CHAPTER 5

POWER PLANT AND RELATED SYSTEMS

SECTION I SCOPE

5-1. PURPOSE.

5-2. The purpose of this chapter is to provide all essential information for maintenance personnel to accomplish organizational maintenance on the complete power plant and related systems. This information includes a detail description and chronological instructions as to methods and procedures. It also includes special tools and equipment required for accomplishment of these maintenance phases in accordance with the Maintenance Allocation Chart. Special tools required for performance of organizational maintenance will be found in TM 55-1520-210-20P, Organizational Maintenance Repair Parts and Special Tools List Manual.

SECTION II POWER PLANT

5-3. POWER PLANT.

5-4. POWER PLANT INSTALLATION.

5-5. Power plant installation consists of a shaft turbine engine equipped with adapting parts and connections to fuel, oil, electrical, instrument, and engine control systems. Engine is horizontally mounted above a service deck behind main rotor pylon. Hinged cowling provides access to engine compartment between forward and rear firewalls. Exhaust area, at rear end, is covered by removable fairing. Air intake and output shafts to main transmission are under a louvered fairing or air filters, and are also protected by an induction baffle and screen with detachable sections for access. Hoses and electrical cables between engine and fuselage have quick-disconnect couplings and connectors. Other connections, such as control linkages, firewalls, drive shaft couplings, and engine mounts, have simple, rapid means of attachment so that engine with its fittings can be considered a quick-change assembly.

5-6. ENGINE MODELS AND USE. As original equipment, the T53-L-9 engine is used on YUH-1D, and T53-L-9A and T53-L-11 series engines are used on the UH-1D. When the T53-L-13 engine is installed the aircraft is designated UH-1H. The various engine models are successively improved versions of the same basic engine, and are physically interchangeable in the field.

5-7. ENGINE ORIENTATION. Directions and locations of equipment on and around the engine are stated as viewed from the rear of the engine, looking forward. Main sections of the engines and directional rotation of principal parts are as shown on diagrams. (See figures 5-1 and 5-2.)

5-8. ENGINE MODEL DIFFERENCES. A brief comparison of engine models is presented below, as to differences in features significant to Organizational Maintenance. Further details are contained in maintenance instructions for the systems where applicable.

Note

When using the T53-L-9/9A/-11/-11C engines in lieu of the T53-L-13 or T53-L-11B/D engines use driveshaft adapter P/N 204-040-010-5. When using T53-L-11B engine and T53-L-13 engine, use driveshaft adapter P/N 204-040-010-13.

a. Engine Output Shaft.

(1) On T53-L-9/-9A/-11/-11C: Requires drive shaft adapter with 24 splines.

(2) On T53-L-11B/D/-13: Requires drive shaft adapter with 26 splines.

b. Compressor Inlet Guide Vanes.

(1) On T53-L-9, -9A, -11 series: Inlet guide vanes rigidly mounted, at same angle of incidence throughout operation.

(2) On T53-L-13: Inlet guide vanes are pivoted, allowing variable angle of incidence during operation. The externally mounted actuator is controlled by the sensing line and linkage from the fuel control.

c. Interstage Airbleed System.

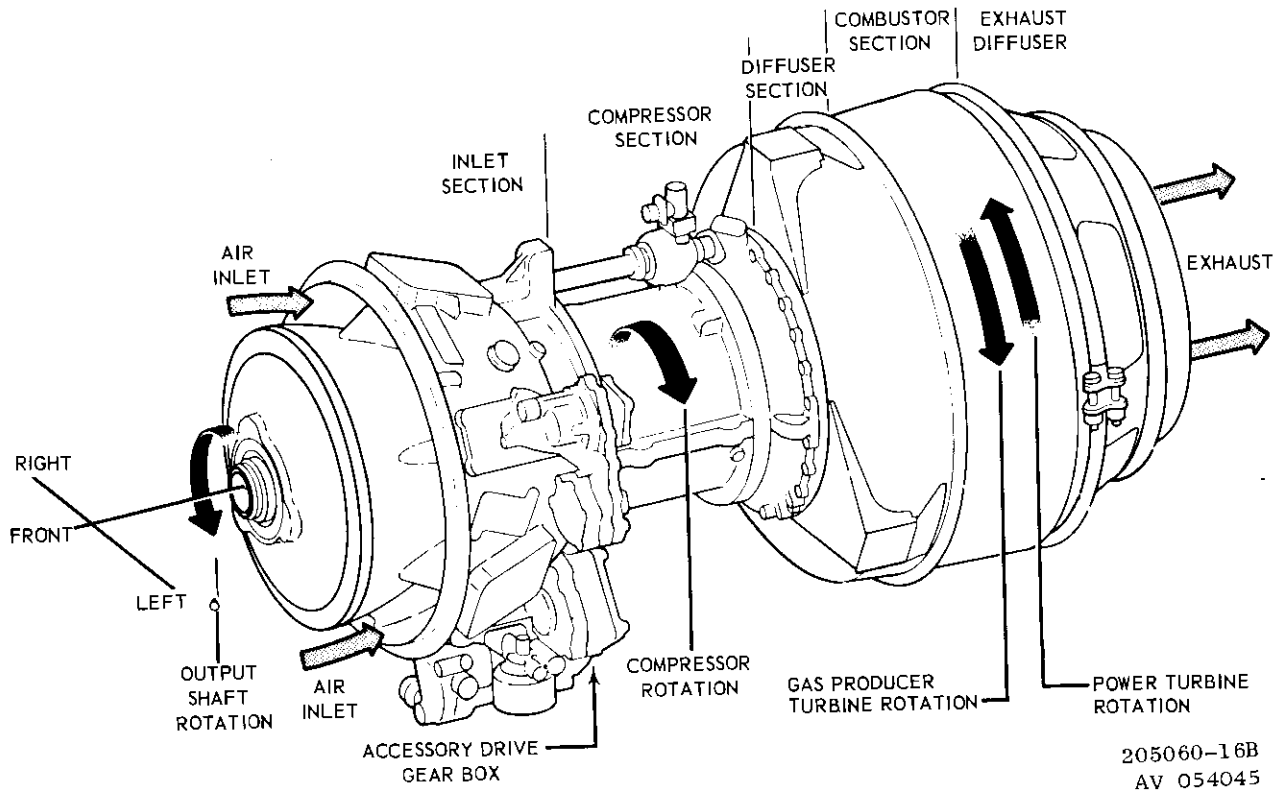


Figure 5-1. Engine orientation diagram T53-L-9/-9A/-11 series

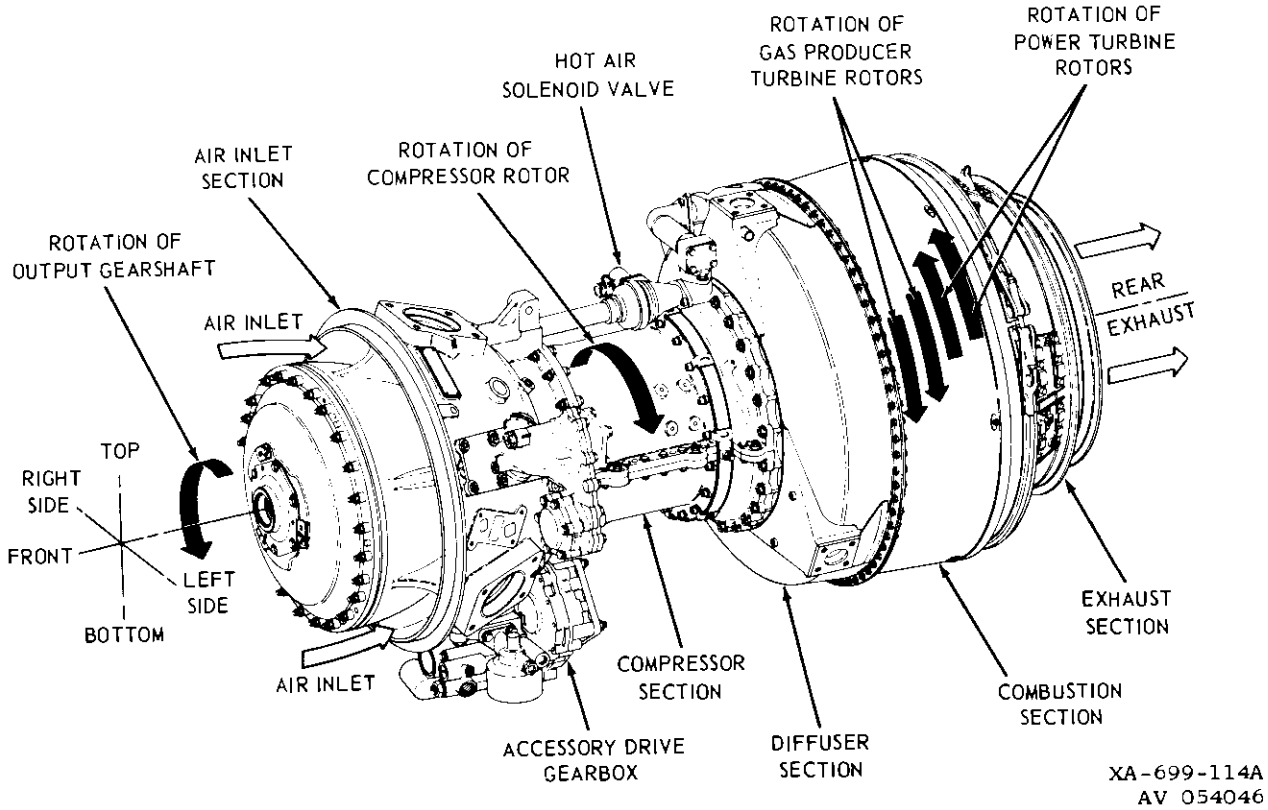


Figure 5-2. Engine orientation diagram - T53-L-13

(1) On T53-L-9, -9A: Bleed band actuator has a controller valve assembly, with a pressure sensing line from engine inlet housing, which aids acceleration in starting cycle.

(2) On T53-L-11 series, -13: Controller valve assembly eliminated. Actuator controlled by sensing line from fuel control, responsive to transient speed changes in operation as well as in starting.

d. Engine Bleed Air Connection (for cabin defrosting and to drive oil cooling blower and left fuel boost pump).

(1) On T53-L-9: Source between axial and centrifugal compressors.

(2) On T53-L-9A, -11 series, -13: Source on engine diffuser, after centrifugal compressor. Hotter and greater volume of air required two different fittings in external lines.

e. Combustion Section:

(1) On T53-L-9, 9A: Combustion chamber incorporates a scoop and shroud assembly, limited to JP-4 fuel (except in emergency). Main fuel manifold has an inlet strainer, feeds eleven vaporizers. Has five starting fuel nozzles, two igniter plugs. (Possibly modified to resemble T53-L-11 combustion section.)

(2) On T53-L-11 series: Combustion chamber is scoopless design, capable of using JP-4 or JP-5 fuel. Main fuel system like -9, -9A except has a bypass strainer in main fuel line instead of in manifold. Has two starting nozzles on a starting fuel manifold around lower side of support cone.

(3) On T53-L-13: Has scoopless-type combustion chamber. Gas producer turbine and power turbine assemblies each have two-stage turbine wheels and nozzles. Main fuel system has no strainer aft of fuel control, has a flow divider assembly and a two-section manifold with primary and secondary flow passages to 22 dual-orifice atomizers. Starting system has four nozzles, four igniter plugs.

f. Fuel Control.

(1) On T53-L-9, -9A: Has no connection to interstage airbleed system. Starting fuel is scheduled by regulator. (unless modification has not been performed). Requires use of LTCT461 cold-weather stop for ground run check of takeoff power.

(2) On T53-L-11 series: Has connection for interstage airbleed actuator sensing line. Starting fuel is scheduled by regulator, has alternate connection for unscheduled starting fuel if required for cold-weather starts on alternate fuel. Has part-power plunger at power lever for use in ground run check of takeoff power.

(3) On T53-L-13: Essentially like T53-L-11. Also has sensing line and linkage to variable inlet guide vane actuator. Starting fuel is not scheduled.

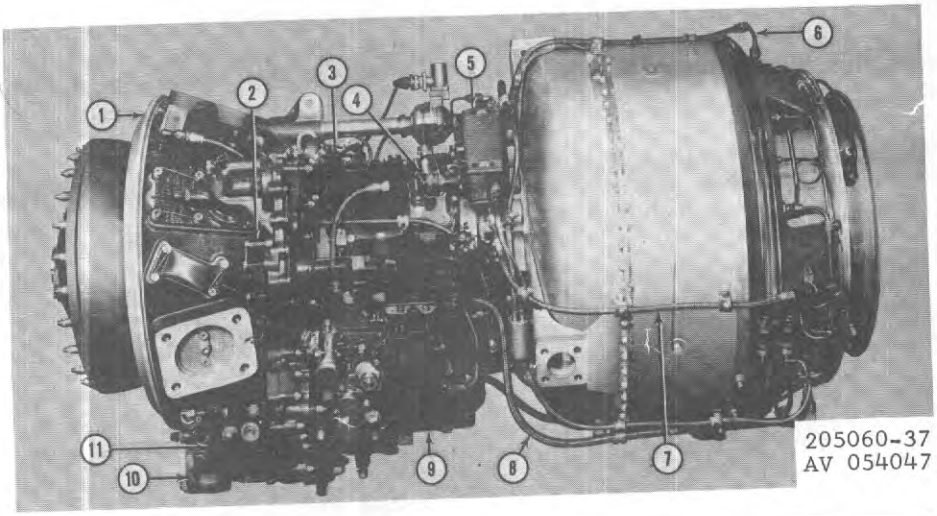
5-9. ENGINE DESCRIPTION.

5-10. The engine is described here, and shown without adapting parts, as introduction to more detailed instructions for complete power plant installation with associated equipment and external systems. (See figures 5-3 and 5-4.) Basic engine consists of an inlet housing and reduction gear section, an axial-centrifugal compressor and diffuser, a combustion chamber, a gas producer turbine driving the compressor, a power turbine driving a power shaft, and an exhaust diffuser. Fuel control, starting and ignition, lubrication, and air systems are separately discussed in detail. Considered functionally, the engine is made up of two mechanically independent groups: The gas producer turbine and associated components, commonly designated as nI on charts and other references; and the power turbine and associated components, designated as nII.

5-11. GAS PRODUCER GROUP. Gas producer (nI) components include air inlet housing, gas producer or compressor rotor assembly (gas producer turbine and compressor which are joined to form a rotating unit), diffuser assembly, combustion chamber assembly, and accessory drive gear box as a driven unit. A tachometer generator on the accessory drive gear box provides an indication of compressor rotor speed in percent rpm on gas producer tachometer.

5-12. Air inlet housing is a one-piece casting formed as an inner housing and an outer shell with six hollow connecting struts. Inner housing contains reduction gears of power train, output bearing support the torquemeter assembly and power take-off gears. Outer shell directs intake air to compressor and provides mounting for external components. Connecting struts provide passages for anti-icing hot air and oil scavenge return, and enclose shafts for gear trains to external components. Entire housing is a main support structure, having pads for engine mounting and an eye for engine hoisting.

5-13. Gas producer rotor consists of five axial-flow compressor rotor stages, a centrifugal impeller, and a driving turbine, all mechanically joined to form a rotating assembly. Axial compressor is made up of disc and blade assemblies alternating with spacers on a rotor sleeve, supported at front



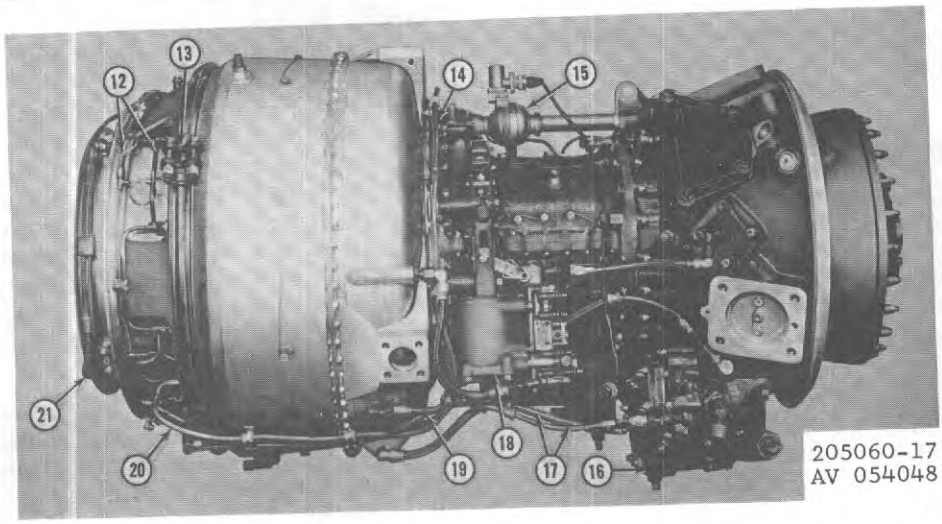


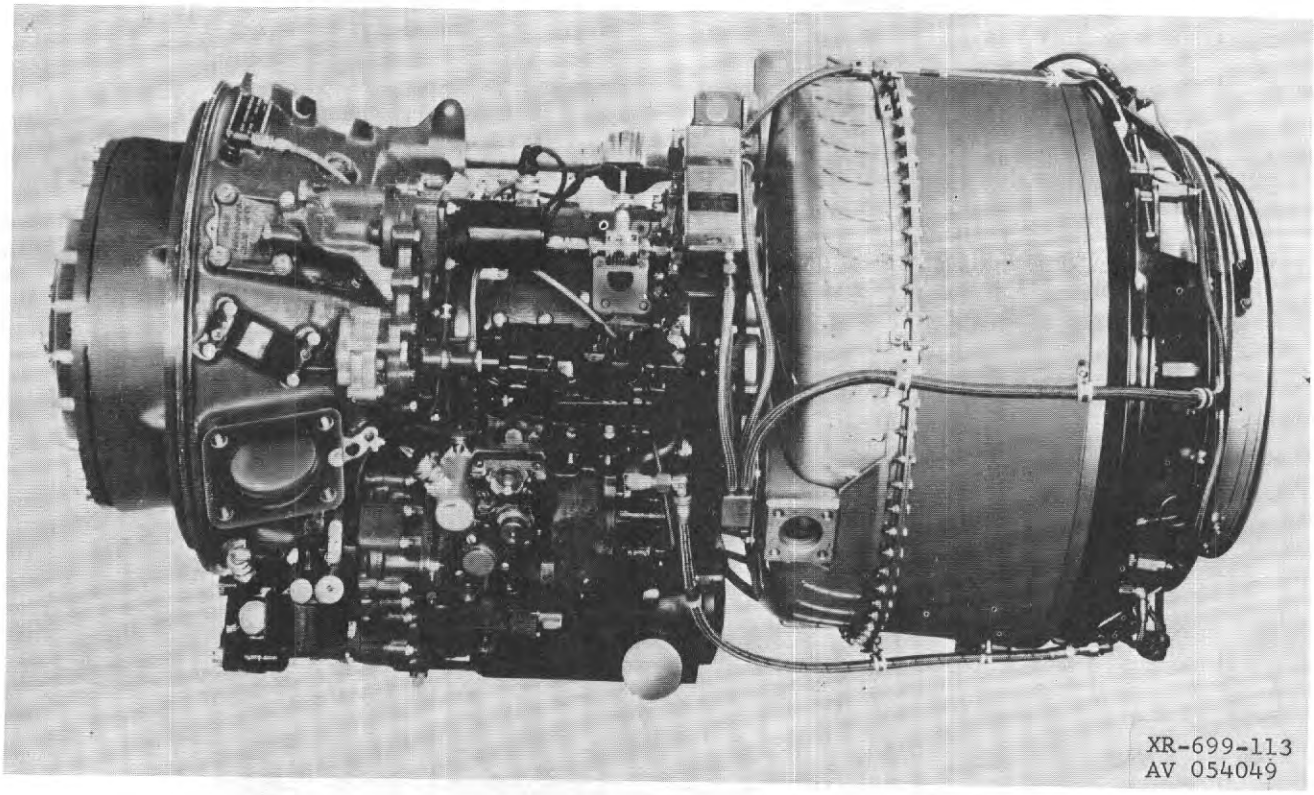
Figure 5-3. Engine left and right side view - typical T53-L-9/-9A/-11 series

end by No. 1 main bearing and attached at rear end to centrifugal impeller. Axial compressor blades turn between vane assemblies which are mounted in two halves of a cylindrical housing. Centrifugal impeller has integral blades, turning within a two-piece housing. Diffuser housing, between centrifugal compressor and combustor section functions to slow the air leaving compressor. Ratio of compressor outlet pressure to air inlet pressure is 6:1. Gas producer turbine is an axial-flow assembly, formed of steel blades secured in the rim of a steel disc, attached to compressor and supported by No. 2 main bearing. The turbine has two stages on T53-L-13 engine, but is single-stage on all prior models.

5-14. The combustion chamber is formed of liner, deflector, and turbine nozzle assemblies supported in cylindrical combustor and diffuser housings. Chamber so formed is an external-annular reverse-flow type, chosen to allow compact design of the engine.

5-15. The accessory drive gear box, which contains the accessory gear train, is mounted on underside of inlet housing and driven through bevel gears from front end of compressor rotor. Drive pads are provided on rear of gear box for fuel control regulator, starter-generator, and gas producer (nI) tachometer generator. Front of gear box provides mounting for oil pump, and has an unused drive pad with connection for vent line from torquemeter pressure transmitter. Accessory drive shaft gears turn clockwise, viewed facing drive pad. Gear box also serves as a scavenge oil collector sump, kept practically empty by pump.

5-16. POWER TURBINE GROUP. The power turbine, exhaust diffuser, power shaft, and output reduction gearing constitute the power turbine (nII) group. The turbine assembly is supported by No. 3 and 4 main bearings in exhaust diffuser housing, and consists of two stages on T53-L-13 engine or a single stage on other models. The turbine is splined to a power shaft



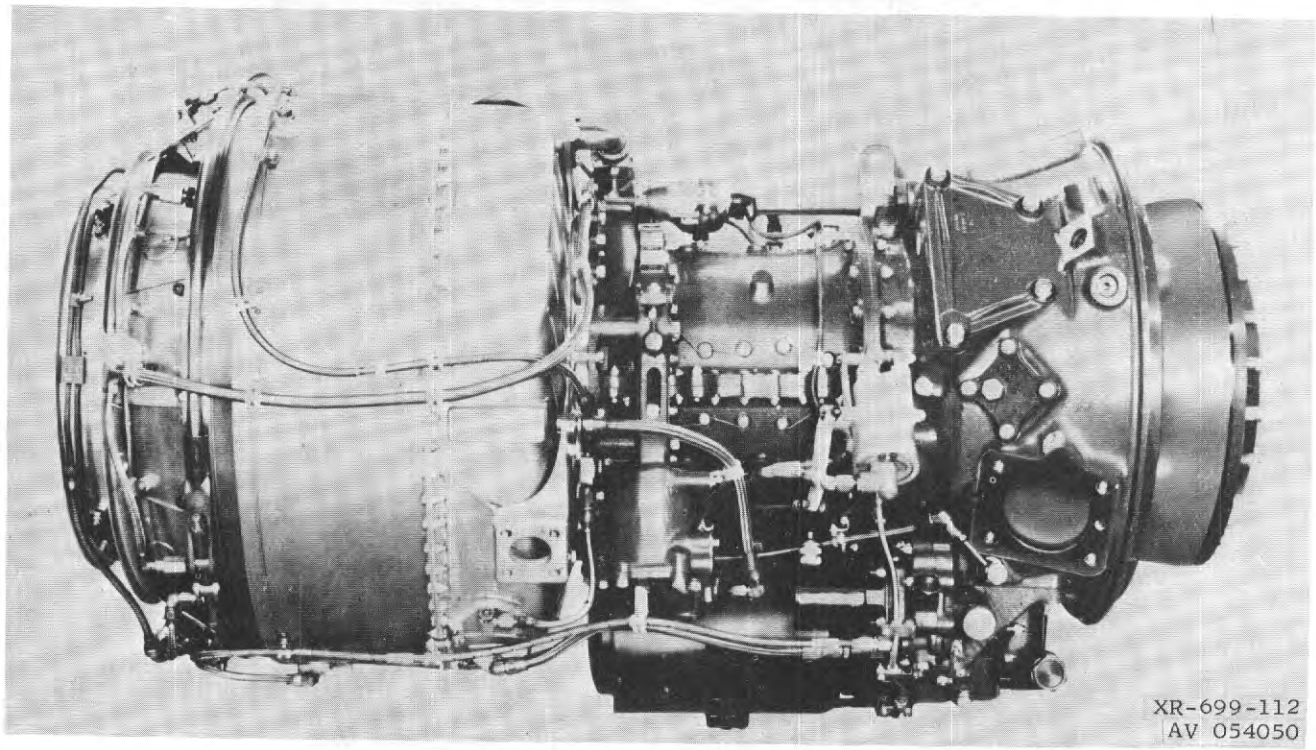


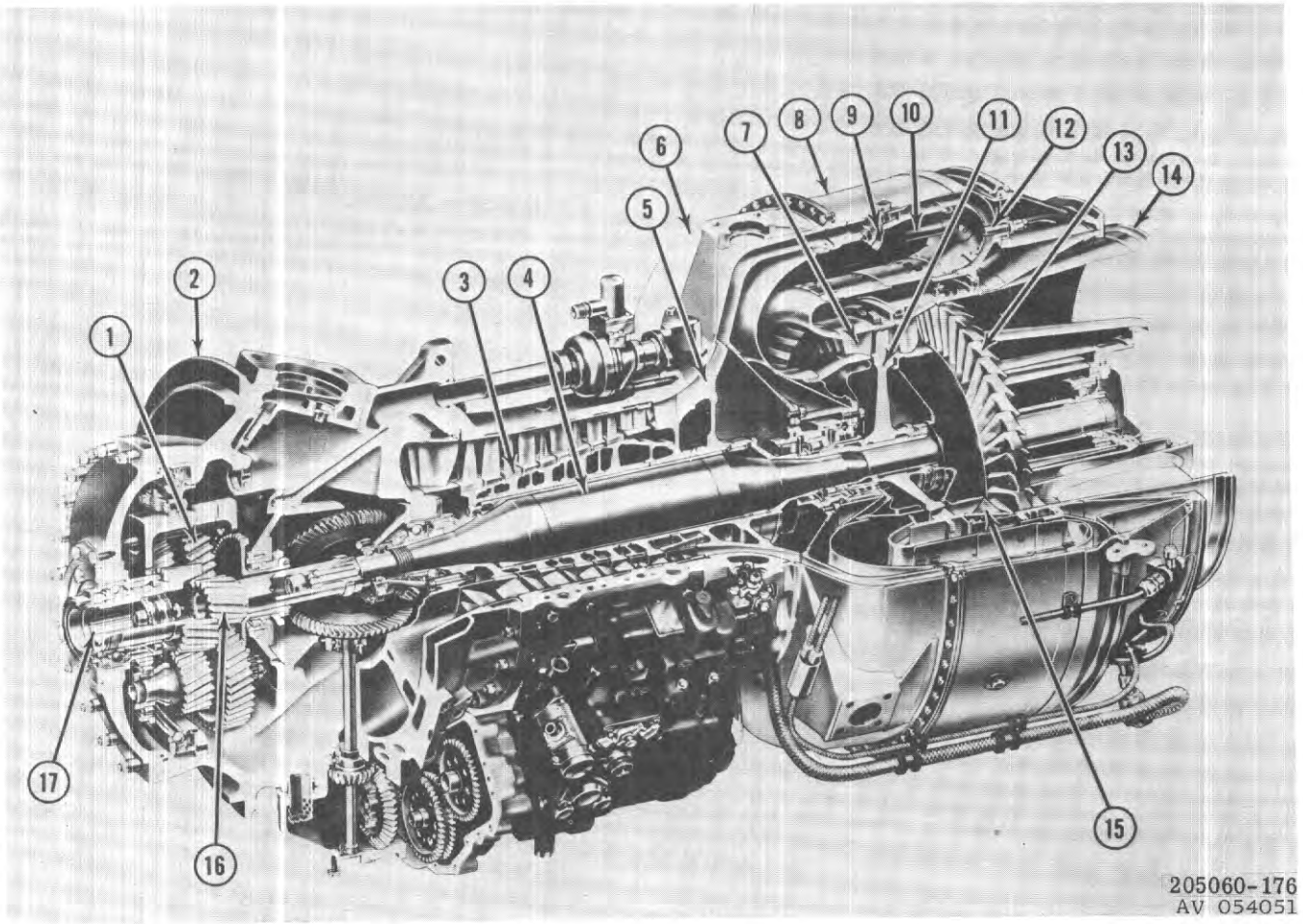
Figure 5-4. Engine left and right side view - T53-L-13

extending coaxially through hollow center of compressor rotor to drive reduction gears and power output gearshaft at front end of engine. An external gear box, mounted at upper left on inlet housing and driven from power shaft, drives an overspeed governor on fuel control assembly which regulates speed of power turbine. A tachometer generator on governor drive gear box provides indication in rpm on dual tachometer.

5-17. Output reduction gearing, contained in inner portion of inlet housing, incorporates a torquemeter assembly which is the means of providing continuous gage indication of torque applied on output gearshaft. This device is grooved plate and ball system working with oil pressure, varied according to torque, to an external pressure transmitter. Oil supply pressure is increased by a boost pump on overspeed governor drive gear box.

5-18. ENGINE PRINCIPLES OF OPERATION.

5-19. Air entering through inlet housing passes through axial and centrifugal stages of compressor as its rotor is turned, either initially by starter through accessory gear box, or in normal operation



1. Output Reduction Gears
2. Inlet Housing
3. Axial Compressor Rotor
4. Power Shaft
5. Centrifugal Compressor
6. Diffuser Housing
7. Gas Producer Turbine Nozzle
8. Combustion Chamber Housing
9. Scoops
10. Fuel Vaporizers
11. Gas Producer Turbine
12. Igniter Nozzles
13. Power Turbine
14. Exhaust Diffuser
15. Power Turbine Nozzle
16. Sun Gearshaft
17. Output Gearshaft

Figure 5-5. Engine cutaway showing internal parts - typical T53-L-9/-9A/-11 series

by gas producer turbine. (See figure 5-5.) Compressed air is directed through vanes of diffuser, with reduction of velocity and swirling of air flow to increase its pressure, then enters combustion chamber to mix with vaporized fuel and create a combustible mixture. Initially, fuel is supplied through starter nozzles by starting fuel system, and combustion occurs when igniter plugs are energized. Thereafter, starting system is manually deactivated and combustion is sustained by fuel supplied through main fuel system to vaporizer tubes or atomizers in combustion chamber. Expanding gases are directed through gas producer turbine, then through power turbine, and out of engine through exhaust diffuser. Gas producer turbine uses enough of available energy from combustion gases to drive compressor and associated gear trains. The power turbine utilizes most of remaining energy for delivery to output shaft and overspeed governor gear train.

5-20. Other engine equipment and features are discussed elsewhere in this section, with systems to which they pertain.

5-21. ENGINE MAINTENANCE PRECAUTIONS.

5-22. MISCELLANEOUS PRECAUTIONS.

Warning

USE OF LUBRICATING OIL. Prolonged contact with lubricating oil, (items 2 and 3, table 1-2) may cause a skin rash. Those areas of skin and clothing that come in contact with lubricating oil should be thoroughly washed immediately. Saturated clothing should be removed immediately. Areas in which lubricating oil is used should be adequately ventilated to keep mist and fumes to a minimum.

Lubricating oil may soften paint upon contact. If lubricating oil is spilled on painted surfaces, these surfaces should be thoroughly washed.

Warning

Be sure tools used on engine are not cadmium plated. Cadmium plating tends to chip from tools, and chips contaminating oil system can cause magnesium parts to deteriorate.

Caution

Do not use tape to seal fuel or oil openings, since tape adhesive is soluble and can cause contamination.

a. Use extreme caution to prevent dirt and foreign objects from entering engine. Place temporary covers on all exposed openings when engine components are removed or disconnected.

b. Protect engine from dust and inclement weather. When possible perform maintenance in a sheltered area.

c. Before removing engine components, disconnect wiring harness at ignition exciter unit and ground the ignition leads.

d. Carefully inspect condition of all parts to be installed on engine.

e. Replace removed lockwire, cotter pins, tabwashers, lock-pins, lock-washers, gaskets, and packing rings with serviceable parts.

f. Remove hoses and tubing that may be damaged during removal of engine components.

g. In removal of external lines and components, brackets will be left in place whenever possible to facilitate reinstallation.

h. When removing or installing engine fuel, oil, or air hoses, do not apply torque to the narrow hex nut of the sleeve and nipple. Apply torque to the wide hex nut only. When loosening or tightening the wide hex nut, hold the nipple or sleeve to prevent twisting of the hose.

i. Properly route and clamp all hose assemblies securely to prevent chafing. Proper clamping and chafe pads shall be used at all times.

5-23. TORQUE VALUES.

a. Apply special torque values whenever stated or shown in maintenance instructions.

b. For general applications other than engine parts, use standard torque values for aircraft structural hardware.

c. On engine only, where no special torque is given, use table of torque values provided by engine manufacturer. (See figure 5-6.) Unless otherwise stated, fittings being tightened must have clean, dry threads.

5-24. ENGINE STUD TORQUE VALUES. For engine studs, use care in determining exact thread size

on both ends of stud. Select proper torque value for stud type and size. (See figure 5-6.)

5-25. LUBRICANTS AND SEALING COMPOUNDS. Unless instructions recommend use of special compounds for a particular installation, only those listed below shall be used in assembly of engine.

a. Petrolatum (item 13, table 1-2) for lubricating fuel system packing rings.

b. Hydrogenated vegetable shortening compound (item 15, table 1-2) or castor oil (item 16, table 1-2) for lubricating oil system packing rings.

TORQUE VALUES
(Inch-Pounds)

STANDARD STEEL BOLTS, NUTS, & SCREWS

SIZE	HEX BOLTS AND NUTS	SLOT HEAD SCREWS
10-32	40-45	18-20
7/32-24	65-70	22-25
1/4-28	70-95	30-35
5/16-24	120-165	40-45
3/8-24	250-325	55-60
7/16-20	400-475	80-90
1/2-20 or -13	500-700	100-110
9/16-18	750-1000	
5/8-18	1000-1400	

PIPE THREAD PLUGS

	SQUARE OR INTERNAL HEX HEAD		SLOT HEAD
SIZE	STEEL	ALUMINUM OR BRASS	STEEL
1/16	35-40	10-15	20-25
1/8	75-125	30-40	35-50
1/4	200-250	70-85	60-90
3/8	300-375	95-110	100-140
1/2	400-500	140-160	150-200
3/4	500-600	175-200	200-250
1	600-700	230-260	250-300

STRAIGHT THREAD PLUGS
(Torqued with sealing compound or lubricant)

SIZE	HEX HEAD	SLOT HEAD
1/4-28	75-80	75-80
5/16-24	90-100	90-100
3/8-24	110-125	110-125
7/16-20	125-140	125-140
1/2-20	145-160	145-160
9/16-18	160-175	160-175
5/8-18	175-200	
3/4-16	215-240	
7/8-14	250-275	
1-14	300-325	
1-1/8-12	325-350	
1-1/4-12	350-400	
1-3/8-12	400-450	
1-1/2-12	425-475	
1-5/8-12	475-525	
1-3/4-12	500-550	
1-7/8-12	550-600	
2-12	600-650	

HOSE "B" NUTS

SIZE	TORQUE
3	70-100
4	70-120
5	85-180
6	100-250
8	210-420
10	300-480
12	500-850
16	700-1150

FLARED TUBE "B" NUTS

TUBE O.D.	ALUMINUM	STEEL
3/16		90-100
1/4	40-65	135-150
5/16	60-80	180-200
3/8	75-125	270-300
1/2	150-250	450-500
5/8	200-350	650-700
3/4	300-500	900-1000
1	500-700	1200-1400

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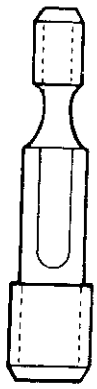
Figure 5-6. Engine hardware torque values (Sheet 1 of 2)

STUDS

TYPE X

TYPE Y



TYPE Z

STEPPED STUD TORQUE VALUES
(POUND-INCHES)

THREAD SIZE NUT END	STUD END	TYPE X	TYPE Y	TYPE Z
0.190-32	0.250-20	25 to 30		
0.250-28	0.3125-18	50 to 110	50 to 75	50 to 165
0.3125-24	0.375-16	100 to 240	100 to 160	100 to 350
0.375-24	0.4375-14	175 to 475	175 to 325	175 to 600
0.4875-20	0.500-13	250 to 725	250 to 525	250 to 1000
0.500-20	0.5625-12	400 to 1150	400 to 825	400 to 1500
0.5625-18	0.625-11	600 to 1650	600 to 1150	600 to 2100
0.625-18	0.6875-11	900 to 2400	900 to 1700	900 to 3100

STRAIGHT STUD TORQUE VALUES
(POUND-INCHES)

THREAD SIZE NUT END	STUD END	TYPE X	TYPE Y	TYPE Z
0.112-48	0.112-40	3 to 7		
0.138-40	0.138-32	8 to 14		
0.164-36	0.164-32	18 to 25		
0.190-32	0.190-24	25 to 35		
0.250-28	0.250-20	50 to 95	50 to 95	50 to 105
0.3125-24	0.3125-18	100 to 225	100 to 225	100 to 250
0.375-24	0.375-16	175 to 375	175 to 375	175 to 400
0.4375-20	0.4375-14	250 to 650	250 to 400	250 to 700
0.500-20	0.500-13	400 to 1000	400 to 700	400 to 1100
0.5625-18	0.5625-12	600 to 1450	500 to 1050	600 to 1600
0.625-18	0.625-11	900 to 2000	700 to 1400	900 to 2200

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Figure 5-6. Engine hardware torque values (Sheet 2 of 2)

(2) Slowly feed approximately 1/2 pound of abrasive grain, by hand, into the inlet housing between two struts.

(3) Allow engine to clear itself of abrasive grain. This will take approximately one minute.

(4) Repeat preceding steps (2) and (3) at each remaining opening between struts.

(5) Shut down engine. Visually inspect inlet guide vanes and first stage rotor through air inlet housing.

Note

If inlet guide vanes are not completely clean, perform step (6) below.

(6) Using a cloth swab and perchloroethylene (item 301, table 1-2), clean inlet guide vanes.

(7) Remove protective caps. Clean capped ports, reconnect lines, and reinstall any removed components.

(8) After 2 to 4 hours of engine operation following compressor cleaning, remove, inspect and clean airbleed valve strainer (T53-L-9 and -9A engines) or airbleed actuator strainer (T53-L-11 series and -13 engines).

d. If dry cleaning solvent or abrasive grain are not available, clean compressor rotor blades and air passages with water as follows:

Note

To avoid freezing at ambient temperatures below 35°F (1.5°C), use anti-detonating injection fluid (item 319, table 1-2) or a mixture containing 40 percent methanol (item 308, table 1-2) and 60 percent water in lieu of water.

(1) If the inlet guide vanes are heavily coated with dirt, clean them with a small, round fiber brush with a long handle.

(2) Start engine and operate at flight idle.

(3) Spray fresh water into all sections of the inlet housing at a rate of 1-1/2 to 2-1/2 gallons per minute for approximately 2 minutes. Let engine run for 3 to 5 minutes to dry out; then shut down engine and inspect inlet guide vanes and compressor for cleanliness.

(4) Repeat cleaning procedure if necessary.

5-31. SPOT PAINTING - ENGINE. Scratches or exposed painted areas of engine shall be spot-painted to prevent surface corrosion.

5-32. ALUMINUM - PAINTED SURFACES.

a. Lightly sandpaper the area to be spot-painted.

b. Clean area with trichloroethylene (item 300, table 1-2) and air dry.

c. Spot-paint exposed area with heat-resistant aluminum enamel (item 102, table 1-2) or equivalent.

d. Air dry, or use heat lamp to force-dry in humid conditions.

5-33. MAGNESIUM-BASE ALLOY SURFACES. The following procedure may be used to remove corrosion and to touch up all magnesium engine parts that have been previously treated. No distinction shall be made between areas coated with engine gray and areas coated with clear epoxy sealant.

a. Blend nicks, scratches, or reworked areas with surrounding metal surface, using a smooth stone or crocus cloth (item 510, table 1-2). The blend shall be smooth and continuous to prevent possible stress-concentration areas.

b. Thoroughly clean area to be treated with acetone (item 307, table 1-2).

c. With a cotton swab, locally apply chrome pickle solution (1.5 pounds sodium dichromate (item 315, table 1-2) and 1.5 pints nitric acid (item 316, table 1-2) specific gravity 1.42, to one gallon of water) to exposed area. Allow solution to remain on surface 2 to 5 minutes then rinse well with clean water.

Warning

Chrome pickle solution is poisonous. Do not allow solution to touch skin, as its entry through cuts or bruises may cause serious illness. Wash any traces of solution from skin with soap and water.

d. Dry part with clean cloth, then with 500-watt heat lamps or equivalent for 5 to 10 minutes.

e. Prepare engine gray A.D. epoxy, (item 107, table 1-2) or equivalent, by mixing equal parts of components A and B. Apply one brush coat of mixture over the exposed area.

f. Using 500-watt heat lamps or equivalent, dry part for 2 hours. Air dry part, at least 24 hours, until paint is no longer tacky.

5-34. TROUBLESHOOTING - ENGINE.

5-35. A chart of possible engine troubles, causes, and remedial action is included below. Power plant malfunctions may be obvious, or may be of a nature which is not obvious but which can cause considerable damage to engine if not detected. Therefore, it is essential that maintenance personnel have thorough knowledge of exhaust gas temperatures, fuel pressures, lubricating oil pressures, and other important details of normal engine performance in order to recognize power plant troubles quickly when they occur. Having recognized trouble, the mechanic must then isolate it by a process of elimination of possible causes, beginning with those most probable and most readily checked. Correction of trouble may require simple repair of faulty installation, replacement of an accessory or part, or removal of engine assembly for inspection and repair at a higher maintenance level. Certain corrective actions in the trouble shooting chart are beyond the scope of organizational maintenance personnel but are included mainly to preserve continuity of trouble shooting task.

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
1. Failure to crank	Low voltage; battery defective	Replace battery; use auxiliary power
	Faulty electrical system	Check circuits, repair connections or replace faulty units
	Starter motor faulty or shaft sheared	Replace starter-generator
2. Cranking difficulty or failure	Compressor rotor seized by icing	Duct hot air into inlet
	Internal seizing of compressor or gas producer turbine	Internal inspection and repair of engine compressor or combustor sections
3. Failure to start		
a. Igniter plugs not firing; no crackling sound when starting system is energized	Weak battery or faulty electrical system	Check for 14 volts minimum input to ignition exciter. Replace battery or repair electrical circuit if required
	Faulty ignition exciter	If plugs still do not fire, replace ignition exciter
	Faulty igniter plugs	Disconnect leads from plugs if still failing to fire. Attach plugs known to be good on leads and let hang free. Energize system. If spark occurs now, replace old plugs.
	Faulty ignition leads	If still no spark, replace ignition leads.
b. No starting fuel; no rise in exhaust gas temperature	Starting fuel nozzles or manifold clogged or damaged	With ignition disconnected, disconnect starting fuel line from manifold. Simulate a start to check for flow at open line. If there is flow, clean or replace starting nozzles or manifold.

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
	Inoperative boost pumps or system shut-off valve	If no fuel flow in previous test, check fuel supply system operation. Repair circuits or replace faulty units.
	Starting fuel solenoid valve inoperative	Disconnect starting fuel line at valve inlet. If there is flow from fuel control, replace solenoid valve or repair connections
	Clogged strainers in fuel control	If still no flow, clean fuel control strainers and replace servo filter
	Faulty fuel control	If still no starting fuel flow, replace fuel control
c. No main fuel; engine stabilizing at 100°C exhaust gas temperature and about 15 percent nI rpm	Faulty fuel supply system	Check fuel servicing. Check operation of boost pumps and system shutoff valve, repair circuits or replace faulty units. Clean main strainer or replace filter element.
	Clogged strainers in fuel control, manifold or line	Check all fuel strainers and lines for restrictions.
	Faulty fuel control	With ignition disconnected, disconnect main fuel line from manifold. Motor engine at 12 to 16 percent nI rpm to check for fuel flow. If no flow, replace fuel control
	Inoperative flow divider, on T53-L-13 engine only	Replace flow divider
d. In cold weather	Wrong fuel	Service with correct fuel
	When using JP-5 fuel on the T53-L-11 series engines only, wrong starting fuel port of fuel control being used for temperature below 10°F (-12.2°C)	Connect starting fuel line to elbow-type fitting of alternate (unscheduled) starting fuel port of fuel control. Cap banjo fitting on normal (scheduled) port Refer to item 3
4. Excessive time in starting	Refer to item 3	
5. Hung start; engine fails to accelerate beyond approximately 30 percent nI rpm and exhaust gas temperature rapidly rises toward overtemperature limits.	Excessive fuel used for start	Shut down engine. If necessary, motor engine to stabilize exhaust temperature. Use proper starting procedure
	Internal engine ginding	Refer to item 2
6. Hot start; exhaust gas temperature limits exceeded	Weak battery	Replace battery
	Wrong starting procedure	Use correct procedure

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
	Starting fuel solenoid valve fails to shut off	Check operation: Disconnect starting fuel line from manifold. Motor engine with main fuel switch on, starting fuel switch off. If fuel flows, replace valve
	Air inlet obstructed	Clean air inlet
	Faulty fuel control	Replace fuel control
7. Torching start: flames shoot from exhaust	Wrong procedure	Use correct procedure
	Fuel accumulation in tail-pipe or combustion chamber	Check tailpipe and combustion chamber drain lines for obstruction. Remove and inspect combustion chamber drain valve. Replace faulty parts.
	Defective starting fuel nozzles	Check starting fuel nozzles for cracks around the disk orifice and for freeness of ball bearings. Replace defective starting fuel nozzles
8. Flame-out during start	Insufficient starting fuel	Maintain starting fuel longer in next start
9. Idle speed low	Power lever control linkage rigged incorrectly	Rig power control linkage
	ENGINE GOV switch at EMER position, or not wired properly, or faulty transfer solenoid valve	Check operation with switch at AUTO; repair circuit or replace faulty solenoid and valve.
	Fuel flow restricted	Check fuel strainers and lines
10. Idle speed high	Power lever control linkage rigged incorrectly	Rig power lever control linkage
11. Torque above or below engine specified torque value	Computation error	Recompute
	Faulty tachometer	Replace tachometer or generator
	Wrong maximum speed setting on fuel control	Adjust fuel control trim as required.
	Faulty fuel control	Replace fuel control
12. Low nII speed	Aircraft maximum gross weight exceeded	Correct loading
	Wrong governor control rigging	Correct rigging of linkage to governor control arm
	Low nI speed	Refer to item 11

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
	Faulty overspeed governor	Replace governor
13. Excessive droop of nII speed	Aircraft maximum gross weight exceeded	Correct loading
	Droop compensator adjustment wrong	Adjust droop compensator cam setting and check rigging of linkage
	Low nII speed	Refer to item 12
14. Overspeed nII	Faulty overspeed governor	Replace governor
	ENGINE GOV switch in EMER position or faulty transfer solenoid	Refer to item 9
15. High exhaust gas temperature during steady-state operation	High setting of nI speed	Refer to item 11.
	Air inlet obstructed	Clear air inlet
	Anti-icing valve staying open; external loss of air	With anti-icing switch at closed position and engine operating, check for flow of hot air from vent holes at forward engine mounts. Air flow means valve is open. Repair electrical circuit or replace faulty valve.
	Faulty interstage airbleed band; external loss of air	Inspect band for severe bends, damage to teflon, teflon separating from band, and adjustment for proper closure. Repair or replace band if necessary.
	Combustion chamber drain valve fails to close; external loss of air	With engine operating, place finger over end of drain line. If air is felt, valve is open; repair or replace.
	Low air flow; dirty compressor	Clean engine internally.
	Faulty exhaust gas temperature gaging system	Check system with Jet-Cal tester; repair or replace faulty wiring or units
	Internal loss of air; damaged turbine nozzle or leaking asbestos seal	Internal inspection and repair of engine combustion section
16. High exhaust temperature during acceleration	All probable causes for same condition in steady-state operation	Refer to item 15.

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
	ENGINE GOV switch in EMER position, or transfer solenoid faulty	Refer to item 9
	Dirty compressor rotor blades	Refer to paragraph 5-30
17. Exhaust gas temperature fluctuating or not indicating	Faulty indicating system	Check indicating system with Jet-Cal tester. Repair wiring or replace faulty units.
18. Fluctuating exhaust gas temperature, nI and nII speeds, and torquemeter pressure	Faulty overspeed governor	Replace governor
	Faulty fuel control	Replace fuel control
	Faulty indicating system	Check separate indicating systems; repair or replace faulty parts
19. Slow acceleration	Faulty or improperly adjusted fuel control	Adjust fuel control (L-9/-9A)
		Replace fuel control (L-11 series/ -13)
20. Engine surge during acceleration	ENGINE GOV switch in EMER position, or transfer solenoid faulty	Refer to item 9
	Fuel control faulty or not correctly adjusted	Adjust or replace fuel control
	Interstage airbleed malfunction	Check operation. Clear any restriction in air lines. Replace faulty units.
	Cracked or damaged P3 fitting on air diffuser	Replace
	Improper inlet guide vane operation on T53-L-13	Check inlet guide vane rigging
21. Low torquemeter indication	Faulty pressure indicator or transmitter	Check by using direct reading pressure gages at torquemeter and vent connections on engine. Replace faulty units.
	Low nI speed	Refer to item 11
	Low torquemeter boost oil pump pressure	Check and adjust torquemeter boost oil pump pressure, by instructions for oil system
	Damaged torquemeter sealing ring	Internal inspection and repair of engine reduction gear section

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
22. High torquemeter indication	Faulty pressure transmitter or indicator	Refer to item 21
	Torquemeter valve fails to close	Check and clear valve. (Refer to paragraph 5-319.)
	High nI speed	Refer to item 11
	Engine to transmission shaft binding	Engine not properly aligned Refer to Chapter 11.
23. Torquemeter response slow	Clogged torquemeter filter	Internal inspection of engine to clean filter
24. No oil pressure	Loose hose connections	Check oil system for leaks
	Oil tank empty	Fill tank.
	Faulty oil pressure gage system	Try direct reading gage at pressure tap on engine oil filter. If pressure is indicated, repair circuit or replace units of gage system
	Oil pump coupling sheared	Replace pump
	Worn female splines on oil pump drive shaftgear	Inspect for worn splines on shaftgear
25. Low oil pressure	Low oil level	Service tank
	Faulty oil pressure gage system	Refer to item 24
	Clogged oil filter	Clean filter
	Oil pump inlet fitting incorrectly installed	Install fitting correctly
	Oil pump relief valve setting wrong	Adjust oil pressure, or replace faulty pump
26. High oil pressure	Faulty oil pressure gage system	Refer to item 24
	Oil pressure lines restricted	Check lines for restrictions
	Clogged oil filter, bypass valve open	Clean filter
	Oil pump relief valve setting wrong	Adjust oil pressure, or replace faulty pump
27. High oil temperature	Low oil supply	Fill tank
	Oil cooler blower inoperative	Repair or replace faulty air line or blower

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
	Obstructed or faulty cooler or thermal valve	Clear oil cooler air flow. Replace faulty cooler or valve.
	Restriction in oil system.	Clean oil filter and check all lines for restrictions
28. Excessive oil consumption	Tank over-filled	Service to correct oil level
	Leaking fittings or hoses	Tighten or replace fittings or hoses
a. With signs of oil around output shaft	Output shaft seal leaking	Replacement of seal by Direct Support Maintenance
b. With indications of oil on inlet guide vanes, at compressor housing joints, or at bleed band holes	No. 1 main bearing seal leaking	Replacement of seal by overhaul facility
c. With oil stains on mating flanges of diffuser and combustor housings; oil fumes from external bleed air port	No. 2 main bearing forward seal leaking	Replacement of seal by Direct Support Maintenance
	Cracked oil tubes in air diffuser section	Brazing repair of tubes by overhaul facility
d. With smoke from tailpipe during operation	No. 2 main bearing aft seal or No. 3 bearing seal leaking	Internal inspection by Direct Support Maintenance to locate and replace faulty seal. (Leaking No. 2 aft seal causes oil stains on forward face of gas producer rotor and curl. Leaking No. 3 seal causes stains on rear face of power turbine disc.)
29. Engine fails to shut-off	Faulty fuel system control circuits	Check operation of circuits, replace faulty switches or units
	Faulty fuel control	Replace fuel control
30. Coastdown noisy	Internal binding	Motor engine to check for noise and signs of binding. Refer to item 2
31. Excessive vibration		Request assistance from Direct Support Maintenance

5-36. ENGINE OVER-LIMIT CONDITIONS. In any case where engine is operated over normal limits, be sure exact circumstances are recorded properly on DA Form 2408-13 (Pilots and Mechanics Remarks column). Notify proper authority to initiate action for special inspection, when required, to be accomplished by qualified personnel.

5-37. ENGINE MOUNTS.

5-38. Engine is suspended at three points by supports made of steel tubing. These supports are attached to fittings on service deck. Bipod support, on right-hand side, and tripod support on left-hand side, both have pillow blocks with hinged bearing caps. These caps retain bearings of two trunnion fittings installed on mounting pads at each side of engine diffuser housing.

5-39. INSPECTION - ENGINE MOUNTS AND COMPONENTS.

a. Attach the engine sling to the engine, take up slack until the sling is supporting the weight of the engine.

b. Open the pillow block caps.

c. Remove the trunnion mounts with the bearings attached from the engine.

d. Remove the bearings from the trunnion and inspect for cracks, wear, and excessive play, (0.006 inch radial - 0.012 inch axial).

e. Inspect trunnion for scored or damaged shaft. Inspect trunnion bearing cap for damage.

f. Inspect all rod end bearings for cracks, wear and excessive play (0.005 radial - 0.010 inch axial).

g. Inspect all support arms, brace rods, bipod and tripod assemblies for bent, cracked, scratched or damaged tubes.

(1) Permanent bends (bends which do not straighten after load is removed) are not permitted.

(2) Scratches not exceeding 0.010 inch depth may be polished out with abrasive cloth (item 508, table 1-2). Transverse scratches longer than 0.3125 inch are not acceptable.

(3) Scratches or dents adjacent to welded areas are not acceptable.

(4) No dents are permitted in the middle 1/3 of tube. Smooth dents of large diameter which do not cause bending of the tube (end to end) are permitted, provided there is no crimping or cracking in the dent, and there is no visible deformation adjacent to the dents.

h. Inspect all engine floor mount attaching brackets and all fittings for security, cracks and general condition.

i. Assemble trunnion bearings and trunnion caps on the trunnion mounts.

j. Reinstall trunnion mounts on the engin close and secure pillow block caps, slack off a remove engine sling from the engine.

5-40. VARIABLE INLET GUIDE VANE SYSTEM.

5-41. The T53-L-13 engine is equipped with variable inlet guide vanes, capable of changing the angle at which inlet air enters the compressor for more efficient air flow in relation to compressor rpm. (See figures 5-7 and 5-8). The vanes are positioned by a synchronizing ring mechanically linked to an actuator, which responds to fluid pressure from a pilot valve in the fuel control, regulated according to nI rpm and compressor inlet temperature. Below 80 percent nl speed, the guide vanes remain at their most nearly closed position. Vanes start to open at 80 percent, and are full open at 93 to 95 percent nl rpm, varying with ambient temperature. (See figure 5-9.) A feedback control rod relays the actuator position back to the fuel control to nullify the fuel-out pressure signal, so that the guide vanes will hold a constant position at any steady-state nI speed between 80 and 95 percent.

5-42. VARIABLE INLET GUIDE VANE ACTUATC ASSEMBLY.

5-43. The variable inlet guide vane actuator is mounted on the right side of compressor housing assembly at the front flange. Fuel seal leakage is drained through a hose and out the starter-generator drive seal drain port on the accessory drive gearbox. The actuator is operated by fuel pump pressure from the fuel control.

5-44. REMOVAL - INLET GUIDE VANE ACTUATOR ASSEMBLY.

a. Position actuator to vane full open position. Record variable inlet guide vane degree position on fuel control indicator plate.

b. Remove cotter pins (15 and 20, figure 5-10), nut (19), washers (10, 16, and 21), and bolts (9 and 18). Remove tube assembly (13).

c. Cut lockwire and loosen nut (4). Unscr bearing (5) from connector.

d. Disconnect three hose assemblies from inlet guide vane actuator assembly. (Refer to paragraph 5-49.) Cap or cover hoses and ports in actator to prevent entrance of foreign matter.

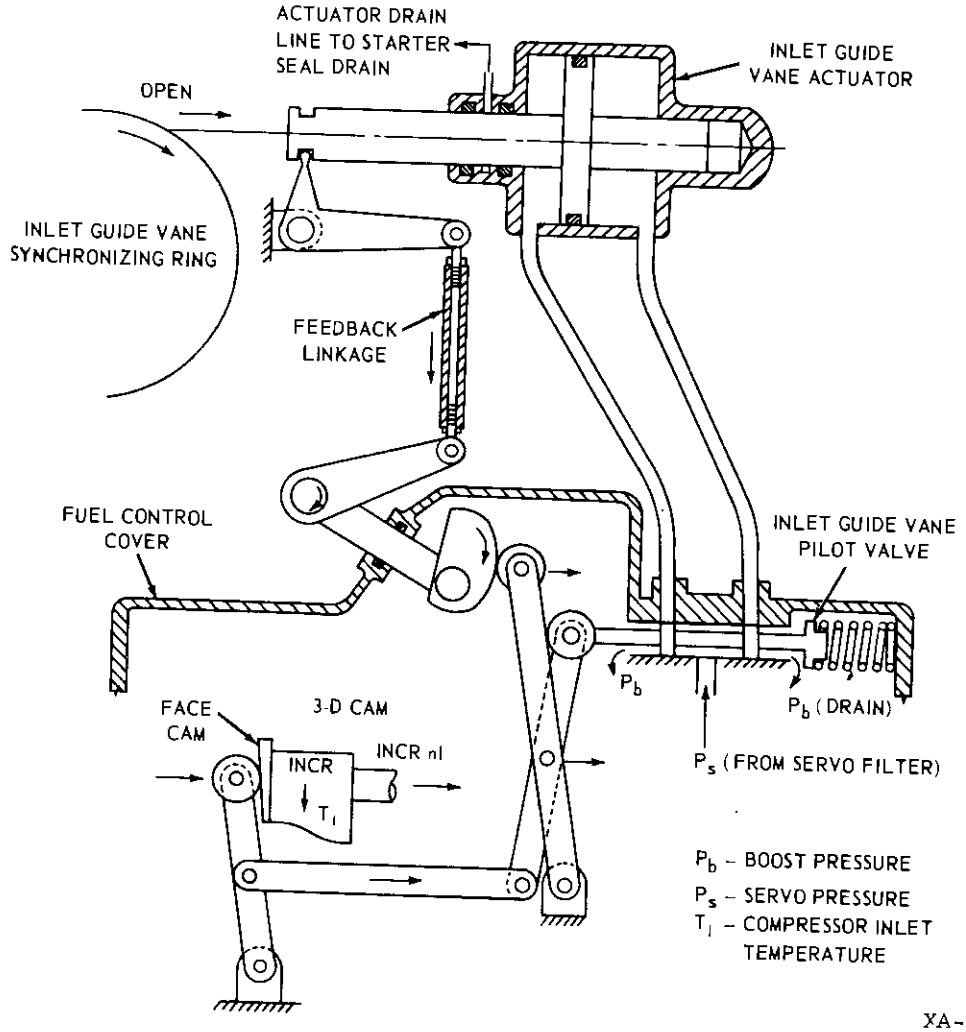


Figure 5-7. Inlet guide vane control system diagram - T53-L-13 engine

e. Cut lockwire and remove nuts (6 and 8), bolts (1 and 22), washer (1A), support (2), and spacer (3). Carefully remove actuator assembly (7) from engine.

5-45. CLEANING - INLET GUIDE VANE ACTUATOR ASSEMBLY. Clean actuator and all removed parts with dry cleaning solvent (item 302, table 1-2).

5-46. INSPECTION - INLET GUIDE VANE ACTUATOR ASSEMBLY.

a. Inspect threaded parts for damaged or stripped threads.

b. Inspect actuator for cracked flanges.

c. Inspect bearing connector retaining screw for tightness and proper staking.

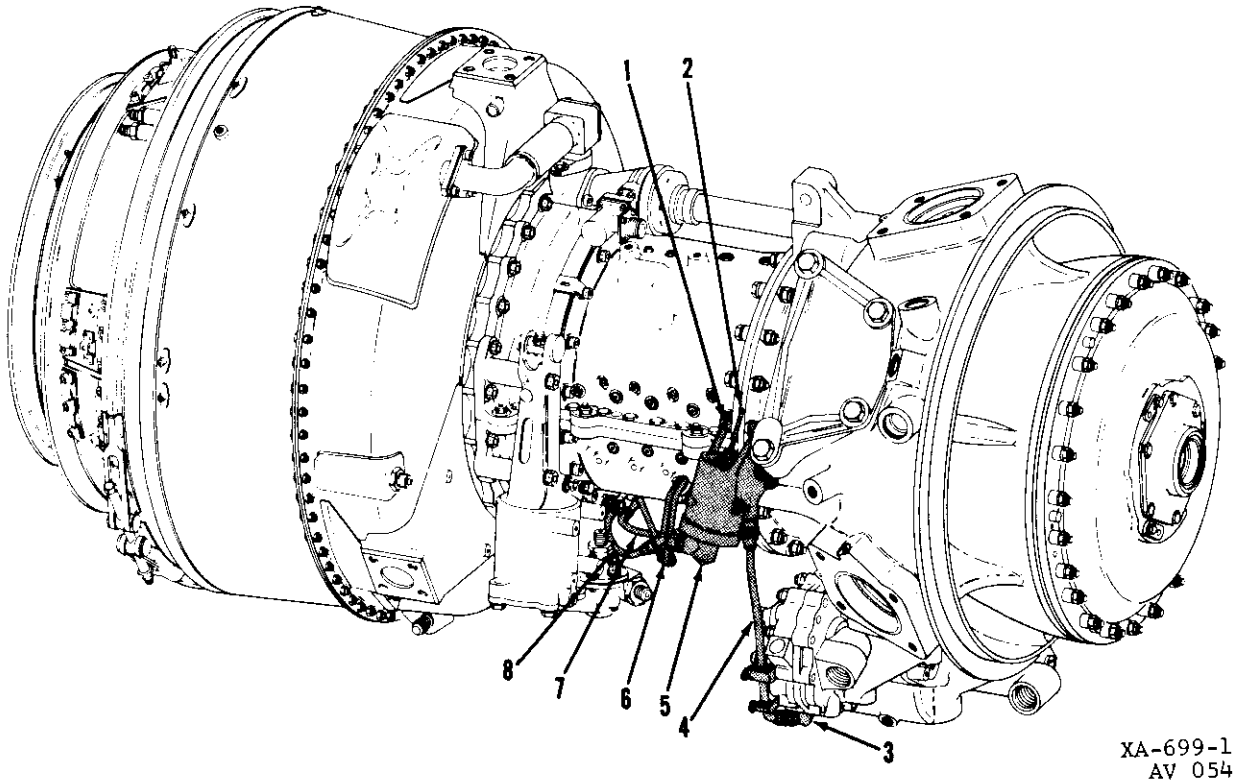
5-47. REPAIR OR REPLACEMENT - INLET GUIDE VANE ACTUATOR ASSEMBLY. Replace all parts that do not meet inspection requirements.

5-48. INSTALLATION - INLET GUIDE VANE ACTUATOR ASSEMBLY.

a. Position inlet guide vane actuator assembly (7, figure 5-10) on rear flange of inlet housing. Install attaching spacer (3), support (2), washer (1A), bolts, (1 and 22), and nuts (6 and 8). Tighten nuts as required and lock-wire.

Note

Use washer (1A) as required to prevent bolt (1) from rubbing against inlet housing.



1. Control Rod Index Plate
2. Inlet Guide Vane Actuator Control Rod
3. Inlet Guide Vane Seal Drain Connector
4. Seal Drain Hose
5. Variable Inlet Guide Vane Actuator
6. Feedback Control Rod
7. Fuel Control to Inlet Guide Vane Actuator Opening Hose
8. Fuel Control to Inlet Guide Vane Actuator Closing Hose

Figure 5-8. Inlet guide vane system external components - T53-L-13 engine

b. Thread bearing (5) onto connector. Hold actuator full open (piston retracted) and adjust bearing until end of matte area on connector closest to the engine housing aligns with open scribe mark on indicator plate (located between engine inlet housing and compressor upper housing mounting flanges). Tighten nut (4) as required and secure with lockwire.

c. Uncap or uncover hoses and ports in actuator. Connect hose assemblies to actuator fittings (Refer to paragraph 5-53).

d. Position tube assembly (13) under engine and connect to actuator assembly and fuel control with bolts (9 and 18), washers (10, 16, and 21), nut (19), and cotter pin (15). Tighten nut (19) as required and insert cotter pin (20).

Note

Use quantity of washers (16) as required to obtain minimum clearance between washer (16) and cotter pin (15).

e. Hold actuator in full open position and adjust rod ends (11 and 17) until indicator of fuel control lever aligns with recorded position on fuel control indicator plate.

Note

When adjusting rod ends a mirror must be used to observe fuel control indicator plate.

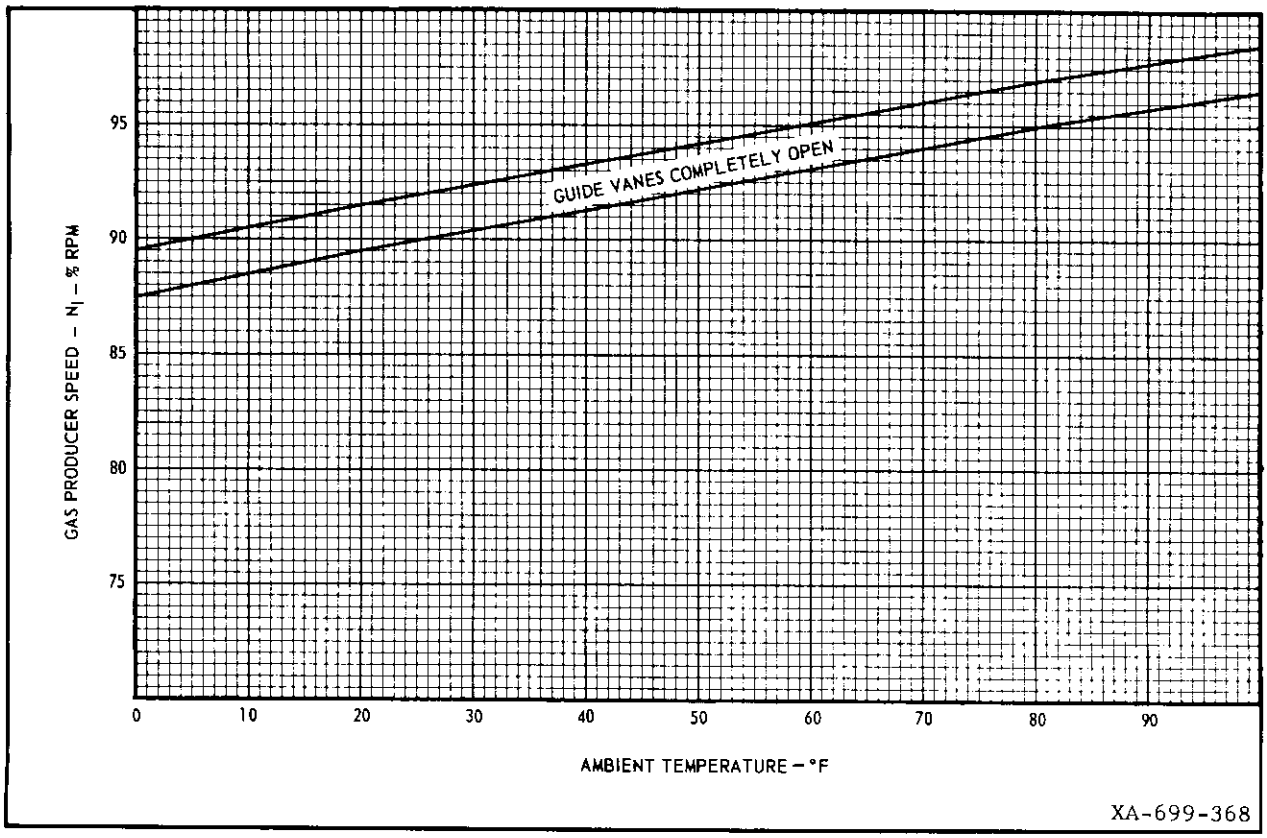


Figure 5-9. Gas producer speed at which inlet guide vanes operate versus ambient temperature - T53-L-13 engine

f. Tighten rod end nuts as required and lockwire.

5-49. REMOVAL - INLET GUIDE VANE ACTUATOR HOSE ASSEMBLIES.

a. Remove screw (19, figure 5-11) and nut (15) that secures clamp (20), and screw (17) and nut (16) that secures clamp (18) to bracket on accessory drive gearbox assembly.

b. Disconnect hose assembly (14) from reducer (13) and from accessory drive gearbox assembly and remove hose assembly. Cap open port on gearbox assembly.

c. Remove reducer (13) with gasket (12) from inlet guide vane actuator assembly. Remove gasket from reducer. Plug open port on actuator assembly.

d. Remove screw (1) and nut (8) that secure clamps (2 and 3) to bracket on bottom rear flange of compressor housing.

e. Tag hose assemblies (9 and 23) to identify port connections from which they will be removed.

f. Disconnect hose assembly (9) from unions (6 and 10) and hose assembly (23) from unions (4 and 22) and remove hose assemblies.

g. Remove unions (4 and 6) with gaskets (5 and 7) from fuel control and unions (10 and 22) with gaskets (11 and 21) from inlet guide vane actuator assembly. Remove gaskets from unions. Plug all open ports.

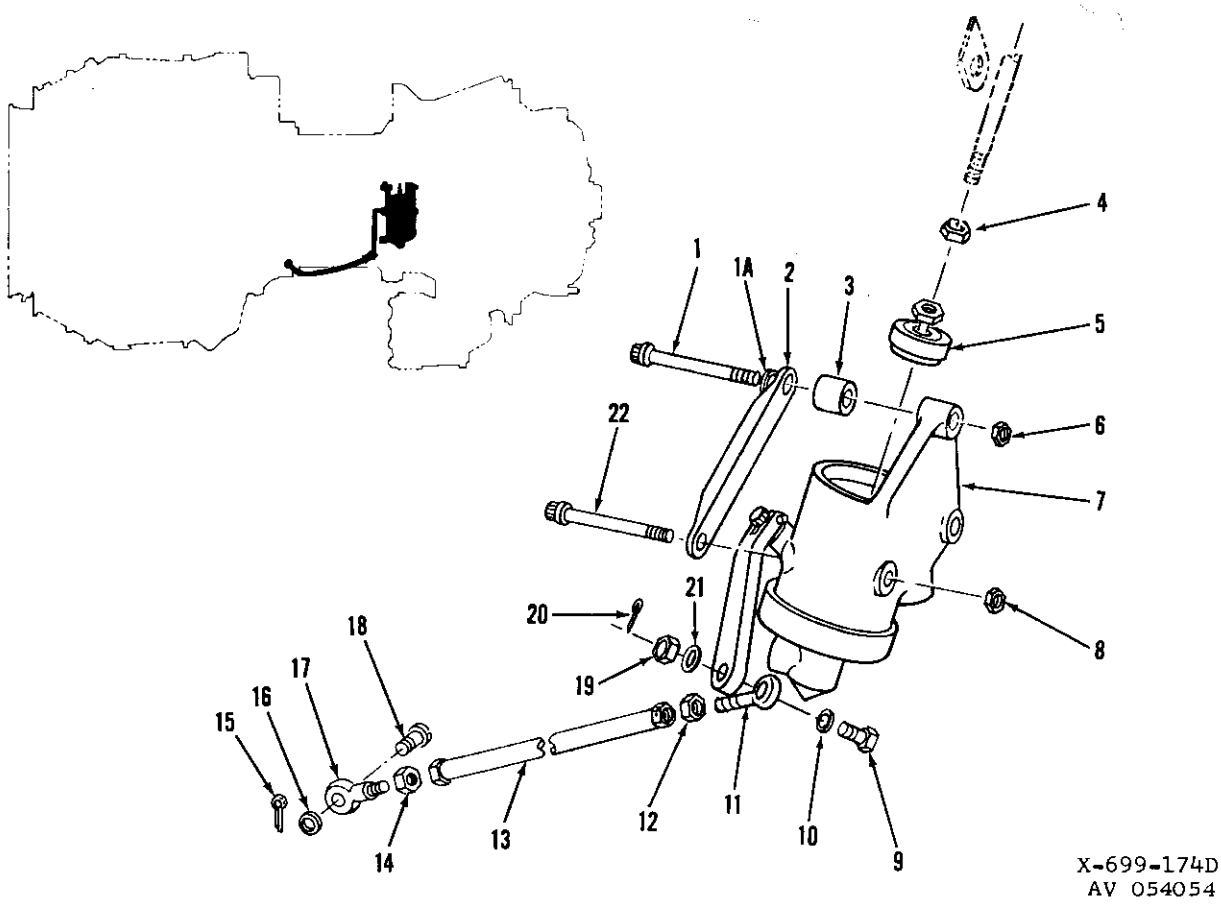
5-50. CLEANING - INLET GUIDE VANE ACTUATOR HOSE ASSEMBLIES. Clean parts with trichloroethylene (item 300, table 1-2).

5-51. INSPECTION - INLET GUIDE VANE ACTUATOR HOSE ASSEMBLIES.

a. Inspect parts for stripped or damaged threads.

b. Inspect hose assemblies for fraying, chafing, and cuts.

5-52. REPAIR OR REPLACEMENT - INLET GUIDE VANE ACTUATOR HOSE ASSEMBLIES. Replace hose assembly if cuts are other than minor or if leakage is noted and replace parts with stripped threads.



1. Bolt
1A. Washer
2. Support
3. Spacer
4. Nut
5. Bearing
6. Nut
7. Inlet Guide Vane Actuator Assembly
8. Nut
9. Bolt
10. Washer
11. Rod End Bearing
12. Nut
13. Tube Assembly
14. Nut
15. Pin
16. Washer
17. Rod End Bearing
18. Bolt
19. Nut
20. Pin
21. Washer
22. Bolt

Figure 5-10. Inlet guide vane actuator assembly - T53-L-13 engine

5-53. INSTALLATION - INLET GUIDE VANE ACTUATOR HOSE ASSEMBLIES.

a. Position gaskets (5 and 7, figure 5-11) into unions (4 and 6) and install unions into fuel control. Tighten unions as required.

b. Position gaskets (11 and 21) into unions (10 and 22) and install unions into inlet guide vane actuator assembly. Tighten unions as required.

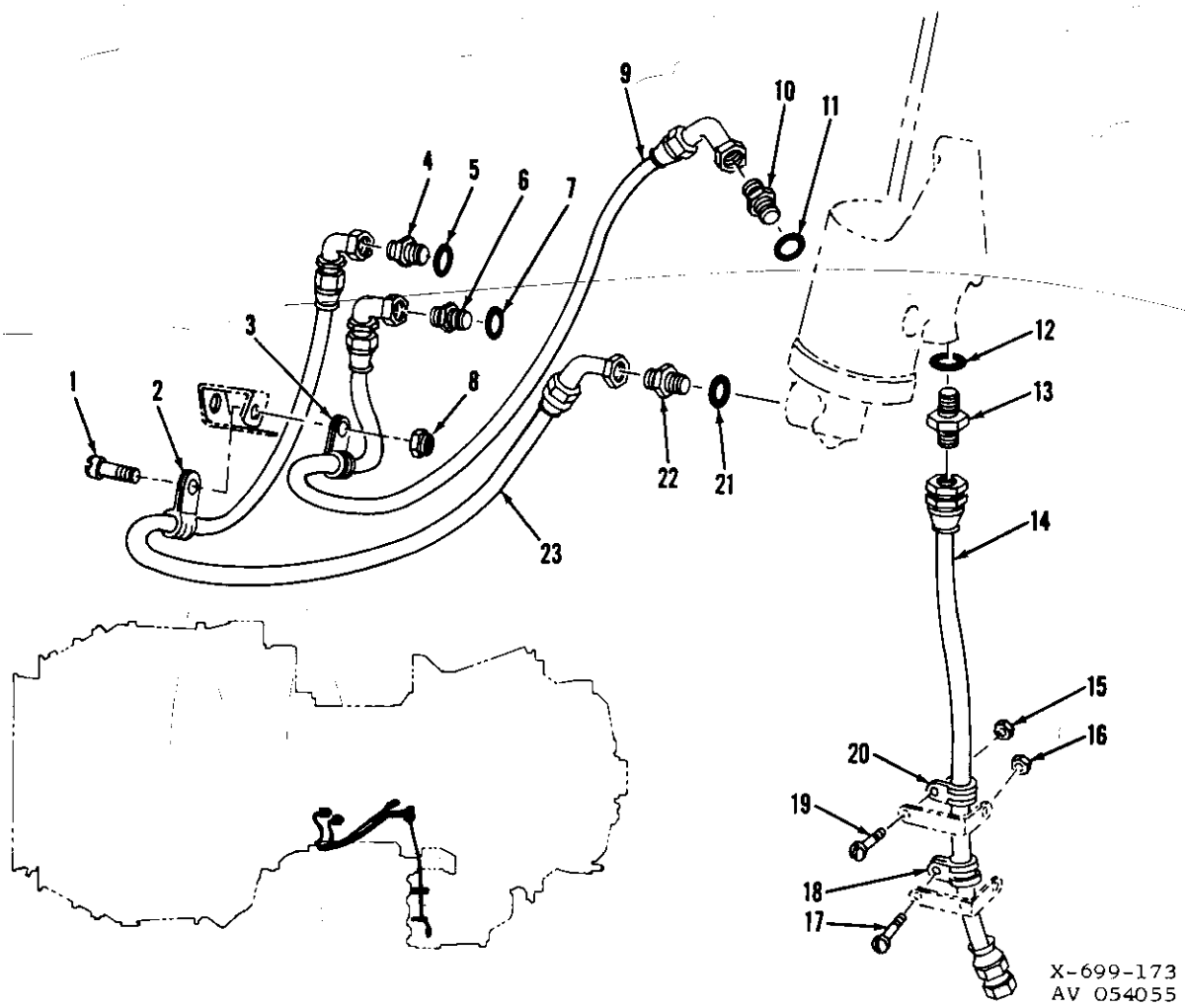
c. Connect hose assembly (9) to unions (6 and 10) and hose assembly (23) to unions (4 and 22). Tighten hose connectors to 70 to 120 inch-pounds of torque.

Note

Refer to identification tags attached to hose assemblies at removal to insure proper connection to ports.

d. Secure clamps (2 and 3) to bracket or bottom rear flange of compressor housing with screw (1) and nut (8).

e. Position gasket (12) onto reducer (13) and install reducer into inlet guide vane actuator assembly. Tighten reducer as required.



1. Screw
2. Clamp
3. Clamp
4. Union
5. Gasket
6. Union
7. Gasket
8. Nut
9. Hose Assembly
10. Union
11. Gasket
12. Gasket
13. Reducer
14. Hose Assembly
15. Nut
16. Nut
17. Screw
18. Clamp
19. Screw
20. Clamp
21. Gasket
22. Union
23. Hose Assembly

Figure 5-11. Inlet guide vane actuator hoses and attaching parts - T53-L-13 engine

f. Connect hose assembly (14) to reducer (13) and accessory drive gearbox assembly. Tighten hose connectors to 70 to 120 inch-pounds of torque.

g. Secure clamp (20) with screw (19) and nut (15) and secure clamp (18) with screw (17) and nut (16) to bracket on accessory drive gearbox assembly.

5-54. INTERSTAGE AIRBLEED SYSTEM.

5-55. An interstage airbleed system is provided on the engine to aid accelerations of the compressor rotor by automatic release of some compressed air through bleed holes around exit end of the axial compressor housing. A bleed band over these holes is operated by a piston-type actuator, spring-loaded to open position. Closing of the band occurs when air pressure, taken from the engine diffuser, is applied to the actuator piston. (See figure 5-12.)

5-56. On T53-L-9 or -9A engine, the airbleed actuator is controlled by a valve assembly (see figure 5-13) which senses the ratio of compressor discharge air pressure to the inlet air pressure through hoses connected to the diffuser and to the inlet housing. With this system, the bleed band

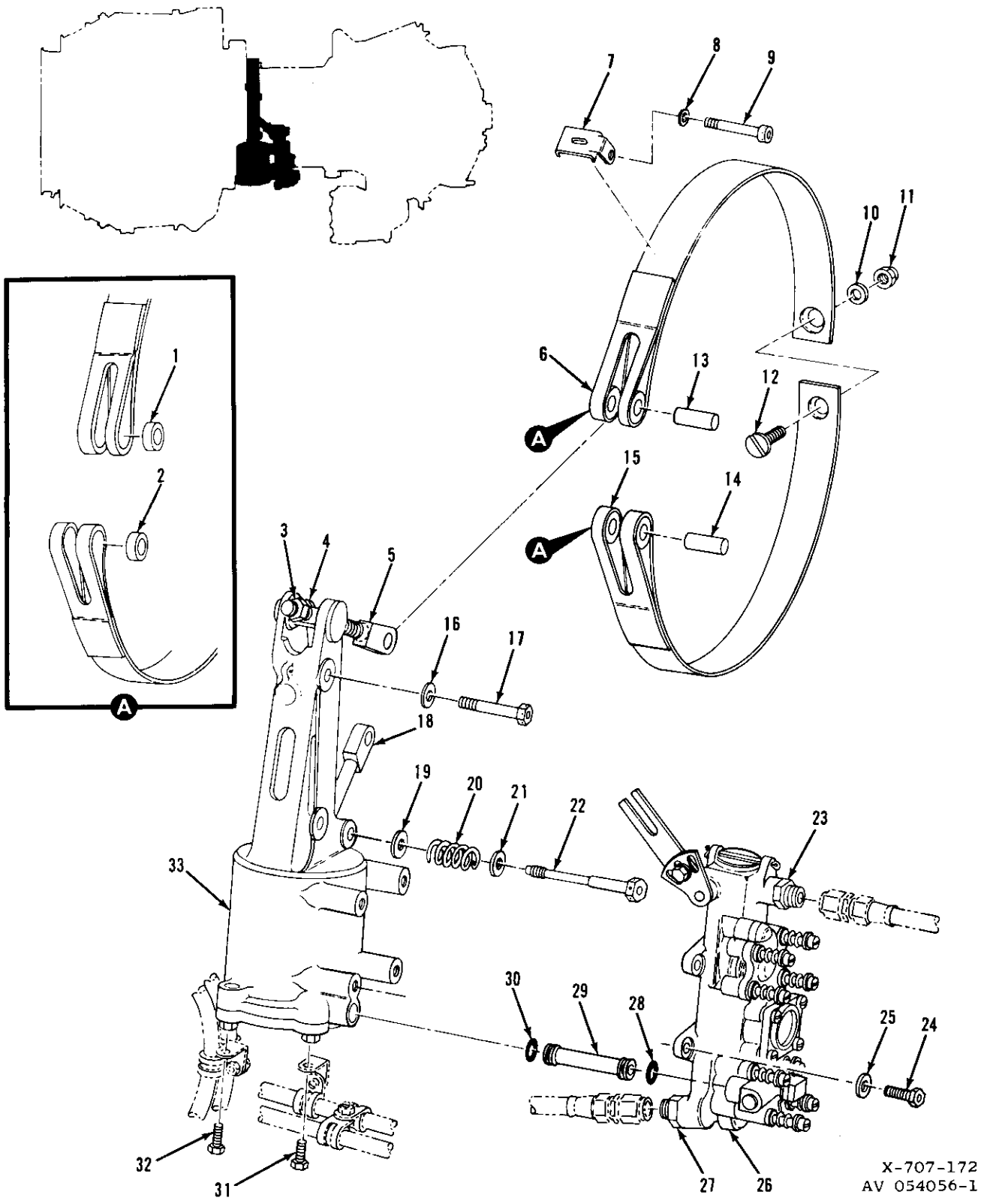
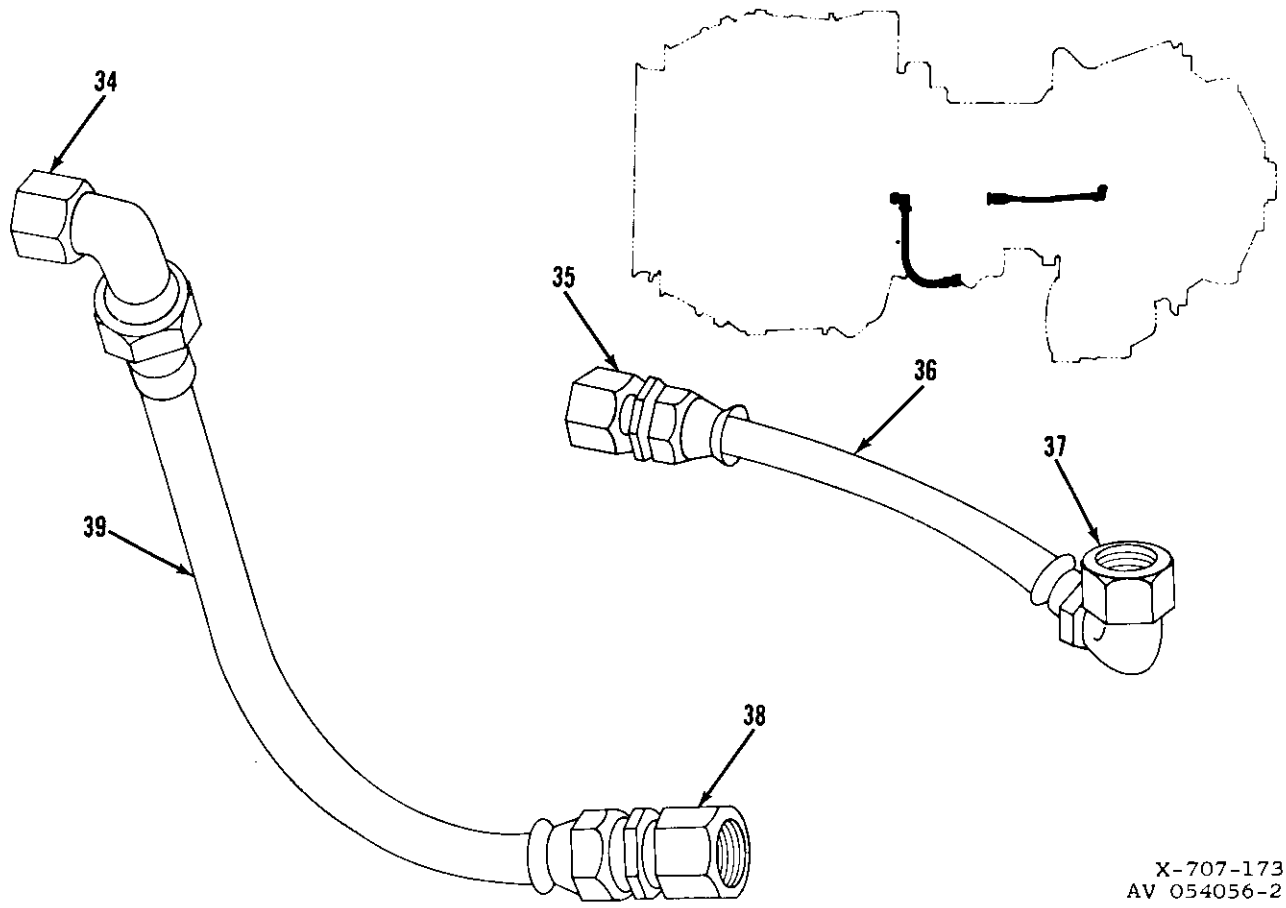


Figure 5-12. Interstage bleed actuator, air bleed valve, bleed bands, hose assemblies, and attaching parts - T53-L-9 and -9A (Sheet 1 of 2)

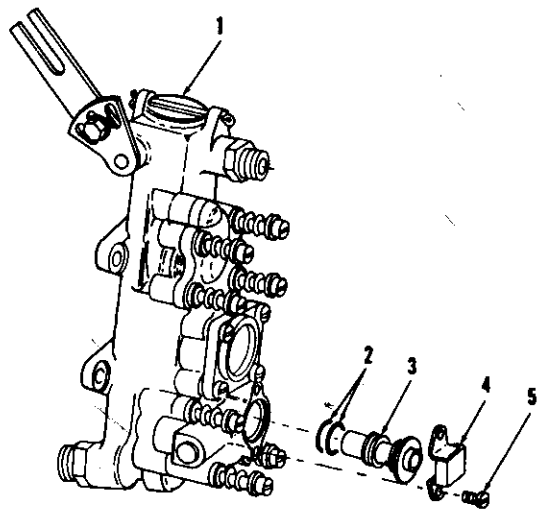


1. Bushing
2. Bushing
3. Nut
4. Nut
5. Rod End Screw Assembly
6. Bleed Band
7. Clip
8. Washer
9. Bolt
10. Washer
11. Nut
12. Screw
13. Pin
14. Pin
15. Bleed Band
16. Washer
17. Bolt
18. Piston and Rod Assembly
19. Washer
20. Spring
21. Washer
22. Bolt
23. Union
24. Bolt
25. Washer
26. Air Bleed Valve
27. Union
28. Packing
29. Transfer Tube
30. Packing
31. Bolt
32. Bolt
33. Interstage Air Bleed Actuator
34. Air Bleed Hose Connector
35. Air Bleed Hose Connector
36. Air Bleed Hose Assembly (to Air Inlet)
37. Air Bleed Hose Connector
38. Air Bleed Hose Assembly Connector
39. Air Bleed Hose Assembly (to Diffuser)

Figure 5-12. Interstage bleed actuator, air bleed valve, bleed bands, hose assemblies, and attaching parts - T53-L-9 and -9A (Sheet 2 of 2)

is open during start and acceleration until approximately 74 percent nI rpm is reached. At this point the bleed band closes tightly over bleed holes and remains closed during operation at higher power settings.

5-57. On T53-L-11 series and T53-L-13 engines, the airbleed actuator incorporates a relay valve with an air pressure connection to the diffuser housing and a pressure sensing connection to a controlling valve in the engine fuel control assembly. (See figures 5-14 and 5-15.) On T53-L-11 series engines, the bleed band is open not only at speeds below approximately 70 percent nl rpm, but also in response to transient acceleration demands at high speeds, as directed by sensors in the engine fuel control assembly. On T53-L-13 engines, the bleed band will be closed at all steady-state



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1. Airbleed Valve Assembly
2. Packing
3. Strainer Assembly
4. Dirt Cover
5. Screw

Figure 5-13. Airbleed valve assembly, exploded view - T53-L-9 and -9A engines

nI rotor speeds above 77 to 80 percent and open during all decelerations and at nI rotor speeds below 77 to 80 percent at standard sea level conditions as directed by the sensors in the fuel control.

5-58. REMOVAL - INTERSTAGE BLEED ACTUATOR ASSEMBLY.

a. On T53-L-9, -9A engines, disconnect hoses as follows:

(1) Remove bolts (31 and 32, figure 5-12) that secure brackets to bottom of interstage bleed actuator (33). Free brackets and reinstall bolts.

(2) Disconnect hose connector (38) from union (27) and hose connector (35) from union (23) on air bleed valve assembly (26).

b. On T53-L-11 series engines, disconnect hoses as follows:

(1) Remove oil scavenge hose clamp from bottom of interstage bleed actuator.

(2) Disconnect air hose (25, figure 5-14) from reducer (23) and air hose (22) from union (24) on interstage bleed actuator and cap openings.

c. On T53-L-13 engines, disconnect hoses as follows:

(1) Remove screw and nut that secure oil scavenge hose clamp to bottom of interstage bleed actuator.

(2) Disconnect air hose connector (33, figure 5-15) from reducer (21), and air hose connector (27) from union (26). Cap reducer and union.

(3) Remove screw (31) that secures diffuser air hose clamp (32) to bleed actuator housing.

d. On T53-L-9, -9A engines, remove interstage bleed actuator as follows:

(1) Support actuator and remove mounting bolts (17, figure 5-12) and washers (16).

(2) Disengage special bolt (22), washers (19 and 20) and spring (20) from compressor housing flange.

Note

If necessary to remove airbleed valve assembly separately, support valve assembly (26) while removing four bolts and washers (24 and 25) which secure it to actuator (33). Carefully remove valve, transfer tube (29), and packings (28 and 30). Discard packings.

1. Spring
2. Strainer
3. Packing
4. Reducer
5. Clip
6. Upper Bleed Band
7. Washer
8. Nut
9. Lower Bleed Band
10. Screw
11. Pin
12. Pin
13. Nut
14. Nut
15. Shaft
16. Screw Assembly
17. Rod
18. Washer
19. Spring
20. Washer
21. Bolt
22. Fuel Control Bleed Air Hose
23. Reducer
24. Union
25. Diffuser Housing Bleed Air Hose
26. Bolt
27. Washer
28. Bolt
29. Washer
30. Airbleed Actuator
31. Bushing
32. Bushing

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Figure 5-14. Interstage bleed actuator, hoses, and bleed bands - T53-L-11 series (Sheet 1 of 2)

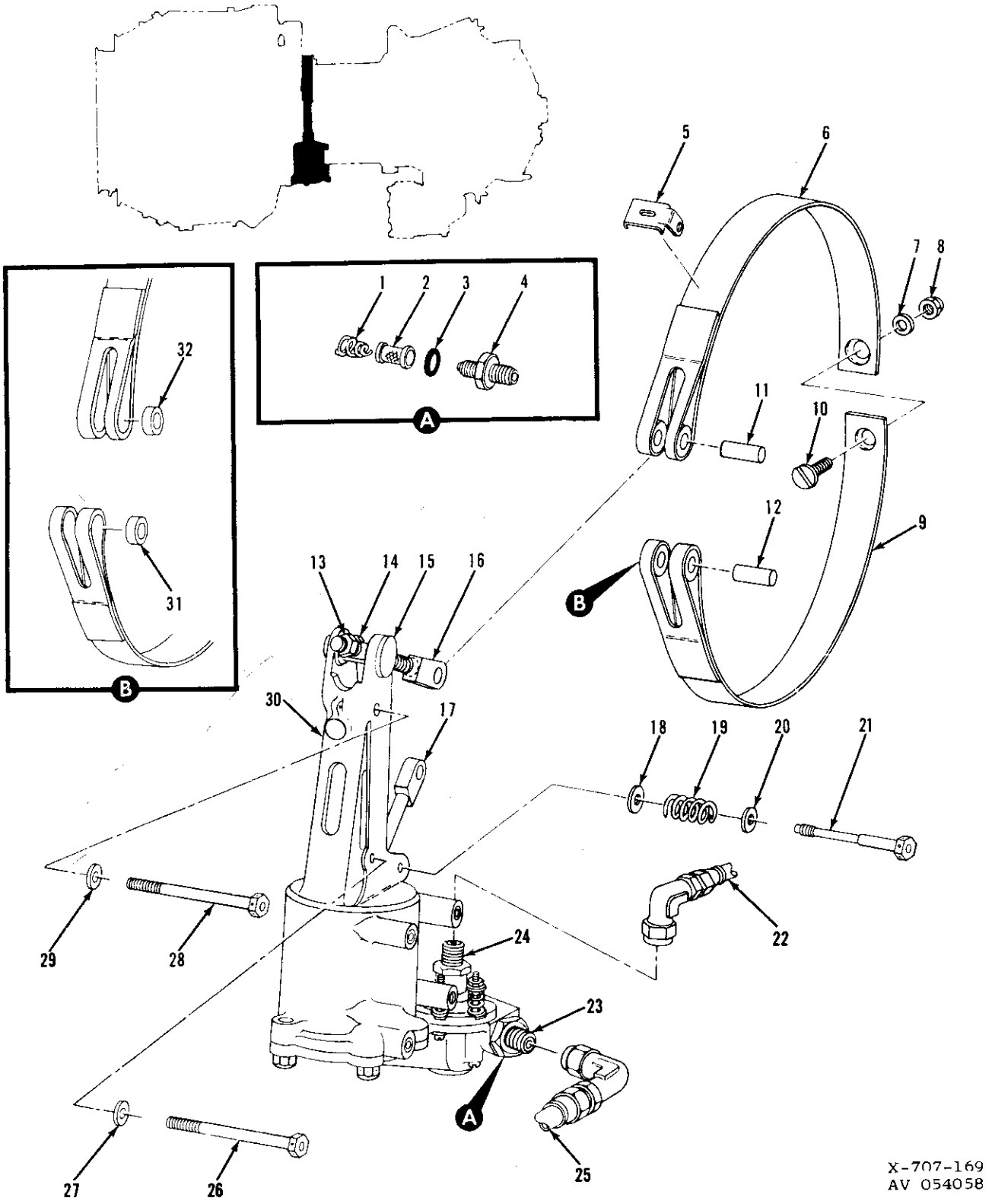


Figure 5-14. Interstage bleed actuator, hoses, and bleed bands - T53-L-11 series (Sheet 2 of 2)

(3) Carefully back off actuator assembly, keeping mounting pad of actuator parallel with mating surface of compressor to expose connections between rod end (5) and upper band (6), and piston (18) and lower band (15).

(4) Push pin (14) from lower bleed band (15), and pin (13) from upper bleed band (6), and carefully remove interstage air bleed actuator assembly.

Note

On bleed band assembly, 1-160-820-04, remove bushings (1 and 2).

e. On T53-L-11 series and -13 engines, remove interstage bleed actuator as follows:

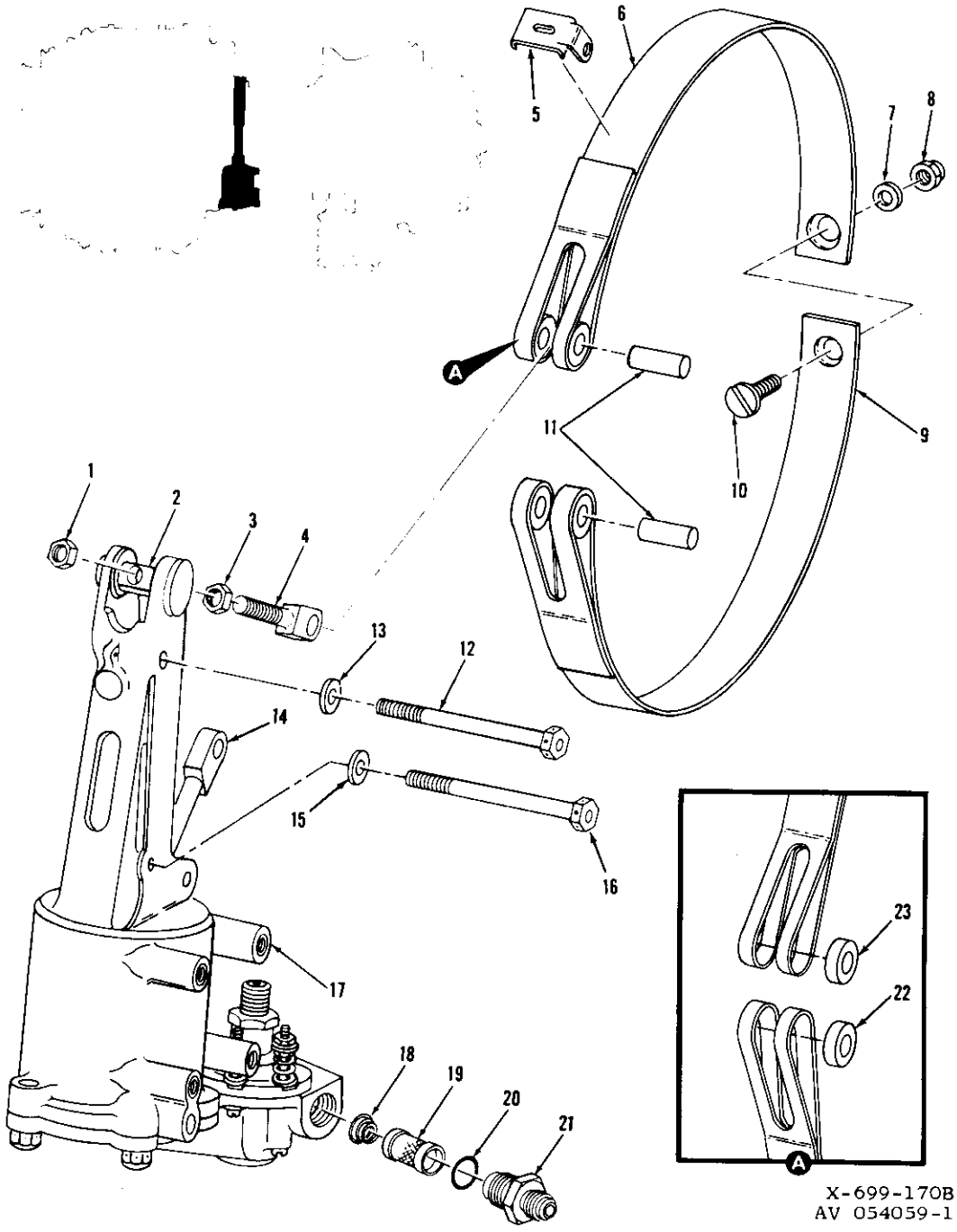
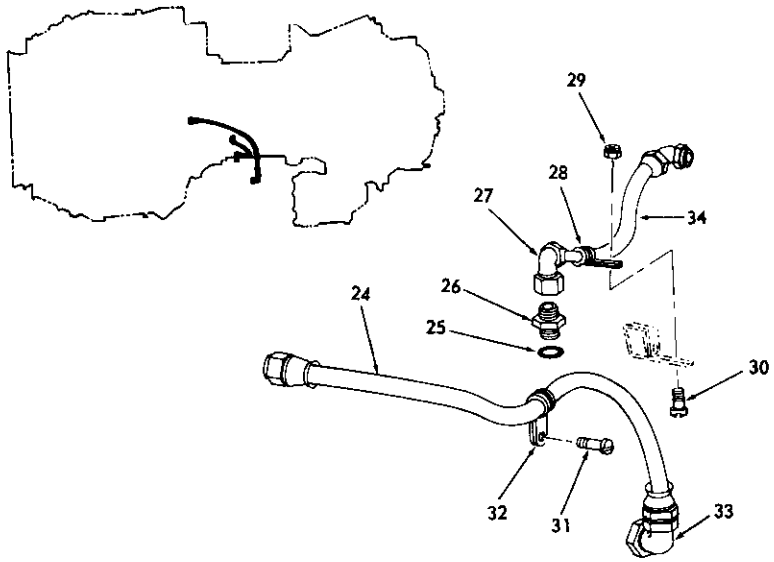


Figure 5-15. Interstage bleed actuator assembly, bleed band, hose assemblies, and attaching parts - T53-L-13 engine (Sheet 1 of 2)



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1. Nut
2. Pin
3. Nut
4. Rod End Screw Assembly
5. Clip
6. Upper Band
7. Washer
8. Nut
9. Lower Band
10. Screw
11. Pin
12. Bolt
13. Washer
14. Piston
15. Washer
16. Bolt
17. Interstage Bleed Actuator Assembly
18. Spring
19. Strainer Element
20. Packing
21. Reducer
22. Bushing
23. Bushing
24. Diffuser Air Bleed Hose Assembly
25. Packing
26. Union
27. Fuel Control Air Bleed Hose Connector
28. Clamp
29. Nut
30. Screw
31. Screw
32. Clamp
33. Diffuser Air Bleed Hose Connector
34. Hose Assembly

Figure 5-15. Interstage bleed actuator assembly, bleed band, hose assemblies, and attaching parts - T53-L-13 engine (Sheet 2 of 2)

(1) Remove mounting bolts (26 and 28, figure 5-14) (12 and 16, figure 5-15) and washers from airbleed actuator. On T53-L-11 series remove special bolt (21) washers (18 and 20) and spring (19).

(2) Pull actuator away from compressor housing to expose connections between rod and screw assembly and upper band (6), and piston rod end and lower band (9).

(3) Support actuator assembly and remove pins (11 and 12) that secure actuator assembly to bleed bands. Remove actuator.

Note

On bleed band assembly, 1-160-820-04, remove bushings.

5-59. CLEANING - INTERSTAGE AIRBLEED ACTUATOR ASSEMBLY AND STRAINER.

a. On T53-L-9, -9A engine, clean strainer in airbleed valve assembly (see figure 5-13) as follows:

(1) Remove screws (5) that secure dirt cover (4) and remove dirt cover.

(2) Carefully remove strainer assembly (3), remove and discard packings (2).

(3) Clean parts with solvent (item 302, table 1-2). If necessary, use a soft bristle brush to clean strainer. If strainer is damaged or foreign matter cannot be removed, replace strainer.

(4) Coat new packings lightly with grease (item 10, table 1-2) and install them on strainer. Carefully insert strainer and packings in airbleed valve assembly.

(5) Position dirt cover over strainer assembly and secure with screws. Tighten screws 20 to 25 inch-pounds torque.

b. On T53-L-11 series and -13 engines, clean sediment strainer element located in the interstage bleed actuator behind the reducer to which the diffuser pressure hose connects as follows:

(1) Carefully remove sediment strainer element, packing, and spring by removing reducer (4, figure 5-14) (21, figure 5-15). Discard packing.

Note

Ensure that the strainer element and spring are not inadvertently released when reducer is removed.

(2) Clean parts with solvent (item 302, table 1-2). If strainer is damaged or foreign matter cannot be removed, replace strainer.

(3) Position strainer element on tapered end of spring. Insert large diameter of spring and strainer element into bleed actuator assembly.

(4) Lightly coat new packing with grease (item 10, table 1-2) and install on reducer. Ensure that strainer and spring are seated properly while installing reducer into bleed actuator port. Tighten reducer as required.

c. Clean actuator assembly and strainer with dry cleaning solvent (item 302, table 1-2).

5-60. INSPECTION - INTERSTAGE BLEED ACTUATOR ASSEMBLY.

a. Inspect for damaged hoses, hose fittings, and attaching parts.

b. Inspect actuator housing (and valve housing on T53-L-9, -9A engines) for cracks, threaded parts for damage, springs for distortion, and rods for bending.

5-61. REPAIR OR REPLACEMENT - INTERSTAGE BLEED ACTUATOR ASSEMBLY. Replace parts damaged beyond inspection limits.

5-62. INSTALLATION - INTERSTAGE BLEED ACTUATOR ASSEMBLY.

a. Position bleed actuator close to and parallel with mounting pad surface on engine compressor or diffuser housing. Pull actuator piston rod end out of actuator housing sufficiently to allow insertion of piston rod end into loop of lower bleed band. Push attaching pin through bushing in loop of lower bleed band and through hole in actuator piston rod end.

b. Swing bleed actuator screw rod end to a downward position and insert into loop of upper bleed band. Push attaching pin through loop of upper bleed band and through hole in screw rod end.

c. Align bleed actuator to mounting bosses in engine compressor or diffuser housing. Make certain that actuator piston rod end with lower bleed band attached is within the actuator housing. Install two mounting bolts and washers in upper and lower outboard mounting holes and insert to finger tight.

d. On T53-L-9, -9A, and -11 series engines place spring with a washer at each end on special bolt (22, figure 5-12) (21, figure 5-14) and bottom bolt in tapped hole. Tighten to 5 inch-pounds torque.

e. Tighten upper and lower mounting bolts and lock-wire all bolts.

f. On T53-L-9, -9A engines, install airbleed valve assembly (if separated from actuator), and connect hoses as follows:

(1) Place packings on each end of transfer tube (29, figure 5-12) and insert tube into actuator port.

(2) Hold airbleed valve assembly (26) to mounting position against actuator, with transfer tube inserted into valve body.

(3) Guide forked lever of valve onto sleeve of controller drive pin, located on actuator rod within actuator assembly housing.

(4) Secure valve assembly to actuator with four bolts and washers. Tighten and lockwire bolts.

(5) Connect hose connector (38, figure 5-12) to union (27) and hose connector (35) to union (23) on airbleed valve assembly.

(6) Remove bolts (31 and 32) from bottom of interstage bleed actuator and reinstall through bracketed oil lines and ignition lead bracket. Tighten bolts.

g. On T53-L-11 series engines, connect hoses as follows:

(1) Remove caps and connect air hose (25, figure 5-14) to reducer (23), and air hose (22) to union (24) on interstage bleed actuator.

(2) Install oil scavenge hose clamp to bottom of interstage bleed actuator.

h. On T53-L-13 engines, connect hoses as follows:

(1) Install diffuser air hose clamp (32, figure 5-15) to bleed actuator housing with screw (31).

Note

Prior to installation of hose assembly (34, figure 5-15) ensure that chafing sleeve is installed and positioned to prevent rubbing against nearby hoses and area of contact with aircraft generator.

(2) Remove caps and connect air hose connector (33) to reducer (21), and air hose connector (27) to union (26) on interstage bleed actuator.

(3) Install oil scavenge hose clamp to bottom of interstage bleed actuator with screw and nut.

5-63. REMOVAL - INTERSTAGE BLEED BAND ASSEMBLY.

a. Remove interstage bleed actuator. (Refer to paragraph 5-58.)

b. Remove seven bolts (9, figure 5-12) and washers (8).

c. Remove clips (7).

d. Remove upper and lower bleed bands (6 and 15).

Note

Exercise care in removing bands to prevent twisting or bending. If bands are separated, mark the upper and lower bands for identification.

5-64. CLEANING - INTERSTAGE BLEED BAND ASSEMBLY. Clean parts with solvent (item 302, table 1-2).

5-65. INSPECTION - INTERSTAGE BLEED BAND ASSEMBLY.

a. Inspect bleed band assembly (1-160-820-01) for worn or elongated captive bushings. Inspect bushings removed from bleed band assembly (1-160-820-04) for wear or elongation, if used.

b. Inspect bleed bands for bends or distortion which may cause improper seating on compressor housing.

c. Inspect teflon tape on upper and lower bleed bands for tears, cuts, and separation from bands.

d. Inspect the bleed band machine screw that joins the upper bleed band to the lower bleed band. Make sure the screw is installed flush or below the surface of the inside diameter of the bleed band assembly.

e. Inspect bleed band for cracks in band to bushing weld (see figure 5-16) by dye penetrant method.

5-66. REPAIR OR REPLACEMENT - INTERSTAGE BLEED BAND ASSEMBLY.

a. Replace damaged captive bushings.

b. Repair or replace, as necessary, bleed bands which are bent or distorted.

c. If tape separation is found on either section of bleed band, remove tape from both sections to allow use without tape. Proceed as follows:

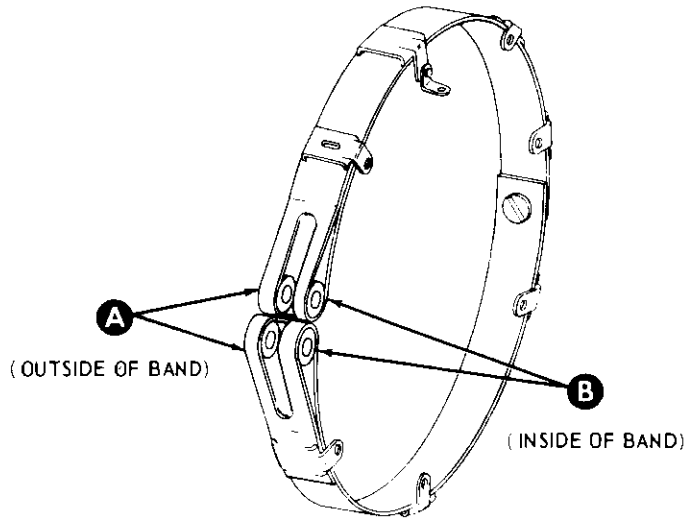
(1) Loosen end of tape from band with a knife. Grasp end of tape with suitable pliers. Carefully hold band so as to avoid deforming while rolling back tape until removed.

Warning

Use protective garments and avoid prolonged breathing of vapors when using stripping compounds.

(2) Remove epoxy resin adhesive residue from band by applying paste stripping compound, (item 317, table 1-2) or equivalent with a brush. Allow paste to remain at least 20 minutes or until adhesive has loosened completely.

(3) As an alternate method of removing adhesive, immerse band sections in a stripping solution, (item 317, table 1-2) or equivalent, or 20 minutes or until adhesive is loosened.



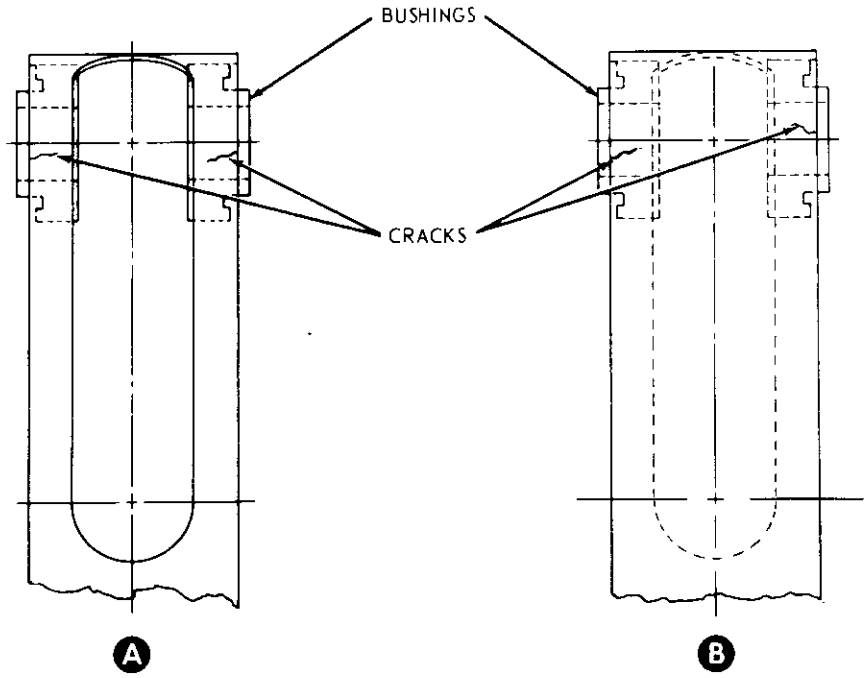


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Figure 5-16. Bleed band crack locations

(4) Wash band in hot water to remove all residue. Air dry.

d. If bleed band machine screw does not fit properly when inspected, reduce the thickness of the screw head and height of the dimple (countersink) in the lower bleed band as shown in figures 5-17 and 5-18.

e. Blend-repair cracks on inside of band that extend up to 0.080 inch into the band (see figure 5-19). Replace band if crack extends more than 0.080 inch into band.

f. Re-inspect band by dye-penetrant method.

Note

After reinstalling airbleed assemblies, adjust for proper fit of bleed band to compressor housing.

5-67. INSTALLATION - INTERSTAGE BLEED BAND ASSEMBLY.

Note

Handle bleed bands with care to avoid twisting or bending them.

a. Place upper and lower bleed bands (6 and 15, figure 5-12) in proper relation to each other and around interstage bleed compressor housing.

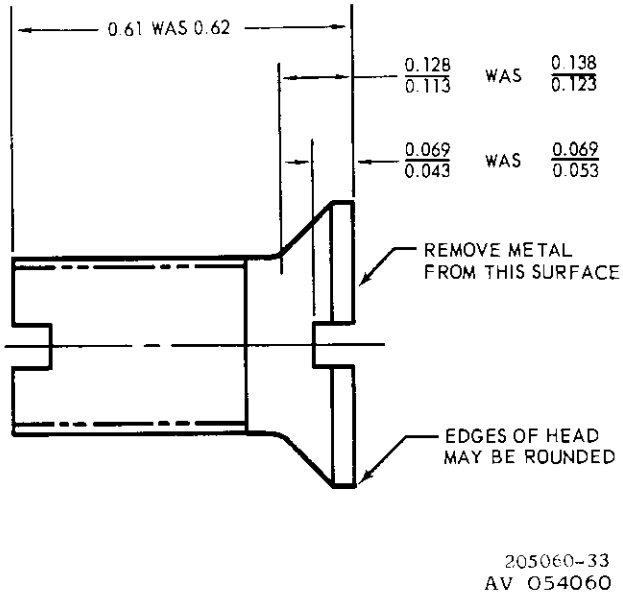


Figure 5-17. Bleed band screw rework

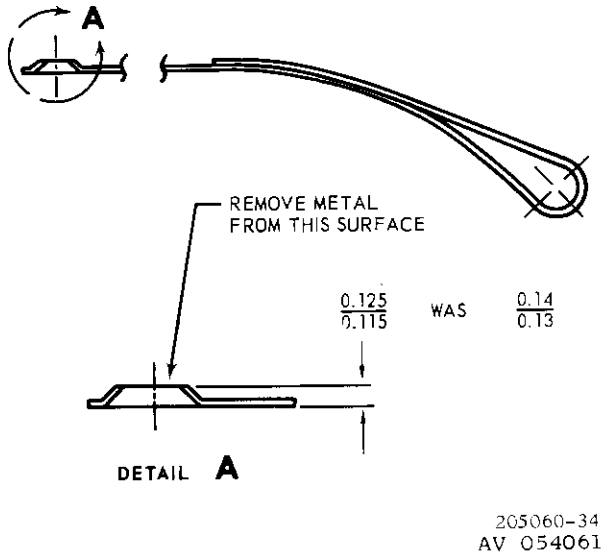


Figure 5-18. Bleed band rework

Note

Accomplish steps b, c, and d only if the bleed bands had been separated.

b. Insert screw (12), with flathead facing compressor housing, into the hole that links upper and lower bleed bands.

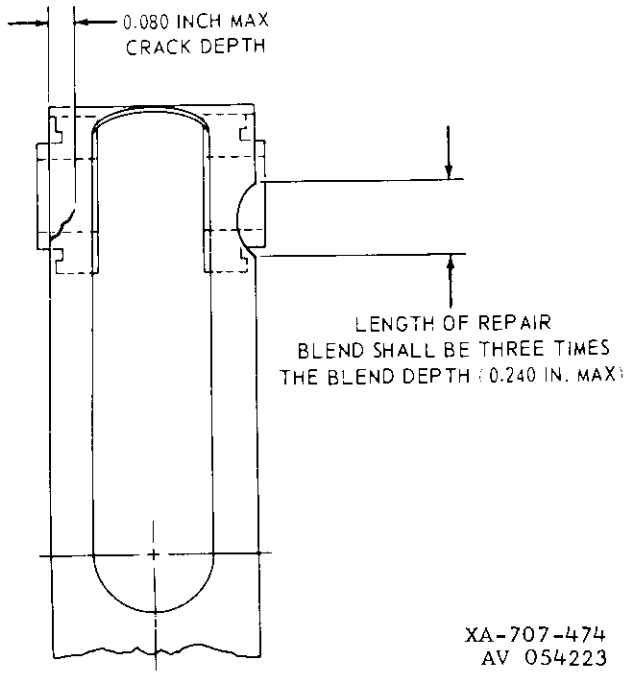


Figure 5-19. Bleed band maximum repairable crack depth and repair dimensions

c. Place washer (10) and nut (11) on screw.

d. Hold screwdriver in the slot on threaded end of screw and tighten nut.

e. Place indexed clips (7) in position.

f. Secure clips to interstage compressor housing with washers (8) and bolts (9). Tighten bolts and ensure clips are properly installed. Lockwire.

Note

The clip is properly installed when legs are so positioned as not to cause bleed band binding. Check all legs and reposition or bend as required. Check assembled bleed band in open and closed position.

g. Install bushings in bleed band upper and lower loops if bleed band assembly (1-160-820-04) is installed.

h. Install or connect interstage bleed actuator.

5-68. ADJUSTMENT - INTERSTAGE BLEED BANDS. Bleed bands shall be adjusted whenever a new band assembly or interstage bleed actuator is installed or when a previously used bleed band is reinstalled after teflon tape has been removed from it. The travel of the bleed actuator piston rod assembly (18, figure 5-12; 17, figure 5-14, 14, figure 5-15) and tightness of the bleed band assembly are adjusted by altering the position of the screw assembly (5, figure 5-12; 16, figure 5-14; 4, figure 5-15).

Note

The screw assembly is secured to a pivoting shaft with nuts (3 and 4, figure 5-12; 13 and 14, figure 5-14; 1 and 3, figure 5-15).

a. With the bleed actuator piston rod assembly retracted in the actuator, determine and mark the horizontal centerline of tapped hole in piston rod and mark this centerline on actuator housing. Place another mark on housing exactly one inch above the first mark (figure 5-20).

Note

On T53-L-11 series and -13 engine bleed actuators, paint a sight mark in the approximate location of tapped hole (figure 5-21).

b. If hose assemblies are connected to airbleed valve or interstage bleed actuator, disconnect hoses as follows:

(1) On T53-L-9, -9A engines, disconnect hose connectors from unions (23 and 27, figure 5-12) in airbleed valve.

(2) On T53-L-11 series and -13 engines, disconnect hose connector from union (24, figure 5-14, or 26, figure 5-15) and hose connector from reducer (23, figure 5-14, or 21, figure 5-15). Install AN924-4 cap on union (26, figure 5-15, T53-L-13 engine).

c. Cut lockwire that secures nuts on each side of screw assembly pivoting shaft. Back off nut (3, figure 5-12; 13, figure 5-14; 1, figure 5-15) to end of threads leaving at least one thread showing.

d. Actuate interstage bleed actuator piston rod assembly to full travel as follows:

(1) On T53-L-9, -9A engines, apply 35 to 37 psig metered air pressure to union (27, figure 5-12). Place finger over union (23) and measure travel at rod assembly.

(2) On T53-L-11 series engines, apply 5 to 15 psig metered air pressure to reducer (23, figure 5-14). Place finger over union (24) and measure travel at rod assembly.

(3) On T53-L-13 engines, close bleed bands by applying 40 psig air pressure to union (26, figure 5-15) in actuator assembly.

Note

A travel of less than 1.0 inch or more than 1.2 inch is unacceptable.

e. Tighten nut (4, figure 5-12; 14, figure 5-14; 3, figure 5-15) until bleed band is snug against compressor housing.

Note

The bleed band is positioned properly when torque on nut increases.

f. Release finger from union (T53-L-9, -9A and -11 series engines) or release pressure (T53-L-13 engine) and tighten nut (3, figure 5-12; 13, figure 5-14; 1, figure 5-15). Replace finger on union or reapply pressure.

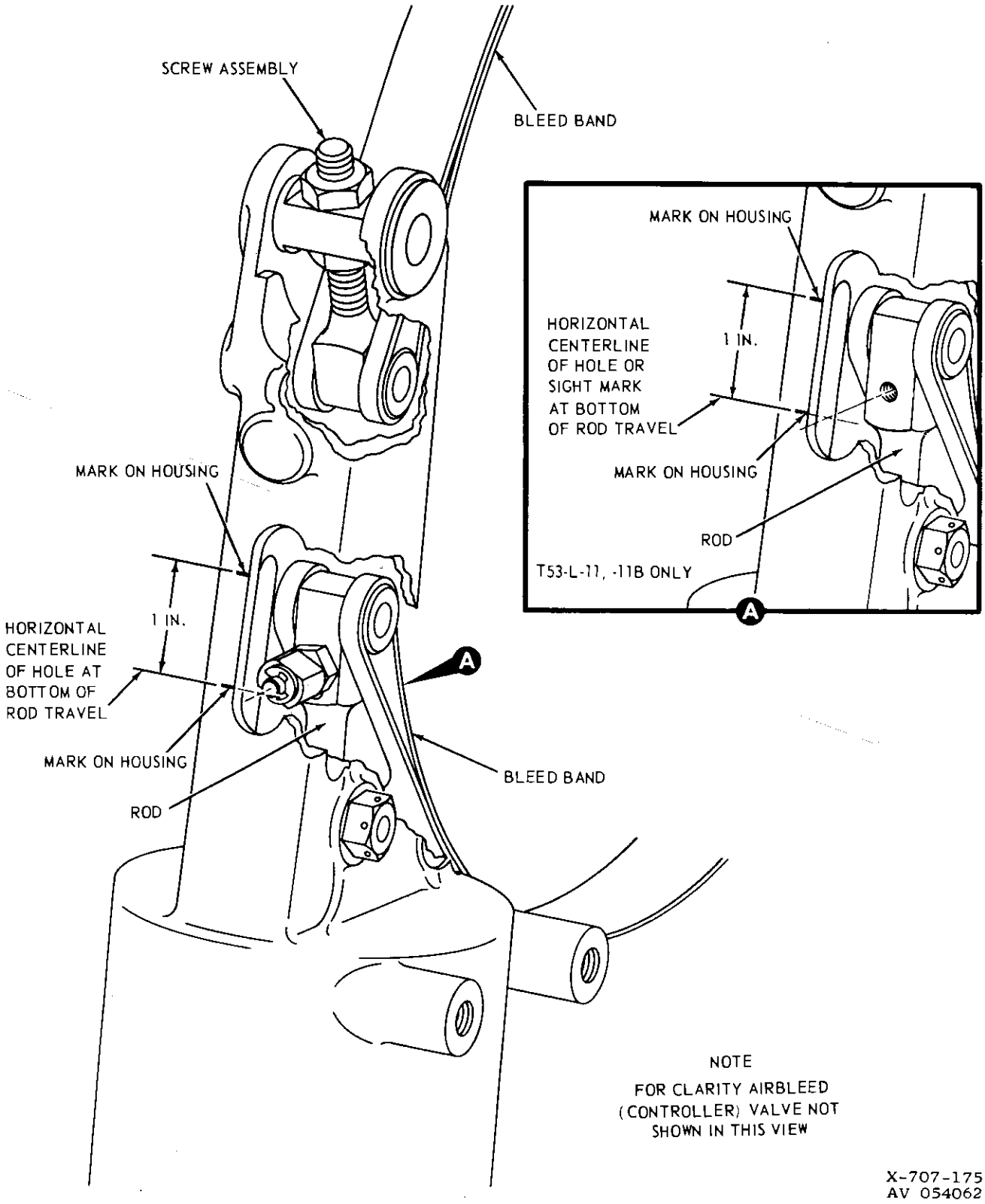


Figure 5-20. Bleed band actuator adjustment - T53-L-9, -9A and -11 series

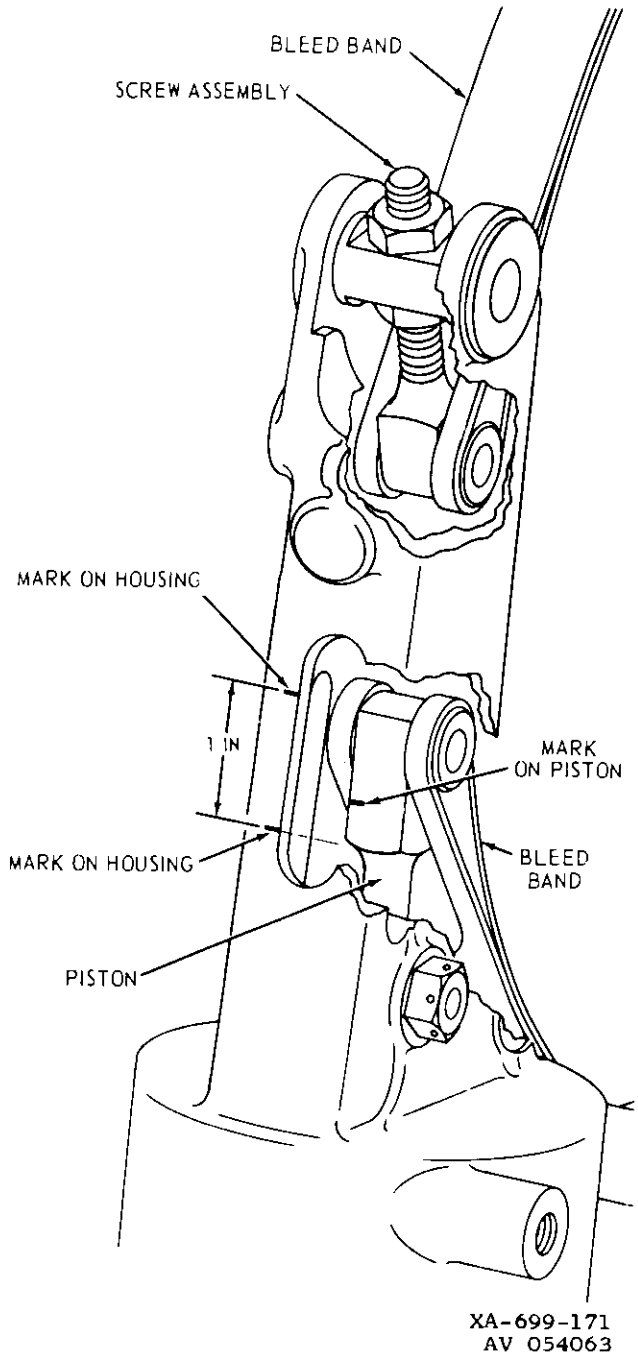


Figure 5-21. Bleed band actuator adjustment - T53-L-13 engine

g. If rod travel is less than 1.0 inch, replace bleed band assembly or bleed actuator assembly, whichever is required, and repeat preceding steps a. through f.

h. If rod travel is more than 1.2 inches, continue to tighten nut (4, figure 5-12; 14, figure 5-14; 3, figure 5-15) and check rod travel under pressure stated in preceding step d.

i. If rod travel is within limits, close bleed band using regulated air pressure prescribed in preceding step d. Using 0.002 feeler gage, check clearance between compressor housing and bleed band in area of single band thickness.

Note

Clearance between compressor housing and bleed band shall not exceed 0.002 inch drag fit. This requirement does not apply under connected halves or spot-welded area, but only under single band thickness area.

j. Adjust nuts (3 and 4, figure 5-12; 13 and 14, figure 5-14; 1 and 3, figure 5-15) to obtain required clearance by either of the following methods:

(1) Tighten band by loosening nut (3, figure 5-12; 13, figure 5-14; 1, figure 5-15) and tightening nut (4, figure 5-12; 14, figure 5-14; 3, figure 5-15).

(2) Loosen band by loosening nut (4, figure 5-12; 14, figure 5-14; 3, figure 5-15) and tightening nut (3, figure 5-12; 13, figure 5-14; 1, figure 5-15).

k. When proper clearance has been established tighten nuts and lock-wire both nuts together.

l. Disconnect air pressure supply from union (27, figure 5-12) or from reducer (23, figure 5-14, or 21, figure 5-15). On T53-L-13 engine, remove AN924-4 cap from union (26, figure 5-15). Reconnect each airbleed hose assembly connector to its respective union or reducer.

m. Perform functional check of airbleed actuator.

5-69. FUNCTIONAL CHECK - INTERSTAGE AIRBLEED SYSTEM.

a. Check for proper operation of interstage airbleed system under the following conditions:

(1) When interstage bleed actuator or bleed band has been repaired or replaced.

(2) When airbleed system malfunction is suspected.

(3) On T53-L-9, -9A engines, when airbleed valve has been repaired or replaced.

(4) On T53-L-11 series, -13 engines, when fuel control has been replaced.

b. Perform closure check as follows:

(1) Start engine and stabilize at flight idle speed.

(2) On T53-L-9, -9A engines, advance power lever until bleed band closes. Bleed band should close between 76 and 81 percent nI speed.

(3) On T53-L-9, -9A engines, retard power lever until bleed band opens. Bleed band should open within limits of closure rpm (power).

(4) On T53-L-11 series engines, slowly advance power lever until bleed band closes. Bleed band shall close as shown in figure 5-22.

Note

If throttle control movement is too rapid, fuel control will sense acceleration and will delay bleed band closing to a higher nI rpm.

(5) On T53-L-11 series engines, slowly retard power lever until bleed band opens. Bleed band shall open within 2 to 8 percent of closing speed.

Note

If throttle movement is too rapid, the fuel control will sense a deceleration and will delay bleed band opening to a lower nI speed.

(6) On T53-L-13 engines, refer to paragraph 5-362.

c. On T53-L-9, -9A engines, if interstage airbleed system does not function properly, check for the following defects.

(1) Leaks or obstructions in hoses or fittings.

(2) Clogged strainer assembly in air inlet port of airbleed valve.

(3) Sticking of air valve in air-bleed valve.

(4) Improper adjustment of bleed band.

d. Proceed as follows to correct the defects listed in preceding step c.

(1) Disconnect airbleed hoses from unions (23 and 27, figure 5-12) on airbleed valve.

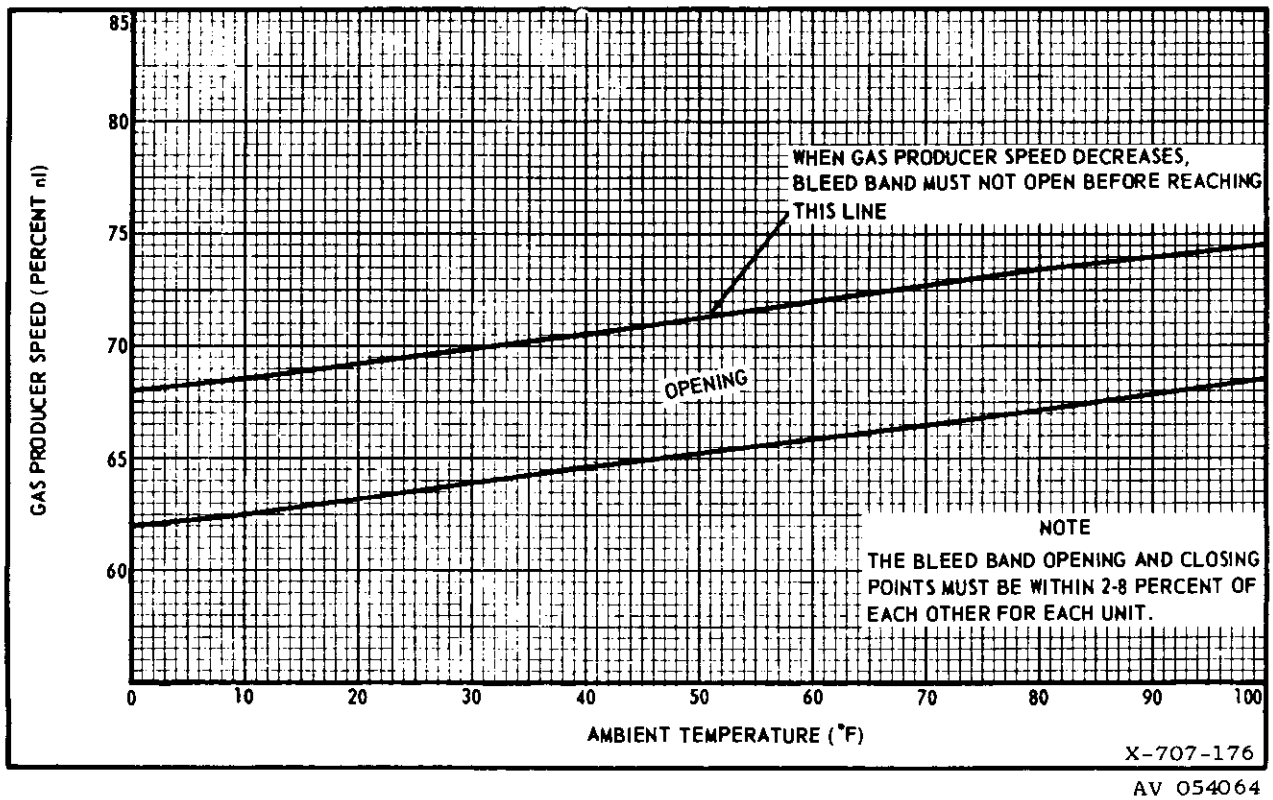


Figure 5-22. Bleed band opening - closing limits - T53-L-11 series

(2) Connect source of compressed air to each hose.

(3) Blow air through hoses to determine that hoses and ports in diffuser and inlet housings are free from obstructions or restrictions.

(4) If hoses and ports are clear, connect air to union (27) in airbleed valve.

(5) Supply approximately 37 to 40 psi maximum air pressure to valve and block union (23). Observe actuator.

Note

Actuator should close. Closing will be indicated by rise of rod assembly.

(6) If actuator does not close under 37 to 40 psi maximum air pressure, replace airbleed valve and repeat preceding steps (4) and (5).

(7) If actuator does not close after valve has been replaced, replace actuator and repeat preceding steps (4) and (5).

(8) When actuator is closing properly, reconnect airbleed hoses to valve and perform closure check for T53-L-9, -9A engine. (Refer to preceding step b.)

e. On T53-L-11 series, -13 engines, if interstage airbleed system does not function properly, check for the following defects:

(1) Leaks or obstructions in hoses or fittings.

(2) Clogged strainer (2, figure 5-11 or 19, figure 5-15) in air-bleed actuator.

(3) Sticking of piston in airbleed actuator.

(4) Improper adjustment of bleed band.

(5) Deposit of dirt and gum that prevents operation of fuel control air-bleed valve on fuel control.

f. Proceed as follows to correct the defects listed in preceding step e.

(1) Disconnect airbleed hose from reducer (23, figure 5-14 or 21, figure 5-15).

(2) Connect source of compressed air to hose and blow air through hose to determine that hose and diffuser housing port are unobstructed.

(3) If hose and diffuser housing port are clear, disconnect airbleed hose at fuel control and at airbleed actuator. Blow air through hose to determine that hose is unobstructed.

(4) Connect source of compressed air to reducer in airbleed actuator.

(5) Supply 15 psi maximum regulated air pressure to actuator and block union.

Note

Actuator should close. Closing will be indicated by rise of rod assembly.

(6) Unblock union.

Note

Actuator should open. Opening will be indicated by drop of rod assembly.

(7) If diffuser housing port is obstructed, determine cause and remedy. Recheck actuator for proper operation.

(8) If hoses are obstructed, replace hoses. Recheck actuator for proper operation.

(9) If actuator does not open and close as indicated in preceding steps (4) through (6), replace actuator. Check new actuator for proper operation.

(10) If hoses and port are clear and actuator opens and closes as indicated in preceding steps (4) through (6), inspect airbleed valve on fuel control. Request assistance from Direct Support Maintenance.

g. If bleed band still does not function properly, replace fuel control.

5-70. ACCESSORY DRIVE GEARBOX ASSEMBLY.

5-71. The accessory drive gearbox is mounted on underside of the engine inlet housing and is driven through bevel gears from the front end of the compressor rotor. Drive pads are provided on rear of the gearbox for the fuel control, the starter-generator, and the gas producer (nI) tachometer generator. The gearbox front side has mounting for the rotary oil pump, and also has an unused drive pad with connection for the torquemeter pressure transmitter vent line. Oil scavenge lines are connected at right rear on the gearbox which serves as an oil collector sump, kept practically empty by the pump. A chip detector plug is located in lower right side, and the oil filter is on the left side. On T53-L-13 engines a drain line from the inlet

guide vane actuator is connected to the right side. The special tools required to perform the following maintenance functions on the accessory drive gearbox are listed below in table 5-1.

TABLE 5-1. SPECIAL TOOLS

PART NUMBER	NOMENCLATURE
LTCT99	Installation and Removal Tool
LTCT100	Oil Seal Installation and Removal Tool
H LTCT101	Seal Removal Tool
LTCT270	Accessory Seal Installer
LTCT501	Seal Installation Tool
LTCT511	Seal Removal Tool
D LTCT3648	Seal Removal Tool

5-72. SPECIAL INSPECTION OF OIL PUMP DRIVE.

a. This inspection is required on all engines except:

(1) Engines marked with an asterisk on accessory drive gearbox. (See figure 5-23.)

(2) T53-L-9 and -9A whose histories indicate they have never been returned to Depot or had their gearboxes changed in the field.

(3) T53-L-11, T53-L-11 serial number suffixed A, and T53-L-11B engines LE10900 or prior whose histories indicate they have never been returned to Depot or had their gearboxes changed in the field.

(4) T53-L-11 series engines subsequent to LE13129A.

(5) T53-L-13 engines subsequent to serial number LE15150, except numbers LE15174, LE15180, LE15200, LE15253 and LE15257.

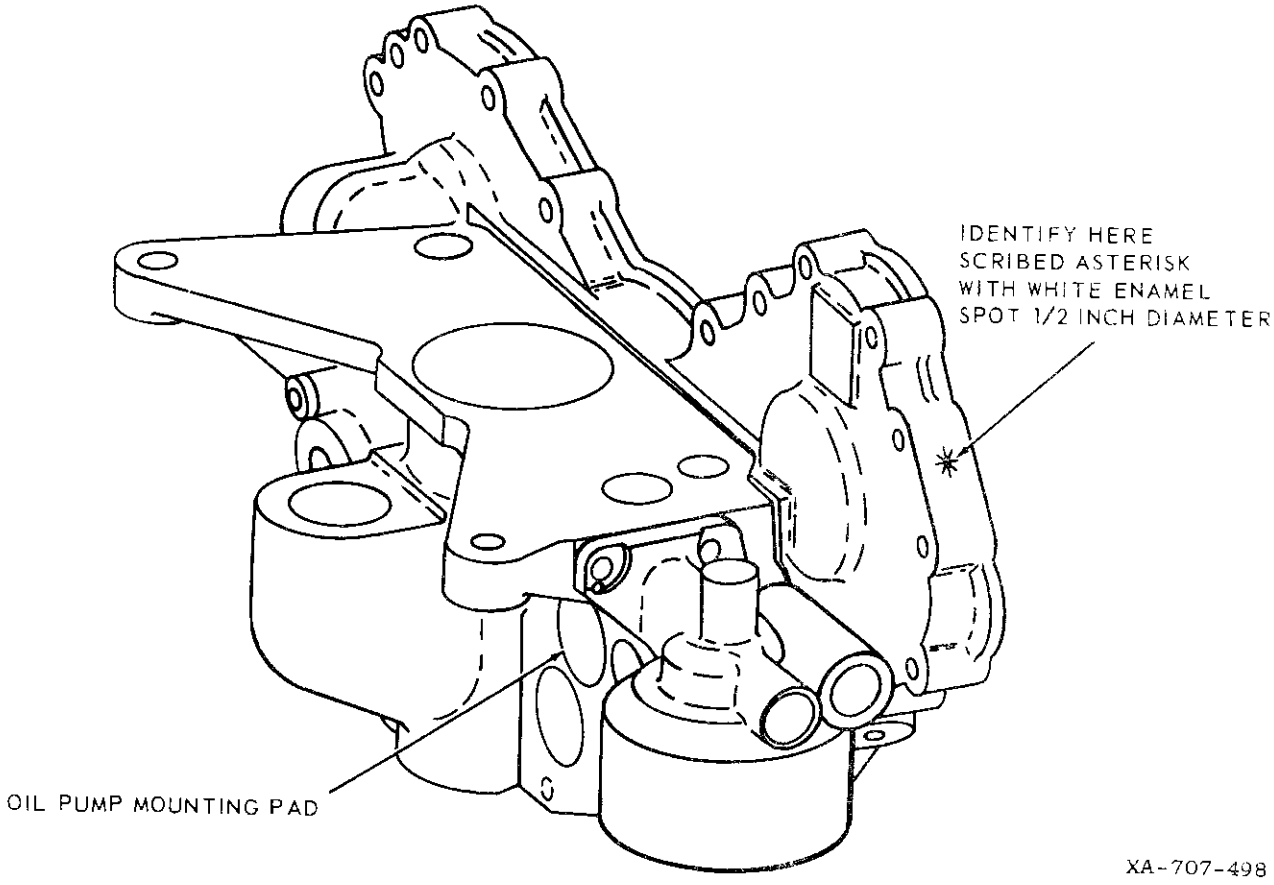


Figure 5-23. Accessory gearbox - two hole identification

b. Schedule inspection of affected engines according to operating time since new or since last overhaul, as follows:

(1) Less than 300 hours, at 300-hour hot-end inspection.

(2) More than 300 hours, at next 25-hour intermediate inspection.

c. Remove oil pump and drive shaft. (Refer to paragraph 5-293.)

d. Inspect oil pump drive gear cavity on accessory drive gearbox for location and number of oil holes. (See figure 5-24.)

(1) If there are two oil holes, located at 6- and 12-o'clock positions as illustrated, no further inspection is required. Mark gearbox with scribed asterisk and white enamel spot as shown on figure 5-23. Proceed to step h.

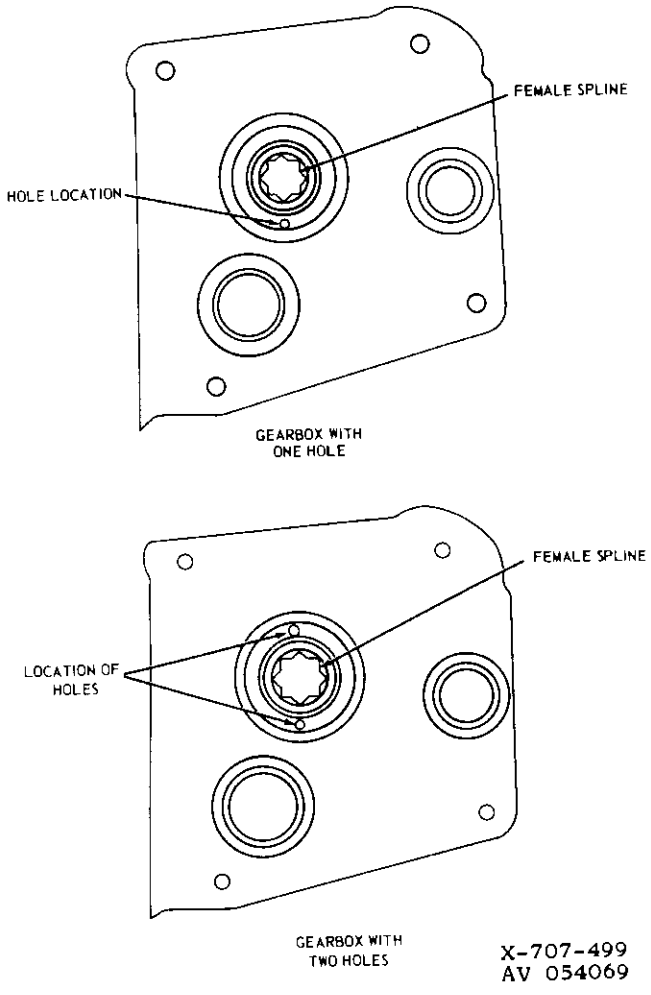


Figure 5-24. Pump mounting pad - hole locations

(2) If there is only one oil hole, at 6-o'clock position under oil pump drive shaftgear, proceed to step e.

e. Use shank of a new "T" size drill (0.358 inch diameter) as a gage for splined hole of oil pump drive shaftgear:

(1) If drill shank can be inserted into shaftgear spline, replace accessory drive gearbox and send rejected gearbox to General Support for repair.

(2) If drill shank cannot be inserted into gearshaft spline, proceed to cleaning and further inspection.

f. Clean female spline of gearshaft thoroughly with a small brush and engine oil. Use absorbing rags and cotton swabs as necessary to remove contaminant.

Caution

Every effort shall be made to prevent contaminant from splines entering other areas of gearbox through drilled passages, bearings, or other ways.

g. Using a mirror and flashlight, visually inspect shaftgear splines to determine amount of wear. (See figure 5-25.)

(1) Splines with less than one-half total wear are acceptable, provided inspection and cleaning is repeated at 100-hour intervals.

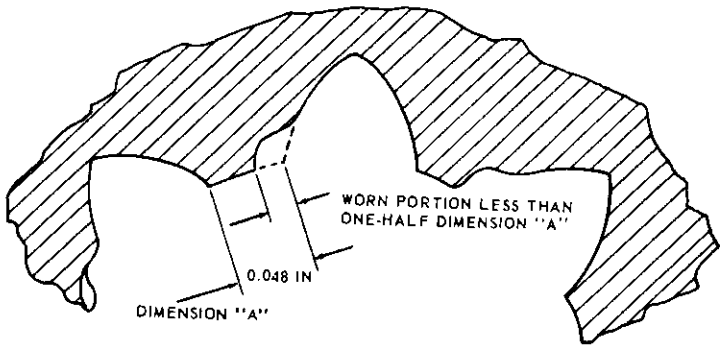
(2) Splines with more than one-half total wear are acceptable, provided inspection and cleaning is repeated at 25-hour intervals.

Caution

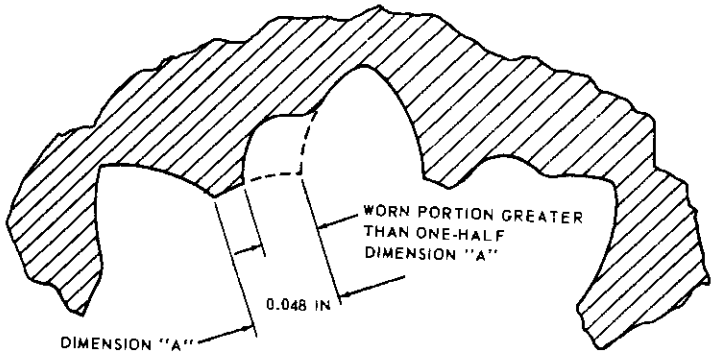
Wear in most cases may be directly proportional to amount of spline contaminant found. It is extremely important that both male and female splines shall be cleaned during each subsequent inspection.

h. Lubricate female drive spline and male coupling spline thoroughly with same type oil as that being used in engine. Reinstall oil pump. (Refer to paragraph 5-296.)

i. Drain accessory drive gear box and reinstall chip detector plug. With oil-in line connected and scavenge line disconnected, motor engine over to rid system of any contaminant that may have washed down into accessory gearbox sump.



SPLINE WITH LESS THAN ONE-HALF TOTAL WEAR



SPLINE WITH GREATER THAN ONE-HALF TOTAL WEAR

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Figure 5-25. Oil pump drive gear spline wear limits

j. Connect scavenge line, reservice oil system, and run engine to check for leaks.

k. Indicate in engine records the schedule for any future inspections required for accessory drive gearbox.

5-73. REMOVAL - ACCESSORY DRIVE GEARBOX.

a. Open engine compartment cowling doors at both sides. Disconnect lubrication scavenge hoses from accessory drive gearbox.

b. On T53-L-13 engines disconnect inlet guide vane actuator seal drain hose from gearbox fitting.

c. Remove rotary oil pump.

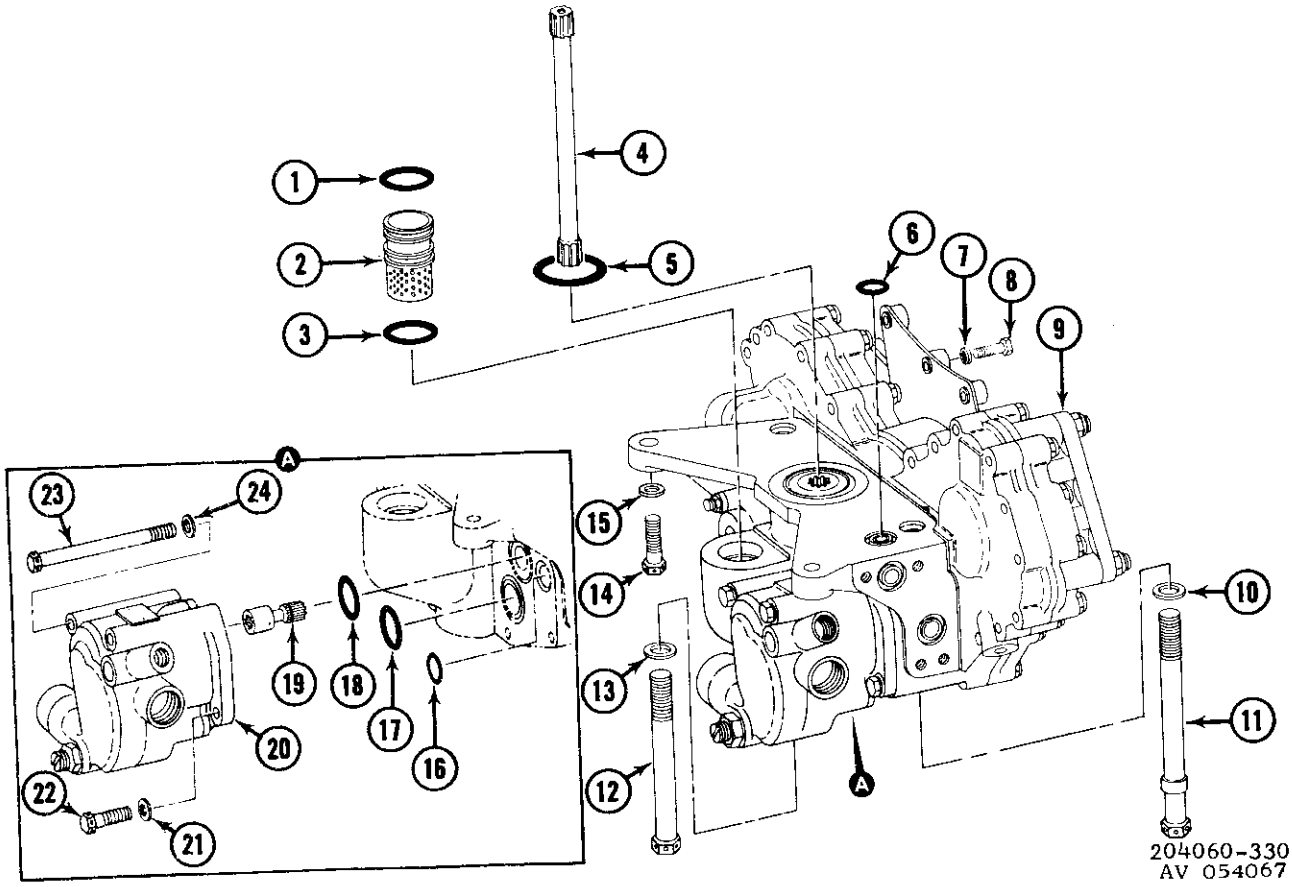
d. Remove fuel control.

e. Remove starter-generator and nI tachometer generator.

f. Remove three bolts (8, figure 5-26) and washers (7) that secure gearbox support to rear flange of inlet housing assembly.

g. Support accessory drive gearbox assembly (9) and remove shouldered bolt (11), bolt (12), two bolts (14), and washers (10, 13 and 15).

h. Remove gearbox assembly and drive shaft (4) from inlet housing.



1. Packing
2. Screen and Transfer Tube
3. Packing
4. Accessory Drive Shaft
5. Packing
6. Packing
7. Washer
8. Bolt
9. Accessory Drive Gearbox
10. Washer
11. Shoulder Bolt
12. Bolt
13. Washer
14. Bolt
15. Washer
16. Packing
17. Packing
18. Packing
19. Drive Shaft
20. Oil Pump
21. Washer
22. Bolt
23. Bolt
24. Washer

Figure 5-26. Accessory drive gearbox assembly

i. Remove packings (5 and 6) from mounting face of gearbox.

j. Remove drive shaft (4), packings (1 and 3), and screen and transfer tube (2) from top of accessory drive gearbox.

Note

If accessory drive gearbox is to be replaced, retain the rotary oil pump, oil filter, and chip detector. Remove and retain support (21, figure 5-27) for installation.

5-74. DISASSEMBLY - ACCESSORY DRIVE GEARBOX ASSEMBLY.

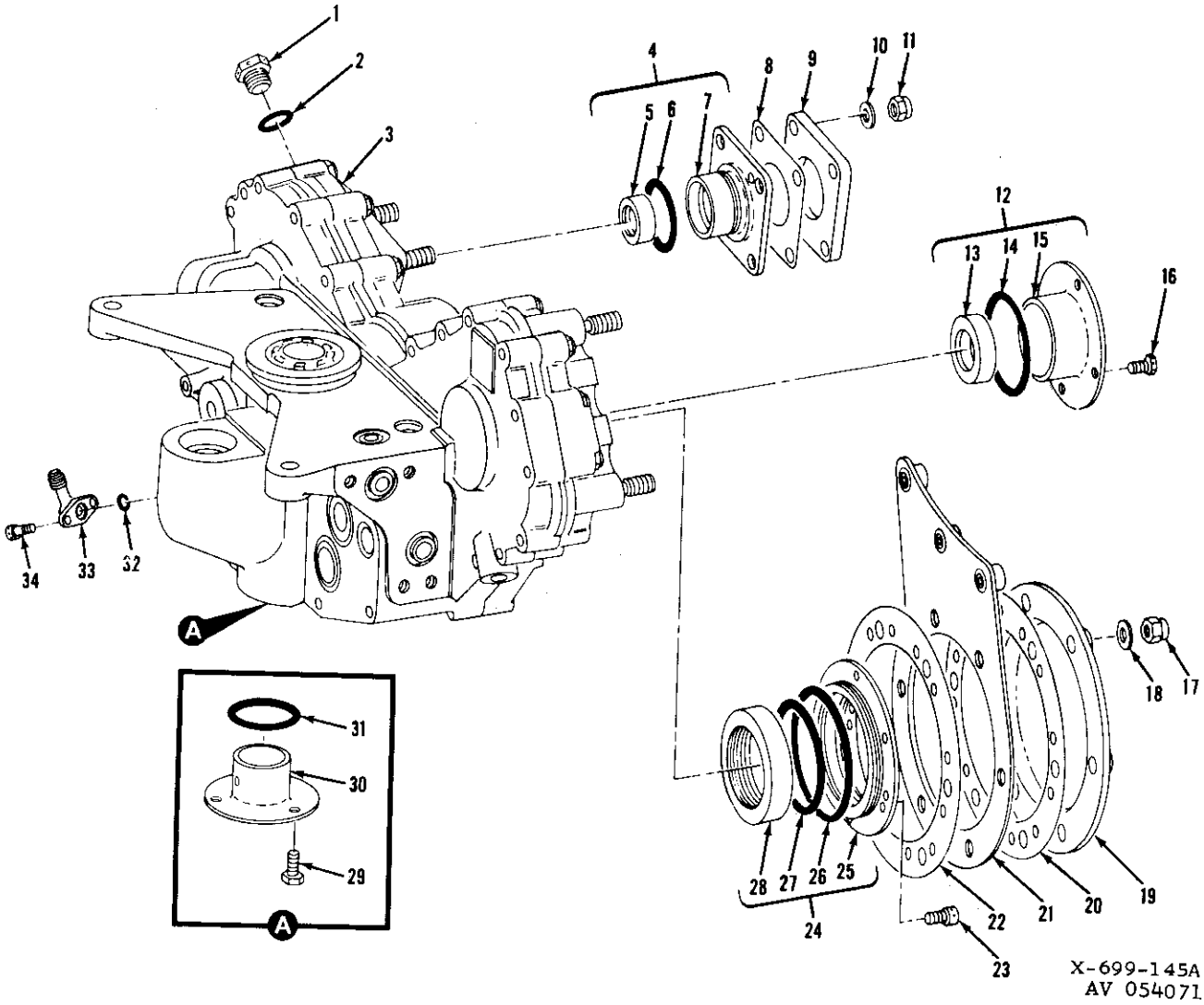
Note

It is not necessary to remove the accessory drive gearbox from the engine in order to replace seals.

a. Remove chip detector.

b. Remove plug (1, figure 5-27) and packing (2).

c. Remove nuts (17) and washers (18) that secure cover (19), if installed, to generator drive pad of gearbox (3).



1. Plug
2. Seal
3. Accessory Drive Gearbox
4. Tachometer Drive Flange Assembly
5. Seal
6. Packing
7. Tachometer Drive Flange
8. Gasket
9. Cover
10. Washer
11. Nut
12. Fuel Control Drive Liner Assembly
13. Seal
14. Packing
15. Fuel Control Drive Liner
16. Bolt
17. Nut
18. Washer
19. Cover
20. Gasket
21. Support
22. Gasket
23. Bolt
24. Oil Seal Housing Assembly
25. Oil Seal Housing
26. Packing
27. Packing
28. Seal
29. Bolt
30. Radial Bearing Housing
31. Packing
32. Packing
33. Adapter
34. Screw

Figure 5-27. Accessory drive gearbox exploded view

d. Remove cover, gasket (20), support (21), and gasket (22).

Note

Support and gasket cannot be removed if gearbox is installed on engine.

e. Remove bolts (23) that secure oil seal housing assembly (24) to fuel control drive pad of gearbox.

f. Using two 10-32 puller screws, remove oil seal housing assembly. Turn screws clockwise until housing assembly separates from gearbox. Remove packing (26) from housing (25).

Note

To prevent oil seal housing assembly from jamming in gearbox, thread both puller screws evenly.

g. Place seal housing on an arbor press, and use seal removal tool LTCT3648 for T53-L-9 and -11 series engines or LTCT101 for T53-L-13 engines remove seal (28) and packing (27) from housing (25).

h. Remove nuts (11) and washers (10) that secure cover (9), if installed, to tachometer drive pad of gearbox.

i. Remove cover and gasket (8) from gearbox.

j. Using two 10-32 puller screws, remove tachometer drive flange assembly (4). Remove packing (6) from flange (7).

Note

To prevent tachometer drive flange assembly from jamming in gearbox, thread both puller screws evenly.

k. Using installing tool (LTCT501) and arbor press, remove seal (5) from flange.

l. Remove bolts (16) that secure fuel control drive liner assembly (12) to gearbox.

m. Using two 10-32 puller screws, remove fuel control drive liner assembly from gearbox. Remove packing (14) from liner (15).

Note

To prevent fuel control drive liner assembly from jamming in gearbox, thread both puller screws evenly.

n. Using installing tool (LTCT100) and arbor press, remove seal (13) from liner.

Note

Omit step o. if housing (30) is part of gearbox.

o. Remove bolts (29) that secure housing (30) to gearbox. Remove housing (30) and packing (31).

p. Remove screws (34) that secure adapter (33) to gearbox. Remove adapter and packing (32).

5-75. CLEANING - ACCESSORY DRIVE GEARBOX ASSEMBLY. Clean all parts with dry cleaning solvent (item 302, table 1-2).

5-76. INSPECTION - ACCESSORY DRIVE GEARBOX ASSEMBLY. Inspect all parts for damage, evidence of wear, and stripped or damaged threads. Inspect mounting studs on gearbox cover for looseness.

5-77. REPAIR OR REPLACEMENT - ACCESSORY DRIVE GEARBOX.

a. Blend repair nicks and burrs. Replace all parts that are cracked, distorted, or excessively worn.

b. Blend repair damaged threads. Request assistance from Direct Support Maintenance for replacement of screw thread inserts.

c. If mounting studs are loose, tighten. If studs cannot be tightened, request assistance from Direct Support Maintenance for replacement of studs.

5-78. REASSEMBLY - ACCESSORY DRIVE GEARBOX.

a. Install packing (31, figure 5-27) on housing (30). Install housing into gearbox (3) and secure with bolts (29). Tighten bolts as required and lockwire.

b. Dip seal (13) in engine lubricating oil. Using removal tool (LTCT101) and arbor press, press seal into liner (15). Position packing (14) on OD of liner.

c. Install fuel control drive liner assembly (12) into gearbox (3) and secure with bolts (16). Tighten bolts as required and lockwire.

d. Dip seal (5) in engine lubricating oil. Using installing tool (LTCT501) and arbor press, press seal into flange (7). Position packing (6) on OD of flange.

e. Position tachometer drive flange assembly over mounting studs of gearbox and install gasket (8) and cover (9). Secure with washers (10) and nuts (11). Tighten nuts as required.

f. Dip seal (28) in engine lubricating oil. Position packing (27) in housing (25). Using seal installer (LTCT270) and arbor press, press seal into housing. Position packing (26) on OD of housing.

g. Using installation tool (LTCT511), install oil seal housing assembly (24) into gearbox. Secure housing with bolts (23). Tighten bolts as required and lockwire.

h. Install gasket (22), support (21), gasket (20), and cover (19) on starter generator drive pad. Secure with washers (18) and nuts (17). Tighten nuts as required.

i. Install seal (2) and plug (1) into gearbox.

j. Install chip detector.

k. Position adapter (33) and packing (32) on gearbox and secure with screws (34).

5-79. INSTALLATION - ACCESSORY DRIVE GEARBOX.

a. Install packings (1 and 3, figure 5-26) on screen and transfer tube (2).

b. Install tube in accessory drive gearbox assembly (9).

c. Position packings (5 and 6) on mounting face of gearbox.

d. Insert drive shaft (4) into inlet housing and mesh with internal spline of accessory drive gear and support shaft.

e. Position accessory drive gearbox on engine, ensuring that drive shaft drops and meshes with gearbox.

f. Carefully raise gearbox, inserting exposed end of drive shaft into inlet housing until the spline meshes with accessory drive gear and the gearbox mates with inlet housing.

g. Place washer (10) on shouldered bolt (11). Insert bolt and finger-tighten.

h. Place washer (13) on bolt (12). Insert bolt and finger-tighten.

i. Place washers (15) on bolts (14). Insert bolts and finger-tighten.

j. Place washers (7) on bolts (8). Insert bolts and finger-tighten.

k. Using 1/4-inch drive extension and ratchet, turn gearbox tachometer drive gear. Check through inlet housing to ensure that compressor rotor is turning. This indicates proper meshing of drive shaft.

l. Tighten bolts (11 and 12) to 400 to 475 pound-inches torque.

m. Tighten bolts (14) to 250 to 325 pound-inches torque.

n. Tighten bolts (8) to 100 to 120 pound-inches torque.

o. Lockwire bolts.

p. Install starter-generator and nI tachometer generator. (Refer to paragraphs 5-336 and 10-92.)

q. Install fuel control. (Refer to paragraph 5-353.)

Caution

Under no circumstances will a fuel control with a short driven splined shaft replace a fuel control with a long driven splined shaft on accessory drive gearbox part number 1-080-250-13 on T53-L-9 and -11 series engines and part numbers 1-080-250-14 or 1-080-250-16 on T53-L-13 engines.

r. On T53-L-13 engines connect inlet guide vane actuator seal drain hose assembly to adapter fitting on gearbox. Tighten connector as required.

s. Reconnect lubrication scavenge hose assemblies to accessory drive gearbox assembly. Install oil pump and oil filter, if removed.

5-80. OVERSPEED GOVERNOR AND TACHOMETER DRIVE ASSEMBLY.

5-81. The overspeed governor and tachometer drive assembly is a gearbox mounted on the engine inlet housing at the upper left side and is driven from the

power shaft. The drive assembly provides mounting and drive pads for the power turbine (nII) tachometer generator and the torquemeter booster oil pump, and also drives the fuel control overspeed governor. A relief valve, on the drive housing, allows adjustment of torquemeter oil pressure. An internal filter and metering cartridge lubricates the gear train.

5-82. REMOVAL - OVERSPEED GOVERNOR AND TACHOMETER DRIVE ASSEMBLY.

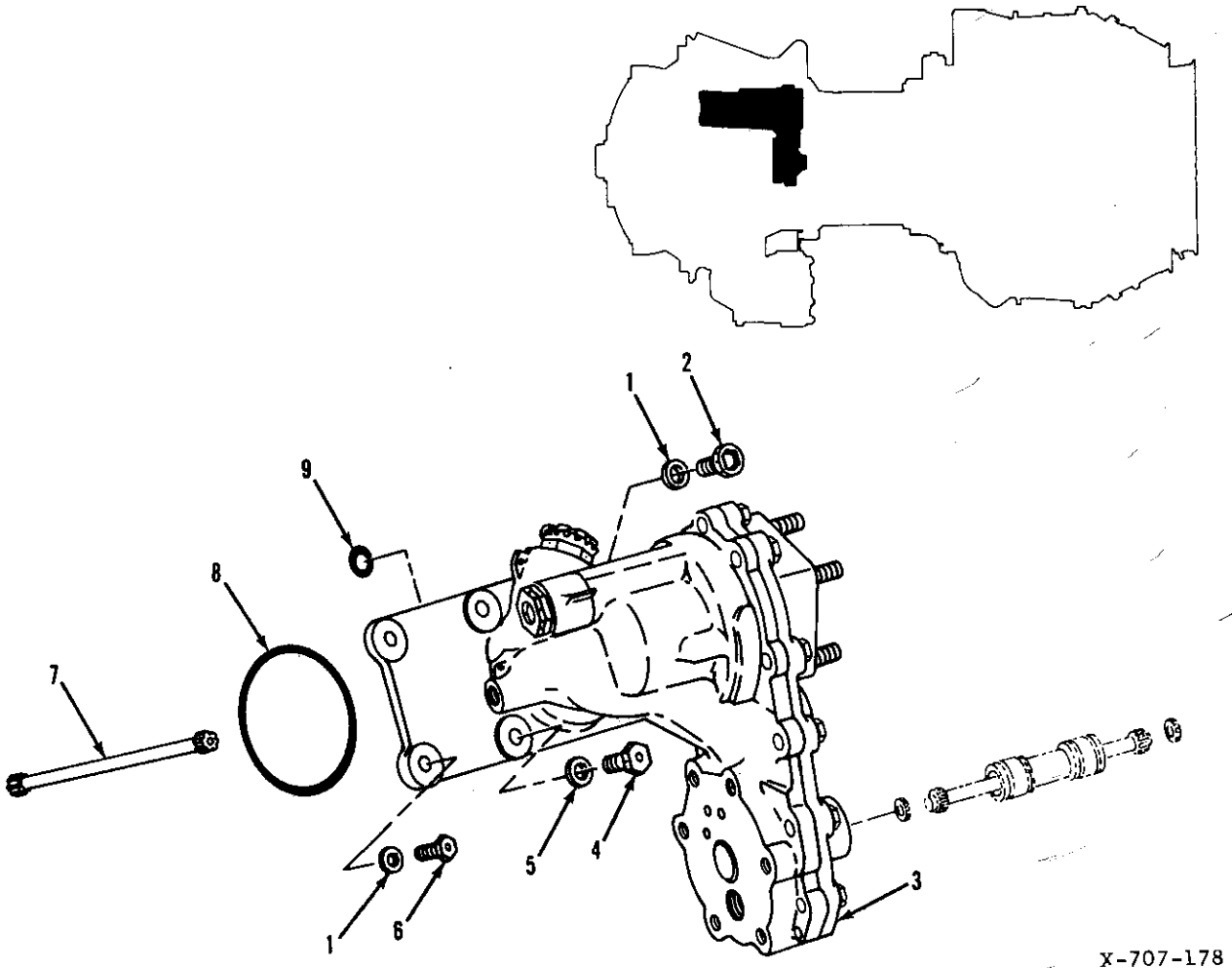
a. Open engine compartment cowling at left side.

b. Remove tachometer generator from rear side of overspeed governor and tachometer drive assembly (3, figure 5-28) by disconnecting electrical connector and removing nuts and washers from four mounting studs.

c. Remove torquemeter booster rotary oil pump from front of drive assembly, by removing attaching bolts and washers.

d. Remove overspeed generator drive shaft through front of pump drive pad, using a threaded rod as in procedure for removing the fuel control. Expand snap-ring and slide it to middle of shaft cover tube and push tube aft into governor housing until clear of drive assembly.

e. Remove bolts (2, 4, and 6) and washers (1 and 5) that secure drive assembly to mounting pad on inlet housing.



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1. Washer
2. Bolt
3. Overspeed Governor and Tachometer Drive Assembly
4. Bolt
5. Washer
6. Bolt
7. Shaft
8. Packing
9. Packing

Figure 5-28. Overspeed governor and tachometer drive assembly and attaching parts

f. Remove overspeed governor and tachometer drive assembly and packings (8 and 9). Withdraw shaft (7) from inlet housing.

5-83. CLEANING - OVERSPEED GOVERNOR AND TACHOMETER DRIVE ASSEMBLY. Clean parts with dry-cleaning solvent (item 302, table 1-2).

5-84. INSPECTION - OVERSPEED GOVERNOR AND TACHOMETER DRIVE ASSEMBLY.

a. Inspect all parts for damage or wear.

b. Inspect gears and splined parts for damaged teeth or uneven tooth wear and surface damage.

c. Inspect parts for stripped or damaged threads.

Note

Inspection and cleaning of filter (3 or 3A, figure 5-29) is not a normal requirement, but should be accomplished if oil contamination or clogging of filter is suspected.

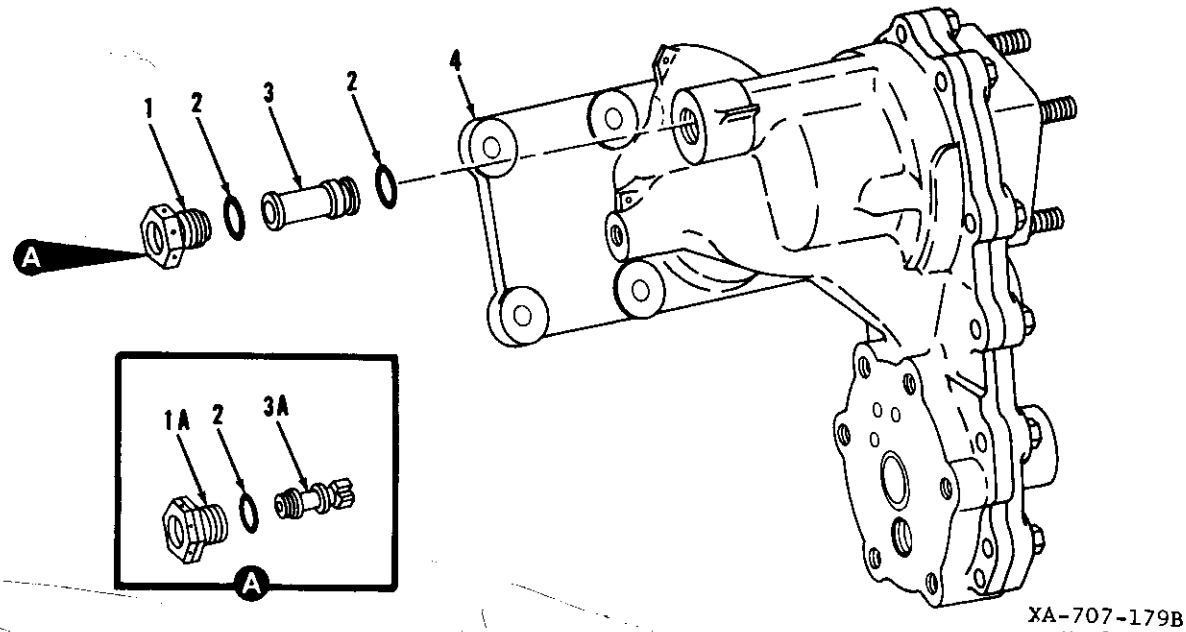
d. When necessary, remove plug (1 or 1A, figure 5-29), packing (2), and filter (3 or 3A) from housing. If filter assembly (3) was removed, remove remaining packing (2). Clean filter with dry-cleaning solvent (item 302, table 1-2) and a soft brush. Inspect filter for damage and replace if unserviceable. If filter (3A) is to be installed, screw into plug (1A) and tighten to 77 to 96 pound-inches torque. (Hold filter in soft-jawed vise to avoid damage to outer surface.) Install new packing on plug. If filter assembly (3) is being installed two packings (2) are required. Install filter and plug into housing. Tighten plug to 70 to 85 inch-pounds torque and secure with lockwire.

5-85. REPAIR OR REPLACEMENT - OVERSPEED GOVERNOR AND TACHOMETER DRIVE ASSEMBLY.

a. Replace all parts that are cracked, excessively worn, or distorted. Blend repair nicks or burrs.

b. Replace splined shafts or gearbox for damaged teeth, uneven tooth wear, or surface damage.

c. If stripped or damaged threads are found, request repair by Direct Support Maintenance.



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1. Plug
1A. Plug
2. Packing
3. Filter Assembly
3A. Filter
4. Overspeed Governor and Tachometer Drive Assembly

Figure 5-29. Overspeed governor and tachometer drive assembly - exploded view

5-86. INSTALLATION - OVERSPEED GOVERNOR AND TACHOMETER DRIVE ASSEMBLY.

a. Insert shaft (7, figure 5-28) into inlet housing mounting pad hose.

b. Install new packings (8 and 9) and overspeed governor and tachometer drive assembly (3) on mounting pad of inlet housing. Ensure that splines of shaft (7) are properly engaged.

c. Secure with bolts (2, 4, and 6), and washers (1 and 5). Tighten bolts as required and lockwire.

d. Slide governor drive shaft cover tube forward into drive assembly housing. Expand and slide snap-ring into place at aft end of tube.

e. Install overspeed governor drive shaft and establish proper end float by procedure used when installing fuel control governor. (Refer to paragraph 5-380.)

f. Install torquemeter booster rotary oil pump on front of drive assembly.

g. Install tachometer generator on rear side of drive assembly.

5-87. COMBUSTION CHAMBER DRAIN VALVE.

5-88. A pressure actuated drain valve, located on lowest point of engine combustion section, is automatically open whenever engine is not in operation. Excess fuel, or any other fluid, is drained through a hose, deck coupling, and drain tube. On T53-L-13 engine, the valve has another hose connection from the flow divider to drain the main fuel manifold after engine shutdown.

5-89. REMOVAL - COMBUSTION CHAMBER DRAIN VALVE.

a. Disconnect drain hose from valve. On T53-L-13, also disconnect flow divider drain hose.

b. Remove lockwire and four bolts to detach valve and gasket from combustion housing. Discard gasket and cover opening.

5-90. CLEANING - COMBUSTION CHAMBER DRAIN VALVE. Clean valve with solvent, (item 302, table 1-2).

5-91. INSPECTION - COMBUSTION CHAMBER DRAIN VALVE. Inspect valve for damage and mating surfaces for unevenness and cracks. Check functioning of valve by depressing plate and observing return to original position.

5-92. REPAIR OR REPLACEMENT - COMBUSTION CHAMBER DRAIN VALVE. Replace drain valve if inspection has shown any defects or malfunction.

5-93. INSTALLATION - COMBUSTION CHAMBER DRAIN VALVE.

a. Using a new gasket (P/N 1-160-045-01) position drain valve in opening at bottom of engine combustion chamber housing, with drain nipple pointing forward. On T53-L-13, the other nipple will point to right side. Install four bolts and torque 35 to 40 inch pounds and lock-wire.

Note

Ensure that bolts do not exceed 3/8 inch in length.

b. Connect drain hose to nipple on front of valve. T53-L-13, connect flow divider drain hose to nipple at right side of valve.

SECTION III AIR INDUCTION SYSTEM

5-94. AIR INDUCTION SYSTEM.

5-95. DESCRIPTION-AIR INDUCTION SYSTEM.

5-96. (Helicopters Serial No. 60-6028 through 66-16867.) (See figure 5-30.) The engine air inlet section draws in air through a bellmouth which is fitted with a coarse wire screen and an ice detector probe. The bellmouth extends through the forward firewall into an air induction area protected by baffles. In original configuration of helicopters through 65-9810, the induction area is covered by a set of louvered fairing. On 65-9811 through 66-16867 serial numbers (and on earlier UH-1D by field modification) the fairing is replaced by a three-piece set of air inlet filters using double layers of porous foam-plastic material to protect the engine from foreign matter. A pressure switch on the firewall will actuate a warning light on the instrument panel if filters become clogged.

5-97. AIR INLET FILTERS.

5-98. The three filter sections have metal frames and are secured in place by cowling fasteners or bolts. The top section is made up of hinged panels with actuating levers, but in this installation the panels are always secured in closed position by means of metal channels and links.

5-99. REMOVAL - AIR INLET FILTERS.

a. Remove each of two side sections of inlet filters by releasing fasteners or bolts at top and bottom edge.

b. Remove top filter section by releasing fasteners or bolts along forward and aft edges.

c. Protect induction area from entry of dirt and foreign objects while filters are not in place.

5-100. CLEANING - AIR INLET FILTERS. Wash filters in a water solution of detergent soap. Flush from inside with clear water. Allow filters to drain and air dry thoroughly. Do not use compressed air drying.

5-101. INSPECTION - AIR INLET FILTERS. Examine filter assemblies for visible damage or shifting of filter material from normal position. Check condition and security of seals around edges.

5-102. REPAIR OR REPLACEMENT - AIR INLET FILTERS. Replace filter assemblies which cannot be made serviceable by cleaning and repair of edge seals by replacing foam tape.

5-103. INSTALLATION - AIR INLET FILTERS.

a. Check that induction area is clear of foreign objects and dirt. (See figure 5-30.)

b. Check that panels of top filter assembly are held securely in closed position by channels installed on upper side over two forward panel joints, and on under side by two links bolted to aft pairs of actuating levers.

c. Align top filter assembly on upper edges of induction baffle and firewall. Secure cowling fasteners or bolts.

d. Align each side filter assembly to mounting holes. Secure fasteners at upper end, and fasteners (or bolts) to cabin roof.

5-104. INDUCTION BAFFLES, INTAKE SCREEN AND BELLMOUTH.

5-105. The induction baffles are sheet metal panels secured by cowling fasteners to mounting brackets on cabin structure and pylon supports, removable for access to drive shafts. The intake bellmouth is secured on the engine inlet housing flange by a V-band clamp, and to the engine forward firewall by means of a retainer ring secured in place over the bellmouth mounting flange in such manner as to form a slip-joint to accommodate variations of engine alignment. The intake screen is a two-piece assembly, secured by bolts to nut-plates on the end of the bellmouth, and rests on shock pads against the engine nose around the main drive shaft. The upper left section of screen can be readily removed for drive shaft access.

5-106. REMOVAL - INTAKE SCREEN, BELLMOUTH, AND BAFFLES.

a. Open transmission fairing. Remove air inlet filters from fairing.

b. Remove access section of intake screen and top section of forward induction baffle by releasing fasteners.

c. Remove main drive shaft. (Refer to Chapter 7.)

d. Remove mounting screws to detach remaining section of intake screen from end of bellmouth.

e. Disconnect and remove ice detector probe from brackets at top of bellmouth.

f. Open engine compartment cowling. Remove V-band clamp to release bellmouth from engine inlet housing.

g. Remove screws from back of firewall to detach retainer ring and bellmouth from front of firewall.

h. Cover front of engine inlet housing to keep out dirt and foreign objects.

i. Remove remaining sections of induction baffle as necessary.

5-107. CLEANING - ENGINE AIR INTAKE. Remove all obstructions, deposits and dirt. Detached parts can be cleaned with solvent (item 302, table 1-2). Clean engine as necessary by appropriate cleaning procedures. (Refer to paragraph 5-26 through 5-29.)

5-108. INSPECTION - ENGINE AIR INTAKE.

a. Inspect all parts for condition and for any indications that foreign objects have entered engine.

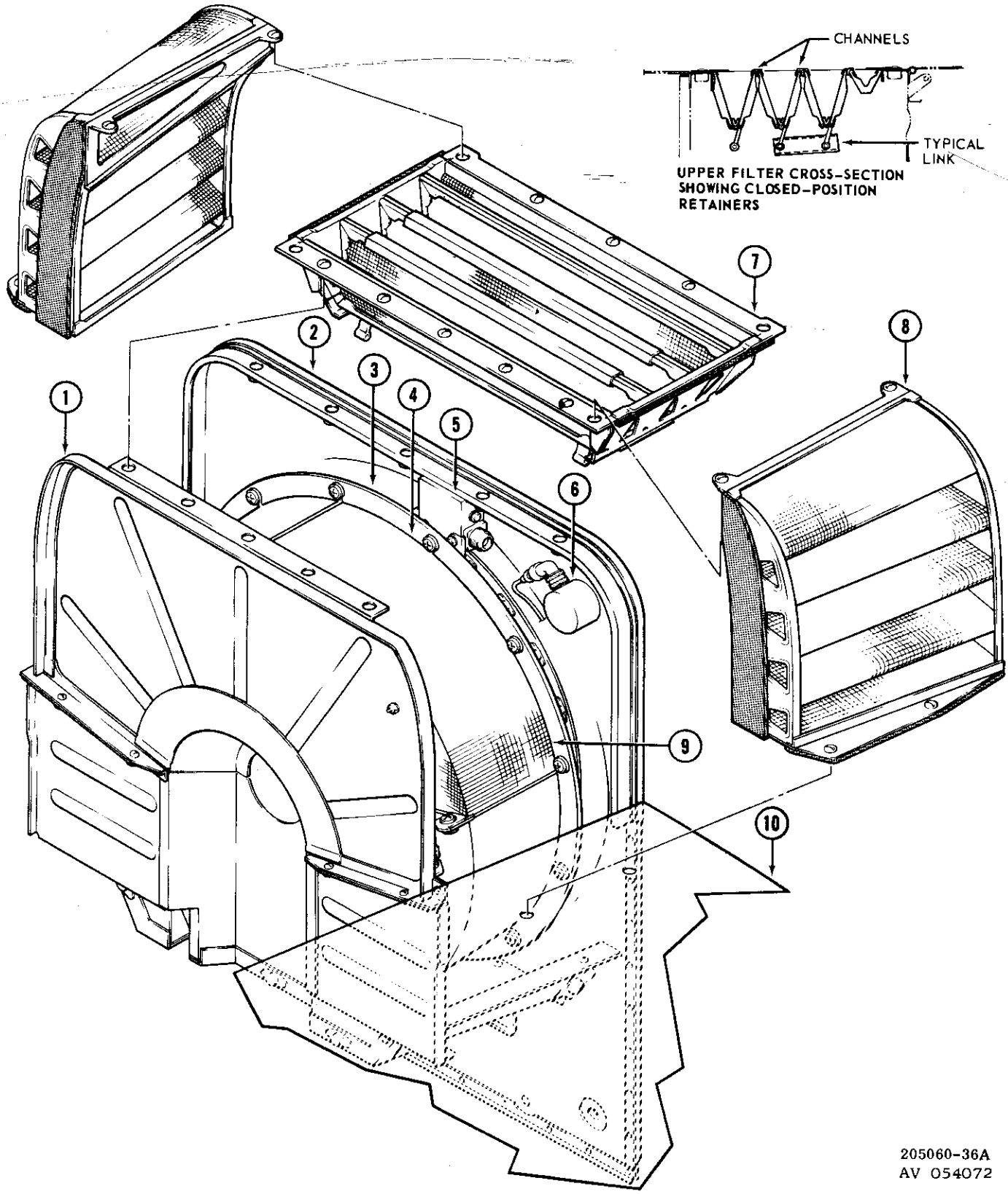

Figure 5-30. Engine air inlet filter installation (Sheet 1 of 2)