

Disassembly and Assembly

402D-403D-404D Industrial Engine

GG (Engine)
GH (Engine)
GJ (Engine)
GK (Engine)
GL (Engine)
GM (Engine)
GN (Engine)
GP (Engine)
GQ (Engine)
GS (Engine)

Important Safety Information

Most accidents that involve product operation, maintenance and repair are caused by failure to observe basic safety rules or precautions. An accident can often be avoided by recognizing potentially hazardous situations before an accident occurs. A person must be alert to potential hazards. This person should also have the necessary training, skills and tools to perform these functions properly.

Improper operation, lubrication, maintenance or repair of this product can be dangerous and could result in injury or death.

Do not operate or perform any lubrication, maintenance or repair on this product, until you have read and understood the operation, lubrication, maintenance and repair information.

Safety precautions and warnings are provided in this manual and on the product. If these hazard warnings are not heeded, bodily injury or death could occur to you or to other persons.

The hazards are identified by the "Safety Alert Symbol" and followed by a "Signal Word" such as "DANGER", "WARNING" or "CAUTION". The Safety Alert "WARNING" label is shown below.



The meaning of this safety alert symbol is as follows:

Attention! Become Alert! Your Safety is Involved.

The message that appears under the warning explains the hazard and can be either written or pictorially presented.

Operations that may cause product damage are identified by "NOTICE" labels on the product and in this publication.

Perkins cannot anticipate every possible circumstance that might involve a potential hazard. The warnings in this publication and on the product are, therefore, not all inclusive. If a tool, procedure, work method or operating technique that is not specifically recommended by Perkins is used, you must satisfy yourself that it is safe for you and for others. You should also ensure that the product will not be damaged or be made unsafe by the operation, lubrication, maintenance or repair procedures that you choose.

The information, specifications, and illustrations in this publication are on the basis of information that was available at the time that the publication was written. The specifications, torques, pressures, measurements, adjustments, illustrations, and other items can change at any time. These changes can affect the service that is given to the product. Obtain the complete and most current information before you start any job. Perkins dealers or Perkins distributors have the most current information available.



When replacement parts are required for this product Perkins recommends using Perkins replacement parts.

Failure to heed this warning can lead to premature failures, product damage, personal injury or death.

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Disassembly and Assembly Section

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Fuel Filter Base - Remove and Install (403D-11, 403D-15, 403D-15T, 403D-17, 404D-15, 404D-22, 404D-22T and 404D-22TA Engines)

Removal Procedure

NOTICE

Do not allow dirt to enter the fuel system. Thoroughly clean the area around a fuel system component that will be disconnected. Fit a suitable cover over disconnected fuel system component.

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.

Note: Place identification marks on all hoses for installation purposes. Plug all hoses and all the ports in the fuel filter base. This helps prevent fluid loss, and this helps to keep contaminants from entering the system.

1. Turn the fuel supply to the OFF position.

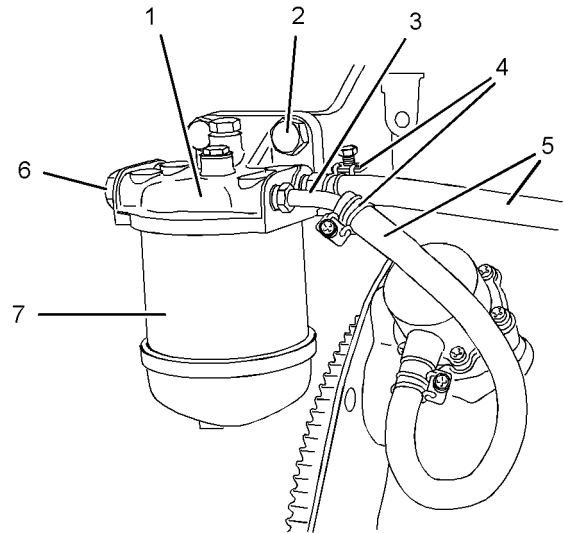


Illustration 1

g01302737

Typical example

2. Loosen hose clamps (4) and disconnect hoses (5).
3. If necessary, remove fuel filter element (7) from fuel filter base (1). Refer to Operation and Maintenance Manual, "Fuel System Filter - Replace".
4. Remove fasteners (2) and remove fuel filter base (1) from the mounting bracket.
5. If necessary, remove plugs (6) and washers (not shown) from fuel filter base (1). Remove tube assemblies (3) and rubber olives (not shown) from fuel filter base (1).

Installation Procedure

NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

Note: If the engine is equipped with a hand priming pump, the hand priming pump is mounted on the fuel filter base. The assembly of the fuel filter base and the hand priming pump is not serviceable.

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

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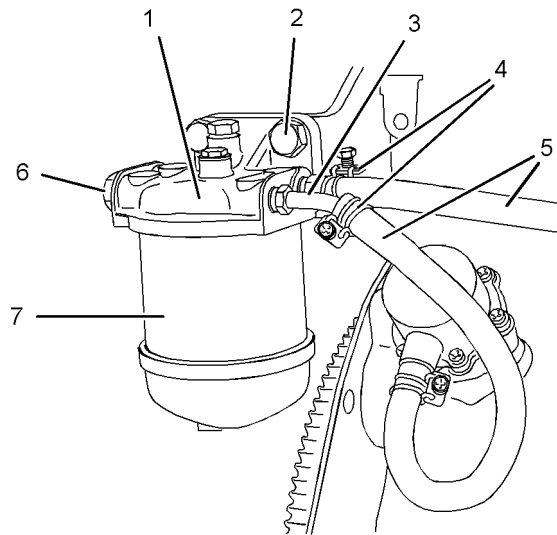


Illustration 2

g01302737

Typical example

2. If necessary, install new rubber olives (not shown) onto tube assemblies (3). Install tube assemblies (3) to fuel filter base (1). Ensure the correct orientation of the tube assemblies. Tighten the nuts to a torque of 9 N·m (80 lb in).
 3. Install washers (not shown) onto plugs (6). Install plugs (6) to fuel filter base (1). Tighten the plugs to a torque of 23 N·m (17 lb ft).
 4. Align fuel filter base (1) with the mounting bracket. Install fasteners (2). Tighten the fasteners to a torque of 50 N·m (37 lb ft).
 5. If necessary, install a new fuel filter element (7) to fuel filter base (1). Refer to Operation and Maintenance Manual, "Fuel System Filter - Replace".
 6. Connect hoses (5) and tighten hose clamps (4).
- Note:** Ensure that the hoses do not contact any other engine components.
7. Turn the fuel supply to the ON position.
 8. Remove the air from the fuel system. Refer to Operation and Maintenance Manual, "Fuel System - Prime".

Fuel Filter Base - Remove and Install (402D-05 and 403D-07 Engines)

Removal Procedure

NOTICE

Do not allow dirt to enter the fuel system. Thoroughly clean the area around a fuel system component that will be disconnected. Fit a suitable cover over disconnected fuel system component.

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.

Note: Place identification marks on all hoses for installation purposes. Plug all hoses and all the ports in the fuel filter base. This helps prevent fluid loss, and this helps to keep contaminants from entering the system.

1. Turn the fuel supply to the OFF position.

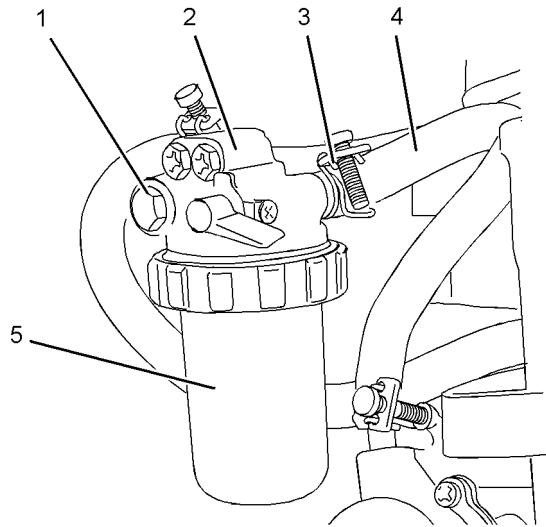


Illustration 3 g01303701

Typical example

2. Loosen hose clamps (3) and disconnect hoses (4).
3. If necessary, remove fuel filter element (5). Refer to Operations and Maintenance Manual, "Fuel System Filter - Replace".
4. Remove bolt (1) and remove fuel filter base (2) from the mounting bracket.

Installation 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.

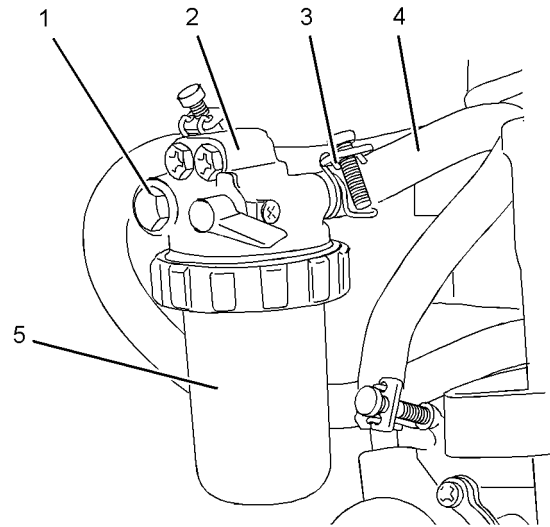


Illustration 4 g01303701

Typical example

2. Align fuel filter base (2) with the mounting bracket. Install bolt (1). Tighten the bolt to a torque of 25 N·m (18 lb ft).
3. If necessary, install a new fuel filter element (6) to fuel filter base (2). Refer to Operation and Maintenance Manual, "Fuel System Filter - Replace".
4. Connect hoses (4) and tighten hose clamps (3).

Note: Ensure that the hoses do not contact any other engine components.

5. Turn the fuel supply to the ON position.
6. Remove the air from the fuel system. Refer to Operation and Maintenance Manual, "Fuel System - Prime".

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Fuel Transfer Pump - Remove and Install (Mechanical Fuel Transfer Pump)

Removal Procedure

NOTICE

Do not allow dirt to enter the fuel system. Thoroughly clean the area around a fuel system component that will be disconnected. Fit a suitable cover over disconnected fuel system component.

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.

Note: Place identification marks on all hoses for installation purposes. Plug all hoses and all the ports in the fuel transfer pump. This helps prevent fluid loss, and this helps to keep contaminants from entering the system.

1. Turn the fuel supply to the OFF position.

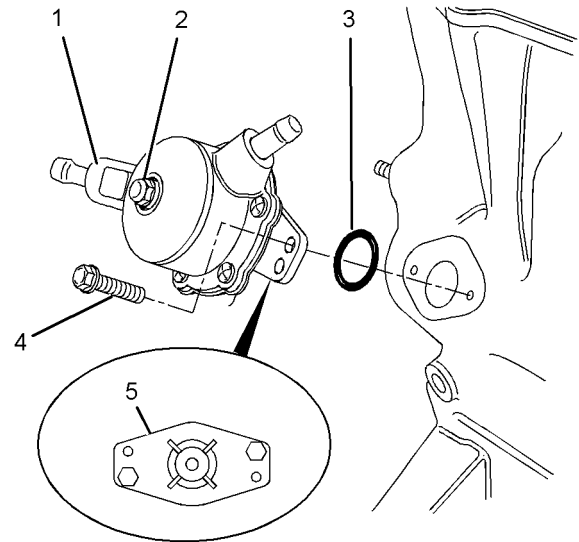


Illustration 5

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Typical example

Note: The fuel transfer pump can be oriented in two positions. Before removing the fuel transfer pump from the cylinder block, note the orientation of flange (5) on fuel transfer pump (1) for assembly.

2. Loosen the hose clamps and disconnect the hoses (not shown) from fuel transfer pump (1).
3. Evenly loosen bolts (4) and remove fuel transfer pump (1) from the cylinder block.

Note: In order to remove the fuel transfer pump, it may be necessary to rotate the crankshaft until the operating plunger of the fuel transfer pump is not under pressure.

4. Remove O-ring seal (3) from fuel transfer pump (1).

Installation Procedure

NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

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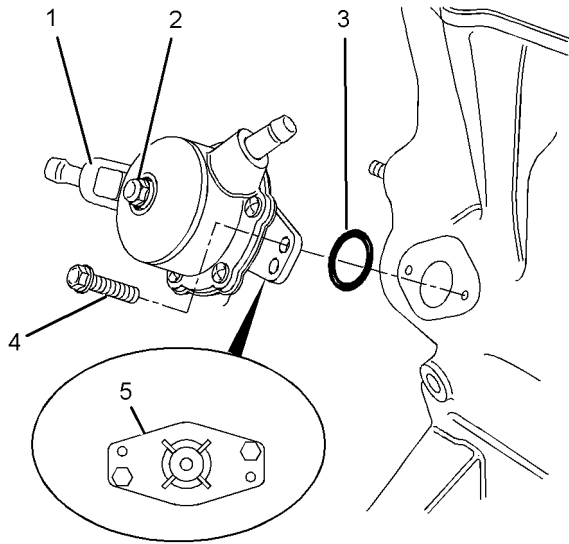


Illustration 6 g01326306

Typical example

1. Clean the mating surfaces of the cylinder block and flange (5) on the fuel transfer pump.

Note: Ensure that the camshaft lobe for the fuel transfer pump is at minimum lift before the fuel transfer pump is installed. The fuel transfer pump can be oriented in two positions. Ensure that the fuel transfer pump is oriented in the correct position.

2. Install a new O-ring seal (3) to fuel transfer pump (1).
3. Lubricate the operating plunger of fuel transfer pump (1) with clean engine oil.
4. Position fuel transfer pump (1) on the cylinder block. Ensure that the operating plunger is positioned correctly on the camshaft lobe. Install bolts (4). Tighten the bolts to a torque of 6 N·m (53 lb in).
5. Connect the hoses (not shown) to fuel transfer pump (1). Tighten the hose clamps.

Note: The inlet for the fuel transfer pump can be rotated 360 degrees by loosening bolt (2). The fuel inlet is adjustable in 15 degree increments. If adjustment is made to the position of the fuel inlet, tighten bolt (2) to a torque of 2.5 N·m (22 lb in).

6. Turn the fuel supply to the ON position.
7. Prime the fuel system. Refer to Systems Operation, Testing and Adjusting, "Fuel System - Prime" for additional information.

Fuel Transfer Pump - Remove and Install (Electrical Fuel Transfer Pump)

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.

Note: Put identification marks on all hoses, on all hose assemblies, on wires and on all tube assemblies for installation purposes. Plug all hose assemblies and tube assemblies. This helps to prevent fluid loss and this helps to keep contaminants from entering the system.

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

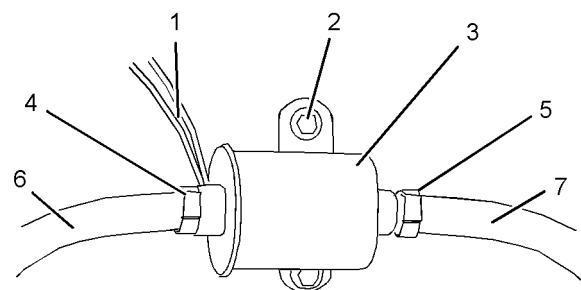


Illustration 7
Typical example

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3. Disconnect harness assembly (1).

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4. Loosen hose clamps (4) and (5). Disconnect hoses (6) and (7).
5. Remove bolts (2) and remove electric transfer pump (3).

Installation Procedure

1. Ensure that the electric transfer pump is clean and free from damage. If necessary, replace the electric transfer pump.

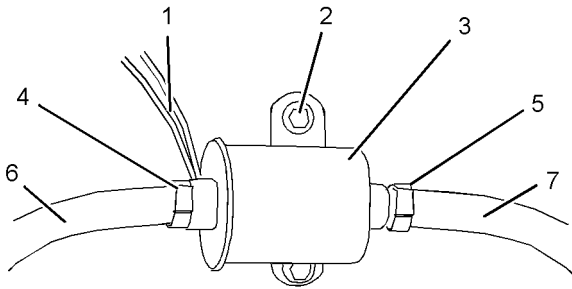


Illustration 8

g01304057

Typical example

2. Position electric transfer pump (3) on the mounting and install bolts (2).
3. Tighten bolts (2) to a torque of 9 N·m (79 lb in).
4. Connect hoses (6) and (7). Tighten hose clamps (4) and (5).
5. Connect harness assembly (1).
6. Turn the fuel supply to the ON position.
7. Turn the battery disconnect switch to the ON position.
8. Remove the air from the fuel system. Refer to Operation and Maintenance Manual, "Fuel System - Prime".

Fuel Injection Lines - Remove and Install

Removal Procedure

NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

NOTICE

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

Dispose of all fluids according to local regulations and mandates.

NOTICE

Do not let the tops of fuel injectors turn when the fuel line nuts are loosened or tightened.

The fuel injectors will be damaged if the top of the injector turns in the body.

The engine will be damaged if a defective fuel injector is used because the shape of fuel (spray pattern) that comes out of the nozzle will not be correct.

Note: Place identification marks on all tube assemblies for installation. Plug all lines and tube assemblies in order to prevent contamination.

1. Turn the fuel supply to the OFF position.

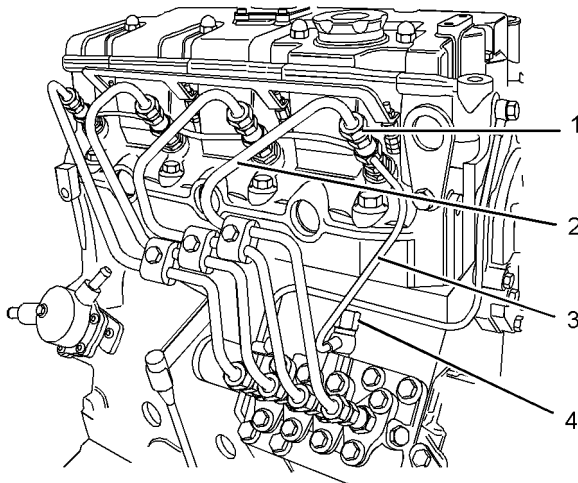


Illustration 9 g01326550

Typical example

2. Disconnect nuts (1) for fuel injection lines (2) from the fuel injectors.
3. Disconnect nuts (1) for fuel injection lines (2) from the fuel injection pump.
4. Remove fuel injection lines (2) from the engine as a unit.
5. Use suitable caps in order to plug the open ports of the fuel injection pump immediately.
6. The 403D-15, 403D-15T, 403D-17, 404D-22, 404D-22T and 404D-22TA engines have a rigid fuel return line.

For engines with a rigid fuel return line, remove banjo bolt (4) from fuel return line (3). Remove washers (8).

The 402D-05, 403D-07, 403D-11 and 404D-15 engines have a flexible fuel return hose.

For engines with a flexible fuel return hose, disconnect the hose from the fuel injection pump.

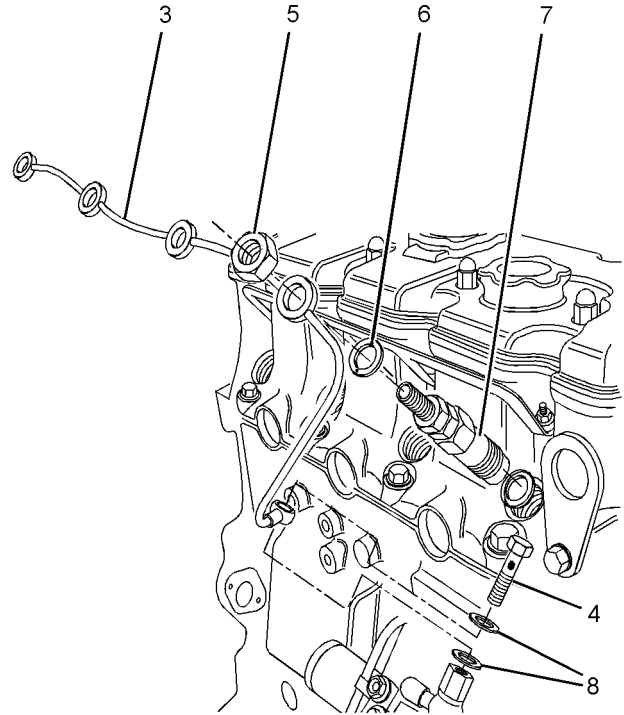


Illustration 10 g01326555

Typical example

7. Remove nuts (5) from fuel injectors (7).
- Note:** For engines with a rigid fuel return line, ensure that the fuel return line is not distorted when the nuts are loosened.
8. Remove fuel return line (3) and washers (6) from fuel injectors (7).
 9. Use suitable caps in order to plug the fuel injectors immediately.

Installation Procedure

Table 1

Required Tools			
Tool	Part Number	Part Name	Qty
A	27610294	Injector Pipe Nut Tool	1

NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

NOTICE

Do not let the tops of fuel injectors turn when the fuel line nuts are loosened or tightened.

The fuel injectors will be damaged if the top of the injector turns in the body.

The engine will be damaged if a defective fuel injector is used because the shape of fuel (spray pattern) that comes out of the nozzle will not be correct.

Note: The installation procedure is similar for the two cylinder, the three cylinder and the four cylinder engines.

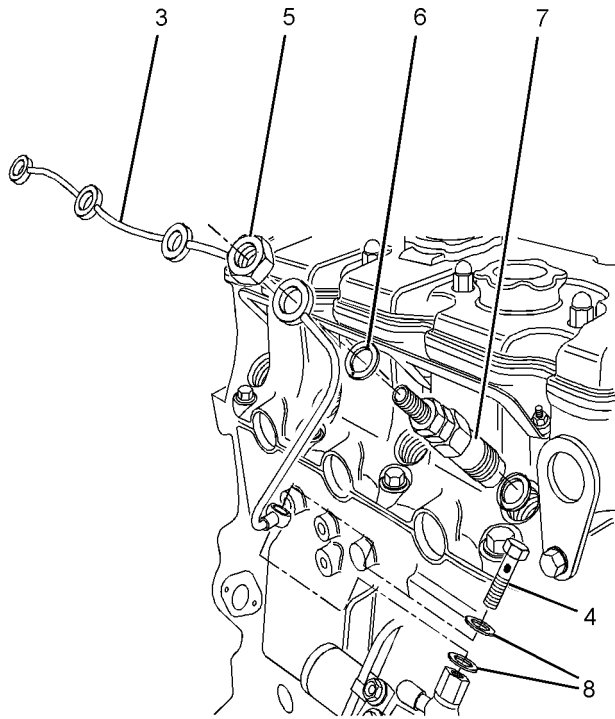


Illustration 11

g01326555

Typical example

1. Remove the caps from fuel injectors (7). Install new washers (6) and fuel return line (3) to fuel injectors (7).

Note: The washers (6) have two small holes.

2. Install nuts (5) to fuel injectors (7).
3. The 403D-15, 403D-15T, 403D-17, 404D-22, 404D-22TA and 404D-22TA engines have a rigid fuel return line.

For engines with a rigid fuel return line, install new washers (8) to fuel return line (3) and install banjo bolt (4) to the fuel injection pump. Tighten banjo bolt (4) to a torque of 7 N·m (62 lb in).

The 402D-05, 403D-07, 403D-11 and 404D-15 engines have a flexible fuel return hose.

For engines with a flexible fuel return hose, connect the fuel return hose to the fuel injection pump.

4. Tighten nuts (5) to a torque of 27 N·m (20 lb ft).

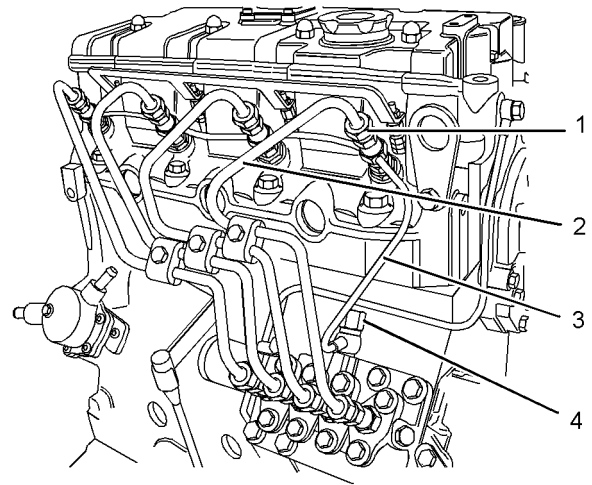


Illustration 12

g01326550

Typical example

5. Remove the caps from the outlet connections of the fuel injection pump. Install the fuel injection lines to the engine as a unit.
6. Connect fuel injection lines (2) to fuel injectors (7). Tighten the union nuts (1) finger tight.
7. Use Tooling (A) to tighten union nuts (1) at the fuel injection pump.

For 402D-05 and 403D-07 engines, tighten union nuts (1) to a torque of 20 N·m (15 lb ft).

For 403D-11, 403D-15, 403D-15T, 403D-17, 404D-15, 404D-22, 404D-22T and 404D-22TA engines, tighten the union nuts (1) to a torque of 23 N·m (17 lb ft).

Note: For the three cylinder and the four cylinder engines, tighten the center union nuts first.

8. Use Tooling (A) to tighten union nuts (1) at the fuel injections.

For 402D-05 and 403D-07 engines, tighten union nuts (1) to a torque of 20 N·m (15 lb ft).

For 403D-11, 403D-15, 403D-15T, 403D-17, 404D-15, 404D-22, 404D-22T and 404D-22TA engines, tighten the union nuts (1) to a torque of 23 N·m (17 lb ft).

9. Turn the fuel supply to the ON position.
10. Prime the fuel system. Refer to Operation and Maintenance Manual, "Fuel System - Prime" for more information.

i02645718

Fuel Shutoff Solenoid - Remove and Install

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 battery disconnect switch to the OFF position.

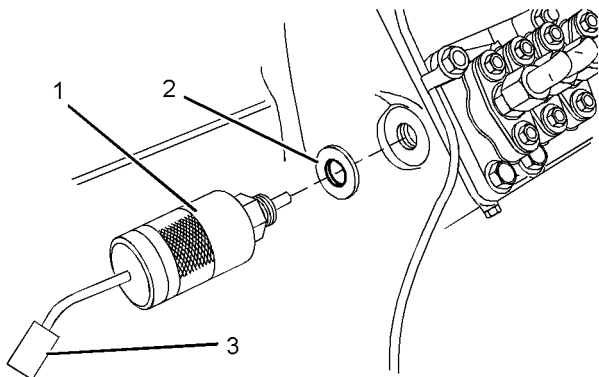


Illustration 13

g01326564

Typical example

2. Disconnect electrical connection (3) from the harness assembly (not shown). Mark all connections for installation.
3. Remove fuel shutoff solenoid (1) from the fuel injection pump housing by rotating the fuel shutoff solenoid in a counterclockwise direction.
4. Remove sealing washer (2) from fuel shutoff solenoid (1).

Installation Procedure

NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

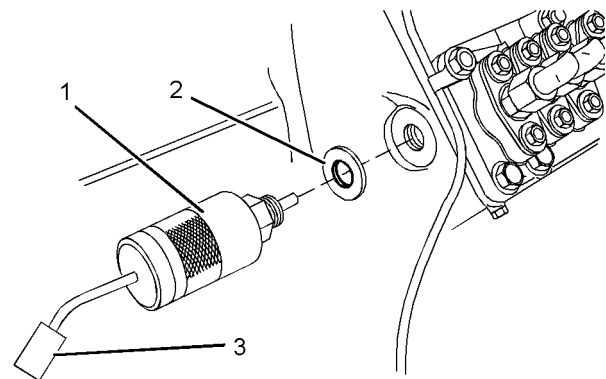


Illustration 14

g01326564

Typical example

1. Install sealing washer (2) to fuel shutoff solenoid (1).
2. Install fuel shutoff solenoid (1) into the fuel injection pump housing by rotating the fuel shutoff solenoid in a clockwise direction. Tighten the fuel shutoff solenoid to a torque of 17 N·m (12 lb ft).
3. Connect electrical connection (3) to the harness assembly (not shown).
4. Turn the battery disconnect switch to the ON position.

i02959957

Fuel Injection Pump - Remove and Install

Removal Procedure

Start By:

- a. Remove the fuel shutoff solenoid. Refer to Disassembly and Assembly, "Fuel Shutoff Solenoid - 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.

Note: The removal procedure is similar for the two cylinder, the three cylinder and the four cylinder engines. The Illustrations show a four cylinder engine.

1. Remove the fuel injection lines. Refer to Disassembly and Assembly, "Fuel Injection Lines - Remove and Install" for more information.

The 402D-05, 403D-07, 403D-11 and 404D-15 engines have a flexible fuel return hose.

For engines with a flexible fuel return hose, disconnect the fuel hose from the inlet connection of the fuel injection pump.

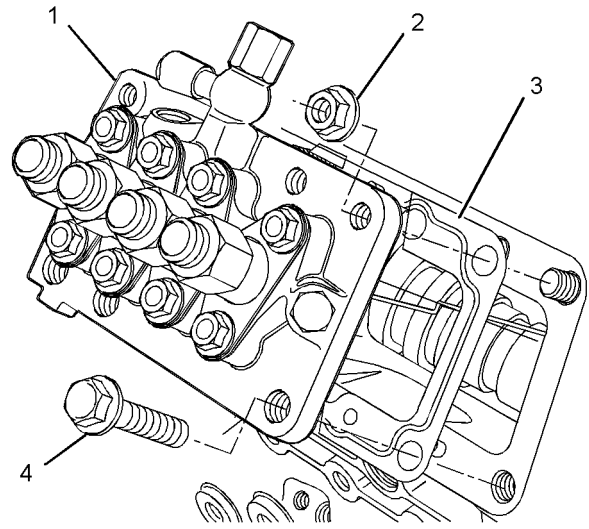


Illustration 15

g01327005

Typical example

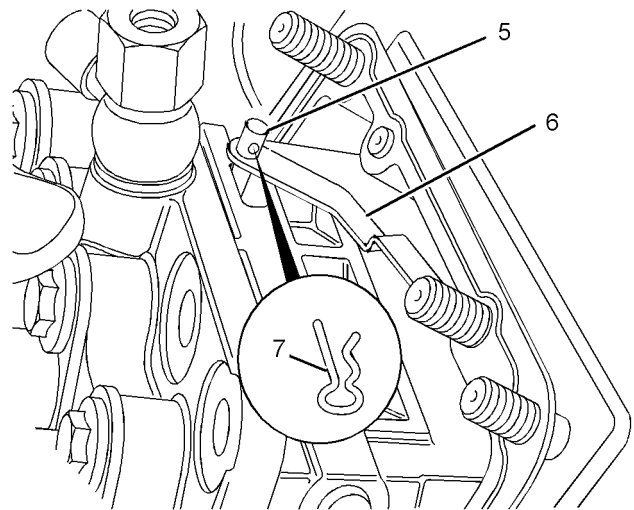


Illustration 16

g01327006

Typical example

2. Gradually loosen bolts (4) and nuts (2) that fasten the fuel injection pump to the cylinder block.
3. Carefully raise fuel injection pump (1) from the cylinder block and remove clip (7) that connects link (6) to fuel rack control (5).
4. Remove fuel injection pump (1) from the cylinder block.
5. Remove shims (3) from the mounting face of the cylinder block.

Note: Record the thickness of each shim and the number of shims for reassembly. The fuel injection timing is determined by the thickness of the shim pack that is between the fuel injection pump and the mounting face on the cylinder block. Refer to Specifications, “Fuel Injection Pump” for more information.

Installation Procedure

NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

Note: The installation procedure is similar for the two cylinder, the three cylinder and the four cylinder engines. The Illustrations show a four cylinder engine.

1. Clean the mating surfaces of the cylinder block and the fuel injection pump.

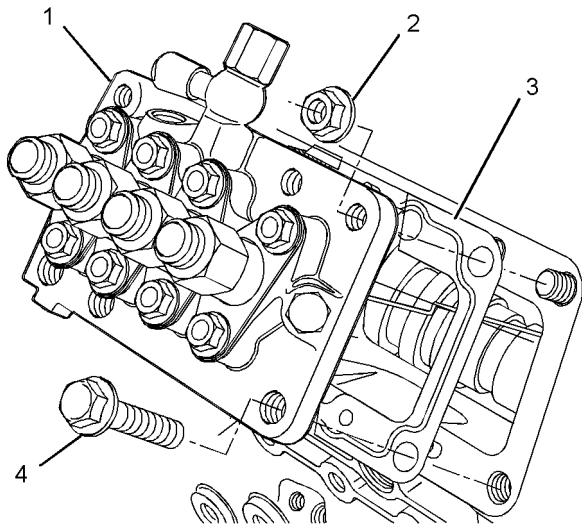


Illustration 17
Typical example

g01327005

2. New shims (3) must be used during assembly. Install the correct thickness and the correct number of shims on the mounting face of the cylinder block. Refer to Specifications, “Fuel Injection Pump” for more information.

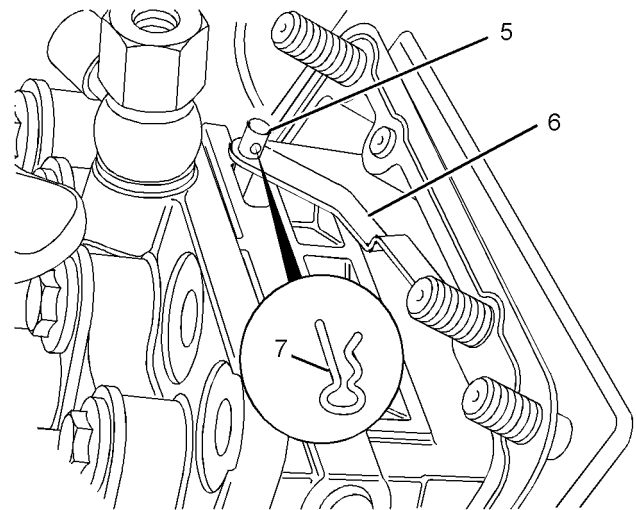


Illustration 18
Typical example

g01327006

3. Position fuel injection pump (1) close to the mounting face of the cylinder block, and connect link (6) and fuel rack control (5) with clip (7).
4. Align fuel injection pump (1) with the studs on the cylinder block. Install the fuel injection pump to the cylinder block.
5. Install bolts (4) and nuts (2). Ensure that the tube clip for the engine oil line is secured by the appropriate fastener.
6. Install the fuel injection lines. Refer to Disassembly and Assembly, “Fuel Injection Lines - Remove and Install”.

For 402D-05, 403D-07, 403D-11 and 404D-15 engines, evenly tighten bolts (4) and nuts (2) to a torque of 6 N·m (53 lb in).

For 403D-15, 403D-15T, 403D-17, 404D-22, 404D-22T and 404D-22TA engines, evenly tighten bolts (4) and nuts (2) to a torque of 15 N·m (11 lb ft).

The 402D-05, 403D-07, 403D-11 and 404D-15 engines have a flexible fuel return hose.

For engines with a flexible fuel return hose, connect the fuel hose to the inlet connection of the fuel injection pump.

End By:

- a. Install the fuel shutoff solenoid. Refer to Disassembly and Assembly, "Fuel Shutoff Solenoid - Remove and Install".

i02959963

Fuel Injector - Remove and Install

Removal Procedure

Start By:

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

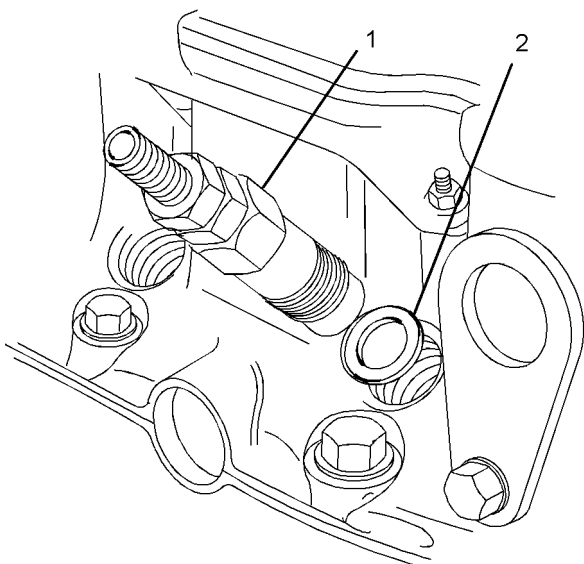


Illustration 19
Typical example

g01320610

1. Use a deep socket to remove fuel injector (1) from the cylinder head.
2. Remove seat washers (2) from the cylinder head.

Note: 402D-05 and 403D-07 engines have two seat washers. The seat washers are different diameters. The 403D-11, 403D-15, 403D-15T, 403D-17, 404D-15, 404D-22, 404D-22T and 404D-22TA engines have one seat washer.

3. Cap all openings or plug all openings immediately.

Installation Procedure

Table 2

Required Tools			
Tool	Part Number	Part Description	Qty
A	1861117	POWERPART Universal Jointing Compound	1

NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

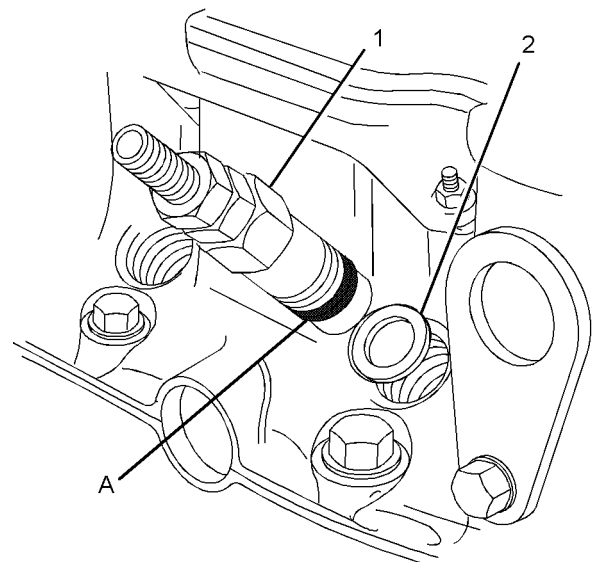


Illustration 20
Typical example

g01304054

1. Clean the bore for the fuel injector in the cylinder head. Ensure that no debris enters the cylinder. Clean the threads on the body of the fuel injector.
2. Install new seat washers (2) into the bore for the fuel injector in the cylinder head.

Note: 402D-05 and 403D-07 engines have two seat washers. The seat washers are different diameters. The 403D-11, 403D-15, 403D-15T, 403D-17, 404D-15, 404D-22, 404D-22T and 404D-22TA engines have one seat washer.

3. Apply a bead of Tooling (A) to the first two threads of the fuel injector that engage into the cylinder head. The bead should have a diameter of 2 mm (0.08 inch) and a length of 6 mm (0.25 inch).

Note: Ensure that Tooling (A) does not cover the body of the fuel injector below the threads.

4. Install fuel injector (1) into the cylinder head. Use a deep socket to tighten the fuel injector to a torque of 64 N·m (47 lb ft).

End By:

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

i02645771

Turbocharger - Remove and Install

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.

Note: Plug and cap all open ports and tube assemblies.

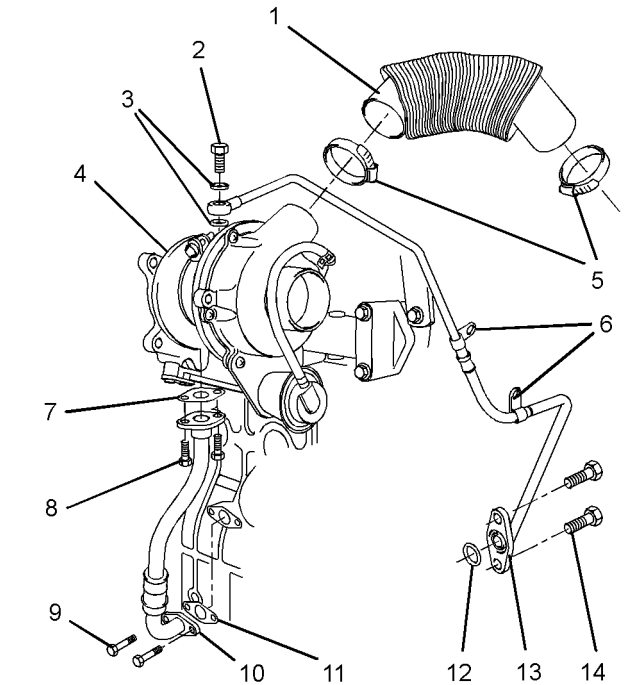


Illustration 21

g01304121

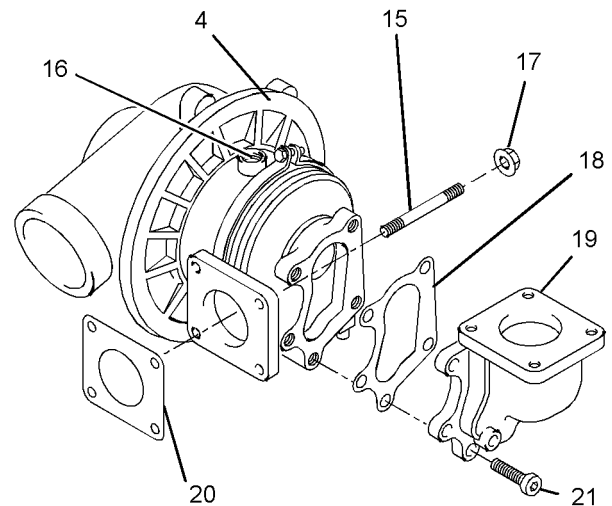


Illustration 22

g01304528

1. Loosen hose clamps (5) and remove air inlet hose (1).
2. Remove allen head screws (21) and remove exhaust elbow (19) from turbocharger (4). Remove gasket (18) from the turbocharger.

3. Remove banjo bolt (2) and washers (3). Remove the fasteners and the spacers (not shown) for tube clips (6). Remove bolts (14) and remove tube assembly (13) from the cylinder block. Remove O-ring seal (12).
4. Remove bolts (8) and disconnect tube assembly (10) from the turbocharger. Remove joint (7).

If necessary, remove bolts (9) and remove tube assembly (10) from the cylinder block. Remove joint (11).
5. Remove nuts (17) and remove turbocharger (4) from the exhaust manifold. Remove gasket (20) from the exhaust manifold. If necessary, remove studs (15) from the exhaust manifold.

Note: Do not use the actuator rod of the wastegate to lift the turbocharger.

Installation procedure

NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

1. Ensure that the turbocharger is clean and free from damage. Inspect the turbocharger for wear. If the turbocharger is worn, the complete turbocharger must be replaced.
2. Test the actuator for correct operation. Refer to Systems Operation, Testing and Adjusting, "Wastegate - Test" for more information. If the actuator is damaged or the actuator does not operate within the specified limits, the complete turbocharger must be replaced.

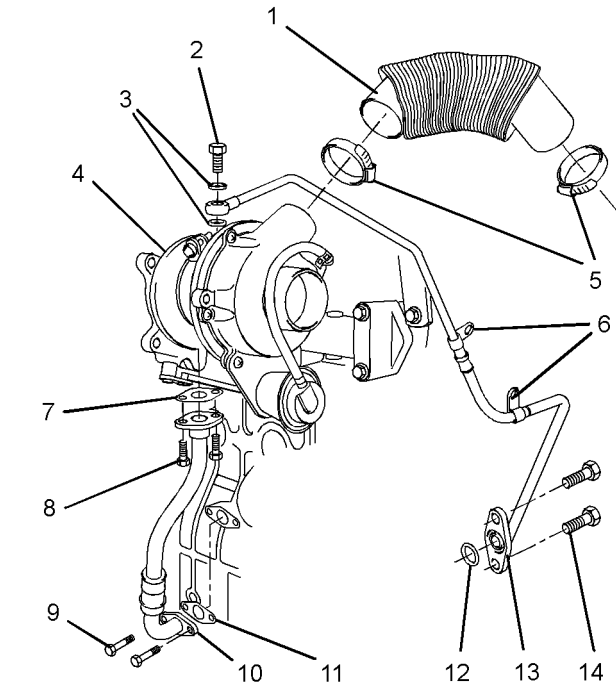


Illustration 23

g01304121

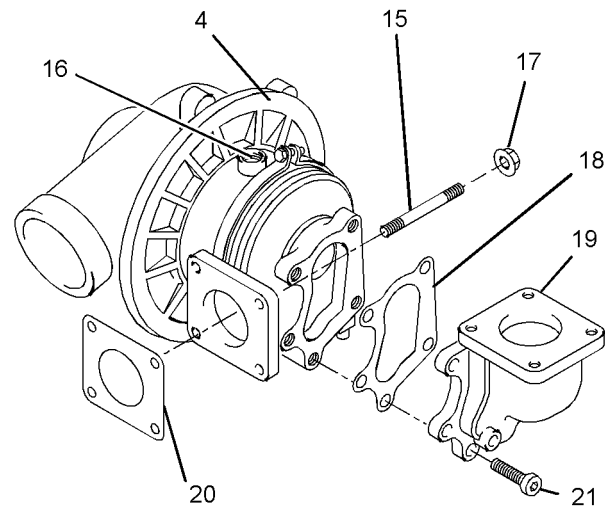


Illustration 24

g01304528

3. Clean the mating surfaces of the exhaust manifold. If necessary, install studs (15) to the exhaust manifold. Tighten the studs to a torque of 18 N·m (13 lb ft). Install a new gasket (20) over the studs.
4. Position turbocharger (4) onto the exhaust manifold. Install nuts (17) and tighten to a torque of 25 N·m (18 lb ft).

Note: Do not use the actuator rod of the wastegate to lift the turbocharger .

i02959965

5. Ensure that tube assemblies (10) and (13) are clean and free from damage. If necessary, replace the tube assemblies.
6. If necessary, position a new joint (11) and tube assembly (10) onto the cylinder block. Install bolts (9). Tighten the bolts finger tight.

Position a new joint (7) on tube assembly (10). Align tube assembly (10) to the bottom of the turbocharger. Install bolts (8). Tighten the bolts finger tight.

Tighten bolts (8) and (9) to a torque of 10 N·m (89 lb in).

7. Lubricate the bearings of turbocharger (4) with clean engine oil through oil inlet port (16). Rotate the shaft of the turbocharger in order to distribute the lubricant.
8. Install a new O-ring seal (12) to tube assembly (13). Position tube assembly (13) against the cylinder block. Install bolts (14). Tighten the bolts to a torque of 10 N·m (89 lb in).
9. Install new washers (3) and banjo bolt (2) to tube assembly (13). Position tube assembly (13) onto turbocharger (4). Tighten the banjo bolt finger tight.
10. If necessary, install the spacer and install the fasteners (not shown) to tube clips (6). Torque the fasteners to 10 N·m (89 lb in).
11. Tighten banjo bolt (2) to a torque of 18 N·m (13 lb ft).

Note: Ensure that the tube assembly does not come into contact with any other components.

12. Clean the mating surfaces of exhaust elbow (19). Position a new gasket (18) and exhaust elbow (19) on turbocharger (4). Install allen head screws (21). Tighten the bolts to a torque of 32 N·m (24 lb ft).
13. Ensure that inlet hose (1) is clean and free from defects or restrictions. Loosely install hose clamps (5) to air inlet hose (1). Install the air inlet hose to the connection of the inlet manifold (not shown) and to the turbocharger. Tighten the hose clamps.

Exhaust Manifold - Remove and Install

Removal Procedure

Start By:

- a. If the engine is equipped with a turbocharger, remove the turbocharger. Refer to Disassembly and Assembly, "Turbocharger, Remove and Install".

NOTICE

Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

Note: The two cylinder, the three cylinder and the four cylinder engines have different exhaust manifolds. The removal procedure is similar for all models.

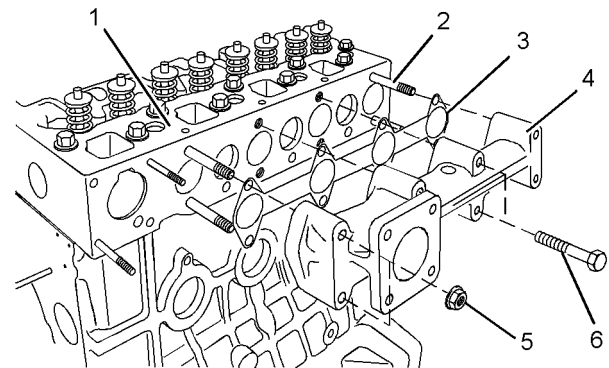


Illustration 25

g01326567

Typical example

1. Loosen nuts (5) and bolts (6).

Note: In order to prevent distortion of the exhaust manifold, loosen the outer fasteners first.

2. Remove nuts (5) and bolts (6).

Note: Identify bolts of different lengths so that the bolts can be installed in the correct positions.

3. Remove exhaust manifold (4) from cylinder head (1). Note the orientation of the exhaust manifold for installation.
4. Remove gasket (3) from cylinder head (1).



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