Table of Contents

Exploded Views.....231
- **Front Sump**.....231
- **Rear Sump**.....232

Removal.....233
- **Drain Engine Oil**.....233
- **Oil Pan and Gasket**.....233
- **Oil Suction Tube Assembly**.....234

Clean and Inspect.....235

Installation.....236
- **Oil Suction Tube Assembly**.....236
- **Oil Pan and Gasket**.....237
- **Fill Engine with Oil**.....238

Specifications.....239

Special Torque.....239

Special Service Tools.....239

Exploded Views

Front Sump

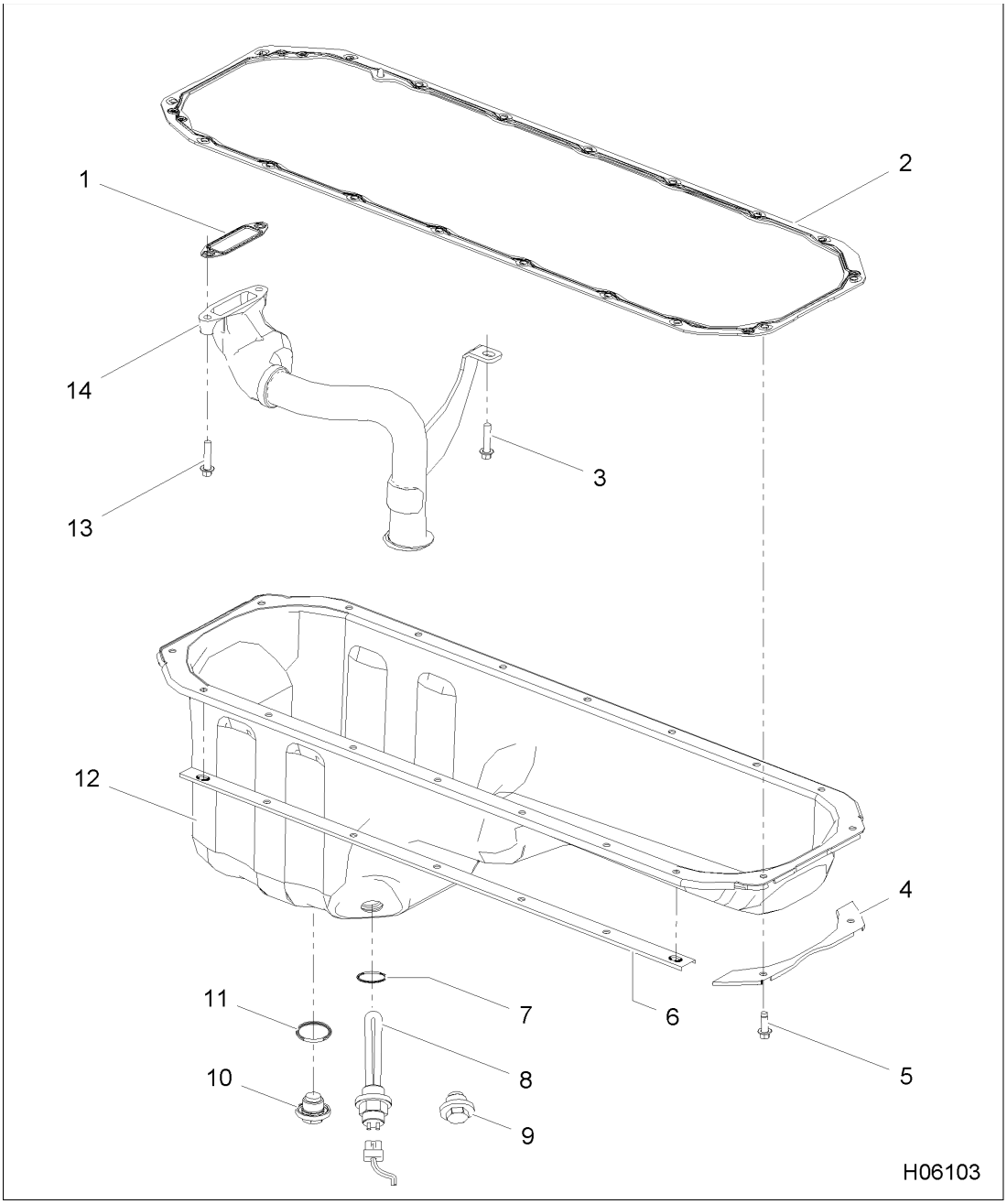

Figure 272 Oil pan and oil suction tube (front sump)

1. Oil suction tube gasket
2. Oil pan gasket
3. M10 x 25 bolt
4. Oil pan end rail stiffener (2)
5. M8 x 24 bolt (18)
6. Oil pan rail stiffener (2)
7. Heater element gasket
8. Heater element (optional)
9. Plug (without oil pan heater)
10. Oil drain plug
11. Oil drain plug O-ring
12. Oil pan (front sump)
13. M8 x 35 bolt (2)
14. Oil suction tube assembly (front sump)

Rear Sump

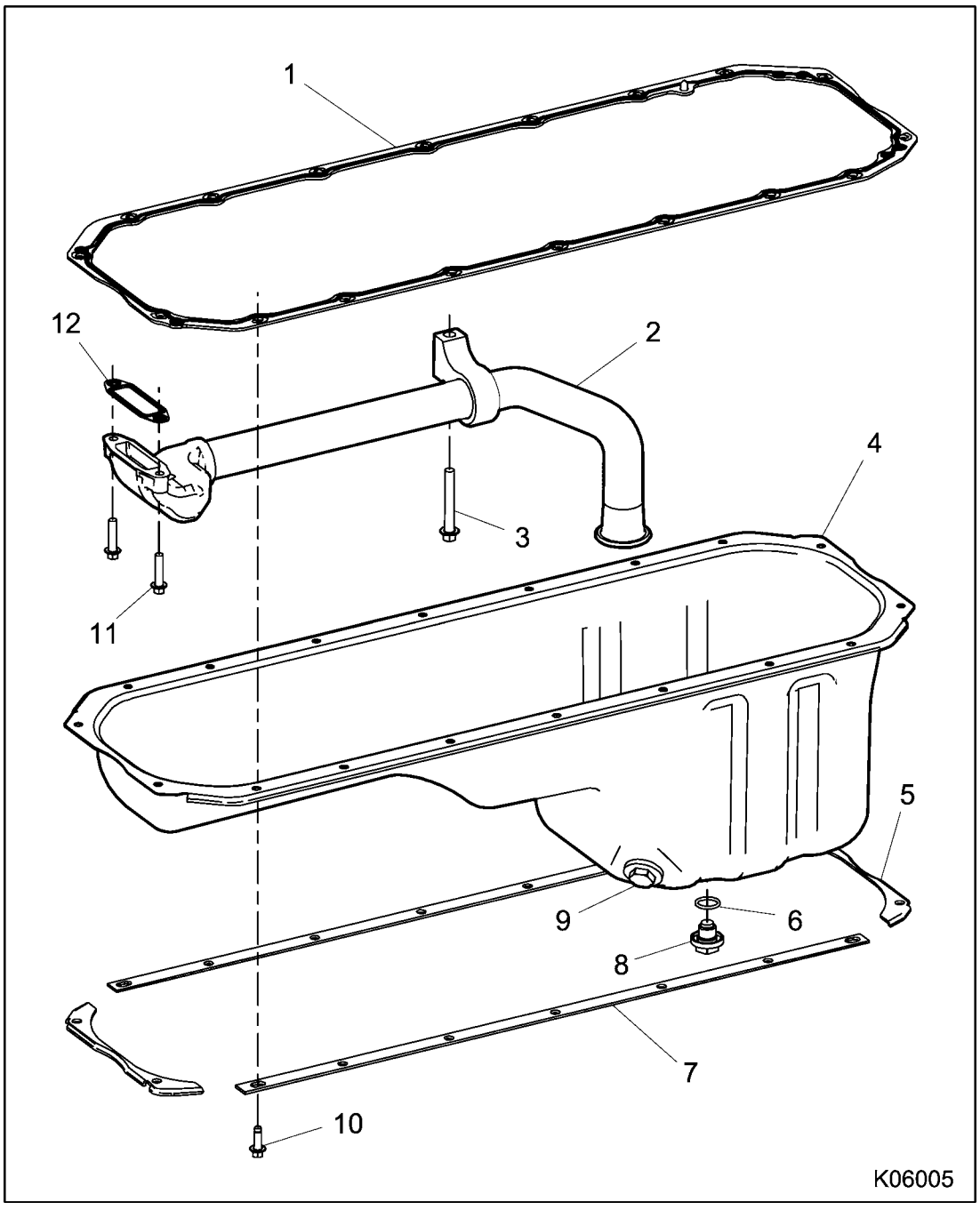

Figure 273 Oil pan and oil suction tube (rear sump)

1. Oil pan gasket
2. Suction tube assembly (rear sump)
3. M10 x 70 bolt
4. Oil pan (rear sump)
5. Oil pan rail end stiffener (2)
6. Oil drain plug O-ring
7. Oil pan rail stiffener (2)
8. Oil drain plug
9. Plug (without oil pan heater)
10. M8 x 24 bolt (18)
11. M8 x 35 bolt (2)
12. Oil suction tube gasket

Removal

WARNING: To prevent personal injury or death, read all safety instructions in the "Safety Information" section of this manual.

WARNING: To prevent personal injury or death, shift transmission to park or neutral, set parking brake, and block wheels before doing diagnostic or service procedures.

WARNING: To prevent personal injury or death, allow engine to cool before removing components.

WARNING: To prevent personal injury or death, do not let engine fluids stay on your skin. Clean skin and nails using hand cleaner and wash with soap and water. Wash or discard clothing and rags contaminated with engine fluids.

GOVERNMENT REGULATION: Engine fluids (oil, fuel, and coolant) may be a threat to the environment. Recycle or dispose of engine fluids and filters according to applicable regulations. Never put engine fluids in the trash, on the ground, in sewers, or bodies of water.

Drain Engine Oil

1. Place an oil drain pan under the engine oil pan.
2. Remove oil drain plug mounted in the bottom of the oil pan.
3. Discard oil drain plug O-ring.
4. Inspect drain plug and replace if necessary.
5. Install a new O-ring on the oil drain plug.
6. After oil has drained, install oil drain plug in the bottom of the oil pan and tighten to special torque (page 239).
7. Recycle or dispose of oil according to applicable regulations.

Oil Pan and Gasket

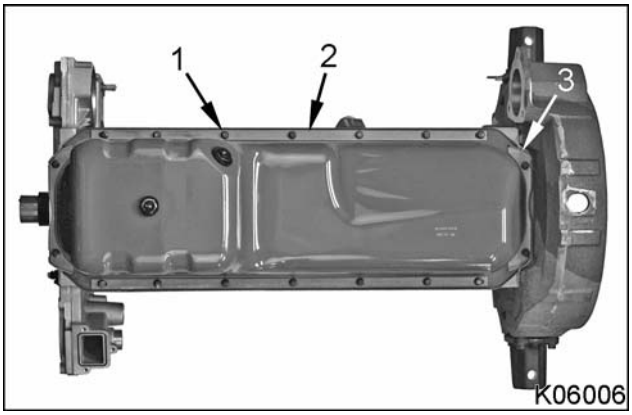

Figure 274 Oil pan bolts and rail stiffeners

1. M8 x 24 bolt (18)
2. Oil pan rail stiffener (2)
3. Oil pan end rail stiffener (2)

1. Remove 18 M8 x 24 oil pan mounting bolts.
2. Remove two oil pan end rail stiffeners and two oil pan rail stiffeners.
3. Separate oil pan from the oil pan gasket and remove oil pan from engine.

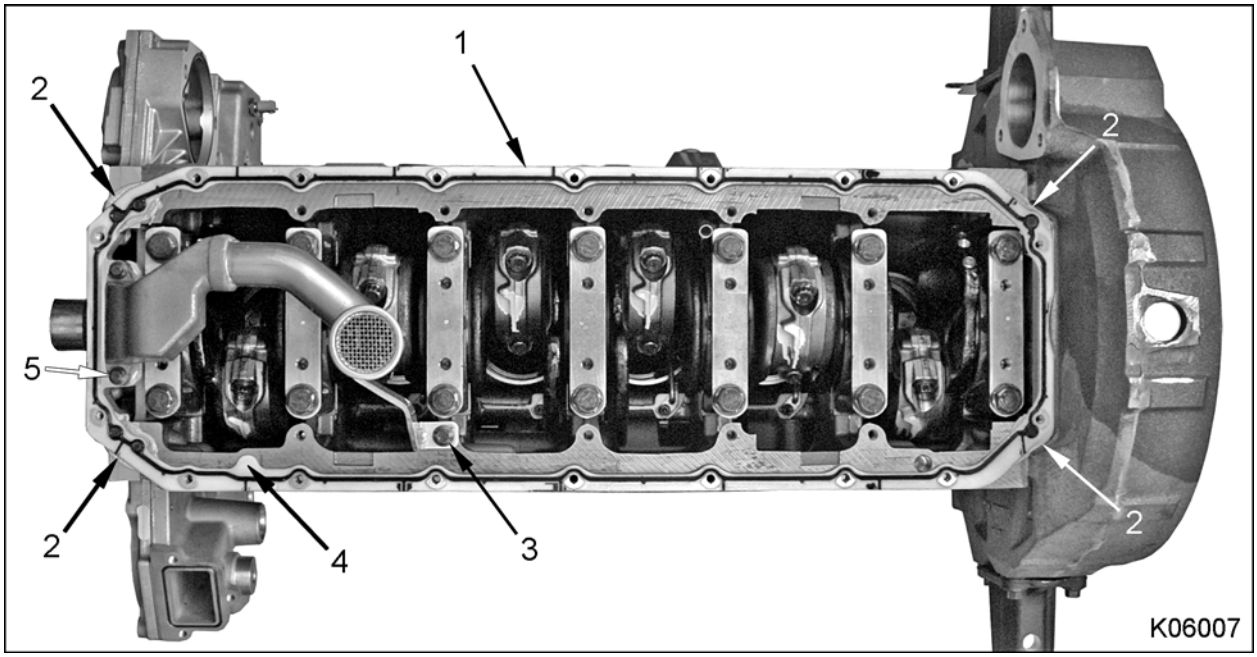

Figure 275 Oil pan gasket, RTV sealant locations, and suction tube assembly (front sump)

1. Oil pan gasket
2. RTV sealant locations
3. M10 x 25 bolt (front sump)
4. Oil pan gasket dowel (into crankcase)
5. M8 x 35 bolt (2)

NOTE: The oil pan gasket is reusable if it is not cracked and the sealing surface is in good condition.

4. Remove the oil pan gasket from the front cover, flywheel housing, and crankcase.
5. Cut through RTV sealant under the oil pan gasket at locations on the oil pan mounting surface using a flat gasket scraper or similar tool. Cut parallel to the gasket path.

Oil Suction Tube Assembly

1. Remove two M8 x 35 bolts connecting the oil suction tube assembly to the front cover.
2. Remove M10 bolt holding the oil suction tube bracket to the crankcase.
3. Remove the oil suction tube assembly and discard gasket.

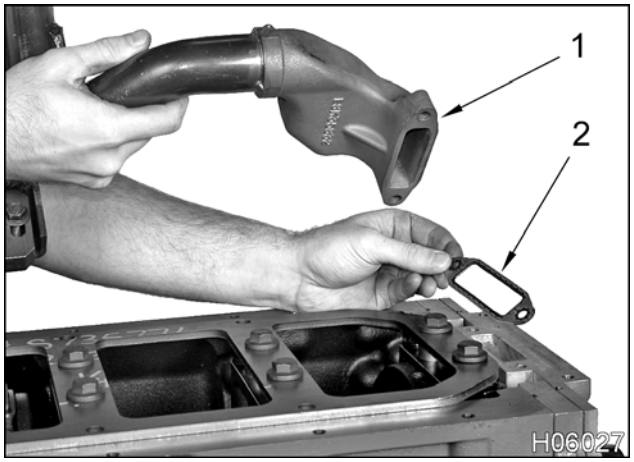

Figure 276 Oil suction tube assembly and gasket

1. Oil suction tube assembly
2. Oil suction tube gasket

Clean and Inspect

1. Remove RTV sealant from the crankcase, oil pan, front cover, and flywheel housing mating surfaces with a flat scraper. Scrape parallel to the gasket path.
2. Clean the oil pan, front cover, flywheel housing, oil suction tube assembly, and crankcase mating surfaces thoroughly with a suitable solvent.
3. Clean and inspect the oil pan gasket. Discard the oil pan gasket if it is cracked or the sealing surfaces are damaged.
4. Clean and inspect the oil suction tube assembly. Make sure the oil suction tube is free of obstructions.
5. Check the oil pan and oil suction tube assembly for cracks and damage. Replace components if necessary.

Installation

Oil Suction Tube Assembly

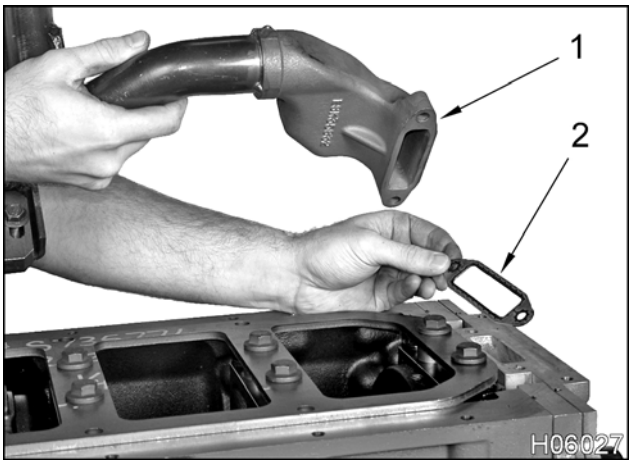

Figure 277 Oil suction tube assembly and gasket

1. Oil suction tube assembly
2. Oil suction tube gasket

1. Install oil suction tube assembly and a new gasket on the front cover and finger tighten two M8 x 35 bolts.

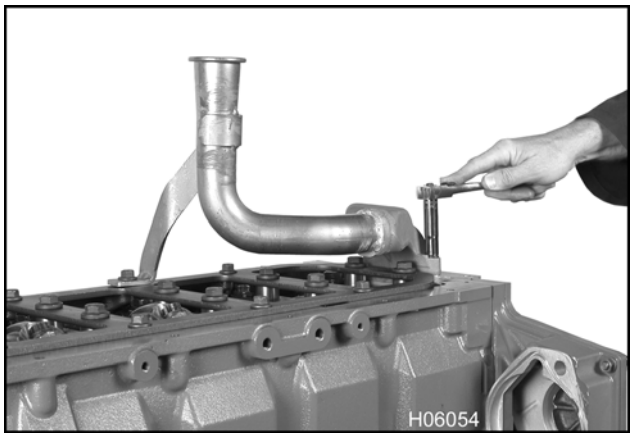

Figure 278 Oil suction tube assembly installation (typical)

2. Install one M10 bolt connecting the oil suction tube mounting bracket to the crankcase and finger tighten.
3. Tighten two M8 x 35 bolts to special torque (page 239).
4. Tighten M10 bolt to standard torque (page 471).

Oil Pan and Gasket

1. Install flywheel housing (page 350).
2. Install front cover (page 264).

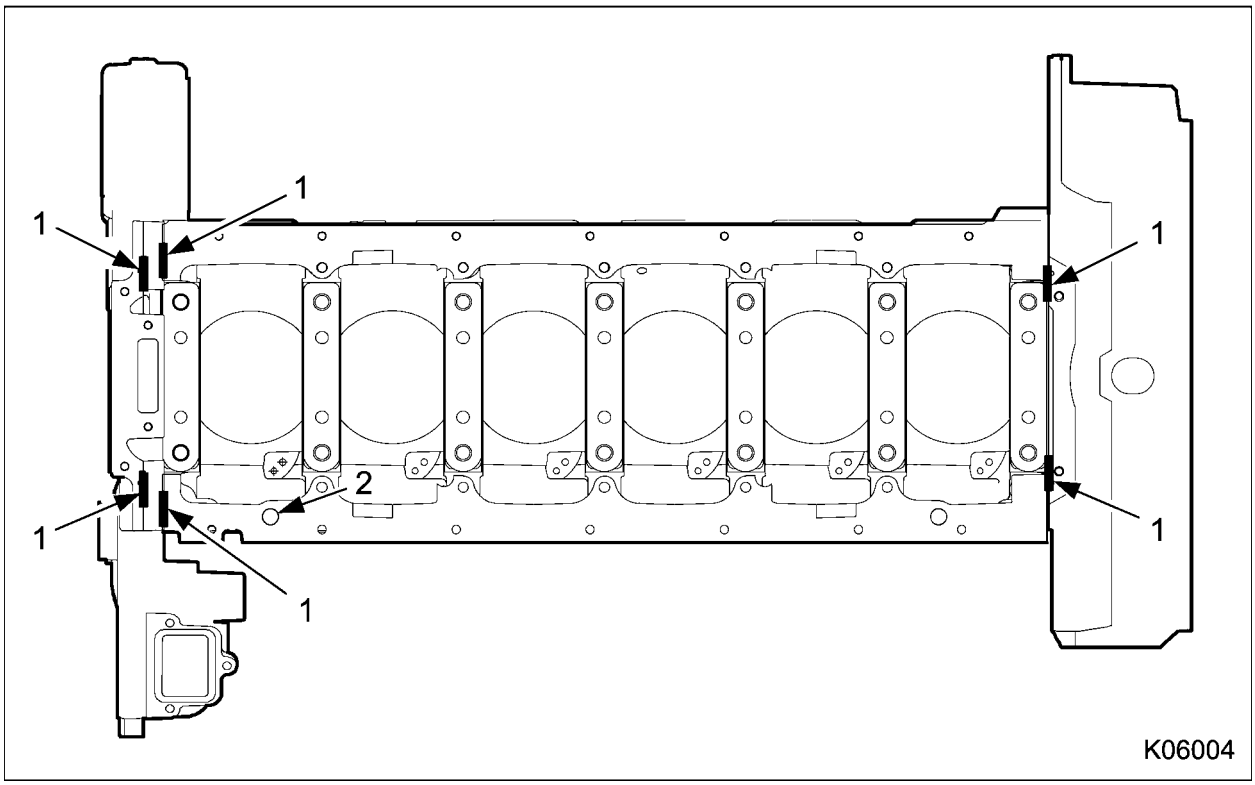

Figure 279 Oil pan gasket mounting surface

1. RTV sealant locations
2. Oil pan gasket dowel hole

3. Apply a 6 mm (0.25 in) bead of Wacker T – 442 RTV sealant (page 239) to the six locations on the oil pan mounting surface. These locations coincide with gasket joints between the front cover halves, crankcase, and flywheel housing.
4. Before the RTV sealant dries, install a clean oil pan gasket on the crankcase mounting surface. Make sure the oil pan gasket dowel is aligned with the hole in the crankcase mounting surface.
5. Install the oil pan on the crankcase.

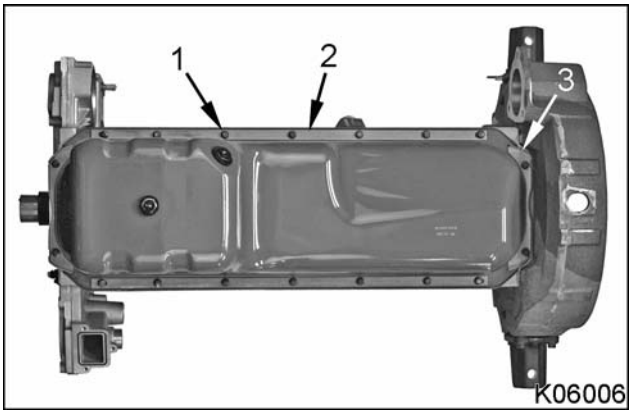

Figure 280 Oil pan, bolts, and rail stiffeners

1. M8 x 24 bolt (18)
2. Oil pan rail stiffener (2)
3. Oil pan end rail stiffener (2)

6. Install two oil pan end rail stiffeners and two oil pan rail stiffeners on the oil pan.
7. Install 18 M8 x 24 oil pan mounting bolts finger tight.
8. Tighten M8 x 24 bolts to special torque (page 239).

Fill Engine with Oil

CAUTION: To prevent engine damage, after engine or lubrication system service, prime engine with oil (page 226) before starting engine. This will lubricate internal engine components during the critical initial startup phase.

1. Fill engine with the proper grade, viscosity, and quantity of engine oil. See *Engine Operation and Maintenance Manual*. Do not exceed engine oil fill specifications (page 239).
2. Start engine and check for oil leaks. If oil is leaking, turn off engine and repair leaks.
3. Turn off engine.
4. Wait 15 minutes. Check oil level and fill to the full mark.

Specifications

Engine oil dry (after rebuild and new filter)	33 L (35 quarts US)
Engine oil wet (after oil drain and filter change)	28 L (30 quarts US)

Special Torque

Oil pan drain plug	68 N·m (50 lbf·ft)
Oil pan heater plug	68 N·m (50 lbf·ft)
Oil pan mounting bolts, M8 x 24	32 N·m (24 lbf·ft)
Oil suction tube bolts, M8 x 35	27 N·m (20 lbf·ft)

Special Service Tools

Wacker T – 442 RTV sealant	Obtain locally

Table of Contents

Exploded View and Description....244

Removal....246
- **Drive Belt....247**
- **Alternator Bracket, Automatic Belt Tensioner, and Single Idler Pulley....247**
- **Secondary Compressor Support, Dual Idler Pulleys, and Idler Mounting Plate....248**
- **Water Supply Housing (Freon® Compressor Mount)....249**
- **Water Outlet Tube, and Thermostat....249**
- **Water Pump Assembly....250**
- **Water Inlet Elbow....250**
- **Fan Drive....251**
  - **Spin-on Fan Drive....251**
  - **Horton DriveMaster® Fan Drive....252**
- **Vibration Damper, Hub, and Wear Sleeve....253**
- **Oil Pump Assembly....254**
- **Front Engine Mounting Bracket....256**
- **Front Cover (Front Half)....257**
- **Idler Gears....258**
- **Front Cover (Rear Half)....260**

Clean, Inspect, and Measure....261
- **Clean and Inspect....261**
- **Measure Gear Backlash....261**
  - **Lower Idler Gear Backlash....261**
  - **Upper Idler Gear Backlash....262**
  - **Camshaft Gear Backlash....262**
- **Measure Oil Pump Side Clearance....263**
- **Measure Oil Pump End Clearance....263**

Installation....264
- **Front Cover (Rear Half)....264**
- **Idler Gears....266**
- **Front Cover (Front Half)....268**
- **Front Engine Mounting Bracket....270**
- **Oil Pump Assembly....270**
- **Vibration Damper, Hub, and Wear Sleeve....274**
- **Fan Drive....277**
  - **Spin-on Fan Drive....277**
  - **Horton DriveMaster® Fan Drive....278**
- **Water Outlet Tube, and Thermostat....279**
- **Water Pump Assembly....280**
- **Water Inlet Elbow....280**
- **Water Supply Housing (Freon® Compressor Mount)....281**
- **Alternator Bracket and Automatic Belt Tensioner....281**
- **Secondary Compressor Support, Dual Idler Pulleys, and Idler Mounting Plate....282**
- **Drive Belt....283**

Specifications.....**284**

Special Torque.....**287**

Special Service Tools.....**287**

Exploded View and Description

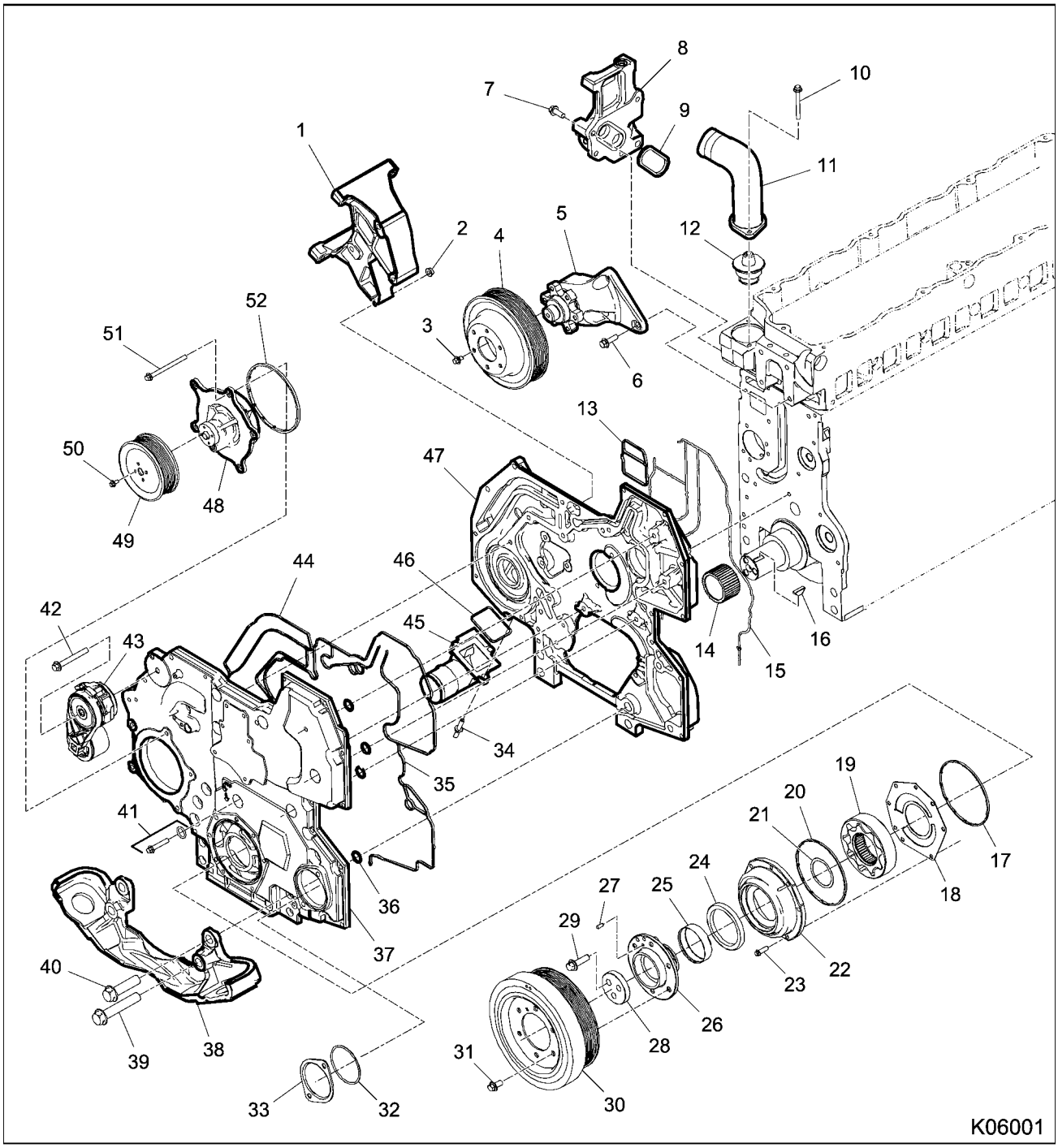

Figure 281 Front cover and related components, less gear train (typical)

1. Alternator bracket
2. M8 nut
3. M8 x 20 bolt (6)
4. Fan drive pulley
5. Fan housing assembly
6. M10 x 30 bolt (3)
7. M10 x 25 bolt (4)
8. Water supply housing (Freon® compressor mount)
9. Coolant port seal
10. M8 x 25 bolt (2)
11. Water outlet tube assembly
12. Thermostat assembly
13. Front cover rear half (coolant) gasket
14. Oil pump spline drive
15. Front cover rear half (oil) gasket
16. Vibration damper key
17. Oil pump (housing plate) seal
18. Oil pump housing plate
19. Rotor assembly
20. Oil pump (housing) seal
21. Washer, seal
22. Oil pump and rotor housing
23. M8 x 25 bolt (See Oil Pump Assembly (page 254))
24. Front oil seal
25. Wear sleeve
26. Damper hub
27. Dowel pin
28. Damper retainer
29. M12 x 40 damper bolt, 12 point (3)
30. Vibration damper assembly
31. M10 x 16 bolt (6)
32. O-ring seal, #235 (PTO equipped only)
33. PTO adapter cover (PTO equipped only)
34. M8 stud bolt (3)
35. Front cover front half (oil) gasket
36. O-ring (4)
37. Front cover (front half)
38. Front engine mounting bracket
39. M18 x 100 bolt, lower (2)
40. M18 x 70 bolt, upper (2)
41. Seal assembly
42. M10 x 90 bolt
43. Automatic belt tensioner
44. Front cover front half (coolant) gasket
45. Water inlet elbow
46. Water inlet gasket
47. Front cover (rear half)
48. Water pump assembly
49. Water pump pulley
50. M6 x 12 bolt (4)
51. M8 x 100 bolt (See Water Pump Assembly (page 250))
52. Water pump housing seal

MaxxForce™ DT, 9, and 10 engines are available in various front cover and cooling system configurations. Engines are available with or without a power takeoff (PTO) adaptor attachment on the front cover. Numerous spin-on and Horton DriveMaster® fan drive configurations are available. Engines can be equipped with one, two, or no Freon® compressor. Several water outlet tubes are also used. See Engine Cooling System (page 36) for additional details.

Removal

WARNING: To prevent personal injury or death, read all safety instructions in the "Safety Information" section of this manual.

WARNING: To prevent personal injury or death, shift transmission to park or neutral, set parking brake, and block wheels before doing diagnostic or service procedures.

WARNING: To prevent personal injury or death, make sure engine has cooled before removing components.

WARNING: To prevent personal injury or death, do not open pressurized Freon® lines.

WARNING: To prevent personal injury or death, wear safety glasses with side shields. Limit compressed air pressure to 207 kPa (30 psi).

WARNING: To prevent personal injury or death, disconnect the main battery negative terminal before disconnecting or connecting electrical components.

WARNING: To prevent personal injury or death, do not let engine fluids stay on your skin. Clean skin and nails using hand cleaner and wash with soap and water. Wash or discard clothing and rags contaminated with engine fluids.

GOVERNMENT REGULATION: Engine fluids (oil, fuel, and coolant) may be a threat to the environment. Recycle or dispose of engine fluids and filters according to applicable regulations. Never put engine fluids in the trash, on the ground, in sewers, or bodies of water.

NOTE: Valve train failures from broken or bent push rods, valves, rocker arms, and worn valve retainers and rotators can be caused by improper gear train timing. Depending on valve lash setting, if the camshaft gear is improperly timed by one tooth, the pistons will strike the intake or exhaust valves.

Drive Belt

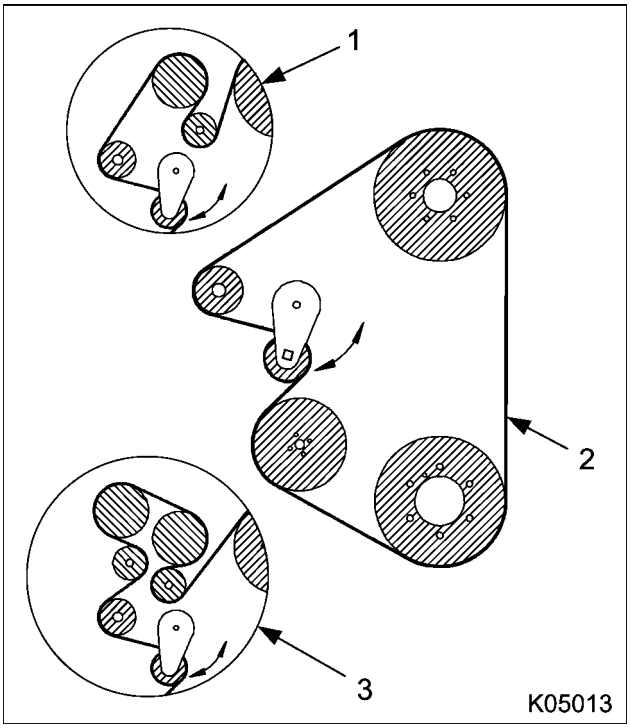

Figure 282 Drive belt routing

1. Single Freon® compressor and single idler pulley
2. Without Freon® compressor
3. Dual Freon® compressors and dual idler pulleys

1. Insert 1/2 inch square drive ratchet or breaker bar into belt tensioner square hole.
2. Rotate belt tensioner clockwise to release belt tension.
3. Remove drive belt and release belt tensioner.

Alternator Bracket, Automatic Belt Tensioner, and Single Idler Pulley

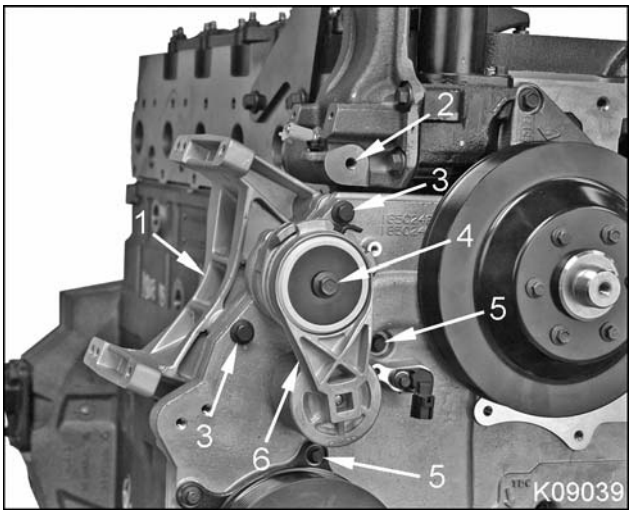

Figure 283 Alternator bracket, belt tensioner, and single idler pulley bolt locations

1. Alternator bracket
2. M10 x 90 bolt hole (single idler pulley)
3. M10 x 120 bolt (2)
4. M10 x 90 bolt (belt tensioner)
5. M8 x 100 bolt (2)
6. Automatic belt tensioner

1. Remove two M8 x 100 bolts and nuts.
2. Remove two M10 x 120 bolts and nuts.
3. Remove alternator bracket.
4. If equipped, remove single idler pulley M10 x 90 bolt and remove pulley from the water supply housing (pulley not shown).
5. Remove automatic belt tensioner M10 x 90 bolt and remove assembly from the front cover.

Secondary Compressor Support, Dual Idler Pulleys, and Idler Mounting Plate

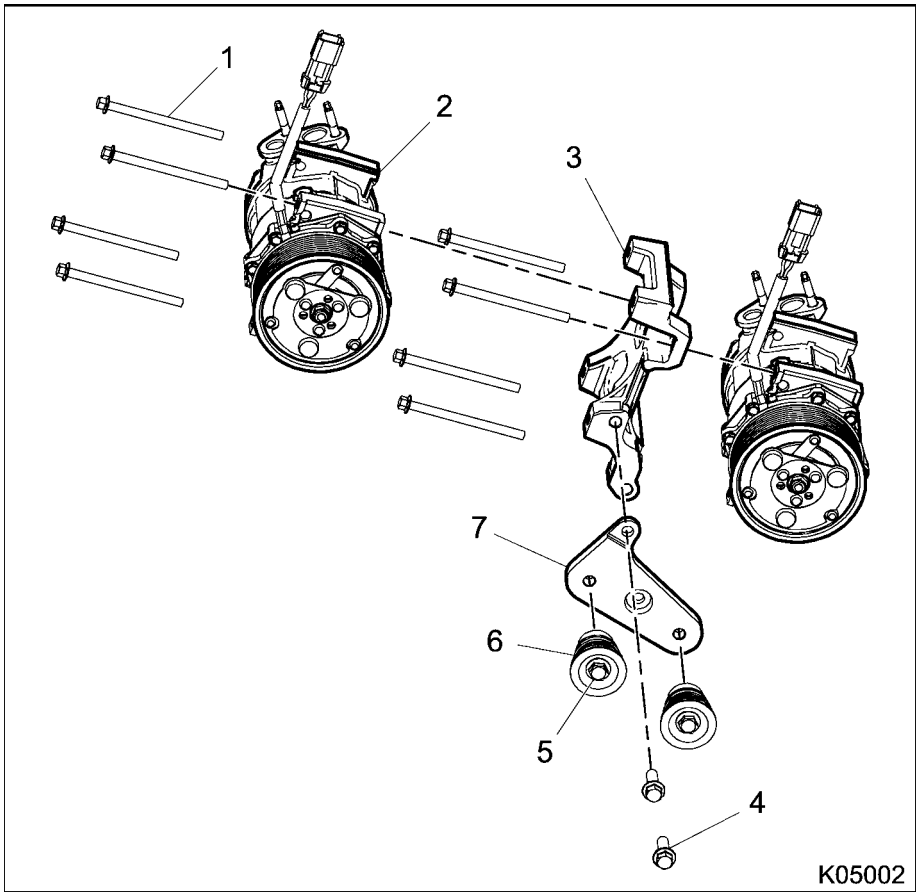

Figure 284 Dual Freon® compressor mounting

1. M8 x 110 bolt (8)
2. A/C (Freon®) compressor (2)
3. Secondary Freon® compressor support
4. M10 x 30 bolt (2)
5. M10 x 60 bolt (2)
6. Flat idler pulley assembly (2)
7. Idler mounting plate

WARNING: To prevent personal injury or death, do not open pressurized Freon® lines.

NOTE: The following procedure only applies to engines equipped with dual A/C (Freon®) compressors.

1. Remove four M8 x 110 bolts holding the outer Freon® compressor to the secondary Freon® compressor support.
2. Do not remove or disconnect pressurized Freon® lines. Move outer Freon® compressor out of the way and secure with a strap or remove from engine.
3. If required, remove two M10 x 60 bolts and remove two flat idler pulley assemblies.
4. If required, remove two M10 x 30 bolts and remove the idler mounting plate from the secondary Freon® compressor support.
5. Remove four M8 x 110 bolts holding the secondary Freon® compressor support and inner Freon® compressor to the cylinder head.

Water Supply Housing (Freon® Compressor Mount)

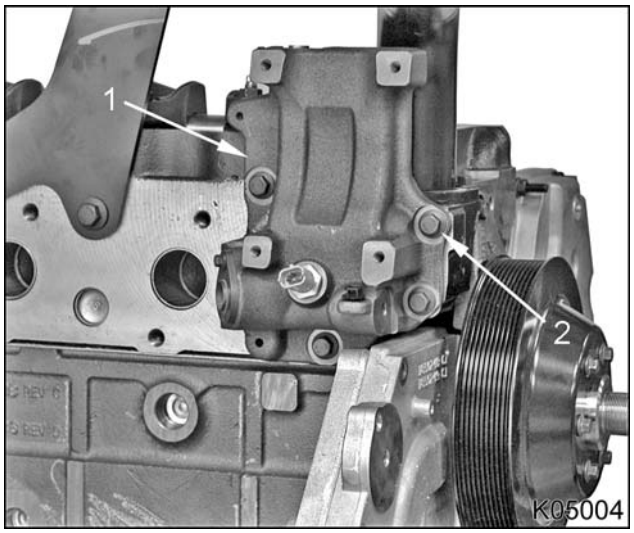

Figure 285 Water supply housing

1. Water supply housing (Freon® compressor mount)
2. M10 x 25 bolt (4)

1. Remove four M10 x 25 bolts and remove water supply housing.

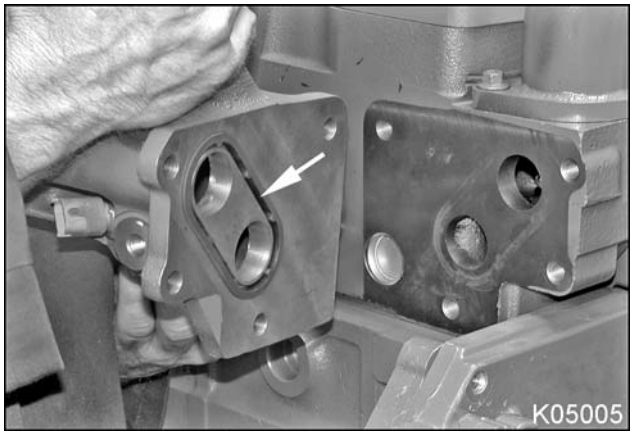

Figure 286 Water supply housing coolant port seal

2. Remove and discard coolant port seal.

Water Outlet Tube, and Thermostat

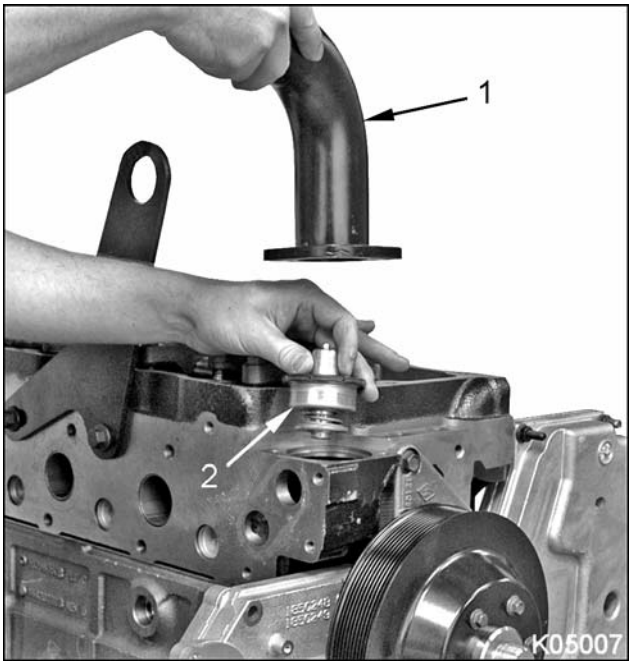

Figure 287 Water outlet tube and thermostat

1. Water outlet tube (typical)
2. Thermostat assembly

NOTE: Water outlet tube configurations use either two M8 x 25 bolts or two M8 x 115 bolts to hold the water outlet tube to the cylinder head.

1. Remove two M8 bolts holding the water outlet tube to the cylinder head.
2. Remove water outlet tube and thermostat.
3. If equipped, remove the thermostat bypass housing and discard gasket.

Water Pump Assembly

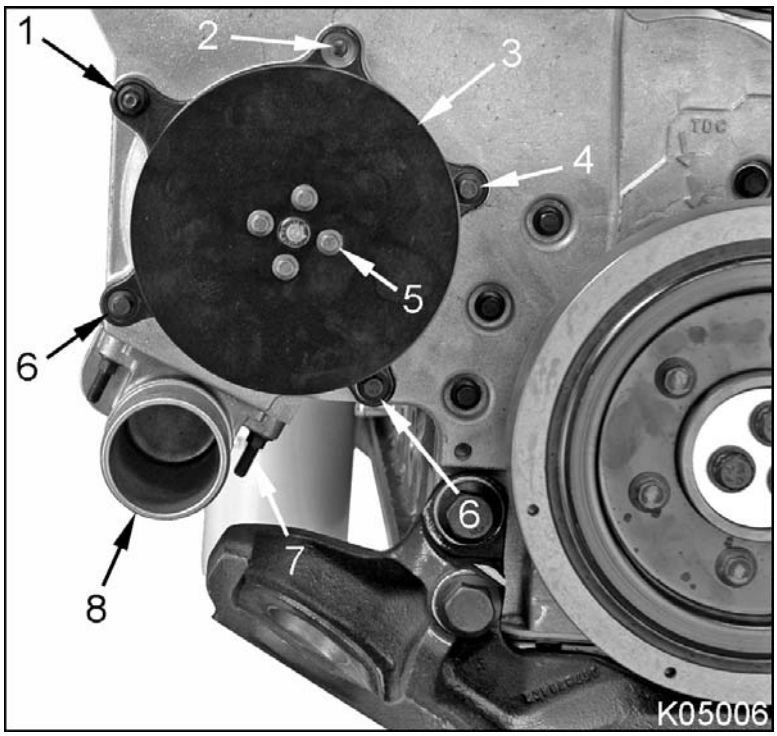

Figure 288 Water pump and inlet elbow (typical)

1. M8 x 55 bolt (nut on front)
2. M8 x 100 bolt (nut on back)
3. Water pump pulley (typical)
4. M8 x 16 bolt
5. M6 x 12 bolt (4)
6. M8 x 45 bolt (2)
7. M8 stud bolt (3)
8. Water inlet elbow

1. Remove four M6 x 12 pulley bolts and remove water pump pulley.
2. Remove M8 x 100 bolt (nut on back).
3. Remove M8 x 55 bolt (nut on front).
4. Remove M8 x 16 bolt.
5. Remove two M8 x 45 bolts.
6. Remove water pump assembly and discard water pump housing seal.

Water Inlet Elbow

NOTE: Water inlet elbow configurations use either three M8 stud bolts or three M8 x 30 bolts to hold the water inlet elbow to the front cover.

1. Remove three M8 bolts holding the water inlet elbow to the front cover.
2. Remove water inlet elbow and discard gasket.

Fan Drive

Spin-on Fan Drive

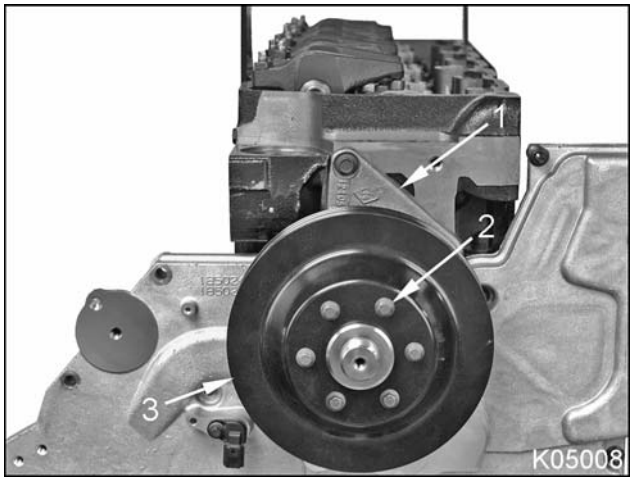

Figure 289 Fan drive pulley, spin-on

1. Fan housing assembly (typical)
2. M8 x 20 bolt (6)
3. Fan drive pulley

1. Remove six M8 x 20 bolts and remove the fan drive pulley.

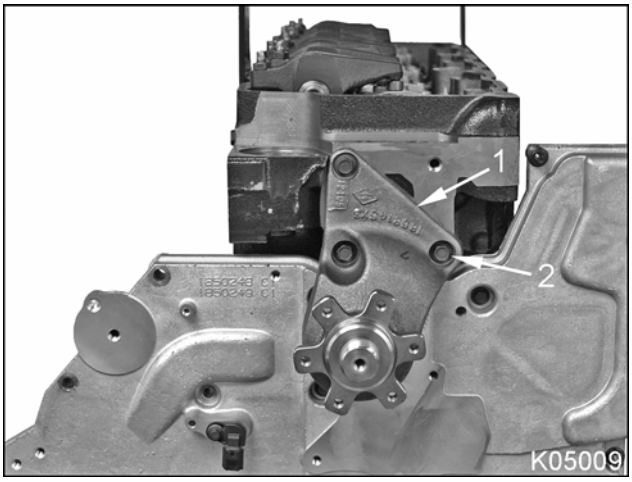

Figure 290 Fan housing assembly, spin-on (typical)

1. Fan housing assembly (typical)
2. M10 x 30 bolt (3)

NOTE: Fan drive configurations use either three or four M10 x 30 bolts to hold the fan housing assembly to the cylinder head.

2. Remove M10 x 30 bolts and remove the fan housing assembly.

Horton DriveMaster® Fan Drive

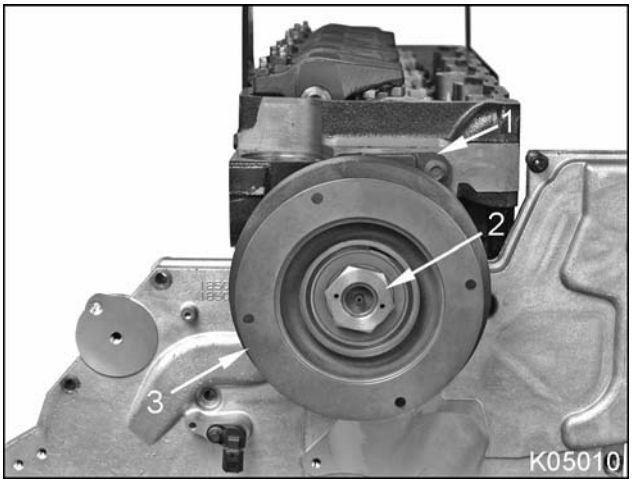

Figure 291 Fan pulley, DriveMaster®

1. Fan mounting bracket (typical)
2. Nut assembly
3. Fan pulley

1. Remove nut assembly from fan mounting bracket, using a Fan Hub Wrench (2 inch) (page 287).

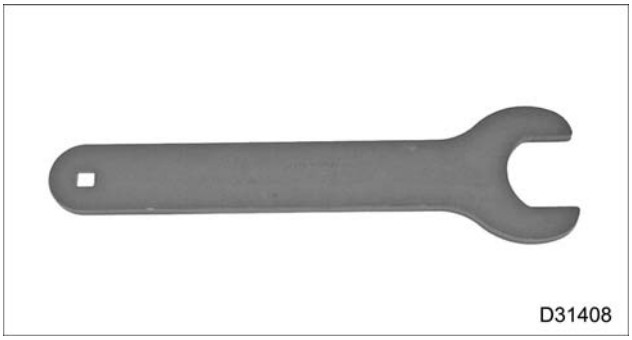

Figure 292 Fan hub wrench

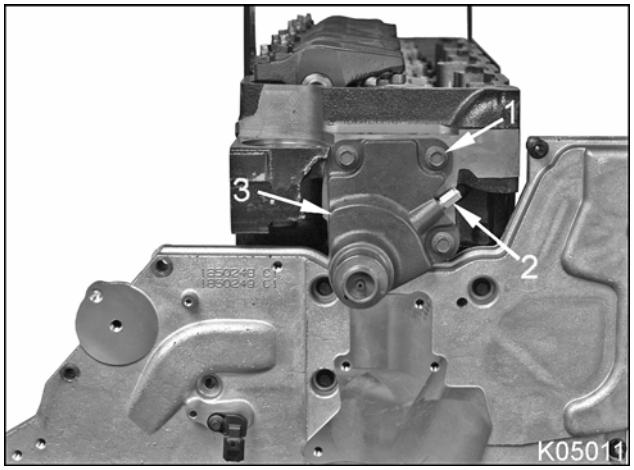

Figure 293 Fan mounting bracket, DriveMaster® (typical)

1. M10 x 30 bolt (3)
2. Fan clutch air supply fitting (typical)
3. Fan mounting bracket (typical)

NOTE: Fan drive configurations use either three or four M10 x 30 bolts to hold the fan mounting bracket to the cylinder head.

2. Remove M10 x 30 bolts and remove the fan mounting bracket.

Vibration Damper, Hub, and Wear Sleeve

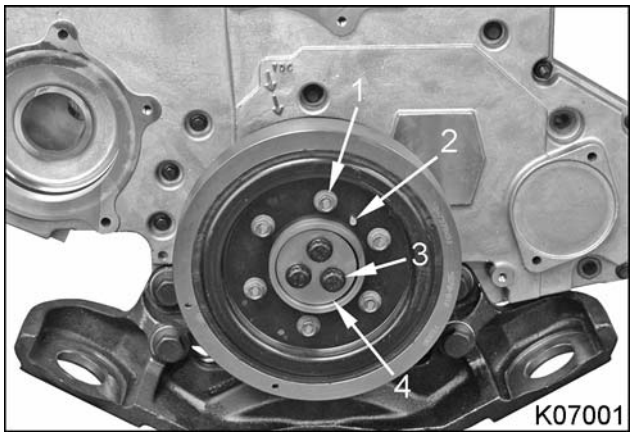

Figure 294 Vibration damper assembly

1. M10 x 16 bolt (6)
2. Dowel pin
3. M12 x 40 (12 point) damper bolt (3)
4. Damper retainer

NOTE: The dowel pin for MaxxForce™ 9 and 10 vibration dampers is almost flush with the damper front surface. The dowel pin for MaxxForce™ DT vibration dampers protrudes out approximately 6 mm (0.24 in).

1. Remove six M10 x 16 bolts holding the vibration damper to the damper hub and remove vibration damper.
2. Remove three M12 x 40 (12 point) damper bolts and remove the damper retainer.

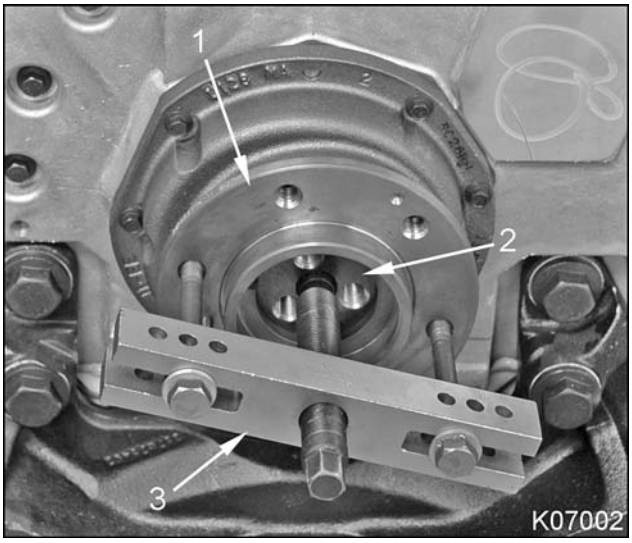

Figure 295 Damper hub and H-bar puller

1. Damper hub
2. Crankshaft
3. H-bar puller

3. Install two M10 x 80 bolts and washers through H-bar puller (page 287) and into the damper hub. Install M10 x 80 bolt heads at equal lengths from the vibration damper mounting surface.
4. Tighten H-bar center shaft to pull damper hub off of crankshaft and remove damper hub.

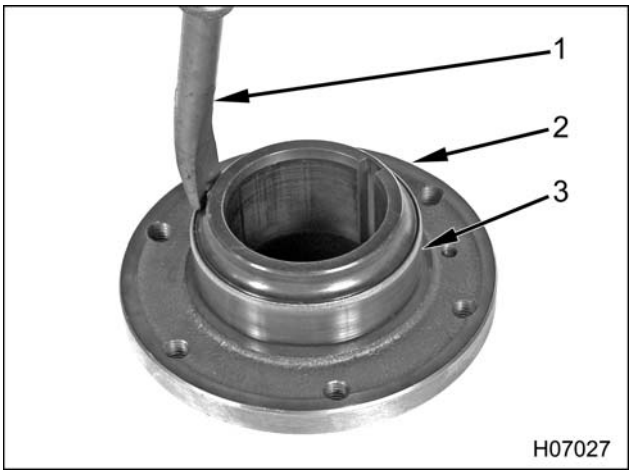

Figure 296 Damper hub and wear sleeve

1. Muffler chisel
2. Damper hub
3. Wear sleeve

CAUTION: To prevent engine damage, do not damage or distort damper hub while removing wear sleeve.

5. Carefully split wear sleeve with a muffler chisel (page 287) and remove sleeve from the damper hub. Be careful not to damage the damper hub.

Oil Pump Assembly

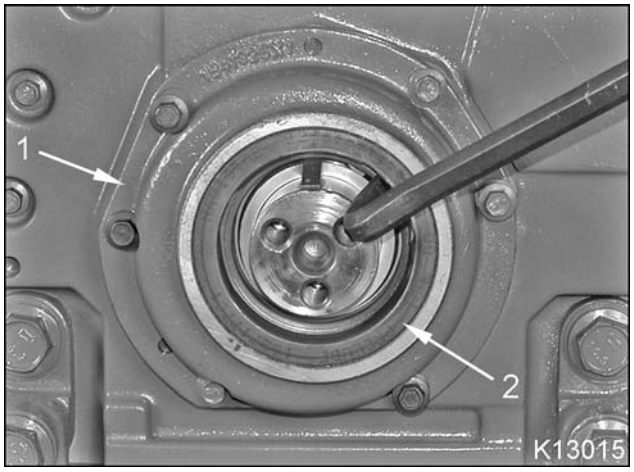

Figure 297 Front oil seal removal

1. Oil pump and rotor housing
2. Front oil seal

NOTE: Be careful not to damage the crankshaft or front oil seal mounting surface while removing the front oil seal.

1. Remove the front oil seal with a heel bar (page 287) or seal puller, while the oil pump and rotor housing assembly is attached to the front cover.
2. Discard front oil seal.

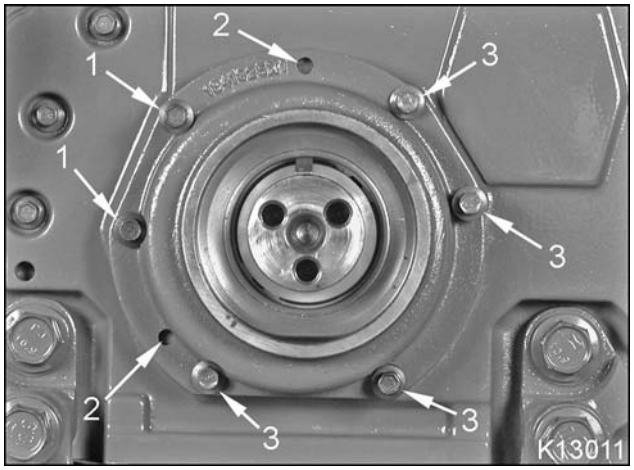

Figure 298 Oil pump and rotor housing assembly

1. M8 x 60 bolt (2)
2. Dowel (2)
3. M8 x 25 bolt (4)

3. Remove two M8 x 60 bolts holding the oil pump and rotor housing to the front cover.
4. Remove four M8 x 25 bolts.

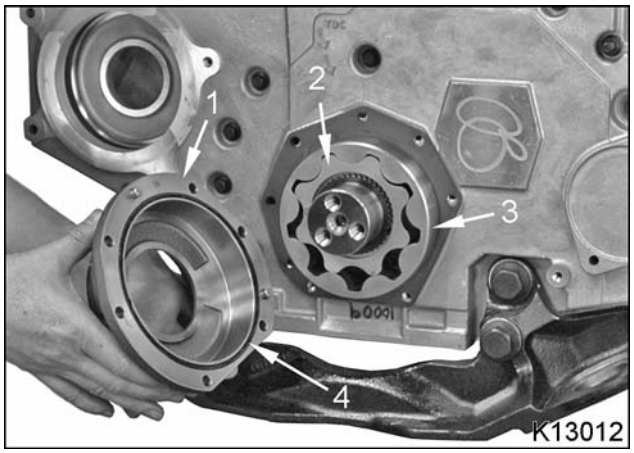

Figure 299 Oil pump housing and rotor assembly

1. Oil pump and rotor housing
2. Inner rotor
3. Outer rotor
4. Oil pump (housing) seal

5. Remove the oil pump and rotor housing and discard oil pump (housing) seal.

CAUTION: To prevent engine damage, use permanent marker to identify internal engine components and their orientation. Do not use paint or temporary markers.

6. Mark inner and outer rotors with a permanent marker, if oil pump is to be reused. Mark will indicate rotor turning direction and orientation to front cover.
7. Remove outer rotor.

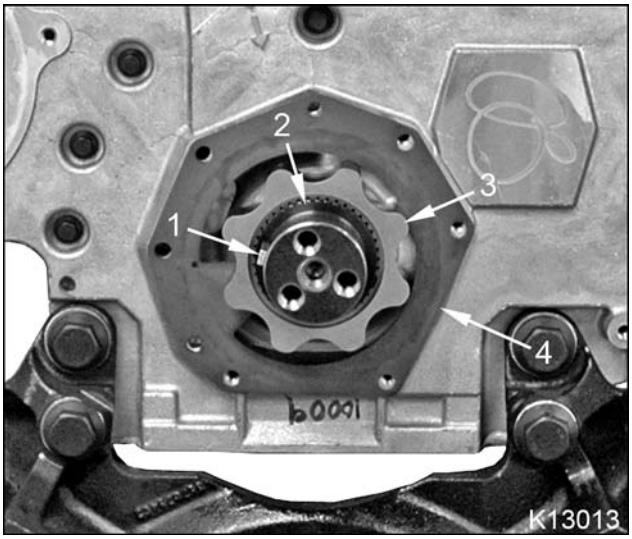

Figure 300 Vibration damper key, inner rotor, and oil pump housing plate

1. Vibration damper key
2. Washer seal
3. Inner rotor
4. Oil pump housing plate

CAUTION: To prevent engine damage, do not damage or distort the crankshaft keyway groove during vibration damper key removal.

8. Carefully tap the vibration damper key out of the crankshaft with a hammer and chisel.
9. Remove washer seal and inner rotor from crankshaft.
10. Remove oil pump housing plate.
11. Remove oil pump housing seal from front cover and discard.

NOTE: To remove the oil pump spline drive. See Oil Pump Spline Drive removal (page 407).

Front Engine Mounting Bracket

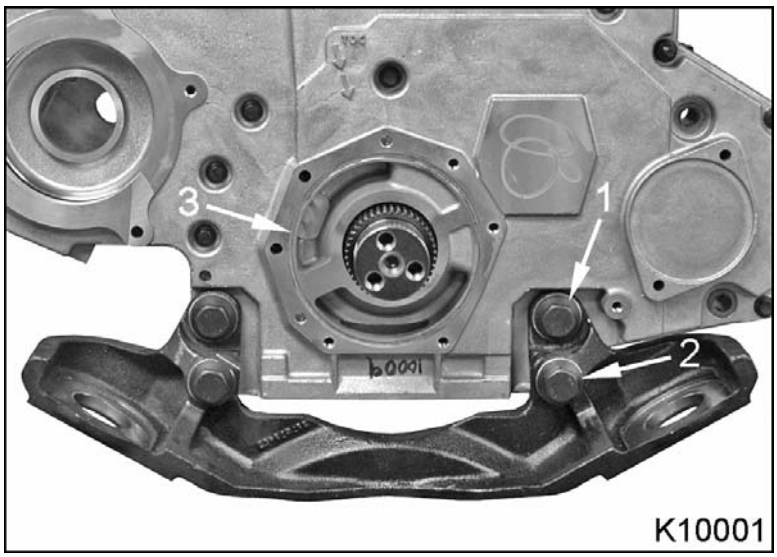

Figure 301 Front engine mount

1. M18 x 70 bolt (2)
2. M18 x 100 bolt (2)
3. Oil pump housing seal groove

WARNING: To prevent personal injury or death, support engine (if in chassis) before removing any bolts from engine mounts.

1. Properly support the engine.
2. Remove two upper M18 x 70 bolts.
3. Support front engine mount and remove two lower M18 x 100 bolts.
4. Remove front engine mounting bracket.

Front Cover (Front Half)

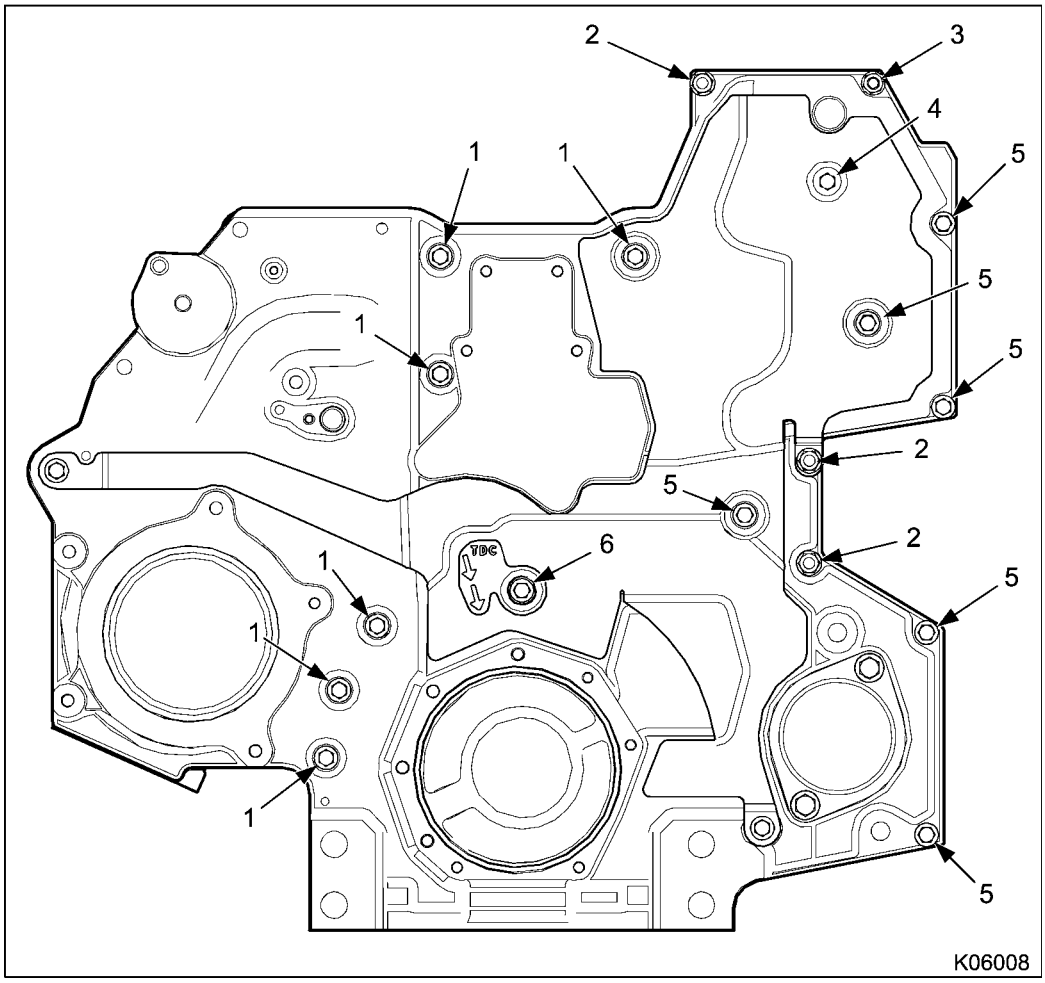

Figure 302 Front cover (front half) – front side

1. M8 x 45 bolt (6)
2. M8 x 50 bolt (nut on front) (3)
3. M8 x 73 stud bolt (nut on back)
4. M8 x 75 bolt (nut on back)
5. M8 x 50 bolt (nut on back) (6)
6. Seal assembly, M8 x 50 bolt and seal washer

NOTE: The oil pan and oil suction tube assembly must be removed before the front cover can be removed.

1. Remove the oil pan (page 233) and oil suction tube assembly (page 234).
2. Remove six M8 x 45 bolts holding the front cover to the crankcase.
3. Remove seven M8 x 50 bolts (nut on back).
4. Remove two M8 x 50 bolts (nut on front).
5. Remove M8 x 73 stud bolt (nut on back).
6. Remove and discard seal assembly M8 x 50 bolt and seal washer.
7. Remove M8 x 75 bolt (nut on back).
8. Remove front cover (front half) by sliding cover forward and off two dowel pins.
9. Remove and discard oil and coolant gaskets and O-ring seals from the front cover (front half) – back side.

Idler Gears

NOTE: Measure lower idler, upper idler, and camshaft gear backlash (page 261) before removing any gears from the gear train.

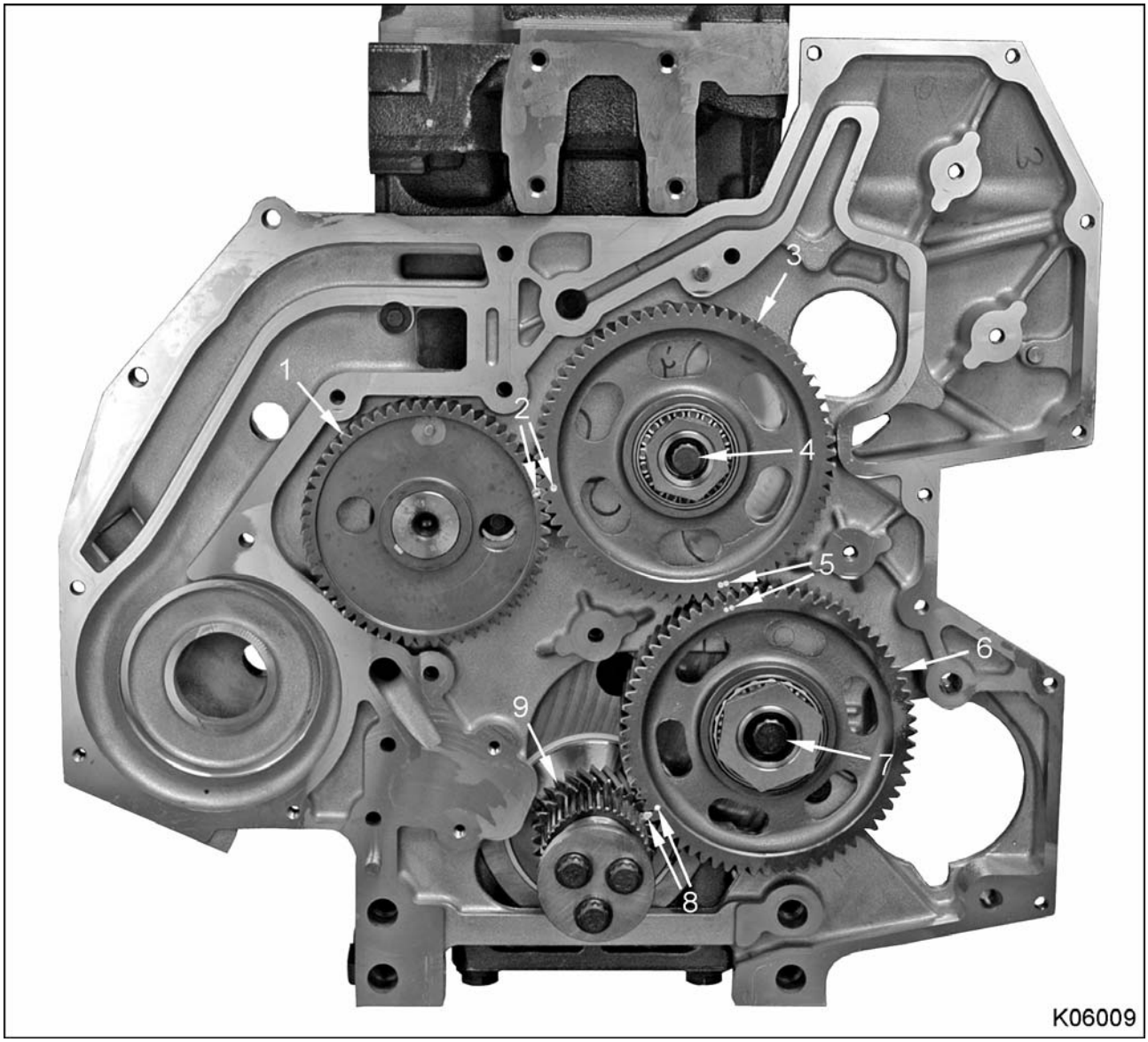

Figure 303 Gear train

1. Camshaft gear
2. Camshaft to upper idler gear timing marks (single dimple)
3. Upper idler gear
4. M16 x 65 bolt
5. Upper idler to lower idler gear timing marks (double dimple)
6. Lower idler gear
7. M20 x 70 bolt
8. Lower idler to crankshaft gear timing marks
9. Crankshaft gear

NOTE: Once timing marks are aligned, the crankshaft will require 34 revolutions to align timing marks again.

1. Rotate crankshaft until camshaft, upper idler, lower idler, and crankshaft gears timing marks are aligned.
2. If required, remove camshaft gear (page 408) from the camshaft.

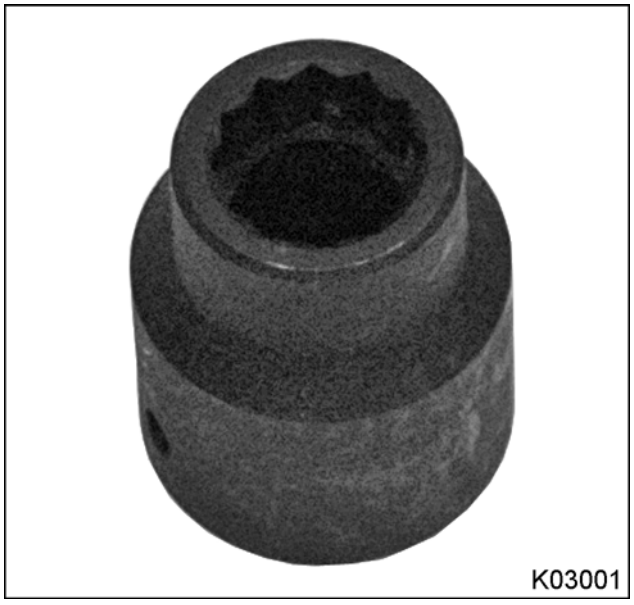

Figure 304 Lower Idler Gear Socket

3. Remove M20 x 70 bolt using Lower Idler Gear Socket (page 287) and a 3/4 inch drive breaker bar.
4. Remove lower idler gear.
5. Remove M16 x 65 bolt using a 16 mm 12 point impact socket (page 287) and a 1/2 inch drive breaker bar.
6. Remove upper idler gear.

NOTE: If required, Measure Camshaft End Play (page 415) after removing the upper idler gear.

Front Cover (Rear Half)

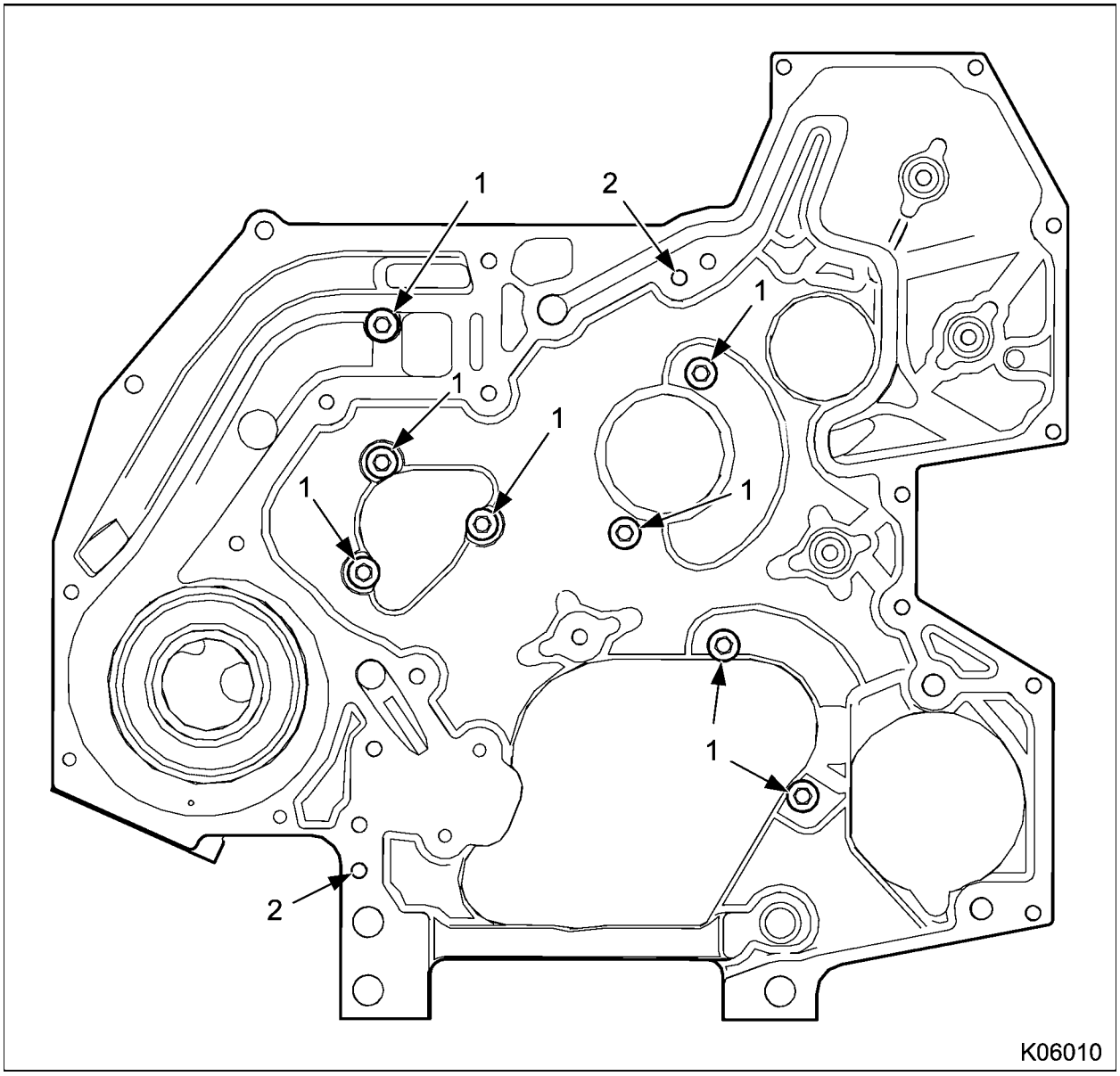

Figure 305 Front cover (rear half) – front side

1. Special hex flange bolt, M8 x 20 (8)
2. Dowel pins

1. Remove Camshaft Gear (page 408) or remove Camshaft Assembly (page 409).
2. Remove eight special M8 x 20 bolts holding the front cover (rear half) to the crankcase.
3. Pull cover outward to slide dowel pins out of crankcase and remove cover from engine.
4. Remove and discard oil and coolant gaskets from the front cover (rear half) – crankcase side.

Clean, Inspect, and Measure

WARNING: To prevent personal injury or death, wear safety glasses with side shields. Limit compressed air pressure to 207 kPa (30 psi).

Clean and Inspect

1. Clean water supply housing, water pump, water inlet elbow, water outlet tube, oil pump housing, front engine mount, and front cover with a suitable non-caustic solvent.
2. Blow parts dry using filtered compressed air.
3. Clean coolant and oil seal mating surfaces on the cylinder head, water supply housing, water pump, water inlet elbow, water outlet tube, oil pump housing, and front cover.
4. Inspect alternator bracket, secondary Freon® compressor support, water supply housing, water inlet elbow, vibration damper assembly, oil pump and rotor housing, oil pump inner and outer rotors, front cover, and idler gears for cracks, damage, or excessive wear. Replace parts if required.
5. Inspect drive belt for excessive cracks and wear. Replace if necessary.
6. Inspect automatic belt tensioner and pulley to make sure tensioner arm and pulley are properly in line with the fan drive belt and not coming apart. Make sure tensioner arm is not binding and pulley bearing is not loose. Replace belt tensioner if required.
7. Inspect thermostat and gasket. If thermostat is stuck open, damaged, cracked, or not opening properly replace thermostat and gasket.
8. Inspect fan drive bearing by wiggling fan pulley. If bearing has excess play, replace fan housing or mounting bracket.
9. Inspect water pump. Wiggle water pump pulley. If water pump bearing has excess play, replace water pump. Inspect water pump housing for coolant leaks. Replace water pump if leaking.

Measure Gear Backlash

NOTE: Remove rocker arm assembly (page 297) to release pressure exerted by valve train.

Lower Idler Gear Backlash

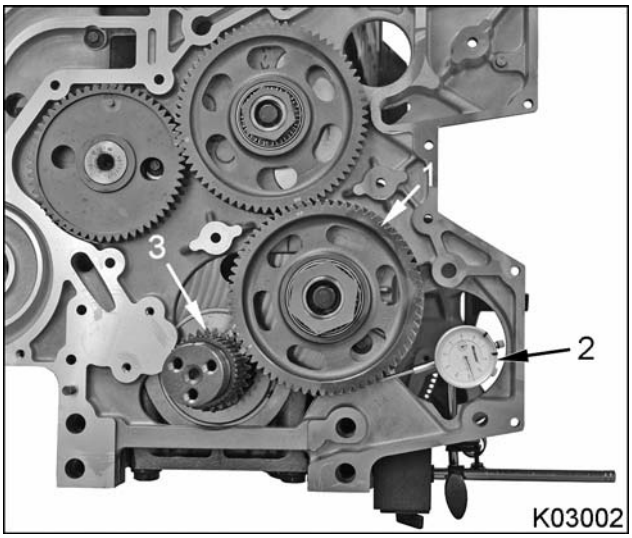

Figure 306 Lower idler gear and dial indicator

1. Lower idler gear
2. Dial indicator
3. Crankshaft gear

1. Mount a dial indicator set (page 287) on a level engine surface.
2. Place dial indicator tip on one of the lower idler gear teeth. Position dial indicator tangent (90 degrees relative to the plane of the gear tooth).
3. Rotate lower idler gear by hand in one direction, without moving the crankshaft gear, and zero the dial indicator.
4. Rock the lower idler gear back and forth without moving the crankshaft gear. If lower idler gear to crankshaft gear backlash exceeds Specifications (page 284), replace the lower idler gear.

Upper Idler Gear Backlash

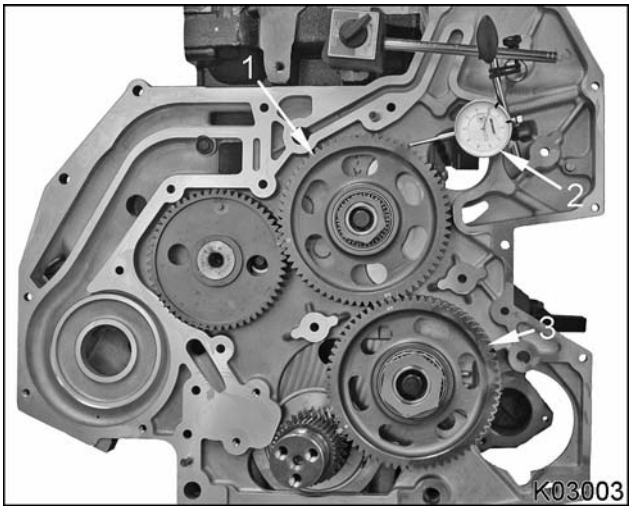

Figure 307 Upper idler gear and dial indicator

1. Upper idler gear
2. Dial indicator
3. Lower idler gear

1. Mount a dial indicator set (page 287) on a level engine surface.
2. Place dial indicator tip on one of the upper idler gear teeth. Position dial indicator tangent (90 degrees relative to the plane of the gear tooth).
3. Rotate upper idler gear by hand in one direction while holding the lower idler gear stationary with a gear locking tool or screwdriver. Zero the dial indicator.
4. Rock the upper idler gear back and forth without moving the lower idler gear. If upper idler gear to lower idler gear backlash exceeds Specifications (page 284), replace upper idler gear.

Camshaft Gear Backlash

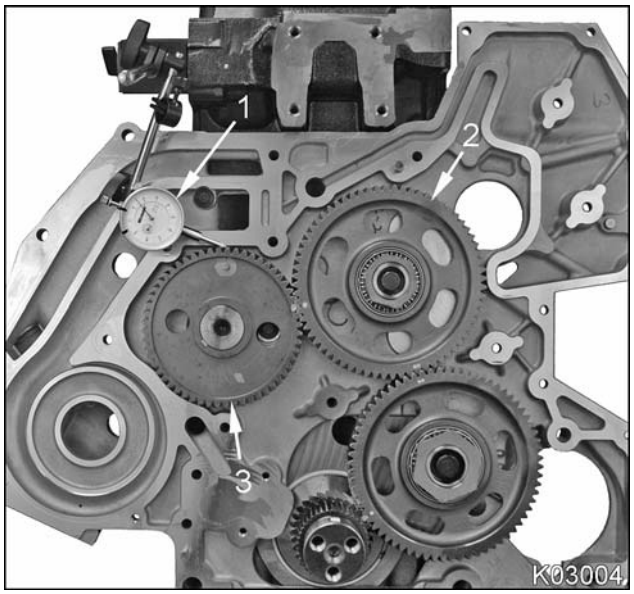

Figure 308 Camshaft gear and dial indicator

1. Dial indicator
2. Upper idler gear
3. Camshaft gear

1. Mount a dial indicator set (page 287) on a level engine surface.
2. Place dial indicator tip on one of the camshaft gear teeth. Position dial indicator tangent (90 degrees relative to the plane of the gear tooth).
3. Rotate camshaft gear by hand in one direction while holding the upper idler gear stationary with a gear locking tool or screwdriver. Zero the dial indicator.
4. Rock the camshaft gear back and forth without moving the upper idler gear. If camshaft gear to upper idler gear backlash exceeds Specifications (page 284), replace camshaft gear.

Measure Oil Pump Side Clearance

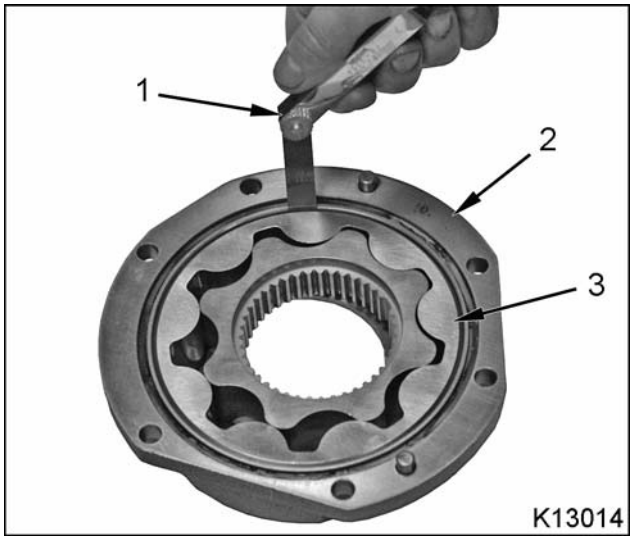

Figure 309 Oil pump side clearance measurement

1. Feeler gauge
2. Oil pump and rotor housing
3. Outer rotor

1. Coat outer rotor with oil and install rotor in oil pump and rotor housing.
2. Check oil pump side clearance Specification (page 284) and choose the appropriate thickness feeler gauge (page 287).
3. Insert feeler gauge between the oil pump and rotor housing and outer rotor.
4. Replace oil pump and rotor assembly if not within specification.

Measure Oil Pump End Clearance

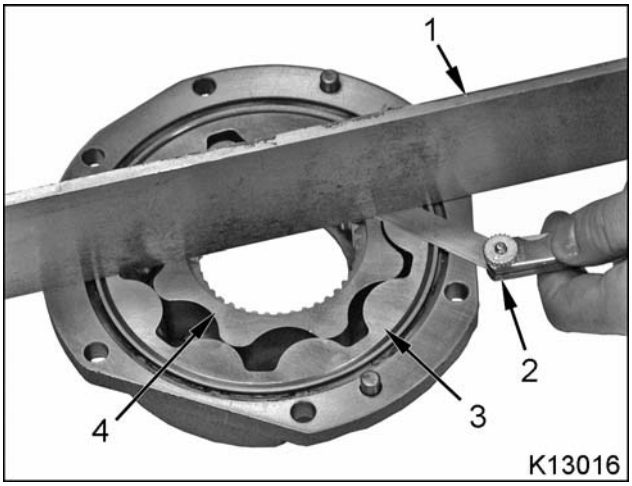

Figure 310 Oil pump end clearance measurement

1. Straightedge
2. Feeler gauge
3. Outer rotor
4. Inner rotor

1. Place a straightedge (page 287) across the oil pump mounting surface.
2. Check oil pump end clearance Specification (page 284) and choose the appropriate thickness feeler gauge (page 287).
3. Slide feeler gauge between the straightedge and the oil pump inner and outer rotors.
4. Replace oil pump and rotor assembly if not within specification.

Installation

Install the crankshaft gear and oil pump drive spline (page 421).

Front Cover (Rear Half)

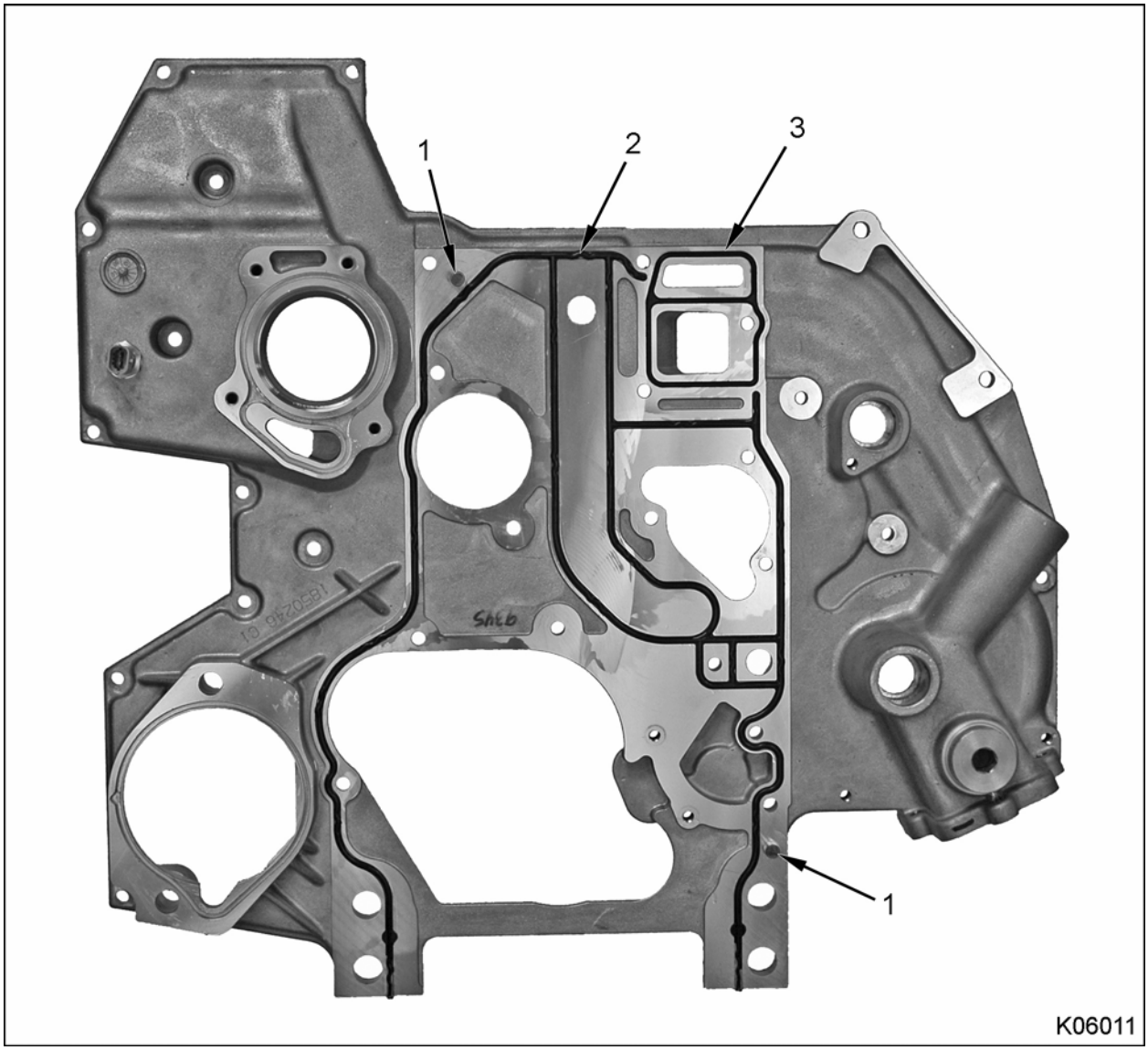

Figure 311 Front cover (rear half) – crankcase side

1. Dowel pin (2)
2. Front cover rear half (oil) gasket
3. Front cover rear half (coolant) gasket

1. Install new oil and coolant gaskets on the front cover (rear half) – crankcase side.
2. Align front cover dowel pins with crankcase dowel holes and install front cover (rear half) on the crankcase.

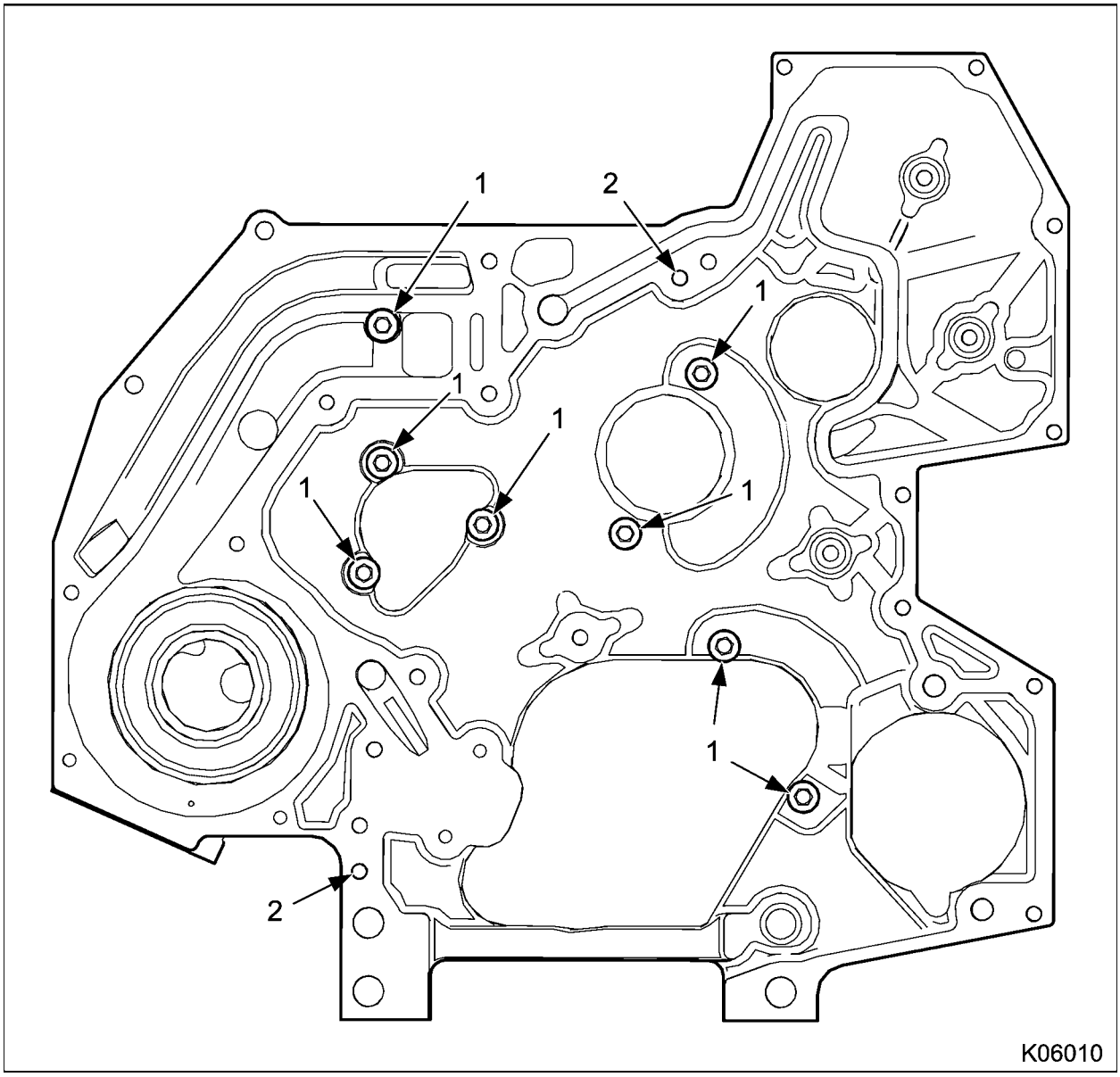

Figure 312 Front cover (rear half) – front side

1. Special hex flange bolt, M8 x 20 (8)
2. Dowel pins

3. Install eight special M8 x 20 mounting bolts finger tight.
4. Tighten eight special M8 x 20 mounting bolts to standard torque (page 471).
5. Install Camshaft Assembly (page 419) or Camshaft Gear (page 420).

Idler Gears

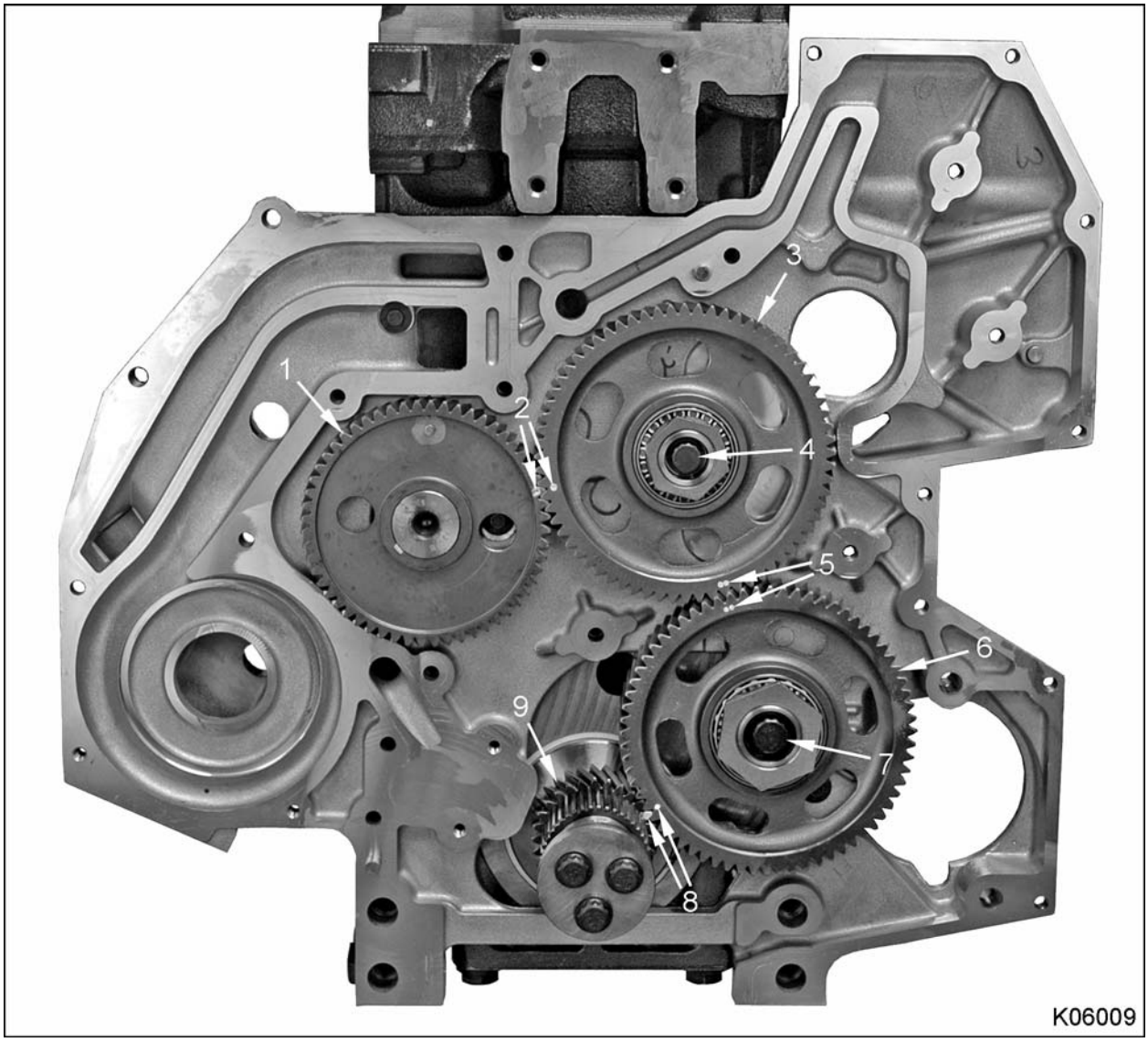

Figure 313 Gear train

1. Camshaft gear
2. Camshaft to upper idler gear timing marks (single dimple)
3. Upper idler gear
4. M16 x 65 bolt (12 point)
5. Upper idler to lower idler gear timing marks (double dimple)
6. Lower idler gear
7. M20 x 70 bolt (12 point)
8. Lower idler to crankshaft gear timing marks
9. Crankshaft gear

NOTE: Gear train gears should be assembled and installed with the timing marks facing out as shown.

1. Install lower idler gear on the crankcase and align lower idler gear timing mark with crankshaft gear timing mark. If upper idler gear is installed align lower idler gear (double dimple) timing mark with upper idler gear (double dimple) timing mark.

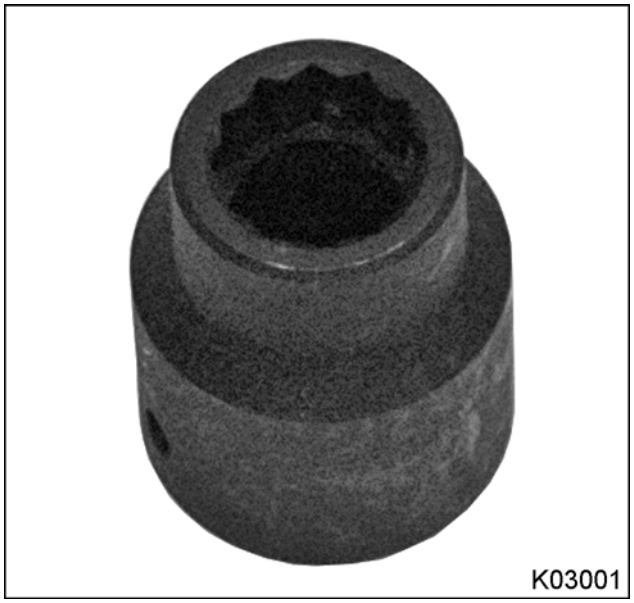

Figure 314 Lower Idler Gear Socket

2. Install lower idler gear M20 x 70 bolt and tighten to special torque (page 287) using Lower Idler Gear Socket (page 287).
3. Install upper idler gear on the crankcase and align upper idler gear (double dimple) timing mark with lower idler gear (double dimple) timing mark. Align upper idler gear (single dimple) timing mark with camshaft gear (single dimple) timing mark.
4. Install upper idler gear M16 x 65 bolt and tighten to special torque (page 287) using a 16 mm 12 point impact socket (page 287).

NOTE: Once timing marks are aligned, the crankshaft will require 34 revolutions to align timing marks again.

5. Measure lower idler, upper idler, and camshaft gears backlash (page 261).
6. Install the high-pressure oil pump (page 174) and measure gear backlash between the upper idler gear and the high-pressure oil pump gear. See Specifications (page 284).
7. Measure high-pressure oil pump end play. See Specifications (page 284).

Front Cover (Front Half)

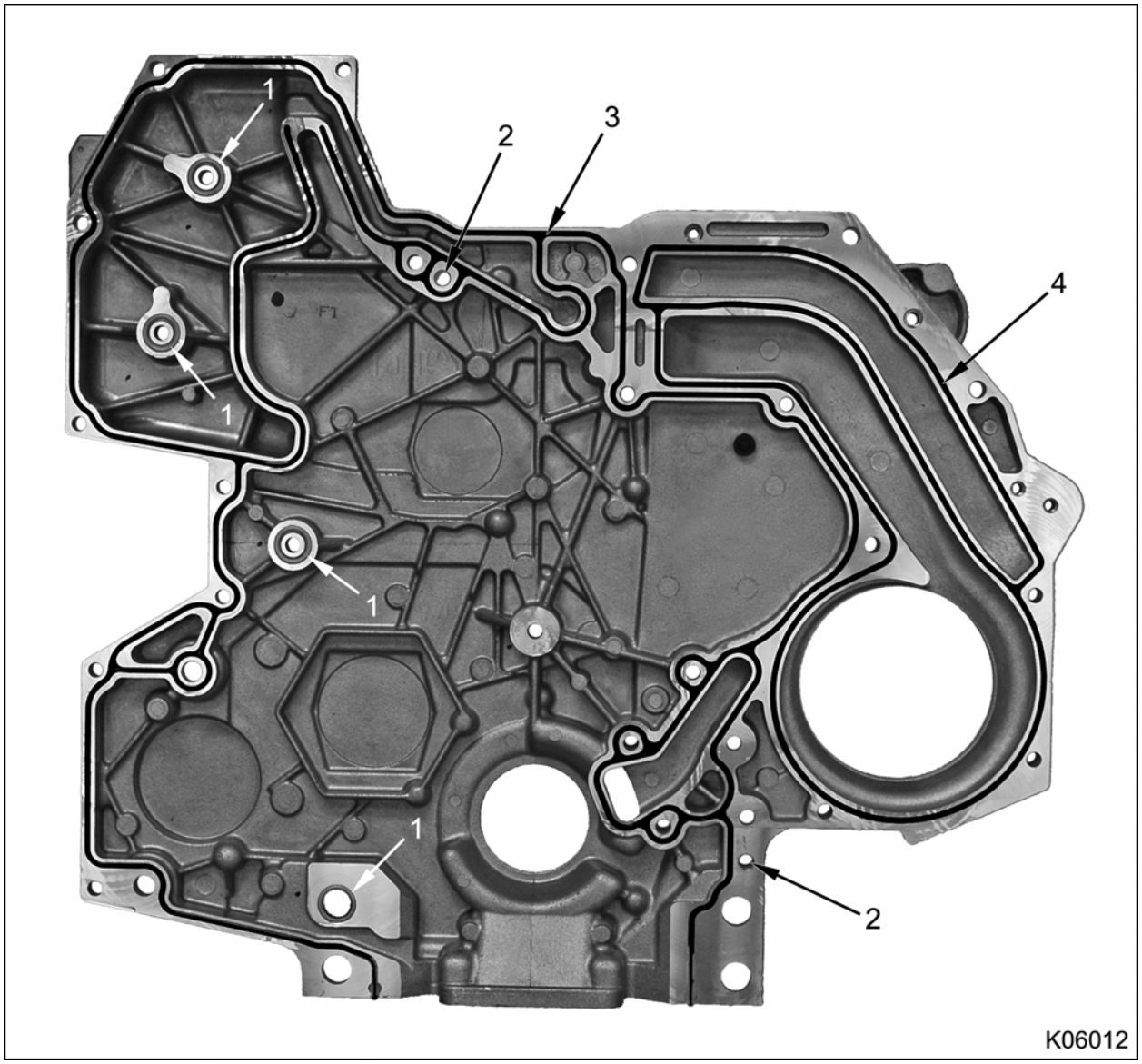

Figure 315 Front cover (front half) – back side

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

1. Install a new oil gasket, coolant gasket, and four O-rings on the front cover (front half) – back side.
2. Install the front cover (front half) on the front cover (rear half) and align front half dowel holes with rear half dowel pins.

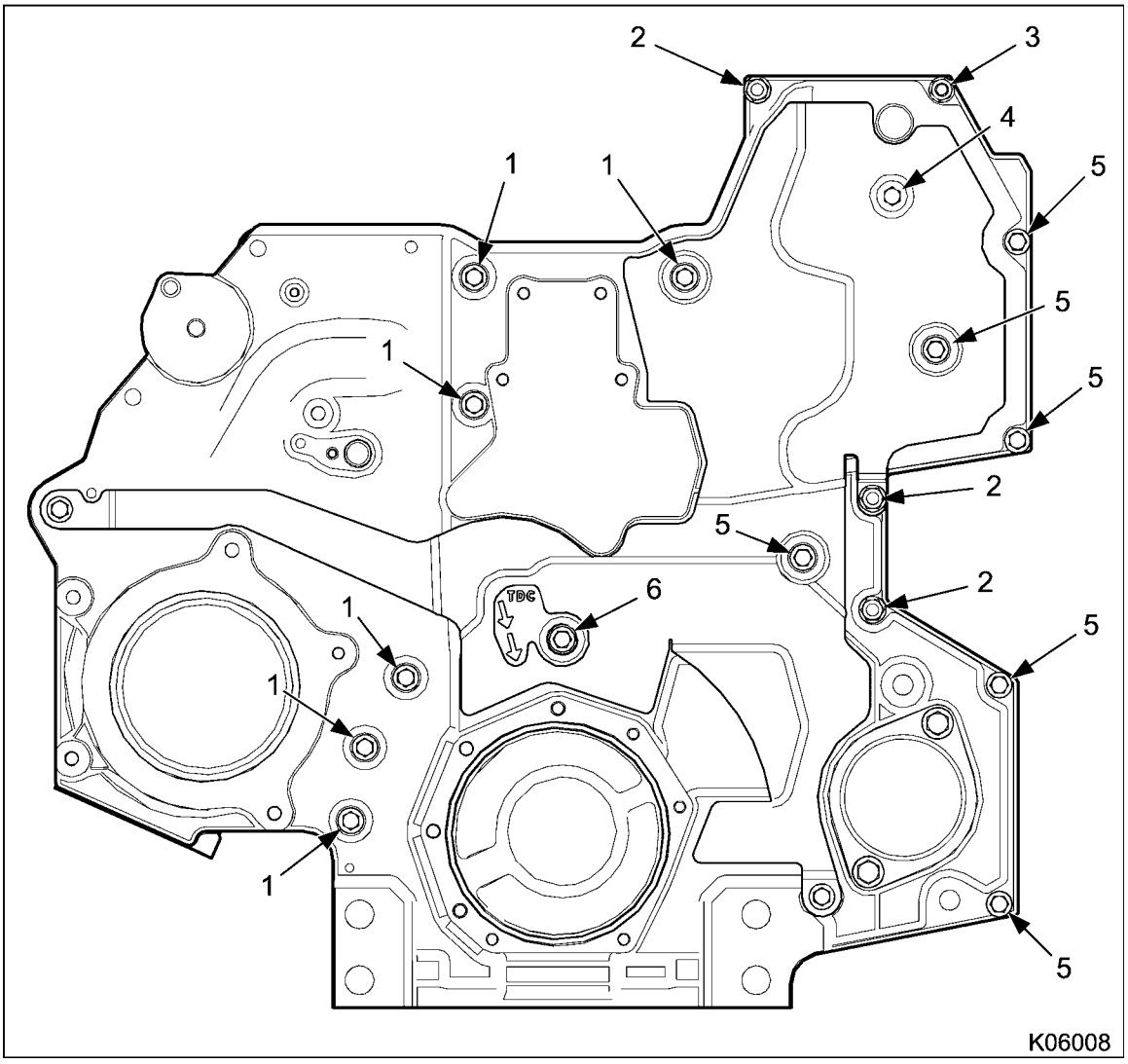

Figure 316 Front cover (front half) – front side

1. M8 x 45 bolt (6)
2. M8 x 50 bolt (nut on front) (3)
3. M8 x 73 stud bolt (nut on back)
4. M8 x 75 bolt (nut on back)
5. M8 x 50 bolt (nut on back) (6)
6. Seal assembly, M8 x 50 bolt and seal washer

3. Install M8 x 75 bolt (nut on back) finger tight.

CAUTION: To prevent engine damage, do not substitute seal assembly M8 x 50 bolt and seal washer with any other bolt.

4. Install a new seal assembly M8 x 50 bolt and seal washer finger tight.
5. Install M8 x 73 stud bolt (nut on back) finger tight.
6. Install two M8 x 50 bolts (nut on front) finger tight.
7. Install seven M8 x 50 bolts (nut on back) finger tight.
8. Install six M8 x 45 bolts finger tight.
9. Tighten 18 M8 front cover (front half) mounting bolts to standard torque (page 471).

Front Engine Mounting Bracket

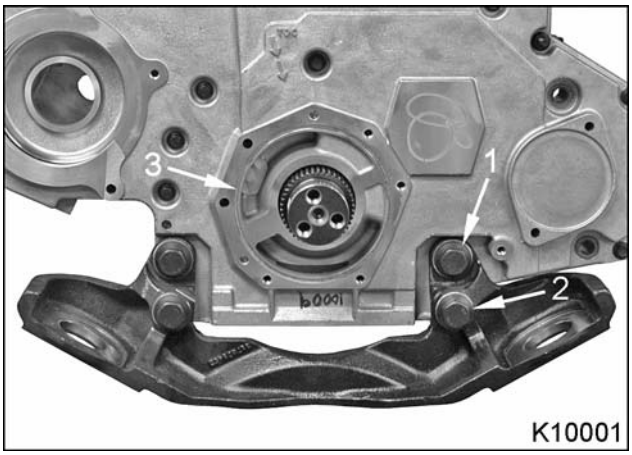

Figure 317 Front engine mount

1. M18 x 70 bolt (2)
2. M18 x 100 bolt (2)
3. Oil pump housing seal groove

1. Position front engine mount on front cover and install two M18 x 100 bolts finger tight.
2. Install two M18 x 70 bolts finger tight.
3. Tighten two M18 x 100 and two M18 x 70 bolts to special torque (page 287).

Oil Pump Assembly

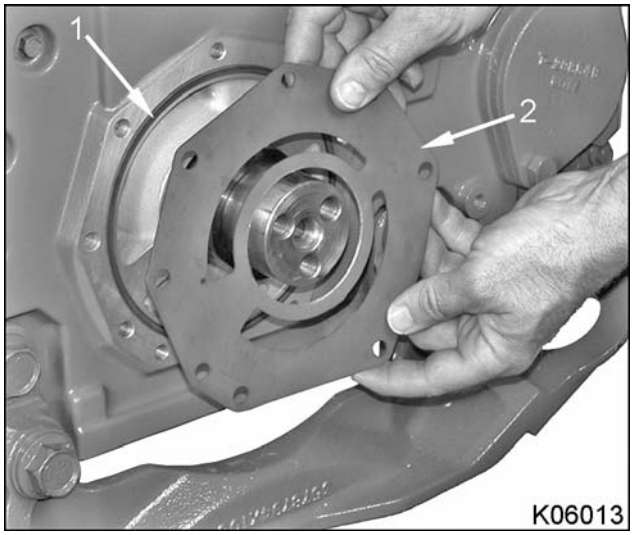

Figure 318 Oil pump housing plate and seal

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

1. Install a new oil pump housing seal in the front cover and install the oil pump housing plate.

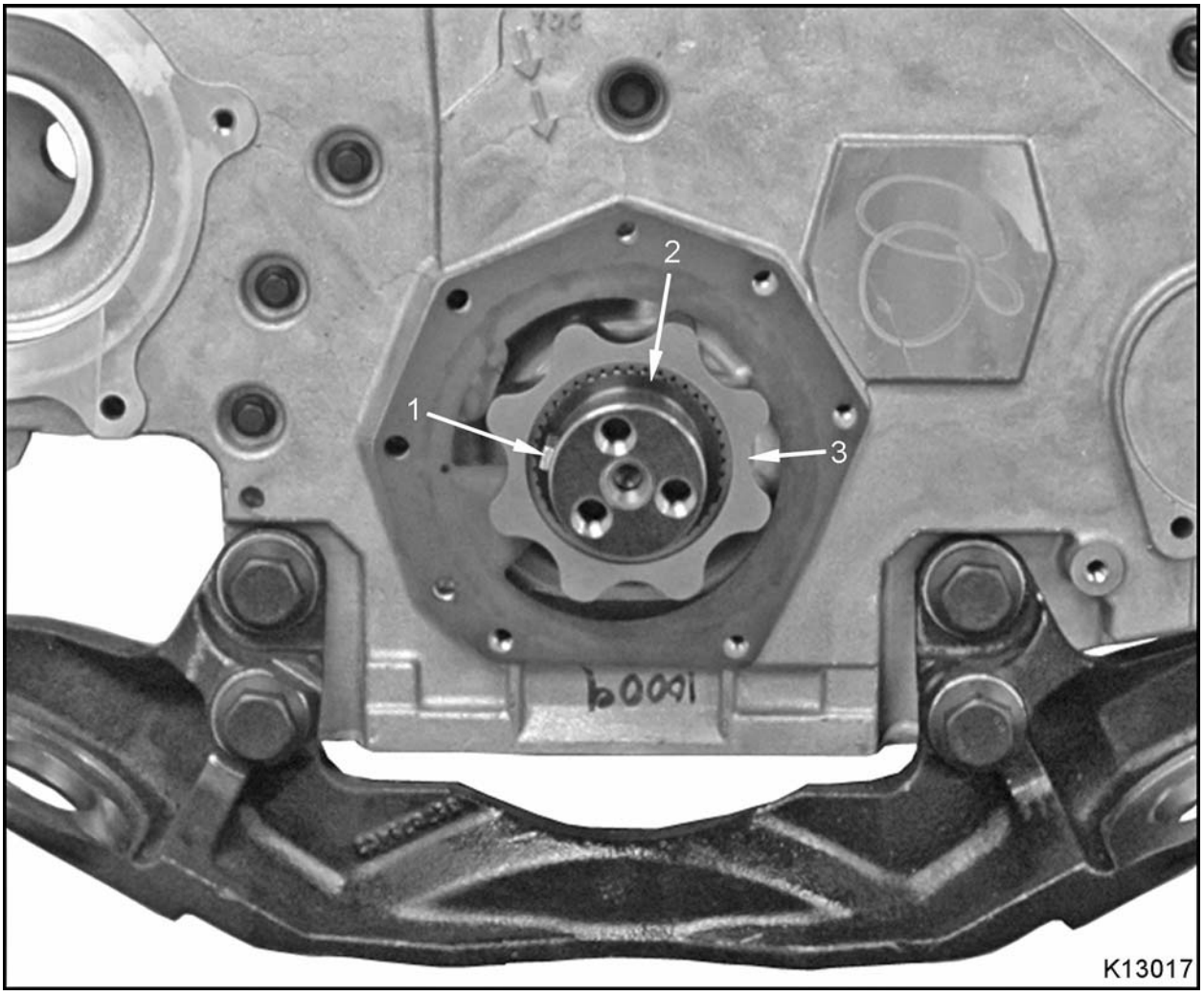

Figure 319 Vibration damper key, inner rotor, and washer seal

1. Vibration damper key
2. Washer seal
3. Inner rotor

CAUTION: To prevent engine damage, make sure used oil pump inner and outer rotors rotate in the same direction as before removal. See marks added during removal for proper rotor orientation.

2. Slide oil pump inner rotor on the crankshaft oil pump spline drive.
3. Install washer seal with angled outer edge pointing out toward the front of the engine.

CAUTION: To prevent engine damage, do not mark or distort the crankshaft keyway groove during vibration damper key installation.

4. Carefully tap the vibration damper key into the crankshaft keyway groove with a hammer.

NOTE: MaxxForce™ 9 and 10 engines use a front oil seal with a POSE dust seal mounted on the damper hub wear sleeve. MaxxForce™ DT engines use a front oil seal without a dust seal.

CAUTION: To prevent engine damage, for MaxxForce™ 9 and 10 engines, replace the POSE dust seal and front oil seal as a set. For MaxxForce™ DT engines, only use a front oil seal designed to not use a matching dust seal.

Figure 320 Hydraulic sealant and front oil seal

5. Apply Loctite 569 Hydraulic sealant to the outside edge of the front oil seal.

CAUTION: To prevent engine damage, wipe excess hydraulic sealant and other contaminates off the front oil seal inside sealing edge.

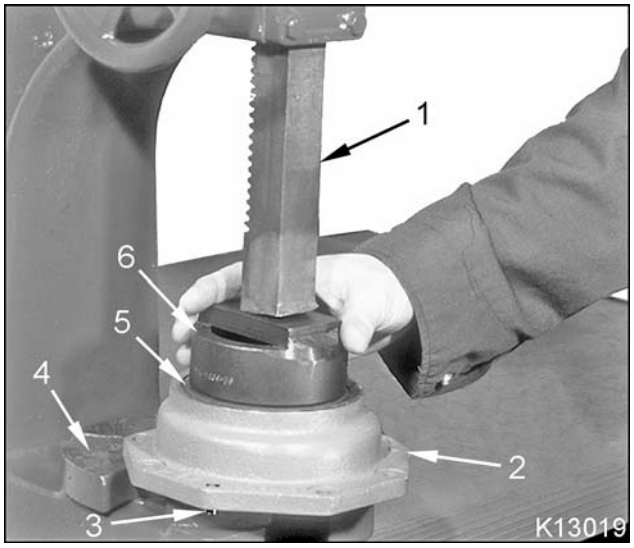

Figure 321 Front oil seal installation

1. Press ram
2. Oil pump and rotor housing
3. Dowel pin (2)
4. Press table
5. Front oil seal
6. Front Seal and Wear Sleeve Installer

6. Place oil pump and rotor housing, new front oil seal, and Front Seal and Wear Sleeve Installer (page 287) on press table.
7. Position oil pump housing on press table so housing mating surface is level and supported. Dowel pins should be recessed in press table openings.
8. Position press ram on the center of the Front Seal and Wear Sleeve Installer and carefully press the front oil seal into the oil pump housing until seal is fully seated.

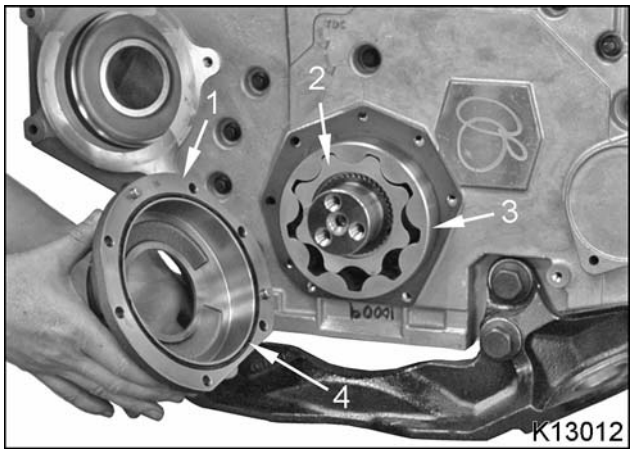

Figure 322 Oil pump housing and rotor assembly

1. Oil pump and rotor housing
2. Inner rotor
3. Outer rotor
4. Oil pump seal

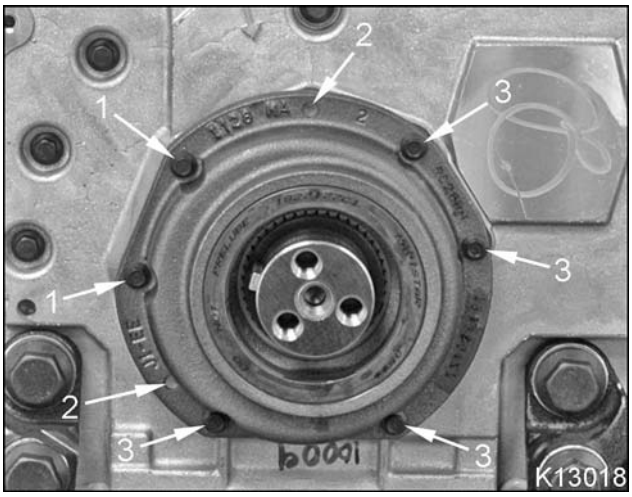

Figure 323 Oil pump and rotor housing assembly

1. M8 x 60 bolt (2)
2. Dowel (2)
3. M8 x 25 bolt (4)

9. Install a new oil pump seal in the oil pump and rotor housing groove.
10. Coat the outer rotor with clean engine oil.

CAUTION: To prevent engine damage, make sure used oil pump inner and outer rotors rotate in the same direction as before removal. See marks added during removal for proper rotor orientation.

11. Install the outer rotor on the inner rotor.
12. Lightly coat the front oil seal inside sealing surface with clean engine oil.
13. Align two oil pump and rotor housing dowels with two front cover dowel holes and install oil pump and rotor housing.
14. Install four M8 x 25 bolts finger tight.
15. Install two M8 x 60 bolts finger tight.
16. Tighten four M8 x 25 bolts and two M8 x 60 bolts to special torque (page 287).

Vibration Damper, Hub, and Wear Sleeve

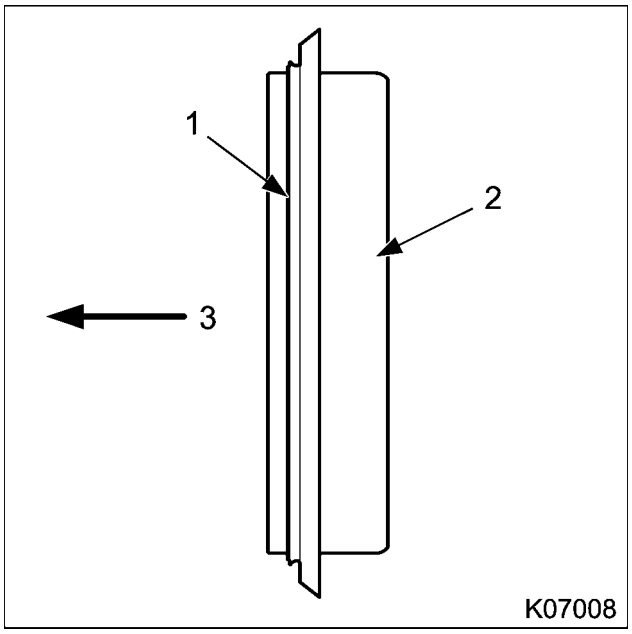

Figure 324 POSE seal (MaxxForce™ 9 and 10 only) and wear sleeve orientation

1. POSE seal (MaxxForce™ 9 and 10 only)
2. Wear sleeve
3. Front of engine

NOTE: If service kit contains more than one wear sleeve, use sleeve that has the same width as the current wear sleeve.

NOTE: MaxxForce™ 9 and 10 engines have a POSE dust seal attached to the wear sleeve. A dust seal is not used on MaxxForce™ DT engines.

CAUTION: To prevent engine damage, for MaxxForce™ 9 and 10 engines, replace the POSE dust seal and front oil seal as a set. For MaxxForce™ DT engines, only use a front oil seal designed without a matching dust seal.

NOTE: The chamfer (rounded edge) of the wear sleeve outside diameter must face in, toward the engine.

1. Apply Loctite® 569 Hydraulic Sealant (page 287) to the inside diameter of a new wear sleeve.

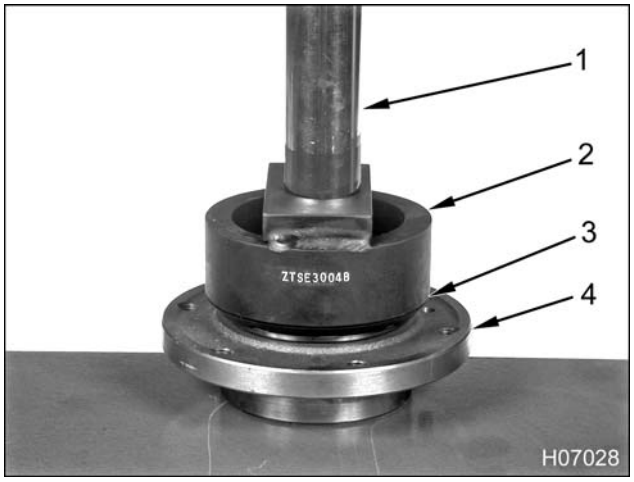

Figure 325 Front seal and wear sleeve installation

1. Press ram
2. Front Seal and Wear Sleeve Installer
3. POSE dust seal (MaxxForce™ 9 and 10 engines only)
4. Damper hub

2. Center the damper hub, new wear sleeve, and Front Seal and Wear Sleeve Installer (page 287) under press ram.
3. Carefully press the new wear sleeve on the damper hub until sleeve is fully seated.
4. Wipe any excess sealant off the outside diameter of the wear sleeve.

5. Mark damper hub with 100 °C (212 °F) Thermo-melt crayon (page 287).

Figure 326 Damper hub and hot plate

CAUTION: To prevent engine damage, do not heat damper hub assembly above 100 °C (212 °F).

6. Heat damper hub on a hot plate or other controlled heat source until Thermo-melt crayon mark melts.

Figure 327 Damper hub installation

⚠ WARNING: To prevent personal injury or death, wear heat insulated gloves when handling heated components.

7. Install damper hub on crankshaft while wearing heat insulated gloves. Make sure keyway groove on damper hub aligns with keyway in crankshaft.

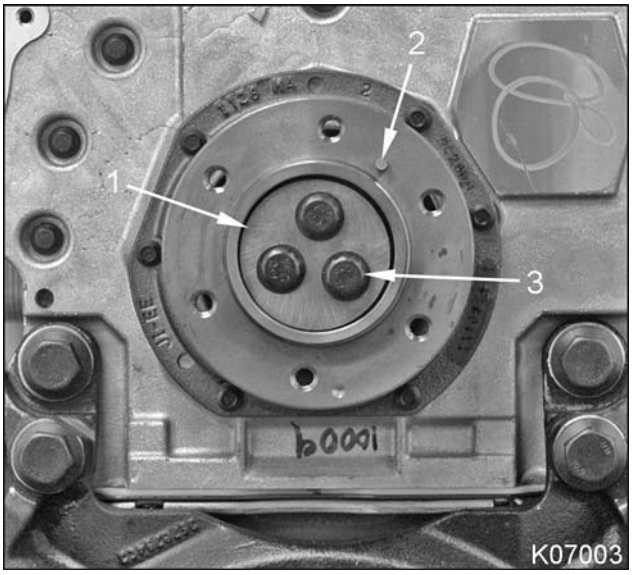

Figure 328 Damper hub

1. Damper retainer
2. Dowel pin
3. M12 x 40 (12 point) damper bolt (3)

WARNING: To prevent personal injury or death, damper hub must be completely seated on the crankshaft.

CAUTION: To prevent engine damage, only use 15.2 mm (0.60) in thick damper retainer and Class 12.9 damper bolts.

8. Install damper retainer and three M12 x 40 damper bolts. Verify damper retainer is 15.2 mm (0.60) in thick and damper bolts are Class 12.9.
9. Tighten three M12 x 40 damper bolts to special torque (page 287).
10. Retighten three M12 x 40 damper bolts in sequence to special torque (page 287) several times until each bolt has no movement.

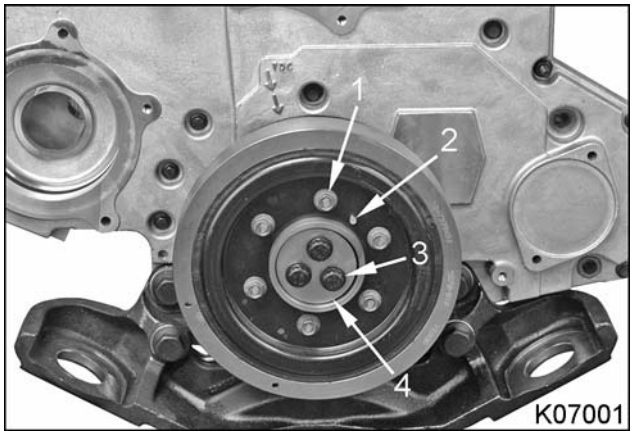

Figure 329 Vibration damper assembly

1. M10 x 16 bolt (6)
2. Dowel pin
3. M12 x 40 (12 point) damper bolt (3)
4. Damper retainer

CAUTION: To prevent engine damage, verify damper hub dowel pin is aligned with dowel hole of the vibration damper assembly.

11. Install vibration damper assembly on damper hub and align dowel hole in damper with dowel pin on damper hub.
12. Install six M10 x 16 bolts finger tight.
13. Tighten six M10 x 16 bolts to special torque (page 287).

Fan Drive

Spin-on Fan Drive

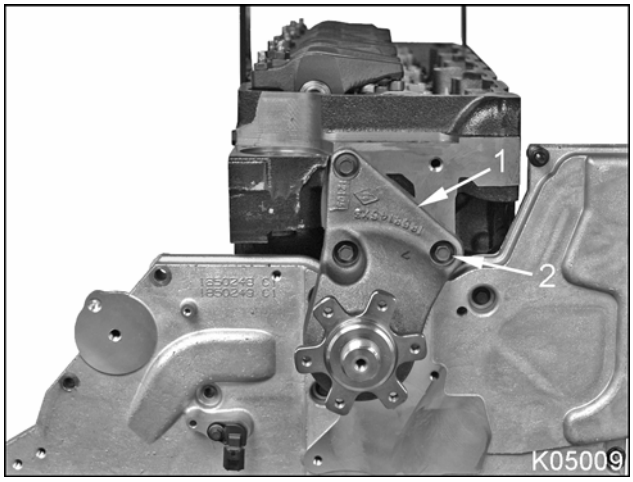

Figure 330 Fan housing assembly, spin-on (typical)

1. Fan housing assembly (typical)
2. M10 x 30 bolt (3)

NOTE: Fan drive configurations use either three or four M10 x 30 bolts to hold the fan housing assembly to the cylinder head.

1. Install fan housing assembly on cylinder head and install M10 x 30 bolts finger tight.
2. Tighten M10 x 30 bolts to standard torque (page 471).

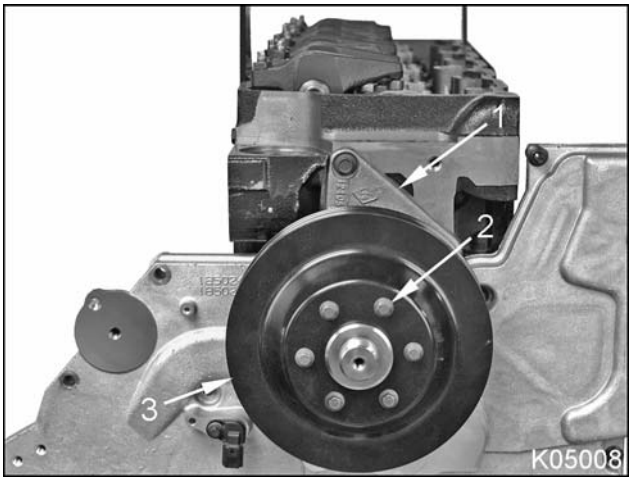

Figure 331 Fan pulley, spin-on

1. Fan housing assembly (typical)
2. M8 x 20 bolt (6)
3. Fan drive pulley

3. Install fan drive pulley on fan housing assembly and install six M8 x 20 bolts finger tight.

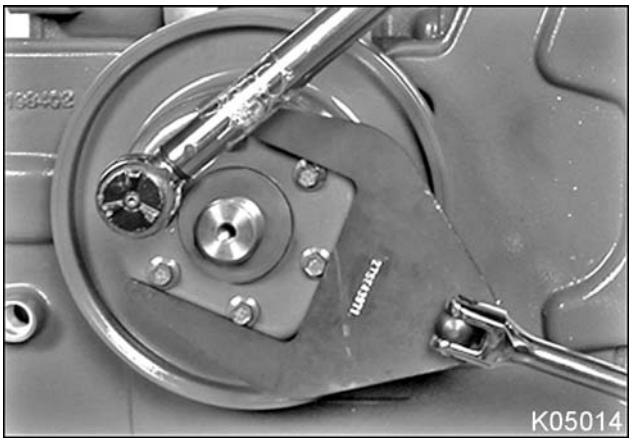

Figure 332 Fan Wrench and fan drive pulley

4. Hold the fan drive pulley stationary with a Fan Wrench (page 287).
5. Tighten six M8 x 20 bolts to standard torque (page 471).

Horton DriveMaster® Fan Drive

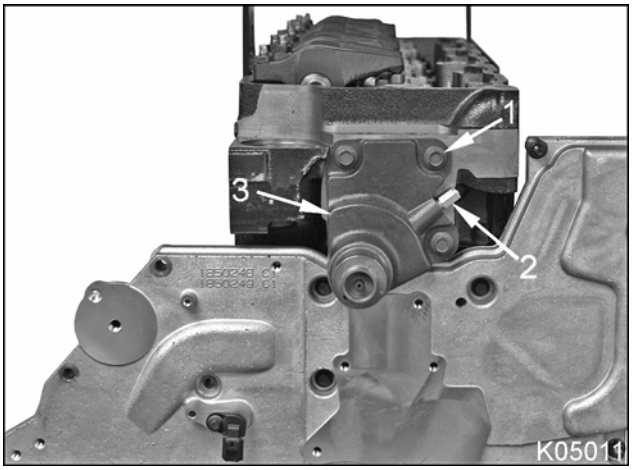

Figure 333 Fan mounting bracket, DriveMaster® (typical)

1. M10 x 30 bolt (3)
2. Fan clutch air supply fitting (typical)
3. Fan mounting bracket (typical)

NOTE: Fan drive configurations use either three or four M10 x 30 bolts to hold the fan mounting bracket to the cylinder head.

1. Install M10 x 30 bolts holding the fan mounting bracket to the cylinder head.
2. Tighten M10 x 30 bolts to standard torque (page 471).

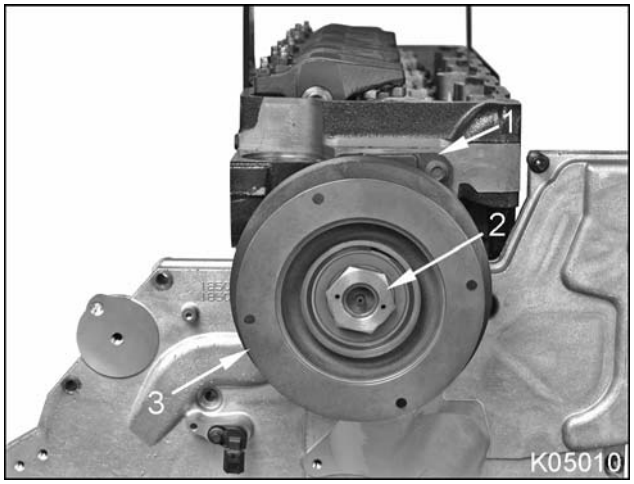

Figure 334 Fan pulley, DriveMaster®

1. Fan mounting bracket (typical)
2. Nut assembly
3. Fan Pulley

3. Slide fan pulley on fan mounting bracket.

CAUTION: To prevent engine damage, install nut assembly with collar toward engine.

4. Install nut assembly (collar toward engine) on the fan mounting bracket and finger tighten.

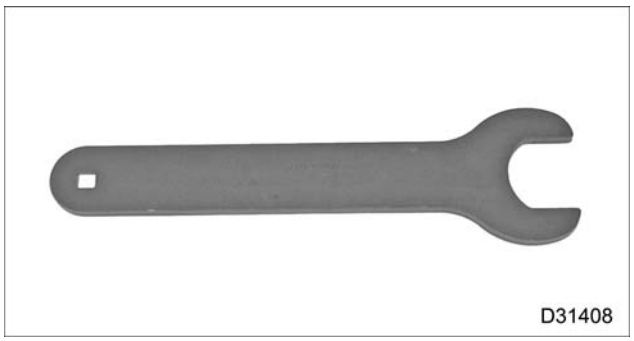

Figure 335 Fan Hub Wrench

5. Tighten nut assembly to special torque (page 287) using a Fan Hub Wrench (2 inch) (page 287) and a torque wrench. See Using a Torque Wrench Extension (page 472) to calculate the correct torque wrench setting.

Water Outlet Tube, and Thermostat

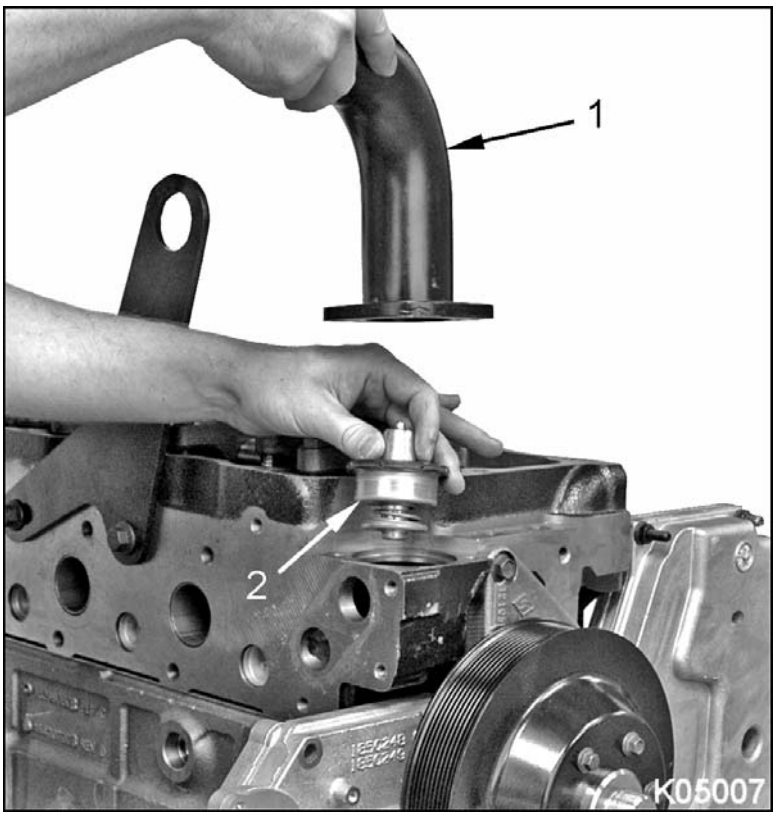

Figure 336 Water outlet tube and thermostat

1. Water outlet tube (typical)
2. Thermostat assembly

1. If equipped with a thermostat bypass, install a new thermostat seal and then install the thermostat bypass housing on the cylinder head.
2. Install thermostat assembly in the cylinder head or thermostat bypass.

NOTE: Water outlet tube configurations use either two M8 x 25 bolts to hold the water outlet tube to the cylinder head or two M8 x 115 bolts to hold the water outlet tube and thermostat bypass housing to the cylinder head.

3. Install water outlet tube and finger tighten two M8 bolts.
4. Tighten two M8 bolts to standard torque (page 471).

Water Pump Assembly

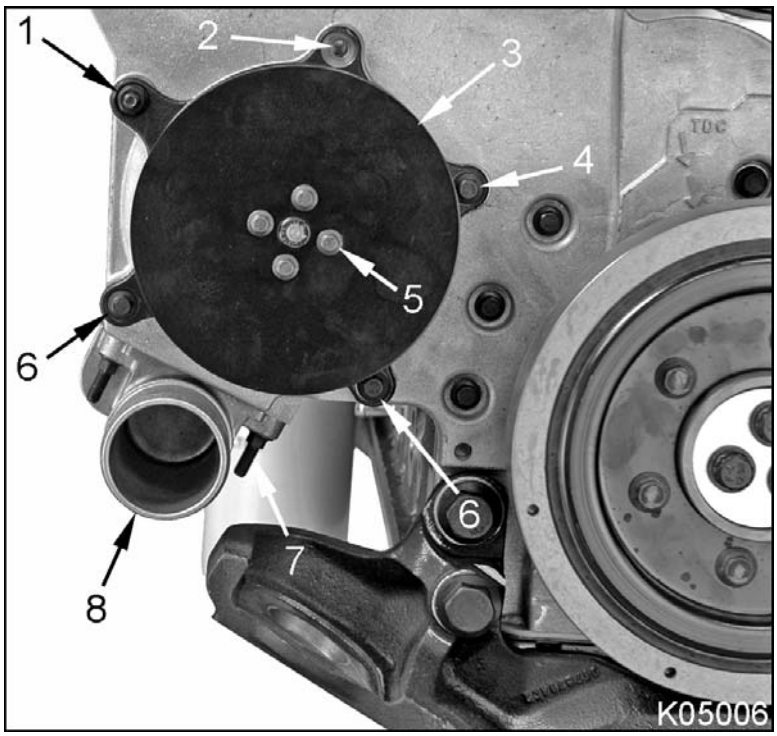

Figure 337 Water pump and inlet elbow

1. M8 x 55 bolt (nut on front)
2. M8 x 100 bolt (nut on back)
3. Water pump pulley (typical)
4. M8 x 16 bolt
5. M6 x 12 bolt (4)
6. M8 x 45 bolt (2)
7. M8 stud bolt (3)
8. Water inlet elbow

1. Install a new water pump housing seal in the water pump assembly.
2. Install water pump assembly on the front cover and install two M8 x 45 bolts.
3. Install M8 x 100 bolt (nut on back), M8 x 55 bolt (nut on front), and M8 x 16 bolt finger tight.
4. Tighten five M8 water pump bolts to standard torque (page 471).
5. Install the water pump pulley on the water pump and install four M6 x 12 pulley bolts finger tight.
6. Tighten four M6 x 12 pulley bolts to standard torque (page 471).

Water Inlet Elbow

NOTE: Water inlet elbow configurations use either three M8 stud bolts or three M8 x 30 bolts to hold the water inlet elbow to the front cover.

1. Install water inlet elbow on the front cover with a new water inlet gasket.
2. Install three M8 water inlet elbow bolts finger tight.
3. Tighten three M8 bolts to standard torque (page 471).

Water Supply Housing (Freon® Compressor Mount)

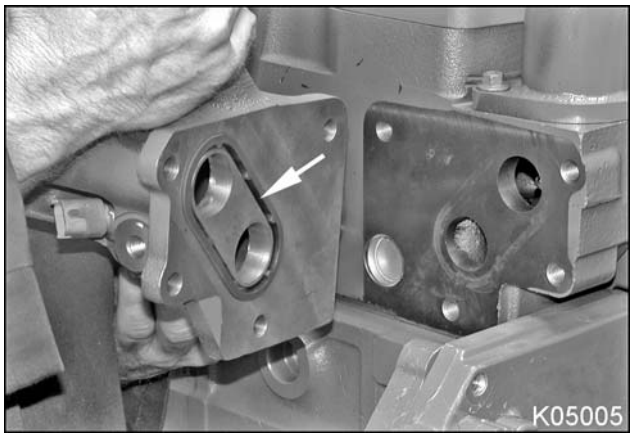

Figure 338 Water supply housing coolant port seal

1. Install a new coolant port seal in the water supply housing.

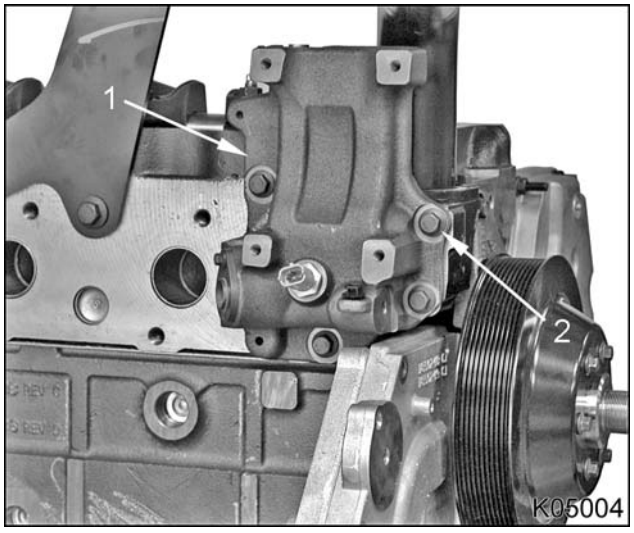

Figure 339 Water supply housing

1. Water supply housing (Freon® compressor mount)
2. M10 x 25 bolt (4)

2. Install water supply housing on the cylinder head and install four M10 x 25 bolts finger tight.
3. Tighten four M10 x 25 bolts to standard torque (page 471).

Alternator Bracket and Automatic Belt Tensioner

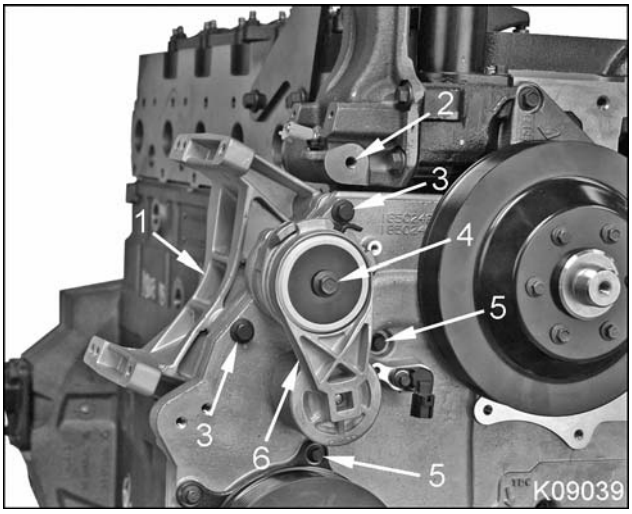

Figure 340 Alternator bracket, belt tensioner, and single idler pulley location

1. Alternator bracket
2. M10 x 90 bolt hole (single idler pulley)
3. M10 x 120 bolt (2)
4. M10 x 90 bolt (belt tensioner)
5. M8 x 100 bolt (2)
6. Automatic belt tensioner

1. Position alternator bracket on the back of the front cover.
2. Install two M10 x 120 bolts through the front cover and alternator bracket. Install M10 nuts on back of bolts.
3. Install two M8 x 100 bolts through the front cover and alternator bracket. Install M8 nuts on back bolts.
4. Tighten two M10 x 120 bolts and two M8 x 100 bolts to standard torque (page 471).
5. Install automatic belt tensioner and M10 x 90 bolt on front cover and tighten bolt to special torque (page 287).
6. If required, install single idler pulley on cylinder head and tighten M10 x 90 bolt to standard torque (page 471). (for applications with single Freon® compressor only)

Secondary Compressor Support, Dual Idler Pulleys, and Idler Mounting Plate

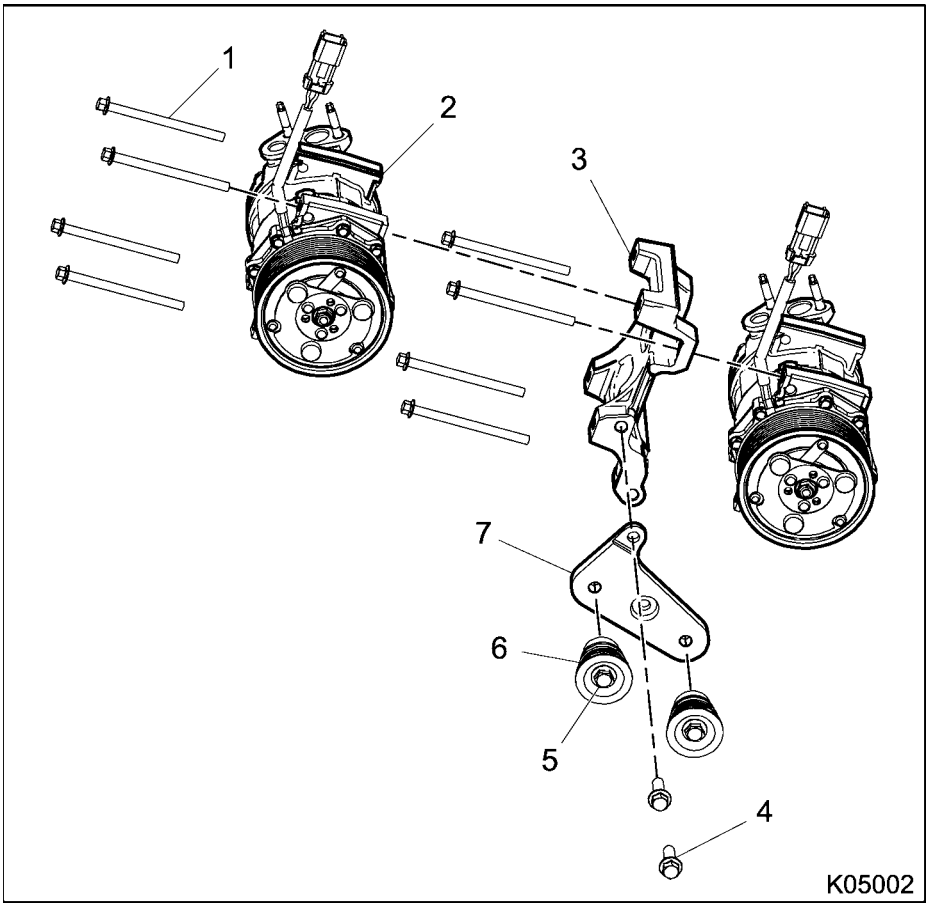

Figure 341 Dual Freon® compressor mounting

1. M8 x 110 bolt (8)
2. A/C (Freon®) compressor (2)
3. Secondary Freon® compressor support
4. M10 x 30 bolt (2)
5. M10 x 60 bolt (2)
6. Flat idler pulley assembly (2)
7. Idler mounting plate

WARNING: To prevent personal injury or death, do not open pressurized Freon® lines.

NOTE: The following procedure only applies to engines equipped with dual A/C (Freon®) compressors.

1. Position inner Freon® compressor on the water supply housing (Freon® compressor mount).
2. Install the secondary Freon® compressor support and four M8 x 110 bolts.
3. Tighten four M8 x 110 bolts to special torque (page 287).
4. Install the idler mounting plate and two M10 x 30 bolts on the secondary Freon® compressor support.
5. Tighten two M10 x 30 bolts to standard torque (page 471).
6. Install two flat idler pulley assemblies on the idler mounting plate and tighten two M10 x 60 bolts to standard torque (page 471).
7. Install outer Freon® compressor and four M8 x 110 bolts.
8. Tighten four M8 x 110 bolts to special torque (page 287).

Drive Belt

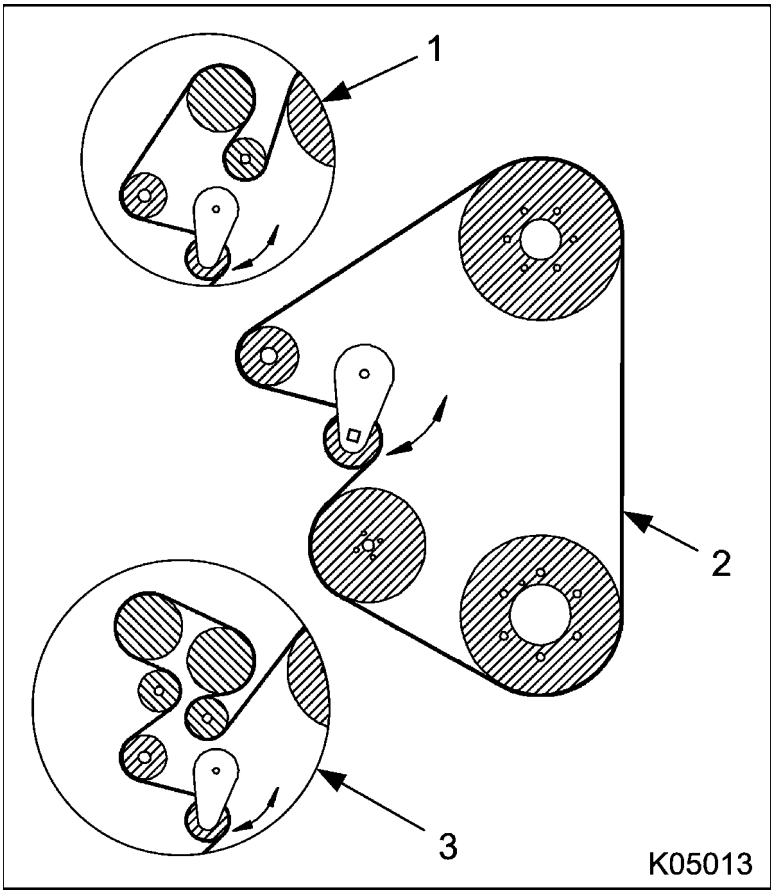

Figure 342 Drive belt routing

1. Single Freon® compressor and single idler pulley
2. Without Freon® compressor
3. Dual Freon® compressors and dual idler pulleys

1. Install drive belt on all engine pulleys, except one.
2. Insert 1/2 inch square drive ratchet or breaker bar into belt tensioner square hole.
3. Rotate belt tensioner clockwise.
4. Fit drive belt on last pulley and slowly release belt tensioner.
5. Inspect each pulley to verify drive belt is properly seated.

Specifications

Camshaft gear to upper idler gear backlash	0.35 mm (0.014 in)
High-pressure oil pump end play	0.127 to 0.457 mm (0.005 to 0.018 in)
Lower idler gear to air compressor gear backlash	0.508 mm (0.020 in)
Lower idler gear to crankshaft gear backlash	0.31 mm (0.012 in)
Oil pump end clearance	0.05 to 0.13 mm (0.002 to 0.005 in)
Oil pump side clearance	0.48 to 0.62 mm (0.019 to 0.024 in)
Upper idler gear to high-pressure oil pump gear backlash	0.48 mm (0.019 in)
Upper idler gear to lower idler gear backlash	0.37 mm (0.015 in)
Vibration damper face runout (maximum)	1.52 mm (0.060 in)

Table 1 Water Pump Pulley Diameters and Spin Ratios

Engine	Pulley Diameter	Spin Ratio
MaxxForce™ DT 210 – 230 BHP	15.54 cm (6.12 in)	1.39: 1
MaxxForce™ DT 245 – 255 BHP	13.93 cm (5.48 in)	1.55: 1
MaxxForce™ DT 260 – 300 BHP	12.54 cm (4.94 in)	1.73: 1
MaxxForce™ 9 and 10	11.54 cm (4.55 in)	1.87: 1

Fan Drive Configurations Diameters and Ratios (Spin-on)

		Fan Center Line (CL)			
Fan Drive Configuration	**Engine**	**Vertical Above Crank**	**Lateral Offset (toward turbo)**	**Pulley Diameter**	**Fan Drive Ratio**
Spin-on 13” fan center	MaxxForce™ DT	330.2 mm (13 in)	25.4 mm (1 in)	21.95 cm (8.64 in)	0.99 : 1
Spin-on 13” fan center	MaxxForce™ DT	330.2 mm (13 in)	25.4 mm (1 in)	20.12 cm (7.92 in)	1.08 : 1
Spin-on 15” fan center	MaxxForce™ DT	381mm (15 in)	25.4 mm (1 in)	21.95 cm (8.64 in)	0.99 : 1
Spin-on 15” fan center	MaxxForce™ 9 and 10	381mm (15 in)	25.4 mm (1 in)	18.14 cm (7.14 in)	1.2 : 1
Spin-on 16.2” fan center	MaxxForce™ DT	411.5 mm (16.2 in)	95.3 mm (3.75 in)	21.95 cm (8.64 in)	0.99 : 1
Spin-on 16.2” fan center	MaxxForce™ DT	411.5 mm (16.2 in)	95.3 mm (3.75 in)	20.12 cm (7.92 in)	1.08 : 1
Spin-on 20” fan center	MaxxForce™ DT	508 mm (20 in)	none	24.28 cm (9.56 in)	0.894 : 1
Spin-on 20” fan center	MaxxForce™ DT	508 mm (20 in)	none	21.95 cm (8.64 in)	0.99 : 1
Spin-on 20” fan center	MaxxForce™ 9 and 10	508 mm (20 in)	none	20.12 cm (7.92 in)	1.08 : 1
Spin-on 20 ” fan center	MaxxForce™ 9 and 10	508 mm (20 in)	none	18.14 cm (7.14 in)	1.2 : 1

Fan Drive Configurations Diameters and Ratios (DriveMaster®)

		Fan Center Line (CL)			
Fan Drive Configuration	**Engine**	**Vertical Above Crank**	**Lateral Offset (toward turbo)**	**Pulley Diameter**	**Fan Drive Ratio**
Horton DriveMaster® 13” fan center	MaxxForce™ DT	330.2 mm (13 in)	25.4 mm (1 in)	21.95 cm (8.64 in)	0.99 : 1
Horton DriveMaster® 13” fan center	MaxxForce™ DT	330.2 mm (13 in)	25.4 mm (1 in)	20.12 cm (7.92 in)	1.08 : 1
Horton DriveMaster® 15” fan center	MaxxForce™ DT	381mm (15 in)	25.4 mm (1 in)	21.95 cm (8.64 in)	0.99 : 1
Horton DriveMaster® 15” fan center	MaxxForce™ 9 and 10	381mm (15 in)	25.4 mm (1 in)	18.14 cm (7.14 in)	1.2 : 1
Horton DriveMaster® 16.2” fan center	MaxxForce™ DT	411.5 mm (16.2 in)	95.3 mm (3.75 in)	21.95 cm (8.64 in)	0.99 : 1
Horton DriveMaster® 16.2” fan center	MaxxForce™ DT	411.5 mm (16.2 in)	95.3 mm (3.75 in)	20.12 cm (7.92 in)	1.08 : 1
Horton DriveMaster® 20” fan center	MaxxForce™ DT	508 mm (20 in)	none	24.28 cm (9.56 in)	0.894 : 1
Horton DriveMaster® 20” fan center	MaxxForce™ DT	508 mm (20 in)	none	21.95 cm (8.64 in)	0.99 : 1
Horton DriveMaster® 20” fan center	MaxxForce™ 9 and 10	508 mm (20 in)	none	20.12 cm (7.92 in)	1.08 : 1
Horton DriveMaster® 20” fan center	MaxxForce™ 9 and 10	508 mm (20 in)	none	18.14 cm (7.14 in)	1.2 : 1

Special Torque

Automatic belt tensioner M10 x 90 bolt	50 N·m (37 lbf·ft)
Damper (hub) bolts, M12 x 40	163 N·m (120 lbf·ft) Retorque all bolts until no movement
Freon® compressor M8 x 110 mounting bolts	27 N·m (20 lbf·ft)
Front engine mounting bracket M18 bolts	386 N·m (284 lbf·ft)
Horton DriveMaster® nut assembly (2 inch)	177 N·m (130 lbf·ft)
Lower idler gear M20 x 70 bolt	639 N·m (470 lbf·ft)
Oil pump and rotor housing M8 bolts	25 N·m (18 lbf·ft)
PTO adapter cover, M10 x 25 bolts (PTO equipped engines only)	61 N·m (45 lbf·ft)
Upper idler gear M16 x 65 bolt	326 N·m (240 lbf·ft)
Vibration damper assembly M10 x 16 mounting bolts	58 N·m (43 lbf·ft)

Special Service Tools

Dial indicator set	Obtain locally
Fan Wrench (for spin-on fan pulley)	ZTSE43971
Fan Hub Wrench, 2 inch (for DriveMaster nut assembly)	ZTSE43972
Feeler gauge	Obtain locally
Front Seal and Wear Sleeve Installer	ZTSE3004B
H-bar puller	Obtain locally
Heat insulated gloves	Obtain locally
Heel bar	Obtain locally
Hot plate	Obtain locally
Loctite® 569 Hydraulic Sealant	Obtain locally
Lower Idler Gear Socket	ZTSE4383
Muffler chisel	Obtain locally
Straightedge	Obtain locally
Thermo-melt crayon, 100 °C (212 °F)	Obtain locally
16 mm 12 point impact socket	Obtain locally