AN 01-60JJA-1

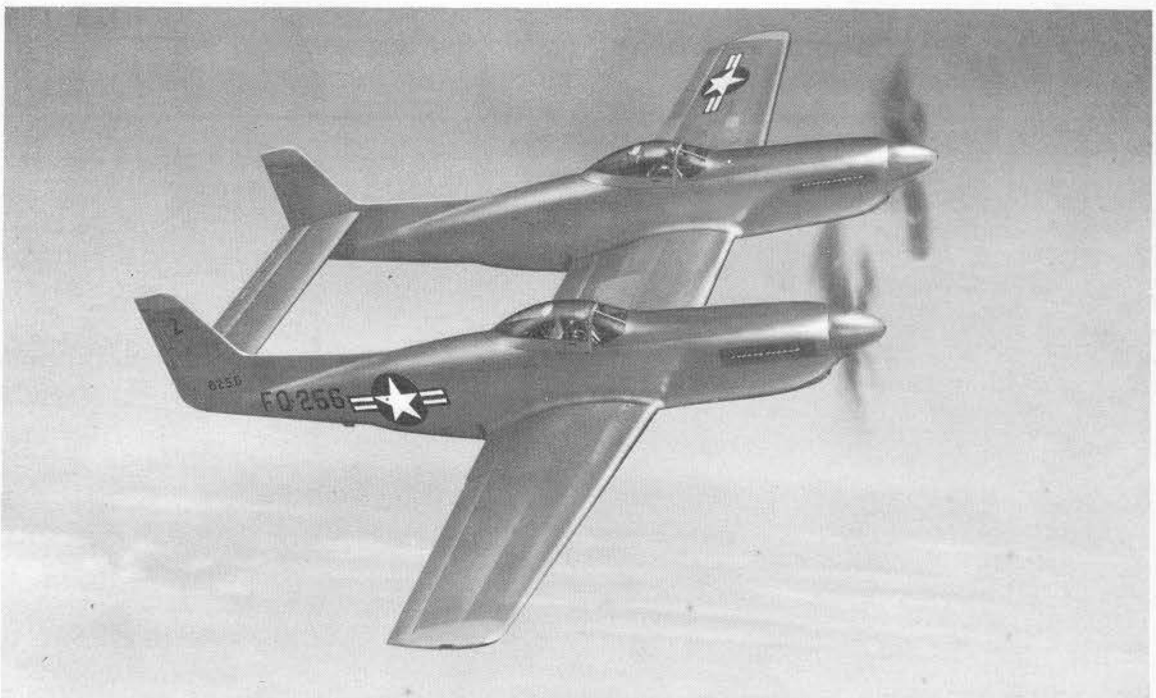
HANDBOOK

FLIGHT OPERATING INSTRUCTIONS

USAF MODEL

F-82E (P-82E)

AIRCRAFT



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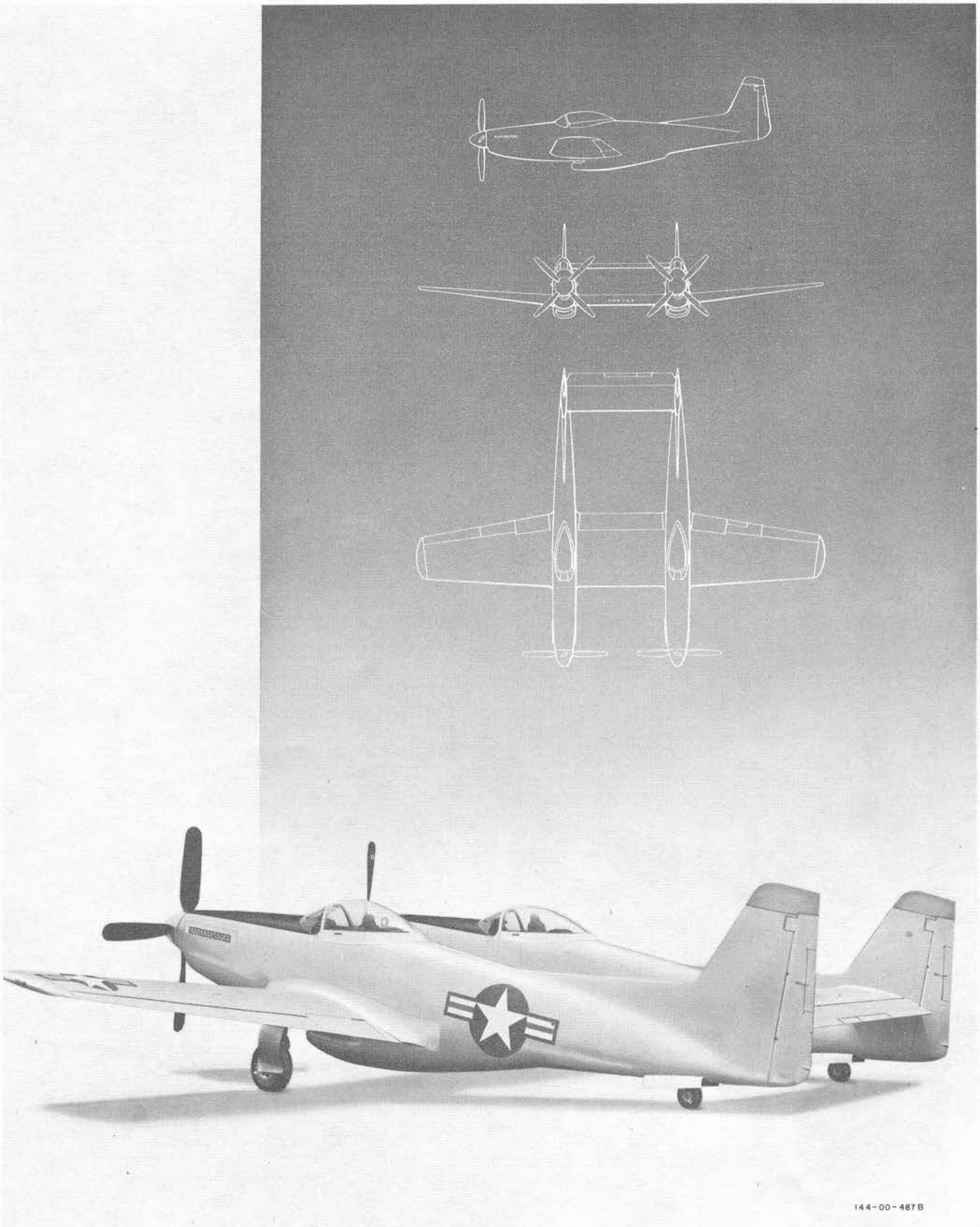


Figure 1-1. Three-quarter View of Airplane

Section I

DESCRIPTION

1-1. AIRPLANE.

1-2. The North American F-82E Airplane is a two-engine, twin-fuselage, low-wing monoplane designed for long range and high-speed performance. Functional versatility is provided by various load combinations and use of alternate equipment which fit the airplane to operate as a long-range fighter, a long-range escort fighter, a fighter bomber, an attack fighter, or an interceptor. Normally operating as a two-place airplane, the F-82E can be converted to a single-place interceptor by removal of equipment from the copilot's cockpit in the right fuselage.

1-3. AIRPLANE SIZE.

Wing span ....51 feet 3 inches
Fuselage length ....39 feet
Height (3-point position)........11 feet 10 inches

1-4. GROSS WEIGHT.

1-5. The normal gross weight of the airplane is approximately 20,775 pounds.

1-6. ARMAMENT AND SPECIAL FEATURES.

1-7. A bank of six .50-caliber machine guns is mounted in a wing center section; and bombs, chemical tanks, rockets, or drop tanks may be installed on racks beneath the wing panels. A release mechanism under the wing center section is provided for attaching a droppable gun nacelle. Figure 1-8 shows the angles of armor plate protection from gunfire.

1-8. INTERCOCKPIT CONTROL. Because of the design of the airplane, equipment necessary for a relief or emergency pilot is duplicated in the right cockpit. Essential power plant and flight controls are provided; and control of guns, fuel, engine charge heat, surface anti-icing, and the command radio can be transferred from one cockpit to the other by operation of control shift switches located in both cockpits. However, the copilot has no control over the following major items: landing gear and flaps (except emergency), ignition, water injection, surface control boost, or bombs (except salvo) and rockets. In the event of injury to the pilot, the copilot can, therefore, assume control of the airplane and effect a landing.

1-9. MAIN DIFFERENCES TABLE—F-82B and F-82E.

1-10. The main differences between the F-82E Airplane and the F-82B Airplane are outlined in the following table:

ITEM	F-82E	F-82B
Engine	Allison	Packard-built Rolls Royce
Supercharger	Integral engine-stage single-speed, and auxiliary-stage variable-speed	Integral two-stage, two-speed
Carburetor	Speed-density metering	Airflow metering
Surface control boost	Elevator, rudder, and aileron boost	Elevator and rudder boost only
Fire extinguisher system	Fire extinguisher system	——
Thermal anti-icing	Wing, empennage, and windshield anti-icing system installed	Provisions for installation
Propeller de-icer	Propeller de-icer	——
Bomb salvo	Electrical release	Mechanical release

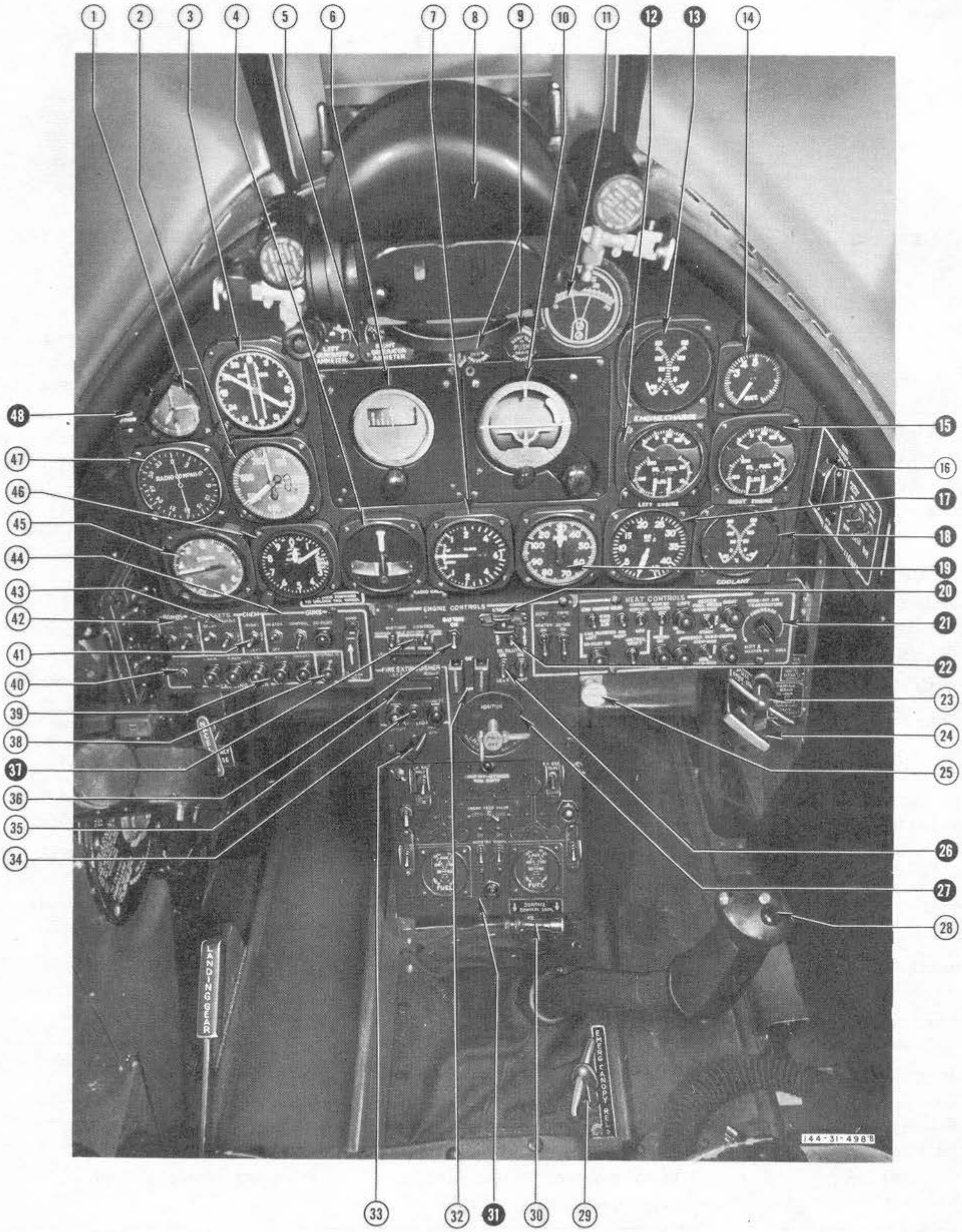


Figure 1-2. Pilot's Cockpit—Forward View

1-11. POWER PLANTS.

1-12. The airplane is powered by two 12-cylinder, liquid-cooled, V-type Allison engines (Model V-1710-145 in right fuselage, Model V-1710-143 in left fuselage) equipped with speed-density carburetors and water injection systems.

1-13. SUPERCHARGERS.

1-14. Both power plants are equipped with an engine stage, gear-driven, single-speed supercharger and an auxiliary-stage variable-speed supercharger. Entirely automatic in operation, the auxiliary-stage supercharger makes available a wide range of supercharger speeds which are determined by engine rpm, airplane altitude, and throttle-selected power setting.

1-15. AUTOMATIC ENGINE POWER CONTROL UNITS.

1-16. Each engine is provided with an automatic engine power control unit which is operated by the throttle. The automatic engine power control unit regulates throttle valve position and the output of the auxiliary-stage supercharger in a manner which keeps engine detonation limits from being exceeded regardless of altitude or throttle control position. When a given manifold pressure is selected, it will automatically be maintained up to a limited altitude. (This altitude will change with variations from standard day temperature because of the effects of inlet air temperature on the efficiency of the auxiliary stage impeller.) With additional increase in altitude, the manifold pressure will decrease along a definite curve unless the throttle lever is advanced. However, at some powers and above a certain altitude, manifold pressure will drop off in a climb, even with the throttle at its full travel. This does not necessarily mean that the airplane has reached critical altitude, but might indicate that manifold pressure is being regulated along a schedule determined by the auxiliary stage supercharger control. If the operating oil supply to the control unit should fail, it is still possible to select any manifold pressure up to approximately 46 in. Hg at sea level.

1-17. PROPELLERS.

1-18. Each power plant drives a four-bladed, constant-speed, full-feathering, Aeroproducts propeller.

1-19. POWER PLANT CONTROLS.

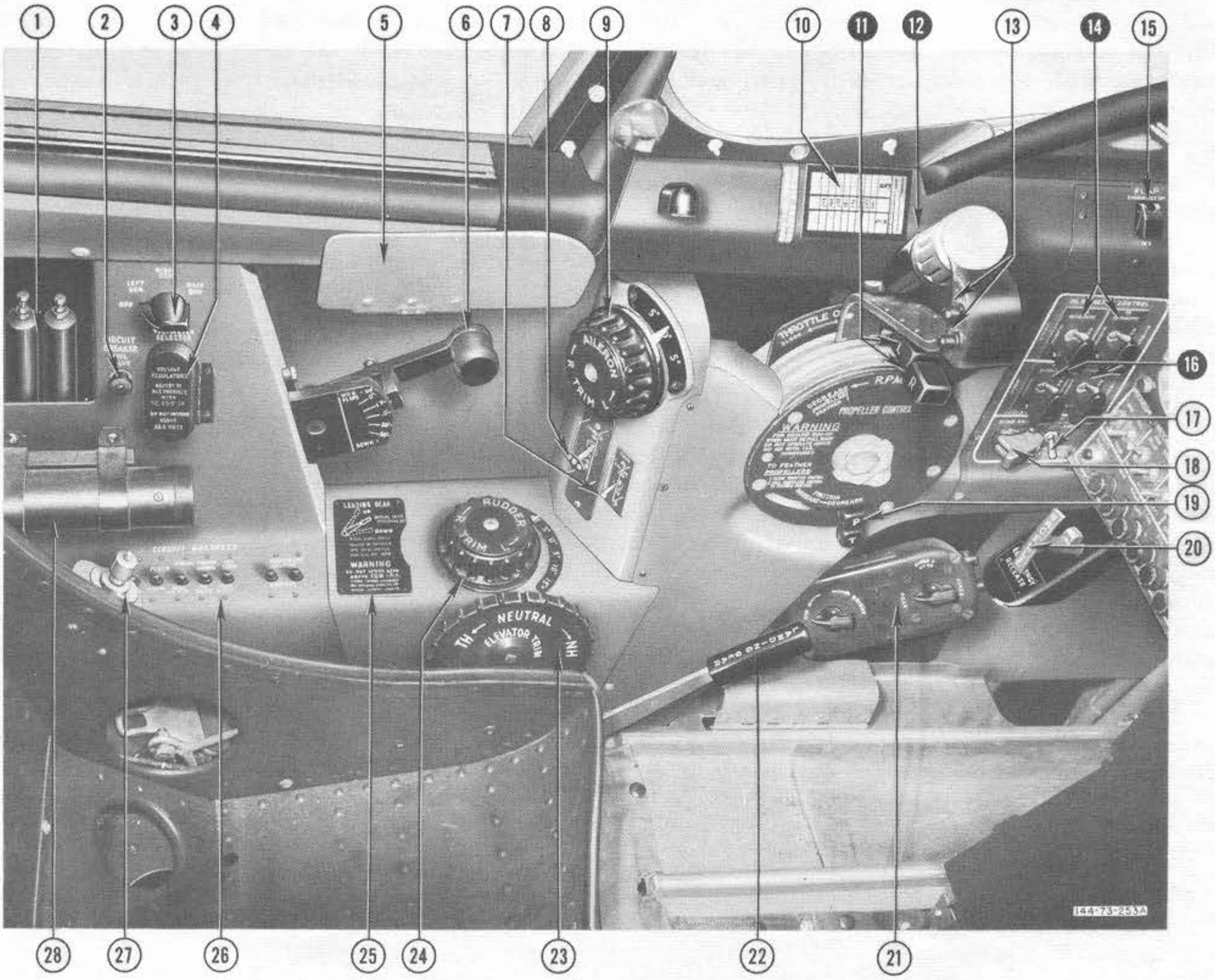
1-20. THROTTLES.

1-21. Dual throttle levers, located on the quadrant at the left side of each cockpit (figure 1-3, reference 12; figure 1-6, reference 8), are mechanically connected to the automatic engine power control unit on each engine. The throttle quadrant is marked "CLOSE," "OPEN," "TAKE-OFF," and "WAR EMERGENCY." Engine power restrictions prohibit the use of "WAR EMERGENCY" position at any time. At the "TAKE-OFF" position, a spring-loaded gate prevents inadvertent throttle advancement to the war emergency powers. Two microswitches in the throttle control system are actuated by throttle movement: one to energize

1. Clock
2. Airspeed and Mach Indicator
3. Remote-indicating Compass
4. Turn-and-Bank Indicator
5. Left and Right Generator Ammeters
6. Directional Gyro
7. Rate-of-Climb Indicator
8. K-18 Gun Sight
9. Manifold Pressure Drain Controls
10. Artificial Horizon
11. Voltmeter
12. Left Engine Gage
13. Engine Charge Air Temperature Gage
14. Suction Gage
15. Right Engine Gage
16. Hydraulic Boost Switch
17. Tachometer
18. Coolant Temperature Gage
19. Manifold Pressure Gage
20. Starter Switch
21. Heat Control Panel
22. Primer Switch
23. Emergency Landing Gear Release
24. Parking Brake Handle
25. Defrost Control
26. Oil Dilution Switches
27. Ignition Switches
28. Bomb-Rocket Release
29. Emergency Canopy Release
30. Surface Control Lock
31. Fuel Control Panel
32. Generator Switches
33. Cockpit Light Rheostat
34. Fire Indicator Push-to-Test Button
35. Fire Extinguisher Switch
36. Battery Switch
37. Mixture Control Switches
38. Hydraulic Pressure Indicator Light
39. Landing Gear Position Indicators
40. Warning Horn Cutout Switch
41. Chemical Tank Selector Switch
42. Bomb Control Panel
43. Rocket Control Panel
44. Gun Control Panel
45. Accelerometer
46. Altimeter
47. Radio Compass Indicator
48. Water Injection Switch

✪ Indicates power plant and fuel system controls and instruments.

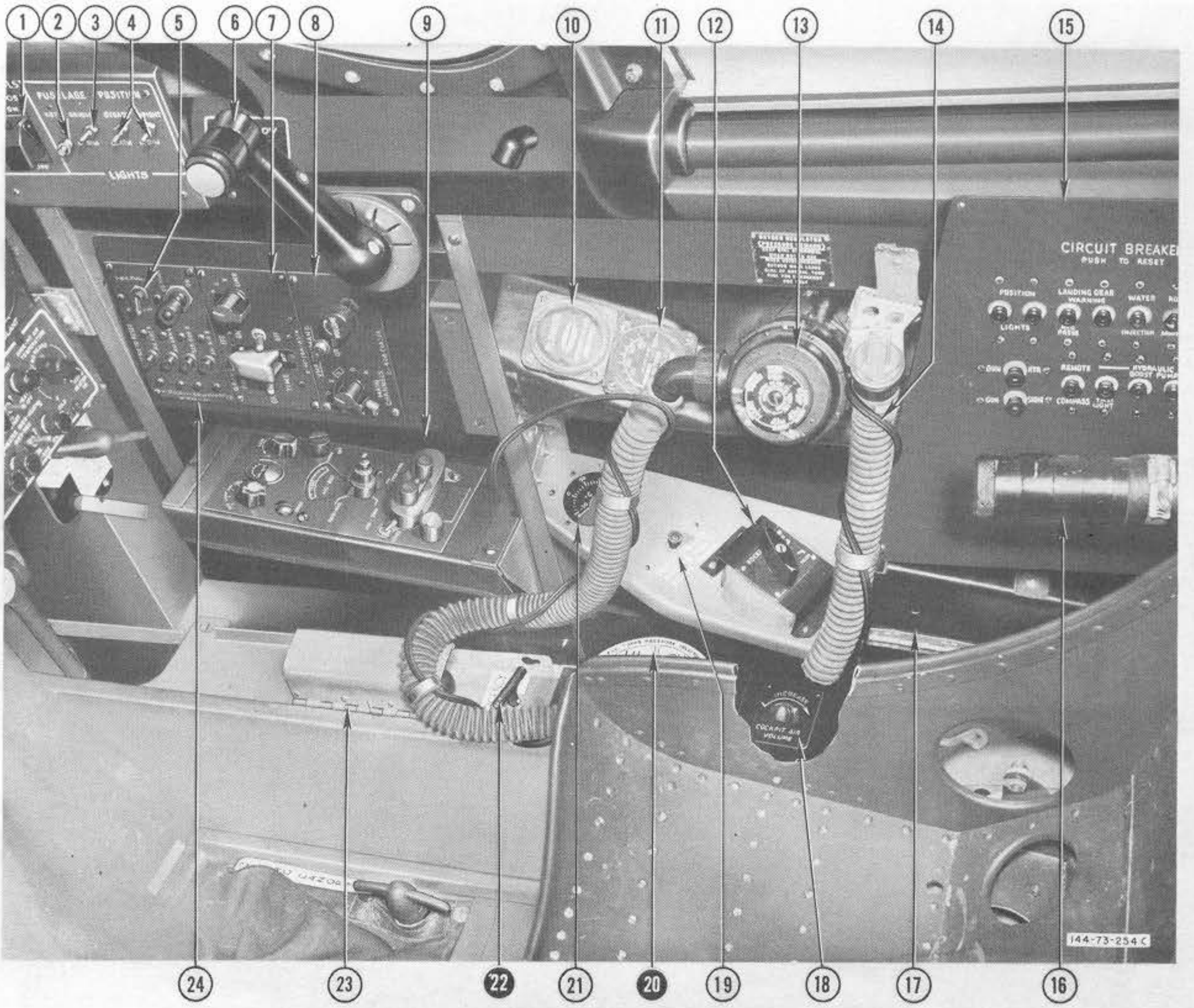
KEY TO FIGURE 1-2



1. Anti-G Suit Valve
2. Fuel Valve Circuit Breaker
3. Voltmeter Selector
4. Voltage Regulators
5. Armrest and Standard Check List
6. Wing Flap Handle
7. Taxi Light Switch
8. Landing Light Switch
9. Aileron Trim Tab Control
10. Remote Compass Correction Card
11. Propeller Controls
12. Throttles (Gun Sight Ranging Control)
13. Radio Push-to-Talk Buttons
14. Oil Radiator Switches
15. Flap Emergency Switch
16. Coolant Radiator Switches
17. Bomb Sequence Switch
18. Bomb Salvo Switch
19. Throttle and Propeller Friction Locks
20. Gun Nacelle Emergency Release
21. Gun Sight Selector-Dimmer Switch
22. Landing Gear Handle
23. Elevator Trim Tab Control
24. Rudder Trim Tab Control
25. Landing Gear Instruction Plate
26. Circuit Breaker Panel
27. Anti-G Suit Connection
28. Heat and Vent Outlet

✖ Indicates power plant and fuel system controls and instruments.

Figure 1-3. Pilot's Cockpit—Left Side



1. Hydraulic Boost Switch
2. Keying Switch
3. Fuselage Light Switch
4. Position Light Switches
5. Command Radio Transfer Switch
6. Canopy Handcrank
7. SCR-695B Radio Control Panel
8. AN/ARC-3 Radio Control Panel
9. AN/ARN-6 Radio Compass Control Panel
10. Oxygen Flow Indicator
11. Oxygen Pressure Indicator
12. Rocket Fire Control
13. Oxygen Regulator
14. Microphone Cord
15. Circuit Breaker Panel
16. Heat and Vent Outlet
17. Data Case
18. Cockpit Air Volume Control
19. Aileron Boost Circuit Breaker
20. Drop Tank Selector
21. Free Air Temperature Gage
22. Emergency Coolant Air Flap Release
23. Rudder Pedal Disconnect Lever
24. Radio Circuit Breaker Panel

✪ Indicates power plant and fuel system controls and instruments.

Figure 1-4. Pilot's Cockpit—Right Side

Figure 1-5. Copilot's Cockpit—Forward View

the water injection pump when the water injection switch is "ON" (figure 1-2, reference 48); one to activate the landing gear warning horn. Incorporated in the throttle handles in both cockpits are push-to-talk buttons (figure 1-3, reference 13; figure 1-6, reference 9) for the radio equipment. A gun sight ranging control (figure 1-3, reference 12) is installed on the right engine throttle in the pilot's cockpit only. A throttle friction lock (figure 1-3, reference 19) is provided on the bottom of the pilot's quadrant.

1-22. PROPELLER CONTROL.

1-23. Dual propeller control levers are located beneath the throttles on the power control quadrant in each cockpit. (See figure 1-3, reference 11; figure 1-6, reference 10.) Feathering is accomplished by pulling the desired propeller control to the extreme aft, "FEATHER," position, after first retarding the corresponding throttle to "CLOSE." No additional controls are provided or required for feathering the propeller. Unless the throttle is fully retarded, a stop in the quadrant prevents movement of the propeller control to the feathering range. A propeller control friction lock is provided on the pilot's quadrant. (See figure 1-3, reference 19.)

1-24. MIXTURE.

1-25. Two mixture control switches (one for each engine) are mounted on the engine control panel in both cockpits. (See figure 1-2, reference 37; figure 1-5, reference 26.) The switches have four positions: "NORMAL," "IDLE CUT-OFF," "LONG RANGE CRUISE," and a central position. The "NORMAL" and "IDLE CUT-OFF" positions are momentary-contact switches and either position is selected by holding the switches at the desired setting for approximately 3 seconds. When released, the switches will return to the central position and the engine will operate in the position selected by the momentary switch operation. A guard prevents inadvertent movement of the switches to the "LONG RANGE CRUISE" setting which is used only for long-range operation at low powers. After "LONG RANGE CRUISE" has been selected, if manifold pressure is increased above 48 in. Hg, the mixture automatically goes to "NORMAL," regardless of switch position; if power is subsequently reduced, the mixture will automatically return to "LONG RANGE CRUISE." If the switch is moved out of the "LONG RANGE CRUISE" position, the mixture will automatically return to the "NORMAL" position.

1-26. WATER INJECTION.

WARNING

At present, the water injection systems are inoperative. When modifications are completed permitting water injection, the engines may be operated in accordance with restrictions in paragraph 2-2.

1-27. A water injection system, including a 13.5-gallon water-alcohol tank, is provided on each engine. Both systems are controlled simultaneously from the pilot's cockpit by a water injection switch above the engine control quadrant (figure 1-2, reference 48) and a microswitch incorporated in the throttle system. When the water injection switch is "ON" and the throttles are advanced to above 64 in. Hg manifold pressure at sea level, the pumps which supply water to the induction systems are started. When water pressure drops or the water supply is depleted, the pumps will automatically stop. Because the water flow may not be equal in both systems, the water supply pump stoppage may not occur simultaneously on both engines.

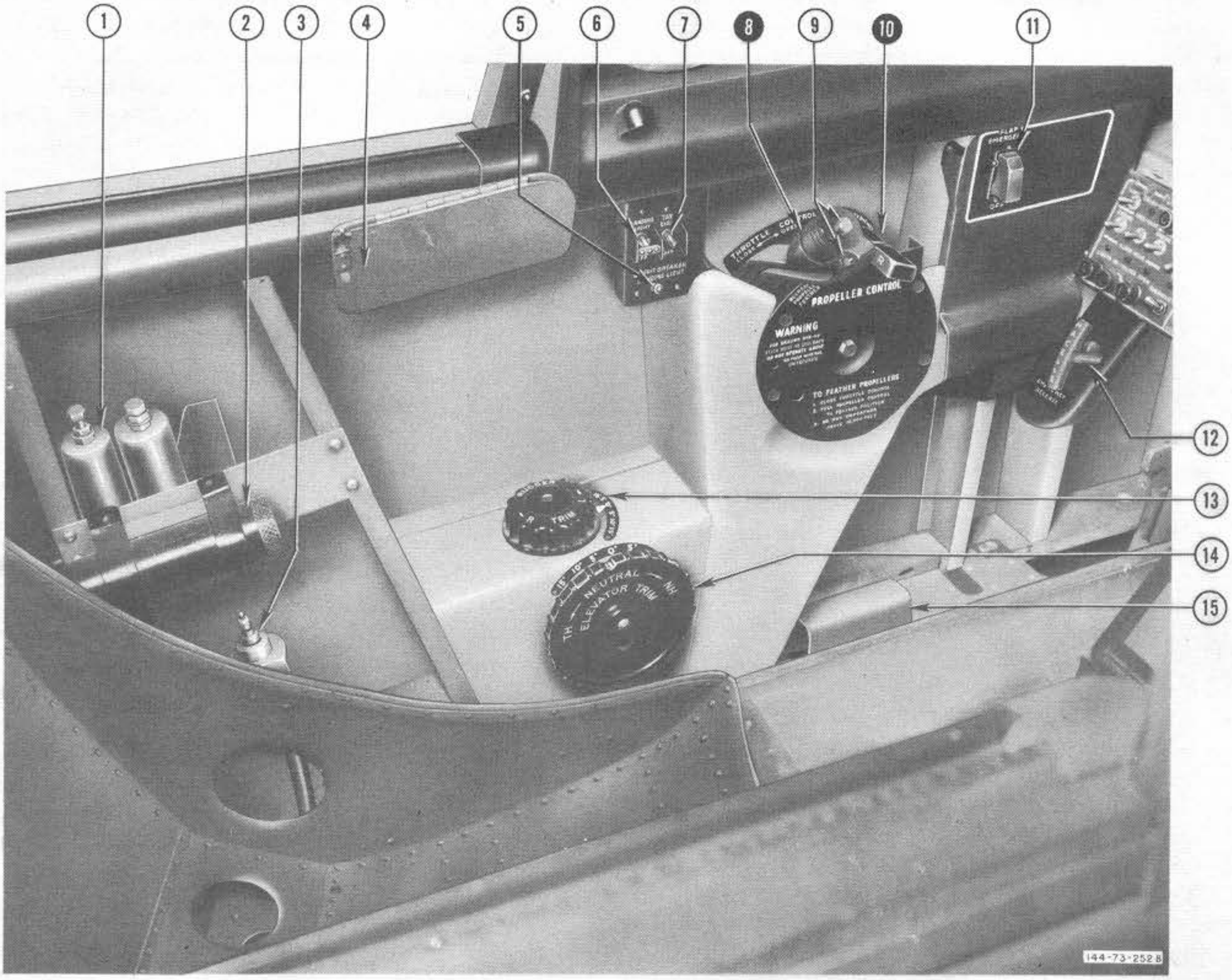
1-28. PRIMER.

1-29. The priming systems on both engines are controlled by a single spring-loaded switch (figure 1-2, reference 22) on the engine control panel in the pilot's cockpit. The switch has two positions: "LEFT" and "RIGHT."

1. Clock
2. Airspeed and Mach Indicator
3. Free Air Temperature Gage
4. Remote-indicating Compass
5. Accelerometer
6. Remote Compass Correction Card
7. Ring-and-Bead Sight
8. Artificial Horizon
9. Manifold Pressure Drain Controls
10. Gun Camera
11. Oil Temperature Gage
12. Coolant Temperature Gage
13. Tachometer
14. Manifold Pressure Gage
15. Heat Control Panel
16. Emergency Landing Gear Release
17. Oil Radiator Switches
18. Coolant Radiator Switches
19. Circuit Breaker Panel
20. Emergency Canopy Release
21. Stand-by Compass Correction Card
22. Fire Indicator Push-to-Test Button
23. Fire Extinguisher Switch
24. Landing Gear Position Indicator Light
25. Bomb Salvo Switch
26. Mixture Control Switches
27. Gunnery Control Shift Switch
28. Fuel Control Panel
29. Gun Selector Switch
30. Cockpit Light Rheostat
31. Turn-and-Bank Indicator
32. Radio Compass Indicator
33. Altimeter

✖ Indicates power plant and fuel system controls and instruments.

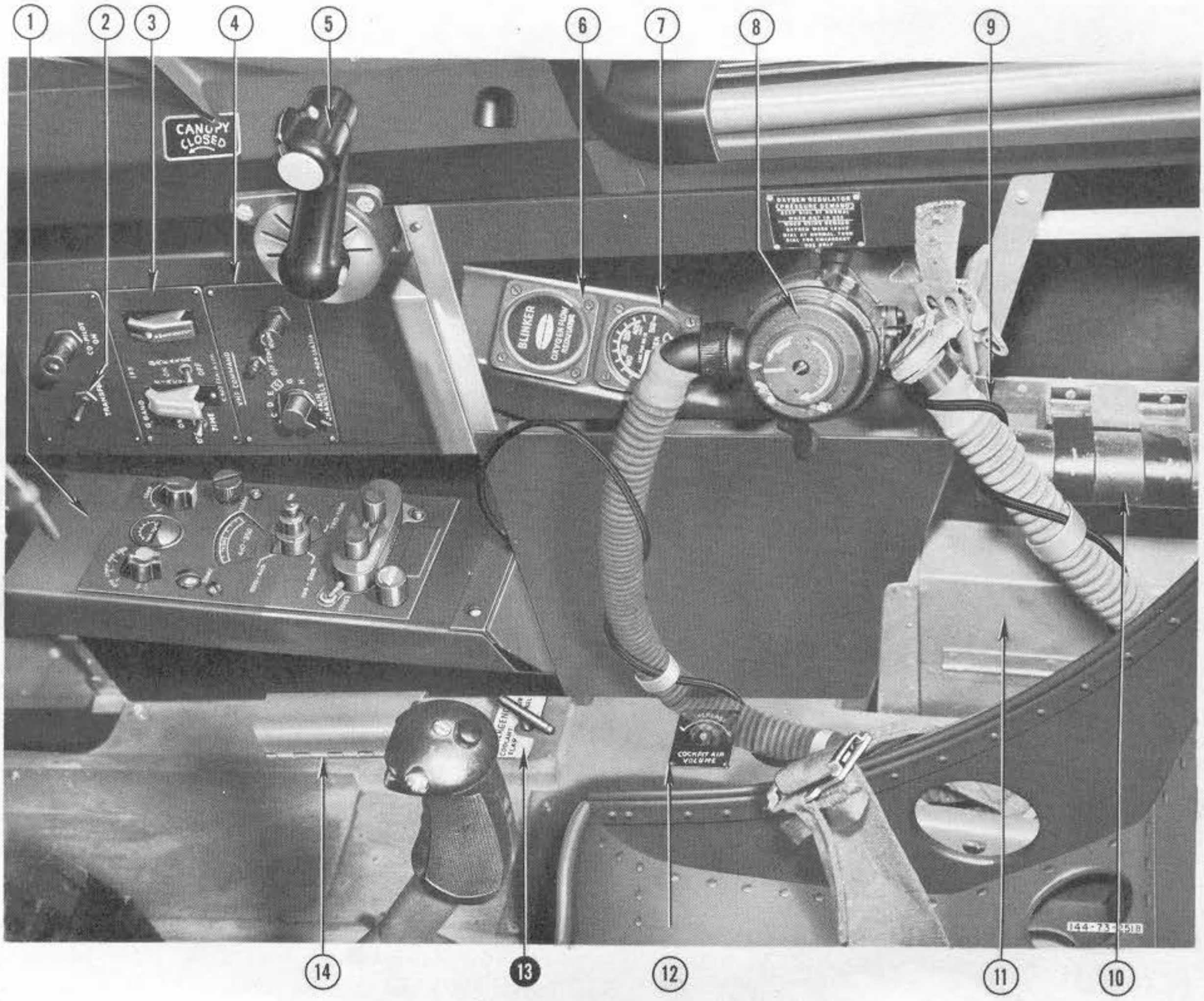
KEY TO FIGURE 1-5



1. Anti-G Suit Valve
2. Heat and Vent Outlet
3. Anti-G Suit Connection
4. Armrest and Standard Check List
5. Landing Light Circuit Breaker
6. Landing Light Switch
7. Taxi Light Switch
8. Throttles
9. Radio Push-to-Talk Buttons
10. Propeller Controls
11. Wing Flap Emergency Switch
12. Nacelle Emergency Release
13. Rudder Trim Tab Control
14. Elevator Trim Tab Control
15. Rudder Pedal Disconnect Lever

✠ Indicates power plant and fuel system controls and instruments.

Figure 1-6. Copilot's Cockpit—Left Side



1. AN/ARN-6 Radio Compass Control Panel
2. Command Radio Transfer Switch
3. SCR-695B Radio Control Panel
4. AN/ARC-3 Radio Control Panel
5. Canopy Handcrank
6. Oxygen Flow Indicator
7. Oxygen Pressure Indicator
8. Oxygen Regulator
9. Microphone Cord
10. Heat and Vent Outlet
11. Data Case
12. Cockpit Air Volume Control
13. Emergency Coolant Air Flap Release
14. Rudder Pedal Disconnect Lever

✖ Indicates power plant and fuel system controls and instruments.

Figure 1-7. Copilot's Cockpit—Right Side

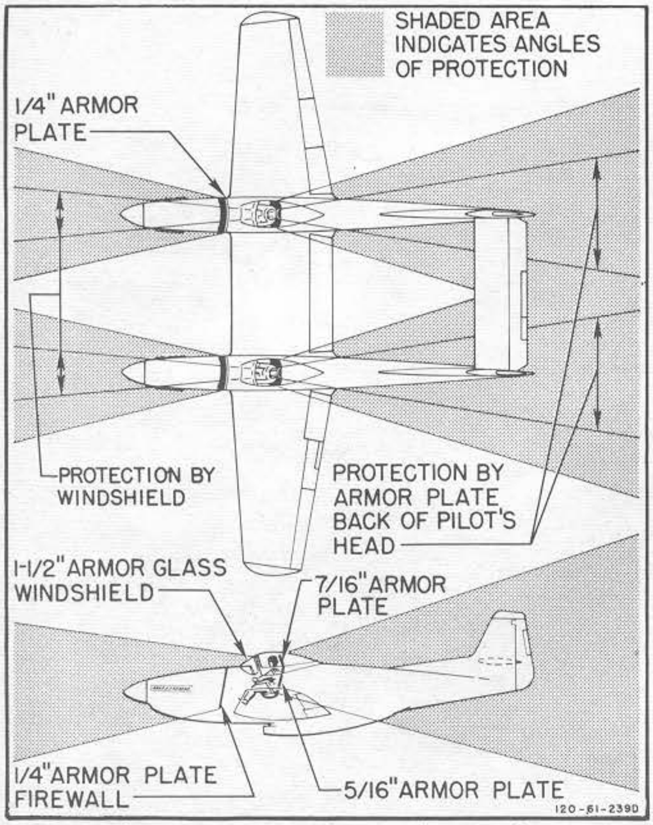


Figure 1-8. Protection Against Gunfire

1-30. IGNITION.

1-31. Standard ignition switches are located at the center of the pilot's engine control panel. (See figure 1-2, reference 27.)

1-32. STARTERS.

1-33. A single toggle switch on the pilot's engine control panel (figure 1-2, reference 20) actuates the direct-cranking starters on both engines. Holding the switch at one of the two spring-loaded positions, "LEFT" or "RIGHT," engages the starter on the corresponding engine.

1-34. ENGINE CHARGE AIR.

1-35. A separate and complete air induction system (figure 1-9) in each fuselage supplies the related engine with cold ram air, cold unrammed filtered air, or heated air. The cold air intake is located just below the propeller spinner, and filters are installed on either side of the cowling. Heated air is normally obtained from aft of the coolant radiator and routed through the surface anti-icing duct forward to the engine air intake duct. However, when the surface anti-icing system is in operation, heated induction air is supplied from the engine compartment through an alternate charge air inlet door in the intake duct. The heated induction air, provided to maintain desired mixture temperatures, helps prevent spark plug fouling during long-range cruise at low powers. The engine charge temperature gage indicates mixture temperature taken at the intake manifold; consequently, the desirable range is higher than that of conventional induction systems which measure ram air temperature.

Note

The engine compartment can be heated on the ground, prior to engine starting during cold weather operation, by use of a heater and blower installed in each fuselage. Refer to paragraph 5-3.b. for engine ground heating operation.

1-36. HEAT CONTROL SHIFT SWITCH.

1-37. Control of the air induction system may be transferred from one cockpit to the other by means of the heat control shift switch (figure 4-3) located on the heat control panel in each cockpit. A "COPILOT ON" indicator light, adjacent to the switch, illuminates when the copilot's controls are operative. When control is transferred, the engine air and anti-icing systems will assume the operating conditions selected on the panel to which control is shifted.

1-38. ENGINE AIR CONTROLS.

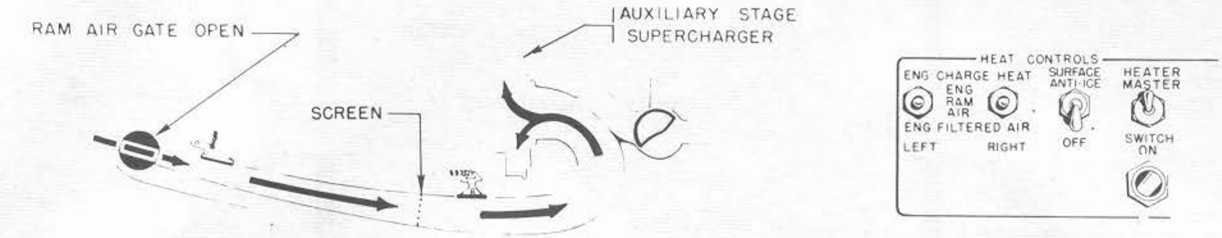
1-39. The engine air control switches (figure 1-2, reference 21), one for each engine, are located on the heat control panel in both cockpits. The switches have three positions: "ENG. RAM AIR," "ENG. FILTERED AIR," and "ENG. CHARGE HEAT." When the control switch is set for "ENG. RAM AIR," an inlet valve at the front of the air intake duct is opened, permitting cold ram air to enter the system. With the switch set for "ENG. FILTERED AIR," the main inlet valve is closed and cold unrammed air is drawn through the filters into the air intake duct. When "ENG. CHARGE HEAT" is selected, hot air obtained from behind the coolant radiator passes forward through the anti-icing duct to the intake duct. When operating with engine charge heat, cold air is metered through the main inlet valve as required to maintain proper mixture temperatures. If the surface anti-icing system is placed in operation when "ENG. CHARGE HEAT" is selected, heat supplied to the engine through the anti-icing duct is cut off and an alternate charge air inlet door in the air intake duct opens, supplying heated air from the engine compartment. (Refer to paragraph 4-55.)

1-40. OIL.

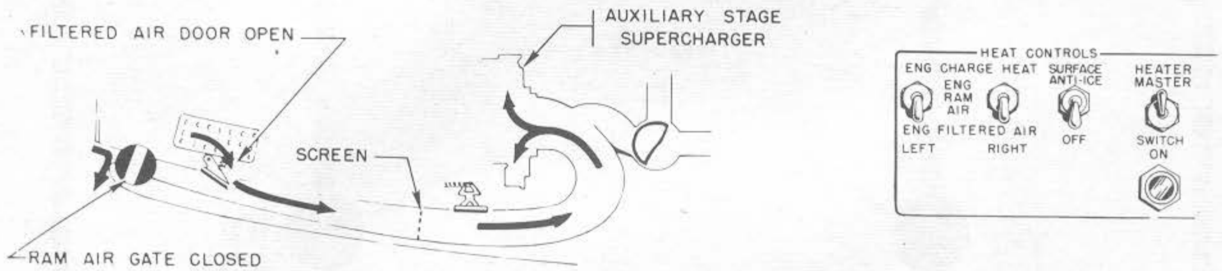
1-41. A separate oil system is provided for each engine. The lubricating oil is cooled in a radiator mounted in an air scoop in the lower portion of each fuselage (forward of the coolant radiator). Airflow through the radiators is regulated by movement of thermostatically controlled outlet flaps.

1-42. OIL SPECIFICATION AND GRADE.

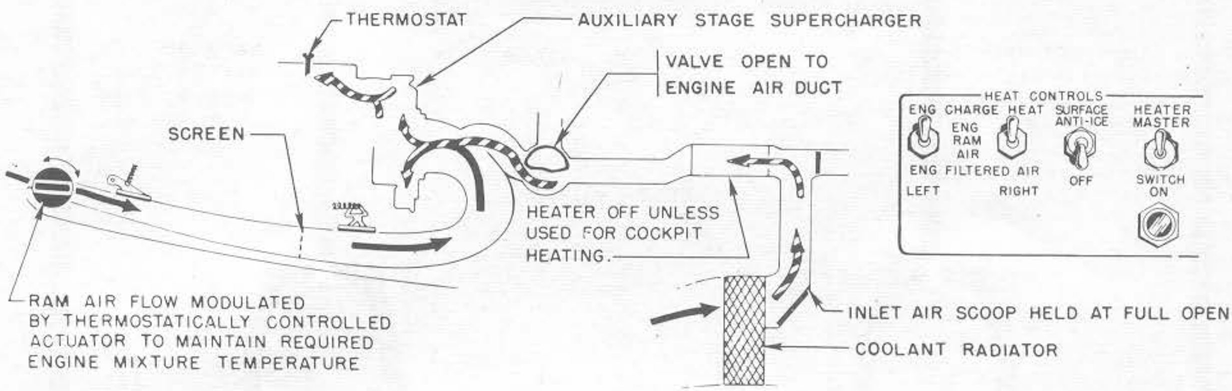
1-43. Oil Specification AN-O-8, Grade 1120.



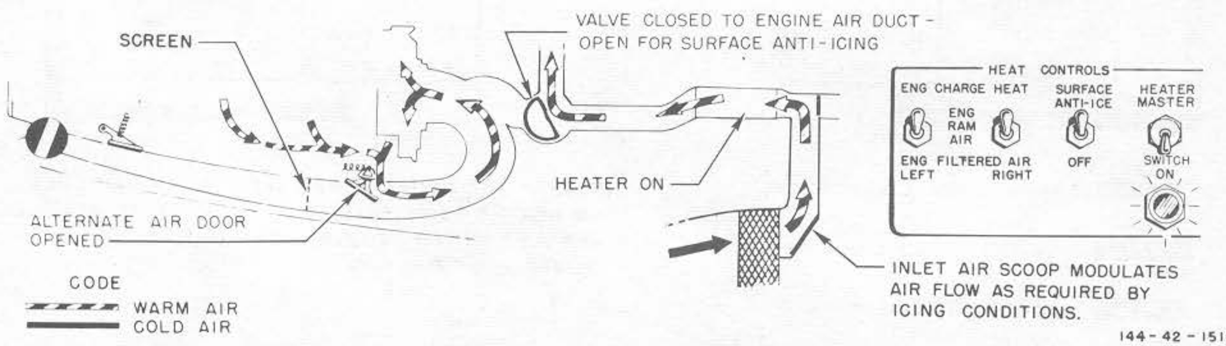
ENGINE RAM AIR OPERATION



ENGINE FILTERED AIR OPERATION



ENGINE CHARGE HEAT OPERATION—WITHOUT SURFACE ANTI-ICING



ENGINE CHARGE HEAT OPERATION—WITH SURFACE ANTI-ICING

Figure 1-9. Air Induction System

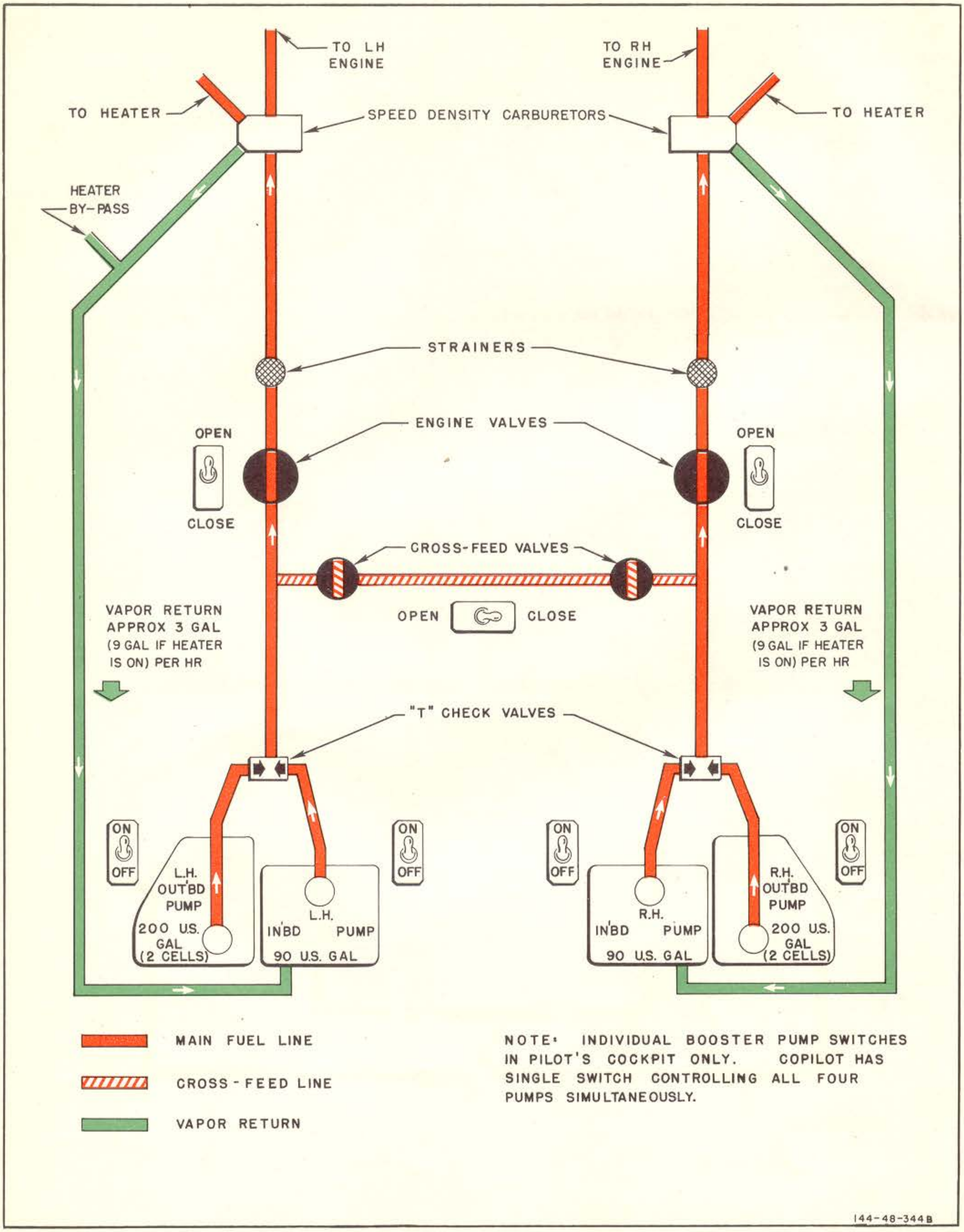


Figure 1-10. Main Fuel System

1-44. OIL RADIATOR CONTROL.

1-45. Two switches, one for each flap actuator, are provided in each cockpit, on the left switch panel (figure 1-3, reference 14) forward of the throttle quadrant in the pilot's cockpit, and on the center pedestal (figure 1-5, reference 17) in the copilot's cockpit. Each switch has four positions: two spring-loaded contacts, "OPEN" and "CLOSE"; and two maintained contacts, "AUTOMATIC" and a center or off position. Guards hold the switches at "AUTOMATIC," the normal operating position. The "OPEN" and "CLOSE" positions are provided for use in case of automatic control failure or during ground check. When automatic control of the flap actuators is desired, the switches in both cockpits must be in the "AUTOMATIC" position. The pilot can select "OPEN" or "CLOSE" independent of copilot's switch position; however, the "OPEN" and "CLOSE" positions of the copilot's switches are effective only when the pilot's switches are in "AUTOMATIC."

1-46. OIL DILUTION.

1-47. Two spring-loaded switches (figure 1-2, reference 26), one for the oil dilution system on each engine, are located on the pilot's engine control panel.

1-48. COOLANT.

1-49. Each engine is supplied with a separate liquid-cooling system. An air scoop in the lower portion of each fuselage houses a radiator (aft of oil radiator) for cooling the liquid after it has passed through the engine. Flow of cooling air through the radiator is regulated by a thermostatically controlled flap at the aft end of the scoop.

1-50. COOLANT RADIATOR CONTROL.

1-51. Two control switches, one for each coolant flap actuator, are located adjacent to the oil radiator controls in each cockpit. (See figure 1-3, reference 16; figure 1-5, reference 18.) Each switch has four positions: two spring-loaded contacts, "OPEN" and "CLOSE"; and two maintained contacts, "AUTOMATIC" and a center or off position. Guards hold the

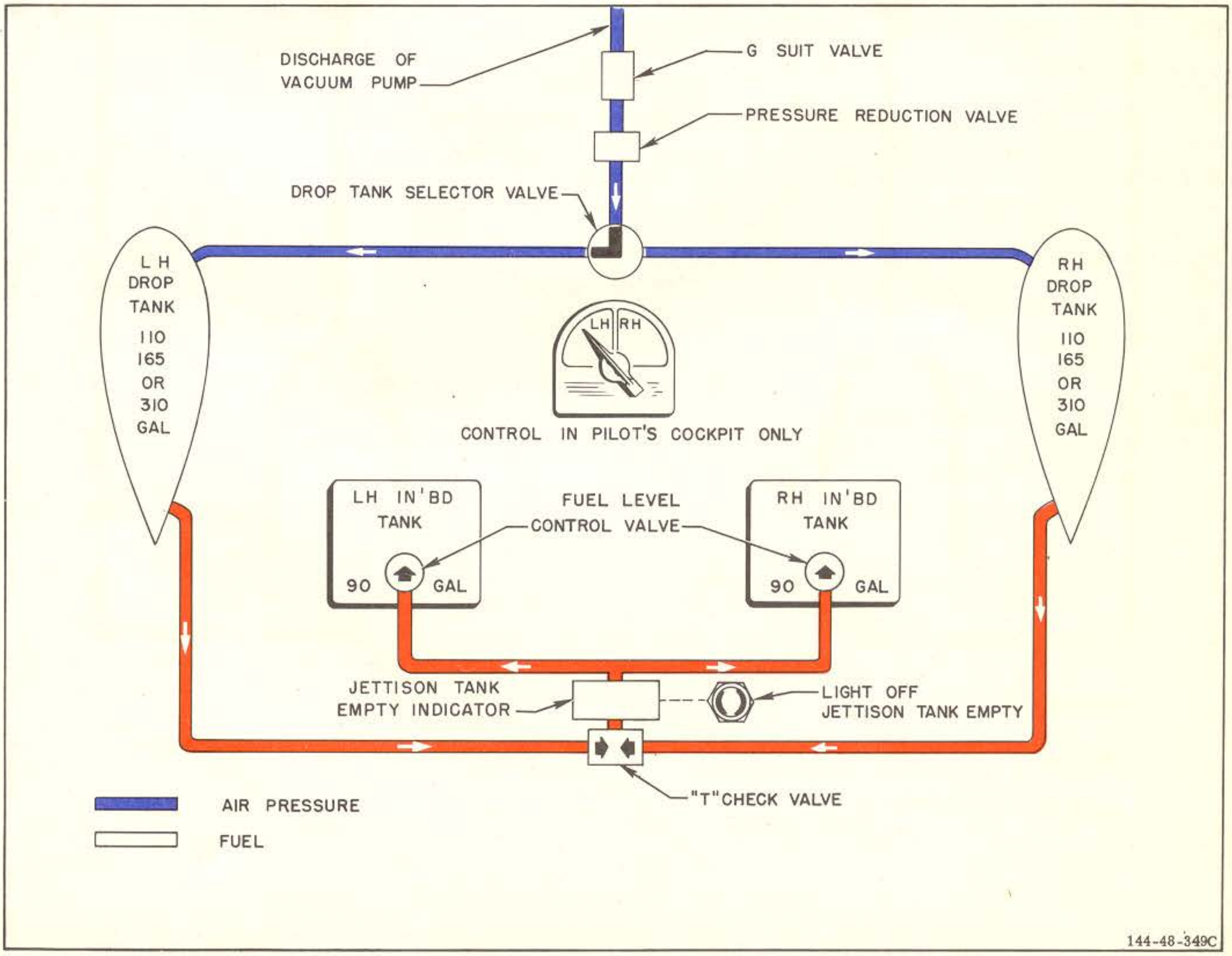


Figure 1-11. Fuel Transfer System

switches at "AUTOMATIC" where they should be kept for all normal operation. The "OPEN" and "CLOSE" positions are provided for use in case of automatic control failure or during ground check. When automatic control of the flap actuators is desired, the switches in both cockpits must be in the "AUTOMATIC" position. The pilot can select "OPEN" or "CLOSE" independent of copilot's switch position; however, the "OPEN" and "CLOSE" positions of the copilot's switches are effective only when the pilot's switches are in "AUTOMATIC." When the landing gear is extended, the coolant flaps are automatically maintained at a position safe for ground operation.

1-52. EMERGENCY COOLANT AIR FLAP RELEASE.

1-53. A mechanical coolant air flap emergency release (figure 1-4, reference 22; figure 1-7, reference 13) is provided in each fuselage to open the flap in the event of actuator failure. The release opens only the flap in the related fuselage. One quick pull will open the flap to a minimum of 6 inches or approximately 5½ inches beyond the flap setting at the time of release. There is no provision for emergency closing of the flap, nor can the emergency release be reset in flight.

1-54. FUEL SYSTEM.

1-55. MAIN FUEL SYSTEM.

1-56. Four self-sealing fuel tanks are installed in the airplane; one (consisting of two interconnected cells) in each outer wing panel and two in the wing center section. (See figure 1-10.) The total usable fuel in all tanks is approximately 575 U.S. gallons. Normally, the two tanks on either side of the airplane centerline supply fuel to the engine on the related side. This provides each engine with a separate and complete fuel system, the two systems being interconnected only by a cross-feed line. Fuel flow from each set of two tanks is controlled by operation of engine shut-off and cross-feed valves (electric motor actuated) and by selection of booster pumps. Vapor return lines from the right and left engine speed-density carburetors are routed to the right and left inboard tanks, respectively.

1-57. FUEL TRANSFER SYSTEM.

1-58. To supplement the main fuel supply, one 110, 165, or 310-gallon drop tank can be installed under each outer wing panel. When the drop tanks are installed, fuel is routed from them to a fuel level control valve in each of the two inboard tanks. (See figure 1-11.) These valves automatically permit fuel flow from the selected drop tank when the level in one or both center section tanks drops below approximately 80 gallons.

1-59. FUEL SPECIFICATION AND GRADE.

1-60. Fuel Specification AN-F-48, recommended Grade 115/145, alternate Grade 100/130.

1-61. FUEL SYSTEM CONTROLS.

1-62. PILOT'S FUEL CONTROL PANEL. The pilot's fuel control panel (figure 2-1), located centrally below the engine control panel, provides a lighted schematic diagram of the main system. All of the fuel controls (except the drop tank selector valve) are mounted on this panel, and lights adjacent to the control switches indicate their operating condition. The panel also contains fuel quantity gages for the internal tanks and an indicator light for the drop tanks which turns off when the tank selected is empty.

1-63. COPILOT'S FUEL CONTROL PANEL. The fuel control panel (figure 2-3), at the lower left side of the copilot's instrument panel, contains all of the copilot's fuel controls: a single switch for all booster pumps, one switch for each engine fuel shut-off valve, one switch for the cross-feed valves, and a control shift switch. Indicator lights on the panel show the operating condition of the switches.

1-64. FUEL CONTROL SHIFT SWITCHES. A "CONTROLS SHIFT" switch, located on the fuel control panel in each cockpit (figures 2-1 and 2-3), transfers control of the fuel system from one cockpit to the

FUEL QUANTITY DATA
GALLONS

TANK	NO.	USABLE FUEL (EACH)	EXPANSION SPACE (EACH)	TRAPPED FUEL (EACH) LEVEL FLIGHT	TOTAL VOLUME (EACH)
L.H. IN'BD	I	91	4	NEGLIGIBLE	98
L.H. OUT'BD	I	198	9	NEGLIGIBLE	208
R.H. IN'BD	I	91	5	NEGLIGIBLE	99
R.H. OUT'BD	I	196	10	NEGLIGIBLE	207

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Figure 1-12. Fuel Quantity Data—Gallons other. An amber "COPILOT ON" indicator light on both panels illuminates when the copilot's controls are operative.

1-65. ENGINE FUEL SHUT-OFF VALVES. Electrically operated fuel shut-off valves, one in the main fuel line to each engine, are controlled by the "LH ENGINE VALVE" and "RH ENGINE VALVE" switches located on the fuel control panel in each cockpit. (See figures 2-1 and 2-3.)

1-66. BOOSTER PUMPS. Four booster pumps, one in each of the fuel tanks, are controlled individually by four switches on the pilot's fuel control panel. (See figure 2-1.) Lights adjacent to the four switches identify them as "LH OUT'BD PUMP," "LH IN'BD PUMP," "RH IN'BD PUMP," and "RH OUT'BD PUMP." Tank selection is accomplished by selection of booster pumps. On the copilot's fuel control panel, a single booster pump switch (figure 2-3) turns all four pumps "ON" or "OFF" simultaneously.

1-67. CROSS-FEED VALVES. The cross-feed valves are controlled by a single cross-feed valve switch at the center of the pilot's fuel control panel. (See figure 2-1.) The switch has two positions, "OPEN" and "CLOSE." Operation of the cross-feed valves, in conjunction with the engine fuel shut-off valves and the booster pump switches, makes it possible for one engine to consume all of the fuel carried in the airplane, or for both engines to be fed by one tank system. For examples of cross-feed operation, see figure 3-1. On the copilot's fuel control panel, a single switch (figure 2-3), marked "CROSS OVER," controls the cross-feed valves. Fuel cannot be transferred from one set of tanks to the opposite set.

1-68. DROP TANK CONTROLS. The drop fuel tanks pressure selector valve (figure 1-4, reference 20), located on the floor to the right of the seat in the pilot's cockpit only, has only two positions, "LH DROP TANK" and "RH DROP TANK." No provision is made to turn fuel from drop tanks "OFF." If drop tanks are installed on airplane, all fuel is first supplied from either the left or right drop tank, according to the position of the selector valve, until tank is empty or selector valve is repositioned to opposite drop tank. Positioning the valve directs air pressure to the desired tank. When the selected tank is empty, a light on the pilot's fuel control panel turns off. Refer to paragraphs 4-32 and 4-34 for drop tank jettison controls.

1-69. HYDRAULIC SYSTEMS.

1-70. The hydraulic systems on the airplane include the main system (which operates landing gear and wing flaps), the brake system, and three completely individual surface control booster systems. The main system is supplied with pressure by an engine-driven pump on the left engine only; the booster systems are supplied with pressure by three electrically driven pumps. No hydraulic pressure gage is provided in the cockpits; therefore, failure of the hydraulic system will be evident only after an attempt to operate the wing flaps or landing gear.

1-71. FLIGHT CONTROLS.

1-72. The primary flight control surfaces are conventionally operated from either cockpit; however, a hydraulic booster system affords boost assistance to the aileron, elevator, and rudder controls, reducing the amount of force required for their movement. The copilot's control stick may be removed from its socket and stowed on the floor to the left of the seat. A permanently installed surface control lock, located forward of the pilot's control stick, locks the ailerons and rudders in a neutral position, the elevators full down.

1-73. RUDDER PEDALS.

1-74. The rudder pedals in both cockpits are adjustable, fore and aft. They may also be disengaged and folded forward to provide the nonpiloting crew member with more room. "RUDDER PEDAL DISCONNECT" levers (figure 1-4, reference 23) are located beneath covers on the floor in each cockpit (one at each side just forward of the seat). When the levers are pushed forward, the pedals will spring forward. The pedals are re-engaged by hooking the toes under the pedals and pulling back until the latches engage, or by pulling back on the release levers and snapping the pedals into the locked position with the toes.

1-75. BOOSTER SYSTEM.

1-76. Surface control boost is supplied by three separate hydraulic systems: one providing aileron boost; and two identical systems (one in the rear of each fuselage), both providing elevator and rudder boost. Each system contains its own hydraulic reservoir and electrically driven pump. The two rudder and elevator boost systems operate independently; however, cable linkage between the control surfaces permits one system to operate effectively in the event the other fails. Pressure from the aileron boost system may be used for emergency lowering of the wing flaps.

1-77. BOOSTER SYSTEM CONTROL. All three surface control booster systems are controlled by a single "ON-OFF" hydraulic boost switch (figure 1-4, reference 1) located on the surface control switch panel at the right side of the pilot's cockpit.

1-78. TRIM TABS.

1-79. Trim tabs on the rudders and elevators are conventionally adjusted in flight by wheels located at the left of the seat in each cockpit. (See figure 1-3, references 23 and 24; figure 1-6, references 13 and 14.) An aileron trim tab control is provided in the pilot's cockpit only. (See figure 1-3, reference 9.)

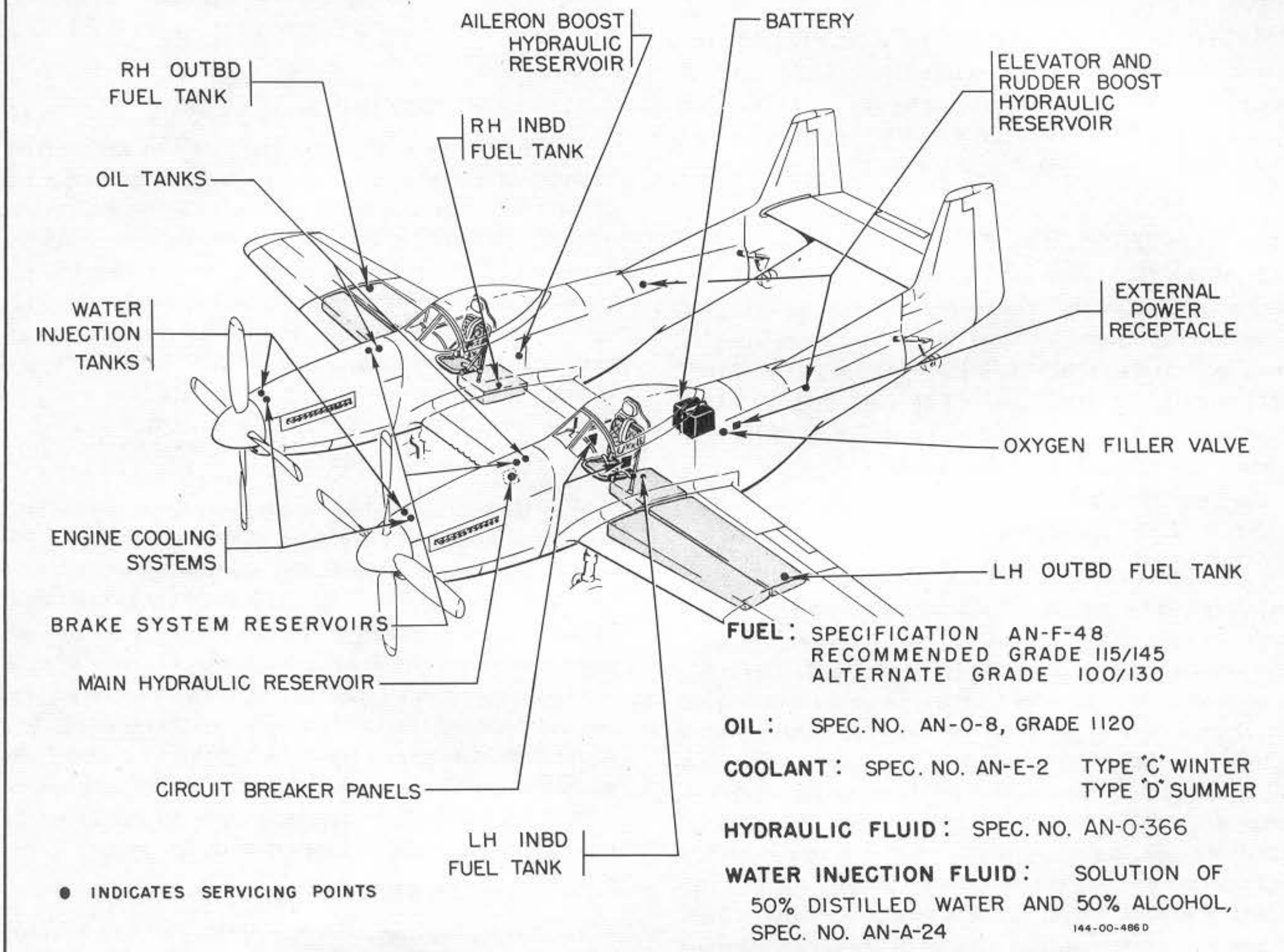


Figure 1-13. General Arrangement

1-80. WING FLAPS.

1-81. NORMAL WING FLAP CONTROL. Hydraulically operated wing flaps extend from the aileron to the fuselage on each wing panel and between the fuselages on the center section. They are interconnected and are controlled by a lever located on the left side of the pilot's cockpit only. (See figure 1-3, reference 6.) The lever moves on an indicator marked from 0° to 50°, and selective positioning of the flaps is accomplished by moving the flap lever to the desired setting. When the flaps reach the selected position, they will remain locked until the handle is moved again. Hydraulic pressure is supplied from an engine-driven pump on the left engine. In the event of left engine failure, a hydraulic accumulator may supply enough pressure to lower the flaps approximately 15 to 25 degrees.

1-82. WING FLAP EMERGENCY SWITCH. A wing flap emergency switch is located on the left side of each cockpit forward of the throttle quadrant. (See figure 1-3, reference 15; figure 1-6, reference 11.) Movement of the switch to the "ON" position diverts pressure from the aileron boost system to the down side of the wing flap actuating cylinders. The resultant momentary pressure drop in the aileron boost system has no appreciable effect on aileron control action. The flaps lower approximately 10 degrees per second and may be stopped at any position desired by turning the flap emergency switch "OFF."

WARNING

The flaps cannot be raised by operation of the flap emergency switch.

1-83. LANDING GEAR.

1-84. The main landing gear and wheel fairing doors are operated hydraulically. The two tail wheels, connected to the main gear by cable linkage, extend and retract in conjunction with them. The tail wheels are locked by holding the control stick aft of neutral; when locked, they may be turned 7 degrees right or left by using the rudder pedals. With the stick forward of neutral, the tail wheels are full-swiveling.

CAUTION

To prevent damage to tail wheel lock mechanisms, the control stick must be moved forward of neutral *before* a turn is started.

1-85. LANDING GEAR CONTROL HANDLE.

1-86. The gear is operated normally by the landing gear control handle on left side of pilot's cockpit only. (See figure 1-3, reference 22.) After the control handle is positioned at "UP" or "DOWN" and the gear reaches the selected position, a hydraulic pressure indicator light (to the right of the pilot's gear position indicators) will illuminate, signifying that system pressure has reached approximately 1250 psi. The control handle should then be returned to "NEUTRAL" to keep the hydraulic pump from operating continuously against pressure. When the weight of the airplane is on the gear, a mechanical lock prevents moving the landing gear control handle to the "UP" position. There is no provision for overriding the lock.

1-87. EMERGENCY LANDING GEAR RELEASE.

1-88. The emergency landing gear release handle (figure 1-2, reference 23) is located at the right side of both cockpits below the instrument panel. Pulling the emergency release mechanically unlocks the gear and fairing doors, and actuates a hydraulic dump valve which allows trapped fuel in the landing gear and wheel door cylinders to return to the system reservoir. This then allows the doors to open and the gear to extend by gravity without hydraulic pressure.

1-89. GEAR POSITION INDICATORS.

1-90. The landing gear position indicator lights are located below the left side of the pilot's instrument panel. (See figure 1-2, reference 39.) Four green lights (one for each gear) and a single red light (connected to all four gears) give a constant visual indication of landing gear position. Each green light illuminates when its respective gear is down and locked. The red light illuminates when the gear is in any position other than down and locked or up and locked, or if the gear is up and locked and the throttle is retarded below cruising rpm. A single red light on the copilot's engine control panel (figure 1-5, reference 24) illuminates simultaneously with the red light on the pilot's panel, indicating the same unsafe conditions. A warning horn, installed in the pilot's cockpit, sounds when the landing gear is in any position other than down and locked and the throttle is retarded below minimum cruising power. A horn cutout switch button (figure 1-2, reference 40), mounted at the left of the gear position indicator lights, is provided to silence the horn for cruising at low power. Throttle advancement automatically resets the horn circuit.

1-91. WHEEL BRAKES.

1-92. Hydraulic brakes on the main wheels are conventionally operated from either cockpit. The brake system is separate from the main hydraulic system and contains its own hydraulic fluid supply. The parking brake handle (figure 1-2, reference 24) is located on the right side of pilot's cockpit below the instrument panel. To set parking brakes, pull out the parking brake handle, depress toe pedals, release toe pedals, and release the parking brake handle.

1-93. ELECTRICAL SYSTEM.

1-94. Two engine-driven 200-ampere generators supply power to the 28-volt, direct-current electrical system. A 24-volt, 34 ampere-hour storage battery serves as a stand-by and provides current for operation of the electrical equipment when the generator is inoperative or generator output is insufficient (below 26.5 volts) to close the reverse-current relays. Each relay closes when the related engine speed reaches approximately 1100 rpm. An external power receptacle (covered by a spring-loaded door) is located on the left side of the left fuselage, aft and above the trailing edge of the wing. Two ammeters and one voltmeter (figure 1-2, references 5 and 11) are located at the top of the pilot's instrument panel.

1-95. ELECTRICALLY OPERATED EQUIPMENT.

1-96. The system supplies power for operation of the following equipment and controls: lights; electrical instruments and transmitters; armament and communication equipment; oil and coolant flap actuators; fuel booster and water injection pumps; starters; primer and oil dilution solenoids; mixture controls; engine air, heating, and anti-icing systems; surface control booster motors; and warning systems.

1-97. ELECTRICAL SYSTEM CONTROLS.

1-98. BATTERY. A battery switch (figure 1-2, reference 36) is located at the center of the engine control switch panel in the pilot's cockpit only. The inverter is turned on with the battery switch.

1-99. GENERATOR. The generator switches (figure 1-2, reference 32) are located at the center of the engine control switch panel (in the pilot's cockpit only). Guards hold the switches in the "ON" position.

1-100. VOLTMETER SELECTOR. A voltmeter selector (figure 1-3, reference 3), located above the circuit breaker panel on left side of pilot's cockpit, provides for reading the voltage output of the "LEFT GEN," "RIGHT GEN," or the "MAIN BUS."

1-101. VOLTAGE REGULATORS. The voltage regulators are preset on the ground, but in an emergency may be adjusted in flight by means of two rheostats (figure 1-3, reference 4), one for each generator, located to the left of the pilot's seat. At power settings above 1100 rpm, the voltmeter readings should be between 28 and 28.5 volts.

1-102. CIRCUIT BREAKERS. All electrical circuits are protected by push-to-reset circuit breakers. The main panel is located at the rear right side of the pilot's cockpit (figure 1-4, reference 15) and a small panel is located on the left side below the voltage regulators (figure 1-3, reference 26). A panel in the copilot's cockpit (figure 1-5, reference 19) contains circuit breakers for instruments and for cockpit, fluorescent, and taxi lights. Circuit breakers for the radio equipment are located on the radio control panel (figure 1-4, reference 24) at the right side of the pilot's cockpit.

1-103. CONTROL SHIFT SWITCHES. Control of engine air, thermal anti-icing, guns, fuel, and the command radio set may be shifted from pilot to copilot, or vice versa, by means of a control shift switch located by each set of controls. An amber indicator light, adjacent to each switch, illuminates when the copilot has control.

1-104. MISCELLANEOUS CONTROLS AND EQUIPMENT.

1-105. FIRE EXTINGUISHER.

1-106. The fire extinguishing system consists of a CO_2 cylinder installed in the left fuselage aft of the seat, fire indicator lights, and a guarded fire extinguisher switch (figure 1-2, reference 35). The fire indicator lights and guarded fire extinguisher switch are located on the engine control panel in each cockpit. When the push-to-test button (figure 1-2, reference 34) between the indicator lights is depressed, the lights will illuminate, indicating that the electrical circuits are operating properly. Should a fire occur in an engine, the related fire indicator light ("LEFT" or "RIGHT") will illuminate. When the fire extinguisher switch above the light is moved to "LEFT" or "RIGHT" as required, CO_2 is discharged into the engine section.

1-107. MANIFOLD PRESSURE DRAIN VALVES.

1-108. The manifold pressure drain valves, located immediately above the artificial horizon in both cockpits, clear the manifold pressure instrument lines of moisture and vapors.

1-109. CANOPIES.

1-110. The clear-vision bubble canopies are operated normally by use of a handcrank (figure 1-4, reference 6) on the right side of each cockpit. The canopies are opened externally from the right side of the fuselage by means of a push-button release below the aft edge of the windshield and a handle on the canopy frame. An emergency release handle for jettisoning the canopy in flight is located on the floor of each cockpit to the right of the control stick. (See figure 1-2, reference 29; figure 1-5, reference 20.) An external canopy emergency release is located on each side of the fuselage, above and forward of flap.

1-111. SEATS.

1-112. The bucket seats may be vertically adjusted by a lever on the right side of the seat. Each seat is also adjustable for tilt by a lever at the right rear of the seat on the armor plate. The shoulder harness release lever is located at the left side of the seat. Removable back cushions provided in each cockpit are kapok-filled and may be used for life preservers.

1-113. DROP MESSAGE CONTAINER.

1-114. Provisions are made for stowing a drop message tube on the floor to the left of the copilot's seat.

1-115. OPERATIONAL EQUIPMENT.

1-116. Information concerning the following operational equipment is supplied in section IV: armament, oxygen, communication, heating, ventilating, anti-icing, and anti-G suit provisions.

Section II

NORMAL OPERATING INSTRUCTIONS

2-1. BEFORE ENTERING PILOT'S COMPARTMENT.

2-2. RESTRICTIONS.

a. Inverted flight must be limited to 10 seconds because of loss of oil pressure.
b. When external fuel tanks are installed, Chandelles, Immelman turns, inverted flight, rolls, and spins, are prohibited.
c. When bombs or rockets are installed, spins are prohibited.
d. Snap rolls are prohibited.
e. Power-on spins are prohibited.
f. Rapid reversal of aileron position is prohibited. (Refer to paragraph 2-37.)
g. Do not extend gear or lower flaps fully above 190 MPH IAS.
h. Maximum permissible indicated airspeed—see figures 2-4, 2-5, and 4-4.
i. Do not unfeather propeller at temperatures below −12.2°C (10°F).
j. The engines in this airplane are restricted as follows:

Take-off—Dry (5 min max), and Military Power—Dry (15 min max),		
Sea Level to 5000 feet	3200 rpm	65 in. Hg
5000 feet to 15,000 feet	3200 rpm	60 in. Hg
15,000 feet and above	3200 rpm	57 in. Hg
Single-engine take-off—Dry (5 min max),		
Sea Level to 5000 feet	3200 rpm	67 in. Hg

When modifications permit the use of water injection:

Take-off—Wet (5 min max), or Military Power—Wet (10 min max),		
Sea Level to 5000 feet	3200 rpm	74 in. Hg
5000 feet to 15,000 feet	3200 rpm	69 in. Hg
15,000 feet and above	3200 rpm	66 in. Hg

Note: Use of water injection not to exceed a total of 10 minutes.

THESE LIMITATIONS AND RESTRICTIONS ARE SUBJECT TO CHANGE AND LATEST SERVICE DIRECTIVES AND ORDERS MUST BE CONSULTED.

2-3. TAKE-OFF GROSS WEIGHT AND BALANCE.

2-4. Check take-off and anticipated landing gross weight, and center of gravity location. Make sure that the weight and balance clearance (Form F) is satisfactory.

a. Normal take-off gross weight (full internal fuel and ammunition) is approximately 20,775 pounds. Maximum gross weight (two 310-gallon drop tanks) is approximately 24,900 pounds; however, weights over 22,000 pounds are considered an overload condition.

b. Extreme center of gravity range is from 20.8% MAC (gear down) to 27% MAC (gear up). Probable range in flight: Max aft CG = 26.8%, Max fwd CG = 21.7%.

c. Make sure the total weight of fuel, oil, ammunition, and special equipment carried is suited to the mission to be performed.

Note

Refer to Handbook of Weight and Balance Data (AN 01-1B-40) for detailed loading information.

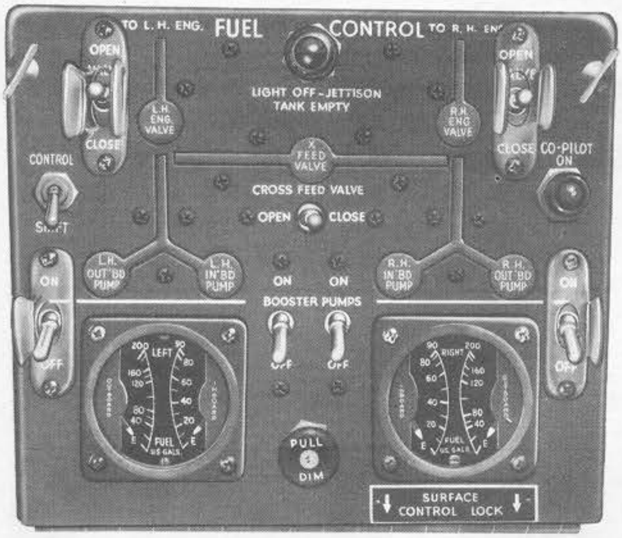


Figure 2-1. Pilot's Fuel Control Panel

2-5. EXTERIOR CHECK.

a. Make sure the airplane has been serviced with proper quantities of fuel, oil, coolant, water injection fluid, hydraulic fluid, and oxygen. Check Forms 1 and 1A.

b. Check security of cowling and all filler caps.

c. Inspect air scoops.

d. Examine propellers for nicks, cracks, and oil leakage. Make sure that blades are clean. Pull through three revolutions.

e. Remove pitot tube cover and be sure tube opening is clear.

f. Check landing gear oleo strut extension.

g. Examine tires for general condition and inflation.

h. Chock wheels.

i. Inspect over-all exterior for obvious damage. Remove accumulations of dirt, dust, frost, snow, or ice.

2-6. MINIMUM CREW REQUIREMENT.

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

2-8. ENTRANCE TO AIRPLANE.

2-9. Each cockpit is accessible from the trailing edge of the wing on either side of the fuselage; however, the canopies can be opened from the right side only. Spring-loaded doors and handles are provided in the fuselage skin, and the wing fairings may be used as steps. To open the canopy, depress the release button on right side of fuselage just below windshield, and using handle, slide canopy aft on canopy frame.

2-10. ON ENTERING PILOT'S COMPARTMENT.

Note

A Pilot's Check List is provided in each cockpit.

2-11. STANDARD CHECK FOR ALL FLIGHTS.

a. Armament switches: bomb arming switch "SAFE," bomb selector switch "OFF," rockets "OFF," guns "SIGHT & CAMERA ONLY."

b. Ignition "OFF."

c. Generators check "ON."

d. Unlock surface controls. Check controls for freedom of movement and proper travel, observing control surfaces for correct response.

e. Adjust seat and rudder pedals.

f. Set parking brakes.

CAUTION

When setting brakes, do not pull parking brake handle excessively hard as it may damage the brake poppet valves.

g. Have external power source connected. If not available, battery switch "ON."

h. Landing gear handle "NEUTRAL." Check gear position lights.

i. Propeller controls "INCREASE RPM"; throttles "OPEN" one inch.

j. Oil and coolant radiator controls "AUTOMATIC."

k. Clock and altimeter set.

l. "COPILOT ON" indicator lights (guns, fuel, engine air controls, and command radio) off. If any light is on, move related "CONTROL SHIFT" switch to opposite position.

m. Hold mixture control switches at "IDLE CUT-OFF" for 3 seconds.

n. Check fuel quantity.

o. Cross-feed valve "CLOSE"; engine valves "OPEN." Make sure that copilot's engine valves are in the open position.

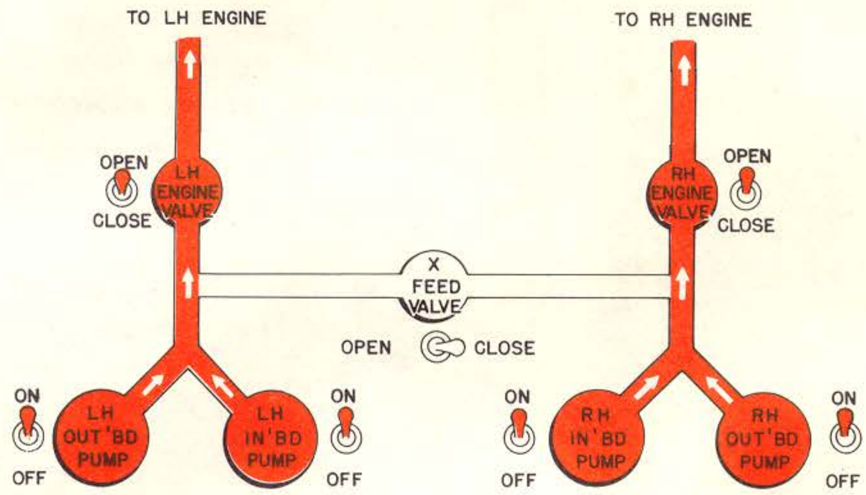
p. Booster pumps—check each pump separately for pressure of 10-14 psi. Pump switches "OFF" until ready to start engines.

Note

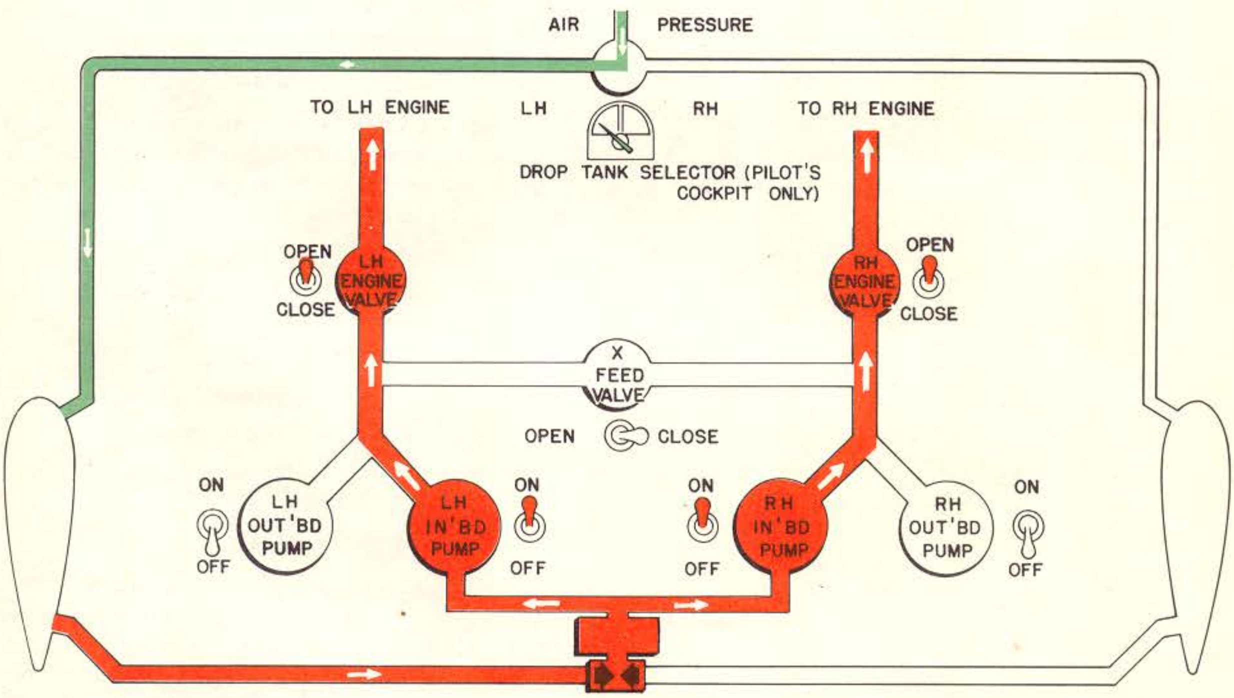
If external power source is not available and booster pumps are checked with airplane's batteries, booster pump pressure will be less, depending on condition of the airplane's batteries.

q. Engine air controls "ENG. RAM AIR," or "ENG. FILTERED AIR" as required.

VAPOR RETURN TO IN'BD TANKS 3 GAL (9 GAL IF HEATER IS ON) PER HR PER ENGINE



COURSE OF FUEL FLOW - WITHOUT DROP TANKS
TAKE - OFF AND CLIMB TO SAFE ALTITUDE: SELECT AS SHOWN. DURING FLIGHT: TURN OUT'BD PUMPS "OFF" AND USE FUEL FROM IN'BD TANKS FIRST; THEN SELECT OUT'BD PUMPS. LANDING: SELECT ALL PUMPS OF TANKS CONTAINING FUEL "ON".



COURSE OF FUEL FLOW DURING FLIGHT - DROP TANKS INSTALLED
TAKE OFF WITH ALL PUMPS "ON" IN FLIGHT, TURN OUT'BD PUMPS "OFF" UNTIL DROP TANKS AND IN'BD TANKS ARE EMPTY. EITHER DROP TANK MAY BE SELECTED FIRST; SWITCH TO OPPOSITE TANK AS NECESSARY TO DRAIN TANKS EVENLY. WHEN INDICATOR LIGHT GOES OUT, SELECTED TANK IS EMPTY.

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Figure 2-2. Courses of Fuel Flow

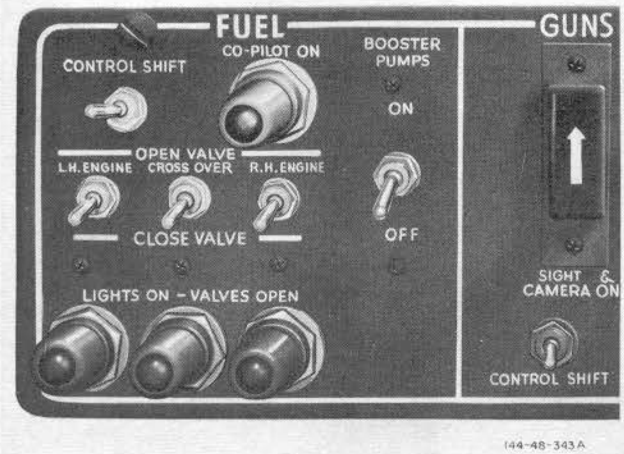


Figure 2-3. Copilot's Fuel Control Panel

CAUTION

Do not use engine charge heat during engine starts, take-offs, or landings, as an engine backfire may cause severe damage to the induction and heating system. Use engine charge heat for all other operations, including ground run-up.

r. Hydraulic boost "ON."

Note

To check operation of surface control booster system, turn hydraulic boost "ON" while moving control stick. A noticeable reduction in friction will be felt.

s. Test operation of oxygen equipment.

t. Test operation of communication equipment if external power is being used.

u. Test operation of gun sight as instructed in paragraph 4-16 if external power is used. Make sure selector-dimmer control is at "GYRO" or "FIXED & GYRO" before starting engine.

v. Before any night flight, check all lighting equipment.

w. Water injection switch in "OFF" position.

x. Heat, ventilating and anti-icing controls set as required.

2-12. ON ENTERING COPILOT'S COMPARTMENT.

2-13. STANDARD CHECK FOR ALL FLIGHTS.

a. Adjust seat and rudder pedals.

b. Set clock and altimeter.

c. Gun switch "SIGHT & CAMERA ONLY."

d. Make sure oil and coolant radiator controls are in "AUTOMATIC."

e. Test operation of oxygen equipment.

f. Before any night flight, check all lighting equipment.

g. Make sure engine fuel valves are at "OPEN."

2-14. FUEL SYSTEM MANAGEMENT.

2-15. See figure 2-2 for fuel system management.

2-16. Alternate grade fuel (100/130) operating limits are the same as limits on recommended grade fuel (115/145).

2-17. STARTING ENGINES.

2-18. After completing all cockpit checks, start engines as follows:

Note

Start right engine first.

a. Recheck throttle, propeller, and mixture control positions.

b. Recheck engine air control switches to "ENG. RAM AIR" or "ENG. FILTERED AIR" as required.

c. All booster pumps "ON."

d. Prime engine 2 seconds when cold, one second when hot.

e. Ignition switch "BOTH."

f. Engage starter. Prime as required.

Note

If engine fails to start after one minute of continuous cranking, allow starter to cool for one minute before making another attempt to start engine.

g. As engine starts, hold mixture control switch at "NORMAL" for 3 seconds. Prime intermittently for smooth operation.

CAUTION

When engine is not firing, mixture control must be at "IDLE CUT-OFF."

Note

Should engine fail to start because of overpriming, turn off ignition, hold mixture switch at "IDLE CUT-OFF" for 3 seconds, and open throttle. Rotate propeller through about three revolutions by hand or with starter, then repeat starting procedure.

h. Check oil pressure. If not within limits in 30 seconds, stop engine and investigate.

i. Disconnect external power source and turn battery "ON" after both engines are started.

Note

Refer to paragraph 3-2 for instructions in case of fire during starting procedure.

2-19. WARM-UP.

CAUTION

Engine run-up with wheels chocked is limited to take-off power on one engine. For checks above that power, the tail must also be secured.

2-20. Move engine air control switches to "ENG. CHARGE HEAT" and warm up engines at 1300 rpm until oil temperature shows a definite increase and oil pressure remains steady when throttle is advanced. The desired oil and coolant temperatures will be maintained by having the radiator air controls in "AUTOMATIC." If the limits are exceeded with the controls in "AUTOMATIC," stop engines and investigate. (See figure A-4.)

2-21. GROUND TEST.

2-22. While engines are warming up, make the following tests:

a. Hydraulic system—check by operating flaps.

b. Oil and coolant radiator controls—check (assisted by outside observer or copilot) by using manual positions of each switch. Return switches to "AUTOMATIC."

CAUTION

Check with copilot that oil and coolant radiator controls in right cockpit are in "AUTOMATIC."

c. With manifold pressures less than 25 in. Hg, depress manifold pressure drains for 3 seconds.

d. Instruments—check for indication in desired ranges.

e. Communication and armament equipment—test if check was not previously accomplished.

2-23.TAXIING INSTRUCTIONS.

2-24. Observe the following instructions and precautions for taxiing:

a. To taxi straight, hold stick slightly aft of neutral to lock tail wheels.

b. To make gradual turns, use rudder pedals when tail wheels are locked.

c. To make sharp turns, neutralize rudders and push stick forward of neutral to allow tail wheels full swiveling action.

CAUTION

To prevent damage to tail wheel lock mechanisms, push control stick forward of neutral *before* a turn is started.

d. Always taxi carefully to prevent possible damage to air scoops and flaps from rocks thrown against them by tires.

Note

Coolant flaps will automatically be maintained in a safe position for ground operation.

e. Make sure wing flaps are up.

f. Steer a zigzag course to obtain an unobstructed view.

g. Use brakes as little as possible.

2-25. BEFORE TAKE-OFF.

2-26. After taxiing to take-off position, set brakes and complete engine ground test and controls check as follows:

a. Advance throttle to 2300 rpm and check engine instruments for desired readings. (See figure A-4.)

b. Check ammeters for positive reading; check voltmeter readings on "LEFT GEN," "RIGHT GEN," and "MAIN BUS" for 28.25 volts maximum.

c. At 2300 rpm, retard propeller control to note drop of 300 rpm (maximum); then return control to full "INCREASE RPM." Manifold pressure should remain constant within one in. Hg.

d. With propeller controls in the full "INCREASE RPM" position, advance throttle to obtain a manifold pressure of 30 in. Hg (approximately 2400 RPM), and check each magneto.

Maximum allowable drop in rpm:
Left magneto—100 rpm
Right magneto—150 rpm

e. Move engine air control switches to "ENG. RAM AIR" or "ENG. FILTERED AIR" as desired.

f. Advance throttle momentarily for high-power check. (Check each engine separately.)

g. Wing flaps 20 degrees if desired.

h. Trim tabs: elevator 5° TH, rudder 0°, aileron 0°.

i. Check all booster pumps "ON."

j. Canopy closed and locked.

k. Safety belt and shoulder harness tightened and locked.

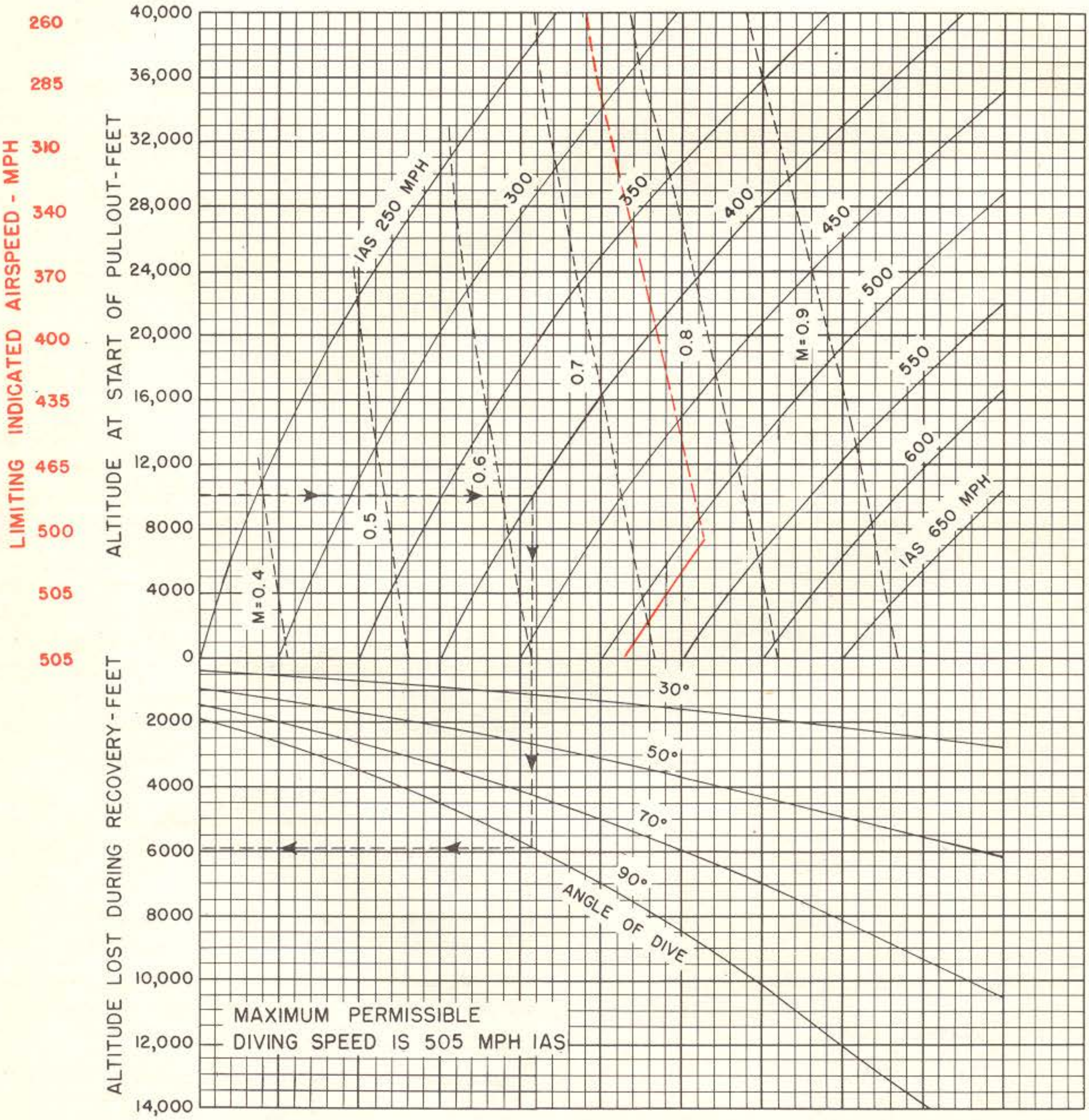
l. Water injection switch "ON" if water is to be used for take-off.

m. Parking brakes off.

TO USE CHART ENTER WITH

(1) MACH NUMBER AND IAS,
OR (2) ALTITUDE AND IAS,
OR (3) ALTITUDE AND MACH NUMBER.

EXAMPLE: IF PULLOUT FROM VERTICAL DIVE IS STARTED AT 10,000 FEET AND 400 MPH IAS, 5900 FEET OF ALTITUDE IS LOST DURING RECOVERY WITH CONSTANT 4 G ACCELERATION.



NOTE

RED FIGURES AND RED LINES ON CHART ARE FOR CLEAN AIRPLANE ONLY.

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Figure 2-4. Diving Limitations—4 G Pull-out

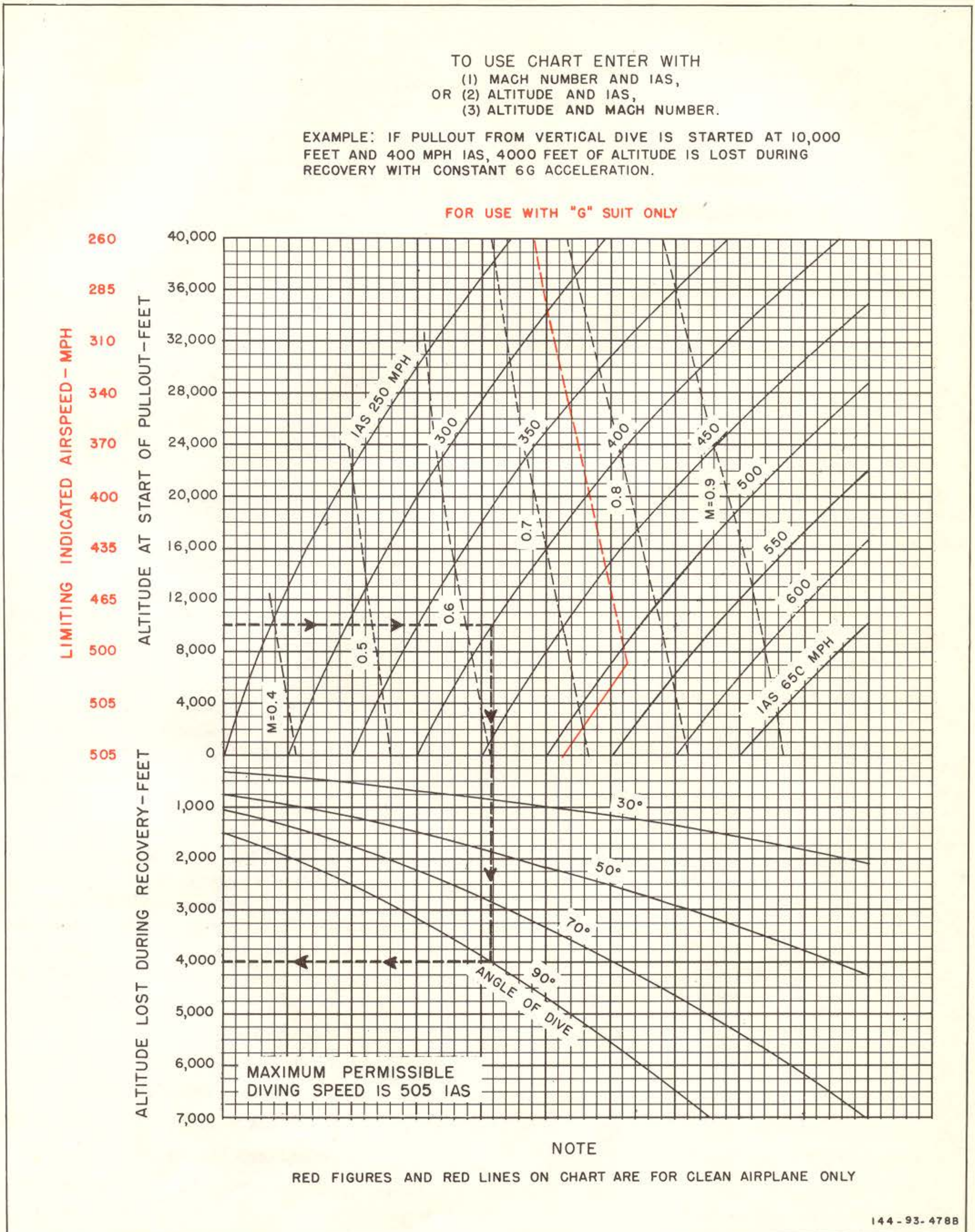

Figure 2-5. Diving Limitations—6 G Pull-out

2-27. TAKE-OFF.

2-28. NORMAL TAKE-OFF.

a. Hold stick back of neutral to lock tail wheels.

b. Start take-off run advancing throttles to take-off power.

WARNING

Engine operation in excess of manifold pressure limitations listed in paragraph 2-2 may cause severe backfiring and damage to the engines.

c. Normal take-off speeds are approximately as follows:

	NORMAL LOAD	MAXIMUM LOAD
Flaps "UP"	120 mph	130 mph
Flaps "20°"	115 mph	125 mph

d. Refer to Take-off, Climb, and Landing Chart (Appendix) for estimated take-off distances.

Note

Refer to paragraph 3-13 for procedure in case of engine failure during take-off.

2-29. MINIMUM RUN TAKE-OFF.

a. Wing flaps 20 degrees.

b. With stick well back to lock tail wheels, hold brakes and advance throttles.

c. As airplane begins to roll, release brakes and continue advancing throttles to take-off power.

2-30. AFTER TAKE-OFF.

a. When definitely airborne, landing gear handle "UP." Wait until gear position lights (green and red) are out and hydraulic pressure light (amber) is on; then return gear control to "NEUTRAL." Approximately 14 seconds is required for gear retraction.

CAUTION

Do not reverse position of the landing gear handle before a retraction or extension cycle is completed.

b. Start initial climb after attaining approximately 135 mph (normal load) or 155 mph (maximum load).

c. Wing flaps "UP" after reaching a safe altitude.

d. Reduce power and begin climb.

e. Water injection switch "OFF."

f. Move engine air control switches to "ENG. CHARGE HEAT."

2-31. CLIMB.

2-32. Refer to the Take-Off, Climb, and Landing Chart in Appendix for recommended indicated airspeeds to be used during climb, and for rate of climb and fuel consumption.

a. Climb at maximum continuous power.

b. With increase in altitude, advance throttle as necessary to maintain manifold pressure.

2-33. DURING FLIGHT.

2-34. ENGINE OPERATION.

a. Set power plant controls to desired settings. (Refer to Flight Operation Instruction Charts in Appendix for cruise data.)

b. Outboard booster pumps "OFF."

c. Periodically check for desired instrument readings. (See figure A-4.)

d. Check engine air control switches to "ENG. CHARGE HEAT."

e. For long-range operation at or below 44 in. Hg and 2400 rpm, use "LONG RANGE CRUISE" position of mixture control.

2-35. FLIGHT CHARACTERISTICS.

2-36. Stability and control characteristics of the airplane are satisfactory, both in accelerated maneuvers and steady flight. Handling qualities are good, the control forces being well-balanced and varying normally with variation in load factor or speed. Rolling maneuvers feel quite natural, and there is no perceptible acceleration of the pilot or copilot about the centerline of the airplane during such maneuvers. Trim tab characteristics are normal, and adequate trim is available for control under all conditions, including single-engine cruise.

2-37. TAIL BOOM DEFLECTION. Rapid reversal of aileron position by stick movement (especially at speeds in excess of 190 mph) results in severe tail boom deflection or "wobbling." Such deflection is an undesirable flight condition and the control movement causing it is, therefore, prohibited. Should the deflection be induced inadvertently, the oscillation will immediately dampen if the stick is neutralized.

2-38. USE OF WATER INJECTION.

WARNING

Engine operation in excess of manifold pressure limitations listed in paragraph 2-2 may cause severe backfiring and damage to the engines.

CAUTION

If the oil has been diluted, operate the engine at maximum continuous power until normal oil temperatures and pressures are maintained.

a. Water injection switch "ON."

b. Propeller controls full "INCREASE RPM."

c. Advance throttles to allowable manifold pressure.

Note

A drop in engine charge air temperature will occur when water injection system goes into operation.

WARNING

When water pressure drops or the water supply is depleted, an immediate rise in engine charge air temperature will occur. It is imperative that the manifold pressure be reduced immediately, to prevent engine damage and possible engine failure.

2-39. STALLS.

2-40. Power-off stalls in this airplane are very mild. Adequate warning in the form of general airplane buffet occurs approximately 9 mph above the stall with power on, flaps and gear up. However, there is little or no stall warning with the flaps and gear down, power on or off, and flaps and gear up, power off. Stalls, power on, are characterized by a moderate rolling tendency. Recovery, accomplished by releasing back pressure on the stick, is entirely normal. See figure 2-6 for stalling speeds.

2-41. SPINS.

WARNING

Power-on spins in this airplane are prohibited.

2-42. This airplane tends to resist all spins and must be forced into the maneuver. Spin entry is characterized by yaw and roll in the direction of the spin, coupled with a nose-down pitch and resultant increase in airspeed. During the following half turn, the airplane's angle of yaw decreases, followed by a nose-up pitch, and a decrease in airspeed. This yawing, pitching, and rolling stabilizes after the spin has progressed through 2½ to 3 turns. Altitude lost during spins is approximately 1000 feet per turn plus 4500 feet to regain level flight after recovery controls are applied. Pilots spinning this airplane should expect to experience moderate lateral accelerations. These forces are not severe enough to restrict the pilot's movements within the cockpit.

2-43. Application of recovery controls, which is full rudder against the spin, ailerons neutral, and almost simultaneous movement of the elevator to neutral, results in instant response towards stopping the spin. Very little back pressure should be used in recovery in order to prevent buffeting and premature stalls.

CAUTION

Gear and flap-down spins, after the first turn, increase the intensity of the lateral accelerations on the pilot and cause heavy airplane buffeting.

2-44. PERMISSIBLE ACROBATICS.

2-45. All acrobatics are permitted, except snap rolls and power-on spins. Inverted flight must be limited to 10 seconds because of the loss of oil pressure.

2-46. DIVING.

2-47. The handling qualities of this airplane in a dive are not appreciably affected by compressibility up to the limit Mach number of .75. At that point, a mild airplane buffet starts. Below .75 Mach number, no wallowing, porpoising, or abnormal motions of the airplane are encountered. Trim tab settings established for level flight with normal rated power are satisfactory for diving; and during the dive a gradual increase in push force is required from the trim speed up to the limit speed. Rudder pedal forces do not increase appreciably and aileron stick forces retain good "feel."

Note

See figures 2-4, 2-5, and A-4, for airspeed and Mach number limitations.

2-48. ENGINE OPERATION.

a. It may be necessary to retard the throttles if it is desired to maintain a constant manifold pressure during a dive.

b. After pull-out, check manifold pressure and, if necessary, reduce power.

2-49. APPROACH.

2-50. During approach to field for landing, make the following checks:

a. Safety belt and shoulder harness tightened and locked.

b. Oil and coolant radiator controls "AUTOMATIC."

c. Armament switches "SAFE," "OFF," and "SIGHT & CAMERA ONLY."

d. Mixture control switches "NORMAL."

e. Engine air control switches positioned to "ENG. RAM AIR" or "ENG. FILTERED AIR" as required.

f. All booster pumps of tanks containing fuel "ON."

g. Propeller controls 2700 rpm.

h. Landing gear handle "DOWN" below 190 mph. Check indicator lights; then return handle to "NEUTRAL."

CAUTION

After moving gear handle to "DOWN," do not attempt to raise gear until the extension cycle is complete.

i. Do not lower flaps above 190 mph.

j. Make initial approach at approximately 145 mph.

2-51. LANDING.

Note

Airplanes of high wing loading require a power-on approach for landing, because the rate of descent with power off is very high.

2-52. NORMAL LANDING.

a. Make a power-on approach.

b. Flaps 40° down on final. Maintain a flat glide angle at a speed of approximately 135 mph.

c. Adjust trim.

d. Start flare, reducing power to idling and speed to approximately 110 mph just above runway.

2-53. AFTER LANDING.

a. Flaps "UP" before taxiing.

2-54. CROSS WIND LANDING.

2-55. The wide-tread landing gear and locked tail wheels of the airplane facilitate the execution of cross-wind landings. Crab, slip, or combination approach may be used.

2-56. MINIMUM RUN LANDING.

2-57. Make a power-on approach using full flaps. As obstacles are cleared, start flare, reducing power and speed as in a normal landing.

2-58. GO-AROUND.

a. Propeller controls full "INCREASE RPM."

b. Open throttles to take-off power.

c. Landing gear "UP." When gear is up and locked, return handle to "NEUTRAL."

d. When sufficient airspeed is attained, gradually raise flaps.

2-59. STOPPING OF ENGINES.

2-60. Stop engines as follows:

a. Set parking brakes.

b. Dilute oil as required. For oil dilution instructions, refer to paragraph 5-11.

c. Run up engines to 1200-1400 rpm for approximately 1-2 minutes; then hold mixture control switches in "IDLE CUT-OFF" position for 3 seconds and advance throttles to gate.

Note

The above procedure will help prolong the life of the spark plugs.

d. When propellers stop rotating, ignition switches "OFF" and throttles "CLOSE."

CAUTION

If throttles are left open, overspeeding of the engines, which cannot be controlled by retarding the throttle levers, may occur on the subsequent starting attempt. This condition is caused by congealed throttle valve control oil which may be trapped in the throttle valve "open" line. By moving the throttle levers to "CLOSE" as soon as the engine stops, it will be possible for the spring-loaded throttle valve to force the warm control oil out of the "open" line and assume the fully closed position.

2-61. BEFORE LEAVING AIRPLANE.

2-62. Before leaving cockpit, make the following checks:

a. Booster pump switches "OFF"; engine valves "CLOSE."

b. All switches except generator switches "OFF."

c. Release parking brakes after wheels are chocked.

d. Lock surface controls.

e. Complete Forms 1 and 1A.

INDICATED STALLING SPEEDS — MPH

GROSS WEIGHT	FLAPS DOWN				FLAPS UP			
	POWER ON NORMAL RATED		POWER OFF		POWER ON NORMAL RATED		POWER OFF	
	LEVEL FLIGHT	45° BANK	LEVEL FLIGHT	45° BANK	LEVEL FLIGHT	45° BANK	LEVEL FLIGHT	45° BANK
26,000 LB	117	139	133	158	127	151	143	170
22,000 LB	108	128	122	145	117	139	132	157
18,000 LB	97	116	111	132	106	126	119	142

NOTE: LANDING GEAR POSITION DOES NOT AFFECT STALL SPEEDS

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Figure 2-6. Indicated Stalling Speeds

Section III

EMERGENCY OPERATING INSTRUCTIONS

3-1. FIRE.

3-2. ENGINE FIRE DURING STARTING PROCEDURE.

a. If possible, keep engine running. The fire may be sucked through engine and extinguished.

b. Signal ground crew to use portable fire extinguishing equipment.

c. Fire extinguisher switch "LEFT" or "RIGHT" as required.

d. If fire persists, shut off fuel supply by moving engine fuel valve switches to "CLOSE." Ignition safety switch "OFF."

e. Get out of airplane as quickly as possible.

3-3. ENGINE FIRE DURING FLIGHT.

a. Related engine valve switch (fuel shut-off) "CLOSE."

b. Feather propeller.

c. Ignition switch "OFF."

d. Fire extinguisher switch "LEFT" or "RIGHT" as required.

CAUTION

Do not restart engine. A single discharge exhausts CO_2 supply, leaving none available in case of additional fire.

3-4. ELECTRICAL FIRE.

a. If source of fire can be determined, turn off switches controlling faulty circuits.

b. When it is impossible to isolate origin of fire, turn battery and generator switches "OFF."

CAUTION

Land as soon as possible. Much of the airplane's equipment becomes inoperative when the electrical power source is shut off.

3-5. WING FIRE.

a. Turn off all switches controlling electrical installations in wing.

b. When possible, attempt to extinguish fire by side-slipping airplane away from flame.

3-6. ENGINE FAILURE.

3-7. SINGLE-ENGINE CONTROL CHARACTERISTICS.

3-8. Single-engine control characteristics of this airplane are exceptionally good. Should engine failure occur either on take-off or during flight, control forces required to hold a constant heading are relatively light, and complete control is easily maintained down to stall speed. Adequate directional trim is also available for single-engine cruise with propeller feathered.

3-9. ENGINE FAILURE CHARACTERISTICS.

3-10. Engine failure at cruising and higher speeds will not always be immediately apparent because of the slight amount of yaw induced by engine failure. Also, the instruments will not always give a positive indication of the engine failure until some time has passed. If flight speed is sufficiently high, the propeller on the dead engine will continue to govern at the rpm selected by the propeller control, and since the superchargers are engine-driven (engine stage supercharger through gears, and the auxiliary stage supercharger through a combination of gears and fluid coupling), manifold pressure will not drop, but will continue to indicate normal operation of the engine. Retarding the throttle will decrease manifold pressure; advancing the throttle will increase manifold pressure. Fuel and oil pressure may be normal, since they are controlled by engine-driven pumps and the automatic coolant flap will maintain coolant temperature within limits for a short time, depending on outside air temperature. The only immediate indication of an engine failure will be an increase in trim requirements. The amount will depend on power being used and airspeed at the time of the engine failure. At cruising powers and airspeeds, and in dives, the amount of yaw will be small and engine failure may not be discovered until increased power demands are made. If engine failure should occur during maneuvers or acrobatics, the resultant yaw might be attributed by the pilot to imperfect coordination or rough air. Engine failure at high powers and low airspeeds will cause considerable yaw and possibly a drop in engine rpm and manifold pressure, depending on airspeed. If the airspeed is so low that the propeller cannot windmill at rpm selected by the propeller control, engine rpm and manifold pressure will drop.

3-11. If it is suspected by the pilot that an engine is dead and windmilling, and there is sufficient altitude available, the following procedure may be used to determine if the engine is dead:

a. Retard the throttle on the good engine.

b. Manipulate the throttle on the questionable engine and note any change in yaw and noise level. If there is no change in yaw and noise level, the engine is dead and windmilling.

3-12. Once it is determined that an engine is dead and windmilling, feather the propeller (paragraph 3-21), and use the single-engine procedure as described in paragraph 3-18.

3-13. ENGINE FAILURE DURING TAKE-OFF.

3-14. ENGINE FAILURE DURING TAKE-OFF RUN. If one engine fails during take-off run, close both throttles immediately and apply brakes. Inasmuch as the landing gear handle cannot be moved to "UP" when the airplane is on the ground, the gear cannot be collapsed. However, under certain conditions it may be desirable, when sufficient speed is available, to lift the airplane off the ground enough to permit moving the handle to "UP" so that the gear will collapse as the airplane settles back to the ground.

3-15. SINGLE-ENGINE FAILURE—CONTINUED FLIGHT. If an engine fails immediately after take-off, quickly determine whether the attained airspeed and altitude will permit continued flight, or if a forced landing must be made. Estimated single-engine stalling speeds are approximately 5 mph higher than normal. (See figure 2-6.) If continued flight is possible, proceed as follows:

a. Immediately apply rudder to correct yaw, and depress nose slightly to maintain airspeed above stall.

b. Increase manifold pressure on good engine as required, within limits specified in paragraph 2-2.

Note

If an obstacle must be cleared, best single-engine climbing speed (gear down, flaps 20°, and windmilling propeller) is 135 mph.

c. Landing gear handle "UP" (if gear is not already retracted) when right engine is dead. If left engine is dead, the hydraulic pump is inoperative and the gear must be left down.

Note

If a safe altitude and airspeed have been reached, it is possible to retract the gear by allowing the dead left engine to windmill and drive the hydraulic pump.

d. Release drop tanks or bombs.

e. Feather propeller on failing engine.

f. Raise wing flaps slowly. (Even if left engine is dead and hydraulic pump therefore inoperative, there will be enough pressure remaining in the system to raise flaps. The flap emergency switch can be used to lower flaps for subsequent landing.)

g. Trim airplane to reduce rudder force.

h. Gain as much speed as possible before starting climb. Best single-engine climbing speed with military power (gear and flaps up, propeller on dead engine feathered) is approximately 170 mph.

3-16. ENGINE FAILURE—FORCED LANDING. If it is impossible to maintain flight after an engine failure during take-off, accomplish as much of the following as time allows:

a. Apply rudder to maintain straight flight, and depress nose of airplane to maintain flying speed.

b. Release drop tanks or bombs if carried.

Note

If rockets are carried, they cannot be released in a safe condition.

c. Landing gear handle "UP." (If left engine is dead and no hydraulic pressure is available, the gear will at least be unlocked and will collapse on landing.)

d. If flaps have been raised, move control to desired setting. If left engine is dead and windmilling, the hydraulic pump will supply pressure for flap operation. The emergency flap switch may be utilized if desired.

e. Both engine valves (fuel shut-off) "CLOSE."

f. Ignition and battery switches "OFF."

g. Jettison canopies.

h. Land straight ahead, changing direction only as necessary to miss obstructions.

3-17. ENGINE FAILURE DURING FLIGHT.

3-18. SINGLE-ENGINE FAILURE. If one engine fails during flight, proceed as follows:

Note

- Estimated single-engine stalling speeds are approximately 5 mph higher than normal. (See figure 2-6.)
- Using normal rated power on single engine, altitude can be maintained up to 10,000 feet with airplane gross weight of 21,000 pounds, up to 5000 feet with airplane gross weight of 23,000 pounds.

a. Hold airplane straight with rudder. A slight yaw is allowable.

b. Feather propeller on failing engine.

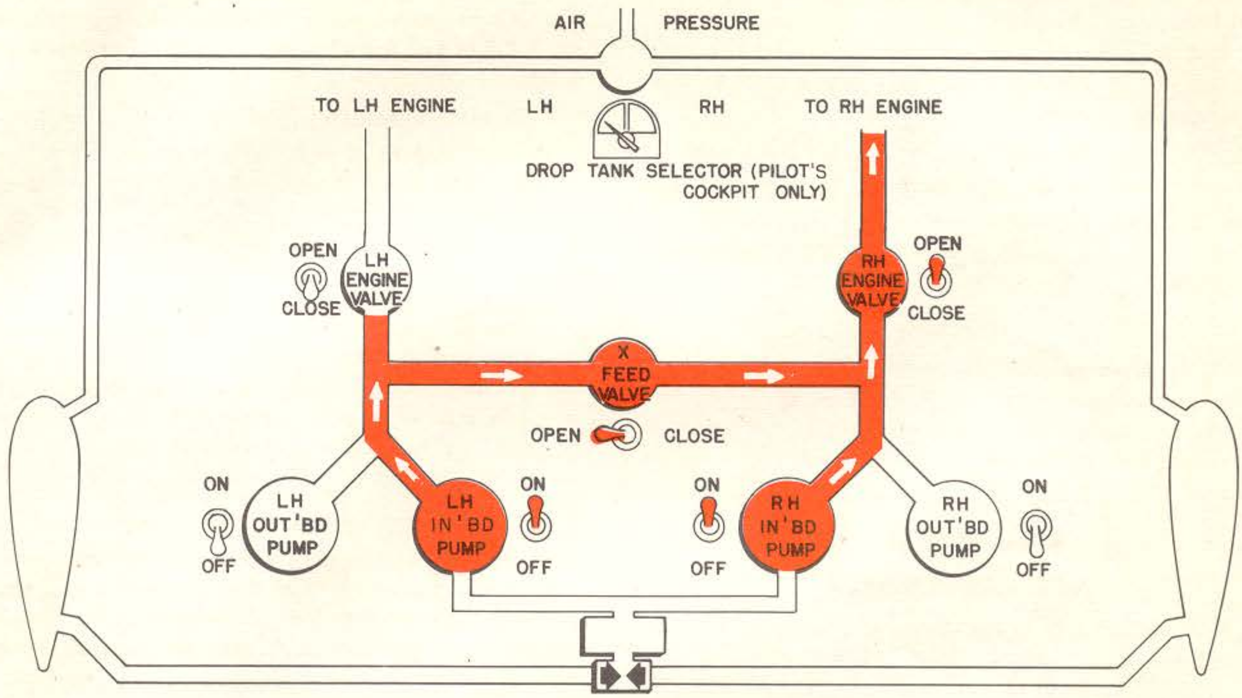
c. Adjust power settings on good engine.

d. Trim airplane as required.

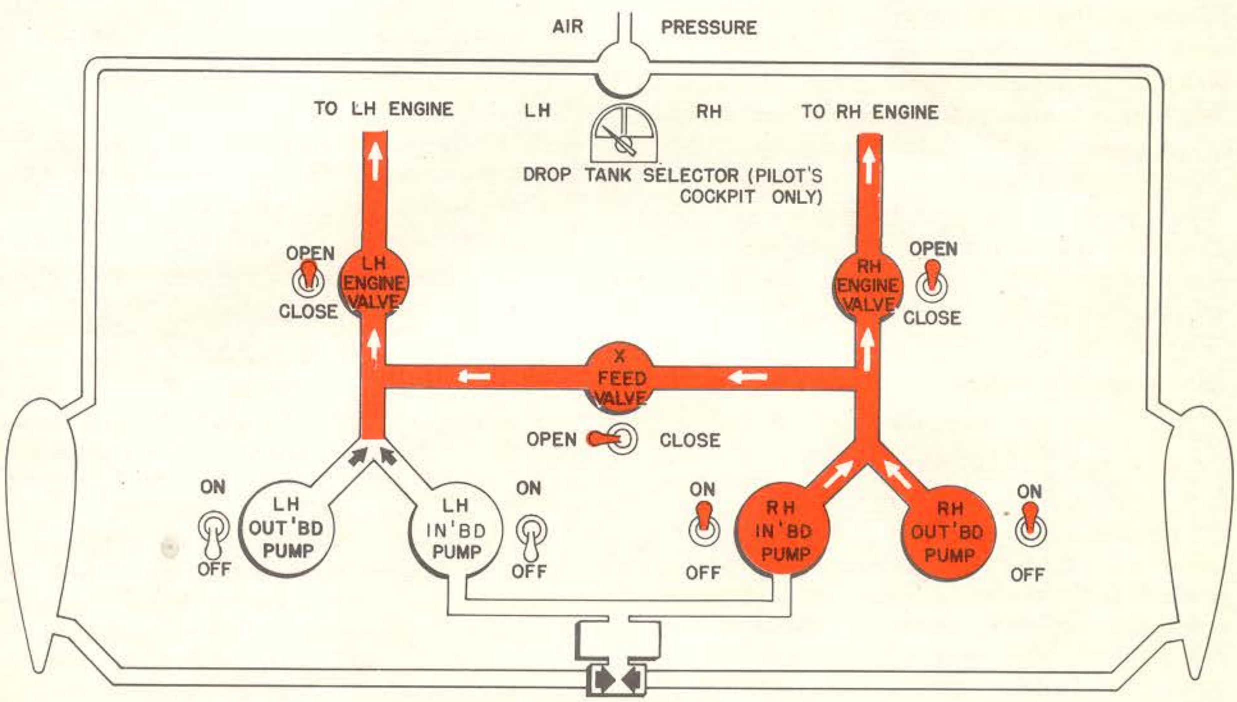
e. See figure 3-1 for fuel selection during single-engine operation, figure A-9 for range data.

3-19. SINGLE-ENGINE LANDING. If it is impossible to maintain flight after one engine failure during flight, land as follows:

a. When in position for normal approach and landing, lower gear. (If left engine is dead, use emergency landing gear release.) The airplane will maintain altitude on single engine with gear extended and propeller on dead engine feathered.



COURSE OF FUEL FLOW - LEFT ENGINE DEAD
OUT'BD PUMPS MAY BE SELECTED WHEN IN'BD TANKS ARE EMPTY. IF DROP TANKS ARE INSTALLED, SELECT AS DESIRED WHILE IN'BD PUMPS ARE "ON."



COURSE OF FUEL FLOW - LEFT TANKS EMPTY

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Figure 3-1. Courses of Fuel Flow—Emergency

b. Reduce rudder trim used for single-engine flight to prevent high rudder forces when good engine is throttled.

c. Use flaps and power on live engine to regulate glide angle. (If left engine is dead, lower flaps by use of flap emergency switch.)

3-20. PROPELLER—EMERGENCY OPERATION.

3-21. PROPELLER FEATHERING. To feather propeller, proceed as follows:

a. Throttle for dead engine "CLOSE"; propeller, "FEATHER."

Note

Unless throttle is fully retarded, propeller control cannot be moved to the feathering range. No additional controls are provided or required for feathering the propellers.

WARNING

If propeller does not feather completely when control is moved to "FEATHER," advance propeller control into governing position and then return to full feather position. If propeller cannot be feathered, leave propeller control in full high pitch (low rpm) position, to reduce drag from windmilling propeller.

b. Mixture switch for dead engine "IDLE CUT-OFF" for 3 seconds.

c. Trim rudder to reduce rudder force.

d. Move dead engine switches as follows: ignition "OFF," generator "OFF," engine valve (fuel shut-off) "CLOSE," booster pumps "OFF."

e. Adjust power setting on good engine.

f. Trim airplane for correct flight attitude.

g. See figure 3-1 for fuel selection during single-engine operation, and figure A-9 for range data.

3-22. PROPELLER UNFEATHERING. To unfeather propeller, proceed as follows:

CAUTION

Do not unfeather propeller at temperatures below −12.2°C (10°F). Low temperatures may partially freeze coolant in engine cooling system while propeller is feathered. This condition results in poor circulation and excessive temperature rise when engine is restarted without first allowing time at a higher temperature for the solution to thaw.

a. Engine valve "OPEN," and inboard or outboard (whichever tank is fuller) booster pump switch "ON."

b. Throttle "OPEN" approximately one inch.

c. Ignition "BOTH."

d. Advance propeller control approximately 2 inches from "FEATHER" until propeller begins to turn.

e. As propeller starts turning, hold mixture switch at "NORMAL" for 3 seconds. Check oil pressure within range.

f. Generator switch "ON."

g. Run engine at reduced power until the oil and coolant temperatures indicate a safe operating condition.

Note

If an attempt to unfeather propeller is unsuccessful, place propeller control in cruising rpm range and engage the starter to start propeller rotating. Rotation of the propeller is required in order to actuate the integral propeller oil pump, and thus move the blades out of the feathered position.

3-23. RUNAWAY PROPELLER.

3-24. Failure of the propeller governor may result in a runaway propeller. When such a failure occurs, the propeller goes to full low pitch and engine speed may exceed allowable limits. It may be possible to reduce rpm as follows:

a. Retard throttle for related engine and reduce airspeed to minimum. (See figure A-4 for maximum allowable rpm.)

b. Attempt to feather propeller.

c. If feathering is not accomplished and rpm cannot be reduced below the maximum allowable, shut down engine completely.

3-25. BAIL-OUT.

3-26. In the event that an emergency exit must be made during flight, the following procedure is recommended:

a. If possible, reduce speed and trim airplane to fly "hands off."

b. Disconnect radio and oxygen equipment.

CAUTION

If bail-out is made at high altitude, remain connected to the regular airplane oxygen supply while all other preparations for leaving the airplane are being made. Just before leaving the airplane, disconnect oxygen mask from mask-to-regulator tubing and place the Type H-2 emergency oxygen cylinder in operation by pulling the rip cord cable of the oxygen cylinder (the caution tag and pin assembly having been removed prior to take-off).

c. Unfasten safety belt and shoulder harness.

d. Jettison canopy. If canopy does not fly off immediately when emergency canopy release is pulled, move handcrank enough to relieve pressure against windshield.

e. Raise seat to topmost position.

f. Rise to a crouched position in the seat and dive *outboard* toward the wing tip.

3-27. FORCED LANDING.

3-28. Power-off landings in airplanes of high wing loading, such as the F-82E, demand exceptional pilot skill and should be executed only in an emergency. When failure of both engines requires it, prepare for such a landing as follows:

Note

Refer to paragraph 3-16 for single-engine landing instructions.

a. Immediately depress nose of airplane to maintain flying speed.

b. Release drop tanks or bombs.

Note

If rockets are carried, they cannot be released in a safe condition.

c. When it is desirable to stretch the glide, feather both propellers. Windmilling propellers will shorten the glide.

d. Both engine valves (fuel shut-off) "CLOSE."

e. Ignition safety switch "OFF."

f. Jettison canopies.

g. Do not lower landing gear (unless absolutely certain that available area is suitable for wheels-down landing).

h. Lower flaps as required by use of flap emergency switch.

i. Without power the airplane will sink very rapidly. Maintain an airspeed well above stall during glide and flare.

j. Battery switch "OFF" just before landing.

Note

Surface control booster system will be inoperative when electrical power source is cut off.

k. After landing, get out of airplane as quickly as possible, and stay out.

3-29. DITCHING.

3-30. As a result of experience with airplanes of similar design, it is recommended that the airplane be ditched only as a last resort. If it is impossible to reach land when trouble arises over water, leave the airplane while in flight. When ditching is unavoidable, proceed as follows:

a. Release drop tanks or bombs.

Note

If rockets are carried, they cannot be released in a safe condition.

b. Unbuckle parachute, tighten safety belt, and lock shoulder harness.

c. Jettison canopies.

d. Lower flaps 20° to 30°. (Flaps will collapse on impact and do not tend to make the airplane dive.)

e. Use as much power as possible.

f. Reduce speed to just above stall.

g. Maintain level attitude.

h. If a wind is blowing, head into wind. Try to touch down just after a wave crest has passed. If wind velocity is under 5 mph, disregard wind and head airplane parellel to any swells that may be running. Try to touch down on the falling side of the swell.

3-31. FUEL SYSTEM EMERGENCY OPERATION.

3-32. COURSES OF FUEL FLOW—EMERGENCY.

3-33. See figure 3-1.

3-34. COOLANT FLAP EMERGENCY OPERATION.

3-35. If under any condition an excessive coolant temperature persists on either engine:

a. First try the manual "OPEN" position of the coolant radiator control switch for the related flap. (Check flap visually from opposite cockpit.)

b. If after approximately 20 to 30 seconds, the temperature remains high and failure of the coolant flap actuator is indicated, pull the emergency coolant air flap release lever in the related cockpit.

c. After using the emergency release, hold the coolant radiator control switch in the "CLOSE" position for approximately 20 seconds. (This will ensure that the flap is not extended beyond 6 inches if the electrical actuator is functioning at all.)

d. Place the switch at the central or off position for the remainder of the flight.

CAUTION

Use the emergency release with discretion. High coolant temperatures may be the result of high power settings, engine malfunction, or a broken indicator rather than actuator failure. When the emergency release has been used, low power operation should be avoided to prevent the coolant temperature from going below the minimum allowable limit as a result of the greater flap opening. There is no provision for emergency closing of the flap, nor can the emergency release be reset in flight.

3-36. LANDING GEAR EMERGENCY OPERATION.

3-37. To lower the landing gear in the event of hydraulic system failure (or if the left engine is dead), proceed as follows:

a. Reduce airspeed to below 140 IAS. (Above that speed, air loads may hold the fairing doors closed.)

b. Pull emergency landing gear handle in either cockpit. Hold handle out until gear is down.

c. If the gear does not lock down because of air pressure against fairings, yaw airplane until gear position indicators show a safe condition.

3-38. WING FLAP EMERGENCY OPERATION.

3-39. To lower the wing flaps when the normal system is inoperative:

a. Move flap emergency switch in either cockpit to "ON." (The flaps will lower approximately 10 degrees per second.)

b. To stop flaps at desired position, return switch to "OFF."

WARNING

The flaps cannot be raised by operation of the flap emergency switch.

3-40. SURFACE CONTROL BOOSTER SYSTEM EMERGENCY OPERATION.

3-41. No emergency system is provided.

3-42. ELECTRICAL SYSTEM EMERGENCY OPERATION.

3-43. GENERATOR FAILURE.

3-44. Should one or both generators fail, turn defective generator "OFF" and operate only essential electrical equipment to reduce the load on the remaining generator or the battery.

3-45. VOLTAGE REGULATOR FAILURE.

3-46. Excessively high voltage may result from failure of the voltage regulator.

a. Adjust voltage with voltage regulator rheostat. If voltage cannot be brought within allowable limit (28 volts), turn generator "OFF."

b. If one or both generators are turned off for any reason, operate as little electrical equipment as possible. If feasible, turn off surface control boost and radio equipment.

c. When it is necessary to disconnect both generators, periodically recharge the battery by turning one generator switch on for approximately 5 minutes. During this charging period, turn off any electrical equipment which may be damaged by excessively high voltage.

Note

Refer to paragraph 1-96 for list of equipment which will be rendered inoperative by failure of electrical system.

3-47. OXYGEN SYSTEM EMERGENCY OPERATION.

3-48. Should symptoms occur suggestive of the onset of anoxia, or the regulator become inoperative, descend below 10,000 feet. Whenever excessive carbon monoxide or other noxious or irritating gas is present or suspected, then, regardless of the altitude, the air valve should be set at "100% OXYGEN," and undiluted oxygen used until danger is past or flight is completed. Should brief removal of mask from face be necessary at high altitude, use the following procedure:

a. Take three or four deep breaths of undiluted oxygen (air valve at "100% OXYGEN").

b. Hold breath and remove mask from face.

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

d. Reset air valve to "NORMAL."

3-49. BOMB AND DROP TANK EMERGENCY RELEASE.

3-50. Bombs and external fuel tanks can be released from either cockpit. Place bomb arming switch in "OFF" position in pilot's cockpit. Lift guard covering the bomb salvo switch in either cockpit and hold the switch on momentarily.

Section IV

OPERATIONAL EQUIPMENT

4-1. GUNNERY EQUIPMENT.

4-2. Six .50-caliber fixed machine guns, with electric heaters, are installed in the wing center section. (Provisions are also made for mounting a droppable gun nacelle, beneath the wing center section.) Four hundred rounds of ammunition can be carried for each gun. All guns must be manually charged prior to flight, through gun bay doors in the upper surface of the wing. A K-18 compensating gun sight is mounted on the instrument panel shroud in the pilot's cockpit (figure 1-2, reference 8), and an electrical ranging control (figure 1-3, reference 12) is incorporated in the throttle grip. A fixed ring and bead sight and a gun camera are installed on the copilot's instrument shroud. (See figure 1-5, references 7 and 10.) Provisions are made for mounting a gun camera on the gun sight in the pilot's cockpit.

4-3. GUNNERY CONTROLS.

4-4. GUNNERY CONTROL SHIFT SWITCH. The guns (and camera) are controllable from either cockpit. A gunnery control shift switch, located on the armament panel in each cockpit (figure 1-2, reference 44; figure 1-5, reference 27), provides for transferring gunnery firing control from one cockpit to the other. Illumination of the "COPILOT ON" indicator light, adjacent to the switch, indicates that the copilot has control of the gun.

4-5. GUN SELECTOR. The gun selector switch (figure 1-2, reference 44), equipped with a guard, is located on the armament panel in each cockpit. The switch may be positioned for operation on "GUNS" which includes sight and camera, or for "SIGHT & CAMERA ONLY." Whenever the guard is closed, the selector switch is automatically moved to the "OFF" position.

4-6. TRIGGER. The control stick grip in each cockpit contains a trigger switch for firing the guns, or for operating the camera alone when the gun selector switch is at "SIGHT & CAMERA ONLY."

4-7. GUN HEATER. The gun heaters are controlled from the pilot's cockpit only. The heater switch (figure 1-2, reference 44) is located on the armament panel.

4-8. K-18 GUN SIGHT.

4-9. The K-18 gun sight is installed in the pilot's cockpit and automatically computes the correct lead angle for target crossing speed at ranges from 200 to 800 yards. Two optical systems, fixed and gyro, are contained in the sight. The reticle of the fixed sight, projected on the reflector glass, consists of a 70-mil circle with a small cross in the center, and a rocket scale located below the cross. Normally blanked out (by depressing the masking lever on left side of sight), the circle and scale are used only for firing rockets, for strafing, or in case of mechanical failure of the gyro. The reticle of the gyro sight projected on the reflector glass consists of a circle of six diamond-shaped images surrounding a central dot. The diameter of the circle is variable, and when the target is properly framed within the circle, the sight automatically computes the amount of lead required. When both reticles are used, the separation of the fixed cross from the central dot shows the lead angle which is computed. Gun sight spare lamps are located outboard of rocket selector on right side of pilot's cockpit.

4-10. GUN SIGHT CONTROLS.

4-11. All controls for the sight are located in the pilot's cockpit. Power is supplied to the gun sight by the gun selector switch on the armament panel.

4-12. SELECTOR-DIMMER CONTROL. A selector-dimmer unit (figure 1-3, reference 21) located below the throttle quadrant in pilot's cockpit, consists of a selector switch that permits choice of reticle images ("FIXED & GYRO," "GYRO," or "FIXED"), and a rheostat for controlling intensity of reticle illumination from "DIM" to "BRIGHT."

4-13. SPAN SCALE KNOB. A span scale knob on the face of the sight (figure 1-2, reference 8) is used to preset the span scale in accordance with the dimensional wing span of the target plane. When the setting of the span scale is changed, the diameter of the circle in the gyro reticle is varied accordingly.

4-14. RANGING CONTROL. An electrical ranging control is incorporated in the throttle grip (figure 1-3, reference 12). The pilot maintains correct range by keeping the target framed within the circle of the gyro reticle; the diameter of the circle is varied by rotating the throttle grip.

4-15. NACELLE EMERGENCY RELEASE. A nacelle emergency release handle is located at the left side of each cockpit below the instrument panel. (See figure 1-3, reference 20; figure 1-6, reference 12.)

4-16. PREFLIGHT OPERATION OF GUN SIGHT. Before take-off, check the gun sight, as follows:

a. Gun selector switch "SIGHT AND CAMERA ONLY."

b. Selector switch on selector-dimmer control "FIXED & GYRO." Both reticles will appear on the reflector. If the circle and scale appear, blank them out with masking lever at left of sight.

c. Rotate dimmer rheostat to obtain desired reticle brilliance.

d. Make sure dot of gyro is superimposed on the fixed cross when aiming at point on horizon.

e. Selector at "GYRO" or "FIXED & GYRO" as desired.

CAUTION

Keep selector switch on "GYRO" or "FIXED & GYRO" at all times when engine is running, as engine vibration and landing shocks may damage gyro pivots if unit is not operating.

f. Check throttle ranging control for operation of gyro reticle from minimum to maximum range.

4-17. COMBAT OPERATION OF GUN SIGHT. In combat, proceed as follows:

a. Identify your opponent; then set the span scale to correspond with the enemy type.

b. Fly airplane so that the enemy appears within the gyro reticle, and rotate the throttle ranging control until the diameter of the gyro reticle corresponds to the size of the enemy.

c. Continue to rotate ranging control, keeping the enemy within the gyro reticle—then fire.

4-18. GUN SIGHT OPERATIONAL NOTES. For most effective use of the K-18 sight, observe the following instructions:

a. Keep sight operating at all times when encounter with enemy is possible.

b. When maneuvering into position for attack, *keep the sight set at the shortest range* (large diameter gyro reticle) and decrease the diameter to correspond to the enemy size.

c. *Always track the target before firing.* By operating the ranging control, continually frame the target while tracking for a minimum period of one second; then fire. Only after such tracking will the gyro sight compensate correctly.

d. Learn to use the sight instead of your flight instruments. Notice that, with the selector set for normal operation ("FIXED & GYRO"), the relative positions of the fixed and gyro reticles indicate what your airplane is doing. If the cross and dot are superimposed, you are flying in a straight line.

e. For firing at a stationary ground target, use the fixed part of the sight.

4-19. ROCKET EQUIPMENT.

4-20. A total of twenty-five 5-inch high-velocity aircraft rockets may be carried on five racks mounted beneath the wing. Two racks are mounted under each outer wing panel, and one rack beneath the wing center section. Rockets may be armed and fired from the pilot's cockpit only. Firing order of the rockets and firing sequence of the racks are not selective. Rockets are fired from the two inboard racks first, from the outboard racks next, and from the center rack last. (See figure 4-1.)

4-21. ROCKET CONTROLS.

4-22. ROCKET ARMING. The rocket arming switch (figure 1-2, reference 43) is located on the pilot's armament panel. The rockets may be armed to detonate on impact ("INSTANT"), or for delayed detonation ("DELAY").

4-23. ROCKET FIRE CONTROL. A rocket fire control (figure 1-4, reference 12), located on right side of pilot's cockpit, provides for firing the rockets either singly or in pairs. With the switch at "SINGLES," one rocket is fired alternately from each outer wing rack; at "PAIRS," two rockets (one from each outer wing rack) are fired simultaneously. Rockets from the rack on the wing center section are fired last, and regardless of switch setting, the two outer rockets are fired simultaneously, the center rocket singly.

4-24. ROCKET SELECTOR. The rocket selector switch (figure 1-2, reference 43) is located on the armament switch panel in the pilot's cockpit. With the selector switch at "SINGLE," rockets are released singly or in pairs (as selected by the rocket fire switch) with each depression of the bomb-rocket release button (figure 1-2, reference 28) on the control stick grip; at "AUTO," rockets are fired in train, singly or in pairs, with one depression of the release button. The switch should remain in the "OFF" position until rockets are ready to be fired, as there is no safety position on the arming switch.

4-25. FIRING ROCKETS. The rockets are armed and fired as follows:

a. Rocket fire control "SINGLES" or "PAIRS" as desired.

CAUTION

After rocket firing has once been started, do not change rocket fire control, as misfiring will result. If the rocket sequence is changed, some rockets will be skipped or previously fired rocket stations will be selected.

b. Selector switch "SINGLE" or "AUTO" as desired.

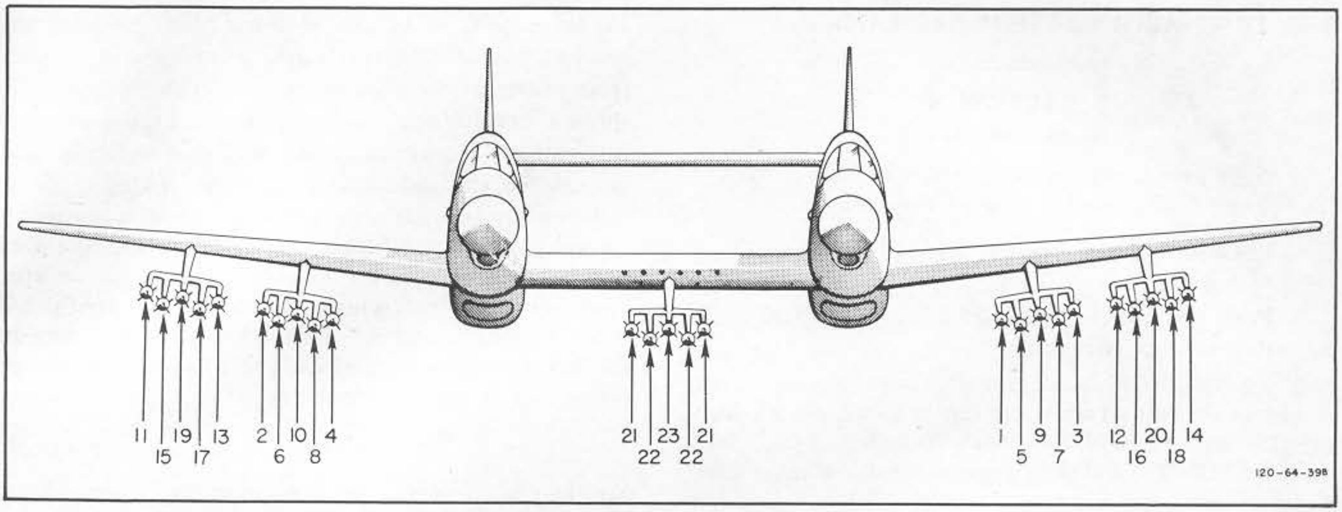


Figure 4-1. Rocket Firing Order

c. Arming switch at "INSTANT" or "DELAY."

d. To fire rockets, depress bomb-rocket release button.

4-26. BOMBING EQUIPMENT.

4-27. Bombs up to 1000 pounds can be carried on removable racks mounted one under each outer wing panel; bombs up to 2000 pounds can be carried on two racks under the wing center section. Bomb controls are provided in the pilot's cockpit only. The bomb-rocket release button, installed on the copilot's stick grip, is inoperative.

4-28. BOMB CONTROLS.

4-29. BOMB ARMING. The bomb arming switch (figure 1-2, reference 42) is on the pilot's armament panel. Bombs may be armed to detonate instantly on impact ("NOSE & TAIL") or for delayed detonation ("TAIL ONLY"). The bombs remain unarmed when switch is in the "SAFE" position.

4-30. BOMB SEQUENCE. The order in which bombs are dropped may be selected by the bomb sequence switch (figure 1-3, reference 17) located below the radiator switches in the pilot's cockpit. The switch may be positioned for dropping bombs from "IN'BD RACKS FIRST" or from "OUT'BD RACKS FIRST." On either setting, the left bomb is released first and then the right one.

4-31. BOMB SELECTOR. The bomb selector switch is located on the armament switch panel in the pilot's cockpit. (See figure 1-2, reference 42.) With the selector switch at "TRAIN," one bomb is dropped with each depression of the bomb-rocket release button on the control stick grip; at "ALL," simultaneous release of all bombs is effected with one depression of the release button.

4-32. BOMB SALVO. Emergency release of all bombs, external fuel tanks, or chemical tanks is provided by an electrical bomb salvo switch (figure 1-3, reference 18; figure 1-5, reference 25) which is equipped with a guard and located adjacent to the bomb sequence switch in the pilot's cockpit, and on the gun control panel in the copilot's cockpit.

4-33. RELEASING BOMBS. The bombs are armed and released as follows:

a. Bomb rack sequence switch "IN'BD RACKS FIRST" or "OUT'BD RACKS FIRST" as desired.

b. Selector switch "TRAIN" or "ALL" as desired.

c. Arming switch "NOSE & TAIL" or "TAIL ONLY."

d. To drop bombs, depress bomb-rocket release button.

e. After releasing bombs, move arming switch to "SAFE" and selector control to "OFF."

4-34. RELEASING DROP FUEL TANKS. The drop fuel tanks are released as follows:

a. Reduce airspeed to 250 mph.

b. To release tanks when no bombs are carried, depress bomb salvo switch.

c. If bombs are being carried on center racks, place bomb sequence switch at "OUT'BD RACKS FIRST," bomb selector at "TRAIN," and depress bomb-rocket release twice.

4-35. CHEMICAL TANKS.

4-36. A chemical tank (Type AN-M10 or AN-M33) may be carried on each outer wing bomb rack. A chemical selector switch (figure 1-2, reference 41) on the pilot's armament switch panel provides for discharging "RIGHT" or "LEFT" tanks when the bomb-rocket release button on the control stick grip is depressed. The tanks may be released from the racks by the normal or emergency bomb release system.

4-37. DISCHARGING CHEMICAL TANKS.

CAUTION

Make sure bomb selector switch is "OFF," to prevent accidental release of the tanks.

a. Chemical selector switch "RIGHT" or "LEFT" as desired.

b. Press bomb-rocket release button on control stick grip to discharge chemicals.

c. To jettison tanks, depress bomb salvo switch, or, if bombs are being carried on center racks, place bomb selector on "TRAIN," sequence switch at "OUT'BD RACKS FIRST," and then depress bomb-rocket release button twice.

4-38. OXYGEN.

4-39. A low-pressure oxygen system is provided in the airplane. Two Type F-2 oxygen cylinders are installed behind each seat; a Type G-1 cylinder is installed on the left side of each fuselage just aft of the wing trailing edge. Normal full pressure is 400 psi. In normal operation all cylinders are interconnected, with floating check valves in the lines. This allows the entire oxygen supply to be available for both the pilot and copilot. Under this condition, if oxygen is released from either of the regulators, both cockpit gages will show a simultaneous loss in pressure. In the event of line failure, the check valves will automatically seat, because of the unbalanced pressure, resulting in an independent oxygen system in each fuselage. A diluter-demand regulator, a blinker flow indicator, and a pressure gage are located on the right side of each cockpit. (See figure 1-4, references 10, 11, and 13; figure 1-7, references 6, 7, and 8.) All oxygen cylinders may be refilled through a single filler valve located on the outboard side of the left fuselage.

Note

In the event violent maneuvers are executed with the airplane, it is possible the oxygen system check valves may seat. This will result in separate and independent oxygen systems in each fuselage. At such time as the oxygen system is refilled and serviced, the system will then revert to a common oxygen supply for both pilot and copilot.

4-40. COMMUNICATIONS EQUIPMENT.

4-41. TABLE OF COMMUNICATIONS EQUIPMENT.

TYPE	DESIGNATION	USE	OPERATOR	ILLUSTRATION
Command	AN/ARC-3	Two-way voice communication.	Pilot or copilot obtains complete control by operating radio control transfer switch.	Figure 1-4, reference 8; figure 1-7, reference 4.
Radio Compass	AN/ARN-6	Reception of voice and code communications; position finding; homing.	Pilot or copilot.	Figure 1-4, reference 9; figure 1-7, reference 1.
IFF	SCR-695B	Automatic identification.	All controls in pilot's cockpit. Copilot's cockpit contains all controls except code selection.	Figure 1-4, reference 7; figure 1-7, reference 3.
Interphone	AM-26A-AIC	Intercockpit communication.	Push-to-talk button on throttle in both cockpits.	Figure 1-3, reference 13; figure 1-6, reference 9.

4-42. OPERATION OF COMMAND SET.

a. Turn radio control transfer switch on to obtain control of equipment.

b. Turn command radio power switch "ON."

c. Rotate selector to desired frequency channel and allow approximately 30 seconds for set to warm up. When the audio tone heard in the earphone stops, the set is tuned and ready for operation.

d. Adjust volume control for desired output.

e. To transmit, press "TRANS" button on throttle.

4-43. OPERATION OF RADIO COMPASS.

a. Turn compass control switch to desired type of operation: "ANT," "COMP," or "LOOP."

MAN-HOUR OXYGEN CONSUMPTION TABLE
(APPROXIMATE DURATION-REGULATOR AIR VALVE AT "NORMAL OXYGEN")

GAGE PRESSURE	ALTITUDE 10,000	15,000	20,000	25,000	30,000	35,000	40,000
400	14:50	11:10	9:10	8:10	8:40	11:40	15:40
350	12:40	9:30	7:50	7:00	7:20	10:00	13:20
300	10:40	8:00	6:30	5:50	6:10	8:20	11:10
250	8:30	6:20	5:20	4:40	5:00	6:40	9:00
200	6:20	4:50	4:00	3:30	4:40	5:00	6:40
150	4:10	3:10	2:40	2:20	2:30	3:20	4:30
100	2:10	1:30	1:20	1:10	1:10	1:40	2:10
50	DESCEND BELOW 10,000 FEET						144-93-333

Figure 4-2. Oxygen Consumption Table

b. Press red button in center of band selector knob for transfer of control.

c. Select one of the four frequency bands.

d. With the tuning crank, tune station desired, for "MAX" on tuning dial.

e. Adjust audio control for desired output.

f. The radio is turned off by rotating control switch to "OFF."

4-44. OPERATION OF IDENTIFICATION RADIO.

WARNING

Before take-off, insert destructor plug in face of IFF equipment (accessible through radio compartment door on outboard side of right fuselage). Remove plug immediately after landing.

a. Rotate code selector to position "1." (Leave in position "1" at all times when operating the equipment, unless directed by commanding officer to use one of the other positions).

b. Move G-band switch to "ON" or hold it momentarily at "TIME" as desired.

c. To turn off the radio, move the code selector and the G-band switch to "OFF."

4-45. OPERATION OF INTERPHONE. To transmit on interphone, press the button marked "INTER" on the throttle.

4-46. COCKPIT HEATING, VENTILATING, AND DEFROSTING.

4-47. A separate heating, ventilating, and defrosting system is provided in each fuselage. Heated air, obtained aft of the coolant radiator, is distributed to defroster outlets at the windshield, to a floor outlet at the pilot's feet, and to controllable outlets at each side of the seat. (See figure 1-3, reference 28.) Ventilating air is secured from forward of the coolant radiator and distributed through the same system. Ground heating or defrosting can be accomplished by operating a combustion-type heater and blower provided in each fuselage. The blower will operate only when the landing gear is extended. During flight, the heater is normally operated only for anti-icing, but may be used to obtain additional cockpit heat under extreme conditions, or in case of engine failure. The system may be operated simultaneously with engine charge heat or surface anti-icing. (Refer to paragraphs 1-39 and 4-55.)

4-48. HEATING, VENTILATING AND DEFROSTING CONTROLS.

4-49. The system is controlled from the cockpit for which heating, ventilating, or defrosting is desired. Controls are identical in both cockpits.

4-50. COCKPIT AIR VOLUME. The amount of air directed to the system for heating or ventilating is controlled by the cockpit air volume control (figure 4-3) located on the floor to the right of the seat. Turning the control clockwise increases the volume. When the volume control is "OFF," no air is admitted to the system, and the heater cannot be operated for cockpit heating. In order to put heater in operation, it is necessary to move the cockpit volume control to any position between two-thirds and full open. (A microswitch is connected to this valve to prevent the heater from operating when the control is one-third or less closed.)

4-51. COCKPIT AIR TEMPERATURE. The air temperature control (figure 4-3) is located on the heat control panel in each cockpit. In the "COLD" position, only ventilating air is admitted to the system; rotating the rheostat counterclockwise increases the temperature accordingly until it reaches the full "HOT" position. The "HEATER ON" position must be used when the heater is operated for cockpit heating. (Refer to paragraph 4-53.c.)

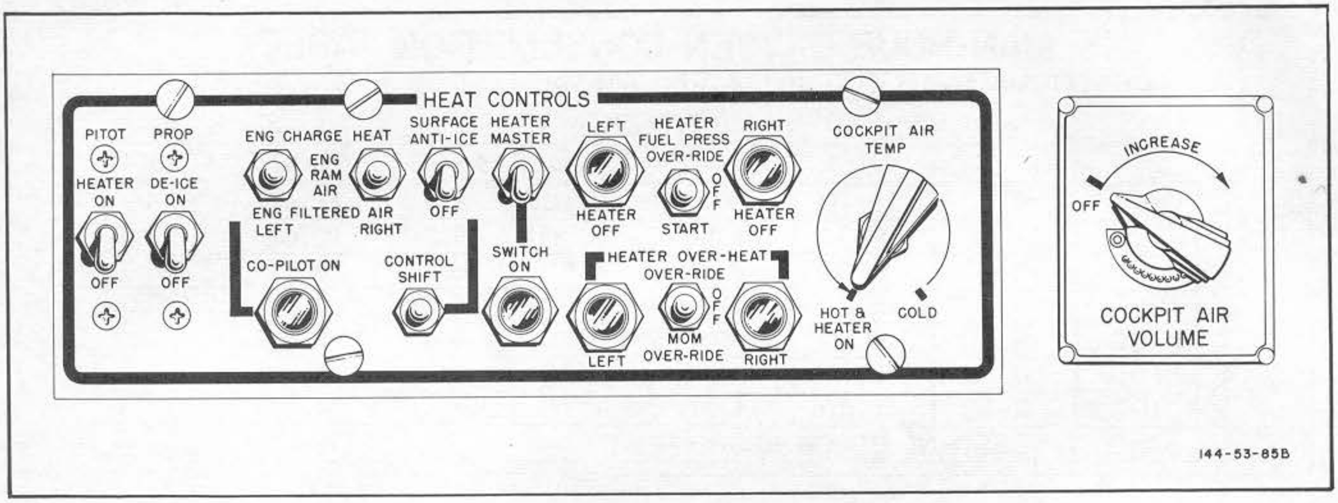


Figure 4-3. Heat Controls

4-52. DEFROST. All or part of the air normally supplied to the foot outlets may be directed to the inside of the windshield by means of a push-pull defroster control (figure 1-2, reference 25) located below the heat control panel in each cockpit.

4-53. OPERATING HEATING, VENTILATING, AND DEFROSTING SYSTEM. Operate the heating, ventilating, and defrosting system as follows:

a. To obtain ventilating air, turn temperature control to "COLD" and rotate volume control clockwise for desired output.

b. For cockpit heat, turn volume control on and adjust temperature control as desired.

c. To operate the heater for cockpit heating in flight, turn on volume control to between two-thirds and full open, and rotate air temperature control to "HEATER ON"; turn heater master switch on and then depress fuel pressure switch to start the heater. For ground operation, it is unnecessary to use the fuel pressure switch to start the heater. (Refer to paragraph 4-61.)

d. Adjust side outlets for desired volume and direction of airflow.

e. For windshield defrosting, pull defroster control to position desired.

4-54. THERMAL ANTI-ICING SYSTEM.

4-55. Hot air for anti-icing is obtained from aft of each coolant radiator, further heated by combustion heaters, and then routed through ducts to the leading edges of the wing and tail surfaces, and to the outer surface of the armor glass. The temperature of the air admitted to the surfaces is automatically controlled to maintain adequate protection against the particular icing conditions encountered. Heating systems in both fuselages supply heated air to their respective halves of the airplane. However, operation of the surface anti-ice switch in either cockpit starts both systems simultaneously. A cross-feed fuel line is provided in the heater fuel system to permit continued operation of both heaters in event either engine is inoperative. The system may be used for defrosting the surfaces on the ground by means of the heater and a blower. The blower will operate only when the landing gear is down.

4-56. ANTI-ICING CONTROLS.

4-57. All controls for anti-icing are provided on a heat control panel (figure 4-3) in each cockpit. (See figure 1-2, reference 21.)

4-58. HEAT CONTROL SHIFT SWITCH. Control of the anti-icing system may be transferred by operation of a heat control shift switch. Illumination of the "CO-PILOT ON" indicator light adjacent to the shift switch, indicates that the copilot has control of the system. The same shift switch also transfers control of the engine air system. When control is transferred, the surface anti-icing and engine air systems will assume the operating condition selected on the panel to which control is shifted.

4-59. SURFACE ANTI-ICING. The surface anti-ice switch, located on the heat control panel in both cockpits, controls the valves which divert airflow to the wing and tail anti-icing ducts.

4-60. HEATER MASTER SWITCH. The heater master switch controls electrical circuits to the heater and must be on to obtain surface anti-icing. The master switch also controls the heater fuel system and turns on the blowers (when landing gear is down). An indicator light below the switch illuminates in both cockpits whenever either heater master switch is turned on.

4-61. HEATER FUEL PRESSURE. Fuel is supplied to the heaters during flight by depressing the fuel pressure switch to the "START" position (with heater

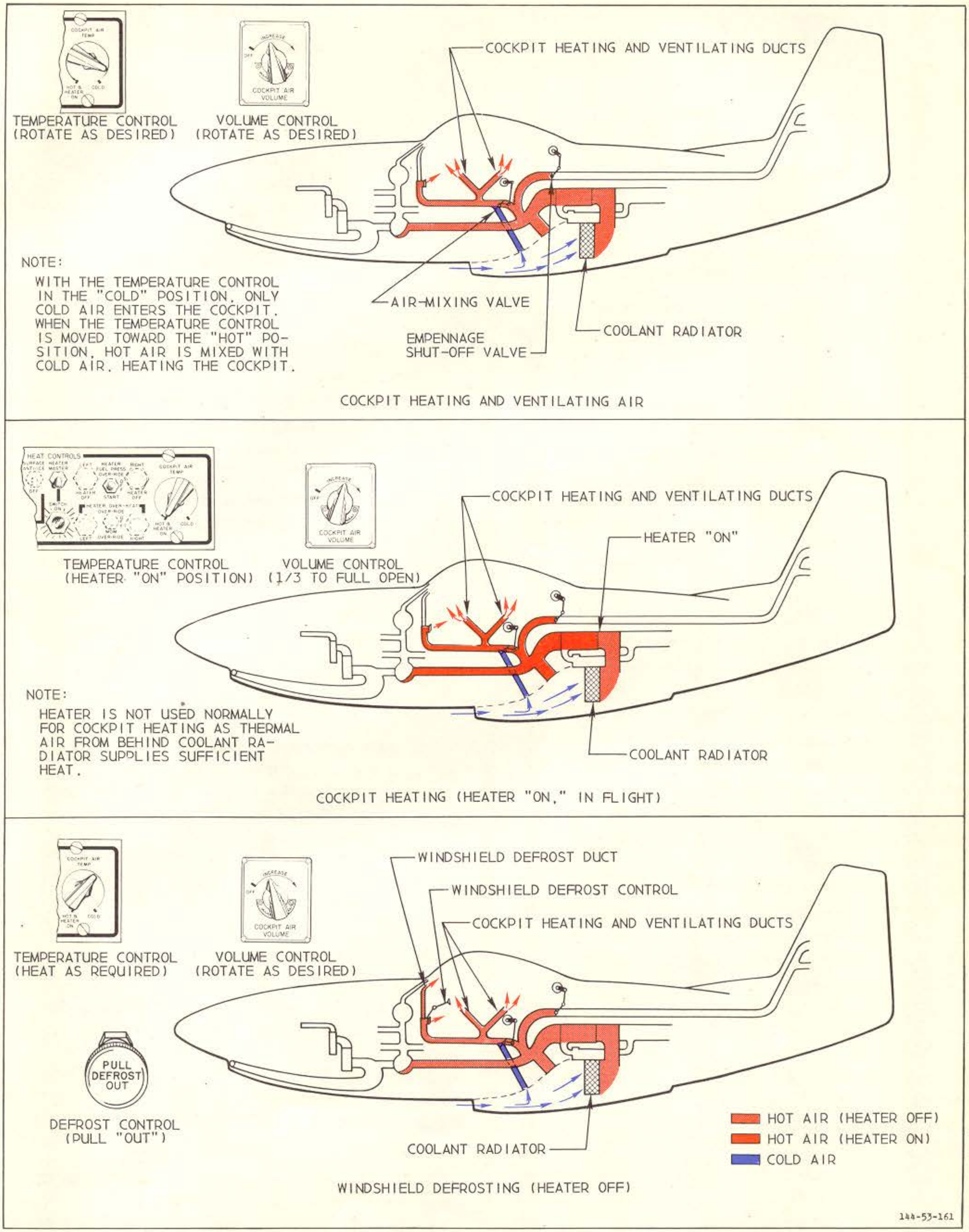


Figure 4-4. Cockpit Heating, Ventilating, and Defrosting

master switch "ON"). When the airplane is on the ground, it is unnecessary to use the fuel pressure switch to start the heater as fuel is supplied through a low pressure solenoid valve which is closed when airplane weight is on the gear.

WARNING

If heaters are operated during take-off, they will go out when airplane is airborne and must be restarted by depressing the fuel pressure switch to the "START" position.

An amber light on either side of the switch will illuminate when the heaters are first started for anti-icing; when both lights go out, it indicates that heaters are operating at sufficient temperature (above 275°F) to maintain heat for anti-icing symmetrical about the airplane centerline. (When operating the anti-icing system on the ground, the indicator lights will not go out, since the heater fuel supply is cycled to restrict heater output to 225°F.) During anti-icing operation, should just one of the lights illuminate again, it indicates that the respective heater is not operating at desired temperature and an uneven ice formation could result on the airplane unless the system were turned off. The heater indicator lights function only during anti-icing and are inoperative when the heaters are used for cockpit heating. A pressure switch in the heater fuel line automatically turns off the fuel supply in case of a broken fuel line. The "OVER-RIDE" position of the heater fuel pressure switch in the cockpit permits continued operation in an emergency or in event of malfunctioning of the pressure switch in the fuel line.

4-62. HEATER OVERHEAT. Should a heater exceed temperature limits (above 415°F), the fuel supply and electrical power to the spark plug are automatically shut off and the heater will go out. This condition is indicated by illumination of overheat lights, one for each heater, located on the heat control panel. An override switch between the lights has three positions: "OFF," "OVER-RIDE," and a spring-loaded position "MOM OVER-RIDE." Moving the switch to either operating position restarts the heater. The momentary position merely restarts the heater, and if overheating reoccurs, the heater will go out again. The fixed "OVER-RIDE" position permits the heater to be operated above the overheat limits if required under extreme icing conditions. However, if the temperature is allowed to reach approximately 700°F when operating with the switch at "OVER-RIDE," a valve will open to dump all air overboard. Should this occur, the heater master switch should be turned off to cut off fuel supply to both heaters.

WARNING

Once the dump valve opens, the entire system will be inoperative, as the valve can be reset only on the ground. Heated induction air can be obtained under these conditions only by leaving surface anti-ice switch "ON," to allow hot air from the engine compartment to enter the intake duct through the alternate air door. (See figure 1-9.)

4-63. OPERATING ANTI-ICING SYSTEM.

a. Obtain control of the system by operation of the heat control shift switch.

b. Master heater switch "ON."

c. Move surface anti-ice switch to "SURFACE ANTI-ICE" position; heater indicator lights will illuminate.

d. Hold heater fuel pressure switch at the "START" position for approximately 10 seconds (necessary in flight only).

e. When the heater indicator lights go off (in flight only), the heaters are operating at sufficient temperature to maintain anti-icing protection symmetrical about centerline of airplane.

Note

After ground operation, keep the master heater switch on momentarily to allow blower to clear heaters of unburned gases.

Note

If the icing condition is encountered in which, with the anti-icing system on, ice accumulates on the wings, the airplane should be flown above the icing condition if possible. If this is not possible, the airplane should be flown at as low an altitude as the terrain permits and at an airspeed below 200 mph IAS. Under these conditions the airplane is making best use of the anti-icing system.

4-64. PROPELLER DE-ICER SYSTEM.

4-65. The propellers are de-iced electrically through heating elements in rubber boots cemented on the leading edge of each propeller blade. The electrical power for the heating elements is supplied by a generator in each propeller hub. A cycling unit actuates the generator, directing current to the blades for 15 out of every 45 seconds.

4-66. PROPELLER DE-ICE CONTROL.

4-67. De-icing for both propellers is controlled by the propeller de-ice switch (figure 4-3), located on the heat control panel in both cockpits. The system must be turned off from the same cockpit from which it was turned on.

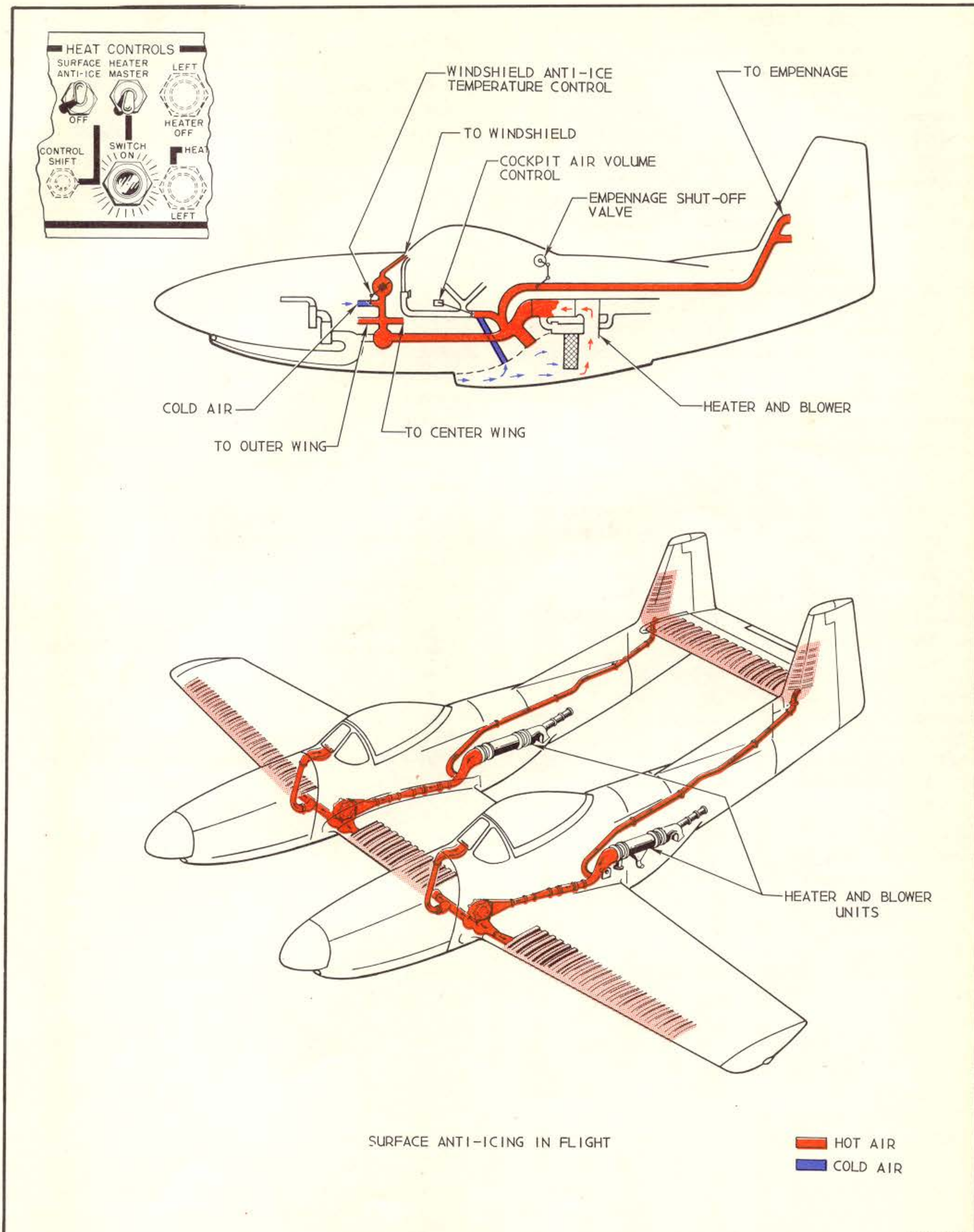


Figure 4-5. Surface Anti-icing System

4-68. ANTI-G SUIT PROVISIONS.

4-69. An air pressure outlet connection on the left side of the seat in each cockpit (figure 1-3, reference 27; figure 1-6, reference 3) provides for attachment of the air pressure intake tube of the anti-G suit. Air pressure for the inflation of the anti-G suit bladders is supplied from the exhaust side of the engine-driven vacuum pump, and is regulated by a Type M-2 valve which is a junction point for pressures exerted in both the drop fuel tanks and the anti-G suit. If drop tanks are installed on the airplane, the accelerating force (G load) required to actuate the M-2 valve should be about 4 G because of the approximately 5 psi pressure exerted in the tanks. Without the drop tanks installed, the valve should open at 2.75 G. After the valve opens, pressure is passed through a regulator valve into the suit in proportion to the G force imposed. For every one G acceleration force, a corresponding one psi air pressure is exerted in the anti-G suit.

4-70. LIGHTING EQUIPMENT.

4-71. EXTERIOR LIGHTING EQUIPMENT.

4-72. POSITION LIGHTS. The position lights on the wing tips and rudders are controlled by two switches (figure 1-4, reference 4) on the right side of pilot's cockpit only. The lights are turned on by the aft switch, and may be placed at "FLASH" or "STEADY." The forward switch controls brilliancy and has "BRIGHT" and "DIM" positions.

4-73. FUSELAGE LIGHTS. The fuselage light switch (figure 1-4, reference 3) is located on the light switch panel in the pilot's cockpit. The lights are illuminated when the switch is placed at "BRIGHT" or "DIM." A keying switch (figure 1-4, reference 2) on the panel provides for manually flashing the fuselage lights.

4-74. LANDING LIGHT. The landing light, located inboard of the right gear, is controlled by a landing light switch above the trim tab controls in the pilot's cockpit (figure 1-3, reference 8) and just aft of throttle in the copilot's cockpit (figure 1-6, reference 6.) The light extends and retracts with the gear, and will illuminate only when the gear is down and locked.

4-75. TAXI LIGHTS. The taxi lights, one under each wing, extend and retract with the gear. The taxi light switch is located adjacent to the landing light switch in each cockpit. (See figure 1-3, reference 7, and figure 1-6, reference 7.)

4-76. INTERIOR LIGHTING EQUIPMENT.

4-77. COCKPIT LIGHTS. The cockpit lights are controlled by a rheostat located on the left side of the engine control switch panel in each cockpit. (See figure 1-2, reference 33; figure 1-5, reference 30.) Indirect instrument panel lighting is provided by fluorescent lamps located one on either side under the shroud and controlled by a rheostat on the lamp itself.

4-78. SPARE LAMPS. Spare lamps for gun sight and cockpit lights are located at the right side of pilot's cockpit above the rocket selector. In the copilot's cockpit, spare lamps are located on left side below the instrument panel shroud. One spare fluorescent lamp is provided in each cockpit, above the pilot's surface control booster switch, and to right of copilot's instrument panel.

4-79. PITOT HEATER.

4-80. The pitot heater is controlled by an on-off switch on the heat control panel in each cockpit. (See figure 4-3.)

Section V

EXTREME WEATHER OPERATION

5-1. ARCTIC OPERATION.

5-2. BEFORE ENTERING AIRPLANE.

a. Remove protective covers from engines, cockpits, air scoops, and wing and tail surfaces.

b. Be sure solid cowl doors are installed in place of the perforated filter doors normally used.

c. Remove snow and ice from surfaces, control hinges, propellers, pitot tube, fuel vents, and crankcase breather outlet.

d. Drain moisture from fuel strainers and drain cocks.

e. Check "Y" drains, oil tank sump drains, and oil cooler drains for free flow, and apply heat if flow is unsatisfactory.

f. Clean shock struts of dirt and ice; check for proper inflation.

g. Pull propellers through five or six revolutions. The ease with which this can be accomplished may aid in determining the amount of engine compartment heat required prior to starting.

h. When required to heat engine compartment, open the alternate air inlet door from left side of each engine cowl by loosening dzus fastener in access door and pulling tab full out.

5-3. AFTER ENTERING AIRPLANE.

a. Make sure that a portable generator cart is connected.

b. With alternate air doors open, heat engine compartments approximately 15 to 30 minutes. Turn on heater master switch and any fuel booster pump; move engine air control switches to "ENG. CHARGE HEAT." (See figure 5-1.)

c. Turn on cockpit heat and windshield defroster if required.

5-4. STARTING ENGINE.

a. Check engine air control switches to "ENG. RAM AIR."

CAUTION

Do not use engine charge heat during engine starts, take-offs, or landings, as an engine backfire may cause severe damage to the induction and heating system. Use engine charge heat for all other operations, including ground run-up.

b. Make crankability test, prior to starting, by holding starter on (ignition switch "OFF") and making sure that propeller will turn over at least 50 rpm. If 50 rpm cannot be attained, continue warming engine compartment.

c. Prime 5 to 10 seconds (or until raw fuel flows from supercharger drain).

d. Turn on ignition switch.

e. Depress starter and prime simultaneously.

Note

If engine fails to start after one minute of continuous cranking, allow starter to cool for one minute before making another attempt to start the engine.

f. As engine fires, hold mixture control switch at "NORMAL" for 3 seconds. Prime intermittently until engine is running smoothly.

g. If there is no oil pressure after 30 seconds running, or if pressure drops after a few minutes ground operation, stop engine and investigate.

h. After engines are started, have external power disconnected and turn on battery switch.

Note

If mission requires use of guns, turn gun heaters on immediately after starting engines.

5-5. WARM-UP.

Note

Use firmly anchored wheel chocks for all engine run-ups. Should a full-power run-up be made, make sure that firmly anchored wheel chocks are used and, in addition, that tail is tied down.

a. Maintain engine rpm between 1300 and 1500 until oil temperatures and pressures reach desired limits.

b. Shut down engines and have ground crew close alternate air inlet doors; then restart.

c. If necessary, turn on surface anti-icing system.

d. Move engine air control switches to "ENG. CHARGE HEAT."

5-6. BEFORE TAKE-OFF.

a. Check controls carefully for freedom of movement.

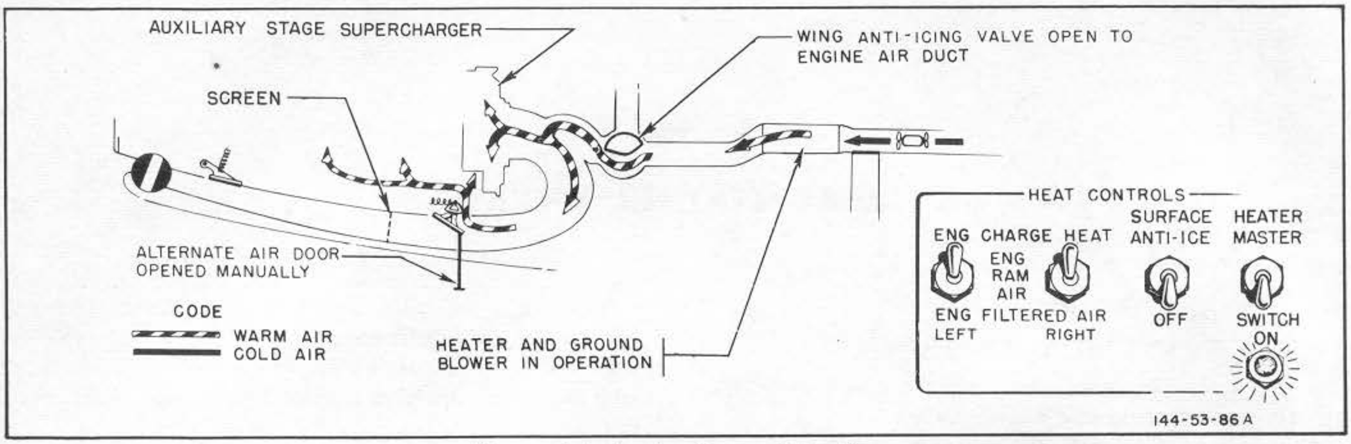


Figure 5-1. Engine Ground Heating

b. Hold brakes, and run up engine until spark plugs have burned clean and engine is operating smoothly. Then check magnetos.

c. At outside air temperatures of 0°F or below, use heated induction air for take-off by turning engine charge air switches to "ENG. FILTERED AIR." Since solid filter doors are installed and the ram air gate will be closed, warm air from the engine compartment will be drawn into the induction system.

CAUTION

Do not use "ENG. CHARGE HEAT" for take-off, as engine backfiring may result in damage to engine and heating system.

d. Turn pitot heater on just prior to rolling into position for take-off.

5-7. TAKE-OFF.

5-8. At start of take-off run, advance throttles rapidly to take-off stops and ascertain that full take-off power is available. If full power is not obtained, immediately discontinue take-off.

WARNING

If heaters are operating during take-off, they will go out when airplane is airborne. Depress fuel pressure switch to "START" position to restart heaters.

5-9. DURING FLIGHT.

a. Operate anti-icing system and cockpit heating as required according to instructions in paragraphs 4-53 and 4-63.

b. To de-ice propellers, turn propeller de-icing switch "ON" from either cockpit.

c. Move engine air control switches to "ENG. CHARGE HEAT."

5-10. APPROACH AND LANDING.

a. As temperature inversions are commonly encountered in the arctic, avoid engine overcooling during letdown.

b. When outside air temperatures are 0°F or below, use heated induction air by turning engine charge air control switches to the "ENG. FILTERED AIR" position.

c. If snow and ice tires are installed on the airplane, apply brakes intermittently and carefully to keep treads from filling and glazing over.

5-11. STOPPING ENGINES.

a. If it is necessary to service oil tanks, shut down engines and service before diluting. Then (with chocks firmly anchored) restart engines and dilute.

b. To dilute oil, maintain 1500 rpm, oil temperature at 70°C or below and oil pressure above 25 psi. Hold oil dilution switches "ON" as required by the outside air temperature. The following table gives percentages and length of time for oil dilution, based on Grade 1100 oil:

Outside Air Temperature	4°C	−12°C	−29°C	−46°C	−54°C
Percent Dilution	0	10	20	30	35
Time (Minutes)	0	2.5	4.5	7.0	8.5

c. Run up engines to 1200-1400 rpm for approximately 1-2 minutes; then hold the mixture control switches in "IDLE CUT-OFF" position for 3 seconds and advance throttles to gate.

Note

This procedure will prolong the life of spark plugs.

d. When propellers stop rotating, move ignition switches to "OFF," and throttles to "CLOSED."

5-12. BEFORE LEAVING AIRPLANE.

a. If heater and blower were used during ground operation, leave heater master switch on for 30 seconds, after turning other systems off, to allow blower to clear heater of unburned gases.

b. Release brakes.

c. Install protective covers on cockpits, engines, air scoops, and wing and tail surfaces.

d. Clean dirt and ice from shock struts.

e. Inspect fuel and oil tank vents and crankcase breathers, and remove ice.

f. Drain oil tank sumps, "Y" drains, and fuel drains of condensate within 30 minutes after stopping engines.

g. If engines are expected to be idle for several days, battery should be removed and oil may be drained.

5-13. DESERT OPERATION.

5-14. Filter doors are installed in the air intake ducts on either side of the engine cowling. For all operations under dusty or sandy conditions, position engine air control switches at "ENG. FILTERED AIR." Cover all openings when the airplane is on the ground to prevent entrance of blowing sand.

Appendix I

OPERATING CHARTS

A-1. FLIGHT PLANNING.

A-2. A series of charts on the following pages is provided to aid in selecting the proper power and altitude to be used for obtaining optimum range of the airplane. Charts are provided for each airplane configuration with the probable ranges of gross weights. If the flight plan calls for a continuous flight where the desired cruising power and airspeed are reasonably constant after take-off and climb and the external load items are the same throughout the flight, the fuel required and flight time may be computed as a single section flight. If this is not the case, the flight may be broken up into sections, and each leg of the flight planned separately, since dropping of external bombs or tanks causes considerable change in range and airspeed for given power. (Within the limits of the airplane, the fuel required and flying time for a given mission depend largely upon the speed desired. With all other factors remaining equal in an airplane, speed is obtained at a sacrifice of range, and range is obtained at a sacrifice of speed.)

A-3. USE OF CHARTS.

A-4. Although instructions for their use are shown on the Flight Operation Instruction Charts, the following expanded information on proper use of the charts may be helpful.

a. Select the Flight Operation Instruction Chart for the gross weight, and external loading to be used at take-off. The amount of gasoline available for flight planning purposes depends upon the reserve required and the amount required for starting and warm-up. Reserve should be based on the type of mission, terrain over which the flight is to be made, and weather conditions. The fuel required for climb and time to climb to various altitudes is shown on the Take-off, Climb, and Landing Chart. Fuel remaining after subtracting reserve, warm-up, and climb fuel from total amount available is the amount to be used for flight planning.

b. Select a figure in the fuel column in the upper section of the chart equal to, or the next entry less than, the amount of fuel available for flight planning. Move horizontally to the right or left and select a figure equal to, or the next entry greater than, the distance (with no wind) to be flown. Operating values contained in the lower section of the column number in which this figure appears represent the highest cruising speeds possible at the range desired. It will be noted that the ranges listed in Column I are figured for the altitude which gives the least miles per gallon. The ranges shown in Column II and other columns to the right of Column II can be obtained at any of the altitudes listed in the altitude column. All of the power settings listed in a column will give approximately the same number of miles per gallon if each is used at the altitude shown on the same horizontal line with it. Note that the time required for the flight may be shortened by selection of the higher altitudes. The flight duration may be obtained by dividing the true airspeed of the flight altitude into the air miles to be flown.

c. The flight plan may be readily changed at any time enroute, and the chart will show the balance of range available at various cruising powers by following the Instructions for Using Chart printed on each chart.

Note

The preceding instructions and following charts do not take into account the effect of wind. Adjustment to range values and flight duration to allow for wind may be made by any method familiar to the pilot, such as by the use of a flight calculator or a navigator's triangle of velocities.

A-5. F-82E SAMPLE PROBLEM.

A-6. PROBLEM 1. To fly 650 miles out at 30,000 feet and return to base after 15 minutes of combat over the target area.

a. Reference to the charts shows that two 165-gallon tanks will be needed, which will make the take-off gross weight around 23,500 pounds. Reference to the climb chart shows that 175 gallons of fuel will be used in climbing to 30,000 feet. This leaves 755 gallons for cruise and combat, assuming the climb was made near the base with a rendezvous at 30,000 feet.

b. The combat allowance chart shows that at 30,000 feet military power will use 4 gallons per minute per engine so that 15 minutes of combat will use 120 gallons. This will leave a balance for cruising of 635 gallons (755 less 120).

c. The range shown in Column IV for 600 gallons is 1330 miles, so the reserve will be approximately 40 gallons. Reference to paragraph d. following will show the method used to obtain the actual reserve.

d. Vertically below in the table and opposite 30,000 feet read 2450 RPM, F.T., 290 MPH, using 130 GPH with the mixtures set in the "NORMAL" position. The range to be covered divided by the TAS will give

AIRSPEED INSTALLATION CORRECTION TABLE (WITH OR WITHOUT EXTERNAL LOAD) SUBTRACT CORRECTION FROM CORRECTED INSTRUMENT READING TO OBTAIN CALIBRATED INDICATED AIRSPEED.			
GEAR AND FLAPS UP		GEAR AND FLAPS DOWN	
IAS (MPH)	CORRECTION (MPH)	IAS (MPH)	CORRECTION (MPH)
150	2	100	4
200	1	120	5
250	0	140	6
300	0	160	7
350	0	180	8
400	0	200	9

144-93-400

Figure A-1. Airspeed Installation Correction Table

COMPRESSIBILITY CORRECTION TABLE SUBTRACT CORRECTION BELOW FROM CALIBRATED INDICATED AIRSPEED TO OBTAIN TRUE INDICATED AIRSPEED.								
PRESSURE ALTITUDE	CALIBRATED IAS (MPH)							
	150	200	250	300	350	400	450	500
10,000	0	1	2	3	4	6	8	10
15,000	0	1	3	4	7	10	13	17
20,000	1	2	4	6	10	14	19	25
25,000	1	3	5	9	13	19	26	
30,000	2	4	7	12	18	25		
35,000	2	5	10	16	24			

144-93-401

Figure A-2. Compressibility Correction Table

COMBAT ALLOWANCE CHART					
74 in. Hg			65 in. Hg		
ALTITUDE	MAN. PRESS.	GPM PER ENGINE	ALTITUDE	MAN. PRESS.	GPM PER ENGINE
SEA LEVEL	74	4.0	SEA LEVEL	65	3.5
5,000	74	4.0	5,000	65	3.5
10,000	74	4.5	10,000	65	3.5
15,000	74	4.5	15,000	65	3.5
20,000	F. T.	4	20,000	65	3.5
25,000	F. T.	4	25,000	65	3.5
30,000	F. T.	3.5	30,000	F.T.	3.5
35,000	F. T.	3.0	35,000	F. T.	3.0

NOTE: F. T. FULL THROTTLE

144-93-474

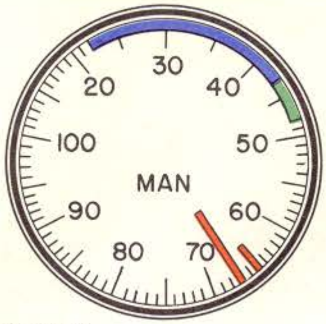
Figure A-3. Combat Allowance Chart

the hours of flight (650 ÷ 290 = 2.25 hours one way). The hours multiplied by the fuel flow equals the gallons used (2.25 × 130 = 295 gallons). The return trip must be computed from the No External Load Chart, as the tanks will have been dropped before entering the combat zone. The operating conditions on the return trip will be 2500 RPM, F.T., 345 MPH using 150 GPH with the mixture set in "NORMAL." The time required will be 1.9 hours (650 ÷ 345) and the fuel used will be 285 gallons (1.9 × 150). Thus the total fuel used for the cruise part of the trip will be 285 plus 295 or 580 gallons leaving a reserve of 55 gallons (635 from preceding paragraph b., less 580).

A-7. PROBLEM 2. During such a flight as that described in Problem 1, suppose one engine is shot up and is lost just after leaving the target area. The fuel remaining is 930 less 590 (175 climb + 120 combat + 295 cruise out) or 340 gallons. Reference to the single engine chart shows that it will be necessary to drop to 10,000 feet in order to obtain the needed range. The operating conditions at 10,000 feet will be 2400 RPM, 44 in. Hg M.A.P., 205 MPH and 81 GPH with the mixture set in "LONG RANGE CRUISE." The time required will be 650 ÷ 205 or 3.15 hours, and the fuel used will be 3.15 × 81 or 260 gallons. Thus the reserve will be around 80 gallons (340 less 260). So in an emergency the range can be extended slightly by the use of only one engine if the gross weight is low enough and a low cruising altitude can be maintained.

A-8. SELECTION OF CRUISING CONDITIONS.

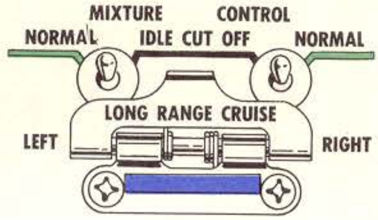
A-9. If arrival over a check point is late because of head winds, similar reference to the charts and calculations will allow the pilot, while in flight, to select new cruising conditions for safe arrival at his destination.



Minimum Cruise	22" Hg
Operation Permitted in "LONG RANGE CRUISE"	22" - 44" Hg
Normal Operating Range	44" - 48" Hg
Max Continuous (Operation Above This Point Limited)	48" Hg
Take-off—Dry (5 Min Max) and Military Power—Dry (15 Min Max)	65" Hg
Single-engine Take-off—Dry (5 Min Max)	67" Hg

NOTE

When airplane modifications are completed permitting the use of water injection, a maximum manifold pressure of 74" Hg (Wet) may be used for take-off. Operation is limited to 5 minutes for take-off or 10 minutes in flight at this manifold pressure.



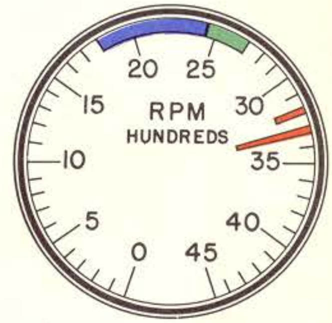
All indications in blue; operation in "LONG RANGE CRUISE" permitted.

Either indicator (man. press. or tach) in green; normal mixture required.

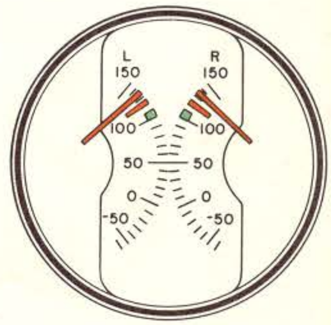
The instrument setting is such that the red pointer will move to indicate the limiting structural airspeed of 505 mph or the airspeed representing the limiting Mach No. of .75, whichever is less.

Max permissible IAS for lowering gear or flaps—190 mph.

FUEL—GRADE 115/145

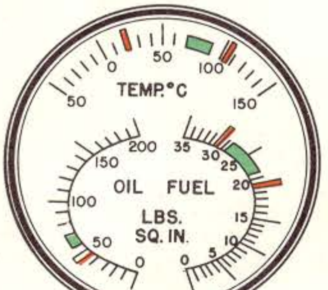


Minimum Cruise	1800 rpm
Operation Permitted in "LONG RANGE CRUISE"	1800 - 2400 rpm
Normal Operating Range	2400 - 2700 rpm
Max Continuous (Operation Above This Point Limited)	2700 rpm
Take-off, Military Power	3200 rpm
Max Diving Overspeed	3300 rpm



COOLANT

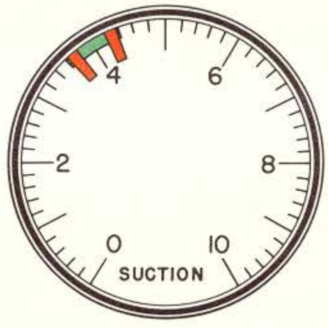
Operating range	105°C - 115°C
Maximum	121°C
Max Military Power	135°C



OIL TEMPERATURE	Minimum for Flight	20°C
	Operating range	70° - 90°C
	Maximum	105°C
OIL PRESSURE	Minimum	55 psi
	Operating range	60 - 70 psi
FUEL PRESSURE	Minimum	20 psi
	Operating range	22 - 28 psi
	Maximum	30 psi

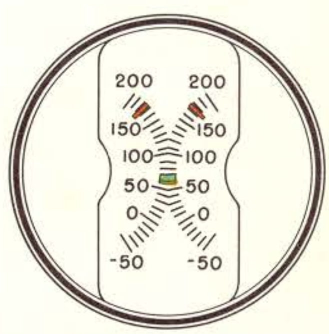
COLOR CODE

- Blue — Operation permitted in "LONG RANGE CRUISE."
- Green — Normal operating range.
- Yellow — Caution.
- Red — Limit, or danger region.



Minimum	3.75" Hg
Operating range	3.75" - 4.25" Hg
Maximum	4.25" Hg

TAKE-OFF CONDITIONS	
OIL TEMP	40°C MIN
OIL PRESS	55 PSI MIN
COOLANT TEMP	85°C MIN



ENGINE CHARGE TEMP

Operating range	60° - 71°C
Danger of Plug Fouling	60°C & Below
Maximum	175°C

123-51-181G

Figure A-4. Instrument Dial Markings

AAFMC-527
4-1-44

AIRCRAFT MODEL(S)
F-82E

TAKE-OFF, CLIMB & LANDING CHART

ENGINE MODEL(S)
ALLISON
V-1710-143
V-1710-145

TAKE-OFF DISTANCE FEET

GROSS WEIGHT LB.	HEAD WIND M.P.H.	HEAD WIND KTS.	HARD SURFACE RUNWAY-65 IN.HG. AT SEA LEVEL GROUND RUN	AT SEA LEVEL TO CLEAR 50' OBJ.	AT 3000 FEET GROUND RUN	AT 3000 FEET TO CLEAR 50' OBJ.	AT 6000 FEET GROUND RUN	AT 6000 FEET TO CLEAR 50' OBJ.	HARD SURFACE RUNWAY-74 IN.HG. AT SEA LEVEL GROUND RUN	AT SEA LEVEL TO CLEAR 50' OBJ.	AT 3000 FEET GROUND RUN	AT 3000 FEET TO CLEAR 50' OBJ.	AT 6000 FEET GROUND RUN	AT 6000 FEET TO CLEAR 50' OBJ.
26,000	0	0	2950	4500	3400	5100	3900	5800	2550	4000	2900	4500	3400	5100
	17	15	2250	3600	2600	4100	3100	4700	1950	3200	2250	3600	2650	4100
	34	30	1650	2750	1950	3200	2300	3700	1450	2400	1700	2800	2000	3200
24,000	0	0	2400	3800	2750	4300	3200	4900	2100	3400	2400	3800	2800	4300
	17	15	1800	3000	2100	3400	2500	3900	1600	2650	1850	3000	2150	3500
	34	30	1300	2250	1550	2550	1850	3000	1150	2000	1350	2300	1600	2650
22,000	0	0	1950	3200	2250	3600	2550	4000	1700	2900	1950	3200	2300	3700
	17	15	1450	2450	1700	2800	1950	3200	1300	2250	1450	2500	1750	2900
	34	30	1050	1850	1250	2100	1450	2450	900	1650	1050	1900	1250	2200

NOTE: INCREASE CHART DISTANCES AS FOLLOWS: 75°F + 10%; 100°F + 20%; 125°F + 30%; 150°F + 40%

OPTIMUM TAKE-OFF WITH 3200 RPM, 65 IN. HG. & 20 DEG. FLAP IS 80% OF CHART VALUES

OPTIMUM TAKE-OFF WITH 3200 RPM, 74 IN. HG. (WET) & 20 DEG. FLAP IS 80% OF CHART VALUES

DATA AS OF *6/7/48* BASED ON: *FLIGHT TESTS*

CLIMB DATA

GROSS WEIGHT LB.	AT SEA LEVEL BEST I.A.S. MPH	BEST I.A.S. KTS	RATE OF CLIMB F.P.M.	GAL. OF FUEL USED	AT 10,000 FEET BEST I.A.S. MPH	BEST I.A.S. KTS	RATE OF CLIMB F.P.M.	FROM SEA LEVEL TIME MIN.	FROM SEA LEVEL FUEL USED	AT 15,000 FEET BEST I.A.S. MPH	BEST I.A.S. KTS	RATE OF CLIMB F.P.M.	FROM SEA LEVEL TIME MIN.	FROM SEA LEVEL FUEL USED
26,000	190		950	45	190		950	10	95	190		850	16	125
24,000	185		1200	45	185		1250	8	80	185		1150	12	100
22,000	180		1400	45	180		1500	7	75	180		1400	10.5	90

GROSS WEIGHT LB.	AT 20,000 FEET BEST I.A.S. MPH	BEST I.A.S. KTS	RATE OF CLIMB F.P.M.	FROM SEA LEVEL TIME MIN.	FROM SEA LEVEL FUEL USED	AT 25,000 FEET BEST I.A.S. MPH	BEST I.A.S. KTS	RATE OF CLIMB F.P.M.	FROM SEA LEVEL TIME MIN.	FROM SEA LEVEL FUEL USED	AT 30,000 FEET BEST I.A.S. MPH	BEST I.A.S. KTS	RATE OF CLIMB F.P.M.	FROM SEA LEVEL TIME MIN.	FROM SEA LEVEL FUEL USED
26,000	190		650	22	155	190		400	32	200	185		100	50	280
24,000	185		950	17	120	185		700	23	150	180		450	31	185
22,000	180		1200	14	110	180		900	19	130	175		650	25	160

POWER PLANT SETTINGS: *2700 RPM, 48 IN. HG*
DATA AS OF *6/7/48* BASED ON: *FLIGHT TESTS*

FUEL USED (U.S. GAL.) INCLUDES WARM-UP & TAKE-OFF ALLOWANCE

LANDING DISTANCE FEET

GROSS WEIGHT LB.	BEST IAS APPROACH POWER OFF MPH	POWER OFF KTS	POWER ON MPH	POWER ON KTS	HARD DRY SURFACE AT SEA LEVEL GROUND ROLL	AT SEA LEVEL TO CLEAR 50' OBJ.	AT 3000 FEET GROUND ROLL	AT 3000 FEET TO CLEAR 50' OBJ.	AT 6000 FEET GROUND ROLL	AT 6000 FEET TO CLEAR 50' OBJ.
20,000	130	115	130	115	2200	3300	2400	3500	2600	3800
17,000	120	105	120	105	1900	2800	2000	3000	2200	3300

GROSS WEIGHT LB.	FIRM DRY SOD AT SEA LEVEL GROUND ROLL	AT SEA LEVEL TO CLEAR 50' OBJ.	AT 3000 FEET GROUND ROLL	AT 3000 FEET TO CLEAR 50' OBJ.	AT 6000 FEET GROUND ROLL	AT 6000 FEET TO CLEAR 50' OBJ.	WET OR SLIPPERY AT SEA LEVEL GROUND ROLL	AT SEA LEVEL TO CLEAR 50' OBJ.	AT 3000 FEET GROUND ROLL	AT 3000 FEET TO CLEAR 50' OBJ.	AT 6000 FEET GROUND ROLL	AT 6000 FEET TO CLEAR 50' OBJ.
20,000												
17,000												

DATA AS OF *6/7/48* BASED ON: *FLIGHT TESTS*

OPTIMUM LANDING IS 80% OF CHART VALUES

REMARKS:

NOTE: TO DETERMINE FUEL CONSUMPTION IN BRITISH IMPERIAL GALLONS, MULTIPLY BY 10, THEN DIVIDE BY 12

FUEL—GRADE 115/145

149-93-504A

LEGEND
I.A.S. : INDICATED AIRSPEED
M.P.H. : MILES PER HOUR
KTS. : KNOTS
F.P.M. : FEET PER MINUTE

Figure A-5. Take-off, Climb, and Landing Chart

AAFMC-528
4-1-44

AIRCRAFT MODEL(S): F-82E

ENGINE(S): V-1710-143 & V-1710-145

FLIGHT OPERATION INSTRUCTION CHART

CHART WEIGHT LIMITS: 21,000 LBS TO EMPTY

EXTERNAL LOAD ITEMS: NONE

NUMBER OF ENGINES OPERATING: 2

LIMITS		R.P.M.	M.P. IN.HG.	BLOWER POSITION	MIXTURE POSITION	TIME LIMIT	COOL. TEMP.	TOTAL GPH PER ENGINE
MILITARY POWER	WET	3200	74		NORMAL	10 Min.	135	225
	DRY	3200	65		NORMAL	15 Min.	135	220

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING[1] MOVE HORIZONTALLY TO RIGHT OR LEFT AND SELECT RANGE VALUE EQUAL TO OR GREATER THAN THE STATUTE OR NAUTICAL AIR MILES TO BE FLOWN. VERTICALLY BELOW AND OPPOSITE VALUE NEAREST DESIRED CRUISING ALTITUDE (ALT.) READ RPM, MANIFOLD PRESSURE (M.P.) AND MIXTURE SETTING REQUIRED.

NOTES: COLUMN I IS FOR EMERGENCY HIGH SPEED CRUISING ONLY. COLUMNS II, III, IV AND V GIVE PROGRESSIVE INCREASE IN RANGE AT A SACRIFICE IN SPEED. AIR MILES PER GALLON (MI./GAL.) (NO WIND), GALLONS PER HR. (G.P.H.) AND TRUE AIRSPEED (T.A.S.) ARE APPROXIMATE VALUES FOR REFERENCE. RANGE VALUES ARE FOR AN AVERAGE AIRPLANE FLYING ALONE (NO WIND)[1]. TO OBTAIN BRITISH IMPERIAL GAL. (OR G.P.H.): MULTIPLY U.S. GAL. (OR G.P.H.) BY 10 THEN DIVIDE BY 12.

COLUMN I		FUEL	COLUMN II		COLUMN III		COLUMN IV		FUEL	COLUMN V	
RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES		RANGE IN AIRMILES		RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES	
STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL	STATUTE	NAUTICAL	STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL
			SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING[1]								
660	580	600	960	840	1200	1040	1380	1200	600	1560	1360
550	480	500	800	700	1000	860	1150	1000	500	1300	1130
440	380	400	640	560	800	690	920	800	400	1040	900
330	290	300	480	420	600	520	690	600	300	780	680
220	190	200	320	280	400	340	460	400	200	520	450
110	90	100	160	140	200	170	230	200	100	260	220

MAXIMUM CONTINUOUS / COLUMN II (1.60 STAT. (1.40 NAUT.) MI./GAL.)

MC R.P.M.	MC M.P. INCHES	MC MIXTURE	MC TOT. GPH	MC T.A.S. MPH	MC T.A.S. KTS.	PRESS ALT. FEET	II R.P.M.	II M.P. INCHES	II MIXTURE	II TOT. GPH	II T.A.S. MPH	II T.A.S. KTS.
						40000						
2700	F.T.	NORMAL	170	375	325	35000						
2700	F.T.	NORMAL	220	390	340	30000	2700	F.T.	NORMAL	220	390	340
2700	F.T.	NORMAL	260	390	340	25000	2600	F.T.	NORMAL	225	380	330
2700	F.T.	NORMAL	285	380	330	20000	2600	F.T.	NORMAL	225	365	315
2700	48	NORMAL	295	365	315	15000	2500	46	NORMAL	215	350	305
2700	48	NORMAL	300	350	300	10000	2500	45	NORMAL	210	330	285
2700	48	NORMAL	295	330	285	5000	2450	45	NORMAL	195	310	270
2700	48	NORMAL	280	310	270	S.L.	2450	45	NORMAL	185	295	255

COLUMN III (2.00 STAT. (1.75 NAUT.) MI./GAL.) / COLUMN IV (2.30 STAT. (2.00 NAUT.) MI./GAL.)

PRESS ALT. FEET	III R.P.M.	III M.P. INCHES	III MIXTURE	III TOT. GPH	III T.A.S. MPH	III T.A.S. KTS.	IV R.P.M.	IV M.P. INCHES	IV MIXTURE	IV TOT. GPH	IV T.A.S. MPH	IV T.A.S. KTS.
40000												
35000	2700	F.T.	NORMAL	170	375	325	2600	F.T.	NORMAL	150	360	310
30000	2600	F.T.	NORMAL	185	370	320	2500	F.T.	NORMAL	150	345	300
25000	2550	F.T.	NORMAL	180	360	310	2450	F.T.	NORMAL	150	340	295
20000	2450	F.T.	NORMAL	175	350	305	2400	F.T.	LRC	145	340	295
15000	2400	44	LRC	160	335	290	2250	F.T.	LRC	140	320	275
10000	2400	44	LRC	160	325	280	2150	42	LRC	130	300	260
5000	2350	44	LRC	150	305	265	2000	42	LRC	125	280	245
S.L.	2300	43	LRC	145	290	250	2000	42	LRC	115	265	230

MAXIMUM AIR RANGE

PRESS ALT. FEET	R.P.M.	M.P. INCHES	MIXTURE	TOT. GPH	T.A.S. MPH	T.A.S. KTS.
40000						
35000						
30000	2400	F.T.	LRC	110	310	270
25000	2400	F.T.	LRC	125	330	285
20000	2250	F.T.	LRC	115	305	265
15000	2050	F.T.	LRC	105	280	245
10000	1850	F.T.	LRC	100	255	220
5000	1800	36	LRC	90	235	205
S.L.	1800	36	LRC	85	215	185

SPECIAL NOTES

(1) MAKE ALLOWANCE FOR WARM-UP, TAKE-OFF & CLIMB PLUS ALLOWANCE FOR WIND, RESERVE AND COMBAT AS REQUIRED.

EXAMPLE

AT 20,500 LB. GROSS WEIGHT WITH 500 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF 100 GAL.) TO FLY 1100 STAT. AIRMILES AT 30,000 FT. ALTITUDE MAINTAIN 2500 RPM AND F.T. IN. MANIFOLD PRESSURE WITH MIXTURE SET: NORMAL

LEGEND

ALT. : PRESSURE ALTITUDE
M.P. : MANIFOLD PRESSURE
GPH : U.S. GAL. PER HOUR
TAS : TRUE AIRSPEED
KTS. : KNOTS
S.L. : SEA LEVEL
LRC: LONG RANGE CRUISE
F.R. : FULL RICH
A.R. : AUTO-RICH
A.L. : AUTO-LEAN
C.L. : CRUISING LEAN
M.L. : MANUAL LEAN
F.T. : FULL THROTTLE

149-93-505A

DATA AS OF 6/7/48 BASED ON: FLIGHT TESTS

FUEL—GRADE 115/145

Figure A-6. Flight Operation Instruction Chart—No External Load

AAFMC-528
4-1-44

AIRCRAFT MODEL(S)
F-82E

ENGINE(S): V-1710-143 &
V-1710-145

FLIGHT OPERATION INSTRUCTION CHART

CHART WEIGHT LIMITS: 23,000 TO 20,000 POUNDS

EXTERNAL LOAD ITEMS
TWO 165-GALLON TANKS

NUMBER OF ENGINES OPERATING: TWO

LIMITS		R.P.M.	M.P. IN.HG.	BLOWER POSITION	MIXTURE POSITION	TIME LIMIT	COOL. TEMP.	TOTAL GPH PER ENGINE
MILITARY POWER	WET	3200	74		NORMAL	10 MIN.	135	225
	DRY	3200	65		NORMAL	15 MIN.	135	220

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING(1) MOVE HORIZONTALLY TO RIGHT OR LEFT AND SELECT RANGE VALUE EQUAL TO OR GREATER THAN THE STATUTE OR NAUTICAL AIR MILES TO BE FLOWN. VERTICALLY BELOW AND OPPOSITE VALUE NEAREST DESIRED CRUISING ALTITUDE (ALT.) READ RPM, MANIFOLD PRESSURE (M.P.) AND MIXTURE SETTING REQUIRED.

NOTES: COLUMN I IS FOR EMERGENCY HIGH SPEED CRUISING ONLY. COLUMNS II, III, IV AND V GIVE PROGRESSIVE INCREASE IN RANGE AT A SACRIFICE IN SPEED. AIR MILES PER GALLON (MI./GAL.) (NO WIND), GALLONS PER HR. (G.P.H.) AND TRUE AIRSPEED (T.A.S.) ARE APPROXIMATE VALUES FOR REFERENCE. RANGE VALUES ARE FOR AN AVERAGE AIRPLANE FLYING ALONE (NO WIND)(1). TO OBTAIN BRITISH IMPERIAL GAL. (OR G.P.H.): MULTIPLY U.S.GAL. (OR G.P.H.) BY 10 THEN DIVIDE BY 12.

COLUMN I		FUEL	COLUMN II		COLUMN III		COLUMN IV		FUEL	COLUMN V	
RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES		RANGE IN AIRMILES		RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES	
STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL	STATUTE	NAUTICAL	STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL
				SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING (1)							
		930							930		
950	830	900	1290	1120	1740	1510	2050	1780	900	2250	1950
840	730	800	1140	990	1540	1340	1810	1570	800	1990	1720
740	640	700	990	860	1340	1160	1570	1360	700	1720	1490
630	540	600	840	730	1140	990	1330	1150	600	1450	1260
520	450	500	700	600	950	820	1100	950	500	1200	1040
420	360	400	560	480	760	660	880	760	400	960	830

MAXIMUM CONTINUOUS						PRESS	(1.40 STAT. (1.20 NAUT.) MI./GAL.)						(1.90 STAT. (1.65 NAUT.) MI./GAL.)						(2.20 STAT. (1.90 NAUT.) MI./GAL.)						PRESS	MAXIMUM AIR RANGE					
R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. GPH.	T.A.S. MPH.	T.A.S. KTS.	ALT. FEET	R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. GPH.	T.A.S. MPH.	T.A.S. KTS.	R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. GPH.	T.A.S. MPH.	T.A.S. KTS.	R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. GPH.	T.A.S. MPH.	T.A.S. KTS.	ALT. FEET	R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. GPH.	T.A.S. MPH.	T.A.S. KTS.
						40000																			40000						
2700	F.T.	NORMAL	170	335	290	35000							2700	F.T.	NORMAL	170	335	290							35000						
2700	F.T.	NORMAL	220	360	315	30000	2700	F.T.	NORMAL	220	360	315	2600	F.T.	NORMAL	175	335	290	2450	F.T.	NORMAL	130	290	250	30000						
2700	F.T.	NORMAL	260	365	320	25000	2600	F.T.	NORMAL	210	350	305	2500	F.T.	NORMAL	175	335	290	2450	F.T.	NORMAL	140	310	270	25000	2400	37	LRC	120	295	255
2700	F.T.	NORMAL	285	360	315	20000	2600	F.T.	NORMAL	240	345	300	2450	F.T.	NORMAL	170	320	280	2350	F.T.	LRC	140	310	270	20000	2200	F.T.	LRC	115	275	240
2700	48	NORMAL	295	345	300	15000	2550	46	NORMAL	240	335	290	2400	44	LRC	160	315	275	2200	F.T.	LRC	130	290	250	15000	2000	F.T.	LRC	105	255	220
2700	48	NORMAL	300	330	285	10000	2500	45	NORMAL	225	315	275	2400	44	LRC	160	305	265	2050	F.T.	LRC	120	270	235	10000	1800	F.T.	LRC	95	230	200
2700	48	NORMAL	295	310	270	5000	2500	45	NORMAL	215	300	260	2350	44	LRC	155	290	250	1900	F.T.	LRC	115	255	220	5000	1800	35	LRC	90	215	185
2700	48	NORMAL	280	295	255	S.L.	2500	45	NORMAL	205	285	245	2300	43	LRC	140	270	235	1900	42	LRC	110	240	210	S.L.	1800	35	LRC	80	195	170

SPECIAL NOTES

(1) MAKE ALLOWANCE FOR WARM-UP, TAKE-OFF & CLIMB PLUS ALLOWANCE FOR WIND, RESERVE AND COMBAT AS REQUIRED.

EXAMPLE

AT 22,500 LB. GROSS WEIGHT WITH 700 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF 230 GAL.) TO FLY 1500 STAT. AIRMILES AT 30,000 FT. ALTITUDE MAINTAIN 2450 RPM AND F.T. IN. MANIFOLD PRESSURE WITH MIXTURE SET: NORMAL

LEGEND

ALT. : PRESSURE ALTITUDE
M.P. : MANIFOLD PRESSURE
GPH : U.S. GAL. PER HOUR
TAS : TRUE AIRSPEED
KTS. : KNOTS
S.L. : SEA LEVEL
LRC: LONG RANGE CRUISE
F.R. : FULL RICH
A.R. : AUTO-RICH
A.L. : AUTO-LEAN
C.L. : CRUISING LEAN
M.L. : MANUAL LEAN
F.T. : FULL THROTTLE

149-93-506A

FUEL—GRADE 115/145

DATA AS OF *6/7/48* BASED ON: *FLIGHT TESTS*

Figure A-7 (Sheet 1 of 2 Sheets). Flight Operation Instruction Chart—Two 165-gallon Drop Tanks

AAFMC-528
4-1-48

AIRCRAFT MODEL(S) F-82E

ENGINE(S): V-1710-143 & V-1710-145

FLIGHT OPERATION INSTRUCTION CHART

CHART WEIGHT LIMITS: 20,000 LBS TO EMPTY

EXTERNAL LOAD ITEMS
TWO 165-GALLON TANKS

NUMBER OF ENGINES OPERATING: TWO

LIMITS		R.P.M.	M.P. IN.HG.	BLOWER POSITION	MIXTURE POSITION	TIME LIMIT	COOL. TEMP.	TOTAL GPH PER ENGINE
MILITARY POWER	WET	3200	74		NORMAL	10 MIN.	135	225
	DRY	3200	65		NORMAL	15 MIN.	135	220

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING(1) MOVE HORIZONTALLY TO RIGHT OR LEFT AND SELECT RANGE VALUE EQUAL TO OR GREATER THAN THE STATUTE OR NAUTICAL AIR MILES TO BE FLOWN. VERTICALLY BELOW AND OPPOSITE VALUE NEAREST DESIRED CRUISING ALTITUDE (ALT.) READ RPM, MANIFOLD PRESSURE (M.P.) AND MIXTURE SETTING REQUIRED.

NOTES: COLUMN I IS FOR EMERGENCY HIGH SPEED CRUISING ONLY. COLUMNS II, III, IV AND V GIVE PROGRESSIVE INCREASE IN RANGE AT A SACRIFICE IN SPEED. AIR MILES PER GALLON (MI./GAL.) (NO WIND), GALLONS PER HR. (G.P.H.) AND TRUE AIRSPEED (T.A.S.) ARE APPROXIMATE VALUES FOR REFERENCE. RANGE VALUES ARE FOR AN AVERAGE AIRPLANE FLYING ALONE (NO WIND).(1) TO OBTAIN BRITISH IMPERIAL GAL. (OR G.P.H.): MULTIPLY U.S.GAL. (OR G.P.H.) BY 10 THEN DIVIDE BY 12.

SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING (1)

COLUMN I STATUTE	COLUMN I NAUTICAL	FUEL U.S. GAL.	COLUMN II STATUTE	COLUMN II NAUTICAL	COLUMN III STATUTE	COLUMN III NAUTICAL	COLUMN IV STATUTE	COLUMN IV NAUTICAL	FUEL U.S. GAL.	COLUMN V STATUTE	COLUMN V NAUTICAL
540	470	500	750	650	1000	860	1200	1040	500	1320	1150
430	370	400	600	520	800	690	960	830	400	1060	920
320	280	300	450	390	600	520	720	620	300	790	690
210	180	200	300	260	400	340	480	410	200	530	460
100	90	100	150	130	200	170	240	210	100	260	230

(All range values in airmiles.)

MAXIMUM CONTINUOUS; COLUMN II (1.50 STAT. (1.30 NAUT.) MI./GAL.)

R.P.M.	M.P. INCHES	MIXTURE	TOT. GPH	T.A.S. MPH	T.A.S. KTS.	PRESS ALT. FEET	R.P.M.	M.P. INCHES	MIXTURE	TOT. GPH	T.A.S. MPH	T.A.S. KTS.
						40000						
2700	F.T.	NORMAL	170	360	315	35000						
2700	F.T.	NORMAL	220	375	325	30000	2700	F.T.	NORMAL	220	375	325
2700	F.T.	NORMAL	260	380	330	25000	2600	F.T.	NORMAL	210	365	315
2700	F.T.	NORMAL	285	370	320	20000	2600	F.T.	NORMAL	235	360	310
2700	48	NORMAL	295	355	310	15000	2550	46	NORMAL	220	340	295
2700	48	NORMAL	300	335	290	10000	2500	45	NORMAL	210	320	280
2700	48	NORMAL	295	320	280	5000	2500	45	NORMAL	200	305	265
2700	48	NORMAL	280	305	265	S.L.	2500	45	NORMAL	195	290	250

COLUMN III (2.00 STAT. (1.75 NAUT.) MI./GAL.); COLUMN IV (2.40 STAT. (2.10 NAUT.) MI./GAL.)

PRESS ALT. FEET	R.P.M.	M.P. INCHES	MIXTURE	TOT. GPH	T.A.S. MPH	T.A.S. KTS.	R.P.M.	M.P. INCHES	MIXTURE	TOT. GPH	T.A.S. MPH	T.A.S. KTS.
40000												
35000	2700	F.T.	NORMAL	170	360	315	2550	F.T.	NORMAL	135	325	280
30000	2600	F.T.	NORMAL	175	355	310	2450	F.T.	NORMAL	135	320	280
25000	2500	F.T.	NORMAL	170	345	300	2400	F.T.	LRC	125	320	280
20000	2450	F.T.	NORMAL	170	335	290	2300	F.T.	LRC	130	315	275
15000	2400	44	LRC	160	330	285	2100	F.T.	LRC	120	290	250
10000	2350	43	LRC	155	310	270	1950	F.T.	LRC	110	265	230
5000	2250	43	LRC	145	290	250	1800	39	LRC	105	250	215
S.L.	2250	43	LRC	135	275	240	1800	40	LRC	95	235	205

MAXIMUM AIR RANGE (COLUMN V)

PRESS ALT. FEET	R.P.M.	M.P. INCHES	MIXTURE	TOT. GPH	T.A.S. MPH	T.A.S. KTS.
40000						
35000						
30000	2400	F.T.	LRC	125	300	260
25000	2400	35	LRC	115	300	260
20000	2200	34	LRC	100	270	235
15000	2000	33	LRC	90	245	215
10000	1800	32	LRC	85	220	190
5000	1800	32	LRC	75	200	175
S.L.	1800	32	LRC	70	185	160

SPECIAL NOTES

(1) MAKE ALLOWANCE FOR WARM-UP, TAKE-OFF & CLIMB PLUS ALLOWANCE FOR WIND, RESERVE AND COMBAT AS REQUIRED.

EXAMPLE

AT 19,500 LB. GROSS WEIGHT WITH 400 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF 100 GAL.) TO FLY 900 STAT. AIRMILES AT 30,000 FT. ALTITUDE MAINTAIN 2450 RPM AND F.T. IN. MANIFOLD PRESSURE WITH MIXTURE SET: NORMAL

LEGEND

ALT. : PRESSURE ALTITUDE
M.P. : MANIFOLD PRESSURE
GPH : U.S.GAL. PER HOUR
TAS : TRUE AIRSPEED
KTS. : KNOTS
S.L. : SEA LEVEL
LRC: LONG RANGE CRUISE
F.R. : FULL RICH
A.R. : AUTO-RICH
A.L. : AUTO-LEAN
C.L. : CRUISING LEAN
M.L. : MANUAL LEAN
F.T. : FULL THROTTLE

FUEL—GRADE 115/145

149-93-507A

DATA AS OF 6/7/48 BASED ON: *FLIGHT TESTS*

Figure A-7 (Sheet 2 of 2 Sheets). Flight Operation Instruction Chart—Two 165-gallon Drop Tanks

AAFMC-528
4-1-44

FLIGHT OPERATION INSTRUCTION CHART

AIRCRAFT MODEL(S): F-82E
ENGINE(S): V-1710-143 & V-1710-145

CHART WEIGHT LIMITS: 24,400 TO 22,500 POUNDS

EXTERNAL LOAD ITEMS: 5 ROCKET TREES

NUMBER OF ENGINES OPERATING: TWO

LIMITS		R.P.M.	M.P. IN.HG.	BLOWER POSITION	MIXTURE POSITION	TIME LIMIT	COOL. TEMP.	TOTAL GPH PER ENGINE
MILITARY POWER	WET	3200	74		NORMAL	10 MIN.	135	225
MILITARY POWER	DRY	3200	65		NORMAL	15 MIN.	135	220

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING(1) MOVE HORIZONTALLY TO RIGHT OR LEFT AND SELECT RANGE VALUE EQUAL TO OR GREATER THAN THE STATUTE OR NAUTICAL AIR MILES TO BE FLOWN. VERTICALLY BELOW AND OPPOSITE VALUE NEAREST DESIRED CRUISING ALTITUDE (ALT.) READ RPM, MANIFOLD PRESSURE (M.P.) AND MIXTURE SETTING REQUIRED.

NOTES: COLUMN I IS FOR EMERGENCY HIGH SPEED CRUISING ONLY. COLUMNS II, III, IV AND V GIVE PROGRESSIVE INCREASE IN RANGE AT A SACRIFICE IN SPEED. AIR MILES PER GALLON (MI./GAL.) (NO WIND), GALLONS PER HR. (G.P.H.) AND TRUE AIRSPEED (T.A.S.) ARE APPROXIMATE VALUES FOR REFERENCE. RANGE VALUES ARE FOR AN AVERAGE AIRPLANE FLYING ALONE (NO WIND)(1). TO OBTAIN BRITISH IMPERIAL GAL. (OR G.P.H.): MULTIPLY U.S. GAL. (OR G.P.H.) BY 10 THEN DIVIDE BY 12.

COLUMN I		FUEL	COLUMN II		COLUMN III		COLUMN IV		FUEL	COLUMN V	
RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES		RANGE IN AIRMILES		RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES	
STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL	STATUTE	NAUTICAL	STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL
			SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING (1)								
550	480	600	720	620	970	840	1140	980	600	1220	1070
460	400	500	600	520	810	700	940	820	500	1010	880
360	320	400	430	410	640	560	740	650	400	800	700
270	240	300	360	310	480	410	550	480	300	590	510
180	160	200	240	210	320	270	370	320	200	390	340

MAXIMUM CONTINUOUS						PRESS ALT. FEET	(1.2 STAT. (1.05 NAUT.) MI./GAL.)						(1.6 STAT. (1.4 NAUT.) MI./GAL.)					
R.P.M.	M.P. INCHES	MIX-TURE	TOT. GPH.	APPROX. T.A.S. MPH.	KTS.		R.P.M.	M.P. INCHES	MIX-TURE	TOT. GPH.	APPROX. T.A.S. MPH.	KTS.	R.P.M.	M.P. INCHES	MIX-TURE	TOT. GPH.	APPROX. T.A.S. MPH.	KTS.
						40000												
						35000												
						30000												
2700	F.T.	NORMAL	250	315	275	25000	2700	F.T.	NORMAL	260	315	275	2550	F.T.	NORMAL	180	290	250
2700	F.T.	NORMAL	285	310	270	20000	2600	F.T.	NORMAL	240	300	260	2450	F.T.	NORMAL	175	280	245
2700	48	NORMAL	295	300	260	15000	2550	46	NORMAL	240	290	250	2400	44	LRC	160	275	240
2700	48	NORMAL	300	285	250	10000	2550	46	NORMAL	235	275	240	2400	44	LRC	160	265	230
2700	48	NORMAL	295	275	240	5000	2550	45	NORMAL	220	260	225	2400	44	LRC	160	255	220
2700	48	NORMAL	280	260	225	S.L.	2500	45	NORMAL	210	250	215	2400	44	LRC	155	240	210

(1.85 STAT. (1.60 NAUT.) MI./GAL.)						PRESS ALT. FEET	MAXIMUM AIR RANGE					
R.P.M.	M.P. INCHES	MIX-TURE	TOT. GPH.	APPROX. T.A.S. MPH.	KTS.		R.P.M.	M.P. INCHES	MIX-TURE	TOT. GPH.	APPROX. T.A.S. MPH.	KTS.
						40000						
						35000						
						30000						
						25000						
2400	F.T.	LRC	145	275	240	20000	2300	F.T.	LRC	130	250	215
2250	F.T.	LRC	140	260	225	15000	2100	F.T.	LRC	120	230	200
2150	42	LRC	135	245	210	10000	1900	F.T.	LRC	110	215	190
2050	42	LRC	125	230	200	5000	1800	39	LRC	105	205	180
2050	42	LRC	120	220	190	S.L.	1800	40	LRC	100	195	170

SPECIAL NOTES

(1) MAKE ALLOWANCE FOR WARM-UP, TAKE-OFF & CLIMB PLUS ALLOWANCE FOR WIND, RESERVE AND COMBAT AS REQUIRED.

EXAMPLE

AT 24,000 LB. GROSS WEIGHT WITH 500 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF 100 GAL.) TO FLY 900 STAT. AIRMILES AT 20,000 FT. ALTITUDE MAINTAIN 2400 RPM AND F.T. IN. MANIFOLD PRESSURE WITH MIXTURE SET: LONG RANGE CRUISE

FUEL—GRADE 115/145

LEGEND

ALT. : PRESSURE ALTITUDE
M.P. : MANIFOLD PRESSURE
GPH : U.S. GAL. PER HOUR
TAS : TRUE AIRSPEED
KTS. : KNOTS
S.L. : SEA LEVEL
LRC: LONG RANGE CRUISE
F.R. : FULL RICH
A.R. : AUTO-RICH
A.L. : AUTO-LEAN
C.L. : CRUISING LEAN
M.L. : MANUAL LEAN
F.T. : FULL THROTTLE

149-93-508A

DATA AS OF 6/7/48 BASED ON: *FLIGHT TEST & ESTIMATED*

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

WF-3-31-44-10M

Figure A-8 (Sheet 1 of 2 Sheets). Flight Operation Instruction Chart—5 Rocket Trees

AAFMC-528
4-1-48

AIRCRAFT MODEL(S)	FLIGHT OPERATION INSTRUCTION CHART	EXTERNAL LOAD ITEMS
F-82E ENGINE(S): V-1710-143 & V-1710-145	CHART WEIGHT LIMITS: 22,500 LBS TO EMPTY	5 ROCKET TREES NUMBER OF ENGINES OPERATING: TWO

LIMITS		R.P.M.	M.P. IN.HG.	BLOWER POSITION	MIXTURE POSITION	TIME LIMIT	COOL. TEMP.	TOTAL GPH PER ENGINE
MILITARY POWER	WET	3200	74		NORMAL	10 MIN.	135	225
	DRY	3200	65		NORMAL	15 MIN.	135	220

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING(1) MOVE HORIZONTALLY TO RIGHT OR LEFT AND SELECT RANGE VALUE EQUAL TO OR GREATER THAN THE STATUTE OR NAUTICAL AIR MILES TO BE FLOWN. VERTICALLY BELOW AND OPPOSITE VALUE NEAREST DESIRED CRUISING ALTITUDE (ALT.) READ RPM, MANIFOLD PRESSURE (M.P.) AND MIXTURE SETTING REQUIRED.

NOTES: COLUMN I IS FOR EMERGENCY HIGH SPEED CRUISING ONLY. COLUMNS II, III, IV AND V GIVE PROGRESSIVE INCREASE IN RANGE AT A SACRIFICE IN SPEED. AIR MILES PER GALLON (MI./GAL.) (NO WIND), GALLONS PER HR. (G.P.H.) AND TRUE AIRSPEED (T.A.S.) ARE APPROXIMATE VALUES FOR REFERENCE. RANGE VALUES ARE FOR AN AVERAGE AIRPLANE FLYING ALONE (NO WIND).(1) TO OBTAIN BRITISH IMPERIAL GAL. (OR G.P.H.): MULTIPLY U.S. GAL. (OR G.P.H.) BY 10 THEN DIVIDE BY 12.

COLUMN I		FUEL	COLUMN II		COLUMN III		COLUMN IV		FUEL	COLUMN V	
RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES		RANGE IN AIRMILES		RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES	
STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL	STATUTE	NAUTICAL	STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL
			SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING (1)								
370	320	400	480	410	660	570	780	680	400	850	730
270 180 90	240 160 80	300 200 100	360 240 120	310 210 100	490 330 160	430 280 140	580 390 190	500 340 170	300 200 100	640 420 210	550 370 180

MAXIMUM CONTINUOUS						PRESS ALT. FEET	COLUMN II (1.2 STAT.) (1.05 NAUT.) MI./GAL.					
R.P.M.	M.P. INCHES	MIX-TURE	TOT. GPH.	T.A.S. MPH.	T.A.S. KTS.		R.P.M.	M.P. INCHES	MIX-TURE	TOT. GPH.	T.A.S. MPH.	T.A.S. KTS.
						40000						
						35000						
						30000						
2700	F.T.	NORMAL	260	325	280	25000	2700	F.T.	NORMAL	260	325	280
2700	F.T.	NORMAL	285	320	275	20000	2600	F.T.	NORMAL	240	310	270
2700	48	NORMAL	295	305	265	15000	2600	46	NORMAL	250	300	260
2700	48	NORMAL	300	290	250	10000	2550	46	NORMAL	235	280	245
2700	48	NORMAL	295	280	240	5000	2550	46	NORMAL	225	270	235
2700	48	NORMAL	280	265	230	S.L.	2550	45	NORMAL	215	255	220

PRESS ALT. FEET	COLUMN III (1.65 STAT.) (1.45 NAUT.) MI./GAL.						COLUMN IV (1.95 STAT.) (1.70 NAUT.) MI./GAL.						MAXIMUM AIR RANGE (COLUMN V)					
	R.P.M.	M.P. INCHES	MIX-TURE	TOT. GPH.	T.A.S. MPH.	T.A.S. KTS.	R.P.M.	M.P. INCHES	MIX-TURE	TOT. GPH.	T.A.S. MPH.	T.A.S. KTS.	R.P.M.	M.P. INCHES	MIX-TURE	TOT. GPH.	T.A.S. MPH.	T.A.S. KTS.
40000																		
35000																		
30000																		
25000	2550	F.T.	NORMAL	180	300	260	2450	F.T.	NORMAL	145	280	245	2400	F.T.	LRC	125	260	225
20000	2450	F.T.	NORMAL	180	290	250	2400	F.T.	LRC	145	270	235	2200	F.T.	LRC	115	245	215
15000	2400	44	LRC	160	280	245	2200	F.T.	LRC	135	260	225	2000	F.T.	LRC	110	225	195
10000	2400	44	LRC	160	270	235	2100	F.T.	LRC	125	245	215	1850	F.T.	LRC	100	210	185
5000	2400	44	LRC	160	260	225	1950	42	LRC	120	230	200	1800	37	LRC	95	200	175
S.L.	2350	44	LRC	150	245	215	1950	42	LRC	115	220	190	1800	38	LRC	90	190	165

SPECIAL NOTES

(1) MAKE ALLOWANCE FOR WARM-UP, TAKE-OFF & CLIMB PLUS ALLOWANCE FOR WIND, RESERVE AND COMBAT AS REQUIRED.

EXAMPLE

AT 22,000 LB. GROSS WEIGHT WITH 300 GAL. OF FUEL
(AFTER DEDUCTING TOTAL ALLOWANCES OF 100 GAL.)
TO FLY 550 STAT. AIRMILES AT 20,000 FT. ALTITUDE
MAINTAIN 2400 RPM AND F.T. IN. MANIFOLD PRESSURE
WITH MIXTURE SET: LONG RANGE CRUISE

LEGEND

ALT. : PRESSURE ALTITUDE
M.P. : MANIFOLD PRESSURE
GPH : U.S. GAL. PER HOUR
TAS : TRUE AIRSPEED
KTS. : KNOTS
S.L. : SEA LEVEL
LRC: LONG RANGE CRUISE
F.R. : FULL RICH
A.R. : AUTO-RICH
A.L. : AUTO-LEAN
C.L. : CRUISING LEAN
M.L. : MANUAL LEAN
F.T. : FULL THROTTLE

149-93-509A

FUEL—GRADE 115/145

DATA AS OF 6/7/48 BASED ON: *FLIGHT TESTS & ESTIMATED*

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

WF-8-31-44-10M

Figure A-8 (Sheet 2 of 2 Sheets). Flight Operation Instruction Chart—5 Rocket Trees

AAFMC-528
4-1-44

AIRCRAFT MODEL(S)
F-82E
ENGINE(S): V-1710-143 & V-1710-145

FLIGHT OPERATION INSTRUCTION CHART

CHART WEIGHT LIMITS: 21,000 TO 19,000 POUNDS

EXTERNAL LOAD ITEMS
NONE

NUMBER OF ENGINES OPERATING: ONE

LIMITS		R.P.M.	M.P. IN.HG.	BLOWER POSITION	MIXTURE POSITION	TIME LIMIT	COOL. TEMP.	TOTAL GPH PER ENGINE
MILITARY POWER	WET	3200	74		NORMAL	10 MIN.	135	225
MILITARY POWER	DRY	3200	65		NORMAL	15 MIN.	135	220

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN FUEL COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING(1) MOVE HORIZONTALLY TO RIGHT OR LEFT AND SELECT RANGE VALUE EQUAL TO OR GREATER THAN THE STATUTE OR NAUTICAL AIR MILES TO BE FLOWN. VERTICALLY BELOW AND OPPOSITE VALUE NEAREST DESIRED CRUISING ALTITUDE (ALT.) READ RPM, MANIFOLD PRESSURE (M.P.) AND MIXTURE SETTING REQUIRED.

NOTES: COLUMN I IS FOR EMERGENCY HIGH SPEED CRUISING ONLY. COLUMNS II, III, IV AND V GIVE PROGRESSIVE INCREASE IN RANGE AT A SACRIFICE IN SPEED. AIR MILES PER GALLON (MI./GAL.) (NO WIND), GALLONS PER HR. (G.P.H.) AND TRUE AIRSPEED (T.A.S.) ARE APPROXIMATE VALUES FOR REFERENCE. RANGE VALUES ARE FOR AN AVERAGE AIRPLANE FLYING ALONE (NO WIND)(1). TO OBTAIN BRITISH IMPERIAL GAL. (OR G.P.H.): MULTIPLY U.S. GAL. (OR G.P.H.) BY 10 THEN DIVIDE BY 12.

SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING (1)

COLUMN I Statute	COLUMN I Nautical	FUEL U.S. GAL.	COLUMN II Statute	COLUMN II Nautical	COLUMN III Statute	COLUMN III Nautical	COLUMN IV Statute	COLUMN IV Nautical	FUEL U.S. GAL.	COLUMN V Statute	COLUMN V Nautical
910	790	600	1210	1050	1560	1350			600	1700	1470
830	720	550	1110	960	1420	1230			550	1550	1340
750	650	500	1010	870	1290	1120			500	1410	1220
680	590	450	900	780	1160	1000			450	1260	1090
600	520	400	800	690	1030	890			400	1120	970
520	450	350	700	600	890	770			350	970	840
450	390	300	600	520	760	660			300	830	720

MAXIMUM CONTINUOUS

PRESS ALT. FEET	R.P.M.	M.P. INCHES	MIXTURE	TOT. GPH	T.A.S. MPH	T.A.S. KTS.
40000						
35000						
30000						
25000						
20000	2700	F.T.	NORMAL	145	235	205
15000	2700	48	NORMAL	150	235	205
10000	2700	48	NORMAL	150	230	200
5000	2700	48	NORMAL	145	220	190
S.L.	2700	48	NORMAL	140	210	180

COLUMN II (2.0 STAT. (1.75 NAUT.) MI./GAL.)

PRESS ALT. FEET	R.P.M.	M.P. INCHES	MIXTURE	TOT. GPH	T.A.S. MPH	T.A.S. KTS.
15000	2500	45	NORMAL	110	215	185
10000	2500	45	NORMAL	110	215	185
5000	2500	45	NORMAL	105	205	180
S.L.	2500	45	NORMAL	100	200	175

COLUMN III (2.55 STAT. (2.20 NAUT.) MI./GAL.)

PRESS ALT. FEET	R.P.M.	M.P. INCHES	MIXTURE	TOT. GPH	T.A.S. MPH	T.A.S. KTS.
10000	2400	44	LRC	81	205	180
5000	2400	44	LRC	79	200	175
S.L.	2400	44	LRC	76	195	170

COLUMN IV (STAT. (NAUT.) MI./GAL.)

MAXIMUM AIR RANGE

PRESS ALT. FEET	R.P.M.	M.P. INCHES	MIXTURE	TOT. GPH	T.A.S. MPH	T.A.S. KTS.
S.L.	2200	42	LRC	65	175	150

SPECIAL NOTES

(1) MAKE ALLOWANCE FOR WARM-UP, TAKE-OFF & CLIMB PLUS ALLOWANCE FOR WIND, RESERVE AND COMBAT AS REQUIRED.

EXAMPLE

AT 20,500 LB. GROSS WEIGHT WITH 500 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF 100 GAL.) TO FLY 1250 STAT. AIRMILES AT 10,000 FT. ALTITUDE MAINTAIN 2400 RPM AND 44 IN. MANIFOLD PRESSURE WITH MIXTURE SET: LONG RANGE CRUISE

LEGEND

ALT. : PRESSURE ALTITUDE
M.P. : MANIFOLD PRESSURE
GPH : U.S. GAL. PER HOUR
TAS : TRUE AIRSPEED
KTS. : KNOTS
S.L. : SEA LEVEL
LRC: LONG RANGE CRUISE
F.R. : FULL RICH
A.R. : AUTO-RICH
A.L. : AUTO-LEAN
C.L. : CRUISING LEAN
M.L. : MANUAL LEAN
F.T. : FULL THROTTLE

149-93-511A

FUEL—GRADE 115/145

DATA AS OF *6/7/48* BASED ON: *FLIGHT TESTS*

Figure A-9 (Sheet 1 of 2 Sheets). Flight Operation Instruction Chart—Single Engine

AAFMC-528
4-1-44

AIRCRAFT MODEL(S) F-82E	FLIGHT OPERATION INSTRUCTION CHART	EXTERNAL LOAD ITEMS
ENGINE(S): V-1710-143 & V-1710-145	CHART WEIGHT LIMITS: 19,000 LBS TO EMPTY	NONE NUMBER OF ENGINES OPERATING: ONE

LIMITS		R.P.M.	M.P. IN.HG.	BLOWER POSITION	MIXTURE POSITION	TIME LIMIT	COOL. TEMP.	TOTAL GPH PER ENGINE
MILITARY POWER	WET	3200	74		NORMAL	10 MIN.	135	225
	DRY	3200	65		NORMAL	15 MIN.	135	220

INSTRUCTIONS FOR USING CHART: SELECT FIGURE IN **FUEL** COLUMN EQUAL TO OR LESS THAN AMOUNT OF FUEL TO BE USED FOR CRUISING[1] MOVE HORIZONTALLY TO RIGHT OR LEFT AND SELECT **RANGE** VALUE EQUAL TO OR GREATER THAN THE STATUTE OR NAUTICAL AIR MILES TO BE FLOWN. VERTICALLY BELOW AND OPPOSITE VALUE NEAREST DESIRED CRUISING ALTITUDE (**ALT.**) READ RPM, MANIFOLD PRESSURE (**M.P.**) AND **MIXTURE** SETTING REQUIRED.

NOTES: COLUMN I IS FOR EMERGENCY HIGH SPEED CRUISING ONLY. COLUMNS II, III, IV AND V GIVE PROGRESSIVE INCREASE IN RANGE AT A SACRIFICE IN SPEED. AIR MILES PER GALLON (**MI./GAL.**) (NO WIND), GALLONS PER HR. (**G.P.H.**) AND TRUE AIRSPEED (**T.A.S.**) ARE APPROXIMATE VALUES FOR REFERENCE. RANGE VALUES ARE FOR AN AVERAGE AIRPLANE FLYING ALONE (NO WIND).[1] TO OBTAIN **BRITISH IMPERIAL GAL.** (OR **G.P.H.**): MULTIPLY **U.S. GAL.** (OR **G.P.H.**) BY **10** THEN DIVIDE BY **12**.

COLUMN I		FUEL	COLUMN II		COLUMN III		COLUMN IV		FUEL	COLUMN V	
RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES		RANGE IN AIRMILES		RANGE IN AIRMILES		U.S.	RANGE IN AIRMILES	
STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL	STATUTE	NAUTICAL	STATUTE	NAUTICAL	GAL.	STATUTE	NAUTICAL
				SUBTRACT FUEL ALLOWANCES NOT AVAILABLE FOR CRUISING[1]							
460	400	300	610	530	790	680			300	870	750
380 310	330 270	250 200	510 410	440 350	660 530	560 460			250 200	730 580	630 500
230 150 70	200 130 60	150 100 50	310 200 100	270 170 80	390 260 130	340 220 110			150 100 50	430 290 140	370 250 120

MAXIMUM CONTINUOUS						PRESS	(2.05 STAT. (1.80 NAUT.) MI./GAL.)					
R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. GPH.	T.A.S. MPH.	T.A.S. KTS.	ALT. FEET	R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. GPH.	T.A.S. MPH.	T.A.S. KTS.
						40000						
						35000						
						30000						
						25000						
2700	F.T.	NORMAL	145	250	215	20000	2550,	F.T.	NORMAL	115	235	205
2700	48	NORMAL	150	245	215	15000	2500	45	NORMAL	110	230	200
2700	48	NORMAL	150	235	205	10000	2500	45	NORMAL	110	225	195
2700	48	NORMAL	145	225	195	5000	2500	45	NORMAL	105	215	185
2700	48	NORMAL	140	215	185	S.L.	2500	45	NORMAL	100	205	180

PRESS	(2.65 STAT. (2.30 NAUT.) MI./GAL.)						(STAT. (NAUT.) MI./GAL.)						PRESS	MAXIMUM AIR RANGE					
ALT. FEET	R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. GPH.	T.A.S. MPH.	T.A.S. KTS.	R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. GPH.	T.A.S. MPH.	T.A.S. KTS.	ALT. FEET	R.P.M.	M.P. INCHES	MIX-TURE	APPROX. TOT. GPH.	T.A.S. MPH.	T.A.S. KTS.
40000													40000						
35000													35000						
30000													30000						
25000													25000						
20000													20000						
15000	2400	44	LRC	80	215	185							15000						
10000	2400	44	LRC	80	215	185							10000						
5000	2400	44	LRC	80	210	180							5000	2150	42	LRC	65	185	160
S.L.	2400	44	LRC	75	200	175							S.L.	2150	42	LRC	65	185	160

SPECIAL NOTES

(1) MAKE ALLOWANCE FOR WARM-UP, TAKE-OFF & CLIMB PLUS ALLOWANCE FOR WIND, RESERVE AND COMBAT AS REQUIRED.

EXAMPLE

AT 18,500 LB. GROSS WEIGHT WITH 250 GAL. OF FUEL (AFTER DEDUCTING TOTAL ALLOWANCES OF 50 GAL.) TO FLY 650 STAT. AIRMILES AT 15,000 FT. ALTITUDE MAINTAIN 2400 RPM AND 44 IN. MANIFOLD PRESSURE WITH MIXTURE SET: LRC

FUEL—GRADE 115/145

LEGEND

ALT. : PRESSURE ALTITUDE
M.P. : MANIFOLD PRESSURE
GPH : U.S. GAL. PER HOUR
TAS : TRUE AIRSPEED
KTS. : KNOTS
S.L. : SEA LEVEL
LRC: LONG RANGE CRUISE
F.R. : FULL RICH
A.R. : AUTO-RICH
A.L. : AUTO-LEAN
C.L. : CRUISING LEAN
M.L. : MANUAL LEAN
F.T. : FULL THROTTLE

149-93-510A

DATA AS OF *6/7/48* BASED ON: *FLIGHT TESTS*

Figure A-9 (Sheet 2 of 2 Sheets). Flight Operation Instruction Chart—Single Engine