Installation

Front Cover (Rear Half)

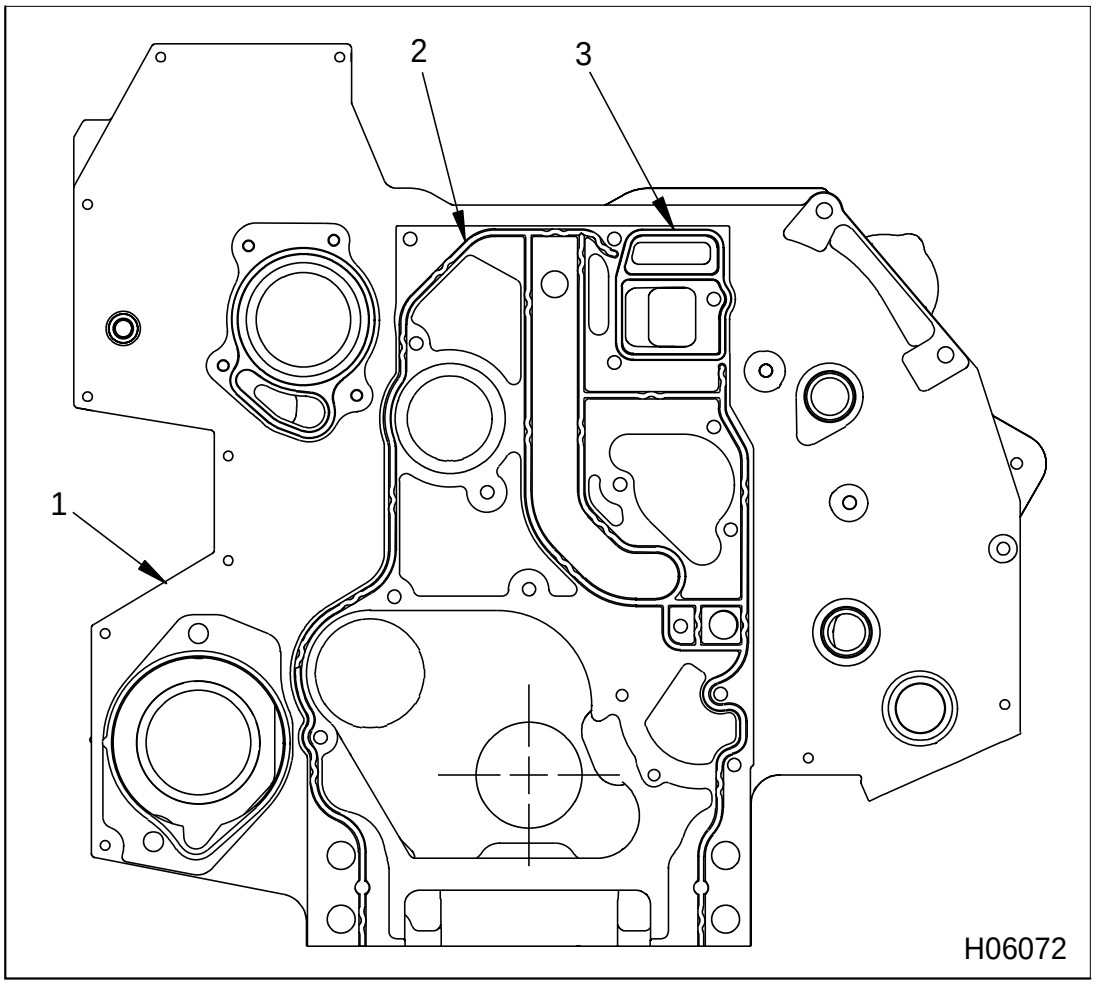

Figure 222 Front cover gaskets – crankcase side

1. Front cover assembly (rear half, crankcase side)
2. Oil gasket
3. Coolant gasket

1. Install a new oil gasket onto the crankcase side of the front cover (rear half).
2. Install a new coolant gasket onto the crankcase side of the front cover (rear half).

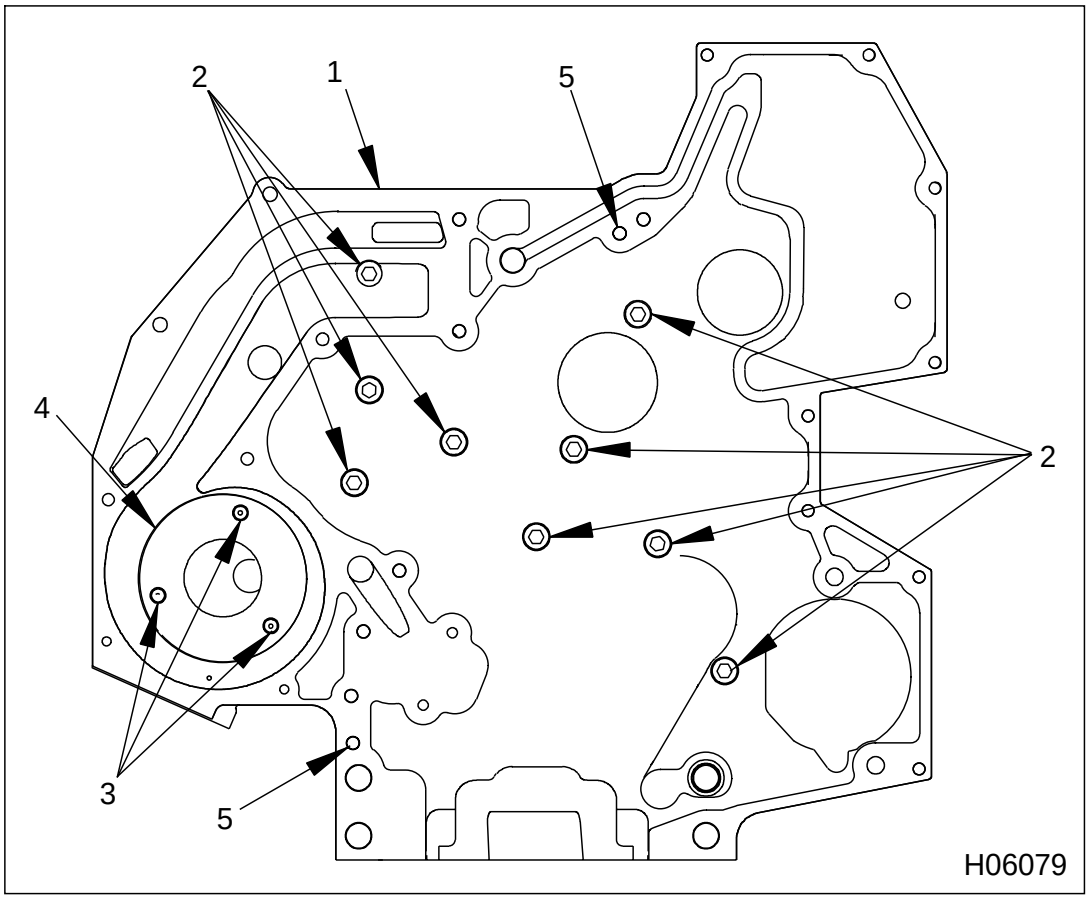

Figure 223 Front cover mounting bolt locations (rear half)

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

3. Position the rear half of the front cover onto the crankcase and install all nine mounting bolts finger tight. Then tighten the mounting bolts to the special torque value (Table 21).
4. Install the cam gear onto the camshaft. See cam gear installation procedure (See Cam Gear on Camshaft, page 239).

Idler Gears

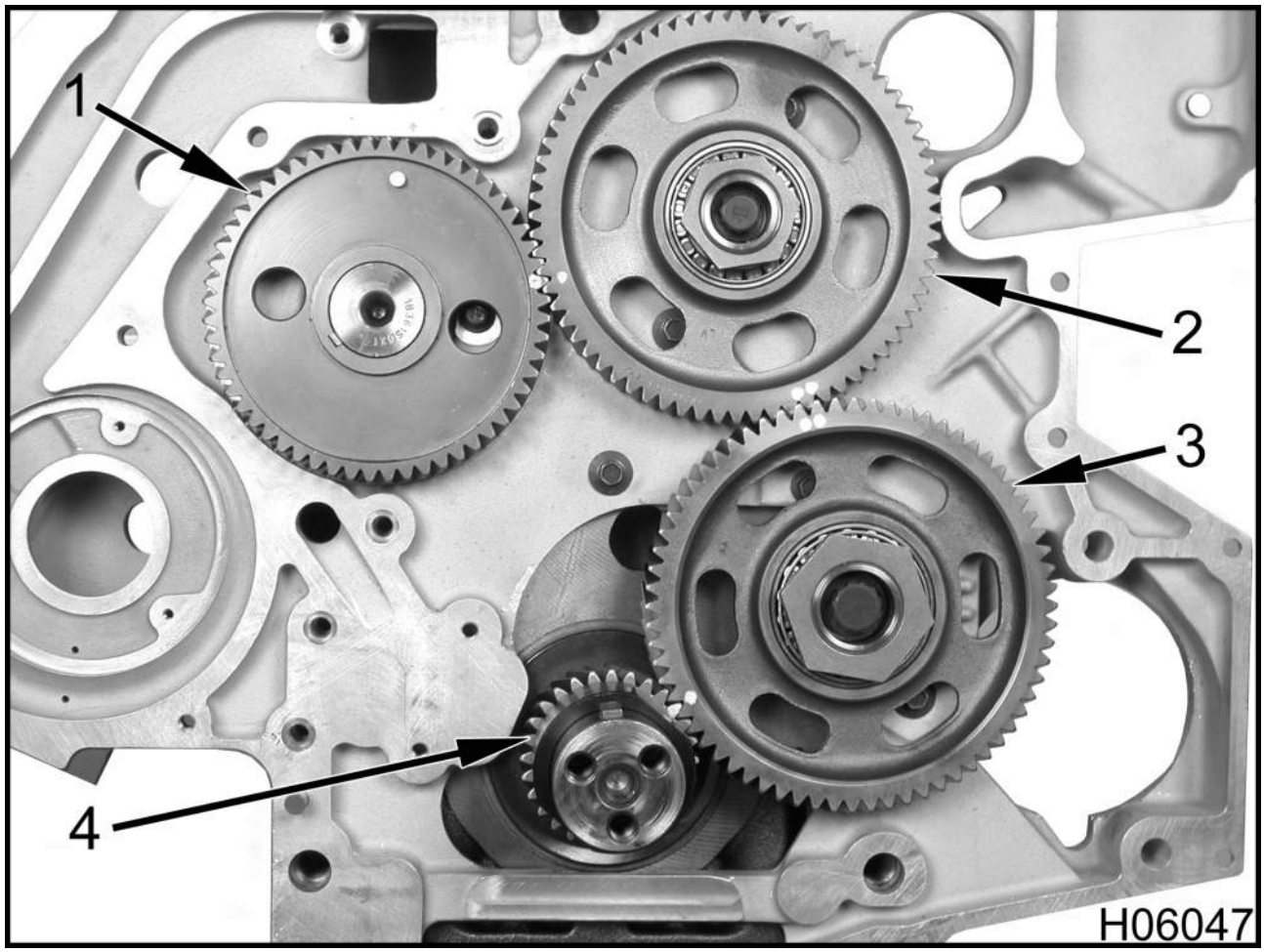

Figure 224 Gears and timing marks

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

NOTE: When installing the gears in the gear train, the timing marks on the edge of each gear must be correctly aligned and oriented (facing outward). Once the gears are properly installed, the crankshaft will require 34 revolutions to align the timing marks again.

- The upper idler gear and camshaft gear are matched with one dimple on each gear
- The upper idler gear and lower idler gear are matched with two dimples on each gear
- The lower idler gear and crankshaft gear are matched with one dimple on each gear

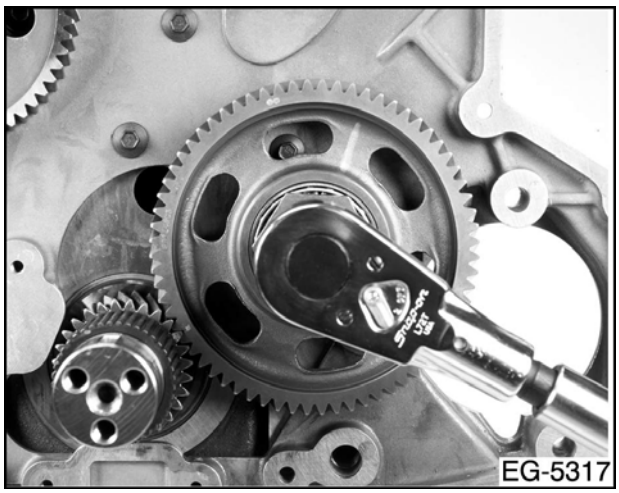

Figure 225 Installing the lower idler gear mounting bolt

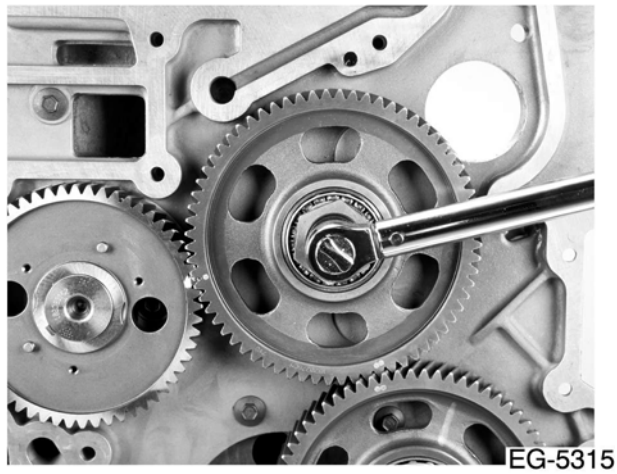

Figure 226 Installing the upper idler gear mounting bolt

1. Install the lower idler gear and mounting bolt (M20 x 70) with timing marks facing outward. Align the dual timing marks on the lower idler gear with those on the upper idler gear and single timing marks between the crankshaft and lower idler gear. Tighten bolt to the special torque value (Table 21).

2. Install the upper idler gear and mounting bolt (M16 x 65) with timing marks facing outward. Align the single marks on the camshaft gear and upper idler gear. Tighten mounting bolt to the special torque value (Table 21).
3. Check gear backlash (Table 20) between upper idler gear and camshaft gear.
4. Check gear backlash between high-pressure pump and upper idler gear (Table 20).
5. Check high-pressure pump end play.
6. Check camshaft end play.

NOTE: If equipped with an air compressor, check gear backlash between air compressor drive gear and lower idler gear.

7. Install wear plate onto the front cover (rear half) and insert three flat head hex socket screws (M5). Tighten screws to the special torque value (Table 21).

Front Cover (Front Half)

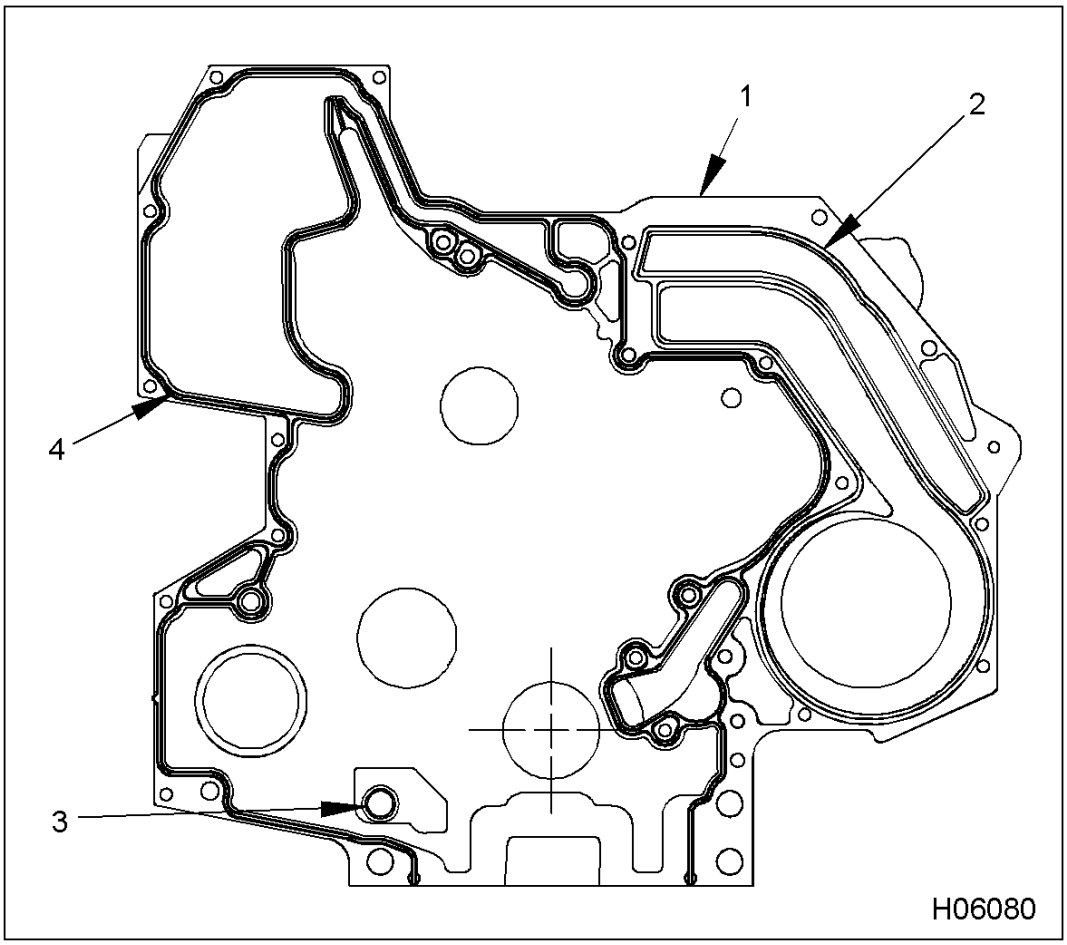

Figure 227 Installing the front cover gaskets (front half)

1. Front cover (front half)
2. Front cover gasket (coolant)
3. O-ring seal
4. Front cover gasket (oil)

1. Install new gaskets and an O-ring seal into the forward half of the front cover.

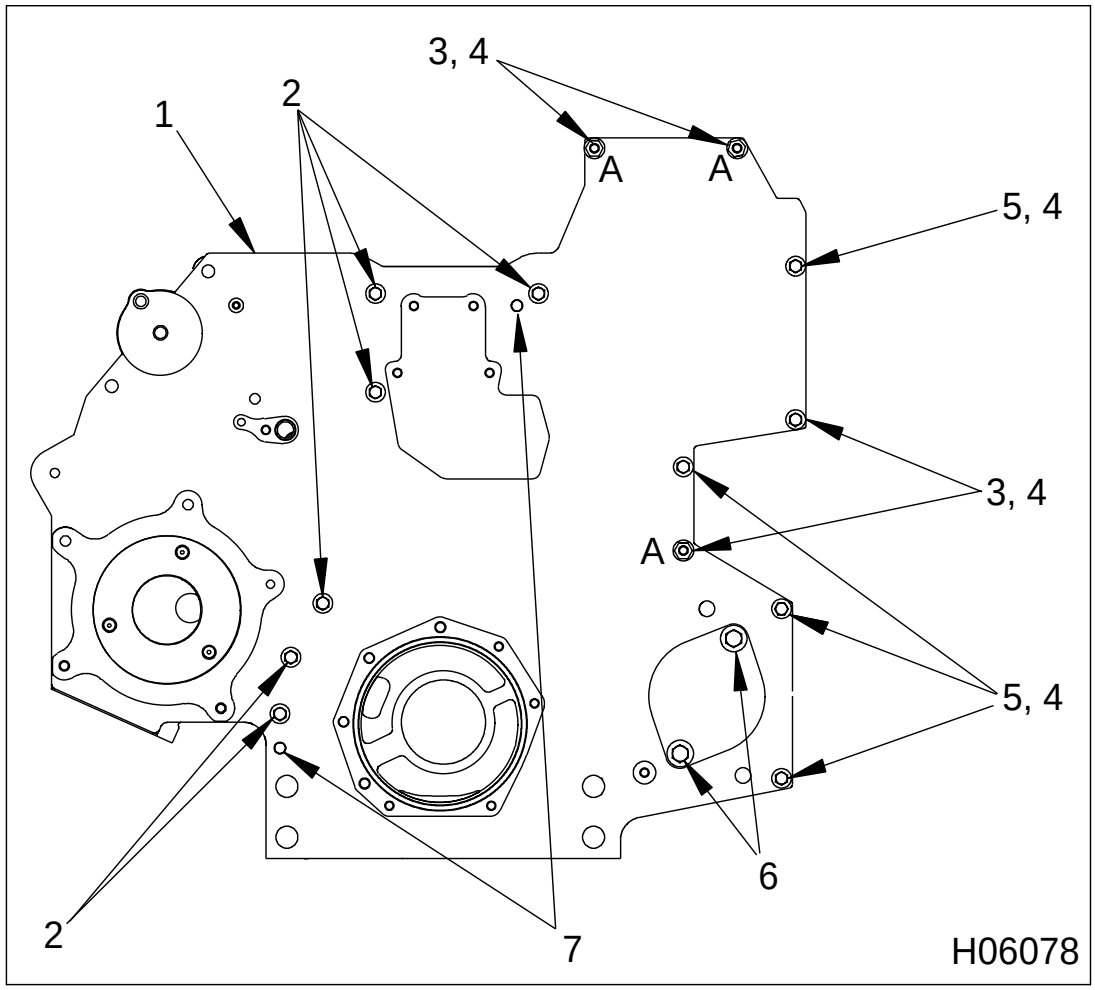

Figure 228 Front cover mounting bolt locations

1. Front cover (front half)
2. Hex flange bolt, M8 x 45 (6)
3. Hex flange bolt, M8 x 40 (4), **Note:** Bolts marked **A** to be inserted from rear side of cover.
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

2. Position the forward half of the front cover onto the rear half of the front cover using the two dowels as a guide.

Thread all mounting bolts finger tight, then tighten all mounting bolts to the standard torque value (See General Torque Guidelines, page 409).

Front Engine Mount

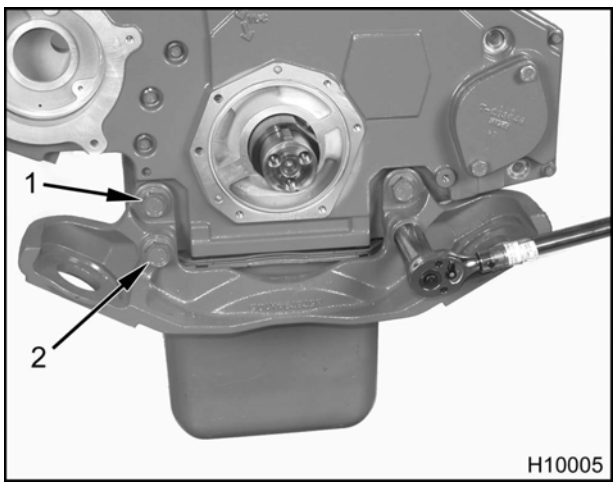

Figure 229 Front engine mount

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

1. Position front engine mount onto front cover assembly.
2. Install two upper bolts (M18 x 70) but do not tighten.
3. Install two lower bolts (M18 x 100).
4. Tighten all four bolts to the special torque value (Table 21).

Gerotor Oil Pump Assembly

1. Install the oil pump drive (spline) onto the crankshaft, (See Crankshaft Assembly, page 240).

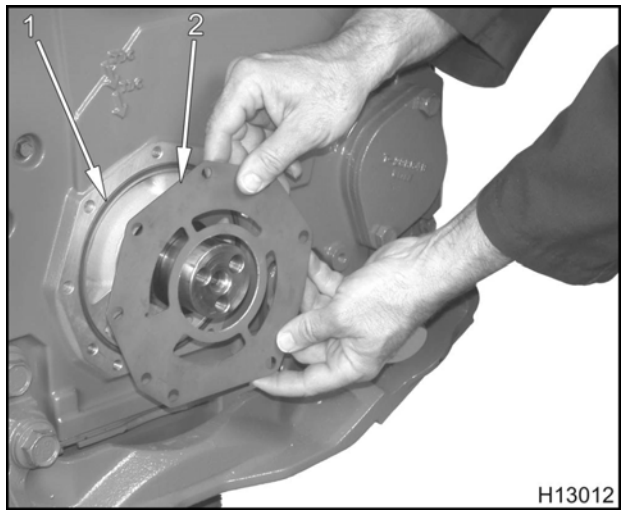

Figure 230 Oil pump housing plate and seal

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

2. Place oil pump housing seal into front cover recess. Align oil pump housing plate with dowels.
3. If reusing the original gerotor oil pump assembly, make sure the marks added during the removal process are properly oriented for installation.

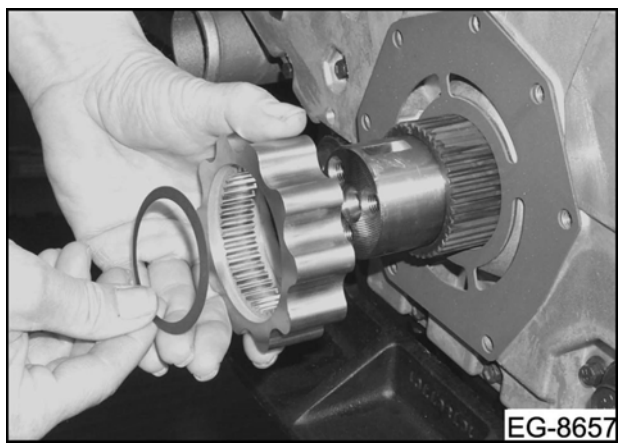

Figure 231 Gerotor oil pump assembly

4. Slide oil pump inner rotor onto oil pump drive (spline). Install the washer seal with outer bevel oriented towards the front.
5. Slide the oil pump outer rotor onto inner rotor.

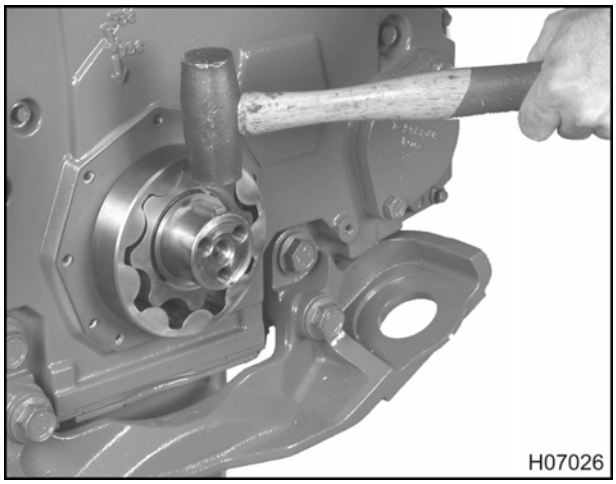

Figure 232 Installing the vibration damper key

6. Tap the vibration damper key into place on the crankshaft.

Figure 233 Applying Loctite® hydraulic sealant to front oil seal

7. Apply Loctite® hydraulic sealant to the outside edge of the front oil seal.

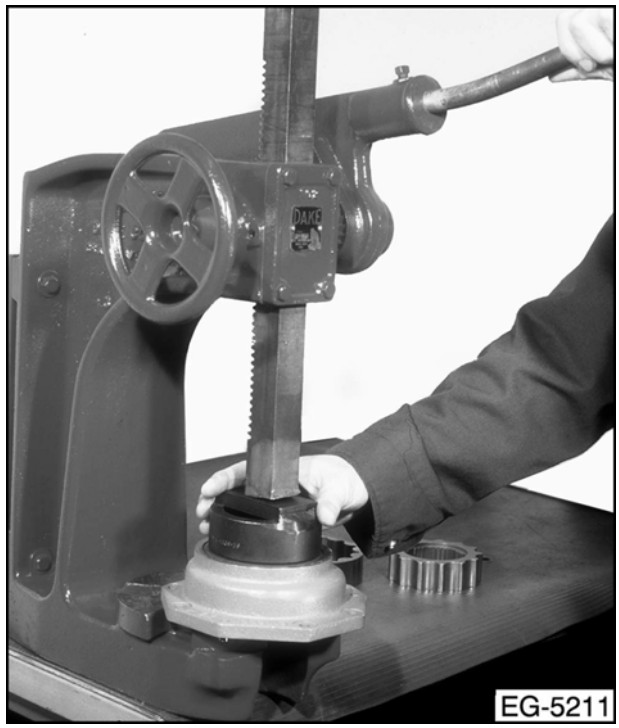

Figure 234 Pressing in a new front oil seal

8. Place oil pump housing into a press and install a new front oil seal using the front seal and wear sleeve installer (Table 22).

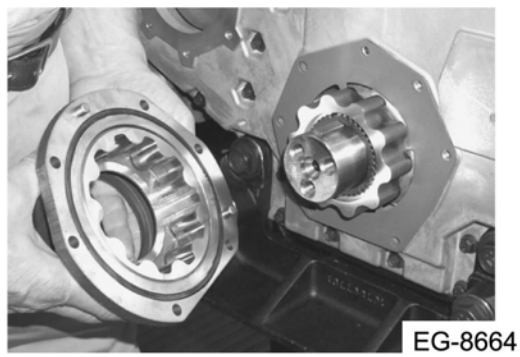

Figure 235 Oil pump housing assembly

9. Align oil pump housing dowels (2) with front cover holes.

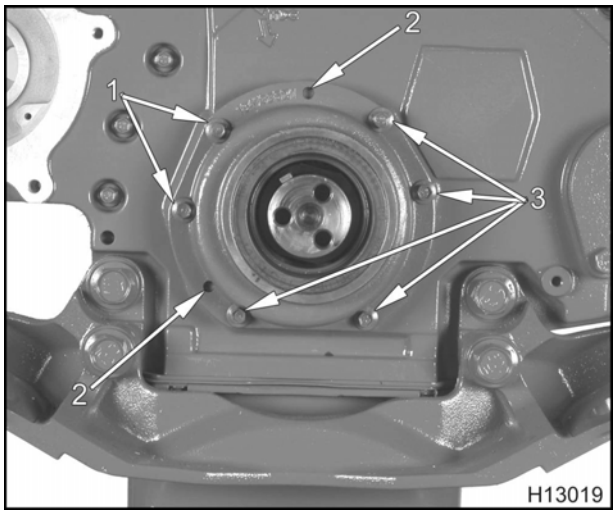

Figure 236 Oil pump housing mounting bolt locations

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

10. Place four bolts (M8 x 25) into housing finger tight.
11. Place two bolts (M8 x 60) into housing.
12. Torque all bolts to the standard torque value (See General Torque Guidelines, page 409).

Vibration Damper Assembly

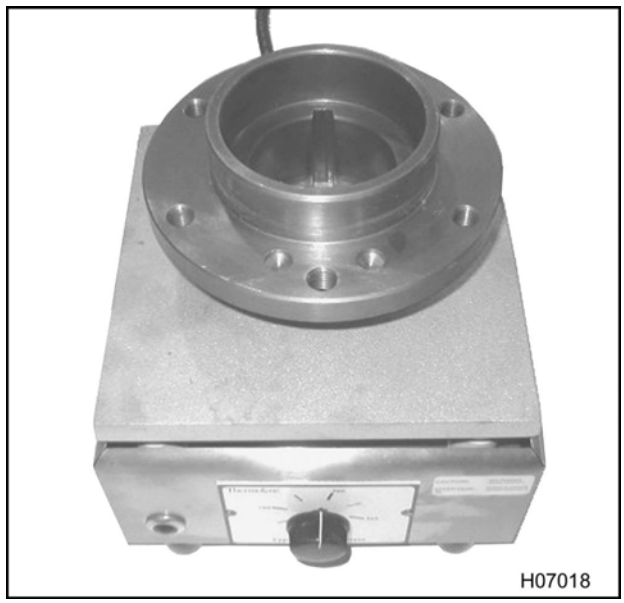

Figure 237 Heating the vibration damper

1. Heat vibration damper hub on a hot plate (Table 22) . Do not heat to more than 212 °F.

WARNING: To avoid serious personal injury, possible death, do not pick up the vibration damper hub with exposed hands. Wear heat protective gloves due to the extremely hot vibration damper hub.

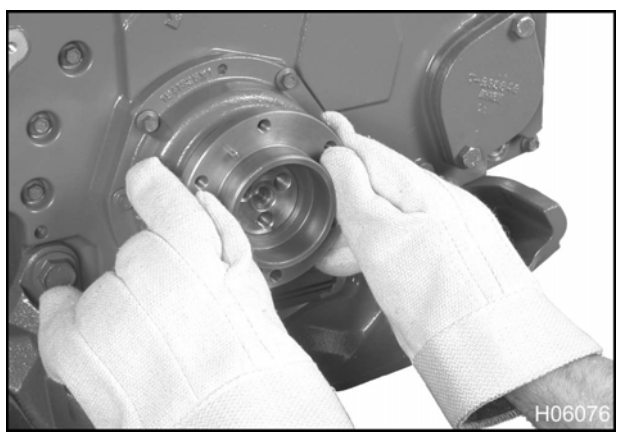

Figure 238 Installing the vibration damper

2. Install heated vibration damper hub onto the crankshaft. Use gloves specifically designed for extremely hot objects.

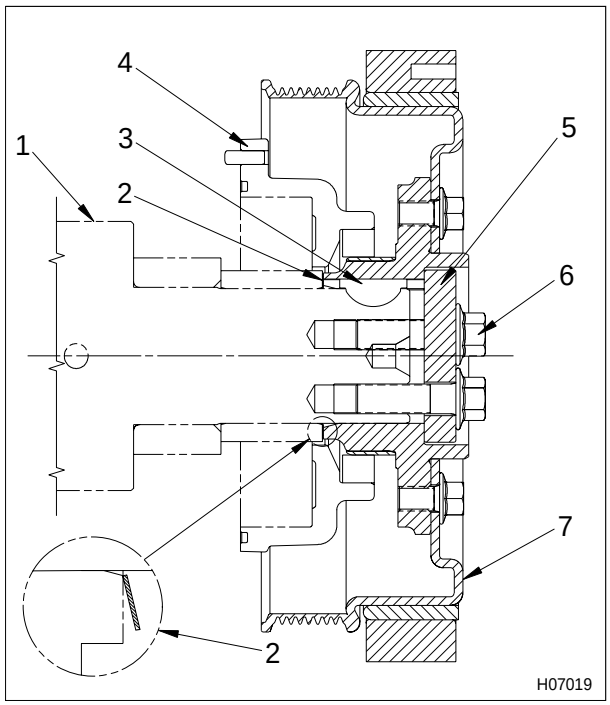

Figure 239 Vibration damper parts detail (rubber damper)

1. Crankshaft
2. Washer seal
3. Vibration damper key
4. Oil pump housing
5. Damper retaining plate
6. Bolt, M12 x 40 (3)
7. Damper assembly with hub

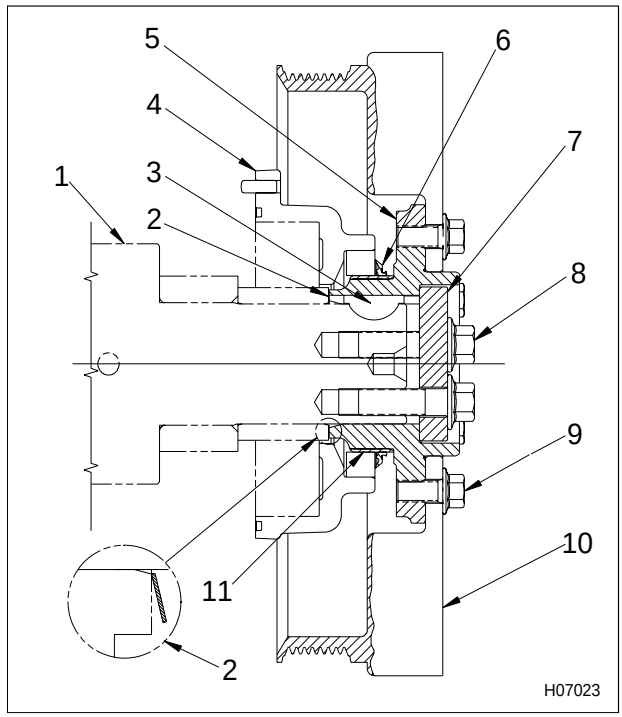

Figure 240 Vibration damper parts detail (viscous damper)

1. Crankshaft
2. Washer seal
3. Vibration damper key
4. Oil pump housing
5. Damper hub assembly
6. POSE seal (570 series only)
7. Damper retaining plate
8. Bolt, M12 x 40 (3)
9. Bolt, M10 x 20 (6)
10. Vibration damper (viscous)
11. Wear sleeve (570 series only)

3. Place washer seal as shown in illustrations (Figure 239) or (Figure 240).

NOTE: Disregard this step if washer seal was previously installed with the oil pump assembly.

4. Position vibration damper key into slot on crankshaft.
5. Slide damper hub assembly onto crankshaft.
6. Position damper retaining plate and torque three bolts (M12 x 40) to specifications (Table 21).

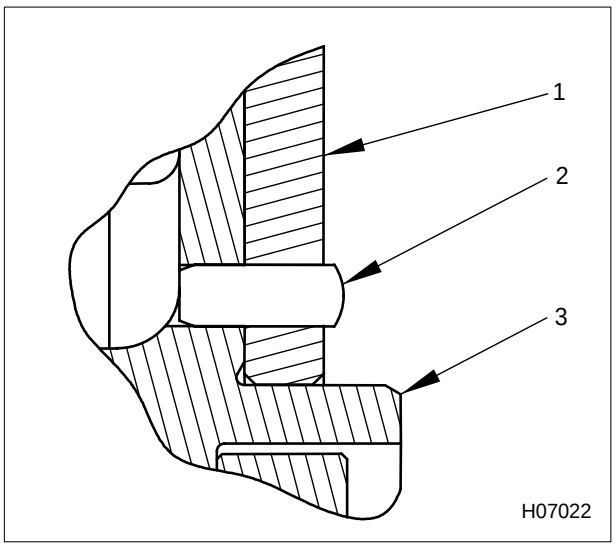

Figure 241 Vibration damper, hub assembly, and timing pin detail

1. Vibration damper
2. Timing pin
3. Hub assembly

7. Position vibration damper onto hub assembly and align timing pin hole in damper with timing pin on hub assembly.

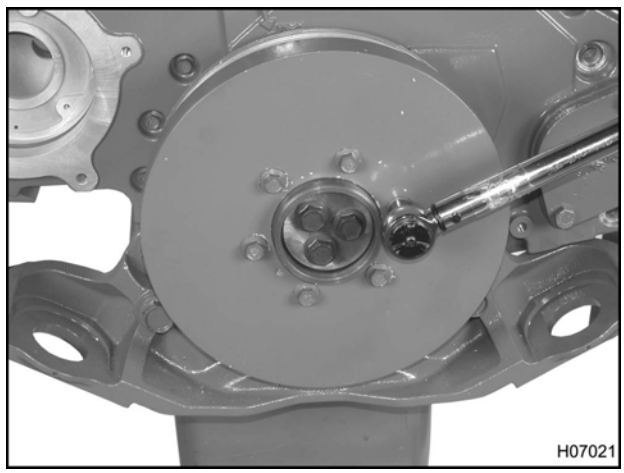

Figure 242 Torquing the vibration damper bolts

8. Install six bolts (M10 x 20) to secure vibration damper to hub assembly. Torque bolts to specifications (Table 21).

Fan Drive

Table 19 Fan Drive Mounting Bolt Sizes

Fan drive mounting configuration	Bolt size	Torque	Quantity
High-mount, Horton (20 in)	M8 x 1.25 x 30	26 N·m (19 lbf·ft)	4
High-mount, Horton (18.3 in)	M8 x 1.25 x 30	26 N·m (19 lbf·ft)	4
Mid-mount, Horton (16.2 in)	M8 x 1.25 x 30	26 N·m (19 lbf·ft)	4
Low-mount (Horton 12.2 in)	M8 x 1.25 x 30	26 N·m (19 lbf·ft)	4
High-mount (spin-on)	M8 x 1.25 x 30	Standard	2
	M8 x 1.25 x 65	Standard	2
Mid-mount (spin-on)	M8 x 1.25 x 30	Standard	2
	M8 x 1.25 x 65	Standard	2
Low-mount (bolt-on and spin-on)	M8 x 1.25 x 65	Standard	4

NOTE: The table located at the back of this section covers fan drive configurations diameters and ratios (Table 20).

1. Install fan hub assembly.

NOTE: The standard fan hub assembly is serviced as a unit. The assembly is made up of the following non serviceable items:

- Fan and pulley mounting hub
- Fan bearing hub
- Bearing assembly
- M10 x 70 bolt
- Fan bearing retainer

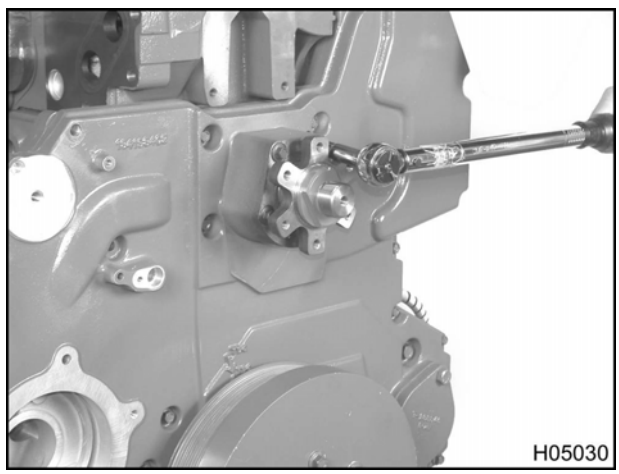

Figure 243 Torquing the fan drive mounting bolts (typical)

2. Install the hex flange bolts required (Table 19) and tighten to the standard torque value (See General Torque Guidelines, page 409), unless otherwise noted (Table 21).

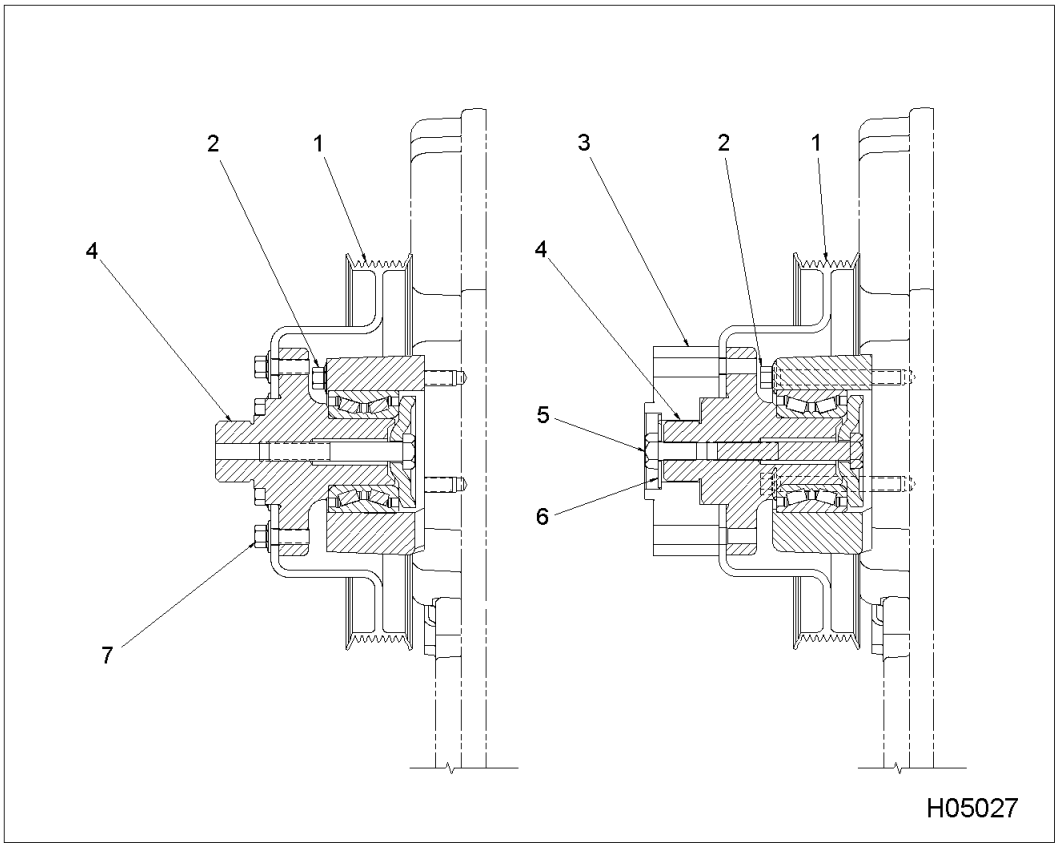

Figure 244 Spin-on fan drive (left) and bolt-on fan drive (right)

1. Fan pulley
2. Bolt, M8 x 65 (4)
3. Fan spacer
4. Fan hub assembly (cross-hatched)
5. Bolt, M10 x 20
6. Spacer retainer washer
7. Bolt, M8 x 20 (6)

3. Install the fan pulley and spacer as required for application.

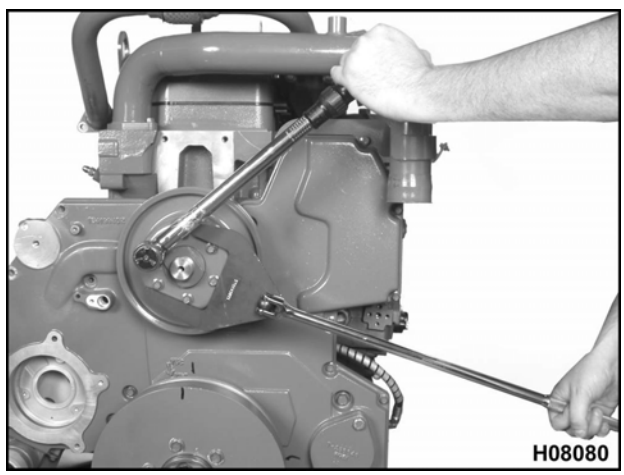

Figure 245 Torquing the fan drive pulley bolts

4. Install six hex flange bolts (M8 x 20) (Table 19) to the pulley and tighten to the standard torque value (See General Torque Guidelines, page 409).

Horton DriveMaster

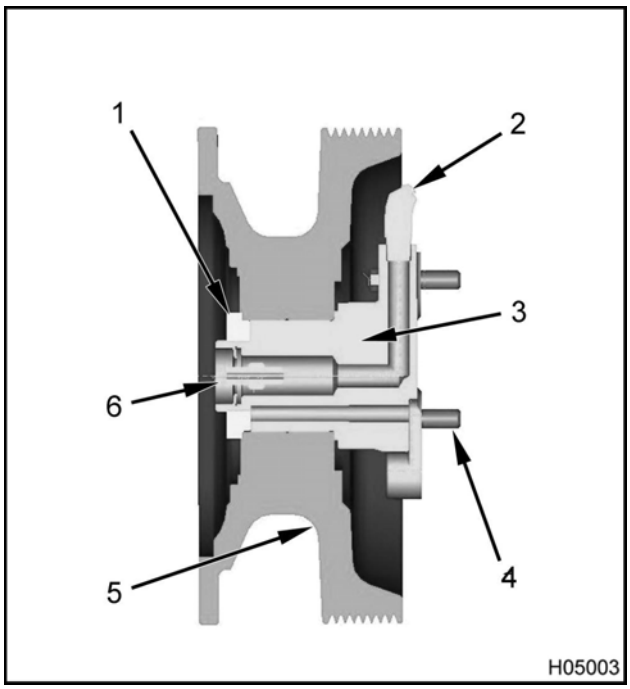

Figure 246 Horton DriveMaster (low mount version)

1. Bearing retainer nut assembly (shoulder relief faces engine)
2. Air channel inlet
3. Bracket assembly
4. Bolt, M8 x 30 (4)
5. Fan pulley
6. Air cartridge (Note: Horton service part only)

1. Install bracket assembly and four hex flange bolts (M8 X30). Torque bolts to the standard torque value (See General Torque Guidelines, page 409).
2. Slide fan pulley onto bracket with clutch mounting flange facing front.
3. Install bearing nut, making sure bearing nut shoulder relief is facing towards engine.
4. Tighten bearing retainer nut to the special torque (Table 21).

Water Pump Assembly

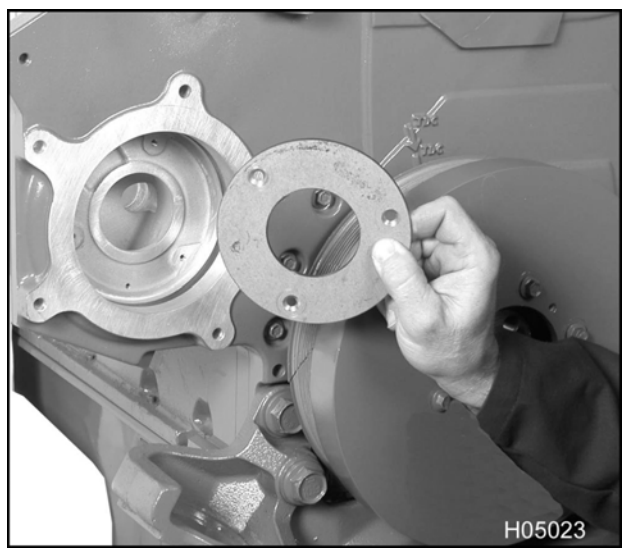

Figure 247 Installing the wear plate

1. Install three flat head hex socket screws (M5) to secure the water pump wear plate to the front cover, if not done previously during front cover installation.
2. Install the water pump seal into the water pump seal recess.
3. Position water pump assembly into front cover.

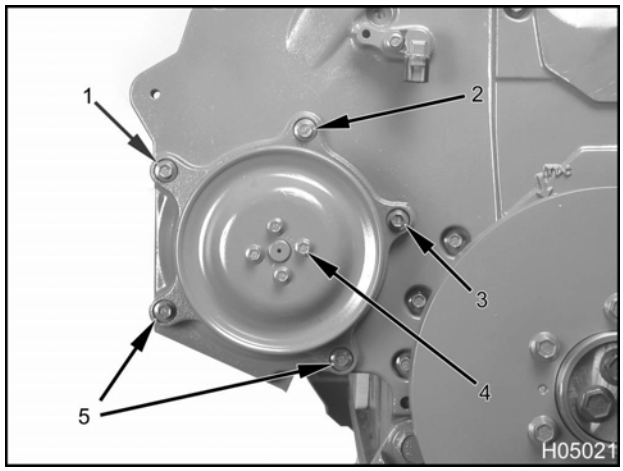

Figure 248 Water pump assembly

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

4. Install one water pump assembly bolt (M8 x 55) from the rear half of the front cover. Thread nut (M8) on finger tight.
5. Install one water pump assembly bolt (M8 x 16) finger tight.
6. Install two water pump assembly bolts (M8 x 40) finger tight.
7. Install four pulley bolts (M6 x 12) finger tight.
8. Tighten all water pump bolts to the standard torque value (See General Torque Guidelines, page 409).

Water Supply Housing

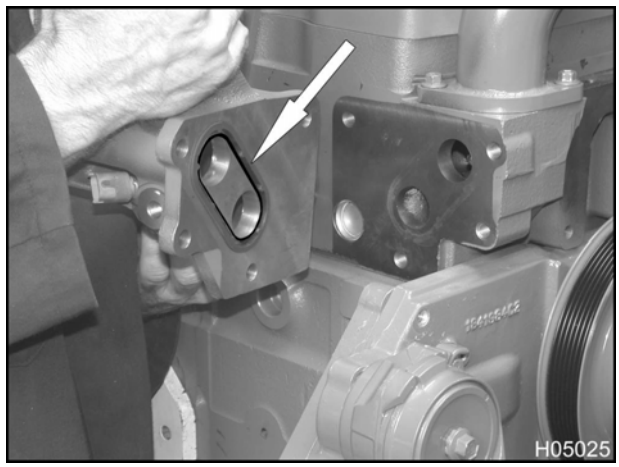

Figure 249 Water supply housing and coolant port seal

1. Position coolant port seal into machined recess at water supply housing.

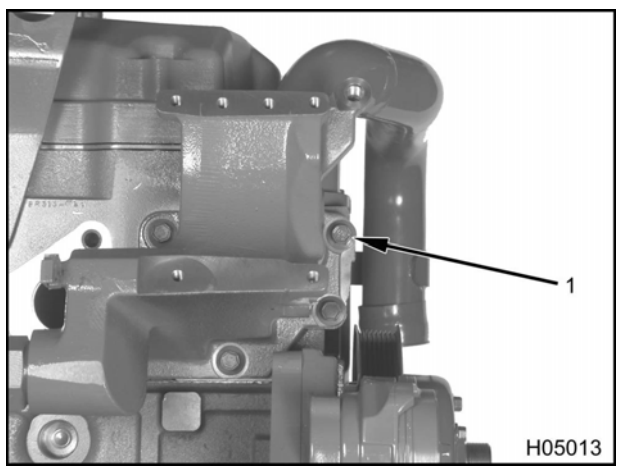

Figure 250 Water supply housing bolts

1. Bolt, M10 x 25 (4)

2. Install four water supply housing bolts (M10 x 25).

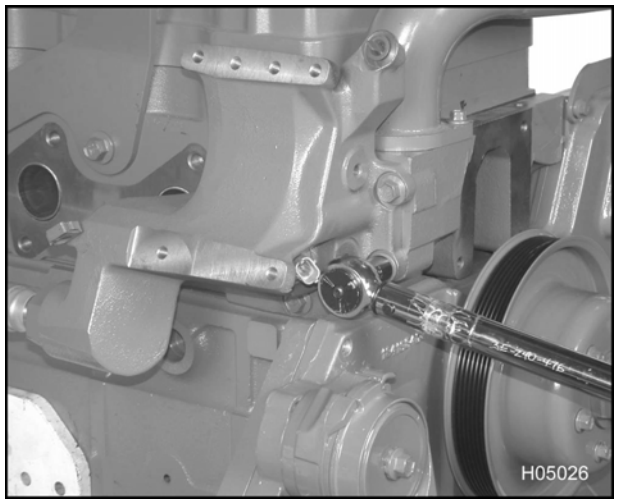

Figure 251 Torquing the water supply housing bolts

3. Tighten all bolts to the standard torque value (See General Torque Guidelines, page 409).

Alternator Bracket

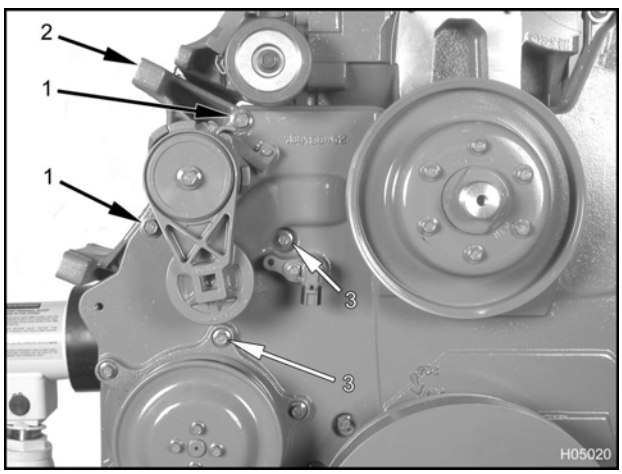

Figure 252 Alternator bracket

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

1. Position alternator bracket to backside of front cover and install two bolts (M10 x 120) and hex flange nuts (M10) finger tight.
2. Install the two remaining bolts (M8 x 100) and hex flange nuts (M8) finger tight.

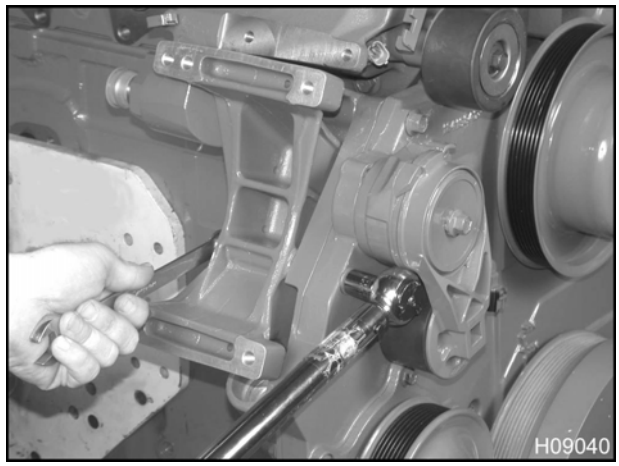

Figure 253 Torquing the alternator bracket bolts

3. Tighten all alternator bracket bolts to the standard torque value (See General Torque Guidelines, page 409).
4. Install harness routing guide and secure guide with an M8 bolt.

Flat Idler Pulley and Automatic Belt Tensioner

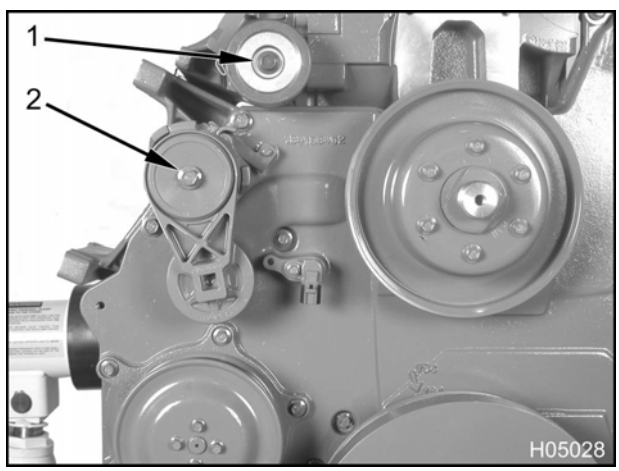

Figure 254 Flat idler pulley and automatic belt tensioner

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

1. Install bolt (M10 x 80) through flat idler pulley assembly and into the water supply housing.

Tighten bolt to the standard torque value (See General Torque Guidelines, page 409).

2. Install bolt (M10 x 80) through the automatic belt tensioner assembly to the front cover assembly and tighten to the special torque (Table 21).

Water Inlet Elbow, Water Outlet Tube and Thermostat

1. Install a water inlet gasket into the machined recess at the front cover.

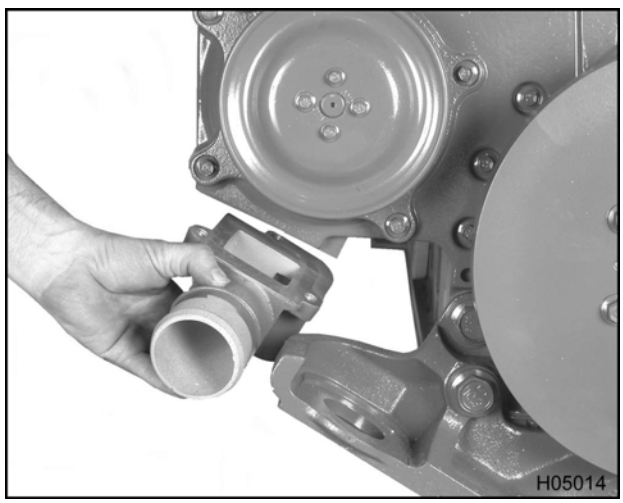

Figure 255 Water inlet elbow

2. Install water inlet (side port) elbow.
3. Install and tighten three hex flange bolts (M8 x 30) to the standard torque value (See General Torque Guidelines, page 409).

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

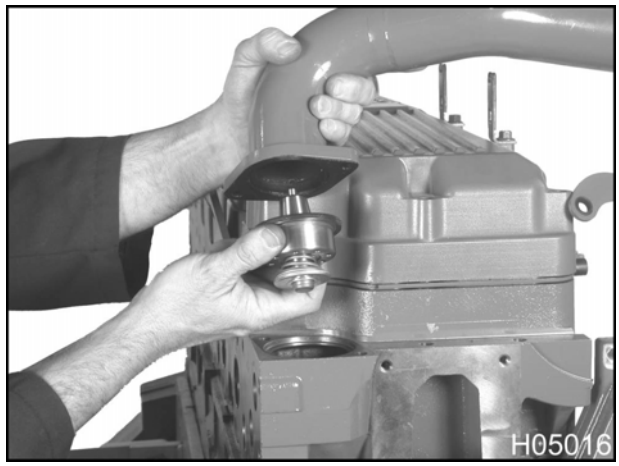

Figure 256 Thermostat assembly

4. Install a new thermostat and gasket into cylinder head.

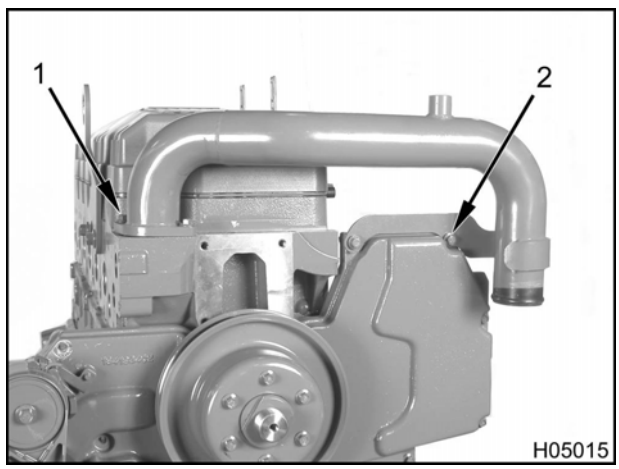

Figure 257 Water outlet tube assembly

1. Bolt, M8 x 25 (2)

5. Install two water outlet tube assembly bolts (M8 x 25) at the cylinder head and tighten to the special torque value (Table 21) .

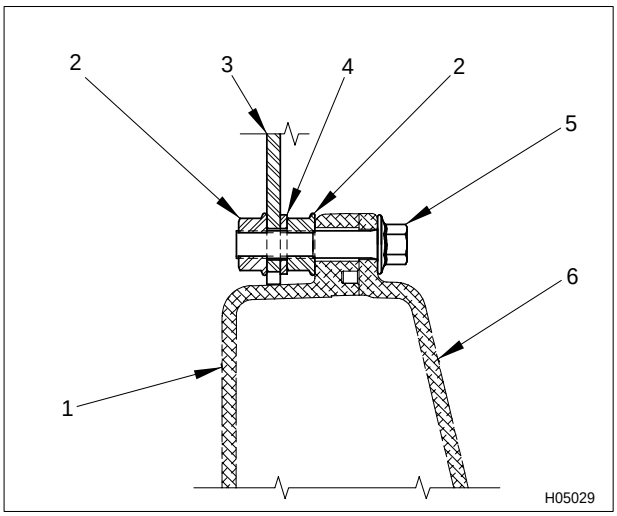

Figure 258 Water outlet tube assembly connection at front cover

1. Front cover (front half)
2. Hex flange nut, M8 (4)
3. Water outlet tube assembly (bracket)
4. Washer (2)
5. Hex flange bolt, M8 x 40 (2)
6. Front cover (rear half)

6. Install nuts, bolts and washers to secure the water outlet tube assembly at the front cover. Tighten nuts and bolts to the special torque value (Table 21).

SPECIFICATIONS

Table 20 Front Cover, Vibration Damper, Gerotor Oil Pump, Front Engine Mount, and Gear Train Specifications

Camshaft gear end play	0.33 mm (0.013 in)
Camshaft gear-to-upper idler gear backlash	0.46 mm (0.018 in)
High-pressure pump end play	0.45-1.22 mm (0.018-0.48 in)
Lower idler gear-to-air compressor gear backlash	0.508 mm (0.020 in)
Lower idler gear-to-crankshaft gear backlash	0.36 mm (0.014 in)
Oil pump end clearance	0.05-0.13 mm (0.002-0.005 in)
Oil pump side clearance	0.36-0.48 mm (0.014-0.019 in)
Upper idler gear-to-high-pressure oil pump gear backlash	0.48 mm (0.019 in)

Table 20 Front Cover, Vibration Damper, Gerotor Oil Pump, Front Engine Mount, and Gear Train Specifications (cont.)

Upper idler gear-to-lower idler gear backlash	0.48 mm (0.019 in)
Vibration damper face runout (max.)	1.52 mm (0.060 in)
Vibration damper maximum allowable member misalignment	1.50 mm (0.060 in)

Fan Drive Configurations Diameters and Ratios

Engine fan drive configuration	Fan CL to Crankshaft CL, mm (in)	Pulley Diameter OBD, mm (in)	Drive Ratio
466 high-mount, (Horton DriveMaster)	508 (20)	242.8 (9.56)	0.894 : 1
570 high-mount, (Horton DriveMaster)	508 (20)	242.8 (9.56)	1.08 : 1
570 high-mount, (Horton DriveMaster)	508 (20)	219.4 (8.636)	1.2 : 1
570 high-mount, (Horton DriveMaster)	465 (18.3)	201.2 (7.92)	1.3 : 1
570 high-mount, (Horton DriveMaster)	465 (18.3)	201.2 (7.92)	1.3 : 1
466 high-mount, (Horton DriveMaster)	465 (18.3)	219.4 (8.636)	1.2 : 1
466 high-mount, (Horton DriveMaster)	465 (18.3)	219.4 (8.636)	0.99 : 1
466 mid-mount, (Horton DriveMaster)	411 (16.2)	201.2 (7.92)	1.08 : 1
466 high-mount, (spin-on)	465 (18.3)	201.2 (7.92)	1.08 : 1
570 high-mount, (spin-on)	465 (18.3)	201.2 (7.92)	1.3 : 1
466 mid-mount, (spin-on)	411 (16.2)	201.2 (7.92)	1.08 : 1
466 low-mount, (spin-on)	310 (12.2)	201.2 (7.92)	1.08 : 1
466 low-mount, Horton DriveMaster)	310 (12.2)	201.2 (7.92)	1.08 : 1
570 low-mount, (spin-on)	310 (12.2)	201.2 (7.92)	1.3 : 1
570 low-mount, (Horton DriveMaster)	310 (12.2)	201.2 (7.92)	1.3 : 1
466 low-mount, (bolt-on)	310 (12.2)	201.2 (7.92)	1.08 : 1
570 low-mount, (bolt-on)	310 (12.2)	201.2 (7.92)	1.3 : 1

NOTE: The high-mount and mid-mount fan drives share the same part number, however the fan drive is inverted depending upon application.

Special Torque

Table 21 Front Cover, Vibration Damper, Gerotor Oil Pump, Front Engine Mount, and Gear Train Special Torques

Automatic belt tensioner assembly	50 N·m (37 lbf·ft)
Damper hub assembly	136 N·m (100 lbf·ft)
End cover adapter (PTO equipped engines only)	52 N·m (38 lbf·ft)
Fan drive, high-mount, Horton DriveMaster (20, 18.3 in.)	26 N·m (19 lbf·ft)
Fan drive, mid-mount, Horton DriveMaster (16.2 in.)	26 N·m (19 lbf·ft)
Fan drive, low-mount, Horton DriveMaster (12.2 in.)	26 N·m (19 lbf·ft)
Fan spacer retaining bolt, M10 x 20 (bolt-on drive only)	52 N·m (38 lbf·ft)
Front cover mounting bolts (rear half)	26 N·m (19 lbf·ft)
Front engine mounting bracket bolts (4)	386 N·m (284 lbf·ft)
Horton DriveMaster bearing retainer nut	177 N·m (130 lbf·ft)
Lower idler gear mounting bolt	639 N·m (470 lbf·ft)
Upper idler gear mounting bolt	326 N·m (240 lbf·ft)
Viscous or rubber vibration damper mounting bolts	54 N·m (40 lbf·ft)
Water outlet tube assembly at cylinder head	33 N·m (24 lbf·ft)
Water outlet tube assembly at front cover	33 N·m (24 lbf·ft)
Wear plate (water pump)	7 N·m (60 lbf·in)

SPECIAL SERVICE TOOLS

Table 22 Front Cover, Vibration Damper, Gerotor Oil Pump, Front Engine Mounts, and Gear Train Special Service Tools

Dial indicator set	Obtain locally
Front seal and wear sleeve installer	ZTSE3004B
Hot plate	Obtain locally
Slide hammer puller set	ZTSE1879
Straightedge	Obtain locally