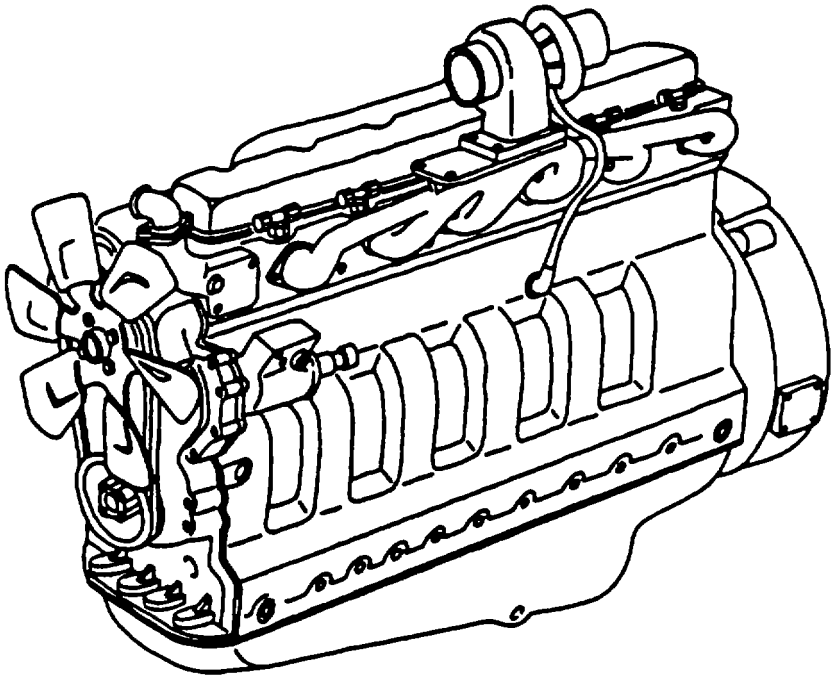
ARMY TM 9-2815-256-24
AIR FORCE TO 38G1-96-2
MARINE CORPS TM 2815-24/5

TECHNICAL MANUAL
UNIT, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

DIESEL ENGINE
MODEL 6059T
6 CYLINDER 5.9 LITER
NSN: 2815-01-350-2209



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HEADQUARTERS, DEPARTMENTS OF THE ARMY, AIR FORCE
AND HEADQUARTERS, U.S. MARINE CORPS
15 SEPTEMBER 1993

SAFETY SUMMARY - Continued

Warning

If injured by escaping fuel, see a doctor immediately. Any fluid injected into skin must be surgically removed within a few hours or gangrene can result.

Warning

Place a clear, protective shield around fuel nozzle spray zone during testing to avoid possible personal injury from spray.

Warning

Ensure each end of cylinder head is supported on blocks of wood to prevent serious injury or death when using valve spring compressor.

Warning

Block cylinder head (2, FIGURE 3-119) using a solid block of wood at each end of head for support while using spring compressor to avoid personal injury.

Warning

Do not stand in front of valve springs while compressing them to avoid personal injury.

Warning

Caustic solutions are highly toxic to the skin, eyes, and respiratory tract. Avoid all contact. Skin and eye protection and vapor control are required.

NOTE
All locations referenced herein are given facing the flywheel end (rear) of the engine.

1-8. DETAILED DESCRIPTION.

1-8.1. Turbocharger. A turbocharger, operated by exhaust gases, compresses intake air and routes it to the combustion chamber.

1-8.2. Camshaft. The camshaft is driven by an intermediate gear in the timing gear train which meshes with the crankshaft gear. Camshaft rotates in honed machined bores in cylinder block; no bushings are used. The camshaft lobes determine the time and rate of opening of each valve and actuates the fuel supply pump.

1-8.3. Intake and Exhaust Valves. Intake and exhaust valves are operated by cam followers, push rods, and rocker arm assembly. Valve seat inserts in cylinder head are used for intake and exhaust valves.

1-8.4. Crankshaft. The crankshaft is a one-piece, heat treated, steel forging which operates in replaceable two-piece front and center main bearings and five-piece rear main bearing. The rear thrust bearing has a five-piece set to support crankshaft thrust and to limit end play.

1-8.5. Cylinder Liners and Pistons. Cylinder liners are "wet" (surrounded by coolant) and are individually replaceable. O-rings are used to seal the connection between cylinder block and liners. Pistons are made of cast high-grade aluminum alloy with internal ribbing. The skirt is cam ground to allow for expansion when heated during operation. The piston crown has a cut-out swivel cup with a truncated cone in the center. Two compression rings and one oil control ring are used. The top compression ring is a keystone type ring. All piston rings are located above the piston pin. The hardened piston pins are fully-floating and held in position by means of retainer rings. Spray jets (piston cooling orifices) in cylinder block direct pressurized oil to lubricate piston pins and cool pistons. Connecting rods are of forged steel and have replaceable bushing and bearing inserts.

1-8.6. Cooling System. The cooling system consists of a radiator, water pump, cooling fan, two thermostats, and connecting hoses. The fan is mounted on shaft of water pump and both are belt driven from the crankshaft pulley. The thermostats control engine temperature and are installed in top of engine. The function of the cooling system is to maintain a specific operating temperature of 175 to 185°F (79 to 85°C) for the engine.

1-8.7. Lubrication System. The lubrication system consists of oil pan (sump), a gear type pump, full flow spin-on oil filter with built-in bypass valve, oil cooler with built-in bypass valve, pressure regulating valve, bypass valve, and the internal passages.

1-8.8. Fuel System. The function of the fuel system is to inject a metered quantity of clean atomized fuel into the engine cylinders at a precise time near the end of the compression stroke of each piston. The fuel system consists of the fuel tank, fuel filter/water separator, fuel supply pump, fuel injection pump, and the fuel injectors. The fuel tank is not mounted on the engine. The fuel supply pump is mounted to the block and is driven by the camshaft. The fuel injection pump is mounted on the front plate and is driven by an intermediate gear in the timing gear train meshing with crankshaft gear.

1-8.9. Electrical System. The electrical system is 24 VDC operation and consists of a battery charging alternator, starter, externally mounted batteries, and other items as required. The battery charging alternator is mounted on front of engine and is belt driven. When engine is operating, the battery charging alternator supplies 24 VDC to recharge the batteries and maintain them at a full state of charge. The starter is mounted on the flywheel housing and when energized, engages the ring gear of the flywheel to rotate the engine.

Table 3-2. Troubleshooting - Continued

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

Step 2. Check for defective thermostat.

a. If thermostat is suspected of being defective, replace thermostat. Refer to paragraph 3-9.

b. If engine continues to overheat, do step 3.

Step 3. Check for defective water pump.

a. Remove and check water pump for damage, refer to paragraphs 3-10.1. and 3-10.2. If not defective, do step 4.

b. Replace defective water pump. Refer to paragraph 3-10.

Step 4. Check improper fuel injection pump timing.

Adjust fuel injection pump timing. Refer to paragraph 3-28.

8. EXCESSIVE OIL CONSUMPTION.

Step 1. Check for oil leakage.

a. Inspect engine for oil leaks. If no leaks, do step 2.

b. Repair or replace defective components.

Step 2. Check for blocked air intake system.

Remove blockage as found. If not blockage, do step 3.

Step 3. Check for defective intake or exhaust valve seals or valve guides.

a. Repair or replace defective components. Refer to paragraph 3-33.

b. Disassemble and inspect valve seals and guides. Refer to paragraphs 3-33.3. and 3-33.4. If not defective, replace engine.

q. Remove crankshaft pulley, refer to paragraph 3-38.1.
r. Remove timing gear cover, refer to paragraph 3-39.1.
s. Remove oil pump drive gear, oil outlet tube, (and its O-ring in block), and pump body, refer to paragraph 3-21.1.
t. Remove oil slinger, timing gears, and camshaft, refer to paragraphs 3-40.1. and 3-41.1. Perform wear checks.
u. Remove engine front plate, refer to paragraph 3-42.1.
v. Remove lube oil system by-pass valve, refer to paragraph 3-22.1.
w. Stamp cylinder number on rod (if required). Remove pistons and rods, refer to paragraph 3-44.1. Perform wear checks with bearing gage (PLASTIGAGEPR1). Remove two at a time.
x. Remove crankshaft and main bearings, refer to paragraph 3-43.1. Perform wear checks with bearing gage.
y. Remove cylinder liners and mark each one with cylinder number from which removed, refer to paragraph 3-44.2.
z. Remove piston cooling orifices, refer to paragraph 3-44.1.
aa. Remove cylinder block plugs and serial number plate (as required) when block is to be put in a "hot tank".
ab. Clean out liner bores (upper and lower areas) with nylon brush.
ac. Measure cylinder block, refer to paragraph 3-46.3.
ad. Cap/cover all openings to prevent entry of foreign material.

3-4.2. Assembly.

NOTE

Remove all caps/covers.

a. Install all plugs (and serial number plates) in cylinder block that were removed to service block.
b. Install clean piston cooling orifices.
c. Install cylinder liners without O-rings and measure stand-out. Install liners with O-rings, refer to paragraph 3-49.2.
d. Install crankshaft and main bearings, refer to paragraph 3-43.4. Bearing gage bearings.
e. Install flywheel housing, rear oil seal, and flywheel, refer to paragraphs 3-37.3., 3-36.2., and 3-35.3.
f. Install pistons and rods, refer to paragraph 3-49.3. Measure piston protrusion for proper piston selection.
g. Install lube oil system by-pass valve, refer to paragraph 3-22.3.
h. Install engine front plate, refer to paragraph 3-42.5.
i. Install oil outlet tube, O-ring in block, and oil pump, refer to paragraph 3-21.3.
j. Install injection pump on front plate, refer to paragraph 3-27.8.
k. Install camshaft, timing gears, and oil slinger, refer to paragraph 3-40.3.
l. Time all gears Top Dead Center (TDC), No.1 cylinder on compression stroke.
m. Install timing gear cover (with new front seal), refer to paragraph 3-39.3.
n. Install oil pan, refer to paragraph 3-20.3.
o. Install oil pressure regulating valve, refer to paragraph 3-17.3.
p. Install cam followers in the same sequence as removed, refer to paragraph 3-34.
q. Install cylinder head gasket, cylinder head, pushrods, and rocker arm assembly, refer to paragraphs 3-34.7. and 3-33.5.
r. Install starter, refer to paragraph 3-12.7.

Section V. ELECTRICAL SYSTEM MAINTENANCE

3-11. BATTERY CHARGING ALTERNATOR.

3-11.1. Battery Charging Alternator Test (Installed).

a. Check for battery voltage in alternator between terminals POS and ground, and EXC and ground with the master switch (S1) in the PRIME & RUN POSITION. Note voltage.

b. Start and operate generator refer to TM 9-6115-645-10 and recheck voltage on alternator terminal POS and ground for 28 " 2 VDC.

WARNING

Prior to removing alternator, ensure negative battery lead is disconnected from battery to prevent serious injury or death.

3-11.2. Removal.

a. Tag and disconnect electrical leads from battery charging alternator.

b. Remove fan belts, refer to end item maintenance manual.

c. Remove capscrew (1, FIGURE 3-5), lockwasher (2), and washer (3); securing bracket (4) and battery charging alternator (5). Discard lockwasher (2).

d. Support weight of battery charging alternator and remove capscrew (6), lockwasher (7), and nut (8); securing bracket (4) and alternator (5). Remove bracket (4) and alternator (5). Discard lockwasher (7).

e. If necessary, remove capscrew (9), washer (19), and lockwasher (10) securing adjusting strap (11) to water pump mounting hole. Remove adjusting strap. Discard lockwasher (10).

f. If necessary, remove two capscrews (12), washers (13), spacers (16), and nuts (14) securing mounting brackets (15 and 17). Remove brackets (15 and 17).

g. If necessary, loosen and remove nuts (20) from terminals POS plus OUTPUT and SEN. Remove jumper wire (18).

3-11.3. Disassembly.

a. Remove terminal nuts (1, FIGURE 3-6), washers (2), bolts (3), back cover (4), and gasket (5) from rear housing (20)

b. Remove nuts (6), washers (33), strap (7), and brush assembly (8) from voltage regulator (11).

c. Remove bolts (9), insulating washers (10), and voltage regulator (11) from rear housing (20).

d. Remove nut (12) and washer (13) and straighten strap (14).

e. Remove screws (15). Tag and remove stator (22) leads from diode-trio (17).

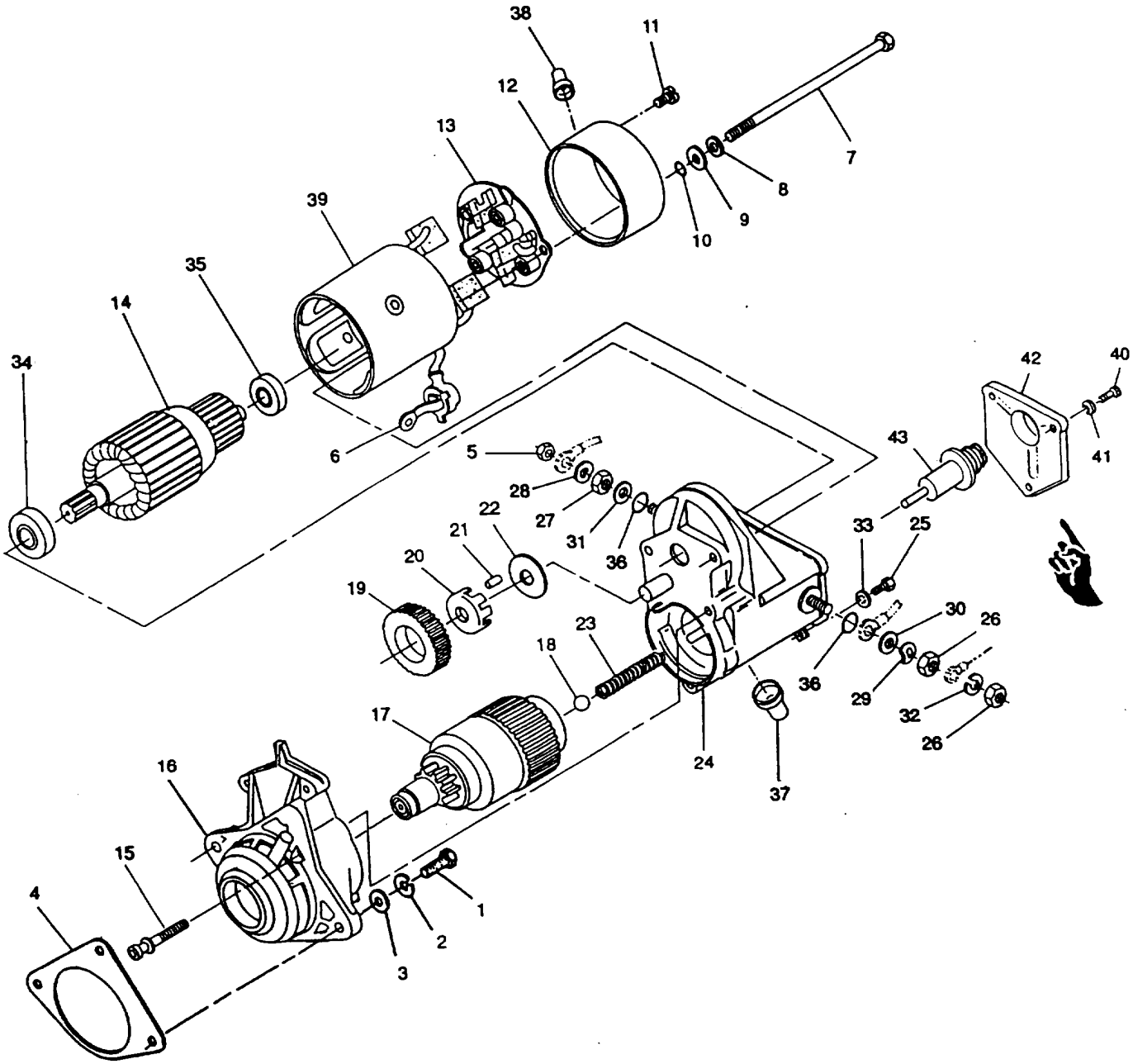

FIGURE 3-15. Starter Assembly

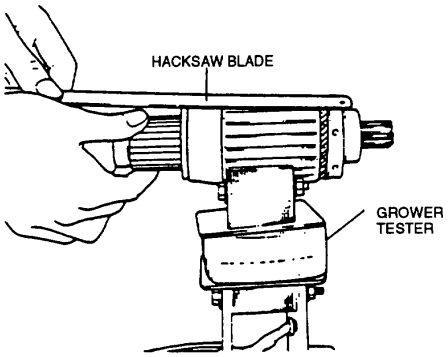

FIGURE 3-33. Growler Test

b. Set multimeter for ohms and touch one probe to a commutator segment and other one to armature core, refer to FIGURE 3-34. There should be no continuity. If there is continuity, armature is grounded. Replace armature if grounded.

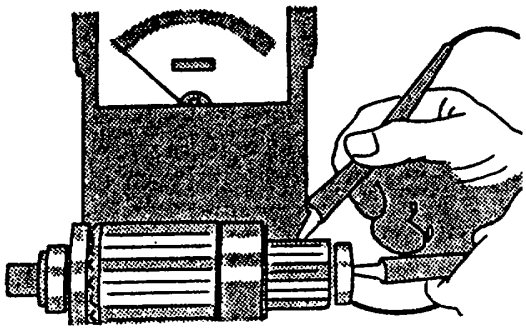

FIGURE 3-34. Testing for Grounded Windings

c. Set multimeter for ohms and touch probes to two segments, refer to FIGURE 3-35. There should be continuity at any point. If there is no continuity, winding is open circuited. Replace the armature if open circuited.

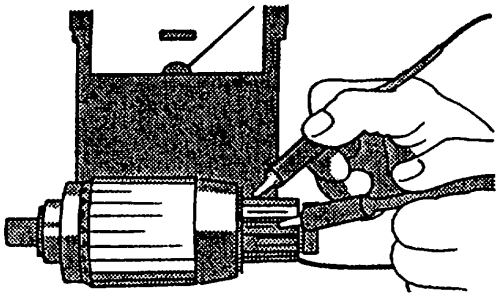

FIGURE 3-35. Checking for Open Circuit Windings

d. Set multimeter for ohms and touch one probe to positive brush holder plate and other one to the holder plate, refer to FIGURE 3-36. There should be no continuity. If there is continuity, replace brush holder.

a. Prime turbocharger lubrication system prior to mounting turbocharger on engine. Fill center housing with new engine lubricating oil (MIL-L-2104) through oil drain hole. Turn rotating assembly by hand to lubricate bearings.
b. Inspect air cleaner-to-turbocharger hose to see that it is in good condition. Replace hose if it is hard, cracked, or shows any signs of deterioration.
c. Remove all covers.
d. Position new stainless steel gasket (13, FIGURE 3-42) and turbocharger (12) on exhaust manifold and secure with four capscrews (10) and flatwashers (11). Tighten capscrews to 35 ft-lbs (47 Nm).
e. Position new gasket (9) and oil drain line (8) on turbocharger and secure with two capscrews (6) and new lockwashers (7). Tighten screws to 20 ft-lbs (27 Nm).
f. Connect oil inlet line (4) to fitting (5) on top of turbocharger.
g. Connect air intake manifold hose to turbocharger using clamps.
h. Connect air intake line and exhaust line to turbocharger, refer to end item maintenance manual.
i. Service engine lubrication system, refer to end item maintenance manual.
j. Before starting engine after installing turbocharger, perform the following:

NOTE
A new or rebuilt turbocharger does not have an adequate oil supply.

(1) Place throttle system so engine cannot start.
(2) Crank engine using starter until oil reaches turbocharger.

3-14. EXHAUST MANIFOLD.

3-14.1. Removal.

a. Remove turbocharger, refer to paragraph 3-13.1.

NOTE
Note location of different size capscrews for use during installation.

b. Remove eight capscrews (1 and 3, FIGURE 3-44) and washers (2), securing exhaust manifold (4) to engine. Remove manifold and six gaskets (5); discard gaskets.
c. Remove all residue and gasket material from gasket surfaces.
d. Thoroughly clean passages in exhaust manifold.
e. Cover all openings.

a. Inspect filler neck for cracks or other damage.
b. Inspect filler cap (10, FIGURE 3-50) and gasket (11) for damage. Replace as necessary.

3-18.3. Installation.
a. Remove covers.
b. Position new gasket (9, FIGURE 3-50) and filler neck (8) on engine block and secure with two capscrews (5 and 7) and washers (6).
c. Service engine lubrication system, refer to end item maintenance manual.

3-19. OIL DIPSTICK.

3-19.1. Removal.

a. Remove dipstick (1, FIGURE 3-51) from tube (3). Remove and discard preformed packing (2).

NOTE

Count number of threads exposed above jam nut (4) before loosening. This will aid in proper installation of tube (3).

b. Loosen jam nut (4) and unscrew tube (3) from engine block. Remove jam nut (4) from tube.

a. Loosen fuel supply line at fuel injection pump.

b. Operate primer lever of fuel supply pump until fuel flow is free from air bubbles. Tighten fuel supply line to 22 ft-lbs (30 Nm). Continue operating hand primer until pumping action is not felt. Pull hand primer outward (away from block) as far as it will go.

3-23.4. Bleed At Fuel Injection Nozzles.

a. Place throttle lever in fast idle position.

CAUTION

Always use two wrenches when loosening or tightening fuel lines at nozzles and/or injection pump to avoid damage.

(7) Remove pump (22) from mounting studs (25).

n. Cover all openings in pump and place pump in a clean area.

3-27.2. Disassembly.

NOTE

Work area must be clean and dirt free prior to disassembly of the fuel injection pump.

NOTE

Prior to disassembly, ensure a clean pan with diesel fuel or calibrating oil is available. Also, ensure a clean pan is available to store disassembled parts.

NOTE

Do not discard seals, gaskets, insulator washers, and preformed packing during disassembly. Seals, gaskets, and preformed packing are to be removed and discarded during assembly. Do not discard retaining ring.

a. Cover inlet and outlet ports.

WARNING

Eye protection must be worn prior to performing any cleaning. Personal injury or blindness can occur if solvents get in eyes.

b. Clean external grease and dirt with diesel fuel. Blow dry with compressed air.

c. Using a flat-blade screwdriver, remove pilot tube seal (1, FIGURE 3-73) from mounting flange end of pump.

CAUTION

Always use holding fixture to mount injector pump and prevent injector pump from being damaged during disassembly. NEVER damp pump in a vise. Damage to pump may occur. Fabricate holding fixture in accordance with FIGURE D-1, Appendix D.

d. Mount injection pump in holding fixture.

e. If necessary, remove connector (1, FIGURE 3-64) and preformed packing (2) from cover.

f. Remove two screws (3), lockwashers (4), washers (5), cap (91), screw (92), and sleeve (93) securing governor control cover (6). Remove cover (6) with solenoid (16) and gasket (7).

g. Remove two self-locking nuts (8), terminal (89), insulator (90), and diode from solenoid studs.

h. If equipped and damaged, remove terminal strap (9), and washer (11) and lockwasher (10).

i. Remove two nuts (12), one lockwasher (13), one washer (14), and two insulator washers (15) securing solenoid (16) to cover (6); remove solenoid.

j. Remove two insulating tubes (85 and 86).

k. Rotate shut-off lever (27) to wide open throttle (WOT) position.

NOTE

Never reuse shut-off lever (17). Always use a new one.

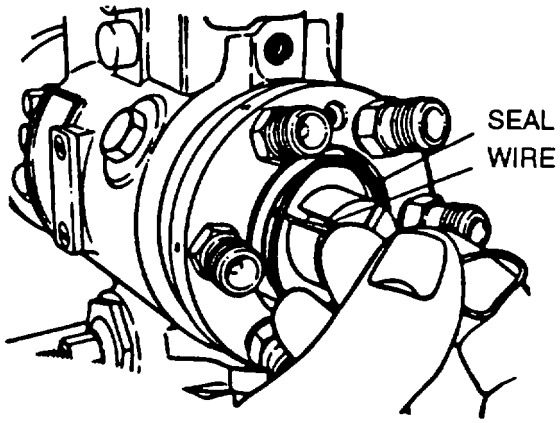

FIGURE 3-76. Removing End Cap Seal

ac. Invert pump and holding fixture in vise.

ad. Remove head locating screw (54, FIGURE 3-64) and two preformed packings (55), refer to FIGURE 3-77.

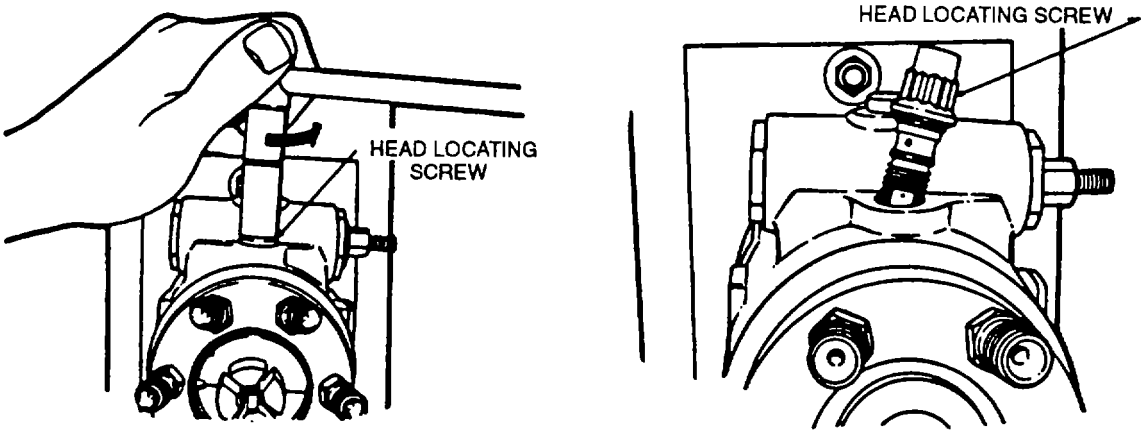

FIGURE 3-77. Removing Head Locating Screw

ae. Remove plug (56, FIGURE 3-64), seal (57), and pin (71), refer to FIGURE 3-78.

c. Place rotor on weight cage and secure in vise.

d. Place three cushion retainers (31) on the weight retainer pins.

NOTE

On some fuel injection pumps, the retainers were secured with six retainer rings. The gasket kit used for reassembly will contain three retaining clips (30). All three retaining clips must be installed in same direction with long slot positioned clockwise relative to hole with short slot.

NOTE

The clips are to be installed over retainers and fastened onto same two pins that are connected by retainers.

e. Place large diameter hole of each of three clips (30) over weight retainer pins.

NOTE

If retaining clip binds or requires excessive force to rotate clip onto pin, stop and check for proper alignment of clip to groove in pin. Do not force clip into place.

f. Rotate clips in clockwise direction while pulling until clip snaps into groove of pin.

NOTE

Upon completion of installation of clips, check to make sure that clips are tight and positioned in grooves of weight retainer pins. Clips should lie flat and be in correct orientation.

g. Rotate slotted end of each clip over adjacent pin and press each side of clip over pin until it snaps into place.

h. Check or relocate timing mark on governor weight retainer (33) as follows:

(1) Place weight retainer (33, FIGURE 3-73) on timing line locator tool (20395).

(2) Rotate weight retainer and rotor hub in direction indicated on tool until movable pointer lines up with 120 degree mark.

(3) Check to see if timing mark on rotor hub is aligned with ± one degree with fixed arrow point on tool.

(4) If not, remove existing mark, repeat step (1) thru (3) and scribe a new mark on hub. New hubs will have no timing mark. The timing mark will have to be added.

NOTE

Do not mistake slight interference of retractor collect in bore for delivery valve sticking. If valve is not secured straight and tight in retractor collect, collect diameter can drag in rotor bore.

i. Using extractor (13383), install delivery valve (37) into bore of rotor. Ensure it slides freely in its bore, refer to FIGURE 3-89.

bc. Insert control rod pin (4, FIGURE 3-67) into hole at end of control rod (5) and insert control rod into control rod guide (6).

bd. Install adjusting cap seal (3) into seal groove on adjusting cap (2). Align roll pin slot in adjusting cap (2) with control rod pin (4) at end of control rod and slide control rod into control rod guide (6).

be. Thread droop control locking cap (1) onto control rod guide (6) and tighten while supporting control rod guide in place.

bf. With bushing (10) threaded against control spring guide on control rod assembly (5), thread control spring (7) five full turns onto control spring guide. Slip free end of control spring (7) over tabs of governor arm (14) with bent-in end part of control spring between the two tabs.

bg. If necessary, assemble throttle shaft assembly as follows:

(1) Install a nut (40, FIGURE 3-64) on each screw (38 and 39). Install screws in shaft assembly (18).

(2) Position spacer (37), adjusting arm (35), lever (34), spring (33), and retainer' (32) on shaft assembly (18) and secure with screw (31).

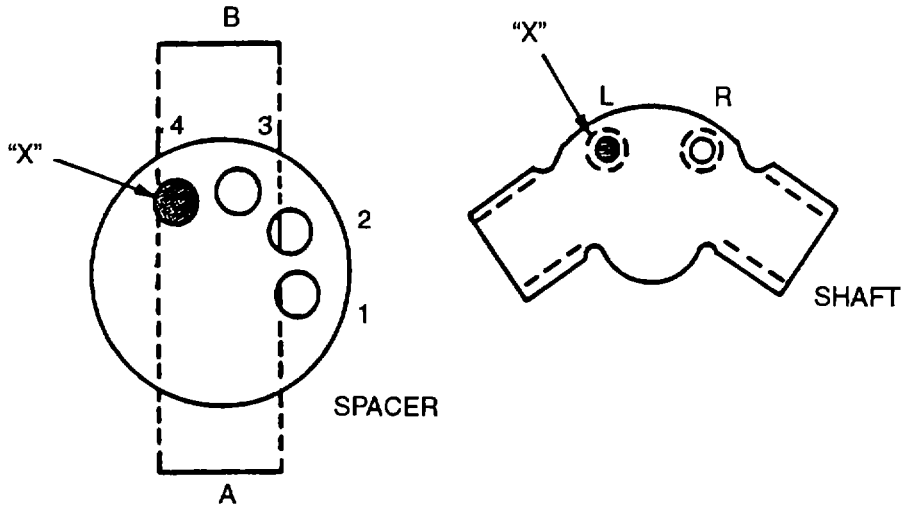

FIGURE 3-100. Alignment of Spacer

bh. If necessary, assemble shutoff lever shaft assembly as follows:

(1) Install a nut (29) on each screw (28) and install screws (28) in shaft assembly (30).

NOTE

FIGURE 3-101 indicates alignment hole for adjustment shutoff arm (27, FIGURE 3-64) for this application.

(2) Position adjustment shutoff arm (27) on shaft assembly (30) and secure with two washers (25 and 26), screw (23), and adjustment shutoff screw (24).

TABLE 3-4. Fuel Injection Pump Specifications - continued

Pump Calibration Checks – Continued:

RPM	THRTL. POS.	mm^3/Stroke	Advance
75	WOT	52 Min.	– – –
200	WOT★	4 Max.	– – –
262 .5	WOT	– – –	1° – 3°
350	WOT	– – –	2.5°– 3.5°
875	WOT	104–108	– – –
875	WOT★	4 Max.	– – –
935	WOT	10–15	– – –
960	WOT	5 Max.	– – –

★E.S.O. De–Energized.

Pump Settings: Following Pump Service.

1. Roller to Roller Dimension: 1.9705 to 1.9735 (50.05 to 50.13 mm)
   Maximum Eccentricity: .004 in. (0.10 mm) T.I.R.
2. Gov. Linkage Gap: .125 to .145 in. (3.2–3.7 mm)
3. 500 RPM (WOT): Operate pump for 10 minutes to bring to operating temperature and clear air from system.
4. 200 RPM (WOT):
   a. Check Shut Off: 4 mm^3/Stroke, Max.
   b. Check for minimum transfer pump lift of 18 in. HG. (60 kPa).
5. 875 RPM (WOT):
   a. Check test stand boost pressure for 1.5 to 2.5 psi (10.3 to 17 kPa)
   b. Set transfer pump pressure for 79 to 81 psi (545–558 kPa).
   c. Adjust return oil to 200–500 cc/min. Substitute vent wire screws as required. Recheck transfer pump pressure.
   d. Check housing pressure for 4–10 psi (28–69 kPa).
6. 262.5 RPM (WOT): Set advance trimmer screw for 2°.
7. 875 RPM (WOT): Set roller to roller fuel delivery – 105.5–106.5 mm^3/Stroke, refer to paragraph 3–27.6., steps p and r.
8. Turn speed droop adjusting cap in 2 full turns clockwise.
9. 935 RPM (WOT): Adjust high idle screw to obtain 10–15 mm^3/Stroke.
10. Check points:

NOTE: Maximum cylinder variation should be ± 4 mm^3/Stroke from average flow of all cylinders.

RPM	THRTL. POS.	mm^3/STROKE	ADVANCE	T.P. PRESS
75	WOT	53 Min.	– – –	★★10 Min.
200	WOT★	4 Max.	– – –	– – –
262 .5	WOT	– – –	1°–3°	– – –
350	WOT	– – –	2.5° –3.5°	– – –
875	WOT	105.5–106.5	– – –	★★★ 78–80
875	WOT★	4 Max.	– – –	– – –
935	WOT	10–15	– – –	– – –
960	WOT	5 Max.	– – –	– – –

★ E.S.O. Deenergized
★★ (69 kPa)
★★★ (546–558 kPa)

c. Install nozzle (5) in cylinder head using a slight twisting motion as nozzle is seated in bore.

d. Install bolt (4). Do not tighten bolt (4) at this time.

CAUTION

Always use two wrenches when loosening or tightening fuel lines at nozzles to avoid damage to equipment.

e. Remove caps and connect fuel pressure line to nozzle. Leave connection slightly loose until air is bled from system.

f. Tighten nozzle hold-down bolt (4) to 27 ft-lbs (37 Nm).

g. Install leak-off line assembly. Secure with new grommet (2) and coupling nut (3).

h. Bleed fuel system, refer to paragraph 3-23.

3-30. AFTER ENGINE INSTALLATION TESTING.

3-30.1. Test Fuel Injection Noz7les (Engine Running).

a. Operate engine at intermediate speed and no load.

CAUTION

Always use two wrenches when loosening or tightening fuel lines at nozzles to avoid damage to equipment.

b. Slowly loosen fuel pressure line at one nozzle until fuel escapes at the connection (fuel not opening nozzle valve).

c. If engine speed changes, injection nozzle is probably working satisfactory. If engine speed does not change, nozzle is faulty and must be checked and/or replaced.

d. Repeat test for each remaining nozzle assembly.

e. Remove faulty injection nozzles and replace, refer to paragraph 3-29.

3-30.2. Fuel Drain Back Test.

NOTE

Fuel draining back through fuel system may cause hard starting. This procedure will determine if air is entering system at connections and allowing fuel to siphon back to fuel tank.

a. Disconnect fuel supply line and fuel return line at fuel tank, refer to end item maintenance manual.

CAUTION

Fuel return line must extend below fuel level in fuel tank before performing this test. Fill fuel tank if necessary.

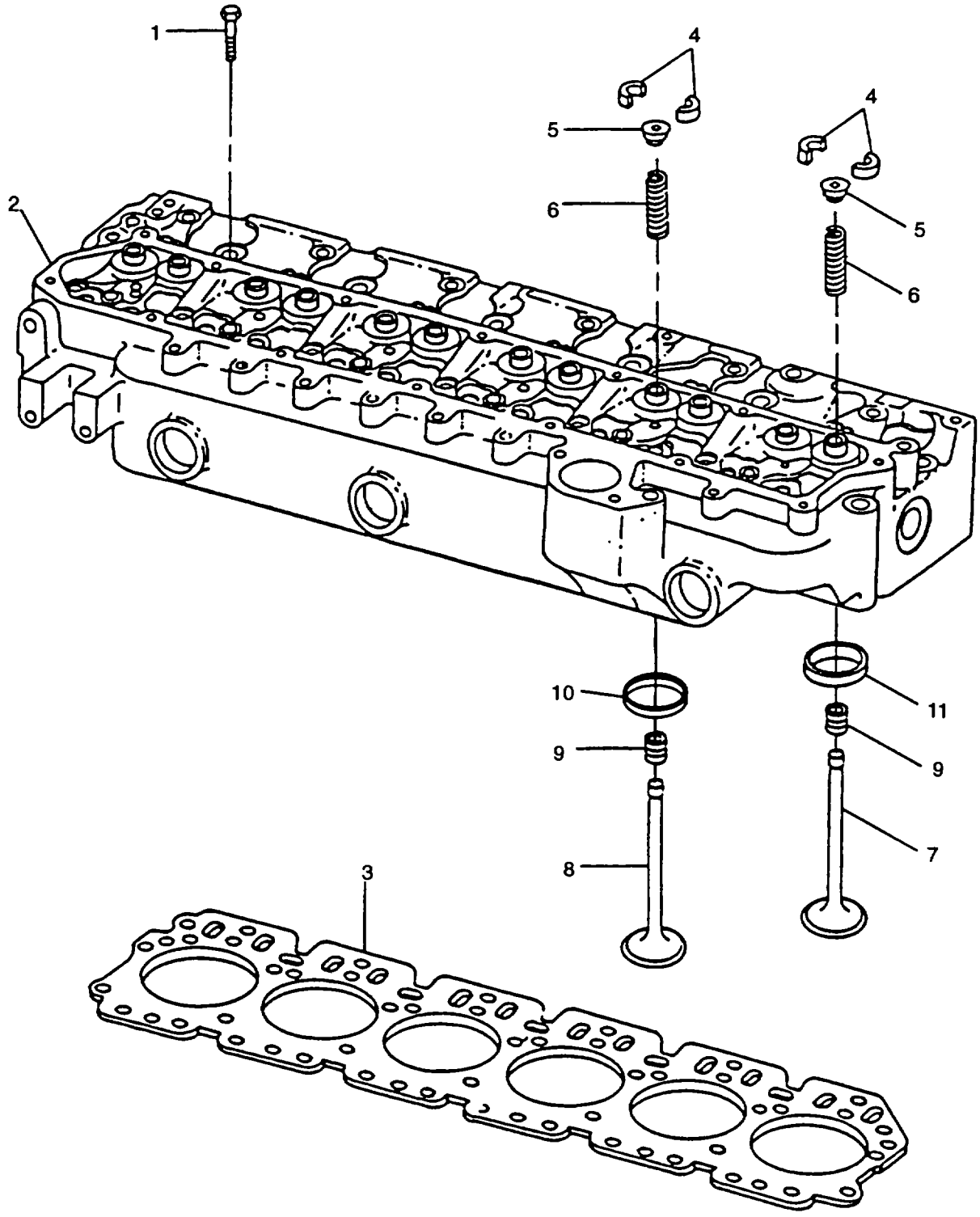

FIGURE 3-119. Cylinder Head Assembly

3-34.7. Installation.

a. Perform procedures in paragraph 3-34.6.
b. Place new cylinder head gasket (3, FIGURE 3-119) on cylinder block. Do not use sealant; install dry.

CAUTION

Without guide studs, viton O-ring seal bonded in cylinder head gaskets (at rocker arm lube oil passage) could become damaged if cylinder head requires repositioning on engine block to align capscrew holes.

c. Install two guide studs in cylinder block (for piloting cylinder head) at locating holes 16 and 17 shown in FIGURE 3-124.

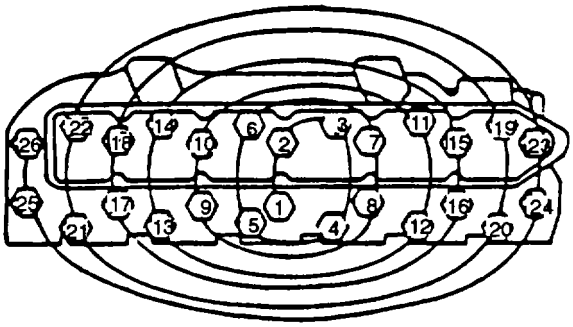

FIGURE 3-124. Cylinder Head Capscrew Tightening Sequence

d. Using a lifting device, position cylinder head (2, FIGURE 3-119) over guide studs and lower into place on cylinder block.

e. Dip entire capscrew (1) in clean engine lubricating oil (MIL-L-2104). Remove excess oil from screw.

f. Remove guide studs. Install twenty-six cylinder head capscrews (1).

g. Tighten capscrews (1) in sequence shown in FIGURE 3-124 to torque specified below, beginning with No. 1 capscrew. Complete each step on all capscrews before proceeding to next step.

(1) Step 1 - Tighten all capscrews to 75 ft-lbs (100 Nm).

(2) Step 2 - Tighten all capscrews to 110 ft-lbs (150 Nm).

(3) Step 3 - Wait 5 minutes and verify 110 ft-lbs (150 Nm).

h. After tightening capscrews (in proper sequence) to 110 ft-lbs (150 Nm), follow the steps below for each capscrew in same sequence as outlined in step g.

(1) Make a mark on socket and make a second mark 1/6 turn (60 10 degrees) counterclockwise from the first.

(2) Make a mark on cylinder head next to each capscrew.

(3) Place socket on capscrew so that first mark aligns with mark on cylinder head.

(4) Tighten (in sequence) all caps crews until second mark on socket aligns with mark on cylinder head.

CAUTION

Do not invert crankshaft front oil seal main (inner) lip. Make sure that this seal lip faces inward towards crankcase to prevent oil leakage. Dust lip (outer) faces installer away from crankcase.

h. Install timing gear cover (6) on engine.

i. Rotating cover back and forth slightly to engage seal (5) lip as cover is pushed into position, secure timing gear cover (6) with two nuts (4), twelve washers (3), two capscrews (2), and ten capscrews (1). Tighten fasteners to 35 ft-lbs (47 Nm).

j. Install oil pressure regulating valve, refer to paragraph 3-17.3.

k. Make and install gasket between timing gear cover and oil pan.

I. Install crankshaft pulley, refer to paragraph 3-38.3.

m. Install oil filler assembly, refer to paragraph 3-18.3.

n. Install battery charging alternator and alternator mounting bracket, refer to paragraph 3-11.6.

o. Install water pump, refer to paragraph 3-10.4.

p. Install fan and fan drive belts, refer to end item maintenance manual.

q. Service lubrication system, refer to end item maintenance manual.

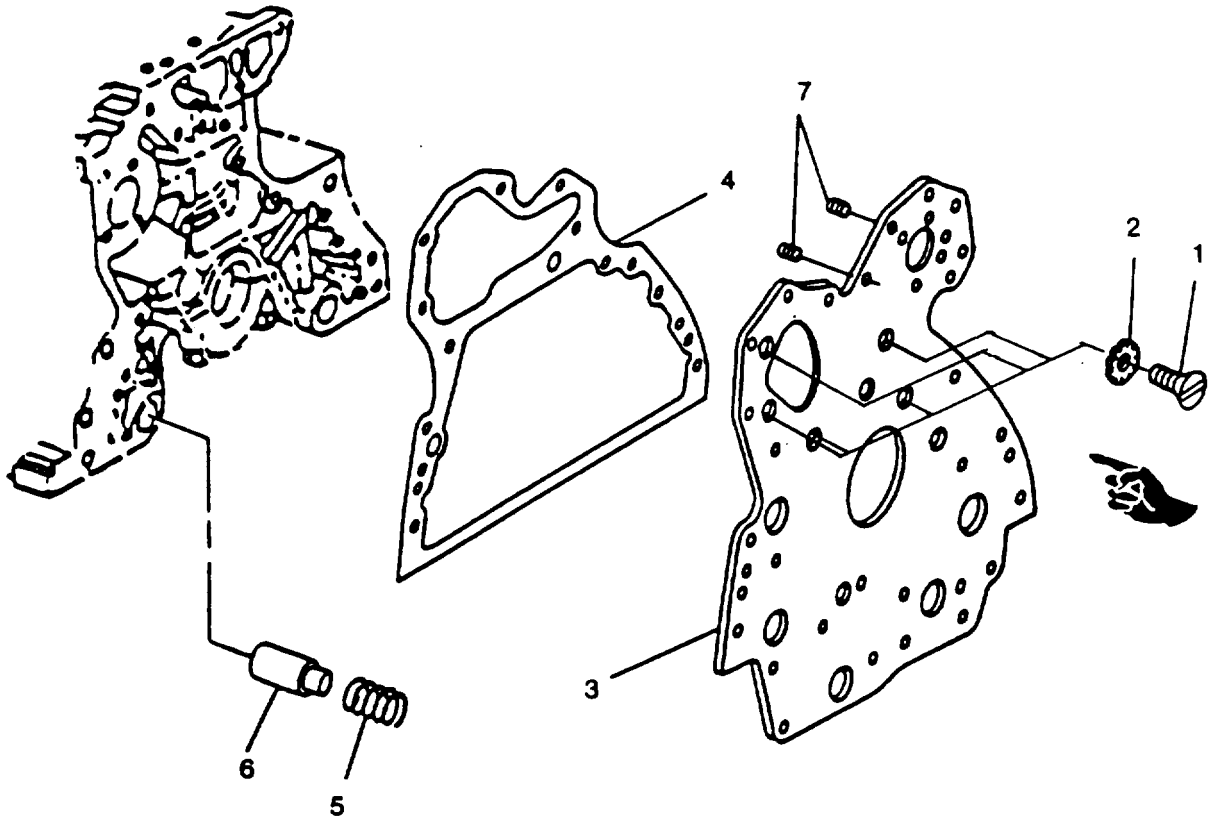

FIGURE 3-136. Front Plate

3-42.2. Inspection.

WARNING

Cleaning solvent is flammable and toxic to eyes, skin, and respiratory tract. Skin/eye protection required. Avoid repeated/prolonged contact. Good general ventilation is normally adequate.

WARNING

Compressed air used for cleaning can create airborne particles that can enter the eyes. Pressure will not exceed 30 psig (207 kPa). Eye protection required.

d. Care must be taken to avoid localized heating which often produces grinding cracks. Use coolant generously to cool crankshaft while grinding. Do not crowd grinding wheel into work.
e. Polish or lap (counterclockwise) ground surfaces to specified finish. Reground journals will be subject to excessive wear unless polished smooth.

NOTE

When thrust surfaces are reground and an oversize washer is used, crankshaft end play specification must be maintained.

f. If thrust surfaces of crankshaft are worn or grooved excessively, they must be reground and polished. Care must be taken to maintain specified radius between each thrust surface and bearing journal. An oversize thrust washer set is available.
g. Stone edge of all oil holes in journal surfaces smooth to provide a radius of approximately 0.060 inch (1.50 mm).
h. After grinding has been completed, inspect crankshaft by fluorescent magnetic particle method, or other similar method to determine if cracks have originated due to grinding operation.
i. Demagnetize crankshaft.

WARNING

Cleaning solvent is flammable and toxic to eyes, skin, and respiratory tract. Skin/eye protection required. Avoid repeated/prolonged contact. Good general ventilation is normally adequate.

WARNING

Compressed air used for cleaning can create airborne particles that may enter the eyes. Pressure will not exceed 30 psig (207 kPa). Eye protection required.

j. Thoroughly clean crankshaft and oil passages with solvent. Dry with compressed air.

3-43.4. Installation.

a. Install gear (11, FIGURE 3-137) on crankshaft as follows:

WARNING

Oil fumes or oil can ignite above 380° F (193°C). Use a thermometer and do not exceed 360°F (182°C). Do not allow a flame or heating element to be in direct contact with oil. Heat oil in a well ventilated area. Plan a safe handling procedure to avoid burns. Wear protective clothing, gloves, apron, etc.

(1) Heat gear (11), in oil, to 360°F (182°C).

NOTE

A properly heated gear may not require a driver for installation.

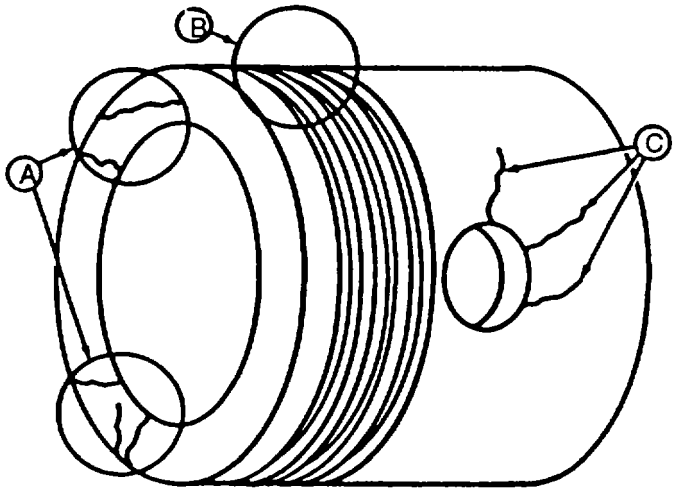

FIGURE 3-147. Piston Inspection

l. If the original machining marks are not visible, or the piston skirt is worn to depth of original machining marks, replace both piston and liner. If any defects are found, replace piston and liner as a matched set. If no defects are found, proceed to next step.

m. Check top ring groove using a new piston ring and feeler gage, refer to FIGURE 3-148. Ring groove clearance must not exceed 0.008 inch (0.20 mm) when measured between top of ring and ring land. If ring groove is worn, replace piston and liner as a matched set. If ring groove is good, proceed to next step.

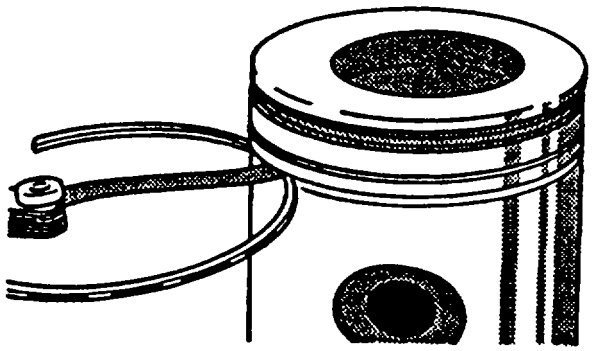

FIGURE 3-148. Checking Piston Ring Groove Clearance

n. Check second and third ring grooves using a new piston ring and a feeler gage. Ring groove clearance must not exceed 0.008 inch (0.20 mm). Replace piston if clearance exceeds specification.

NOTE

Piston pin must be in good condition and not worn beyond specification given in step q.

o. Dip piston pin in clean engine lubricating oil (MIL-L-2104)

p. Install pin (6, FIGURE 3-143) through piston.

(1) Pin should pass through piston using only light thumb pressure.
(2) Check taper in piston pin bore by inserting pin from both sides, refer to FIGURE 3-149. If pin enters freely, but binds in center, bore could be tapered. If bore is not tapered, insert pin to check for bore alignment. Pin should not click or need to be forced into bore on opposite side.

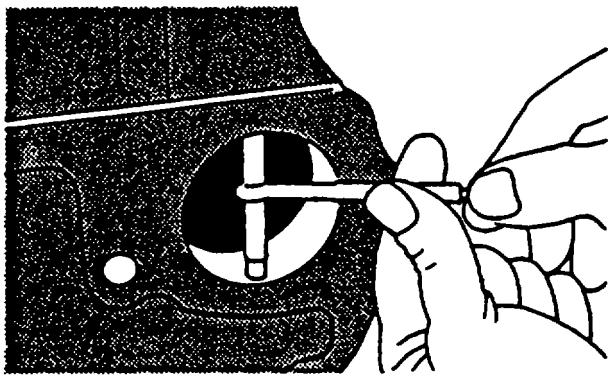

FIGURE 3-159. Measuring Camshaft Bore Diameter

(6) Measure cylinder block top deck flatness using precision straightedge, refer to FIGURE 3-160. New flatness is 0.003 inch (0.08 mm). If flatness is not as specified, resurface engine block.

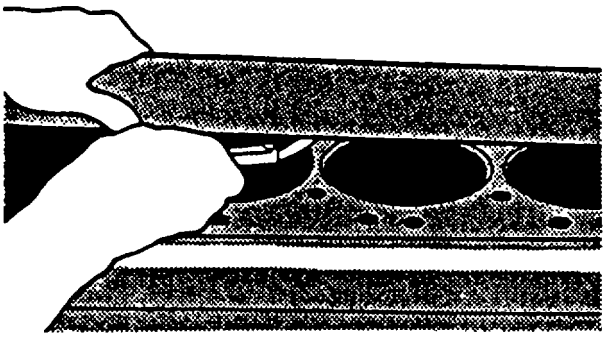

FIGURE 3-160. Measuring Cylinder Block Top Deck Flatness

CAUTION

When cylinder block is machined (top deck or crankshaft bearing bores), the dimension from centerline of crankshaft bearing bore to top deck will be changed. Make sure that this dimension will not be less than 11.889 inches (301.98 mm). Otherwise, piston may contact cylinder head.

CAUTION

If cylinder block top deck is resurfaced, also measure depth of liner counter bores. Bore depth must be within 0.234 to 0.236 inch (5.95 to 5.99 mm).

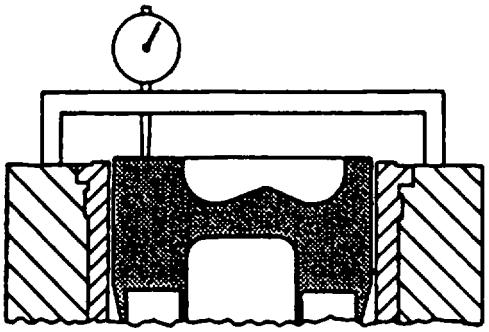

FIGURE 3-172. Measuring Piston Protrusion

l. Install oil pump and outlet tube, refer to paragraph 3-21.3.

m. Install oil pan, refer to paragraph 3-20.3.

n. Install cam followers, refer to paragraph 3-34.7.

o. Install cylinder head, refer to paragraph 3-34.7.

p. If engine was completely disassembled, perform steps r through ad of paragraph 3-34.2.

SECTION III TOOL AND TEST EQUIPMENT REQUIREMENTS FOR DIESEL ENGINE MODEL 6059T

TOOL OR TEST EQUIPMENT REF CODE	MAINTENANCE LEVEL	NOMENCLATURE	NATIONAL NATO STOCK NUMBER	TOOL NUMBER
1	O	SHOP EQUIPMENT, AUTOMOTIVE MAINTENANCE AND REPAIR: ORGANIZATIONAL MAINTENANCE COMMON NO. SS POWER	4910-00-754-0654	SC4910-95-CL-A74
2	F, H	SHOP EQUIPMENT, FUEL AND ELECTRICAL SYSTEM ENGINE, FIELD MAINTENANCE BASIC, LESS POWER	4940-00-754-0714	SC4910-95-CL-B20
3	H	SHOP EQUIPMENT, AUTOMOTIVE MAINTENANCE AND REPAIR: FIELD MAINTENANCE, SUPPLEMENTAL SET NO. 2, LESS POWER	4910-00-754-0707	SC4910-95-CL-A63
4	F, H	TOOL SET, BASIC, FIELD MAINTENANCE	4910-00-754-0705	SC4910-95-CL-A31
5	O, F, H	TOOL KIT, GENERAL MECHANIC'S	5180-00-177-7033	SC5180-90-CL-N26
6	F	CENTER, VALVE INSPECTION		D-05058ST
7	H	SEAUBEARING INSTALLATION TOOL	5120-01-351-3955	28316
8	H	SEAUBEARING REMOVAL TOOL	5120-01-351-3953	28311
9	H	DRIVER, IDLER GEAR		JD-252
10	H	TOOL, GEAR TIMING	5120-01-353-1121	JD-254
11	F	DRIVER, PILOT		JDG-676
12	F, H	PIN, ECCENTRIC	5315-01-321-6068	JDE-81-4
13	F	ADAPTER, VALVE INSERT		JDG-675
14	H	GAGE, PISTON/LINER	5210-01-351-5114	JDG451
15	F, H	HANDLE, OIL SEAL DRIVER	5120-00-034-0881	10914188
16	H	DRIVER, GEAR		JDH-7
17	F	DRIVER, BUSHING		JD248A
18	F, H	INSTALLER SET, SEAL	5120-01-334-7012	JT30040
19	F	STAND, CALIBRATION	4910-01-121-6869	77-7028
20	H	EXTRACTOR	5120-00-816-7059	13383
21	H	FIXTURE	5120-01-200-4526	19969
22	H	GAGE, LINKAGE	5120-00-816-7031	18914
23	F	HANDLE, OIL REGULATING VALVE BUSHING DRIVER		JDG-536

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