NAVWEPS 01-40ALF-2

Handbook
Maintenance Instructions

NAVY MODELS

A-1H • A-1J
AIRCRAFT

SECTION V
POWER PLANT AND RELATED SYSTEMS

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SECTION V

POWER PLANT AND RELATED SYSTEMS

TABLE OF CONTENTS

TABLES

5-1. POWER PLANT AND RELATED SYSTEMS.

5-2. GENERAL. For the purpose of correlating the information contained in this section of the manual, the power plant and accessory equipment and systems are discussed under the following principal headings:

Demountable Power Plant
Engine
Engine Controls
Engine Mount
Engine Drain and Vent System
Engine Exhaust System
Engine Cowling
Propeller
Fuel System
Oil System
Engine Build-Up.

5-2A. The Table of Contents on page 199 preceding this section should be consulted to determine where specific information can be found within the section. The Alphabetical Index at the end of the handbook should also be consulted for determining where specific information is contained within the handbook.

5-3. DEMOUNTABLE POWER PLANT.

5-4. DESCRIPTION. (See figure 5-1.) The demountable power plant for the A-1H airplane includes the R-3350-26WB, 26WC, or 26WD engine manufactured by Wright Aeronautical Corporation, accessories and parts furnished to adapt the engine to the A-1H airframe.

5-4A. The demountable power plant for the model A-1J airplane includes the Wright R-3350-26WB or 26WD engine, accessories, and parts furnished to adapt the engine to the A-1J airframe. (See figure 5-1.)

5-5. REMOVAL. (See figure 5-1.)

a. Deflate main landing gear shock struts.

b. If facilities do not permit ready handling of demountable power plant with propeller installed, remove propeller.

c. Remove engine accessory cowling and side panels.

d. Remove oil cooler front and rear fairings.

e. Remove oil cooler drain plug and permit cooler to drain.

f. Drain oil from supply tank.

g. Install engine work platforms.

h. Remove carburetor air scoop.

i. Relieve hydraulic system pressure by pulling manual bypass valve control handle (on cockpit left-hand control panel).

j. Place fuel tank selector valve in OFF and drain fuel supply lines at fuel strainer drain valve.

k. Disconnect propeller pitch control bracket just forward of cowl bow and install engine hoisting sling, K-57202-501.

l. Loosen conduit nut and disconnect ignition switch cable lead from receptacle on right-hand side of magneto.

m. Disconnect engine lines, conduit, and control linkage as illustrated.

n. Engage hoisting sling hook with engine sling ring and raise hoisting gear far enough to support weight of engine.

o. Using special wrench (K-38902), remove engine-mount lower bolts. Using special wrench (K-38903), remove engine-mount upper bolts.

p. Carefully remove demountable power plant from airplane and secure to QECU stand (R89-S-799720) with K-55901 adapters.

5-6. INSTALLATION. (See figure 5-1.)

a. Carefully hoist engine and mount into position against firewall.

b. Install bolts which attach engine-mount upper legs to fittings on firewall and tighten bolts with tool (K-38903) sufficiently to assure contact between mount and firewall.

c. Install bolts which attach engine-mount lower legs to fittings on firewall and tighten bolts with tool (K-38902) to 85 to 100 foot-pounds.

d. Tighten engine-mount upper attaching bolts to 242 to 259 foot-pounds.

e. Lockwire all engine-mount attaching bolts.

f. Disengage hoisting gear hook from engine hoisting sling and remove sling from engine.

g. Connect engine lines and conduit.

h. Install oil cooler duct and fairings.

i. Connect oil cooler door actuator to oil cooler door.

j. Install carburetor air scoop.

k. Install heating system connecting ducts.

l. Inflate main landing gear shock struts.

m. Check engine to ensure that all items which were disconnected during engine removal have been reconnected.

n. Install propeller.
o. Pre-oil engine.
p. Adjust engine controls.
q. Install cowling.

5-7. ENGINE.

5-8. DESCRIPTION. The model R-3350-26WB, 26WC, or 26WD engine installed on the model A-1H and A-1J airplane, is an 18-cylinder, two-row, air-cooled, radial engine. It is equipped with an injection-type carburetor and a two-speed supercharger. The lubrication system is the dry sump type, in which oil is supplied under pressure to the moving parts of the engine, except the propeller shaft and crankshaft anti-friction bearings. Lubrication for individual pistons and cylinder walls is supplied by jets. A vent and drain system vents the crankcase breather case, and provides drainage for the supercharger gear case; another system drains accumulated oil from the intake pipes after engine shut-down. The crankcase main section is made from steel forgings; all other crankcase sections are magnesium. The cylinder barrels are machined from forged steel and are provided with

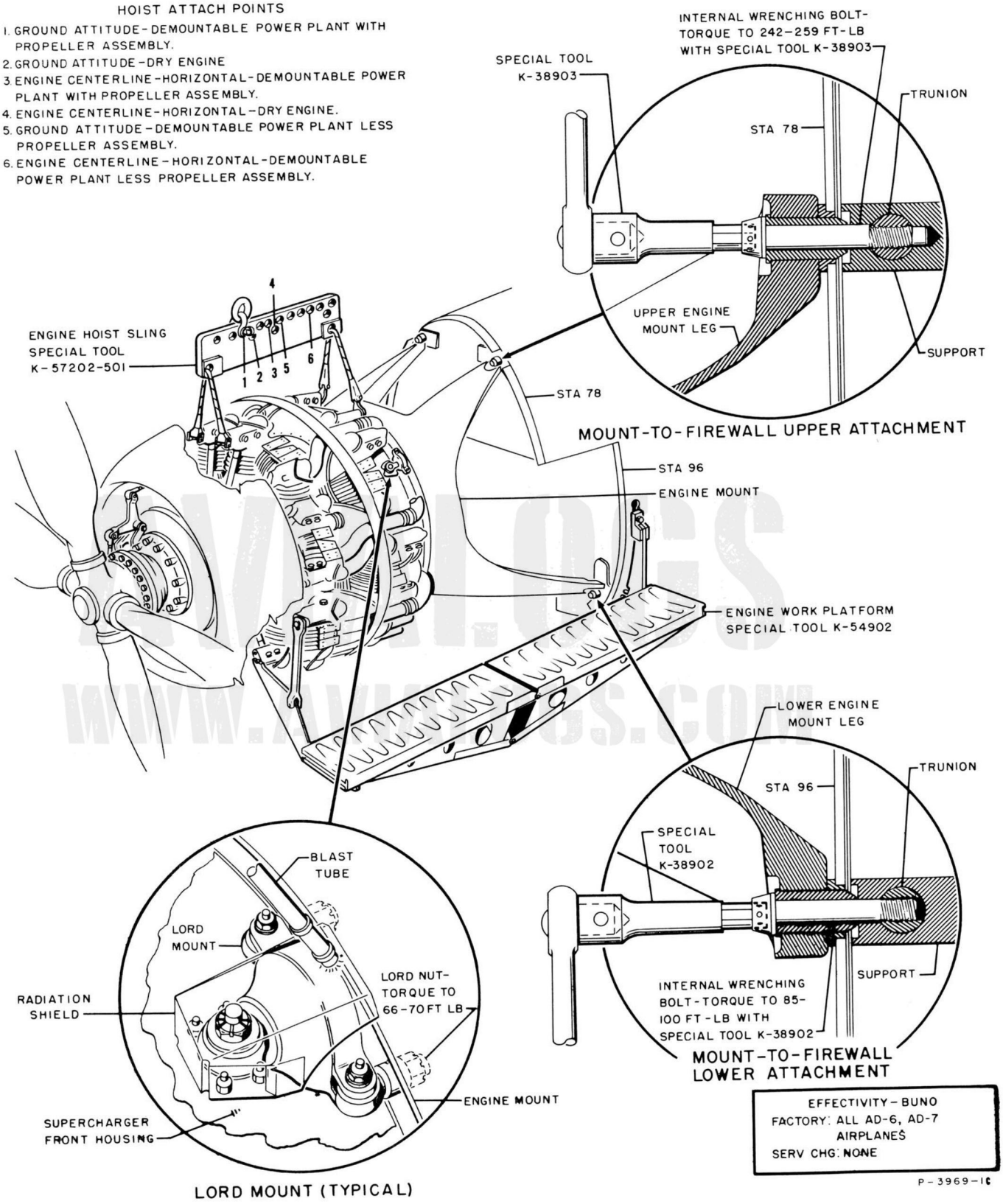


Figure 5-1. Demountable Power Plant—Removal and Installation (Sheet 1)

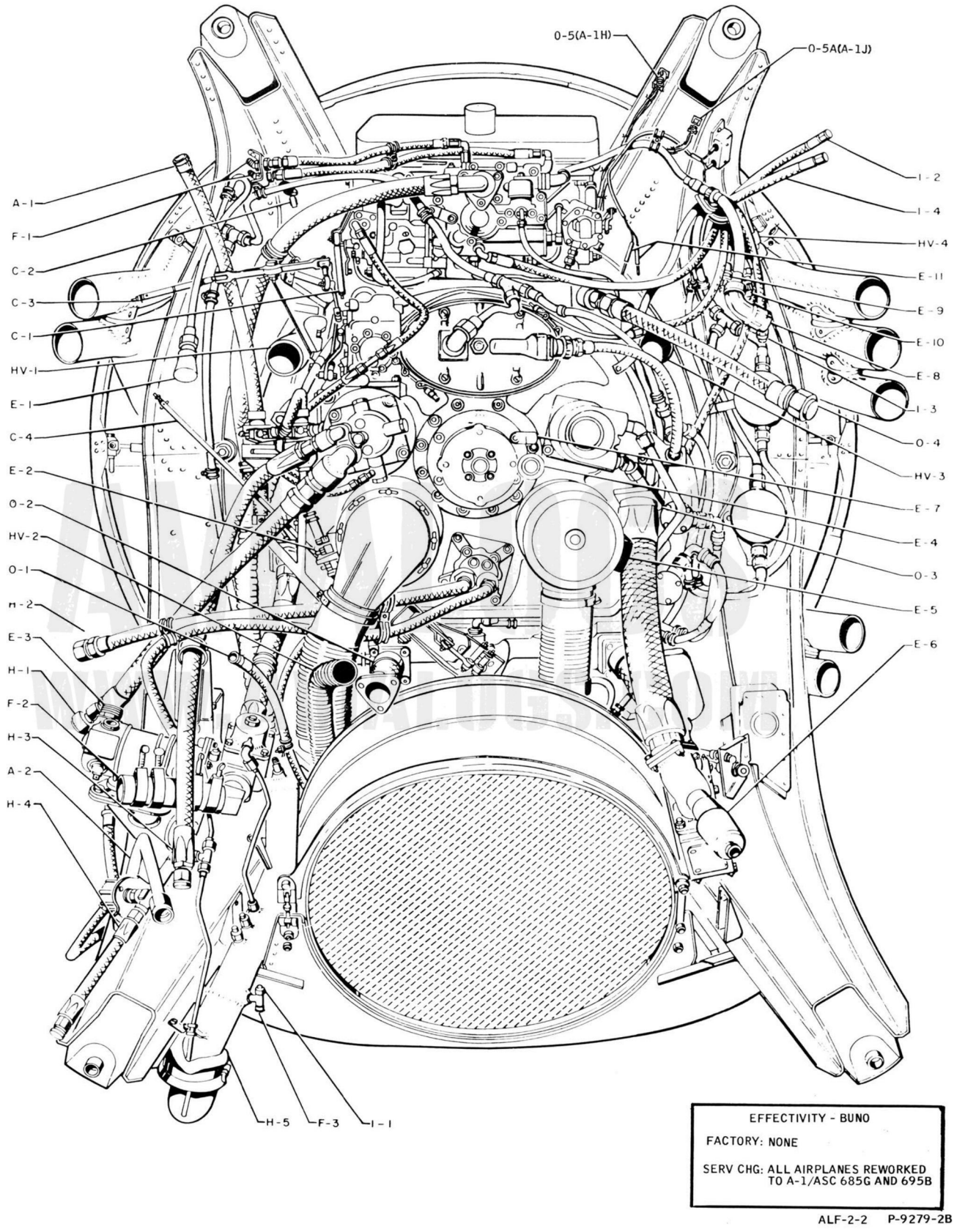


Figure 5-1. Demountable Power Plant — Removal and Installation (Sheet 5)

Figure 5-1 (Sheets 2, 3, and 4) and pages 202, 202A, and 202B deleted. 202C

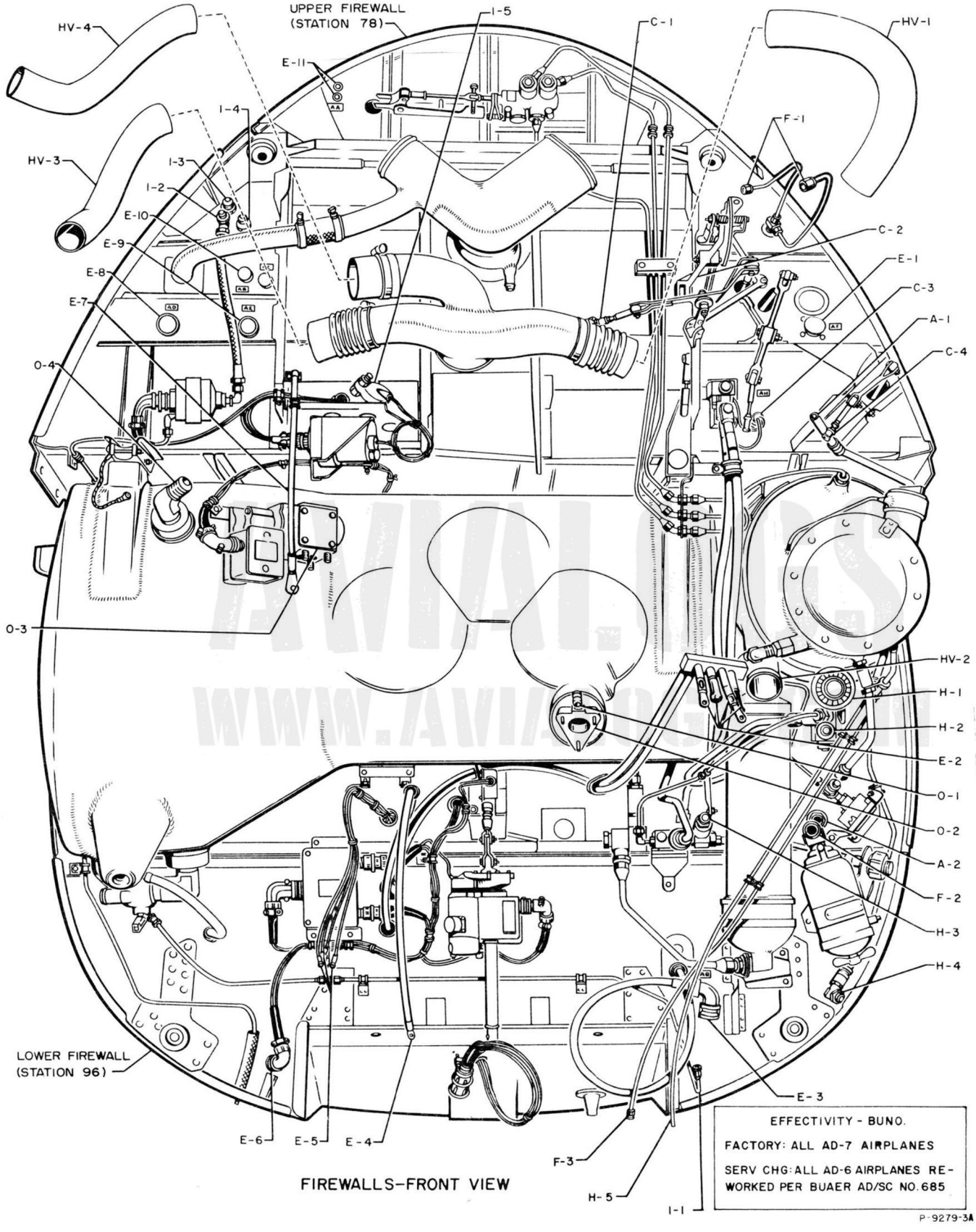


Figure 5–1. Demountable Power Plant—Removal and Installation (Sheet 6)

Items to be disconnected during removal, connected during installation, are identified on the illustration by letter-and-number coding, which corresponds to the systems and numbers included in this key. Letter coding is as follows:

A = Anti-G System
C = Controls, Engine
E = Electrical
F = Fuel System
H = Hydraulic Systems
HV = Heating and Ventilating Systems
I = Instruments
O = Oil System

To facilitate removal and installation, each disconnect point is identified by the same letter-and-number code on both firewall and engine views.

	Disconnect at FIREWALL (Unit to Remain on Engine)	Disconnect at ENGINE (Unit to Remain on Firewall
	ANTI-G SYSTEM	
A-1	Pump pressure line—at hose below supercharger-control bellcrank.	
A-2	Pump suction line—at coupling inboard of hydraulic accumulator pressure gage.	
	CONTROLS, ENGINE	
C-1	Mixture control linkage—at quick-disconnect.	
C-2	Propeller control cable—at crank.	
C-3	Throttle control linkage—at quick-disconnect.	
C-4	Supercharger control linkage—at quick-disconnect.	
	ELECTRICAL	
E-1	Magneto ignition cable—at receptacle.	E-2 Dc generator leads.
		E-3 Auxiliary fuel pump wiring—at pump.
		E-4 Starter power lead.
		E-5 Ac generator leads.
		E-6 Oil cooler door thermostat wiring plug.
		E-7 Starter ground lead.
E-8	Priming valve, oil dilution valve, tachometer generator, oil temperature bulb—plug containing all leads.	
E-9	Cowl flap actuator wiring plug.	
E-10	Ignition vibrator wiring plug.	
E-11	Cylinder head temperature thermocouple leads—at plug.	
	FUEL SYSTEM	
		F-1 Carburetor vent lines—at elbows on engine-mount upper left leg.
F-2	Auxiliary fuel pump supply line—at strainer.	
		F-3 Fuel pressure switch vent line—at drain manifold.
	HYDRAULIC SYSTEMS	
H-1	System pump supply line hose—at reservoir.	
H-2	Aileron power boost pump supply line hose—at reservoir.	
H-3	System pump pressure line hose—at regulator.	
H-4	Aileron power boost pump pressure line hose—at elbow (below fuel strainer).	
		H-5 Reservoir vent line—at drain manifold clamp.
	HEATING AND VENTILATING SYSTEMS	
HV-1	Heating system connecting duct, LH.	
HV-2	Hydraulic reservoir cooling duct—at reservoir.	
HV-3	Heating system connecting duct, lower RH*.	
HV-4	Heating system connecting duct, upper RH*.	
*Disconnect (or connect) both ends of duct and support brace.		
	INSTRUMENTS	
		I-1 Fuel pressure gage vent line—at drain manifold.
I-2	Fuel pressure gage line—at tee.	
I-3	Oil pressure gage line—at fitting.	
I-4	Manifold Pressure gage line—at fitting.	
		I-5 Torquemeter capillary and adapter—at engine crankcase front section.

Figure 5-1. Demountable Power Plant—Removal and Installation (Sheet 7)

OIL SYSTEM	
O-1	Oil dilution hose—at tank.
O-2	Oil supply line hose—at tank.
O-3	Oil tank return line—at diverter valve.
O-4	Oil tank vent line—at elbow.
O-5	Magnetic sump plug warning light harness assembly.
O-5A	Magnetic sump plug warning light harness assembly.

Figure 5-1. Demountable Power Plant - Removal and Installation (Sheet 7A)

aluminum cooling fins. The cylinder heads are forged aluminum alloy and the cylinder bores are nitrided. The master rod bearings are silver with lead-indium plating.

5-8A. Deleted.

5-9. CLEANING ENGINE. Refer to section I.

5-10. ENGINE WORK PLATFORM INSTALLATION. (See figure 5-1.) The engine work platform (special tool K-45902) can be attached to either the left- or right-hand side of the engine to provide the mechanic with a convenient working area.

a. Open cowling side panel sufficiently to permit installation of platform forward support bracket.

b. Place keyhole of platform forward support bracket strap over nut of foward rocker box stud of No. 8 cylinder on right-hand side, or over rocker box stud of No. 12 cylinder on left-hand side.

c. Pull strap downward until keyhole slot in strap is locked to stud.

d. Engage slotted end of forward support bracket around outboard rocker box stud of No. 10 cylinder.

e. Insert bolt of platform aft support bracket in keyhole in fuselage at fuselage station 96. Pull aft support bracket downward until bolt head is locked in fuselage keyhole slot.

f. Insert pin near bottom of aft support bracket into hole in fuselage at fuselage station 96 immediately forward of leading edge of wing.

g. Unfold platform and install bolt to lock panels in extended position. Place platform on support brackets.

CAUTION

Make certain that holes and pins in platform and support brackets are properly engaged.

h. Raise cowling side panels and engage support tubes in sockets to hold panels open.

5-11. ENGINE CONTROLS.

5-12. DESCRIPTION. Engine controls are of two types, manual and electric. Manual controls originate at the engine control quadrant in the cockpit and through linkage affect the operation of the following control systems:

Carburetion
Manifold pressure regulating
Supercharger.

5-13. Electrical controls also originate in the cockpit and are switch actuated for the following:

Air induction
Starting
Ignition.

5-14. ENGINE CONTROL QUADRANT.

5-15. DESCRIPTION. (See figure 5-3.) The engine control quadrant is installed in the left-hand control panel in the cockpit. Included as integral parts of the quadrant assembly are levers which operate mixture, throttle, supercharger, and propeller governor controls. An adjustable gate stop for the throttle control lever is incorporated in the quadrant assembly and the knob on the throttle lever contains a microphone switch for the communication radio. Friction adjustment for the levers and linkage is effected by the knob recessed in the inboard face of the control panel beneath the quadrant.

5-16. REMOVAL.

a. Remove access cover from inboard side of left-hand control panel.

b. Remove bolts which attach engine control rod ends to quadrant levers.

c. Remove friction adjustment knob and shaft assembly by removing cotter pin and washer on outboard end of shaft.

d. Remove screw which attaches throttle knob to lever and disconnect switch wiring from lever and quadrant.

e. Remove screws which attach quadrant to control panel and lift quadrant clear.

5-17. INSTALLATION.

a. Place engine control quadrant in position in left-hand control panel.

b. Connect microphone switch wiring and install throttle control knob.

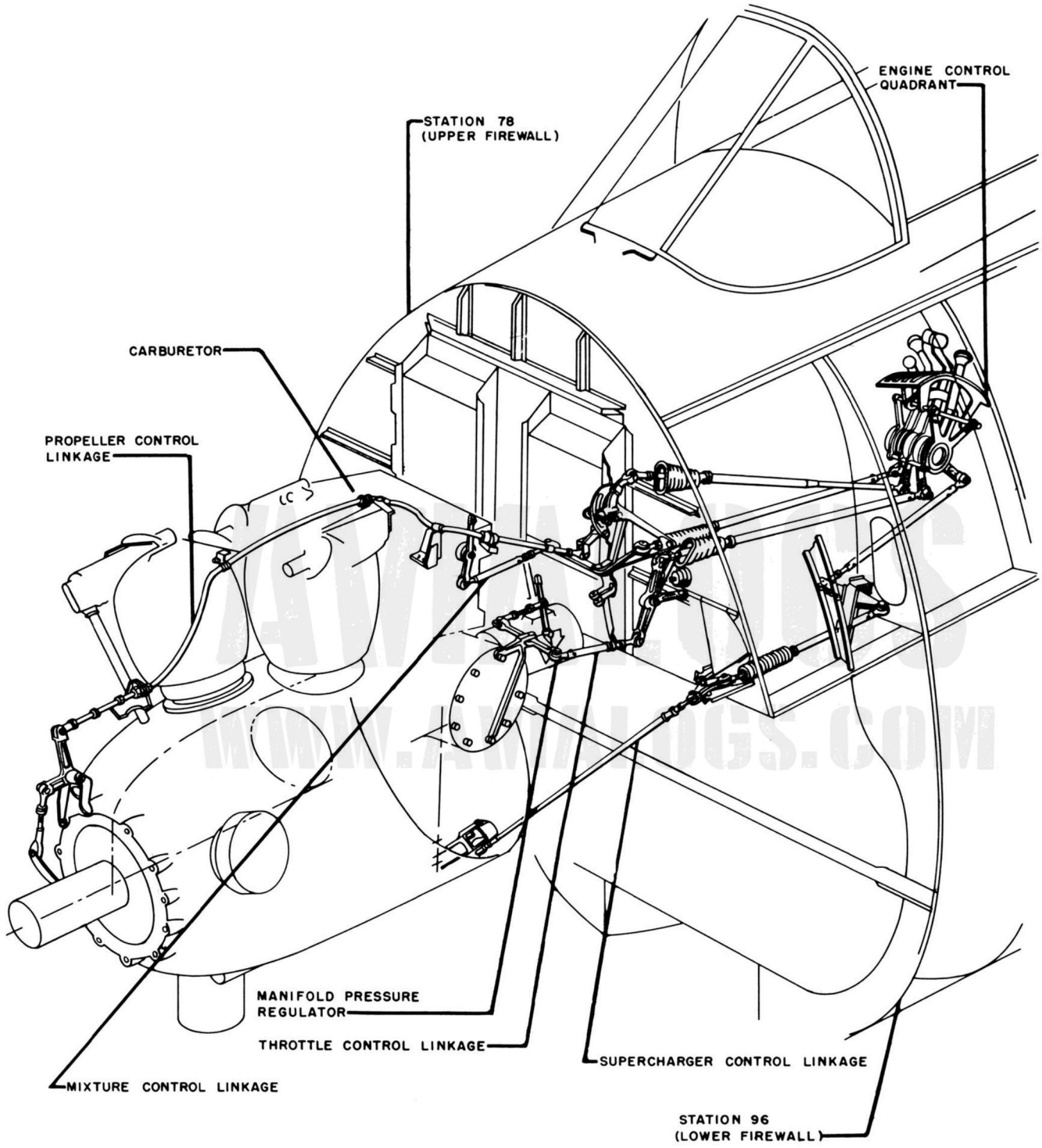


Figure 5–2. Engine Mechanical Controls

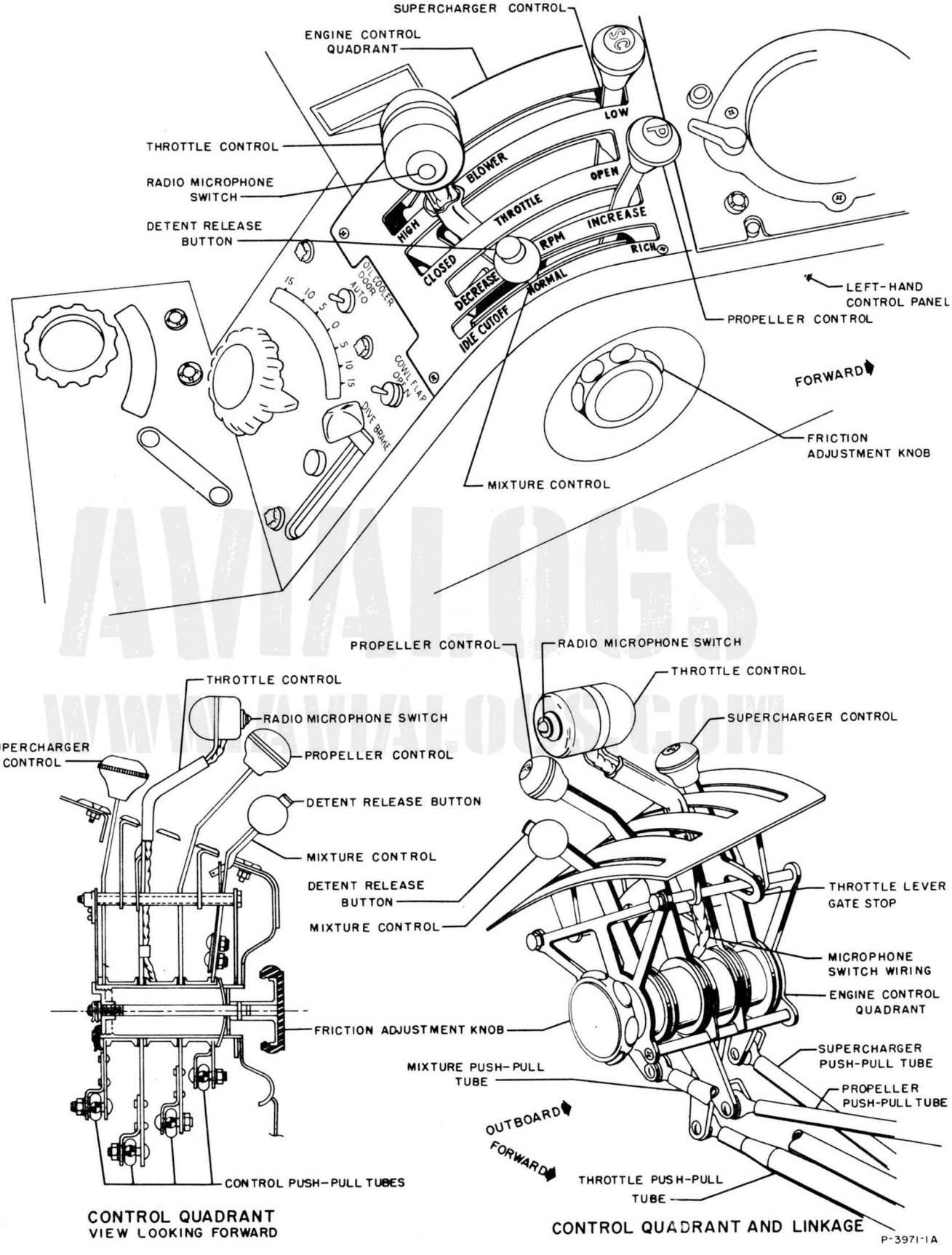


Figure 5–3. Engine Control Quadrant

c. Fasten quadrant to control panel with screws.

d. Place friction control knob and shaft assembly in position and install cotter pin in outboard end of shaft.

e. Bolt control rods to applicable levers in quadrant.

f. Install access cover on inboard side of control panel.

5-18. CARBURETION AND AIR INDUCTION SYSTEM.

5-19. DESCRIPTION. (See figure 5-4.) The carburetion and air induction system, consisting of a carburetor and an air scoop, supplies the engine with a combustible mixture of air and fuel. The carburetor is installed on the supercharger rear housing, and the air scoop is mounted above the carburetor between the engine mount and the firewall. The carburetor air control circuit, controlled by a switch on the left-hand control panel, controls the carburetor air door in the air scoop duct to direct either ram air from the scoop or non-ram air from the accessory section into the carburetor.

5-20. TROUBLESHOOTING. Refer to table 5-1.

5-21. CARBURETOR.

5-22. DESCRIPTION. (See figure 5-5.) The carburetor is a part of the basic engine and is mounted on the supercharger rear housing. Its function is to control and measure the mass air flow to the engine; to compensate for changes in mixture ratio with changes in altitude; and to meter fuel to the engine blower section. For a detailed description of the carburetor and its components, refer to Handbook of Overhaul Instructions, AN 03-10BA-3A, Injection Carburetor, PD, PR, PT series.

5-23 through 5-26. Deleted.

5-27. REMOVAL. (See figure 5-5.)

a. Remove engine accessory cowling.

b. Remove carburetor air scoop.

c. Remove cockpit heating system overboard air duct.

d. Remove throttle control rod attaching bolt.

e. Disconnect mixture control rod at quick disconnect fitting.

f. Disconnect electrical wiring and priming line from engine priming valve.

g. Make certain fuel tank selector valve is in OFF.

h. Remove three 1/8-inch pipe plugs from bottom of carburetor regulator unit, allow fuel to drain from carburetor, replace three plugs, and secure with safety wire.

i. Disconnect carburetor vapor vent lines and fuel pressure gage line from carburetor.

j. Disconnect main fuel supply line from carburetor.

CAUTION

Since the main fuel supply line contains trapped fuel, disconnect line carefully.

k. Using (special tools K-3270198 and K-32315), remove bolts which secure carburetor to mounting pad on top of supercharger rear housing and remove carburetor, carburetor seal, and carburetor gasket, by lifting carburetor slightly aft to avoid interference with surrounding structure.

CAUTION

Try to prevent entrance of foreign matter into blower section while carburetor is being removed. Remove any such matter which may have fallen into induction system.

TABLE 5-1. TROUBLESHOOTING CARBURETOR AIR SCOOP

Trouble	Probable Cause	Remedy
1. Engine fails to start.	Obstruction in carburetor air scoop.	Remove obstruction.
2. Ice on carburetor air screen causes engine to run rough or backfire.	a. Air door control switch in DIRECT. b. Air door actuator defective.	Place air door control switch in ALT. Replace actuator.
3. Engine fails to develop full power.	a. Carburetor air to warm. b. Icing of induction system.	Place air door control switch in DIRECT. Place air door control switch in ALT.
4. Engine backfires.	Refer to trouble 3 a.	

NOTE

If the trouble cannot be corrected by the suggested procedures, refer to carburetor trouble shooting in NAVWEPS 02A-35JP-502, Service Instructions.

l. Cover carburetor mounting pad and secure cover with attaching bolts.

5-28. CLEANING. The fuel strainer in the pressure regulator unit of the carburetor can be readily cleaned, using clean unleaded gasoline. Agitating the strainer screen in the gasoline will usually dislodge all foreign matter, but a brush with bristles of medium hardness can be used with the gasoline, if necessary to complete the removal of any foreign matter; to dry the screen quickly and thoroughly, a blast of compressed air should be applied to the outside of the screen.

5-29. INSTALLATION.

NOTE

Prior to shipment by the manufacturer, the carburetor is drained of fuel and then flushed with oil (Spec. MIL-L-6082, grade 1065). Before installation of the carburetor on the engine, all oil should be drained from the carburetor and the carburetor should be thoroughly flushed with clean gasoline.

a. Attach seal assembly to carburetor.

b. Remove cover from carburetor mounting pad.

c. Inspect interior of blower section for foreign matter which may have fallen into induction system; remove before proceeding.

d. Install new carburetor gasket and new spinner injection fuel passage gasket, and bolt carburetor to mounting pad with (special tools K-3270198 and K-32315).

CAUTION

Do not allow foreign matter to fall into blower section while carburetor is being installed.

e. Apply antiseize compound (Fed. Spec. TT-A-580) to threads of priming valve electrical connector and connect to priming valve.

f. Connect priming line to priming valve.

g. Connect main fuel supply line to carburetor.

h. Connect carburetor vapor vent lines and fuel pressure gage line to carburetor.

i. Place throttle control linkage in position and install attaching bolt.

j. Connect mixture control rod at quick-disconnect fitting.

k. Adjust throttle and mixture control linkage.

l. Remove 1/8-inch pipe plug from large hex head plug in top of carburetor fuel control unit.

m. Place manual mixture control lever in RICH, and open throttle about halfway.

n. Place fuel tank selector valve handle in MAIN, and operate auxiliary fuel pump until fuel is level with plug opening in fuel control unit.

o. Turn off auxiliary pump, place manual mixture control in IDLE CUTOFF, close throttle, and place fuel tank selector valve handle in OFF.

p. Replace and lockwire 1/8-inch pipe plug.

NOTE

When a new or a reconditioned carburetor is being filled for the first time after installation, it should be allowed to soak for at least eight hours to permit fuel diaphragms to become flexible. (If time is an important factor, the soaking operation can be performed prior to installing the carburetor on the engine, or prior to installing the engine in the airplane.)

q. Install carburetor air scoop.

r. Install cockpit heating system overboard air duct.

5-30. TESTING. Refer to NAVWEPS 02A-35JP-502, Service Instructions.

5-31. CARBURETOR AIR SCOOP.

5-32. DESCRIPTION. (See figure 5-4.) The carburetor air scoop is installed between the cowl bow and the fuselage upper firewall. The air scoop structure covers the upper portion of the engine accessory section. A large duct in the center of the scoop directs outside air into the carburetor. Two small ducts outboard of the large duct direct outside air to the cockpit heating and ventilating systems. A door in the carburetor air duct is electrically actuated to open or close the duct. When the door is rotated downward and aft, outside ram air is directed through the duct into the carburetor. When the door is rotated upward and forward, warm air from the engine accessory section is drawn into the carburetor.

5-33. The forward end of the air scoop structure is supported by two rods which are attached to the engine mount. The rods incorporate quick-disconnects to facilitate removal of the air scoop. The after end of the scoop structure is attached by dzus fasteners to an angle on the upper firewall. When the scoop is installed, the leading edge of the scoop assembly should fair with the trailing edge of the cowling side panels; this position can be obtained by adjusting the two support rods.

5-34. A synthetic rubber seal extends across the air scoop and is in contact with the engine mount, a seal mounted on the leading edge of the scoop is in contact with the trailing edge of the cowling side panels, and seals for the two positions of the duct door are parts of the door assembly.

5-35. Provisions are included in the carburetor air scoop assembly for the installation, if desired, of a filter for warm air between the accessory section of the engine and the carburetor.

5–36. REMOVAL.

a. Open side cowl flaps.

b. Remove upper accessory cowling panels.

c. Raise cowling side panels.

Note

If the door actuator is to be separated from the scoop or if the scoop is to be disassembled after being removed from the airplane, it will be necessary to have the door in an intermediate position to relieve door preload. This should be done prior to step d, and may be accomplished by turning off d-c power control switch while door is at mid-travel.

d. Disconnect air door actuator wiring at upper firewall.

e. Remove access cover from top of scoop and remove filter, if installed.

f. Disconnect cockpit ventilating air ducts at scoop.

g. Disconnect rods which support forward end of scoop by releasing quick-disconnect fittings.

h. Release dzus fasteners along trailing edge, and carefully remove scoop from airplane.

5–37. INSTALLATION.

Note

If the air door actuator has been removed from the scoop assembly, or if the scoop assembly has been completely disassembled, it will be necessary to adjust the door lever arm prior to installing the scoop on the airplane. (Refer to paragraph 5–45.)

a. Place scoop in position, guide coupling assembly at forward end of heating air duct into heating muff, and connect rods which support forward end of scoop.

b. Adjust support rods until leading edge of scoop assembly fairs with trailing edge of cowling side panels.

c. Tighten dzus fasteners on trailing edge of scoop.

d. Connect ventilating air duct to scoop.

e. Install filter (if used) and install access cover on top of scoop.

f. Apply anti-seize compound (Specification JAN-A-669) to threads of actuator plug and connect to receptacle on upper firewall.

5–38. CARBURETOR AIR CONTROL CIRCUIT.

5–39. DESCRIPTION. The door in the carburetor air scoop is controlled by an electrical circuit which includes the following:

Name	*Location*
Circuit breaker, 5 amp	Cockpit circuit-breaker panel
Control switch	Cockpit—LH control panel
Door actuator	Carburetor air scoop

5–40. The circuit is powered by the d-c secondary bus and is completed from the circuit breaker to the door actuator with the control switch in either of its indicated positions: in "DIRECT," the scoop is open and cold, ram air is permitted to reach the carburetor; in "ALT," the scoop is closed and warm air from the engine accessory section is routed to the carburetor.

5–41. CARBURETOR AIR DOOR ACTUATOR.

5–42. DESCRIPTION. The door actuator is mounted on a bracket attached to the left-hand side of the carburetor air scoop. The actuator is connected to the door by an arm which is splined to engage the door hinge bolt. Movement of the actuator shaft closes, opens, or holds the door in response to the position of the control switch.

5–43. REMOVAL.

a. Remove accessory-cowling upper left-hand panel.

b. Remove bolt which connects actuator shaft and door actuating arm.

c. Disconnect wiring from receptacle on actuator.

d. Remove bolt from actuator support bracket.

5–44. INSTALLATION.

a. Place actuator in position and bolt actuator to support bracket.

b. Apply anti-seize compound (Specification JAN-A-669) to threads of actuator wiring receptacle and connect wiring.

c. Adjust actuator shaft relative to door actuating arm; then install attaching bolt.

5–45. ADJUSTMENT. (See figure 5–6.)

a. Remove accessory cowling upper left-hand panel.

b. With door fully open, place arm on splines of hinge bolt to obtain angle of 38 + 0 —10 degrees between arm and line perpendicular to plane of scoop base: distance from centers of actuating arm bolt should be $6\frac{3}{4} + \frac{5}{32} - 0$ inches.

c. If necessary, install one or two washers under actuator support bracket to align actuator with actuating arm.

5–46. CARBURETOR MIXTURE CONTROL.

5–47. DESCRIPTION. The mixture control lever is the inboard lever of the engine control quadrant. It is connected, through linkage, with the mixture control section of the carburetor and can be placed in "IDLE CUTOFF," "NORMAL," or "RICH." The control lever guide is notched to prevent movement of the lever aft —to a leaner mixture—unless the spring-loaded latch is released by depressing the button in the control lever knob. An adjustable rod connects the control lever with a bellcrank on the forward side of the upper firewall; a second adjustable rod extends forward from the bellcrank to the rod attaching bracket of the mixture control lever arm on the left-hand side of the carburetor.

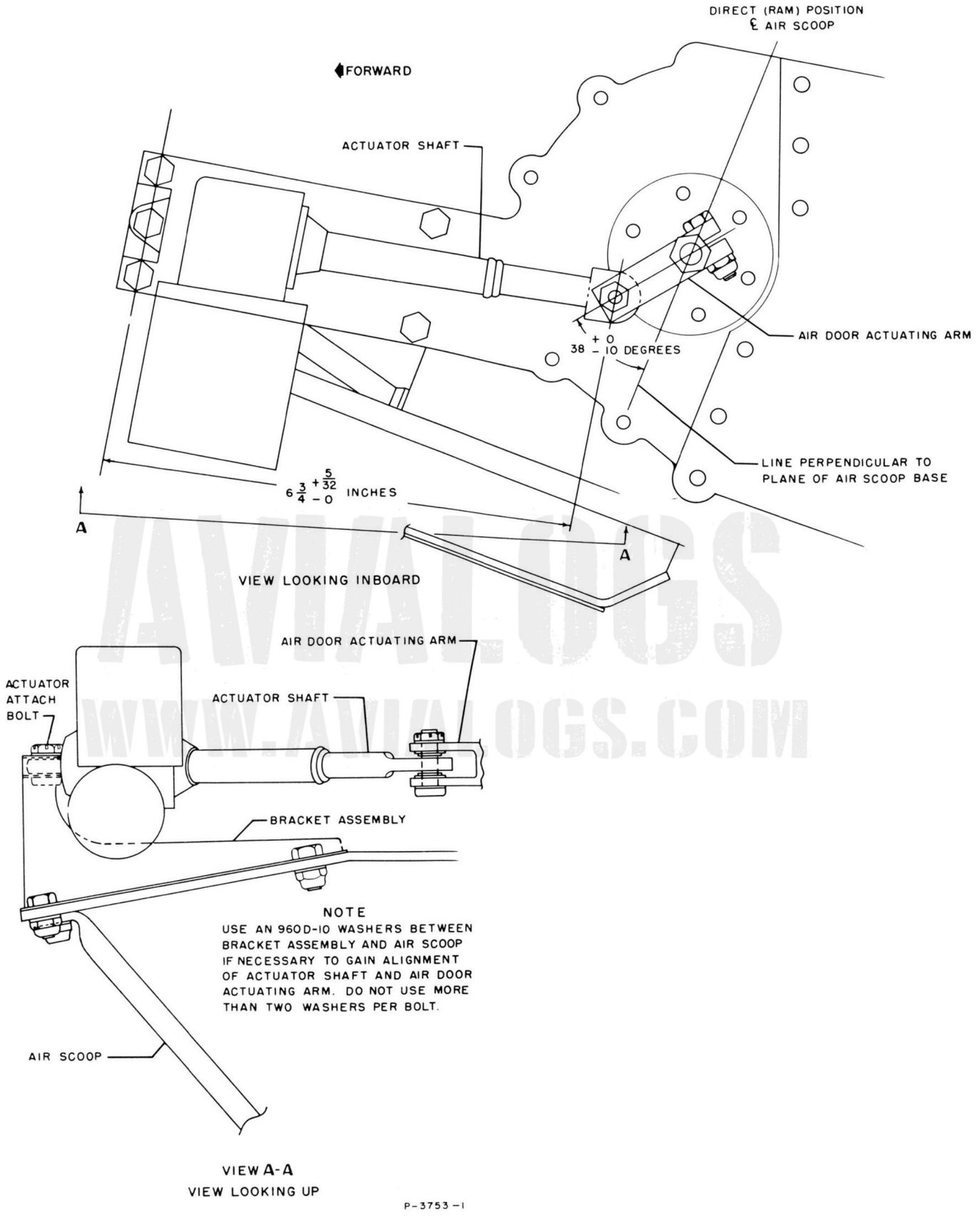
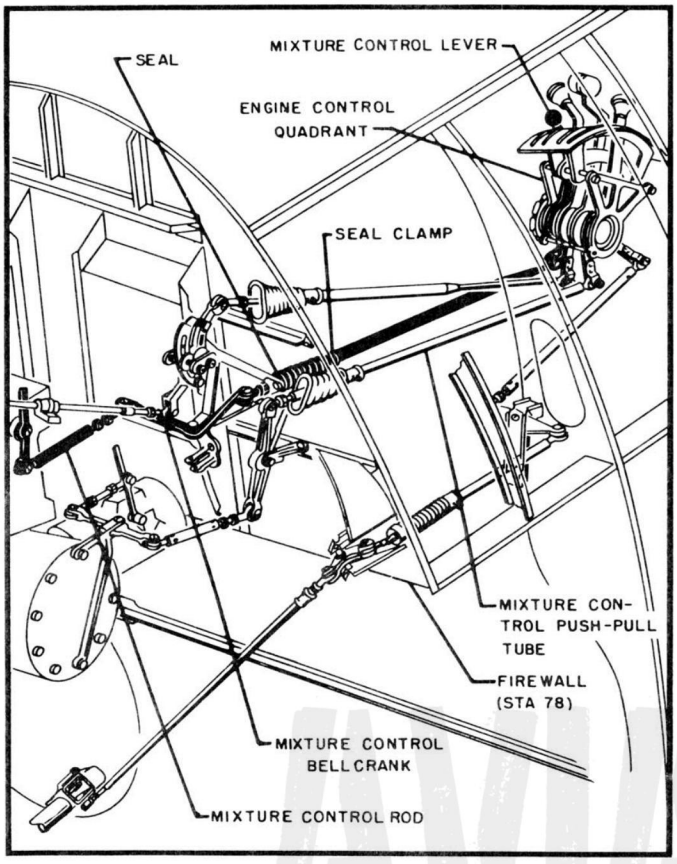
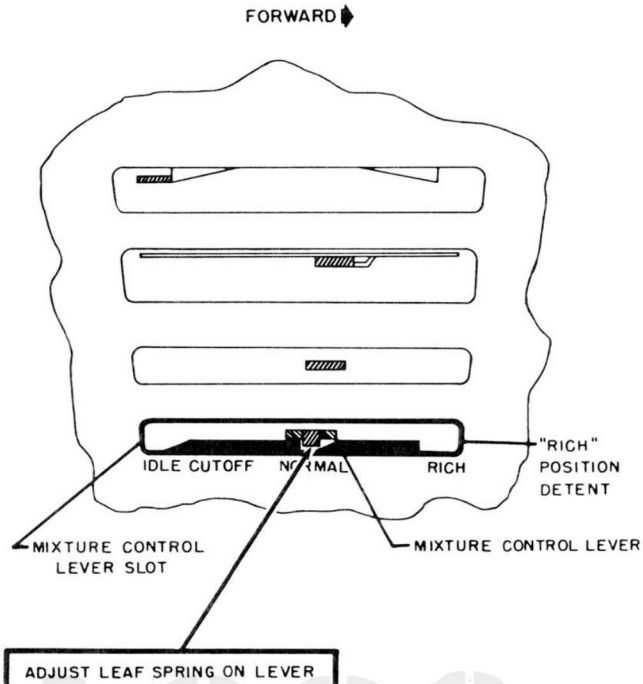


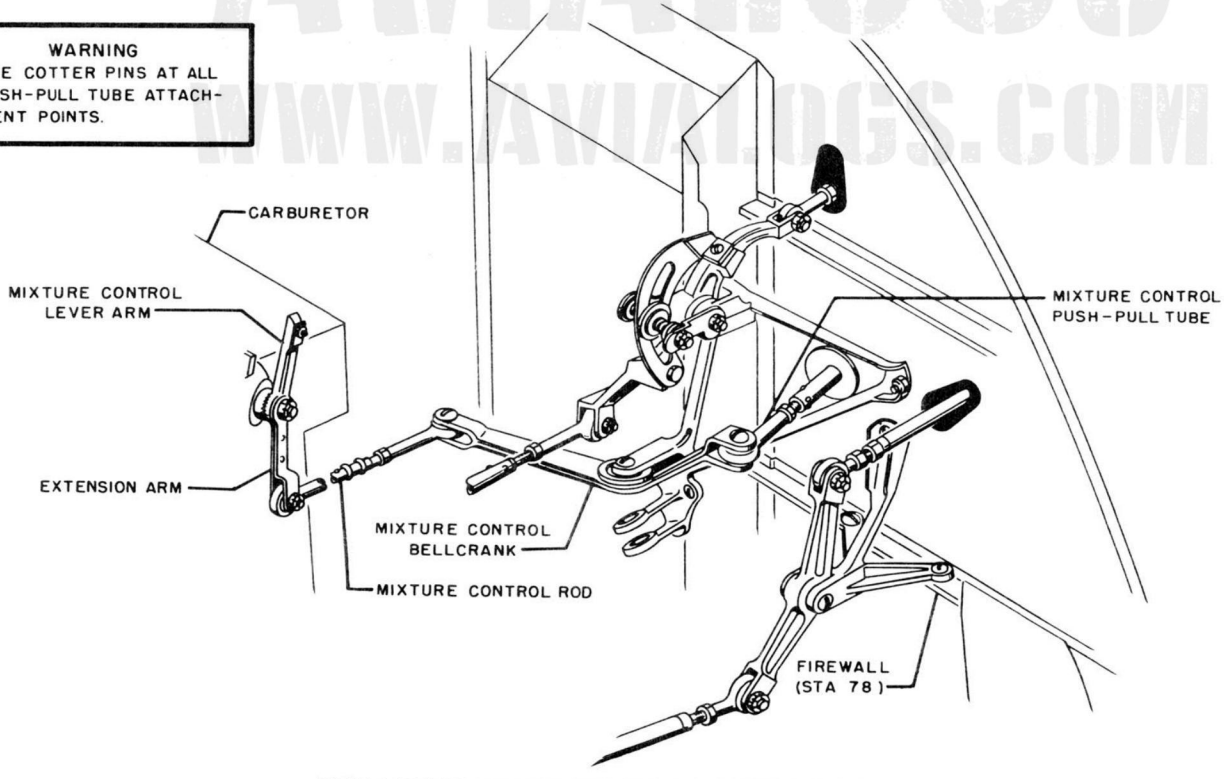
Figure 5–6. Carburetor Air Door Adjustment





PLAN VIEW OF CONTROL QUADRANT FACE PLATE

WARNING
USE COTTER PINS AT ALL PUSH-PULL TUBE ATTACHMENT POINTS.



VIEW LOOKING INBOARD AND AFT, LEFT-HAND SIDE OF AIRPLANE

P-3975-1A

Figure 5–7. Carburetor Mixture Control

5–48. REMOVAL.

a. Remove side panel from left-hand control panel.

b. Remove bolt which attaches mixture control lever to push-pull tube.

c. Loosen clamp which attaches seal on firewall to mixture control push-pull tube.

d. Remove left-hand accessory cowling.

e. Disconnect both mixture control push-pull tubes from bellcrank on forward side of firewall.

f. Disconnect rod assembly and extension arm from mixture control on carburetor.

5–49. INSTALLATION.

a. Assemble extension arm and rod assembly with mixture control on carburetor and install attaching bolts.

b. Bolt rod assembly to bellcrank on forward side of firewall.

c. Insert mixture control push-pull tube through firewall cut-out and bolt to bellcrank on forward side of firewall.

d. Tighten clamp which attaches firewall seal to push-pull tube.

e. Bolt push-pull tube to mixture control lever.

f. Adjust linkage and then tighten all connections.

5–50. ADJUSTMENT.

a. Remove left-hand accessory cowling.

b. Adjust mixture control push-pull tube end fitting until positions of mixture control latch assembly on carburetor agree with mixture control lever positions on engine control quadrant.

c. Adjust mixture control linkage until crank on carburetor contacts stops.

Note

Any excess travel in the mixture control lever in the cockpit should be applied to the "IDLE CUTOFF" position.

d. Reinstall accessory cowling.

5–51. ENGINE MANIFOLD PRESSURE REGULATING SYSTEM.

5–52. DESCRIPTION. Any selected manifold pressure setting is maintained automatically up to critical altitude by the manifold absolute pressure regulator which is linked between the pilot's throttle control lever and the carburetor throttle arm. Engine manifold pressure is indicated by the manifold pressure gage located on the pilot's instrument panel.

5–53. ENGINE MANIFOLD PRESSURE REGULATOR.

5–54. DESCRIPTION. The manifold absolute pressure regulator is installed on an adapter unit on the left-hand

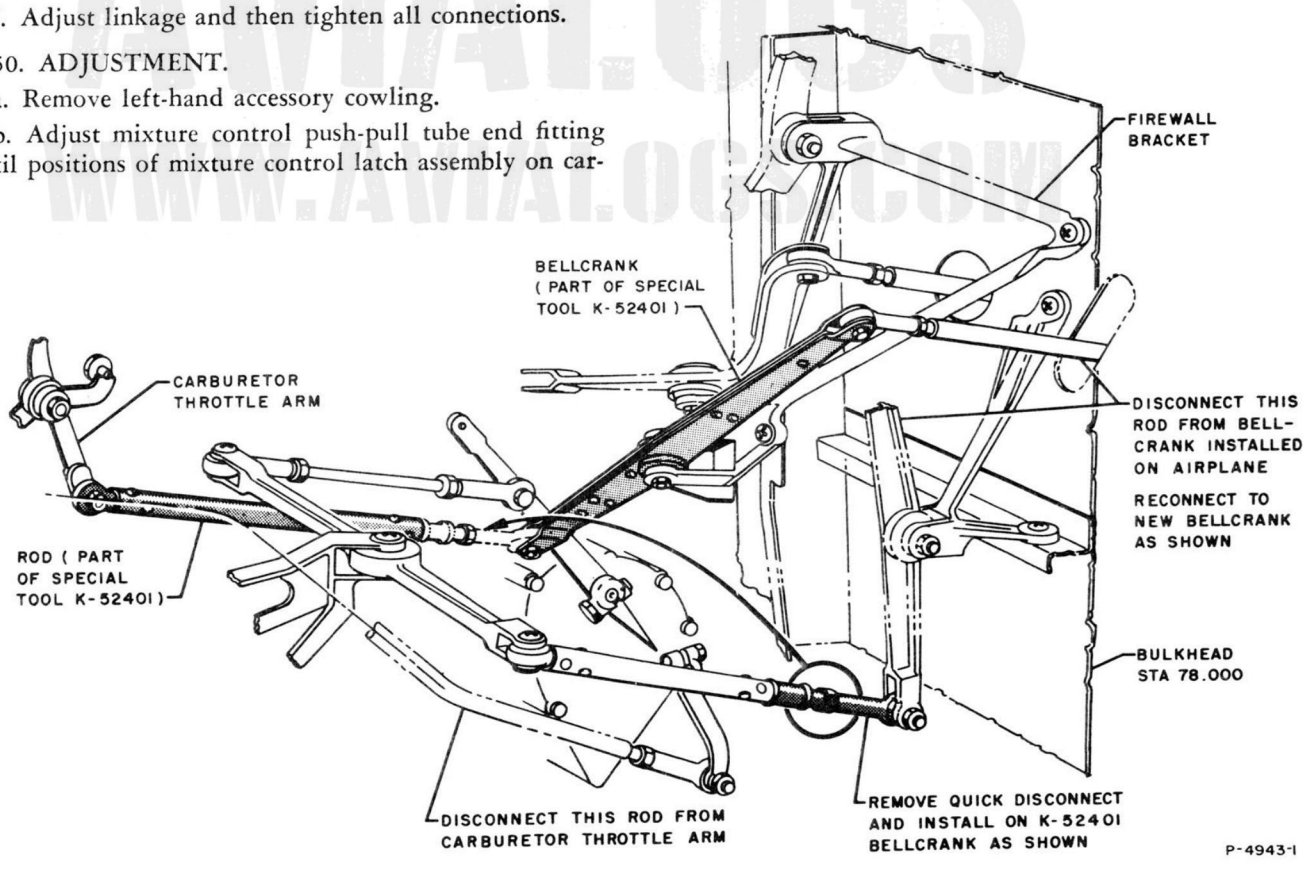


Figure 5–8. Manifold Pressure Regulator Bypass Test

side of the supercharger rear housing and is linked between the pilot's throttle control and the carburetor throttle arm. The regulator maintains a selected manifold pressure under all flight conditions up to critical altitude and automatically resets the manifold pressure during the shift from low to high, or from high to low, blower. A pressure-sensitive element in the regulator responds to changes in manifold pressure and controls a hydraulic servo unit which automatically readjusts the throttle.

5-55. On A-1J airplanes, the manifold absolute pressure regulator includes a power limiter pick-up. The temperature from a thermocouple, located in the left-hand boundary layer bleed duct of the oil cooler forward fairing assembly, is transmitted through a capillary tube to the power limiter pick-up which acts on the water injection reset mechanism of the manifold absolute pressure regulator, and eliminates the possibility of exceeding the engine power limits when using water injection. This allows less manifold absolute pressure in cold weather and more manifold absolute pressure in hot weather on water injection. The thermocouple and capillary tubes are a part of the modified manifold absolute pressure regulator and must be loosened from the oil cooler fairing and engine before the regulator can be removed. (See figure 5-8A.)

5-56. Deleted.

5-57. TESTING. (See figure 5-8.) The manifold pressure regulator can be tested for proper performance by operating the throttle control while bypassing the regulator. To bypass or test the regulator, install special tool K-52401 and test regulator as follows:

a. Remove left-hand accessory cowling.

b. Remove bolt which attaches throttle push-pull tube to crank on forward side of upper firewall.

c. Remove bolt which attaches throttle actuating rod to carburetor throttle arm.

d. Disconnect bellcrank control rod from firewall crank. Remove adjustable end and connect it to rod unit of test rod assembly (special tool K-52401).

e. Install test rod assembly between carburetor throttle arm and throttle push-pull tube.

f. Test manifold pressure regulator in accordance with instructions in NAVWEPS 02A-35JP-502, Service Instructions.

g. Stop engine and remove test rod assembly.

h. If necessary, install new or replacement regulator.

i. Reconnect throttle control linkage.

5-58. ENGINE THROTTLE CONTROL.

5-59. DESCRIPTION. (See figure 5-9.) The throttle control lever, located in the engine control quadrant, has OPEN and CLOSED positions. Push-pull tubes and bellcranks link the throttle lever to the manifold pressure regulator control arm. An adjustable throttle lever gate stop is installed on the quadrant for adjusting the throttle OPEN position during engine run-up. A catapult hand grip above the control quadrant is used in conjunction with the throttle lever during catapulting operations. The lever handle contains a microphone switch for communication radio operation.

5-60. REMOVAL.

a. Remove side panel from left-hand control panel.

b. Disconnect throttle control lever from push-pull tube.

c. Loosen clamp which attaches seal on firewall to throttle control push-pull tube.

d. Remove left-hand accessory cowling.

e. Disconnect throttle control push-pull tube from bellcrank on forward face of firewall.

f. Disconnect bellcrank control rod from engine-supported and firewall-supported bellcranks.

g. Disconnect rod from manifold pressure regulator arm and engine-supported bellcrank.

5-61. INSTALLATION.

a. Bolt rod assembly to manifold pressure regulator arm.

b. Bolt rod assembly to firewall-supported bellcrank and engine-supported bellcrank.

c. Insert throttle control push-pull tube through firewall and bolt to bellcrank on forward face of firewall.

d. Tighten clamp which attaches seal on firewall to push-pull tube.

e. Bolt push-pull tube to throttle control lever in quadrant.

f. Adjust linkage and tighten all connections.

WARNING

Ensure the throttle support bracket P/N 3255899 is attached to the engine cover plate with AN5-H13A bolts as shown in figure 5-9. These bolts are longer than the bolts used to hold the cover plate in place on the engine.

5-62. ADJUSTMENT.

NOTE

Prior to adjustment of throttle control linkage, adjust manifold pressure regulator linkage in accordance with instructions contained in NAVWEPS 02A-35JP-502, Service Instructions.

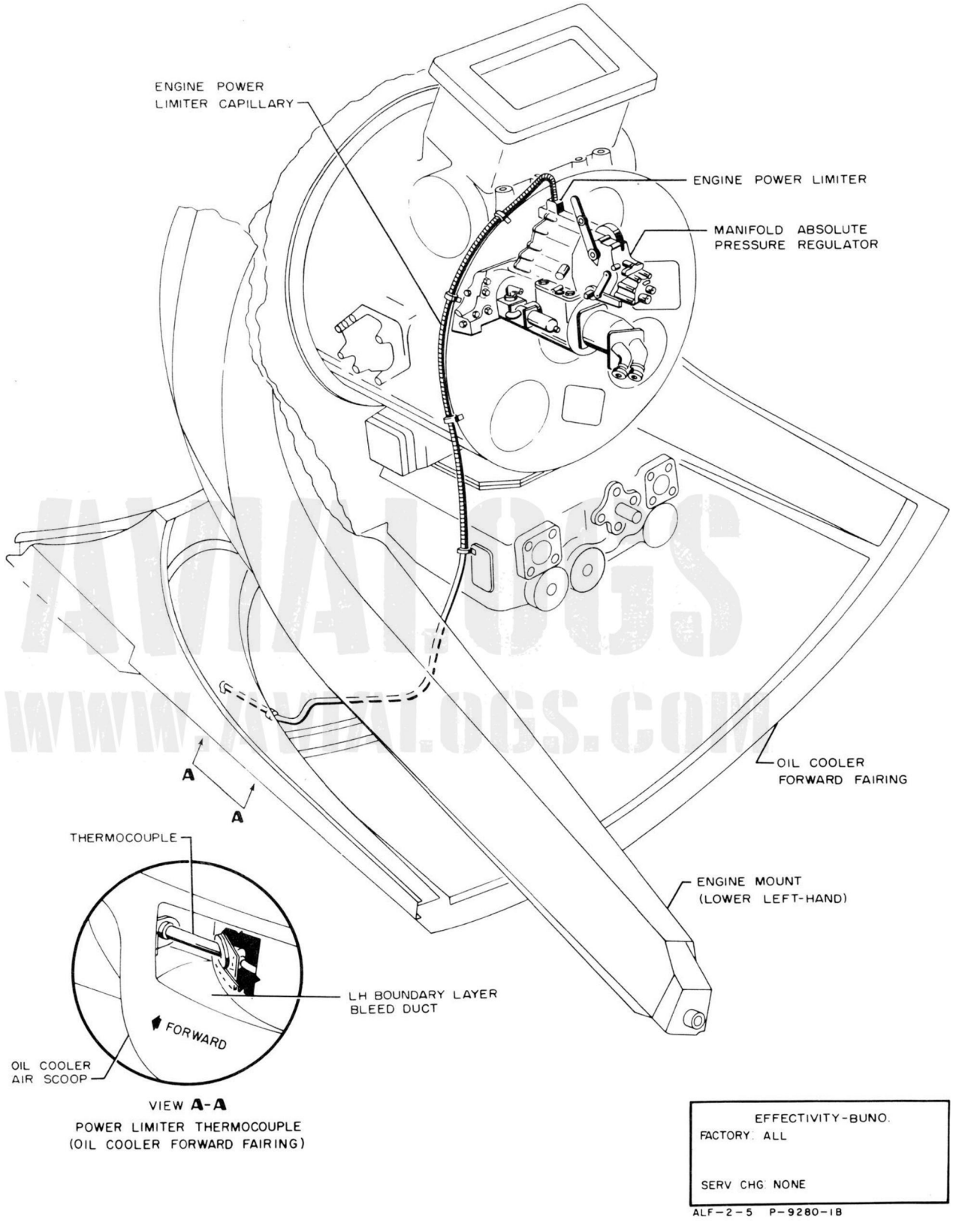


Figure 5-8A. Power Limiter Pick-Up Installation

a. Place throttle control lever 1/2 inch from aft end of slot; hold in this position while making adjustments in steps b and c.

b. Adjust push-pull tube so that attaching bolt on bellcrank upper ends is 5-1/16 ±1/8 inches from forward face of firewall.

c. Adjust linkage between firewall bellcrank and manifold pressure regulator main lever until main lever contacts low-rpm stop.

d. Tie down tail of airplane.

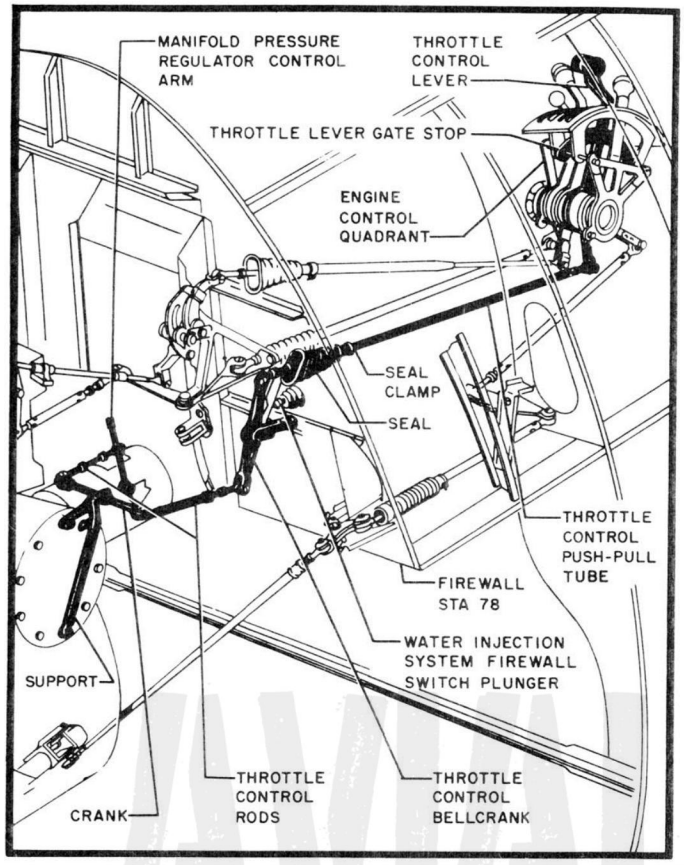
e. Run engine and adjust throttle lever gate stop on quadrant so that lever engages stop when manifold pressure is 58.5 inches Hg.

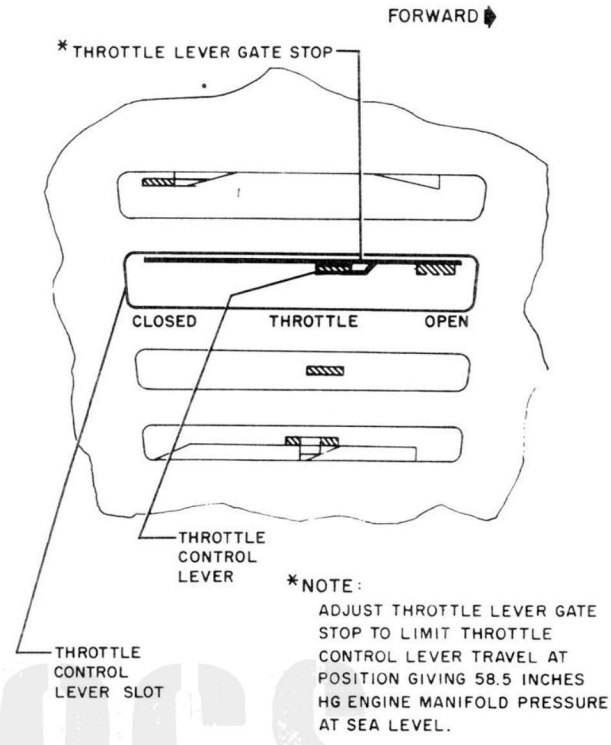
f. To adjust frictional load on throttle control lever, turn adjustment knob (on inboard face of control panel) clockwise to increase, or counterclockwise to decrease, load.

g. Make any required minor adjustments during engine run-up.

5-63. ENGINE SUPERCHARGER.

5-64. DESCRIPTION. The two-speed supercharger in the engine incorporates high- and low-blower positions which are selected from the cockpit. The principal function of the supercharger is to increase mass air flow by raising air pressure, thus increasing the density and weight of the fuel-air charge directed to the engine combustion chambers.





PLAN VIEW OF CONTROL QUADRANT FACE PLATE

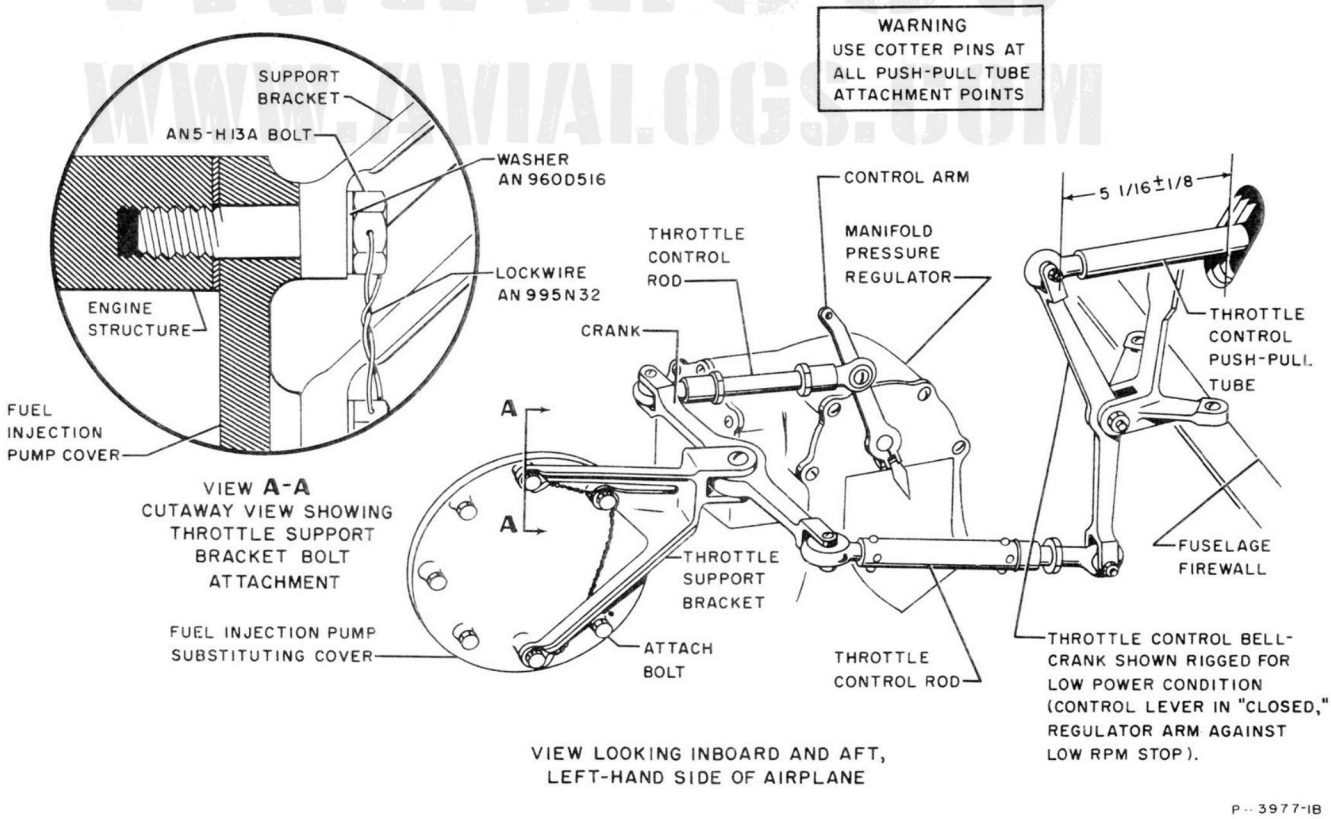


Figure 5–9. Throttle Control and Adjustment

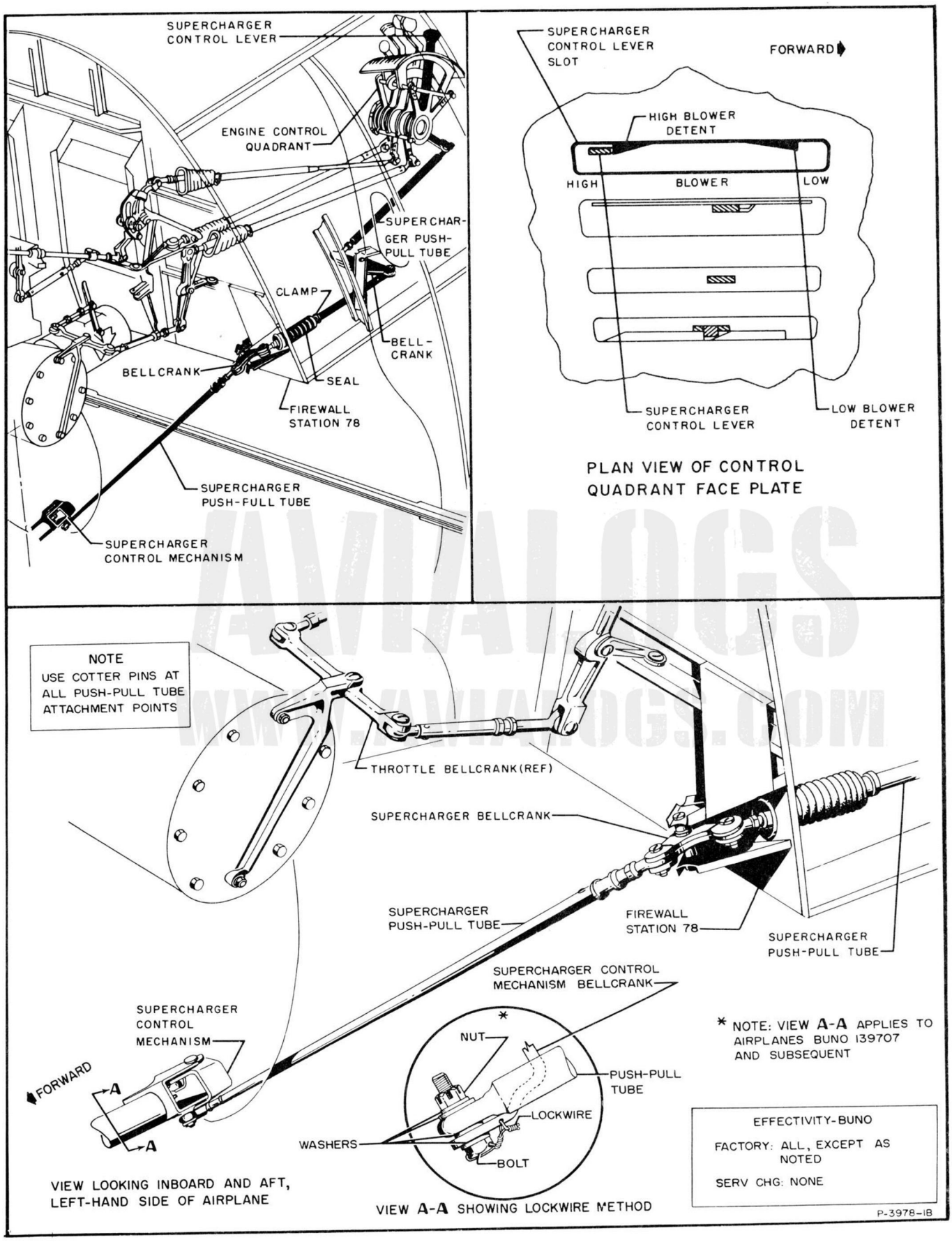
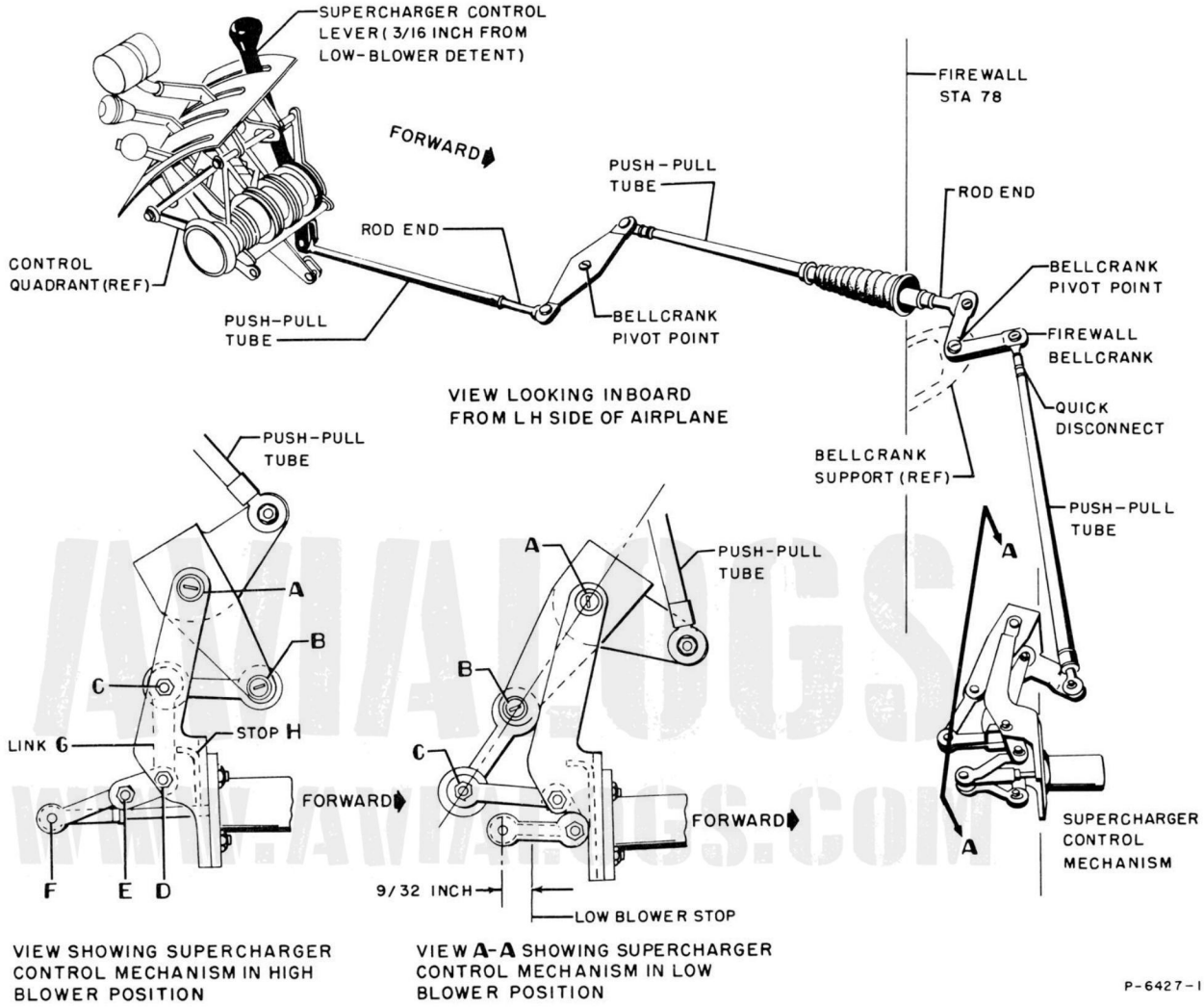


Figure 5–10. Supercharger Control Installation



ADJUSTMENT

a. Remove accessory cowling.

b. Remove side panel from left-hand control panel in cockpit.

c. Place supercharger control lever $\frac{3}{16}$ inch from low-blower detent.

d. Turn push-pull tube rod ends to align tubes with points "A," "B," and "C" of supercharger control mechanism in low blower position, while engine control rod is $\frac{9}{32}$ inch from low blower stop (obtained by pushing rod into mechanism as far as possible and then pulling it out to $\frac{9}{32}$ inch) and control lever is $\frac{3}{16}$ inch from low blower detent. (See view A-A.)

e. Tighten all connecting bolts.

f. Place supercharger control lever in high blower position.

g. With supercharger in high blower position and points "D," "E," and "F" in line, adjust stop "H" to contact link "G" as shown in figure.

Figure 5–10A. Supercharger Control Adjustment

5-65. ENGINE SUPERCHARGER CONTROL.

5-66. DESCRIPTION. (See Figure 5-10.) The supercharger control lever is located outboard of the throttle lever in the engine control quadrant. It can be placed in LOW or HIGH, both of which are detented to prevent inadvertent movement of the lever out of position. Moving the lever inboard releases it from the detent. The supercharger control is not affected by the friction adjustment knob on the inboard side of the control panel.

5-67. An adjustable rod connects the supercharger control lever with the inboard end of a bellcrank inside the control panel near the firewall. A second adjustable rod extends from the outboard end of the bellcrank, through the firewall, and is connected to a bellcrank on the forward face of the firewall. A third adjustable rod extends downward and inboard, from the lower end of the bellcrank at the firewall to the supercharger control mechanism at the after side of the engine rear oil sump; a quick-disconnect in this rod facilitates engine removal. A stop is installed in A-1H airplanes BuNo. 134599 and subsequent, and prior airplanes reworked to A-1/ASC 448. The stop, located on the engine rear sump, prevents overtravel of the supercharger control mechanism linkage when the supercharger control lever is placed in the HIGH position.

5-68. REMOVAL.

a. Remove left-hand accessory cowling.

b. Remove side panel from left-hand control panel in cockpit.

c. Disconnect push-pull tube from supercharger control lever.

d. Disconnect supercharger control push-pull tubes from bellcrank inside panel.

e. Loosen clamp which attaches seal on firewall to push-pull tube.

f. Disconnect push-pull tubes from bellcrank on forward face of firewall.

g. Disconnect push-pull tube from supercharger control mechanism bellcrank.

5-69. INSTALLATION.

a. Bolt forward push-pull tube to supercharger control mechanism bellcrank.

NOTE

Secure supercharger control mechanism bellcrank attaching bolt with lockwire as shown on figure 5-10.

b. Insert center push-pull tube through firewall and connect to firewall bellcrank.

c. Bolt center and aft push-pull tubes to bellcrank inside control panel.

d. Tighten clamp which attaches seal on firewall to push-pull tube.

e. Bolt aft push-pull tube to supercharger control lever.

f. Adjust supercharger controls. Then tighten all connections.

5-70. ADJUSTMENT. See figure 5-10A.

5-70A. WATER INJECTION SYSTEM.

5-70B. DESCRIPTION. (See figure 5-10B.) A water injection system (less water pump) is installed in airplanes BuNo. 135278 and subsequent, and complete water injection systems are installed in airplanes BuNo. 135277 and prior, reworked to A-1/ASC 447. The system provides a means of increasing the power output of the engine without incurring overheating or detonation, and it allows the engine to operate at take-off manifold pressure with a leaner mixture by furnishing a water-alcohol mixture to the induction section of the engine. The principal components of the system include the following:

Water injection system control circuit

Water injection system supply tank

Water injection system pump

Water injection system power control valve.

5-70C. The water injection system supply tank serves as a reservoir for the water-alcohol fluid, and the pump transfers the water-alcohol fluid from the supply tank through lines to the power control valve located on the engine manifold pressure regulator adapter. The power control valve meters the fluid and directs the metered fluid through a line to the induction section of the engine. The power control valve also directs unmetered fluid through a line to the derichment valve in the carburetor. Fluid pressure on the derichment valve deriches the fuel air mixture to the induction section of the engine during water injection system operation. A vent line installed between the carburetor and the diaphragm section of the pump maintains carburetor pressure on the pump diaphragm to enable the pump to produce an output pressure of 27 psi. A line installed between the supply tank vent fitting and a tee on the pump outlet port is provided with a restrictor to direct air (which may be drawn into the fluid supply line) to the vent fitting on the supply tank. Air is thus prevented from entering the water injection power control valve. The water injection system is an electrically controlled system.

5-70C-1. ADJUSTMENT.

a. Check rigging of S shaped throttle rod installed between carburetor throttle lever and manifold pressure regulator drive lever to determine that rod is properly installed. Refer to NAVWEPS 02A-35JP-502, Service Instructions.

b. Check rigging of throttle control push-pull linkage between manifold pressure regulator and throttle control lever to determine that linkage is properly adjusted. Refer to paragraph 5-62.

c. With tail of airplane tied down, run-up engine and mark control quadrant at throttle lever position giving 58.5 inches manifold pressure.

Note

If 58.5 inches manifold pressure is not obtained, mark the quadrant where further advance of the throttle control lever does not result in an increase in manifold pressure and retarding of throttle lever results in reduction of manifold pressure from maximum observed. If the maximum manifold pressure obtainable is less than 57 inches Hg, replace manifold pressure regulator.

d. Mark control quadrant at throttle lever position giving 50 inches Hg manifold pressure.

e. Shut down engine and adjust throttle lever gate stop to limit throttle control lever travel at position marked in step c.

Note

Proceed with water injection system adjustments by adjusting water injection system firewall switch as noted in steps f, g, and h.

f. Lock throttle at position marked in step d, using throttle friction knob.

g. Turn adjusting bolt on firewall switch plunger out against throttle bellcrank until switch contacts close. Closing of switch contacts is determined by light click made by switch.

h. Secure firewall switch adjustment bolt locknut, and lockwire.

Note

If the adjusting bolt is too short (less than five threads engaged), replace it with one that is 1/4-inch longer.

5–70C-2. TESTING.

a. Disconnect water pressure line at firewall or at support fitting attached to lower starboard leg of engine mount and temporarily connect a line from this fitting to suitable pressure gage.

Note

An air pressure gage calibrated from 0 to 50 psi is suitable for this test.

b. Place five gallons of clear gasoline in water injection system supply tank and agitate with air hose immersed in fluid.

WARNING

Observe necessary precautions to prevent gasoline from spilling on ground. Keep gasoline away from open flame.

c. With 28 volts d-c external power supplied to aircraft electrical system, energize water pump by closing master switch and advancing throttle lever to close firewall switch.

d. Observe that system pump pressure is 27 to 28 psi.

Note

If system pressure is not within range noted in step d, the pump relief valve must be adjusted to provide the proper pressure. Refer to the applicable Service Handbook for information concerning adjustment of pump relief valve.

e. Stop pump by closing throttle, disconnect pressure gage and route gage line into suitable container clear of airplane.

f. Re-energize pump until water injection system is empty of gasoline.

g. Open water tank drain valve and drain off residue gasoline from water tank sump.

h. Place three (3) gallons of injection fluid (50% water and 50% methanol) into water tank.

i. Route temporary pressure line into suitable external container.

j. Re-energize pump until system is empty.

k. Reconnect water pressure line which was disconnected in step a.

Note

Continue by testing discharge valves.

l. Disconnect discharge valve line at power control valve and connect a source of air pressure to valve line. Listen for discharge of air from valves.

Note

The valves normally open at a pressure between 6.5 and 10 psi. If they are stuck or corroded as much as 50 psi pressure may be required to free them initially, after which the opening pressure should return to normal.

m. Reconnect discharge valve line at power control valve.

Note

Continue by testing carburetor derichment valve.

n. Disconnect derichment line at power control valve and energize *auxiliary fuel pump* with mixture control lever placed in idle cut-off.

Note

If fuel drips from derichment line, replace derichment valve diaphragm with a new diaphragm.

o. Make certain that power control valve has high blower reset provisions partially or completely eliminated. Refer to applicable Engine Bulletin.

Note

This change precludes loss of oil during high blower operation.

p. Make certain water metering valve of power control valve is adjusted to open at approximately 49 inches Hg manifold pressure.

Note

This change is identified by blue paint on the head of the bellows stop screw which extends from the rear of the regulator.

q. Continue testing operation of system as noted in steps r and s.

r. Temporarily connect suitable length of hose or tubing to derichment line fitting on power control valve and route opposite end of hose overboard, clear of accessory compartment. Tie hose to available structure to prevent damage from propeller slip stream.

s. With three (3) gallons of water injection fluid in water tank and tail of airplane tied down, close water injection system master control switch and run-up engine to 45 inches Hg manifold pressure. Gradually advance throttle lever to actuate firewall switch set to close at 50 inches Hg manifold pressure and observe that water is flowing from temporary derichment line.

Note

If water does not flow when firewall switch is actuated, proceed with steps t and u.

t. Continue advancing throttle and observe manifold pressure at which water begins to flow from temporary derichment line. Reduce throttle slowly and observe manifold pressure at which water stops flowing.

u. Back out reset stop screw extending from rear of water regulator until water flows freely when firewall switch is initially actuated.

v. Remove temporary line and reconnect derichment line to power control valve.

CAUTION

If torque indicating equipment is not installed in the airplane the water line must be disconnected from the manifold pressure regulator and a vented plug installed in its place.

5–70D. WATER INJECTION SYSTEM CONTROL CIRCUIT.

5–70E. DESCRIPTION. The water injection system control circuit receives power from the primary bus through the WATER INJECT 15-ampere circuit breaker, located on the right-hand circuit breaker panel. The circuit includes a master control switch, located on the lower left side of the instrument panel, a throttle control actuated firewall switch, located on the firewall aft of the throttle control bellcrank, and the water injection system pump motor. When the master control switch is in "ON" and the throttle control lever is moved forward past a position giving 50 inches Hg manifold pressure during engine run-up, the firewall switch is actuated to close and

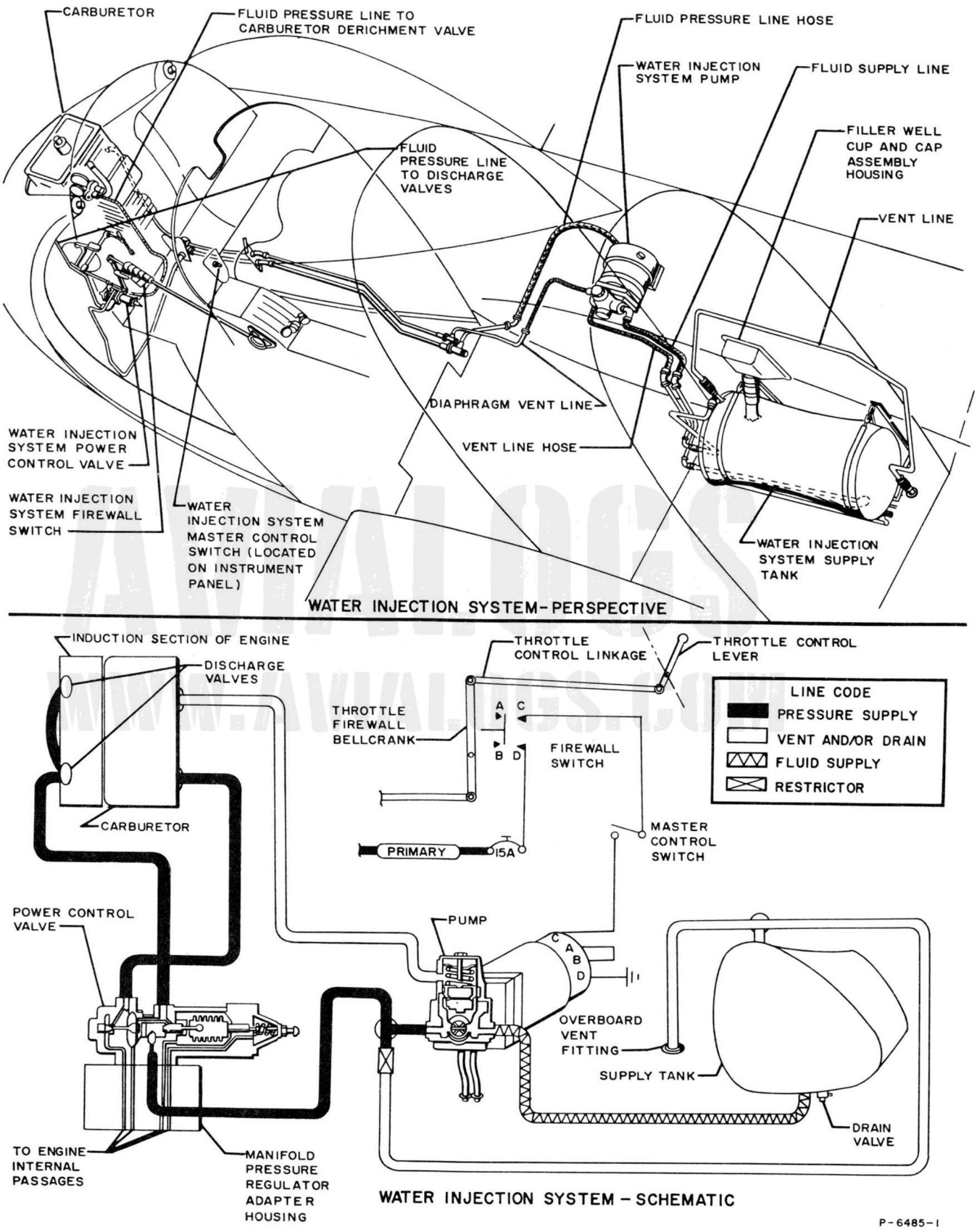


Figure 5–10B. Water Injection System (Sheet 1)

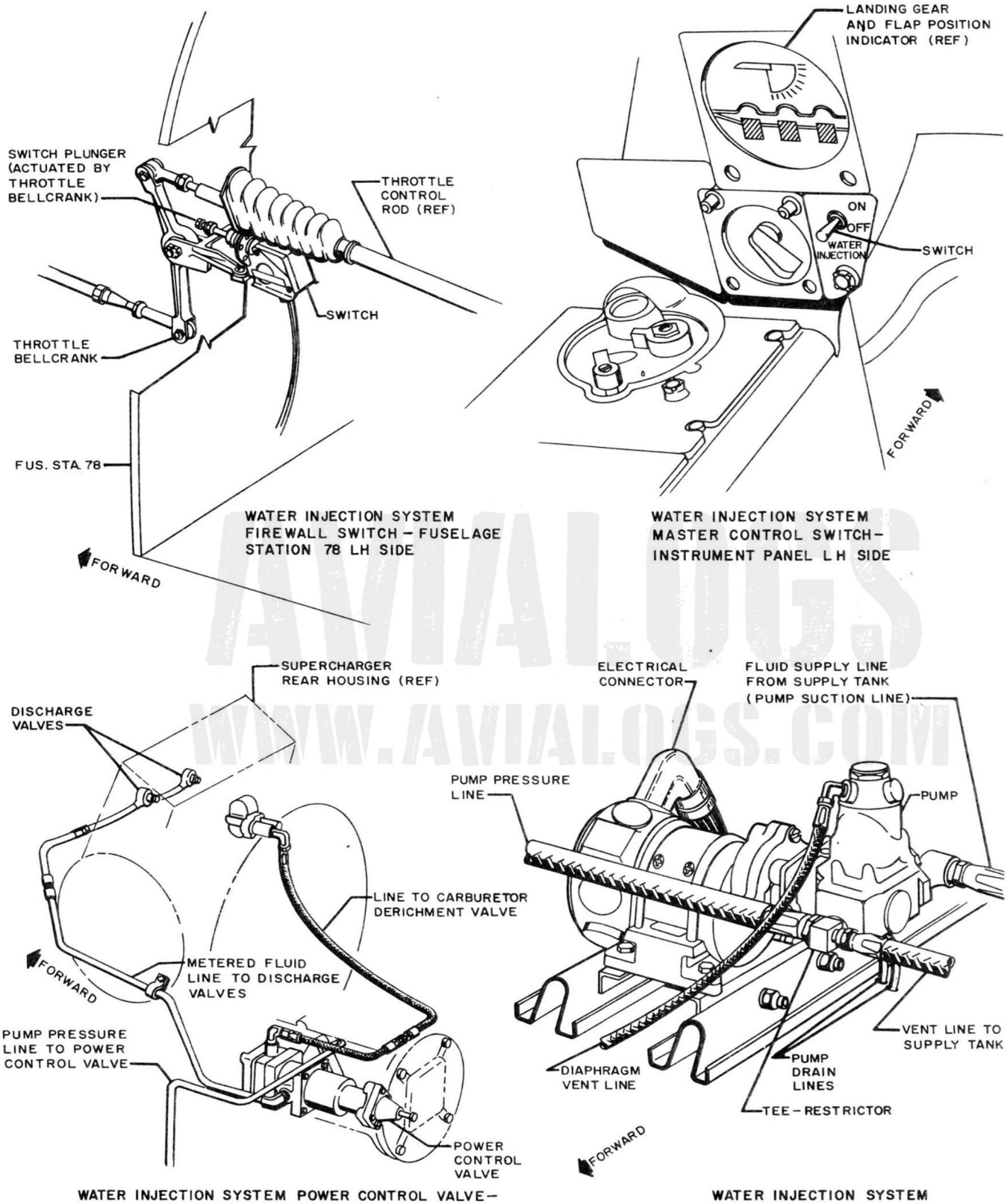


Figure 5–10B. Water Injection System (Sheet 2)

the circuit is completed through the switches to the pump motor to energize the motor and actuate the pump.

5–70F. TROUBLE SHOOTING. Refer to table 5–2.

5–70G. WATER INJECTION SYSTEM MASTER CONTROL SWITCH.

5–70H. DESCRIPTION. (See figure 5–10B.) The water injection system master control switch is located on the lower left side of the instrument panel and is identified as WATER INJECTION. The switch is a single-pole, single-throw type switch with "OFF" and "ON" indicated positions.

5–70J. WATER INJECTION SYSTEM FIREWALL SWITCH.

5–70K. DESCRIPTION. (See figure 5–10B.) The water injection system firewall switch is a plunger type switch installed on the aft side of fuselage station 78 firewall. The switch plunger extends through a hole in the firewall and is actuated by the throttle control bellcrank. When the switch plunger is actuated the switch contacts close and the water injection system control circuit is completed through the switch.

5–70L. ADJUSTMENT. Refer to paragraph 5–70C-1.

5–70M. WATER INJECTION SYSTEM SUPPLY TANK.

5–70N. DESCRIPTION. (See figure 5–10C.) The water injection system supply tank is installed in the fuel cell compartment to the right of the main fuel cell and is secured in place by means of cradle and strap assemblies. The tank, of welded aluminum alloy construction, has a capacity of 20 U.S. gallons (16½ Imperial gallons). A filler neck, located at the top forward end of the tank is connected to a filler well cup and cap assembly at fuselage station 149 by means of a synthetic rubber hose. The filler neck is accessible through a door on the right-hand side of the fuselage. A vent line that connects to the top of the tank extends aft to a fitting in the bottom of the fuselage at station 180. The vent line enables atmospheric pressure to be maintained within the tank. A drain valve and an outlet fitting-screen assembly are located in the bottom of the tank. The drain valve allows the tank to be drained and the outlet fitting-screen assembly prevents foreign particles from entering the system lines. The outlet fitting-screen assembly is removed for cleaning by removing a snap retaining ring from its retaining groove in the bottom of the tank.

WARNING

Water injection fluid contains methanol (methyl alcohol), a deadly poison, and must not be taken internally.

5–70P. REMOVAL. (See figure 5–10C.)

a. Remove access door from bottom of airplane at fuselage station 163.

b. Drain fluid from water injection system supply tank into suitable external container.

c. Remove main fuel cell.

d. Disconnect fluid supply line hose assembly from supply tank outlet fitting.

e. Disconnect hose assemblies from filler neck, vent line, and air return line.

f. Remove lock wire from support strap turnbuckles and detach strap turnbuckles from attaching trunnions.

g. Remove supply tank from airplane.

5–70Q. INSTALLATION. (See figure 5–10C.)

a. Place tank in position on cradle support structure.

b. Install filler neck, vent line, and air return line hose assemblies.

c. Connect fluid supply line hose assembly to supply tank outlet fitting.

TABLE 5–2. TROUBLE SHOOTING—WATER INJECTION SYSTEM

Trouble or Symptom	*Probable Cause*	*Correction*
1. Pump fails to operate.	a. Control switch not "ON."	Turn control switch "ON."
	b. Firewall switch out of adjustment.	Adjust. Refer to paragraph 5–70C-1.
	c. Faulty firewall switch.	Replace firewall switch.
	d. Faulty master control switch.	Replace master control switch.
	e. Faulty pump.	Replace pump.
2. Pump operates but no water-alcohol mixture is delivered to engine.	a. Supply tank empty.	Fill supply tank.
	b. Supply tank strainer clogged.	Remove and clean strainer.
	c. Pump shaft broken.	Replace pump.
	d. Foreign matter holding pump relief valve open.	Replace pump.
3. Fluid leak.	a. Loose or damaged line.	Tighten or replace line.
	b. Damaged supply tank.	Replace supply tank.

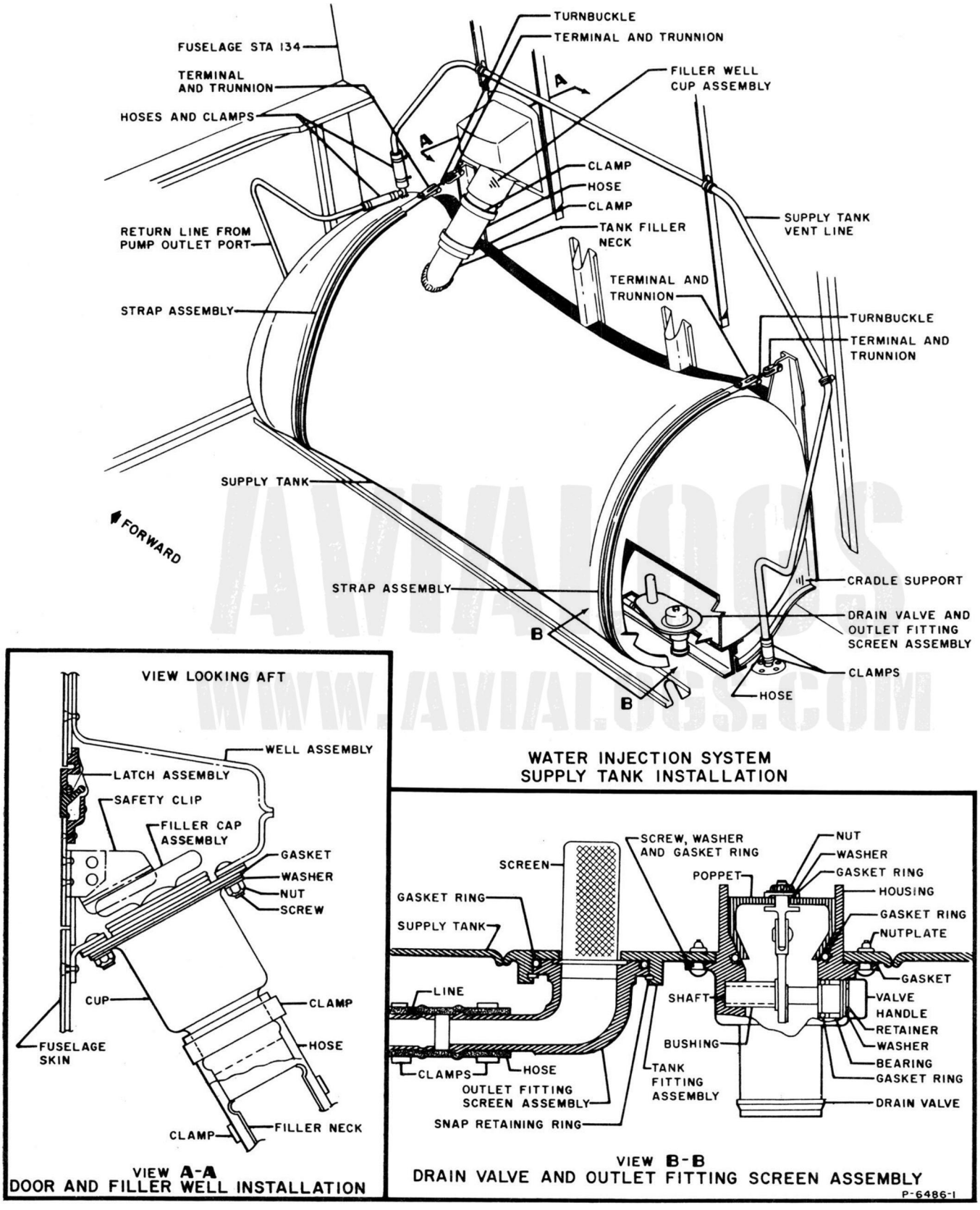


Figure 5–10C. Water Injection System Supply Tank Installation

d. Connect strap turnbuckles to attaching trunnions, tighten turnbuckles and lock wire.

e. Install main fuel cell.

f. Secure fuselage station 163 access door.

5-70R. WATER INJECTION SYSTEM PUMP.

5-70S. DESCRIPTION. (See figure 5-10B.) The water injection system pump is installed in A-1H airplanes BuNo. 135277 and prior, reworked to A-1/ASC 447, Provisions for installation of a water injection system pump are installed in A-1H airplanes BuNo. 135278 and subsequent.

5-70T. The pump is located at wing station 45 in the right-hand section of the center wing and is accessible through the bulkhead access door at wing station 30. It is a positive displacement vane-type pump which is actuated by a self-contained electric motor and an AN standard drive shaft. The diaphragm section of the pump is vented to the carburetor through a line which enables the pump to maintain an outlet pressure of 27 psi at varying altitudes. The pump suction port is connected by a line to the outlet port of the injection system supply tank. Two lines connect to a tee on the pump pressure port, one is directed to the power control valve and the other to the vent fitting on the injection system supply tank. A fluid seal drain line and a gear case drain line are connected to the pump drain ports located on the underside of the pump. The drain lines are routed through the skin on the underside of the wing to drain pump residue overboard.

5-70U. REMOVAL. (See figure 5-10B.)

a. Open right-hand access door to forward equipment compartment.

NOTE

To gain access to the water injection system pump, it is necessary to remove the No. 2 inverter. Make certain aircraft engine is not operating, dc power control switch is OFF, and no external power is connected to airplane.

b. Remove No. 2 inverter attaching bolts and electrical leads and remove the No. 2 inverter.

c. Remove access door at wing station 30.

NOTE

Disconnect and cap pump lines as noted in step d.

d. Disconnect pump diaphragm vent line at diaphragm port elbow, pump suction line at suction port elbow, pump pressure line and air return line at pressure port tee and drain lines at drain port elbows.

e. Disconnect electrical connector from pump motor.

f. Remove pump attaching bolts, nuts, and washers and remove pump.

5-70V. INSTALLATION. (See figure 5-10B.)

a. Place pump in position on supporting structure and secure pump with attaching bolts, nuts, and washers.

NOTE

Uncap and connect pump lines as noted in step b.

b. Connect pump diaphragm vent line to diaphragm port elbow, pump suction line to suction port elbow, pump pressure line and air return line to pressure port tee, and drain lines to drain port elbows.

c. Apply antiseize compound (Fed. Spec. TT-A-580) to threads of electrical connector and attach electrical connector to pump motor receptacle.

d. Install access door at wing station 30.

e. Install No. 2 inverter.

f. Close forward equipment compartment right-hand access door.

5-70W. WATER INJECTION SYSTEM POWER CONTROL VALVE.

5-70X. DESCRIPTION. (See figure 5-10B.) The water injection system power control valve is installed on the engine manifold pressure regulator adapter. The valve meters the water-alcohol fluid to the induction system of the engine and governs fluid pressure to the carburetor derichment valve. For additional information on the power control valve refer to NAVWEPS 02A-35JP-502, Service Instructions.

5-70Y. REMOVAL. (See figure 5-10B.)

a. Remove engine accessory cowling left-hand panels.

b. Disconnect lines at power control valve.

c. Remove power control valve attaching bolts and remove power control valve.

5-70Z. INSTALLATION. (See figure 5-10B.)

a. Place power control valve with new gasket against mounting flange on regulator adapter and secure with attaching bolts.

b. Connect lines to power control valve.

c. Install engine accessory cowling left-hand panels.

5-71. ENGINE STARTING SYSTEM.

5-72. DESCRIPTION. (See figure 5-11A.) The engine starting system includes the units necessary for engine cranking and also the units for transforming secondary bus voltage (24-volt dc electrical power) into interrupted dc voltage for starting ignition. The components in the starting system are:

Name	Location
Circuit breaker, 10 amp	Forward equipment compartment — circuit-breaker panel.
Starter control switch	Right-hand control panel
Starter relay	Forward equipment compartment–terminal panel 17
Starter	Engine—supercharger rear housing cover
Starting vibrators	Engine mount—aft RH

5-72A. The starting system on model A-1H and A-1J aircraft utilize two starting vibrators.

5-73. The starter control switch, located on the right-hand pilot's control panel, controls the engine starting system. When the starter control switch is depressed, the circuit is completed from the secondary bus, through the 10-ampere circuit breaker, identified as STARTER AND BOOSTER, to the coil of the starter relay. When the coil of the starter relay is energized, the contact points A1 and A2 close to connect the primary bus to the starter. Energizing the starter engages the starter jaw with the engine crankshaft. When either the engine starts or the starter control switch is released, the starter jaw is disengaged from the engine crankshaft. Power from the secondary bus, through the 10-ampere circuit breakers and starter control switch, energizes the starting vibrators which provides interrupted direct current to the magneto for starting ignition.

5-74. TROUBLESHOOTING. Refer to table 5-3.

5-75. STARTER RELAY.

5-76. DESCRIPTION. The solenoid-type starter relay serves as a high-current capacity switch to connect the primary bus with the starter, when it is energized by closing the starter control switch. The switch contacts of the relay are rated to handle 200 amperes of continuous current.

5-77. STARTER.

5-78. DESCRIPTION. The direct-cranking, electric starter unit consists of a heavy-duty electric motor, three planetary gear trains in series to produce a total reduction of 133:1, a friction-disc dry clutch, preset to a torque of 800 foot-pounds, and an automatic engaging and disengaging jaw mechanism. An oil seal around the starter jaw prevents engine oil from entering the starter. The seal also serves as a friction device to advance the starter jaw so that it engages the engine jaw when the starter motor is energized. The starter is mounted on a pad in the center of the supercharger rear housing cover, directly in line with the engine crankshaft, and is secured by six studs and nuts. A grounding link is fastened under one of the mounting stud nuts and is grounded to the firewall structure through a cable.

5-79. REMOVAL.

a. Install right-hand engine work platform.
b. Remove accessory cowling.
c. Disconnect and cap oil tank engine vent line.

TABLE 5-3. TROUBLESHOOTING STARTING SYSTEM

Trouble	Probable Cause	Remedy
1. Starter operates but fails to crank engine.	a. Engine oil leaking into starter.	Replace starter.
	b. Clutch not properly set.	Replace starter.
	c. Worn or scored clutch discs.	Replace starter.
	d. Starter does not advance into engagement.	Replace starter.
2. Starter fails to operate or operates at too low a speed.	a. Low voltage caused by discharged battery.	Test and recharge battery.
	b. Control switch or relay inoperative.	Replace defective unit.
	c. Shorted, grounded or open armature.	Replace starter.
	d. Grounded or open field coil.	Replace starter.
	e. Worn, broken, or improperly lubricated bearings and gears.	Lubricate or replace starter.
	f. Excessive wear and arcing of brushes.	
	(1) Binding, worn, or improperly seated brushes.	Service brushes.
	(2) Dirty commutator.	Clean commutator.
	(3) Brush spring tension incorrect.	Replace starter.
3. Starting vibrator fails to function.	a. Unit not grounded.	Adjust mounting bolts to contact grounding plate.
	b. Loose or disconnected positive cable.	Secure terminal clip to positive cable and to positive terminal post.
	c. Loose or disconnected magneto terminal.	Secure magneto cable to terminal nuts and springs.

d. Remove a-c generator.

e. Remove safetywire, hold-down screws, and cover from electrical terminal housing on starter.

f. Disconnect starter cable, loosen knurled nut, and pull cable free of housing.

g. Remove starter mounting stud nuts, removing top nut last.

h. Remove grounding link from mounting stud.

i. Pull starter straight aft and away from supercharger rear cover.

5–80. INSTALLATION.

Note

Before the starter can be installed, the right-hand generator must be off the engine, the right-hand engine work platform must be installed, the accessory cowling removed, and the oil tank engine vent line disconnected from the tank.

a. Place starter in position on supercharger rear cover so that electrical terminal housing is at bottom.

b. Make certain that starter mounting flange is clean and install grounding link on upper right-hand stud.

c. Install remaining mounting stud nuts.

d. Insert electrical cable into starter terminal housing and connect cable to starter terminal.

e. Apply anti-seize compound (Specification JAN-A-669) to threads of conduit knurled nut and tighten nut.

Note

Rotate conduit fitting on starter to horizontal and straight aft position to provide clearance between starter cable and right-hand generator.

f. Fasten cover to starter terminal housing with hold-down screws and safetywire.

g. Install a-c generator. (Refer to section VII.)

h. Connect oil tank engine vent line to tank.

5–81. STARTING VIBRATOR.

5–82. DESCRIPTION. Two starting vibrators are installed on the right-hand side of the engine mount on AD-6 and AD-7 airplanes using the Wright R3350-26WB and -26WC engines, whereas model AD-6 aircraft not reworked in accordance with BuAer AD/SC No. 685 utilize one starting vibrator only. The starting vibrators supply d-c interrupted voltage to the right-hand primary coil in the magneto for starting ignition. The right-hand coils in the magneto transmits the d-c interrupted voltage to the right-hand distributor for distribution to the ignition coils located adjacent to the engine cylinder heads, and to the front spark plug in each cylinder. On the R3350-26WA engine high-tension system, voltage is transmitted directly from the distributor to the front spark plug in each cylinder. The vibrators are connected in parallel with the starter relay and are energized when the starter control switch is depressed. Inherent capacitance in the starting vibrators suppresses radio interference caused by the starting ignition. For more detailed information concerning the starting vibrators refer to AN03-5-190, Handbook, Operation and Service Instructions, Starter Vibrator, Models V-JS24A1 and V-JS24A2.

5–83. REMOVAL.

a. Install engine work platform on right-hand side.

b. Remove right-hand accessory-section cowling.

c. Unscrew strap-and-clamp assembly holding vibrator cover in position and remove cover.

d. Disconnect positive terminal clip from positive terminal post.

e. Unscrew conduit nut and pull positive terminal clip through positive cable outlet.

f. Disconnect magneto terminal clip from magneto terminal post.

g. Unscrew MAG outlet nut and pull magneto conduit free of MAG outlet.

h. Remove vibrator attaching screws.

i. Repeat steps a through h for removal of second vibrator.

5–84. INSTALLATION.

Note

Before the vibrator can be installed, the right-hand engine work platform must be in place and the right-hand accessory cowling must be off the airplane.

a. Place starting vibrator in position with positive cable outlet on top. Secure with three attaching screws.

b. Insert magneto terminal clip through MAG cable outlet.

c. Apply anti-seize compound (Specification JAN-A-669) to threads of MAG outlet nut and connect to MAG outlet.

d. Place magneto terminal clip on magneto terminal post and secure with screw.

e. Insert positive terminal clip through positive cable outlet.

f. Apply anti-seize compound (Specification JAN-A-669) to threads of positive outlet nut and connect to positive outlet.

g. Place positive terminal clip on positive terminal post and secure with screw.

h. Place vibrator cover in position and secure in place with strap-and-clamp assembly.

i. Repeat steps a through h for installation of second vibrator.

5-84A. (Deleted.)

5-84B. (Deleted.)

5-84C. (Deleted.)

5-84D. (Deleted.)

5-85. ENGINE IGNITION SYSTEM.

5-86. GENERAL. The Wright model R3350-26WB and -26WC engine installed in model AD-6 and AD-7 airplanes utilizes a low tension, high-altitude ignition system. Model AD-6 aircraft not reworked per BuAer AD/SC No. 685 are equipped with Wright R3350-26WA engines utilizing a high tension ignition system. The systems differ in operation and are described in the following paragraphs under the heading of IGNITION SYSTEM—HIGH TENSION and LOW TENSION.

5-87. IGNITION SYSTEM—HIGH TENSION.

5-88. DESCRIPTION. (See figure 5-11.) The high tension ignition system utilized on the Wright R3350-26WA engine, installed on the model AD-6 airplane, not reworked per BuAer AD/SC No. 685, incorporates a two coil type magneto which generates high tension current. The high tension current generated by the magneto is conducted through high-tension wires to two high tension distributors, located on the engine crankcase front section. The distributors are geared to the engine and direct the high tension current from the magneto through an ignition harness to the appropriate spark plug of each cylinder. The high tension ignition system distributors provide dual ignition, each distributor supplying ignition to one spark plug at each engine cylinder. The system includes the following principal components:

Name	*Location*
Ignition switch	Instrument panel
Magneto	Engine—supercharger rear cover
Distributors and ignition harness	Engine crankcase front section
Spark plugs	Engine cylinder heads

5-89. For additional information concerning the ignition system, refer to AN 02A-35JG-2, Handbook of Service Instructions, Models R3350-26W, -26WA, and -26WB Aircraft Engines.

5-90. TROUBLE SHOOTING. Refer to the AN 03-5DA-28, Handbook of Service Instructions, Aircraft Magnetos, Models DF 18LN-1, DF 18LN-2, and refer to the AN 02A-35JG-2, Handbook of Service Instructions, Models R3350-26W, -26WA, and -26WB Aircraft Engines for information concerning trouble shooting of the ignition system.

5-91. IGNITION SWITCH—HIGH TENSION SYSTEM.

5-92. DESCRIPTION. (See figure 5-11.) The single engine ignition switch utilized in the high tension ignition system is a manually operated, four-position, selector switch. When the switch is in "OFF," both ignition circuits are grounded and are inoperative. When the switch is in "BOTH," both ignition circuits are ungrounded and current produced by the magneto is directed to all the spark plugs. In the "L" position, the left-hand (rear) spark plug circuit is operative, and the right-hand (front) spark plug circuit is grounded. In the "R" position, the right-hand (front) spark plug circuit is operative, and the left-hand (rear) spark plug circuit is grounded. Detents are provided at each position, and positive stops at the "OFF" and "BOTH" positions prevent overtravel of the switch.

5-93. REMOVAL.

a. Remove accessory cowling upper right-hand panel.

b. Loosen conduit nut and disconnect ignition switch cable electrical lead from receptacle on right-hand side of magneto.

c. Inside cockpit, remove screws which attach ignition switch to instrument panel.

d. Loosen conduit nut at switch receptacle and remove screw and nuts securing switch terminal cover to switch housing.

e. Disconnect switch wiring from switch terminals and remove switch.

5-94. INSTALLATION.

a. Place conduit nut and switch terminal cover over switch wiring, and secure switch wiring to switch terminals.

b. Secure switch terminal cover to switch housing with screw, washers and nuts.

c. Secure conduit nut at switch receptacle.

d. Place ignition switch in position on instrument panel and secure with attaching screws.

WARNING

Make sure ignition switch is in "OFF" before connecting cable to magneto.

d. Remove ac generator.

e. Remove safetywire, hold-down screws, and cover from electrical terminal housing on starter.

f. Disconnect starter cable, loosen knurled nut, and pull cable free of housing.

g. Remove starter mounting stud nuts, removing top nut last.

h. Remove grounding link from mounting stud.

i. Pull starter straight aft and away from supercharger rear cover.

5-80. INSTALLATION.

NOTE

Before the starter can be installed, the right-hand generator must be off the engine, the right-hand engine work platform must be installed, the accessory cowling removed, and the oil tank engine vent line disconnected from the tank.

a. Place starter in position on supercharger rear cover so that electrical terminal housing is at bottom.

b. Make certain that starter mounting flange is clean and install grounding link on upper right-hand stud.

c. Install remaining mounting stud nuts.

d. Insert electrical cable into starter terminal housing and connect cable to starter terminal.

e. Apply antiseize compound (Fed. Spec. TT-A-580) to threads of conduit knurled nut and tighten nut.

NOTE

Rotate conduit fitting on starter to horizontal and straight aft position to provide clearance between starter cable and right-hand generator.

f. Fasten cover to starter terminal housing with hold-down screws and safetywire.

g. Install ac generator. (Refer to section VII.)

h. Connect oil tank engine vent line to tank.

5-81. STARTING VIBRATOR.

5-82. DESCRIPTION. Two starting vibrators are installed on the right-hand side of the engine mount on A-1H and A-1J airplanes using the Wright R-3350-26WB, -26WC, or -26WD engine. The starting vibrators supply dc interrupted voltage to the right-hand primary coil in the magneto for starting ignition. The right-hand coils in the magneto transmits the dc interrupted voltage to the right-hand distributor for distribution to the ignition coils located adjacent to the engine cylinder heads, and to the front spark plug in each cylinder. The vibrators are connected in parallel with the starter relay and are energized when the starter control switch is depressed. Inherent capacitance in the starting vibrators suppresses radio interference caused by the starting ignition.

5-83. REMOVAL.

a. Install engine work platform on right-hand side.

b. Remove right-hand accessory-section cowling.

c. Unscrew strap-and-clamp assembly holding vibrator cover in position and remove cover.

d. Disconnect positive terminal clip from positive terminal post.

e. Unscrew conduit nut and pull positive terminal clip through positive cable outlet.

f. Disconnect magneto terminal clip from magneto terminal post.

g. Unscrew MAG outlet nut and pull magneto conduit free of MAG outlet.

h. Remove vibrator attaching screws.

i. Repeat steps a through h for removal of second vibrator.

5-84. INSTALLATION.

NOTE

Before the vibrator can be installed, the right-hand engine work platform must be in place and the right-hand accessory cowling must be off the airplane.

a. Place starting vibrator in position with positive cable outlet on top. Secure with three attaching screws.

b. Insert magneto terminal clip through MAG cable outlet.

c. Apply antiseize compound (Fed. Spec. TT-A-580) to threads of MAG outlet nut and connect to MAG outlet.

d. Place magneto terminal clip on magneto terminal post and secure with screw.

e. Insert positive terminal clip through positive cable outlet.

f. Apply antiseize compound (Fed Spec. TT-A-580) to threads of positive outlet nut and connect to positive outlet.

g. Place positive terminal clip on positive terminal post and secure with screw.

h. Place vibrator cover in position and secure in place with strap-and-clamp assembly.

i. Repeat steps a through h for installation of second vibrator.

5-84A through 5-84D. Deleted.

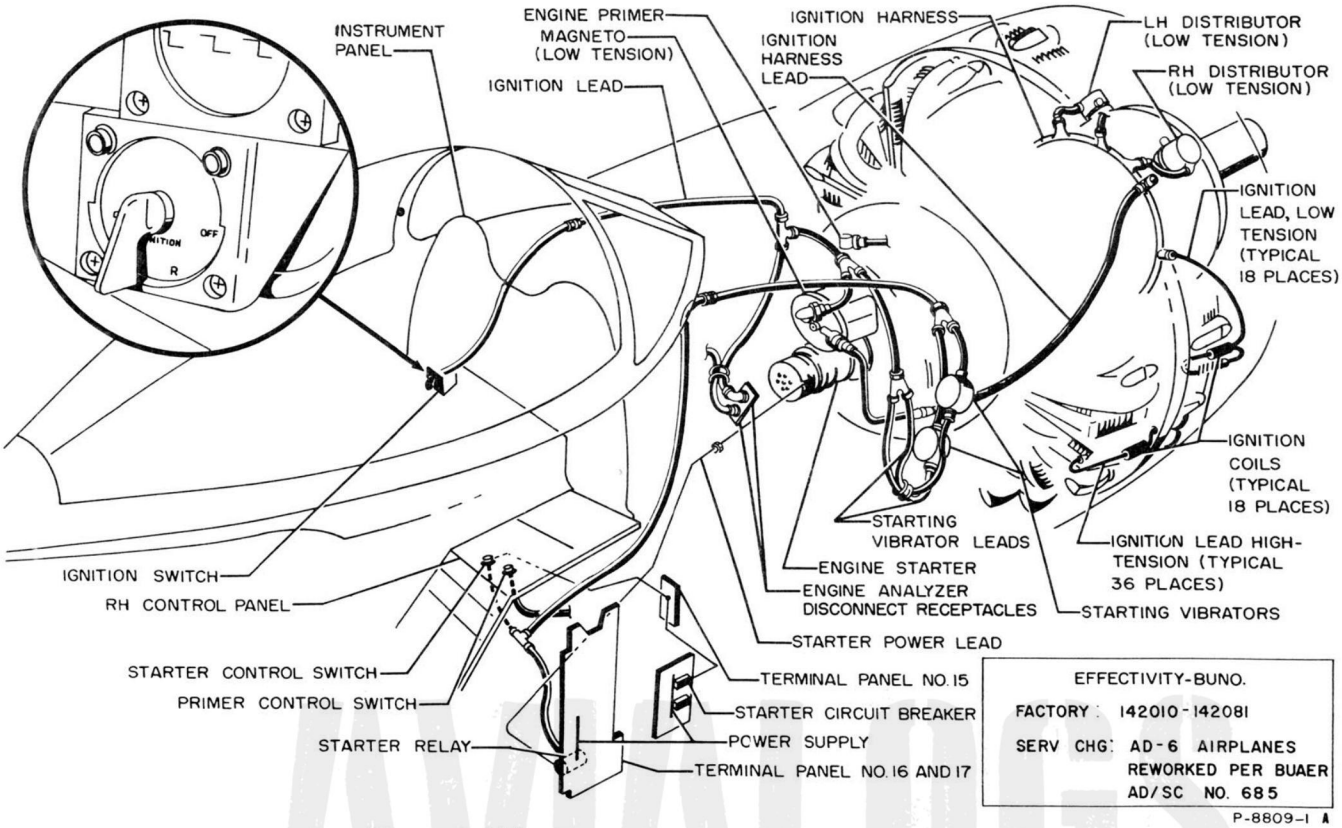


Figure 5-11A. Engine Starting and Ignition Systems

5-85. ENGINE IGNITION SYSTEM.

5-86 through 5-100A. Deleted.

5-100B. DESCRIPTION. (See figure 5-11A.) The low tension high altitude ignition system incorporates a four-coil type magneto which generates low tension current. The low tension current generated by the magneto is conducted through low-tension wires to two low tension distributors, located on the engine crankcase front section. The distributors are geared to the engine and direct low tension current from the magneto through ignition wiring to ignition coils which are installed adjacent to the engine cylinder heads. The ignition coils then transform low tension current into high tension current for distribution through high tension leads to the engine spark plugs. The low tension ignition system distributors provide dual ignition, each distributor supplying ignition to one spark plug at each engine cylinder. The system includes the following principal components:

Name	Location
Ignition switch	Instrument panel
Magneto	Engine — supercharger rear cover
Distributors and ignition harness	Engine crankcase front section
Ignition coils	Adjacent to engine cylinder heads
Spark plugs	Engine cylinder heads

5-100C. For additional information concerning the low-tension ignition system refer to NAVWEPS 02A-35JP-502, Service Instructions.

5-100D. TROUBLESHOOTING. Refer to paragraph 5-90.

5-100E. IGNITION SWITCH

5-100F. DESCRIPTION. (See figure 5-11A.) The ignition switch utilized in the low tension ignition system is similar to the ignition switch used in the high tension ignition system. When the switch in in OFF, both ignition circuits are grounded and are inoperative. When the switch is in BOTH, both ignition circuits are ungrounded and current produced by the magneto is directed to all the spark plugs. In the L position, the left-hand (rear) spark plug circuit is operative, and the right-hand (front) spark plug circuit is grounded. In the R position, the right-hand (front) spark plug circuit is operative, and the left-hand (rear) spark plug circuit is grounded. Detents are provided at each position, and positive stops at the OFF and BOTH positions prevent overtravel of the switch.

 Figure 5-11 Deleted.

5-100G. REMOVAL.

a. Remove accessory cowling upper right-hand panel.

b. Loosen conduit nut and disconnect ignition switch cable electrical lead from receptacle on right-hand side of magneto.

c. Inside cockpit, remove screws which attach ignition switch to instrument panel.

d. Loosen conduit nut at switch receptacle and remove screw and nuts securing switch terminal cover to switch housing.

e. Disconnect switch wiring from switch terminals and remove switch.

5-100H. INSTALLATION.

a. Place conduit nut and switch terminal cover over switch wiring, and secure switch wiring to switch terminals.

b. Secure switch terminal cover to switch housing with screw, washers and nuts.

c. Secure conduit nut at switch receptacle.

d. Place ignition switch in position on instrument panel and secure with attaching screws.

WARNING

Make sure ignition switch is in OFF before connecting cable to magneto.

e. Insert ignition switch cable electrical lead into magneto receptacle. Apply antiseize compound (Fed. Spec. TT-A-580) to threads of conduit nut, and install nut.

f. Install accessory cowling upper right-hand panel.

5-100J. MAGNETO.

5-100K. DESCRIPTION. (See figure 5-11A.) The low tension ignition system magneto is installed on the upper center-portion of the supercharger rear housing cover. The magneto includes two 4-pole magnets which are mounted on a common shaft, four primary coils, and an outlet assembly. The magneto generates low tension current which is directed through low tension wiring to the two low tension distributors installed on the engine crankcase front section. The two right-hand magneto coils furnish electrical impulses to the right-hand distributor and the front spark plug in each cylinder. The two left-hand magneto coils furnish electrical impulses to the left-hand distributor and the rear spark plug in each cylinder. The magneto is essentially an alternating current generator. There are no secondary windings in the low tension system magneto, so the current is at a relatively low voltage, or low tension. For detailed information concerning the low tension ignition system magneto refer to NAVWEPS 02A-35JP-502, Service Instructions.

5-100L. DISTRIBUTORS AND IGNITION HARNESS.

5-100M. DESCRIPTION. (See figure 5-11A.) The two low tension ignition system distributors, with ignition harness, are installed on model A-1H and A-1J aircraft. The distributors synchronize the ignition current generated by the low tension magneto with the proper firing position of each engine piston. The two distributors are installed on the engine crankcase front section. Each distributor includes two 9-lobe compensated cams, two breaker assemblies, two condensers, a collector plate assembly, and a distributor finger. The ignition harness comprises a manifold, ignition leads, and two distributor shields. Spring contacts in the distributor shields route current into the distributors, and distributor shield segments conduct current out of the distributors. Each distributor shield is secured to the distributor housing by a clamping ring which fits over the ridges formed at the parting lines of these parts. The 9-lobe compensated distributor cam actuates two distributor breakers, one for the primary circuit, and one for an ignition booster circuit. However, the ignition booster circuit is inoperative. The distributor collector plate assembly which contains three contact pieces for incoming current insulates two concentric collector rings from each other. One of these collector rings is attached to breaker "1" and provides current for the rear row cylinders; the other ring is attached to breaker "2" and provides current for the front row cylinders. The distributor finger which is secured to the distributor drive shaft selects current from one of the collector rings and directs it through carbon brushes to the appropriate contact segment of the distributor shield. The distributor shield directs current through the ignition harness wiring to the ignition coils, located adjacent to the engine cylinder heads, and to the spark plugs. For detailed information concerning the low tension ignition system distributors and ignition harness refer to NAVWEPS 02A-35JP-503, Service Instructions.

5-100N. IGNITION COILS.

5-100P. DESCRIPTION. (See figure 5-11A.) The low tension ignition system coils are provided to transform low tension current from the distributors into high tension current needed at the engine spark plugs. There are 18 coil assemblies consisting of two coils each. The coil assemblies are attached to brackets which are mounted on the engine cylinder heads. High tension current produced in the coils is directed to the spark plugs through high tension "coil to spark plug" leads.

5-100Q. SPARK PLUGS.

5-100R. DESCRIPTION. Each of the 18 cylinders is equipped with two spark plugs which fire simultaneously. The forward spark plugs are cooled by direct ram air, and the rear spark plugs are cooled by air which is directed to them by the cylinder head air deflectors.

5-101. ENGINE ANALYZER EQUIPMENT PROVISIONS.

5-102. DESCRIPTION. (See figure 5-12.) Engine analyzer equipment provisions are installed to facilitate the use of a portable oscilloscope type engine ignition analyzer. The provisions include a three phase synchronizing generator and wiring to a quick-disconnect receptacle, and wiring from the engine ignition system to a second quick-disconnect receptacle. The leads of a portable ignition analyzer when connected to the two quick-disconnect receptacles provide a means for testing the condition of the aircraft engine ignition system. The disconnect receptacles are located on the left-hand side of the oil cooler support structure and are accessible through the oil dilution shut-off valve access door in the oil cooler front fairing.

5-102A. ENGINE ANALYZER SYNCHRONIZING GENERATOR.

5-102B. DESCRIPTION. (See figure 5-12.) The engine analyzer synchronizing generator is installed on an adapter, on the right-hand side of the engine supercharger rear housing, adjacent to the tachometer generator. The synchronizing generator is a three phase, ac type, and operates at a speed of one-half engine speed. The function of the generator is to time a portable oscilloscope type ignition analyzer to engine crankshaft rotation.

5-102C. REMOVAL.

a. Remove right-hand accessory section cowling.

b. Disconnect electrical connector at synchronizing generator.

c. Remove four attaching nuts securing generator to adapter and remove generator.

5-102D. INSTALLATION.

a. Place generator and new gasket on adapter, and thread four nuts on adapter studs.

NOTE

Do not secure nuts tightly.

b. Adjust generator. Refer to paragraph 5-102E.

c. Apply antiseize compound (Fed. Spec. TT-A-580) to threads of electrical connector and attach electrical connector to generator.

d. Install right-hand accessory section cowling.

5-102E. ADJUSTMENT. The adjustment procedure applies to timing the generator to the engine and is accomplished as follows:

a. Rotate engine to position No. 1 cylinder (top cylinder—rear bank) at top dead center on compression.

NOTE

If synchronizing generator attaching nuts are secured tightly, loosen them. If synchronizing generator is not installed, install generator. Refer to paragraph 5-102D.

b. Connect a 20,000 ohm per volt ohmmeter with a 100 micro ampere scale to electrical connector on synchronizing generator. Connect ohmmeter negative lead to A position of generator electrical connector. Tie leads for B and C positions together, and connect to positive lead of ammeter.

c. Rotate generator stator housing in short jerking steps to cause negative deflection of ammeter needle. Continue this operation until no further deflection of ammeter needle occurs.

NOTE

As the generator approaches the correct position, ammeter needle deflection will become less in amplitude with each short movement. At a certain point, as the stator housing is moved, no deflection of the ammeter will occur. This is the correct position of the stator housing for generator tuning. Do not rotate generator housing further in the same direction. The needle of the ammeter will deflect in the positive direction, or past the correct position for generator tuning.

d. When synchronizing generator is in correct position, tighten attached nuts to secure generator to adapter.

e. Disconnect test equipment leads from generator electrical connector.

f. Apply antiseize compound (Fed. Spec. TT-A-580) to threads of permanent electrical connector, and attach electrical connector to generator.

5-102F. ENGINE TORQUE PRESSURE INDICATING SYSTEM.

5-102G. DESCRIPTION. (See figure 5-11B.) A complete engine torque pressure indicating system is installed on all A-1H and A-1J airplanes. The system is composed of the following principle components:

Name	Location
Torque pressure transmitter	Firewall, fuse sta 78
Servo Amplifier	Radio compartment, LH side, fuse sta 182
Torque Pressure Indicator	Instrument panel, RH

5-102H. The engine torque pressure indicating system provides a direct indication of the power delivered

to the propeller shaft in terms of torque oil pressure and is utilized for maintaining safe engine operating limits during full throttle operation with water injection. Basically, the system consists of an electrical transmitter which generates voltage combinations corresponding to torque oil pressure exerted by the engine torque meter piston in the crankcase front section. The voltage combinations energize a servoed, autosyn-type indicator which denotes propeller shaft torque in terms of pressure psi.

5-102J. The stator of the transmitter synchro and the indicator autosyn are connected in parallel. Any change in torque oil pressure acts to mechanically reposition the transmitter synchro rotor relative to its stator. Thus, an electrical misalignment occurs between its rotor and the rotor of the indicator autosyn. This condition causes a voltage to be induced in the transmitter synchro stator which is directed to the indicator autosyn stator, and its rotor turns to align electrically with the transmitter rotor. Concurrently voltage is also supplied through an amplifier to energize a servo motor in the indicator which acts through a gear train to position the pointers. Amplification and phase-detection of the voltage transmitted to the servo motor is accomplished by the amplifier. When the two rotors are aligned electrically, voltage ceases to flow between the stators and the servo motor is de-energized.

5-102K. The engine torque pressure indicating system receives 26 volts from its own transformer. This transformer receives power from the number two inverter and provides engine torque meter information during take-off as well as during normal flight. (See figure 10-39A.)

5-102L. TROUBLESHOOTING. (Refer to table 5-3A.)

5-102M. TORQUE PRESSURE TRANSMITTER.

5-102N . DESCRIPTION. The torque pressure transmitter produces voltage combinations corresponding directly to the power delivered to the propeller shaft. It is a 26-volt, 400-cycle unit which attaches to a supporting bracket on the forward right-hand side of the firewall. The assembly, capable of handling a pressure range from 0 to 350 psi, includes a transmitter mechanism and a pressure sensing unit. The pressure sensing unit is attached by an inlet stud to the lower left-hand side of the engine crankcase front section. Oil from the engine torque meter piston enters the sensing unit housing through the stud and surrounds a diaphragm which is connected by a liquid-filled capillary tube to a pressure bourdon tube in the transmitter mechanism. This bourdon tube is linked to and opposed by a second bourdon tube which is connected by a capillary arrangement to the outside atmosphere. Both tubes are linked mechanically to a segment that magnifies and transfers their resultant motion through a pinion to the rotor of a synchro motor. Thus, the slightest change in torque oil pressure exerted against the pressure sensing unit diaphragm is transmitted through the liquid-filled capillary tube and the bourdon tubes react by mechanically repositioning the synchro rotor. The second bourdon tube provides a corrective factor for pressure variations due to atmospheric changes. Any change in the position of the synchro rotor relative to its stator generates a proportional voltage combination which is transmitted to the indicator autosyn stator. All components of the transmitter mechanism are hermetically sealed within a cylindrical case which is filled with 8 per cent helium and 92 per cent

TABLE 5-3A. TORQUEMETER TROUBLESHOOTING

Trouble	Probable Cause	Correction
1. Torquemeter does not read 69 ± 2.5 psi at 2310 ± 50 rpm.	a. Air is trapped in torquemeter adapter.	With engine oil warm, bleed air from bleed cap AN929-2 at torquemeter adapter located on front crankcase section.
	b. Power failure.	Make a continuity check of entire power circuit.
2. With dc power control switch on, there is no power at terminal panel 25, terminal 8.	Torquemeter fuses, torquemeter transformer and/or No. 2 inverter.	Replace defective part.
3. Less than 26 v, 400 cps, ac at terminal panel 25, terminal 8.	Torquemeter transformer	Replace torquemeter transformer.
4. Defective torquemeter system units.	a. Amplifier b. Torquemeter c. Transmitter	If 26 volts ac is applied to terminal B of all torquemeter system units, replace amplifier first, then torquemeter and transmitter, in that order until torque pressure of 69 ± 2.5 psi is obtained at 2310 ± 50 rpm.

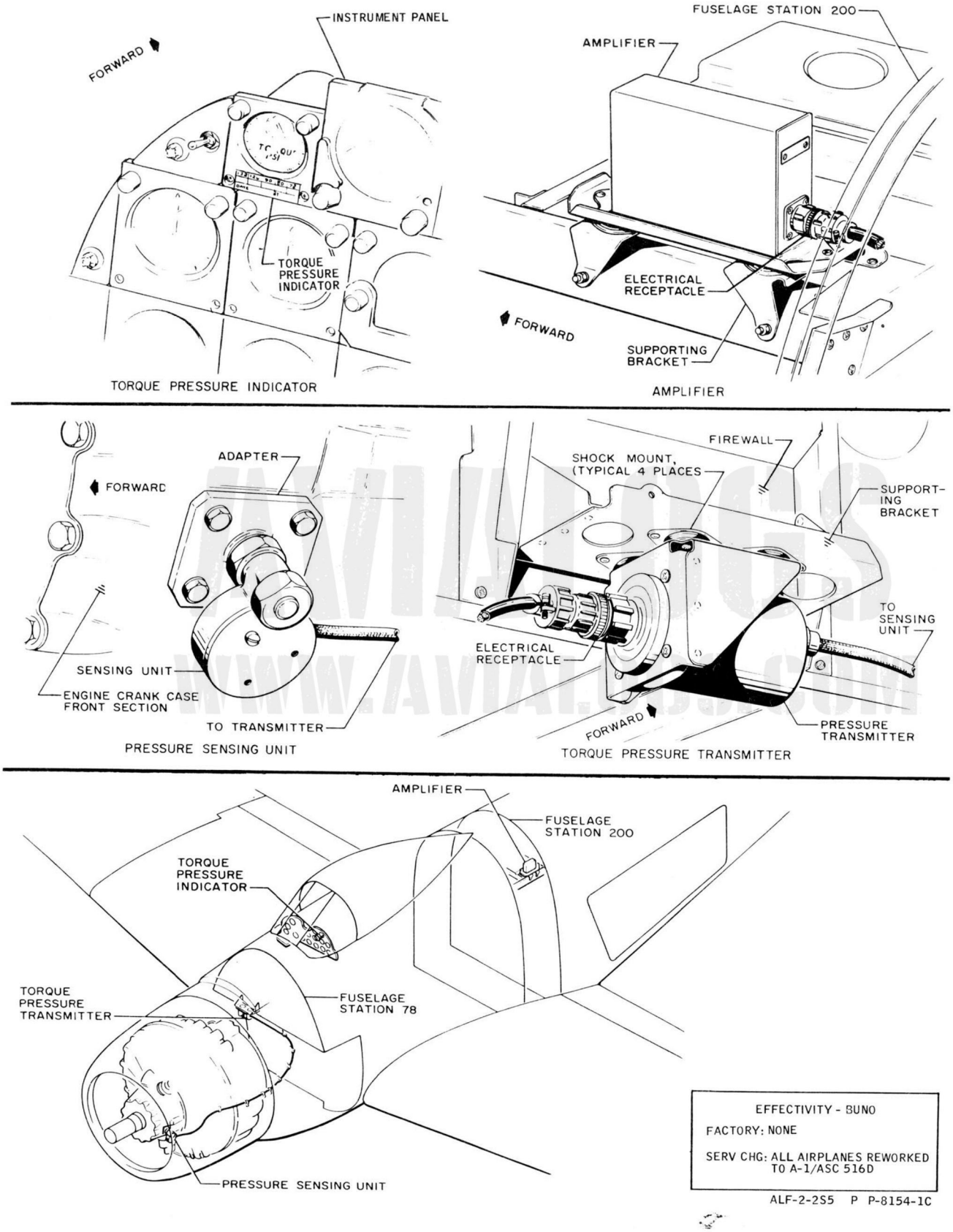


Figure 5-11B. Engine Torque Pressure Indicating System

nitrogen at atmospheric pressure. Electrical connections to the components are made through a single receptacle at one end of the case. For complete maintenance instructions on this item refer to Handbook Overhaul Instructions, Torque Pressure Transmitter Synchro Style.

5-102P. SERVO AMPLIFIER.

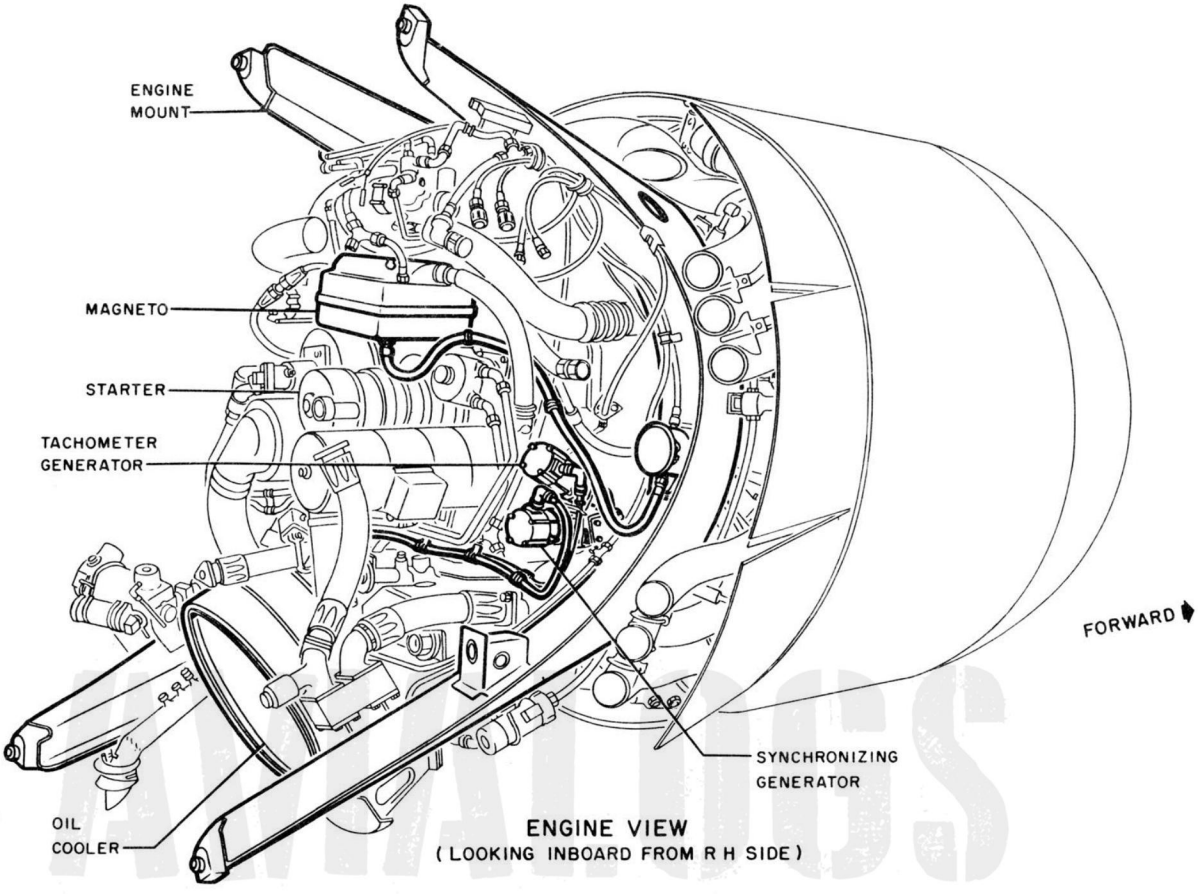
5-102Q. DESCRIPTION. The servo amplifier takes a weak signal from the rotor of the indicators synchro controlled transformer, called an autosyn; strengthens the signal and returns the amplified signal to an indicator servo which mechanically operates the indicator pointers to a degree which is proportional to the torque pressure of the engine. The actuation of the servo by the amplifier also repositions the autosyn rotor making it assume the identical position, electrically, as that of the transmitter. When these rotors are aligned electrically, the voltage between like stator terminals are equal. Since the terminals are connected in parallel, no current flows in the stator circuit, and the signal which the amplifier strengthened is washed out. This completes one cycle of the torque pressure indicating system and the system assumes a state of equilibrium on the new level of indication until the rotor of the transmitter's synchro generator is displaced by either an increase in engine power or a decrease in engine power. The servo amplifier is located in the radio compartment on the left-hand side of the top shelf of the equipment rack. For complete maintenance instruction on this item refer to Handbook Maintenance Instructions, Servo Amplifier.

5-102R. TORQUE PRESSURE INDICATOR.

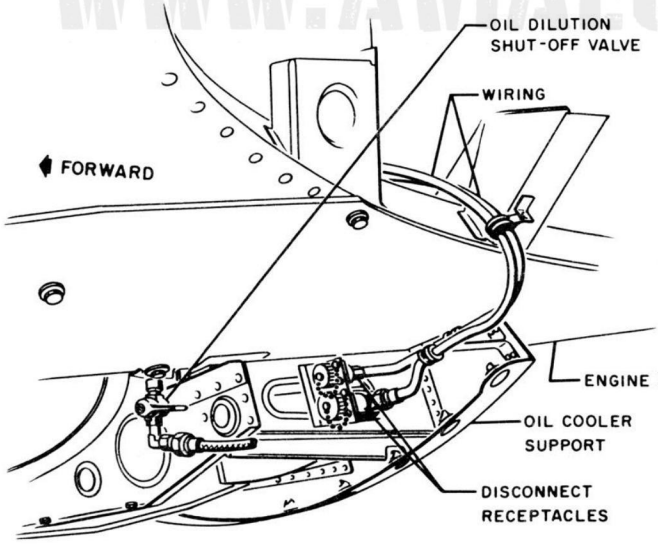
5-102S. DESCRIPTION. The torque pressure indicator denotes the amount of power delivered to the propeller shaft in terms of torque oil pressure. Essentially it is a single, servoed, autosyn-type indicator, hermetically sealed within a cylindrical case and installed on the upper left-hand side of the instrument panel. Electrical connections to the components are made through a single receptacle at the end of the case opposite from the dial face. A large pointer revolves about an axis in the center of the circular dial which is calibrated in increments of ten from 50 to 350 psi torque pressure. A small pointer near the top of the dial rotates through an arc of 360 degrees to provide a vernier-type indication of a sub-scale. The sub-scale is divided into single increments from 0 to 10 psi pressure and the pointer makes one complete revolution for each increment covered by the large pointer. Both pointers are actuated through a gear train by a servo motor in the indicator. The stator of the indicator autosyn is connected in parallel to the torque pressure transmitter synchro stator. Thus, when an electrical misalignment occurs between the respective rotors, voltage is induced in the transmitter synchro stator and transmitted to the indicator autosyn stator to align its rotor. Concurrently voltage is supplied from the indicator autosyn rotor through an amplifier to energize the servo motor and as the indicator rotor moves to align electrically with the transmitter rotor, the servo motor positions the indicator pointers on the dial. When the rotors are aligned electrically, voltage is no longer induced in the stators. This de-energizes the servo motor and the pointers are retained in position to denote the torque oil pressure. For complete maintenance instructions on this item refer to Handbook Overhaul Instructions, Autosyn Sensitive Pressure Indicators.

5-103. ENGINE MOUNT.

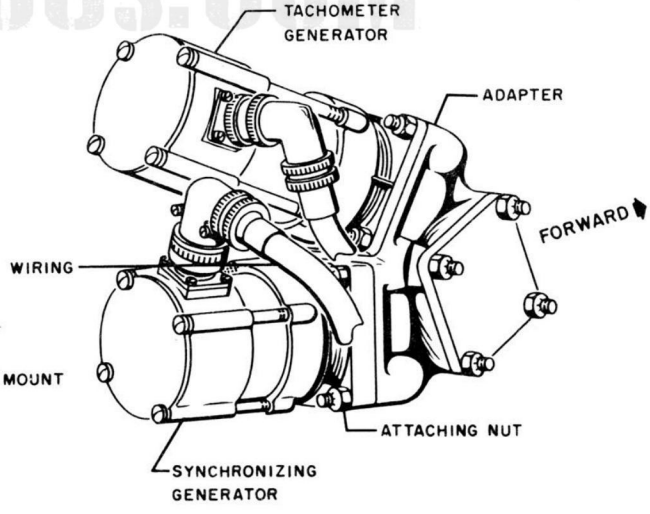
5-104. DESCRIPTION. (See figure 5-35.) The primary function of the engine mount is to support the engine and to transmit the weight and the thrust of the engine to the structural framework of the airplane. The mount is of semi-monocoque construction; bulkheads between the inner and the outer plating serve to distribute the load and to maintain the normal contour of the mount under all flight conditions. The engine mount is attached to the fuselage structure at four points. The engine is supported on the engine mount by six lord-mount assemblies which are installed on pads on the supercharger front housing. Two studs at the after side of each lord mount engage holes in supporting brackets, which are built into the engine mount and are not removable. All of the lord mounts are cooled by individual blast tubes and radiation shields. A fireseal, which mates with the fireseal adapter on the engine, is also part of the mount assembly.



ENGINE VIEW
(LOOKING INBOARD FROM R H SIDE)



DETAIL VIEW OF ENGINE ANALYZER DISCONNECT RECEPTACLES (VIEW LOOKING INBOARD FROM LH SIDE OF OIL COOLER SUPPORT STRUCTURE)



DETAIL VIEW OF SYNCHRONIZING GENERATOR

P-8151-1

Figure 5–12. Engine Analyzer Equipment Provisions—Installation

5–105. REMOVAL.

a. Remove engine and mount from airplane.

b. To permit engine mount to be removed from engine, provide clearance between inner plating of mount and items aft of inner plating by first removing:

Throttle control bracket
Drain manifold hose
Engine-driven fuel pump
Carburetor
Rear oil sump and pump body
Tachometer generator and mounting pad
Lines and wiring as required

CAUTION

After carburetor is removed, place protective cover over mounting pad.

c. Remove nuts which secure engine mount brackets to lord mount studs, and carefully remove mount.

Figure 5–13. Deleted

5–106. INSTALLATION. For engine mount installation instructions, refer to Engine Build-Up.

5–107. ENGINE VENT AND DRAIN SYSTEM.

5–108. DESCRIPTION. (See figure 5–14.) An engine vent and drain system is provided for the engine to drain the supercharger gear case, both engine-driven hydraulic pumps, both the engine-driven and the auxiliary fuel pumps, and to vent the crankcase breather, and the fuel pressure gage exhaust line. The vent and drain lines terminate at a manifold assembly installed on the lower left leg of the engine mount. The manifold assembly drains overboard.

5–109. ENGINE EXHAUST SYSTEM.

5–110. DESCRIPTION. Eleven corrosion-resistant steel exhaust stack assemblies vent engine exhaust to the atmosphere, between the cowl flaps and the accessory cowling. The forward ends of the exhaust stacks are connected with sleeves at the rear cylinder exhaust ports and with extension pipes from the front cylinder exhaust ports. The stack assembly outlets for cylinders 1 to 10, inclusive, are on the right side of the airplane, and the outlets for cylinders 11 to 18, inclusive, are on the left side of the airplane. The accessory cowling is contoured to accommodate the stacks. The upper stack assembly on the right-hand side incorporates a muff for heating air which is part of the cockpit heating system.

5–111. ENGINE EXHAUST STACKS.

5–112. DESCRIPTION. (See figure 5–15.) Individual stacks are provided for venting cylinders 5, 6, 12, and 14. Each of the remaining stack assemblies vents the exhaust of two cylinders. The forward ends of the stack assemblies are secured to the forward extension pipes by means of corrosion-resistant steel clamp assemblies. Aft of the forward extension pipes the stacks are supported by brackets attached to the rocker boxes by the same bolts which fasten the cowl bow brackets.

5–113. REMOVAL.

a. Remove carburetor air scoop.

b. Remove oil cooler front fairing.

c. Disconnect jackscrews from side cowl flaps.

Note

Do not turn jackscrews after disconnecting, or they will require adjustment before reconnecting to cowl flaps.

d. Loosen clamps which connect stacks at after ends and remove spacers.

e. Remove clamps which attach exhaust stacks to support brackets.

f. Remove clamps which connect exhaust stacks to extension pipes and to exhaust port fittings.

g. Carefully remove exhaust stack assemblies from airplane.

5–114. INSTALLATION.

a. Attach exhaust stack assemblies to rear cylinder exhaust port fittings and to forward extension pipes, installing clamps loosely.

b. Loosely install clamps which connect stack assemblies at after end.

c. Loosely install stack supporting-bracket clamps and spacers.

d. Adjust positions of stack assemblies so that close connection is made at all points.

e. Tighten clamps at exhaust port fittings, and at forward extension pipes.

f. Tighten connecting clamps at after end of stacks.

g. Tighten exhaust stack bracket clamps.

5–115. ENGINE EXHAUST STACK FORWARD EXTENSION PIPES.

5–116. DESCRIPTION. Forward extension pipes connect the exhaust stacks to the front cylinders. The pipes are inserted into adapter flanges at the cylinder exhaust ports, and are clamped to the forward ends of the exhaust stacks.

5–117. ENGINE COWLING.

5–118. DESCRIPTION. (See figure 5–16.) The cowling which houses the engine and engine accessories comprises the following:

Name	*Para Ref*
Nose section	5–121
Side panels	5–125
Cowl bow	5–131
Cowl flaps	5–135
Accessory section	5–160

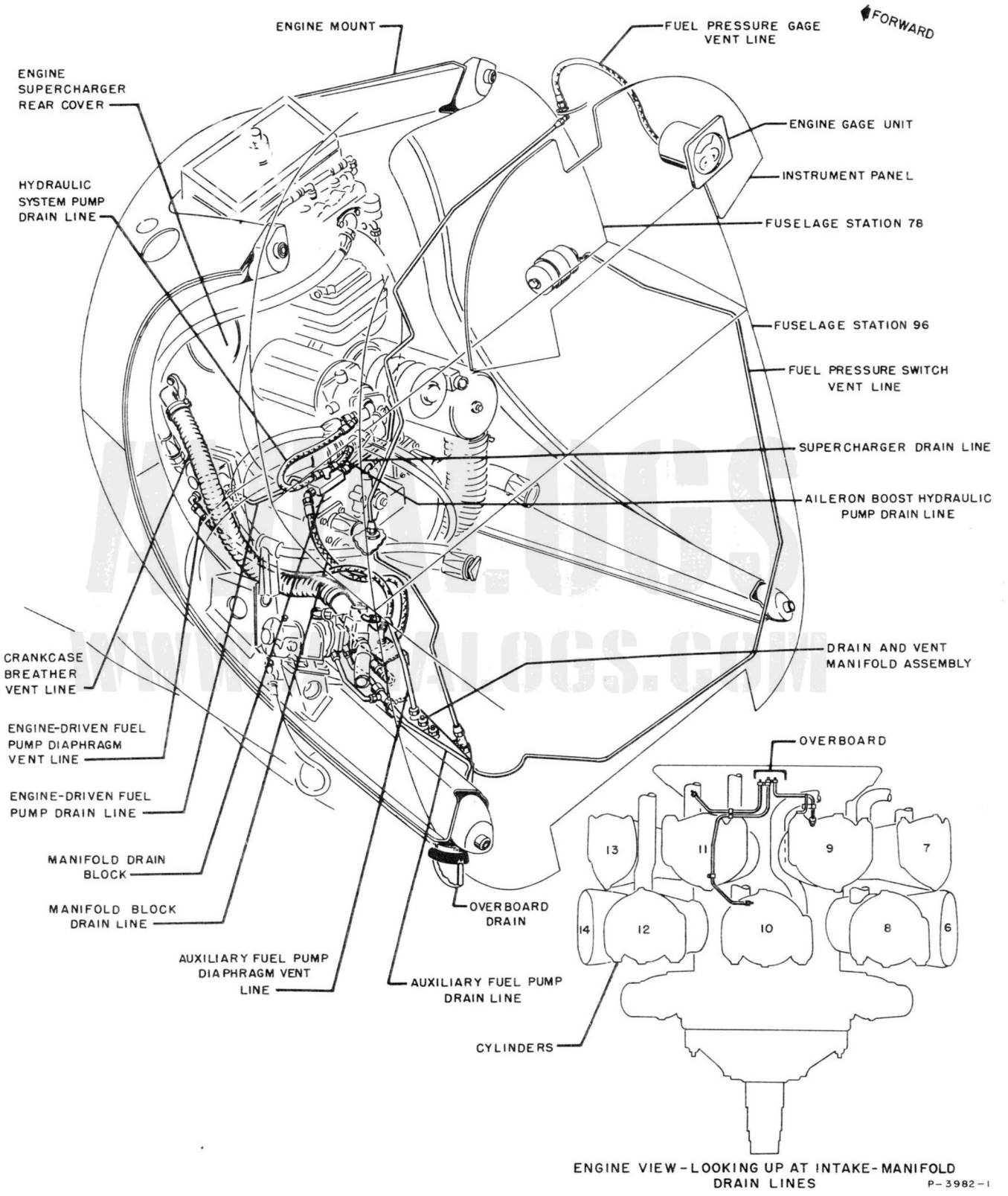


Figure 5–14. Engine Vent and Drain System

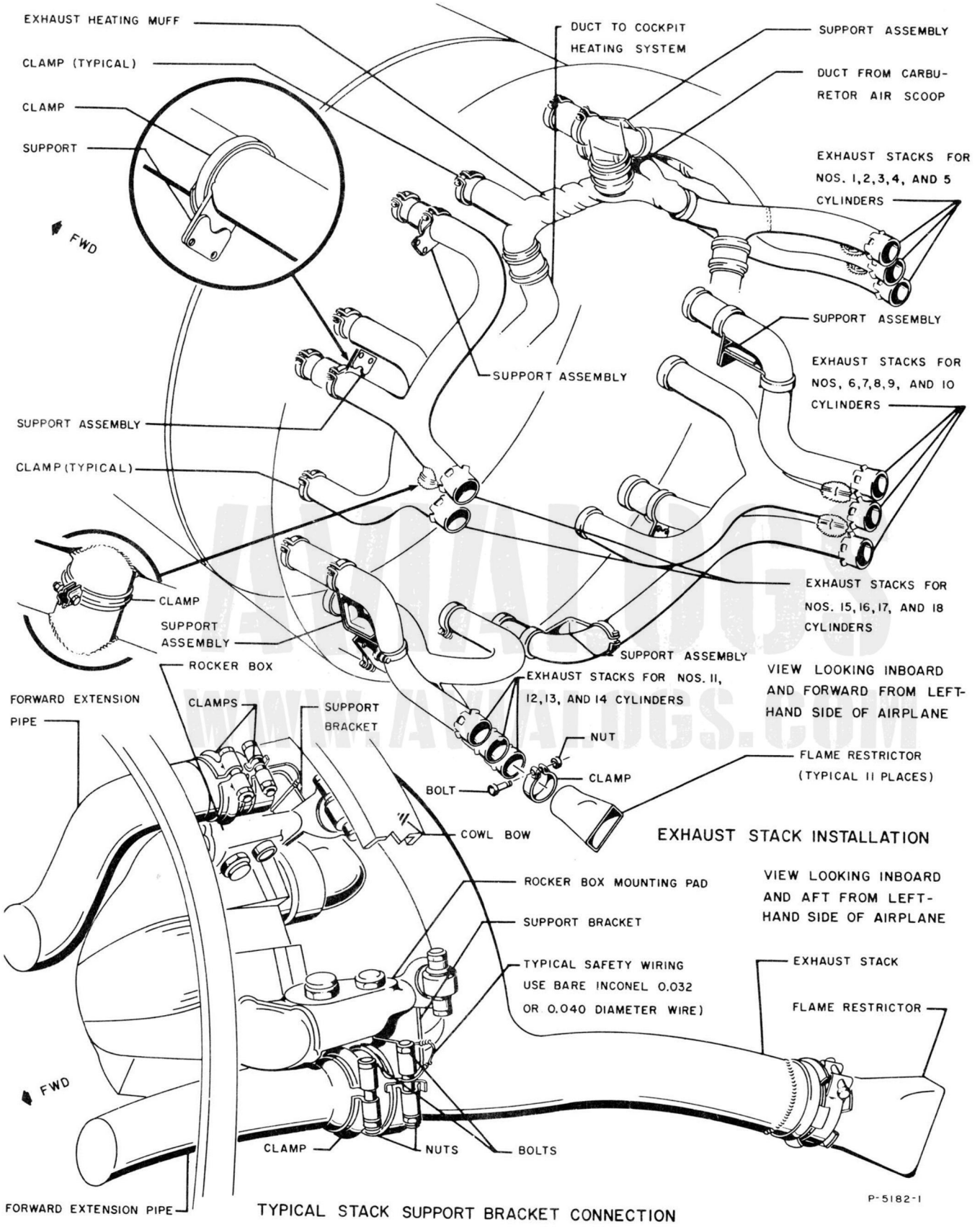


Figure 5–15. Engine Exhaust Stacks

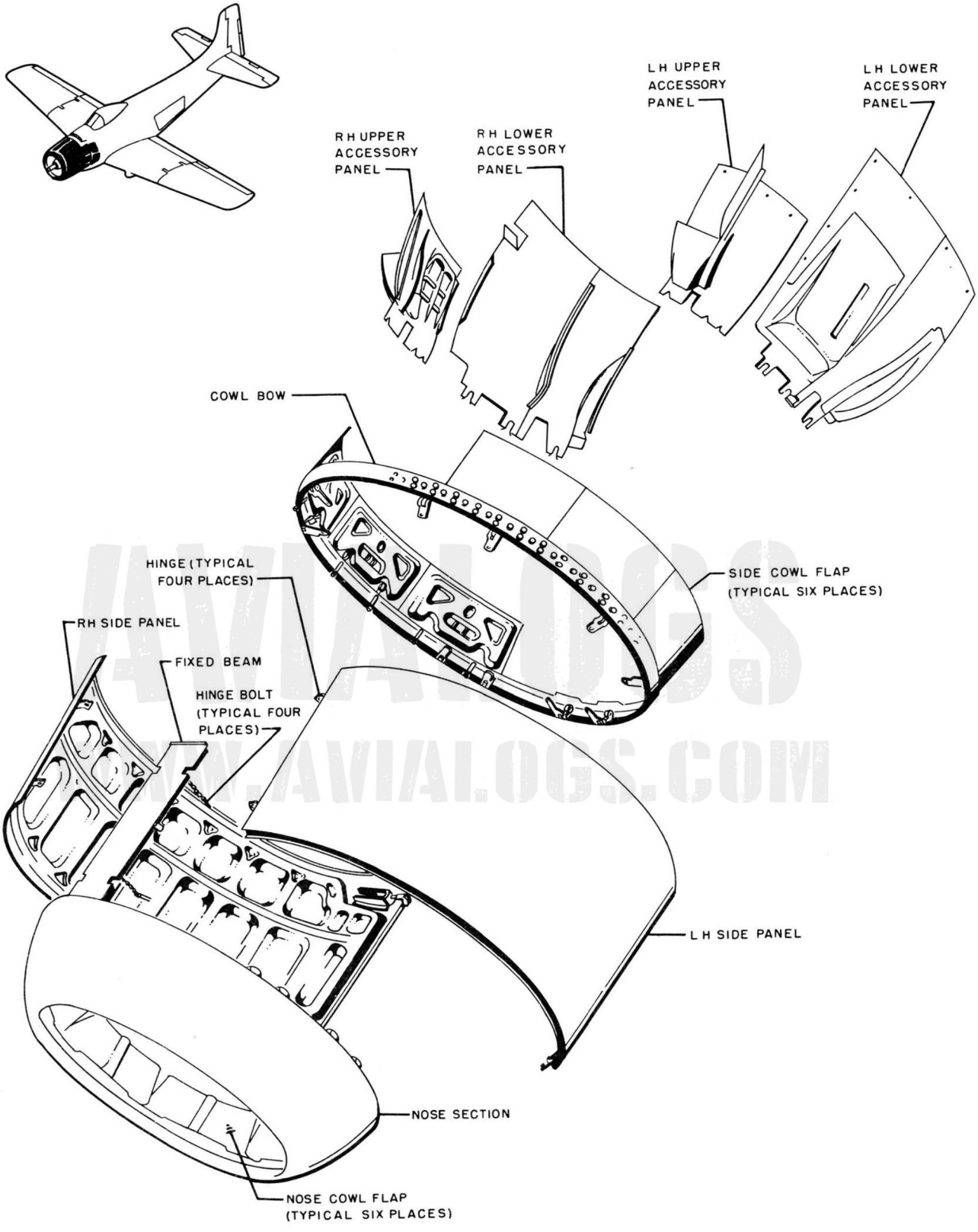
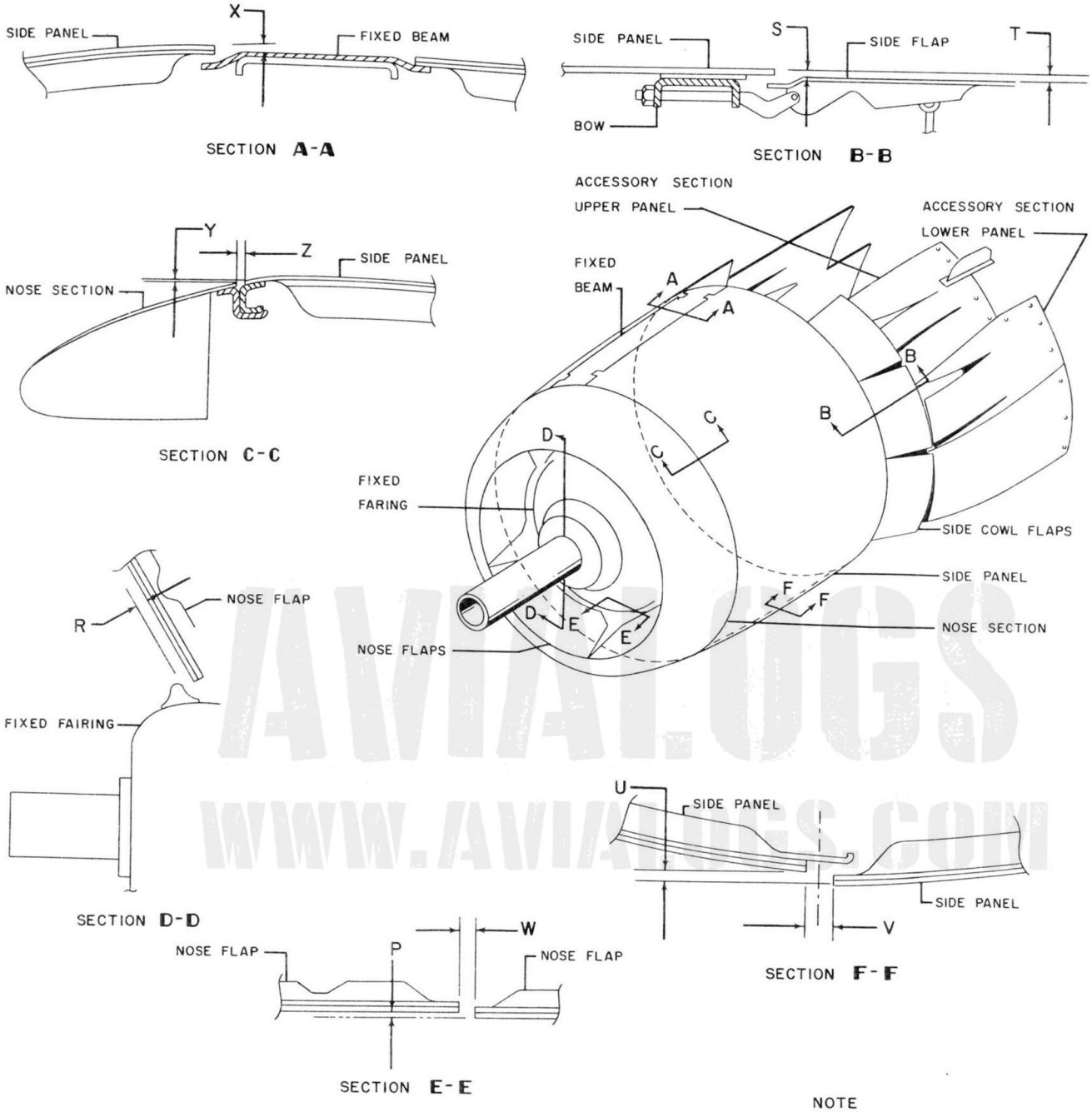


Figure 5–16. Engine Cowling



NOTE

"Y" DIMENSION FOR UPPER HALF OF COWLING ONLY. THIS DIMENSION MAY FAIR FROM "Y" AT SIDES TO 1/4 INCH MAXIMUM AT BOTTOM.

P-3985-18

DIMENSION	P	R	S	T	U	V	W	X	Y	Z
LIMIT (IN.)	0±1/8	1/4 +1/8 -1/4	0±1/16	0 +1/4 -1/8	0±1/16	3/8±1/8	3/16±1/16	0±1/16	0±1/32	3/32±1/16

Figure 5–17. Engine Cowling Installation and Clearances

5–119. The nose section and the cowl bow are fixed installations. The side panels are hinged and the accessory section contains removable panels. There are two sets of cowl flaps, one at the nose and one on the cowl bow; both sets are electrically controlled by a common circuit. Clearances to be maintained between cowling components are shown on figure 5–17.

5–120. CLEANING. Refer to section I.

5–121. COWLING NOSE SECTION.

5–122. DESCRIPTION. (See figure 5–18.) The nose section forms the forward end of the engine cowling. It is constructed of aluminum alloy plating riveted to aluminum alloy ribs. Twelve support links, two of which incorporate sockets to support the cowling side panels in the open position, are bolted to brackets mounted on the engine front row rocker box studs; the forward ends of the links are bolted to the after edge of the nose section. A hook-shaped extrusion, riveted along the after outside edges of the nose section, engages an angle along the leading edge of the side panels when the panels are closed. The beam which supports the side panels is part of the nose section. The beam can be raised by loosening two bolts which secure it to the cowl bow, and is held open by up-lock linkage.

5–123. REMOVAL.

a. Remove propeller.

b. Install engine work platforms.

c. Remove side panels by disengaging hinge bolts.

d. Remove bolts which attach beam to cowl bow and remove bolts from beam up-lock linkage.

e. Disconnect electrical connector from nose cowl flap actuator.

f. Remove bolts which attach support links to brackets and carefully remove nose section and beam.

5–124. INSTALLATION.

a. Support nose section in proper position, and install support link attaching bolts.

Note

If support links were removed while nose section was off airplane, it is recommended that they be installed on nose section before they are attached to support brackets.

b. Apply anti-seize compound (Specification JAN-A-669) to threads of electrical connector and connect to nose cowl flap actuator.

c. Bolt up-lock linkage to fixed beam. With screwdriver, move up-lock to unlocked position, close beam and bolt to cowl bow.

d. Connect side panels with fixed beam by installing hinge pins.

5–125. COWLING SIDE PANELS.

5–126. DESCRIPTION. (See figure 5–19.) The two side panels are installed on the beam between the nose section and the cowl bow. Each side panel is hinged to the beam at two points and the two panels are latched together at the bottom. A synthetic-rubber seal is installed inside the side panels, approximately midway between the forward and aft ends; a metal seal along the trailing edge contacts synthetic-rubber seals on the carburetor air scoop and the oil cooler forward fairing; a metal seal along the lower edge of the left-hand panel eliminates any gap between the two panels when they are closed. A support tube attached to the inside of each panel is provided to hold it in the open position.

5–127. REMOVAL. The cowling side panels can be removed by removing the hinge bolts attaching them to the fixed beam.

5–128. MINOR REPAIR. A side-panel latch spring can be replaced as follows:

a. Depress and turn fastener counterclockwise to unlock latch.

b. With narrow screwdriver or similar tool, raise end of lock ring with turned-in tang sufficiently to release fastener.

CAUTION

Hold fastener firmly to prevent it from flying out as soon as released.

c. Remove fastener and spring.

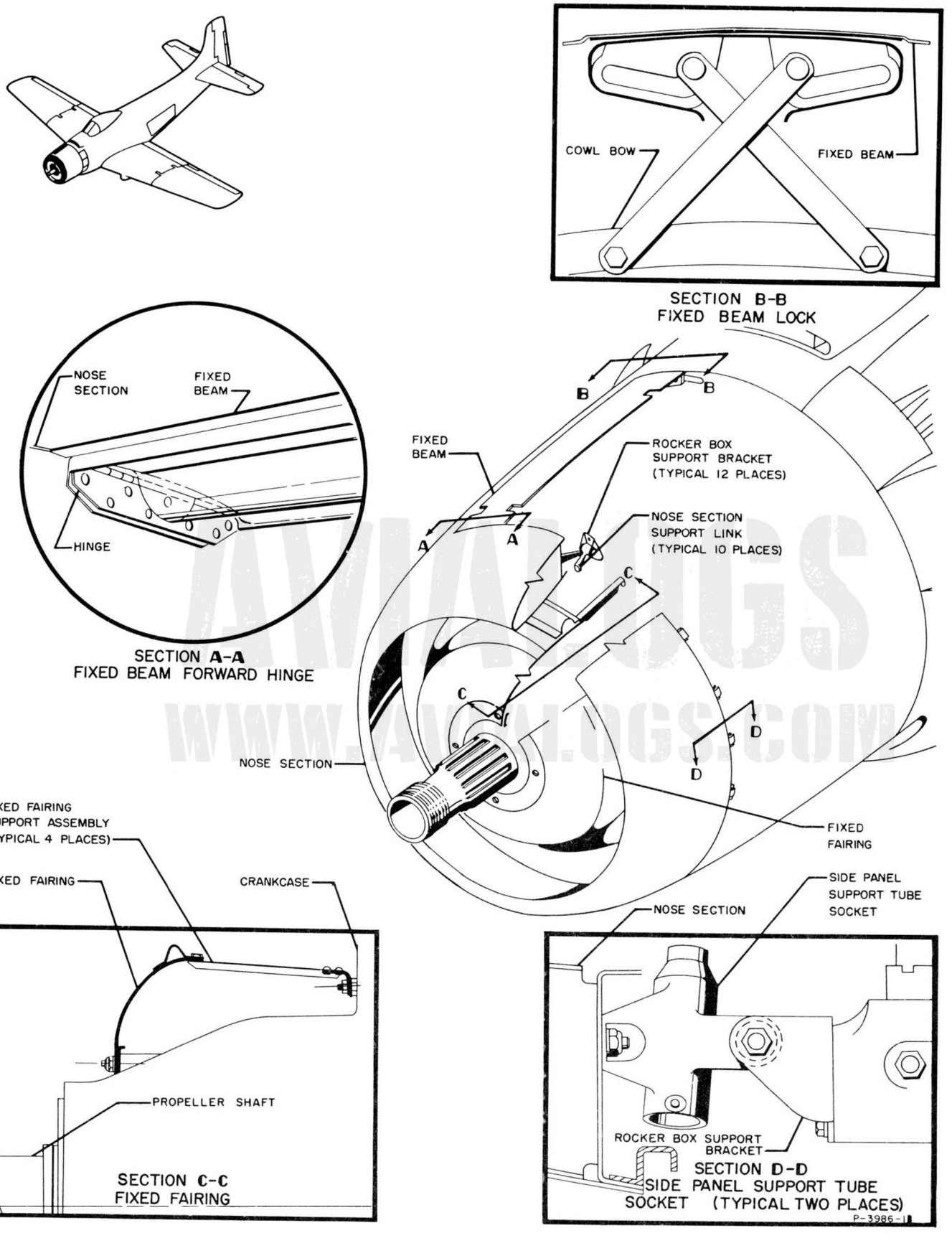


Figure 5–18. Engine Cowling—Nose Section Installation

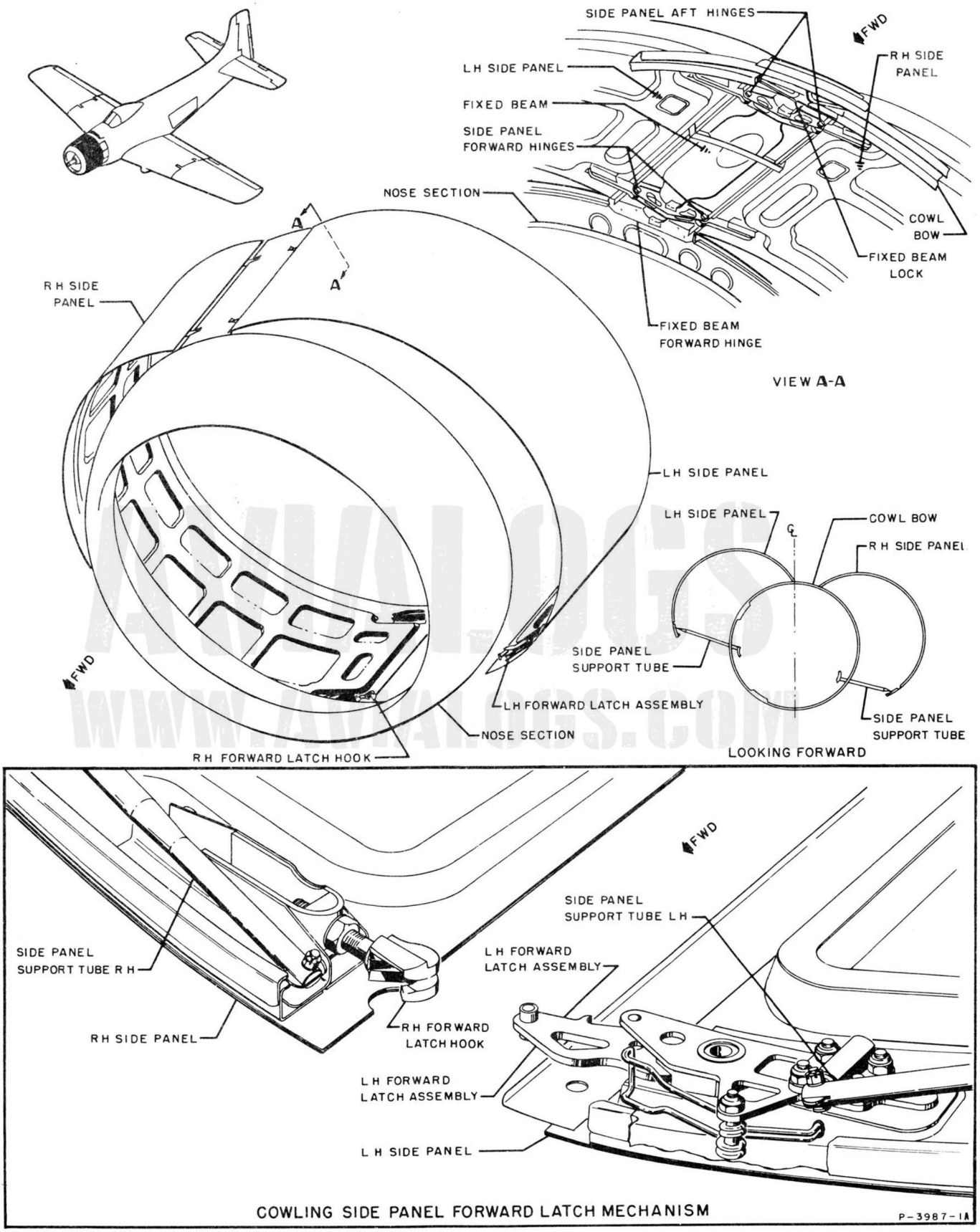


Figure 5–19. Engine Cowling—Side Panel Installation

d. Grease (Specification MIL-G-3278) new spring and install in fastener assembly.

e. Align long slot of fastener assembly with turned-in tang of lock ring and insert fastener into latch assembly.

f. Raise end of lock ring sufficiently to provide clearance between tang and fastener, and push fastener into latch assembly. Lower end of lock ring into long slot of fastener assembly.

g. Insert screwdriver in slot and turn fastener clockwise to lock latch assembly.

Note

Fastener assembly must be pushed in before it can be turned.

5–129. INSTALLATION. Prior to installation of the cowling side panels check for the following:

a. Insure that latch hooks are in line with pins on latches and that hook lock nuts are tight.

b. Insure that hooks properly engage latches.

c. Check fixed beam and side panel hinge pins for proper security and wear.

d. Check for worn or missing snap-on pads on cowl bow and replace snap-on pads as required.

e. Check cowling side panels and fixed beam for cracks or severe dents and repair as required.

5–129A. Whenever the cowling side panels are installed and/or the latches are secured, observe the following procedure to obtain the proper torque.

a. Place cowling side panels in position on beam and install hinge bolts.

b. Remove work platforms.

c. Close panels to engage hooks with latches.

d. Rotate forward latch over center.

e. Rotate aft latch over center.

f. Check torque of aft latch by unlatching and latching.

g. Check torque of forward latch by unlatching and latching.

CAUTION

With forward and aft latches engaged, torque of forward and aft latches must reach 35 ± 5 foot-pounds each as determined in steps f and g respectively.

h. When less than 35 ± 5 foot-pounds torque is obtained for either forward or aft latches, with opposite latch engaged, make adjustments to latches to obtain 35 ± 5 foot-pounds torque for *both forward and aft* latches. Refer to paragraph 5–130.

i. Lock forward and aft latch assemblies.

j. Inspect hooks through inspection holes to be sure that hooks are engaged properly.

Note

Latch is locked by spring-loaded plunger which is operated by screwdriver. Latch is locked when slots of lock are aligned with slots of latch actuator and colors match.

5–130. ADJUSTMENT.

a. Release latches and raise side panels.

b. Loosen lock nuts on latch hooks along lower edge of right-hand panel and screw hooks farther into (to tighten latch) or out of (to loosen latch) attaching trunnions.

c. Close and latch side panels.

Note

If adjustment is correct, side panels will be snug against nose section and cowl bow, but excessive torque must not be required to operate the latches. The correct torque for *both forward and aft* latches is 35 ± 5 foot-pounds.

d. If further adjustments are necessary, repeat steps a through c.

e. After adjustment has been completed satisfactorily, tighten hook lock nuts.

5–131. COWL BOW.

5–132. DESCRIPTION. (See figure 5–16.) The cowl bow is installed just forward of the aft end of the cowling side panels. It consists of upper and lower curved channel segments of equal length, joined to form a circle. The cowl bow supports the aft end of the cowling side panels and also the side cowl flaps. Synthetic rubber snap-on pads, mounted around the bow, serve as rub strips. A phenolic strip is located in the area adjacent to the junction of the cowling side panels. The cowl bow is supported by 10 link assemblies attached to the rear cylinder rocker boxes.

5–133. REMOVAL.

a. Remove cowling side panels.

b. Remove bolts that secure fixed beam to cowl bow.

c. Disengage beam up-lock linkage from bow, and raise fixed beam out of way.

d. Operate cowl flap control switch to open side flaps.

e. Remove bolts which attach flaps to jackscrews.

f. Remove bolts from bow upper- and lower-segment splice fittings.

g. Remove bolts which attach cowl bow links to supporting brackets on rocker boxes, and carefully remove upper and lower segments with cowl flaps attached.

5–134. INSTALLATION.

a. Support upper and lower segments of cowl bow in position.

Note

Cowl bow is properly positioned when fixed beam attachment area is at top of upper segment and just to right of vertical center line.

b. Install bolts which attach cowl bow links to supporting brackets on engine rocker boxes.

NOTE

At points where exhaust stack brackets are installed in addition to cowl bow brackets, cowl bow brackets are installed adjacent to rocker boxes.

c. Align splice fittings with bow upper and lower segments, and install attaching bolts.

d. Lower fixed beam into position and install uplock linkage attaching bolts.

e. Install cowling side panels.

f. Adjust side cowl flap jackscrews and install bolts which attach cowl flaps to jackscrews.

5-135. COWL FLAPS.

5-136. DESCRIPTION. Two sets of cowl flaps are installed on the airplane: one set of six in the nose section and one set of six on the cowl bow. The flaps are utilized to vary the amount of cooling air which passes between the engine cylinder fins in order to control the cylinder head temperature. Both nose and side flaps are controlled by a single electrical circuit.

5-137. NOSE COWL FLAPS.

5-138. DESCRIPTION. (See figures 5-20 and 5-20A.) Each of the six nose cowl flaps is hinged at two points to the cowling nose section. All are operated simultaneously by their common actuating mechanism. A mechanical flap-position indicator projects through the upper right-hand surface of the nose section cowling and is visible from the cockpit except when the flaps are fully open.

5-139. REMOVAL.

a. Install engine work platforms.

b. Close nose cowl flaps.

c. Remove bolt which attaches each flap to corresponding jackscrew.

d. Remove bolts which attach nose flap hinges to nose section.

5-140. INSTALLATION.

a. Place flaps in position and install bolts which attach nose flap hinges to nose section.

b. Adjust flap actuating mechanism.

c. Install bolt which attaches each flap to corresponding jackscrew.

5-141. NOSE COWL FLAP ACTUATOR AND JACKSCREWS.

5-142. DESCRIPTION. (See figures 5-20 and 5-20A.) The electrically driven nose cowl flap actuator is connected to a coupling gear box by means of a flexible shaft assembly. The coupling gear box is interconnected with the six jackscrews which actuate the nose flaps by means of flexible shafts. The gear ratio of the coupling gear box between input and output is 1 to 1. Internal limit switches within the actuator are pre-set to stop actuator motor travel when jackscrews are fully extended or retracted.

5-143. REMOVAL.

a. Unlock and raise cowling side panels.

b. Install engine work platforms.

c. Close nose cowl flaps.

d. Disconnect each flap from corresponding jackscrew.

e. Remove clamp which supports actuator flexible shaft.

f. Unscrew nut at each end of each flexible drive shaft.

NOTE

Shafts vary in length and should be tagged to insure proper replacement.

g. Remove bolts which attach jackscrews to hinge brackets.

h. Remove bolts which attach coupling box to support bracket.

i. Disconnect electrical connector from actuator and remove actuator attaching U-bolt.

5-144. INSTALLATION. (See figures 5-20 and 5-20A.)

a. Place nose flap actuator in position and secure with U-bolt and nuts.

b. Apply antiseize compound (Fed. Spec. TT-A-580) to threads of electrical connector and attach connector to actuator.

c. Install coupling box and secure with attaching bolts and nuts.

d. Bolt jackscrews to hinge brackets.

e. Place cowl flap control switch in CLOSE to position actuator.

f. Turn ends of jackscrews to extend them to within one-half turn of complete overtravel.

g. Install jackscrew flexible shafts.

h. Screw nut at each end of each flexible shaft finger-tight and lockwire in place.

i. Bolt flaps to corresponding jackscrews.

j. Install clamp which supports actuator flexible shaft.

k. Operate control switch to open nose cowl flaps: flaps should fair. If adjustment is necessary to obtain fairing, refer to paragraph 5-145.

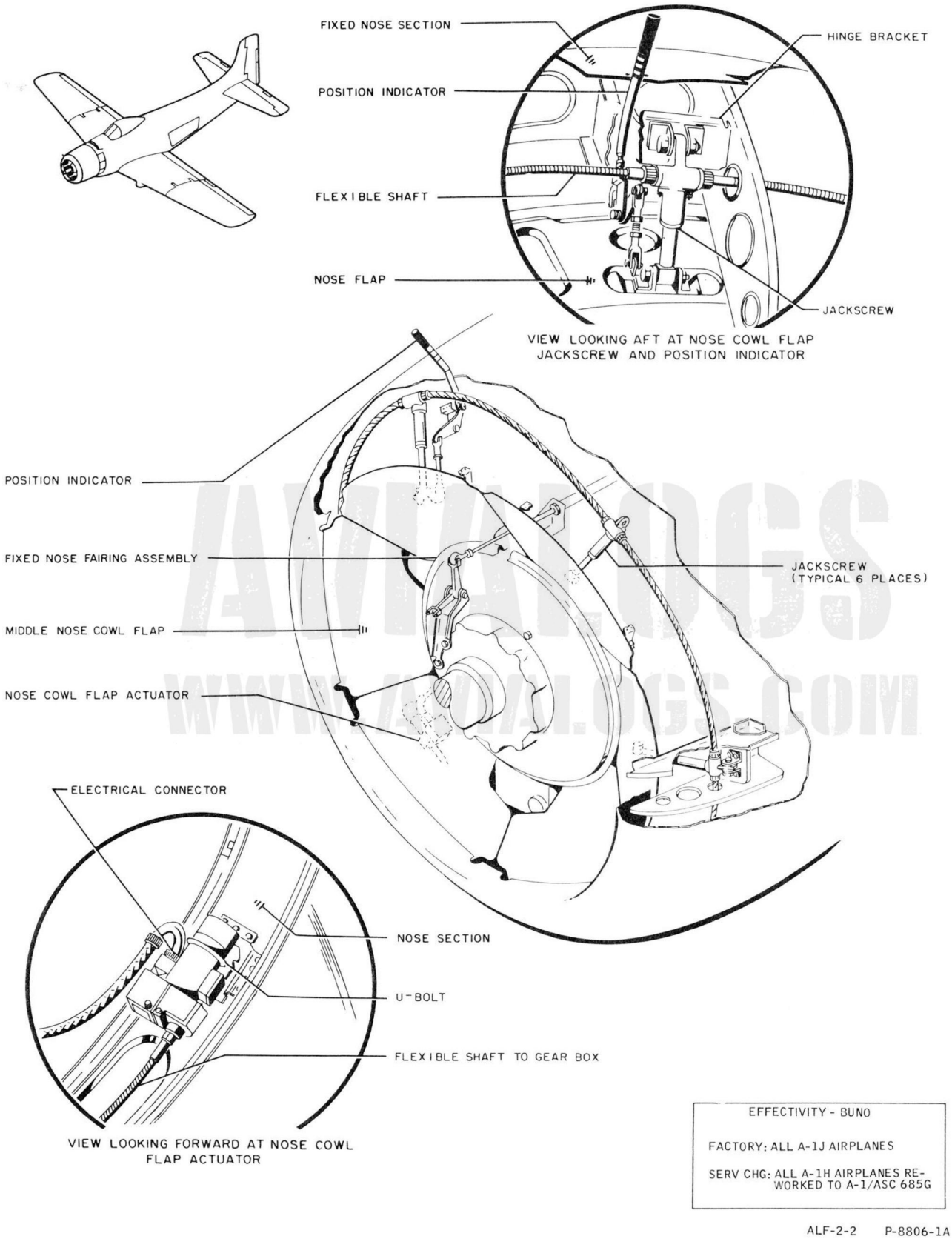
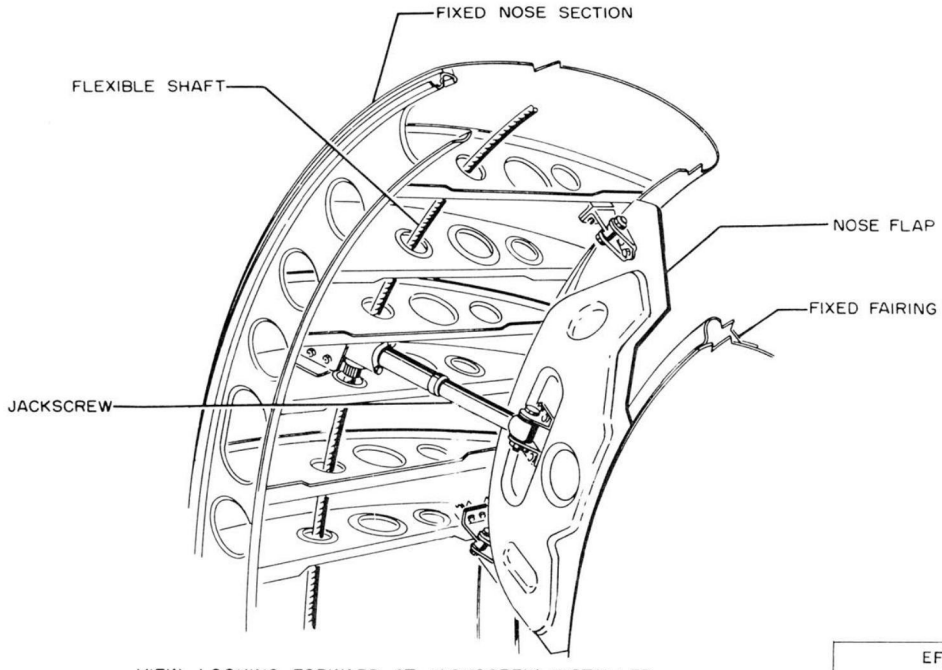


Figure 5-20. Engine Nose Cowl Flap Installation (Sheet 1)



VIEW LOOKING FORWARD AT JACKSCREW INSTALLED (TYPICAL)

EFFECTIVITY - BUNO

FACTORY: ALL A-1J AIRPLANES

SERV CHG: ALL A-1H AIRPLANES REWORKED TO A-1/ASC 685G

ALF-2-2S5 P-8806-2A

Figure 5-20. Engine Nose Cowl Flap Installation (Sheet 2)

5-145. ADJUSTMENT.

a. Install engine work platforms.

b. Operate cowl flap control switch to close nose flaps.

c. Disconnect each flap from corresponding jackscrew.

d. Turn end of each jackscrew in or out sufficiently to fair flap; reconnect screw to flap.

CAUTION

Jackscrews must have one-half turn of overtravel remaining after adjustment is made.

e. Operate flaps through complete cycle to verify adjustment.

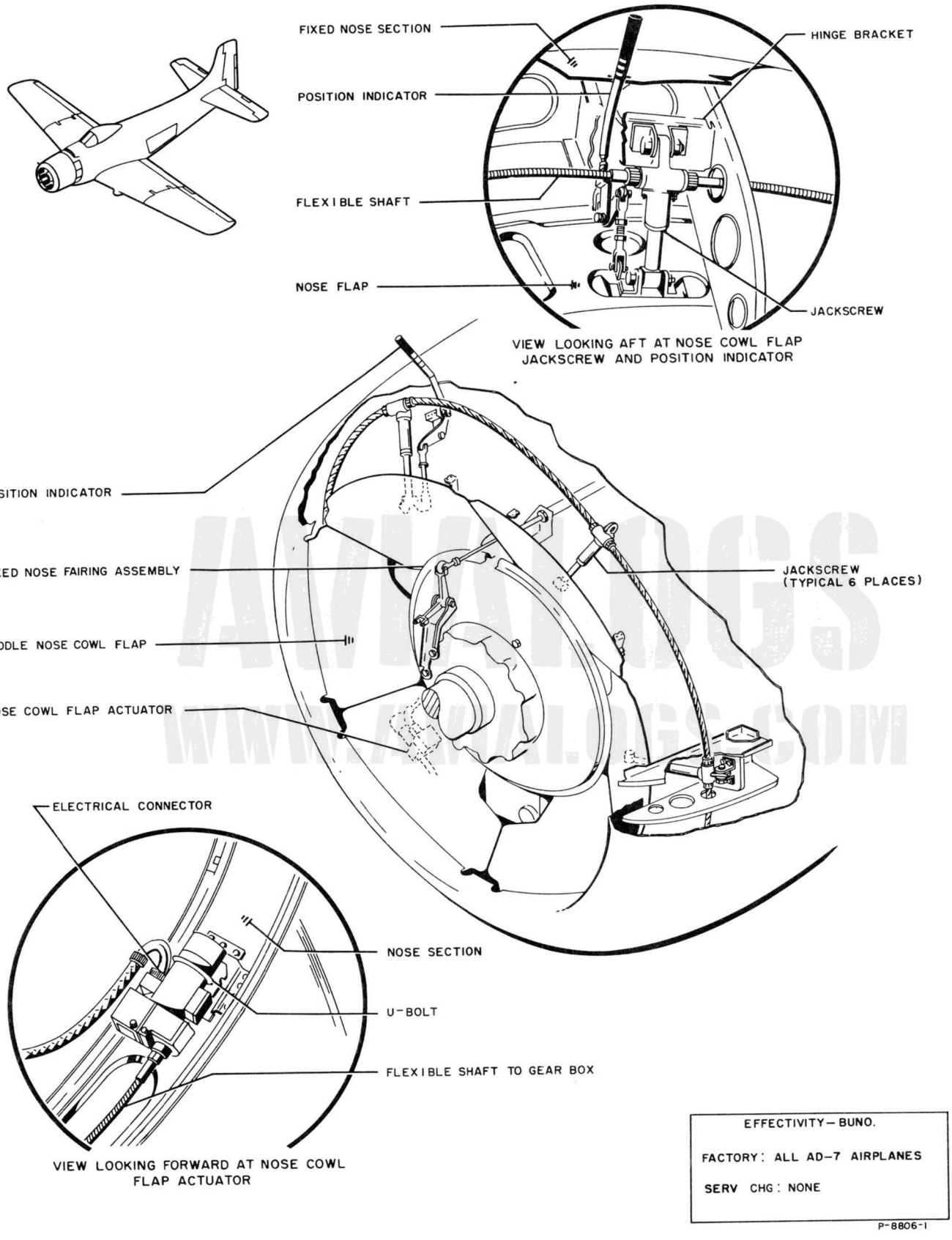
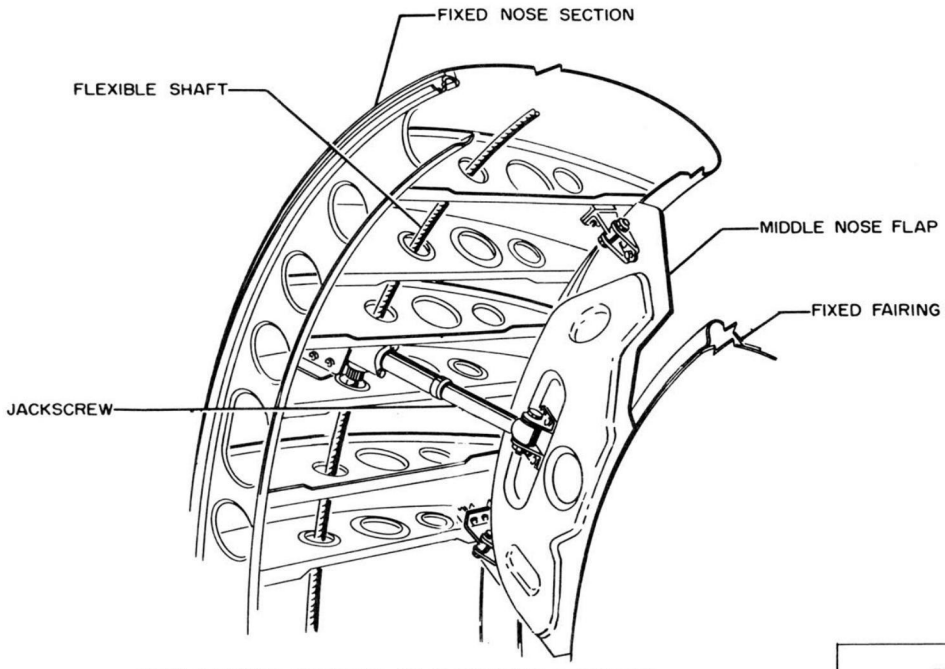


Figure 5–20A. Engine Nose Cowl Flap Installation—Model AD-7 Airplane (Sheet 1)



VIEW LOOKING FORWARD AT JACKSCREW INSTALLED (TYPICAL)

EFFECTIVITY-BUNO

FACTORY: ALL AD-7 AIRPLANES

SERV CHG: NONE

P-8806-2

Figure 5–20A. Engine Nose Cowl Flap Installation—Model AD-7 Airplane (Sheet 2)

5–146. NOSE COWL FLAP POSITION INDICATOR.

5–147. DESCRIPTION. The nose cowl flap position indicator located in the upper right-hand portion of the cowling nose section is mechanically actuated as the flaps are closed or opened. When the flaps are fully closed the indicator extends through the surface of the nose section and four yellow and five red stripes on the indicator are visible from the cockpit. When the flaps are full open the indicator is retracted and the yellow stripes on the indicator are not visible; only the portion which is painted black. Intermediate positions of the flaps are indicated by the number of yellow stripes visible on the indicator from the cockpit.

5–148. SIDE COWL FLAPS.

5–149. DESCRIPTION. (See figure 5–21.) Each of the six side cowl flaps is hinged in two places to the cowl bow and is actuated to open or close by means of a mechanical jackscrew which is installed between the flap and the forward end of the engine mount. The jackscrews are actuated by flexible shafts which are connected through a gear box to an electrical actuator. The side cowl flap actuator is electrically controlled by the same circuit which controls the nose cowl flap actuator.

5–150. REMOVAL.

a. Open cowling side panels.

b. Install engine work platforms.

c. Operate cowl flap control switch to open side cowl flaps.

d. Disconnect each flap from corresponding jackscrew.

e. Remove nuts from ends of flap hinge links and disengage flap from bow.

5–151. INSTALLATION.

a. Insert side cowl flap hinge links through holes in cowl bow, install spacer, and secure links with nuts.

b. Adjust flap actuating mechanism.

c. Bolt each flap to corresponding jackscrew.

5–152. SIDE COWL FLAP ACTUATOR AND JACKSCREWS.

5–153. DESCRIPTION. (See figure 5–21.) The electrically controlled side cowl flap actuator is connected to a coupling gear box by means of a flexible shaft assembly. The coupling gear box is interconnected with the six side cowl flap jackscrews by means of flexible shafts. The gear ratio of the coupling gear box between input and output is 1 to 1. Internal limit switches within the actuator are pre-set to stop actuator motor travel when the jackscrews are fully extended or retracted.

Note

The side cowl flap actuator and the nose cowl flap actuator are identical units except that the setting of the limit switch upper cam in the actuator is varied to allow for the difference between working travel of the side cowl flap, and the nose cowl flap jackscrews. The actuator limit switch upper cam is set to allow for a 1-inch working travel of the *side* cowl flap jackscrews, when used with the side cowl flaps; and, when used with the nose cowl flaps, the limit switch upper cam is set to allow for a 2⅛-inch working travel of the *nose* cowl flap jackscrews. The actuators are interchangeable provided the limit switch upper cam is properly arranged to provide the correct travel of the actuator and, consequently, the jackscrews. The actuator limit switch upper cam settings are obtained as outlined:

a. Turn actuator power unit so that lower cam is in contact with lower switch.

b. For 1-inch travel of *side* cowl flap jackscrews, set upper cam in position #1 as shown on figure 5–21A, or for 2⅛-inch travel of *nose* cowl flap jackscrews set upper cam in position #2.

c. When cam is set in position #1, adjust limit switches to stop actuator motor travel at 107, plus seven, minus zero revolutions in either direction; and when set in position #2, adjust limit switches to stop actuator motor travel at 228, plus seven, minus zero revolutions in either direction.

d. Make fine adjustments by means of the limit switch adjustment screws.

5–154. REMOVAL. (See figure 5–21.)

a. Install engine work platforms.

b. Operate cowl flap control switch to open side cowl flaps.

c. Remove oil cooler front fairing.

d. Disconnect jackscrews from flaps.

e. Remove flexible shaft support clamps.

f. Unscrew nut from each end of each flexible shaft.

Note

Shafts vary in length and should be tagged for proper replacement.

g. Disconnect jackscrews from support brackets.

h. Remove bolts which attach coupling box to support bracket.

i. Disconnect electrical connector from actuator.

j. Remove actuator by disconnecting U-bolts.

5–155. INSTALLATION. (See figure 5–21.) The oil cooler front fairing must be off the airplane when the side cowl flap actuating mechanism is being installed.

a. Place actuator in position and secure with U-bolts and nuts.

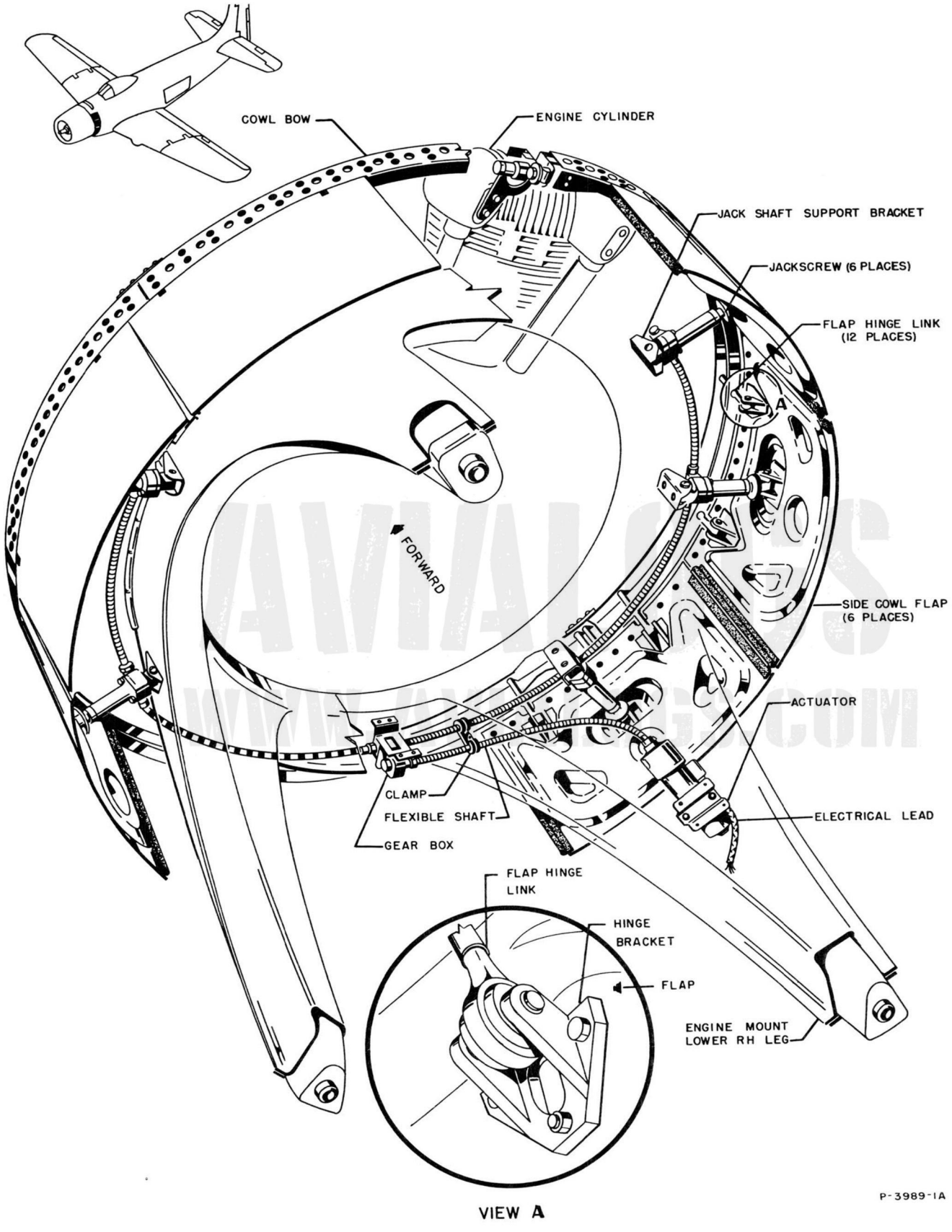


Figure 5–21. Engine Side Cowl Flap Installation

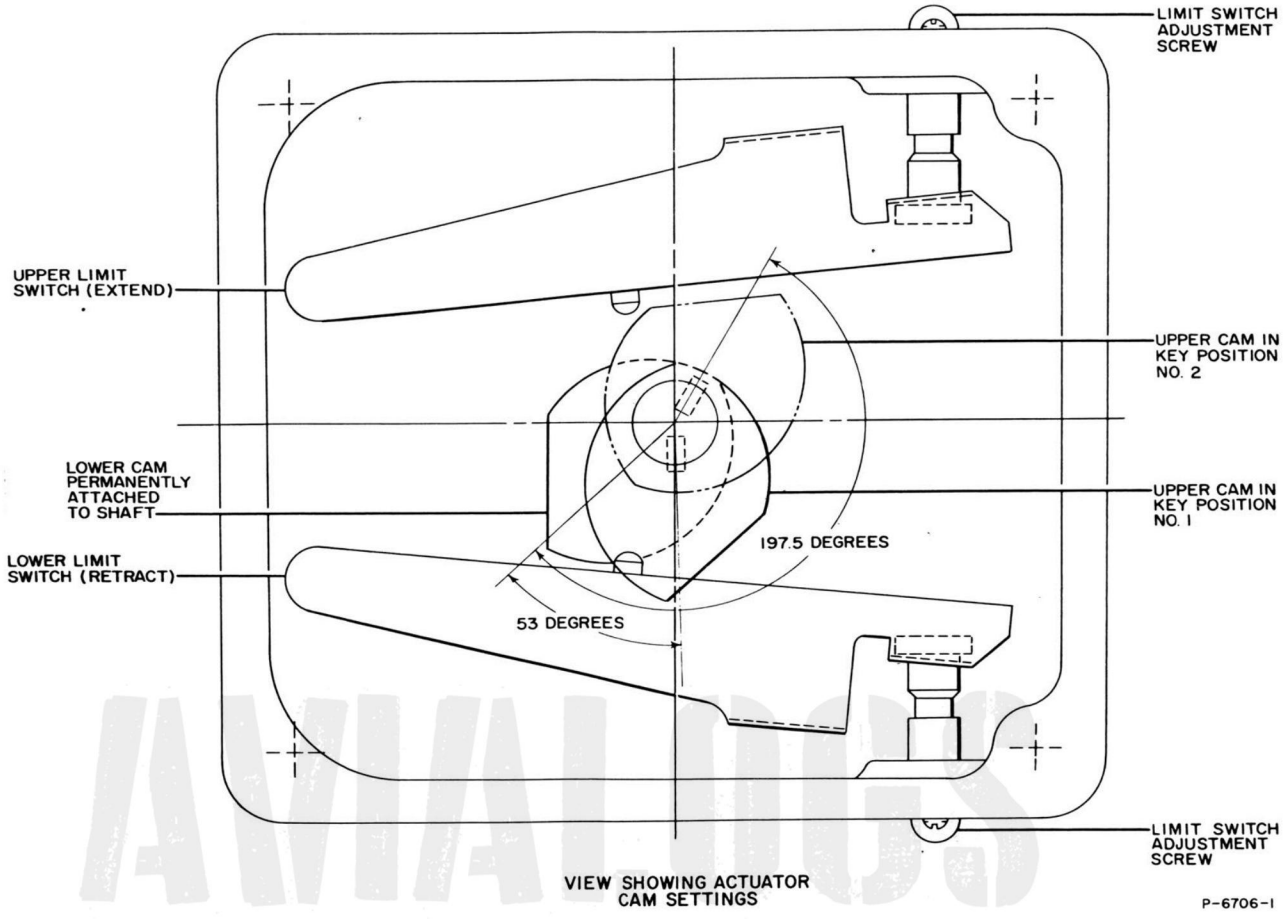


Figure 5–21A. Actuator Cam Settings

b. Apply anti-seize compound (Specification JAN-A-669) to threads of electrical connector and connect to actuator.

c. Place coupling box in position and secure with attaching nuts and bolts.

d. Place jackscrews in position and bolt them to support brackets.

e. Place cowl flap control switch in "CLOSE" to position actuator.

f. Turn ends of jackscrews to retract them to within one turn of fully retracted length.

g. Install jackscrew flexible shafts and tighten nut at each end of each flexible shaft finger tight; lockwire in place.

h. Install flexible shaft support clamps.

i. Bolt jackscrews to corresponding flaps.

Note

Observe position of flaps: they should be faired with closed cowling side panels. If adjustment is necessary to fair flaps, refer to paragraph 5–156.

j. Place cowl flap control switch in "OPEN."

k. Install oil cooler forward fairing.

5–156. ADJUSTMENT.

a. Install engine work platforms.

b. Disconnect all jackscrews from flaps.

c. Place cowl flap control switch in "CLOSE."

d. Manually turn jackscrews in or out as far as is necessary to align flaps with after end of cowling side panels, but not closer than one full turn from retracted mechanical stop.

Note

Minimum of one full turn must be provided to allow for possible overtravel of actuator.

e. Reconnect jackscrews to flaps.

f. Operate cowl flaps through one complete cycle to verify adjustment.

5–157. COWL FLAP CONTROL CIRCUIT.

5–158. DESCRIPTION. Operation of both nose and side cowl flaps is effected electrically by a circuit pow-

ered by the d-c secondary bus. Principal components include:

Name	*Location*
Circuit breaker, 15-amp	Cockpit—circuit-breaker panel
Control switch	Cockpit—LH control panel
Relay, single pole, double throw	Forward equipment compartment—terminal panel No. 17
Nose cowl flap actuator	Cowling nose section—RH side
Side cowl flap actuator	Engine mount—RH side
Cowl flap filter	Forward equipment compartment—terminal panel No. 15

5–159. When the cowl flap control switch is held in "OPEN," the circuit is completed first to the nose cowl flap actuator and the nose flaps are opened. When the nose flaps are fully opened the actuator internal limit switch closes and completes the circuit to the side cowl flap actuator and the side cowl flaps are opened. When the control switch is held in "CLOSE," the sequence of flap operation is reversed and the circuit is first completed to the side cowl flap actuator to close the side cowl flaps. With the flap control switch in "OFF" and the airplane on the ground and the retraction release switch on the left-hand main landing gear closed, the cowl flap control circuit is completed through the relay contacts to energize the flap actuators and open the cowl flaps. The cowl flaps can be closed while the airplane is on the ground by holding the control switch in "CLOSE" until the flaps are in the desired position. The automatically "OPEN" condition cannot be restored until the circuit has been interrupted by actuating the retraction release switch, the COWL FLAP circuit breaker, or the d-c power control switch.

5–159A. On AD-6 airplanes BuNos. 134466, 134535 and subsequent, a radio noise filter, identified as COWL FLAP FILTER, is added into the cowl flap control circuit. The prime purpose of the filter is to reduce noise interference with the various communication systems during cowl flap actuator operations.

5–160. ACCESSORY SECTION COWLING.

5–161. DESCRIPTION. (See figure 5–22.) Four removable panels comprise the cowling which covers the engine accessory section: an upper and a lower panel on each side, between the carburetor air scoop and the oil cooler aft fairing. Synthetic rubber seals between each pair (upper and lower) of panels prevent air flow between the panels. Similarly, seals on the lower panels prevent air flow between the panels and the oil cooler aft fairing, and seals on the upper panels prevent air flow between the panels and the carburetor air scoop. Corrosion-resistant steel sheet is used in the areas adjacent to the exhaust stack outlets to prevent exhaust gases from damaging the panels. Exhaust glare shields are attached by screws to both upper panels.

5–162. The upper panels are secured by springs along the leading edges and by dzus fasteners along the trailing edges. The retaining springs are parts of the engine mount assembly. The lower panels are secured in position by pre-installed bolts and spacers along their leading edges and by dzus fasteners along their trailing edges. Dzus fasteners are also used along the upper edge of the lower panels. A positioning slot in the leading edge of each upper panel accommodates the side cowl flap jackscrew support bracket and prevents movement of the upper panels after they are installed.

5–163. REMOVAL.

a. Install engine work platforms.

b. With screwdriver, release dzus fasteners along trailing edges of upper panels and remove panels by pulling them aft and outboard.

c. With screwdriver, release dzus fasteners along upper and trailing edges of lower panels and pull panels aft and outboard until contact is made with work platforms.

d. Disengage work platforms from their aft supports and move aft ends of platforms outboard sufficiently to allow lower panels to be removed.

5–164. INSTALLATION.

a. If engine work platforms are installed, disengage them from their aft supports and move them outboard sufficiently to allow lower panels to be installed.

b. Engage slots along leading edge of lower panels with attaching bolts on engine mount.

c. Install engine work platforms (or reconnect them to their aft supports).

d. With screwdriver, secure dzus fasteners along upper and trailing edges of lower panels.

e. Engage slots along leading edge of upper panels with attaching bolts on engine mount; secure dzus fasteners along trailing edges.

5–165. PROPELLER.

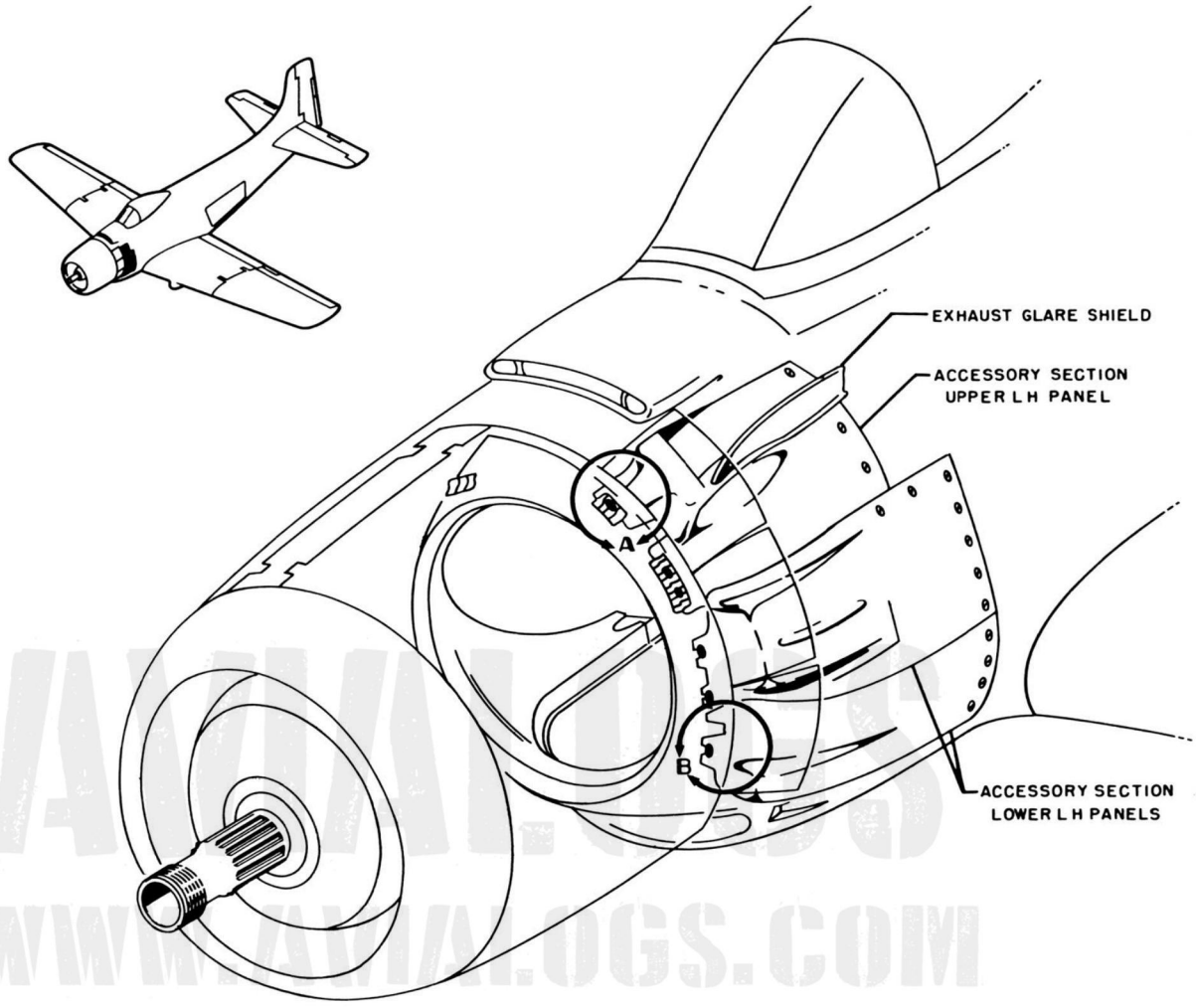
5–166. DESCRIPTION. An Aeroproducts propeller, Model A642-G804/M20A2-162-0 is installed on AD-6 airplanes prior to BuNo. 135307. On AD-6 airplanes BuNo. 135307 and subsequent, a Model A642-G805/M20A2-162-0 propeller is installed. The propellers are manufactured by Aeroproducts Division, General Motors Corporation. Pertinent information concerning propeller construction, performance characteristics, and maintenance is contained in publication AN 03-20EC-1, Handbook of Operation, Service and Overhaul Instructions. It is discussed in this handbook only within the limits of its adaptation to the requirements of the AD-6 airplane.

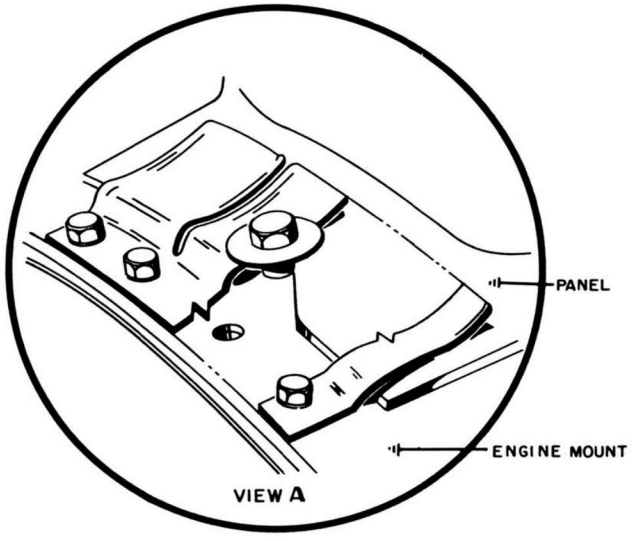
5–167. Propeller operation is automatic in response to settings effected by linkage from the RPM control lever mounted in the engine control quadrant in the cockpit.

5–168. REMOVAL. (See figure 5–23.)

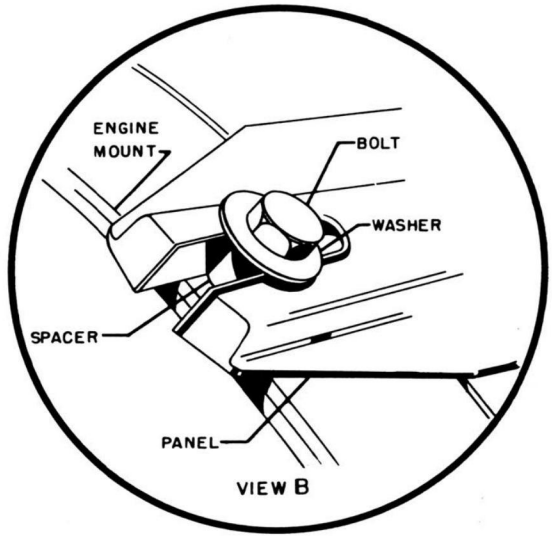
a. Make certain ignition switch is off.

b. Disconnect propeller control linkage at propeller.





UPPER PANEL FORWARD ATTACHMENT



LOWER PANEL FORWARD ATTACHMENT

P-3990-IB

Figure 5–22. Engine Accessory Section Cowling Installation

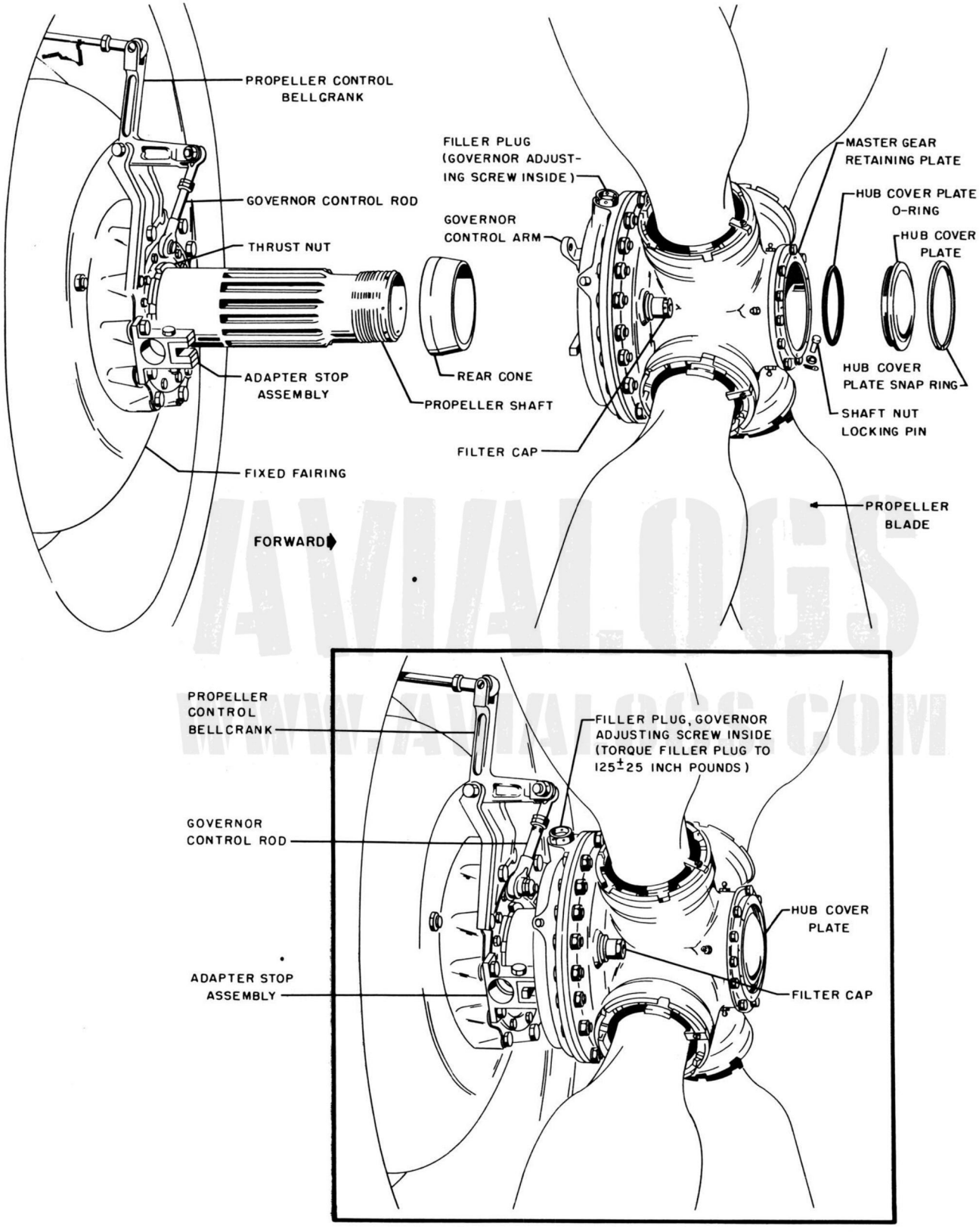


Figure 5–23. Propeller Installation

c. Remove snap ring which retains hub cover plate inside master gear retaining plate.

d. Remove hub cover plate.

e. Remove cotter pin and washer which secure shaft nut locking pin in place and remove locking pin.

f. Attach hoisting slings to two upper blades of propeller.

g. Install shaft nut wrench and use four-foot bar to loosen shaft hub by turning counterclockwise.

h. Turn shaft nut until it is free of threads and use hoisting sling to gradually relieve shaft of propeller weight.

WARNING

Carefully manipulate hoist to prevent propeller weight from damaging shaft on rear cone seat in hub.

i. After removing propeller, place on dolly in such a manner that regulator is not supporting weight of propeller.

j. Remove rear cone.

5–169. INSTALLATION.

Note

Prior to installation of the propeller, inspect propeller shaft and thrust bearing nut area for evidence of corrosion. Refer to paragraph 5–171 for preservation procedures.

a. Check engine propeller shaft thrust bearing nut seating, using thrust bearing nut hydraulic wrench (Wright tool No. 806956) to apply 2200 to 2400 foot-pounds of torque on thrust bearing nut.

b. Remove hydraulic torque wrench and install thrust bearing nut lug wrench (Wright tool No. 83403) and strike wrench handle with 3-pound lead hammer to make certain thrust bearing nut is properly seated.

c. Paint new alignment stripe on nut and nose section of engine.

CAUTION

Do not remove old alignment stripe.

WARNING

If thrust nut can be turned as much as ½ inch from factory marked position, it should be inspected by authorized personnel for possible replacement.

d. Clean propeller shaft and thrust nut with solvent (Federal Specification P-S-661) and inspect for scratches or burrs on threads and splines.

e. Stone out burrs and use crocus cloth to remove scratches.

f. Wipe shaft clean and dry with clean cloth.

g. Coat propeller shaft at location of thrust nut with grease (Specification MIL-L-3545).

h. Apply thin film of grease to propeller shaft aft of propeller retaining threads.

i. Wipe mating surfaces of thrust bearing nut and rear cone dry, and slide rear cone onto propeller shaft.

j. Apply thin coat of anti-seize compound (Specification JAN-A-669) to propeller shaft threads.

k. Use hoisting sling to align propeller with propeller shaft, and guide propeller over shaft.

CAUTION

Be careful not to damage cone seat, threads, or splines.

l. Align adapter plate bracket with adapter stop assembly on crankcase front section.

m. Start shaft nut by turning seven or eight times.

n. Remove hoisting sling from propeller.

o. Insert propeller shaft nut wrench, and tighten shaft nut to 2000 foot-pounds torque.

p. Remove torque wrench unit, hold torque force on shaft nut wrench, strike bar several times near wrench with 5-pound hammer to make certain that shaft nut has been tightened sufficiently.

q. Install shaft nut locking pin through hole in propeller shaft which aligns with castellation of shaft nut, and install washer and cotter pin on shaft nut.

CAUTION

If none of holes in propeller shaft mate with any castellation on shaft nut, tighten shaft nut slightly. Never loosen shaft nut to obtain alignment for locking pin.

r. Apply thin film of grease (Specification MIL-L-3545) to exposed edges of rear cone and thrust bearing nut.

s. Apply thin spray coat of oil to area between propeller and engine nose section.

t. Install O-ring packing on hub cover plate assembly and insert cover plate in position against flange inside master gear retaining plate.

u. Install snap ring which retains hub cover plate.

v. Connect propeller control linkage.

w. Turn propeller until regulator filler plug is in horizontal position on left-hand side of airplane; remove filler plug.

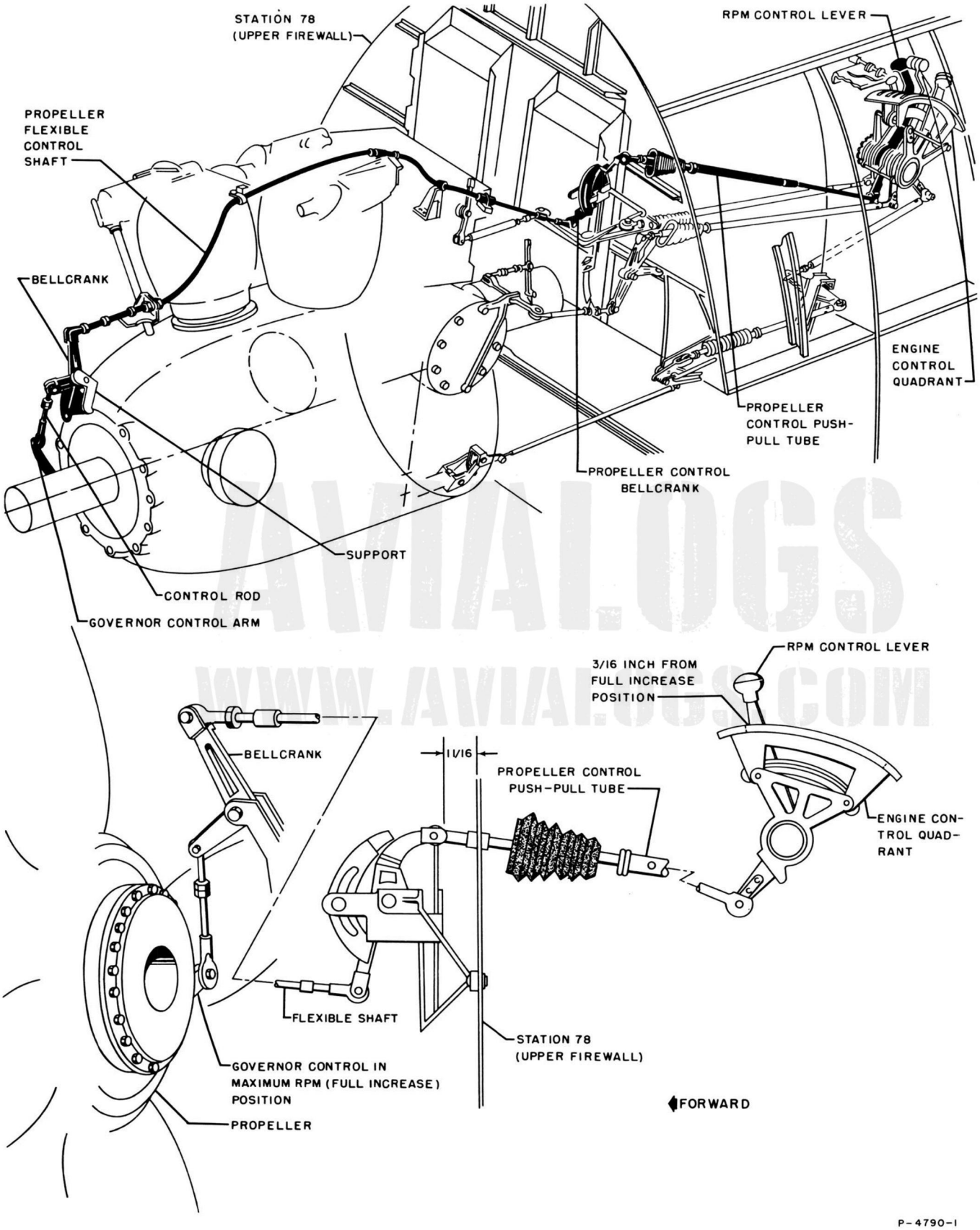


Figure 5–23A. Propeller Control Installation and Adjustment

x. Add hydraulic fluid, if necessary, until fluid flows from filler port.

y. Install filler plug, apply 125 ± 25 inch-pounds torque, and secure with lockwires.

z. After running engine, recheck level of fluid in regulator.

5-170. ADJUSTMENT.

a. Turn propeller by hand until regulator filler plug is above horizontal center line to prevent fluid from spilling out of regulator when plug is removed.

b. Remove filler plug and insert screwdriver into governor adjusting screw.

c. Turn adjusting screws counterclockwise to increase rpm or clockwise to decrease rpm.

NOTE

Each notch of the adjustment will make a change of approximately 15 to 20 engine rpm.

d. Install and tighten filler plug to 125 ± 24 inch-pounds torque and install lockwire.

e. Securely harness airplane.

f. Start engine and warm up to normal operating temperature.

g. Operate RPM control level through three complete cycles to purge air from propellant regulator hydraulic system.

h. Move RPM control level to full INCREASE position, and open throttle until 2600 rpm is indicated by tachometer.

i. Advance throttle rapidly and note that rpm increases to slightly more than 2900 rpm and drops back to 2600 rpm.

CAUTION

Do not hold throttle open for more than five or six seconds.

j. If rpm does not drop back and remain at 2860 ± 15 rpm, repeat adjustment procedure.

5-171. PROPELLER INSPECTION AND PERSERVATION. At each two hundred and forty (240) hour inspection when carrier based and each six hundred (600) hour inspection when land based or every six month period if aircraft has not accumulated specified hours, the propeller should be removed for inspection of the propeller shaft and thrust bearing nut threads for evidence of corrosion. If corrosion is noted, proceed as follows:

a. Clean propeller shaft as outlined in paragraphs 5-168 and 5-169.

b. Remove thrust bearing nut as outlined in NAVWEPS 02A-35JP-502, Service Instructions, and clean thrust bearing nut threads thoroughly with solvent, being careful to prevent solvent from entering engine.

c. Using crocus cloth or hand buffing wheel, with jewelers rouge or levigated alumina, remove all traces of corrosion.

CAUTION

Do not use abrasives other than those specified. Pitted or scoring of propeller shafts should be inspected by authorized personnel for possible rejection.

d. Clean propeller shaft with solvent to remove all traces of corrosion and polishing agent. Dry with clean cloth.

e. Reinstall thrust bearing nut as outlined in NAVWEPS 02A-35JP-502, Service Instructions.

f. Completely fill space between thrust bearing nut and propeller shaft with grease (Spec. MIL-L-3545).

g. Apply thin coating of grease over entire propeller shaft, aft of propeller retaining nut threads, however, not to areas under propeller cones.

CAUTION

Propeller cones and cone seating areas on shaft and thrust bearing nut must be kept dry and free of grease to insure maximum friction between mating surfaces.

h. Install propeller as outlined in paragraph 5-169.

i. After propeller is installed, spray light coating of oil over thrust bearing nut area between propeller and engine nose section.

5-172. PROPELLER CONTROL.

5-173. DESCRIPTION. (See figure 5-23A.) The propeller governor is controlled from the cockpit by the lever installed in the slot marked RPM of the engine control quadrant. The lever knob is identified by the letter P. Lever operation can be modified by turning the friction adjustment knob on the inboard face of the left-hand control panel; clockwise to increase, or counterclockwise to decrease friction.

5-174. Linkage between the control level and the propeller regulator arm is composed of push-pull tubes, bellcranks, and a flexible control shaft.

CAUTION

Do not lubricate flexible control shaft. Lubrication will result in stiff operation causing excessive wear of throttle quadrant.

5-175. REMOVAL.

a. Inside cockpit, remove side panel from left-hand control panel.

b. Remove bolt which attaches push-pull tube end fitting to RPM control lever.

c. Loosen clamp which attaches seal on after face of firewall to propeller control push-pull tube.

d. Remove accessory-section cowling left-hand panels.

e. Disconnect push-pull tube and flexible control from bellcrank on forward face of firewall.

f. Remove carburetor air scoop.

g. Disconnect flexible control from left side of engine mount.

h. Remove clamps which support flexible control assembly to bracket on No. 1 cylinder rocker box pad.

i. Remove clamp which attaches flexible control assembly to engine cooling baffle.

j. Remove nuts which attach bracket to propeller governor drive cover.

k. Disconnect flexible control assembly from bellcrank on crankcase front section.

l. Disconnect rod from bellcrank and from propeller control arm.

5-176. INSTALLATION. (See figure 5-23A.)

a. Place rod assembly in position with propeller control arm and bellcrank on crankcase front section and install attaching bolts.

b. Position flexible control assembly and fitting with bellcrank on crankcase front section and install attaching bolt.

c. Place control assembly bracket in position on propeller governor drive cover and install attaching nuts.

d. Install clamp to support flexible control assembly on engine cooling baffle.

e. Install clamps to support flexible control assembly to No. 1 cylinder exhaust rocker box pad support bracket.

f. Install clamp to attach flexible control assembly to upper side of engine mount.

g. Position control assembly on upper left-hand leg of engine mount and install U-bolt and nuts.

h. Install carburetor air scoop.

i. Position flexible control assembly end fitting with bellcrank on forward side of firewall and install attaching bolt.

j. Insert RPM control push-pull tube through firewall and bolt forward end to bellcrank on forward face of firewall.

k. Inside cockpit, tighten clamp which attaches seal to propeller control push-pull tube.

l. Bolt push-pull tube fitting to RPM control lever.

m. Adjust propeller control linkage.

5-177. ADJUSTMENT. (See figure 5-23A.)

a. Adjust propeller governor for maximum rpm.

b. Disconnect control rod from covernor control arm on propeller regulator.

c. Place RPM control lever (in cockpit) at 3/16 inch from stop in full INCREASE position.

d. Remove left-hand accessory section cowling and adjust propeller control push-pull tube until upper end of bellcrank on forward side of firewall is 11/16 inch from firewall.

e. Adjust end fitting of flexible control assembly until linkage can be connected with bellcrank 11/16 inch from firewall, and with governor control arm in full increase rpm position.

f. Bolt control rod to governor control arm.

5-178. FUEL SYSTEM.

5-179. DESCRIPTION. (See figure 5-24.) The fuel system includes the following principal units of fuel supply and control:

Main fuel cell
Fuel quantity indicating system
External auxiliary fuel tanks
External Fuel Quantity Indicating System
Fuel tank selector valve and control
Fuel system strainer
Engine-driven fuel pump
Auxiliary fuel pump
Engine priming valve
Fuel pressure warning system.

5-180. The main source of fuel supply is the main fuel cell, installed in the fuselage directly aft of the cockpit. A vent line, connected to a vent fitting on top of the fuel cell access door, insures that proper air pressure is maintained within the cell. The fuel quantity indicating system reflects the amount of fuel available in the main cell. An external fuel quantity indicating system is installed to provide a fuel quantity indication for drop tanks. Auxiliary fuel tanks can be carried on the inner-station external stores racks to supplement the fuel contained in the main fuel cell.

5-181. The supply source, main or auxiliary, for system operation is determined by the position of the fuel selector valve which is connected between the tanks and the system pumps.

5-182. Fuel is transferred from the source of supply, through the selector valve, to the carburetor by the action of the system pumps.

5-183. The fuel strainer, which is in the system between the selector valve and the auxiliary pump, filters the fuel to prevent foreign particles from entering the system.

5-184. The engine priming valve is installed on the carburetor to provide a means of priming the engine before it is started.

NOTE

Comply with operating procedures and precautions prescribed in NAVWEPS 16-1-529, Radio Frequency Hazards Manual, which establishes the restrictions to be observed when fueling in RF environments.

5-185. TROUBLESHOOTING. Refer to table 5-4.

5-186. MAIN FUEL CELL.

5-187. DESCRIPTION. (See figure 5-26.) The main fuel cell, located aft of the cockpit, is a self-sealing flexible type cell which has a capacity of 2280 pounds (380 US. gallons; 316 Imperial gallons). The cell is retained in the compartment by a hammock-type support. A metal door on top of the cell permits access to the interior for cleaning and repair, and also provides support for the tank unit of the fuel quantity indicating system. A vent line connected to a fitting on the access door permits atmospheric pressures to be maintained within the cell and a vapor vent line between the vent fitting and the carburetor permits vaporized fuel in the carburetor to return to the fuel cell. An anti-siphon vent line, attached at the same point as the vapor vent line, prevents fuel in the cell from siphoning overboard through the cell vent line. A catch basin installed between the upper portion of the fuel cell and the surrounding support structure prevents stray raw stock and tools from falling between the cell and the support structure. A drain line below the basin drains spilled fuel overboard.

5-187A. The fuel compartment cover, which is a removable portion of the fuselage upper plating, incorporates a window to facilitate inspection of the cell support fittings and the surrounding area without removing the cover. A grounding receptacle is also installed in the fuel compartment cover, adjacent to the filler well, for grounding the fuel nozzle to the airplane during fueling and defueling. A fuel filler neck on the upper right-hand side of the cell is linked by a hose to the filler well in the compartment cover; the access panel above the filler well cannot be installed until the filler cap is closed and locked. A line between the filler well and the cell vent line drains fuel overflow and prevents dangerous vapors from entering the radio compartment. The bellmouth assembly in the bottom of the cell incorporates a screen which strains the fuel before it enters the supply line. A defueling valve is installed in a boss on the bellmouth assembly aft of the outlet fitting; access to the valve is through a plate in the bottom of the fuselage.

5-188. The hammock which supports the cell is shock-mounted to the upper engine-mount stiffeners. Clips bolted to intermediate channel supports prevent sagging of the cell. Fore-and-aft and sidewise movements at the top of the cell are prevented by rods which extend between the cell supporting structure and the engine-mount stiffeners and by a rod which extends between the cell supporting structure and the fuselage frame aft of the cell. Movement at the bottom of the cell is prevented by a circular brace assembly and four adjustable cables. The brace assembly is bolted to the cell and two of the four cables extend forward to the spar. The other two cables extend aft to the rear shear web.

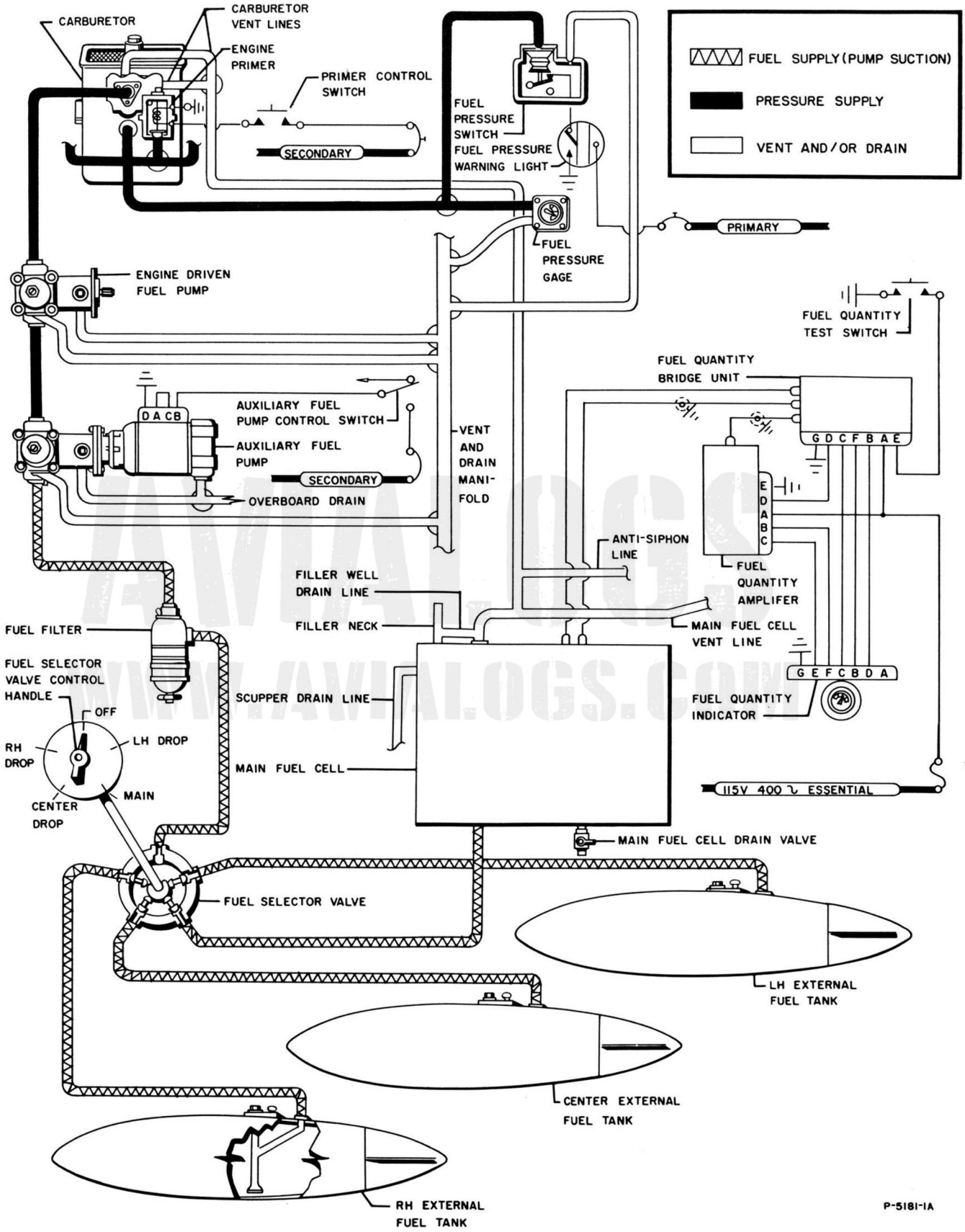


Figure 5–24. Fuel System Schematic Diagram

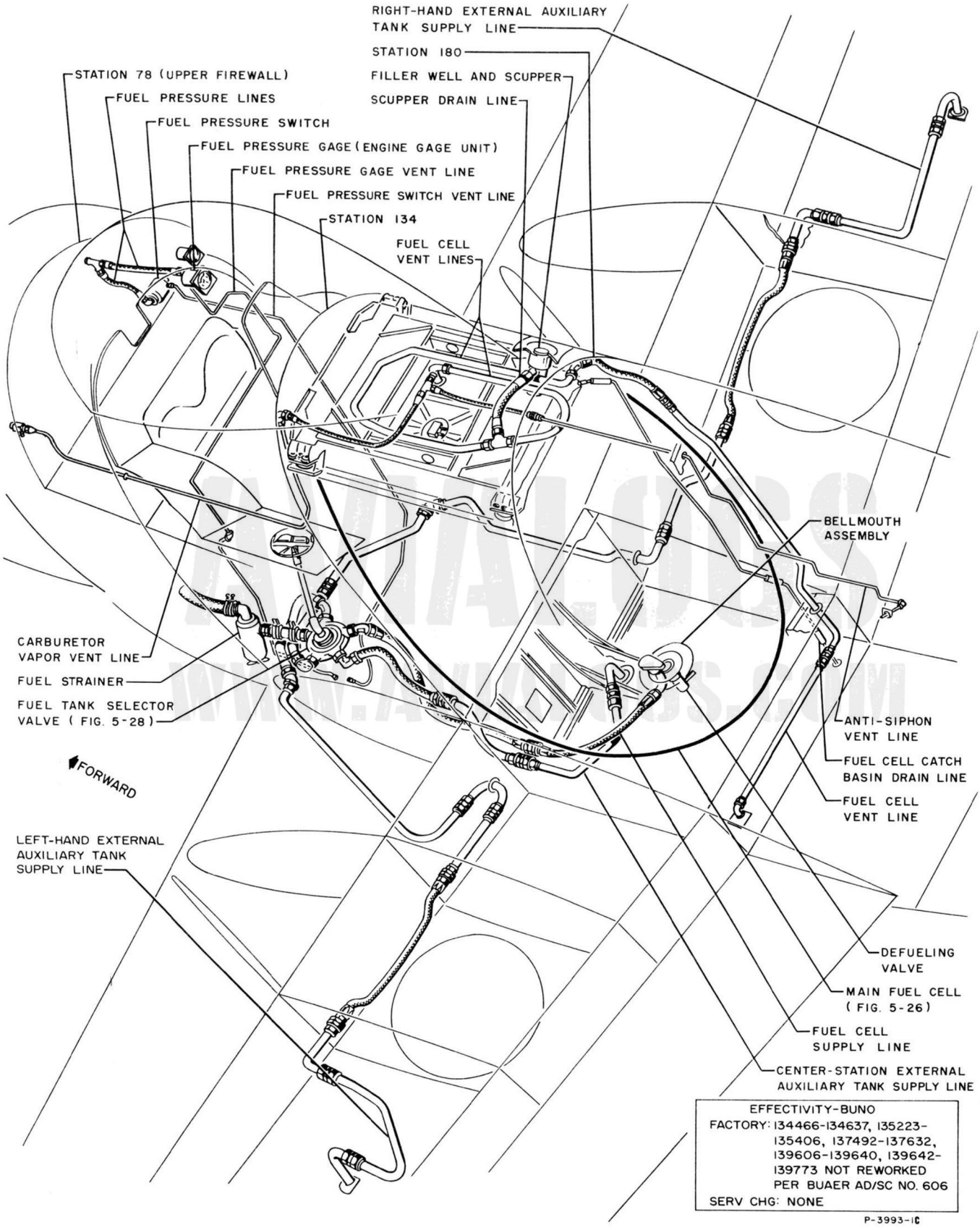


Figure 5–25. Fuel System—Perspective (Sheet 1)

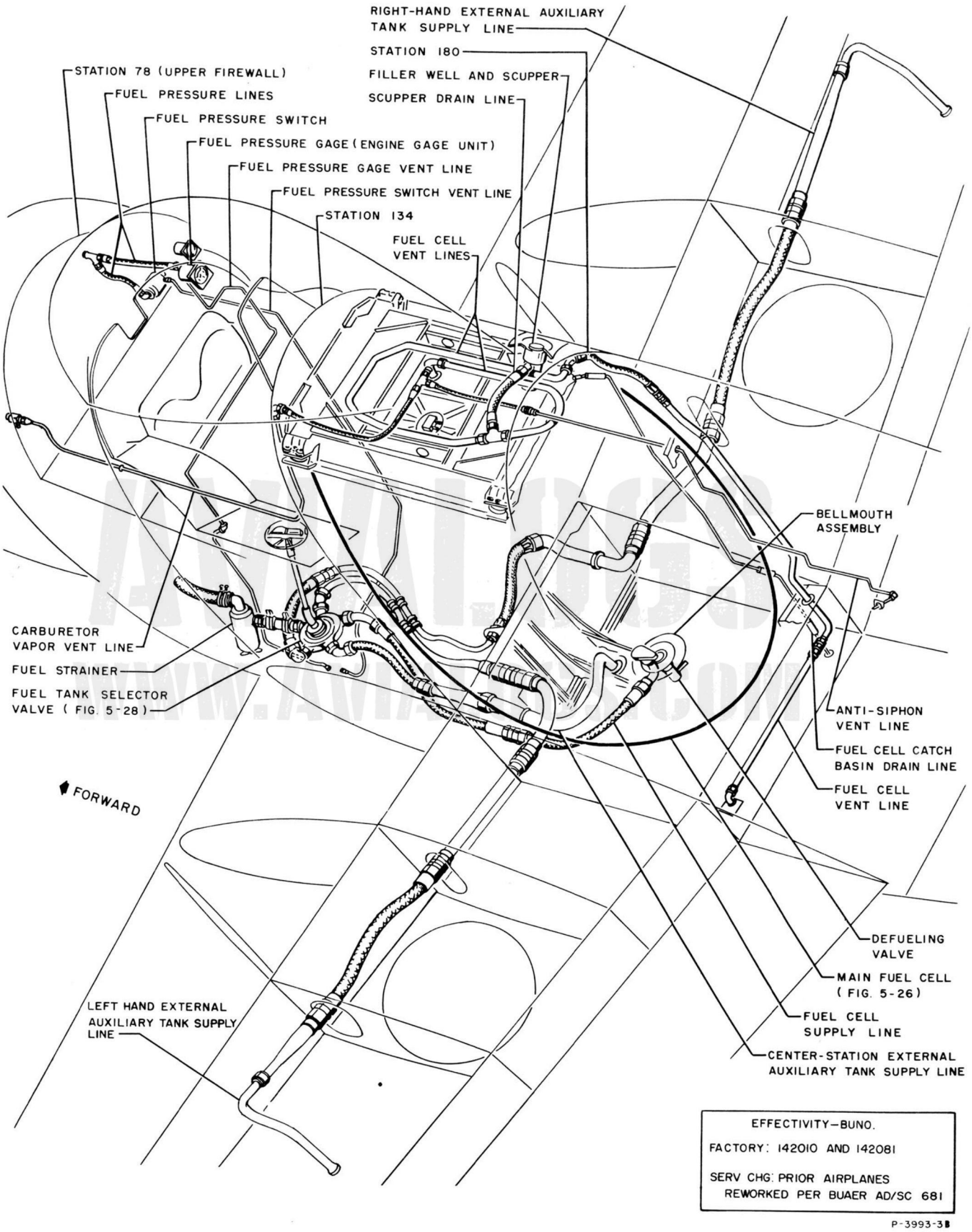


Figure 5–25. Fuel System — Perspective (Sheet 2)

WARNING

Before fueling or defueling main fuel cell, fuel nozzle must be grounded to grounding receptacle installed adjacent to filler well.

5–189. INSPECTION. The main fuel cell should be inspected daily by opening the defueling valve. If rubber particles are found, a close inspection for deterioration of the fuel cell, both inside and out, should be made. Every three months the cell should be defueled and refilled, noting the amount of fuel required to fill the cell. If there is more than 5 percent difference between cell capacity, as indicated on the filler cap, and the amount of fuel required to fill the cell, the interior of the cell should be given a close inspection.

Note

The cell lower support cables should be inspected periodically, with the fuel cell filled, to insure that the cell is centered in the compartment and that the cables are snug.

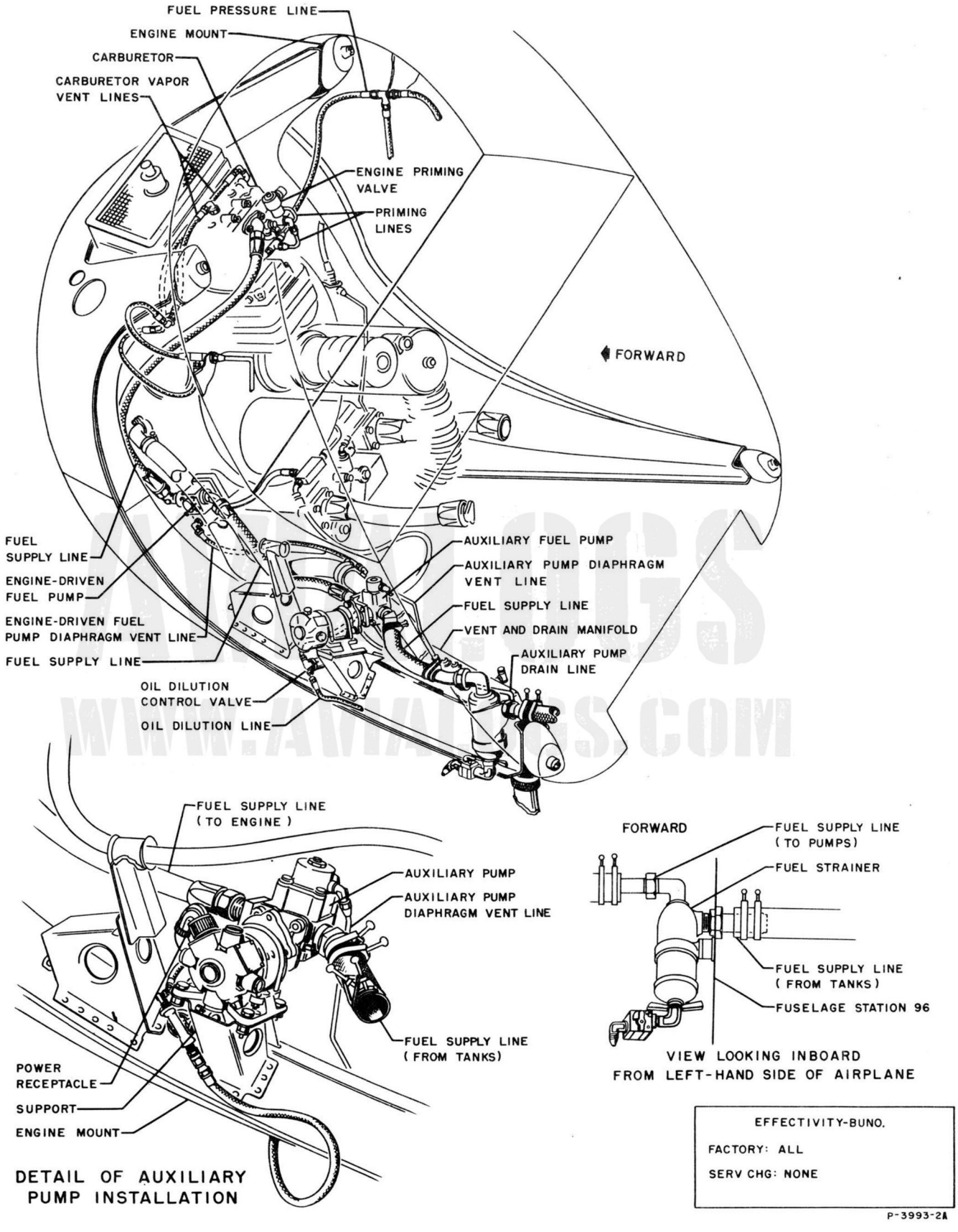


Figure 5–25. Fuel System—Perspective (Sheet 3)

TABLE 5-4. TROUBLESHOOTING FUEL SYSTEM

Trouble	Probable Cause	Remedy
1. Low fuel pressure shown on gage. (Indication should be 19 to 21 psi at engine manifold pressure of 30 inches Hg and while auxiliary pump is inoperative; 3.5 psi maximum increase is satisfactory when auxiliary pump is turned on.)	a. Air entering fuel supply line.	Tighten hose connections.
	b. Fuel pump relief valves improperly set.	Adjust relief valves to obtain correct pressure setting.
	c. Fuel strainer or tank screen dirty. Rotate tank selector valve control and note effect on fuel pressure reading. If pressure remains low for all positions, dirt is probably in strainer; if pressure is low for one position only, check screen of affected tank.	Clean strainer or screen.
	d. Fuel supply line clogged. Rotate tank selector valve control and note effect on fuel pressure reading.	Remove obstruction.
	e. Fuel pump malfunctioning.	Replace pump.
	f. Fuel tank vent line obstructed. Rotate tank selector valve control and note effect on fuel pressure reading. Inspect vent lines of tanks for which low readings are obtained.	Remove obstruction
	g. Fuel pressure gage defective.	Replace engine gage unit.
2. High fuel pressure shown on gage. (Indication should be 19 to 21 psi at engine manifold pressure of 30 inches Hg and while auxiliary pump is inoperative; 3.5 psi maximum increase is satisfactory when auxiliary pump is turned on.)	a. Refer to trouble 1 b.	
	b. Diaphragm vent line obstructed. If pressure is high when auxiliary pump is inoperative, inspect vent line of engine-driven pump; if pressure is high only when auxiliary pump is turned on, inspect vent line of auxiliary pump.	Remove obstruction.
	c. Refer to trouble 1 g.	
3. No fuel pressure.	a. No fuel in tank or cell.	Fill fuel tank or cell.
	b. Pressure gage line disconnected at one or both ends.	Connect line.
	c. Wrong lines connected to fuel pressure section of engine gage unit.	Ascertain if gage is damaged; replace it if necessary. Connect proper lines.
	d. Clogged fuel pressure gage line.	Remove obstruction.
	e. Refer to trouble 1 g.	
	f. Air entering fuel supply line on "upstream" side of pumps.	Tighten hose connections.
	g. Refer to trouble 1 c.	
	h. Fuel line clogged. Rotate tank selector valve control and note effect on fuel pressure reading. If pressure is nonexistent for all positions, clogged portion of line is probably forward of tank selector valve; if pressure is nonexistent for one position only, inspect line between selector valve and affected tank.	Remove obstruction.
	i. Refer to trouble 1 e and f.	
4. Erratic fuel pressure shown on gage.	a. Auxiliary pump not turned on during high altitude operation.	Place auxiliary pump switch in ON position.
	b. Obstruction on inlet side of fuel pumps. Rotate tank selector control and note effect on fuel pressure reading. If pressure is erratic for all positions, obstruction is probably forward of tank selector valve; if pressure is erratic for one position only, inspect line between selector valve and affected tank.	Remove obstruction.
	c. Refer to trouble 1 d.	

5–190. DRAINING. Condensate should be drained from the cell daily, by rotating the defueling valve approximately 30 degrees counterclockwise. When sediment accumulates at the defueling valve, the valve should be fully opened until about two gallons of fuel have drained out, then closed.

5–191. DEFUELING.

a. Remove inspection plate from fuselage below fuel cell compartment.

b. Connect suitable drain hose to defueling valve.

c. Remove cotter pin from valve handle and turn handle 180 degrees counterclockwise from closed position.

d. Drain fuel from cell into suitable external container.

e. After cell is defueled, close valve handle and install cotter pin.

f. Remove hose from defueling valve and install inspection plate.

5–192. PURGING.

CAUTION

Before purging fuel cell, make certain that it is completely defueled, and that all access covers are removed.

a. Place air hose in cell and purge by permitting large quantity of air to circulate in and out of access openings, for period of one to three hours. While purging, check fuel vapor content of cell from time to time with a Davis Fuel Tank Vapor Tester, or equivalent, to determine when cell is free of fumes. *Continue purging until meter indicates danger point is passed.*

b. Remove air hose after vapor tester indicates cell is satisfactorily purged.

WARNING

Do not use carbon dioxide to purge cell.

–193. REMOVAL. (See figure 5–26.)

WARNING

When working in the fuel tank or tank compartment, adequate ventilation of the tank compartment as well as the fuel tank must be provided.

a. Place fuel tank selector valve handle in "OFF."

b. Defuel main fuel cell.

c. Remove cockpit enclosure.

d. Remove inspection window from top of fuel cell compartment cover.

e. Reach through opening in compartment cover and remove clamps which secure filler well hose.

f. Disconnect filler well drain hose from filler well.

g. Remove screws that attach fuel compartment cover to fuselage.

h. Pull hydraulic bypass valve control handle in cockpit to relieve hydraulic system pressure.

i. Relieve pressure from enclosure air bottle through filler valve fitting.

j. Disconnect hydraulic lines and air lines at forward end of compartment cover.

k. Disconnect cover grounding-jack wire.

l. Disconnect enclosure control cable turnbuckles in left-hand side of cockpit.

m. Remove pulleys from brackets at forward end of fuel cell cover and disconnect enclosure air valve actuating arm.

n. Pull cockpit enclosure cable clear of compartment cover.

o. Remove bolts which attach air-to-oil transfer cylinder fitting to seat armor plate.

p. Remove fuel compartment cover, with enclosure control units still attached, from airplane.

q. Make certain d-c power control switch is off and then disconnect power leads from fuel-quantity tank unit.

r. Remove bolts which attach tank unit to cell cover and lift unit from cell.

s. Purge fuel cell.

t. Disconnect fuel supply line at fuel cell outlet fitting.

u. Remove bolts that attach circular brace assembly to cell outlet fitting and lower brace assembly.

v. Disconnect vapor vent line on both sides of forward bulkhead fitting and remove fitting.

w. Disconnect anti-siphon vent line from bulkhead and disconnect fuel cell vent line at elbow.

x. Disconnect catch basin drain line at hose connection.

y. Remove clips which attach fuel-quantity tank unit leads to cell supporting structure.

z. In radio compartment, remove AN/ARC-27 and AN/ARN-12 units from support racks to clear access to fuel cell compartment.

aa. Enter fuel cell area and manually depress sides of cell; maintain depression by inserting wooden blocks between depressed sides and reinforced members of air-

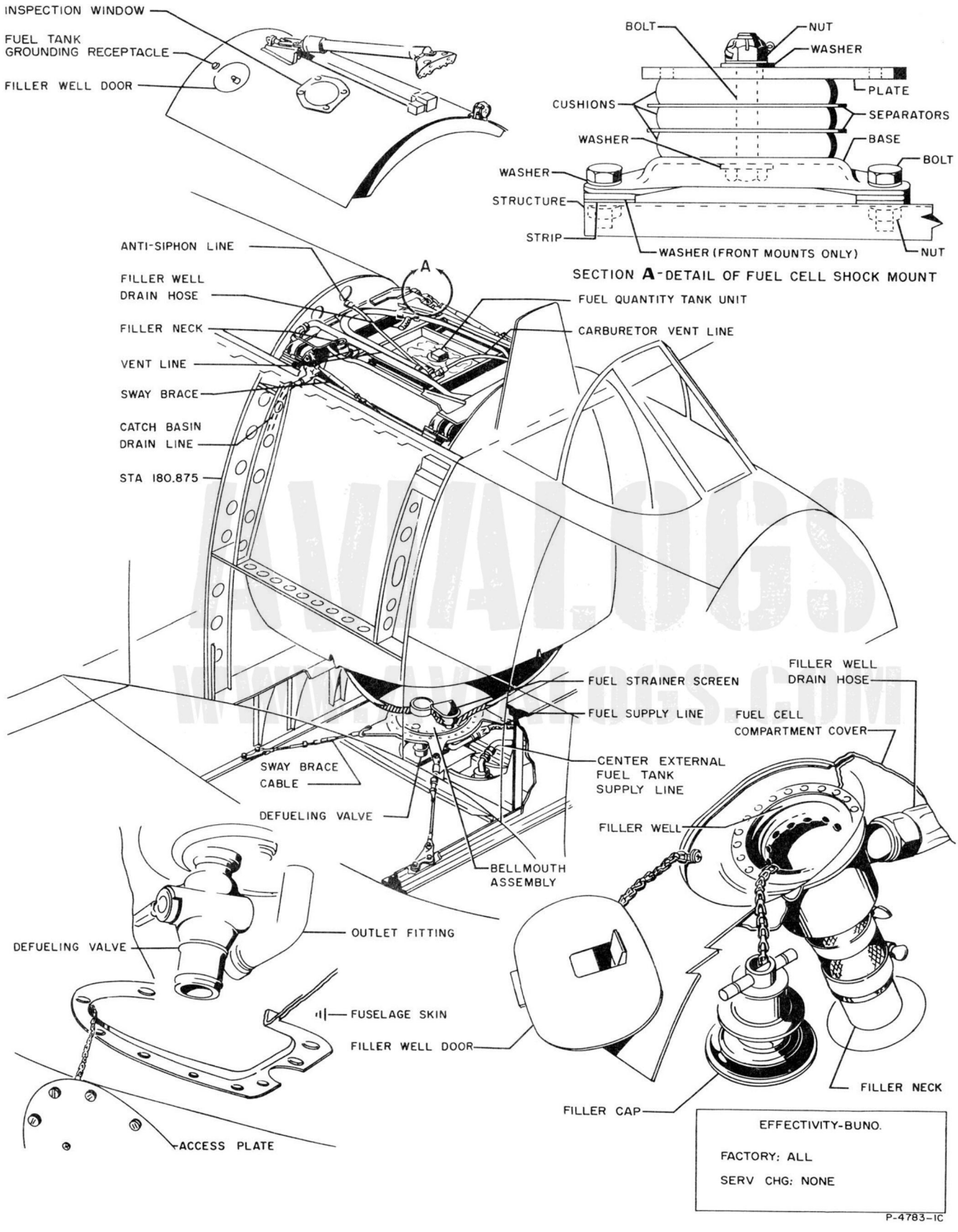


Figure 5–26. Main Fuel Cell Installation

plane structure. As sides are depressed, encircle cell with wide strap, apply tourniquet action to free ends of strap for further depression. When cell is collapsed sufficiently for removal, tie strap.

ab. Remove bolts which attach adjusting rods to fuselage support brackets and remove nuts which secure fuel cell support structure to shock mounts.

ac. Screw hoist rings (special tool K-54701) into threaded inserts provided on fuel cell supporting structure, attach hoist to rings, and carefully lift cell from compartment.

ad. Place cell in handling stand or suspend it by cell supporting structure.

ae. Remove sway brace assembly from airplane by removing bolts that attach fittings to airplane structure.

5–194. INSTALLATION.

a. Place circular brace assembly in position on bottom of cell and install attaching bolts. Safety bolts with lockwire.

b. Attach hoist to hoist rings on cell supporting structure and lift cell from handling stand.

c. Depress four sides of cell and maintain collapsed condition by using suitable strap.

Note

Inspect condition of shock mount cushions and separators. If either cushions or separators are damaged or show signs of deterioration, replace them as necessary with new parts before installing fuel cell. Forward, inboard shock-absorber mounting bolts should be in reverse direction from outboard and aft shock-absorber mounting bolts. This positioning of the forward, inboard shock-absorber mounting bolts eliminates adverse shock absorber loading conditions.

d. Hoist fuel cell and lower it into compartment.

CAUTION

Carefully guide fuel cell into compartment to prevent damage to cell and to make certain that adjusting rods are properly positioned.

e. Remove strap from fuel cell.

f. Install bolts which secure sway brace cable fittings to airplane structure.

Note

Two men are required to install the bolts and nuts on the sway brace fittings.

g. Install nuts that secure fuel cell support structure to shock mounts; then remove hoist rings from support structure.

h. Install bolts which attach three adjusting rods to fuselage support brackets. Adjust rods to obtain an undistorted condition of shock mounts. If necessary, adjust lengths of sway brace cables to obtain uniform clearance between fuel cell and structure.

i. Install fuel-quantity tank unit.

j. Connect catch basin drain line at hose connection.

k. Connect anti-siphon vent line to fuel cell compartment bulkhead fitting and connect fuel cell vent line at elbow.

l. Install vapor vent line fitting on forward bulkhead and connect vapor vent lines to fitting. Torque vapor vent line connections to 112 inch-pounds.

m. Connect fuel supply line to fuel outlet fitting.

n. Place fuel compartment cover in position and install attaching screws.

o. Install bolts which attach air-to-oil transfer cylinder fitting to seat armor plate.

p. Place cockpit enclosure control cable in position, install pulleys on brackets, and connect cable turnbuckles at left-hand side of cockpit. Adjust cable tension.

q. Connect enclosure air valve actuating arm and secure fuel compartment cover grounding-jack wire.

r. Connect enclosure hydraulic and air lines at forward end of compartment cover.

s. Reach through inspection opening in compartment cover and connect filler well hose to filler well and to fuel cell fitting.

t. Connect filler well drain hose to filler well and install inspection and access window to top of compartment cover.

u. Install cockpit enclosure.

v. Fill enclosure air bottle.

w. Install AN/ARC-27 and AN/ARN-12 units on support rack in radio compartment.

5–194A. MAIN FUEL CELL BELLMOUTH ASSEMBLY.

5–194B. DESCRIPTION. (See figure 5–26A.) The main fuel cell bellmouth assembly, located in the lower portion of the main fuel cell, is secured to the fuel cell by means of screws, washers, a stiffener ring, and lock wire. The bellmouth assembly consists of a plate with attaching holes to which a bellmouth and screen, a fuel outlet tube, and two bosses are welded. The bellmouth and screen unit is welded to one side of the plate, above an outlet hole in the plate, and the fuel outlet tube is welded to the opposite side of the plate, below the outlet hole. Fuel passing from the main fuel cell through the bellmouth screen and outlet tube into the main fuel system line is filtered by the screen, thus preventing foreign particles from entering the main fuel line. One of the bosses in the bellmouth assembly is plugged, the other

serves as an attaching port for the main fuel cell defueling valve.

5–194C. REMOVAL. (See figure 5–26A.)

a. Remove lock wire, screws, washers and stiffener ring attaching bellmouth assembly to main fuel cell, and remove bellmouth assembly.

5–194D. INSTALLATION. (See figure 5–26A.)

a. Place bellmouth assembly in correct position against fuel cell flange.

b. Place stiffener ring against bellmouth assembly and align attaching screw holes.

c. Install bellmouth assembly attaching washers and screws, finger tight.

d. With a dial torque wrench, tighten bellmouth assembly attaching screws to 15 inch-pounds torque, in sequence from one to twelve as shown on figure 5–26A.

e. After completion of step d, tighten bellmouth assembly attaching screws to 30 inch-pounds torque, in sequence from one to twelve as shown in figure 5–26A.

f. After completion of step e, lock wire bellmouth assembly attaching screws.

5–195. FUEL CELL DEFUELING VALVE.

5–196. DESCRIPTION. The fuel cell is defueled and periodically drained of condensed moisture by means of the defueling valve located just aft of the fuel supply outlet in the fuel cell bellmouth assembly. It is a poppet type valve, having one inlet and one outlet port, with the poppet seat in the inlet port, and is actuated by manually turning the camshaft 180 degrees. A lever-actuated detent pin in the handle locks the valve in the closed position; the detent pin is safetied against accidental operation by inserting a cotter pin through holes in the lever flanges.

5–197. REMOVAL.

a. Defuel main fuel cell.

b. Unscrew valve from bellmouth assembly boss.

5–198. INSTALLATION.

a. Place valve in position and screw into boss until valve is tight and valve handle faces aft.

b. Safety valve handle in closed position by inserting cotter pin through holes in flanges of detent pin lever.

5–199. MAIN FUEL CELL FUEL QUANTITY INDICATING SYSTEM.

5–200. DESCRIPTION. (See figure 5–27.) The fuel

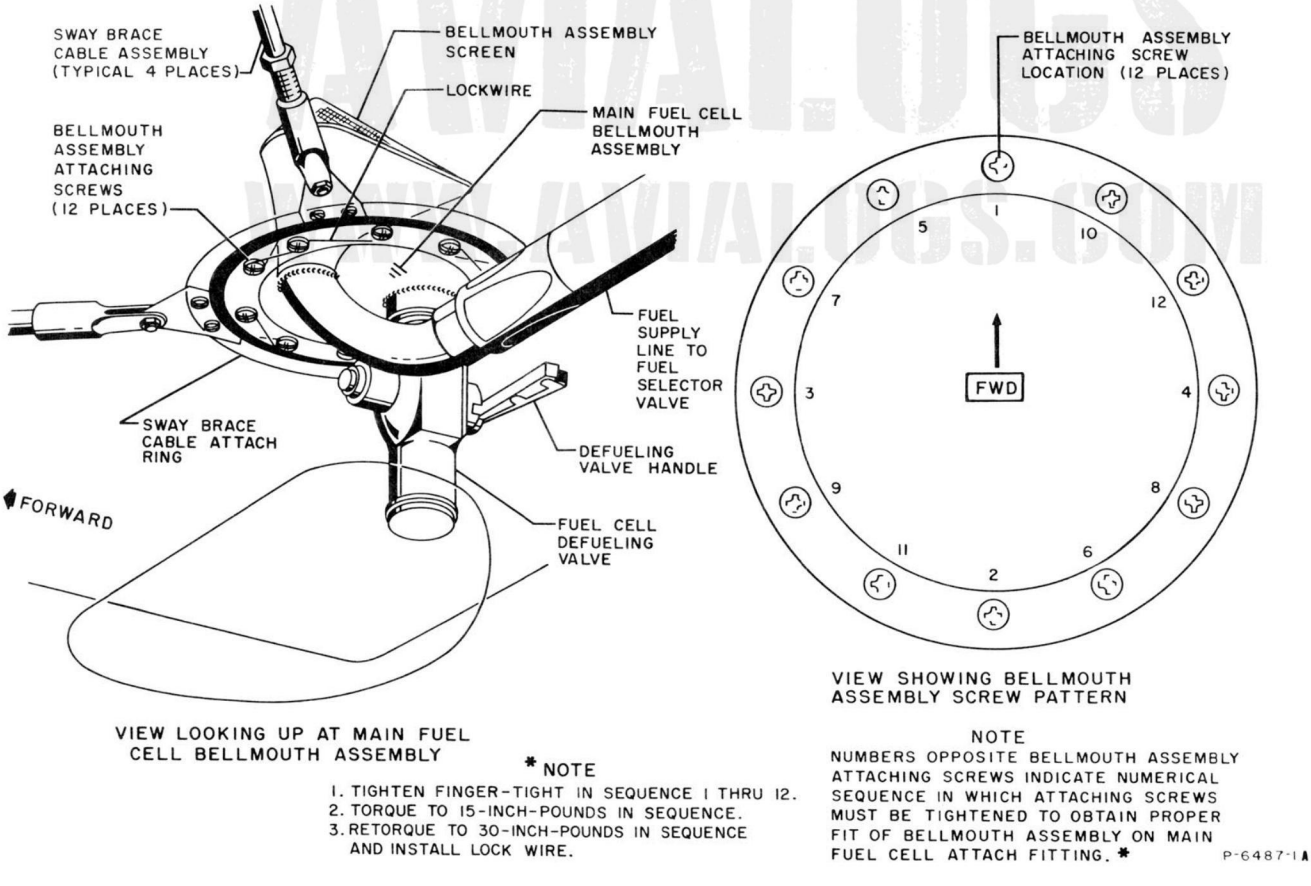


Figure 5–26A. Fuel Cell Bellmouth Assembly Installation

quantity indicating system reflects the amount of fuel available in the main fuel cell and is powered by a 115-volt, 400-cycle constant-frequency a-c electrical system. The system comprises the following units:

Name	*Location*
Tank unit	Main fuel cell
Bridge unit	Radio compartment—shelf
Amplifier	Radio compartment—shelf
Indicator	Cockpit—instrument panel
Test switch	Cockpit—instrument panel

5–201. The system utilizes the dielectric properties of aircraft fuel to vary the capacitance existing between two coaxial cylinders of the tank unit mounted within the main fuel cell. The capacitance value of the tank unit is proportional to the weight of fuel within the main fuel cell. The bridge unit, amplifier, and indicator measure the capacitance of the tank unit and display the result on the indicator.

5–201A. A rough check on the quantity of fuel in the main fuel cell can be made manually with a dip stick, Special Tool K-3270143.

5–202. TROUBLE SHOOTING. Refer to table 5–5.

5–203. ADJUSTMENT.

a. Disconnect tank unit leads at bridge unit and connect field tester to tank unit receptacles of bridge unit. Unfasten dzus fasteners and remove cover from bridge unit.

b. Connect external d-c power source to airplane to obtain 115-volt, 400-cycle a-c power in system.

c. Set field tester to capacitance of 159.0 $\mu\mu f$. Rotate "EMPTY" screwdriver-adjust potentiometer, located at bridge unit, until indicator reads zero.

d. Set field tester to capacitance of 309.9 $\mu\mu f$ and adjust "FULL" potentiometer until indicator reads 2260 pounds.

e. Reset field tester to capacitance of 159.0 $\mu\mu f$ and readjust "EMPTY" potentiometer until indicator again reads zero. Recheck 2260 pound setting (step "d") and, if necessary, repeat steps "c" and "d" until this setting remains unchanged in step "e."

f. Disconnect power to system, disconnect field tester from bridge unit and reconnect tank unit leads.

Note

With fuel in tanks, omit following steps. With empty tanks, complete following steps.

g. Apply power to system.

h. If pointer is at zero within ± 3 degrees, reset to zero with EMPTY potentiometer in bridge unit.

i. If pointer is not at zero ± 3 degrees, check tank unit.

j. When adjustment is complete, replace cover of bridge unit and secure with dzus fasteners.

5–204. MAIN FUEL CELL FUEL QUANTITY TANK UNIT.

5–205. DESCRIPTION. (See figure 5–27.) The fuel quantity tank unit is installed in the access door on top

TABLE 5–5. TROUBLE SHOOTING FUEL QUANTITY INDICATING SYSTEM

Trouble or Symptom	*Probable Cause*	*Correction*
1. Indicator pointer rotates continuously clockwise.	a. Coaxial cable between tank unit and bridge shorted.	Replace defective cable or connector.
	b. Tank unit defective; inner tube shorted to ground or to middle tube.	Replace tank unit.
2. Indicator pointer rotates counterclockwise and comes to rest off scale below zero, or rotates continuously in counterclockwise direction.	a. Unshielded wire at bridge unit grounded out.	Locate and remove short.
	b. Middle cylinder of tank unit grounded out.	Replace tank unit.
	c. Either of two leads from tank unit to bridge unit open.	Tighten connectors at bridge unit and tank unit. Replace if defective.
3. Indicator does not operate.	a. Power supply defective.	Check power supply for 115-volt, 400-cycle output. (Refer to section VII.)
	b. Inner conductor of shielded lead from bridge unit to amplifier grounded or open.	Check connector and cables to locate and remove fault.
	c. Open or shorted wire in connector at indicator or in indicator cable.	Locate and remove fault.
	d. No amplifier output.	Check tubes, replacing where necessary.
4. Indicator rotates slowly in either direction.	a. Amplifier plate-load resistor or grid-leak resistor shorted-out or open.	Replace amplifier.
	b. Amplifier tube defective. (Check particularly the twin triode voltage amplifier, V-102.)	Replace defective tube, or if replacement not available, replace amplifier.

of the main fuel cell. The unit is made up of three tubes: two inner tubes which calibrate the dielectric constant of the fuel in the cell and an outer tube which serves as a housing. The unit is preadjusted for capacitance, and is constructed so that changing coaxial cables does not necessitate recalibration of the unit.

5–206. REMOVAL. (See figure 5–27.)

a. Remove cockpit enclosure and fuel cell compartment cover.

b. Make certain that d-c power control switch in cockpit is off and that no external d-c power is connected to airplane; then disconnect coaxial leads from head of fuel-quantity tank unit.

c. Remove lockwire, bolts, and washers from head of tank unit and lift it out of fuel cell.

5–207. INSTALLATION. (See figure 5–27.)

a. Place new gasket in position on fuel cell cover and lower fuel-quantity tank unit into cell.

b. Assemble washers and new O-rings on tank unit attaching bolts; insert bolts through flange and tighten into cell cover. Secure with lockwire.

WARNING

Make certain that d-c power control switch is off and that no external d-c supply is connected to airplane.

c. Connect power leads to head of fuel-quantity tank unit.

d. Install fuel cell compartment cover and cockpit enclosure.

5–208. MAIN FUEL CELL FUEL QUANTITY BRIDGE UNIT.

5–209. DESCRIPTION. (See figure 5–27.) The bridge unit is identified as FUEL GAGE BRIDGE; it produces a voltage which is directed to the amplifier. Input from the tank unit is applied to one leg of a capacitance bridge, the other leg being the reference condenser in the bridge unit. Mounted within the bridge unit is a transformer supplying bridge voltage as well as filament power. All components of the bridge unit except the *empty* and *full* adjustment potentiometers are fixed. Each potentiometer is provided with a high-torque screwdriver shaft which will withstand vibration without causing calibration shift.

5–209A. When a new bridge unit is installed in the model AD-6 airplane, a reference condenser of proper value must be added to the new bridge unit. The proper reference condenser for the bridge unit used in model AD-6 airplane is part number 166-07-240 (Avien).

5–210. MAIN FUEL CELL FUEL QUANTITY AMPLIFIER.

5–211. DESCRIPTION. (See figure 5–27.) The fuel quantity amplifier is shock-mounted and is identified as FUEL GAGE AMPLF. The amplifier receives voltage from the bridge unit and develops sufficient power to drive the indicator.

CAUTION

Fuel-quantity-amplifier aft retaining pins must be properly seated in shock mount before forward, amplifier retaining pin is seated and friction locked, therefore spring load aft retaining pins before installation, then check aft retaining pins for proper seating before locking forward retaining pin.

5–212. MAIN FUEL CELL FUEL QUANTITY INDICATOR.

5–213. DESCRIPTION. (See figure 5–27.) The fuel quantity indicator is mounted in the upper right-hand portion of the pilot's instrument panel. The indicator is hermetically sealed; it is calibrated for 2500 pounds, and the indicator needle is driven by an integral 2-phase, 400-cycle control motor and requires approximately 80 seconds to make the full swing of the dial.

5–214. MAIN FUEL CELL FUEL QUANTITY TEST SWITCH.

5–215. DESCRIPTION. The fuel quantity test switch is mounted in the upper right-hand portion of the instrument panel next to the indicator and is identified as FUEL QUAN TEST. Switch contacts are momentary; when the button is depressed the fuel quantity indicating system is grounded so that the indicator needle swings toward zero; when the switch button is released, the needle moves to the proper fuel quantity reading, provided power is available and the system is functioning satisfactorily.

5–216. EXTERNAL AUXILIARY FUEL TANKS.

5–217. DESCRIPTION. (Refer to table 5–6.) Provisions are made to adapt various types of auxiliary fuel tanks for use on each of the three main stores racks. The various types of tanks which can be used include the following:

Model	*Capacity*
Mark 8 Mod. 1	300 US gallons; 1800 pounds, or (250 Imperial gallons).
Mark 12	150 US gallons; 900 pounds, or (125 Imperial gallons).
Aero 1A (5434628-503)	150 US gallons; 900 pounds, or (125 Imperial gallons).
Aero 1A (5265098-507)	300 US gallons; 1800 pounds, or (250 Imperial gallons).
ATP-D1 (5556400)	400 US gallons; 2400 pounds, or (333.16 Imperial gallons).

5-218. Because the maximum fuel-oil ratio is approximately 29 to 1 or not more than 980 gallons of fuel for flight consumption, any combination of external tanks that would bring the amount of external fuel over 600 gallons should not be used unless they are carried for inflight refueling purposes.

WARNING

Do not use a combination of external tanks that would increase the external fuel load over 600 gallons unless the additional fuel is carried for inflight refueling purposes.

5-219. The Aero Series 150 and 300 gallon external fuel tanks are constructed of aluminum alloy sections, and have internal baffles which aid in stabilizing fuel motion within the tank. An atmospheric pressure vent hold, located just aft of the filler port, permits atmospheric pressure to be maintained in the tank at all times. An outlet fitting on the top side near the aft end of the tank, is connected, by a short length of hose, to the fuel system supply line which is located within the stores rack fairing. Internally, the outlet fitting is connected to a bellmouth fitting located at the normal low point of the tank. At the low point of the tank a drain valve and strainer assembly is installed so that the strainer fits into the outlet bellmouth and prevents foreign particles from entering the fuel system or the drain valve. The drain valve is accessible from the outside of the tank and is used to periodically drain condensed moisture from the tank. On modified tanks, an additional spring loaded drain plug is provided at the extreme aft end of the fuel cell. This additional drain enables periodical extraction of condensed moisture from the tanks while the airplane is in the static three point position. Tank probes are also included in some of these tanks for an external fuel quantity indicating system. For tanks that contain external fuel quantity indicating tank probes see table 5-5A. The 1800 pound capacity external fuel tank has access covers on each side of the tank for repairing, replacing parts, or cleaning the inside of the tank. The 900 pound capacity external fuel tank only has access covers on the left-hand side.

NOTE

An adapter and hose must be used as connectors when drop tanks are installed.

5-219A. The ATP-D1 400-gallon external fuel tank (Douglas-5556400) differs from the Aero 150 and 300 gallon external tanks in that it is larger, it has no access doors, it incorporates a pressure fueling system, and a fuel quantity probe. Access to the internal parts is accomplished by removing the hose assembly. The nose assembly attaching bolts are made accessible by removing the pressure fueling shut-off valve which is located on the forward left-hand side of the tank. The pressure fueling system comprises a pressure fueling shut-off valve, and a pilot float vent valve assembly. Each of the tanks is provided with a removable fuel strainer assembly in order that a tanker fuel booster pump may be installed. The fuel booster pump is part of the tanker conversion kit. Information concerning the fuel booster pump and additional information on the 400-gallon auxiliary fuel tanks may be found in section IV under the in-flight fueling system. An extended lug is used as the forward suspension lug to ensure the tank's clearance from the ground when the landing gear shock strut is compressed and the tire flat.

CAUTION

Lock bottom dive brake in closed position when using ATP-D1 400-gallon external tank (Douglas-5556400) on centerline stores rack. (Refer to paragraph 2-138.)

5-219B. A displacing strut socket has been installed through the lower wing plating aft of each center wing external stores rack so that a displacing strut can be used when applicable. Refer to table 5-6.

5-220. PURGING. External auxiliary tanks are purged in the same manner as the main fuel cell. (Refer to paragraph 5-192.

TABLE 5-5A. EXTERNAL FUEL QUANTITY INDICATING TANK PROBES

Tank Part Numbers	Tank Capacity	Tank Probe Part Numbers
5548328-503 (Pressurized)	150 Gallon	Liquidometer EA 772DLP-1551
5265098-515 or -517	300 Gallon	Liquidometer EA 772DLP-1552
7548503-503	300 Gallon	Liquidometer EA 772DLP-1552
5556400	400 Gallon	Liquidometer EA 772DLP-1553

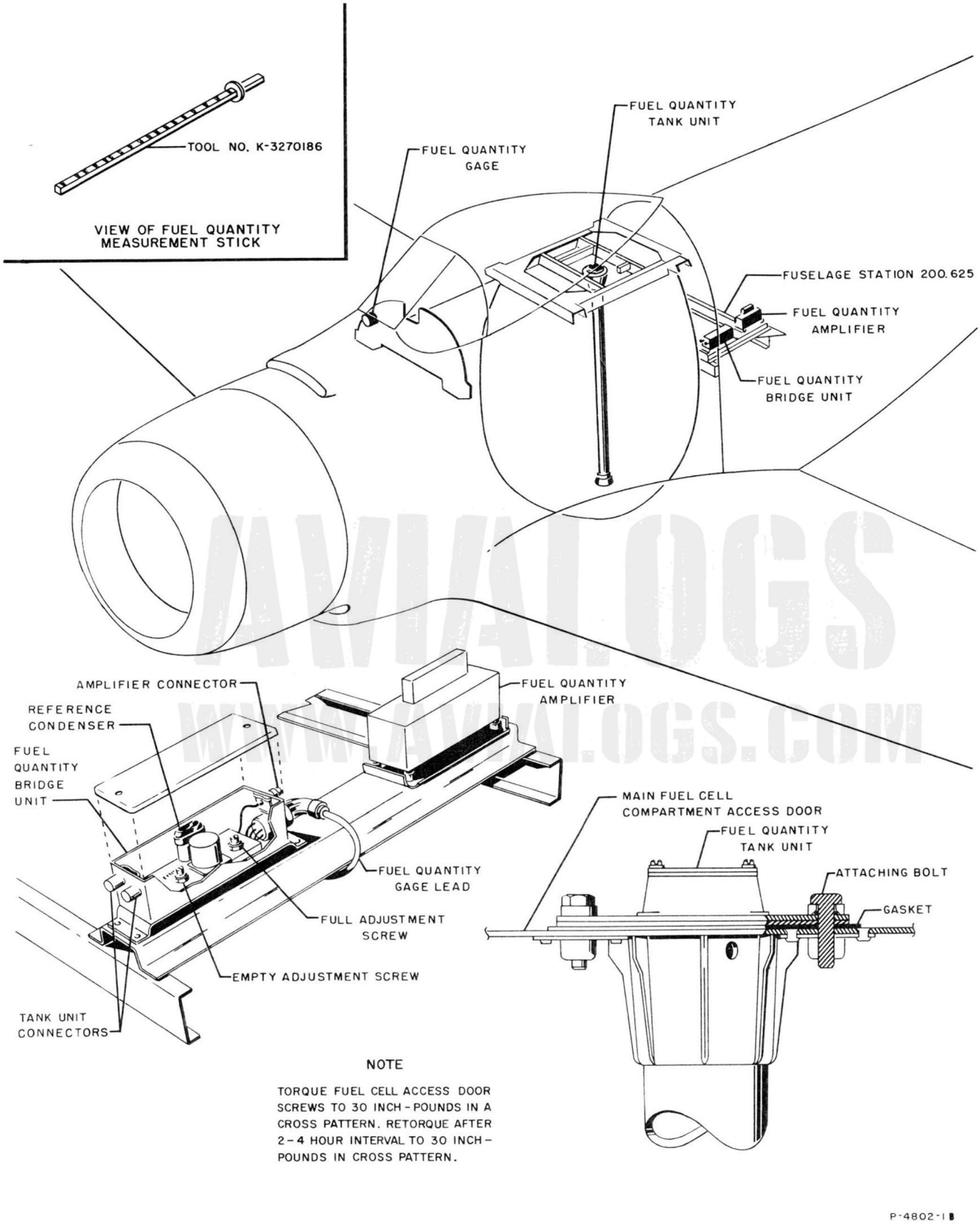


Figure 5–27. Fuel Quantity Indicating System — Main Fuel Cell

5-221. REMOVAL.

a. Place fuel tank selector valve handle in OFF.

b. Remove drain plug from tank and drain fuel into suitable container.

WARNING

For fueling or defueling external auxiliary fuel tanks, ground fuel nozzle to stores rack or to rack fairing.

c. Support tank and operate manual release at external stores rack to release tank.

WARNING

Manual release at each rack is recommended to avoid danger entailed by inadvertent electric release from fuselage (ejector) rack when airplane is on ground. However, when tanks are installed only on wing racks, they can be released electrically.

d. Lower tank to ground: fuel supply line hose will disconnect at point where it attaches to supply line in rack fairing.

e. Remove plugs from stowage clamps (in wheel wells

TABLE 5-6. AUXILIARY FUEL TANK HOOK SUSPENSION AND CONFIGURATION DATA APPLICABLE TO AUXILIARY FUEL TANKS USED WITH MARK 51 BOMB RACKS (SEE FIGURES 5-27A AND 5-27B.)

Auxiliary Tank and Capacity	Stores Rack Location	Required Tank Configuration	Hook Suspension	Remarks
MK 8 MOD 1 (300 gallon)	Centerline Stores Rack	Without Fins	30 inch or 14 inch	Use adapters Part No. 4554843 or 4554821 as required.
	Inner Wing Stores Rack	Without Fins With Displacing Struts	30 inch or 14 inch	Use Aero 1A adapters with 30 inch suspension.
MK 12 (150 gallon)	Centerline Stores Rack	Without Fins	30 inch or 14 inch	
	Inner Wing Stores Rack	With Fins	30 inch or 14 inch	Use Aero 1A adapters with 30 inch suspension.
AERO 1A (300 gallon)	Centerline Stores Rack	Short Tail Cone Without Fins	30 inch or 14 inch	Use Douglas Part No. 2430537-501 lugs (2 required) with 30 inch suspension. Use Douglas Part No. 2430533-501 lugs (2 required) with 14 inch suspension.
	Inner Wing Stores Rack	Long Tail Cone With Horizontal Fins Only	30 inch or 14 inch	Use Aero 1A adapters and Douglas Part No. 2430537-501 lugs (2 required) with 30 inch suspension. Use Douglas Part No. 2430533-501 lugs (2 required) with 14 inch suspension.
AERO 1A (150 gallon)	Centerline Stores Rack	Horizontal Fins, or Without Fins	14 inch	Use Douglas Part No. 2430533-501 lugs (2 required) with 14 inch suspension.
	Inner Wing Stores Rack	Horizontal Fins Only	14 inch	Use Douglas Part No. 2430533-501 lugs (2 required) with 14 inch suspension.
AERO 1A (400 gallon)	Centerline Stores Rack	Horizontal Fins	30 inch or 14 inch	Use Douglas Part No. 4555001 forward lug (1 required) and rear lug 4544419 (1 required) with 30-inch suspension.
	Inner Wing Stores Rack	Horizontal Fins	30 inch or 14 inch	Use Douglas Part No. 4555001 forward lug (1 required) and rear lug 4544419 (1 required) with 30-inch suspension.

TANK RELEASE METHOD ON GROUND

Manual release at each rack is recommended to avoid danger entailed by inadvertent electric release from centerline (ejector) rack when airplane is on ground. However, when tanks are installed only on wing racks, they can be released electrically.

NOTE

For information regarding jettison of auxiliary fuel tanks during flight, refer to NATOPS Flight Manual Navy Model A-1H and A-1J aircraft.

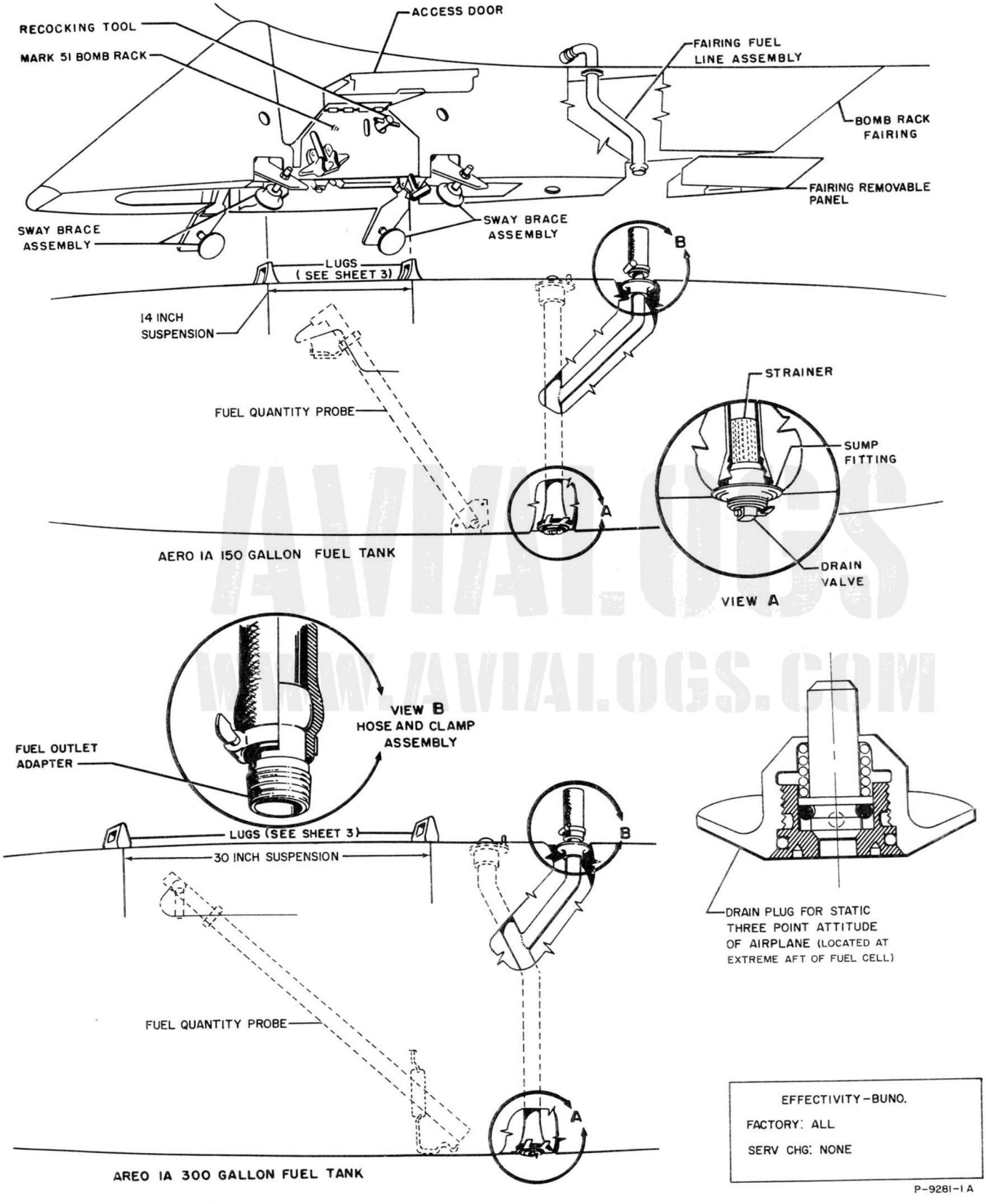


Figure 5–27A. External Auxiliary Fuel Tank Installation (Sheet 1)

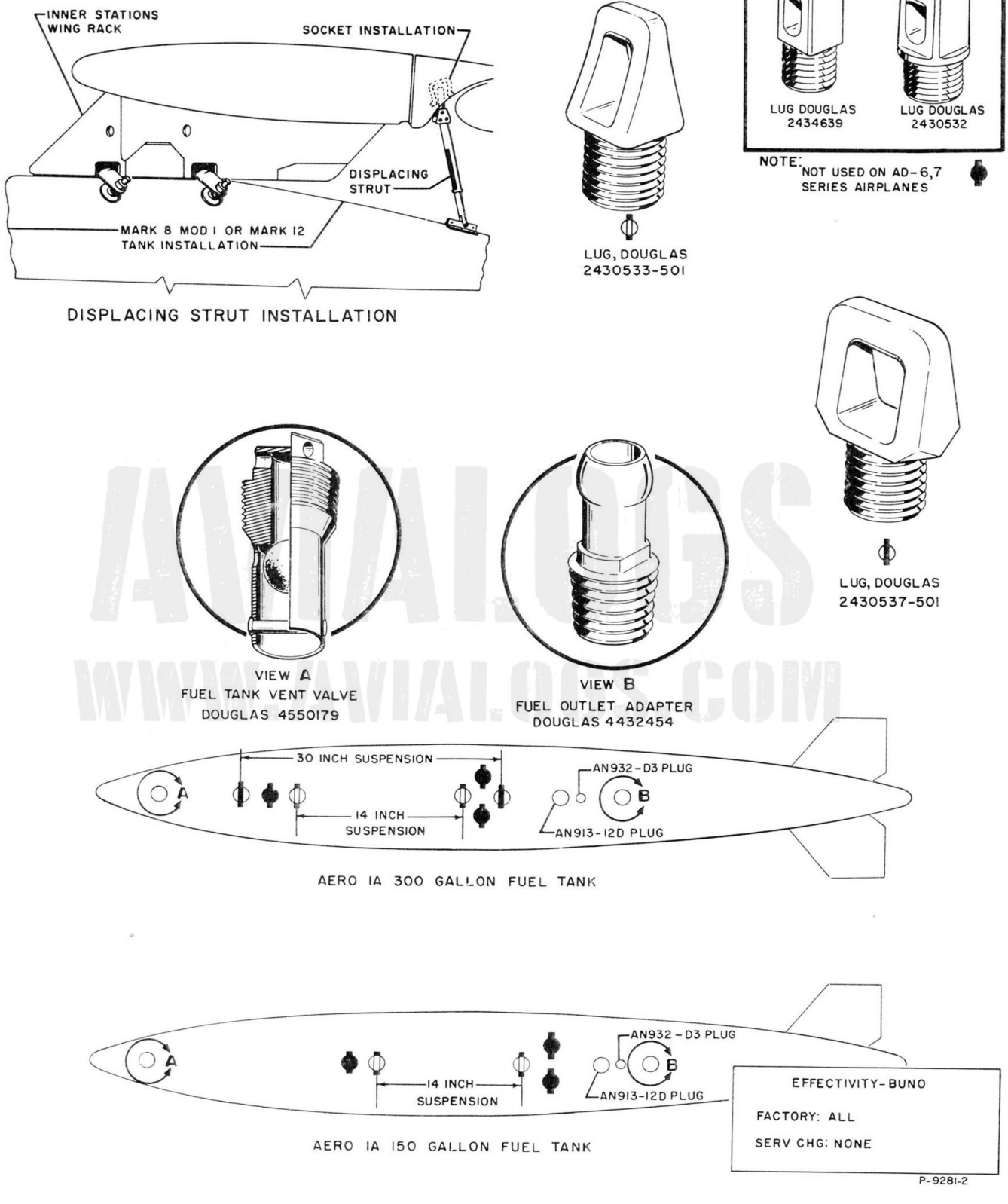
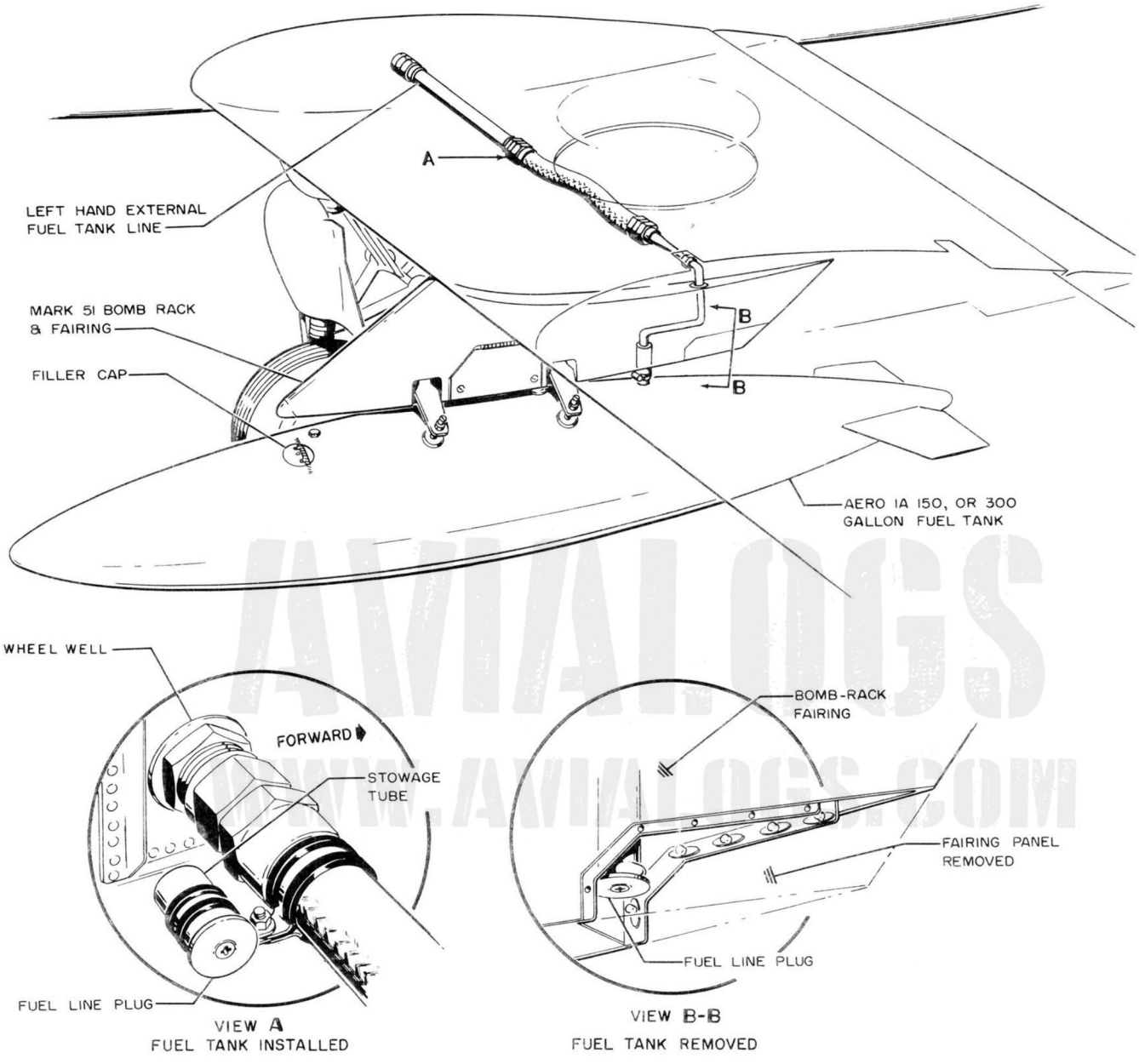


Figure 5–27A. External Auxiliary Fuel Tank Installation (Sheet 2)

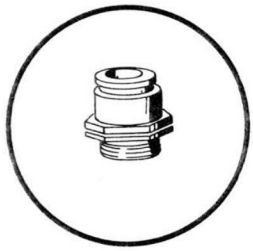


FUEL LINE PLUG ASSEMBLY (TYPICAL, RIGHT & LEFT HAND WING)

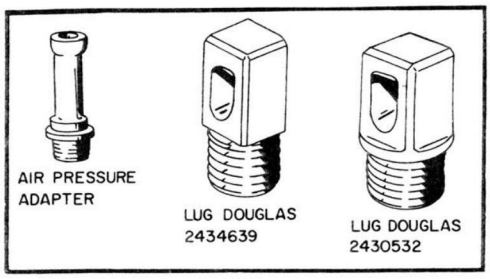
EFFECTIVITY-BUNO.
FACTORY : ALL
SERV. CHG: NONE

P-9281-3

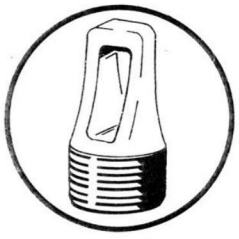
Figure 5–27A. External Auxiliary Fuel Tank Installation (Sheet 3)



ELECTRICAL QUICK
DISCONNECT ADAPTER



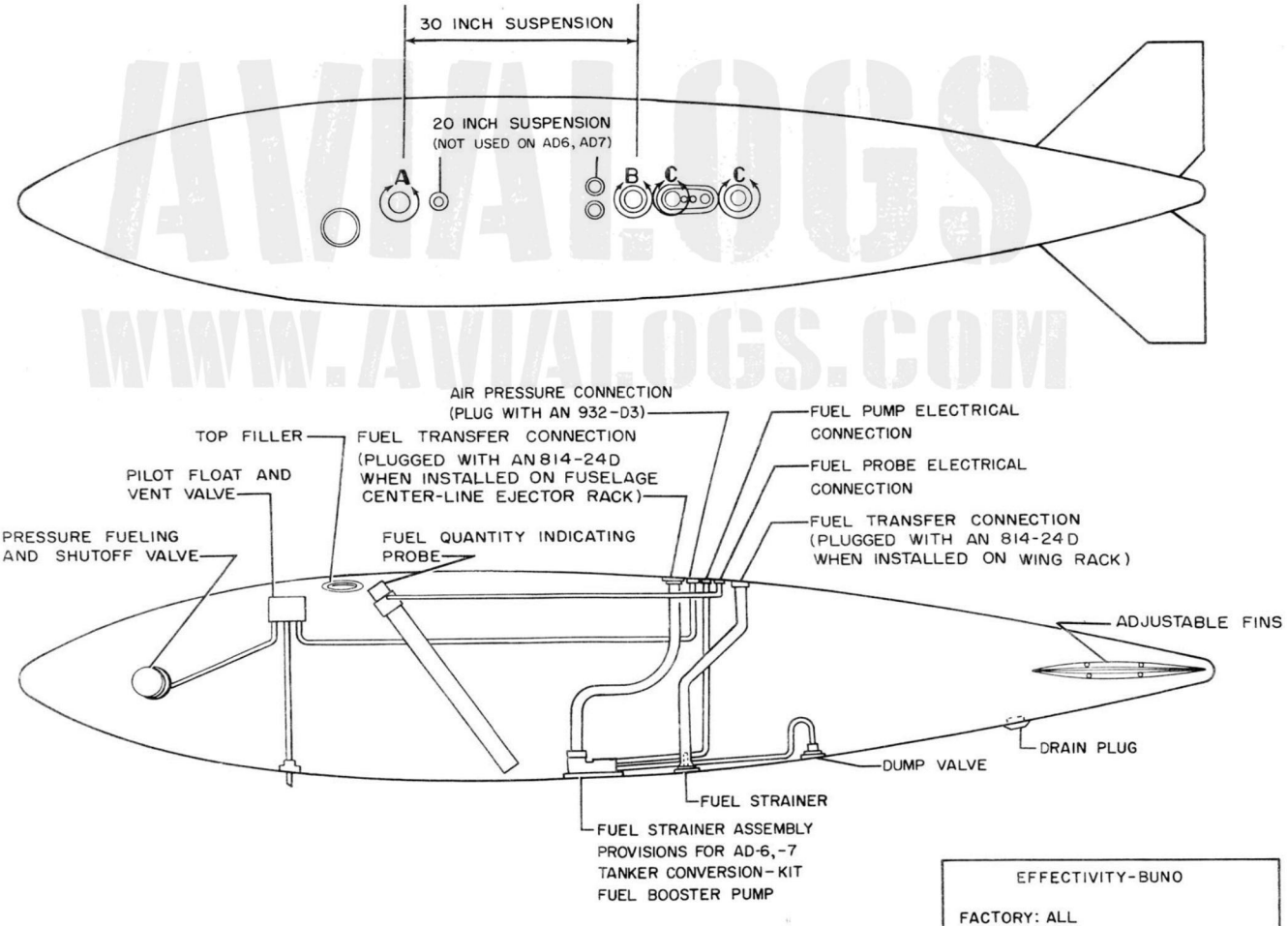
NOTE
NOT USED ON AD-6,7 SERIES AIRPLANES



VIEW A
FORWARD LUG (DOUGLAS 4555001)

VIEW B
AFT LUG (DOUGLAS 4544419)

VIEW C
FUEL HOSE ADAPTER (DOUGLAS 4550619)



400 GALLON FUEL TANK

EFFECTIVITY-BUNO

FACTORY: ALL
SERV CHG: NONE

P-9281-48

Figure 5-27A. External Auxiliary Fuel Tank Installation (Sheet 4)

and forward of main fuel cell lower access door) and install in open ends of fuel lines in stores rack fairings.

5-222. INSTALLATION. Inspect tank internally for foreign matter and flush clean before installing.

a. Attach applicable suspension lugs to top of tank. (Lugs to be used depend on type of stores rack installation.)

b. Open stores rack fairing access door and remove plug from metal fuel line in fairing. Stow plug in stowage clamp provided.

c. Connect short fuel supply line hose to metal fuel line inside fairing.

d. Raise fuel tank into position below rack.

e. Install tank by engaging tank lugs with hooks on rack.

f. Adjust rack sway braces.

NOTE

Use the MK-2 MOD-0 (short) cartridge in the center-line stores ejector rack when external fuel tank is installed on the rack.

g. On BuNo. 134525 and subsequent, install displacing strut when applicable. Refer to table 5-6.

NOTE

Step g is to be followed whenever Mark 8-MOD 1 external fuel tanks are carried at inner wing stores racks.

h. Install clamp where supply line hose attaches to fitting on tank.

CAUTION

Do not install clamp where hose connects with metal supply line in rack fairing.

i. Make certain that tank vent fitting is unobstructed.

j. Perform leakage check outlined in table 5-6B.

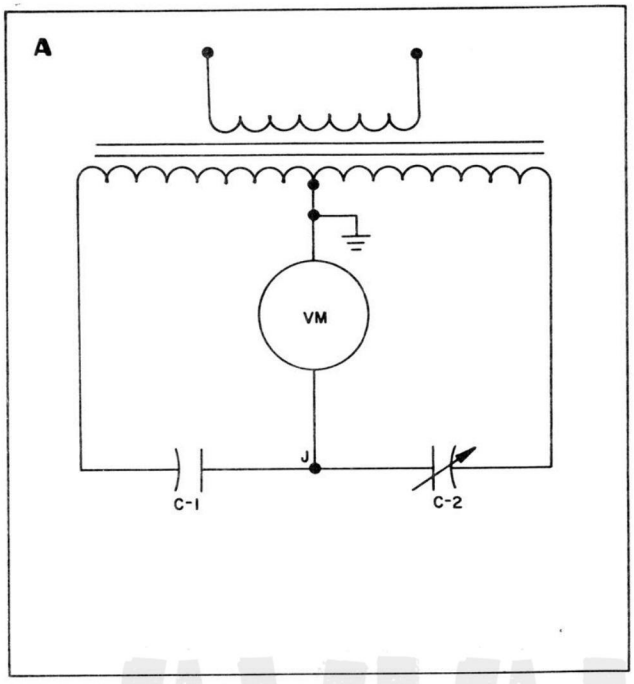
5-222A. EXTERNAL FUEL QUANTITY INDICATING SYSTEM.

5-222B. GENERAL. (See figure 5-27B.) The external fuel quantity indicating system is an uncompensated capacitor type indicating system in which three tank probes wired in parallel form one leg of a self-balancing capacitive bridge circuit. The tank probes are variable capacitors. Total capacitance of all three tank probes or the capacitance of any one of the tank probes is measured and displayed upon an indicator in terms of full weight. In order to maintain this system properly, it is necessary to understand the operating principle of a simple capacitive bridge circuit. By coordinating frames A, B and C of figure 5-27B, with the following explanation, the operating principle of the external fuel quantity indicating system will become apparent.

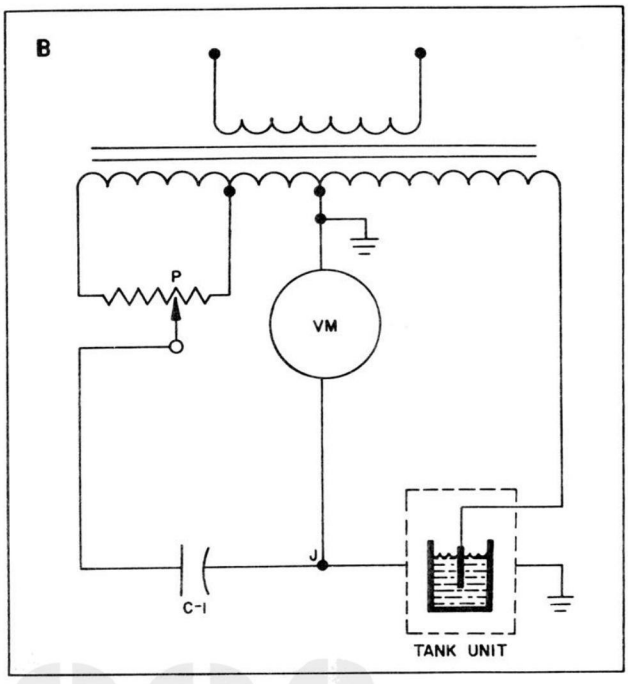
5-222C. In the simple capacitive bridge circuit, shown in frame A of figure 5-27B, two legs of the bridge are taken off the ends of a transformer secondary coil. To indicate the state of balance, a voltmeter is connected between center tap on the transformer secondary and junction point J of the two bridge legs. If capacitor C-1 and C-2 are equal, there will be no voltage at point J and consequently no reading on the voltmeter. If the capacitance of C-2 is made larger or smaller than C-1, the bridge would be unbalanced; the resulting voltage at J would be indicated by a reading on the voltmeter. Now assume that the capacitance C-2 is replaced by a tank probe partly filled with fuel, and that an adjustable potentiometer is inserted into the circuit P as shown in frame B of figure 5-27B. If the bridge is in balance when the fuel is at height shown, no voltage will be indicated on the voltmeter. If the fuel level changes, the capacitance of the tank probe will change; the bridge will become unbalanced, and voltage will be indicated on the voltmeter. By adjusting the potentiometer until the voltmeter reading drops to zero (null position), the bridge could be brought back into balance. Frame C of figure 5-27B shows a more complete schematic of the uncompensated capacitor type fuel indicating system. No voltmeter is used; instead, the center tap of the secondary coil is grounded, and an amplifier in a power unit is connected between the junction point J and ground. Therefore, any voltage which would be impressed on the voltmeter in frame B of figure 5-27B is fed into the amplifier. An amplifier step down transformer causes the motor in the indicator to rotate. The direction of rotation, determined by the phase relationship in the windings, is such as to move the wiper arm of the rebalancing potentiometer in the indicator until there is a minimum voltage at J and the bridge is again in balance. At the same time, the indicator pointer is also moved by the potentiometer shaft to provide a reading on the face of the indicator.

5-222D. The principal components of the external fuel quantity indicating system are as follows:

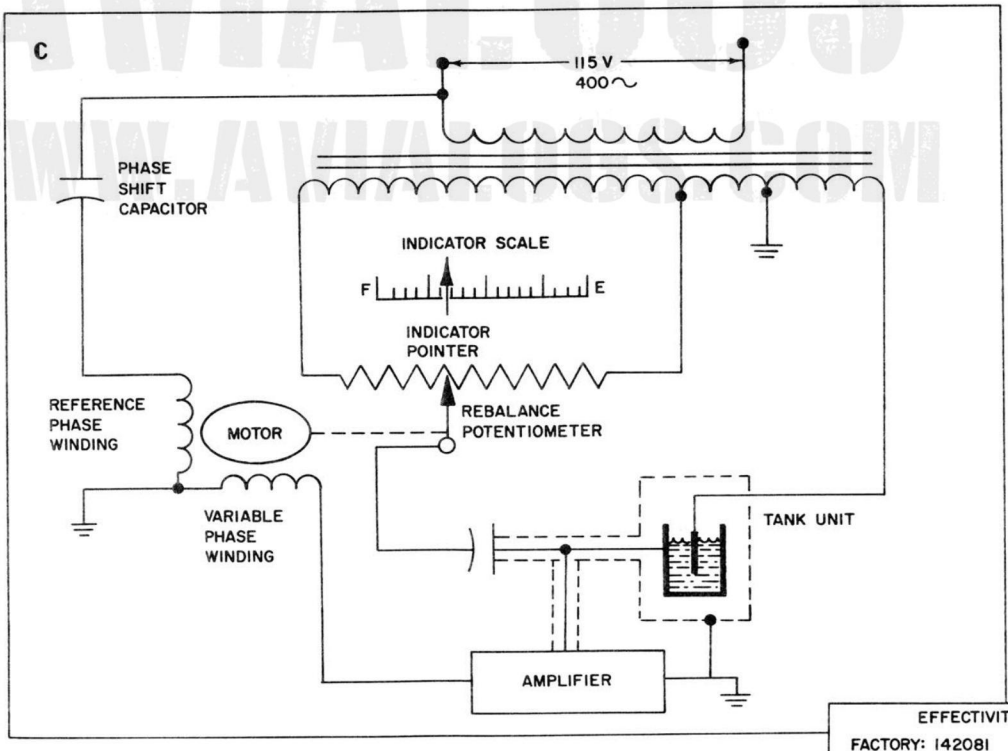
External Fuel Quantity Indicating Tank Probes
External Fuel Quantity Indicating Quick Disconnects
External Fuel Quantity Indicating Junction Box
External Fuel Quantity Indicating Selector Switch
External Fuel Quantity Indicating Power Unit
External Fuel Quantity Indicator
External Fuel Quantity Indicating Test Switch.



SIMPLIFIED CAPACITANCE BRIDGE



CAPACITANCE BRIDGE WITH TANK UNIT ON ONE LEG AND ADJUSTABLE POTENTIOMETER ON THE OTHER



SIMPLIFIED SCHEMATIC OF UNCOMPENSATED CAPACITOR TYPE FUEL QUANTITY INDICATING SYSTEM

EFFECTIVITY - BUNO.
FACTORY: 142081
SERV CHG: PRIOR AIRPLANES REWORKED PER BUAER AD/SC NUMBER 672

P-10005-1

Figure 5–27B. External Fuel Indicating System Schematic

5–222E. TROUBLE SHOOTING. Refer to table 5–5.

5–222F. ADJUSTMENT. (See figures 2–27B and 2–27C.)

a. With empty external tanks installed at all three bomb rack positions, connect 28 V d-c to d-c external power receptacle.

b. Engage number 2 inverter circuit breaker and allow system to warm up for 15 minutes.

c. Place selector switch in TOTAL position.

d. Loosen adjustment coverplate nut on rear of power unit and rotate coverplate counterclockwise.

e. Adjust empty screw (E) on power unit until indicator pointer reads zero.

f. Disconnect high and low impedance plugs from power unit.

g. Install tee connectors (Liquidometer S68TL and S68TH, or equivalent) on power unit.

h. Re-connect system low and high impedance plugs to tee connectors installed in step g.

i. Connect precision variable capacitor (Specification MIL-T-8579, type MD-1 or equivalent) to tee connectors installed in step g.

Note

Variable capacitor is now connected in parallel with tank probes.

j. Set precision variable capacitor to 325.64 $\mu\mu$f and adjust full screw (F) on power unit until indicator pointer reads 8000-pounds.

k. Disconnect precision variable capacitor.

l. Repeat steps e, i, and j until no further adjustment is necessary.

m. Set selector switch in left-hand, center, and right-hand external tank positions; indicator should indicate zero $\pm$100-pounds for each position.

n. Remove tee connectors from power unit, and re-install system plugs on power unit.

o. Disengage number 2 inverter circuit breaker and disconnect external power from airplane.

5–222G. EXTERNAL FUEL QUANTITY INDICATING TANK PROBES.

5–222H. DESCRIPTION. (See figure 5–27C.) The probes are tubular capacitors, internally mounted in the auxiliary fuel tanks. One in each tank. Two coaxial cables are provided with each probe to interconnect the active elements of the probe with the fuel indicating receptacle on top of the tank. For Liquidometer miniature bayonet type electrical connectors, see figure 5–27D. The tank receptacle contains two jacks inside of the tank and two female contacts imbedded in plastic on the outside of the tank. One jack of the tank receptacle contains a male contact identified by red coding. The other jack contains a female contact identified by white coding. Exercise care when connecting probe line plugs to the tank receptacle jacks to insure correct mechanical and code mating of the contacts in the tank. The plastic on the outside of the tank is slotted in a manner that prevents mismating of the quick disconnect plug. The probe consists of an outer tubular jacket containing an inner assembly of two concentrically arranged tubes. The jacket and the tubes are vented so that the fuel level inside the probe is the same as that of the tank. The jacket acts as a grounded shield to remove the effects of stray capacitance, and as a mechanical support for the inner tubes. The inner tubes are the plates of the capacitor.

5–222J. Capacitance of a capacitor is determined by three variables: (1) the area of the plates, (2) the distance between the plates, and (3) the dielectric insulating material between the plates. The tank probes are fixed in area and in the distance between the plates. Therefore, the capacitance of the tank probes will vary only with a change in the dielectric of the insulating material between the plates, which in this case is fuel and air. Since the dielectric of fuel is approximately twice that of air, a tank probe full of fuel has twice the capacitance of an empty tank; intermediate fuel levels produce proportionate capacitance. Total capacitance of all three tank probes, or the capacitance of any one of the tank probes, is measured by a self-balancing capacitive bridge circuit, and the result is mechanically transferred to an instrument panel indicator where it is displayed on a graduated scale in pounds of fuel.

CAUTION

DO NOT interchange tank probes between tanks of different capacity.

5–222K. REMOVAL. (For 150 gallons and 300 gallons tanks.)

a. Defuel tank. (Refer to Section V.)

b. Purge tank. (Refer to Section V.)

c. Remove aft access panel.

d. Disconnect coaxial cables from tank receptacle.

e. Remove clamp holding upper portion of probe to support.

f. Disengage lower portion of tank probe from grommet and remove probe from tank.

5–222L. INSTALLATION. (For 150 gallons and 300 gallons tanks.)

a. Place probe in tank through aft access and insert lower portion of probe through grommet in tank bulkhead.

b. Clamp upper part of probe to support.

c. Connect coaxial leads to tank receptacle (connect red to red and white to white).

5–222M. REMOVAL. (For 400 gallon tank.)

a. Defuel tank. (Refer to Section V.)

b. Purge tank. (Refer to Section V.)

c. Remove pressure fueling regulator from tank.

d. Remove nose of tank (bolts are accessible through pressure-fueling regulator access).

e. Disconnect probe from upper and lower supports.

f. Disconnect coaxial cable leads from tank receptacle.

g. Remove probe from tank.

5–222N. INSTALLATION. (For 400 gallon tank.)

a. Remove pressure fueling regulator from tank.

b. Remove nose of tank (bolts are accessible through pressure-fueling regulator access).

c. Connect coaxial leads to tank receptacles (connect red to red and white to white).

d. Connect upper and lower portions of tank probe to upper and lower supports respectively.

e. Re-install nose of tank.

f. Re-install pressure fueling regulator.

5–222P. EXTERNAL FUEL QUANTITY INDICATING QUICK DISCONNECT CABLES.

5–222Q. DESCRIPTION. The external fuel quantity indicating quick disconnect cables provide the means of disengaging aircraft system wiring from the auxiliary fuel tanks. The cables are suspended from a support bolt in the trailing edge of each bomb rack fairing, and extend into the center wing where they connect to supported bulkhead adapters. The quick disconnect plugs are keyed to correctly engage the auxiliary-tank external fuel quantity indicating receptacles. Each quick disconnect plug contains a capacitor which is equivalent to empty capacitance of an auxiliary tank. As the quick disconnect plug breaks contact with the tank receptacle, the breakaway action inserts the capacitor into the external quantity fuel indicating system. Thus, the integrity of the system is continued and an empty indication is given for the missing tank. When the quick disconnect plug engages the tank receptacle, the capacitor is mechanically removed from the circuit, and the system receives capacitance that is equivalent to the amount of the fuel within the tank. The line plugs of the cable connect to bulkhead adapters, located on a drop tank disconnect and stowage support within the wing. The white coded plug or low impedance plug attaches to adapter labeled "A," and the red coded plug or high impedance plug attaches to adapter labeled "B." When auxiliary fuel tanks are not carried on the airplane, the quick disconnect cables are stored on the drop tank disconnect and stowage supports. The drop tank disconnect and stowage supports are accessible through access openings adjacent to each bomb rack.

5–222R. REMOVAL.

a. Remove access cover adjacent to aft end of bomb rack.

b. Working through access, disconnect quick disconnect plugs from supported adapters "A" and "B."

c. Loosen bomb-rack-fairing cable support bolt and slip disconnect cable lanyard from bolt.

d. Remove quick disconnect cable and re-install cable support bolt.

5–222S. INSTALLATION.

Note

Steps a, b, e and h are NOT necessary for fuselage bomb rack.

a. Remove bomb-rack sway brace assemblies.

b. Remove bomb rack fairing.

c. Insert double plugged end of quick disconnect cable through 5/8-inch hole, approximately 5 inches aft of spray tank receptacle.

d. Working through adjacent access, attach white plug to supported adapter labeled "A" and red plug to supported adapter labeled "B."

e. Re-install bomb rack fairing.

f. Loosen bomb-rack-fairing cable support bolt, located on left side of fairing.

g. Insert fairing cable support bolt through lanyard of quick disconnect plug and re-install support bolt.

h. Re-install bomb-rack sway brace assemblies.

5–222T. EXTERNAL FUEL QUANTITY INDICATING JUNCTION BOX.

5–222U. DESCRIPTION. (See figure 5–27C.) The external fuel quantity indicating junction box is located in the forward equipment compartment, above and to the left of the external fuel quantity indicating power unit. The junction box contains five high impedance jacks connected in series. It acts as a central terminal for all high impedance leads and permits the system to indicate a total fuel quantity reading, when the selector switch is placed in "TOTAL."

5–222V. EXTERNAL FUEL QUANTITY INDICATING SELECTOR SWITCH.

5–222W. DESCRIPTION. (See figure 5–27C.) The external fuel quantity indicating selector switch is located on the cockpit left-hand console, just outboard of the fuel selector. It is a four-position, four-pole, manually operated switch which permits selection of the capacitance for either one or all of the three external fuel quantity probes. The switch incorporates a fixed capacitor equal in value to empty capacitance of any two of the three tank probes. When a quantity reading is desired for one tank, the switch is rotated to the tank desired. The switch action inserts the capacitor into the system circuit and grounds the quantity probes in the other two tanks. Consequently, the system appears empty for the grounded probes, and the quantity shown on the indicator reflects only the contents of the tank selected. For a

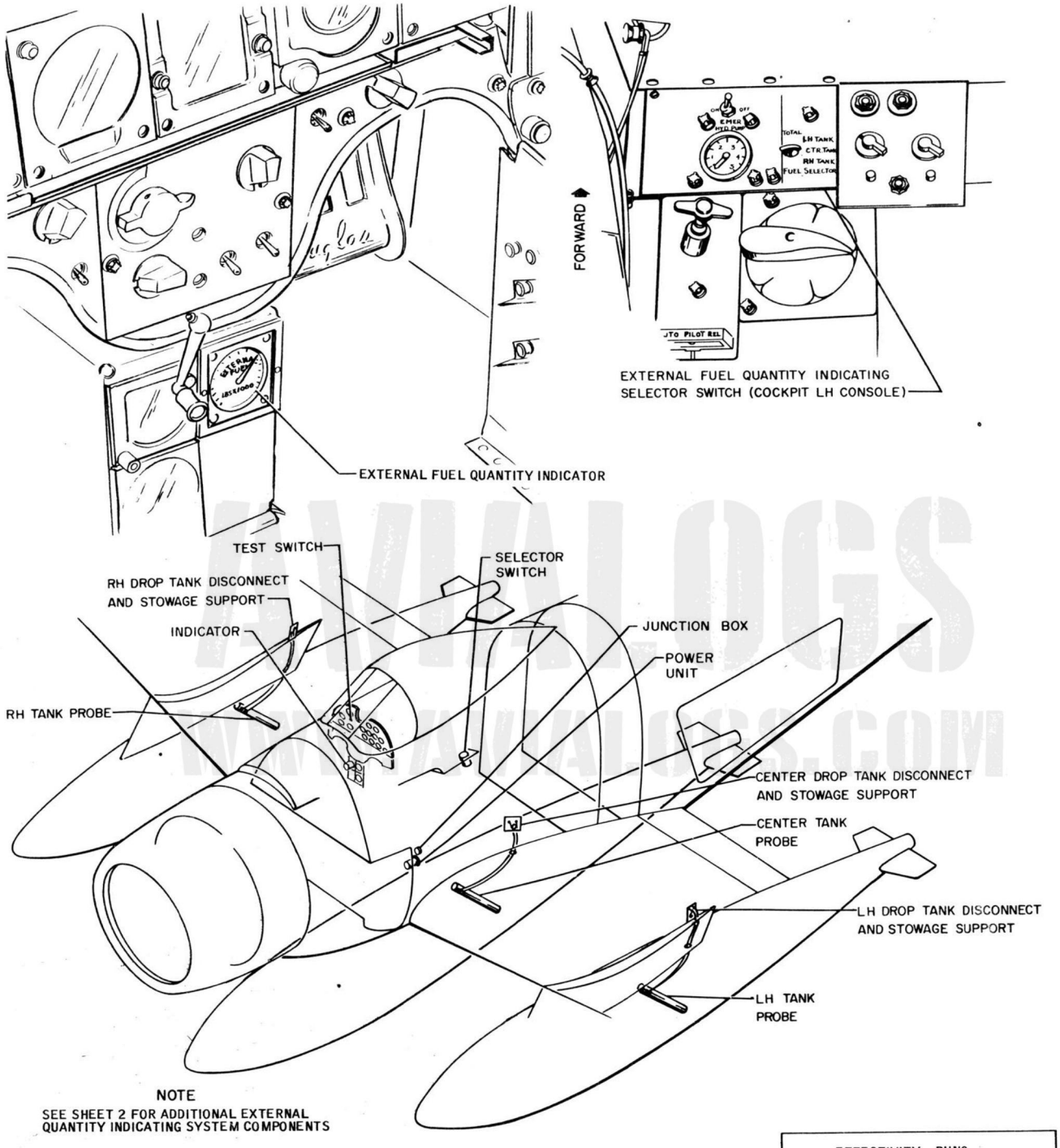
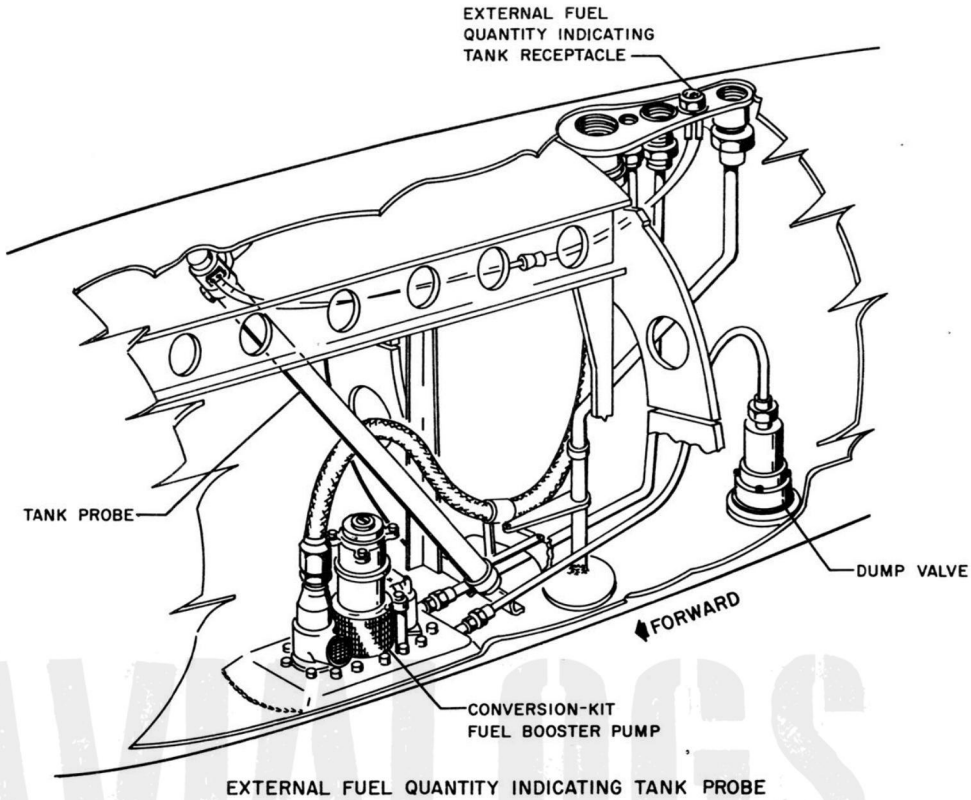
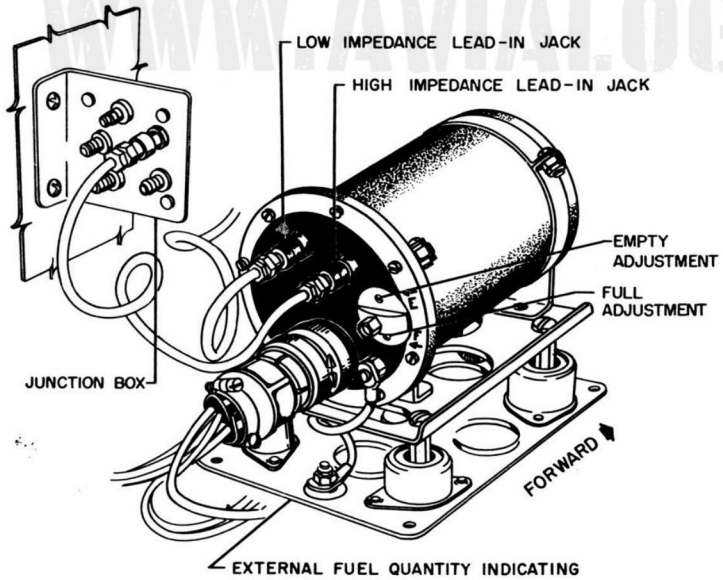


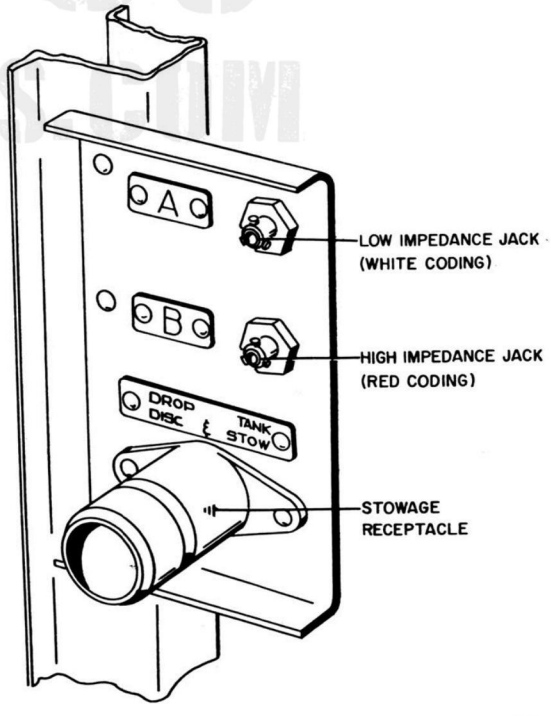
Figure 5-27C. External Fuel Indicating System Components (Sheet 1)



EXTERNAL FUEL QUANTITY INDICATING TANK PROBE
(SHOWN IN 400 GALLON TANK)



EXTERNAL FUEL QUANTITY INDICATING POWER UNIT (VOLTAGE REGULATOR SHELF, FORWARD OF LH FORWARD EQUIPMENT COMPARTMENT ACCESS)



DROP TANK DISCONNECT AND STOWAGE SUPPORT
(ABOVE EACH BOMB RACK WITHIN CENTER WING)

P-10006-2

Figure 5-27C. External Fuel Indicating System Components (Sheet 2)

total fuel quantity reading of all three external tanks combined, the selector grounds the fixed capacitor and the power unit receives a combined capacitive signal from the junction box.

5-222X. REMOVAL.

a. Remove side panel from cockpit left-hand console.

b. Remove selector switch knob.

c. Disconnect electrical plugs.

d. Holding bottom of switch through console access, remove nut from knob shaft.

e. Remove switch through access.

5-222Y. INSTALLATION.

a. Remove side panel from cockpit left-hand console.

b. Insert switch shaft through hole outboard of fuel selector.

c. Align switch so that high impedance jack is facing pilot's seat.

d. Place locking ring, lockwasher and nut over protruding shaft and secure by hand.

e. Align switch knob with lighting panel callouts.

f. Adjust if necessary and then tighten nut with open-end wrench.

g. Install knob so that it points toward TOTAL.

h. Connect high impedance plug to switch jack. Connect electrical plug to bottom of switch.

i. Re-install side panel on cockpit left-hand console.

5-222Z. EXTERNAL FUEL QUANTITY INDICATING POWER UNIT.

5-222AA. DESCRIPTION. (See figure 5-27C.) The external fuel quantity indicating power unit is located on the dc voltage regulator shelf, just forward of the left-hand forward equipment compartment access. It is identified by a nameplate labeled DROP TANK. The unit includes a bridge transformer, a reference capacitor, and a voltage sensing amplifying circuit. The bridge transformer primary coil is energized by the number 2 inverter phase C, 115 V, 400 cycle bus. Its secondary coil is center tapped to form two legs of the capacitive bridge, while the reference capacitor and the tank probes form the other two legs, respectively. To complete the bridge circuit, the amplifier is connected between center tap and between the reference capacitor and probes.

5-222AB. In order to standardize the unit for different size tanks, one leg of the transformer includes four adjustments: range, empty, full and bridge rebalancing. The range adjustment is a factory adjustment that provides a middle capacitance in order to cause the indicator needle to swing left or right. The empty and full adjustments provide a means for making one leg of the bridge equal to empty and full capacitance of the external fuel tanks used. Both adjustments are located on the power unit case to the right of the receptacle, and are accessible by loosening the cover nut and then rotating the cover counterclockwise. The rebalancing potentiometer is located in the indicator and it operates to balance the bridge for fuel quantity change between empty and full capacitances. The rebalancing potentiometer is wired in parallel with one leg of the bridge transformer. When the bridge becomes unbalanced because of a change in fuel quantity, a voltage is created across the amplifier. The amplified voltage is placed across a step down transformer which increases the current sufficiently to run an indicator motor. The indicator motor in turn moves the rebalancing potentiometer until one leg of the bridge becomes equal to the capacitance of the remaining fuel. Thus, the bridge is balanced, the voltage input to the amplifier ceases, and the indicator needle registers the fuel quantity change.

5-222AC. REMOVAL.

a. Disconnect electrical connectors.

b. Remove screws attaching shock mount to dc voltage regulator shelf and remove power unit with mount attached.

5-222AD. INSTALLATION.

a. Place power unit with shock mount attached in position on dc voltage regulator shelf.

b. Secure with screws.

c. Connect electrical connectors (connect red to red and white to white).

5-222AE. EXTERNAL FUEL QUANTITY INDICATOR.

5-222AF. DESCRIPTION. (See figure 5-27C.) The external fuel quantity indicator is mounted on an extension to the pilot's instrument panel located on the centerline of the cockpit just below the armament panel. The indicator includes a two phase miniature motor, a rebalancing potentiometer, a graduated scale and a needle that pivots above the scale between zero and 800-pounds. The motor is energized through an amplifier step down transformer to move the arm of the rebalancing potentiometer until the potentiometer balances one leg of the bridge transformer with the capacitative change of the external tank probes. When this happens, the bridge becomes balanced; voltage ceases; current no longer flows; and the indicator motor stops. Because the indicator needle is indirectly connected to the monitor, it stops and remains in the new indicating position until the bridge is again unbalanced by a fuel quantity change.

5-222AG. EXTERNAL FUEL QUANTITY INDICATING TEST SWITCH.

5-222AH. DESCRIPTION. (See figure 5-27C.) Provisions for a test switch to unbalance the bridge is made in the external fuel quantity indicating power unit. The switch is the same switch which unbalances the main fuel cell capacitive bridge circuit. In operation, it momentarily reduces the voltage to the tank probes by shunting the bridge to ground. This unbalances the bridge and provides a qualitative indication of a malfunction in the system. When the switch is released, the correct fuel capacitance of both the external fuel tanks and the main fuel cell is shown on their respective instruments. The test switch is located on the right-hand side of the instrument panel, adjacent to the main fuel cell quantity indicator.

TABLE 5–6A. TESTING EXTERNAL FUEL QUANTITY INDICATING SYSTEM

1. EQUIPMENT REQUIRED:

a. Three wire capacitive bridge and megohmmeter tester (Specification MIL-T-4687, type MD-2 tester or equivalent).

b. Precision variable capacitor (Specification MIL-T-8579, type MD-1 tester or equivalent).

c. Continuity tester.

2. PRELIMINARY CONDITIONS:

a. Connect 28 V d-c external power receptacle.

b. Engage number 2 inverter circuit breaker.

3. INDICATOR AND POWER UNIT TEST:

Note

High impedance side of circuit is distinguishable by red insert in connector. Low impedance side of circuit is distinguishable by white insert in connector.

Procedure	*Desired Result*
a. Disconnect low and high impedance plugs from power unit.	
b. Connect precision variable capacitor to low and high impedance jacks on power unit.	
c. Set variable capacitor to 285.39 $\mu\mu f$.	
d. Uncover power unit empty (E) and full (F) adjustment screws.	
e. Adjust empty screw until indicator pointer reads zero.	Indicator points to zero.
f. Set precision variable capacitor to 611.03 $\mu\mu f$.	
g. Adjust full screw until indicator pointer reads 8000-pounds.	Indicator points to 8.
h. Repeat steps c, e, f and g until no further adjustment is necessary.	When pointer comes to rest after each setting, use fuel quantity test switch to unbalance system; then allow system to rebalance itself.
i. Adjust precision variable capacitor for intermediate indicator readings as follows:	Repeat desired result for step h.

Indicator Reading in pounds	*Precision variable capacitor in $\mu\mu f$*
0	285.39 ± 1.0
1000	326.09 ± 2.5
2000	366.80 ± 2.5
3000	407.50 ± 2.5
4000	448.21 ± 2.5
5000	488.71 ± 2.5
6000	529.62 ± 2.5
7000	570.32 ± 2.5
8000	611.03 ± 1.0

4. TANK PROBE TEST:

Procedure	*Desired Result*
a. Disconnect low and high impedance plugs at power unit.	
b. Connect plugs disconnected in step a to capacitive bridge and megohmmeter tester.	
c. With tanks empty read capacitance on tester.	Tester should read 285.39 ± 2.8 $\mu\mu f$.
d. With megohmmeter check insulation resistance between plugs and between each plug and ground.	Insulation resistance should be greater than 500 megohms under a relative humidity of NOT more than 50%.
e. Disconnect bridge and megohmmeter tester and restore system circuitry.	
f. Disconnect tanks from airplane.	
g. With tanks empty, connect bridge and megohmmeter tester to external fuel quantity indicating receptacle of each tank. Test each tank probe for capacitance and insulation resistance.	Capacitance value should be 95.13 ± 1.0 $\mu\mu f$. Insulation resistance between electrodes and electrodes and ground should be greater than 500 megohms under a relative humidity of NOT more than 50%.

5. QUICK DISCONNECT CABLE TEST:

Procedure	*Desired Result*
a. Disconnect low and high impedance plugs at power unit.	
b. Connect capacitive bridge and megohmmeter tester to plugs disconnected in step a.	
c. Remove external tanks.	
d. Check insulation resistance.	Insulation resistance should be greater than 500 megohms under relative humidity of NOT more than 50%.
e. Remove bridge and megohmmeter tester and connect it to breakaway plug at bomb rack.	
f. Actuate breakaway plug placing internal capacitor into circuit and measure capacitance.	Capacitance value should be 95.13 ± 1.0 $\mu\mu f$.
g. Measure insulation resistance.	Insulation resistance should be the same as desired result of step d.

6. SELECTOR SWITCH TEST:

Procedure	*Desired Result*
a. With tanks empty rotate selector switch through all positions.	Indicator should NOT change from zero reading ± 100-pounds.

Note

If results obtained in step a are unsatisfactory proceed with the following:

b. Disconnect wiring from selector switch.	

TABLE 5–6A. TESTING EXTERNAL FUEL QUANTITY INDICATING SYSTEM (Continued)

6. SELECTOR SWITCH TEST: (Cont'd)

Procedure	*Desired Result*
c. Connect pin A of selector switch to low impedance jack of capacitive bridge and megohmmeter tester.	
d. Connect pin B of selector coaxially to a capacitor of 82 $\mu\mu f$.	
e. In parallel with pin B connect pin C to a capacitor of 68 $\mu\mu f$.	
f. In parallel with pins B and C connect pin D to a capacitor of 50 $\mu\mu f$.	
g. Connect high impedance jack of selector switch in parallel with pins B, C and D.	
h. Ground pin E of selector switch.	
i. Ground shields of coaxial cables.	
j. Connect parallel circuit formed by steps d, e, f and g to high impedance jack of capacitive bridge and megohmmeter tester.	
Note Accuracy of capacitive bridge should be within .5% of full scale range selected.	
k. Check capacitive reading for all positions of selector switch.	Values should be as follows:

Position	*Reading in $\mu\mu f$*
Total	200 ± 2.0
Right-hand	272 ± 2.7
Center	258 ± 2.6
Left-hand	240 ± 2.4

7. SYSTEM WIRING AND CONNECTOR TEST:

Procedure	*Desired Result*
a. Connect capacitive bridge and megohmmeter tester to high and low impedance plugs on power unit.	
b. Disconnect quick disconnect low and high impedance plugs from "DROP TANK DISC AND STOW" supports.	
c. Check insulation resistance of wires and connectors.	Value should be greater than 500 megohms.
Note If insulation resistance is NOT greater than 500 megohms, check for dirt and/or moisture in connectors. Clean and dry connectors or replace if damaged.	
d. Look for bends in radii of wiring.	Minimum bend radius should NOT be less than 2-inches.
e. Check system wiring for continuity per applicable wiring diagram in section X.	

TABLE 5–6B. EXTERNAL FUEL TRANSFER SYSTEM LEAKAGE CHECK

Procedure	*Desired Result*
1. With external fuel tanks empty, remove lower access door and support assembly.	
2. Remove lower hose connection from fuel strainer.	
3. Use following items to construct an adapter for connecting air pressure to lower hose connection: a. Pressure gage, 0-20 psi. b. Metering valve. c. Shut-off valve. d. Necessary connecting lines.	
4. Turn cockpit selector valve to MAIN TANK FEED.	
5. Connect adapter and apply 20 psig air pressure to lower tank hose. a. If leakage is noted, disconnect fuel line at selector valve and cap line. Recheck with 20 psig air pressure for 5 minutes.	No pressure drop permissible (5 minutes minimum).
b. If leakage still exists, use soap bubble test on all line connections.	
6. If no leakage is evident, disassemble and replace damaged parts of selector valve.	
7. Reassemble selector valve as follows and repressure test: a. Assemble valve without O-rings on poppets or under cover. b. Adjust fittings with shims so that each poppet has a closed position clearance of .004 to .012 inch between fitting and poppet. c. Remove cover and install O-rings.	
d. Reinstall cover and pressure test at 50 psig air pressure.	No allowable leakage.
8. Disconnect pressure adapter and reassemble tank connections.	

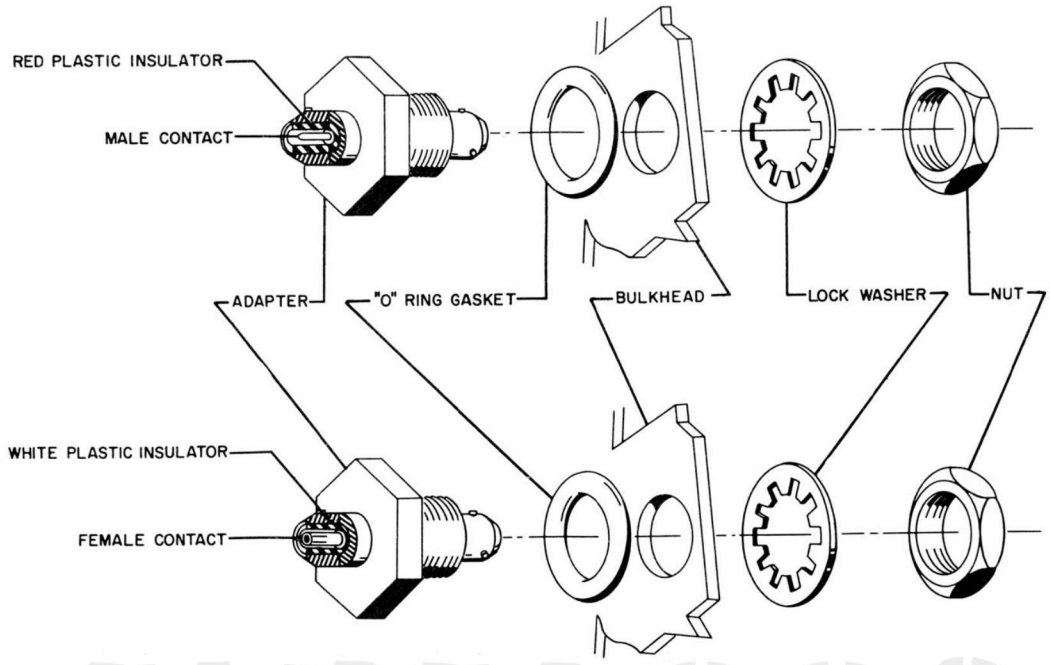


Figure 5-27D. External Fuel Quantity Indicating Cable and Cable Fitting Installation (Sheet 1)

5–223. FUEL TANK SELECTOR VALVE AND CONTROL.

5–224. DESCRIPTION. (See figure 5–28.) The cell or tank which is to supply fuel to the engine is selected by the fuel tank selector valve, controlled from the cockpit either in flight or on the ground. The installation comprises the following:

Name	*Location*
Selector valve	Forward equipment compartment—LH side
Control handle	Cockpit—LH control panel
Control linkage	Handle to valve

5–225. The selector valve is a five-ported, poppet type valve, with positive opening and closing action at each inlet (tank) port obtained by a special sealing O-ring. The poppets are actuated by rollers and a cam; the movement of the cam is controlled by the control handle and connecting linkage. Detents in the cam determine each positive position of the valve, and spring-loaded balls in the valve body engage the detents.

5–226. The control handle is seated in a dial plate which indicates positions that correspond to the inlet ports of the selector valve—"LH DROP," "MAIN," "CENTER DROP," and "RH DROP"—and "OFF." The handle is connected with the valve by linkage which consists of a control rod, extending from the handle through the control panel into the equipment compartment, and a universal joint by which the control rod is connected with the valve.

5–227. REMOVAL.

a. Defuel sources of fuel supply (main fuel cell and any external fuel tanks which are installed).

b. Remove lower left-hand panel of accessory cowling.

c. Attach hose to fuel system strainer drain valve, open valve, and drain fuel from strainer and supply line; then close drain valve.

d. Remove hose from strainer and replace lower left-hand panel of accessory cowling.

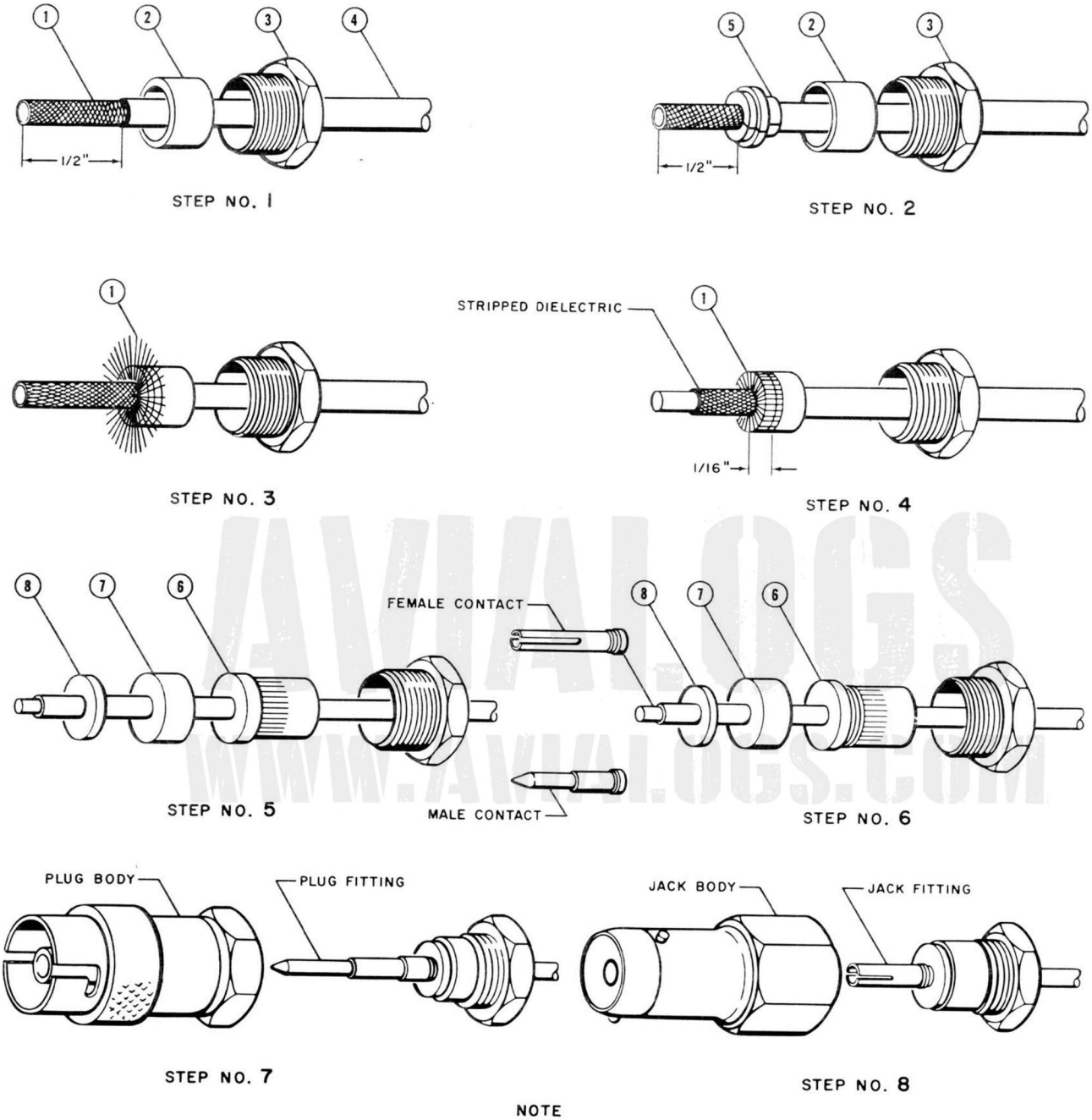
e. Open left-hand access door to forward equipment compartment.

f. Disconnect lines from fuel tank selector valve.

g. Remove bolts which attach control rod to universal joint at valve and to handle shank.

h. Remove bolt which attaches universal joint assembly to valve shaft.

i. Remove valve attaching bolts.



NOTE

FOR ASSEMBLY PROCEDURE
SEE SHEET 2

LIQUIDOMETER MINIATURE BAYONET TYPE CONNECTOR ASSEMBLY

ALF-2-5 P-10012-1A

Figure 5-27D. External Fuel Quantity Indicating Cable and Cable Fitting Installation (Sheet 2)

ASSEMBLY PROCEDURE

a. Slide clamp nut (3) and bushing (2) over cable (4).

b. Strip outer insulation back ½ inch from end of conductor, without damaging braid (1).

c. Place cable clamp (5) halves over cable, aligning front (large end of cable clamp (5) with stripped end of outer jacket.

d. Compress with pliers (NB-665-98793-GT).

CAUTION

Keep mating edges perpendicular to plier jaws to prevent damage to clamp or cable.

e. Slide bushing (2) over tapered ends of cable clamp (5) to hold clamp together

f. Fan braid (1) to cable back over cable clamp (5) and bushing (2).

g. Trim braid (1) 1/16 inch back from front shoulder of cable clamp (5).

h. Strip dielectric to within ¼ inch of front shoulder of clamp.

i. Slide cup washer (6) over dielectric and up to fanned braid (1).

j. Flatten fanned braid (1) over cable clamp (2) and bushing (2).

Note

At least 1/32 inch of fanned braid must be visible after cup washer (6) has been pushed against bushing.

k. Slide gasket (7) and flat washer (8) over dielectric and up to cup washer (6).

l. Trim excess conductor to permit conductor to bottom in contact pin with no gap between dielectric and contact pin.

m. Solder wire in contact pin.

Note

Solder must bottom in solder cup with pin flush against inner dielectric.

CAUTION

Remove solder from outer surface of contact pin prior to final assembly of connector to prevent shorting.

Note

Do not permit solder to flow into interior surface of female pin.

n. Insert completed assembly into plug or jack body, until contact shoulder seats against the insulator in the body.

o. Hold clamp nut (3) with suitable wrench, mate by turning fitting body.

Note

Slight rounding of hex points on clamp nut (3) is permissible providing any sharp protrusions or burr are smoothed.

p. Tighten to 15 inch pounds torque, taking care not to turn the cable, and/or contact pin.

Note

After tightening, contact depth on connectors may vary from flush to ±1/32 inch measured from end of connector body. Marked mating pin and socket may be used for visual assurance that contact pin is not turning.

Note

Connector assembly should be tested with megger. Pin to shield should read 7000 megohms minimum.

q. Torque-stripe the connector using Vaporite marking pen with a ⅛ inch nib, immediately after torquing the fitting. Use red, oil-resistant ink.

Note

Fittings which will not be located inside airplane fuel tank should be torque sealed with lacquer putty, adjacent to Vaporite pen stripe.

Note

Some miniature Liquidometer, bayonet type connections have two flat washers instead of one flat washer and one cup washer. Assembly procedure with units having two flat washers varies slightly from previously described assembly procedure in that fanned cable braids are bent back against forward side of cable clamp (5) but not over bushing (2). Flat washer, gasket and second flat washer are pressed against fanned braid. Excess fanning around flat washer is trimmed off. Remainder of assembly procedure is identical.

Figure 5-27D. External Fuel Quantity Indicating Cable and Cable Fitting Installation (Sheet 3)

j. In cockpit, lift handle clear of dial plate and remove plate attaching screws.

5-228. INSTALLATION.

a. In cockpit, fasten handle dial plate to left-hand control panel with screws. Insert handle and place in OFF.

b. In forward equipment compartment, place fuel tank selector valve in position on mounting bracket on left-hand side of compartment, with outlet port, designated OUT, pointing forward and slightly to right. Install attaching bolts.

c. Connect engine fuel supply line to valve OUT port.

d. Connect inlet (tank) lines to corresponding valve ports.

e. Align index mark on valve shaft with valve outlet port, which points forward and slightly to right.

f. With handle still in OFF, bolt control rod to handle shank.

g. Bolt linkage universal joint to valve shaft.

h. Engage valve joint with control rod and install attaching bolts.

5-229. FUEL SYSTEM STRAINER.

5-230. DESCRIPTION. (See figure 5-25.) The fuel system strainer is installed on the forward left-hand side of the lower firewall. The function of the strainer is to prevent foreign particles from entering the fuel pumps and the carburetor. The main fuel supply line from the fuel tank selector valve is connected to the inlet port on the fuel strainer. A hose assembly links the outlet port of the fuel strainer with the inlet port of the auxiliary fuel pump. The strainer is equipped with a removable screen and with a condensed-moisture drain valve.

5-231. REMOVAL.

a. Place fuel tank selector valve control handle in OFF.

b. Remove lower left-hand panel of accessory cowling.

c. Open fuel strainer drain valve and drain fuel from strainer and main supply line.

d. Disconnect and cap fuel line at outlet port of fuel strainer.

e. Open forward equipment compartment left-hand access door.

f. Disconnect fuel line from fuel strainer inlet port fitting.

g. Remove nut and washer from fuel strainer inlet port fitting.

h. Remove bolts which attach strainer to support bracket.

5-232. INSTALLATION.

a. Insert fuel strainer inlet port fitting through cutout in lower firewall and install two bolts which attach strainer to support bracket.

b. Secure inlet port with nut and washer.

c. Connect selector valve line to inlet port and secure with two hose clamps.

d. Connect pump line to strainer outlet port and secure with two hose clamps.

e. Make certain that strainer drain valve is closed.

5-233. FUEL STRAINER DRAIN VALVE.

5-234. DESCRIPTION. (See figure 5-25.) The fuel strainer drain valve is a two-ported, manually operated shut-off valve, installed on the strainer to provide a means of draining condensed moisture and fuel from the strainer and the system between the tank selector valve and the pumps.

5-235. REMOVAL.

a. Place fuel tank selector valve control handle in OFF.

b. Remove lower left-hand panel of engine accessory cowling.

c. Open drain valve on fuel strainer and drain fuel from strainer into suitable external container.

d. Remove drain valve by unscrewing it from strainer.

e. On airplanes BuNo. 139649 and subsequent, remove drain valve by unscrewing it from strainer elbow.

5-236. INSTALLATION.

CAUTION

The drain valve could be inadvertently positioned on installation so that the drain valve would hit hard against the armor plate of the lower access cowl or against the engine mount during engine operation causing failure.

a. Screw drain valve into fuel strainer.

NOTE

On airplanes BuNo. 139649 and subsequent, install drain valve on strainer elbow.

b. Position drain valve to allow sufficient clearance from cowling and engine mount. Position side of valve parallel to lower access cowl, to provide 5/8-inch minimum clearance to engine mount.

c. Place valve handle in OFF.

5-236A. IN-FLIGHT FUELING SYSTEM. For information concerning in-flight fueling system refer to section IV.

5-237. ENGINE-DRIVEN FUEL PUMP.

5-238. DESCRIPTION. (See figure 5-25.) The engine-driven fuel pump is installed on the lower left-hand side of the engine supercharger rear housing. It is a positive-displacement, vane-type pump which is coupled directly to the engine pump drive by an AN

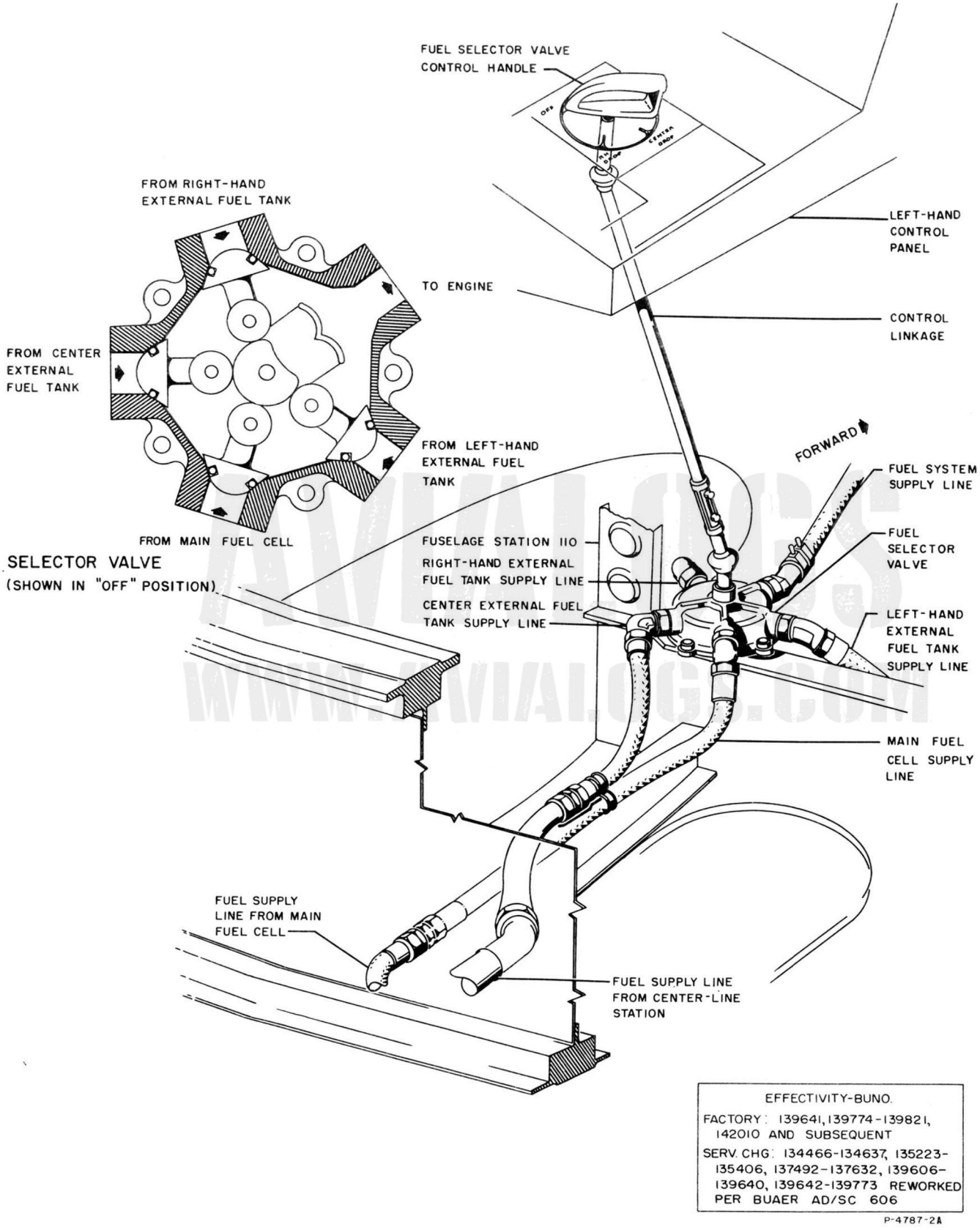


Figure 5–28. Fuel Tank Selector Valve and Control (Sheet 2)

splined drive shaft, which has a reduced diameter shear section to protect the engine and the pump against excessive loads. The pump contains a bypass valve which allows fuel to flow around the pump when it is inoperative and the auxiliary pump is operating. The bypass valve also serves as a safety valve if back-firing should reverse the direction of rotation of the engine. The valve is not adjustable.

5-239. REMOVAL.

a. Make certain that fuel tank selector valve control handle is in OFF.
b. Remove lower left-hand panel of engine accessory cowling.
c. Disconnect crankcase breather line from supercharger rear housing.
d. Disconnect diaphragm vent line at fitting on engine-driven fuel pump.
e. Disconnect fuel seal drain line at pump.
f. Disconnect and cap fuel lines at pump.

CAUTION

Fuel is generally trapped in lines; disconnect carefully.

g. Remove nuts which attach fuel pump to supercharger rear housing.

5-240. INSTALLATION.

a. Place engine-driven pump in position on studs on supercharger rear housing and install four attaching nuts.
b. Uncap and connect fuel lines to pump.
c. Connect fuel seal drain line to pump.
d. Connect diaphragm vent line to pump.
e. Connect crankcase breather line to supercharger rear housing.
f. Adjust pump.

5-241. ADJUSTMENT.

a. Start engine and allow it to warm up to provide smooth operation necessary for accurate pressure setting. When smooth operation is obtained, turn off auxiliary pump.
b. After engine has been warmed up, increase manifold pressure to 30 inches Hg: fuel pressure reading should be 20 ± 1 psi (20 psi is desirable). If this pressure reading is not obtained, proceed with steps c through g.
c. Allow engine to idle.

NOTE

At idling speeds any fuel pressure which will keep engine running is considered acceptable.

d. Loosen pump adjustment screw lock nut.
e. Turn adjustment screw clockwise to increase fuel pressure or counterclockwise to decrease fuel pressure. Then tighten lock nut.
f. Increase manifold pressure to 30 inches Hg and again check fuel pressure. If pressure is still incorrect, repeat steps c through e, until correct pressure reading is obtained.
g. After adjustment has been satisfactorily completed, secure lock nut with lockwire.

5-242. AUXILIARY FUEL PUMP.

5-243. DESCRIPTION. (See figure 5-25.) The electrically driven, positive-displacement, auxiliary pump is installed directly forward of the fuel strainer, on the lower left-hand leg of the engine mount. The pump furnishes fuel pressure for starting the engine, and aids the engine-driven fuel pump in maintaining sufficient system operating pressure. A pressure increase of 3.5 psi maximum pressure is satisfactory when the auxiliary pump is being operated in conjunction with the engine-driven pump. When the auxiliary pump is inoperative, fuel is directed through the pump bypass valve. The pump motor is energized by a switch in the cockpit, either directly, when the switch is ON, or indirectly when the oil dilution system is in operation. Sufficient fuel pressure is assured for the oil dilution procedure, because the take-off point for the oil dilution fuel supply line is located at the outlet port fitting of the auxiliary pump. An adjustable pressure relief valve is incorporated in the pump.

5-244. REMOVAL.

a. Place fuel tank selector valve control handle in OFF.
b. Remove lower left-hand panel of accessory cowling.
c. Open drain valve on fuel strainer and drain fuel from strainer into a suitable external container.
d. Close drain valve.
e. Disconnect auxiliary pump wiring at receptacle.
f. Disconnect diaphragm vent line, fuel seal drain line, and gear case drain line from pump.
g. Disconnect fuel supply line from pump inlet port fitting.
h. Disconnect normal fuel supply line and oil dilution fuel line from pump outlet port fitting.
i. Remove bolts which attach pump to bracket.

5-245. INSTALLATION.

a. Place auxiliary fuel pump on bracket on engine mount and install four attaching bolts.
b. Connect normal fuel supply and oil dilution fuel lines to pump outlet port fitting.
c. Connect fuel supply line to pump inlet port fitting.
d. Connect diaphragm vent line, fuel seal drain line, and gear case drain line to pump.
e. Apply antiseize compound (Fed. Spec. TT-8-580) to threads of electrical connector and connect to pump.

5-246. ADJUSTMENT.

a. Make certain that mixture control lever is in IDLE CUTOFF.

b. Turn on auxiliary pump.

c. Observe fuel pressure gage: reading should be 20 ± 1 psi pressure.

NOTE

If 20 ± 1 psi pressure is not obtained, proceed with steps d through f.

c. Disconnect crankcase breather line from supercharger rear housing.

d. Disconnect diaphragm vent line at fitting on engine-driven fuel pump.

e. Disconnect fuel seal drain line at pump.

f. Disconnect and cap fuel lines at pump.

CAUTION

Fuel is generally trapped in lines; disconnect carefully.

g. Remove nuts which attach fuel pump to supercharger rear housing.

5–240. INSTALLATION.

a. Place engine-driven pump in position on studs on supercharger rear housing and install four attaching nuts.

b. Uncap and connect fuel lines to pump.

c. Connect fuel seal drain line to pump.

d. Connect diaphragm vent line to pump.

e. Connect crankcase breather line to supercharger rear housing.

f. Adjust pump.

5–241. ADJUSTMENT.

a. Start engine and allow it to warm up to provide smooth operation necessary for accurate pressure setting. When smooth operation is obtained, turn off auxiliary pump.

b. After engine has been warmed up, increase manifold pressure to 30 inches Hg: fuel pressure reading should be 20 ± 1 psi (20 psi is desirable). If this pressure reading is not obtained, proceed with steps c through g.

c. Allow engine to idle.

Note

At idling speeds, any fuel pressure which will keep engine running is considered acceptable.

d. Loosen pump adjustment screw lock nut.

e. Turn adjustment screw clockwise to increase fuel pressure or counterclockwise to decrease fuel pressure. Then tighten lock nut.

f. Increase manifold pressure to 30 inches Hg and again check fuel pressure. If pressure is still incorrect, repeat steps c through e, until correct pressure reading is obtained.

g. After adjustment has been satisfactorily completed, secure lock nut with lockwire.

5–242. AUXILIARY FUEL PUMP.

5–243. DESCRIPTION. (See figure 5–25.) The electrically driven, positive-displacement, auxiliary pump is installed directly forward of the fuel strainer, on the lower left-hand leg of the engine mount. The pump furnishes fuel pressure for starting the engine, and aids the engine-driven fuel pump in maintaining sufficient system operating pressure. A pressure increase of 2.5 psi maximum pressure is satisfactory when the auxiliary pump is being operated in conjunction with the engine-driven pump. When the auxiliary pump is inoperative, fuel is directed through the pump bypass valve. The pump motor is energized by a switch in the cockpit, either directly, when the switch is "ON," or indirectly when the oil dilution system is in operation. Sufficient fuel pressure is assured for the oil dilution procedure, because the take-off point for the oil dilution fuel supply line is located at the outlet port fitting of the auxiliary pump. An adjustable pressure relief valve is incorporated in the pump.

5–244. REMOVAL.

a. Place fuel tank selector valve control handle in "OFF."

b. Remove lower left-hand panel of accessory cowling.

c. Open drain valve on fuel strainer and drain fuel from strainer into a suitable external container.

d. Close drain valve.

e. Disconnect auxiliary pump wiring at receptacle.

f. Disconnect diaphragm vent line, fuel seal drain line, and gear case drain line from pump.

g. Disconnect fuel supply line from pump inlet port fitting.

h. Disconnect normal fuel supply line and oil dilution fuel line from pump outlet port fitting.

i. Remove bolts which attach pump to bracket.

5–245. INSTALLATION.

a. Place auxiliary fuel pump on bracket on engine mount and install four attaching bolts.

b. Connect normal fuel supply and oil dilution fuel lines to pump outlet port fitting.

c. Connect fuel supply line to pump inlet port fitting.

d. Connect diaphragm vent line, fuel seal drain line, and gear case drain line to pump.

e. Apply anti-seize compound (Specification JAN-A-669) to threads of electrical connector and connect to pump.

5–246. ADJUSTMENT.

a. Make certain that mixture control lever is in "IDLE CUTOFF."

b. Turn on auxiliary pump.

c. Observe fuel pressure gage: reading should be 20 ± 1 psi pressure.

Note

If 20 ± 1 psi pressure is not obtained, proceed with steps d through f.

d. Loosen lock nut on auxiliary pump adjustment screw.

e. Turn adjusting screw clockwise to increase pressure or counterclockwise to decrease pressure.

f. When correct pressure of 20 ± 1 psi is obtained, tighten lock nut on adjustment screw and safety with lockwire.

5–247. AUXILIARY FUEL PUMP CONTROL CIRCUIT.

5–248. DESCRIPTION. The auxiliary pump is controlled by a circuit which receives power from the d-c secondary bus. In addition to the pump motor, the circuit includes:

Name	*Location*
Circuit breaker, 15-amp	Cockpit circuit-breaker panel
Control switch	Cockpit—LH control panel

5–249. When the control switch is turned "ON," the circuit is completed to the pump motor to place the pump in operation. In the "OFF" position, the auxiliary fuel pump control switch is connected to the oil dilution circuit so that auxiliary fuel pump operation is assured when the oil dilution circuit is energized.

5–250. ENGINE PRIMING VALVE.

5–251. DESCRIPTION. (See figure 5–25.) The engine priming valve is attached to the after side of the carburetor and is electrically controlled from the cockpit. Fuel flows directly from the pressure side of the carburetor into the priming valve, and then through two lines to the blower case of the engine. The auxiliary fuel pump circuit must be energized to supply fuel under pressure to the carburetor.

5–252. DELETED.

5–253. REMOVAL.

a. Make certain that fuel tank selector valve control handle is in "OFF."

b. Remove upper right-hand panel of engine accessory cowling.

c. Remove cockpit heating system overboard duct.

d. Disconnect electrical connector at priming valve.

e. Disconnect fuel line at priming valve.

f. Remove nuts which attach priming valve to carburetor.

5–254. INSTALLATION.

a. Use new gasket, place engine priming valve on its mounting studs on carburetor, and install attaching nuts.

b. Connect fuel line to priming valve.

c. Apply anti-seize compound (Specification JAN-A-669) to threads of electrical connector and install on priming valve.

d. Install heating system overboard duct.

5–255. TESTING.

a. While fuel pumps are inoperative, turn primer switch "ON" and "OFF" alternately. Place hand on valve and check frequency of pulsations with those produced by switch operation.

b. If pulsation is not felt, check electrical circuit for continuity before undertaking repairs.

5–256. An alternative method of testing is as follows:

a. Disconnect fuel line at elbow on valve.

b. Turn on auxiliary pump control switch and inspect valve for leakage at open port: there should be none. (If leakage is present, remove and repair or replace valve.)

c. Turn primer switch on and off alternately and observe valve for fuel flow: it should correspond to momentary action of switch.

d. If valve response is faulty, hold primer switch on for 30 to 60 seconds. Then feel valve solenoid jacket: if cold, check electric circuit; if hot, replace valve (plunger probably sticking).

5–257. ENGINE PRIMING VALVE CIRCUIT.

5–258. DESCRIPTION. The priming valve circuit is powered by the d-c secondary bus and includes the following:

Name	*Location*
Circuit breaker, 5-amp	Forward equipment compartment circuit-breaker panel
Control switch	Cockpit—RH control panel
Solenoid	Component of priming valve

5–259. When the normally open control switch is depressed, its momentary contacts are closed to complete the circuit to the valve solenoid, which retracts the valve plunger to permit fuel to flow from the carburetor, through the valve, to the engine blower case.

5–260. FUEL PRESSURE WARNING SYSTEM.

5–261. DESCRIPTION. The pressure warning system is designed to operate automatically should fuel pressure fall to 17 psi, which is generally an indication that the supply tank currently connected with the fuel pressure system is nearly empty. The system is electrically powered and is one of the circuits supplied by the d-c primary bus through a 5-ampere circuit breaker, located in the cockpit circuit-breaker panel and identified as DC INSTR. A 220-ohm resistor in the circuit is used to dim the fuel pressure warning light when the interior lights are on. Principal components of the fuel pressure warning system are:

Name	*Location*
Fuel pressure switch	Upper firewall—forward face, RH side
Warning light	Instrument panel—upper RH
Resistor, 15-watt, 220-ohm	Fwd equip. compt

5–262. The pressure switch is diaphragm-operated and is connected with the fuel pressure gage line from the carburetor. When fuel pressure is greater than 17 psi, the switch is in the normal, open condition and is not connected to the warning light. When pressure drops to 17 psi, the switch momentary contact is closed and the warning light becomes grounded through the switch, causing the lamp to light. Condition of the lamp can be tested by pushing it in momentarily: the lamp will light if it is not burned out. The resistor is installed in the circuit between power and the warning light to reduce light glare.

5–263. OIL SYSTEM.

5–264. DESCRIPTION. (See figure 5–29.) The function of the oil system is to cool the engine internally and to provide the lubrication necessary for proper engine operation. Two sumps, with internal pumps, are integral with the engine, one below the supercharger rear housing and one below the crankcase front section. Oil is pumped, under pressure, to and from all moving parts of the engine, except the propeller shaft and the crankshaft anti-friction bearings. The principal components of the oil system comprise:

Name	*Para Ref*
Supply tank	5–270
Diverter valve	5–274
Cooler	5–289
Oil cooler door	5–295
Cooler bypass-and-surge-protection valve	5–314
Oil dilution system	5–320
Magnetic chip detector warning system	5–330A

5–265. The oil supply tank, mounted on the forward face of the engine firewall, provides oil as required. When the engine is operating, oil flows from the tank to the inlet port of the engine sumps. The combined output of the pumps in the sumps is circulated through the engine. Oil drained from the engine is recovered in the scavenging sections of the sumps and is discharged by scavenge pumps into a return line to the supply tank. The oil cooler, installed in the return line between the pumps and the supply tank, cools the oil before it reaches the tank. The oil cooler door controls the amount of air flowing through the cooler.

5–266. The oil supply tank is constructed with an internal warm-up compartment in addition to the main compartment. An electrically controlled diverter valve, on the return inlet fitting of the tank, directs oil either to the main compartment or to the warm-up compartment of the tank, depending on oil temperature requirements.

5–267. The oil cooler, connected with the return line between the engine and the tank, provides an additional means of cooling oil if it is above normal operating temperature. A muff around the cooler allows oil below normal operating temperature to bypass the cooler core. The bypass and surge protection valve, which contains thermo-sensitive elements, is attached to the cooler port fitting and reacts to oil temperature and pressure to regulate the direction of oil flow through the cooler. Air flow through the cooler and the degree of its effectiveness are controlled by the position of a controllable door in the cooler outlet.

5–268. The electrically controlled oil dilution system provides for the injection of fuel into the oil system supply line just prior to engine shut-down during cold weather. The dilution process prevents oil in the engine from congealing while the engine is inoperative, and assures easier engine starts. Refer to the service instructions in section I of this manual for information concerning the type oil required for use in the oil system at varying atmospheric temperatures, and engine operating restrictions to be observed during the use of grade 1065 lubricating oil.

5–269. TROUBLE SHOOTING. When symptoms indicate low or no oil pressure, the level in the oil tank should be checked and the lines and plugs on the engine inspected for leakage before proceeding with more complex trouble shooting. Other types of troubles are noted in table 5–7.

5–270. OIL SUPPLY TANK.

5–271. DESCRIPTION. (See figure 5–31.) The oil supply tank has a maximum service capacity of 36 U.S. gallons and is shock-mounted on the forward face of the lower firewall. One end of the tank encloses a warm-up compartment. The position of the warm-up compartment relative to the oil outlet fitting in the tank sump permits cold oil which enters the compartment to be directed almost immediately into the oil outlet fitting to facilitate rapid engine warm-up. When heated oil enters the large body of oil surrounding the warm-up compartment, part of the oil flows through an open area between the warm-up compartment and the forward side of the tank to the outlet fitting; the remaining oil flows between the warm-up compartment and the bottom of the tank to the outlet fitting. Whether the oil returning from the engine is directed into the warm-up compartment or into the main compartment is determined by the oil diverter equipment which reflects the temperature of the oil in the tank sump. The tank is filled through the opening on the right-hand side, accessible through a cover in the accessory cowling. The tank can be filled without the use of a special funnel, and is so constructed that the space provided for oil expansion cannot be filled inadvertently when the airplane is in its normal ground position. A scupper assembly and an overflow drain line are installed at the filler well. The filler assembly incorporates a dip stick for measuring the oil in the tank; a screen around the dip stick prevents foreign objects from falling into the tank. The upper right-hand portion of the tank also contains a vent fitting; a line between the fitting and the engine provides for correct air pressure relationship between the tank and the engine crankcase. The sump, located on the lower right-hand side of the oil tank, contains a drain valve. To drain the tank com-

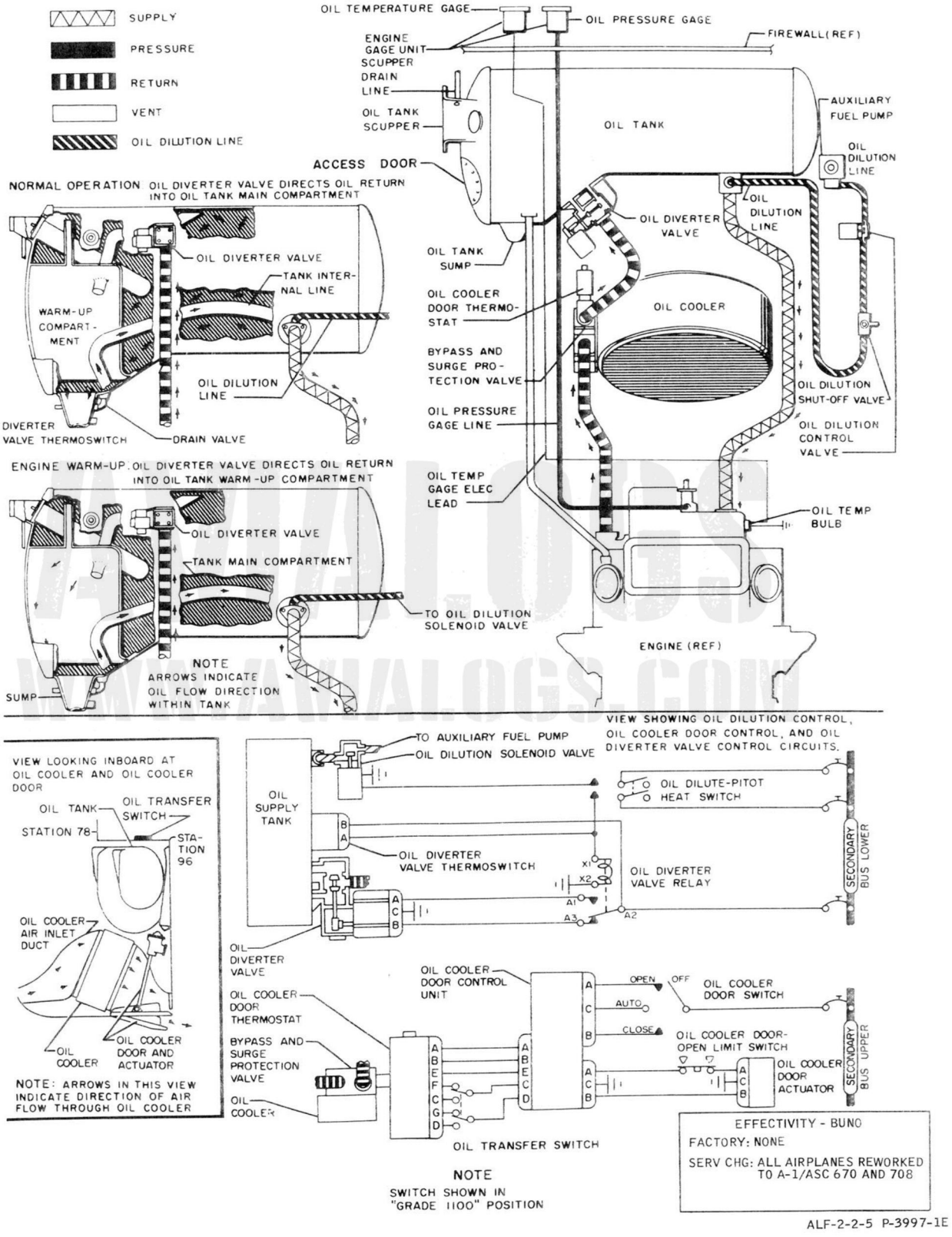


Figure 5-29. Oil System Schematic Diagram

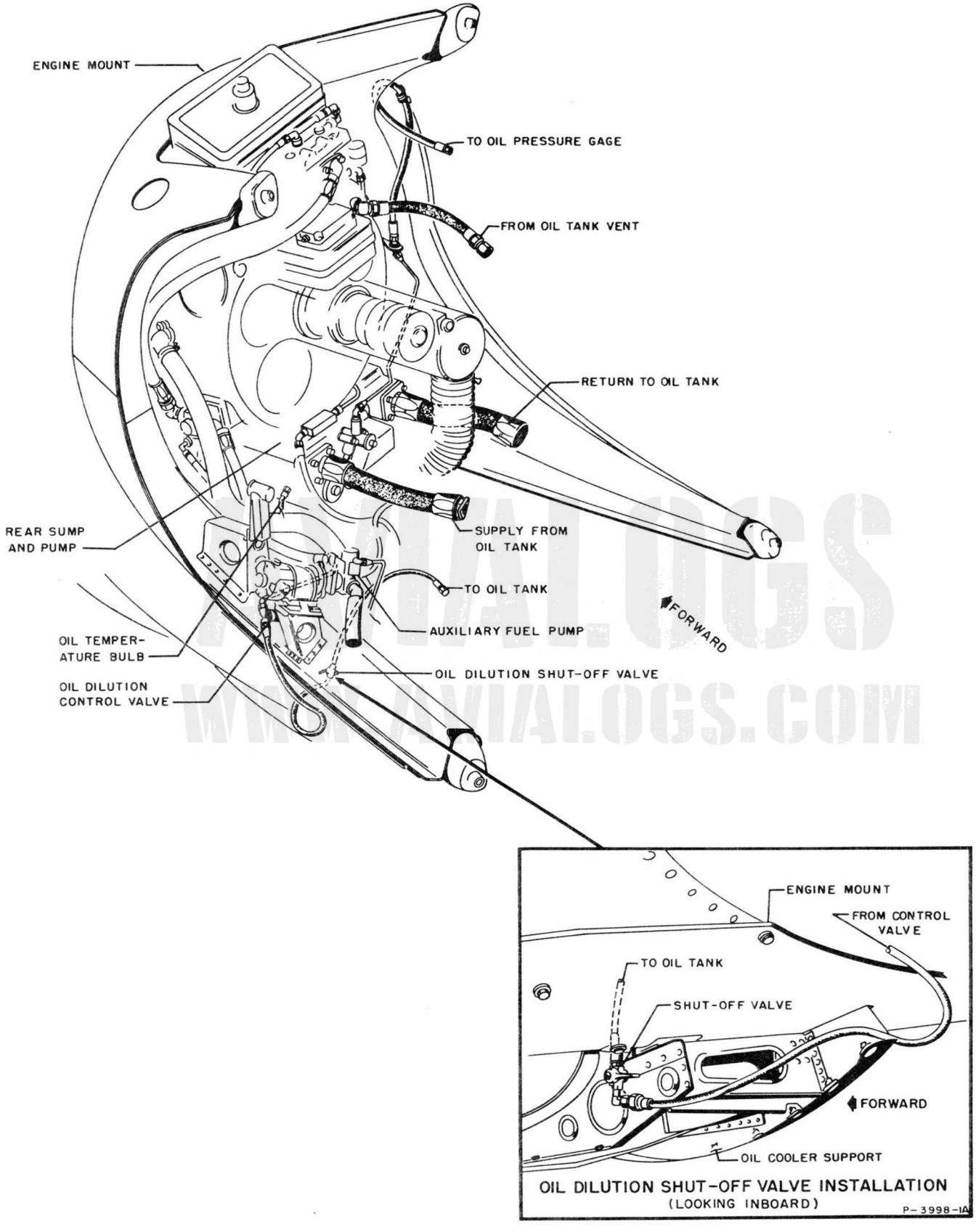


Figure 5–30. Oil System—Perspective (Sheet 1)

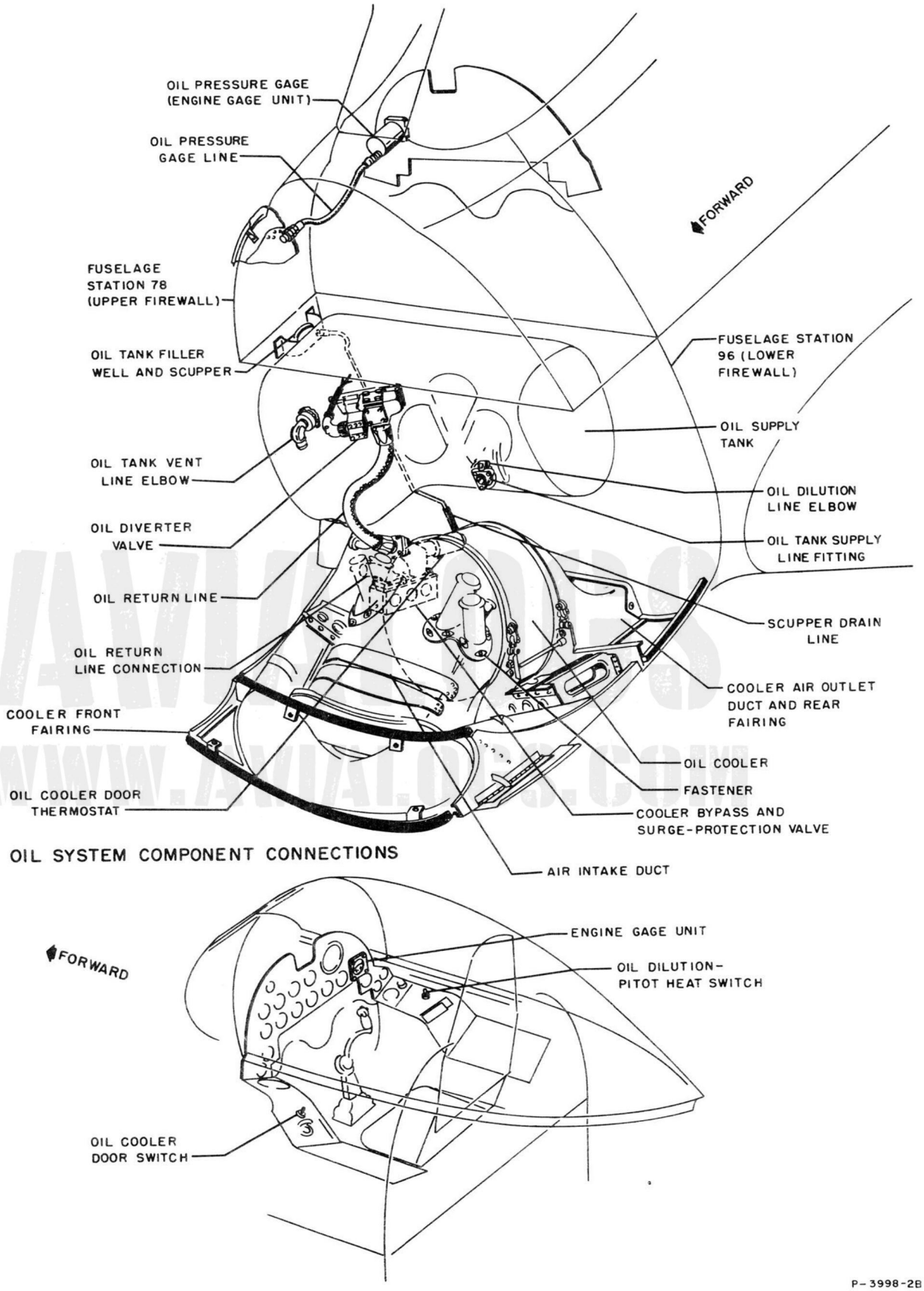


Figure 5–30. Oil System—Perspective (Sheet 2)

TABLE 5-7. TROUBLESHOOTING OIL SYSTEM

Trouble	Probable Cause	Remedy
1. Oil pressure low as shown on oil pressure gage. (Indication should be 80 to 90 psi throughout power range.)	a. Oil supply line air leak.	Tighten hose connections.
	b. Oil pressure gage line clogged.	Remove and clean oil pressure gage line.
	c. Main oil supply line clogged.	Remove and clean line.
	d. Oil too light.	Drain oil from oil tank and refill with warm oil. If congealment is too great to drain oil from system, insert an immersion heater in oil tank through filler opening. Wrap cloths saturated with hot water around supply and return lines.
	e. Outside air temperature low.	insert an immersion heater in oil tank through filler opening. Wrap cloths saturated with hot water around supply and return lines.
	f. Oil pressure gage defective	Replace engine gage unit.
	g. Oil dilution solenoid valve leaking.	Replace valve. After oil dilution valve is replaced, drain and refill oil system with new oil.
	h. Oil tank vent line clogged.	Remove and clean line.
2. Oil pressure high as shown on oil pressure gage. (Indication should be 80 to 90 psi throughout power range.)	a. Oil too heavy.	Drain system of heavy oil and refill with specified oil of correct viscosity. Refer to service instructions in section I of manual.
	b. Refer to trouble 1 f.	
3. No indication on oil pressure gage.	a. Oil pressure gage line disconnected.	Bleed line and connect it properly.
	b. Refer to trouble 1 b.	
	c. Refer to trouble 1 f.	
	d. Refer to trouble 1 c.	
	e. Refer to trouble 1 e.	
4. Oil temperature low as shown on oil temperature gage: desired temperature is 80°C (176°F). A variance of ± 9°C (16°F) indicated oil temperature is acceptable.	a. Oil cooler door too far open.	Close oil cooler door sufficiently to raise temperature.
	b. Engine not sufficiently warmed up.	Continue warm-up period.
	c. Oil cooler door thermostat improperly set or malfunctioning.	Replace thermostat and control unit.
	d. Oil temperature gage defective.	Replace gage.
5. Oil temperature high as shown on oil temperature gage: desired temperature is 80°C (176°F). A variance of ±9°C (16°F) indicated oil temperature is acceptable.	a. Oil cooler door not sufficiently open.	Open oil cooler door sufficiently to lower temperature.
	b. Oil cooler air passages clogged with foreign particles.	Clean oil cooler air passages with compressed air. If passages are still dirty, remove and clean cooler.
	c. Oil supply line air leak.	Tighten hose connections.
	Oil system contains oil of improper viscosity.	Drain system of oil and refill with specified oil of correct viscosity. Refer to service instructions in section I of manual.
	e. Refer to trouble 4 c.	
	f. Refer to trouble 1 g.	
	g. Refer to trouble 4 d.	
	h. Oil cooler bypass valve malfunctioning.	Replace valve.
6. Excessive oil consumption.	a. Oil lines leak.	Repair leaks.

NOTE

If the trouble cannot be corrected by the suggested procedures, refer to oil system trouble shooting in Handbook of Service Instructions, Models R-3350-26WA, -26WB, -26WC and -26WD Aircraft Engines.

pletely, the handle of the drain valve should be rotated 180 degrees counterclockwise from its closed position. To drain sediment, the handle should be rotated approximately 30 degrees counterclockwise from its closed position. BuWeps AD/ASC No. 708 provides for the modification of the engine oil supply tank hopper section on all AD-6 and -7 airplanes to prevent oil starvation during catapult launching. This aircraft service change involves the installation of a flapper valve assembly in the hopper section of the oil tank, relocation of the oil inlet tube and installation of an access door on the outboard end of the oil tank.

5–272. REMOVAL.

a. Remove accessory cowling.

b. Attach hose to drain valve and drain oil from tank.

c. Remove oil cooler.

d. Disconnect thermoswitch wiring at lower firewall.

e. Disconnect oil supply line from tank.

f. Disconnect oil dilution fuel supply line from tank.

g. Disconnect wiring from oil diverter valve.

h. Disconnect wiring from generators.

i. Remove ventilating air cover from d-c generator.

j. Disconnect vent line from fitting on top of tank.

k. Disconnect oil return line from diverter valve.

l. Support oil tank and remove nuts which attach shock mounts to tank brackets.

5–273. INSTALLATION.

a. Carefully place tank in position and bolt brackets to shock mounts.

b. Connect oil return line to diverter valve.

c. Connect vent line to vent fitting on top of tank.

d. Install ventilating air cover on d-c generator.

e. Connect wiring to generators.

f. Apply anti-seize compound (Specification JAN-A-669) to threads of electrical connector and connect to oil diverter valve.

g. Connect oil dilution fuel supply line to tank fitting.

h. Connect oil supply line to tank outlet fitting.

i. Apply anti-seize compound (Specification JAN-A-669) to threads of electrical connector and connect to oil diverter thermoswitch at lower firewall.

j. Make certain that drain valve handle is fastened securely in closed position.

k. Install oil cooler.

5–274. OIL DIVERTER VALVE.

5–275. DESCRIPTION. (See figure 5–31.) The oil diverter valve is mounted on the forward side of the oil supply tank. Oil returning from the engine flows through the valve either to the warm-up compartment, or to the main compartment of the tank, a disc within the valve being actuated by the valve drive mechanism to open and close the two ports which direct oil into the tank. The diverter valve motor is connected with the diverter valve control circuit; internal limit switches open the circuit when the motor reaches its extreme limits of travel.

5–276. REMOVAL.

a. Remove accessory cowling lower right-hand panel.

b. Disconnect electrical connector from oil diverter valve receptacle.

c. Disconnect oil return line from valve.

Note

The return line should be kept upright to prevent oil trapped in the line from draining out of the line.

d. Remove bolts which attach oil diverter valve to tank.

5–277. INSTALLATION.

a. Place diverter valve and new gasket in position on oil tank and install attaching bolts.

b. Connect oil return line to oil diverter valve.

c. Apply anti-seize compound (Specification JAN-A-669) to threads of electrical connector and connect to valve.

5–278. ADJUSTMENT. Adjustment should be made only in an emergency. Normally the valve must be replaced if it does not seat properly.

a. Test valve to determine port at which valve disc does not seat. (Refer to paragraph 5–279.)

Note

The adjustment screw on the valve limit-switch box, adjacent to the receptacle, controls the position of the valve shaft disc when the disc is at the port which leads to the tank warm-up compartment. The adjustment screw on the side of the switch box opposite the receptacle is used to adjust the position of the valve shaft disc when the disc is at the port which leads to the tank main compartment.

b. Turn appropriate adjustment screw clockwise to increase travel of valve shaft disc toward corresponding valve port seat.

CAUTION

Exercise extreme care when making adjustment to avoid building up too high a load. An excessive load may cause damage to mechanism.

5–279. TESTING.

a. Remove accessory cowling lower right-hand panel.

b. Place d-c power control switch in "ON."

c. Disconnect thermoswitch wiring at quick-disconnect fittings just aft of lower firewall.

d. Remove cover plate from forward side of oil diverter valve.

Note

The port to the tank warm-up compartment should be closed by the valve disc.

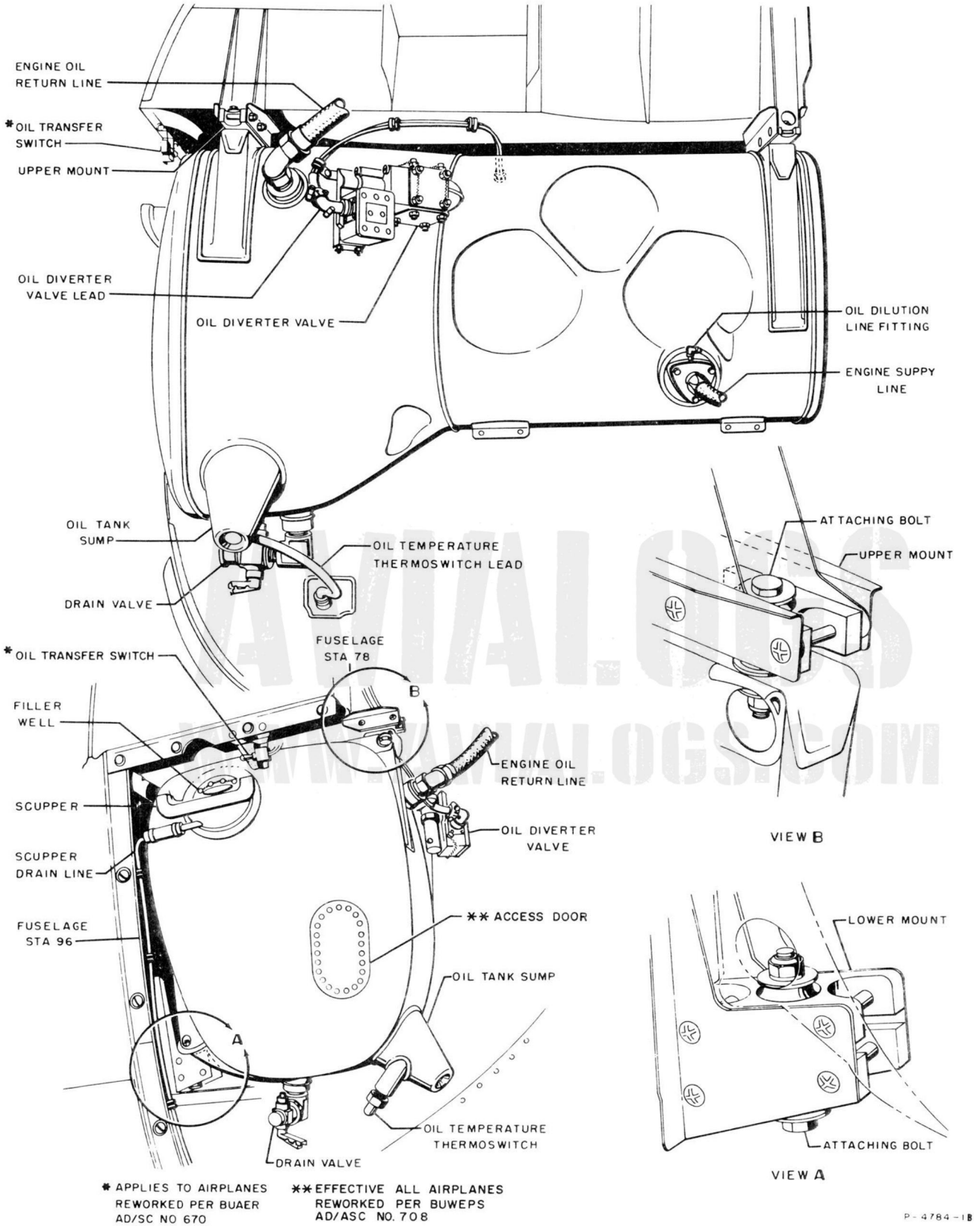


Figure 5-31. Oil Tank Installation

e. Touch ends of wires which were disconnected in step c: valve disc should close port which leads to tank main compartment.

f. Separate ends of two wires: valve disc should move to close port which leads to tank warm-up compartment.

g. If diverter valve remains inoperative during steps e and f, check electric circuit before removing and replacing valve.

NOTE

If the valve does not seat at either one or both of its maximum positions, it should be removed and replaced. However, in an emergency the valve may be adjusted by altering the limit switch settings.

5-280. OIL DIVERTER VALVE CONTROL CIRCUIT.

5-281. DESCRIPTION. The oil diverter valve is electrically controlled by a circuit which includes, in addition to the valve motor, the following:

Name	Location
Circuit breaker, 5-amp	Forward equipment compartment—circuit-breaker panel
Thermoswitch	Oil tank sump boss
Relay	Forward equipment compartment—terminal panel 17

5-282. The circuit is powered by the d-c secondary bus and is automatic in operation (except when it is connected with the oil dilution system, discussed in paragraph 5-320). When the temperature of the oil in the tank sump is below 55°C (130°F) the thermoswitch contacts are closed, energizing the diverter valve relay to complete the circuit to the diverter valve motor; the motor actuates the valve shaft and disc to close the valve port to the tank main compartment so that oil flows to the warm-up compartment. When oil temperature in the tank sump is above 55°C (130°F) the thermoswitch contacts open, the diverter valve relay is de-energized, and the circuit is completed to the other side of the motor, actuating the valve disc to close the valve port to the warm-up compartment so that oil is directed into the main compartment. Automatic control of the circuit is relinquished by the thermoswitch when the oil dilution system is in operation; the oil dilution circuit, when energized, bypasses the thermoswitch and energizes the oil diverter relay, thus completing the circuit to the valve motor to divert all oil, regardless of temperature, to the tank warm-up compartment.

5-283. OIL DIVERTER VALVE-ACTUATING THERMOSWITCH.

5-284. DESCRIPTION. The contacts of the oil diverter thermoswitch are opened and closed by the varying temperature of the oil in the supply tank sump. When oil temperature is 55°C (130°F) or more, the contacts are open, the oil diverter relay is de-energized, and oil returning from the engine is directed into the main compartment of the tank. When oil temperature is below 55°C (130°F) the thermoswitch contacts are closed, the relay is energized, and the returning oil is directed into the tank warm-up compartment.

5-285. REMOVAL.

a. Remove lower right-hand panel of accessory cowling.

b. Attach external hose to oil tank drain valve and drain oil from tank into suitable container.

c. Close and secure drain valve, and remove hose.

d. Disconnect thermoswitch electrical connector from lower firewall.

e. Remove thermoswitch by unscrewing it from tank. Drain residual oil from sump into small can.

5-286. INSTALLATION.

a. Screw thermoswitch into fitting provided on oil tank sump.

b. Apply antiseize compound (Fed. Spec. TT-A-580) to threads of electrical connector and connect at lower firewall.

c. Fill oil tank with suitable oil.

5-287. OIL DIVERTER VALVE RELAY.

5-288. DESCRIPTION. The oil diverter valve relay is energized when the contact points of the thermoswitch are closed. When energized, the relay completes the diverter valve circuit to the oil diverter valve motor and positions the valve shaft to direct oil to the tank warm-up compartment.

5-289. OIL COOLER AND SUPPORTING STRUCTURE.

5-290. DESCRIPTION. (See figure 5-32.) A cylindrical, free-flow type oil cooler assembly is mounted on a support bolted to the lower legs of the engine mount. The cooler assembly is designed to lower the temperature of the oil returning from the engine before it re-enters the supply tank. An air intake duct is located directly forward of the cooler and joins the cooler front fairing assembly. An air outlet duct is part of the cooler rear fairing and is located directly aft of the cooler. A door in the outlet duct controls the amount of air flowing through the cooler. The door is controlled electrically, either automatically or manually, as desired.

5-291. The oil cooler is of aluminum construction and consists primarily of a shell and a core fabricated as a unit. The shell assembly includes a bypass jacket, stiffeners, and the mounting flange for the bypass-and-surge protection valve, which operates to direct the oil, ei-

ther through the bypass jacket for limited cooling, or through the core for full cooling, depending on oil temperature.

5–292. The core of the cooler consists of tubes and baffles. The tube bundle, or core, is divided into separate sections by the baffles, which are inserted parallel to the axes of the core tubes. Hot oil entering the core circulates back and forth before returning to the oil tank.

5–293. REMOVAL.

a. Remove accessory-section cowling.

b. Disconnect accessory cooling-air ducts from oil cooler intake duct.

c. Release latches which secure oil cooler front fairing to intake duct.

d. Support oil cooler front fairing; release fasteners along trailing edge of fairing and disconnect supporting rods.

e. Release clamp which secures air outlet duct to after end of oil cooler.

f. Release actuator boot clamp.

g. Place oil cooler door control switch in "OPEN" to extend actuator jackscrew.

h. Disconnect actuator from oil cooler door.

i. Support rear fairing assembly and release fasteners along trailing edge.

j. Release clamp which secures intake duct to cooler.

k. On airplanes BuNo. 135335 and subsequent and prior airplanes reworked per BuAer AD/SC No. 567, disconnect clip securing oil cooler air intake duct to oil cooler support structure.

l. Remove air intake duct.

m. Remove drain plug from oil cooler, and drain oil.

n. Reinstall drain plug in cooler and lockwire.

o. Disconnect electrical wiring from thermostat at bypass-and-surge-protection valve.

p. Disconnect two oil return lines at bypass-and-surge-protection valve.

q. Support oil cooler and remove bolts and screws which attach cooler supporting structure to engine mount.

Note

The supporting structure is separated from the engine mount lower legs by several aligning washers. It is advisable to note the number of washers at each point to insure proper alignment of the supporting structure when the cooler is reinstalled.

5–294. INSTALLATION.

a. With two front screws inserted into legs of engine mount, and correct number of spacing washers secured in place, carefully place oil cooler and supporting structure in position.

b. Install nuts on two forward screws.

c. Tilt cooler slightly aft, partially insert rear mounting bolts, place correct number of spacing washers on each bolt and press bolts completely into place.

d. Install nuts on bolts; tighten nuts on bolts and screws.

e. Connect oil return lines to bypass-and-surge-protection valve.

f. Apply anti-seize compound (Specification JAN-A-669) to threads of wiring connector and attach connector to thermostat on bypass-and-surge-protection fitting.

g. Place intake duct in position on cooler and secure with clamp.

h. On airplanes BuNo. 135335 and subsequent and prior airplanes reworked per BuAer AD/SC No. 567, connect clip which secures oil cooler air intake duct to oil cooler support structure.

Note

Make certain that entire circumference of aft end of duct is resting against oil cooler flange and that duct is horizontal to fuselage reference plane.

i. Place rear fairing assembly in position and tighten fasteners along trailing edge.

CAUTION

Use particular care during installation to avoid damaging actuator boot.

j. Tighten clamp to secure outlet duct to after end of cooler.

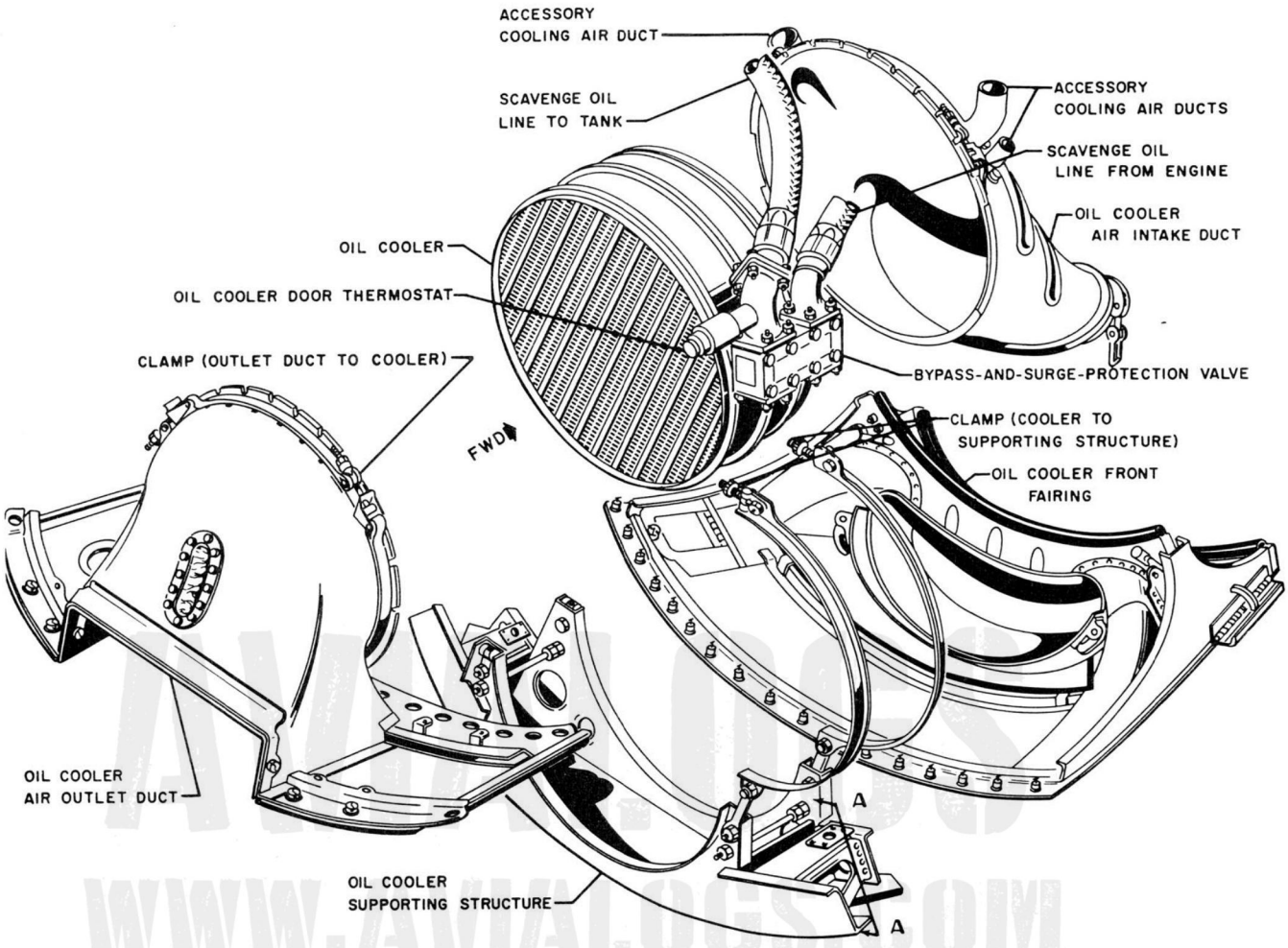
k. Place oil cooler front fairing in position, tighten fasteners along trailing edge of fairing, and connect rods which support forward end of fairing.

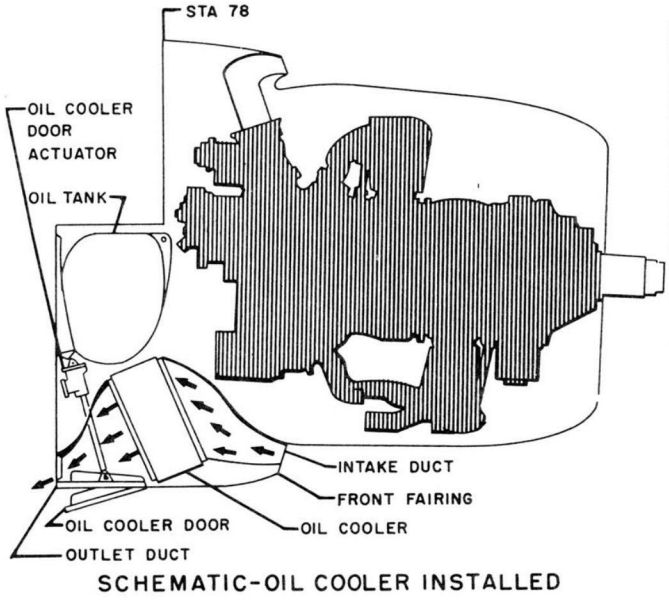
l. Secure latches which attach oil cooler front fairing to intake duct.

m. With oil cooler door actuator extended, connect jackscrew to cooler door.

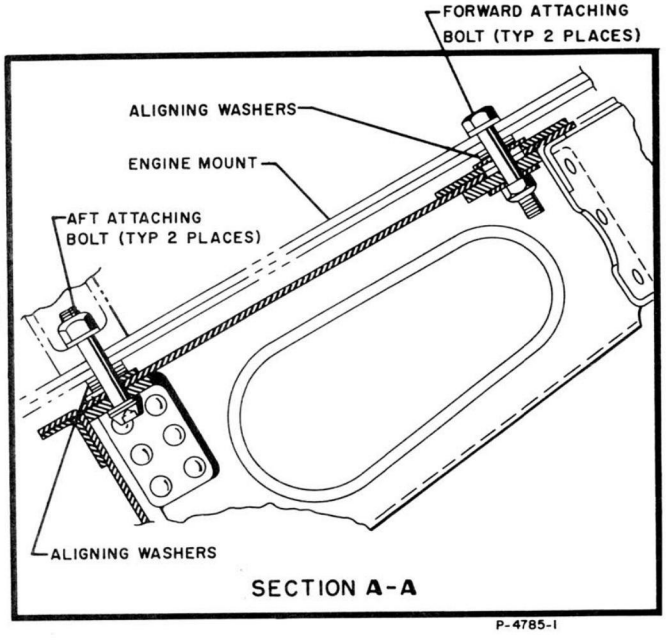
n. Retract door actuator and install clamp which secures boot.

o. Connect accessory cooling air ducts to oil cooler intake duct.





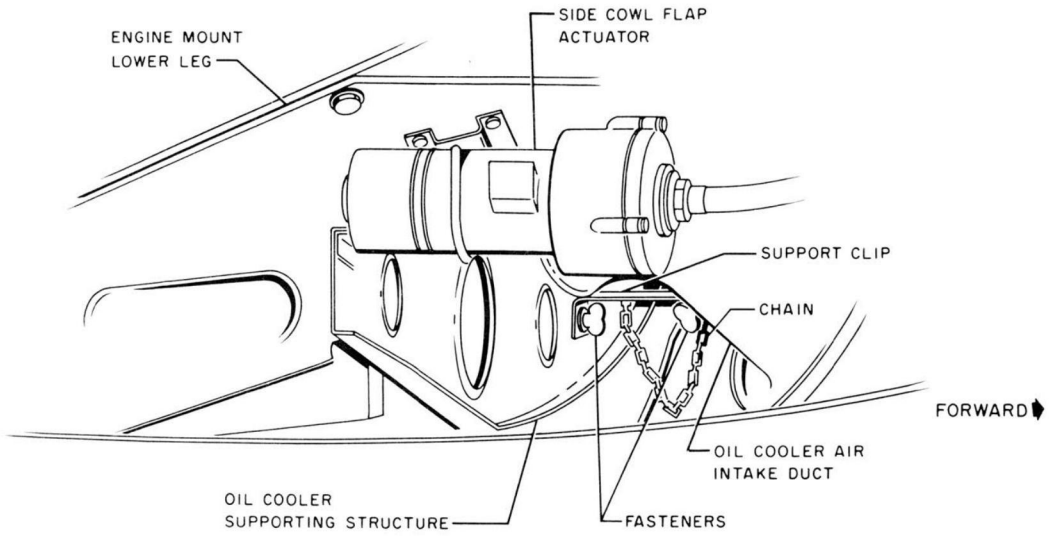
SCHEMATIC-OIL COOLER INSTALLED



SECTION A-A

P-4785-1

Figure 5–32. Oil Cooler Installation (Sheet 1)



VIEW LOOKING INBOARD AT OIL COOLER SUPPORT STRUCTURE AND AIR INTAKE DUCT FROM RIGHT-HAND SIDE OF AIRPLANE

P-4785-2

Figure 5-32. Oil Cooler Installation (Sheet 2)

5-295. OIL COOLER DOOR.

5-296. DESCRIPTION. The oil cooler door is hinged across the outlet duct in the cooler rear fairing assembly and is electrically controlled.

5-297. OIL COOLER DOOR CONTROL CIRCUIT.

5-298. DESCRIPTION. The oil cooler door control circuit is powered by the dc secondary bus and includes the following components:

Name	Location
Circuit breaker, 10-amp	Cockpit circuit-breaker panel
Control switch	LH control panel
Thermostat	Oil cooler - on inlet line fitting
Control unit	Lower firewall - forward face
Door actuator	Door-to-lower firewall
Open-limit switch	Lower firewall - center

5-299. The door actuator is controlled either automatically by the thermostat, or manually by the control switch. The control switch is in series between the power source and the oil cooler door control unit. The control switch has OPEN, AUTO, and CLOSE positions. In the OPEN and CLOSE positions, the circuit is completed directly to the actuator motor, causing the actuator to open and close the door as indicated by the switch setting; the thermostat is out of the circuit. When the switch is in AUTO, the circuit is completed through relays in the control unit, the thermostat, and the actuator; control is then automatic and is governed by the thermostat. When oil temperature is high the circuit is energized on the door-open side; when oil temperature is low, on the door-closed side. When oil temperature is at 80 ± 3-1/2°C (176 ± 6-1/2°F) the thermostat opens the circuit and the cooler door remains in the last selected position. The open-limit switch is installed in the circuit between the actuator and the control unit as a safety device to preclude damaging the door and/or the actuator when large stores are carried on the fuselage external stores rack.

5-300. OIL COOLER DOOR CONTROL THERMOSTAT.

5-301. DESCRIPTION. The oil cooler door thermostat is a dual-setting thermostat installed in the return line fitting, mounted on the oil cooler bypass and surge protection valve. The temperature sensitive thermostat opens or closes the circuit to the oil cooler door actuator, to control the position of the oil cooler doors when the control switch is placed in AUTO. The transfer switch, located at station 70 on the right-hand side of the fuselage permits the use of either grade 1065 or grade 1100 oil in the oil system.

5-302. REMOVAL. With the oil cooler out of the airplane, the thermostat can be removed by unscrewing it from the connecting fitting.

5-303. INSTALLATION. With the oil cooler out of the airplane, the thermostat can be installed by screwing it into the fitting on the cooler bypass-and-surge-protection valve. Electrical connection is made after the cooler has been installed.

5-304. OIL COOLER DOOR CONTROL UNIT.

5-305. DESCRIPTION. The oil cooler door control unit operates in conjunction with the oil cooler door thermostat to provide automatic control for the door when the control switch is in AUTO. The unit is accessible when the accessory cowling right-hand panels are removed.

5-306. OIL COOLER DOOR ACTUATOR.

5-307. DESCRIPTION. (See figure 5-33.) The oil cooler door actuator consists of an electric motor, a gear box and jackscrew mechanism, and a limit switch box assembly. The actuator is controlled either directly by the control switch in the cockpit or automatically by the thermostat.

5-308. REMOVAL.

a. Place oil cooler door control switch in OPEN to extend actuator jackscrew.

b. Disconnect jackscrew from oil cooler door.

c. Remove accessory cowling lower panels.

d. Remove clamp which secures boot to actuator jackscrew.

e. Place oil cooler door control switch in CLOSE to retract actuator jackscrew.

f. Disconnect electrical connector from actuator.

g. Remove bolt which attaches actuator to supporting bellcrank and lift actuator upward and clear of cut-out in air outlet duct.

CAUTION

To avoid damaging boot, remove actuator with care.

5-309. INSTALLATION.

a. Insert actuator jackscrew through opening in boot.

b. Bolt actuator to supporting bellcrank on firewall.

c. Apply antiseize compound (Fed. Spec. TT-A-580) to threads of electrical connector and connect to actuator.

d. Place oil cooler door control switch in OPEN to extend actuator jackscrew.

e. Bolt actuator jackscrew to oil cooler door.

f. Place oil cooler door control switch in CLOSE.

g. Clamp boot to actuator jackscrew.

h. Adjust open-limit switch.

NOTE

When closed the oil cooler door should fair with the oil cooler rear fairing. Minor adjustments to the actuator integral limit switches may be necessary. (Refer to paragraph 5-310.)

5-310. ADJUSTMENT. (See figure 5-33.)

a. Turn retraction-adjustment screw on upper side of actuator limit switch case to obtain 12-3/4 ± 1/8 inch retracted actuator length, measured between centers of actuator attaching bolt holes.

b. Turn extension-adjustment screw on lower side of actuator limit switch case to obtain 17-5/8 ± 1/8 inch extended actuator length, measured between centers of actuator attaching bolt holes.

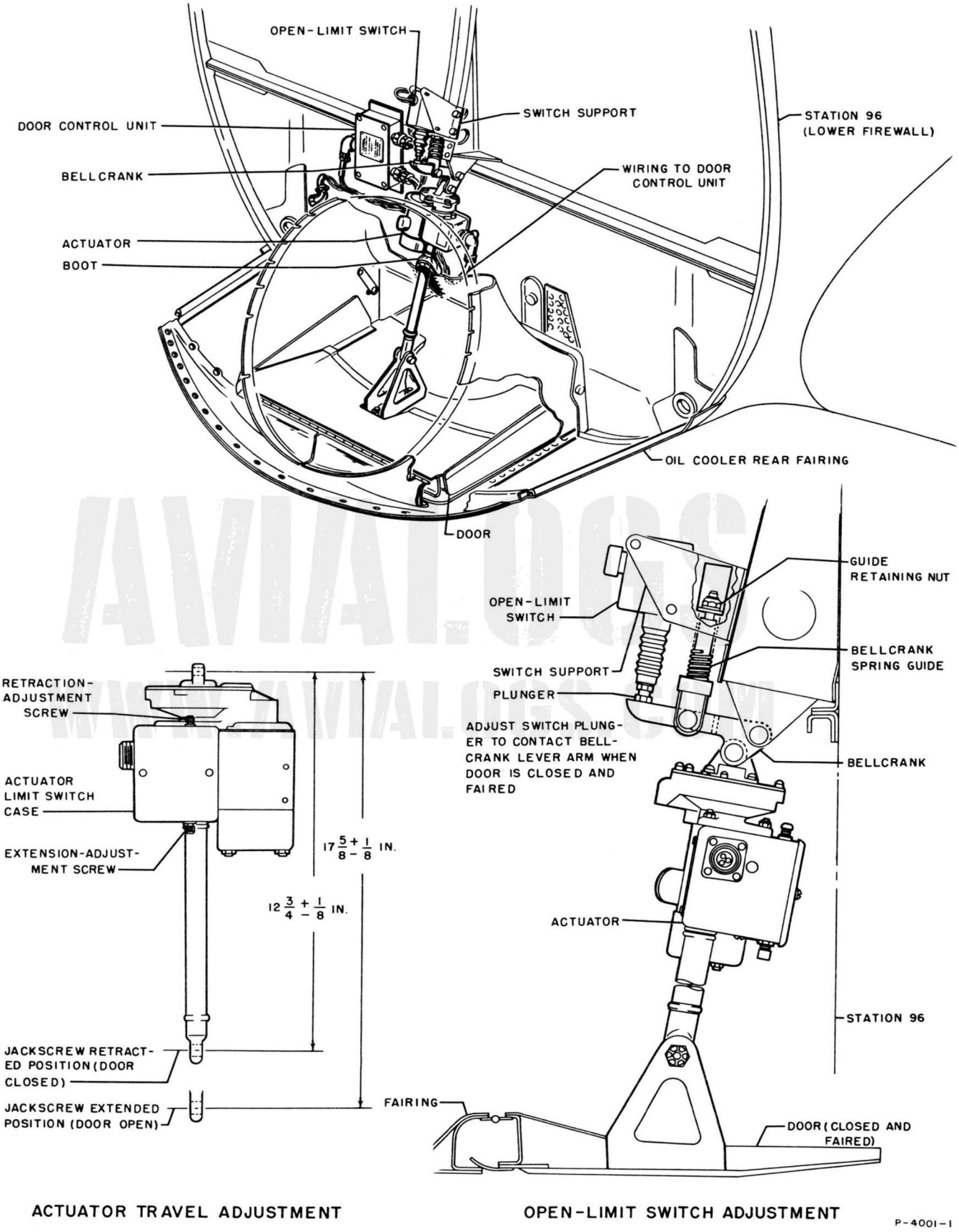


Figure 5–33. Oil Cooler Door and Actuator

5–311. OIL COOLER DOOR-OPEN LIMIT SWITCH.

5–312. DESCRIPTION. (See figure 5–33.) The oil cooler door-open limit switch is in the "open" leg of the door control circuit, which is completed through the normally closed contacts of the switch. When the cooler door opens far enough to contact a large store being carried on the fuselage external stores rack, the actuator supporting bellcrank is deflected against the switch plunger, depressing it to open the circuit; actuator travel then stops, and cannot resume in the open direction until release of the store permits the limit switch contacts to return to their normal, closed condition.

5–313. REMOVAL.

a. Remove right-hand accessory cowling.

b. Disconnect switch wiring from switch.

c. Remove switch attaching screws.

5–314. INSTALLATION.

a. Place switch in position on support and secure with screws, washers, and nuts.

b. Connect wiring to switch.

c. Adjust switch plunger.

5–315. ADJUSTMENT. (See figure 5–33.) The open-limit switch plunger should be adjusted to obtain contact between the plunger and the bellcrank lever while the oil cooler door is closed and faired.

5–316. OIL COOLER BYPASS-AND-SURGE-PROTECTION VALVE.

5–317. DESCRIPTION. The bypass-and-surge-protection valve serves a dual purpose: it directs the flow of oil through or around the cooler to control the oil temperature, and it allows oil to bypass the cooler, thus protecting the cooler structure from pressure surges. Valve action is automatic and is dependent upon the pressure and the temperature of the incoming oil. The valve assembly consists of an aluminum alloy housing which contains ports for a surge-protection valve, a bypass jacket and core relief valve, and a core check valve.

5–318. REMOVAL.

a. Remove oil cooler from airplane.

b. Remove valve attaching screws.

5–319. INSTALLATION.

a. Place new gasket on valve mounting flange of oil cooler, place bypass-and-surge-protection valve on flange, and install attaching screws.

b. Install oil cooler in airplane.

5–320. OIL DILUTION SYSTEM.

5–321. DESCRIPTION. (See figure 5–34.) The oil dilution system is a manually controlled electrical circuit which is utilized, when required, during engine shutdown. Its principal components include:

Name	*Location*
Circuit breaker, 15-amp	Forward equipment compartment circuit-breaker panel
Control valve	Engine mount—lower left leg
Shut-off valve	Engine mount—lower left leg
Control switch	RH control panel

5–322. The circuit is powered by the d-c secondary bus through the circuit breaker, which is also utilized by the pitot tube heater circuit. When the shut-off valve is open and the control switch is held in "OIL DILUTION," the control valve solenoid is energized and the auxiliary fuel pump circuit and the "open" side of the oil diverter valve circuit are connected to the oil dilution system. Fuel then flows through the control valve to the oil system and the diverter valve opens to direct oil into the warm-up compartment of the supply tank.

5–323. OIL DILUTION CONTROL VALVE.

5–324. DESCRIPTION. The oil dilution valve is normally closed (solenoid de-energized). The valve inlet port is connected by a hose to an elbow at the outlet port of the auxiliary fuel pump; the valve outlet port is connected, also by a hose, to the inlet port of the shut-off valve. When the dilution system is placed in operation, the plunger in the control valve is lifted from its seat, and fuel flows through the valve into the engine oil supply system.

5–325. REMOVAL.

a. Make certain that fuel selector valve control handle is in "OFF."

b. Remove lower left-hand panel of engine accessory section cowling.

c. Disconnect electrical connector from valve.

d. Disconnect fuel lines from valve.

e. Disconnect support clamp from valve.

5–326. INSTALLATION.

a. Place valve in position and install clamp and attaching screw.

b. Connect fuel lines to valve.

c. Apply anti-seize compound (Specification JAN-A-669) to threads of electrical connector and connect to valve.

5–327. OIL DILUTION SHUT-OFF VALVE.

5–328. DESCRIPTION. The manually controlled shut-off valve is installed in the oil dilution system between the control valve and the oil supply line fitting. It is accessible through a panel in the oil cooler front fairing. The shut-off valve must be placed in the open position

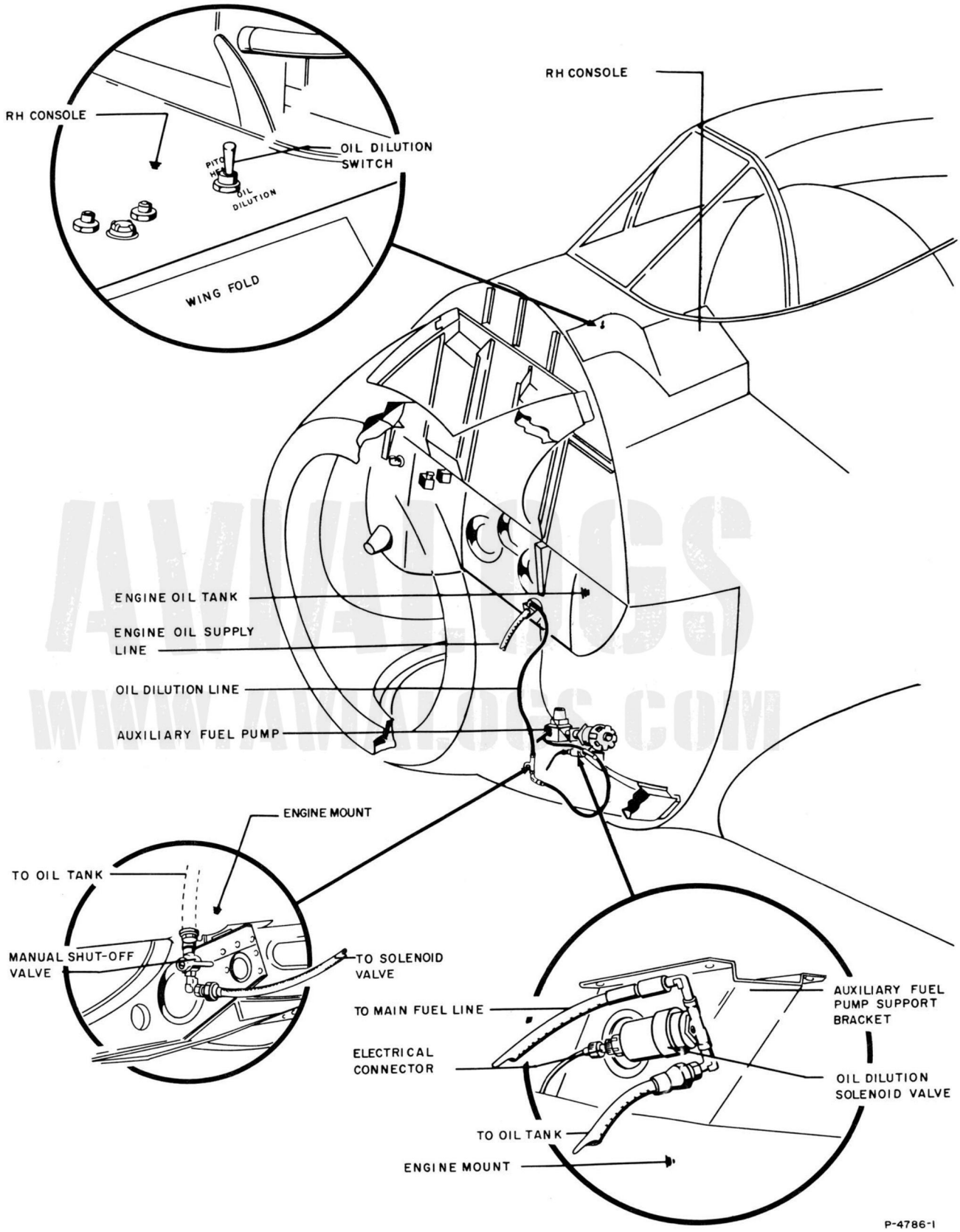


Figure 5–34. Oil Dilution System

before oil can be diluted and must be kept in the closed position at all other times.

5-329. REMOVAL.

a. Open shut-off valve access door.
b. Disconnect fuel lines from shut-off valve.
c. Unscrew shut-off valve from adapter.

5-330. INSTALLATION.

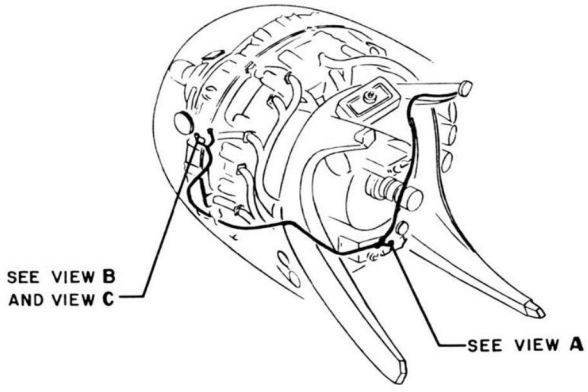
a. Place valve in position and screw valve onto adapter.
b. Connect fuel lines to shut-off valve.

5-330A. MAGNETIC CHIP DETECTOR WARNING SYSTEM.

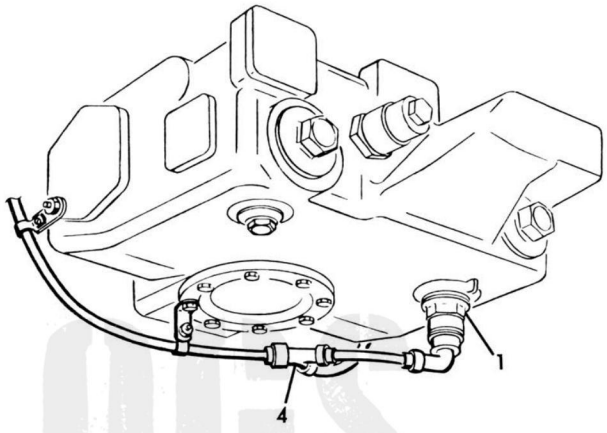
5-330B. DESCRIPTION. (See figure 5-34A and 5-34B.) The system provides a cockpit warning light for the Lisle magnetic chip detector plugs installed in the fore and aft oil sumps and a press-to-test light assembly on the instrument panel. The warning light is located on the upper center portion of the cockpit instrument panel under the glareshield and is illuminated when the magnetic plugs detect metal chips in the oil system.

5-331. ENGINE BUILD-UP.

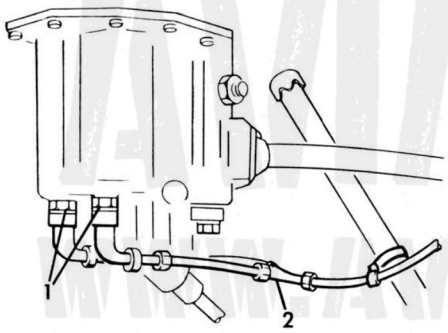
5-332. DESCRIPTION. The engine build-up consists of the installation of parts and accessories on the basic engine in order to adapt it for installation on the A-1H and A-1J airframe as a complete unit. It is recommended that the parts and accessories be installed on the engine in the sequence noted in figure 5-35.



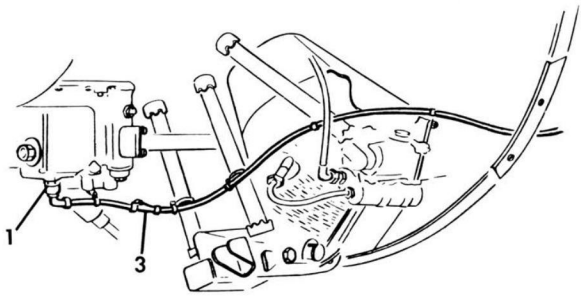
WAC-R3350-26WA, B AND C ENGINE (REF)



VIEW **A**
AFT OIL PUMP AND SUMP
(WAC-3350-26 WA ENGINE)
(WAC-3350-26 WB ENGINE)
(WAC-3350-26 WC ENGINE)



VIEW **B**
FORWARD OIL PUMP AND SUMP
(WAC-3350-26 WA ENGINE)
(WAC-3350-26 WC ENGINE)



VIEW **C**
FORWARD OIL PUMP AND SUMP
(WAC-3350-26 WB ENGINE)

NOTE

1 MAGNETIC CHIP DETECTOR PLUG, LSL-2091D15

2 HARNESS ASSEMBLY, 412808

3 HARNESS ASSEMBLY, 412806-8

4 HARNESS ASSEMBLY, 412808 *
HARNESS ASSEMBLY, 412806-8 **

* EFFECTIVE WAC-3350-26WA AND WC ENGINE

** EFFECTIVE WAC-3350-26WB ENGINE

EFFECTIVITY—BUNO.
FACTORY: NONE
SERV CHG: ALL AD-6, -7 AIRPLANES REWORKED PER BUAER AD/ASC NO. 695A

ALF-2-5 P-18934-1

Figure 5-34A. Magnetic Chip Detector Plug Installation

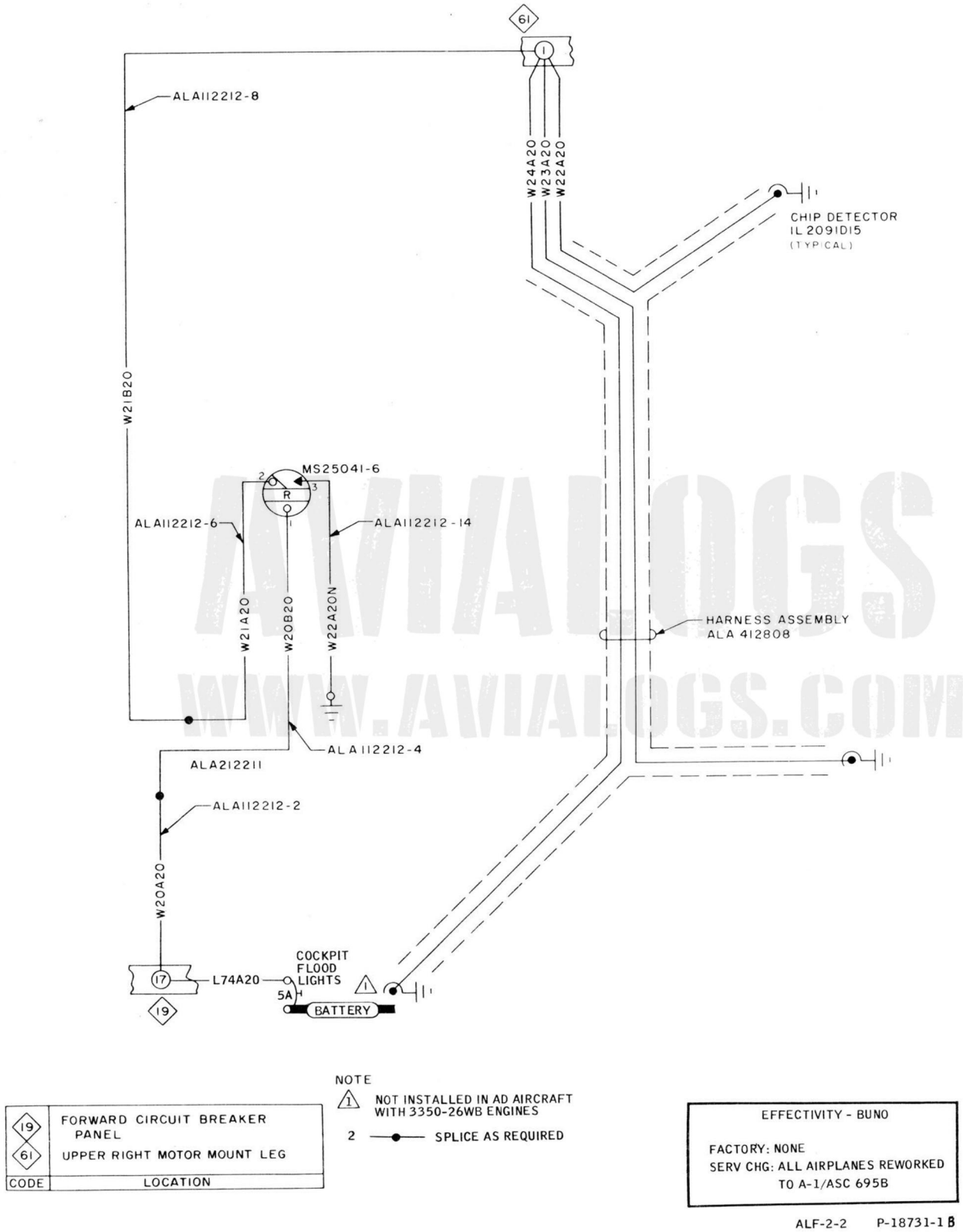


Figure 5-34B. Magnetic Chip Detector Warning System - Wiring Diagram

280B Figure 5-35 (Sheets 1, 2, 3, 4, and 5) and Pages 281 through 284A deleted.

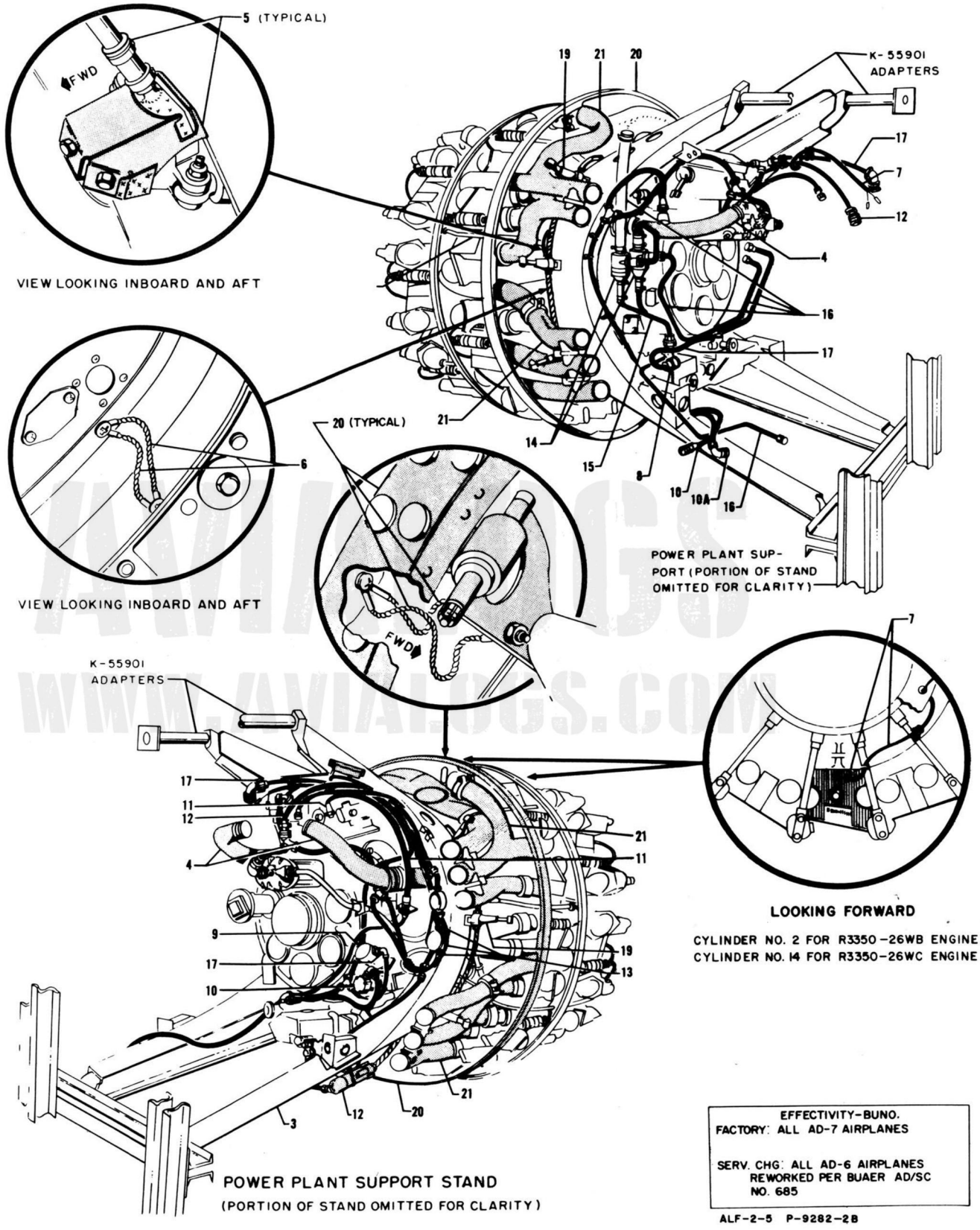


Figure 5-35. Engine Build-Up (Sheet 7)

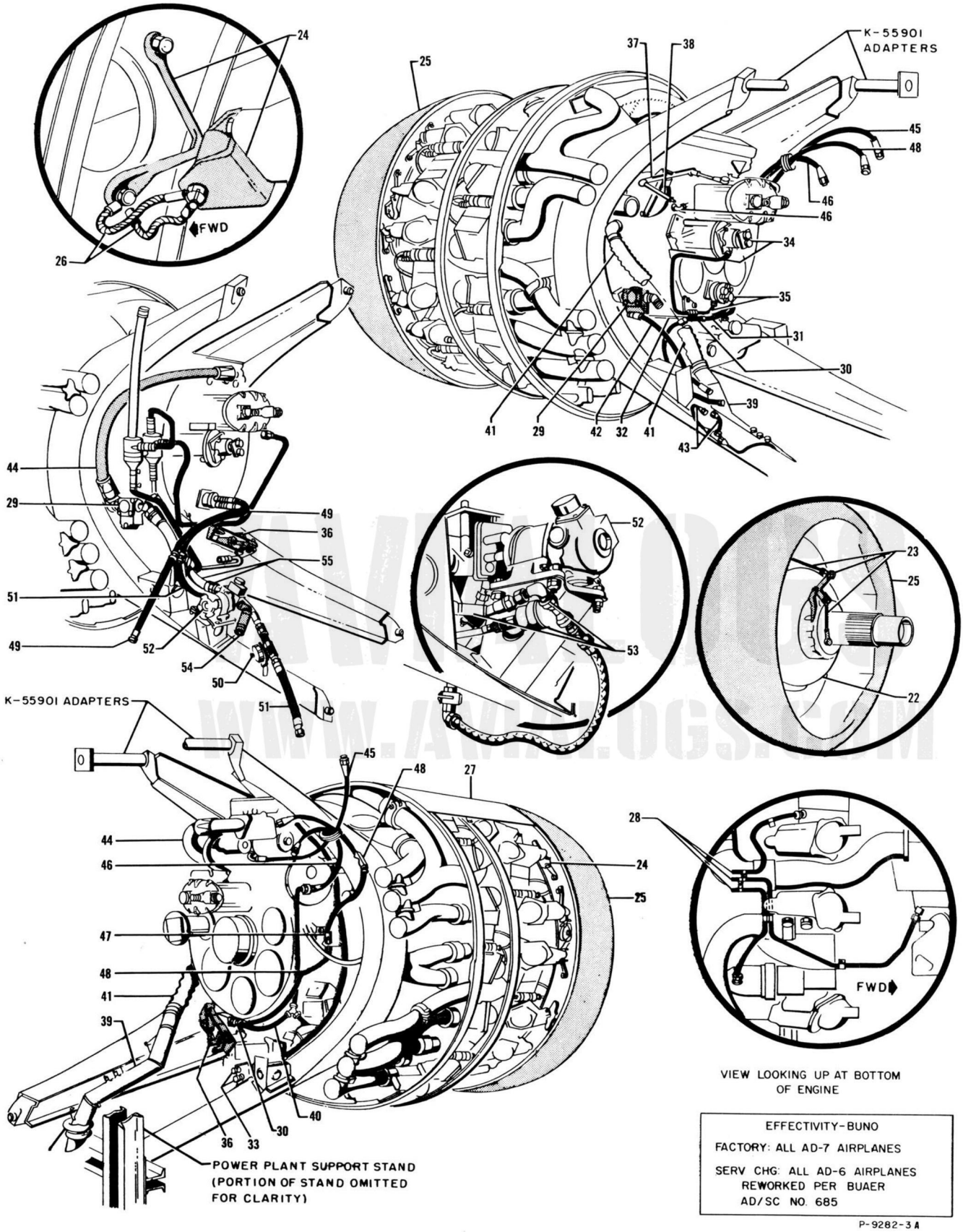


Figure 5–35. Engine Build-Up (Sheet 8)

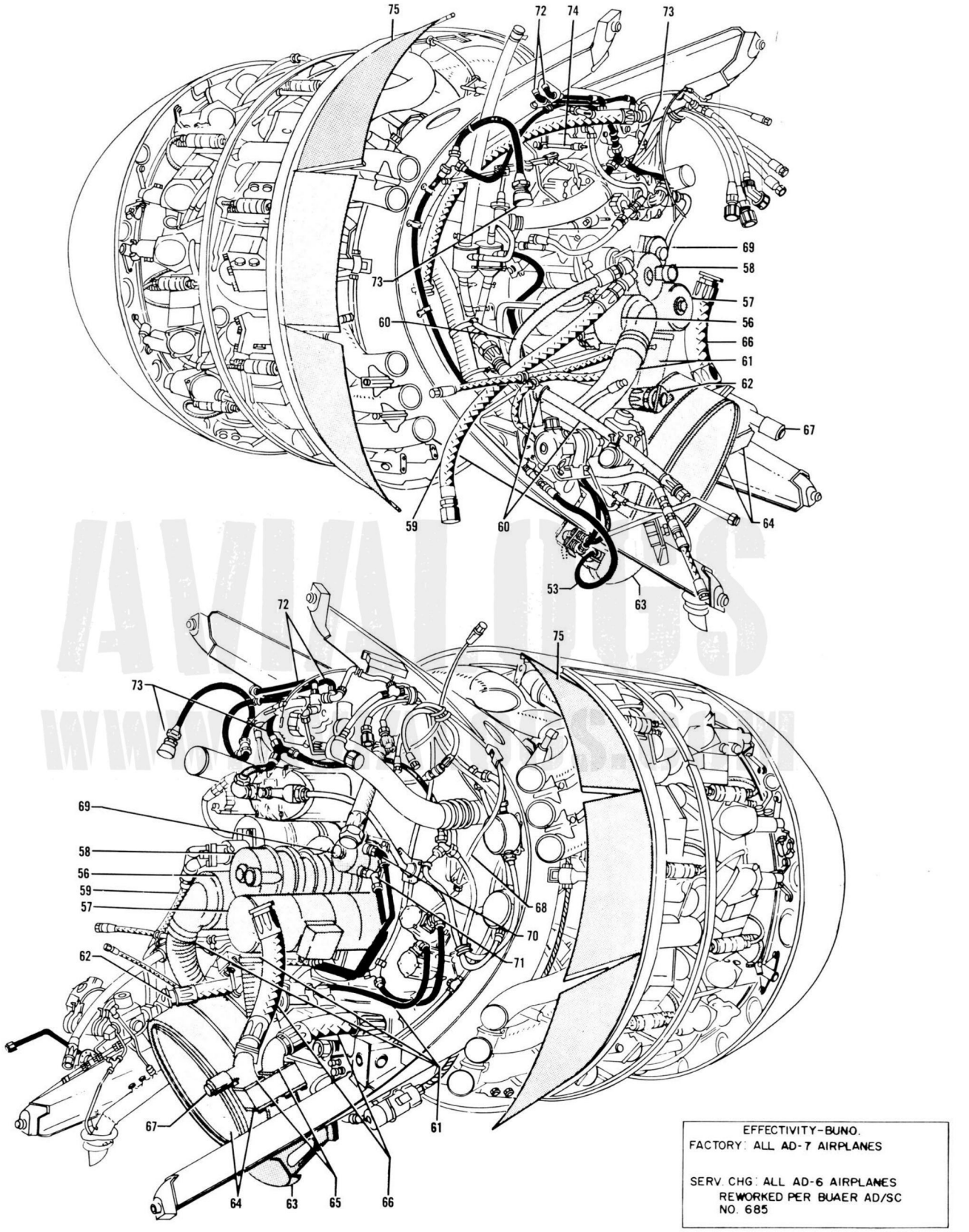


Figure 5–35. Engine Build-Up (Sheet 9)

Index	Name
1	Radiation shield base
2	Lord mount
3	Engine mount
4	Heating ducts and hoses
5	Radiation shield and blast tubes
6	Engine fireseal bonding jumpers
7	Cylinder head temperature thermocouple resistor and electrical wiring
8	Oil temperature thermometer bulb
9	Tachometer generator
10	Engine analyzer synchronizing generator
10A	Engine analyzer ignition lead
11	Rear oil pressure gage tube and resistor
12	Cowl side flap actuator and electrical wiring
13	Starting vibrators, magneto lead and power lead
14	Oil separators and support assembly (anti-G)
15	Separator drain line nipple and tube assembly to engine rear sump
16	Pressure and vacuum system hoses and lines
17	Power plant main electrical wiring bundle
18	Cowl side flap, gear box, and flexible cables
19	Cowl side flap jackscrews
20	Cowl bow and cowl bow bonding jumpers
21	Exhaust stack support brackets, exhaust stacks, and exhaust stack clamps
22	Fixed fairing
23	Propeller pitch control cable, bellcrank support, bellcrank, and control rod
24	Fixed nose ring support brackets
25	Fixed nose ring and flap actuator assembly
26	Fixed nose ring bonding jumpers
27	Fixed nose ring beam
28	Nos. 10, 9, and 11 cylinders intake port drain lines
29	Engine-driven fuel pump
30	Drain manifold block support bracket and drain manifold block
31	Supercharger housing drain lines
32	Engine fuel pump drain line to manifold block
33	Water injection system lines
34	Main hydraulic pump and drain line
35	Aileron boost hydraulic pump and drain line
36	Supercharger control mechanism
37	Throttle bellcrank support bracket and throttle bellcrank
38	Throttle rods
39	Lower drain and vent manifold
40	Lower drain and vent manifold rubber seal
41	Crankcase vent elbow and duct to drain and vent manifold
42	Engine-driven fuel pump diaphragm vent line
43	Auxiliary fuel pump drain lines
44	Engine-driven fuel pump supply line hose to carburetor
45	Fuel pressure gage and pressure switch restrictor and hose
46	Manifold pressure gage hose restrictor and manifold pressure gage hose
47	Instrument gage hose line support
48	Aft oil pressure gage hose assembly
49	Aileron boost pump supply line hose
50	Aileron boost pump pressure line external power receptacle
51	Aileron boost pump pressure line hoses
52	Auxiliary fuel pump
53	Oil dilution solenoid valve, shut-off valve, supply line hoses, elbows, and restrictor
54	Fuel supply line
55	Auxiliary fuel pump outlet port union and supply line to engine-driven fuel pump
56	Dc generator
57	Ac generator
58	Starter and starter ground cable
59	Main hydraulic pump supply line hose
60	Main hydraulic pump pressure line hose and hose support
61	Ac generator and dc generator air-cooling ducts
62	Engine oil supply line hose assembly
63	Oil cooler support assembly
64	Oil cooler and bypass valve assembly
65	Oil cooler bypass valve elbows
66	Engine oil return line hose assemblies
67	Oil cooler door thermostat
68	Oil tank vent line elbow and hose to supercharger rear housing
69	Pressure and vacuum pump
70	Pump vacuum port elbow
71	Pump pressure port elbow and tube assembly
72	Carburetor vent line hose elbows and carburetor vent line hoses
73	Ignition lead
74	Carburetor mixture control arm and control rod
75	Cowl side flaps

Figure 5-35. Engine Build-Up (Sheet 10)