100	145	—	—	165						100			

CRUISING AT 25,000'						EFFECTIVE WIND	CRUISING AT 30,000'						CRUISING AT 35,000'					
	APPROXIMATE							APPROXIMATE						APPROXIMATE				
CAS	% RPM	GPH	G.S.	RANGE FACTOR	Let Down Dist.		CAS	% RPM	GPH	G.S.	RANGE FACTOR	Let Down Dist.	CAS	% RPM	GPH	G.S.	RANGE FACTOR	Let Down Dist.
258	94	293	272	.7	26	120 HW	245	95	265	282	.7	34	225	96	238	285	.7	47
252	93	277	297	.8	27	80 HW	239	94	254	308	.8	36	225	96	238	320	.8	50
252	93	277	332	.9	29	40 HW	238	94	254	342	.9	38	225	96	238	355	.9	52
243	92	267	355	1.0	30	0	231	93	242	367	1.0	40	219	95	227	378	1.0	55
235	91	255	378	1.1	31	40 TW	226	93	236	394	1.1	42	219	95	227	413	1.1	57
233	91	255	411	1.2	33	80 TW	225	92	232	426	1.2	43	212	94	215	437	1.2	60
225	90	240	433	1.3	34	120 TW	223	92	224	457	1.3	45	213	94	215	473	1.3	63

CRUISING AT 40,000'						EFFECTIVE WIND	CRUISING AT 45,000'					
	APPROXIMATE							APPROXIMATE				
CAS	% RPM	GPH	G.S.	RANGE FACTOR	Let Down Dist.		CAS	% RPM	GPH	G.S.	RANGE FACTOR	Let Down Dist.
						120 HW						
						80 HW						
						40 HW						
						0						
						40 TW						
						80 TW						
						120 TW						

SPECIAL NOTES

1. Climb at 100% RPM — Without Afterburning.
2. Multiply nautical units by 1.15 to obtain statute units.
3. Range and fuel consumption are 5% conservative to allow for variations in service aircraft and operating techniques.
4. Read lower half of chart opposite effective wind only.
5. Make additional allowances for landing, navigational errors, combat, formation flight etc. as required.
6. Multiply range by .92 when using gasoline.

DATA AS OF: 12-1-50 BASED ON: CALCULATION

EXAMPLE

If you are at S.L. with 750 gallons of available fuel, you can fly 370 airmiles by holding 297 CAS. However, you can fly 895 airmiles by immediately climbing to 35,000 feet using 100% RPM. At 35,000 feet cruise at 219 CAS and start letdown 55 airmiles from destination. With a 40 knot headwind the range at 35,000 feet will be 895 x .9 or 805 airmiles. Cruise at 225 CAS with this wind and start letdown 52 airmiles from destination.

BASED ON MIL-F-5624 FUEL (JP-3)

RED FIGURES HAVE NOT BEEN FLIGHT CHECKED

LEGEND

EFFECTIVE WIND — HW, Headwind; TW, Tailwind — Knots

RANGE FACTOR = GROUND DISTANCE (Effective Wind) / RANGE IN AIRMILES (Zero Wind)

G.S. — GROUND SPEED IN KNOTS

CAS — CALIBRATED AIRSPEED IN KNOTS

GPH — TOTAL FUEL CONSUMPTION — U.S. GAL. PER HR.

RANGE — NAUTICAL MILES

( ) RANGE FIGURES QUOTED FOR PURPOSES OF INTERPOLATION ONLY

Figure A-18 (Sheet 2 of 2 Sheets) — Flight Operation Instruction Charts

MAXIMUM RANGE SUMMARY CHART

NACA STANDARD DAY

AIRPLANE MODEL: F-94B **ENGINE MODEL: J33-A-33**

Configuration: Clean
Gross Weight: 13,400 to 10,900 Lbs.

ALTITUDE	CAS (knots)	MACH No.	NAUT. Mi./Gal.	APPROX. % RPM
S. L.	309	.47	.58	86
5,000	299	.49	.78	84
10,000	289	.52	.93	84
15,000	278	.55	1.10	85
20,000	266	.58	1.31	86
25,000	253	.61	1.53	87
30,000	240	.64	1.77	89
35,000	226	.68	2.00	90
40,000	202	.68	2.22	91

Configuration: 2 — 230 Gal. Tip Tanks Dropped When Empty
Gross Weight: 16,775 to 13,400 Lbs.

ALTITUDE	CAS (knots)	MACH No.	NAUT. Mi./Gal.	APPROX. % RPM
S. L.	297	.45	.56	88
5,000	287	.47	.69	86
10,000	278	.50	.83	87
15,000	267	.53	.97	89
20,000	255	.56	1.17	90
25,000	243	.59	1.31	91
30,000	231	.62	1.48	93
35,000	219	.66	1.62	95
40,000				

Configuration: 2 — 230 Gal. Tip Tanks Carried All the Way
Gross Weight: 16,775 to 11,200 Lbs.

ALTITUDE	CAS (knots)	MACH No.	NAUT. Mi./Gal.	APPROX. % RPM
S. L.	297	.45	.58	87
5,000	287	.47	.70	87
10,000	278	.50	.85	88
15,000	267	.53	.99	89
20,000	255	.56	1.18	90
25,000	243	.59	1.33	92
30,000	231	.62	1.52	93
35,000	219	.66	1.67	95
40,000				

REMARKS: (1) MULTIPLY NAUTICAL UNITS BY 1.15 FOR CONVERSION TO STATUTE UNITS
(2) FUEL ECONOMY IS 5% CONSERVATIVE TO ALLOW FOR VARIATIONS IN SERVICE AIRCRAFT AND OPERATING TECHNIQUES

DATA AS OF: 12-1-50
BASED ON: CALCULATION
BASED ON MIL-F-5624 (JP-3) FUEL
FUEL DENSITY 6.5 LB/GAL
RED FIGURES HAVE NOT BEEN FLIGHT CHECKED

LEGEND:
FUEL — U.S. GALLONS
CAS — CALIBRATED AIRSPEED
FUEL ECONOMY — NAUTICAL MILES PER GALLON OF FUEL

Figure A-19 — Maximum Range Summary Chart

INDEX

(Numbers in parentheses ( ) denote illustrations)

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