

i01964553

1. Lift the assembly (3) of the idler gear and the hub over the housing for the crankshaft front seal (2) and insert the hub into the recess in the cylinder block. Refer to illustration 127.
2. Ensure that the word "Top" (1) is at the top of the plate.
3. Align the holes (4) in the assembly to the holes in the cylinder block. Install the three setscrews and tighten the setscrews to a torque of 44 N·m (32 lb ft).

End Play

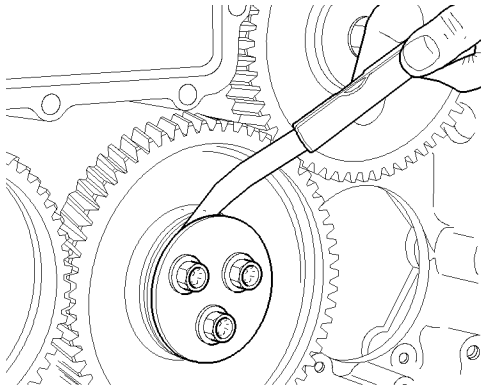


Illustration 130

g01141765

Typical example

1. Check the end play of the idler gear. Refer to illustration 130.
2. Install the fuel pump gear. Refer to this Disassembly and Assembly Manual, "Gear Group (Front)-Install".
3. Ensure that all timing pins are removed.
4. Check the backlash of the gear train. Refer to Specifications Manual, "Gear Group (Front)" for more information.

End By:

- a. Install the rocker shaft. Refer to this Disassembly and Assembly Manual, "Rocker Shaft and Pushrod - Install".
- b. Install the glow plugs if the glow plugs were previously removed. Refer to this Disassembly and Assembly Manual, "Glow Plugs - remove and Install".
- c. Install the front cover. Refer to this Disassembly and Assembly Manual, "Front Cover - Remove and Install".

Housing (Front) - Remove

Removal Procedure

Start By:

- a. Drain the coolant into a suitable container for storage or disposal.
- b. Remove the fan drive. Refer to this Disassembly and Assembly Manual, "Fan Drive - Remove and Install".
- c. If necessary, remove the alternator. Refer to this Disassembly and Assembly Manual, "Alternator - Remove".
- d. Remove the fuel injection pump. Refer to the appropriate fuel injection pump within this Disassembly and Assembly Manual, "Fuel Injection Pump - Remove".
- e. Remove the engine oil pan. Refer to this Disassembly and Assembly Manual, "Engine Oil Pan - Remove and Install".
- f. Remove the gear group (front). Refer to this Disassembly and Assembly Manual, "Gear Group (Front) - Remove".

NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

NOTICE

Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Dispose of all fluids according to local regulations and mandates.

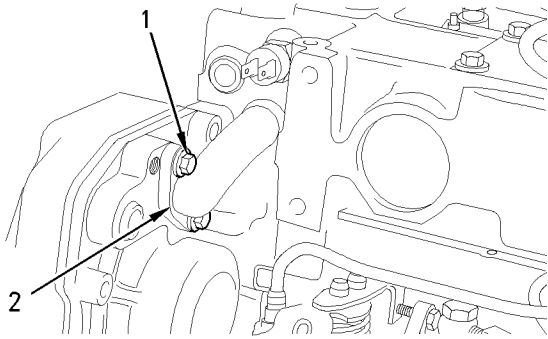


Illustration 131 g00995185

1. Remove the setscrews (1). Remove the bypass tube (2) from the cylinder head. Remove the O-rings from the bypass tube (2). Discard the O-rings.

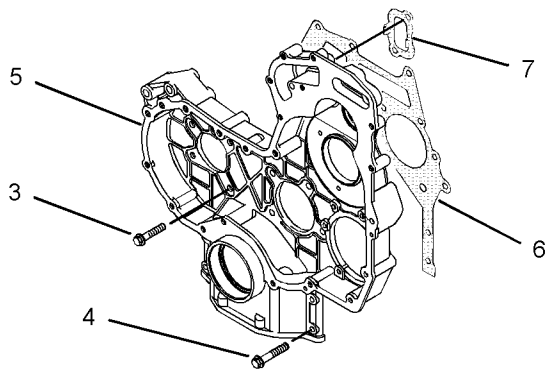


Illustration 132 g01024469

2. Remove the setscrews (3) and the setscrews (4) that fasten the front housing (5) to the cylinder block.
3. Remove the front housing (5). Remove the joint (6) from the cylinder block and the front housing (5).
4. Remove the joint (7) from the back side of the front housing (5).

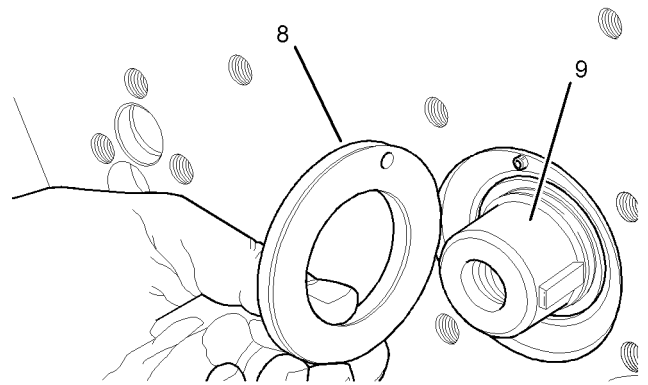


Illustration 133 g01024472

5. Remove the thrust washer (8) from the camshaft (9).

i02281563

Housing (Front) - Install

Installation Procedure

Table 20

Required Tools		
Part Number	Part Name	Qty
27610216	Alignment Tool	1

NOTICE

Keep all parts clean from contaminants.

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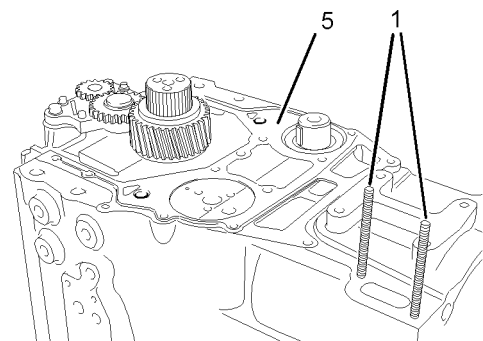


Illustration 134
Typical example

g01024529

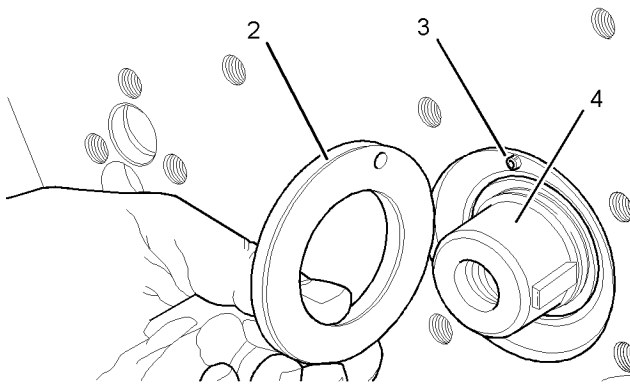


Illustration 135
Typical example
g01024492

1. Thoroughly clean the mating surfaces on the cylinder block for the front housing. Install two temporary studs (1) into the cylinder block. Ensure that the thrust washer (2) is aligned with the hollow dowel (3). Install the thrust washer onto the camshaft (4). Install a new joint (5) onto the cylinder block.

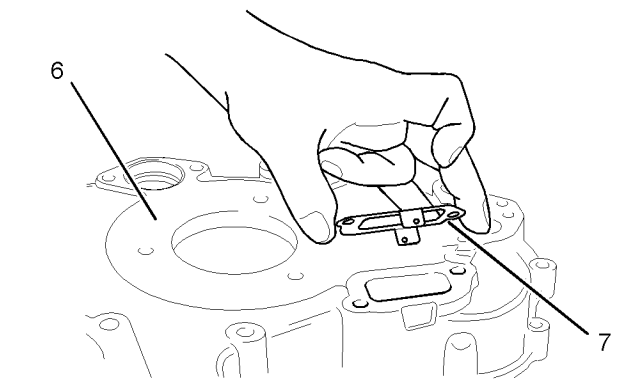


Illustration 136
Typical example
g01024547

2. Thoroughly clean the front housing (6). Especially clean the mating surfaces of the front housing (6). Inspect the front housing (6) for wear and for damage. If necessary, replace the front housing (6).

Note: If it is necessary to replace the front housing (6), it may also be necessary to install blanking plugs which should be sealed with a suitable sealant into the front housing.

3. Install a new joint (7) to the front housing (6).

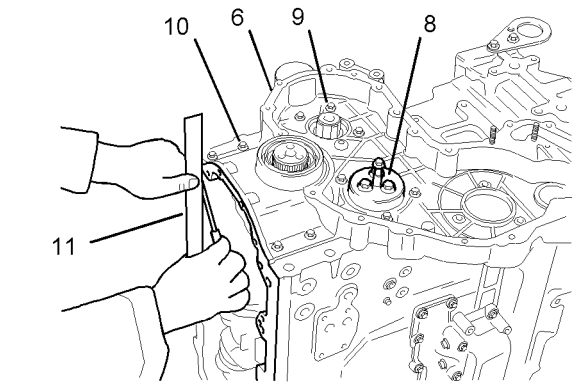


Illustration 137
Typical example
g01024551

4. Install the 27610216 Alignment Tool (8) into the recess within the cylinder block. Install the front housing (6) onto the cylinder block.
5. Install the setscrews (9). Tighten the setscrews (9) finger tight. Except for the two holes with the temporary studs (1), install the setscrews (10). Tighten the setscrews (10) finger tight. Remove the two temporary studs (1). Install the remainder of the setscrews (10). Tighten the remaining two setscrews (10) finger tight.
6. Align the front housing (6) to the lower machined face of the cylinder block (11). Use a suitable straight edge and a feeler gauge to check the tolerance for the alignment (11). Refer to the Specifications Manual, "Front Housing and Covers" for further information.
7. With the alignment within tolerance, tighten the setscrews (9) and the setscrews (10) to a torque of 22 N·m (16 lb ft). Remove the alignment tool (8).

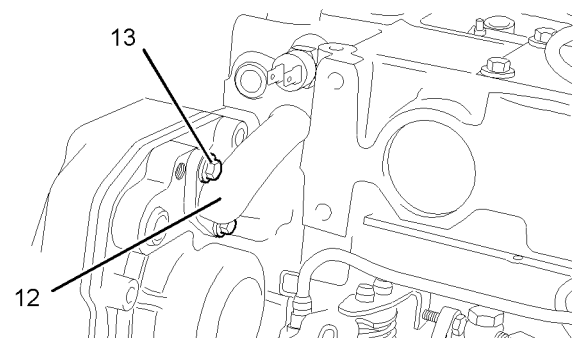


Illustration 138
Typical example
g01024687

8. Install new O-rings onto the bypass tube (12). Apply POWERPART 21820221 Red Rubber Grease to the O-rings. Install the bypass tube (12) into the cylinder head. Install the setscrews (13).

End By:

- a. Install the gear group (front). Refer to this Disassembly and Assembly Manual, "Gear Group (Front) - Install".
- b. Install the engine oil pan. Refer to this Disassembly and Assembly Manual, "Engine Oil Pan - Remove and Install".
- c. Install the fuel injection pump. Refer to the appropriate fuel injection pump within this Disassembly and Assembly Manual, "Fuel Injection Pump - Install".
- d. Install the alternator if the alternator was removed previously. Refer to this Disassembly and Assembly Manual, "Alternator - Install".
- e. Install the fan drive. Refer to this Disassembly and Assembly Manual, "Fan Drive - Remove and Install".
- f. At the appropriate time, fill the cooling system.

i02641608

Accessory Drive - Remove and Install

Removal Procedure

NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

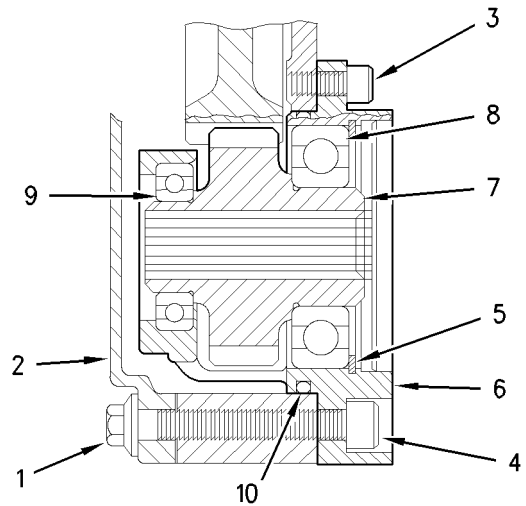


Illustration 139

g01004414

1. Remove the setscrews (1) and the front cover (2).
2. Remove the Allen head screws (3) and (4). Remove the accessory drive assembly from the rear face of the front housing (6).
3. Remove the circlip (5).
4. Place the flange of the front housing (6) onto a suitable support. Press the assembly of the gear (7) and the bearings (8 and 9) out of the front housing (6). Use a suitable puller in order to remove the bearings (8 and 9) from the gear (7).
5. Remove the O-ring (10) from the front housing (6) and discard the O-ring.

Installation Procedure

NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

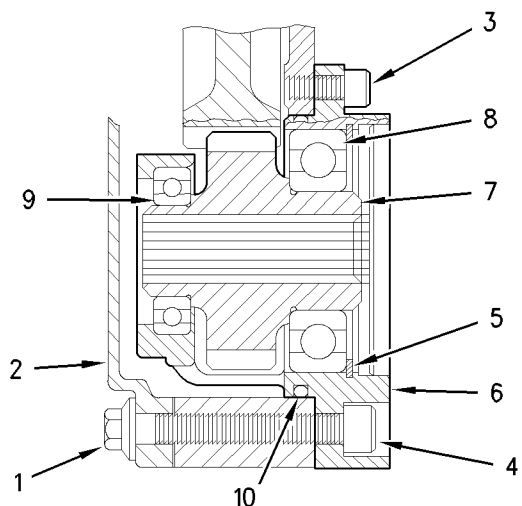


Illustration 140

g01004414

1. Inspect the condition of the teeth and the splines of the gear (7), the bearings (8 and 9), the circlip (5), and the groove for the circlip in the front housing (6) for wear and for damage. Replace any worn component or any damaged component.

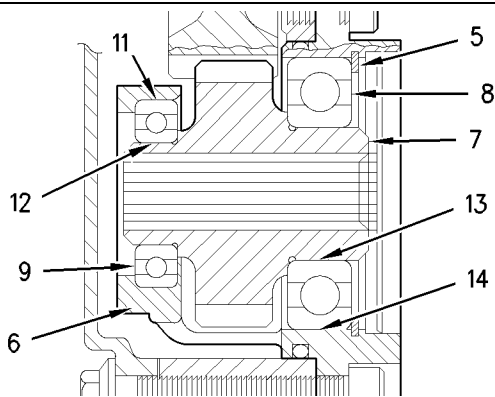


Illustration 141

g01004637

2. Apply a small continuous bead (11) of 21820603 POWERPART Retainer (oil tolerant) to the outer surface of the bearing (9). Place the front flange of the front housing (6) onto a suitable support. Press on the outer race of the bearing (9) until the bearing is against the front face of the recess for the bearing in the front housing (6). Remove any excess sealant.
3. Apply a small continuous bead (12) of 21820603 POWERPART Retainer (oil tolerant) to the inner surface of the bearing (9). Place the front face of the inner race of the bearing (9) onto a suitable support. Press the smaller shaft of the gear (7) into the bearing (9) until the shoulder of the gear is against the bearing. Remove any excess sealant.

4. Apply a small continuous bead (14) of 21820603 POWERPART Retainer (oil tolerant) to the outer surface of the bearing (8). Apply a small continuous bead (13) of 21820603 POWERPART Retainer (oil tolerant) to the inner surface of the bearing (8). Ensure that the front face of the inner race of the bearing (9) is still on a suitable support. Press the bearing (8) onto the larger shaft of the gear (7) until the bearing (9) is against the shoulder of the gear. Remove any excess sealant.
5. Install the circlip (5) into the groove in the front housing (6). Ensure that the circlip (5) is correctly positioned in the groove.

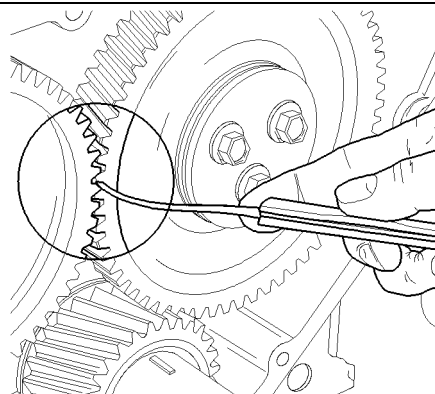


Illustration 142

g00946787

Typical Example

6. Refer to the illustration 142 and check the backlash between the idler gear and gear (7). The backlash should be within 0.11 mm (0.004 inch) to 0.17 mm (0.007 inch).
7. Lightly lubricate a new O-ring (10) with 21820221 POWERPART Red Rubber Grease and install the O-ring into the recess in the front housing (6). Lightly lubricate the bearing (8), the bearing (9), and the gear (7) with clean engine lubricating oil.
8. By using the Allen head screws (3 and 4), install the assembly of the accessory drive to the rear of the front housing (6). Torque the Allen head screws to a torque of 22 N·m (16 lb ft).
9. By using the setscrews (1), install the front cover (2). Refer to this Disassembly and Assembly Manual, "Front Cover - Remove and Install."

i02245984

Crankcase Breather - Remove and Install

Removal Procedure for the Diaphragm Valve

Note: All naturally aspirated four cylinder engines in the 1100 Series are equipped with a closed breather system. A closed breather system is optional for turbocharged four cylinder engines in the 1100 Series.

Note: All of the engines that are equipped with a closed breather system have a diaphragm valve in the valve mechanism cover.

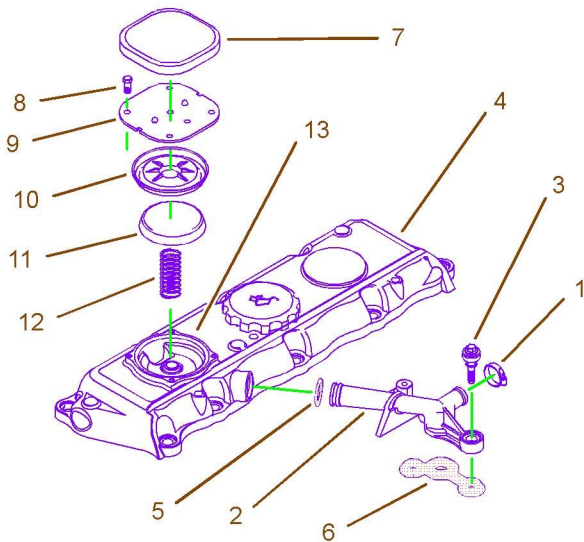


Illustration 143

g01025007

Typical turbocharged example

1. Loosen the hose clamp (1) and release the hose from the connector (2).
2. Remove the fasteners (3) and remove the connector (2) from the cylinder head and from the valve mechanism cover (4). Remove the O-ring (5) from the connector (2). Discard the O-ring (5). Remove the joint (6). Discard the joint (6).
3. Remove the plastic cover (7) from the valve mechanism cover (4).

WARNING

Personal injury can result from parts and/or covers under spring pressure.

Spring force will be released when covers are removed.

Be prepared to hold spring loaded covers as the bolts are loosened.

4. Remove the screws (8). Remove the plate (9).
5. Remove the diaphragm (10) and the cap (11). Remove the spring (12).
6. If the recess (13) for the assembly of the diaphragm valve needs to be cleaned, remove the valve mechanism cover (4). Refer to this Disassembly and Assembly Manual, "Valve Mechanism Cover - Remove and Install". If necessary, thoroughly clean the valve mechanism cover (4) and especially clean the recess (13).

Installation Procedure for the Diaphragm Valve

1. Thoroughly clean all of the previously removed components. Inspect all of the components for wear and for damage. Especially check the condition of the hose for the connector (2) and the diaphragm (10) for damage. Replace any component that is worn and/or damaged.
2. If the valve mechanism cover (4) was removed, install the valve mechanism cover. Refer to this Disassembly and Assembly Manual, "Valve Mechanism Cover - Remove and Install".

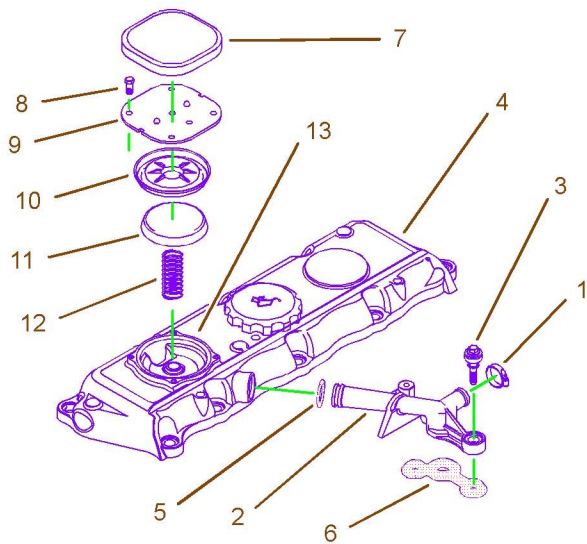


Illustration 144
Typical example g01025007

⚠ WARNING
Improper assembly of parts that are spring loaded can cause bodily injury.

To prevent possible injury, follow the established assembly procedure and wear protective equipment.

3. Install the spring (12), the cap (11), and the diaphragm (10) into the recess (13) in the valve mechanism cover (4).

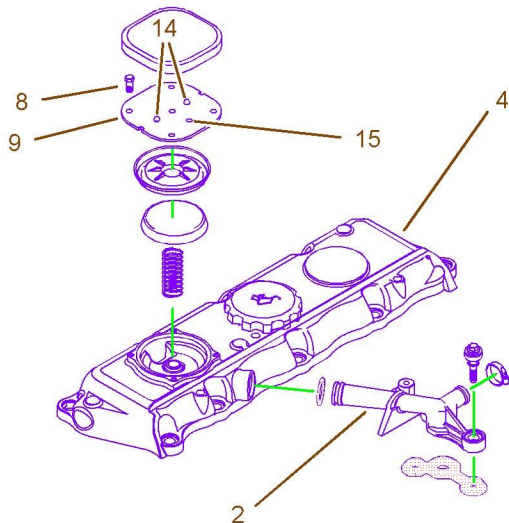


Illustration 145
Typical example g01042226

4. Ensure that the two domes (14) are uppermost and ensure that the hole (15) is toward the connector (2) of the valve mechanism cover (4). Refer to illustration 145. Install the plate (9). Install the screws (8). Tighten the screws (8) to a torque of 1.3 N·m (11.5 lb in).
5. Push the plastic cover (7) onto the valve mechanism cover (4).
6. Install a new O-ring (5) onto the connector (2).
7. Install a new joint (6) to the connector (2). Install the connector (2) into the valve mechanism cover (4) and onto the cylinder head.
8. Install the fasteners (3). Tighten the fasteners (3) to a torque of 9 N·m (80 lb in).
9. Install the hose onto the connector (2). Ensure that the hose is clear of all hot surfaces, clear of all components that move, and clear of all components that vibrate when the engine is operating. Tighten the hose clamp (1) to a torque of 5 N·m (44 lb in).

Removal Procedure for Engines that have a Filtered Breather

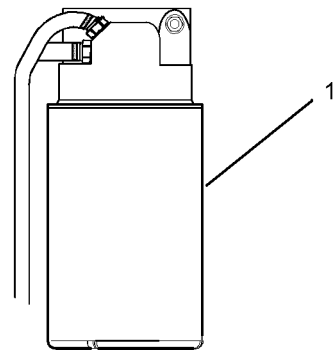


Illustration 146
Typical example g01131061

1. Remove the canister (1).

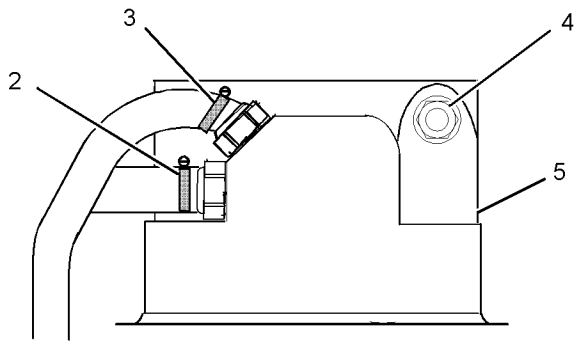


Illustration 147 g01139608

Typical example

2. Remove the clips (2 and 3) and remove both oil line hose.
3. Remove the setscrews (4) and remove the head assembly (5) from the engine.

Installation procedure

1. Ensure that all components are clean. Replace any components that are damaged.

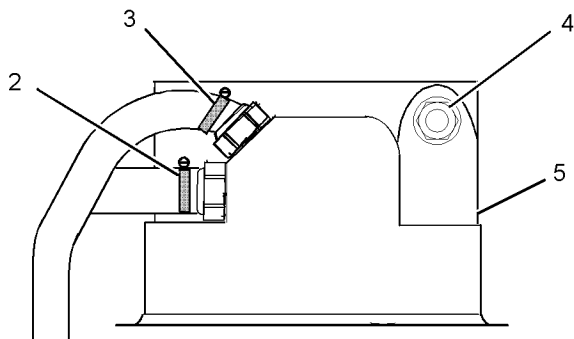


Illustration 148 g01139608

Typical example

2. Align the head assembly (5) to the engine and install the setscrews (4). Tighten the setscrews to 22 N·m (16 lb ft).
3. Install the oil feed and the clip (2). Install the vent line and clip (3). Tighten both clips to 3 N·m (26 lb in).

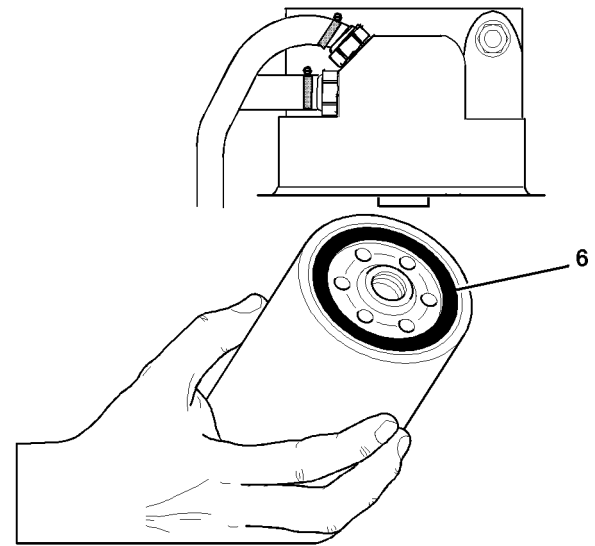


Illustration 149 g01139984

Typical example

4. Lubricate the O-ring seal (6) and install the canister. Tighten the canister to 12 N·m (8 lb ft).

i02282046

Valve Mechanism Cover - Remove and Install

Removal Procedure

Start By:

- a. Remove the heat shields, if equipped.
- b. Remove the cover for the fuel injectors. Refer to this Disassembly and Assembly Manual, "Fuel Injector Cover - Remove and Install".

NOTICE

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NOTICE

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Dispose of all fluids according to local regulations and mandates.

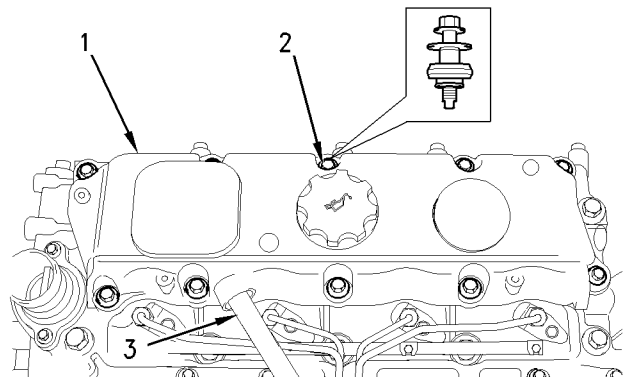


Illustration 150
Typical example
g00951080

1. Remove the breather tube (3) from the valve mechanism cover (1). Refer to this Disassembly and Assembly Manual, "Crankcase Breather - Remove and Install".
2. Remove the fasteners (2). Remove the valve mechanism cover (1). Remove the joint for the valve mechanism cover and discard the joint.

Installation Procedure

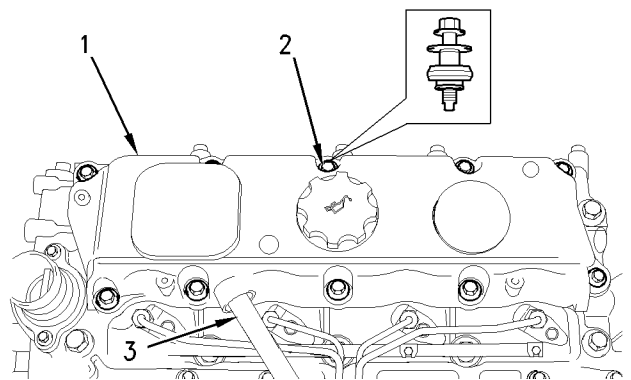


Illustration 151
Typical example
g00951080

1. Thoroughly clean the valve mechanism cover (1). Ensure that the groove for the joint for the valve mechanism cover (1) is clean and dry. Ensure that the mating face on the cylinder head is clean and dry.

2. If the valve mechanism cover (1) is equipped with an oil filler cap, check the condition of the O-ring for the oil filler cap. If necessary, replace the O-ring.
3. Install a new joint to the valve mechanism cover (1) and install the valve mechanism cover onto the cylinder head.
4. Check the condition of the fasteners (2). Replace the fasteners (2), if necessary. Install the fasteners (2).

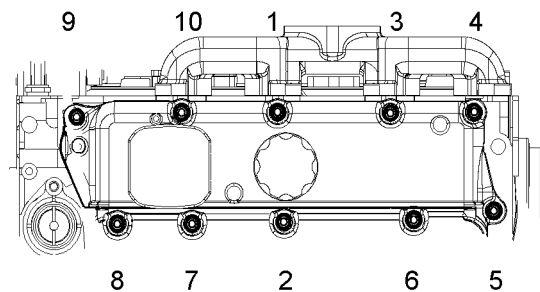


Illustration 152
Typical example
g01142847

5. Tighten the fasteners to a torque of 9 N·m (80 lb in).
6. Tighten the fasteners in sequence. Refer to illustration 152.
7. Connect the breather tube (3) to the valve mechanism cover (1). Refer to this Disassembly and Assembly Manual, "Crankcase Breather - Remove and Install".

End By:

- a. Install the cover for the fuel injectors. Refer to this Disassembly and Assembly Manual, "Fuel Injector Cover - Remove and Install".
- b. If equipped, ensure that the heat shields are clean and free from dust, oil, and paint. Install the heat shields.

i02282003

Rocker Shaft and Pushrod - Remove

Removal Procedure

Table 21

Required Tools		
Part Number	Part Description	Qty
27610227	Rocker Assembly Tool	4

Start By:

- a. Remove the valve mechanism cover. Refer to this Disassembly and Assembly Manual, "Valve Mechanism Cover - Remove and Install".

NOTICE

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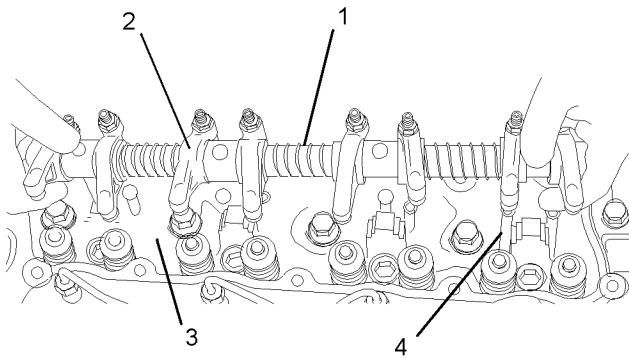


Illustration 153
Typical example

g01014000

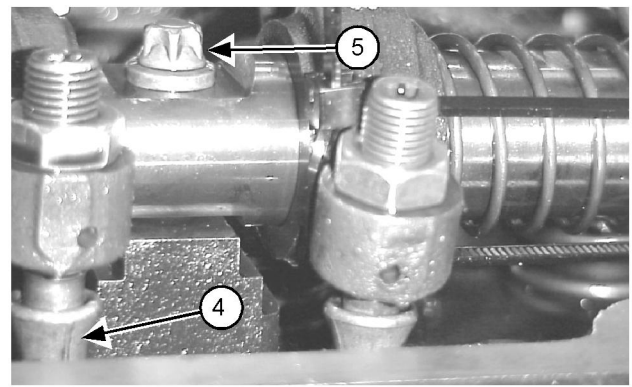


Illustration 154
Typical example

g01013998

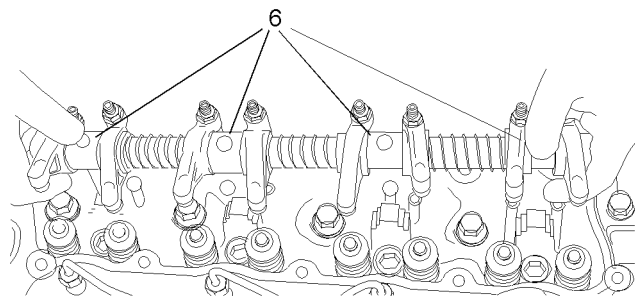


Illustration 155
Typical example

g01015730

1. If the rocker shaft will not be disassembled, install the rocker assembly tools (6) between each pair of rocker arms (2). The rocker arms (2) must be held away from the machined face of the cylinder head (3) during reassembly.
2. Start from the ends of the rocker shaft assembly (1) and work toward the center of the rocker shaft assembly in order to remove the torx screws (5). Evenly loosen the torx screws (5) in order to remove the rocker shaft assembly (1).
3. Remove the rocker shaft assembly (1) from the cylinder head (3).
4. Place an identification mark on the pushrods (4) for installation. Remove the pushrods (5) from the cylinder head (3).