SECTION 10A

ENGINES

(TURBOCHARGED)
(AIRCRAFT SERIALS 337-0526 THRU 33701598
AND F33700001 THRU F33700045)

TABLE OF CONTENTS

	Page
ENGINE COWLING	10A-2
Description	10A-2
Front	10A-2
Rear	10A-2
Removal and Installation	10A-2
Cleaning and Inspection	10A-2
Repair	10A-2
ENGINES	10A-2
Description	10A-2
Engine Data	10A-3
Trouble Shooting	10A-4
Removal	10A-8
Front	10A-8
Rear	10A-9
Cleaning	10A-10
Accessories Removal	10A-10
Inspection	10A-10
Build-Up	10A-10
Installation	10A-10
Front	10A-10
Rear	10A-12
Flexible Fluid Hoses	10A-13
Pressure Test	10A-13
Replacement	10A-13
Engine Baffles	10A-13
Description	10A-13
Cleaning and Inspection	10A-13
Removal and Installation	10A-13
Repair	10A-13
Engine Mount	10A-13
Description	10A-13
Removal and Installation	10A-13
Repair	10A-13
Engine Shock-Mount Pads	10A-13
COWL FLAPS	10A-13
Description	10A-13
Trouble Shooting	10A-13
Removal and Installation	10A-13
Rigging	10A-13
Front	10A-13
Rear	10A-13
CONTROL QUADRANT	10A-14
Description	10A-14
Removal and Installation	10A-14
Disassembly and Reassembly	10A-14
ENGINE CONTROLS	10A-14
Description	10A-14
Removal and Installation	10A-14
Rigging	10A-14
Throttle-Operated Gear Warning Switches	10A-14
Description	10A-14
Rigging	10A-14
INDUCTION AIR SYSTEM	10A-14
Description	10A-14
Removal and Installation	10A-14
Front	10A-14
Rear	10A-16
Cleaning Induction Air Filter	10A-16
FUEL INJECTION SYSTEM	10A-16
Description	10A-16
Trouble Shooting	10A-18
Fuel-Air Control Unit	10A-19
Description	10A-19
Removal and Installation	10A-19
Adjustments	10A-19
Fuel Manifold Valve (Fuel Distributor)	10A-19
Description	10A-20
Removal and Installation	10A-20
Cleaning	10A-20
Fuel Discharge Nozzles	10A-20
Description	10A-20
Removal	10A-20
Cleaning and Inspection	10A-20
Installation	10A-20
Fuel Injection Pump	10A-20
Description	10A-20
Removal and Installation	10A-20
Adjustments	10A-21
EXHAUST SYSTEMS	10A-21
Description	10A-21
Front Engine	10A-21
Rear Engine	10A-21
Removal	10A-21
Front Engine	10A-21
Rear Engine	10A-24
Inspection	10A-24
Installation	10A-24
Front Engine	10A-25

Rear Engine 10A-25
TURBOCHARGER 10A-25
Description 10A-25
Removal and Installation 10A-25
Front Engine 10A-25
Rear Engine 10A-27
Controllers and Waste-Gate Actuator 10A-27
Functions 10A-27
Operation 10A-27
Trouble Shooting 10A-31
Removal and Installation 10A-33
Variable Controller 10A-33
Rate-of-Change Controller . . . 10A-33
Waste-Gate and Actuator . . . 10A-33
Adjustments 10A-33
Variable Controller 10A-33
Rate-of-Change Controller . . 10A-33
Waste-Gate and Actuator . . . 10A-36
Operational Flight Check 10A-38
OIL SYSTEM 10A-40
Description 10A-40
Trouble Shooting 10A-40
Full-Flow Oil Filter 10A-40
Description 10A-40
Element Removal and Installation . 10A-40
Adapter Removal 10A-40
Adapter Disassembly, Inspection and Reassembly 10A-40
Adapter Installation 10A-40
IGNITION SYSTEM 10A-40
Description 10A-40
Trouble Shooting 10A-40
Magnetos 10A-40
Description 10A-40
Removal and Installation 10A-40
Internal Timing 10A-40
Magneto-to-Engine Timing 10A-40
Magneto Check 10A-40
Maintenance 10A-40
Tachometer Breaker Point Adjustment 10A-40
Spark Plugs 10A-40
STARTING SYSTEM 10A-40
Description 10A-40
Trouble Shooting 10A-40
Starter Motor 10A-40
Removal and Installation 10A-40
Primary Maintenance 10A-40
EXTREME WEATHER MAINTENANCE . . . 10A-40
Cold Weather 10A-40
Hot Weather 10A-40
Seacoast and Humid Areas 10A-40
Dusty Areas 10A-40
Ground Service Receptacle 10A-40
Hand Cranking 10A-40

10A-1. ENGINE COWLING.

10A-2. DESCRIPTION.

a. FRONT. The front engine cowling is similar to that described in Section 10, except it is wider at the front, with additional ram air openings in the right and left nose caps. The opening in the right side supplies ram air to the turbocharger. The opening in the left side supplies ram air to the cabin heating system.

b. REAR. The rear engine cowling is similar to that described in Section 10, except it is larger at the tail cap and only one exhaust outlet protrudes through the lower portion of the cowl. The larger tail cap permits greater engine cooling and the additional space needed for the installation of the turbocharger system.

10A-3. REMOVAL AND INSTALLATION. Refer to paragraph 10-3.

10A-4. CLEANING AND INSPECTION. Refer to paragraph 10-4.

10A-5. REPAIR. Refer to paragraph 10-5.

10A-6. ENGINES.

10A-7. DESCRIPTION. Air cooled, wet sump, six cylinder, horizontally-opposed, fuel-injected, turbocharged Continental TSIO-360 series engines are installed on the aircraft. Both engines are located on the fuselage centerline, one forward and one aft of the cabin. The engines themselves are similar, although their front (propeller) ends point in opposite directions. A conventional tractor propeller is required for the front engine and a pusher propeller is required for the rear engine. Each propeller rotates in the same direction in relation to its engine, but rotates in opposite directions in relation to each other. Cooling for the rear engine is obtained by an overhead air scoop and laterally mounted cowl flaps. Refer to paragraph 10A-8 for engine data. For repair and overhaul of the engines, accessories and propellers, refer to the appropriate publications issued by their manufacturer's. These publications are available from the Cessna Service Parts Center.

NOTE

Since the installed engines face in opposite directions, some confusion might arise from terms such as "right," "left," "front" and "rear". Except where further clarified in the text, these terms shall be applied to the rear engine as though it were removed from the aircraft and viewed from its accessory case end. Rear engine baffles, cowling and firewall are not considered part of the basic engine and shall be identified as "right," "left," etc., in relation to the aircraft.

10A-8. ENGINE DATA.

MODEL (Continental)	
Aircraft serials 337-0526 thru 337-0755	TSIO-360-A (Front) TSIO-360-B (Rear)
Beginning with aircraft serial 337-0756	TSIO-360-A (Front and Rear)
BHP at RPM	210 at 2800
Limiting Manifold Pressure (Sea Level)	32 Inches Hg.
Number of Cylinders	6-Horizontally-Opposed
Displacement	360 Cubic Inches
Bore	4.438 Inches
Stroke	3.875 Inches
Compression Ratio	7.5:1
Magnetos	Bendix-Model S6LN-25
Right Magneto	Fires 20° BTC Upper Right and Lower Left
Left Magneto	Fires 20° BTC Upper Left and Lower Right
Firing	1-6-3-2-5-4
Spark Plugs	18MM x .750-20 (Refer to current Continental active factory approved spark plug chart.)
Torque Value	330±30 Lb-In.
Fuel Metering System	Continental Fuel Injection
Unmetered Fuel Pressure	6.5 to 7.5 PSI at 600 RPM FRONT or 650 RPM REAR 29 to 32 PSI at 32.5 Hg. and 2800 RPM
Oil Sump Capacity	10 U.S. Quarts
With Filter Element Change	11 U.S. Quarts
Tachometer	Electric (Operated by Magneto Pick-Up)
Oil Pressure	
Minimum Idling	10 PSI
Normal	30 to 60 PSI
Maximum (Cold Oil Starting)	100 PSI
Connection Location	Between No. 2 and No. 4 Cylinders (Front and Rear)
Oil Temperature	
Normal Operation	Within Green Arc
Maximum Permissible	Red Line (240°F)
Cylinder Head Temperature	460°F Maximum
Probe Location	Lower Side No. 2 Cylinder (Rear) Thru aircraft serial 337-1193 Lower Side No. 5 Cylinder (Front) Thru aircraft serial 337-1193 Lower Side No. 1 Cylinder (Front and Rear) Beginning with aircraft serials 33701194 and F33700001
Approximate Dry Weight with Standard Accessories (Excluding Turbocharger System)	327 Pounds

10A-9. TROUBLE SHOOTING.

TROUBLE	PROBABLE CAUSE	REMEDY
ENGINE FAILS TO START.	Engine flooded or improper use of starting procedure.	Use proper starting procedure. Refer to Owner's Manual.
	Defective aircraft fuel system.	Refer to Section 11.
	Fuel tanks empty.	Service fuel tanks.
	Spark plugs fouled or defective.	Remove, clean, inspect and regap. Use new gaskets. Check cables to persistently fouled plugs. Replace if defective.
	Magneto impulse coupling failure.	Repair or install new coupling.
	Defective magneto switch or grounded magneto leads.	Repair or replace switch and leads.
	Defective ignition system.	Refer to paragraph 10-92.
	Induction air leakage.	Correct cause of air leakage.
	Clogged fuel screen in fuel control unit or defective unit.	Remove and clean. Replace defective unit.
	Clogged fuel screen in fuel manifold valve or defective valve.	Remove and clean screen. Replace defective valve.
	Clogged fuel injection lines or discharge nozzles.	Remove and clean lines and nozzles. Replace defective units.
	Defective auxiliary fuel pump.	Refer to Section 11.
	Engine-driven fuel pump not permitting fuel from auxiliary pump to bypass.	Install new engine-driven fuel pump.
	Vaporized fuel in system. (Most likely to occur in hot weather with a hot engine.)	Refer to paragraph 10-103.
ENGINE STARTS BUT DIES, OR WILL NOT IDLE PROPERLY.	Propeller control in high pitch (low rpm) position.	Use low pitch (high rpm) position for all ground operations.
	Improper idle speed or idle mixture adjustment.	Refer to paragraph 10-55.
	Defective aircraft fuel system.	Refer to Section 11.
	Spark plugs fouled or defective.	Remove, clean, inspect and regap. Use new gaskets. Check cables to persistently fouled plugs. Replace if defective.
	Water in fuel system.	Drain fuel tank sumps, lines and fuel strainer.
	Defective ignition system.	Refer to paragraph 10-92.

10A-9. TROUBLE SHOOTING (Cont).

TROUBLE	PROBABLE CAUSE	REMEDY
ENGINE STARTS BUT DIES, OR WILL NOT IDLE PROPERLY (Cont).	Induction air leakage.	Correct cause of air leakage.
	Clogged fuel screen in fuel control unit or defective unit.	Remove and clean. Replace defective unit.
	Clogged fuel screen in fuel manifold valve or defective valve.	Remove and clean. Replace defective valve.
	Restricted fuel injection lines or discharge nozzles.	Remove, clean lines and nozzles. Replace defective units.
	Defective engine-driven fuel pump.	Install and calibrate new pump.
	Vaporized fuel in system. (Most likely to occur in hot weather with a hot engine.)	Refer to paragraph 10-103.
	Manual engine primer leaking.	Disconnect primer outlet line. If fuel leaks through primer, repair or replace primer.
	Obstructed air intake.	Remove obstruction; service air filter, if necessary.
	One or more cylinder head drain lines broken or disconnected.	Connect lines; replace if broken.
	Discharge nozzle air vent manifolding restricted or defective.	Check for bent lines or loose connections. Tighten loose connections. Remove restrictions and replace defective components.
	Defective engine.	Check compression and listen for unusual engine noises. Check oil filter for excessive metal. Repair engine as required.
ENGINE HAS POOR ACCELERATION, RUNS ROUGHLY AT SPEEDS ABOVE IDLE OR LACKS POWER.	Idle mixture too lean.	Refer to paragraph 10-55.
	Propeller control in high pitch (low rpm) position.	Use low pitch (high rpm) position for all ground operations.
	Incorrect fuel-air mixture, worn control linkage or restricted air filter.	Replace worn elements of control linkage. Service air filter.
	Defective ignition system.	Refer to paragraph 10-92.
	Malfunctioning turbocharger.	Check operation, listen for unusual noise. Check operation of wastegate valve and for exhaust system defects. Tighten loose connections.
	Improper fuel-air mixture.	Check intake manifold connections for leaks. Tighten loose connections. Check fuel controls and linkage for setting and adjustment. Check fuel filter screens for dirt. Check for proper pump pressure.

10A-9. TROUBLE SHOOTING (Cont).

TROUBLE	PROBABLE CAUSE	REMEDY
ENGINE HAS POOR ACCELERATION, RUNS ROUGHLY AT SPEEDS ABOVE IDLE OR LACKS POWER (Cont).	Defective fuel injection system.	Refer to paragraph 10A-51.
	Spark plugs fouled or defective.	Remove, clean, inspect and regap. Use new gaskets. Check cables to persistently fouled plugs. Replace of defective.
	Engine or engine mount attaching bolts loose or broken.	Torque as specified. Replace if defective.
	Defective engine shock-mount.	Replace defective parts.
	Interference between engine mount and cowling.	Check for positive clearance. Edges of cowling stiffeners and doublers may be ground for clearance.
	Propeller out of balance.	Check and balance propeller.
	Defective engine.	Check compression, check oil filter for excessive metal. Listen for unusual noises. Repair engine as required.
	Exhaust system leakage.	Refer to paragraph 10A-72.
	Turbocharger wheels rubbing.	Replace turbocharger.
	Improperly adjusted or defective variable controller.	Refer to paragraph 10A-82.
	Leak in turbocharger discharge pressure system.	Correct cause of leaks. Repair or replace damaged parts.
	Manifold pressure overshoot. (Most likely to occur when engine is accelerated too rapidly.)	Move throttle about two-thirds open. Let engine accelerate and peak. Move throttle to full open.
	Engine oil viscosity too high for ambient air.	Refer to Section 2 for proper grade of oil.
POOR IDLE CUT-OFF.	Mixture control linkage improperly rigged.	Refer to paragraph 10-41.
	Defective or dirty fuel manifold valve.	Remove and clean manifold valve.
	Fuel contamination.	Drain all fuel and flush out fuel system. Clean all screens, fuel strainers, fuel manifold valves, nozzles and fuel lines.
	Defective mixture control valve in fuel pump.	Replace fuel pump.
ENGINE LACKS POWER, REDUCTION IN MAXIMUM MANIFOLD PRESSURE OR CRITICAL ALTITUDE.	Incorrectly adjusted throttle control, "sticky" linkage or dirty air filter.	Check movement of linkage by moving control through range of travel. Make proper adjustments and replace worn components. Service air filter.

TROUBLE	PROBABLE CAUSE	REMEDY
ENGINE LACKS POWER, REDUCTION IN MAXIMUM MANIFOLD PRESSURE OR CRITICAL ALTITUDE (Cont).	Defective ignition system.	Inspect spark plugs for fouled electrodes, heavy carbon deposits, erosion of electrodes, improperly adjusted electrode gaps and cracked porcelains. Test plugs for regular firing under pressure. Replace damaged or misfiring plugs.
	Improperly adjusted waste-gate valve.	Refer to paragraph 10A-82.
	Loose or damaged exhaust system.	Inspect entire exhaust system to turbocharger for cracks and leaking connections. Tighten connections and replace damaged parts.
	Loose or damaged manifolding.	Inspect entire manifolding system for possible leakage at connections. Replace damaged components, tighten all connections and clamps.
	Fuel discharge nozzle defective.	Inspect fuel discharge nozzle vent manifolding for leaking connections. Tighten and repair as required. Check for restricted nozzles and lines and clean and replace as necessary.
	Malfunctioning turbocharger.	Check for unusual noise in turbocharger. If malfunction is suspected, remove exhaust and/or air inlet connections and check rotor assembly, for possible rubbing in housing, damaged rotor blades or defective bearings. Replace turbocharger if damage is noted.
BLACK SMOKE EXHAUST.	Turbo coking, oil forced through seal of turbine housing.	Clean or change turbocharger.
HIGH CYLINDER HEAD TEMPERATURE.	Defective cylinder head temperature indicating system.	Refer to Section 14.
	Improper use of cowl flaps.	Refer to Owner's Manual.
	Defective cowl flap operating system.	Refer to paragraph 10-31.
	Engine baffles loose, bent or missing.	Install baffles properly. Repair or replace if defective.
	Dirt accumulated on cylinder cooling fins.	Clean thoroughly.
	Incorrect grade of fuel.	Drain and refill with proper fuel.

TROUBLE	PROBABLE CAUSE	REMEDY
HIGH CYLINDER HEAD TEMPERATURE (Cont).	Incorrect ignition timing.	Refer to paragraph 10-90.
	Defective fuel injection system.	Refer to paragraph 10A-51.
	Improper use of mixture control.	Refer to Owner's Manual.
	Defective engine.	Repair as required.
HIGH OR LOW OIL TEMPERATURE OR PRESSURE.		Refer to paragraph 10-76.
NOTE Refer to paragraph 10A-80 for trouble shooting of controller and waste-gate actuator.		

10A-10. REMOVAL. If an engine is to be placed in storage or returned to the manufacturer for overhaul, proper preparatory steps should be taken for corrosion prevention prior to beginning the removal procedure. Refer to Section 2 for storage preparation. The routing and location of wires, cables, lines, hoses and controls will vary with optional equipment installed, however, the following general procedure may be followed.

a. FRONT. The front engine may be removed as a complete unit with the turbocharger and accessories installed.

CAUTION

Place suitable padded stands under the tail boom tie-down rings before removing front engine. The loss of front engine weight will cause the aircraft to be tail heavy.

NOTE

Tag each item when disconnected to aid in identifying wires, hoses, lines and control linkages when engine is reinstalled. Likewise, shop notes made during removal will often clarify reinstallation. Protect openings, exposed as a result of removing or disconnecting units, against entry of foreign material by installing covers or sealing with tape.

1. Place all cabin switches in the OFF position.
2. Place fuel selector valves in the OFF position.
3. Remove engine cowling and nose caps in accordance with paragraph 10-3.
4. Disconnect battery cables, remove battery and battery box for additional clearance, if desired.
5. Drain fuel strainer and lines with strainer drain control.

NOTE

During the following procedures, remove any clamps which secure controls, wires, hoses or lines to the engine, engine mounts or attached brackets, so they will not interfere with the engine removal. Some of these items listed can be disconnected at more than one place. It may be desirable to disconnect some of these items at other than the placed indicated. The reason for engine removal should be the governing factor in deciding at which point to disconnect them. Omit any of the items which are nor present on a particular engine installation.

6. Remove induction air inlet flexible duct at right front side of engine for access to engine mount.
7. Disconnect control and remove heater from left side of engine.
8. Remove vacuum hoses from pump and suction relief valve and remove de-ice components from firewall.
9. Place propeller control in high-rpm position. Release unfeathering accumulator pressure through the filler valve and disconnect hose at accumulator.
10. Drain the engine oil sump and oil cooler.
11. Disconnect magneto primary lead wires at magnetos.

WARNING

The magnetos are in a SWITCH ON condition when the switch wires are disconnected. Ground the magneto points or remove the high tension wires from the magnetos or spark plugs to prevent accidental firing.

12. Remove the spinner and propeller in accordance with Section 12. Cover the exposed end of the crankshaft to prevent entry of foreign material.

13. Disconnect throttle, mixture and propeller governor controls. Remove clamps attaching controls to engine and pull controls aft clear of engine. Use care to avoid bending controls too sharply.

14. Disconnect oil temperature wire at sending unit.

15. Disconnect tachometer pick-up wire from [illegible] of right magneto.

CAUTION

When disconnecting starter cable do not permit starter terminal bolt to rotate. Rotation of the bolt could break the conductor between bolt and field coils causing the starter to be inoperative.

16. Disconnect starter electrical cable at starter.

17. Disconnect cylinder head temperature wire at probe.

18. Disconnect electrical wires and wire shielding ground at alternator.

19. Disconnect electrical wires at throttle-operated switch.

20. Disconnect exhaust gas temperature wires at probe leads.

21. Disconnect ground strap and any other electrical wiring not previously noted which may be damaged during engine removal.

22. Disconnect fuel strainer drain control wire at strainer bellcrank and remove control housing lock nuts securing housing to nose gear tunnel. Pull control and housing from tunnel area.

23. Disconnect vacuum hose at suction relief valve if not completed during step 8.

24. Disconnect supply and pressure hoses at firewall and hydraulic filter. Remove hydraulic pump drain line.

25. Disconnect manifold pressure line at firewall.

26. Disconnect fuel supply hose at nose gear tunnel and vapor return hose at firewall. Remove fuel pump drain line.

WARNING

Residual fuel and oil draining from disconnected lines and hoses constitutes a fire hazard. Use caution to prevent accumulation of such fuel and oil when lines or hoses are disconnected.

27. Disconnect fuel-flow gage hose at firewall.

28. Disconnect oil pressure hose at firewall.

29. Disconnect cylinder fuel drain line at hose connection on each side of engine.

30. Disconnect fuel-flow gage vent line at firewall.

31. Disconnect engine primer line at firewall.

32. Disconnect air inlet duct at turbocharger compressor.

33. Carefully check the engine again to ensure ALL hoses, lines, wires, cables and clamps are disconnected or removed which would interfere with the engine removal. Ensure all wires, cables and engine controls have been pulled aft to clear the engine.

34. Attach a hoist to the lifting eye at the top center of the engine crankcase. Lift engine just enough to relieve the weight from the engine mounts.

35. Remove bolts attaching engine to engine mounts and slowly hoist engine and pull it forward. Checking for any items which would interfere with the engine removal. Balance the engine by hand and carefully guide the disconnected parts out as the engine is removed.

36. Remove the engine shock-mounts.

b. REAR. The rear engine may be removed as a complete unit WITH the turbocharger, accessories and engine mount installed, or WITHOUT the turbocharger and engine mount installed. The following procedures outline engine removal with the turbocharger system and engine mount left on the aircraft.

NOTE

Tag each item disconnected to aid in identifying wires, hoses, lines and control linkages when the engine is reinstalled. Likewise, shop notes made during removal will often clarify reinstallation. Protect openings, exposed as a result of removing or disconnecting units, against entry of foreign material by installing covers or sealing with tape.

1. Place all cabin switches in the OFF position.

2. Place fuel selector valves in the OFF position.

3. Remove ALL engine cowling in accordance with paragraph 10-3.

4. Remove front engine left upper cowl section, disconnect battery ground cable and insulate terminal as a safety precaution.

5. Drain fuel strainer and lines with strainer drain control.

NOTE

During the following procedures, remove any clamps or lacings which secure controls, wires, hoses or lines to the engine, engine mount or attached brackets, so they will not interfere with engine removal. Some of the items listed can be disconnected at more than one place. It may be desirable to disconnect some of these items at other than the places indicated. The reason for engine removal should be the governing factor in deciding at which point to disconnect them. Omit any of the items which are not present on a particular engine.

6. Remove induction air filter and adapter fastened to engine baffle. Disconnect compressor inlet duct and remove duct.

7. Remove de-ice components from firewall.

8. Drain the engine oil sump and oil cooler.

9. Disconnect magneto primary lead wires at magnetos.

WARNING

The magnetos are in a SWITCH ON condition when the switch wires are disconnected. Ground the magneto points or remove the high tension wires from the magnetos or spark plugs to prevent accidental firing.

10. Remove the spinner and propeller in accordance with Section 12. Cover the exposed end of the crankshaft to prevent entry of foreign material.
11. Disconnect throttle, mixture and propeller governor controls. Remove any clamps attaching controls to engine and pull controls clear of engine. Use care to avoid bending controls too sharply.
12. Disconnect oil temperature wire at sending unit.
13. Disconnect tachometer pick-up wire from bottom of right magneto.

CAUTION

When disconnecting starter cable do not permit starter terminal bolt to rotate. Rotation of the bolt could break the conductor between bolt and field coils causing the starter to be inoperative.

14. Disconnect starter electrical cable at starter.
15. Disconnect cylinder head temperature wire at probe.
16. Disconnect electrical wires and wire shielding ground at alternator.
17. Disconnect electrical wires at throttle-operated switch.
18. Disconnect exhaust gas temperature wires at probe leads.
19. Disconnect ground strap and any other electrical wiring not previously noted which may be damaged during engine removal.
20. Disconnect fuel strainer drain control wire at strainer and remove control housing lock nuts securing housing to fuselage structure. Pull control and housing from structure area.
21. Disconnect vacuum hose at vacuum pump if not completed during step 7.
22. Disconnect manifold pressure line at firewall.
23. Disconnect fuel supply hose at auxiliary pump, vapor return hose at firewall and fuel pump drain line.

WARNING

Residual fuel and oil draining from disconnected lines and hoses constitutes a fire hazard. Use caution to prevent accumulation of such fuel and oil when lines or hoses are disconnected.

24. Disconnect fuel-flow gage hose at firewall.
25. Disconnect oil pressure hose at firewall.
26. Disconnect cylinder fuel drain line at hose connection at each side of engine.
27. Disconnect fuel-flow gage vent line at firewall.
28. Disconnect engine primer line at firewall.
29. Disconnect drain lines protruding through fuselage skin to prevent damage.
30. Disconnect oil hoses at waste-gate actuator. Plug or cap hoses and fittings.
31. Disconnect oil hoses to turbocharger. Plug or cap hoses and fittings.
32. Disconnect supply and pressure hoses at firewall and hydraulic filter. Remove hydraulic pump drain line.
33. Disconnect exhaust pipes at collector on each side of the engine, so that turbocharger, waste-gate actuator, waste-gate and exhaust tailpipe may be left in the aircraft. Note that exhaust system braces are attached to the aft engine mount bolts.
34. Remove bolts attaching turbocharger to support brackets.
35. Remove turbocharger outlet air duct.
36. Carefully check the engine again to ensure ALL hoses, lines, wires, cables and clamps are disconnected or removed which would interfere with the engine removal. Ensure all wires, cables and engine controls have been pulled forward to clear the engine.
37. Attach a hoist to the lifting eye at the top center of the engine crankcase. Lift engine just enough to relieve the weight from the engine mount assembly.

CAUTION

Be sure there is clearance at the top of the tail section, as the tail section of the aircraft will rise with the loss of engine weight.

38. Remove bolts attaching engine to engine mount, slowly hoist the engine and pull it aft.
39. Balance the engine by hand and carefully work the engine from aircraft, guiding the disconnected parts as the engine is removed.
40. Remove engine shock-mounts.

10A-11. CLEANING. Refer to paragraph 10-11.

10A-12. ACCESSORIES REMOVAL. Refer to paragraph 10-12.

10A-13. INSPECTION. Refer to paragraph 10-13.

10A-14. BUILD-UP. Refer to paragraph 10-14.

10A-15. INSTALLATION.
a. FRONT. Before installing the front engine on the aircraft, install any items which were removed from the engine or aircraft after the engine was removed.

NOTE

Remove all protective covers, plugs, caps and identification tags as each item is connected or installed. Omit any items not present on a particular engine installation.

1. Hoist the engine to a point just above the nacelle.

2. Install engine shock-mount pads as illustrated in figure 10-1.

3. Carefully lower engine slowly into place on the engine mount pads. Route controls, lines, hoses and wires in place as the engine is positioned on the engine mounts.

NOTE

Be sure engine shock-mount pads, spacers and washers are in place as the engine is lowered into position.

4. Install engine mount bolts, washers and nuts, then remove the hoist and tail boom support stands. Torque bolts to 450-500 lb-in.

5. Connect air inlet duct to turbocharger compressor.

6. Route throttle, mixture and propeller governor controls to their respective units and connect. Secure controls in position with clamps.

7. Connect engine primer line at firewall.

8. Connect fuel-flow gage vent line at firewall.

9. Connect cylinder fuel drain lines at hose connection on each side of engine.

10. Connect oil pressure hose at firewall.

11. Connect fuel-flow gage hose at firewall.

12. Connect fuel supply hose and vapor return line at tunnel and firewall. Install fuel pump drain line.

NOTE

Throughout the aircraft fuel system, from the fuel tanks to the engine-driven fuel pump, use RAS-4 (Snap-On Tools Corp., Kenosha, Wisconsin), MIL-T-5544 (Thread Compound, Anti-seize, Graphite-Petrolatum) or equivalent, as a thread lubricant or to seal a leaking connection. Apply sparingly to male fittings only, omitting the first two threads. Always ensure that a compound, the residue from a previously used compound or any other foreign material cannot enter the system. Throughout the fuel injection system, from the engine-driven pump through the discharge nozzles, use only a fuel soluble lubricant, such as engine lubricating oil, on fitting threads. Do not use any other form of thread compound on the injection system fittings.

13. Connect manifold pressure line at firewall.

14. Connect vacuum hose at suction relief valve.

15. Connect supply and pressure hoses at firewall and hydraulic filter. Install hydraulic pump drain line.

16. Install all clamps and lacings securing hoses and lines to the engine or structure.

17. Connect ground strap to engine mount.

18. Connect exhaust gas temperature wires to probe leads. Be sure wires are not crossed.

19. Connect electrical wires to throttle-operated switch.

20. Connect wires and wire shielding ground to alternator.

21. Connect cylinder head temperature wire to probe.

CAUTION

When connecting starter cable, do not permit starter terminal bolt to rotate. Rotation of the bolt could break the conductor between bolt and field coils causing the starter to be inoperative.

22. Connect starter electrical cable at starter.

23. Connect tachometer pick-up wire at bottom of right magneto.

24. Connect oil temperature wire at sending unit.

25. Install all clamps and lacings securing wires and cables to the engine or structure.

26. Route the fuel strainer drain control through the nose gear tunnel structure to the strainer, install the lock nuts to secure housing and connect control wire to strainer control bellcrank.

27. Install propeller and spinner in accordance with instructions outlined in Section 12.

28. Complete a magneto switch ground-out and continuity check, then connect primary lead wires to the magnetos. Remove the temporary ground or connect spark plug leads, whichever procedure was used during removal.

WARNING

Be sure magneto switch is in OFF position when connecting switch wires to magnetos.

29. Connect unfeathering accumulator hose at accumulator and service accumulator in accordance with Section 12.

30. Install de-ice components and hoses on firewall.

31. Install heater and connect control.

32. Clean induction air filter and install filter and induction air inlet duct.

33. Service engine with proper grade and quantiy of engine oil. Refer to Section 2 if engine is new, newly overhauled or has been in storage.

34. Check all switches are in the OFF position, install battery box and battery and connect cables.

35. Rig engine controls in accordance with paragraph 10-41.

36. Inspect engine installation for security, correct routing of controls, lines, hoses and electrical wiring, proper safetying and tightness of all components.

37. Install engine cowling in accordance with paragraph 10-3.

38. Check cowl flaps and rig in accordance with paragraph 10-33, if necessary.

NOTE

When installing a new or newly overhauled engine and prior to starting the engine, disconnect the oil inlet line at the controller and oil outlet line at the controller. Connect these oil lines to a full flow oil filter, allow-

ing oil to bypass the controller. With filter installed, operate engine for approximately 15 minutes to filter out any foreign particles from the oil. This is done to prevent foreign material from entering the controller.

39. Perform an engine run-up and make final adjustments on the engine controls.

b. REAR. Before installing the rear engine on the aircraft, reinstall any items which were removed from the engine or aircraft after the engine was removed.

NOTE

Remove all protective covers, plugs, caps and identification tags as each item is connected or installed. Omit any items not present on a particular engine installation.

1. Hoist the engine assembly to a point near the engine mount and route controls, lines, hoses and wires in place.
2. Install engine shock-mount pads as illustrated in figure 10-1.
3. Carefully work engine assembly in position on the engine mount.

NOTE

Be sure shock-mount pads, spacers and washers are in place as the engine is lowered into position.

4. Install engine mount bolts, washers and nuts, then remove the hoist. Torque bolts to 450-500 lb-in.

NOTE

Exhaust stack braces are secured to the aft engine mount bolts.

5. Install bolts attaching turbocharger to support brackets.
6. Connect exhaust pipes to collector on each side of the engine.
7. Connect supply and pressure hoses at firewall and hydraulic filter. Install hydraulic pump drain line.
8. Connect oil hoses to turbocharger.
9. Connect oil hoses to waste-gate actuator.
10. Route throttle, mixture and propeller governor controls to their respective units and connect. Secure controls in position with clamps.
11. Connect drain lines protruding through fuselage skin.
12. Connect engine primer line at firewall.
13. Connect fuel-flow gage vent line at firewall.
14. Connect cylinder fuel drain line at hose connections on each side of engine.
15. Connect oil pressure hose at firewall.
16. Connect fuel flow gage hose at firewall.

NOTE

Throughout the aircraft fuel system, from the fuel tanks to the engine-driven fuel pump, use RAS-4 (Snap-On Tools Corp., Kenosha, Wisconsin), MIL-T-5544 (Thread Compound, Antiseize, Graphite-Petrolatum) or equivalent, as a thread lubricant or to seal a leaking connection. Apply sparingly to male fittings only, omitting the first two threads. Always be sure that a compound, the residue from a previously used compound or any other foreign material cannot enter the system. Throughout the fuel injection system, from the engine-driven fuel pump through the discharge nozzles, use only a fuel soluble lubricant, such as engine lubricating oil, on the fitting threads. Do not use any other form of thread compound on the injection system fittings.

17. Connect fuel supply hose to auxiliary pump, vapor return hose at firewall and fuel pump drain line.
18. Connect manifold pressure line at firewall.
19. Connect vacuum pump hose at vacuum pump.
20. Install all clamps and lacings securing hoses and lines to engine, engine mount or structure.
21. Route the strainer drain control through fuselage structure to the strainer, install control housing lock nuts securing housing to structure and connect control wire to strainer.
22. Connect ground strap to engine mount.
23. Connect exhaust gas temperature wires at probe leads. Be sure wires are not crossed.
24. Connect electrical wires at throttle-operated switch.
25. Connect electrical wires and wire shielding ground at alternator.
26. Connect cylinder head temperature wire at probe.

CAUTION

When connecting starter cable, do not permit starter terminal bolt to rotate. Rotation of the bolt could break the conductor between bolt and field coils causing the starter to be inoperative.

27. Connect starter electrical cable at starter.
28. Connect tachometer pick-up wire at bottom of right magneto.
29. Connect oil temperature wire at sending unit.
30. Install all clamps and lacings securing wires and cables to engine, engine mount or structure.
31. Install propeller and spinner in accordance with instructions outlined in Section 12.
32. Complete a magneto switch ground-out and continuity check, then connect primary ground or connect spark plug leads, whichever procedure was used during removal.

WARNING

Be sure magneto switch is OFF when connecting primary leads to magnetos.

33. Install de-ice components and hoses on firewall.

34. Install induction air ducts, clean air filter and install adapter.

35. Service engine with proper grade and quantity of engine oil. Refer to Section 2 if engine is new, newly overhauled or has been in storage.

36. Check all switches are in the OFF position and connect battery ground cable.

37. Rig engine controls in accordance with paragraph 10-41.

38. Check engine installation for security, correct routing of controls, lines, hoses and electrical wiring, proper safetying and tightness of all components.

39. Install engine cowling in accordance with paragraph 10-3.

40. Check cowl flaps and rig in accordance with paragraph 10-33, if necessary.

NOTE

When installing a new or newly overhauled engine and prior to starting the engine, disconnect the oil inlet line at the controller and oil outlet line at the controller. Connect these oil lines to a full flow oil filter, allowing oil to bypass the controller. With filter installed, operate engine for approximately 15 minutes to filter out any foreign particles from the oil. This is done to prevent foreign material from entering the controller.

41. Perform an engine run-up and make final adjustments on the engine controls.

10A-16. FLEXIBLE FLUID HOSES. Refer to paragraph 10-16.

10A-17. PRESSURE TEST. Refer to paragraph 10-17.

10A-18. REPLACEMENT. Refer to paragraph 10-18.

10A-19. ENGINE BAFFLES. Refer to paragraph 10-19.

10A-20. DESCRIPTION. Refer to paragraph 10-20.

10A-21. CLEANING AND INSPECTION. Refer to paragraph 10-21.

10A-22. REMOVAL AND INSTALLATION. Refer to paragraph 10-22.

10A-23. REPAIR. Refer to paragraph 10-23.

10A-24. ENGINE MOUNT. Refer to paragraph 10-24.

10A-25. DESCRIPTION. Refer to paragraph 10-25.

10A-26. REMOVAL AND INSTALLATION. Refer to paragraph 10-26.

10A-27. REPAIR. Refer to paragraph 10-27.

10A-28. ENGINE SHOCK-MOUNT PADS. Refer to paragraph 10-28.

10A-29. COWL FLAPS.

10A-30. DESCRIPTION. The front and rear cowl flaps are the same as described in paragraph 10-30 except for the follow-up control attachment location.

10A-31. TROUBLE SHOOTING. Refer to paragraph 10-31.

10A-32. REMOVAL AND INSTALLATION. Refer to paragraph 10-32.

10A-33. RIGGING.

a. FRONT. (Refer to paragraph 10-33.) Rigging of the FRONT cowl flaps on turbocharged aircraft is the same as outlined in paragraph 10-33 except for the follow-up control attachment location.

b. REAR. (THRU AIRCRAFT SERIAL 337-0755 WHEN NOT MODIFIED IN ACCORDANCE WITH SK337-8.) (Refer to paragraph 10-33.)

1. Complete steps 1 thru 16 of subparagraph "d."

2. Operate cowl flaps to the single-engine position and measure travel at trailing edge. The cowl flap should open 6.50 +.25 -.00 inches, but still remain open .50 inch in the CLOSED position. Readjust push-pull rods to bellcranks and cowl flaps and select a different hole in the bellcranks as required for proper travel and opening in the closed position. Check that the stops on the bellcranks just clear the engine mount tubes. Lower wing flaps cautiously with cowl flaps full open, and check for at least 1/4 inch clearance in any position.

3. Place rear cowl flap control lever in the NORMAL OPEN position (twin-engine operation) and check that the cowl flaps are open 4 ± .25 inches, measured at the trailing edges.

4. Check that all rod ends and clevis ends have sufficient thread engagement, all jam nuts are tight and all safeties are installed.

c. REAR. (AIRCRAFT SERIALS 337-0756 THRU 337-0978 AND ALL AIRCRAFT MODIFIED IN ACCORDANCE WITH SK337-8.)

1. Complete steps 1 and 2 of paragraph 10-33, subparagraph "e."

2. Complete steps 1 thru 16 of paragraph 10-33, subparagraph "d."

3. Complete steps 1 thru 3 of paragraph 10A-33, subparagraph "b."

4. Complete steps 4 thru 7 of paragraph 10-33, subparagraph "e."

d. REAR. (BEGINNING WITH AIRCRAFT SERIALS 337-0979 AND F33700001.)

1. Complete steps 1 thru 3 of paragraph 10-33, subparagraph "f."

2. Install RIGHT HAND cowl panel, connect horizontal push-pull rod (49) to torque tube arm (24). The cowl flap (56) must be open .50 inch in the CLOSED POSITION. If not, readjust push-pull rods as necessary.

3. Using jumper wires and external power supply, run the right hand cowl flap to open 6.50+.25-.00 inches, measured from the trailing edge of cowl flap to aft edge of cowl flap opening.

CAUTION

Do not use master switch before rigging has been completed. When using jumper wires connect only one wire to motor lead and "strike" the other wire against other motor lead. If motor does not move in the correct direction, reverse jumper leads.

4. Loosen screws on OPEN-LIMIT switch (43) and adjust switch toward actuating bracket (47) until switch just de-actuates.

NOTE

Opening of the microswitch may be determined by listening for a faint "click," or continuity may be checked.

5. Complete step 10 of paragraph 10-33, subparagraph "d."

6. Install LEFT HAND cowl panel, connect vertical push-pull rod (49) to torque tube arm (24) and horizontal push-pull rod (53) to cowl flap (56). The cowl flap should be open 6.50+.25-.00 inches in the open position. If not, readjust push-pull rods as necessary.

7. Place master switch in the ON position and using cowl flap toggle switch (index 41, sheet 1), slowly run the cowl flaps to the CLOSED position and check that the LEFT cowl flap is open .50 inch in the CLOSED position. If not, readjust the push-pull rods as necessary.

NOTE

In all cases, the final result of rigging, is that the cowl flaps are to be open .50 inch in the CLOSED position and are to be open 6.50+.25-.00 inches in the OPEN position.

8. Using toggle switch (index 41, sheet 1), run cowl flaps through several cycles. Check position indicating lights for operation. Stop cowl flaps at intermediate openings to check toggle switch operation.

9. Check that all rod ends and clevis ends have sufficient thread engagement, all jam nuts are tight, all safeties are installed and reinstall upper cowling section.

10A-34. CONTROL QUADRANT. Refer to paragraph 10-34.

10A-35. DESCRIPTION. Refer to paragraph 10-35.

10A-36. REMOVAL AND INSTALLATION. Refer to paragraph 10-36.

10A-37. DISASSEMBLY AND REASSEMBLY. Refer to paragraph 10-37.

10A-38. ENGINE CONTROLS. Refer to paragraph 10-38.

10A-39. DESCRIPTION. Refer to paragraph 10-39.

10A-40. REMOVAL AND INSTALLATION. Refer to paragraph 10-40. Omit any references to the intake heater controls.

10A-41. RIGGING. Refer to paragraph 10-41. Omit any references to the intake heater controls.

10A-42. THROTTLE-OPERATED GEAR WARNING SWITCHES. Refer to paragraph 10-42.

10A-43. DESCRIPTION. Refer to paragraph 10-43.

10A-44. RIGGING. Refer to paragraph 10-44.

10A-45. INDUCTION AIR SYSTEM.

10A-46. DESCRIPTION. Ram air to the front engine induction system enters an air duct at the right side of the nose cap cowling. Ram air to the rear engine induction system enters from the air scoop above the fuselage. The air is filtered through a dry filter, located in the induction airbox on each engine. From the filter, the air passes through an air duct to the inlet of the turbocharger compressor where the air is compressed. The pressurized induction air is then routed through an air duct to the fuel-air control unit mounted on the top side of the engine. From the fuel-air control unit, the air is supplied to the cylinders through the right and left intake manifolds located on the top side of the cylinders. The fuel-air control unit is connected to the cylinder intake manifold by hoses and clamps. The intake manifold is attached to each cylinder by two bolts through a welded flange, which is sealed by a gasket. An alternate air door, mounted in the air duct between the filter and the turbocharger compressor is held closed by a small magnet. If the filter should become clogged, suction from the turbocharger compressor will cause the alternate air door to open. This permits the compressor to draw heated unfiltered air from within the engine compartment. The alternate air door should be checked periodically for freeness of operation and complete closing. The induction filters should be cleaned, inspected and replaced as outlined in Section 2.

10A-47. REMOVAL AND INSTALLATION.

a. FRONT. (Refer to figure 10A-1.)

1. Remove filter access door on right side of lower cowl.

2. Pull filter (12) from airbox (6).

3. Remove engine cowling as required for access to the upper duct (4) and airbox (6).

4. Loosen clamps and remove turbocharger compressor outlet duct from compressor outlet and engine baffle.

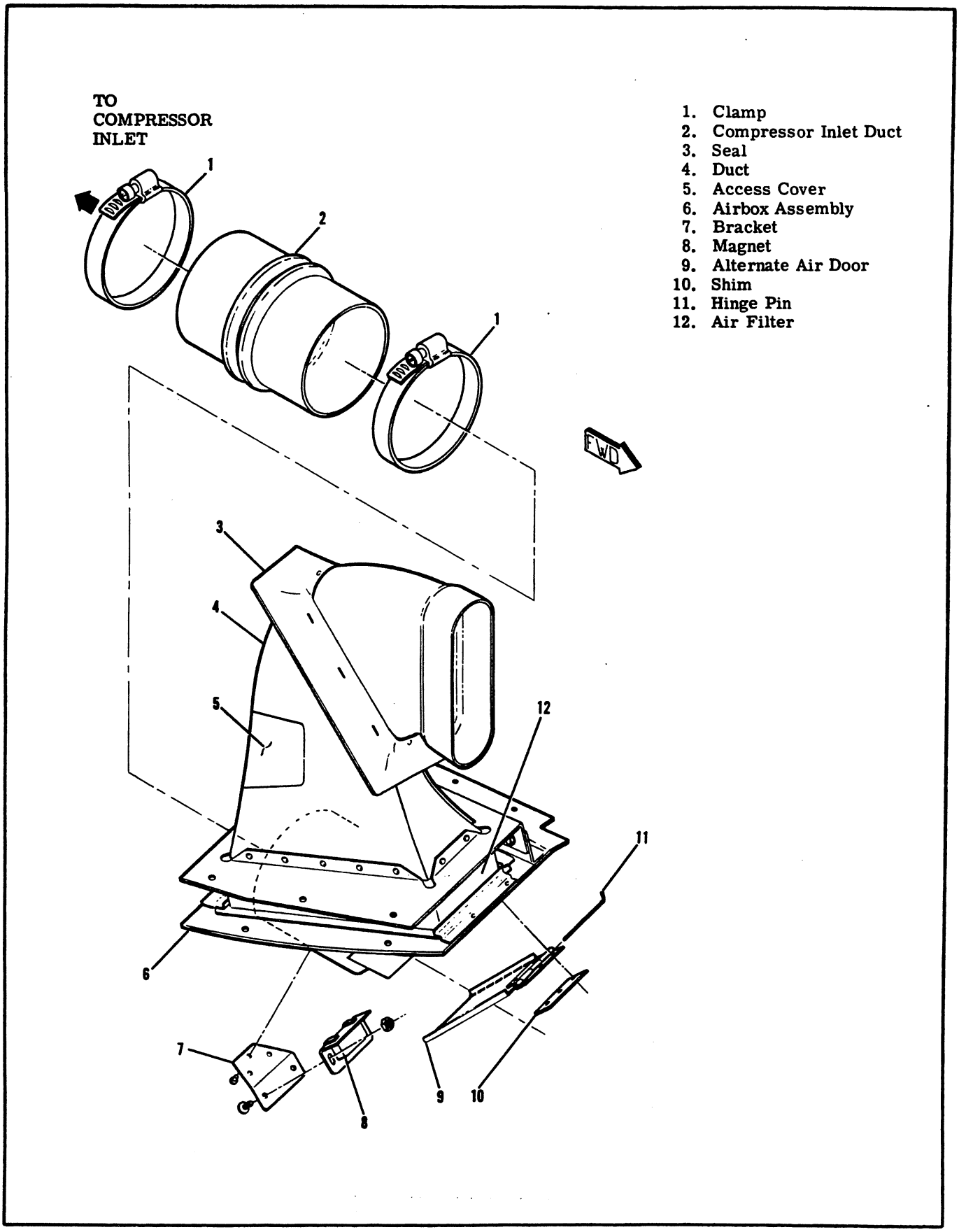


Figure 10A-1. Front Engine Induction Air System

5. Working through air filter access door, remove bolt from inboard side of filter cavity.

6. Working through air filter access door, remove screws attaching upper inlet air duct to lower cowl.

7. Loosen clamp and disconnect upper duct (4) from nose cap inlet.

8. Work upper inlet air duct (4) aft and out of aircraft.

9. Remove screws attaching airbox assembly to nose gear tunnel.

10. Remove screws attaching airbox assembly to lower cowling.

11. Loosen clamps (1) and remove compressor inlet air duct (2) from airbox and compressor.

12. Work airbox assembly from aircraft.

13. Reverse the preceding steps for reinstallation.

NOTE

When installing the air filter, ascertain that the filter fits snugly in airbox. The area between the upper inlet air duct and airbox is adjustable by the addition of a shim between the upper air duct and duct mounting bracket on the lower cowling. Also, the inboard side of the filter area is adjustable by loosening the bolt and sliding the duct up or down.

b. REAR. (Refer to figure 10A-7.)

1. Remove left half of rear cowling.

2. Remove hardware attaching filter (1) to air inlet duct (2).

3. Remove hardware attaching air inlet duct to horizontal baffle and remove duct.

4. Remove bolt attaching airbox to clamp on engine mount.

5. Loosen and remove clamps securing flexible duct (6) to compressor and engine mount. Remove duct and airbox assembly.

6. Remove clamps securing compressor discharge tube (18) to compressor and throttle body and work tube out of engine compartment.

7. Reverse the preceding steps for reinstallation.

10A-48. CLEANING INDUCTION AIR FILTER. Refer to Section 2.

10A-49. FUEL INJECTION SYSTEM. (Refer to figure 10A-2.)

10A-50. DESCRIPTION. The fuel injection system is a low-pressure system of injecting metered fuel into the intake valve ports in the cylinders. It is a multi-nozzle, continuous-flow system which controls fuel flow to match engine airflow. Any change in throttle position, engine speed or a combination of both, causes changes in fuel flow in the correct relation to engine airflow. A manual mixture control and a fuel-flow indicator are provided for leaning at any combination of altitude and power setting. The four major components of the system are: the fuel injection pump, fuel-air control unit, fuel manifold (distributor) valve and the fuel discharge nozzles. The fuel injection pump incorporates an adjustable aneroid sensing unit which is pressurized from the discharge side of the turbocharger compressor. Turbocharger discharge air pressure is also used to vent the fuel discharge nozzles and the vent port of the fuel-flow indicator. Since the intake manifolds are installed on the top side of the cylinders, drain lines are installed in the bottom side of the intake ports to drain fuel which may have accumulated in the intake ports during engine shut-down.

NOTE

Throughout the aircraft fuel system, from the tanks to the engine-driven fuel pump, use Never-Seez RAS-4 (Snap-On Tools Corporation, Kenosha, Wisconsin) or MIL-T-5544 (Thread Compound, Antiseize, Graphite-Petrolatum) or equivalent, as a thread lubricant or to seal a leaking connection. Apply sparingly to male fittings only, omitting the first two threads on the fitting. Always be sure that a compound, the residue from a previously used compound or any other foreign material cannot enter the system. Throughout the fuel injection system, from the engine-driven fuel pump through the discharge nozzles, use only a fuel soluble lubricant, such as engine lubricating oil, on the fitting threads. Do not use any other form of thread compound on the injection system fittings.

WARNING

Residual fuel draining from lines and hoses constitutes a fire hazard. Use caution to prevent accumulation of fuel when lines or hoses are disconnected throughout the fuel injection system.

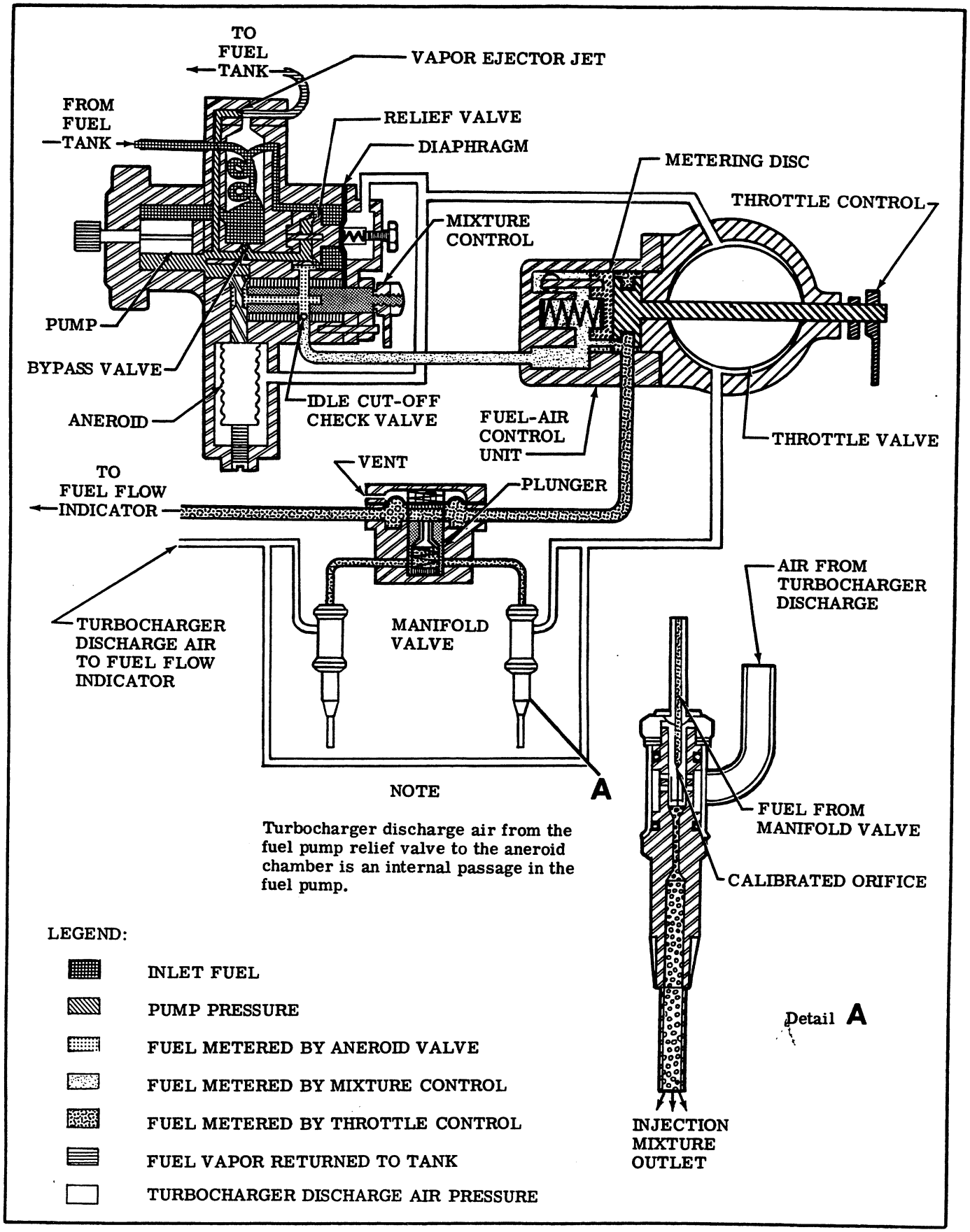


Figure 10A-2. Fuel Injection Schematic

10A-51. TROUBLE SHOOTING.

TROUBLE	PROBABLE CAUSE	REMEDY
NO FUEL DELIVERED TO ENGINE.	Fuel tanks empty.	Service with desired quantity of fuel.
	Defective aircraft fuel system.	Refer to Section 11.
	Vaporized fuel. (Most likely to occur in hot weather with a hot engine.)	Refer to paragraph 10-103.
	Fuel pump not permitting fuel from electric pump to bypass.	Check fuel-flow through pump. Replace engine-driven fuel pump if defective.
	Defective fuel control unit.	Check fuel flow through unit. Replace fuel-air control unit if necessary.
	Defective fuel manifold valve, or clogged screen inside valve.	Check fuel flow through valve. Remove and clean in accordance with paragraphs 10-58 and 10-59. Replace if defective.
	Clogged fuel injection lines or discharge nozzles.	Check fuel flow through lines and nozzles. Clean and replace if defective.
HIGH FUEL PRESSURE.	Restricted discharge nozzles.	Clean or replace plugged nozzle or nozzles.
	Restriction in vapor vent return line or check valve.	Clean vapor return line. Clean or replace check valve.
ENGINE RUNS ROUGH AT IDLE.	Improper idle mixture adjustment.	Refer to paragraph 10-55.
	Restriction in aircraft fuel system.	Refer to Section 11.
	Low unmetered fuel pressure.	Refer to paragraph 10A-68.
	High unmetered fuel pressure.	Refer to paragraph 10A-68.
	Worn throttle plate shaft or shaft O-rings.	Replace shaft and/or O-rings.
	Intake manifold leaks.	Repair leaks or replace defective parts.
	Leaking intake valves.	Engine repair required.
	Discharge nozzle air vent manifolding restricted or defective.	Check for bent or loose connections, restrictions or defective components. Tighten loose connections; replace defective components.

10A-51. TROUBLE SHOOTING (Cont).

TROUBLE	PROBABLE CAUSE	REMEDY
FLUCTUATING FUEL PRESSURE OF FUEL FLOW.	Defective manifold valve.	Replace manifold valve.
	Restriction in engine-driven fuel pump vapor ejector.	Clean vapor ejector on fuel pump. Do not use wires to clean jet.
	Defective check valve in vapor vent return line.	Clean vapor return vent line and repair or replace check valve.
	Air in line from manifold valve to gage.	Bleed air from line.
LOW METERED FUEL PRESSURE.	Malfunctioning relief valve in engine-driven fuel pump.	Clean or replace relief valve if defective.
	Defective gage or restricted gage line.	Replace gage. Clean restriction from line.
	Plugged main fuel strainer.	Clean strainer.
	Air leak on suction side of engine-driven fuel pump.	Repair leak. Replace defective parts.
FUEL DRAINING FROM MANIFOLD VALVE VENT.	Ruptured diaphragm.	Replace diaphragm or manifold valve.
POOR IDLE CUT-OFF.	Dirt in fuel pump or defective pump.	Remove pump and flush out thoroughly. Check that mixture arm contacts cut-off stop.
	Dirty or defective fuel manifold valve.	Remove and clean in accordance with paragraphs 10-58 and 10-59.

10A-52. FUEL-AIR CONTROL UNIT. Refer to paragraph 10-52.

10A-53. DESCRIPTION. Refer to paragraph 10-53.

10A-54. REMOVAL AND INSTALLATION.

a. Remove cowling as required to gain access.

b. Turn fuel selector valves to OFF position.

c. Tag and disconnect hoses at fuel metering unit. Cap or plug disconnected hoses and fittings.

d. Disconnect manifold pressure line at fuel-air control unit.

e. Disconnect throttle control at air throttle arm. Note position of washers.

f. Disconnect variable controller rod at air throttle arm. Note position of washers and spacers. Do not rotate rod end.

g. Remove four bolts, washers and nuts attaching air inlet duct to throttle body. Lay parts of landing gear warning switch to one side. Note any other parts attached by these bolts.

h. Loosen clamps securing throttle body to intake manifold and slide hoses away from throttle body.

i. Remove bolts, washers and nuts attaching fuel-air control unit to bracket on engine and remove unit. Cover open ends of manifold and air inlet duct.

j. Reverse the preceding steps for reinstallation. Rig throttle, throttle-operated landing gear warning switch and variable controller.

10A-55. ADJUSTMENTS. Refer to paragraph 10-55.

10A-56. FUEL MANIFOLD VALVE (FUEL DISTRIBUTOR). Refer to paragraph 10-56.

10A-56. DESCRIPTION. Refer to paragraph 10-57.

10A-58. REMOVAL AND INSTALLATION. Refer to paragraph 10-58.

10A-59. CLEANING. Refer to paragraph 10-59.

10A-60. FUEL DISCHARGE NOZZLES.

10A-61. DESCRIPTION. From the fuel manifold valve, individual, identical size and length fuel lines carry metered fuel to the fuel discharge nozzles located in the cylinder heads. The outlet of each nozzle is directed into the intake port of each cylinder. The nozzle body contains a drilled central passage with a counterbore at each end. The lower end is used as a chamber for fuel-air mixture before the spray leaves the nozzle. The upper bore contains an orifice for calibrating the nozzles. Near the top, radial holes connect the upper counterbore with the outside of the nozzle body for air admission. These radial holes enter the counterbore above the orifice and draw outside air through a cylindrical screen fitted over the nozzle body. This screen prevents dirt and foreign material from entering the nozzle. A press-fit shield is mounted on the nozzle body and extends over the greater part of the filter screen, leaving a small opening at the bottom of the shield. This provides an air bleed into the nozzle which aids in vaporizing the fuel by breaking the high vacuum in the intake manifold at idle rpm and keeps the fuel lines filled. The nozzles are calibrated in several ranges. All nozzles furnished for one engine are the same range and are identified by a number and a suffix letter stamped on the flat portion of the nozzle body. When replacing a fuel discharge nozzle, be sure it is of the same calibrated range as the rest of the nozzles in the engine. When a complete set of nozzles is being installed, the number must be the same as the one removed, but the suffix letters may be different, as long as they are the same for all nozzles being installed on a particular engine.

10A-62. REMOVAL.

a. Remove engine cowling as required for access.

NOTE

Plug or cap all disconnected lines and fittings. Use care to prevent damage to fuel injection lines.

b. Disconnect nozzle pressurization line at nozzles and disconnect pressurization line at union fitting so that pressurization line may be moved away from discharge nozzles.

c. Disconnect fuel injection line at discharge nozzle.

d. Using care to prevent damage or loss of washers and O-rings, lift sleeve assembly from discharge nozzle.

e. Using a standard 1/2-inch deep socket, remove fuel discharge nozzle from cylinder.

10A-63. CLEANING AND INSPECTION. Refer to paragraph 10-63.

10A-64. INSTALLATION.

a. Using a standard 1/2-inch deep socket, install nozzle body in cylinder and tighten to a torque value of 60-80 lb-in.

b. Install O-rings, sleeve assembly and washers on nozzle bodies.

c. Align sleeve assembly and connect pressurization lines to nozzles. Connect pressurization line to union fitting.

d. Install O-ring and washer at top of discharge nozzle and connect fuel injection line to nozzle.

e. Inspect installation for crimped lines and loose fittings.

f. Inspect nozzle pressurization vent system for leakage. A tight system is required, since turbocharger discharge pressure is applied to various other components of the injection system.

g. Install cowling.

10A-65. FUEL INJECTION PUMP.

10A-66. DESCRIPTION. The fuel pump is a positive-displacement, rotating vane type, located opposite the propeller governor at the propeller end of the engine. Fuel enters the pump at the swirl well of the pump vapor separator. Here, vapor is separated by a swirling motion so that only liquid fuel is fed to the pump. The vapor is drawn from the top center of the swirl well by a small pressure jet of fuel and is fed into the vapor return line, where it is returned to the fuel line manifold. Since the pump is engine-driven, changes in engine speed effect total pump flow proportionally. A check valve allows the auxiliary fuel pump pressure to bypass the engine-driven fuel pump for starting, or in the event of engine-driven fuel pump failure in flight. The pump supplies more fuel than is required by the engine; therefore, a spring-loaded, diaphragm type relief valve is provided to maintain a constant fuel pump pressure. The engine-driven fuel pump is equipped with an aneroid valve. The aneroid valve and relief valve are pressurized from the discharge side of the turbocharger compressor to maintain a proper fuel/air ratio at altitude. The aneroid valve is adjustable for fuel pump outlet pressure at full throttle and the relief valve is adjustable for fuel pump outlet pressure in the idle rpm range. Refer to paragraph 10A-68 for pressure adjustments. The fuel pump is equipped with a manual mixture control to limit the fuel pump output from full rich to idle cut-off. Non-adjustable mechanical stops are located at these positions.

10A-67. REMOVAL AND INSTALLATION.

a. Turn fuel selector valves to the OFF position.

b. Remove cowling, baffles and covers as necessary to gain access.

c. Disconnect mixture control from lever on pump. Note position of washers.

d. Tag and disconnect fuel hoses and vent line attached to pump. Plug or cap all disconnected hoses and fittings.

e. Disconnect and plug or cap air vent line at fuel pump.

f. Remove mounting nuts and bolts and pull pump and gasket from engine pad.

WARNING

Residual fuel draining from lines and hoses constitutes a fire hazard. Use caution to prevent accumulation of fuel when lines or hoses are disconnected.

g. The drive shaft coupling may come off with the fuel pump, or it may remain in the engine. If it comes off with the pump, reinstall it in the engine to prevent dropping or losing it.

h. If a replacement pump is not being installed immediately, a temporary cover should be installed on the fuel pump mount pad.

i. Reverse the preceding steps for reinstallation. Using a new gasket, do not force engagement of the pump drive. Rotate engine crankshaft and pump drive will engage smoothly when aligned properly. Check mixture control rigging.

j. Start engine and perform an operational check, adjust fuel pressure as required in accordance with paragraph 10A-68.

10A-68. ADJUSTMENTS. (Refer to figure 10A-3.)

a. Remove engine cowling as required for access.

b. Remove cap from fuel metering unit. Using test hose and fittings, connect test gage pressure port into the fuel injection system as illustrated in figure 10A-3.

NOTE

Cessna Service Kit No. SK320-2J provides a test gage, line and fittings for connecting the test gage into the system to perform accurate calibration of the engine-driven fuel pump.

c. Allow engine to warm-up. Set mixture control full rich and propeller control full forward (low pitch, high-rpm).

d. Idle engine at 600 ± 25 rpm (front engine) or 650 ± 25 rpm (rear engine) and check for fuel pressure specified in paragraph 10A-8.

WARNING

DO NOT make fuel pressure adjustments while engine is operating.

e. If pressure is not within prescribed tolerances, stop engine and adjust pressure by turning the screw on the fuel pump relief valve (turn IN to increase pressure and OUT to decrease pressure) to obtain correct pressure and repeat steps "c and d."

NOTE

After adjusting fuel pressure, idle speed and idle mixture must be readjusted (refer to paragraph 10-55).

f. Advance throttle to obtain maximum rpm and check for fuel pressure specified in paragraph 10A-8.

WARNING

DO NOT make fuel pump pressure adjustments while the engine is operating.

g. If pressure is not within prescribed tolerances, stop engine and adjust pressure by loosening locknut and turning the slot-headed needle valve located just below the fuel pump inlet fitting counterclockwise (CCW) to increase pressure and clockwise (CW) to decrease pressure. Repeat steps "f and g" until pressure is within prescribed tolerances specified in paragraph 10A-8.

h. After correct pressure is obtained, safety adjustable orifice locknut and remove test equipment.

i. Install cowling.

j. Repeat preceding steps for other engine if adjustment is required.

10A-69. EXHAUST SYSTEMS.

10A-70. DESCRIPTION. Each engine exhaust system consists of two exhaust stack assemblies, one for the left and one for the right bank of cylinders. The exhaust stack assemblies of each engine are joined together to route the exhaust from all cylinders of that engine through the waste-gate or turbine.

a. FRONT ENGINE. The three risers on the left bank of cylinders are joined together into a common pipe to form the left stack assembly. The three risers on the right bank of cylinders are joined together into a common pipe to form the right stack assembly. The left stack assembly connects to the right stack assembly at the front of the engine. Mounting pads for the waste-gate and turbine are provided at the rear of the right stack assembly. From the exhaust port of the turbine, a tailpipe routes the exhaust overboard through the lower cowling. The exhaust port of the waste-gate is routed into the tailpipe so the exhaust gases can be expelled from the system when not needed at the turbine.

b. REAR ENGINE. The rear exhaust system routes the exhaust gases into a common turbine inlet assembly, then overboard through a single tailpipe. The exhaust stacks are made in sections that are clamped together. The turbine inlet assembly contains an outlet for the waste-gate valve. Exhaust from the waste-gate is routed into the tailpipe so the exhaust gases can be expelled from the system when not needed at the turbine.

10A-71. REMOVAL. (Refer to figure 10A-4.)

a. FRONT ENGINE.

1. Remove engine cowling, right and left nose caps and front engine baffles.

2. Remove nuts attaching each riser assembly to the cylinders on the left bank. It may be necessary to remove clamp from riser assembly between number 2 and 4 cylinders.

3. Work left exhaust stack assembly down from cylinders and out of right exhaust stack assembly at front of engine.

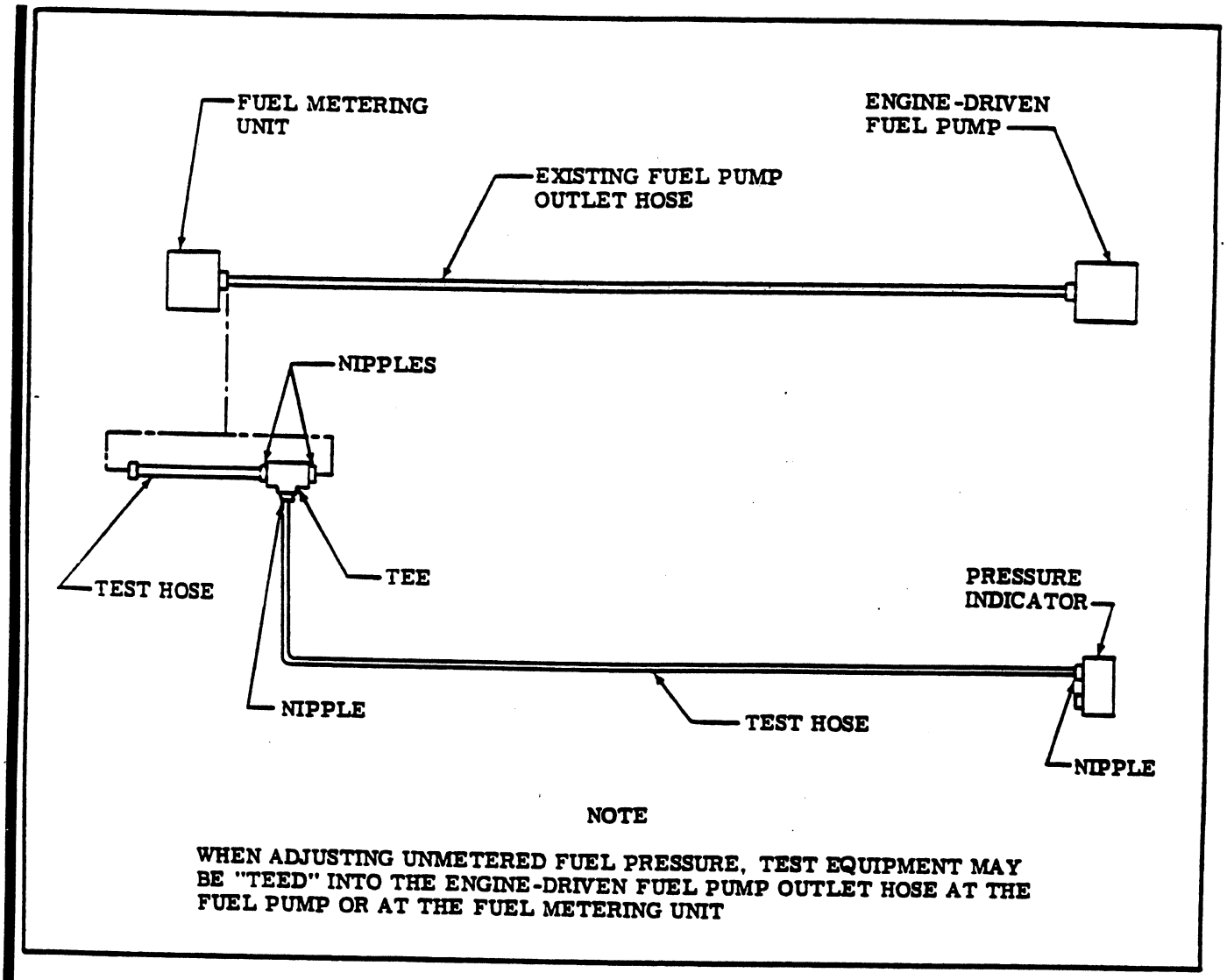


Figure 10A-3. Fuel Injection Pump Adjustment Test Harness (Turbocharged Engine)

SHOP NOTES:

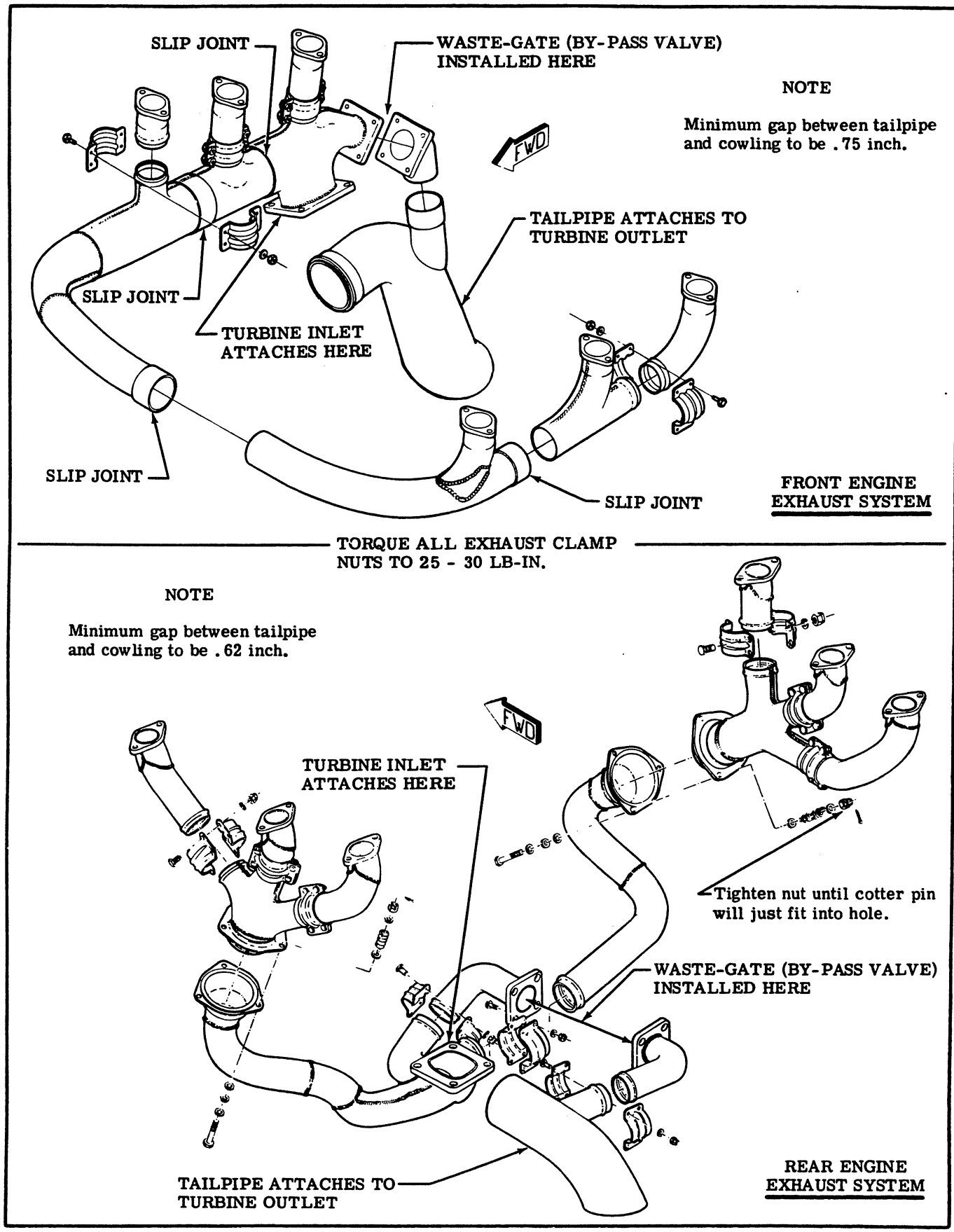


Figure 10A-4. Exhaust Systems

4. Remove bolts, washers and nuts attaching waste-gate exhaust tube to waste-gate.

5. Loosen clamp at turbine exhaust outlet and work tailpipe from turbine and waste-gate exhaust outlet.

6. If installed, disconnect exhaust gas temperature wires.

7. Loosen clamps and disconnect compressor air outlet duct at compressor.

8. Loosen clamps and disconnect compressor air inlet duct at compressor and induction air box.

9. Remove nut and spacer attaching turbocharger mounting bracket to crankcase and remove bolts attaching bracket to the engine rear mounting leg.

10. Remove bolts, washers and nuts attaching waste-gate and actuator to exhaust stack assembly. Tie waste-gate and actuator up to provide clearance for removal of exhaust stack.

11. Remove bolts, washers and nuts attaching turbocharger to exhaust stack assembly. Support turbocharger as the bolts are removed and lower turbocharger into cowling.

12. Remove bolts, nuts and clamps attaching right exhaust stack assembly to riser pipes on right side of engine. Work exhaust stack from engine.

13. Remove nuts attaching riser pipes to cylinders at right side of engine. Remove riser pipes and gaskets. Riser pipes should be marked so that they may be installed on the same cylinder.

b. REAR ENGINE.

1. Remove engine cowling and tail caps as required for access.

2. Remove cotter pins, nuts, washers, bolts and springs at lower end of collector assembly on the right side.

3. Remove exhaust gas temperature probe if installed.

4. Remove two nuts attaching exhaust pipe riser to each cylinder on right bank of cylinders and remove collector assembly and gaskets. The risers may be removed from collector by removing clamps attaching riser pipes to collector assembly.

5. Remove clamp attaching right exhaust pipe to turbine inlet assembly.

6. Remove clamp attaching waste-gate exhaust outlet to tailpipe and loosen clamp attaching tailpipe to turbine exhaust outlet and work tailpipe from turbine.

7. Remove clamp attaching waste-gate exhaust inlet to turbine inlet assembly.

8. Remove cotter pins, nuts, washers, bolts and springs at lower end of collector assembly at left bank of cylinders.

9. Remove two nuts attaching exhaust pipe riser to each cylinder on left bank of cylinders and remove collector assembly and gaskets. The risers may be removed from collector by removing clamps attaching riser pipes to collector assembly.

10. Remove bolts, washers and nuts attaching turbine inlet assembly to the turbine.

11. Work turbine inlet assembly from aircraft.

10A-72. INSPECTION. Since exhaust systems of this type are subject to burning, cracking and general deterioration from alternate thermal stresses and vibrations, inspection is important and should be accomplished every 100 hours of operation. Also, a thorough inspection of the engine exhaust system should be made to detect cracks causing leaks which could result in loss of optimum turbocharger efficiency and engine power. To inspect the engine exhaust system, proceed as follows:

a. Remove engine cowling as required so that ALL surfaces of the exhaust assemblies can be visually inspected.

NOTE

Especially check the areas adjacent to welds and slip joints. Look for gas deposits in surrounding areas, indicating that exhaust gases are escaping through a crack or hole or around the slip joints.

b. After visual inspection, an air leak check should be made on the exhaust system as follows:

1. Attach the pressure side of an industrial vacuum cleaner to the tailpipe opening, using a rubber plug to effect a seal as required.

NOTE

The inside of the vacuum cleaner hose should be free of any contamination that might be blown into the engine exhaust system.

2. With vacuum cleaner operating, all joints in the exhaust system may be checked manually by feel, or by using a soap and water solution and watching for bubbles. All joints should be free of air leaks with the exception of the waste gate bearing which will show some bubbling. Also, some bubbles will appear at the joint of the turbocharger turbine and compressor bearing housing.

c. Where a surface is not accessible for a visual inspection, or for a more positive test, the following procedure is recommended:

1. Remove exhaust stack assemblies.

2. Use rubber expansion plugs to seal openings.

3. Using a manometer of gage, apply approximately 1-1/2 psi (3 inches of mercury) air pressure while each stack assembly is submerged in water. Any leaks will appear as bubbles and can be reaily detected.

4. It is recommended that exhaust stacks found defective be replaced before the next flight.

d. After installation of exhaust system components, perform the inspection in step "b" of this paragraph to ascertain there are no leaks at the joints of the system.

10A-73. INSTALLATION.

NOTE

Since it is important that the complete exhaust system, including the turbocharger and waste gate, be installed without preloading any section of the exhaust stack assembly, follow the sequence outlined for

installation on the applicable engine. Use new gaskets at each end of the waste-gate and between turbocharger and exhaust stack assembly. The gasket between each riser pipe and cylinder may be re-used as long as it is not damaged in any way.

a. FRONT ENGINE.

1. Place all sections of the exhaust stack assemblies in position with all clamps loose.
2. Torque nuts attaching riser pipes to the cylinders to 200-210 lb-in.
3. Manually check that slip-joints do not bind.
4. Raise turbocharger mounting bracket to crankcase. Install and tighten bolts attaching mounting bracket to engine rear mounting leg. Torque crankcase thru-bolt to 490-510 lb-in and install "Palnut". Torque bracket to mounting leg bolts to 160-190 lb-in.
5. Install bolts, washers and nuts attaching turbocharger to right exhaust stack assembly. Tighten securely.
6. Install bolts, washers and nuts attaching waste-gate to right exhaust stack assembly. Tighten securely.
7. Install tailpipe and tighten clamp securing tailpipe to turbine.
8. Install bolts, washers and nuts attaching waste-gate exhaust outlet tube to waste-gate. Tighten securely.
9. Tighten clamps attaching stack assemblies to the riser pipes.
10. Install or connect exhaust gas temperature probe if installed.
11. Connect turbocharger compressor outlet air duct and tighten clamps.
12. Install turbocharger compressor inlet air duct. Tighten clamps securely.
13. Be sure all parts are secure and safetied as required, then perform step "b" of paragraph 10A-72 to check for any air leaks. Correct any leaks found as result of check.
14. Install any parts removed for access, then install nose caps and cowling.

b. REAR ENGINE.

1. Place all sections of the exhaust stack assemblies in position with all clamps loose.
2. Install bolts, washers and nuts attaching turbine inlet assembly to the turbine outlet. Tighten securely.
3. Install bolts, washers and nuts attaching waste-gate inlet and outlet tubes to waste-gate.
4. Install tailpipe and tighten clamp securing tailpipe to turbine. Tighten bolts attaching waste-gate exhaust and inlet tubes to tailpipe and turbine inlet assembly.
5. Torque nuts attaching riser pipes to the cylinders to 200 to 210 lb-in.
6. Install bolts, springs, washers and nuts at collector and tube on each side of engine. Tighten nut until cotter pin will just fit in hole of bolt and install cotter pin.
7. Tighten clamps attaching collector to risers on both sides of the engine.
8. Be sure all parts are secure and safetied as required, then perform step "b" of paragraph 10A-72 to check for any air leaks. Correct any leaks found as result of check.
9. Install any parts removed for access, then install tailcaps and cowling.

10A-74. TURBOCHARGER.

10A-75. DESCRIPTION. The turbocharger is an exhaust gas-driven compressor, or air pump, which provides high velocity air to the engine intake manifold. The turbocharger is comprised of a turbine wheel, compressor wheel, turbine housing and compressor housing. The turbine wheel, compressor wheel and interconnecting drive shaft comprise one complete assembly and are the only moving parts in the turbocharger. Turbocharger bearings are lubricated with filtered oil supplied from the engine lubricating oil system. Engine exhaust gas enters the turbine housing to drive the turbine wheel. The turbine wheel, in turn, drives the compressor wheel, producing a high velocity of air entering the engine inducation intake manifold. Exhaust gas is then dumped overboard through the exhaust outlet of the turbine housing and exhaust tailpipe. Air is drawn into the compressor housing through the induction air filter and is forced out of the compressor housing through a tangential outlet to the intake manifold. The degree of turbocharging is varied by means of a waste-gate valve, which varies the amount of exhaust gas allowed to bypass the turbine wheel. The waste-gate is controlled by the air-oil operated waste-gate controller.

10A-76. REMOVAL AND INSTALLATION.

a. FRONT ENGINE.

1. (Refer to figure 10A-6.) Remove engine cowling as required for access to turbocharger components.
2. Remove right cowl flap by disconnecting the push-pull rod at the cowl flap and at the torque tube. Remove screws securing cowl flap hinge to lower fuselage and remove cowl flap.
3. Loosen clamp (13) at turbine exhaust outlet and work tailpipe (16) from turbine and waste-gate outlets.
4. (Refer to figure 10A-8, sheet 1.) Remove the four bolts attaching waste-gate (15) and actuator (13) to the exhaust stack assembly. Tie waste-gate and actuator up to provide clearance for removal of the turbocharger.
5. (Refer to figure 10A-6.) Loosen clamps and remove compressor air outlet duct and compressor air inlet duct from compressor (10).
6. Disconnect oil inlet check valve (8) at adapter (15) and oil scavenger line (2) at adapter (11). Plug or cap disconnected lines and fittings.
7. Remove hardware attaching front mounting bracket (7) to engine.
8. Remove bolts, washers and nuts attaching turbine (14) to the exhaust stack assembly (5). Support turbocharger assembly as the bolts are removed and work assembly from aircraft through the cowl flap opening.

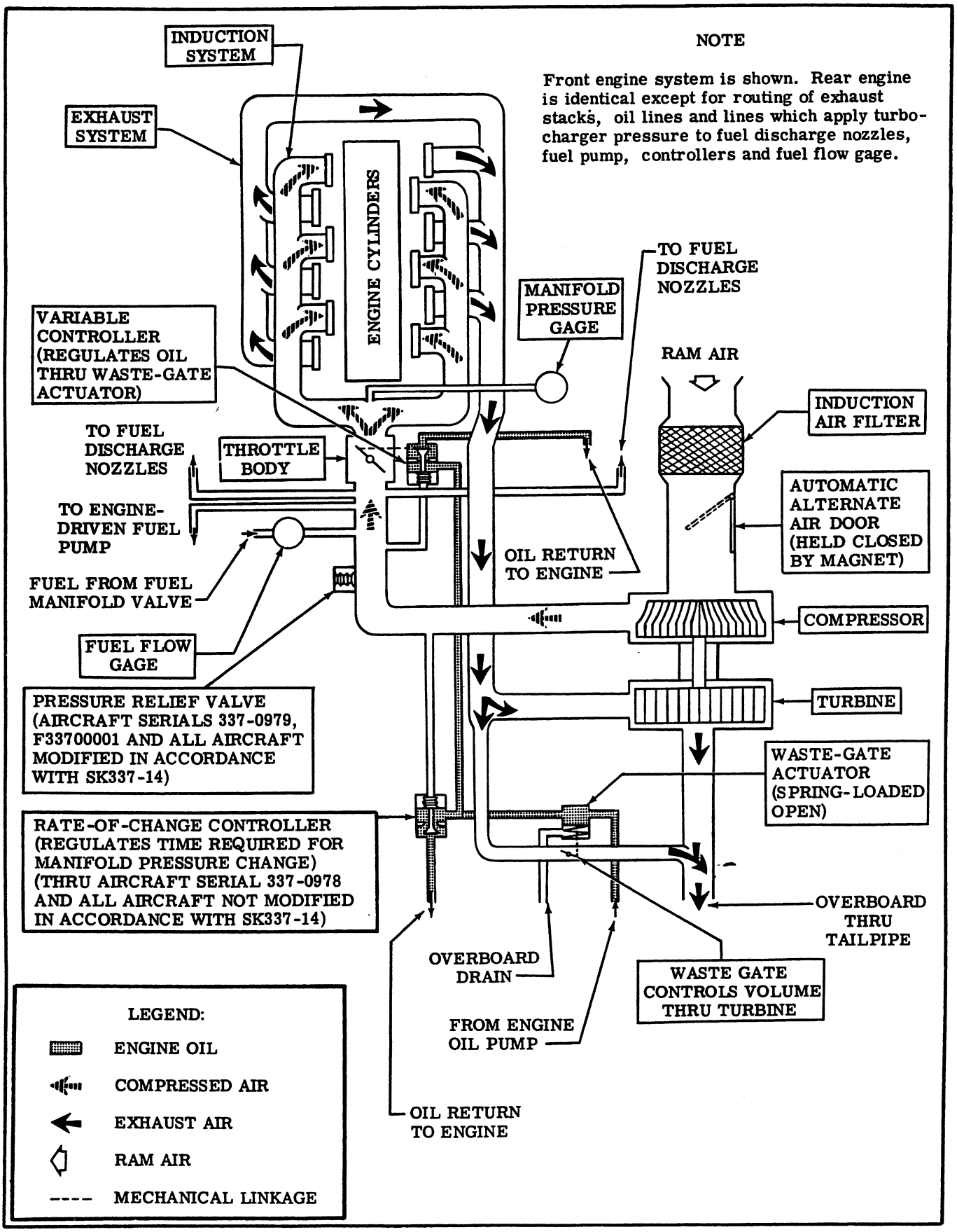


Figure 10A-5. Turbocharger System Schematic

NOTE

When installing a NEW turbocharger on the FRONT engine, it will be necessary to remove the six bolts attaching the exhaust turbine housing to the center section of the unit. Rotate the exhaust portion of housing 180 degrees. This is done so that oil outlet (11) in the center section will be pointed downward when installed in the aircraft. Also loosen the band on the compressor portion of turbocharger and rotate housing so that the outlet can be connected to the duct going to the throttle body. Refer to figure 10A-6 for torque value of bolts attaching center section to exhaust turbine housing.

9. Reverse the preceding steps for reinstallation. Install new gaskets between turbocharger and exhaust manifold and between waste-gate and exhaust manifold. Reinstall all safety wire where removed. Refer to figure 10A-6 for torque values of the attaching bolts.

b. REAR ENGINE.

1. (Refer to figure 10A-7.) Remove engine cowling and tail caps as required for access to the turbocharger components.

2. Remove clamp attaching waste-gate exhaust to tailpipe (12).

3. Loosen clamp at turbine exhaust outlet and work tailpipe (12) from turbine (9) and waste-gate exhaust.

4. Loosen clamps at compressor and slide coupler securing discharge tube (18) to compressor (7) upward.

5. Loosen clamps (5) and disconnect air inlet duct (6) from compressor (7).

6. Disconnect oil inlet line (17) from check valve (19) and scavenger line (8) from check valve (10). Plug or cap disconnected lines and fittings.

7. Remove bolts, washers and nuts attaching turbine to exhaust assembly.

8. Remove bolts (14) securing turbocharger to support assembly (16) and bolts securing turbocharger to bracket (13). Support turbocharger as these bolts are removed.

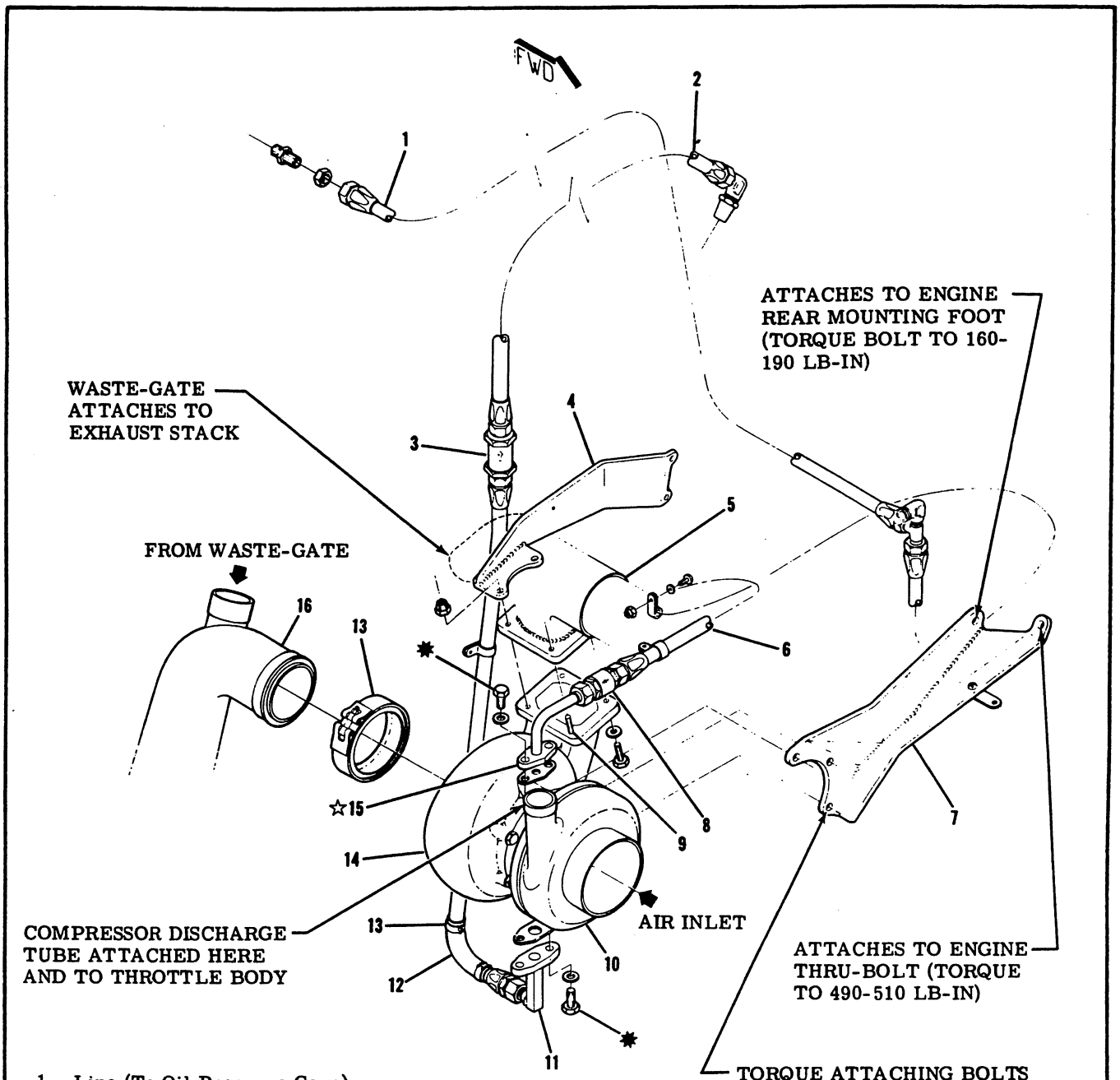
9. Work turbocharger from aircraft.

10. Reverse the preceding steps for reinstallation. Install a new gasket between the exhaust stack and turbine and reinstall all safety wire where removed.

10A-77. CONTROLLERS AND WASTE-GATE ACTUATOR.

10A-78. FUNCTIONS. The waste-gate actuator, variable controller and rate-of-change controller use engine oil for supply power to control the turbocharger. The waste-gate is used to control engine exhaust flow through the turbine and regulate its speed. Since the exhaust energy is the force that drives the turbocharger unit, the output of the compressor is controlled by bleeding or dumping of excess exhaust energy as needed. The waste-gate actuator, which is physically connected to the waste-gate by mechanical linkage, controls the position of the waste-gate butterfly valve. The butterfly valve position is controlled by the variable controller. Engine oil is supplied to the waste-gate actuator through the capillary tube where the pressure of oil determines the position of the valve. The variable controller cam arm is connected to the throttle linkage and controls the output of the compressor discharge pressure. Thru aircraft serial 337-0978, the rate-of-change controller regulates time required for manifold pressure change. Beginning with aircraft serials 337-0979 AND F33700001, the rate-of-change controller is deleted and a pressure relief valve is installed in the induction air inlet. This pressure relief valve bleeds off compressor discharge pressure that is in excess of maximum manifold pressure. This helps control overboosting of the engine in cold temperatures.

10A-79. OPERATION. The waste-gate actuator is spring-loaded to position the waste-gate butterfly valve to the open position when there is no oil pressure. When the engine starts, oil pressure is admitted into the actuator through the capillary tube. This automatically fills the cylinder and lines leading to the controller metering valves. At engine idle the turbocharger runs slowly with low compressor output and the metering valve in the variable controller remains open. As the throttle is advanced, the cam of the variable controller is rotated, calling for an increase in compressor output by closing its metering valve, resulting in a build up of oil pressure in the waste-gate actuator cylinder. The oil pressure overcomes the spring force in the actuator cylinder, causing the waste-gate butterfly valve to close, which causes the engine exhaust gases to pass through the turbine. As the engine increases in power and speed, the increase in temperature and pressure of the exhaust gas causes the turbocharger to spin faster, raising the compressor and outlet pressure. The variable controller senses the compressor outlet pressure on an aneroid bellows. As engine output increases, the proper absolute pressure is reached and the force on the aneroid bellows opens the metering valve. This lowers the oil pressure in the waste-gate actuator cylinder. When this oil pressure is lowered sufficiently, the spring force causes the waste-gate butterfly valve to partially open. A portion of the engine exhaust gases then bypasses the turbocharger turbine, thus preventing further increase of turbocharger speed and holding the compressor discharge pressure to the preselected manifold pressure as determined by the throttle control. The waste-gate will modulate toward the closed position or open position to maintain the selected manifold pressure during changes of altitude, airspeed or engine speed. Above 20,000 feet the variable controller will continue to maintain 32 inches of mercury manifold pressure at full throttle. It is necessary to reduce manifold pressure with the throttle to follow the maximum pressure versus altitude schedule shown on instrument panel placard. The rate-of-change controller is connected in parallel with the variable controller and regulates the rate of change in compressor discharge pressure and prevents engine overboost. This controller sen-

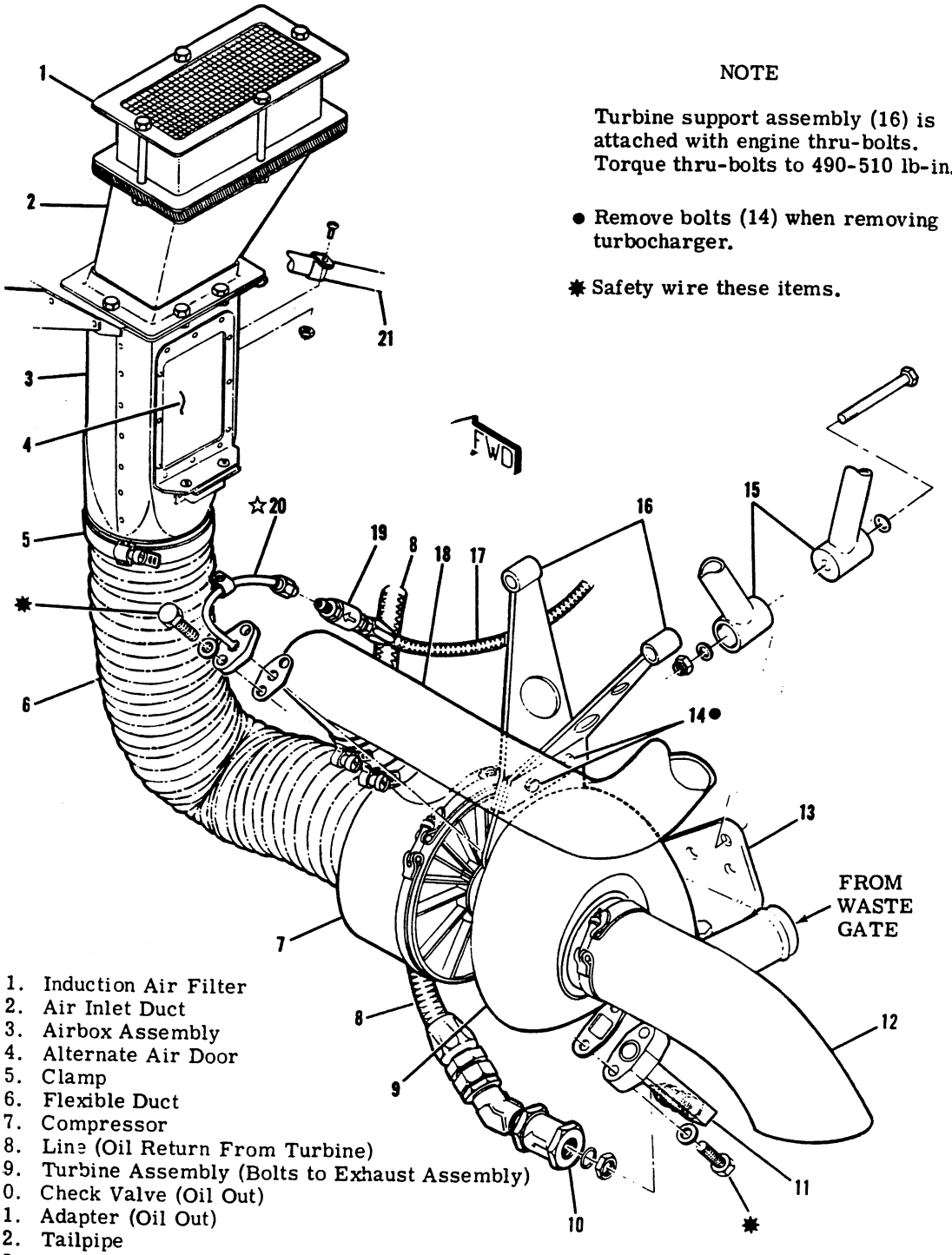


1. Line (To Oil Pressure Gage)
2. Line (Oil Return From Turbine)
3. Check Valve
4. Rear Mounting Bracket
5. Exhaust Stack Assembly
6. Line (Pressure Oil To Turbine)
7. Front Mounting Bracket
8. Check Valve
9. Stud
10. Compressor
11. Adapter (Oil Out)
12. Cover
13. Clamp
14. Turbine
15. Adapter (Oil In)
16. Tailpipe

✸ Safety wire these items.

☆ Beginning with aircraft serials 33701362 and F337-00046 and on and all service parts, a new turbine oil inlet adapter and check valve is used. When an oil inlet adapter or check valve is to be replaced on aircraft prior to the above serials, it will be necessary to install BOTH the check valve and oil inlet adapter.

Figure 10A-6. Front Engine Turbocharger Installation



1. Induction Air Filter
2. Air Inlet Duct
3. Airbox Assembly
4. Alternate Air Door
5. Clamp
6. Flexible Duct
7. Compressor
8. Line (Oil Return From Turbine)
9. Turbine Assembly (Bolts to Exhaust Assembly)
10. Check Valve (Oil Out)
11. Adapter (Oil Out)
12. Tailpipe
13. Turbine Bracket
14. Bolt
15. Turbine Brace
16. Turbine Support Assembly
17. Line (Oil Pressure to Turbine)
18. Compressor Discharge Tube (Connects to Throttle Body)
19. Check Valve (Oil In)
20. Adapter (Oil In)
21. Engine Mount

☆ Beginning with aircraft serials 33701362 and F33700046 and on and all service parts, a new turbine oil inlet adapter and check valve is used. When an oil inlet adapter or check valve is to be replaced on aircraft prior to the above serials, it will be necessary to install BOTH the check valve and oil inlet adapter.

Figure 10A-7. Rear Engine Turbocharger and Induction Air Installation

ses the compressor outlet pressure in the upper chamber through an internal capillary tube in the lower chamber. When compressor discharge pressure increases more rapidly than approximately 6.5 inches of mercury per second, a pressure differential exists between the upper and lower chambers of the diaphragm. As the pressure in the upper chamber becomes greater than that of the lower chamber, the diaphragm between the upper and lower chamber is forced downward, causing the metering valve to open and lower the oil pressure in the waste-gate actuator power cylinder, causing the waste-gate butterfly valve to open. This prevents the turbocharger compressor discharge pressure from increasing at too fast a rate and prevents overboosting the engine. The pressure relief valve is installed in the induction air duct ahead of the throttle control unit. This valve senses the compressor outlet pressure and bleeds off the pressure that is in excess of maximum manifold pressures.

CAUTION

The turbocharged engines are equipped with controller systems which automatically control the engine power within prescribed manifold pressure limits. Although these automatic controller systems are very reliable and eliminate the need for manual control through constant throttle manipulation, they are not infallible. For instance, such things as rapid throttle manipulation (especially with cold oil), momentary waste-gate sticking, air in the oil system of the controller, etc., can cause overboosting. Consequently, it is still necessary that the pilot observe and be prepared to control manifold pressure, particularly during take-off and power changes in flight. Slight overboosting of manifold pressure beyond established maximums, which is occasionally experienced during initial take-off roll or during a change to full throttle operation in flight, is not considered detrimental to the engines as long as it is momentary. Momentary overboost is generally in the area of 2 to 3 inches and can usually be controlled by slower throttle movement. No corrective action is required where momentary overboosting corrects itself and is followed by normal engine operation. However, if overboosting of this nature persists, or if the amount of overboost goes as high as 6 inches, the controllers and pressure relief valve should be checked for necessary adjustment or replacement. overboost exceeding 6 inches beyond established maximums is excessive and can result in engine damage. It is recommended that overboosting of this nature be reported to your Cessna Dealer, who will be glad to determine what, if any, corrective action needs to be taken.

SHOP NOTES:

10A-80. TROUBLE SHOOTING.

TROUBLE	PROBABLE CAUSE	REMEDY
UNABLE TO GET RATED POWER BECAUSE MANIFOLD PRESSURE IS LOW.	Controller not getting enough oil pressure to close the waste-gate.	Check oil pump outlet pressure, oil filter and external lines for obstructions. Clean lines and replace if defective. Replace oil filter.
	Controllers out of adjustment or defective.	Refer to paragraph 10A-82. Replace controllers if defective.
	Defective actuator.	Refer to paragraph 10A-82. Replace actuator if defective.
	Leak in exhaust system.	Check for cracks and other obvious defects. Replace defective components. Tighten clamps and connections.
	Leak in intake system.	Check for cracks and loose connections. Replace defective components. Tighten all clamps and connections.
ENGINE SURGES OR SMOKES.	Defective controllers.	Refer to paragraph 10A-82. Replace if not adjustable.
	Waste-gate actuator linkage binding.	Refer to paragraph 10A-82.
	Waste-gate actuator leaking oil.	Replace actuator.
TURBOCHARGER NOISY WITH PLENTY OF POWER.	Turbocharger overspeeding from defective or improperly adjusted controllers.	Refer to paragraph 10A-82. Replace if defective.
	Waste-gate sticking closed.	Correct cause of sticking. Refer to paragraph 10A-82. Replace defective parts.
	Controller drain line (oil return to engine sump) obstructed.	Clean line. Replace if defective.
ENGINE POWER INCREASES SLOWLY OR SEVERE MANIFOLD PRESSURE FLUCTUATIONS WHEN THROTTLE ADVANCED RAPIDLY.	Waste-gate operation is sluggish.	Refer to paragraph 10A-82. Replace if defective. Correct cause of sluggish operation.
ENGINE POWER INCREASES RAPIDLY AND MANIFOLD PRESSURE OVERBOOST WHEN THROTTLE ADVANCED RAPIDLY.	Rate-of-change controller/ overboost control valve out of adjustment or defective.	Refer to paragraph 10A-82. Replace if defective.
	Waste-gate operation is sluggish.	Refer to paragraph 10A-82. Replace if defective. Correct cause of sluggish operation.

TROUBLE	PROBABLE CAUSE	REMEDY
FUEL PRESSURE DECREASES DURING CLIMB, WHILE MANIFOLD PRESSURE REMAINS CONSTANT.	Compressor discharge pressure line to fuel pump aneroid restricted.	Check and clean out restrictions.
	Leaking or otherwise defective engine-driven fuel pump aneroid.	Replace engine-driven fuel pump.
MANIFOLD PRESSURE DECREASES DURING CLIMB AT ALTITUDES BELOW NORMAL PART THROTTLE CRITICAL ALTITUDE, OR POOR TURBOCHARGER PERFORMANCE INDICATED BY CRUISE RPM FOR CLOSED WASTE-GATE. (Refer to paragraph 10A-82.)	Leak in intake system.	Check for cracks and other obvious defects. Tighten all hose clamps and fittings. Replace defective components.
	Leak in compressor discharge pressure line to controller.	Check for cracks and other obvious defects. Tighten all clamps and fittings. Replace defective components.
	Controller seal leaking.	Replace controller.
	Waste-gate actuator leaking oil.	Replace actuator.
	Waste-gate butterfly - closed gap is excessive.	Refer to paragraph 10A-82.
	Intake air filter obstructed.	Service air filter. Refer to Section 2 for servicing instructions.
FUEL FLOW DOES NOT DECREASE AS MANIFOLD PRESSURE DECREASES AT PART-THROTTLE CRITICAL ALTITUDE.	Defective engine- driven fuel pump aneroid mechanism.	Replace engine-driven fuel pump.
	Obstruction or leak in compressor discharge pressure line to engine-driven fuel pump.	Check for leaks or obstruction. Clean out lines and tighten all connections.
FUEL FLOW INDICATOR DOES NOT REGISTER CHANGE IN POWER SETTINGS AT HIGH ALTITUDES.	Moisture freezing in indicator line.	Disconnect lines, thaw ice and clean out lines.
SUDDEN POWER DECREASE ACCOMPANIED BY LOUD NOISE OR RUSHING AIR.	Intake system air leak from hose becoming detached.	Check hose condition. Install hose and hose clamp securely.
MANIFOLD PRESSURE GAGE INDICATION WILL NOT REMAIN STEADY AT CONSTANT POWER SETTINGS.	Defective variable controller.	Replace controller.
	Waste-gate operation is sluggish.	Refer to paragraph 10A-82. Replace if defective. Correct cause of sluggish operation.

10A-81. REMOVAL AND INSTALLATION.

a. VARIABLE CONTROLLER. (Refer to figure 10A-8.)

1. Remove engine cowling as required for access.

2. Disconnect and tag oil lines (2 and 9) at controller (1) and plug or cap open lines and fittings.

3. Disconnect compressor outlet pressure sensing line (8) from controller and plug or cap open line and fitting.

4. Disconnect control rod (7) from controller. Note position and size of washers and spacers. Do not disturb control rod length.

5. Remove screws securing controller to bracket on top of engine.

6. Remove bolts, washers and nuts securing aft end of controller to bracket on top of engine.

7. Remove controller from engine, reinstall screws removed in step 5.

8. Reverse the preceding steps for reinstallation. Tighten firward mounting screws to 20-30 lb-in. Adjust controller in accordance with paragraph 10A-82.

9. The rear engine controller may be removed in a similar manner using figure 10A-8 as a guide.

b. RATE-OF-CHANGE CONTROLLER. (Thru aircraft serail 337-0978.) (Refer to figure 10A-8.)

1. Remove engine cowling as required for access.

2. Disconnect and tag oil lines (2 and 9) at controller (10) and plug or cap open lines and fittings.

3. Disconnect compressor outlet pressure sensing line (11) from controller and plug or cap open line and fitting.

4. Remove controller mounting bolts.

5. Remove controller from engine.

6. Reverse the preceding steps for reinstallation. Adjust controller in accordance with paragraph 10A-82.

7. The rear engine controller may be removed in a similar manner using figure 10A-8 as a guide.

c. WASTE-GATE AND ACTUATOR. (Refer to figure 10A-8.)

1. Remove cowling as required for access.

2. Disconnect and tag oil lines (9 and 12) from actuator (13) and plug or cap open lines and fittings. On the rear engine remove clamp securing turbocharger oil inlet line to bracket on waste-gate.

3. Remove bolts, washers and nuts attaching waste-gate and actuator assembly to tailpipe.

4. Loosen clamp attaching tailpipe to turbine exhaust outlet and work tailpipe from aircraft.

5. Remove bolts, washers and nuts attaching waste-gate and actuator assembly to the exhaust stack.

6. Carefully work assembly from aircraft.

7. Reverse the preceding steps for reinstallation using new gaskets. Adjust waste-gate in accordance with paragraph 10A-82.

8. The rear engine assembly may be removed in a similar manner using figure 10A-8 as a guide.

10A-82. ADJUSTMENTS.

a. VARIABLE CONTROLLER. (Refer to figure 10A-8.)

1. Place throttle in full OPEN position and check that throttle arm (6) and controller arm contact their stops at the same time. If not, adjust control rod (7) until the stops are contacted at the same time.

2. With engine running and oil temperature at middle of green arc, slowly open throttle and note maximum manifold pressure obtainable. Do not exceed 32±.5 in Hg.

3. Loosen the high manifold pressure adjustment screw locknut and adjust screw (4) counterclockwise (CCW) to increase or clockwise (CW) to decrease manifold pressure. Tighten locknut after adjustment.

NOTE

Approximately one turn of the high setting screw will change the manifold pressure reading about one inch Hg.

4. Operate engine as in step 2 to check that adjustment has not caused a radical change in manifold pressure.

NOTE

When making adjustments on the ground, the hotter the engine gets, the lower the manifold pressure will be.

5. Flight test the aircraft after each adjustment to check results until desired results are obtained.

6. The rear engine controller is adjusted in a similar manner using figure 10A-8 as a guide.

b. RATE-OF-CHANGE CONTROLLER. (Thru aircraft serial 337-0978.) (Refer to figure 10A-9.)

1. Remove controller as outlined in paragraph 10A-81.

2. Remove fitting from drain port of controller.

3. Remove ambient (low pressure) plug from controller.

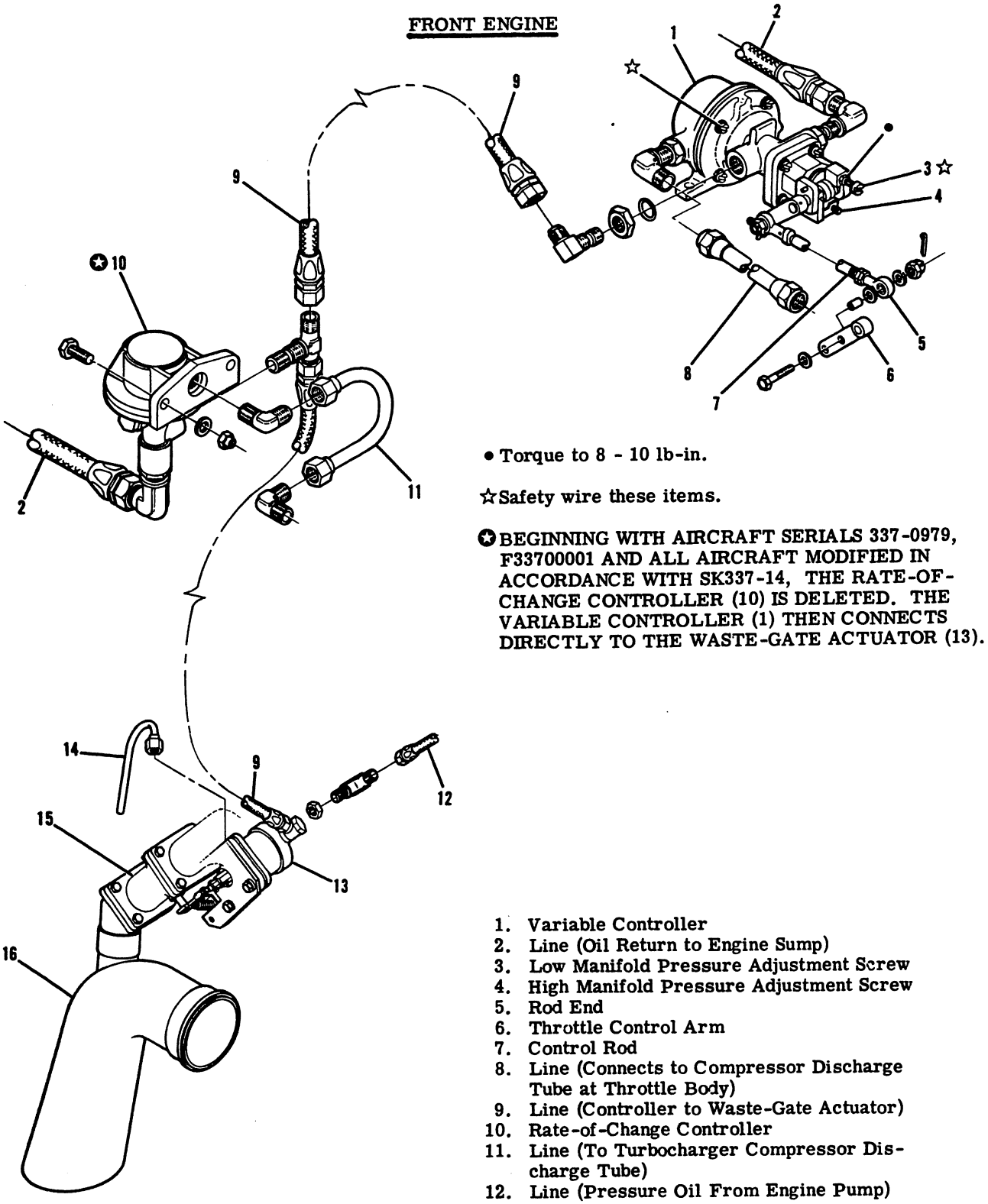
4. Insert tool (Part No. 5090002-1) into drain port. Insert small bladed screwdriver into low pressure port. Rotate poppet assembly until screwdriver blade engages slot provided in bellows assembly boot.

5. Holding bellows assembly boot, rotate poppet assembly clockwise (CW) to increase, counterclockwise (CCW) to decrease. Lightly tap the unit after each adjustment to seat internal parts.

NOTE

When adjusting, rotate in VERY small increments as this is an extremely sensitive adjustment.

6. Reinstall plug and fitting. Reinstall controller as outlined in paragraph 10A-81.



• Torque to 8 - 10 lb-in.

☆Safety wire these items.

✪BEGINNING WITH AIRCRAFT SERIALS 337-0979, F33700001 AND ALL AIRCRAFT MODIFIED IN ACCORDANCE WITH SK337-14, THE RATE-OF-CHANGE CONTROLLER (10) IS DELETED. THE VARIABLE CONTROLLER (1) THEN CONNECTS DIRECTLY TO THE WASTE-GATE ACTUATOR (13).

1. Variable Controller
2. Line (Oil Return to Engine Sump)
3. Low Manifold Pressure Adjustment Screw
4. High Manifold Pressure Adjustment Screw
5. Rod End
6. Throttle Control Arm
7. Control Rod
8. Line (Connects to Compressor Discharge Tube at Throttle Body)
9. Line (Controller to Waste-Gate Actuator)
10. Rate-of-Change Controller
11. Line (To Turbocharger Compressor Discharge Tube)
12. Line (Pressure Oil From Engine Pump)
13. Waste-Gate Actuator
14. Overboard Drain Line
15. Waste-Gate
16. Tailpipe

Figure 10A-8. Controllers and Waste-Gate Installation (Sheet 1 of 2)

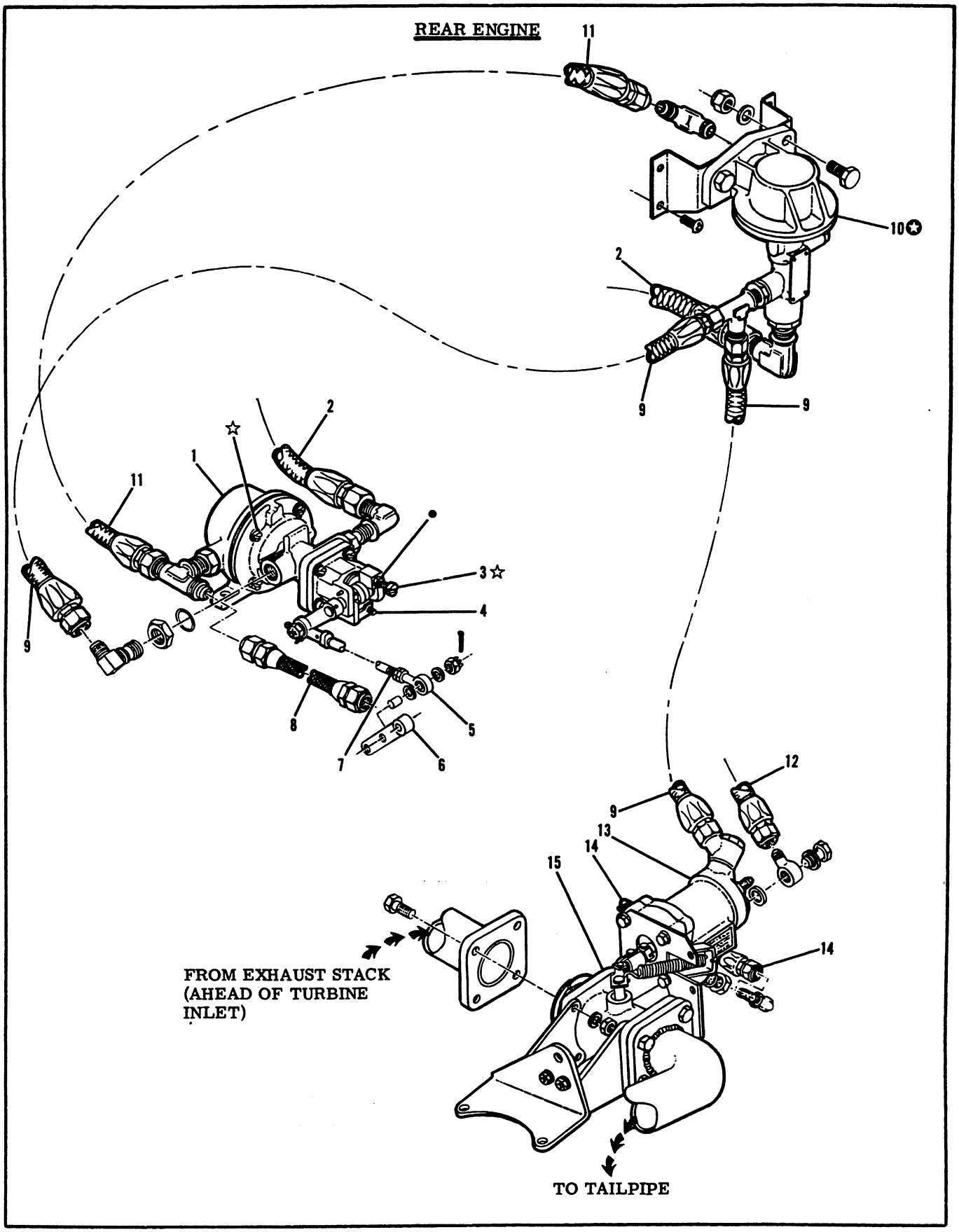


Figure 10A-8. Controllers and Waste-Gate Installation (Sheet 2 of 2)

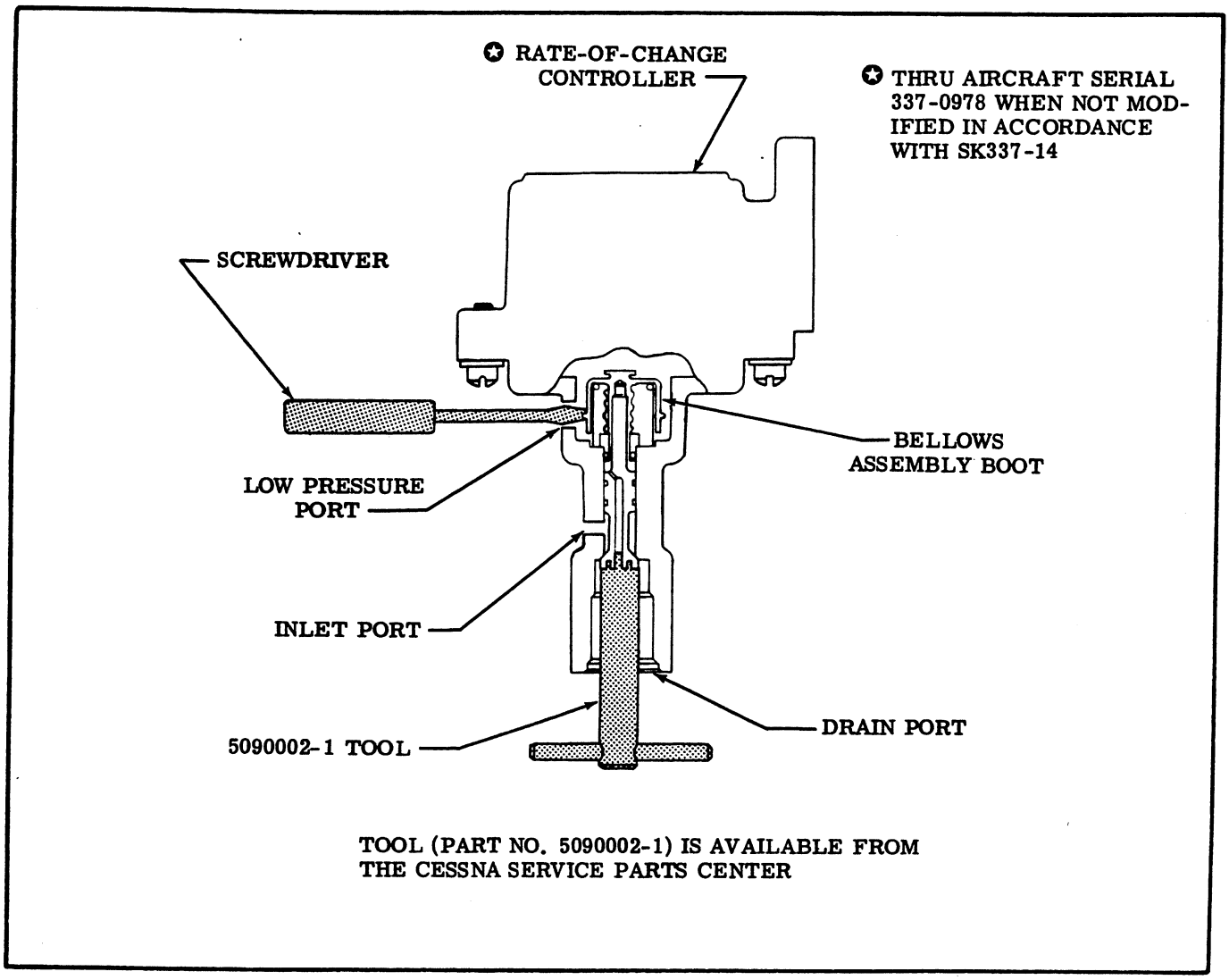


Figure 10A-9. Rate-Of-Change Controller Adjustment

7. Flight test aircraft after each adjustment to check results until desired results are obtained as outlined in step 4 of paragraph 10A-83.

c. WASTE-GATE AND ACTUATOR. (Refer to figure 10A-10.)

1. Remove waste-gate and actuator in accordance with paragraph 10A-81.
2. Install a plug in the actuator outlet port and apply a 50-60 psig air pressure to the inlet port of the actuator.
3. Check for .005 to .015 inch gap between butterfly and waste-gate body as illustrated.
4. If adjustment is required, release the air pressure and remove the pin from the actuator shaft.
5. Hold clevis end and turn shaft clockwise (CW) to increase gap or counterclockwise (CCW) to decrease gap of butterfly. Install pin through clevis and shaft, securing pin with washer and cotter pin.
6. After adjusting closed position of waste-gate and with zero pressure in cylinder, check butterfly for a clearance of .700 to .800 inch in the full-open position as illustrated.
7. If adjustment is required, loosen locknut and turn screw clockwise to decrease or counterclockwise to increase opening of butterfly.
8. Recheck butterfly in the closed position to ascertain that gap tolerance has been maintained.

NOTE

To assure correct spring loads, actuate butterfly with air pressure. Actuator and butterfly should move freely. Actuator should start to move at 15 ± 2 psig and fully extend at 35 ± 2 psig. Two to four psig hysteresis is normal due to friction of O-rings against cylinder wall.

9. Remove air pressure line and plug from actuator.
10. Install waste gate and actuator in accordance with paragraph 10A-81.

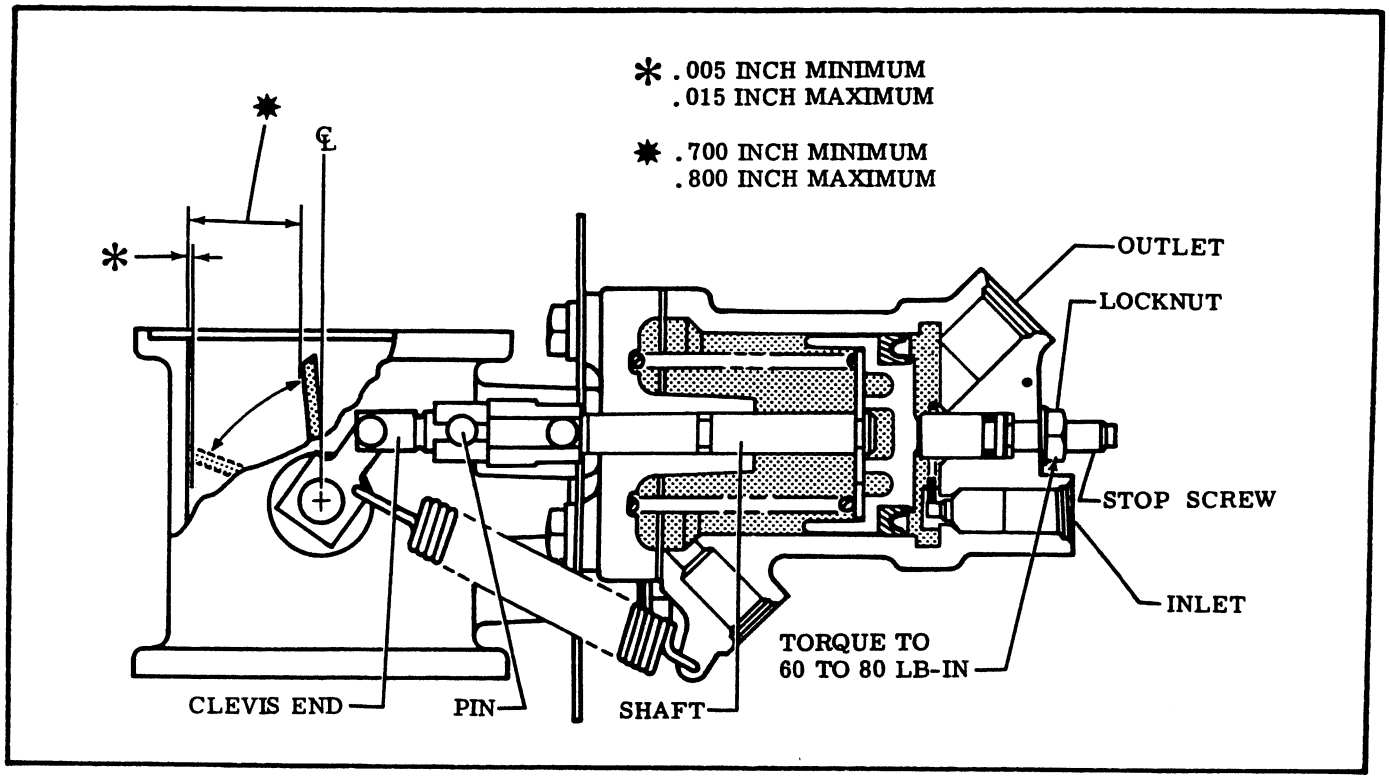


Figure 10A-10. Waste-Gate Adjustments

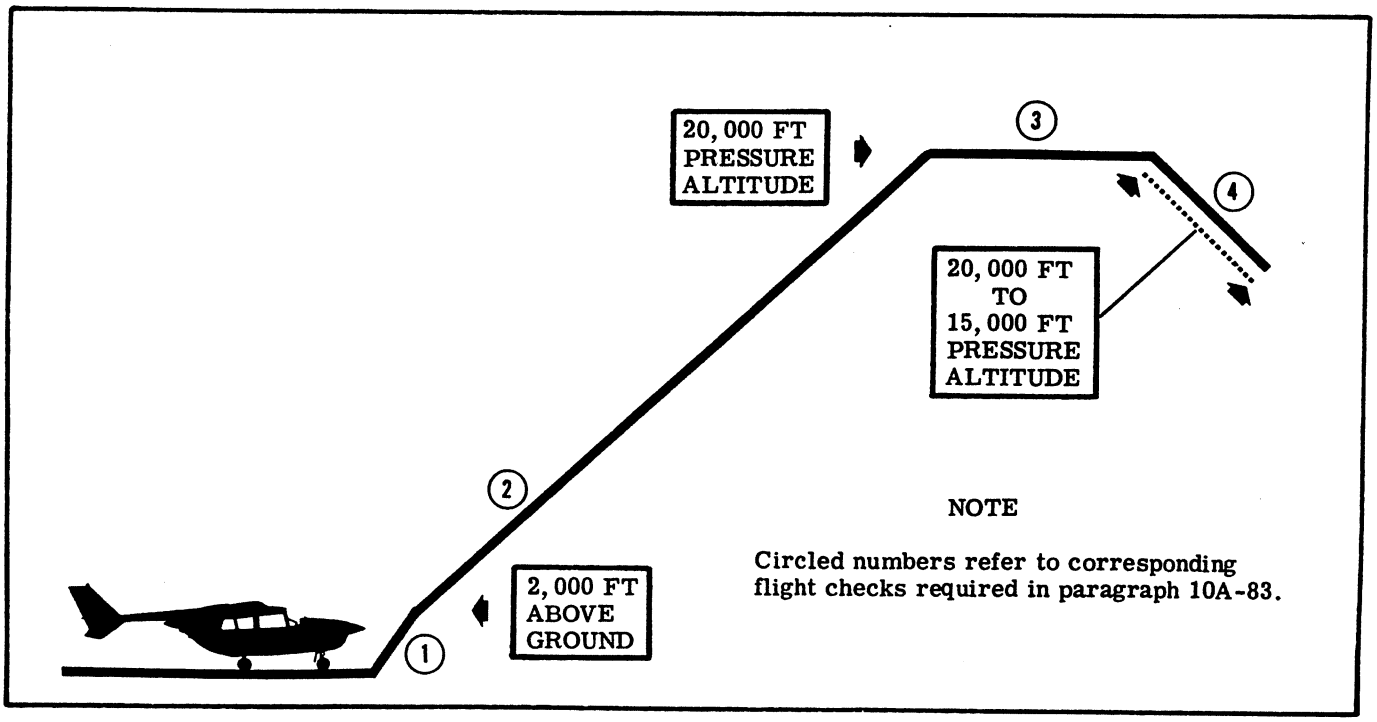


Figure 10A-11. Operational Flight Check

10A-83. CONTROLLER AND TURBOCHARGER OPERATIONAL FLIGHT CHECK. The following procedure details the method of checking the operation of the variable reference and rate-of-change controller and a performance check of the turbocharger.

(1) TAKEOFF - VARIABLE REFERENCE CONTROLLER CHECK.

a. Cowl Flaps - Open
b. Airspeed - 100 MPH IAS
c. Oil Temperature - Middle of green arc
d. Engine Speed - 2800 ± 25 RPM
e. Fuel Flow - 21 to 22 GPH (Full Rich Mixture)
f. Full Throttle M.P. - Variable reference controller should maintain 32 ± .5 in Hg (stabilized).

Climb 2000 feet after takeoff to be sure manifold pressure has stabilized. It is normal on the first takeoff of the day for full throttle manifold pressure to decrease 1/2 to 1.0 inch of mercury within one minute after the initial application of full power. Refer to paragraph 10A-82 for variable reference controller adjustment.

(2) CLIMB - VARIABLE REFERENCE CONTROLLER AND TURBOCHARGER PERFORMANCE CHECK.

a. Cowl Flaps - Open
b. Engine Speed - 120 MPH IAS
c. Engine Speed - 2600 RPM
d. Fuel Flow - Adjust mixture for 14.5 GPH
e. Part-Throttle M.P. - 28 in. Hg.
f. Climb to 20,000 feet - Check manifold pressure stability during climb.

Once the climb power setting is established after take-off, the controller should maintain a steady manifold pressure up to 24,000 feet which is the maximum operating altitude for 28 inches Hg.

(3) CRUISE - TURBOCHARGER PERFORMANCE CHECK.

a. Cowl flaps - closed
b. Airspeed - Level flight
c. Pressure Altitude - 20,000 feet
d. Engine Speed - 2800 RPM
e. Part - Throttle M.P. - 28 in. Hg.
f. Fuel Flow - Lean to 15 GPH
g. Propeller Control -
   (1) Slowly decrease engine speed to 2200 RPM or until manifold pressure starts to drop, indicating waste-gate is closed.

NOTE

If the waste-gate closes at engine speeds lower than 2200 RPM, the turbocharger performance is normal. If the waste-gate closes at engine speeds higher than 2200 RPM, refer to the trouble shooting chart in paragraph 10A-80.

   (2) Note outside air temperature and RPM as manifold pressure starts to drop, which should be in accordance with the following chart.
   (3) After noting temperature and RPM, increase engine speed 50 RPM to stabilize manifold pressure, with the waste-gate modulating exhaust flow to control compressor output.

Outside Air Temperature	RPM where M.P. Starts to Decrease
40°F Above Standard	2400
Standard Temperature	2300
40°F Below Standard	2200

(4) DESCENT - RATE-OF-CHANGE CONTROLLER.

a. Cowl Flaps - Closed
b. Airspeed - 100 MPH IAS
c. Pressure Altitude - 20,000 to 15,000 feet
d. Propeller - High RPM
e. Mixture - Full Rich
f. Throttle - Idle, until M. P. stabilizes
   (1) Rapidly advance throttle to full power.
   (2) Note time required for M.P. to increase from 20 to 30 in. Hg.

Time required should be 1.8 to 2.9 seconds (3.5 to 5.5 in. Hg. per second). Refer to paragraph 10A-82 for rate-of-change controller adjustment.

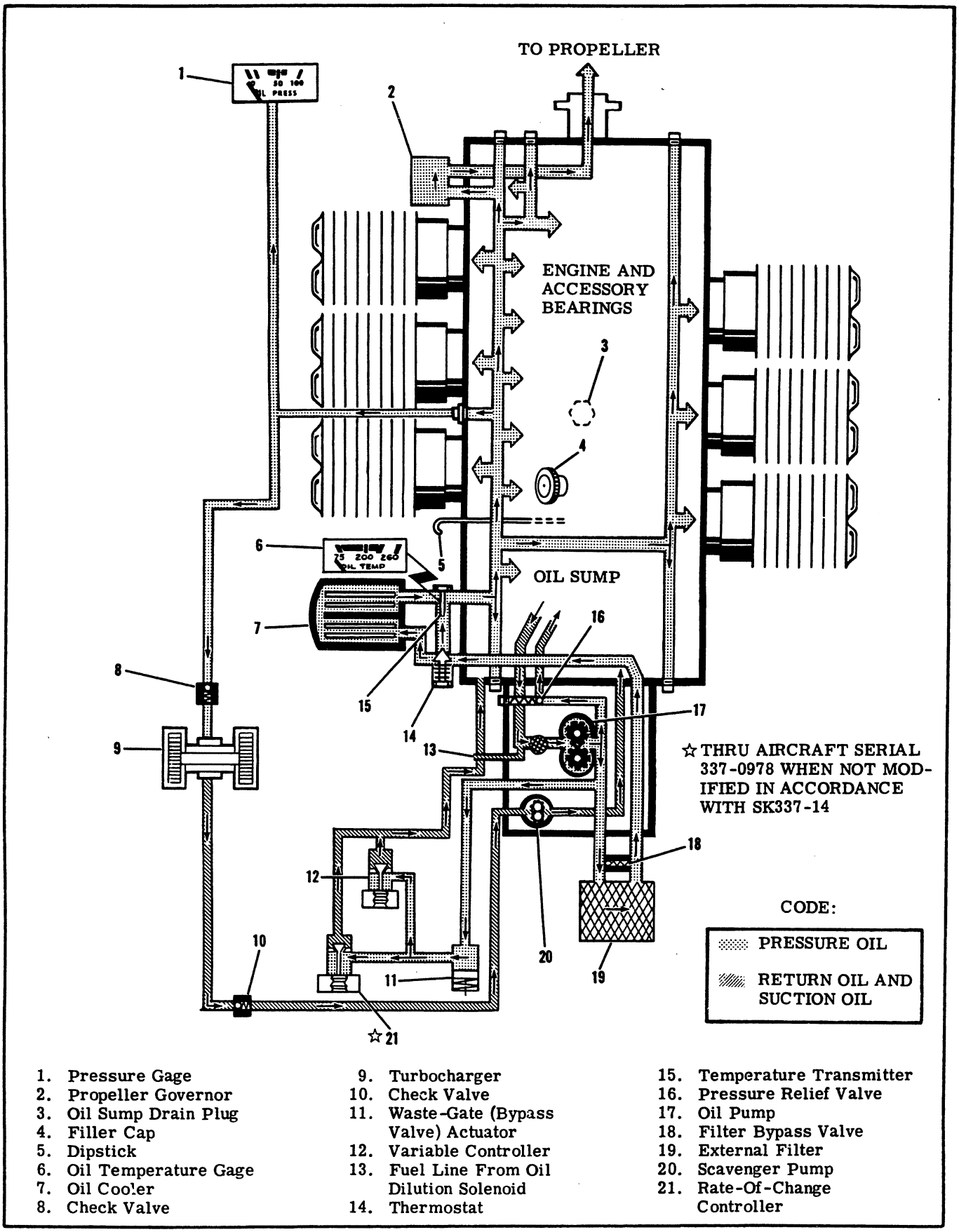


Figure 10A-12. Oil System Schematic

10A-84. ENGINE OIL SYSTEM.

10A-85. DESCRIPTION. The engine oil system is the same as described in paragraph 10-75 except the external oil filter is standard equipment on turbocharged engines. Also, the engine oil is used to control the waste-gate and lubricate the turbocharger bearings. Engine oil is returned from the turbocharger sump by a scavenger pump, which is an integral part of the engine. Refer to figure 10A-12 for a schematic diagram of the oil system.

10A-86. TROUBLE SHOOTING. Refer to paragraph 10-76.

10A-87. FULL-FLOW OIL FILTER. Refer to paragraph 10-77.

10A-88. DESCRIPTION. Refer to paragraph 10-78.

10A-89. ELEMENT REMOVAL AND INSTALLATION. Refer to paragraph 10-79.

10A-90. ADAPTER REMOVAL. Refer to paragraph 10-80.

10A-91. ADAPTER DISASSEMBLY, INSPECTION AND REASSEMBLY. Refer to paragraph 10-81.

10A-92. ADAPTER INSTALLATION. Refer to paragraph 10-82.

10A-93. IGNITION SYSTEM. Refer to paragraph 10-83.

10A-94. DESCRIPTION. Refer to paragraph 10-84.

10A-95. TROUBLE SHOOTING. Refer to paragraph 10-85.

10A-96. MAGNETOS. Refer to paragraph 10-86.

10A-97. DESCRIPTION. Refer to paragraph 10-87.

10A-98. REMOVAL AND INSTALLATION. Refer to paragraph 10-88.

10A-99. INTERNAL TIMING. Refer to paragraph 10-89.

10A-100. MAGNETO-TO-ENGINE TIMING. Refer to paragraph 10-90.

10A-101. MAGNETO CHECK. Refer to paragraph 10-91.

10A-102. MAINTENANCE. Refer to paragraph 10-92.

10A-103. TACHOMETER BREAKER POINT ADJUSTMENT. Refer to paragraph 10-93.

10A-104. SPARK PLUGS. Refer to paragraph 10-94.

10A-105. STARTING SYSTEM. Refer to paragraph 10-95.

10A-106. DESCRIPTION. Refer to paragraph 10-96.

10A-107. TROUBLE SHOOTING. Refer to paragraph 10-97.

10A-108. STARTER MOTOR. Refer to paragraph 10-98.

10A-109. REMOVAL AND INSTALLATION. Refer to paragraph 10-99.

10A-110. PRIMARY MAINTENANCE. Refer to paragraph 10-100.

10A-111. EXTREME WEATHER MAINTENANCE. Refer to paragraph 10-101.

10A-112. COLD WEATHER. Refer to paragraph 10-102.

10A-113. HOT WEATHER. Refer to paragraph 10-103.

10A-114. SEACOAST AND HUMID AREAS. Refer to paragraph 10-104.

10A-115. DUSTY AREAS. Refer to paragraph 10-105.

10A-116. GROUND SERVICE RECEPTACLE. Refer to paragraph 10-106.

10A-117. HAND CRANKING. Refer to paragraph 10-107.