Perkins®
THE HEART OF EVERY GREAT MACHINE

UENR0622-01
April 2013

Specifications

854E-E34TA and 854F-E34T Industrial Engines

JR (Engine)
JS (Engine)
JT (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.

⚠ WARNING

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.

⚠ WARNING

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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i04134174

Engine Design

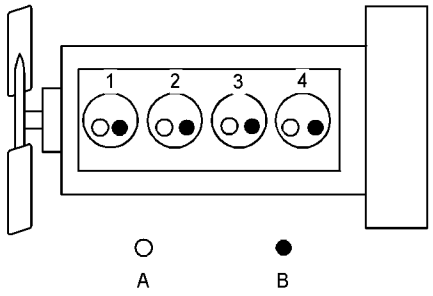

Illustration 1 g01353215

Cylinder and valve location

(A) Inlet valve
(B) Exhaust valve

Bore ..... 99 mm (3.90 inch)

Stroke ..... 110 mm (4.33 inch)

Displacement ..... 3.4 L (207 in3)

Cylinder arrangement ..... In-line

Type of combustion ..... Direct injection

Compression ratio

Turbocharged aftercooled 17.5:1

Number of cylinders 4

Valves per cylinder 2

Firing order 1, 3, 4, 2

When the crankshaft is viewed from the flywheel end of the engine, the crankshaft rotates in the following direction: ..... Counterclockwise

When the camshaft is viewed from the flywheel end of the engine, the camshaft rotates in the following direction: ..... Counterclockwise

Note: The left side and the right side of the engine are viewed from the flywheel end. The No. 1 cylinder is the front cylinder.

i05240674

Fuel Injection Lines

⚠ 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.

Refer to Operation and Maintenance Manual, "General Hazard Information and High Pressure Fuel Lines" before adjustments and repairs are performed.

NOTICE

Refer to Systems 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.

Ensure that all adjustments and repairs are performed by authorized personnel that have had the correct training.

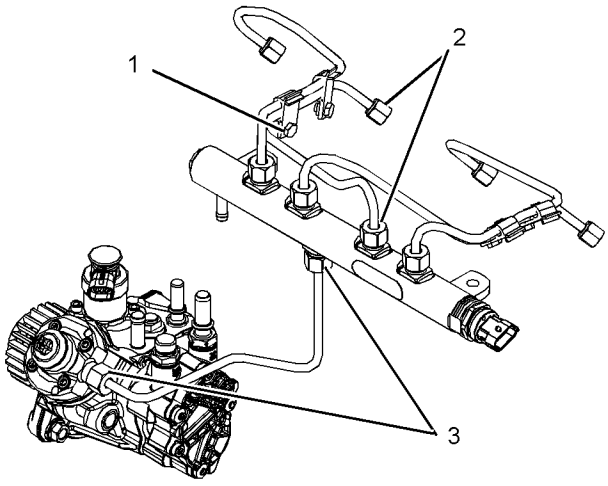

Illustration 2 g02501177

Typical example

(1) Tighten the screws to the following torque. ..... 10 N·m (89 lb in)

(2) (3) Torque for the nuts on the fuel injection lines ..... 25 N·m (18 lb ft)

i05240671

Fuel Injection Pump

NOTICE
Refer to Systems 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.

Ensure that all adjustments and repairs are performed by authorized personnel that have had the correct training.

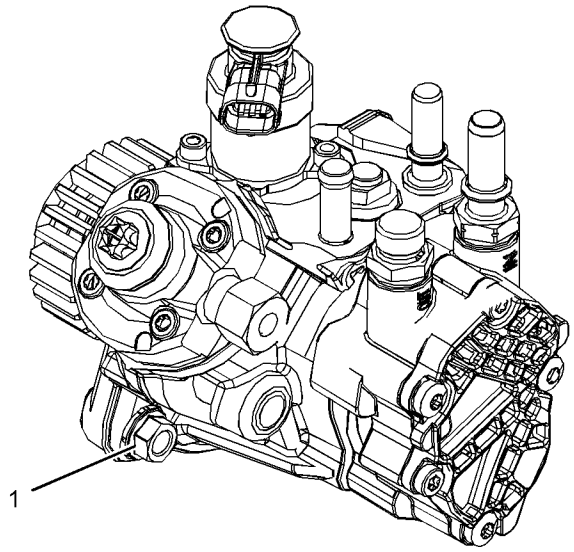

Illustration 3 g02621683
Typical example

Tighten the studs (not shown) to the following torque. .....18 N·m (13 lb ft)

(1) Tighten the nuts to the following torque. .....25 N·m (18 lb ft)

i05240672

Fuel Injectors

Refer to Operation and Maintenance Manual, "General Hazard Information and High Pressure Fuel Lines" before adjustments and repairs are performed.

NOTICE
Refer to Systems 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.

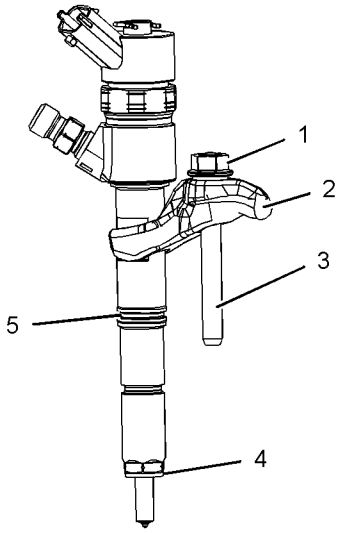

Illustration 4 g03342579
Typical example
(2) Clamp
(4) Washer
(5) O ring seal

(3) Tighten the studs in the cylinder head to the following torque.....20 N·m (15 lb ft)

(1) Tighten the injector fastening nut to an initial torque.....15 N·m (11 lb ft)

(1) Tighten the injector fastening nut to a final torque. .....25 N·m (18 lb ft)

i05240679

Fuel Filter Base
(Secondary Fuel Filter Base)

NOTICE
Refer to Systems 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.

If necessary, install a new fuel filter element to canister (6). Refer to Operation and Maintenance Manual, “Fuel System Secondary Filter - Replace” for the correct procedure.

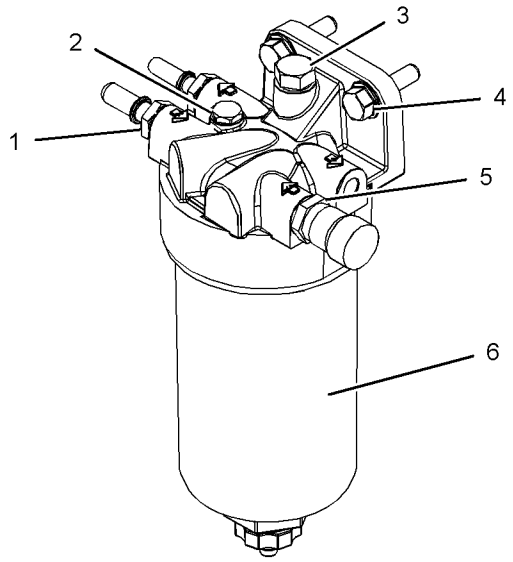

Illustration 5 g02621258
Typical example

(1) Tighten the connections to the following torque. .....25 N·m (18 lb ft)

(2) Tighten the screw to the following torque. .....2.5 N·m (22 lb in)

(3) Tighten the screw to the following torque. .....17 N·m (13 lb ft)

(4) Tighten the setscrews to the following torque. .....25 N·m (18 lb ft)

(5) Tighten the fuel temperature sensor to the following torque.....22 N·m (16 lb ft)

i05240680

Fuel Filter Base
(Primary Fuel Filter Base)

NOTICE
Refer to Systems 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.

If necessary, install a new fuel filter element to canister (2). Refer to Operation and Maintenance Manual, “Fuel System Primary Filter (Water Separator) Element - Replace” for the correct procedure.

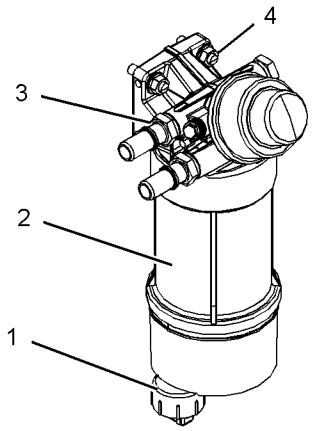

Illustration 6 g02606186
Typical example

(1) Tighten the water in fuel sensor to the following torque.....2.5 N·m (22 lb in)

Note: Tighten water in fuel sensor until the O-ring seal comes into contact with the bowl of the water separator. Tighten the water in fuel sensor an additional 180 degrees.

(3) Tighten the connection to the following torque. .....20 N·m (15 lb ft)

(4) Tighten the setscrews to the following torque. .....44 N·m (32 lb ft)

i04424550

Fuel Manifold (Rail)

Refer to Operation and Maintenance Manual, “General Hazard Information and High Pressure Fuel Lines” before adjustments and repairs are performed.

NOTICE
Refer to Systems 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.

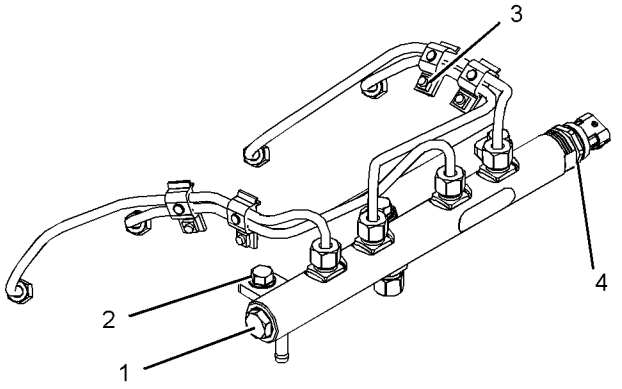

Illustration 7 g02621238

Typical example

(1) Tighten the fuel pressure relief valve to the following torque.....100 N·m (74 lb ft)

(2) Tighten the bolts to the following torque.....25 N·m (18 lb ft)

(3) Tighten the bolts to the following torque.....10 N·m (89 lb in)

(4) Tighten the fuel pressure sensor to the following torque.....70 N·m (52 lb ft)

i04332521

Lifter Group

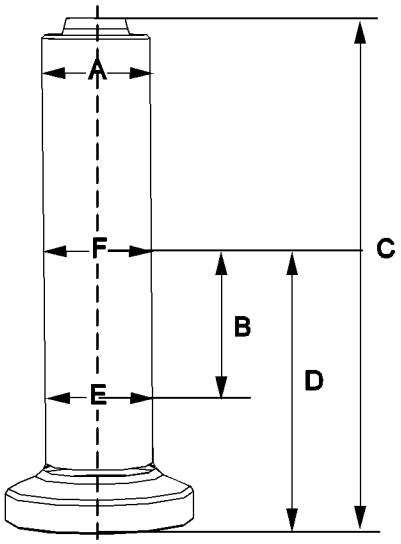

Illustration 8 g02488296

Typical example

(B) 26 mm (1.02362 inch)
(D) 38 ± 0.25 mm (1.49606 ± 0.00984 inch)

(A) Diameter of the lifter body..... 14.780 ± 0.04 mm (0.58189 ± 0.00157 inch)

(C) Height of the lifter body..... 67 ± 0.25 mm (2.63779 ± 0.00984 inch)

(E) Diameter of the lifter body..... 14.970 ± 0.02 mm (0.58937 ± 0.00079 inch)

(F) Diameter of the lifter body..... 14.780 ± 0.04 mm (0.58189 ± 0.00157 inch)

Bore diameter in the cylinder block ... 15.4 to 15.6 mm (0.60630 to 0.61417 inch)

Clearance

Clearance of the lifter..... 0.020 to 0.054 mm (0.00079 to 0.00213 inch)

i04823040

Rocker Shaft

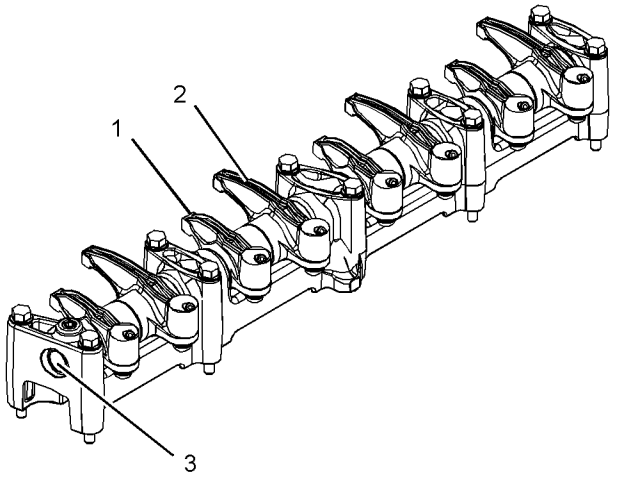

Illustration 9 g02842156

Typical example

(1) Inlet rocker arm

Diameter of the rocker arm bore
.....19.020 to 19.033 mm
(0.74882 to 0.74933 inch)

(2) Exhaust rocker arm

Diameter of the rocker arm bore
.....19.020 to 19.033 mm
(0.74882 to 0.74933 inch)

Clearance

Maximum clearance of both the rocker arm bores. .....0.020 to 0.054 mm
(0.00079 to 0.00213 inch)

(3) Diameter of the rocker shaft
.....18.979 to 19.000 mm (0.74720 to 0.74803 inch)

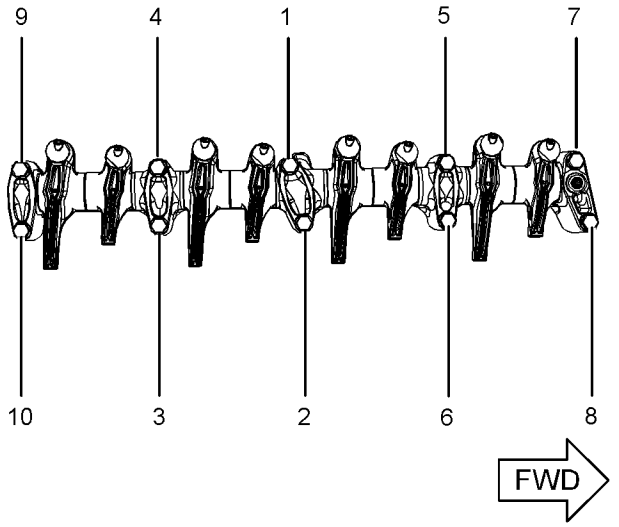

Illustration 10 g02681778

Tightening sequence

Tighten the fasteners in the sequence that is in illustration 10 . Tighten the fasteners to the following torque.....10 N·m (89 lb in)

i04335229

Valve Mechanism Cover

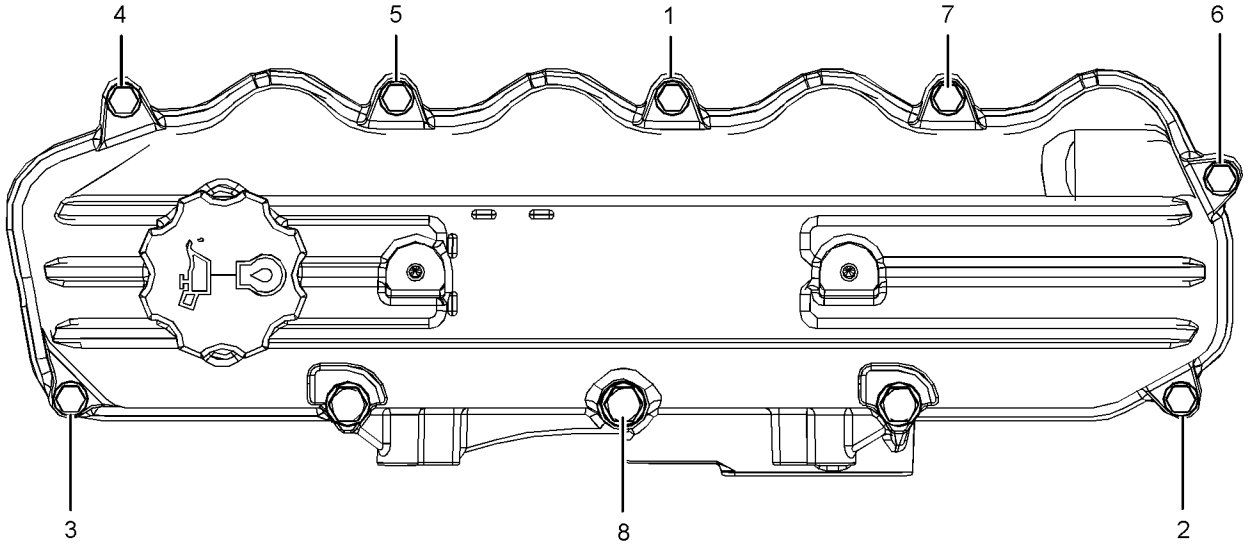

Illustration 11 g02490536

Typical example

Tighten the M6 fasteners (1), (2), (3), (4), (5), (6) and (7) in the sequence shown in illustration 11 to an initial torque. .....5 N·m (44 lb in)

Tighten the M8 fastener (8) in the sequence shown in illustration 11 to an initial torque.....10 N·m (89 lb in)

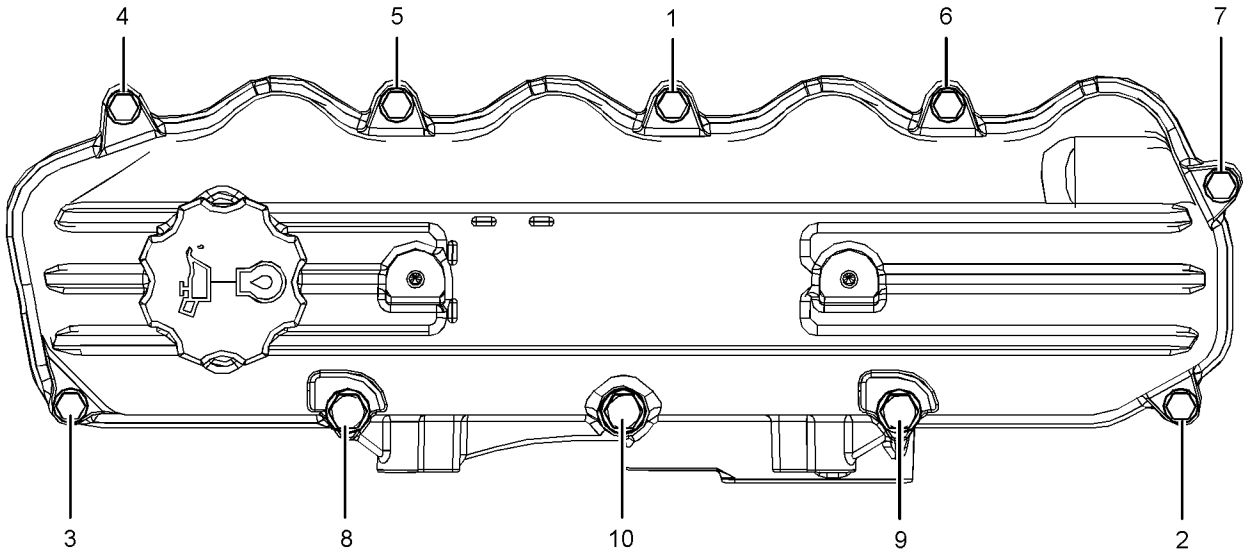

Illustration 12 g02727663

Typical example

Tighten the M6 fasteners (1), (2), (3), (4), (5), (6) and (7) in the sequence shown in illustration 12 to a final torque.....10 N·m (89 lb in)

Tighten the M8 fasteners (8), (9) and (10) in the sequence shown in illustration 12 to a final torque. .....25 N·m (18 lb ft)

i04335069

Cylinder Head Valves

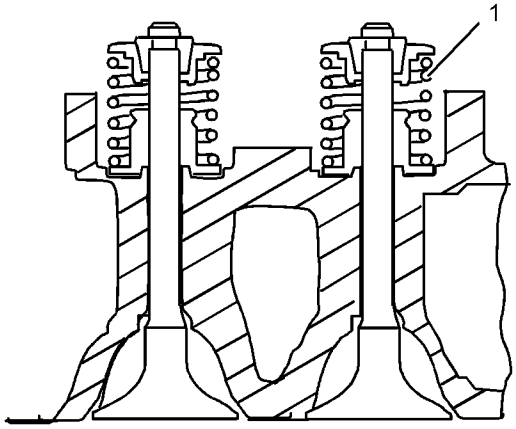

Illustration 13 g01335203

Typical example

When the valve springs (1) are replaced the valve springs must be replaced in pairs.

The free length for the valve spring ..... 44.6 mm (1.75590 inch)

Table 1

The load for the valve spring	The length of the valve spring
270 N (61 lb)	34 mm (1.33858 inch)
528 N (119 lb)	23.8 mm (0.93701 inch)

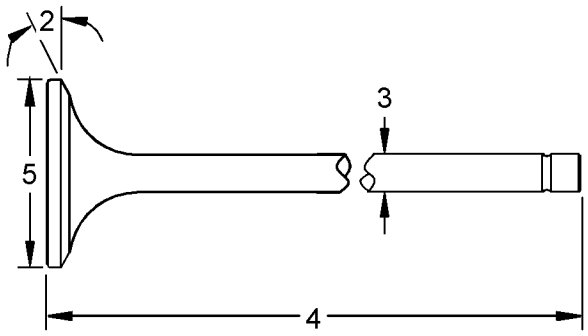

Illustration 14 g01335204

(2) Valve face angle

Inlet ..... 30 degrees
Exhaust ..... 30 degrees

(3) Valve stem diameter

Inlet..... 7.985 to 8.000 mm (0.31437 to 0.31496 inch)
Exhaust ..... 7.985 to 8.000 mm (0.31437 to 0.31496 inch)

Clearance

Clearance of the inlet valve stem
.....0.040 to 0.053 mm (0.00157 to 0.00209 inch)

Clearance

Clearance of the exhaust valve stem
.....0.040 to 0.053 mm (0.00157 to 0.00209 inch)

(4) Length of valve

Inlet valve and exhaust valve
..... 132.75 to 133.15 mm (5.22637 to 5.24212 inch)

(5) Valve head

Diameter of inlet valve head ... 41.43 to 41.69 mm (1.63110 to 1.64134 inch)
Diameter of exhaust valve head
.....37.27 to 37.53 mm (1.46732 to 1.47756 inch)

i04894560

Cylinder Head

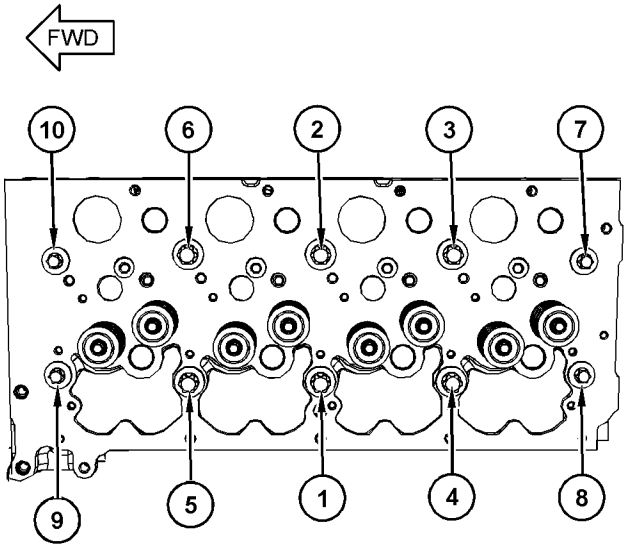

Illustration 15 g03005658

Typical example

Lubricate the threads and the underside of the head bolts with clean engine oil.

Tighten the M15 bolts in the sequence that is shown in illustration 15 to the following torque. ..... 130 N·m (96 lb ft)

Tighten the M12 bolts in the sequence that is shown in illustration 15 to the following torque. ..... 65 N·m (48 lb ft)

Tighten the M15 bolts in the sequence that is shown in illustration 15 to the additional amount. ..... 90 degrees

Tighten the M12 bolts in the sequence that is shown in illustration 15 to the additional amount. ..... 90 degrees

Tighten the M15 bolts in the sequence that is shown in illustration 15 to the additional amount. ..... 70 degrees

Tighten the M12 bolts in the sequence that is shown in illustration 15 to the additional amount. ..... 60 degrees

Minimum thickness of cylinder head ..... 90 mm (3.54330 inch)

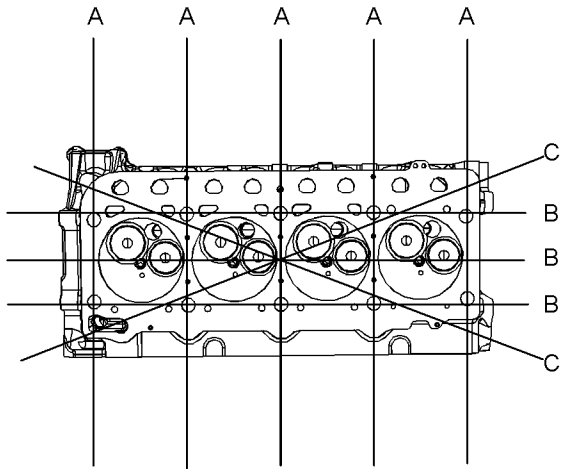

Illustration 16 g02490336

Note: The maximum distortion of the bottom face of the cylinder head is given in table 2 .

Table 2

Dimension	Maximum Permissible Distortion
Width (A)	0.05 mm (0.00197 inch)
Length (B)	0.05 mm (0.00197 inch)
Diagonal Line (C)	0.05 mm (0.00197 inch)

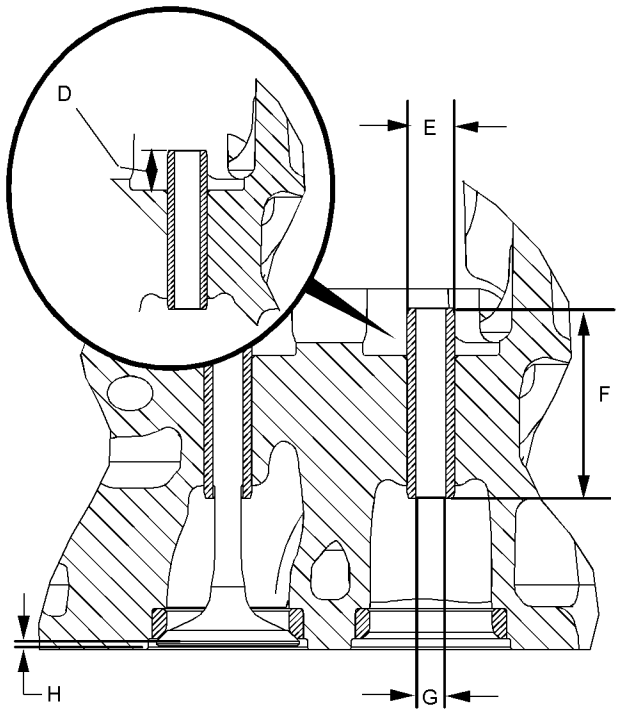

Illustration 17 g02328933
Typical example

(D) Valve guide height from the top of the valve guide to the valve spring seat ..... 6.5 mm (0.25590 inch)

(E) Outside diameter of the valve guides ..... 12.950 to 12.985 mm (0.50984 to 0.51122 inch)

(F) Length of the valve guides ..... 56 mm (2.20472 inch)

(G) Internal diameter of the valve guides ..... 8.023 to 8.038 mm (0.31587 to 0.31646 inch)

(H) Valve depths

Inlet..... 0.3 to 0.7 mm (0.01181 to 0.02756 inch)
The service limit for the depth of the inlet valve ..... 0.9 mm (0.03543 inch)
Exhaust ..... 0.3 to 0.7 mm (0.01181 to 0.02756 inch)
The service limit for the exhaust valve depth ..... 1 mm (0.03937 inch)

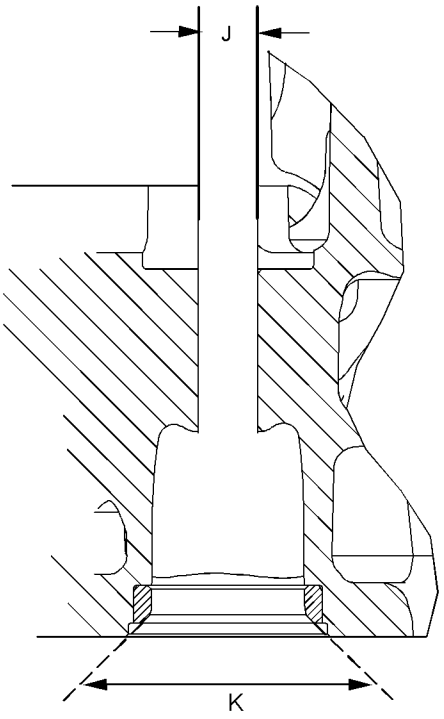

Illustration 18 g02474819
Typical example

(J) Diameter of the parent bore in the cylinder head ..... 12.960 to 12.995 mm (0.51024 to 0.51161 inch)

(K) Seat angle

Inlet ..... 59.5 degrees
Exhaust ..... 59.5 degrees

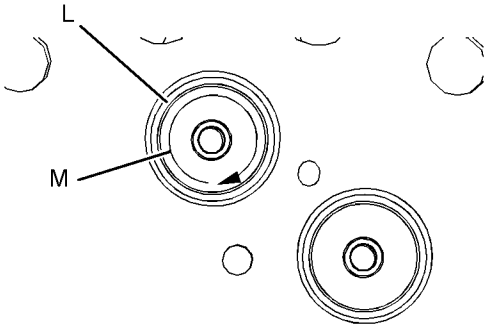

Illustration 19 g02847819
Typical example

(L) Seat surface finish ..... Ra 0.5 microns

(M) Concentricity of valve seat to valve guide parent bore Maximum Total Indicated Reading (TIR) ..... 0.05 mm (0.00197 inch)

i05239446

Turbocharger

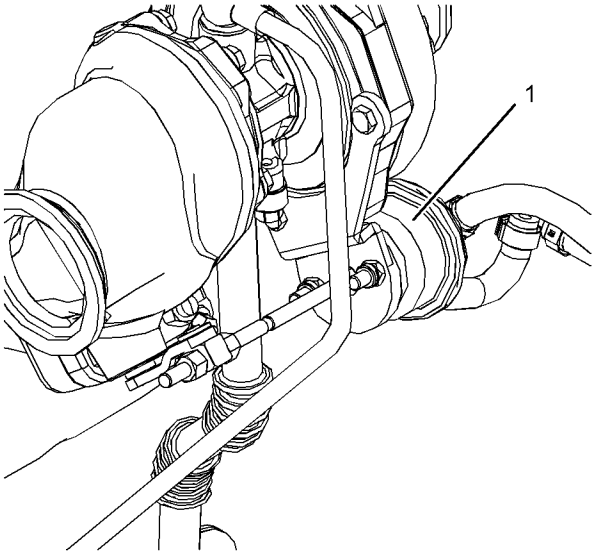

Illustration 20 g02626265

Typical example

(1) Actuator

The test pressure for the wastegate actuator .....170 kPa (24.6568 psi)
The movement for the rod actuator..... 10 mm (0.3937 inch)

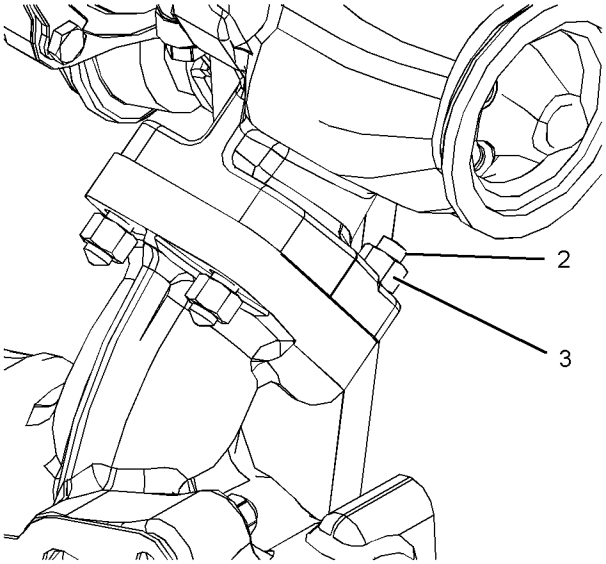

Illustration 21 g02626267

Typical example

(2) Tighten the studs to the following torque. .....15 N·m (11 lb ft)

(3) Tighten the nuts to the following torque. .....25 N·m (18 lb ft)

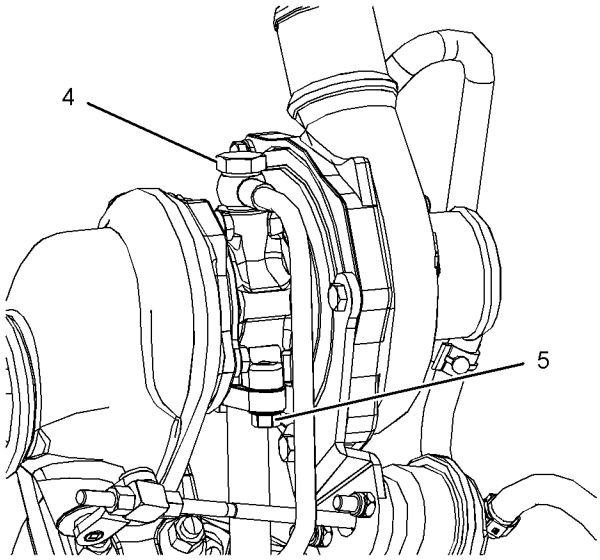

Illustration 22 g02626269

Typical example

(4) Tighten the bolt to the following torque. .....22 N·m (16 lb ft)

(5) Tighten the bolts to the following torque.....25 N·m (18 lb ft)

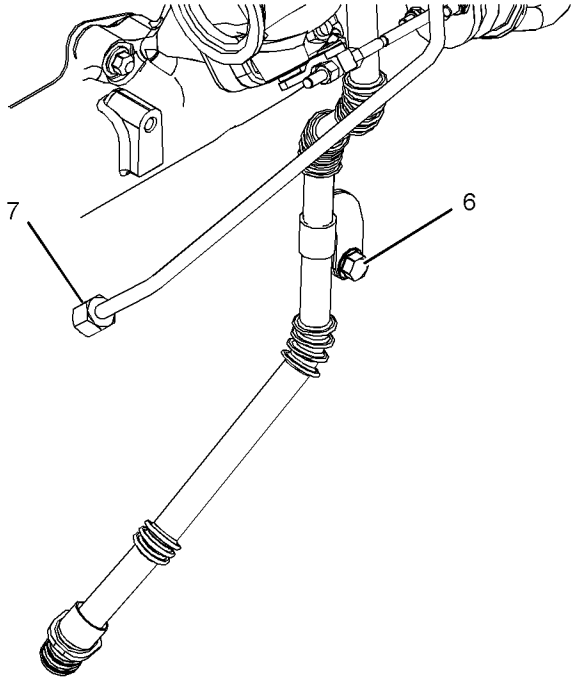

Illustration 23 g02626270

Typical example

(6) Tighten the setscrew to the following torque. .....25 N·m (18 lb ft)

(7) Tighten the nut to the following torque. .....25 N·m (18 lb ft)

i05239430

Exhaust Gas Valve (NRS)

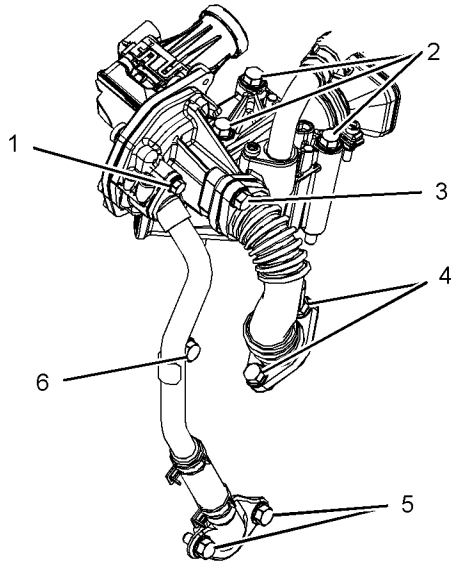

Illustration 24 g02626260

Typical example

(1) Tighten the setscrews to the following torque. .....10 N·m (89 lb in)

(2) Tighten the setscrews to the following torque. .....40 N·m (30 lb ft)

(3) Tighten the setscrews to the following torque. .....20 N·m (15 lb ft)

(4) Tighten the setscrews to the following torque. .....20 N·m (15 lb ft)

(5) Tighten the setscrews to the following torque. .....20 N·m (15 lb ft)

(6) Tighten the setscrew to the following torque. .....20 N·m (15 lb ft)

i04426264

Exhaust Cooler (NRS)

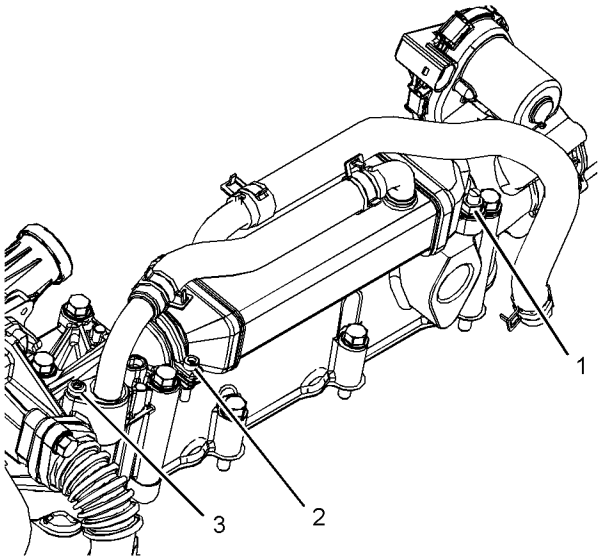

Illustration 25 g02621805
Typical example

(1) Tighten the nuts to the following torque. .....25 N·m (18 lb ft)

(2) Tighten the fastener to the following torque. .....3.5 N·m (31 lb in)

(3) Tighten the fastener to the following torque. .....10 N·m (89 lb in)

i05239453

Exhaust Manifold

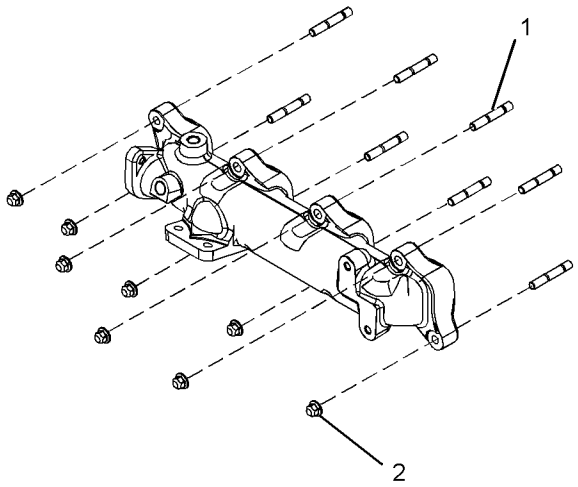

Illustration 26 g02909156
Typical example

(1) Tighten the studs to the following torque. .....18 N·m (13 lb ft)

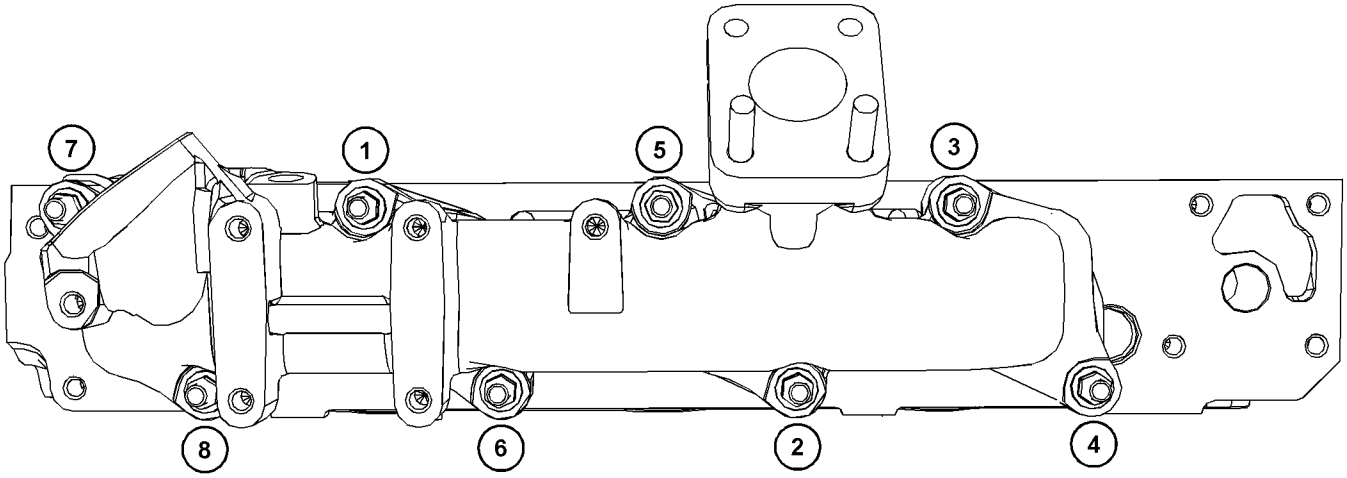

Illustration 27 g02725251

Typical example

(2) Tighten the nuts to an initial torque. Tighten the nuts in the sequence that is shown in Illustration 27 . .....10 N·m (89 lb in)

(2) Tighten the nuts to a final torque. Tighten the nuts in the sequence that is shown in Illustration 27 . .....27 N·m (20 lb ft)

i05287664

Flexible Exhaust Pipe

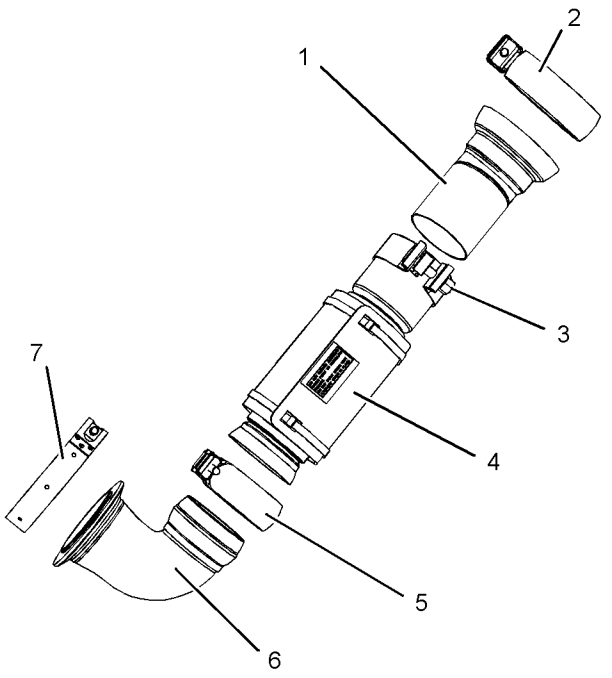

Illustration 28 g03180056

Typical example

(1) Tube assembly
(4) Bellows
(6) Elbow

(2) Tighten the ball clamp to the following torque. .....35 N·m (26 lb ft)

(3) Tighten the clamp to the following torque. .....55 N·m (41 lb ft)

(5) Tighten the ball clamp to the following torque. .....35 N·m (26 lb ft)

(7) Tighten the V-band clamp to the following torque. .....12 N·m (106 lb in)

i05287843

Diesel Particulate Filter (Through Flow Diesel Particulate Filter (DPF))

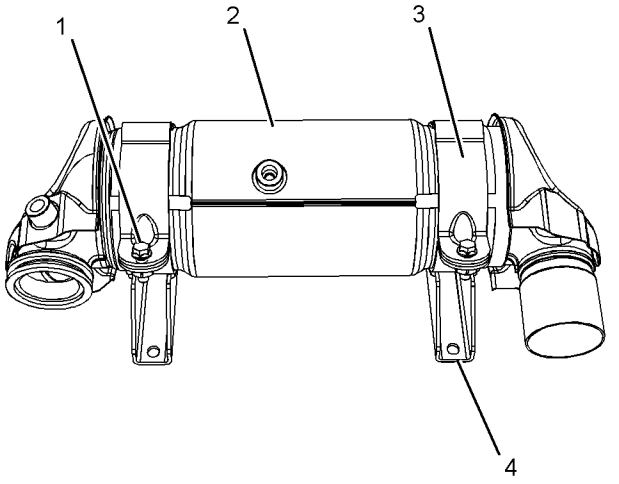

Illustration 29 g03358495

Typical example

(2) Diesel Particulate Filter (DPF)
(3) Clamps
(4) Mounting bracket

(1) Tighten the bolts to an initial torque.....8 N·m (71 lb in)

(1) Tighten the bolts to a second torque. .....16 N·m (12 lb ft)

(1) Tighten the bolts to a final torque. .....25 N·m (18 lb ft)

i05287571

Diesel Particulate Filter (Wall Flow Diesel Particulate Filter (DPF))

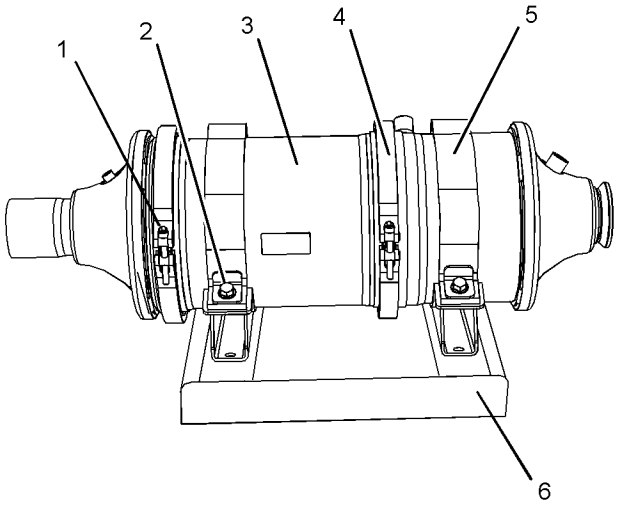

Illustration 30 g03358816

Typical example

(3) Diesel Particulate Filter (DPF)
(4) Clamps
(5) Clamps
(6) Mounting bracket

(1) Tighten the bolts to the following torque.....9 N·m (80 lb in)

(2) Tighten the bolts to an initial torque.....8 N·m (71 lb in)

(2) Tighten the bolts to a second torque. .....16 N·m (12 lb ft)

(2) Tighten the bolts to a final torque. .....25 N·m (18 lb ft)

i05239470

Camshaft

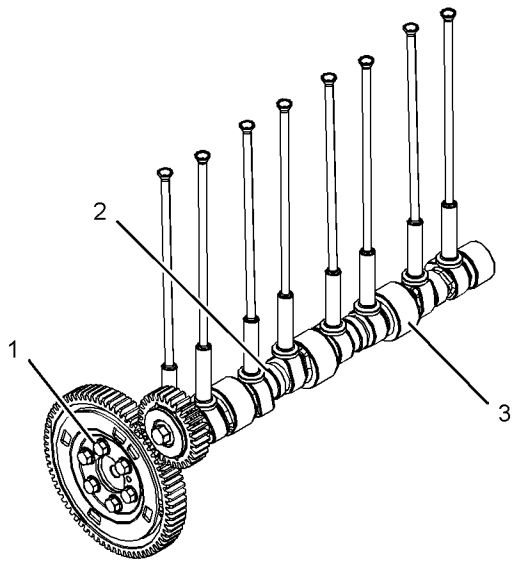

Illustration 31 g02844377
Typical example

(1) Bolts

Torque for the bolts .....25 N·m (18 lb ft)

(2) End play of a camshaft..... 0.1 to 0.3 mm (0.00394 to 0.01181 inch)

Maximum permissible end play of a worn camshaft .....0.3 mm (0.01181 inch)

(3) The diameters of the camshaft journals are given in the following tables.

Table 3

Camshaft Journals from the Front End of the Engine	Standard Diameter
1 Front	53.995 to 54.045 mm (2.12578 to 2.12775 inch)
2, 3 and 4	49.975 to 50.025 mm (1.96752 to 1.96948 inch)
5 Rear	39.975 to 40.025 mm (1.57382 to 1.57578 inch)

Check the camshaft lobes for visible damage. If a new camshaft is installed, you must install new lifters.

i04411212

Camshaft Bearings

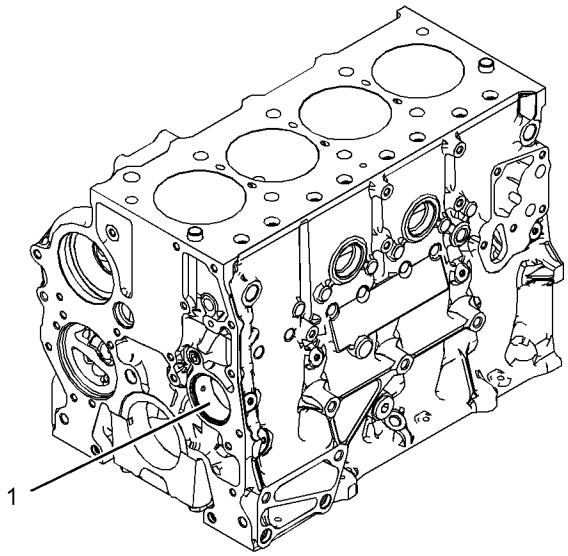

Illustration 32 g02608336
Typical example

(1) The diameter of the installed camshaft bearing .....54.083 to 54.147 mm (2.12925 to 2.13177 inch)

i05240691

Engine Oil Filter Base

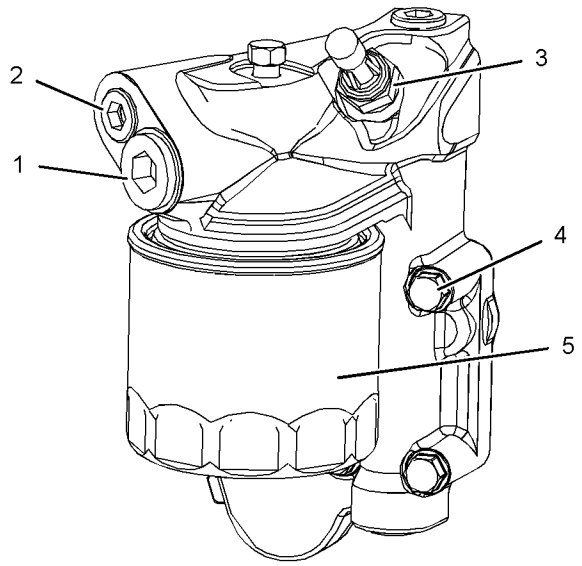

Illustration 33 g02659546
Typical example

(1) Tighten the plug to the following torque. .....30 N·m (22 lb ft)

(2) Tighten the plug to the following torque. .....30 N·m (22 lb ft)

(3) Tighten the engine oil pressure switch to the following torque.....35 N·m (26 lb ft)

(4) Tighten the bolts to the following torque.....25 N·m (18 lb ft)

(5) Tighten the filter to the following torque. .....30 N·m (22 lb ft)

i05240850

Engine Oil Cooler

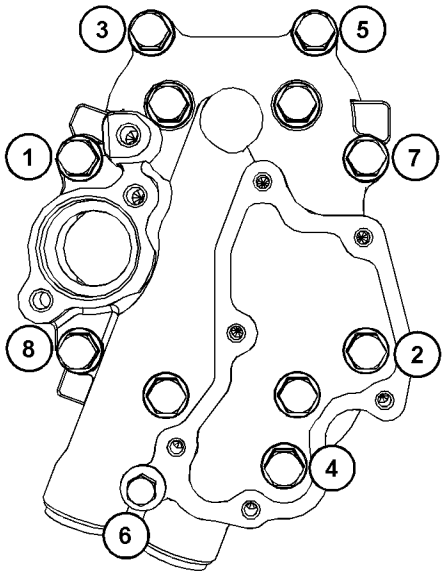

Illustration 34 g02871598

Typical example

Tighten the setscrews in the sequence shown in illustration 34 to the following torque. .....22 N·m (16 lb ft)

i04346369

Engine Oil Pump

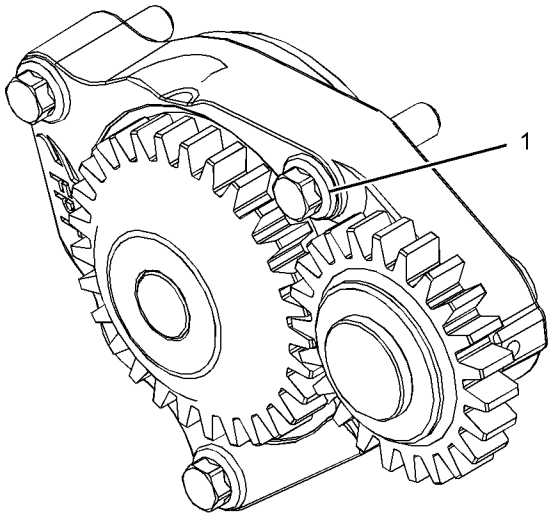

Illustration 35 g02501357

Typical example

(1) Tighten the bolts to an initial torque.....15 N·m (11 lb ft)

(1) Tighten the bolts to a final torque. .....25 N·m (18 lb ft)

i04333169

Engine Oil Pressure

The minimum oil pressure at normal operating temperature and at an engine speed of 750 rpm is the following value. .....200 kPa (29 psi)

The minimum oil pressure at normal operating temperature and at an engine speed of 2400 rpm is the following value. .....400 kPa (58 psi)

i05288769

Engine Oil Pan
(Cast Iron Oil Pan)

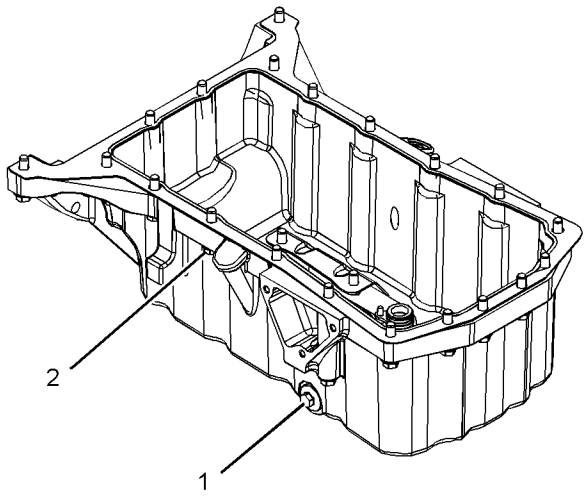

Illustration 36 g02676701
Typical example

(1) Tighten the drain plug to the following torque.
.....50 N·m (37 lb ft)

Tighten the fasteners (2) to a torque of 70 N·m (52 lb ft). Tighten the fasteners in sequence that is shown in illustration 37 .

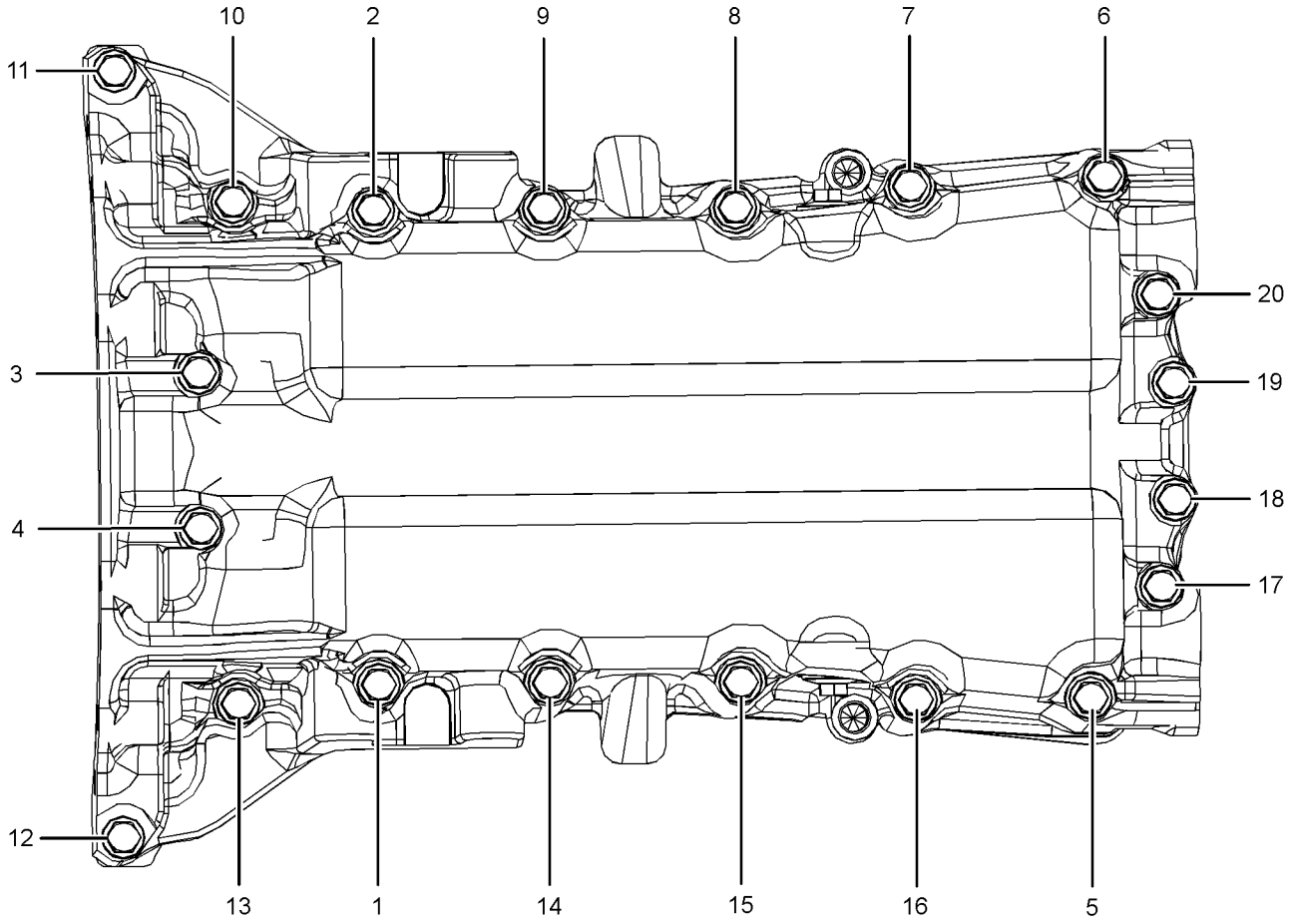

Illustration 37 g02904098

Tightening sequence for the deep tunnel oil pan

Tighten the fasteners (2) to a torque of 70 N·m (52 lb ft). Tighten the fasteners in sequence that is shown in illustration 38 .

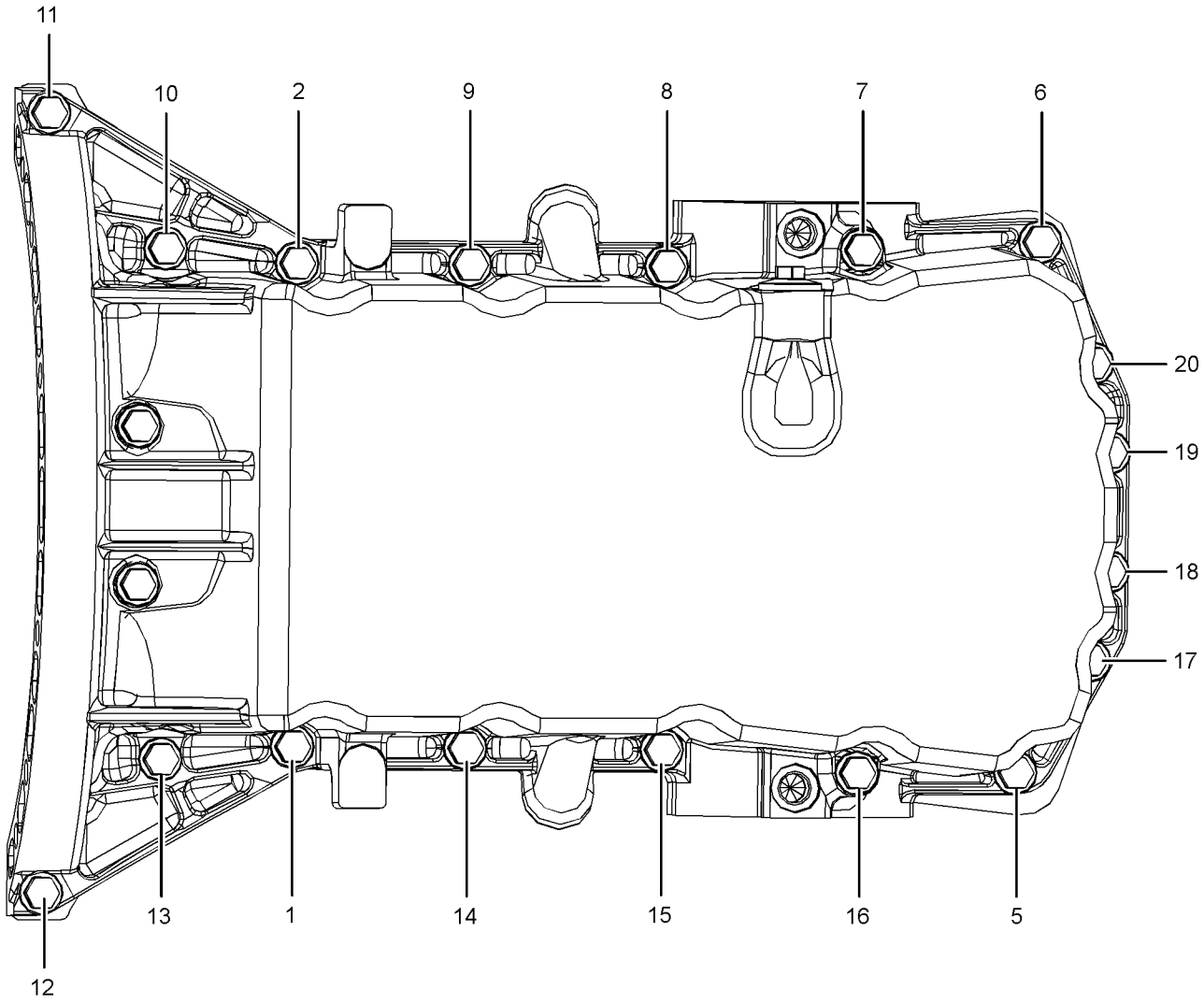

Illustration 38 g02904216

Tightening sequence for the flat bottom oil pan

i04790655

Engine Oil Pan
(Aluminum Oil Pan)

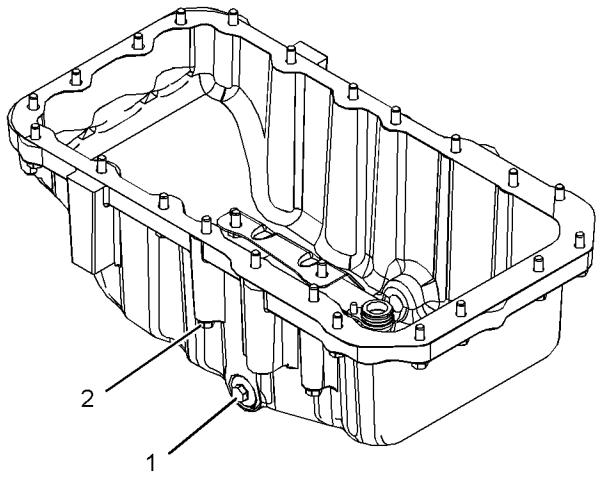

Illustration 39 g02906220
Typical example

(1) Tighten the drain plug to the following torque.
.....50 N·m (37 lb ft)

Tighten the fasteners (2) in sequence that is shown in illustration 40 . Tighten the M8 fasteners to an initial torque of 7.5 N·m (66 lb in). Tighten the M10 fasteners to an initial torque of 13.5 N·m (10 lb ft).

Tighten the fasteners (2) in sequence that is shown in illustration 40 . Tighten the M8 fasteners to a final torque of 25 N·m (18 lb ft). Tighten the M10 fasteners to a final torque of 45 N·m (33 lb ft).

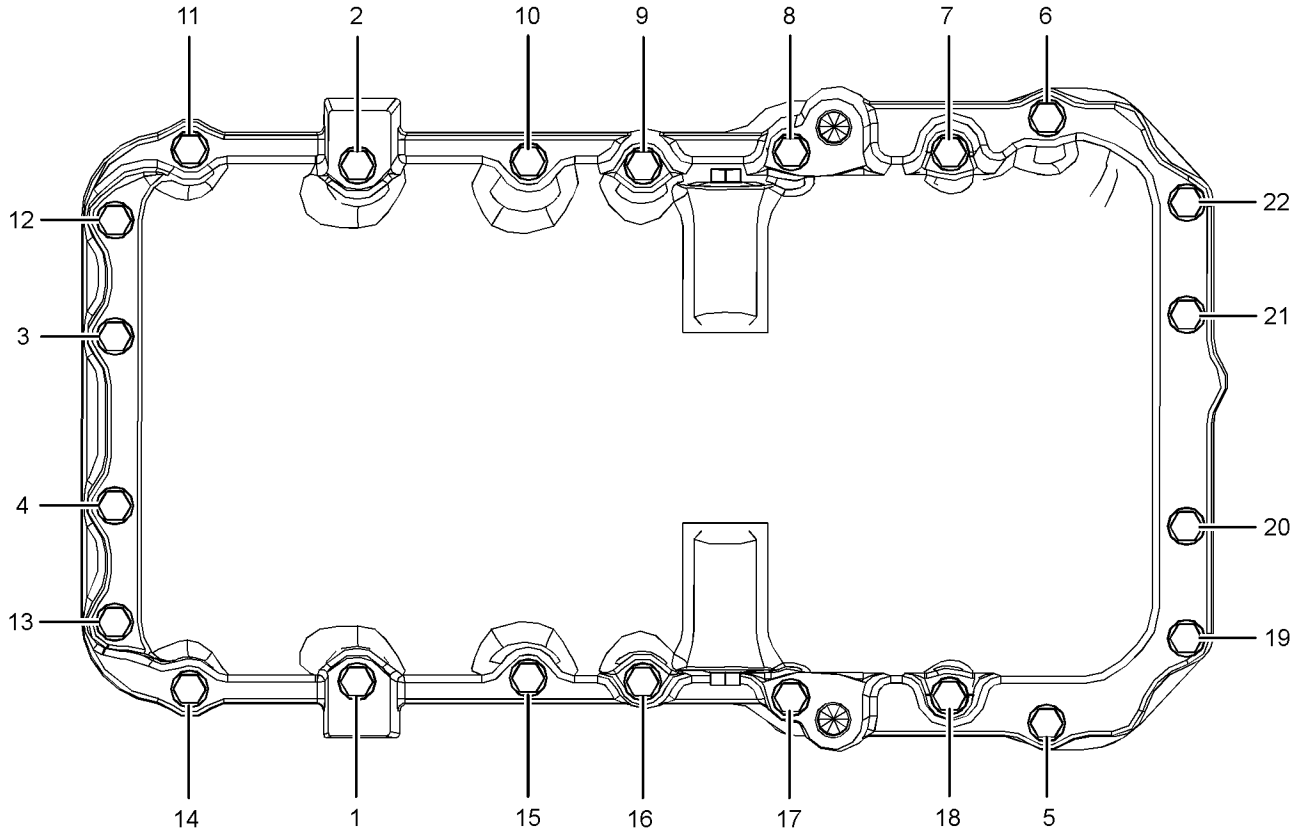

Illustration 40 g02906221

Tightening sequence

i04789574

Engine Oil Pan
(Pressed Steel Oil Pan)

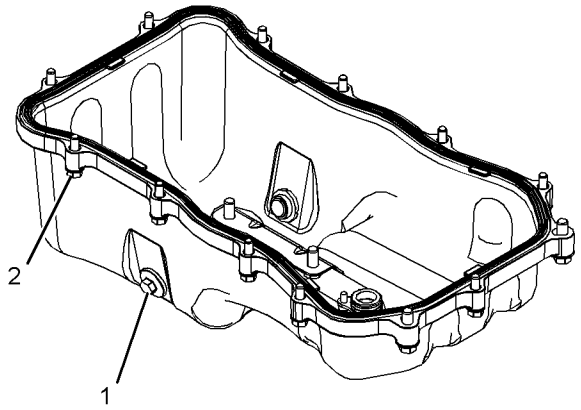

Illustration 41 g02904316

Typical example

(1) Tighten the drain plug to the following torque.
.....50 N·m (37 lb ft)

Tighten the fasteners (2) in sequence that is shown in illustration 42 . Tighten the M8 fasteners to an initial torque of 7.5 N·m (66 lb in). Tighten the M10 fasteners to an initial torque of 13.5 N·m (10 lb ft).

Tighten the fasteners (2) in sequence that is shown in illustration 42 . Tighten the M8 fasteners to a final torque of 25 N·m (18 lb ft). Tighten the M10 fasteners to a final torque of 45 N·m (33 lb ft).

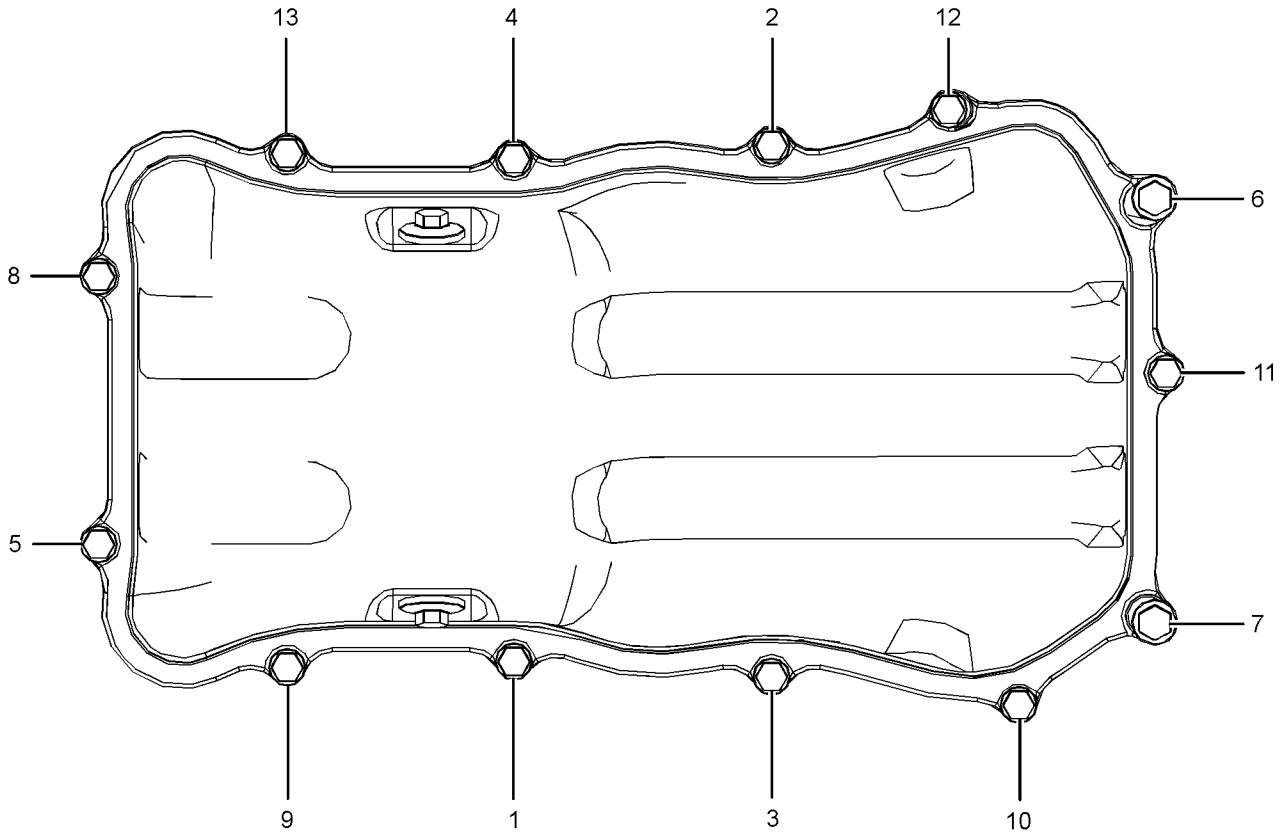

Illustration 42 g02904337

Tightening sequence for the pressed steel oil pan

i05239495

Crankcase Breather

For the correct procedures to remove and install the crankcase breather, refer to Disassembly and Assembly, “Crankcase Breather - Remove” and Disassembly and Assembly, “Crankcase Breather - Install”.

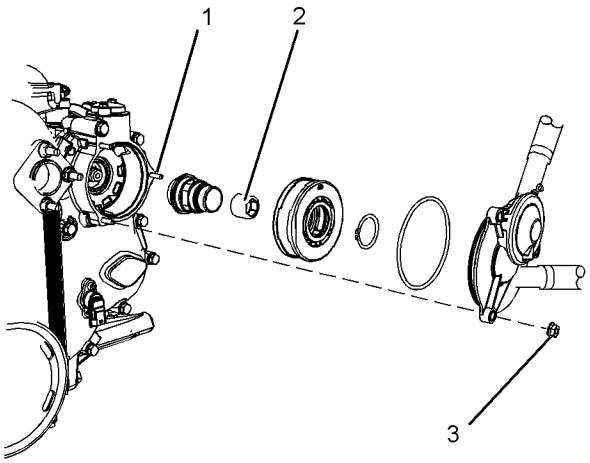

Illustration 43 g02721003

Typical example

(1) Tighten the studs to the following torque.....8 N·m (71 lb in)

(2) Tighten the insert to the following torque. .....85 N·m (63 lb ft)

(3) Tighten the nuts to the following torque. .....10 N·m (89 lb in)

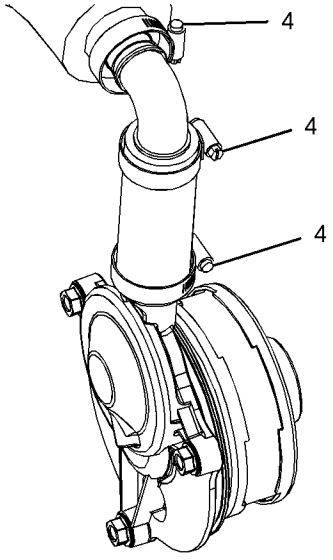

Illustration 44 g02621860

Typical example

(4) Tighten the clamps to the following torque. .....5 N·m (44 lb in)

i04335212

Water Temperature Regulator and Housing

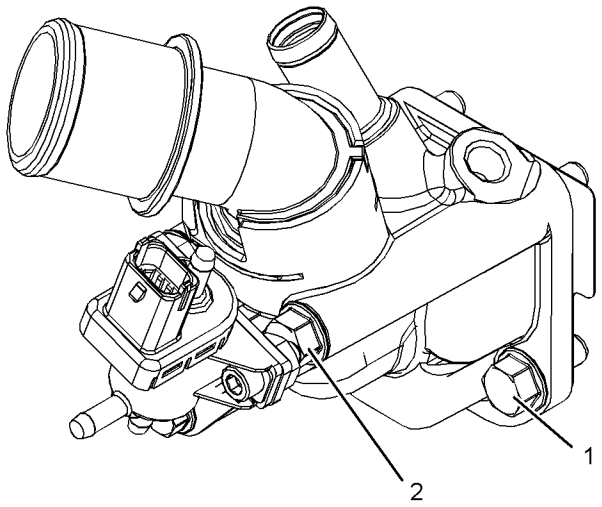

Illustration 45 g02842121

Typical example

Torque for the vent plug .....40 N·m (30 lb ft)

Torque for the bolts (1) and (2) that fasten the housing to the cylinder head .....25 N·m (18 lb ft)

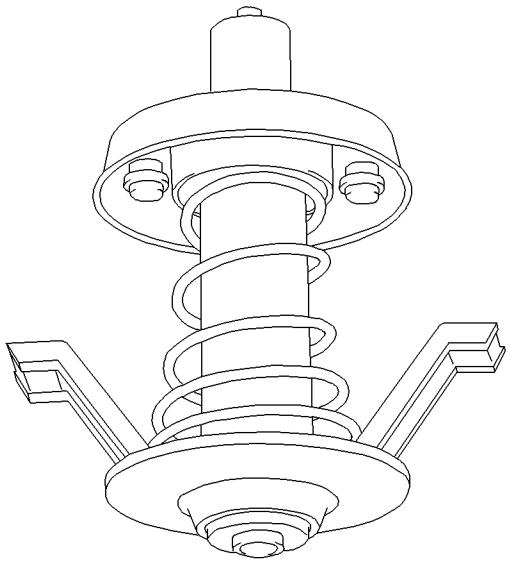

Illustration 46 g00906121

Typical example

Water temperature regulator

Opening temperature.....77° to 81°C (171° to 196°F)
Maximum open length of 11.5 mm (0.45276 inch) is achieved at the following temperature.
..... 130° C (266° F)

i04335189

Water Pump

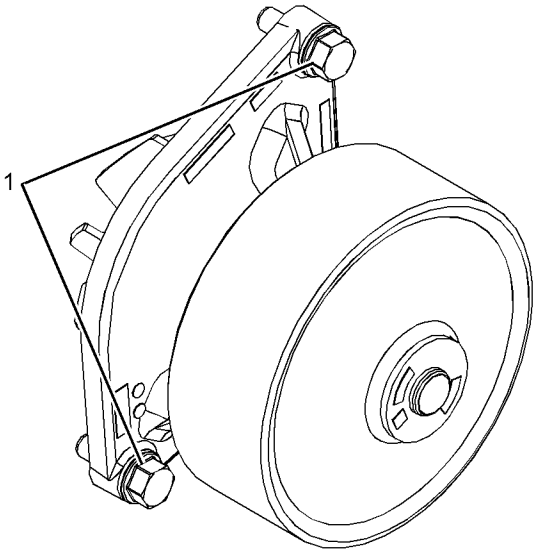

Illustration 47 g02490498
Typical example

(1) Tighten the setscrews to the following torque.
.....25 N·m (18 lb ft)

i04332590

Cylinder Block

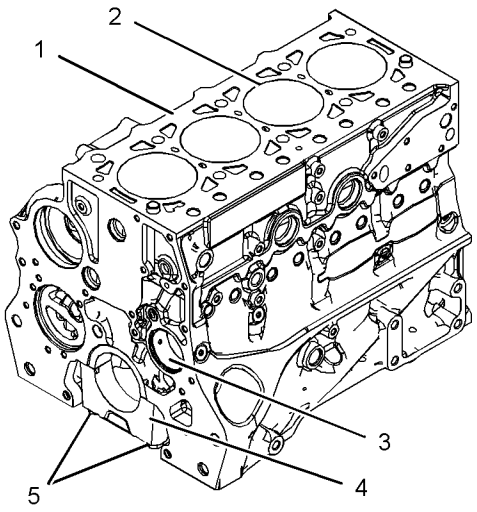

Illustration 48 g02488336
Typical example

(1) Cylinder block

(2) Cylinder bore..... 99.00 to 99.02 mm (3.8976 to 3.8984 inch)

(3) Camshaft bearings

Diameter of the bushing in the cylinder block for the number 1 camshaft bearing
..... 59.222 to 59.248 mm (2.33157 to 2.33259 inch)
Diameter of the bore in the cylinder block for numbers 2, 3 and 4 camshaft journals
.....50.069 to 50.119 mm (1.97122 to 1.97319 inch)
Diameter of the bore in the cylinder block for the number 5 camshaft journal
.....40.069 to 40.119 mm (1.57752 to 1.57949 inch)

(4) Main bearings

Bore in the cylinder block for the number 1, 2, 3 and 4 main bearings.....80.588 to 80.614 mm (3.17275 to 3.17377 inch)

Bore in the cylinder block for the number 5 main bearings .....87.588 to 87.614 mm (3.44834 to 3.44936 inch)

(5) Main bearing cap bolts

Use the following procedure in order to install the main bearing cap bolts:

1. Apply clean engine oil to the threads of the main bearing cap bolts.

2. Put the main bearing caps in the correct position that is indicated by a number on the top of the main bearing cap. Install the main bearing caps with the locating tabs in correct alignment with the recess in the cylinder block.

3. Evenly tighten the main bearing cap bolts.

Initial torque for the main bearing cap bolts.....50 N·m (37 lb ft)

Final torque for the main bearing cap bolts. .....80 N·m (59 lb ft)

4. After torquing the bolts for the main bearing caps, the bolts must be rotated for an additional 90 degrees.

Note: Ensure that the crankshaft can rotate freely.

i04605731

Crankshaft

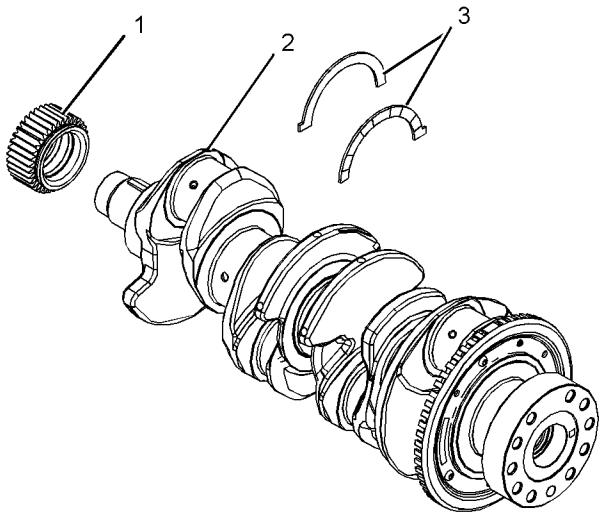

Illustration 49 g02155393

Typical example

(1) Crankshaft gear
(2) Crankshaft
(3) Crankshaft thrust washers

Maximum permissible temperature of the gear for installation on the crankshaft..... 180 °C (356 °F)

Maximum permissible temperature of the timing gear for the balancer (if equipped) for installation on the crankshaft..... 180 °C (356 °F)

Note: Refer to Disassembly and Assembly for the correct procedure to remove and install the timing gear for the balancer.

The end play of a new crankshaft..... 0.1 to 0.41 mm (0.00394 to 0.01614 inch)

Standard thickness of thrust washer .....2.69 to 2.75 mm (0.10591 to 0.10827 inch)

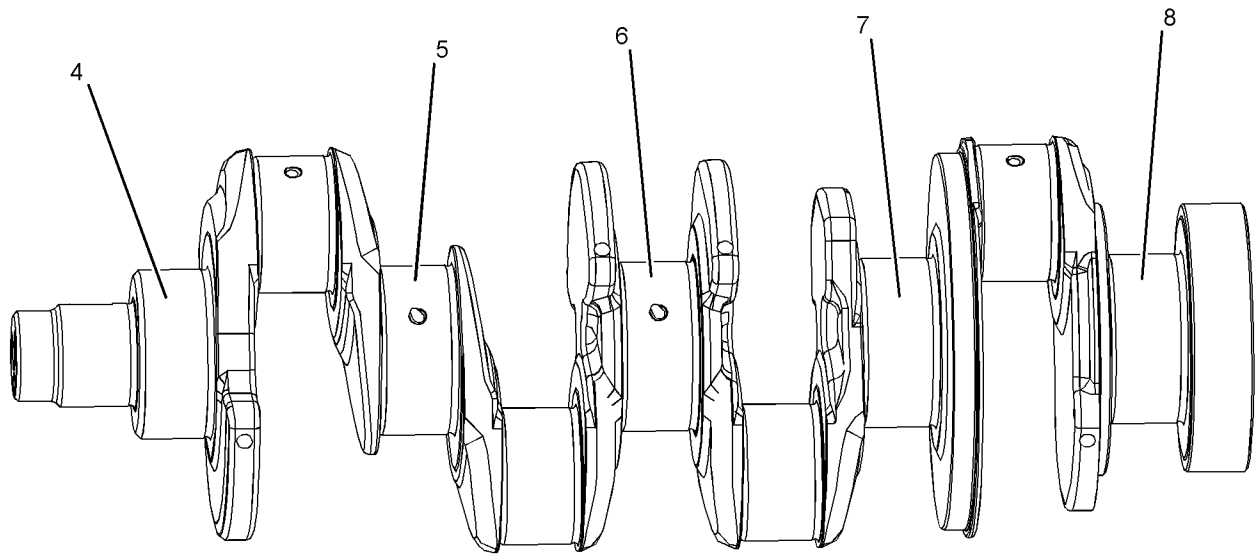

Illustration 50 g02155394

Typical example

(4) Journal 1
(5) Journal 2
(6) Journal 3
(7) Journal 4
(8) Journal 5

Refer to table 4 for the run out of the crankshaft journals.

Table 4

Journal	Run out of the Journals
(1)	Mounting
(2)	0.03 mm (0.00118 inch)
(3)	0.03 mm (0.00118 inch)
(4)	0.03 mm (0.00118 inch)
(5)	Mounting

Inspect the crankshaft for wear or for damage. For more information regarding the servicing of the crankshaft, contact the Global Technical Support Center.

Refer to Specifications, “Connecting Rod Bearing Journal” for more information on the connecting rod bearing journals and connecting rod bearings.

Refer to Specifications, “Main Bearing Journal” for information on the main bearing journals and for information on the main bearings.

i04332830

Connecting Rod Bearing Journal

The original size of the connecting rod bearing journal on the crankshaft .....71.970 to 71.990 mm (2.83346 to 2.83425 inch)

Maximum permissible wear of a bearing journal on the crankshaft when a new connecting rod is installed .....0.04 mm (0.00157 inch)

Width of the connecting rod bearing journals on the crankshaft .....37.962 to 38.038 mm (1.4946 to 1.4976 inch)

Radius of the fillet of the connecting rod bearing journals ..... 1.6 to 1.7 mm (0.06299 to 0.06693 inch)

Surface finish of connecting rod bearing journals .....Ra 0.3 microns maximum

Surface finish of radii ..... Ra 0.3 microns maximum

i04332763

Main Bearing Journal

The original size of the main bearing journal .....83.980 to 84.000 mm (3.30629 to 3.30708 inch)

Maximum permissible wear of the main bearing journals .....0.040 mm (0.0016 inch)

Radius of the fillet of the main bearing journals .....3.875 to 4.125 mm (0.15256 to 0.16240 inch)

Surface finish of bearing journals and crank pins .....Ra 0.2 microns

Surface finish of radii .....Ra 0.4 microns

Width of new main bearing journal where the thrust washer is installed .....35.235 to 35.165 mm (1.3872 to 1.3844 inch)

Width of new main bearing journal where the thrust washer is not installed .....35.25 to 35.15 mm (1.38779 to 1.38386 inch)

The shell for the main bearings

The shells for the main bearings are available for remachined journals which have the following oversize dimensions.

Oversize bearing shell ..... 0.127 mm (0.005 inch)
Oversize bearing shell ..... 0.254 mm (0.010 inch)
Oversize bearing shell ..... 0.508 mm (0.020 inch)

Thickness at center of the shells of oversize bearing shell 0.25 mm (0.010 inch) .....2.226 to 2.232 mm (0.08764 to 0.08787 inch)

Thickness at center of the shells of oversize bearing shell 0.50 mm (0.020 inch) .....2.353 to 2.359 mm (0.09264 to 0.09287 inch)

Thickness at center of the shells of oversize bearing shell 0.76 mm (0.030 inch) .....2.480 to 2.486 mm (0.09764 to 0.09787 inch)

Width of the main bearing shells ... 26.32 to 26.58 mm (1.03622 to 1.04645 inch)

Clearance between the bearing shell and the main bearing journals .....0.032 to 0.102 mm (0.00126 to 0.00402 inch)

i04479212

Connecting Rod

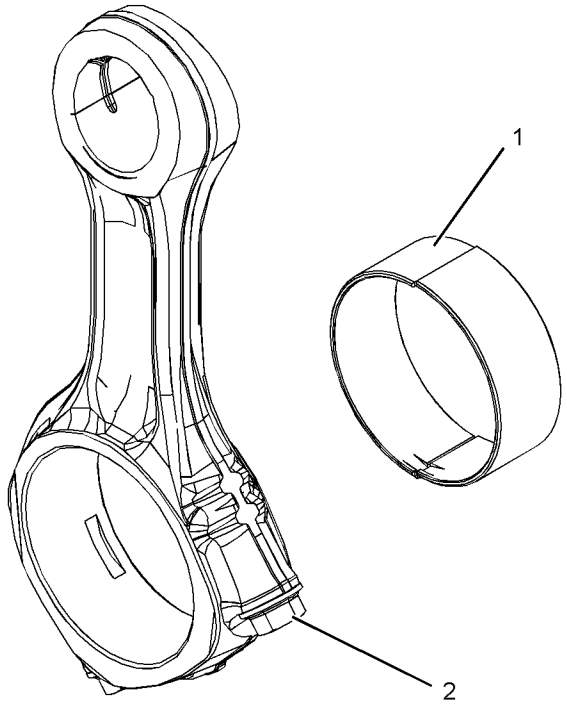

Illustration 51 g02859356
Typical example

(1) The bearing shell for the connecting rod

For the correct procedure to install the bearing shell for the connecting rod, refer to Disassembly and Assembly, “Pistons and Connecting Rods - Assemble”.

Table 5

Thickness of Connecting Rod Bearing at the Center	1.955 to 1.968 mm (0.07697 to 0.07748 inch)
Thickness of Bearing Cap at the Center	1.955 to 1.968 mm (0.07697 to 0.07748 inch)
Bearing Clearance	0.080 to 0.035 mm (0.00315 to 0.00138 inch)

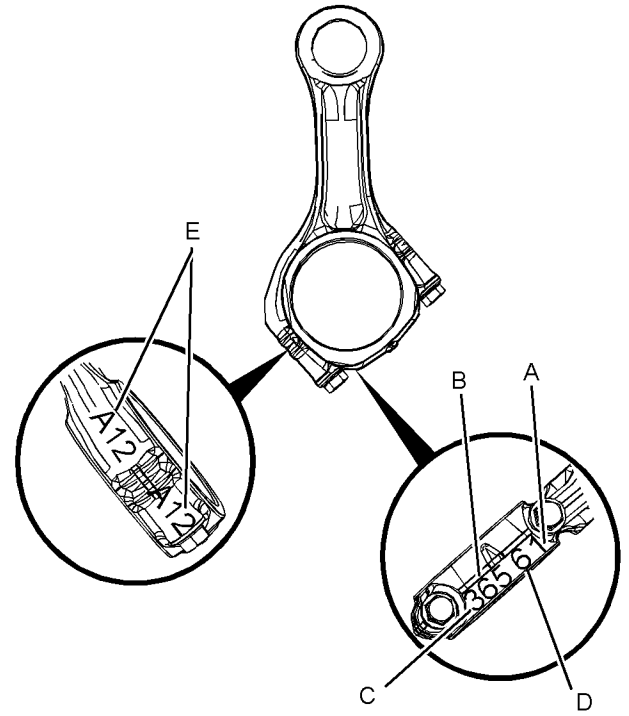

Illustration 52 g02844317

Typical example

(A) Class of weight
(B) Part number
(C) Date of production (DD/MM)
(D) Date of production (Year)
(E) Serial number markings on the connecting rod and connecting rod cap

The mating surfaces of the connecting rod are produced by hydraulically fracturing the forged connecting rod. Ensure that the correct cap for the connecting rod is installed with the correct connecting rod. Ensure that the serial numbers (E) for both components match. Refer to illustration 52 for more information.

(2) Torque of the setscrews for the connecting rod .....50 N·m (37 lb ft)

Tighten the setscrews (2) for the connecting rod for an additional 70 degrees. The setscrews for the connecting rod must be replaced after this procedure.

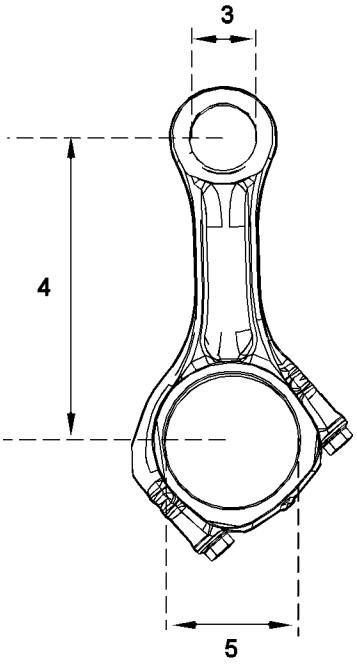

Illustration 53 g02859357

Typical example

(3) Diameter of the finished bore for the piston pin .....36.01 to 36.02 mm (1.41771 to 1.41811 inch)

(4) Distance between the parent bores .....219.05 to 219.1 mm (8.6240 to 8.6260 inch)

(5) Diameter for the finished bore for the connecting rod bearing.....67.833 to 67.848 mm (2.67059 to 2.67118 inch)

Refer to table 6 for the length of connecting rod.

Table 6

Specifications for the Connecting Rod
Length Of The Connecting Rod
161.8 to 162.2 mm (6.37 to 6.38 inch)

i04332709

Piston and Rings

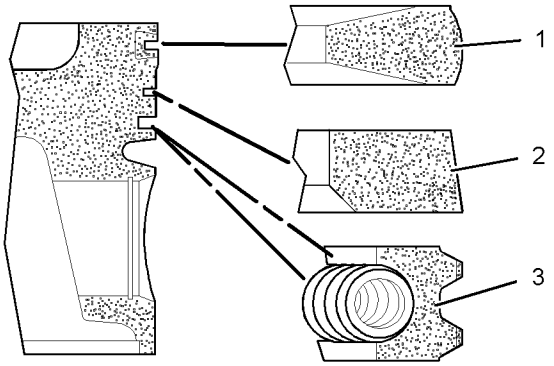

Illustration 54 g01155119
Typical example

(1) Top compression ring

Width of top compression ring
.....2.068 to 2.097 mm (0.08142 to 0.08256 inch)

Ring gap.....0.112 to 0.157 mm
(0.00441 to 0.00618 inch)

Note: When you install a new top compression ring, make sure that the word "TOP" is facing the top of the piston. New top piston rings have a black identification mark. The identification mark must be on the left of the ring end gap when the top piston ring is installed on an upright piston.

(2) Intermediate compression ring

Width of intermediate compression ring
.....1.970 to 1.990 mm (0.07756 to 0.07835 inch)

The clearance between a new intermediate compression ring and the piston groove in a new piston.....0.06 to 0.16 mm
(0.00236 to 0.00630 inch)

Ring gap.....0.060 to 0.100 mm
(0.00236 to 0.00394 inch)

Note: When you install a new intermediate compression ring, make sure that the word "TOP" is facing the top of the piston. New intermediate rings have a blue identification mark. The identification mark must be on the left of the ring end gap when the top piston ring is installed on an upright piston.

(3) The oil control ring

Width of oil control ring.....2.470 to 2.490 mm
(0.09724 to 0.09803 inch)

The clearance between a new oil control ring and the groove in a new piston .....0.015 to 0.05 mm
(0.00059 to 0.00197 inch)

Ring gap.....0.050 to 0.090 mm
(0.00197 to 0.00354 inch)

Note: When you install a new oil control ring, make sure that the word "TOP" is facing the top of the piston. New oil control rings have a red identification mark. The identification mark must be on the left of the ring end gap when the top piston ring is installed on an upright piston. The oil control ring is a two-piece ring that is spring loaded. A pin is used in order to hold both ends of the spring of the oil control ring in position. The ends of the spring of the oil control ring must be installed opposite the end gap of the oil control ring.

Note: Ensure that the ring end gaps of the piston rings are spaced 120 degrees from each other.

Piston

Note: An arrow which is marked on the piston crown must be toward the front of the engine.

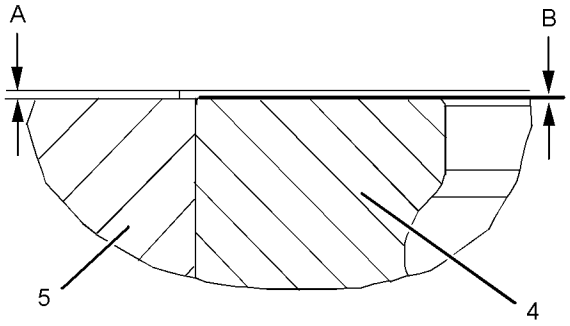

Illustration 55 g02659840
Typical example
(4) Piston
(5) Cylinder bore

Measure the piston height above the cylinder block. Refer to Systems Operation, Testing and Adjusting, "Piston Height - Inspect" for the correct procedure. Refer to table 7 to select the correct gasket.

Table 7

Piston Height (A)	Engine Gasket Thickness (B)
0 to 0.07 mm (0 to 0.00276 inch)	0.80 mm (0.03150 inch)
0.08 to 0.22 mm (0.00315 to 0.00866 inch)	0.70 mm (0.02756 inch)

Width of top groove in the piston ..... 2.21 mm
(0.08701 inch)

Width of second groove in new piston
.....2.05 to 2.07 mm (0.08071 to 0.08150 inch)

Width of third groove in new piston.... 2.54 to 2.56 mm
(0.10000 to 0.10079 inch)

Piston pin

Diameter of a new piston pin
.....35.996 to 35.999 mm
(1.41716 to 1.41728 inch)

i04335149

Piston Cooling Jet

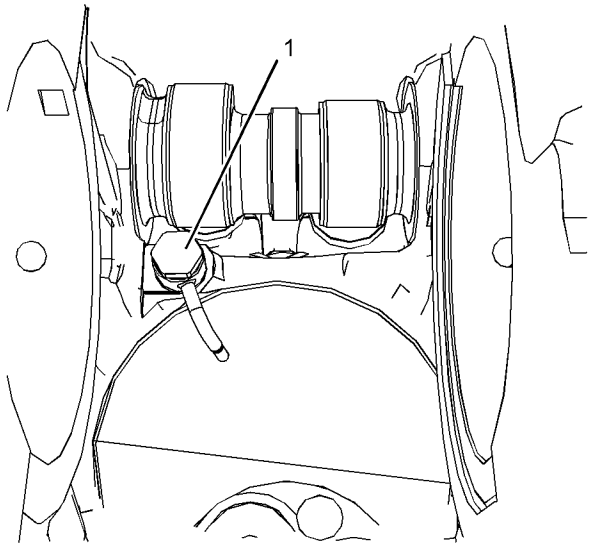

Illustration 56 g02490436

Typical example

(1) Tighten the bolt to the following torque. .....18 N·m
(13 lb ft)

Piston Cooling Jet Alignment

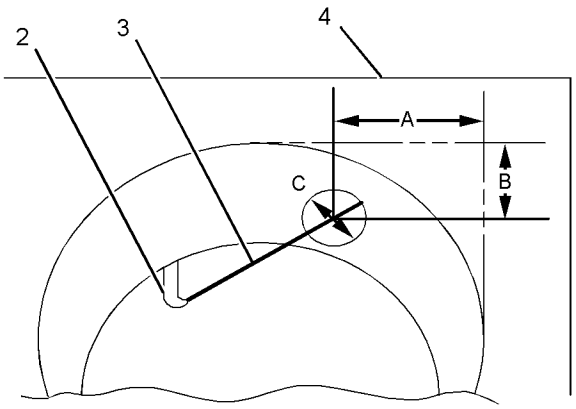

Illustration 57 g01352578

(2) Piston cooling jet
(3) Rod
(4) Cylinder block

Use the following procedure in order to check the alignment of the piston cooling jet.

1. Insert rod (3) into the end of the piston cooling jet (2). Rod (3) has a diameter of 1.70 mm (0.067 inch). Rod (3) must protrude out of the top of the cylinder block.

2. Dimension (A) is 50.75 mm (1.9980 inch) and dimension (B) is 9.35 mm (0.3681 inch). Dimension (A) and dimension (B) are tangential to the cylinder bore (4).

3. The position of the rod (3) must be within dimension (C). Dimension (C) is 14 mm (0.5512 inch).

Note: Ensure that the rod (3) cannot damage the piston cooling jet when the alignment is checked. The piston cooling jets cannot be adjusted. If a piston cooling jet is not in alignment, the piston cooling jet must be replaced.

i04555081

Balancer

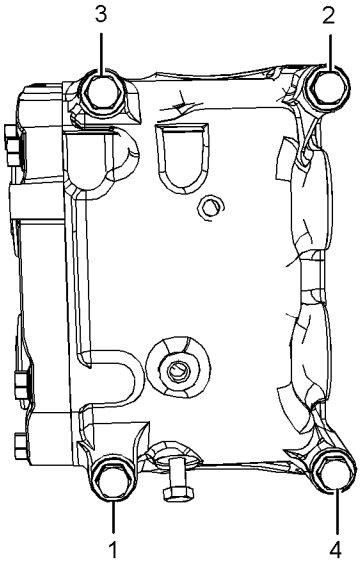

Illustration 58 g02727673

Typical example

Tighten the bolts in the sequence that is shown in illustration 58 to the following torque. .....70 N·m (52 lb ft)

Backlash values

Backlash between the balancer gears .....0.075 to 0.165 mm (0.00295 to 0.00650 inch)

Backlash between the balancer gear and the crankshaft gear .....0.110 to 0.210 mm (0.00433 to 0.00827 inch)

i05240669

Front Housing and Covers

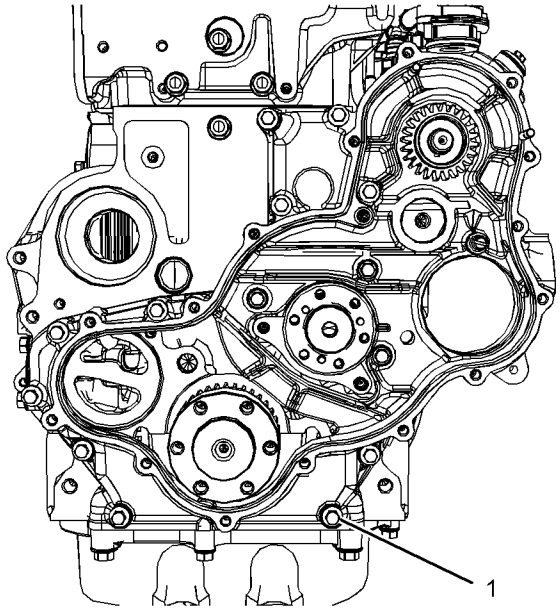

Illustration 59 g02909257

Typical example

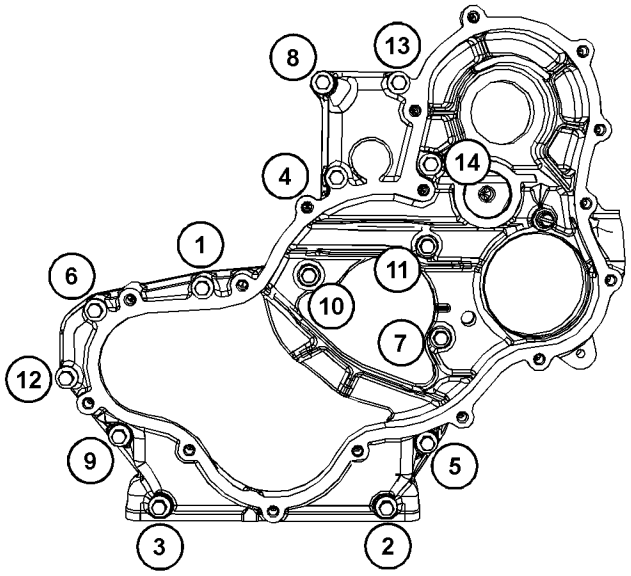

Illustration 60 g02951436

Typical example

(1) Tighten the setscrews in the sequence that is shown in illustration 60 to the following torque. .....25 N·m (18 lb ft)

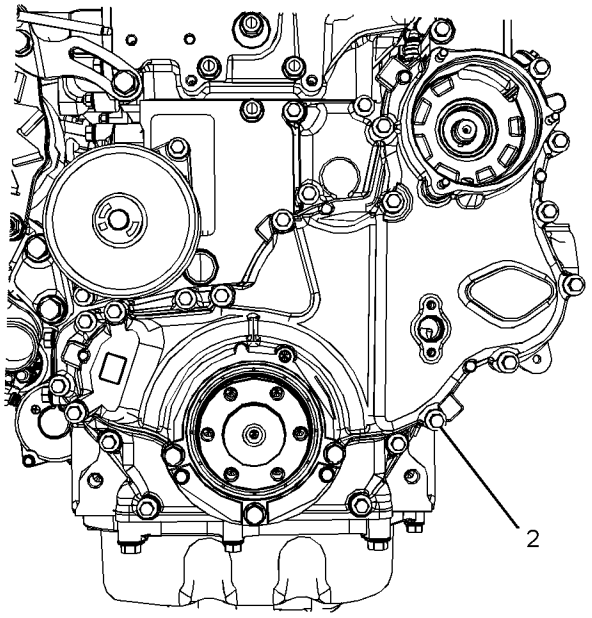

Illustration 61 g02909258
Typical example

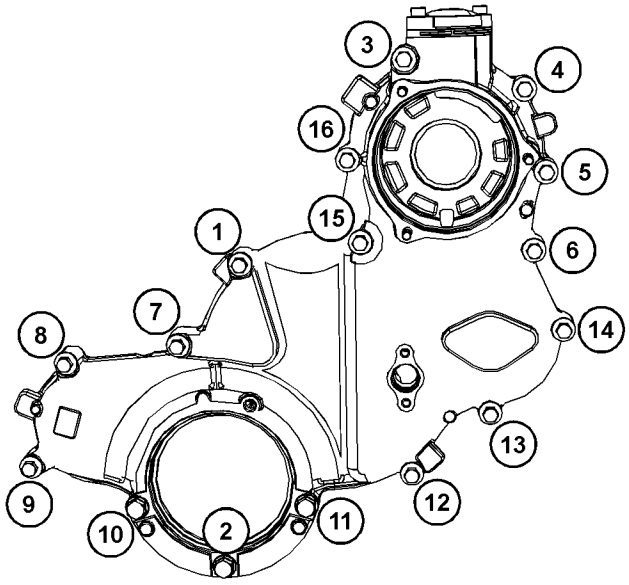

Illustration 62 g02727967
Typical example

(2) Tighten the setscrews for the front cover in the sequence that is shown in illustration 62 to the following torque.....25 N·m (18 lb ft)

i05240675

Gear Group (Front)

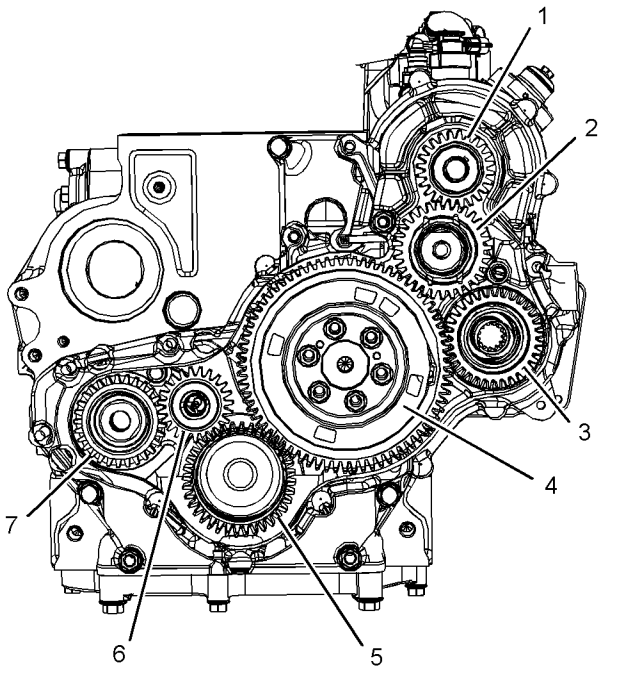

Illustration 63 g02659957
Typical example

(1) Fuel injection pump drive gear

Initial torque for the nut.....18 N·m (13 lb ft)

Final torque for the nut.....90 N·m (66 lb ft)

Number of teeth 24

(2) Idler gear

Torque for the bolt for the idler gear .....50 N·m (37 lb ft)

Width of idler gear and bearing assembly .....20.8 mm (0.81890 inch)

Inside diameter of idler gear bearings ..... 36.990 to 37.075 mm (1.45630 to 1.45964 inch)

Outside diameter of idler gear hub ..... 36.950 to 36.975 mm (1.45472 to 1.45571 inch)

Clearance of idler gear bearing on hub ..... 0.015 to 0.125 mm (0.00059 to 0.00492 inch)

The end play of the idler gear ..... 0.3 to 0.483 mm (0.01181 to 0.01902 inch)

Number of teeth 31

(4) Camshaft gear

Torque for the bolts for the camshaft gear ..... 25 N·m (18 lb ft)

Number of teeth 72

(5) Crankshaft gear

Bore diameter of crankshaft gear ..... 50.88 to 50.92 mm (2.00315 to 2.00472 inch)

Outside diameter of crankshaft hub ..... 50.984 to 51.000 mm (2.00724 to 2.00787 inch)

Clearance of gear on crankshaft ... −0.06 to -0.12 mm (−0.00236 to -0.00472 inch)

Number of teeth 36

(6) Oil pump idler gear

Inside diameter of oil pump idler gear bearing ..... 16.012 to 16.043 mm (0.63039 to 0.63161 inch)

Outside diameter of oil pump idler gear shaft ..... 15.987 to 16.000 mm (0.62941 to 0.62992 inch)

End play of the oil pump idler gear ..... 0.05 to 0.15 mm (0.00197 to 0.00591 inch)

(7) Oil pump gear

Inside diameter of oil pump gear bearing ..... 15.932 to 15.957 mm (0.62724 to 0.62823 inch)

Outside diameter of oil pump gear shaft ..... 15.987 to 16.013 mm (0.62941 to 0.63043 inch)

End play of the oil pump gear ..... 0.05 to 0.15 mm (0.00197 to 0.00591 inch)

Backlash values

Backlash between the fuel injection pump gear (1) and the idler gear (2) ..... 0.07 to 0.17 mm (0.00276 to 0.00669 inch)

Backlash between the idler gear (2) and the accessory drive gear (if equipped) (3) ..... 0.07 to 0.17 mm (0.00276 to 0.00669 inch)

Backlash between the idler gear (2) and the camshaft gear (4) ..... 0.07 to 0.17 mm (0.00276 to 0.00669 inch)

Backlash between the camshaft gear (4) and the crankshaft gear (5) ..... 0.07 to 0.17 mm (0.00276 to 0.00669 inch)

Backlash between the crankshaft gear (5) and the oil pump idler gear (6) ..... 0.07 to 0.17 mm (0.00276 to 0.00669 inch)

Backlash between the oil pump idler gear (6) and the oil pump gear (7) ..... 0.07 to 0.17 mm (0.00276 to 0.00669 inch)

i04346169

Flywheel

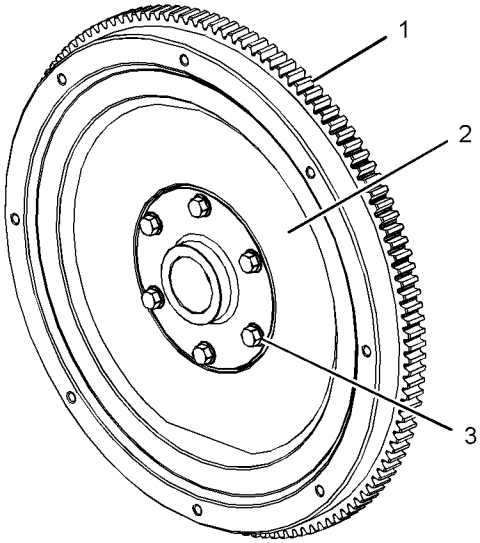

Illustration 64 g02501156

Typical example

(1) Flywheel ring gear

Heat the flywheel ring gear to the following temperature..... 180° C (356° F)

Note: Do not use an oxyacetylene torch to heat the flywheel ring gear.

(2) Flywheel

(3) Bolt

Tighten the flywheel bolts to an initial torque. .....30 N·m (22 lb ft)
Tighten the flywheel bolts to the additional amount. ..... 90 degrees

i04346112

Flywheel Housing

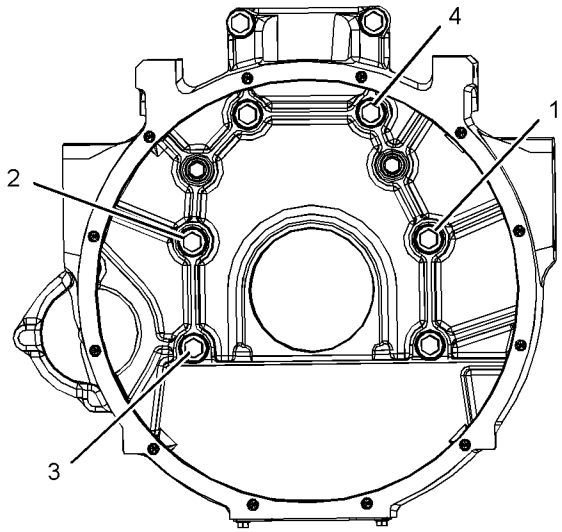

Illustration 65 g02501136
Typical example

Tighten the setscrews in the sequence that is shown in illustration 65 to an initial torque. .....20 N·m (15 lb ft)

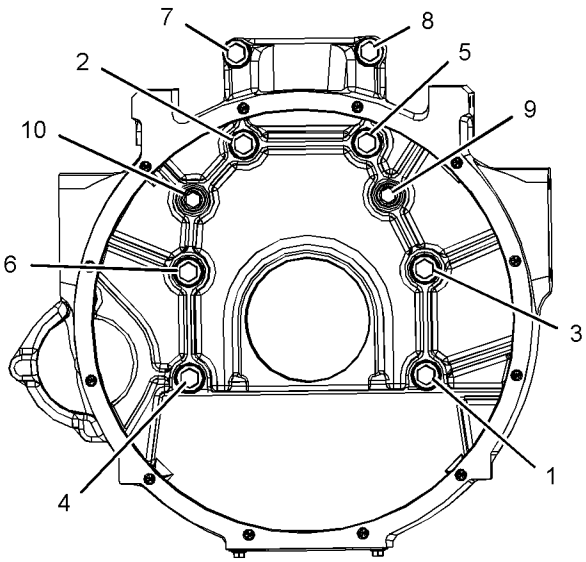

Illustration 66 g02727691
Typical example

Tighten setscrews (1), (2), (3), (4), (5), (6), (7) and (8) in the sequence that is shown in illustration 66 to a final torque. .....110 N·m (81 lb ft)

Tighten setscrews (9) and (10) in the sequence that is shown in illustration 66 to a final torque.....35 N·m (26 lb ft)

i05240730

Crankshaft Pulley

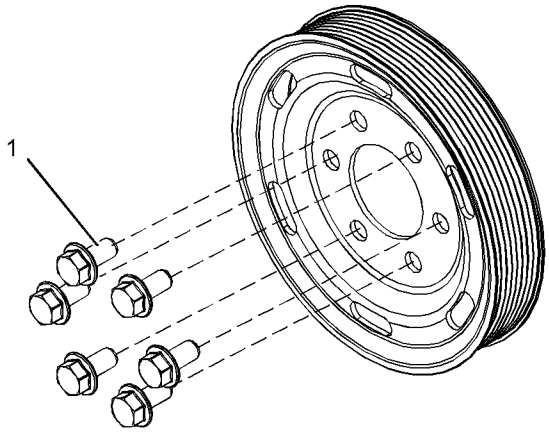

Illustration 67 g02501059
Typical example

(1) Tighten the bolts to the following torque.....45 N·m (33 lb ft)

i05240729

Fan Drive

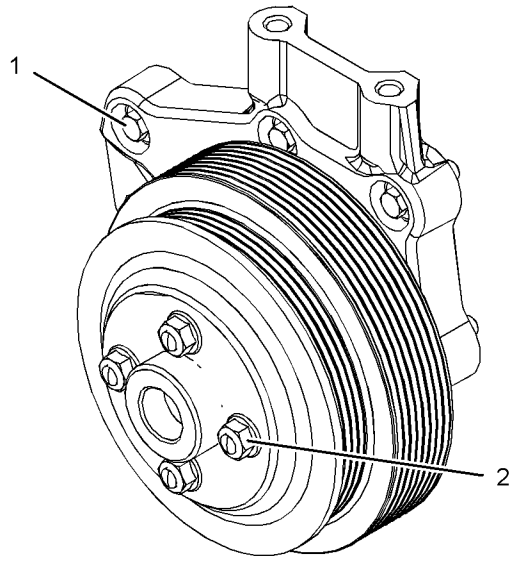

Illustration 68 g02844797
Typical example

(1) Tighten the bolts that secure the fan drive to the engine to the following torque.....25 N·m (18 lb ft)

(2) Tighten the fasteners for the fan support to the following torque.....25 N·m (18 lb ft)

i05240694

Engine Lifting Bracket

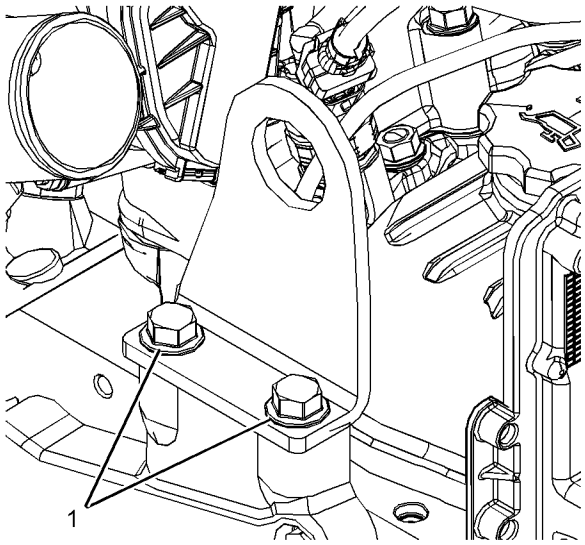

Illustration 69 g02488718
Typical example

(1) Tighten the bolts on the front engine lifting bracket to the following torque.....45 N·m (33 lb ft)

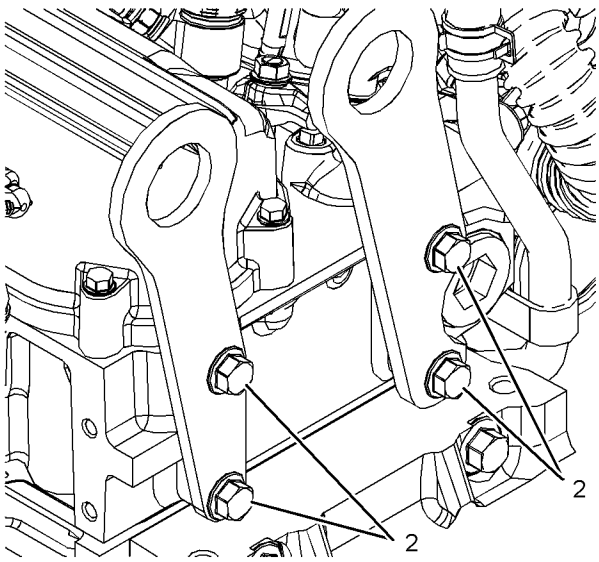

Illustration 70 g02488736
Typical example

(2) Tighten the bolts on the rear engine lifting brackets to the following torque.....65 N·m (48 lb ft)

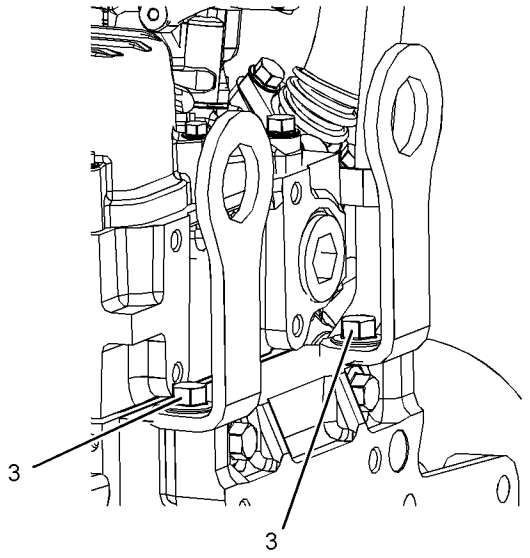

Illustration 71 g03342585
Typical example

(3) Tighten the bolts on the rear engine lifting brackets to the following torque.....110 N·m (81 lb ft)

i05282770

Alternator

12V Alternator

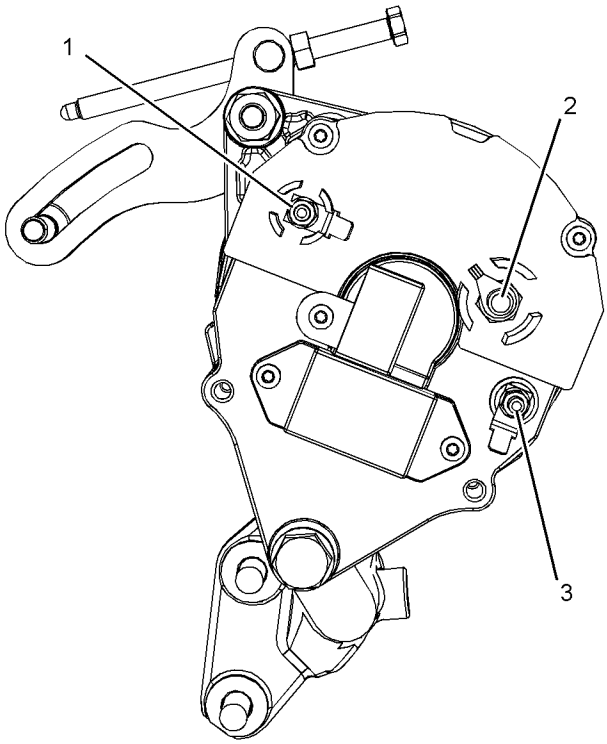

Illustration 72 g03357091
Typical example
(1) Terminal "D+"
(3) Terminal "W"

(2) Terminal "B+"

Tighten the nut on the terminal to the following torque.....11 N·m (97 lb in)

Tighten the nut for the alternator pulley to the following torque.....50 N·m (37 lb ft)

Output

The output of the alternator .....65 Amp

12V Alternator

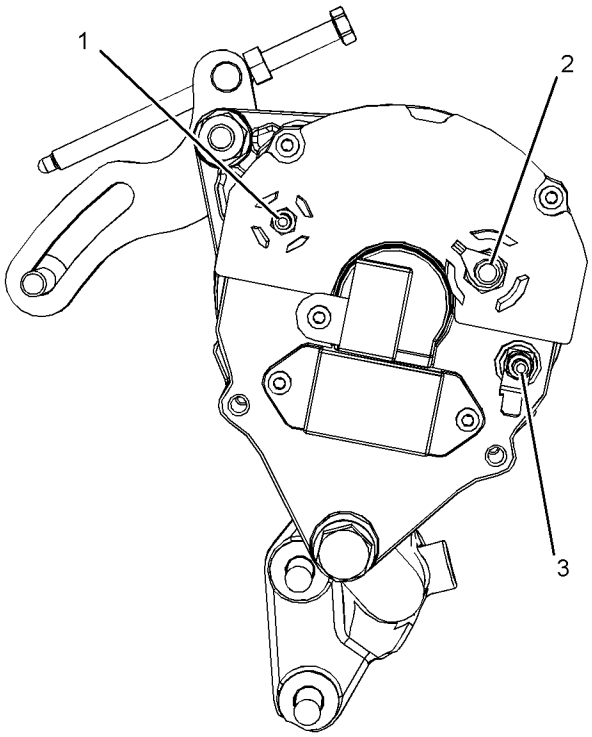

Illustration 73 g03357125

Typical example

(3) Terminal "W"

(1) Terminal "D+"

Tighten the nut on the terminal to the following torque. ..... 3.25 N·m (28.76 lb in)

(2) Terminal "B+"

Tighten the nut on the terminal to the following torque. ..... 11 N·m (97 lb in)

Tighten the nut for the alternator pulley to the following torque..... 50 N·m (37 lb ft)

Output

The output of the alternator ..... 80 Amp

12V Alternators

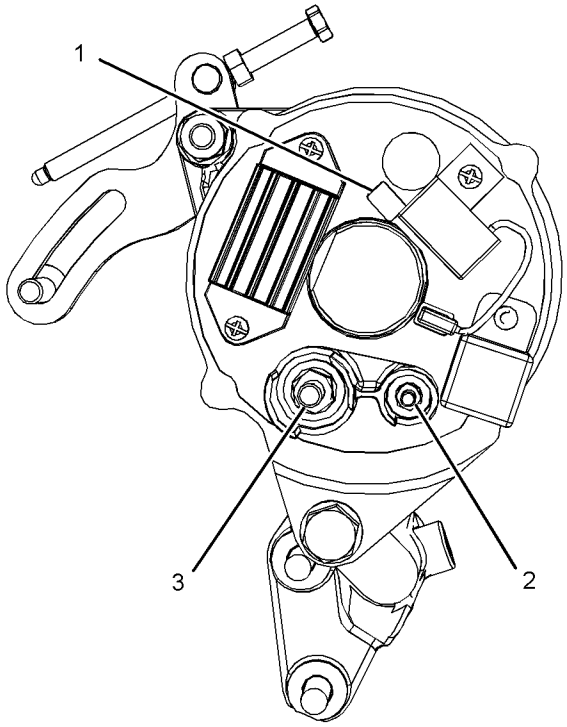

Illustration 74 g03357160

Typical example

(1) Terminal "W"
(2) Terminal "D+"

(3) Terminal "B+"

Tighten the nut on the terminal to the following torque. ..... 7.75 N·m (68.60 lb in)

Tighten the nut for the alternator pulley to the following torque..... 50 N·m (37 lb ft)

Output

The outputs of the alternators ..... 100 Amp, and 120 Amp

24V Alternator

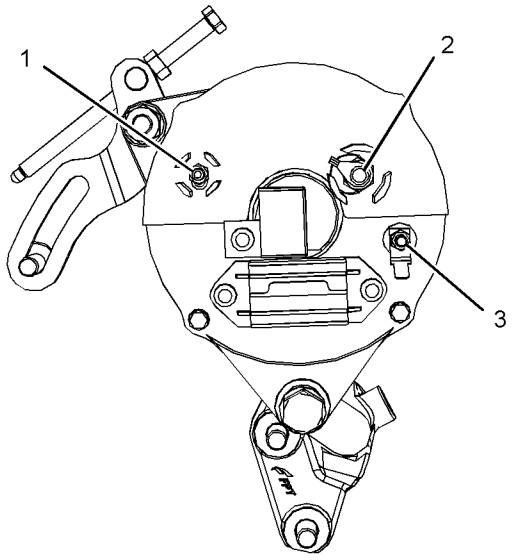

Illustration 75 g02620019

Typical example

(3) Terminal “W”

(1) Terminal “B+”

Tighten the nut on the terminal to the following. .....7.75 N·m (68.60 lb in)

(2) Terminal “D+”

Tighten the nut on the terminal to the following. .....3.25 N·m (28.76 lb in)

Tighten the nut for the alternator pulley to the following torque.....50 N·m (37 lb ft)

Output

The outputs of the alternators .....65 Amp

i04415750

Starter Motor

12 V Starting Motor 3.2 kW

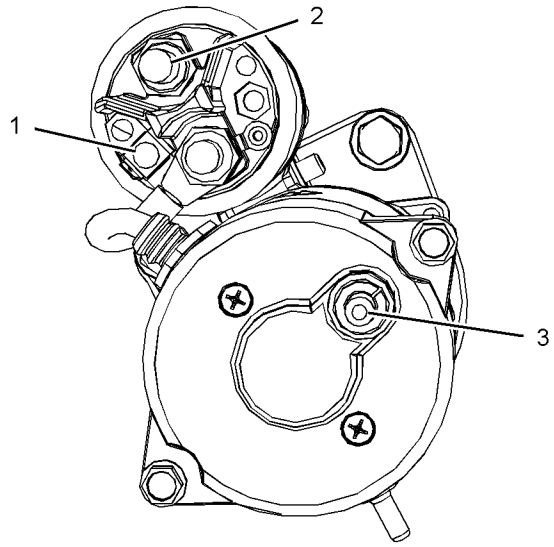

Illustration 76 g02614019

Typical example

(1) Tighten the solenoid terminal to the following torque.....5.8 N·m (51 lb in)

(2) Tighten the positive terminal nut to the following torque.....15 N·m (11 lb ft)

(3) Tighten the negative terminal nut to the following torque.....12 N·m (106 lb in)

12 V Starting Motor 4.2 kW

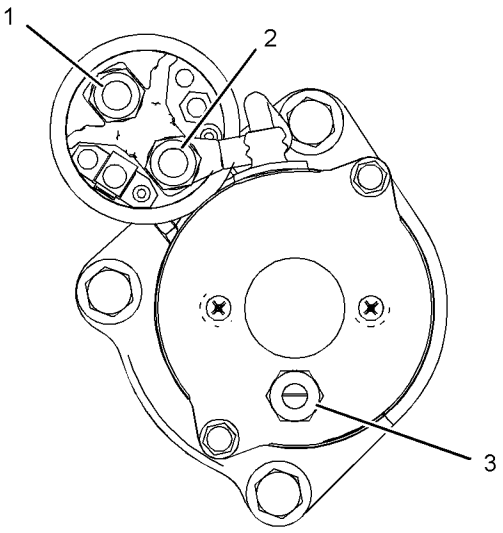

Illustration 77 g02678770

Typical example

(1) Tighten the positive terminal nut to the following torque.....15 N·m (11 lb ft)

(2) Tighten the solenoid terminal to the following torque.....15 N·m (11 lb ft)

(3) Tighten the negative terminal nut to the following torque.....18 N·m (13 lb ft)

24 V Starting Motor 4.5 kW

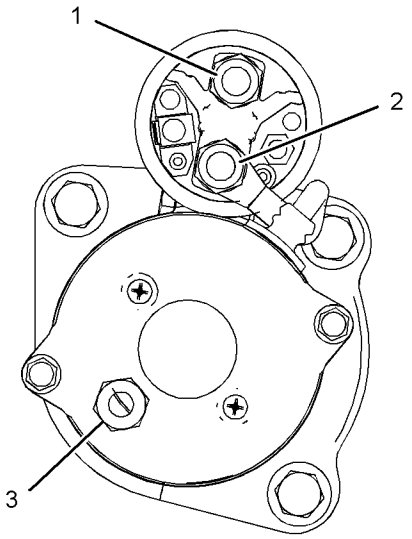

Illustration 78 g02678817
Typical example

(1) Tighten the positive terminal nut to the following torque.....15 N·m (11 lb ft)

(2) Tighten the solenoid terminal to the following torque.....5.8 N·m (51 lb in)

(3) Tighten the negative terminal nut to the following torque.....18 N·m (13 lb ft)

i04346352

Coolant Temperature Sensor

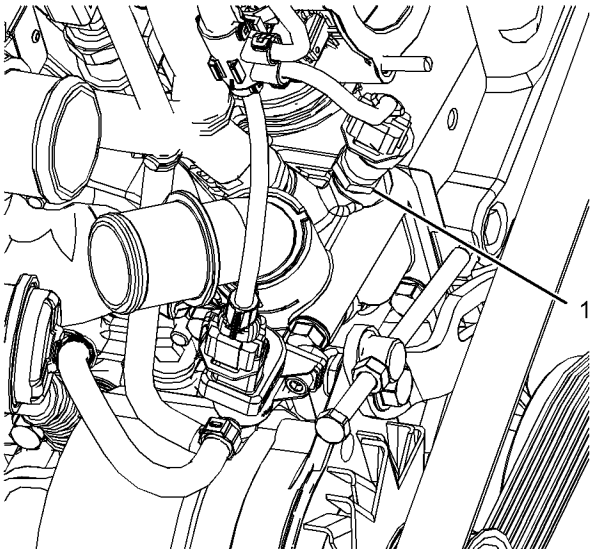

Illustration 79 g02621136
Typical example

(1) Tighten the coolant temperature sensor to the following torque.....25 N·m (18 lb ft)

i05246996

Boost Pressure Sensor
(If equipped)

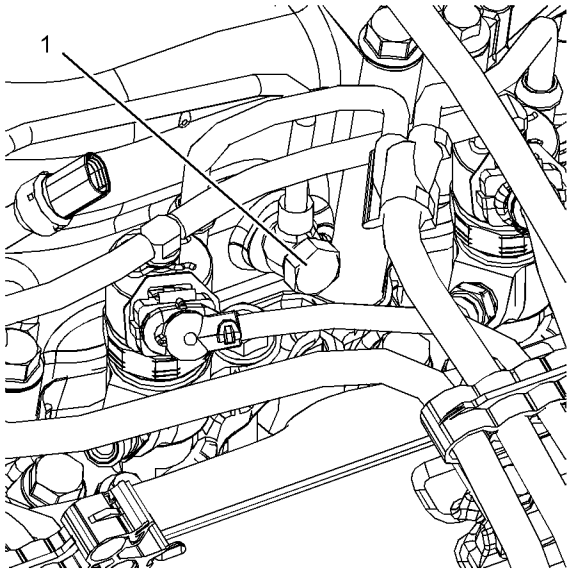

Illustration 80 g03344803
Typical example

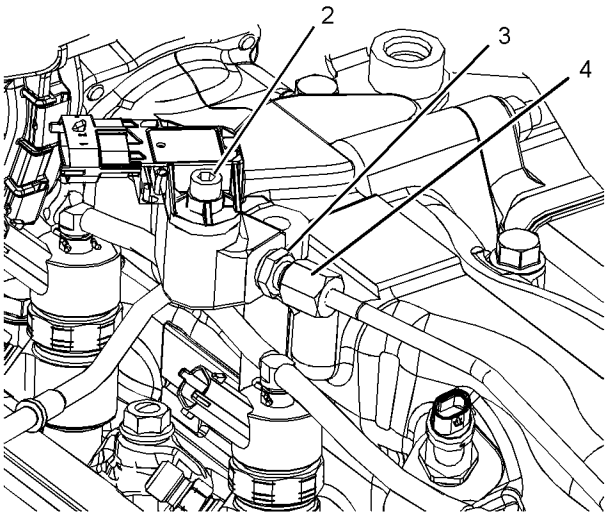

Illustration 81 g03344804
Typical example

(1) Tighten the fastener to the following torque.
.....15 N·m (11 lb ft)

(2) Tighten the fastener to the following torque.
.....10 N·m (89 lb in)

(3) Tighten the sensor to the following torque.
.....10 N·m (89 lb in)

(4) Tighten the fastener to the following torque.
.....15 N·m (11 lb ft)

i04555069

Oxygen Sensor

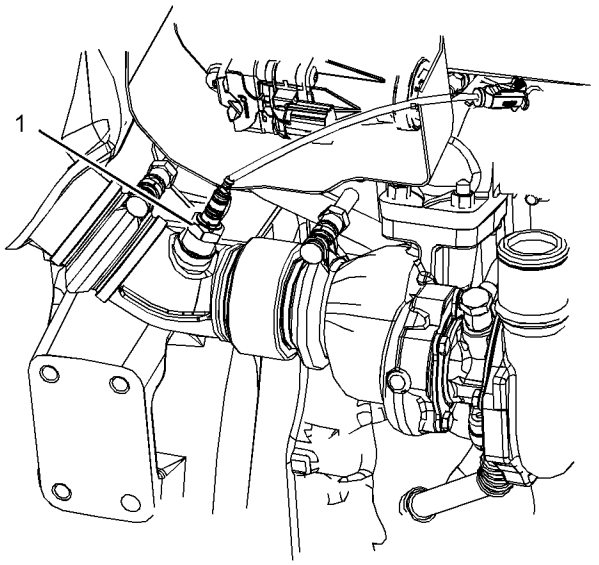

Illustration 82 g02844456
Typical example

(1) Tighten the sensor to the following torque.
.....50 N·m (37 lb ft)

i05246995

Inlet Manifold Temperature Sensor
(If equipped)

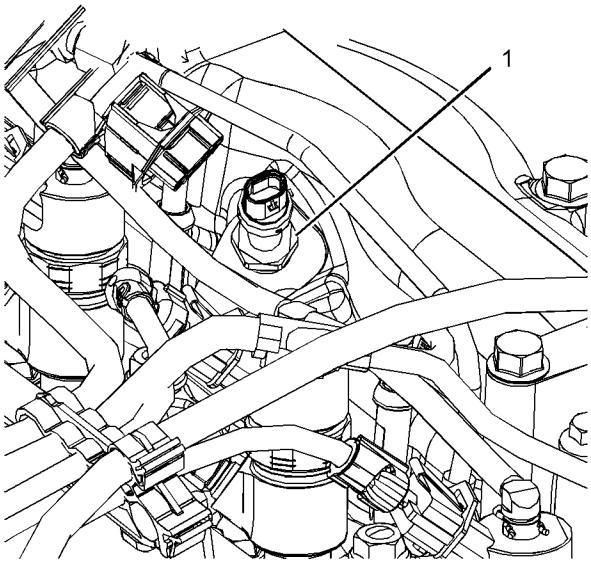

Illustration 83 g03344802
Typical example

Tighten the sensor to the following torque.....15 N·m (11 lb ft)

i04550539

Inlet Manifold Temperature and Pressure Sensor (If equipped)

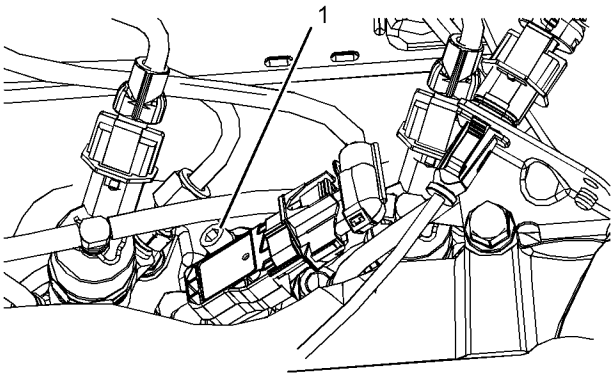

Illustration 84 g02722054

Typical example

(1) Tighten the screw for the inlet manifold air pressure and temperature sensor to the following torque.....10 N·m (89 lb in)

i04550469

Temperature Sensor (DPF Inlet)

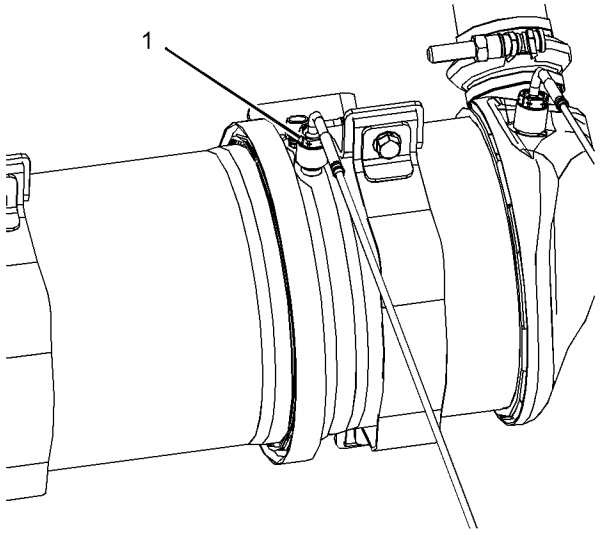

Illustration 85 g02722006

Typical example

(1) Tighten the temperature sensor to the following torque.....45 N·m (33 lb ft)

i04550534

Temperature Sensor (DOC Inlet)

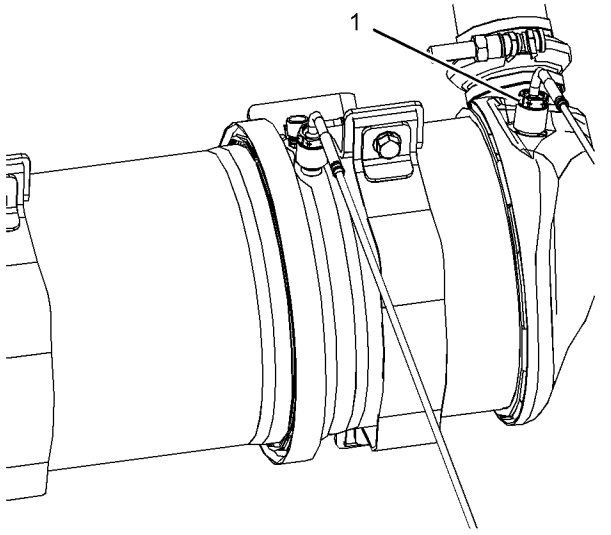

Illustration 86 g02722047

Typical example

(1) Tighten the temperature sensor to the following torque.....45 N·m (33 lb ft)

i05240876

Pressure Sensor (NOx Reduction System)

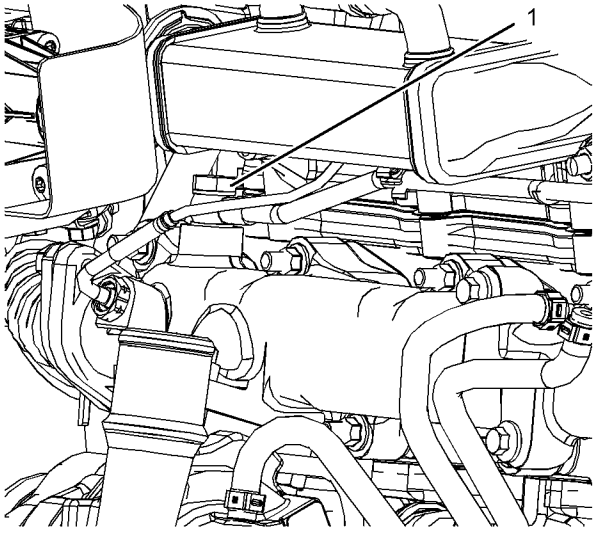

Illustration 87 g02724012
Typical example

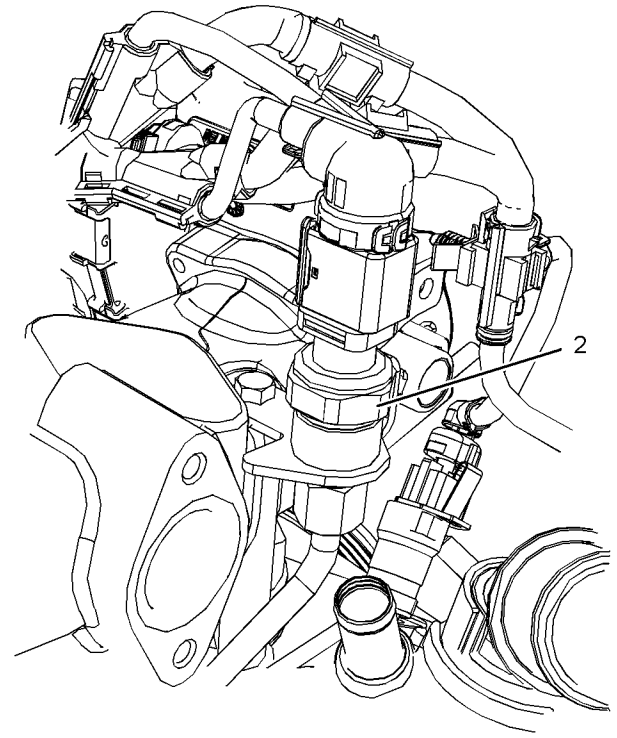

Illustration 88 g03342627
Typical example

(1) Tighten the fastener to the following torque.
.....15 N·m (11 lb ft)

(2) Tighten the sensor to the following torque.
.....15 N·m (11 lb ft)

i05240937

Temperature Sensor (NOx Reduction System)

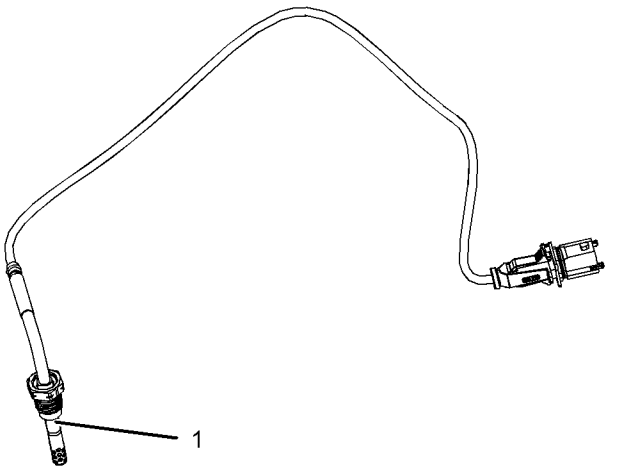

Illustration 89 g03342646
Typical example

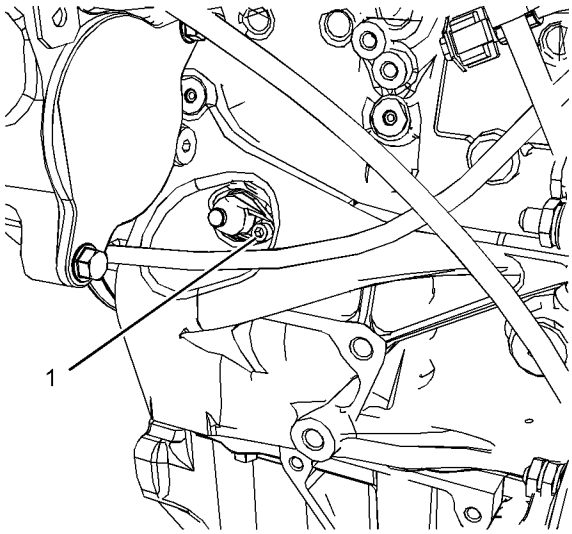

Illustration 91 g02620180
Typical example

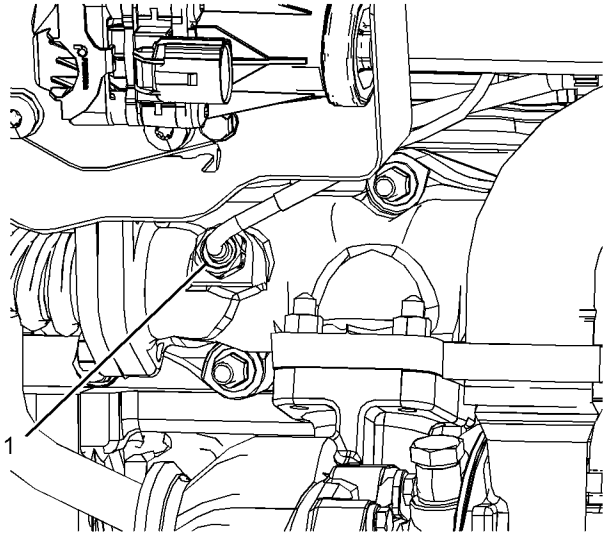

Illustration 90 g02722380
Typical example

(1) Tighten the sensor to the following torque. .....45 N·m (33 lb ft)

Operating voltage .....5 VDC

i05239559

Speed/Timing Sensor

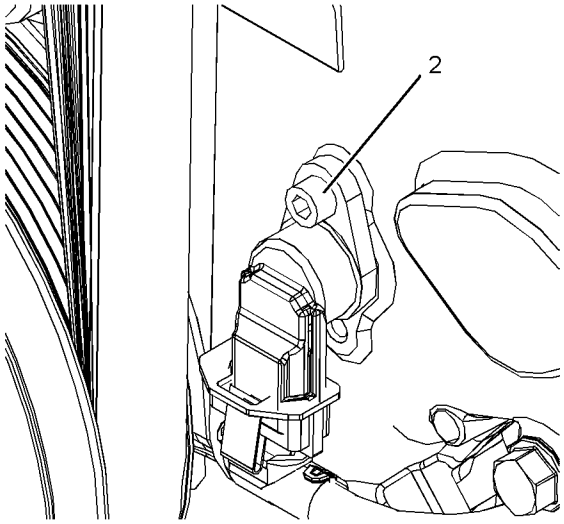

Illustration 92 g02620181
Typical example

(1) Tighten the screw for the crankshaft position sensor to the following torque.....10 N·m (89 lb in)

(2) Tighten the screw for the camshaft position sensor to the following torque.....10 N·m (89 lb in)

i05241792

Electronic Control Module

Tighten the M6 fasteners to the following torque
.....8 N·m (71 lb in)

i04425773

Glow Plugs

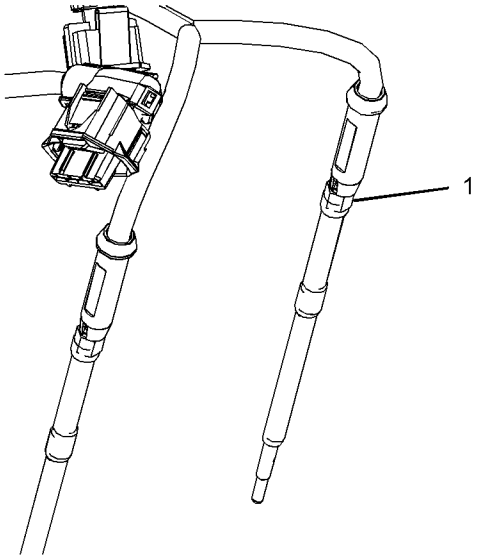

Illustration 93 g02621690
Typical example

(1) Tighten the glow plugs to the following torque.
.....9 N·m (80 lb in)

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