

# Disassembly and Assembly

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## **1104D-E44T and 1104D-E44TA Industrial Engine**

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NP (Engine)  
NR (Engine)



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# Disassembly and Assembly Section

i05918516

## Fuel Priming Pump - Remove and Install (Electric Fuel Lift Pump (EFLP))

### Removal Procedure

Table 1

Required Tools			
Tool	Part Number	Part Description	Qty
A	T410437	Capping Kit	1

#### NOTICE

Ensure that all adjustments and repairs that are carried out to the fuel system are performed by authorized personnel that have the correct training.

Before beginning ANY work on the fuel system, refer to Operation and Maintenance Manual, "General Hazard Information and High Pressure Fuel Lines" for safety information.

Refer to System Operation, Testing and Adjusting, "Cleanliness of Fuel System Components" for detailed information on the standards of cleanliness that must be observed during ALL work on the fuel system.

#### NOTICE

Ensure that the plastic tube assemblies are installed in the original positions. Failure to connect the plastic tube assemblies to the correct ports will allow contamination to enter the fuel system. Serious damage to the engine will result if contaminated fuel enters the fuel system.

1. Turn the fuel supply to the OFF position.
2. Turn the battery disconnect switch to the OFF position.

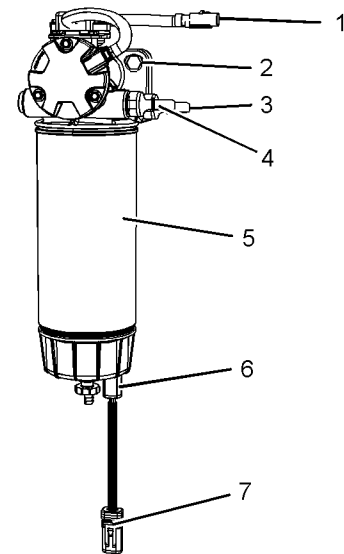


Illustration 1

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3. The fuel priming pump can be installed in any location on a machine. Ref to the Original Equipment Manufacture (OEM) for the correct location.
4. Make temporary identification marks on tube assemblies in order to show the correct position of the tube assemblies.
5. Place a suitable container below the fuel filter base in order to catch any fuel that might be spilled.
6. Disconnect tube assembly (3) and tube assembly (4) from the assembly of primary fuel filter (5).
7. Use Tooling (A) in order to plug the tube assemblies. Use Tooling (A) in order to cap the connections on the primary fuel filter.
8. Disconnect the OEM harness assembly from the connection on harness assembly (7) for water in fuel sensor (6).
9. Disconnect the OEM harness assembly from the connection on harness assembly (1).
10. Remove bolts (2) and remove the assembly of primary fuel filter (5) from the mounting. Support the primary fuel filter as the bolts are removed.
11. If necessary, disassemble the assembly of primary fuel filter (5). Ref to Disassembly and Assembly, "Water Separator and Fuel Filter (Primary) - Remove and Install" for the correct procedure.

## Installation Procedure

### NOTICE

Ensure that all adjustments and repairs that are carried out to the fuel system are performed by authorized personnel that have the correct training.

Before beginning ANY work on the fuel system, refer to Operation and Maintenance Manual, "General Hazard Information and High Pressure Fuel Lines" for safety information.

Refer to System Operation, Testing and Adjusting, "Cleanliness of Fuel System Components" for detailed information on the standards of cleanliness that must be observed during ALL work on the fuel system.

1. Ensure that the fuel priming pump is clean and free from wear and damage. If necessary, replace the fuel priming pump.
2. If necessary, assemble the assembly of primary fuel filter (5). Ref to Disassembly and Assembly, "Water Separator and Fuel Filter (Primary) - Remove and Install" for the correct procedure.

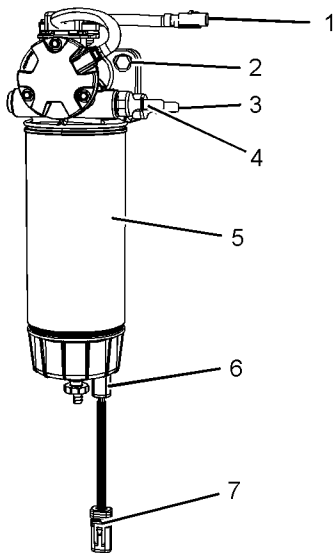


Illustration 2

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3. Position the assembly of primary fuel filter (3) onto the mounting.
4. Install bolts (2) to the assembly of primary fuel filter (3).

For M8 8.8 graded bolts, tighten the bolts to a torque of 22 N·m (195 lb in).

For M10 8.8 graded bolts, tighten the bolts to a torque of 44 N·m (32 lb ft).

For different graded bolts, refer to the OEM for the correct torque values.

### NOTICE

Ensure that the plastic tube assemblies are installed in the original positions. Failure to connect the plastic tube assemblies to the correct ports will allow contamination to enter the fuel system. Serious damage to the engine will result if contaminated fuel enters the fuel system.

5. Remove plug from tube assembly (3). Remove cap from the connection on the primary fuel filter.
6. Connect tube assembly (3) to primary fuel filter (5).
7. Remove plug from tube assembly (4). Remove cap from the connection on the primary fuel filter.
8. Connect tube assembly (4) to primary fuel filter (5).
9. Connect the OEM harness assembly to the connection on harness assembly (7) for water in fuel sensor (6).
10. Connect the OEM harness assembly to the connection on harness assembly (1).
11. Turn the fuel supply to the ON position.
12. Turn the battery disconnect switch to the ON position.
13. Prime the fuel system. Refer to Operation and Maintenance Manual, "Fuel System - Prime" for the correct procedure.

i05918514

## Fuel Priming Pump - Remove and Install (Mechanical Priming Pump)

### Removal Procedure

Table 2

Required Tools			
Tool	Part Number	Part Description	Qty
A	T410437	Capping Kit	1

**NOTICE**

Ensure that all adjustments and repairs that are carried out to the fuel system are performed by authorized personnel that have the correct training.

Before beginning ANY work on the fuel system, refer to Operation and Maintenance Manual, "General Hazard Information and High Pressure Fuel Lines" for safety information.

Refer to System Operation, Testing and Adjusting, "Cleanliness of Fuel System Components" for detailed information on the standards of cleanliness that must be observed during ALL work on the fuel system.

**NOTICE**

Ensure that the plastic tube assemblies are installed in the original positions. Failure to connect the plastic tube assemblies to the correct ports will allow contamination to enter the fuel system. Serious damage to the engine will result if contaminated fuel enters the fuel system.

1. Turn the fuel supply to the OFF position.

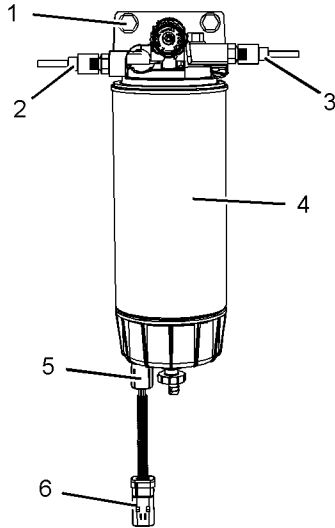


Illustration 3

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2. The fuel priming pump can be installed in any location on a machine. Ref to the Original Equipment Manufacture (OEM) for the correct location.
3. Make temporary identification marks on tube assemblies in order to show the correct position of the tube assemblies.
4. Place a suitable container below the fuel filter base in order to catch any fuel that might be spilled.

5. Disconnect tube assembly (2) and tube assembly (3) from the assembly of primary fuel filter (4).
6. Use Tooling (A) in order to plug the tube assemblies. Use Tooling (A) in order to cap the connections on the primary fuel filter.
7. Disconnect the OEM harness assembly from the connection on harness assembly (5) for water in fuel sensor (6).
8. Remove bolts (1) and remove the assembly of primary fuel filter (4) from the mounting. Support the primary fuel filter as the bolts are removed.
9. If necessary, disassemble the assembly of primary fuel filter (5). Ref to Disassembly and Assembly, "Water Separator and Fuel Filter (Primary) - Remove and Install" for the correct procedure.

## Installation Procedure (Manual Priming Pump)

**NOTICE**

Ensure that all adjustments and repairs that are carried out to the fuel system are performed by authorized personnel that have the correct training.

Before beginning ANY work on the fuel system, refer to Operation and Maintenance Manual, "General Hazard Information and High Pressure Fuel Lines" for safety information.

Refer to System Operation, Testing and Adjusting, "Cleanliness of Fuel System Components" for detailed information on the standards of cleanliness that must be observed during ALL work on the fuel system.

1. Ensure that the fuel priming pump is clean and free from wear and damage. If necessary, replace the fuel priming pump.
2. If necessary, assemble the assembly of primary fuel filter (5). Ref to Disassembly and Assembly, "Water Separator and Fuel Filter (Primary) - Remove and Install" for the correct procedure.

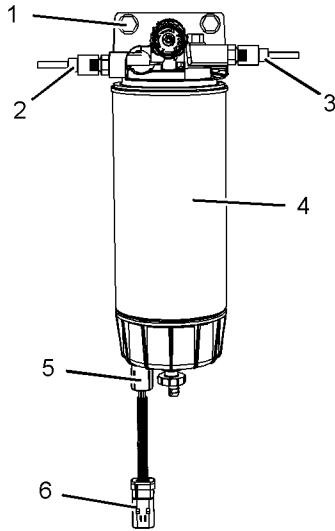


Illustration 4

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3. Position the assembly of primary fuel filter (4) onto the mounting.
4. Install bolts (2) to the assembly of primary fuel filter (3).

For M8 8.8 graded bolts, tighten the bolts to a torque of 22 N·m (195 lb in).

For M10 8.8 graded bolts, tighten the bolts to a torque of 44 N·m (32 lb ft).

For different graded bolts, refer to the OEM for the correct torque values.

#### NOTICE

Ensure that the plastic tube assemblies are installed in the original positions. Failure to connect the plastic tube assemblies to the correct ports will allow contamination to enter the fuel system. Serious damage to the engine will result if contaminated fuel enters the fuel system.

5. Remove plug from tube assembly (2). Remove cap from the connection on the primary fuel filter.
6. Connect tube assembly (2) to primary fuel filter (4).
7. Remove plug from tube assembly (3). Remove cap from the connection on the primary fuel filter.
8. Connect tube assembly (3) to primary fuel filter (4).
9. Connect the OEM harness assembly to the connection on harness assembly (6) for water in fuel sensor (5).
10. Turn the fuel supply to the ON position.

11. Prime the fuel system. Refer to Operation and Maintenance Manual, "Fuel System - Prime" for the correct procedure.

i05918515

## Flow Control Valve - Remove and Install

### Removal Procedure

Table 3

Required Tools			
Tool	Part Number	Part Description	Qty
A	T410437	Capping Kit	1

#### WARNING

Contact with high pressure fuel may cause fluid penetration and burn hazards. High pressure fuel spray may cause a fire hazard. Failure to follow these inspection, maintenance and service instructions may cause personal injury or death.

#### NOTICE

Ensure that all adjustments and repairs that are carried out to the fuel system are performed by authorized personnel that have the correct training.

Before beginning ANY work on the fuel system, refer to Operation and Maintenance Manual, "General Hazard Information and High Pressure Fuel Lines" for safety information.

Refer to System Operation, Testing and Adjusting, "Cleanliness of Fuel System Components" for detailed information on the standards of cleanliness that must be observed during ALL work on the fuel system.

1. Turn the fuel supply to the OFF position.
2. Turn the battery disconnect switch to the OFF position.
3. If necessary, remove fuel filter base. Refer to Disassembly and Assembly, "Fuel Filter Base - Remove and Install" for the correct procedure.
4. If necessary, remove crankcase breather canister filter. Refer to Operation and Maintenance Manual, "Engine Crankcase Breather Element - Replace" for the correct procedure.

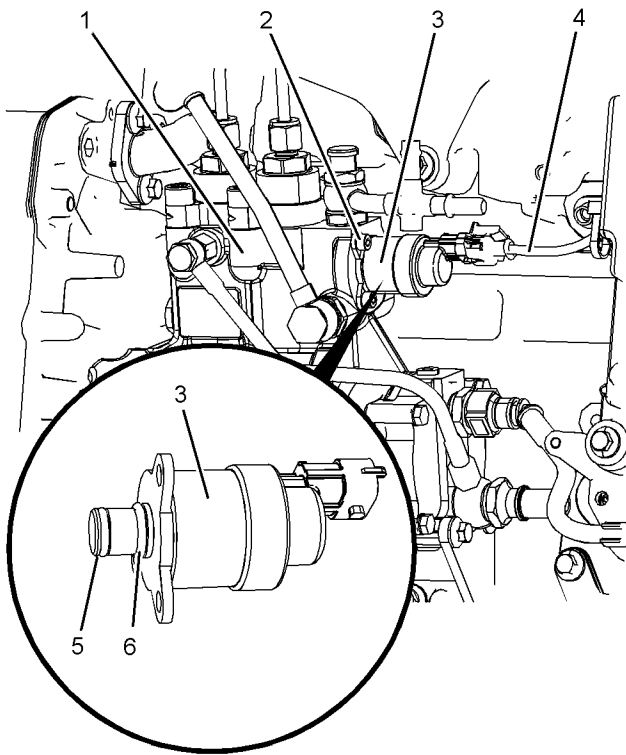


Illustration 5

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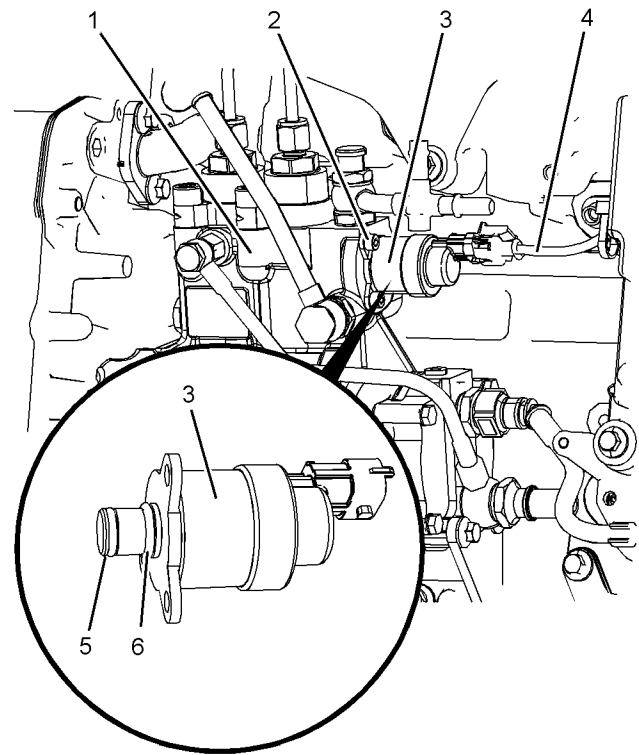


Illustration 6

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5. Clean the area around flow control valve (3) and fuel injection pump (1). Ensure that the area is free from contamination before beginning disassembly.
6. Disconnect harness assembly (4) from flow control valve (3).
7. Make temporary marks on flow control valve (3) and the fuel injection pump for installation purpose.
8. Remove allen heads screws (2) from flow control valve (3).
9. Remove flow control valve (3) from fuel injection pump (1).
10. Use Tooling (A) to plug fuel injection pump (1).
11. Remove O-ring seal (5) and O-ring seal (6).
12. Use Tooling (A) to cap flow control valve (3).

## Installation Procedure

1. Ensure that all component at free from wear and damage. If any part of the flow control valve is worn or damaged, the flow control valve must be replaced as an assembly.

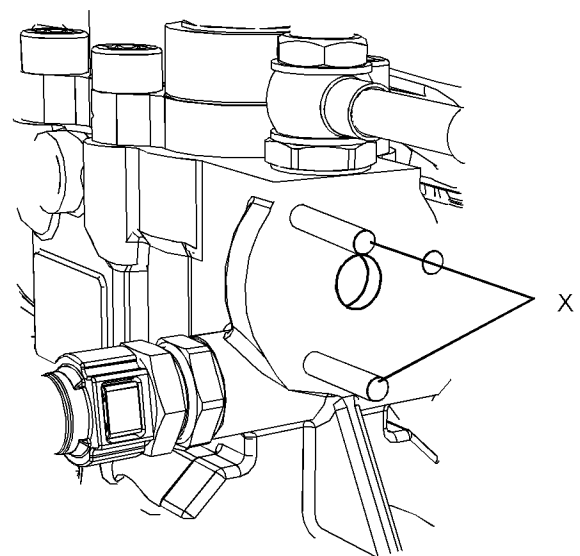


Illustration 7

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### Flow control valve guide pins

2. Remove cap from flow control valve (3). Position new O-ring seal (5) and new O-ring seal (6) onto flow control valve (3).
3. Install guide pins into Position (X) on fuel injection pump (1).



4. Lubricate O-ring seal (5) and O-ring seal (6) with clean fuel.

**Note:** Ensure that the O-ring seal is not damaged or misaligned.

5. Remove plug from fuel injection pump (1). Align flow control valve (3) onto guide pins.
  6. Install flow control valve (3) to fuel injection pump (1).
  7. Remove guide pins from the fuel injection pump.
  8. Install allen head screws (2) from the flow control valve repair kit.
  9. Tighten allen head screws (2) equally until the flow control valve is seated correctly onto the fuel injection pump.
- Note:** Ensure that the allen screws are tightened equally. Failure to ensure that the allen screws are tightened equally will result in damage to the fuel injection pump.
10. Tighten allen head screws (2) to a torque of 9 N·m (80 lb in).
  11. Connect harness assembly (4) to flow control valve (3).
  12. Replace the filters for primary fuel system. Refer to Operation and Maintenance Manual, "Fuel System Primary (Water Separator) Element - Replace" for the correct procedure.
  13. Replace the filters for secondary fuel system. Refer to Operation and Maintenance Manual, "Fuel System Secondary Filter - Replace" for the correct procedure.
  14. Turn the fuel supply to the ON position.
  15. Turn the battery disconnect switch to the ON position.
  16. Remove the air from the fuel system. Refer to Operation and Maintenance Manual, "Fuel System - Prime" for more information.

**End By:**

- a. Remove the air from the fuel system. Refer to Operation and Maintenance Manual, "Fuel System - Prime" for the correct procedure.
- b. After replacement of the flow control valve, the fuel injection pump requires a high-pressure fuel pump calibration procedure to be performed. Refer to Troubleshooting, "Fuel Rail Pressure Problem" for the correct procedure.

i05918517

## Fuel Filter Base - Remove and Install

### Removal Procedure

Table 4

Required Tools			
Tool	Part Number	Part Description	Qty
A	T410437	Capping Kit	1

#### NOTICE

**Ensure that all adjustments and repairs that are carried out to the fuel system are performed by authorized personnel that have the correct training.**

**Before beginning ANY work on the fuel system, refer to Operation and Maintenance Manual, "General Hazard Information and High Pressure Fuel Lines" for safety information.**

**Refer to System Operation, Testing and Adjusting, "Cleanliness of Fuel System Components" for detailed information on the standards of cleanliness that must be observed during ALL work on the fuel system.**

#### 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.

1. Turn the fuel supply to the OFF position.
2. Turn the battery disconnect switch to the OFF position.
3. Drain the secondary filters. Refer to Operation and Maintenance Manual, "Fuel System Secondary Filter - Replace" for the correct procedure.

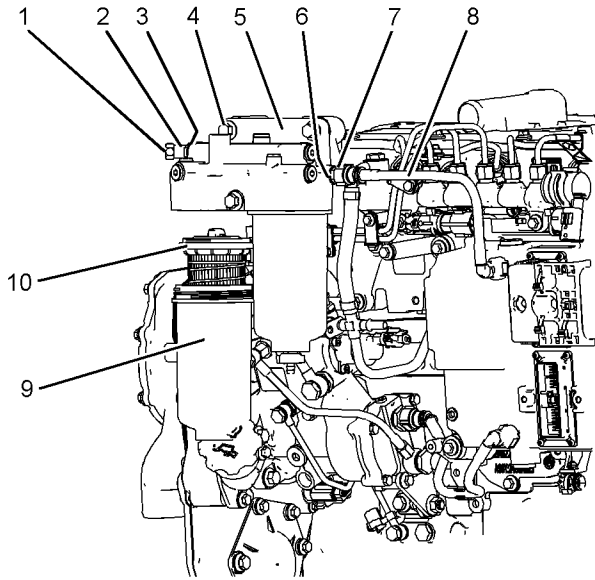


Illustration 8

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4. Make temporary identification marks on all the tube assemblies in order to show the correct position of the tube assemblies. **On some engines the tube assemblies on the fuel filter assembly may be in a different location.**
5. Place a suitable container below the fuel filter base in order to catch any fuel that might be spilled.
6. Remove banjo bolt (1) and remove sealing washers (3) (not shown).
7. Use Tooling (A) in order to plug tube assembly (2). Use Tooling (A) in order to cap the port of fuel filter head (5).
8. Disconnect tube assembly (8) from connection (7)
9. Use Tooling (A) in order to plug tube assembly (8). Use Tooling (A) in order to cap connection (7).
10. If necessary, remove connection (7) and remove sealing washer (6) (not shown). Use Tooling (A) in order to cap the port of fuel filter head (5).
11. Remove secondary filters (10) from canisters (9). Refer to Operation and Maintenance Manual, "Fuel System Secondary Filter - Replace" for the correct procedure.
12. Remove bolts (4) from fuel filter base (5). Remove the fuel filter base from the mounting bracket.

**Note:** Note the position of different length bolts.

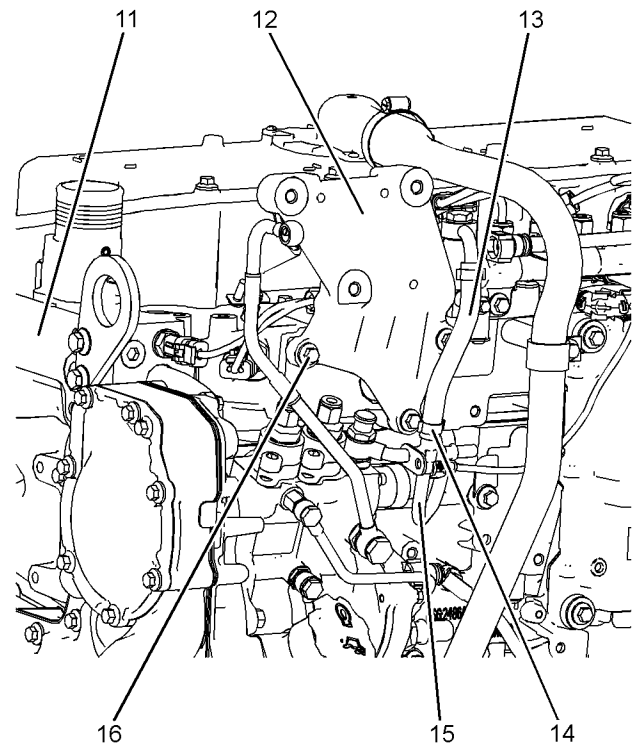


Illustration 9

g03700080

13. If necessary, follow Step 13.a. through Step 13.d. in order to remove fuel filter bracket (11).
  - a. Remove hose clamp (14).
  - b. Disconnect tube assembly (13) from pipe assembly (15). Use Tooling (A) to plug and cap all open ports.
  - c. Remove bolts (16) from fuel filter bracket (12).
  - d. Remove fuel filter bracket (12) from cylinder head (11).

## Installation Procedure

### NOTICE

**Ensure that all adjustments and repairs that are carried out to the fuel system are performed by authorized personnel that have the correct training.**

**Before beginning ANY work on the fuel system, refer to Operation and Maintenance Manual, "General Hazard Information and High Pressure Fuel Lines" for safety information.**

**Refer to System Operation, Testing and Adjusting, "Cleanliness of Fuel System Components" for detailed information on the standards of cleanliness that must be observed during ALL work on the fuel system.**

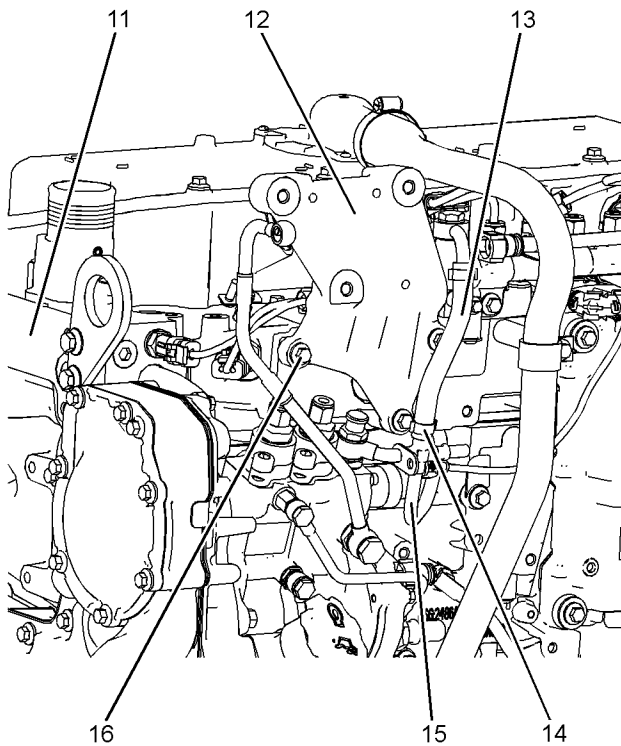


Illustration 10

g03700080

1. Ensure that fuel filter bracket (13) is clean and free from damage. If necessary, replace the complete fuel filter bracket.
2. If necessary, follow Step 2.a. through Step 2.e. in order to install fuel filter bracket (13).
  - a. Position fuel filter bracket (12) onto cylinder head (11).
  - b. Install bolts (16) to fuel filter bracket (12).
  - c. Tighten bolts (16) to a torque of 22 N·m (195 lb in).
  - d. Position new hose clamp (14) to tube assembly (13).
  - e. Remove plugs and caps and install tube assembly (13) immediately to pipe assembly (15). Tighten hose clamp (14) securely.

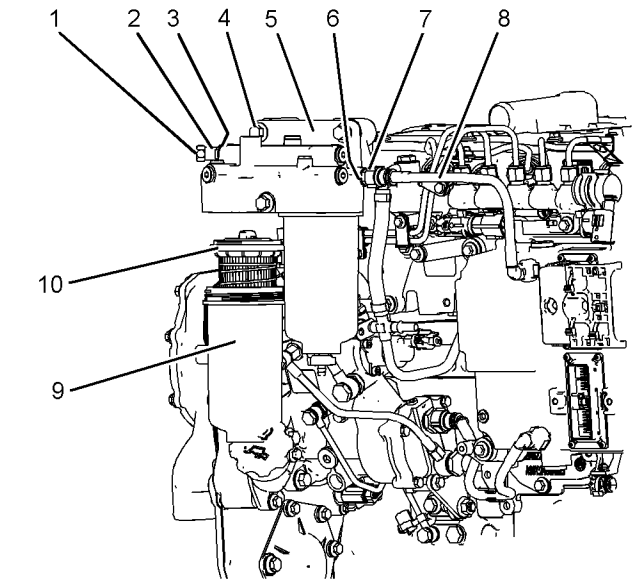


Illustration 11

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3. Position fuel filter base (5) onto the fuel filter bracket. Install bolts (4). Tighten the bolts to a torque of 44 N·m (32 lb ft).
  4. If necessary, install new fuel filters (9) to canisters (8). Refer to Operation and Maintenance Manual, "Fuel System Secondary Filter - Replace" for the correct procedure.
  5. If necessary, follow Step 5.a. through Step 5.d. to install connection (7) to fuel filter base (5).
    - a. Remove plug from fuel filter base (4).
    - b. Install a new sealing washer (6) (not shown) to connection (7).
    - c. Install connection (7) to fuel filter base (5).
    - d. Tighten connection (7) to a torque of 21 N·m (186 lb in).
- NOTICE**
- Ensure that the plastic tube assemblies are installed in the original positions. Failure to connect the plastic tube assemblies to the correct ports will allow contamination to enter the fuel system. Serious damage to the engine will result if contaminated fuel enters the fuel system.
6. Install tube assembly (8) to connection (7).
  7. Position a new sealing washer (3) (not shown) onto banjo bolt (1).

8. Remove plug from tube assembly (2) and install banjo bolt (1). Install remaining sealing washer (3) (not shown) onto banjo bolt (1).
9. Install banjo bolt (1) to fuel filter base (5).
10. Tighten banjo bolt (1) to a torque of 21 N·m (186 lb in).
11. Turn the fuel supply to the ON position.
12. Turn the battery disconnect switch to the ON position.

**End By:**

- a. Remove the air from the fuel system. Refer to Operation and Maintenance Manual, "Fuel System - Prime" for the correct procedure.

i05918549

## Water Separator and Fuel Filter (Primary) - Remove and Install

### Removal Procedure

Table 5

Required Tools			
Tool	Part Number	Part Description	Qty
A	T410437	Capping Kit	1

**NOTICE**

Ensure that all adjustments and repairs that are carried out to the fuel system are performed by authorized personnel that have the correct training.

Before beginning ANY work on the fuel system, refer to Operation and Maintenance Manual, "General Hazard Information and High Pressure Fuel Lines" for safety information.

Refer to System Operation, Testing and Adjusting, "Cleanliness of Fuel System Components" for detailed information on the standards of cleanliness that must be observed during ALL work on the fuel system.

1. Turn the battery disconnect switch to the OFF position.
2. Turn the fuel supply to the OFF position.

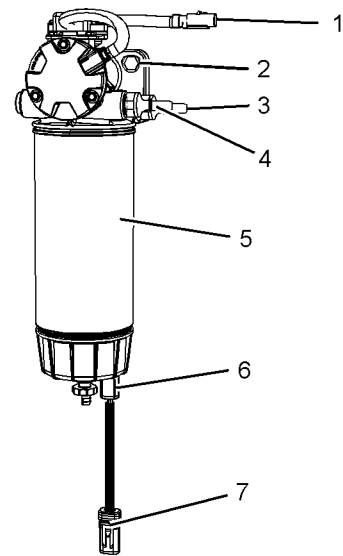


Illustration 12

g03411000

3. The water separator and fuel filter can be installed in any location on a machine. Ref to the Original Equipment Manufacture (OEM) for the correct location.
4. Make temporary identification marks on tube assemblies in order to show the correct position of the tube assemblies.
5. Place a suitable container below the fuel filter base in order to catch any fuel that might be spilled.
6. Disconnect tube assembly (3) and tube assembly (4) from the assembly of primary fuel filter (5).
7. Use Tooling (A) in order to plug the tube assemblies. Use Tooling (A) in order to cap the connection on the primary fuel filter.
8. Disconnect the OEM harness assembly from the connection on harness assembly (7) for water in fuel sensor (6).
9. Disconnect the OEM harness assembly from the connection on harness assembly (1).
10. Remove bolts (2) and remove the assembly of primary fuel filter (5) from the mounting. Support the primary fuel filter as the bolts are removed.

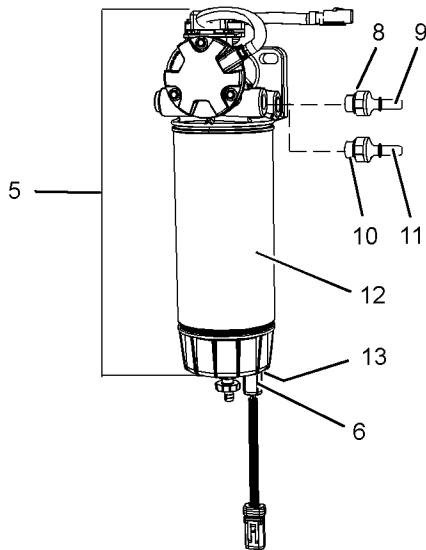


Illustration 13

g03411001

11. If necessary, follow Step 11.a. through Step 11.d. in order to disassembly the assembly of primary fuel filter (5).
- Remove connection (9) and remove O-ring seal (8).
  - Remove connection (11) and remove O-ring seal (10).
  - Remove water in fuel sensor (6) and remove O-ring seal (13) (not shown).
  - Remove the filter element from fuel filter canister (12). Refer to Operation and Maintenance Manual, "Fuel System Primary Filter (Water Separator) Element - Replace" for the correct procedure.

## Installation Procedure

### NOTICE

Ensure that all adjustments and repairs that are carried out to the fuel system are performed by authorized personnel that have the correct training.

Before beginning ANY work on the fuel system, refer to Operation and Maintenance Manual, "General Hazard Information and High Pressure Fuel Lines" for safety information.

Refer to System Operation, Testing and Adjusting, "Cleanliness of Fuel System Components" for detailed information on the standards of cleanliness that must be observed during ALL work on the fuel system.

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

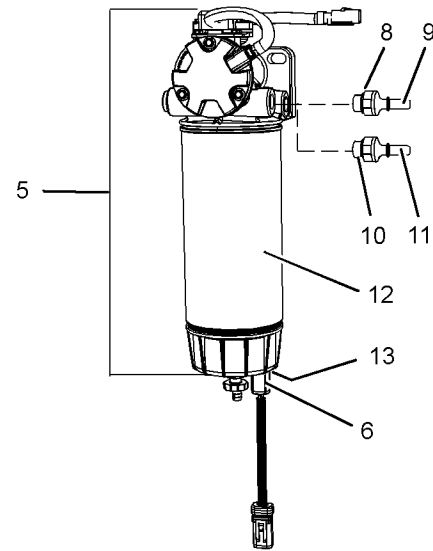


Illustration 14

g03411001

2. If necessary, follow Step 2.a. through Step 2.d. in order to assembly primary fuel filter (5).
- Install a new O-ring seal (8) to connection (9). Install connection (9) to primary fuel filter (5). Tighten the connection to a torque of 20 N·m (177 lb in).
  - Install a new O-ring seal (10) to connection (11). Install connection (11) to primary fuel filter (3). Tighten the connection to a torque of 20 N·m (177 lb in).
  - Install a new O-ring seal (13) (not shown) to water in fuel sensor (6). Install water in fuel sensor (6). Tighten water in fuel sensor (6) hand tight.
  - Install a new filter element to fuel filter canister (12). Refer to Operation and Maintenance Manual, "Fuel System Primary Filter (Water Separator) Element - Replace" for the correct procedure.

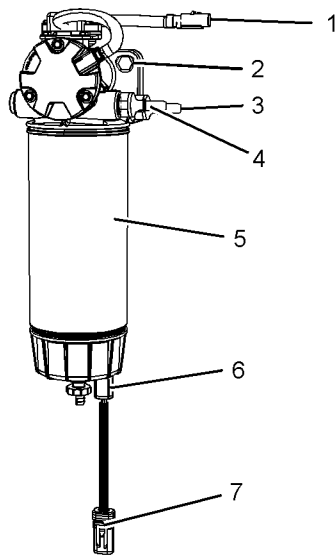


Illustration 15

g03411000

3. Position the assembly of primary fuel filter (3) onto the mounting.

4. Install bolts (2) to the assembly of primary fuel filter (3).

For M8 8.8 graded bolts, tighten the bolts to a torque of 22 N·m (195 lb in).

For M10 8.8 graded bolts, tighten the bolts to a torque of 44 N·m (32 lb ft).

For bolts that are graded differently, refer to the OEM for the correct torque values.

#### NOTICE

Ensure that the plastic tube assemblies are installed in the original positions. Failure to connect the plastic tube assemblies to the correct ports will allow contamination to enter the fuel system. Serious damage to the engine will result if contaminated fuel enters the fuel system.

5. Remove plug from tube assembly (3). Remove cap from the connection on the primary fuel filter.

6. Connect tube assembly (3) to primary fuel filter (5).

7. Remove plug from tube assembly (4). Remove cap from the connection on the primary fuel filter.

8. Connect tube assembly (4) to primary fuel filter (5).

9. Connect the OEM harness assembly to the connection on harness assembly (7) for water in fuel sensor (6).

10. Connect the OEM harness assembly to the connection on harness assembly (1).

11. Turn the fuel supply to the ON position.

12. Turn the battery disconnect switch to the ON position.

#### End By:

- a. Remove the air from the fuel system. Refer to Operation and Maintenance Manual, "Fuel System - Prime" for the correct procedure.

i05918546

## Fuel Manifold (Rail) - Remove and Install

### Removal Procedure

Table 6

Required Tools			
Tool	Part Number	Part Description	Qty
A	T410437	Capping Kit	1

#### Start By:

- a. Remove the fuel injection lines. Refer to Disassembly and Assembly, "Fuel Injection Lines - Remove" for the correct procedure.

### WARNING

Contact with high pressure fuel may cause fluid penetration and burn hazards. High pressure fuel spray may cause a fire hazard. Failure to follow these inspection, maintenance and service instructions may cause personal injury or death.

#### NOTICE

Ensure that all adjustments and repairs that are carried out to the fuel system are performed by authorized personnel that have the correct training.

Before beginning ANY work on the fuel system, refer to Operation and Maintenance Manual, "General Hazard Information and High Pressure Fuel Lines" for safety information.

Refer to System Operation, Testing and Adjusting, "Cleanliness of Fuel System Components" for detailed information on the standards of cleanliness that must be observed during ALL work on the fuel system.

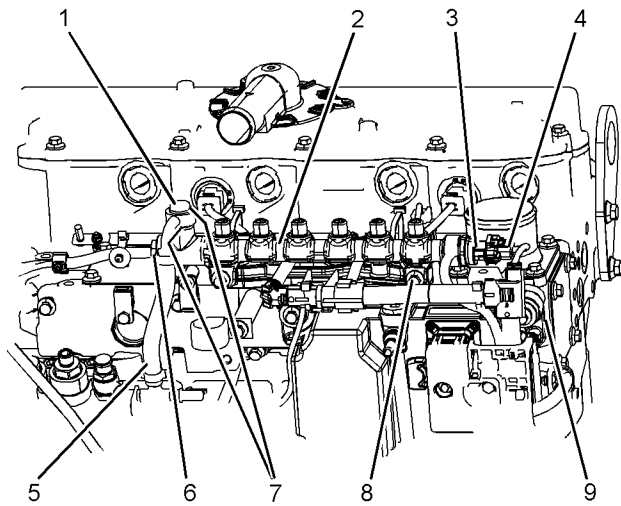


Illustration 16

g03584583

1. Thoroughly clean the area around fuel manifold (2).
2. Disconnect harness assembly (4) from fuel pressure sensor (3).
3. Remove banjo bolt (1) from tube assembly (5).
4. Remove sealing washers (7) (not shown).
5. Immediately use Tooling (A) to cap the open port in fuel manifold (2). Immediately use Tooling (A) to plug the open end of tube assembly (5).
6. Remove bolts (8) from fuel manifold (2). Remove the fuel manifold from inlet manifold (9)
7. If necessary, remove fuel pressure sensor (3). Refer to Disassembly and Assembly, "Fuel Pressure Sensor - Remove and Install" for the correct procedure.
8. If necessary, remove fuel pressure relief valve (6). Refer to Disassembly and Assembly, "Relief Valve (Fuel) - Remove and Install" for the correct procedure.

## Installation Procedure

### NOTICE

Ensure that all adjustments and repairs that are carried out to the fuel system are performed by authorized personnel that have the correct training.

Before beginning ANY work on the fuel system, refer to Operation and Maintenance Manual, "General Hazard Information and High Pressure Fuel Lines" for safety information.

Refer to System Operation, Testing and Adjusting, "Cleanliness of Fuel System Components" for detailed information on the standards of cleanliness that must be observed during ALL work on the fuel system.

1. Ensure that all ports on the fuel manifold are capped. Ensure that the fuel manifold is externally clean and free from damage.

**Note:** Do not install a fuel manifold that has not been capped. All caps must be left in place until the fuel injection lines or the fuel pressure relief valve are installed.

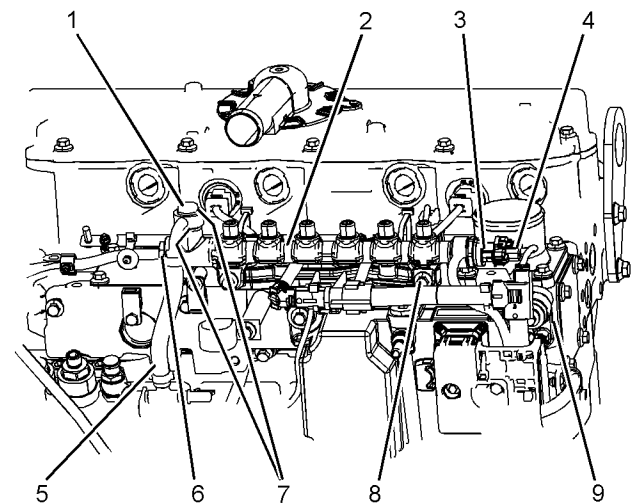


Illustration 17

g03584583

2. If necessary, install fuel pressure sensor (3). Refer to Disassembly and Assembly, "Fuel Pressure Sensor - Remove and Install" for the correct procedure.
3. If necessary, install fuel pressure relief valve (6). Refer to Disassembly and Assembly, "Relief Valve (Fuel) - Remove and Install" for the correct procedure.

4. Position fuel manifold (2) onto inlet manifold (8). Install bolts (7) to fuel manifold (2) finger tight.
5. **Install a new set of seals and a new set of fuel injection lines.** Refer to Disassembly and Assembly, "Fuel Injection Lines - Install" for the correct procedure.
6. Tighten bolts (7) to a torque of 22 N·m (195 lb in).
7. Connect harness assembly (4) to fuel pressure sensor (3).
8. Install a new sealing washer (6) (not shown) on to banjo bolt (1).
9. Remove the cap from tube assembly (5).
10. Install banjo bolt (1) to tube assembly (5). Install remaining new sealing washer (6) (not shown) to the banjo bolt.
11. Install banjo bolt (1) and tube assembly (5) to fuel manifold (2). Tighten the banjo bolt finger tight.
12. Tighten banjo bolt (1) to a torque of 21 N·m (186 lb in). Ensure that tube assembly (5) is not strand as the banjo bolt is tightened.
13. Replace the filters for primary fuel system. Refer to Operation and Maintenance Manual, "Fuel System Primary (Water Separator) Element - Replace" for the correct procedure.
14. Replace the filters for secondary fuel system. Refer to Operation and Maintenance Manual, "Fuel System Secondary Filter - Replace" for the correct procedure.
15. Remove the air from the fuel system. Refer to Operation and Maintenance Manual, "Fuel System - Prime" for more information.

i05918547

## Relief Valve (Fuel) - Remove and Install

### Removal Procedure

#### Start By:

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

Table 7

Required Tools			
Tool	Part Number	Part Description	Qty
A	T410437	Capping Kit	1

### WARNING

Contact with high pressure fuel may cause fluid penetration and burn hazards. High pressure fuel spray may cause a fire hazard. Failure to follow these inspection, maintenance and service instructions may cause personal injury or death.

#### NOTICE

Ensure that all adjustments and repairs that are carried out to the fuel system are performed by authorized personnel that have the correct training.

Before beginning ANY work on the fuel system, refer to Operation and Maintenance Manual, "General Hazard Information and High Pressure Fuel Lines" for safety information.

Refer to System Operation, Testing and Adjusting, "Cleanliness of Fuel System Components" for detailed information on the standards of cleanliness that must be observed during ALL work on the fuel system.

1. When the fuel pressure relief valve is removed, a new fuel pressure relief valve must be installed.

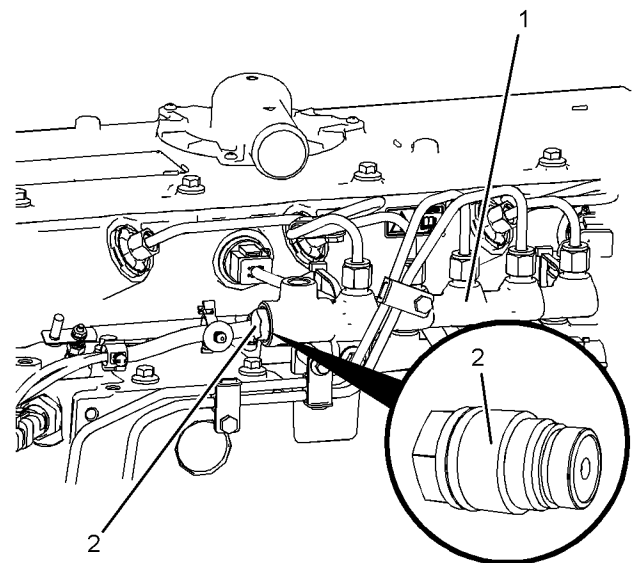


Illustration 18

g03692123

Typical example.

Breather hose removed for clarity.

2. Thoroughly clean the area around fuel manifold (1) and fuel pressure relief valve (2).
3. Follow Step 3.a. through Step 3.c. in order to remove fuel pressure relief valve (2) from fuel manifold (1).



- a. Ensure that the area around the fuel pressure relief valve (2) and fuel manifold (1) is still thoroughly clean.
  - b. Remove fuel pressure relief valve (2) from fuel manifold (1).
  - c. Immediately use tooling (A) to cap the open port in fuel manifold (1).
4. Discard fuel pressure relief valve (2).

## Installation Procedure

Table 8

Required Tools			
Tool	Part Number	Part Description	Qty
B	-	Bosch Grease FT1V27	1

### NOTICE

Ensure that all adjustments and repairs that are carried out to the fuel system are performed by authorized personnel that have the correct training.

Before beginning ANY work on the fuel system, refer to Operation and Maintenance Manual, "General Hazard Information and High Pressure Fuel Lines" for safety information.

Refer to System Operation, Testing and Adjusting, "Cleanliness of Fuel System Components" for detailed information on the standards of cleanliness that must be observed during ALL work on the fuel system.

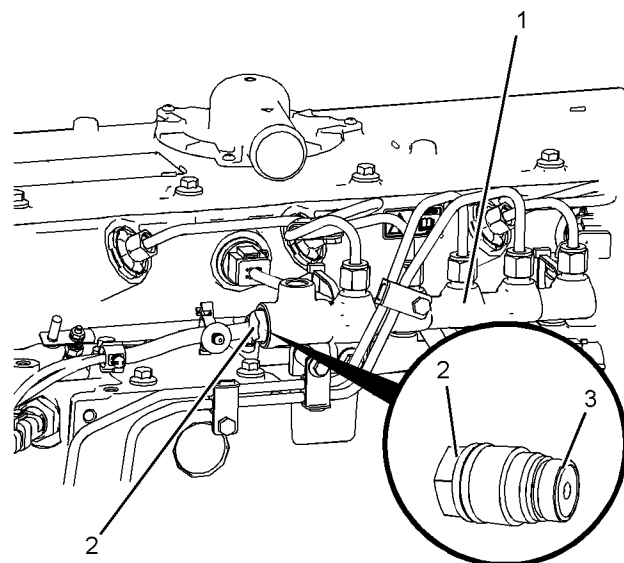


Illustration 19

g03692712

1. Remove the cap from the port in fuel manifold (1).

2. Immediately clean the threads in fuel manifold (1) for fuel pressure relief valve (2). Ensure that the thread is clean and free from debris. Ensure that the thread in the fuel manifold (1) is free from damage.
  3. Immediately use Tooling (A) to cap the open port in fuel manifold (2) after cleaning and inspection.
  4. Remove the cap from the threaded end of the new fuel pressure relief valve (1). Lightly lubricate the thread and bite edge (3) of the pressure relief valve with Tooling (B).
  5. Inspect the O-ring seal on the new fuel pressure relief valve (3) for damage. Replace the fuel pressure relief valve as an assembly if the O-ring seal is damaged.
  6. Remove the cap from the port of fuel manifold (1). Install fuel pressure relief valve (2) into fuel manifold (1) hand tight.
  7. Tighten fuel pressure relief valve (1) to a torque of 100 N·m (74 lb ft).
  8. Clean excessive Tooling (B) from fuel pressure relief valve (2) and fuel manifold (1).
  9. Clean the gasket surfaces of the inlet connection (1) and the inlet manifold.
- End By:**
- a. Install the fuel filter base. Refer to Disassembly and Assembly, "Fuel Filter Base - Remove and Install" for the correct procedure.
  - b. Remove the air from the fuel system. Refer to Operation and Maintenance Manual, "Fuel System - Prime" for the correct procedure.

i05918545

## Fuel Injection Lines - Remove

### Removal Procedure for One Fuel Injection Line

Table 9

Required Tools			
Tool	Part Number	Part Description	Qty
A	T410437	Capping Kit	1

## ⚠ WARNING

Contact with high pressure fuel may cause fluid penetration and burn hazards. High pressure fuel spray may cause a fire hazard. Failure to follow these inspection, maintenance and service instructions may cause personal injury or death.

### NOTICE

Ensure that all adjustments and repairs that are carried out to the fuel system are performed by authorized personnel that have the correct training.

Before beginning ANY work on the fuel system, refer to Operation and Maintenance Manual, "General Hazard Information and High Pressure Fuel Lines" for safety information.

Refer to System Operation, Testing and Adjusting, "Cleanliness of Fuel System Components" for detailed information on the standards of cleanliness that must be observed during ALL work on the fuel system.

### 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.

1. This removal procedure is for removal of one fuel injection line between the fuel manifold and the electronic unit injector.
2. Turn the fuel supply to the OFF position.
3. Turn the battery disconnect switch to the OFF position.
4. Remove the crankcase breather canister and tube assemblies. Refer to Disassembly and Assembly, "Crankcase Breather - Remove" for the correct procedure.

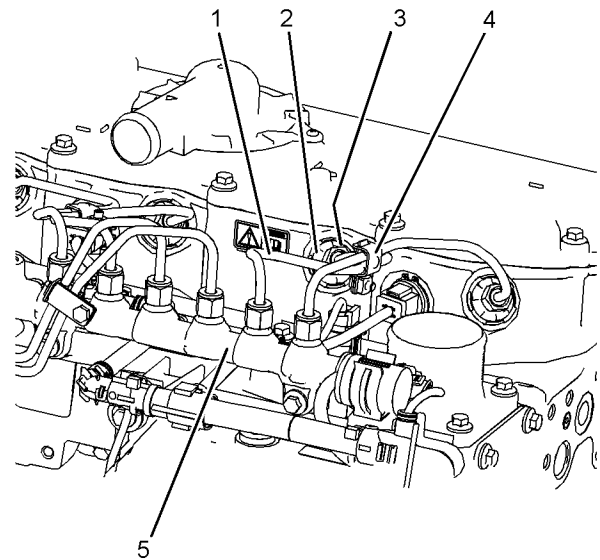


Illustration 20

g03667999

5. Remove the clamp and isolator (4) from fuel injection line (1).
6. Remove fuel injection line (1) from fuel manifold (5) and electronic unit injectors (3) (not shown).

### Discard the fuel injection lines.

7. Use Tooling (A) to cap fuel manifold (5).
8. Remove seal (2) from the cylinder head.
9. Use Tooling (A) to cap electronic unit injectors (3) (not shown).

## Removal Procedure for Set of Fuel Injection Lines

Table 10

Required Tools			
Tool	Part Number	Part Description	Qty
A	T410437	Capping Kit	1

## ⚠ WARNING

Contact with high pressure fuel may cause fluid penetration and burn hazards. High pressure fuel spray may cause a fire hazard. Failure to follow these inspection, maintenance and service instructions may cause personal injury or death.

---

**NOTICE**

**Ensure that all adjustments and repairs that are carried out to the fuel system are performed by authorized personnel that have the correct training.**

**Before beginning ANY work on the fuel system, refer to Operation and Maintenance Manual, “General Hazard Information and High Pressure Fuel Lines” for safety information.**

**Refer to System Operation, Testing and Adjusting, “Cleanliness of Fuel System Components” for detailed information on the standards of cleanliness that must be observed during ALL work on the fuel system.**

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**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.

---

- 1. This removal procedure is for removal of all fuel injection line between the fuel manifold, the electronic unit injectors, and fuel injection pump.**
2. Turn the fuel supply to the OFF position.
3. Turn the battery disconnect switch to the OFF position.
4. Remove the crankcase breather canister and tube assemblies. Refer to Disassembly and Assembly, “Crankcase Breather - Remove” for the correct procedure.

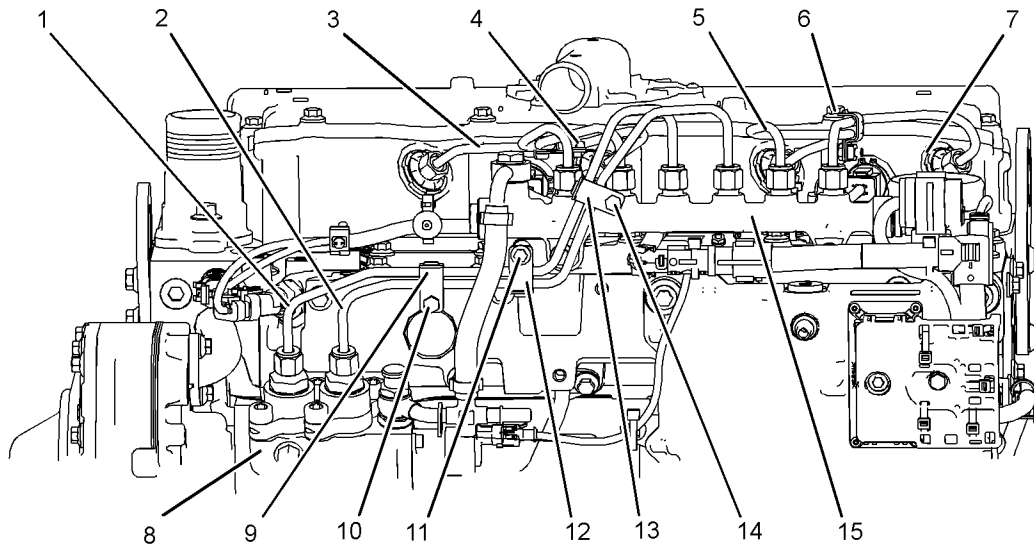


Illustration 21

g03695624

5. Remove bolt (10) from clamp (9) for the fuel injection lines.

Remove bolt (11) and the spacer from clamp (12) for fuel injection line.

**Note:** On some engines there may be only one clamp retaining the fuel injection lines to the cylinder head.

6. Remove the nut and bolt (14) from the clamp for fuel injection pipes.
7. Remove the clamps and isolator (9) and the clamps and isolator (12) from fuel injection line (1) and fuel injection line (2).
8. Remove the clamps and isolator (13) from fuel injection line (1) and fuel injection line (2).
9. Remove fuel injection line (1) and fuel injection line (2) from fuel injection pump (8) and fuel manifold (15).
10. Use Tooling (A) to cap fuel injection pump (8) and fuel manifold (15).
11. Remove clamp and isolator (4) from the assembly of fuel injection lines (3).
12. Remove clamp and isolator (6) from the assembly of fuel injection lines (5).
13. Remove fuel injection lines (3) from fuel manifold (15) and the electronic unit injectors.

**Discard the fuel injection lines.**

14. Remove fuel injection lines (5) from fuel manifold (15) and the electronic unit injectors.

**Discard the fuel injection lines.**

15. Use Tooling (A) to cap fuel manifold (15) and the electronic unit injectors.

16. Remove seals (7) from the cylinder head.

## Removal Procedure for more than One Fuel Injection Line

Table 11

Required Tools			
Tool	Part Number	Part Description	Qty
A	T410437	Capping Kit	1

### **WARNING**

Contact with high pressure fuel may cause fluid penetration and burn hazards. High pressure fuel spray may cause a fire hazard. Failure to follow these inspection, maintenance and service instructions may cause personal injury or death.

**NOTICE**

Ensure that all adjustments and repairs that are carried out to the fuel system are performed by authorized personnel that have the correct training.

Before beginning ANY work on the fuel system, refer to Operation and Maintenance Manual, "General Hazard Information and High Pressure Fuel Lines" for safety information.

Refer to System Operation, Testing and Adjusting, "Cleanliness of Fuel System Components" for detailed information on the standards of cleanliness that must be observed during ALL work on the fuel system.

**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.

**1. This removal procedure is for removal of more than one fuel injection line between the fuel manifold and the electronic unit injector.**

2. Turn the fuel supply to the OFF position.
3. Turn the battery disconnect switch to the OFF position.
4. Remove the crankcase breather canister and tube assemblies. Refer to Disassembly and Assembly, "Crankcase Breather - Remove" for the correct procedure.

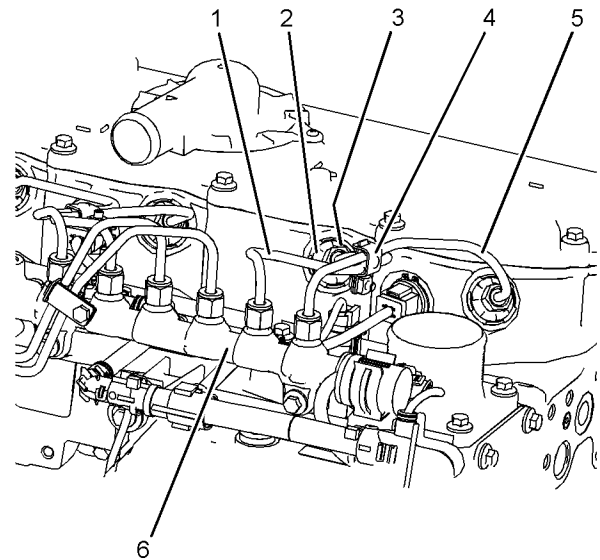


Illustration 22

g03668016

5. Remove the clamp and isolator (4) from fuel injection line (1) and fuel injection line (5).
  6. Remove fuel injection line (1) and fuel injection line (5) from fuel manifold (6) and electronic unit injectors (3) (not shown).
- Discard all the fuel injection lines.**
7. Use Tooling (A) to cap fuel manifold (6).
  8. Remove seals (2) from the cylinder head.
  9. Use Tooling (A) to cap electronic unit injectors (3) (not shown).

i05918555

## Fuel Injection Lines - Install

### Installation Procedure for One Fuel Injection Line

Table 12

Required Tools			
Tool	Part Number	Part Description	Qty
B	27610294	Injector Pipe Nut Tool	1

**NOTICE**

Ensure that all adjustments and repairs that are carried out to the fuel system are performed by authorized personnel that have the correct training.

Before beginning ANY work on the fuel system, refer to Operation and Maintenance Manual, "General Hazard Information and High Pressure Fuel Lines" for safety information.

Refer to System Operation, Testing and Adjusting, "Cleanliness of Fuel System Components" for detailed information on the standards of cleanliness that must be observed during ALL work on the fuel system.

1. This installation procedure is for installing one fuel injection line between the fuel manifold and the electronic unit injector.

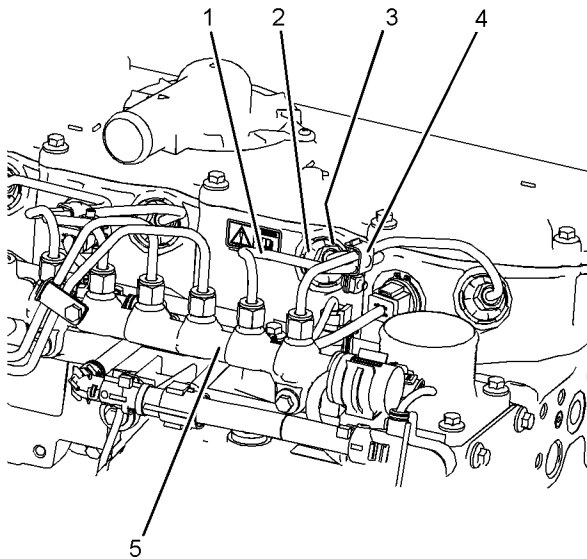


Illustration 23

g03667999

2. Remove the cap from electronic unit injector (3) (not shown).
3. Install a new seal (2) to the cylinder head. Ensure that the flange on the seal is flush with the cylinder head.
4. Remove the cap from fuel manifold (5).
5. Install a new fuel injection line (1) to fuel manifold (5) and electronic unit injectors (3) (not shown) hand tight. Ensure that the ends of the fuel injection line are correctly seated in the electronic unit injector and in the fuel manifold.
6. Install the isolator and clamp(4) onto the fuel injection lines.

**Note:** Ensure that the isolators are correctly positioned onto the fuel injection lines.

7. Use Tooling (B) to tighten the nuts on fuel injection line (1) to a torque of 30 N·m (266 lb in).

**Note:** Ensure that fuel injection lines do not contact any other engine component.

8. Install the crankcase breather canister and tube assemblies. Refer to Disassembly and Assembly, "Crankcase Breather - Install" for the correct procedure.
9. Turn the fuel supply to the ON position.
10. Turn the battery disconnect switch to the ON position.

## Installation Procedure for Set of Fuel Injection Lines

Table 13

Required Tools			
Tool	Part Number	Part Description	Qty
B	27610294	Injector Pipe Nut Tool	1

**NOTICE**

Ensure that all adjustments and repairs that are carried out to the fuel system are performed by authorized personnel that have the correct training.

Before beginning ANY work on the fuel system, refer to Operation and Maintenance Manual, "General Hazard Information and High Pressure Fuel Lines" for safety information.

Refer to System Operation, Testing and Adjusting, "Cleanliness of Fuel System Components" for detailed information on the standards of cleanliness that must be observed during ALL work on the fuel system.

**NOTICE**

Ensure that wiring harness are correctly routed and the cable straps are not over tightened. Over tightening of the cable straps will damage the wiring harness convoluting.

1. This installation procedure is for installing all fuel injection line between the fuel manifold, the electronic unit injectors, and the fuel injection pump. Loosening of all the electronic unit injectors and the fuel manifold will be necessary. Refer to Disassembly and Assembly, "Electronic Unit Injector - Remove" and Disassembly and Assembly, "Fuel Manifold (Rail) - Remove and Install" and for correct procedure.

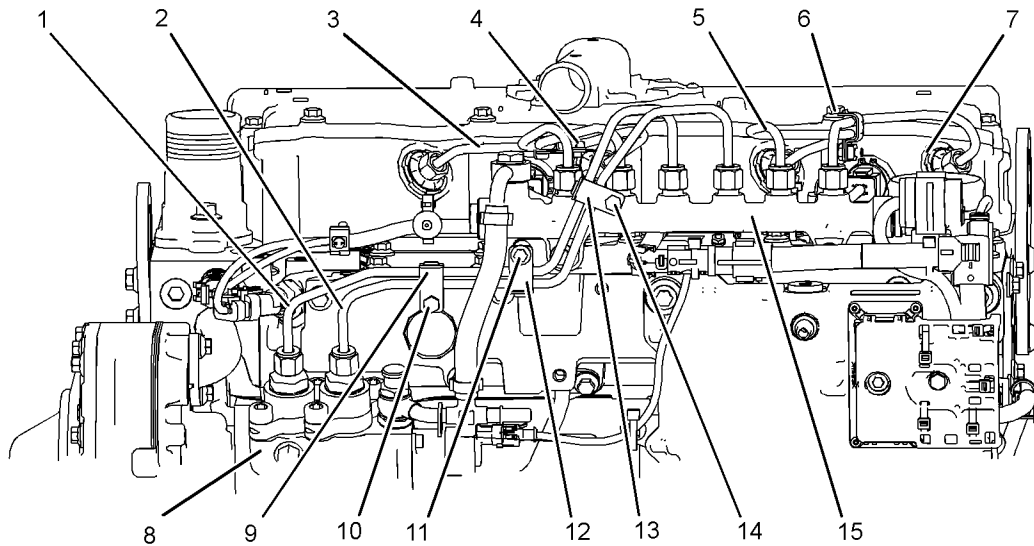


Illustration 24

g03667375

2. Install new seals (7) to the electronic unit injector and the cylinder head. Ensure that the flange on the seals is flush with the cylinder head.
3. Remove the caps from new fuel injection line (1) and new fuel injection line (2).
4. Remove the caps from the appropriate ports in fuel manifold (15) and fuel injection pump (8).
5. Position fuel injection line (1) and fuel injection line (2) onto fuel injection pump (8) and fuel manifold (15). Hand tighten the nuts for the fuel injection line onto the fuel manifold and the fuel injection pump.
6. Ensure that the ends of fuel injection line (1) and fuel injection line (2) are correctly seated in the fuel manifold and the fuel injection pump.
7. Position the clamp and isolator (9) onto the fuel injection lines. Install new bolt (10) hand tight. Ensure that the isolators are correctly positioned onto the fuel injection lines.

Position the clamp and isolator (12) onto the fuel injection lines. Position the spacer behind clamp (12) and install new bolt (11) hand tight. Ensure that the isolators are correctly positioned onto the fuel injection lines.

**Note:** On some engines there may be only one clamp retaining the fuel injection lines to the cylinder head.

8. Position the clamps and isolator (13) to the fuel injection lines. Install the nut and bolt (14) hand tight.

**Note:** Ensure that the isolators are correctly positioned onto the fuel injection lines.

9. Remove the caps from new fuel injection lines (3) and new fuel injection lines (5).
10. Remove the caps from the port of the electronic unit injector and from the ports in fuel manifold (15).
11. Loosely connect the nuts at both ends of fuel injection line (3) and fuel injection lines (5) to the electronic unit injector and to the appropriate port in fuel manifold (15). Ensure that the ends of the fuel injection line are correctly seated in the electronic unit injector and in the fuel manifold.
12. Install clamp and isolator (4) to the assembly of fuel injection pipe (3).
13. Install clamp and isolator (6) to the assembly of fuel injection pipe (5).
14. If necessary, tighten the electronic unit injector and the fuel manifold. Refer to Disassembly and Assembly, "Electronic Unit Injector - Install" and Disassembly and Assembly, "Fuel Manifold (Rail) - Remove and Install" for the correct procedure.
15. Use Tooling (B) to tighten the nuts on fuel injection line (1) and fuel injection line (2) to a torque of 30 N·m (266 lb in).

**Note:** Ensure that fuel injection lines do not contact any other engine component.

16. Use Tooling (B) to tighten the nuts on the assembly fuel injection line (3) and the assembly fuel injection line (5) to a torque of 30 N·m (266 lb in).

**Note:** Ensure that fuel injection lines do not contact any other engine component.

17. Tighten the nuts and bolt (14) to a torque of 4 N·m (35 lb in).

18. Tighten bolt (10) (not shown) and bolt (11) to a torque of 4 N·m (35 lb in).

19. Install the crankcase breather canister and tube assemblies. Refer to Disassembly and Assembly, "Crankcase Breather - Install" for the correct procedure.

20. Turn the fuel supply to the ON position.

21. Turn the battery disconnect switch to the ON position.

## Installation Procedure for more than One Fuel Injection Line

Table 14

Required Tools			
Tool	Part Number	Part Description	Qty
B	27610294	Injector Pipe Nut Tool	1

### NOTICE

Ensure that all adjustments and repairs that are carried out to the fuel system are performed by authorized personnel that have the correct training.

Before beginning ANY work on the fuel system, refer to Operation and Maintenance Manual, "General Hazard Information and High Pressure Fuel Lines" for safety information.

Refer to System Operation, Testing and Adjusting, "Cleanliness of Fuel System Components" for detailed information on the standards of cleanliness that must be observed during ALL work on the fuel system.

1. This installation procedure is for installation of more than one fuel injection line between the fuel manifold and the electronic unit injector. Loosening of the appropriate electronic unit injectors will be necessary. Refer to Disassembly and Assembly, "Electronic Unit Injector - Remove"

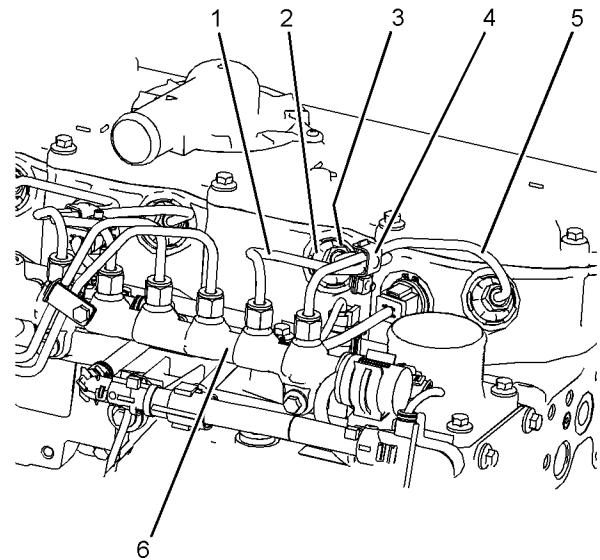


Illustration 25

g03668016

2. Remove the caps from electronic unit injectors (3) (not shown).

3. Install new seals (2) to the cylinder head. Ensure that the flange on the seal is flush with the cylinder head.

4. Remove the caps from fuel manifold (6).

5. Install new fuel injection line (1) and fuel injection line (5) to fuel manifold (6) and electronic unit injectors (3) (not shown) hand tight. Ensure that the ends of the fuel injection lines are correctly seated in the electronic unit injectors and in the fuel manifold.

6. Install the isolator and clamp (4) onto the fuel injection lines.

**Note:** Ensure that the isolators are correctly positioned onto the fuel injection lines.

7. If necessary, tighten the electronic unit injector. Refer to Disassembly and Assembly, "Electronic Unit Injector - Install" for the correct procedure.

8. Use Tooling (B) to tighten the nuts on fuel injection line (1) and fuel injection line (6) to a torque of 30 N·m (266 lb in).

**Note:** Ensure that fuel injection lines do not contact any other engine component.

9. If necessary, install the crankcase breather canister and tube assemblies. Refer to Disassembly and Assembly, "Crankcase Breather - Install" for the correct procedure.

10. Turn the fuel supply to the ON position.





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