

# Disassembly and Assembly

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## **2206-E13 Industrial Engine**

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TGB (Engine)  
TGD (Engine)  
TGF (Engine)

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## Disassembly and Assembly Section

### Fuel Priming Pump - Remove and Install

i02736695

#### Removal Procedure

##### 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.

##### NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

1. Turn the fuel supply to the "OFF" position.

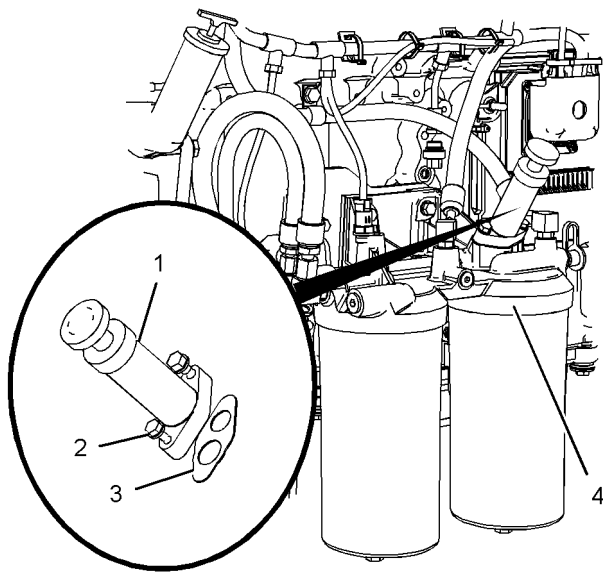


Illustration 1

g01380207

Typical example

2. Remove bolts (2). Remove fuel priming pump (1) from fuel filter base (4).
3. Remove joint (3).

#### Installation Procedure

##### NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

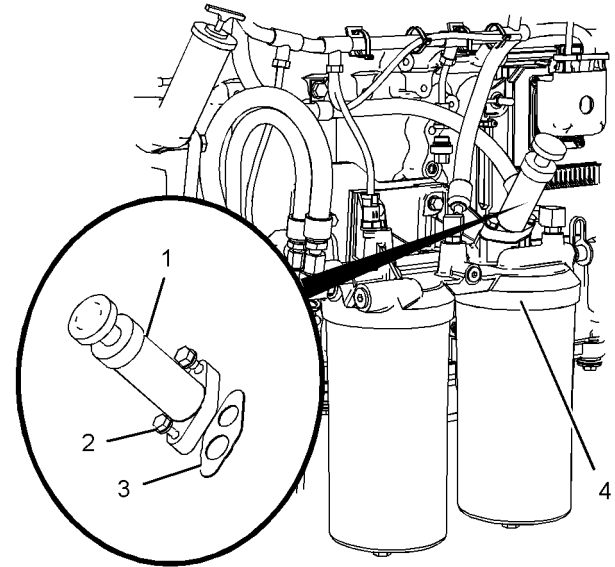


Illustration 2

g01380207

Typical example

1. Position a new joint (3) on fuel filter base (4).

**Note:** Ensure correct orientation of the joint.

2. Position fuel priming pump (1) on fuel filter base (4) and install bolts (2). Tighten the 1/4" bolt to a torque of 12 N·m (105 lb in). Tighten the 5/16" bolt to a torque of 25 N·m (221 lb in).
3. Turn the fuel supply to the "ON" position.
4. Remove the air from the fuel system. Refer to Operation and Maintenance Manual, "Fuel System - Prime".

i02754755

## Fuel Filter Base - Remove

### Removal Procedure

#### 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.

#### NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

1. Turn the fuel supply to the "OFF" position.
2. Place a suitable container below the fuel filter base in order to drain the fuel.

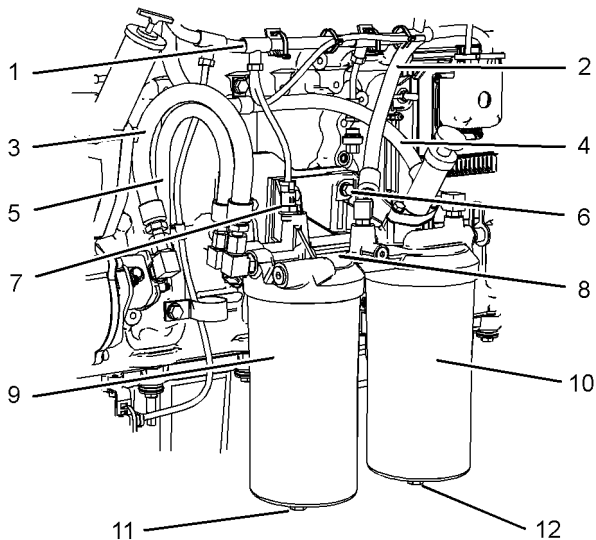


Illustration 3  
Typical example

g01380208

3. Remove plugs (11) and (12). Allow the fuel to drain.
4. Slide the locking tab into the unlocked position and disconnect harness assembly (1) from fuel temperature sensor (7).

5. Disconnect hose assembly (2). Disconnect hose assembly (4). Disconnect hose assemblies (3) and (5). Cap the hose assemblies.
6. Remove fuel filters (9) and (10). Remove the O-ring seals and the fuel filter elements from the fuel filters. Refer to Operation and Maintenance Manual, "Fuel System Primary Filter - Replace" and refer to Operation and Maintenance Manual, "Fuel System Secondary Filter - Replace" for more information.
7. Remove bolts (6). Remove fuel filter base (8).

i02754756

## Fuel Filter Base - Disassemble

### Disassembly Procedure

#### Start By:

- a. Remove the fuel filter base. Refer to Disassembly and Assembly, "Fuel Filter Base - Remove".

#### NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

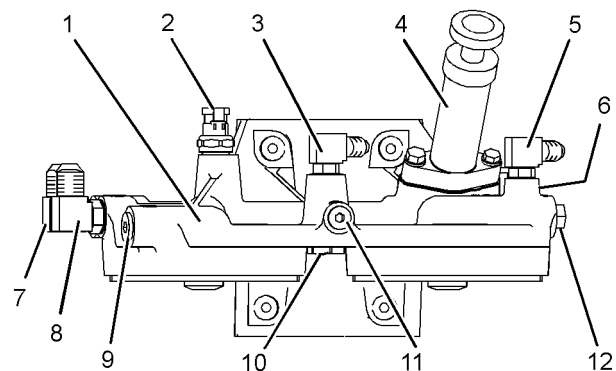


Illustration 4  
Typical example

g01380210

1. Remove fuel priming pump (4) from fuel filter base (1). Refer to Disassembly and Assembly, "Fuel Priming Pump - Remove and Install" for the correct procedure.
2. Remove fuel temperature sensor (2) from fuel filter base (1). Refer to Disassembly and Assembly, "Fuel Temperature Sensor - Remove and Install" for the correct procedure.

3. Remove fuel bypass valve (6) (not shown) from fuel filter base (1). Remove the O-ring seals from the fuel bypass valve.
4. Remove fuel check valve (10) from fuel filter base (1). Remove the O-ring seals from the fuel check valve.
5. Remove connections (3), (5), (7) and (8) from fuel filter base (1). Remove the O-ring seals from the connections.
6. Remove plugs (9), (11) and (12) from fuel filter base (1). Remove the O-ring seals from the plugs.

i02754757

## Fuel Filter Base - Assemble

### Assembly Procedure

**NOTICE**

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

1. Ensure that the fuel filter base is clean and free from damage. If necessary, replace the fuel filter base.

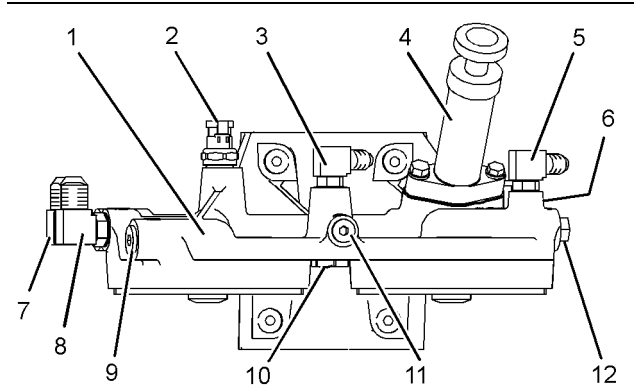


Illustration 5

g01380210

Typical example

2. Install new O-ring seals to plugs (9), (11) and (12). Install the plugs to fuel filter base (1). Tighten plug (9) to a torque of 41 N·m (30 lb ft). Tighten plugs (11) and (12) to a torque of 15 N·m (11 lb ft).
3. Install new O-ring seals to connections (3), (5), (7) and (8). Install the connections to fuel filter base (1). Tighten connections (3), (5) and (7) to a torque of 15 N·m (11 lb ft). Tighten connection (8) to a torque of 41 N·m (30 lb ft).

**Note:** Ensure correct orientation of the connections.

4. Install new O-ring seals to fuel bypass valve (6) (not shown). Install the fuel bypass valve to fuel filter base (1). Tighten the fuel bypass valve to a torque of 35 N·m (26 lb ft).
5. Install new O-ring seals to fuel check valve (10). Install the fuel check valve to fuel filter base (1). Tighten the fuel check valve to a torque of 35 N·m (26 lb ft).
6. Install fuel temperature sensor (2) to fuel filter base (1). Refer to Disassembly and Assembly, "Fuel Temperature Sensor - Remove and Install" for the correct procedure.
7. Install fuel priming pump (4) to fuel filter base (1). Refer to Disassembly and Assembly, "Fuel Priming Pump - Remove and Install" for the correct procedure.

**End By:**

- a. Install the fuel filter base. Refer to Disassembly and Assembly, "Fuel Filter Base - Install".

i02754758

## Fuel Filter Base - Install

### Installation Procedure

Table 1

Required Tools			
Tool	Part Number	Part Description	Qty
A	CV60889	POWERPART Special Lubricant	1

**NOTICE**

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

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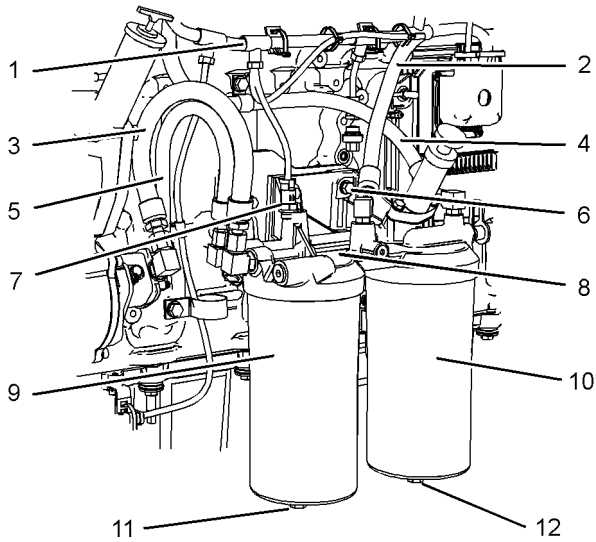


Illustration 6  
Typical example  
g01380208

1. Position fuel filter base (8) onto the mounting bracket and install bolts (6). Tighten the bolts to a torque of 55 N·m (41 lb ft).
2. Install new O-ring seals and new fuel filter elements to fuel filters (9) and (10). Apply Tooling (A) to the threads of the fuel filters. Install the fuel filters to fuel filter base (8). Tighten the fuel filters.

Refer to Operation and Maintenance Manual, "Fuel Filter Primary Filter - Replace" and refer to Operation and Maintenance Manual, "Fuel Filter Secondary Filter - Replace" for more information.

3. Install new O-ring seals to plugs (11) and (12). Install the plugs to fuel filters (9) and (10).
4. Connect hose assemblies (2), (3), (4) and (5).
5. Connect harness assembly (1) to fuel temperature sensor (7). Slide the locking tab into the locked position.
6. Turn the fuel supply to the "ON" position.
7. Remove the air from the fuel system. Refer to Operation and Maintenance Manual, "Fuel System - Prime".

## Fuel Transfer Pump - Remove

### Removal Procedure

#### 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.

#### NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

1. Turn the fuel supply to the "OFF" position.
2. Place a suitable container below the fuel transfer pump in order to catch any fuel that might be spilled.

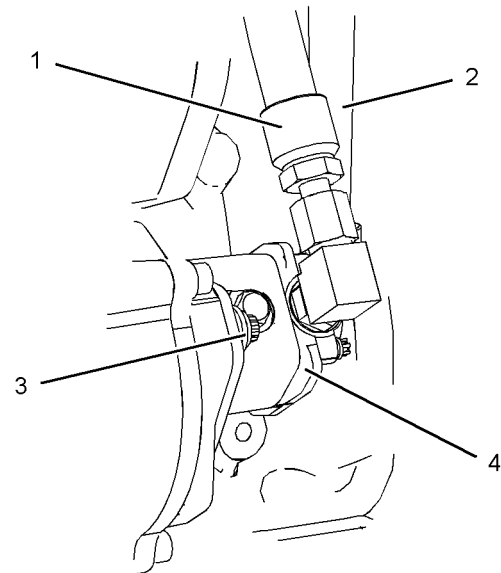


Illustration 7  
Typical example  
g01380887

3. Disconnect hose assemblies (1) and (2) from fuel transfer pump (4). Cap the hose assemblies.
4. Remove bolts (3) and remove fuel transfer pump (4).

- Remove the O-ring seal from fuel transfer pump (4).

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## Fuel Transfer Pump - Install

### Installation Procedure

#### NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

- Ensure that the fuel transfer pump is clean and free from damage.

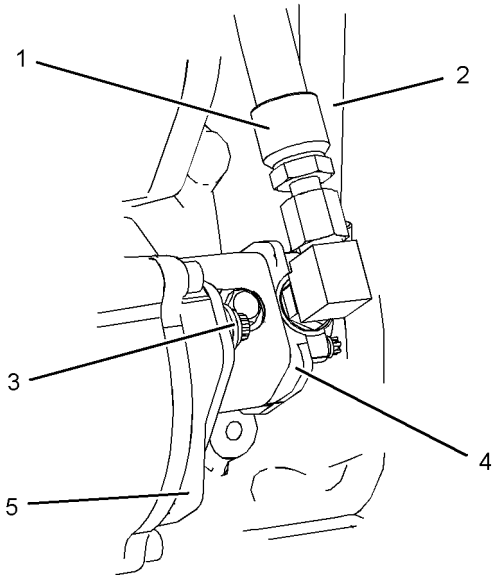


Illustration 8

g01416997

Typical example

- Lubricate a new O-ring seal with clean engine oil. Install the O-ring seal to fuel transfer pump (4).
- Position fuel transfer pump (4) on pump drive (5).

**Note:** Ensure that the splines on the shaft of the fuel transfer pump are correctly engaged into the pump drive.

- Install bolts (3). Tighten the bolts to a torque of 55 N·m (41 lb ft).
- Remove the caps from the hose assemblies. Connect hose assemblies (1) and (2) to fuel transfer pump (4).
- Turn the fuel supply to the "ON" position.

- Remove the air from the fuel system. Refer to Systems Operation and Maintenance Manual, "Fuel System - Prime".

i02754762

## Electronic Unit Injector - Remove

### Removal Procedure

Table 2

Required Tools			
Tool	Part Number	Part Description	Qty
A	27610288	Pry Bar	1

#### Start By:

- Remove the rocker shafts. Refer to Disassembly and Assembly, "Rocker Shaft and Pushrod - Remove".

#### NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

- Turn the fuel supply to the OFF position.

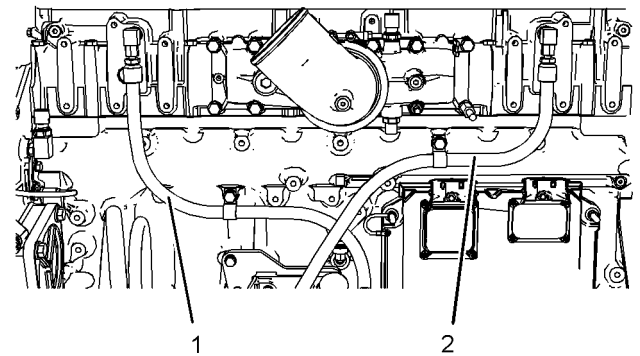


Illustration 9

g01411598

- Disconnect hoses (1) and (2) from the fuel filter base in order to drain fuel from the cylinder head.



i02754763

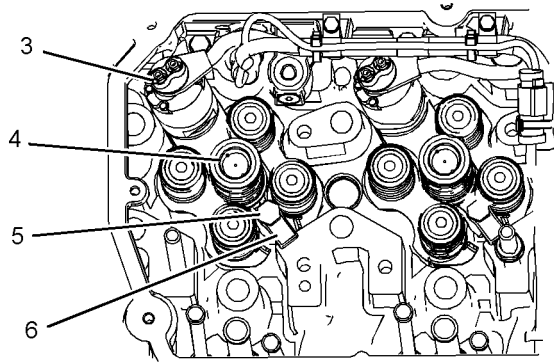


Illustration 10

g01380214

3. Disconnect harness assembly (3) from electronic unit injector (4).
4. Remove bolt (5).
5. Place an identification mark on electronic unit injector (4) for installation purposes. Each electronic unit injector must be reinstalled in the original location in the cylinder head.
6. Use Tooling (A) to pry beneath clamp (6) and free electronic unit injector (4).
7. Remove electronic unit injector (4) and clamp (6) from the cylinder head.

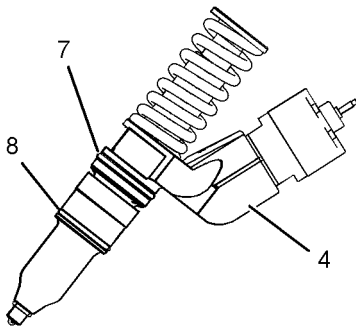


Illustration 11

g01380213

8. Remove O-ring seals (7) and (8) from electronic unit injector (4).

## Electronic Unit Injector - Install

### Installation Procedure

Table 3

Required Tools			
Tool	Part Number	Part Description	Qty
B	GE50023	Tapered Brush	1
C	GE50024	Small Bore Brush	1
D	GE50028	Vacuum Pump	1
	GE50046	Fluid Sampling Bottle	1
	GE50030	Tube 7.9 mm (0.31 inch) OD	1
E	27610296	Torque Wrench	1

#### NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

1. Use Tooling (B) and (C) to clean the carbon deposit from the inside of the electronic unit injector sleeve.
2. Use Tooling (D) to remove the fuel and oil from the cylinder. Evacuate as much fuel and oil as possible from the cylinder before installing the electronic unit injector. Several evacuations may be necessary.

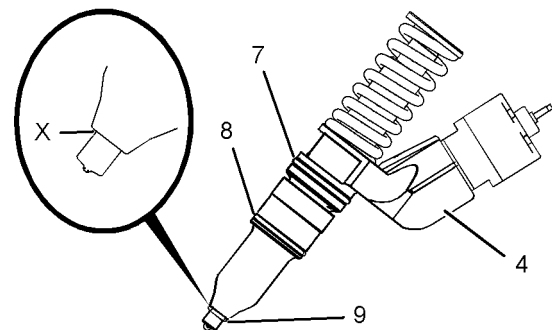


Illustration 12

g01380273

3. Ensure that seat area (X) on electronic unit injector (4) is clean and free carbon.

4. Install new O-ring seals (7) and (8) to electronic unit injector (4). Lubricate the O-ring seals with clean engine oil.
5. Install a new O-ring seal (9) to electronic unit injector (4).

**Note:** O-ring seal (9) should be installed dry.

#### NOTICE

If a replacement electronic unit injector is installed, the calibration code must be programmed into the electronic control module. Refer to Troubleshooting Guide, "Injector Trim File" for more information.

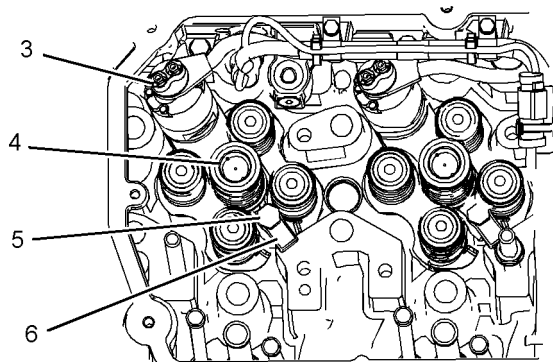


Illustration 13

g01380214

6. Install clamp (6) to electronic unit injector (4). Install electronic unit injector (4) into the original location in the cylinder head.
7. Install bolt (5). Tighten the bolt to a torque of 55 N·m (41 lb ft).
8. Connect harness assembly (3) to electronic unit injector (4). Use Tooling (E) to tighten the nuts to a torque of 2.5 N·m (22 lb in).

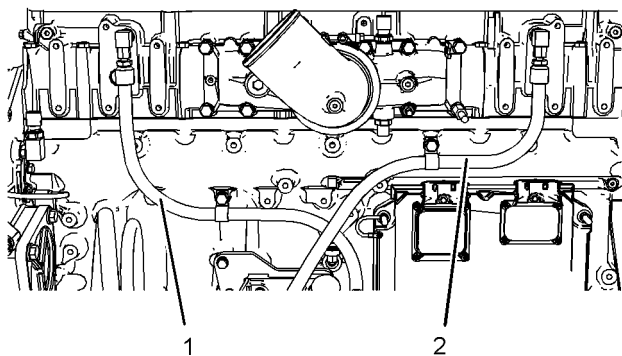


Illustration 14

g01411598

9. Connect hoses (1) and (2) to the fuel filter base.
10. Turn the fuel supply to the "ON" position.

11. Remove the air from the fuel system. Refer to Operation and Maintenance Manual, "Fuel System - Prime".

#### End By:

- a. Install the rocker shafts. Refer to Disassembly and Assembly, "Rocker Shaft and Pushrod - Install".

i02754765

## Electronic Unit Injector Sleeve - Remove

### Removal Procedure

Table 4

Required Tools			
Tool	Part Number	Part Description	Qty
A	GE50021	Injector Sleeve Tool	1

#### NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

1. Drain the coolant from the cooling system into a suitable container for storage or for disposal. Refer to Operation and Maintenance Manual, "Cooling System Coolant - Change".
2. Remove the electronic unit injectors. Refer to Disassembly and Assembly, "Electronic Unit Injector - Remove".

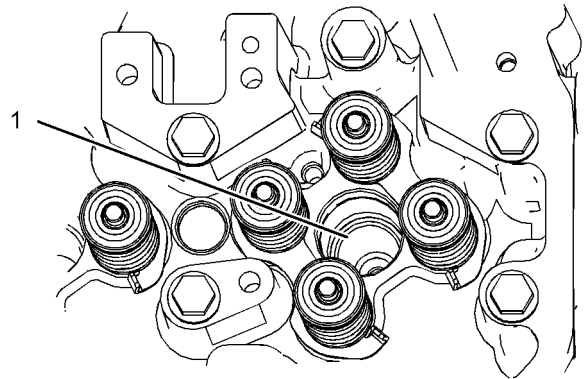


Illustration 15

g01391954

3. Install Tooling (A) into electronic unit injector sleeve (1).

4. Tighten the nut on Tooling (A) until electronic unit injector sleeve (1) is pulled free from the cylinder head.

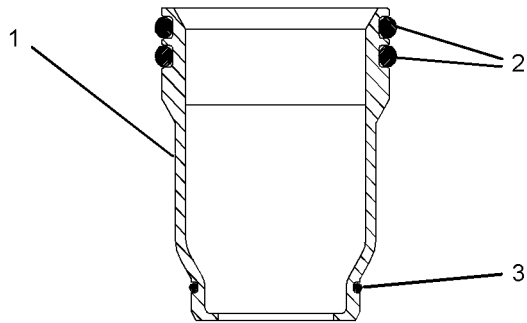


Illustration 16

g01393881

5. Remove O-ring seals (2) and O-ring seal (3) from electronic unit injector sleeve (1).

i02754766

## Electronic Unit Injector Sleeve - Install

### Installation Procedure

Table 5

Required Tools			
Tool	Part Number	Part Description	Qty
A	GE50021	Injector Sleeve Tool	1
B	GE50023	Tapered Brush	1
	GE50024	Small Bore Brush	1
	GE50022	End Brush	1
C	CV60893	Retaining Compound	1

#### NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

1. Use Tooling (B) to clean the bore in the cylinder head for the electronic unit injector sleeve.

#### NOTICE

Ensure that the electronic unit injector sleeve and the cylinder head bore are completely free of oil, dirt, and sealant debris.

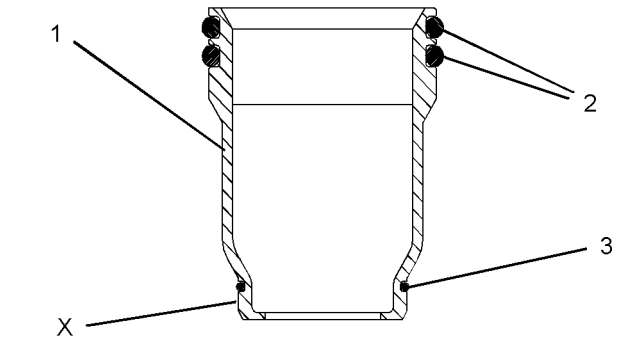


Illustration 17

g01043165

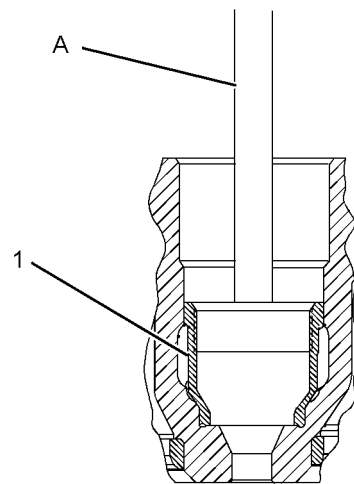


Illustration 18

g01393891

2. Install new O-ring seals (2) and (3) to electronic unit injector sleeve (1).
3. Install electronic unit injector sleeve (1) to Tooling (A).
4. Apply a small continuous bead of Tooling (C) to surface (X) of electronic unit injector sleeve (1).
5. Lubricate O-ring seals (2) with clean engine oil.
6. Position electronic unit injector sleeve (1) and Tooling (A) in the cylinder head. Use care not to damage O-ring seals (2) and (3).
7. Use Tooling (A) and a soft faced hammer to install electronic unit injector sleeve (1) to the cylinder head.

**Note:** Ensure that the electronic unit injector sleeve is properly seated in the cylinder head.

8. Install the electronic unit injectors. Refer to Disassembly and Assembly, "Electronic Unit Injector - Install".
9. Fill the cooling system with coolant. Refer to Operation and Maintenance, "Cooling System Coolant - Change".

i02754770

## Air Cleaner - Remove and Install

### Removal Procedure

#### NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

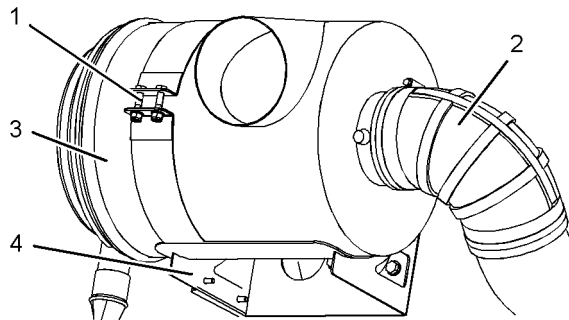


Illustration 19

g01380888

Typical example

1. Loosen the hose clamp and disconnect hose (2).
2. Remove fasteners (1) and remove air cleaner (3) from mounting bracket (4). Note the orientation of the air cleaner.
3. If necessary, remove the bolts that secure mounting bracket (4) and remove the mounting bracket.

### Installation Procedure

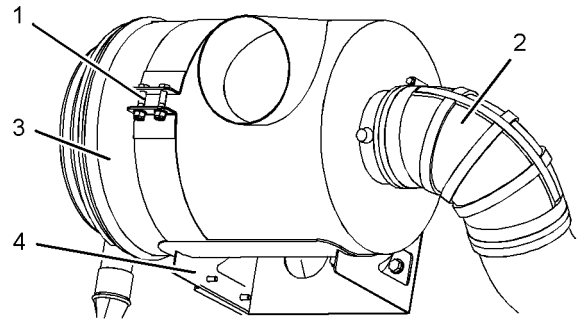


Illustration 20

g01380888

Typical example

1. If necessary, position mounting bracket (4) on the cylinder head and install the bolts that secure the mounting bracket. Tighten the M12 bolts to a torque of 100 N·m (74 lb ft). Tighten the 3/8" bolts to a torque of 47 N·m (35 lb ft).
2. Position air cleaner (3) on mounting bracket (4). Ensure the correct orientation of the air cleaner.
3. Install fasteners (1). Tighten the fasteners to a torque of 55 N·m (41 lb ft).
4. Connect hose (2) and tighten the hose clamp securely.

i02754771

### Turbocharger - Remove

#### Removal Procedure

##### Start By:

- a. Remove the exhaust elbow. Refer to Disassembly and Assembly, "Exhaust Elbow - Remove and Install".

#### 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.

**NOTICE**

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

1. Disconnect the air hoses from the turbocharger inlet and from the turbocharger outlet.

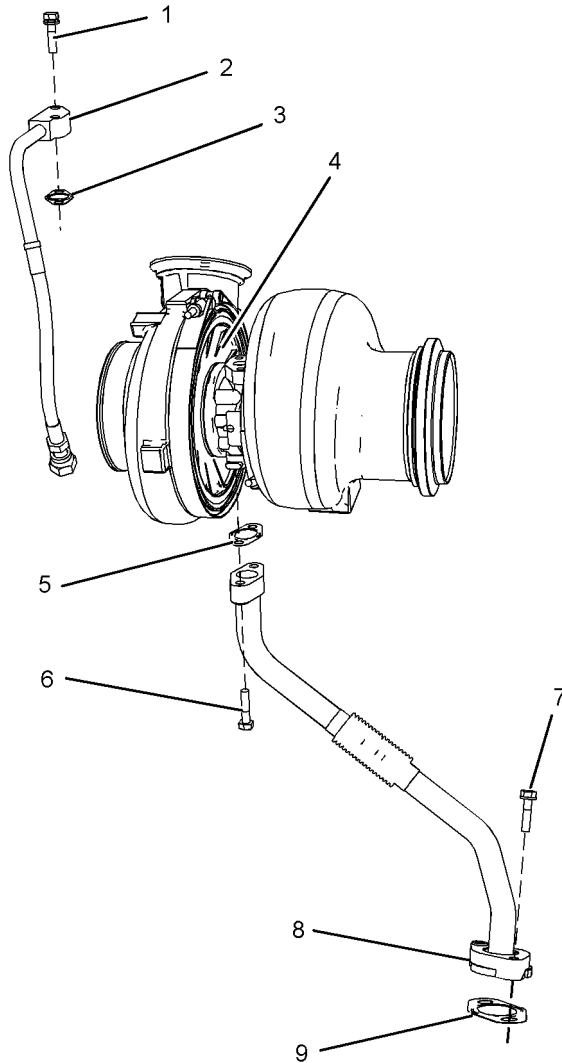


Illustration 21  
Typical example

2. Follow Steps 2.a through 2.c in order to remove the tube assembly for the oil feed to the turbocharger.
  - a. Disconnect tube assembly (2) from the engine oil filter base.
  - b. Remove bolts (1).

- c. Remove tube assembly (2) and joint (3) from turbocharger (4).
3. Follow Steps 3 through 3.c in order to remove the tube assembly for the oil drain to the turbocharger.
  - a. Remove bolts (6) and (7).
  - b. Remove tube assembly (8).
  - c. Remove joints (5) and (9).
4. Attach a suitable lifting device to turbocharger (4). The weight of the turbocharger is approximately 32 kg (71 lb).

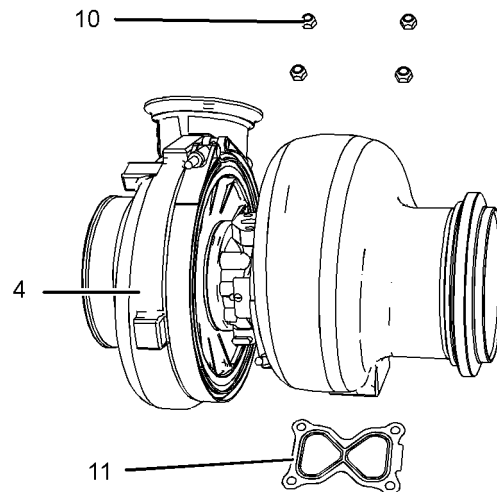


Illustration 22  
Typical example

5. Remove nuts (10). Use the lifting device to remove turbocharger (4) from the exhaust manifold.
6. Remove gasket (11).

i02754772

## Turbocharger - Install

### Installation Procedure

Table 6

Required Tools			
Tool	Part Number	Part Description	Qty
A	CV60889	Anti-Seize Compound	1

**NOTICE**

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

1. Ensure that all mating surfaces are clean and free from damage.

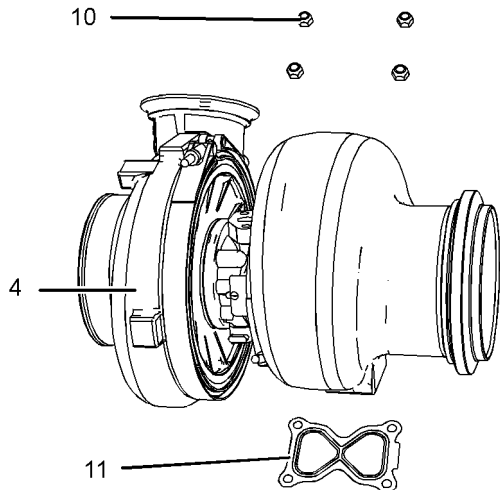


Illustration 23

g01382805

Typical example

2. Position a new gasket (11) on the exhaust manifold.
3. Attach a suitable lifting device to turbocharger (4). The weight of turbocharger is approximately 32 kg (71 lb). Use the lifting device to install the turbocharger to the exhaust manifold.
4. Apply Tooling (A) to the threads of the exhaust manifold studs.
5. Install nuts (10). Tighten the nuts to a torque of 55 N·m (41 lb ft).

If a new turbocharger is installed, loosen the V-band clamps and rotate the bearing housing and the compressor housing to the correct positions.

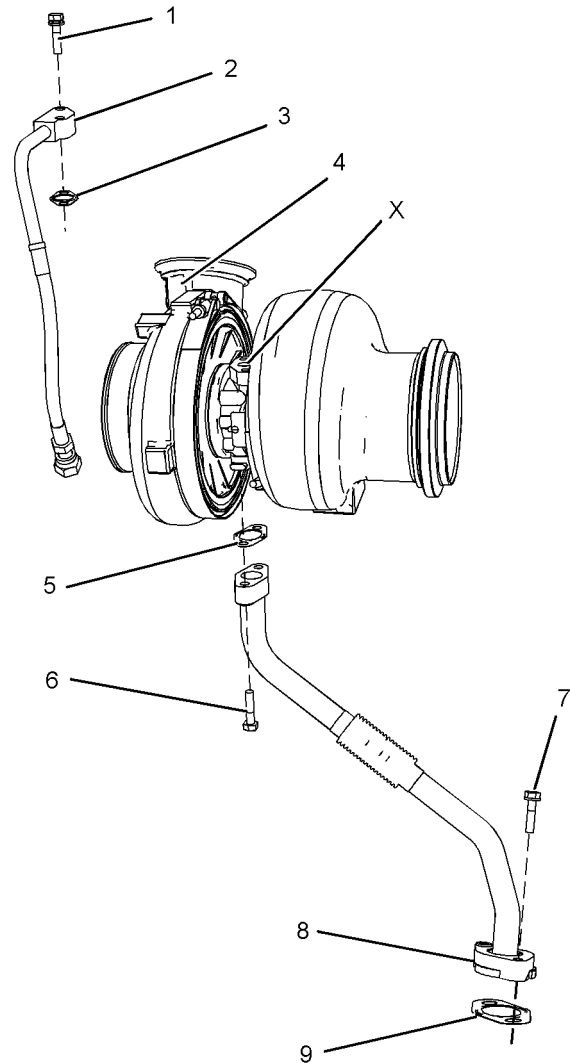


Illustration 24

g01413397

Typical example

6. Follow Steps 6.a through 6.c in order to install the tube assembly for the oil drain to the turbocharger.
  - a. Place a new joint (9) and tube assembly (8) in position and install bolts (7) finger tight.
  - b. Position a new joint (5) between turbocharger (4) and tube assembly (8). Install bolts (6) finger tight.
  - c. Tighten bolts (6) and (7) to a torque of 28 N·m (21 lb ft).
7. Lubricate the bearings of turbocharger (4) with clean engine oil through oil inlet port (X). Rotate the shaft of the turbocharger in order to distribute the lubricant.

8. Follow Steps 8.a through 8.c in order to install the tube assembly for the oil feed to the turbocharger.
  - a. Place a new joint (3) and tube assembly (2) in position on turbocharger (4).
  - b. Install bolts (1). Tighten the bolts to a torque of 28 N·m (21 lb ft).
  - c. Connect tube assembly (2) to the engine oil filter base.
9. Connect the air hoses to the turbocharger inlet and the turbocharger outlet.

If a new turbocharger was installed, tighten the V-band clamp for the exhaust housing to 13.5 N·m (120 lb in). Tighten the V-band clamp for the compressor housing to 18 N·m (160 lb in).

#### End By:

- a. Install the exhaust elbow. Refer to Disassembly and Assembly, "Exhaust Elbow - Remove and Install"

i02754773

## Exhaust Manifold - Remove and Install

### Removal Procedure

#### Start By:

- a. Remove the turbocharger. Refer to Disassembly and Assembly, "Turbocharger - Remove".

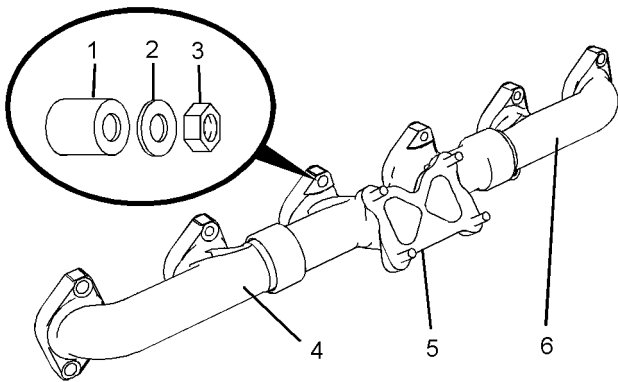


Illustration 25

g01380890

1. Remove nuts (3), washers (2) and spacers (1).
2. Remove exhaust manifolds (4), (5) and (6).

**Note:** Remove the manifolds as one assembly.

3. Remove the exhaust manifold gaskets.
4. Remove exhaust manifolds (4) and (6) from exhaust manifold (5).
5. If necessary, remove the taperlock studs from the cylinder head.

### Installation Procedure

Table 7

Required Tools			
Tool	Part Number	Part Description	Qty
A	CV60889	Anti-Seize Compound	1

#### NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

1. If necessary, install the taperlock studs to the cylinder head. Tighten the taperlock studs to a torque of 35 N·m (26 lb ft).

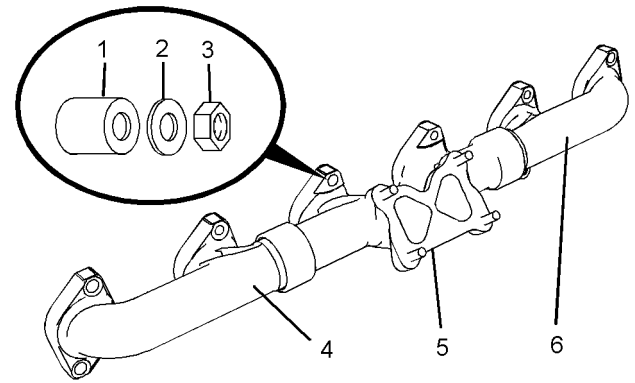


Illustration 26

g01380890

2. Assemble exhaust manifolds (4), (5) and (6).
3. Position the exhaust manifold gaskets onto the taperlock studs.
4. Install the assembly of the exhaust manifolds to the cylinder head.

**Note:** Ensure that the holes in exhaust manifolds are centralized with the taperlock studs.

5. Apply Tooling (A) to the threads of the taperlock studs. Install spacers (1), washers (2) and nuts (3).

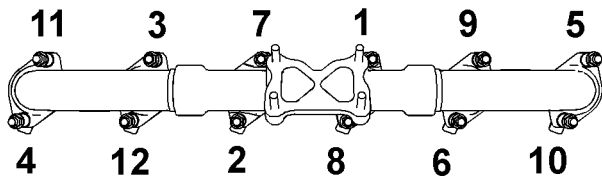


Illustration 27

g01380891

- Tighten the nuts to a torque of 55 N·m (41 lb ft) in a numerical sequence that is shown in Illustration 27.

**End By:**

- Install the turbocharger. Refer to Disassembly and Assembly, "Turbocharger - Install".

i02754774

**Exhaust Elbow - Remove and Install****Removal Procedure****NOTICE**

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

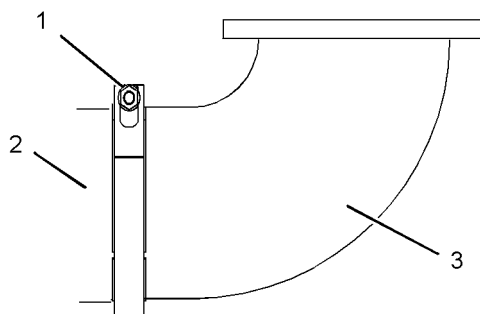


Illustration 28

g01382827

- Loosen clamp (1).
- Remove exhaust elbow (3) and clamp (1) from turbocharger (2).

**Installation Procedures****NOTICE**

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

- Thoroughly clean the exhaust elbow and the outlet of the turbocharger. Inspect the components for wear or damage. Replace any components that are worn or damaged.

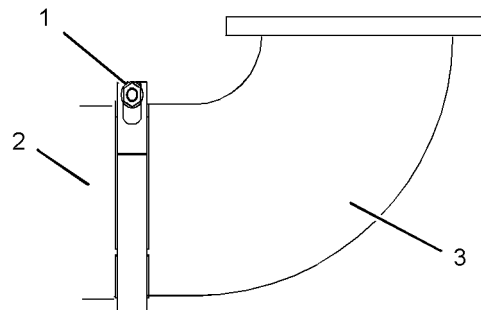


Illustration 29

g01382827

- Position clamp (1) and install exhaust elbow (3) to turbocharger (2). Ensure correct orientation of the clamp.
- Tighten clamp (1) to a torque of 14 N·m (10 lb ft).

i02763449

**Inlet Manifold - Remove and Install****Removal Procedure****NOTICE**

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.



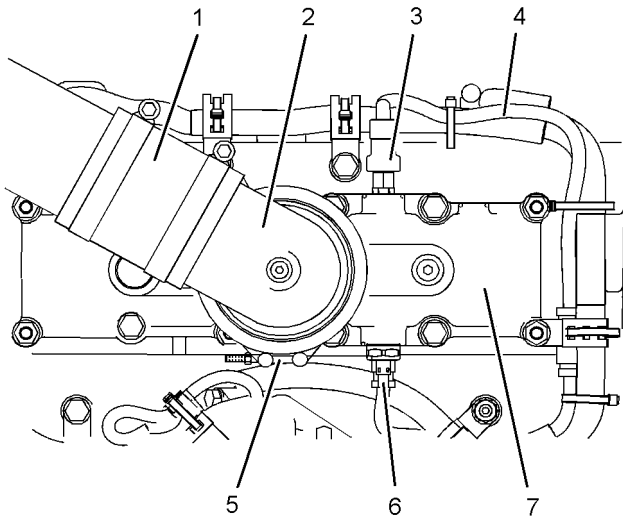


Illustration 30

g01383308

Typical example

1. Loosen the hose clamps and disconnect air hose (1) from connection (2).
2. Slide the locking tab into the unlocked position and disconnect harness assembly (4) from inlet manifold pressure sensor (3).
3. Slide the locking tab into the unlocked position and disconnect harness assembly (4) from inlet manifold temperature sensor (6).
4. Loosen clamp (5) and remove connection (2) from inlet manifold (7).

**Note:** Make a temporary mark in order to show the orientation of the connection.

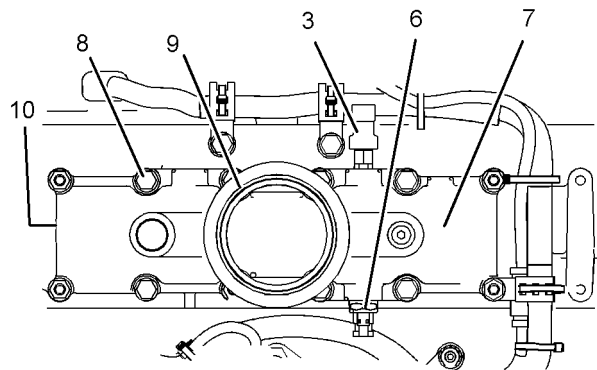


Illustration 31

g01384161

Typical example

5. Remove O-ring seal (9) from inlet manifold (7).

6. Remove fasteners (8). Note the position of the brackets that are retained by the fasteners.
7. Remove inlet manifold (7) from the cylinder head.
8. Remove gasket (10) (not shown).
9. If necessary, remove inlet manifold pressure sensor (3) and remove inlet manifold temperature sensor (6) from inlet manifold (7). Refer to Disassembly and Assembly, "Inlet Manifold Pressure Sensor - Remove and Install" and Disassembly and Assembly, "Inlet Manifold Temperature Sensor - Remove and Install" for more information.

## Installation Procedure

### NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

1. Ensure that all mating surfaces are clean and free from debris.

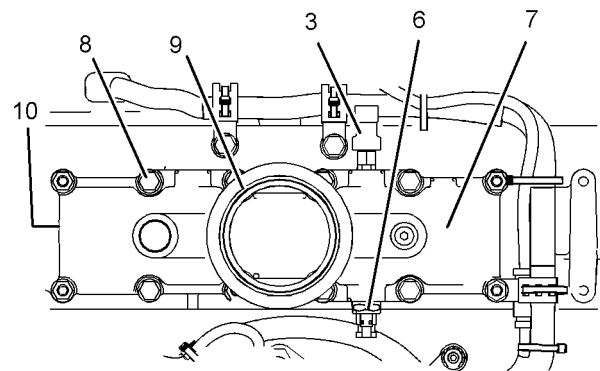


Illustration 32

g01384161

Typical example

2. Place a new gasket (10) (not shown) in position on inlet manifold (7).
3. Position inlet manifold (7) on the cylinder head.
4. Install fasteners (8). Ensure that the brackets that are retained by the fasteners are installed in the correct positions.
5. Tighten fasteners (8) to a torque of 55 N·m (41 lb ft).
6. Install a new O-ring seal (9) to inlet manifold (7).

i02754775

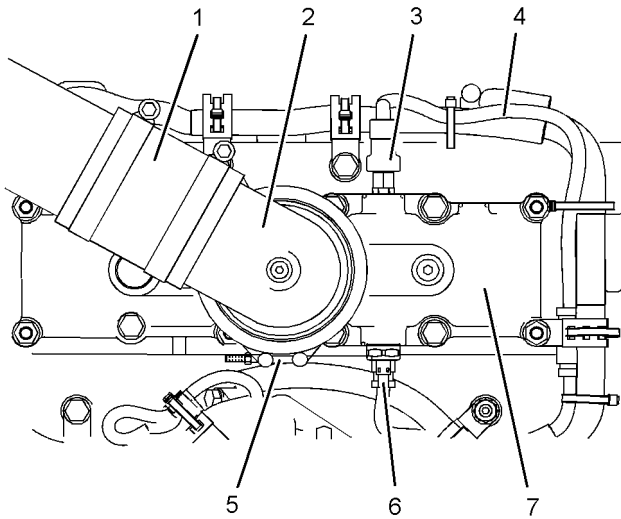


Illustration 33

g01383308

Typical example

7. Install connection (2) and clamp (5) to inlet manifold (7). Tighten the clamp to a torque of 14 N·m (10 lb ft).

**Note:** Ensure correct orientation of the connection.

8. If necessary, install inlet manifold pressure sensor (3) and install inlet manifold temperature sensor (6) to inlet manifold (7). Refer to Disassembly and Assembly, "Inlet Manifold Pressure Sensor - Remove and Install" and Disassembly and Assembly, "Inlet Manifold Temperature Sensor - Remove and Install" for more information.
9. Connect harness assembly (4) to inlet manifold pressure sensor (3) and slide the locking tab into the locked position.
10. Connect harness assembly (4) to inlet manifold temperature sensor (6) and slide the locking tab into the locked position.
11. Connect air hose (1) to connection (2) and tighten the hose clamps securely.

## Inlet and Exhaust Valve Springs - Remove and Install

### Removal Procedure

Table 8

Required Tools			
Tool	Part Number	Part Description	Qty
A	CH11148	Engine Turning Tool	1
B	CVT0003	Valve Spring Compressor	1

#### Start By:

- a. Remove the electronic unit injectors. Refer to Disassembly and Assembly, "Electronic Unit Injector - Remove".

#### NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

**Note:** The following procedure should be adopted in order to remove the valve springs when the cylinder head is installed to the engine. Refer to Disassembly and Assembly, "Inlet and Exhaust Valves - Remove and Install" for the procedure to remove the valve springs from a cylinder head that has been removed from the engine.

1. Use Tooling (A) to position the appropriate piston at the top center position before the valve spring is removed.

**Note:** Failure to ensure that the piston is at the top center position may allow the valve to drop into the cylinder bore.

#### NOTICE

Do not turn the crankshaft while the valve springs are removed.

**Note:** Valve springs must be replaced in pairs for the inlet valves or the exhaust valves of each cylinder. If all valve springs require replacement the procedure can be carried out on two cylinders at the same time. The procedure can be carried out on the following pairs of cylinders. 1 with 6, 2 with 5, and 3 with 4. Ensure that all of the valve springs are installed before changing from one pair of cylinders to another pair of cylinders.

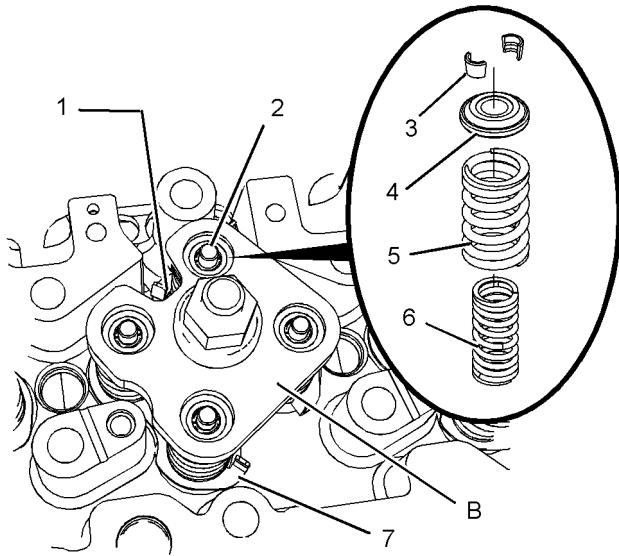


Illustration 34

g01380893

**⚠ WARNING**

Personal injury can result from being struck by parts propelled by a released spring force.

Make sure to wear all necessary protective equipment.

Follow the recommended procedure and use all recommended tooling to release the spring force.

**NOTICE**

Plug the apertures for the push rods in the cylinder head in order to prevent the entry of loose parts into the engine.

2. Position electronic unit injector clamp (1) on Tooling (B). Install Tooling (B) into the electronic unit injector sleeve. Tighten the bolt on the electronic unit injector clamp in order to secure Tooling (B).
3. Tighten the nut on Tooling (B) until valve keepers (3) are loose on valves (2).
4. Remove valve keepers (3).
5. Loosen the nut in order to release the pressure on Tooling (B). Remove electronic unit injector clamp (1) and Tooling (B) from the electronic unit injector sleeve.
6. Remove valve rotators (4).
7. Remove outer valve springs (5) and inner valve springs (6).

8. Remove spring seats (7) from the valve guides.

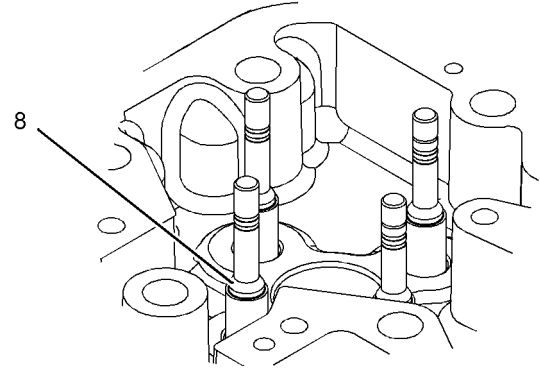


Illustration 35

g01411612

9. If necessary, remove valve stem seals (8).

**Installation Procedure**

Table 9

Required Tools			
Tool	Part Number	Part Description	Qty
B	CVT0003	Valve Spring Compressor	1

**NOTICE**

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

1. Inspect the valve springs for damage and for the correct length. Refer to Specifications, "Cylinder Head Valves".
2. Lubricate the valve stems with clean engine oil.

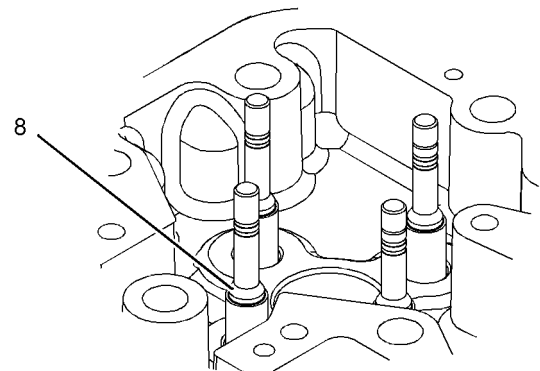


Illustration 36

g01411612

3. If necessary, install new valve stem seals (8).



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