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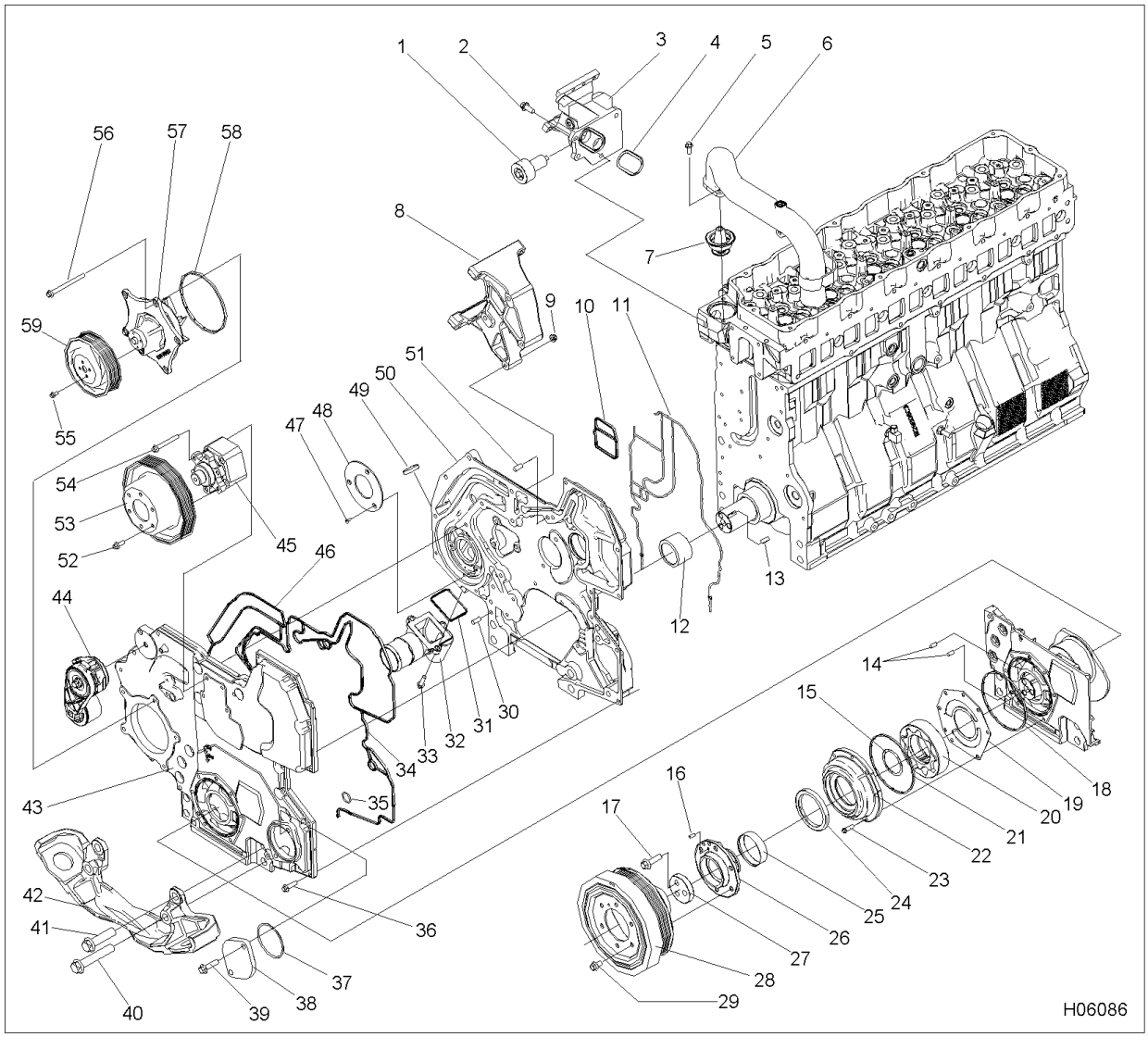

Figure 186 Front cover related components (less gear train)

1. Flat idler pulley assembly
2. Bolt, M10 x 25 (4)
3. Water supply housing
4. Coolant port seal
5. Bolt, M8 x 25 (2)
6. Water outlet tube assembly
7. Thermostat assembly
8. Alternator bracket
9. Nut, M8
10. Coolant gasket
11. Oil gasket
12. Oil pump drive
13. Vibration damper key
14. Dowels (2)
15. Washer, seal
16. Pin, 6 mm x 16 mm
17. Bolt, M12 x 40 (3)
18. Oil pump housing seal
19. Oil pump housing plate
20. Gerotor oil pump assembly
21. Oil pump housing seal
22. Oil pump housing
23. Bolt, M8 x 25 see bolt locations (Figure 236)
24. Front oil seal
25. Wear sleeve
26. Damper hub
27. Damper retaining plate
28. Vibration damper
29. Bolt, M10 x 20 (6)
30. Dowel
31. Water inlet gasket
32. Water inlet elbow
33. Bolt, M8 x 30 (3)
34. Front cover gasket (oil)
35. O-ring seal
36. Bolt, M8 x 30 see bolt locations (Figure 228)
37. O-ring seal (#235), PTO equipped only
38. End cover adapter, PTO equipped only
39. Bolt, M10 x 40 (2), PTO equipped only
40. Bolt, M18 x 100 (2)
41. Bolt, M18 x 70 (2)
42. Front engine mount
43. Cover, front half (PTO equipped)
44. Auto tensioner
45. Fan drive assembly
46. Coolant gasket
47. Flat head socket screw, M5 (3)
48. Wear plate
49. Cup plug
50. Cover, rear half
51. Dowel
52. Bolt, M8 x 20 (6)
53. Fan drive pulley
54. Bolt, (4) see bolt sizes (Table 19)
55. Bolt, M6 x 12 (4)
56. Bolt, (5) see water pump (Figure 248)
57. Water pump assembly
58. Water pump seal
59. Water pump pulley

Checking Gear Train Timing Without Removing Front Cover

Valve train failures from broken or bent push rods, valves, rocker arms and worn valve keepers and/or rotators in many instances could be caused by improper timing of the gear train. Depending on valve lash setting, if the camshaft gear is improperly timed by one tooth early, the engine pistons will strike the intake valve heads or if the timing is set one tooth late, the exhaust valves may contact pistons.

NOTE: Before attempting to check gear train timing, it will be necessary to remove the valve cover, valve cover gasket, and high-pressure oil manifold or Diamond Logic™ engine brake. See the appropriate sections of this manual regarding removal and installation procedures.

DT 466 Engines Only

Method One – Using a Feeler Gauge

1. Rotate the engine to approximately TDC (Top Dead Center) compression on No. 1 cylinder (no valves open). Set the lash on the No. 1 intake valve to the nominal lash setting of 0.48 mm (0.019 in).

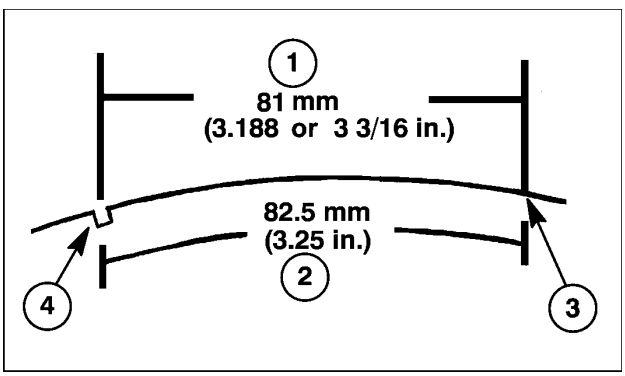

Figure 187 Checking Engine Gear Train Timing

1. Straight line dimension
2. Radial distance dimension
3. Scribe mark
4. Damper timing notch

2. Scribe a mark on the damper pulley at a radial distance of 82.5 mm (3.25 in) or a straight line distance of 81 mm (3.188 in) clockwise from the timing notch as viewed from the front of the engine.
3. Place a 0.28 mm (0.011 in) feeler gauge between the rocker arm and the valve bridge of the No. 1 intake valve. Slowly rotate the engine forward (clockwise) until the intake valve starts to lift and the feeler gauge becomes tight. The mark should line up with the TDC arrow on the front cover or be within 3.5 crankshaft degrees of it. 3.5 degrees is equivalent to a radial (or straight) line distance of 6.8 mm (0.27 in) at the damper pulley.

NOTE: One tooth “out of time” on the gear train equals approximately 11 degrees of movement or 21.4 mm (27/32 in) of radial distance of damper pulley.

4. If the timing on the No. 1 valve is within specifications, the other valves, barring extreme camshaft lobe wear or poor adjustment, will also be in time. If timing is found to be incorrect, removal of the front cover is required to inspect the punch marks on the gear train.

Method Two – Using a Dial Indicator

1. Adjust the No. 1 intake valve with the No. 1 piston set at TDC (Top Dead Center) compression stroke to 0.48 mm (0.019 in). Install a 0.28 mm (0.011 in) feeler gauge between the rocker arm and the valve bridge of the No. 1 intake valve.
2. Position the magnetic base dial indicator on the valve cover fence of the cylinder head rail with the indicator tip on the No. 1 intake rocker arm tip.
3. Zero the dial indicator.
4. Rotate the engine approximately one full revolution in either direction to a position 360 degrees from starting point.
5. The dial indicator should read within the range of 0.13-0.25 mm (0.005-0.010 in) from the starting position for proper gear train timing.
6. If dial indicator readings are found to be outside of this range, removal of the front cover is required to inspect the punch marks on the gear train.

DT 570 and HT 570 Engines Only

Method One – Using a Feeler Gauge

1. Rotate the engine to approximately TDC (Top Dead Center) compression on No. 1 cylinder (no valves open). Set the lash on the No. 1 intake valve to the nominal lash setting of 0.48 mm (0.019 in).

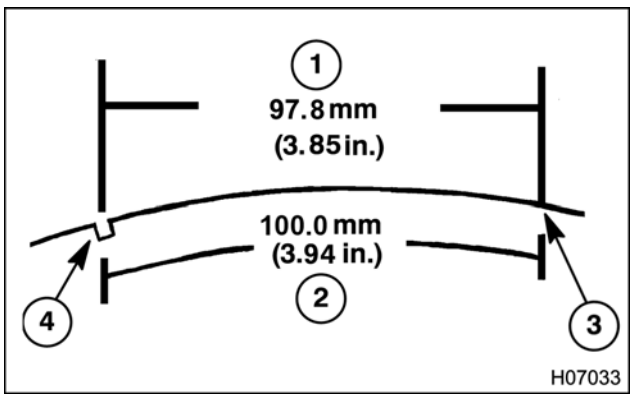

Figure 188 Checking Engine Gear Train Timing

1. Straight line dimension
2. Radial distance dimension
3. Scribe mark
4. Damper timing notch

2. Scribe a mark on the damper pulley at a radial distance of 100.0 mm (3.94 in) or a straight line distance of 97.8 mm (3.85 in) clockwise from the timing notch as viewed from the front of the engine.
3. Place a 0.28 mm (0.011 in) feeler gauge between the rocker arm and the valve bridge of the No. 1 intake valve. Slowly rotate the engine forward (clockwise) until the intake valve starts to lift and the feeler gauge becomes tight. The mark should line up with the TDC arrow on the front cover or be within 3.5 crankshaft degrees of it. 3.5 crank degrees is equivalent to a radial (or straight) line distance of 8.1 mm (0.32 in) at the damper pulley.

NOTE: One tooth “out of time” on the gear train equals approximately 11 degrees of movement or 21.4 mm (27/32 in) of radial distance of damper pulley.

4. If the timing on the No. 1 valve is within specifications, the other valves, barring extreme camshaft lobe wear or poor adjustment, will also be in time. If timing is found to be incorrect, removal of the front cover is required to inspect the punch marks on the gear train.

Method Two – Using a Dial Indicator

1. Adjust the No. 1 intake valve with the No. 1 piston set at TDC (Top Dead Center) compression stroke to 0.48 mm (0.019 in). Install a 0.28 mm (0.011 in) feeler gauge between the rocker arm and the valve bridge of the No. 1 intake valve.
2. Position the magnetic base dial indicator on the valve cover fence of the cylinder head rail with the indicator tip on the No. 1 intake rocker arm tip.
3. Zero the dial indicator.
4. Rotate the engine approximately one full revolution in either direction to a position 360 degrees from starting point.
5. The dial indicator should read within the range of 0.13-0.25 mm (0.005-0.010 in) from the starting position for proper gear train timing.
6. If dial indicator readings are found to be outside of this range, removal of the front cover is required to inspect the punch marks on the gear train.

Removal

Alternator Bracket

WARNING: To avoid serious personal injury, possible death, or damage to the engine or vehicle, read all safety instructions in the "Safety Information" section of this manual.

WARNING: To avoid serious personal injury, possible death, or damage to the engine or vehicle, make sure the transmission is in neutral, parking brake is set, and wheels are blocked before doing diagnostic or service procedures on engine or vehicle.

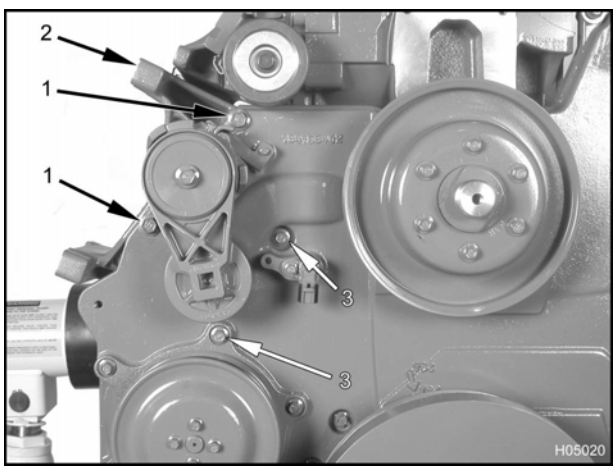

Figure 189 Alternator bracket bolts

1. Bolt, M10 x 120 (2)
2. Alternator bracket
3. Bolt, M8 x 100 (2)

1. Remove bolt (M8) and harness routing guide.
2. Remove two hex flange bolts and nuts (M10 x 120).
3. Remove two hex flange bolts and nuts (M8 x 100).
4. Remove alternator bracket.

Flat Idler Pulley and Automatic Belt Tensioner

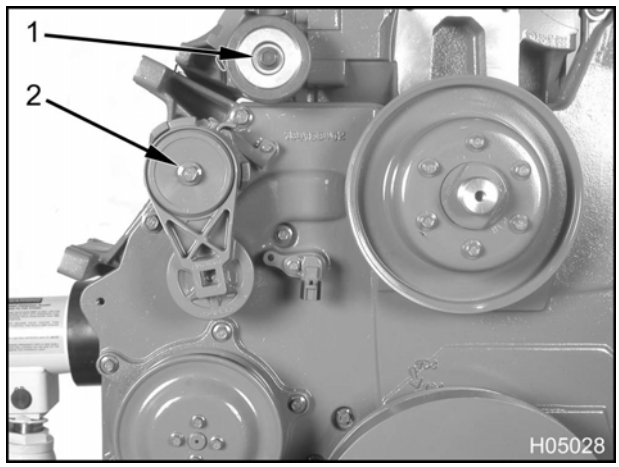

Figure 190 Flat idler pulley and automatic belt tensioner

1. Flat idler pulley assembly mounting bolt, M10 x 80
2. Automatic belt tensioner assembly mounting bolt, M10 x 80

1. Remove flat idler pulley mounting bolt (M10 x 80) and assembly from the water supply housing.
2. Remove automatic belt tensioner mounting bolt (M10 x 80) and assembly from the front cover assembly.

Water Supply Housing

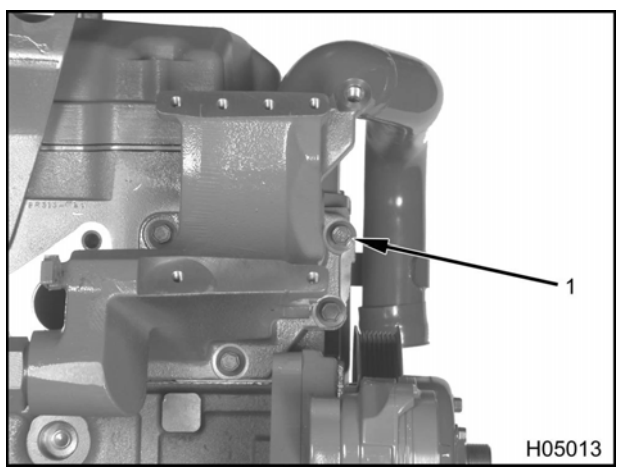

Figure 191 Water supply housing bolts

1. Bolt, M10 x 25 (4)

1. Support water supply housing and remove four water supply housing bolts (M10 x 25).

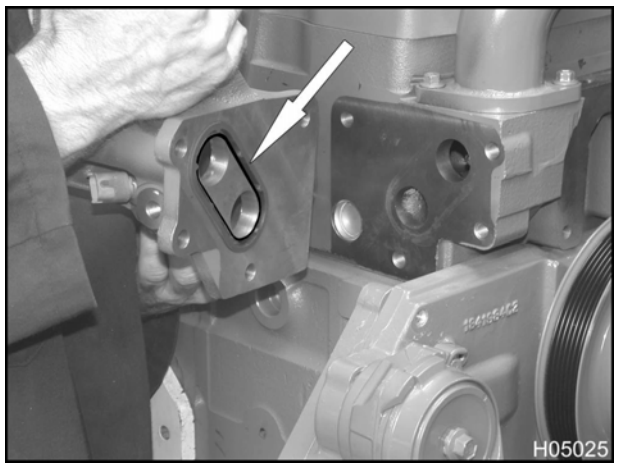

Figure 192 Water supply housing and coolant port seal

2. Tap water supply housing with a hammer to break coolant seal. Remove housing and discard coolant port seal.

Water Inlet Elbow, Water Outlet Tube and Thermostat

1. Remove three hex flange bolts (M8 x 30) securing water inlet elbow to front cover.

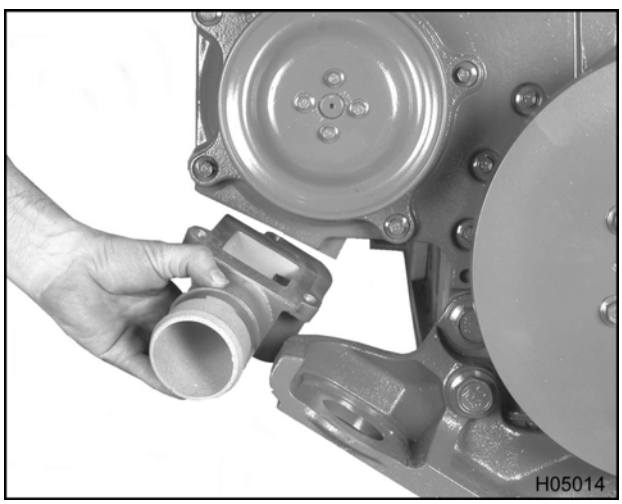

Figure 193 Water inlet elbow

2. Tap water inlet elbow with a hammer to break coolant seal. Remove water inlet elbow and discard gasket seal.

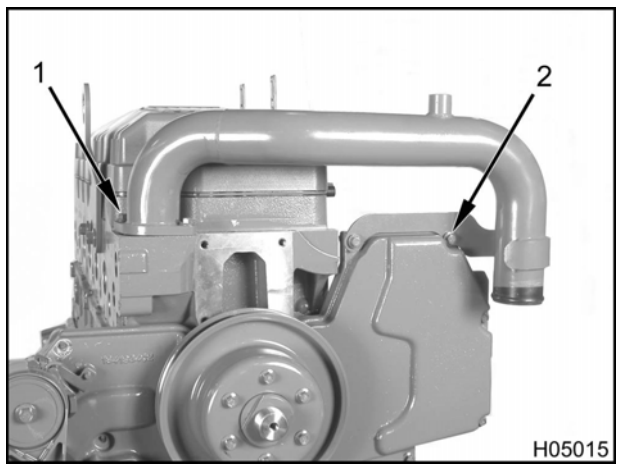

Figure 194 Water outlet tube assembly

1. Bolt, M8 x 30 (2)
2. Hex flange nut, M8 (2)

3. Remove two water outlet tube assembly bolts (M8 x 25) at the cylinder head.
4. Remove two hex flange nuts (M8) retaining the water outlet tube assembly to front cover and remove tube assembly.

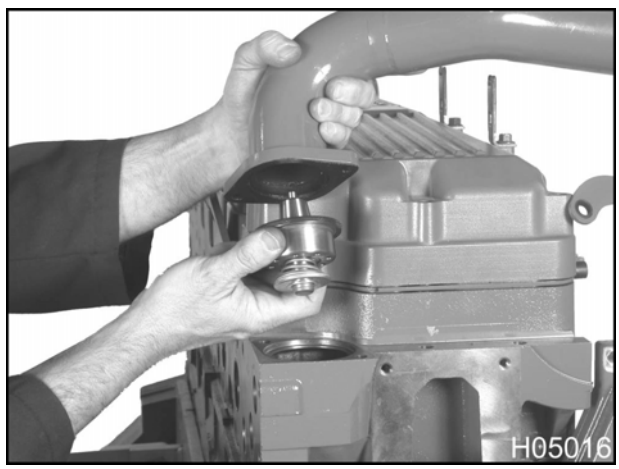

Figure 195 Thermostat assembly

5. Lift thermostat out of cylinder head.

NOTE: The thermostat seal cannot be purchased separately. It is only available with the thermostat assembly.

Fan Drive Hub

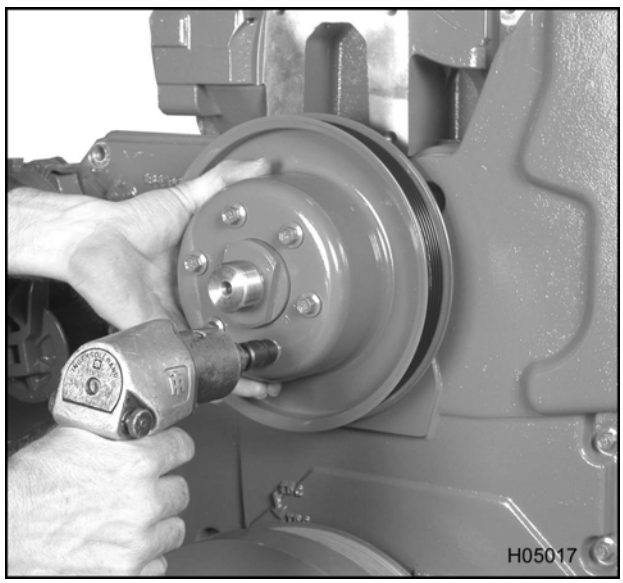

Figure 196 Removing the fan drive pulley

1. Remove six hex flange bolts (M8 x 20) and the fan drive pulley.

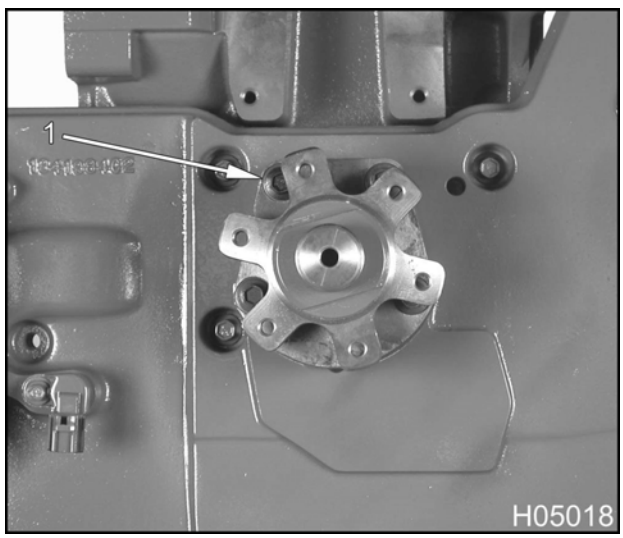

Figure 197 Fan hub assembly (typical)

1. Bolt, M8 x 65 (4)

2. Remove four hex flange bolts. See fan drive applications (Table 19).
3. Remove fan hub assembly.

Water Pump Assembly

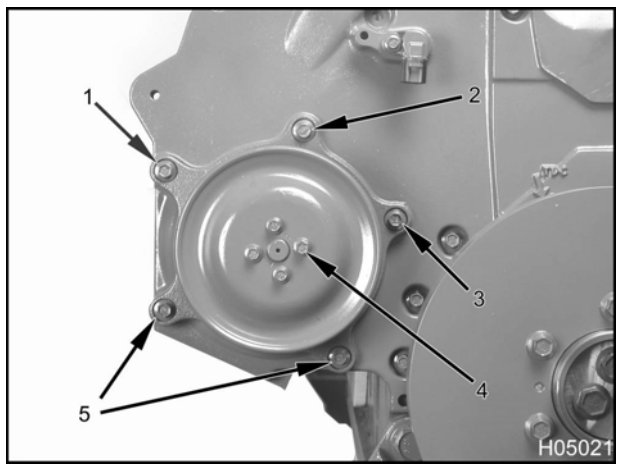

Figure 198 Water pump assembly

1. Bolt, M8 x 55 , nut, M8 (1)
2. Bolt, M8 x 100, nut, M8 (1)
3. Bolt, M8 x 16 (1)
4. Bolt, M6 x 12 (4)
5. Bolt, M8 x 40 (2)

1. Remove four pulley bolts (M6 x 12).
2. Remove one water pump assembly bolt (M8 x 55).
3. Remove one nut (M8) and bolt (M8 x 100).
4. Remove one water pump assembly bolt (M8 x 16).
5. Remove two water pump assembly bolts (M8 x 40).

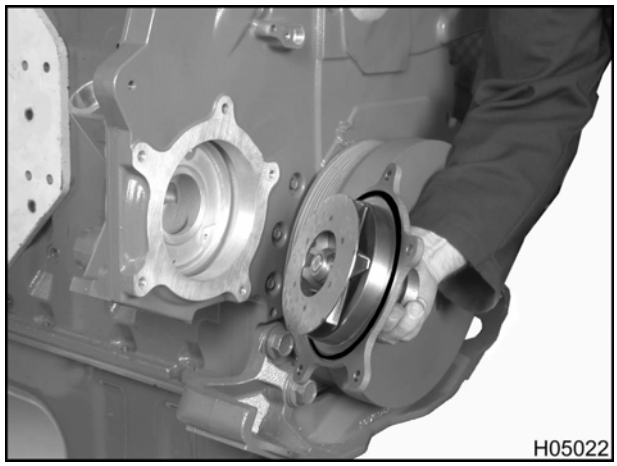

Figure 199 Water pump assembly

6. Remove water pump assembly. Remove and discard seal.

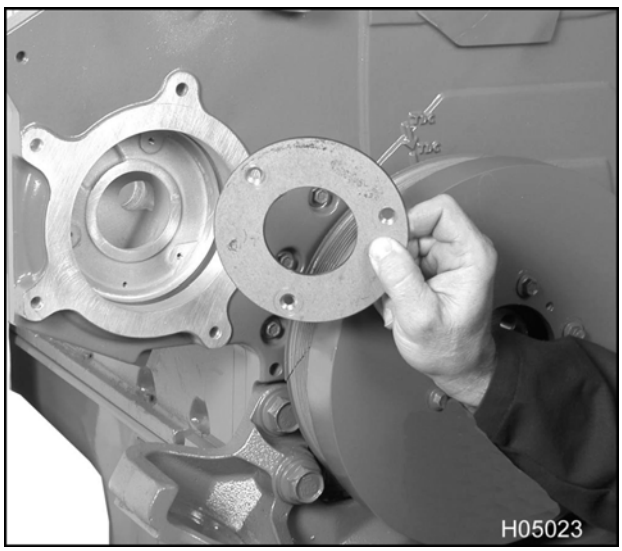

Figure 200 Removing the wear plate

7. Remove three flat head hex socket screws (M5) securing the wear plate to the front cover.

Vibration Damper, Hub, and Wear Sleeve

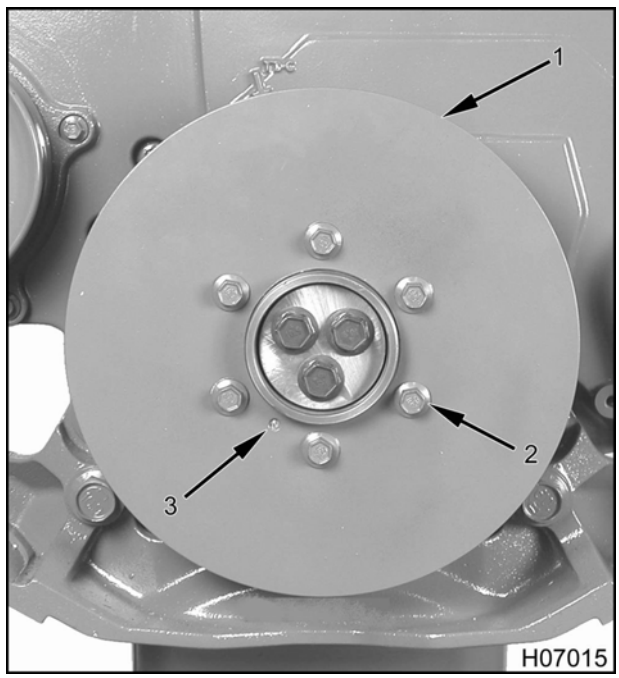

Figure 201 Vibration damper

1. Vibration damper
2. Bolt, M10 x 20 (6)
3. Dowel

1. Remove the six bolts (M10 x 20) securing the vibration damper to the hub assembly and remove the vibration damper.

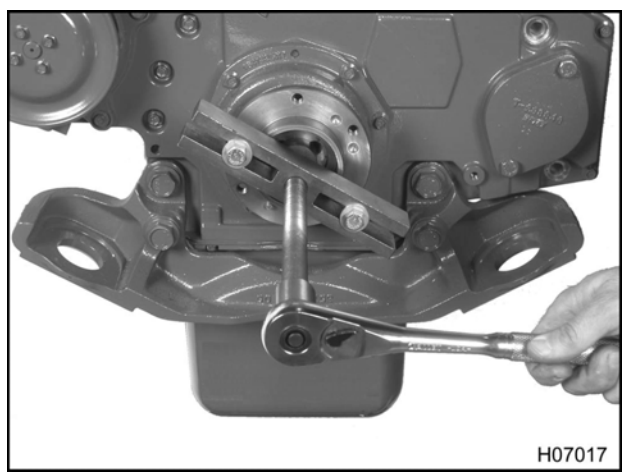

Figure 202 Removing the damper hub assembly

2. Remove the damper hub assembly with an H-bar puller and two bolts (M10 x 80).

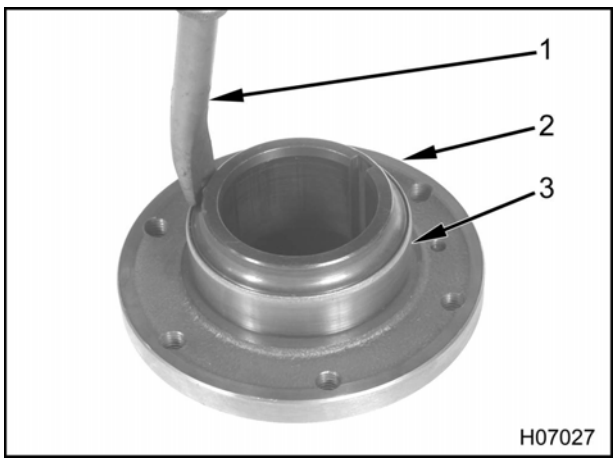

Figure 203 Removing the wear sleeve with a muffler chisel

1. Muffler Chisel
2. Vibration damper hub
3. Wear Sleeve

3. Split the wear sleeve with a muffler chisel to remove it from the damper. Be careful not to damage the vibration damper hub.

NOTE: If your service kit contains more than one wear sleeve, use the sleeve that has the same width as the current wear sleeve located on the vibration damper hub.

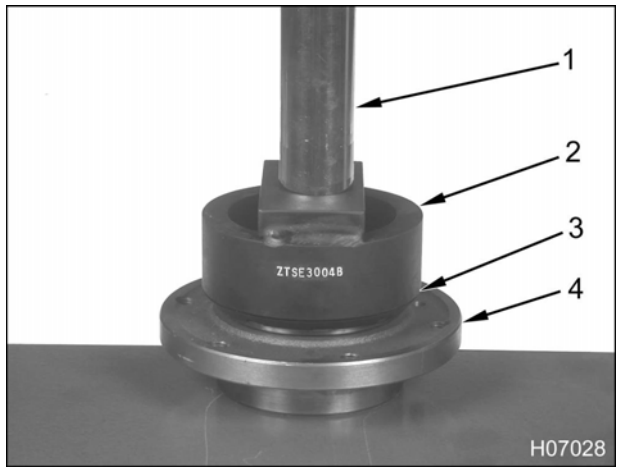

Figure 204 Pressing on the wear sleeve and seal

1. Arbor press ram
2. Wear sleeve installer
3. Wear sleeve seal (570 engines only)
4. Vibration damper hub

NOTE: The chamfer on the wear sleeve outside diameter must be facing in, towards the crankshaft.

4. Apply hydraulic sealant sparingly to the inside diameter of a new wear sleeve. Use the wear sleeve installer (Table 22) to press wear sleeve onto the vibration damper hub. Wipe any excess sealant from the outside diameter of the wear sleeve.
5. Use the same procedure for the wear sleeve and dust lip (POSE) assemblies where applicable.

NOTE: Do not remove the POSE seal from wear sleeve on DT 570 and HT 570 engines.

The front POSE seal is not used on DT 466 or HT 466 engines.

Gerotor Assembly Oil Pump

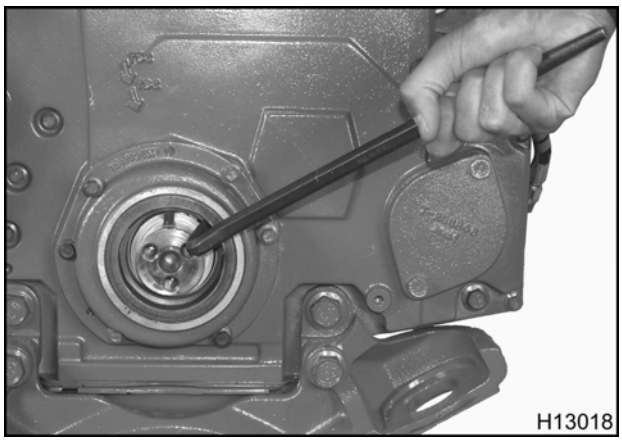

Figure 205 Removing the front oil seal

1. Remove front oil seal with a heel bar while oil pump housing assembly is still attached to front cover. Discard the front oil seal.

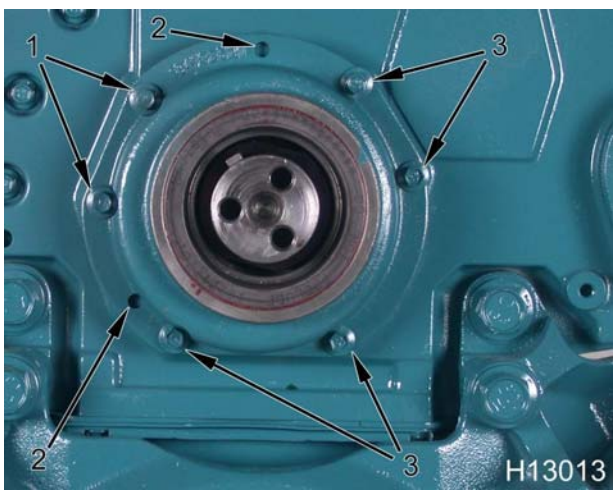

Figure 206 Oil pump housing mounting bolt locations

1. Bolt, M8 x 60 (2)
2. Dowels (2)
3. Bolt, M8 x 25 (4)

2. Remove two bolts (M8 x 60) retaining the oil pump housing cover.

3. Remove four bolts (M8 x 25) retaining the oil pump housing cover.

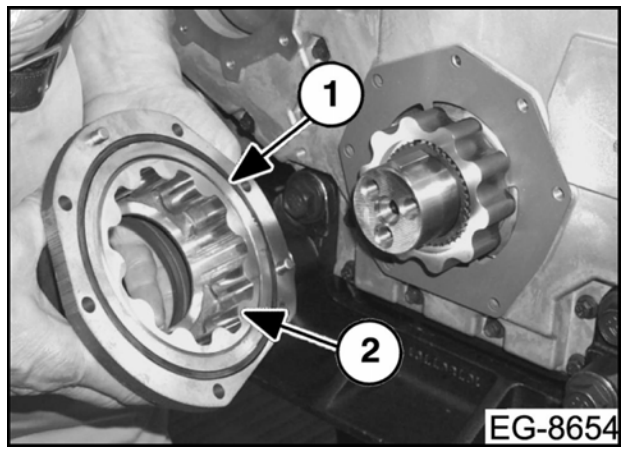

Figure 207 Oil pump housing cover

1. Oil pump housing seal
2. Outer rotor

4. Remove oil pump housing cover and discard oil pump housing seal.

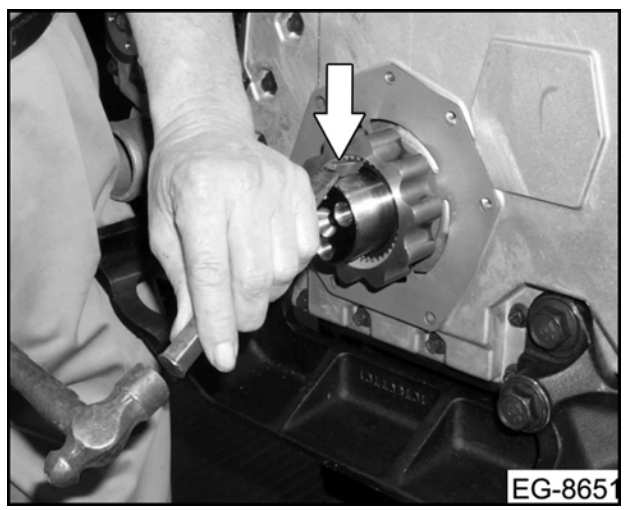

Figure 208 Removing the vibration damper key

5. Using a hammer and chisel, tap the vibration damper key out of the crankshaft. Exercise caution not to mark the crankshaft or distort the keyway groove.

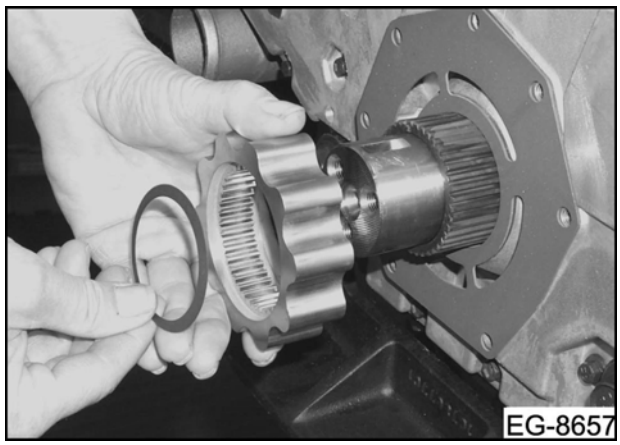

Figure 209 Washer seal and inner rotor

6. Remove the washer seal and inner rotor.
7. Mark the gerotor oil pump assembly with a permanent marker if pump is to be returned to service. The mark is to indicate the inner and outer rotor relationship to each other and orientation to the front cover. Remove oil pump gerotor assembly.

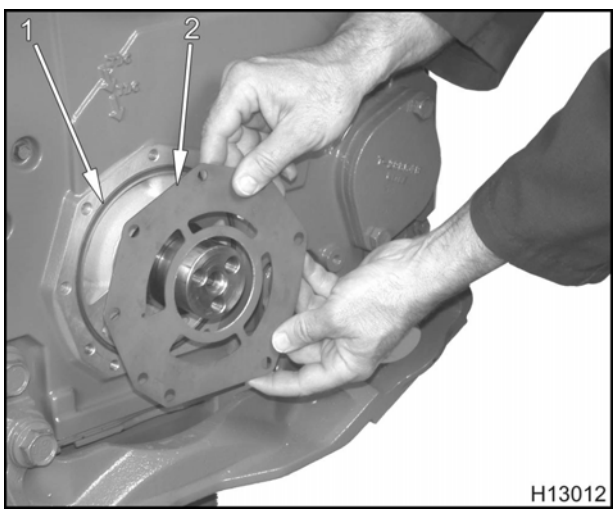

Figure 210 Oil pump housing plate and seal

1. Oil pump housing seal
2. Oil pump housing plate

8. Remove oil pump housing plate and discard seal.
9. Refer to the disassembly of crankshaft oil pump drive (spline) (See Crankshaft Disassembly, page 229) for procedure relating to oil pump drive.

Front Engine Mount

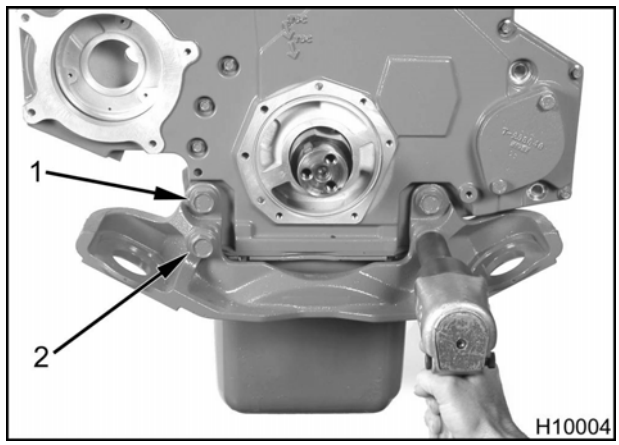

Figure 211 Front engine mounting bracket

1. Bolt, M18 x 70 (2)
2. Bolt, M18 x 100 (2)

1. Remove two upper bolts (M18 x 70).
2. Support engine mounting bracket and remove two lower bolts (M18 x 100).
3. Remove front engine mounting bracket.

Front Cover (Front Half)

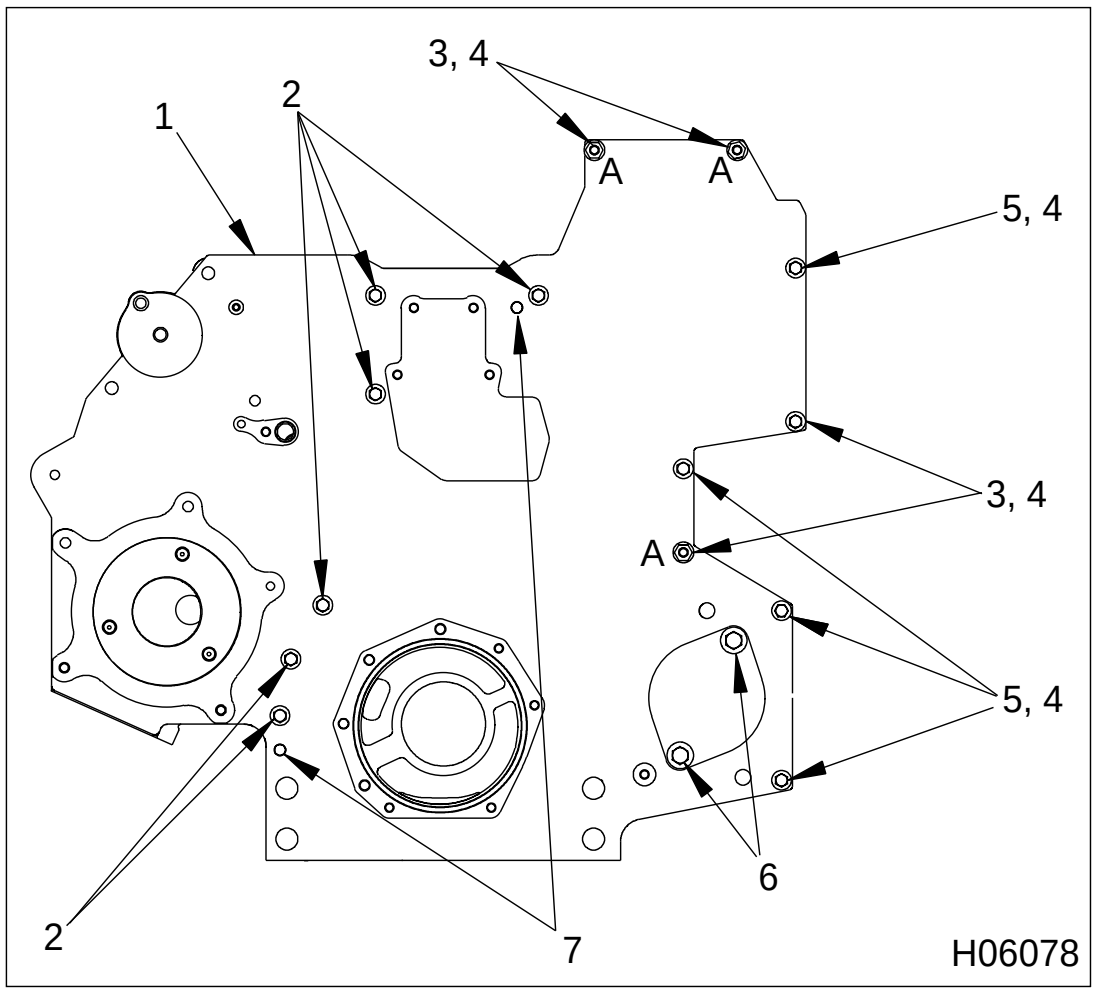

Figure 212 Front cover mounting bolt locations

1. Front cover (front half)
2. Hex flange bolt, M8 x 45 (6)
3. Hex flange bolt, M8 x 40 (4)
4. Hex flange nut, M8 (6)
5. Hex flange bolt, M8 x 30 (3)
6. Heavy hex flange bolt, M10 x 25 (2) (PTO equipped engines only)
7. Dowel hole locations

CAUTION: To avoid engine damage, the oil pan (See Removing the Oil Pan, page 184) and oil suction tube (See Removing the Oil Suction Tube, page 186) must be removed before the front cover can be removed.

1. Remove six hex flange bolts (M8 x 45).
2. Remove four hex flange bolts (M8 x 40) and nuts (M8).
3. Remove four hex flange bolts (M8 x 30) and nuts (M8).
4. Remove front cover (front half) by sliding off the two dowel pins.
5. Remove the oil and coolant gaskets and O-ring seal from the inside of the front cover, as required and discard.

Idler Gears

NOTE: Before removing any gears from the gear train, check the backlash between each gear and the camshaft end play. See the inspection procedures (See Inspection, page 158) located within this section.

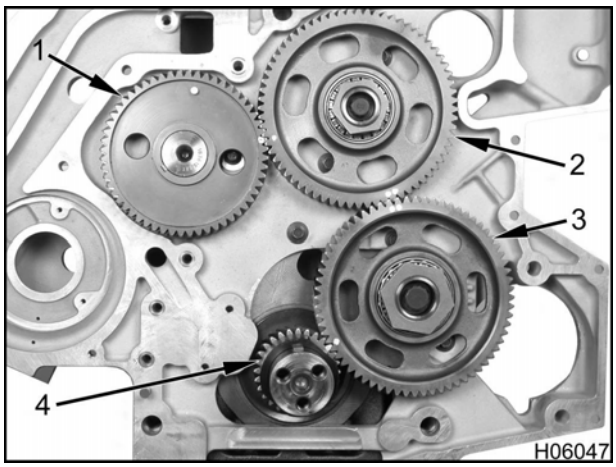

Figure 213 Gear train locations

1. Camshaft gear
2. Upper idler gear
3. Lower idler gear
4. Crankshaft gear

Figure 214 Removing the lower idler gear

1. Remove the lower idler gear and mounting bolt (M20 x 70).

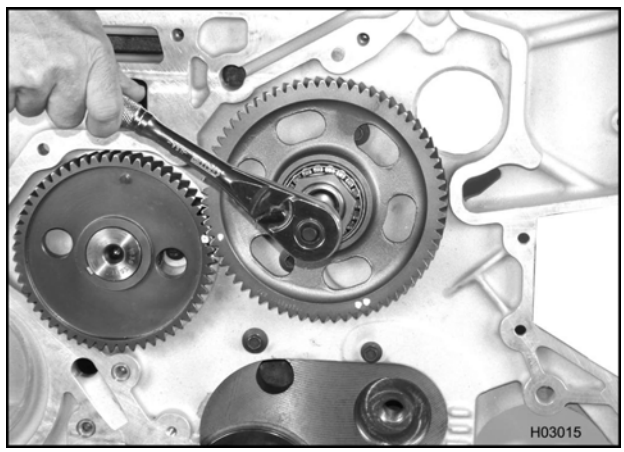

Figure 215 Removing the upper idler gear

2. Remove the upper idler gear and mounting bolt (M16 x 65).

Front Cover (Rear Half)

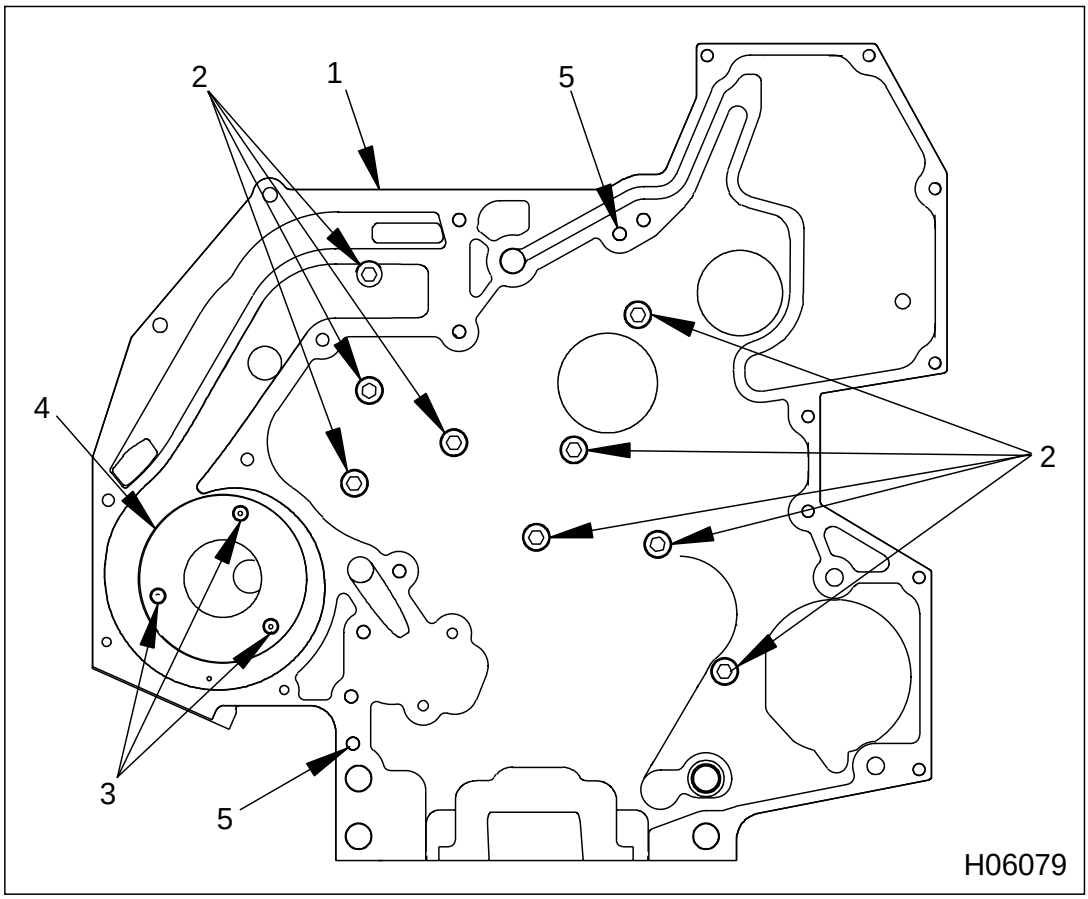

Figure 216 Front cover mounting bolt locations (rear half)

1. Front cover assembly (rear half)
2. Special hex flange bolt, M8 x 20 (9)
3. Flat head hex socket, M5 (3)
4. Wear plate
5. Dowel pin locations

1. Remove the cam gear from the camshaft (See Cam Gear from Camshaft, page 231).
2. Remove nine mounting bolts (M8 x 20) that secure the rear half of the front cover to the crankcase. Pull cover straight outward to slide dowels out of the crankcase. These dowels are retained in the rear half of the front cover.
3. Remove the oil and coolant gaskets from the rear half of the front cover and discard.

Inspection

Checking Lower Idler Gear Backlash

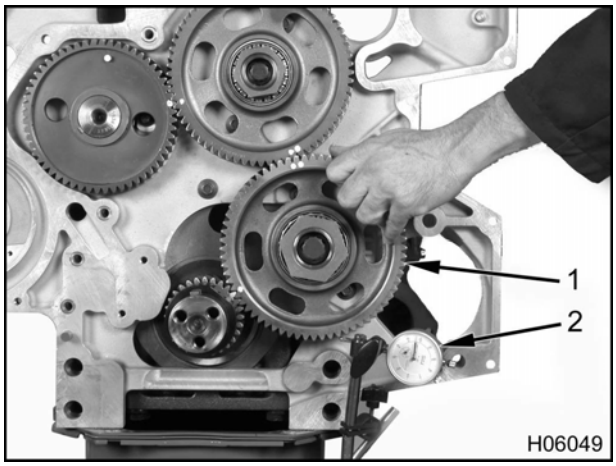

Figure 217 Checking lower idler gear backlash

1. Lower idler gear
2. Dial indicator

1. Clamp a dial indicator onto the front cover.
2. Place the tip of the dial indicator as tangent as possible to a gear tooth, and zero dial indicator.
3. Rock lower idler gear back and forth. Record the reading on the dial indicator face. If the backlash exceeds specifications, replace lower idler gear.

Checking Upper Idler Gear Backlash

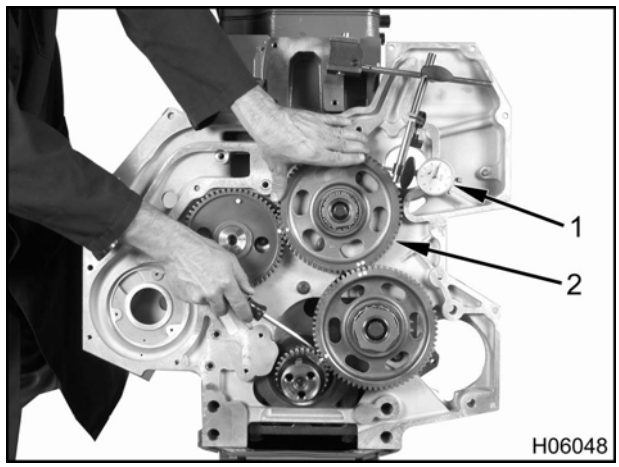

Figure 218 Checking upper idler gear backlash

1. Dial indicator
2. Upper idler gear

1. Mount a dial indicator on top of the crankcase.
2. Place the tip of the dial indicator as tangent as possible to a gear tooth and zero dial indicator.
3. Place a screwdriver between the crankshaft and the lower idler gear to keep the lower idler gear from rotating.
4. Rock upper idler gear back and forth. Record the reading on the dial indicator face. If the backlash exceeds specifications, replace upper idler gear.

Checking Camshaft Gear Backlash

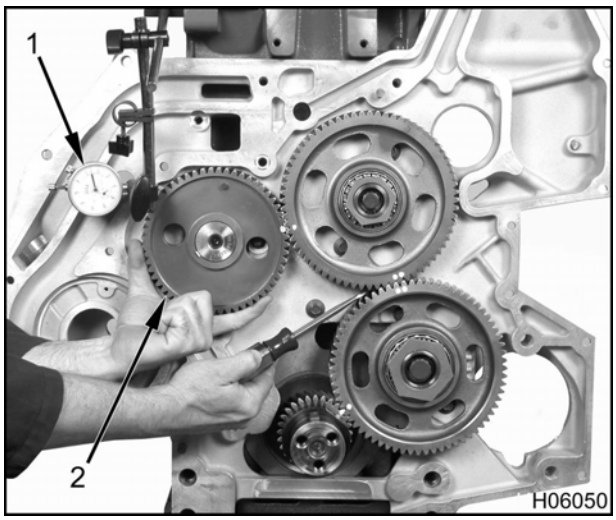

Figure 219 Checking camshaft gear backlash

1. Dial indicator
2. Camshaft gear

NOTE: Pressure exerted by the valve train must be relieved before doing the following procedure.

1. Clamp a dial indicator on the front cover or the cylinder head if the dial indicator stand is magnetic
2. Place the tip of the dial indicator as tangent as possible to a gear tooth and zero dial indicator.
3. Place a screwdriver between the upper idler gear and the lower idler gear to keep the upper idler gear from rotating.
4. Rotate the camshaft gear back and forth. Record reading on the dial indicator face. If the backlash exceeds specifications, replace camshaft gear.

Oil Pump Side and End Clearance

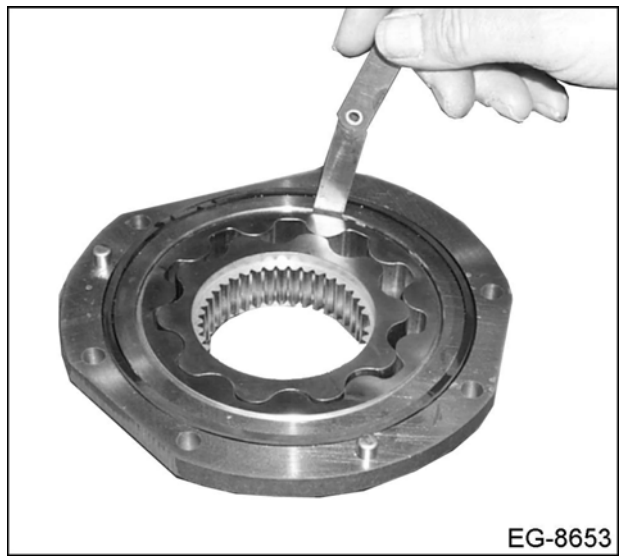

Figure 220 Oil pump outer gear side clearance

1. With a film of oil coating the outer wall of the outer rotor, measure the oil pump side clearance by placing a feeler gauge between the oil pump housing and outer rotor.

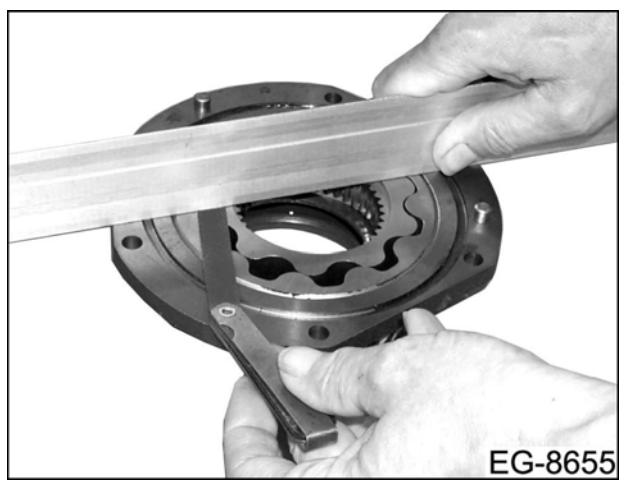

Figure 221 Gerotor oil pump end clearance

2. Place a straightedge across the gerotor oil pump surface. Measure end clearance by sliding a feeler gauge between the straightedge and gerotor assembly.
3. Compare measurements with specifications (Table 20).