



## Service

<b>Chassis ID</b> N 913139	<b>Path</b> 20/Specifications//Specifications
<b>Model</b> VN	<b>Identity</b> 154003236
<b>Publish date</b> 12/22/2020	<b>ID/Operation</b>

## Tightening Torques and Patterns

### Engine component torque specifications (Critical Fasteners)

Note: All components are to be clean and free from foreign material or corrosion. Assemblies are to be made using suitable tools and procedures so that no permanent damage occurs as a result of the assembly.

Threads, washers under the head of the screw and the washer face of the nuts should be lubricated with clean engine oil unless otherwise specified.

The following listed fasteners require the use of a calibrated manual torque wrench. If an adaptor is required in combination with a torque wrench, a correction factor must be applied to the torque wrench settings (readings) in order to obtain accurate fastener torque values.



### Caution

Repeated tightening of fasteners and threaded components reduces their capacity to function adequately. The following table describes the various items and the limits of their reusability. Failure to conform to these limits can result in severe component damage.

Fasteners	Examples	Reusable Limit	Reuse Recommendations
Highly loaded screws (phosphating plus oil)	Cylinder head	3 times	Apply engine oil on threads and under screw head. Mark bolt head with an indentation. Dry mounting for new screws (delivered with oil pre-applied and anti-rust treatment for spare parts). If a part is replaced, e.g., cylinder head, also replace the screws.
	Cylinder block (main bearing cap screw)	3 times	
	Injector yoke	3 times	
	Camshaft bearing housing	3 times	
	Transmission (timing gear screw)	3 times	
	Flywheel	3 times	
	Connecting rods	3 times	
Special screws (specific shape)	Oil pan and valve cover	No limit	No limit if no cracks, corrosion or damage to the flat surfaces.
Stainless steel/bronze studs and flange locknuts (Spiralock)	Turbocharger	5 times	Lubricate with high temperature screw joint paste GLEITMO 165 (Part No-1161929). If turbocharger, exhaust manifold or EGR valve studs, or nuts are loosened, they must be replaced.
	Exhaust manifold	5 times	
	EGR valve	5 times	
Prevailing torque feature screws (Grid-lock Plastic or Tuflock)	Piston cooling nozzles	5 times	Clean the thread and apply Loctite 222 on the screw thread for each operation.
	Timing gear plate	5 times	
Standard screws	Property class 8.8	No limit	No limit if no cracks,

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	Property class 10.9	No limit	corrosion or damage to the flat surfaces.
	Property class 12.9	No limit	
V-nipple with taper threads	With locking fluid pre-applied	Do not reuse	Before fitting the new nipple, clean the hole with a nipple tap and apply sealant on the nipple thread, or use a new coated nipple.
Taper plugs or nipples	With sealer fluid pre-applied	Do not reuse	Before fitting the new nipple, clean the hole with a nipple tap and apply sealant on the nipple thread, or use a new coated nipple.

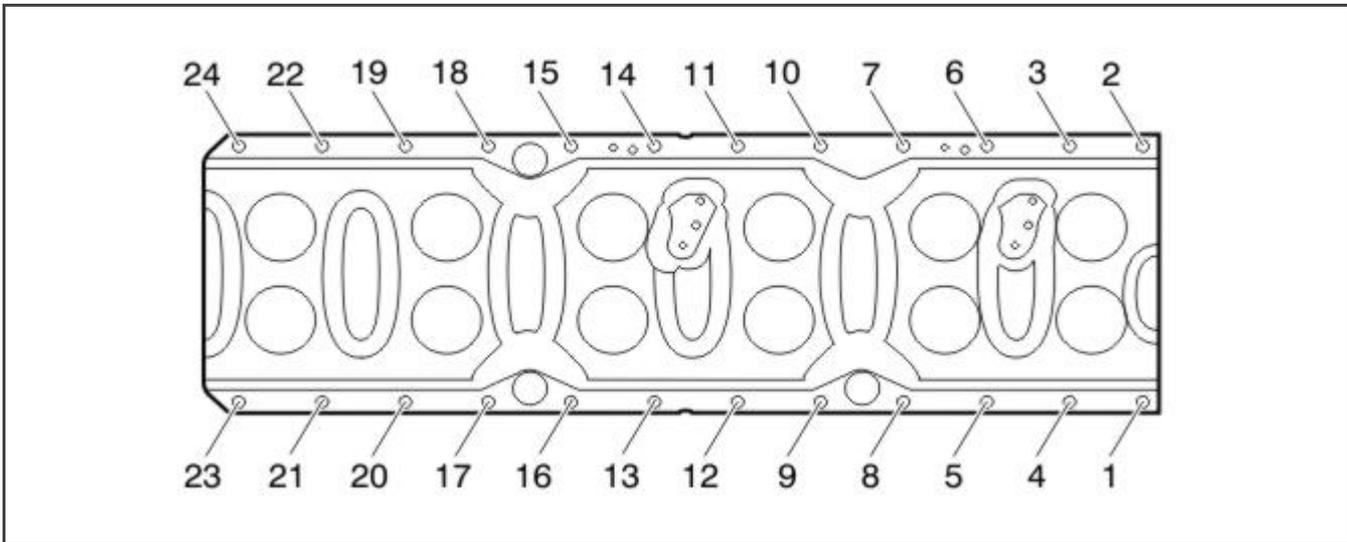
## Tightening torques function group 20

General tightening torques
M6 standard bolt 8.8..... $10 \pm 1.5$ Nm ( $7.4 \pm 1$ ft-lb) ( $89 \pm 13$ in-lb) M8 standard bolt 8.8..... $24 \pm 4$ Nm ( $18 \pm 3$ ft-lb) M10 standard bolt 8.8..... $48 \pm 8$ Nm ( $35 \pm 6$ ft-lb) M12 standard bolt 8.8..... $85 \pm 15$ Nm ( $63 \pm 11$ ft-lb) M14 standard bolt 8.8..... $140 \pm 25$ Nm ( $103 \pm 18$ ft-lb) M16 standard bolt 8.8..... $220 \pm 35$ Nm ( $162 \pm 26$ ft-lb)
Bolts that have been torque-tightened only, can be reused.
Torque-tightened, angle-tightened, yield-limit-tightened bolts: 10.9.....Can be reused 12.9.....Can be reused
Note: Check bolts before reusing. There should be no visible change in the screw pitch. Bolts showing damage, for example cut marks on the underside or distortion of the flats, should be discarded.

## Tightening torques function group 21

Intermediate front engine mounting brackets (accessories brackets): Step 1..... $105 \pm 15$ Nm ( $77.5 \pm 11$ ft-lb) Step 2 (angle tightening)..... $60 \pm 5$ degrees
Front engine mounting: Bracket to engine block..... $275 \pm 45$ Nm ( $203 \pm 33$ ft-lb) Bracket to engine cushion..... $140 \pm 25$ Nm ( $103 \pm 18$ ft-lb) Cushion to cross member..... $85 \pm 15$ Nm ( $63 \pm 11$ ft-lb)
Rear engine mounting: Bracket to flywheel housing..... $300 \pm 45$ Nm ( $221 \pm 33$ ft-lb) Bracket to engine cushion..... $540 \pm 90$ Nm ( $398 \pm 66$ ft-lb) Cushion to frame..... $200 \pm 30$ Nm ( $148 \pm 24$ ft-lb)
Crankshaft main bearing cap:

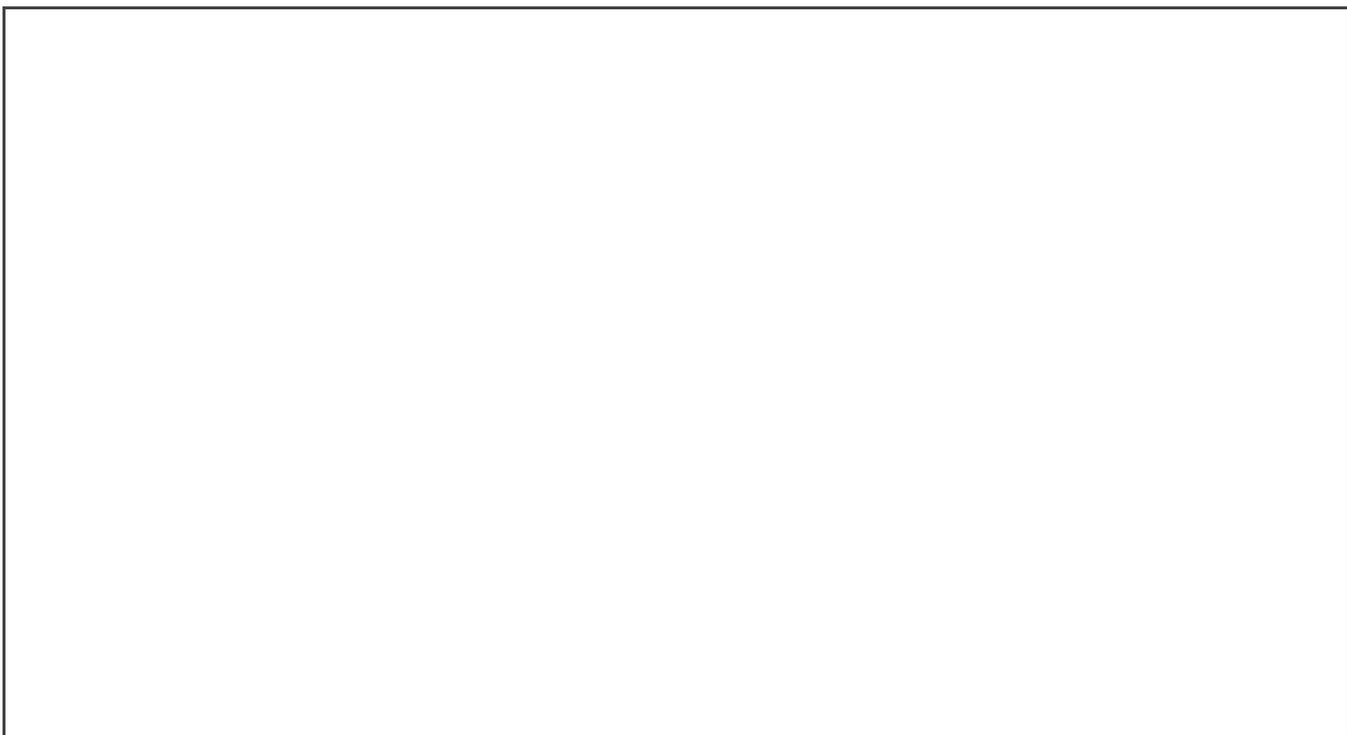
Step 1.....150 ± 20 Nm (111 ± 15 ft-lb) Step 2 (angle tightening).....120 ± 5 degrees
Connecting rod cap: Step 1.....20 ± 3 Nm (15 ± 2 ft-lb) Step 2.....60 ± 3 Nm (44 ± 2 ft-lb) Step 3 (angle tightening).....90 ± 5 degrees
Piston cooling nozzle.....24 ± 4 Nm (18 ± 3 ft-lb)
Engine block plugs.....50 ± 5 Nm (37 ± 7 ft-lb)

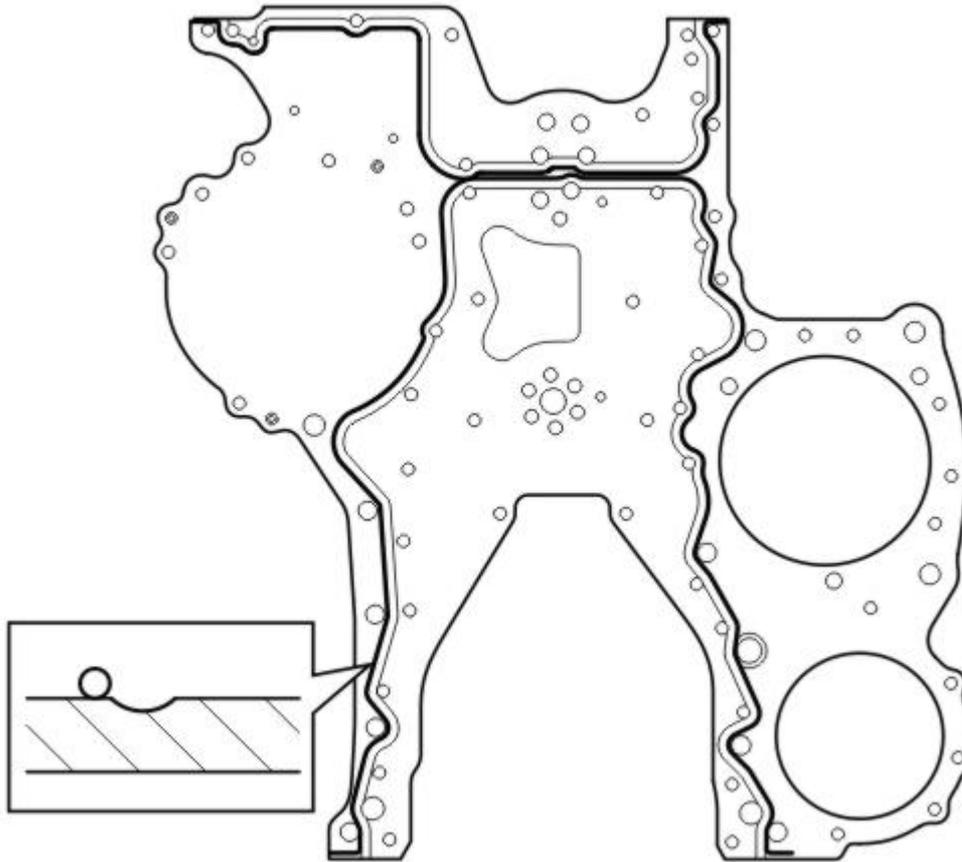


Engine stiffening frame:  
 Step 1: Tighten the screws 1–24 in numerical order.....40 ± 5 Nm (30 ± 4 ft-lb)  
 Step 2: Tighten the screws 1–24 in numerical order (angle tightening).....90 ± 5 degrees

Note: Do not reuse the screws.

Timing gear plate without integral gasket



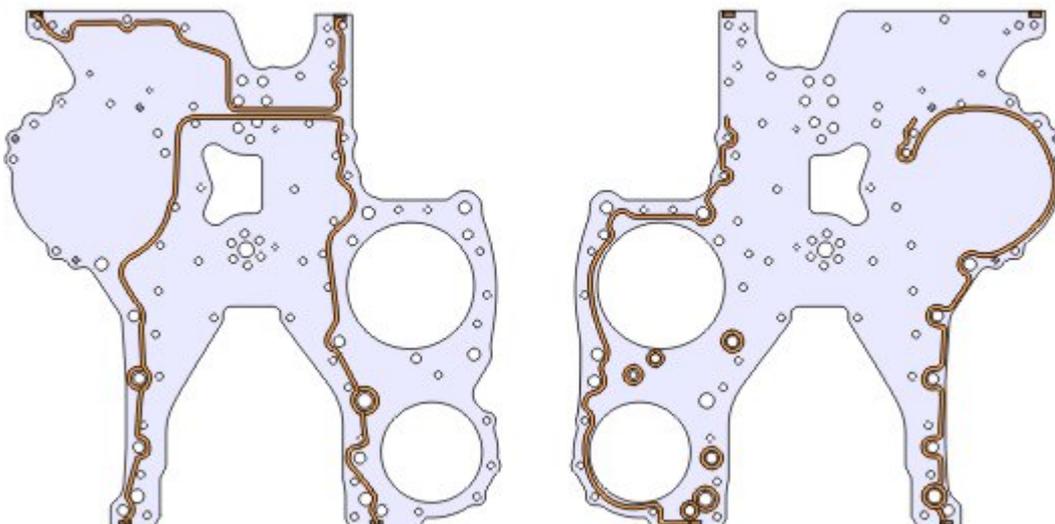


Step 1: Clean the cylinder block and cylinder head contact surface. Clean the timing gear plate.

Note: Use an appropriate cleaning agent. Ensure that the cleaning agent is completely evaporated before mounting the timing gear cover.

Step 2: Apply sealant outside the groove as illustrated, maximum 20 minutes before mounting.  
Thickness of sealant bead: US2014, US2017: 2 mm (0.079 inch)

### Timing gear plate with integral gasket

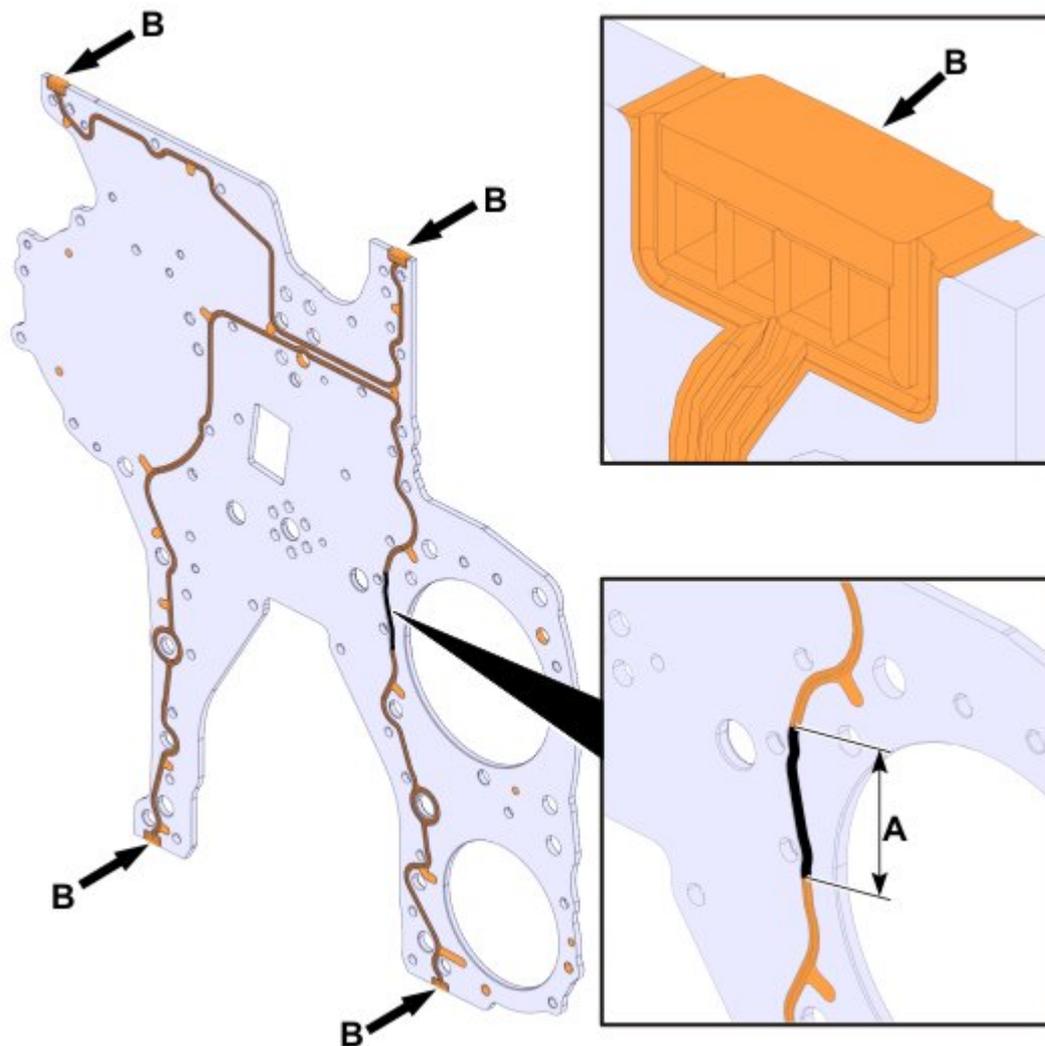


Sealant is not used on the timing gear plate with integral gasket. Sealant may be used for repair of the integral gasket. Refer to Timing Gear Plate Integral Gasket Repair.

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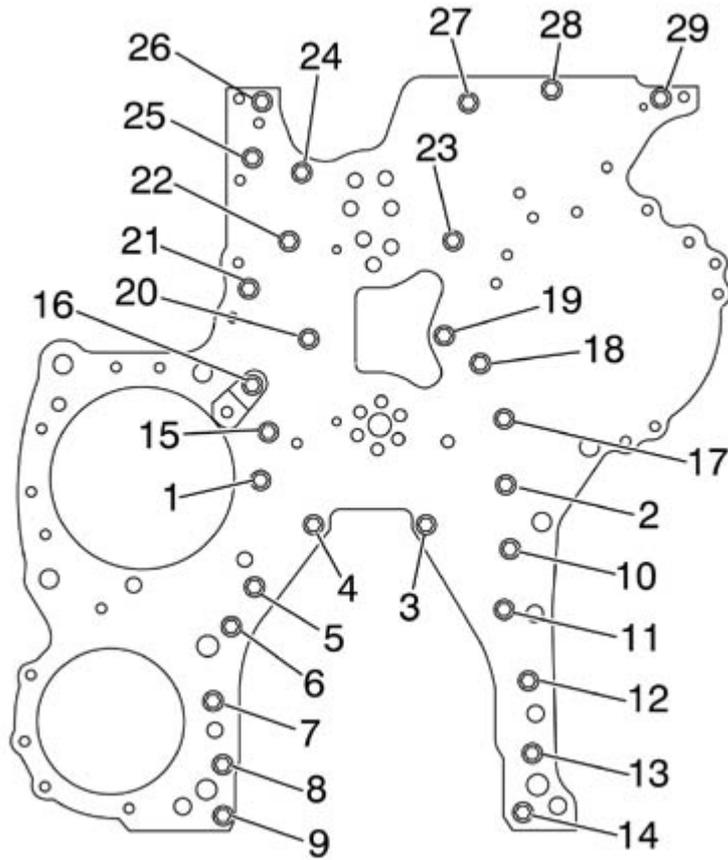
## Timing gear plate integral gasket repair



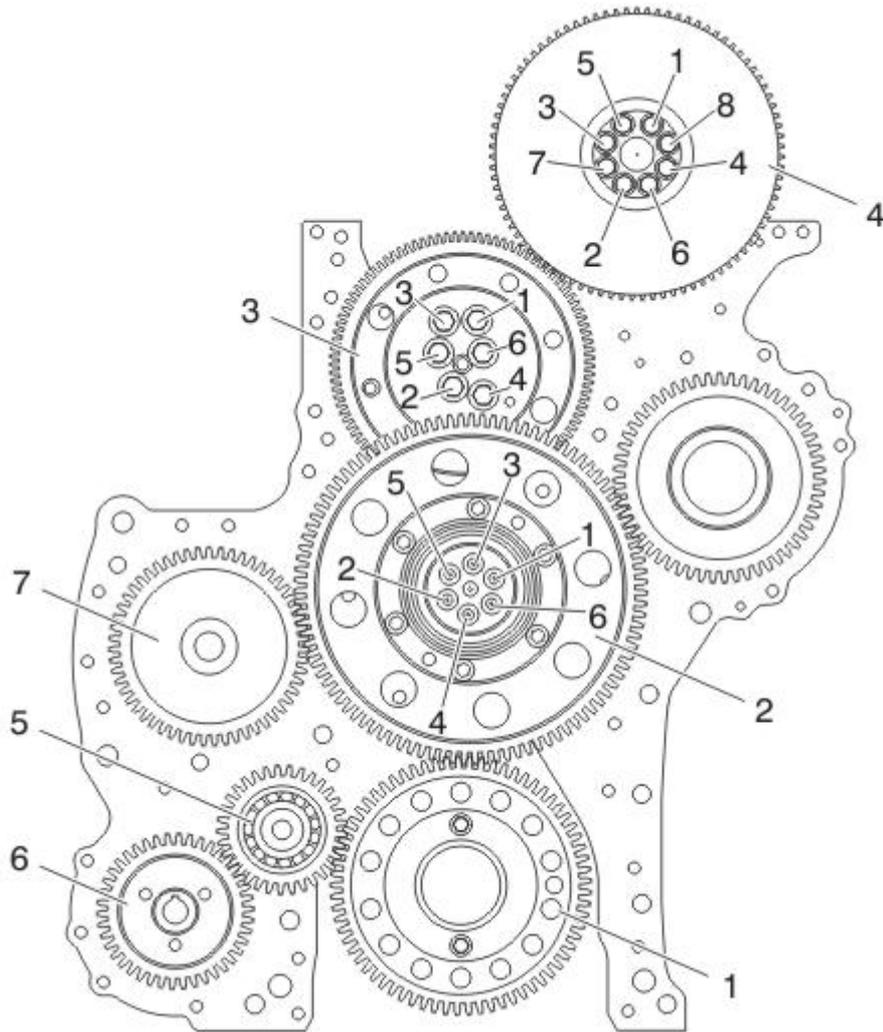
Use sealant to repair the integral gasket. The repair can be no more than 100 mm (3.937 inch) in length (A). The thickness of the sealant bead (for the repair) is 2 mm (0.079 inch). The integral gasket can be repaired in multiple places.

The timing gear plate must be installed to the cylinder block within 20 minutes after applying the sealant.

If any of the four pads (B) are damaged or loosened, the timing gear plate must be replaced.



Timing gear plate, tighten in sequence shown..... $28 \pm 4$  Nm ( $21 \pm 3$  ft-lb)



Timing gears:

1. Drive gear, crankshaft..... $24 \pm 4$  Nm ( $18 \pm 3$  ft-lb)

2. Double idler gear:

Step 1..... $25 \pm 3$  Nm ( $19 \pm 2$  ft-lb)

Step 2 (angle tightening)..... $110 \pm 5$  degrees

Note: Tighten following the order shown in the illustration.

3. Idler gear, adjustable:

Step 1..... $35 \pm 4$  Nm ( $26 \pm 3$  ft-lb)

Step 2 (angle tightening)..... $120 \pm 5$  degrees

Note: Tighten following the order shown in the illustration.

4. Drive gear, camshaft (includes vibration damper):

Step 1..... $45 \pm 5$  Nm ( $33 \pm 4$  ft-lb)

Step 2 (angle tightening)..... $90 \pm 5$  degrees

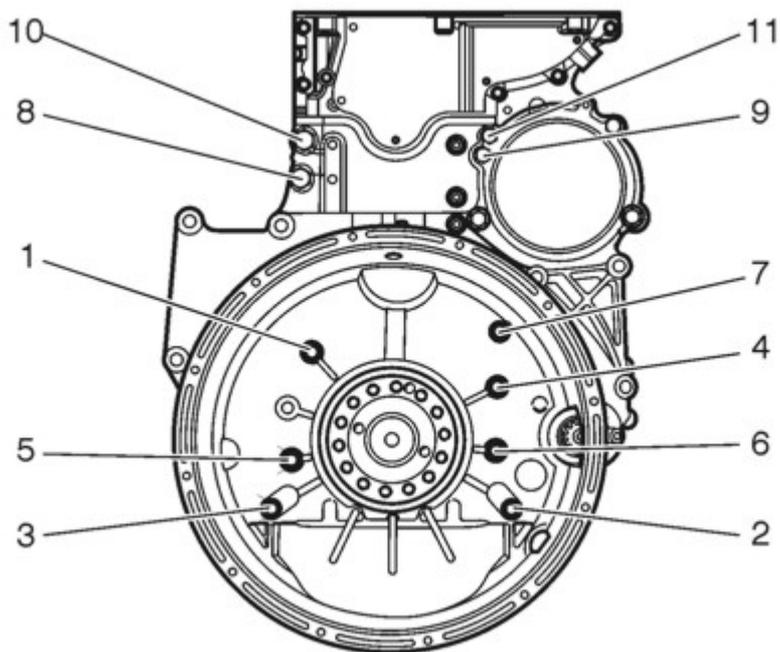
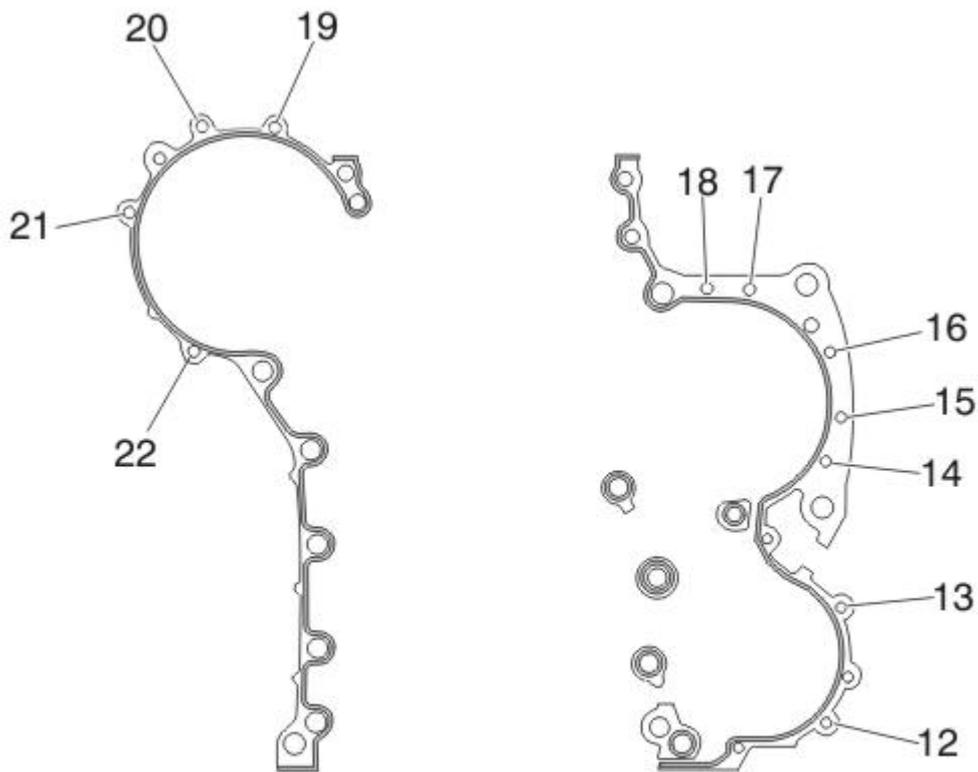
Note: Tighten following the order shown in the illustration.

5. Idler gear:  $140 \pm 10$  Nm ( $103 \pm 7$  ft-lb)

6. Drive gear, power steering pump:  $100 \pm 10$  Nm ( $74 \pm 7$  ft-lb)

7. Drive gear, non-clutched air compressor:  $200 \pm 50$  Nm ( $147 \pm 37$  ft-lb)

7. Drive gear, clutched air compressor:  $12 \pm 2$  Nm ( $9 \pm 1.5$  ft-lb)



Flywheel housing:

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Step 1: Tighten all M14, M10, M8 bolts..... $24 \pm 4$  Nm ( $18 \pm 3$  ft-lb)

Step 2: Tighten all bolts in numerical order to the following torque:

M14 bolts (1–7)..... $140 \pm 20$  Nm ( $103 \pm 15$  ft-lb)

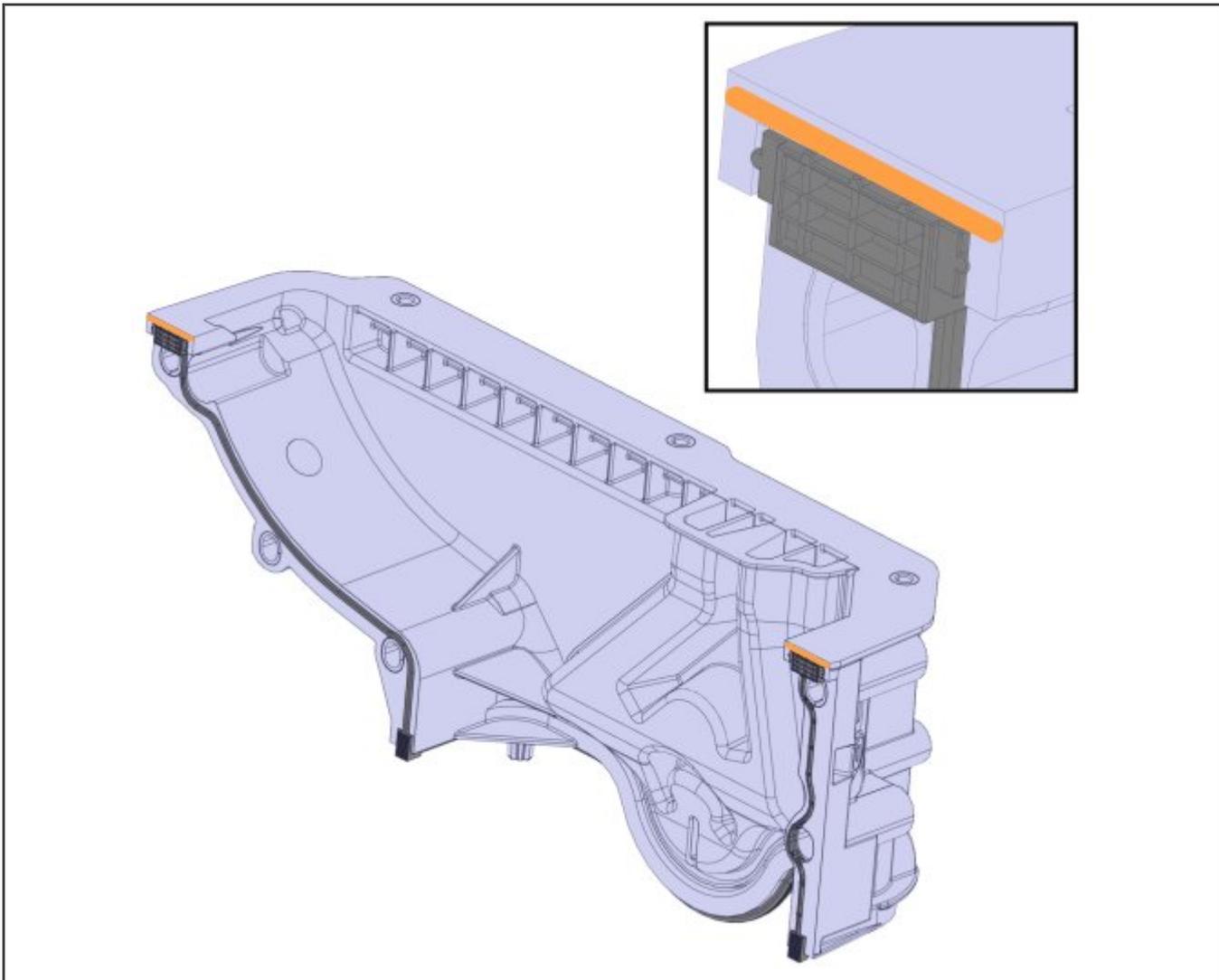
M10 bolts (8–11)..... $48 \pm 8$  Nm ( $36 \pm 6$  ft-lb)

M8 bolts (12–22)..... $24 \pm 4$  Nm ( $18 \pm 3$  ft-lb)

Note: Apply the sealant in a 2 mm (0.079 inch) thick bead as illustrated.

## Timing gear cover

Timing gear cover for engine without integral gasket timing gear plate



Step 1: Clean the cylinder head contact surface.

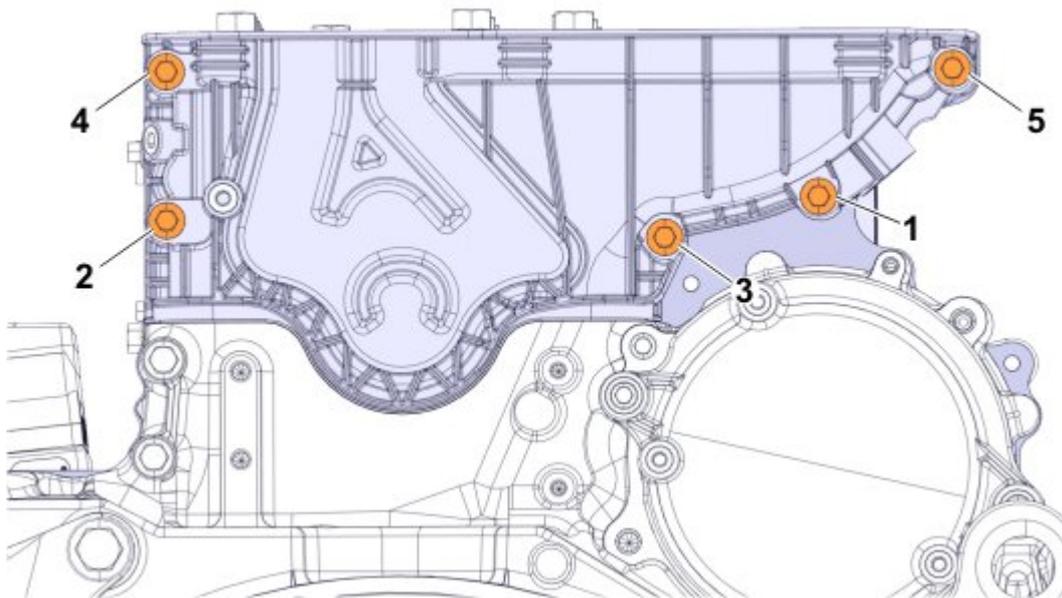
Note: Use an appropriate cleaning agent. Ensure that the cleaning agent is completely evaporated before mounting the timing gear cover.

Step 2: Check that the gasket in the timing gear cover is installed properly.

Step 3: Apply 2-mm thick bead of sealant on the timing gear cover (two places).

Note: Ensure that the sealant is in contact with the gasket.

Note: The timing gear cover must be installed within 20 minutes after applying the sealant.



Step 4: Position the timing gear cover with two screws 1 and 2, torque tighten ..... $3 \pm 1$  Nm.

Note: Ensure that the cover is aligned with the cylinder head.

Step 5: Install the alignment tool above the cylinder head..... $27 \pm 3$  Nm.

Step 6: Torque tighten the screws in sequence 1 – 5..... $27 \pm 3$  Nm.

#### Timing gear cover for engine with integral gasket timing gear plate



Step 1: Check that the gasket in the timing gear cover is installed properly.

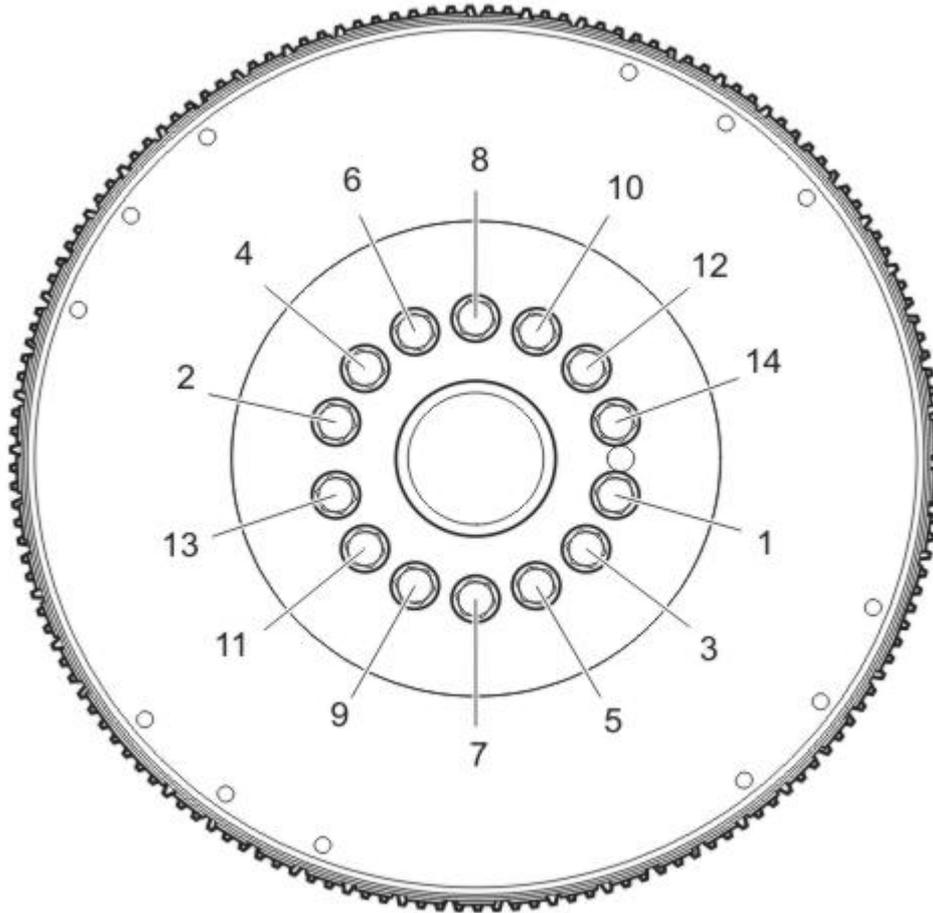
Note: Sealant is not used during the installation of this cover (engine with integral gasket timing gear plate)

Step 2: Position the timing gear cover with two screws 1 and 2, torque tighten to  $3 \pm 1$  Nm.

Note: Ensure that the cover is aligned with the cylinder head.

Step 3: Install the alignment tool above the cylinder head..... $27 \pm 3$  Nm.

Step 4: Torque tighten the screws in sequence 1 – 5.....27 ± 3 Nm.

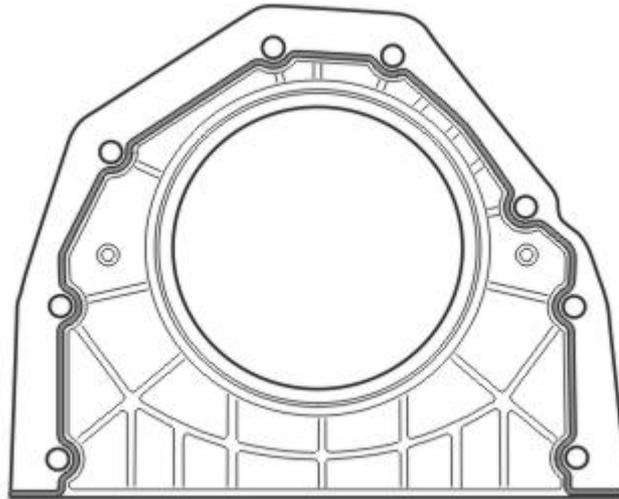
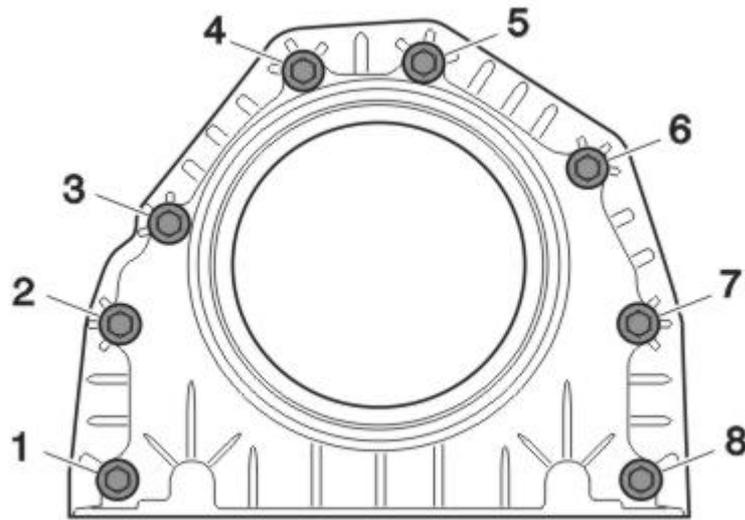


Flywheel:

Step 1.....60 ± 5 Nm (44 ± 4 ft-lb)

Step 2 (angle tightening).....120 ± 10 degrees

Note: Make sure that the flange is dry and clean. Tighten the bolts in the numerical order as shown.

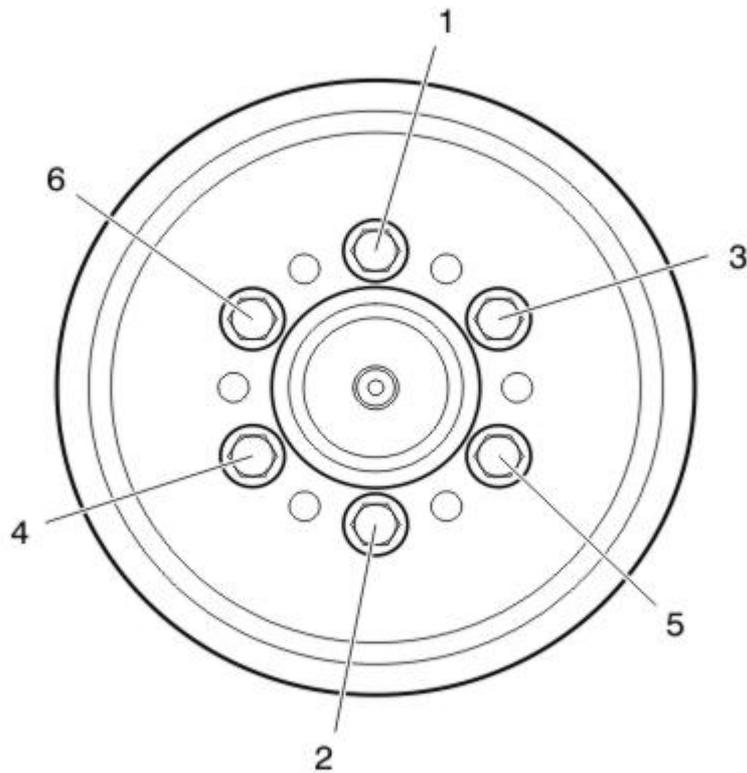


**Cover, crankshaft seal:**

Step 1. Position the cover with bolts 2 and 7 and tighten to contact

Step 2: Tighten the bolts in numerical order 1–8 as shown..... $24 \pm 4$  Nm ( $18 \pm 3$  ft-lb)

Note: Apply the sealant in a 2 mm (0.079 inch) thick bead as illustrated and tighten bolts in numerical order.

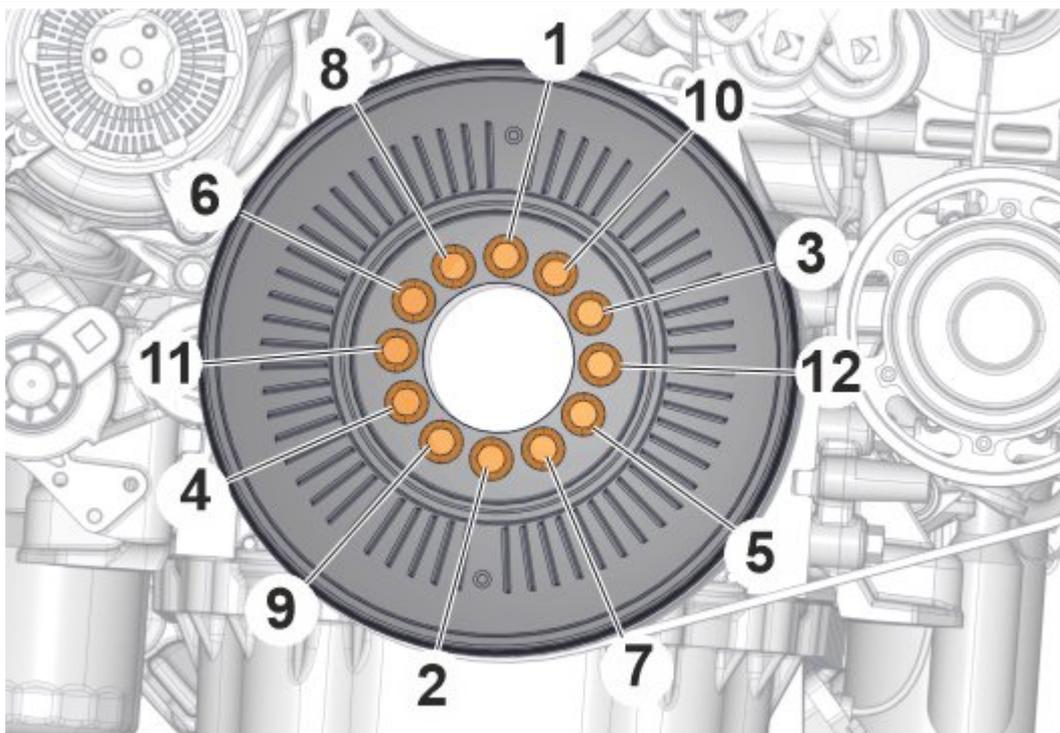


Crankshaft vibration damper (6 screw assembly):

Step 1..... $35 \pm 5$  Nm ( $26 \pm 4$  ft-lb)

Step 2..... $90 \pm 10$  Nm ( $66 \pm 7$  ft-lb)

Note: Tighten the bolts in the numerical order 1–6 in each step.

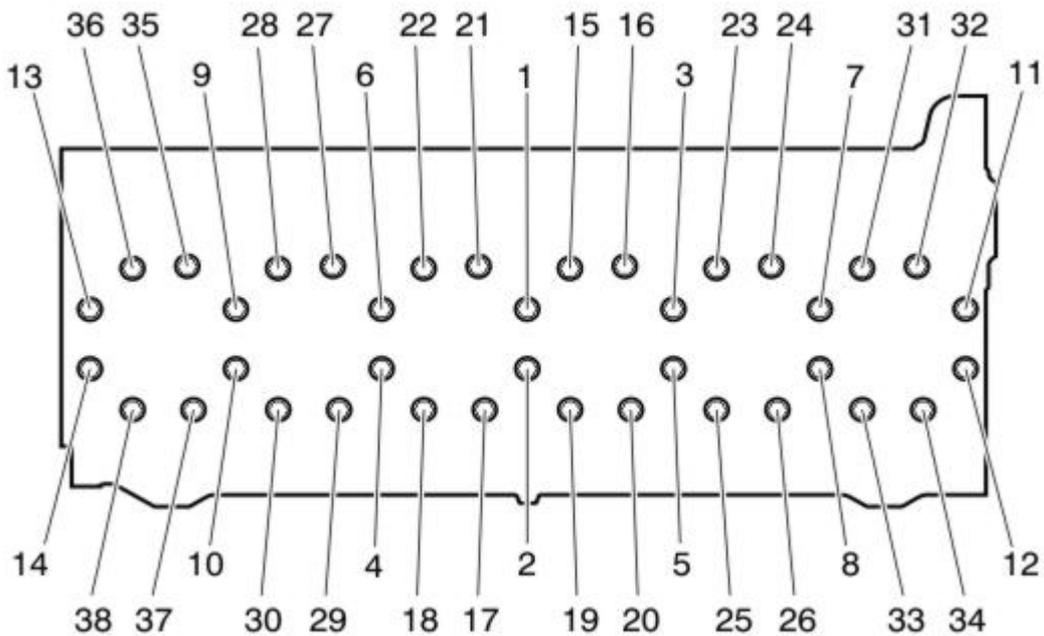


Crankshaft vibration damper (12 screw assembly):

Step 1.....35 ± 5 Nm (26 ± 4 ft-lb)

Step 2.....90 ± 10 Nm (66 ± 7 ft-lb)

Note: Tighten the bolts in the numerical order 1–12 in each step.



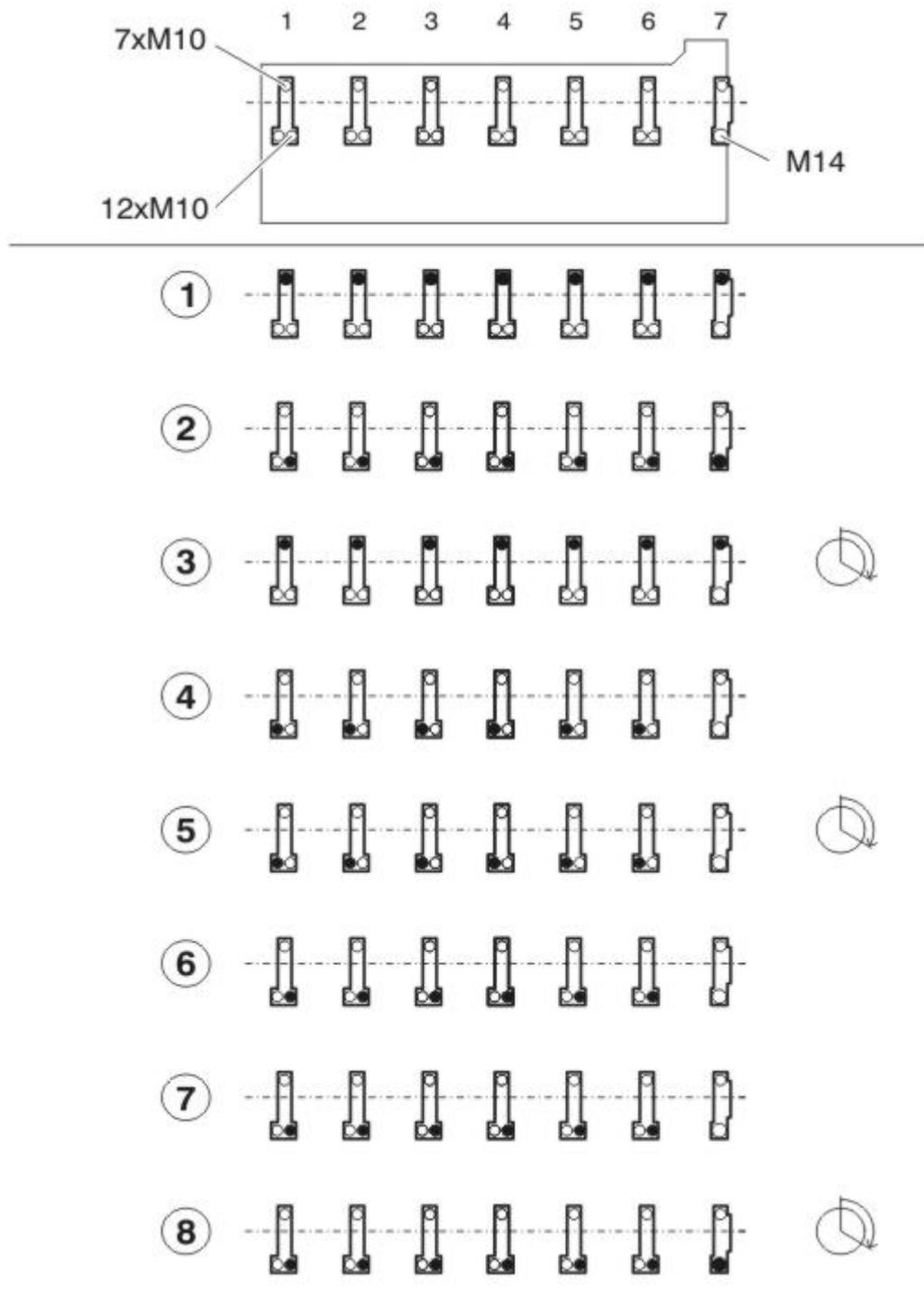
Cylinder head:

Step 1.....100 ± 5 Nm (74 ± 4 ft-lb)

Step 2 (angle tightening).....120 ± 5 degrees

Step 3 (angle tightening).....90 ± 5 degrees

Note: The cylinder head must be mounted according to instructions, see cylinder head, replacement function group 21.



**Bearing cap, camshaft/rocker arm shaft:**

Bearing caps 1 to 6 are attached with one bolt on the engine right side and two bolts on the engine left side, while bearing cap 7 is attached with only one bolt per side. Tighten the bolts in the following steps as illustrated:

Note: Tighten the bolts in numerical order from bearing cap 1 to 7 or 7 to 1, except in step 2.

Step 1: With camshaft and bearing caps in place, tighten the marked bolts of bearing caps 1 to 7..... $40 \pm 3$  Nm ( $30 \pm 2$  ft-lb)

Step 2: With the rocker shaft in place, tighten the marked bolts (in stages) in the order 4, 3, 5, 2, 6, 1, 7..... $60 \pm 5$  Nm ( $44 \pm 4$  ft-lb)

Note: The bolts must be tightened in stages to ensure that the rocker arm shaft is seated without bending.

Step 3: Angle tighten marked bolts of bearing caps 1 to 7..... $90 \pm 5$  degrees

Step 4: Tighten the marked bolts of bearing caps 1 to 6..... $40 \pm 3$  Nm ( $30 \pm 2$  ft-lb)

Step 5: Angle tighten the bolts of bearing caps 1 to 6..... $120 \pm 5$  degrees

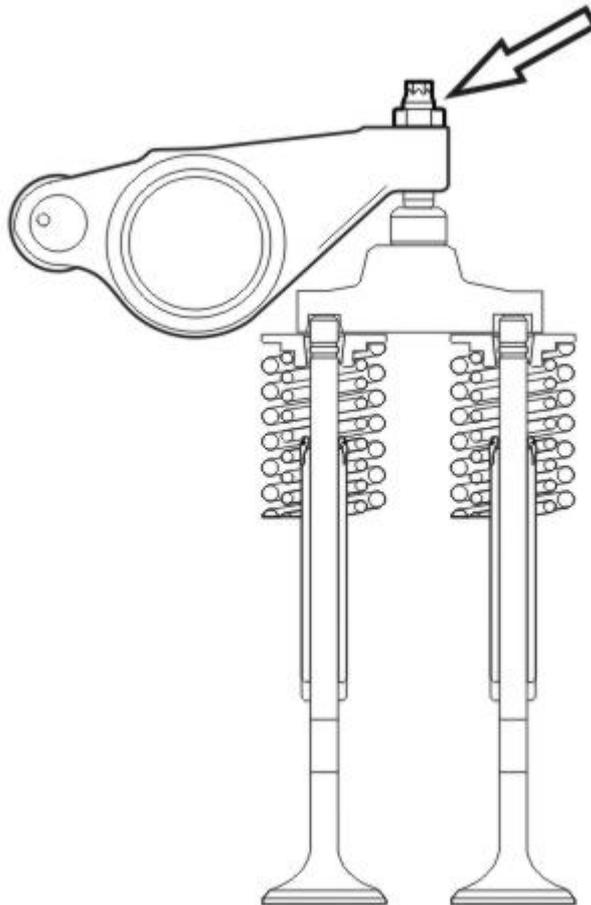
Step 6: Loosen the marked bolts of bearing caps 1 to 6.

Step 7: Tighten the marked bolts of bearing caps 1 to 6..... $40 \pm 3$  Nm ( $30 \pm 2$  ft-lb)

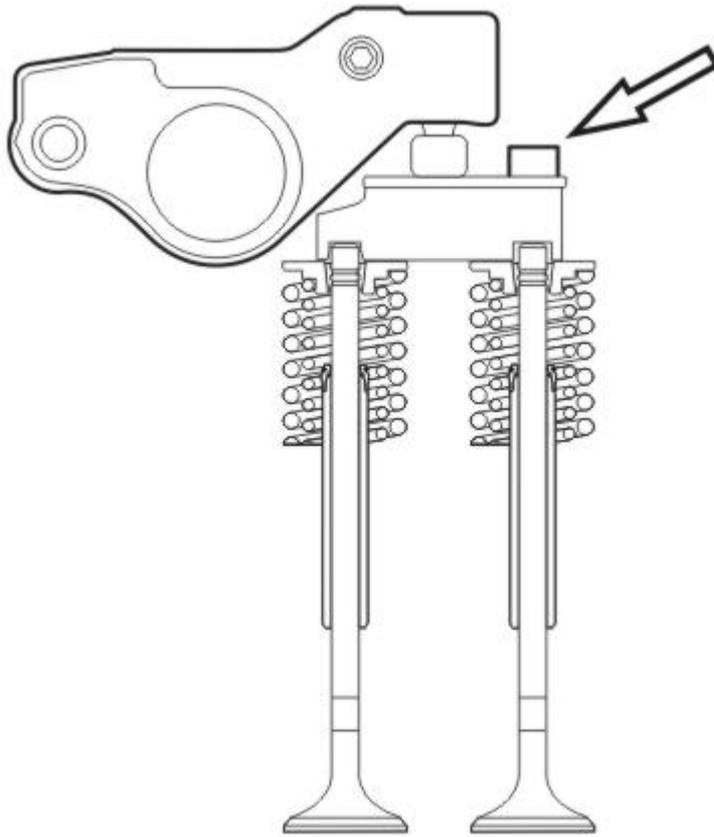
Step 8: Angle tighten the bolts of bearing caps 1 to 6 and the bolt of bearing cap 7..... $120 \pm 5$  degrees

Note: When only the rocker arm has been loosened, step 1 and step 3 are not required.

Engine brake control valve..... $24 \pm 4$  Nm ( $18 \pm 3$  ft-lb)

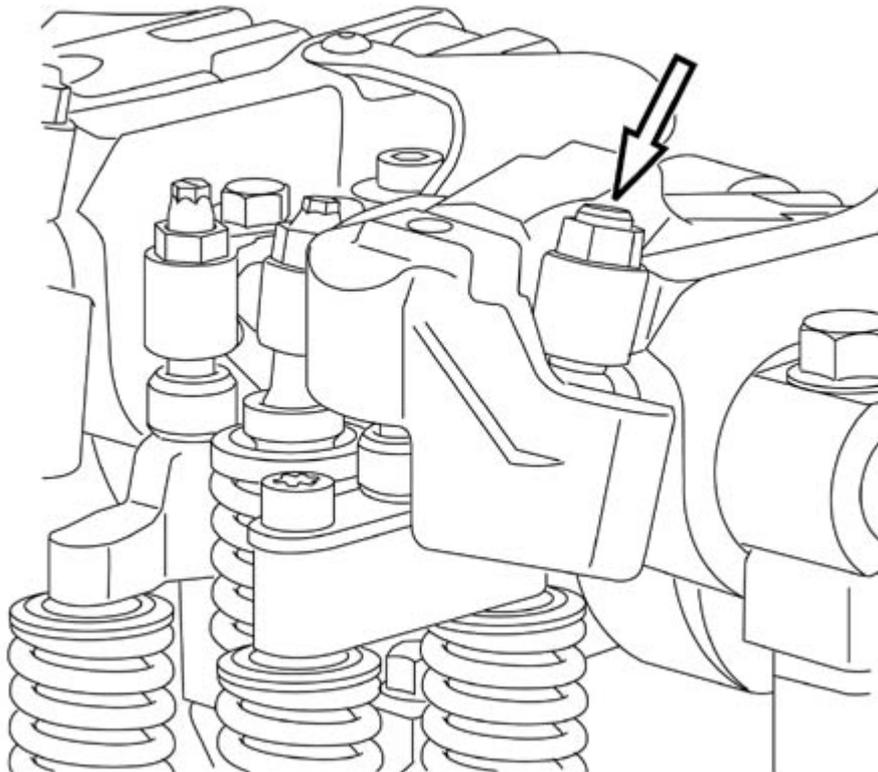


Lock nut, valve adjustment screw (inlet/exhaust)..... $38 \pm 4$  Nm ( $28 \pm 3$  ft-lb)

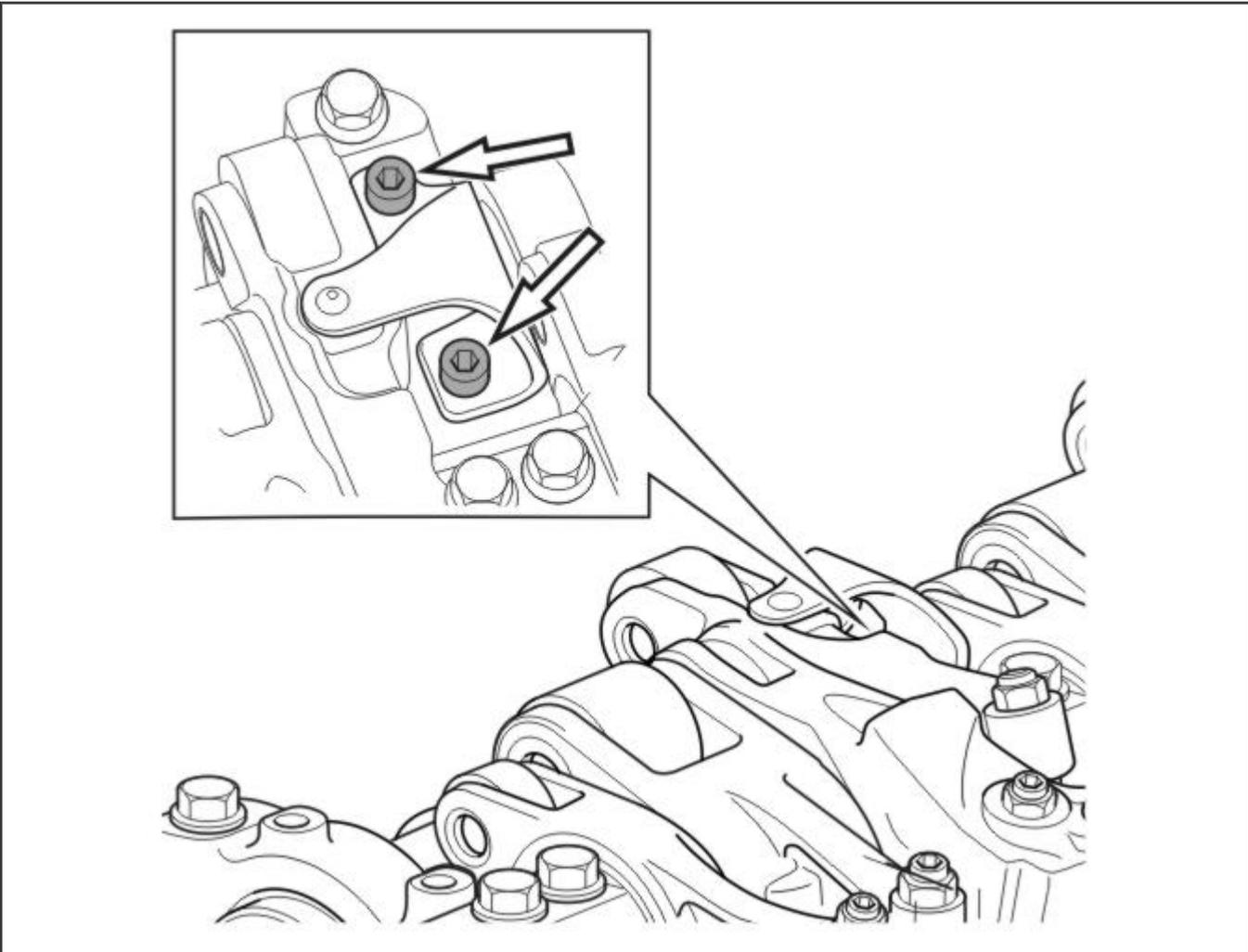


Lock nut, valve adjustment screw (exhaust, engine brake)..... $38 \pm 4$  Nm ( $28 \pm 3$  ft-lb)

Note: Hold the valve bridge while tightening.



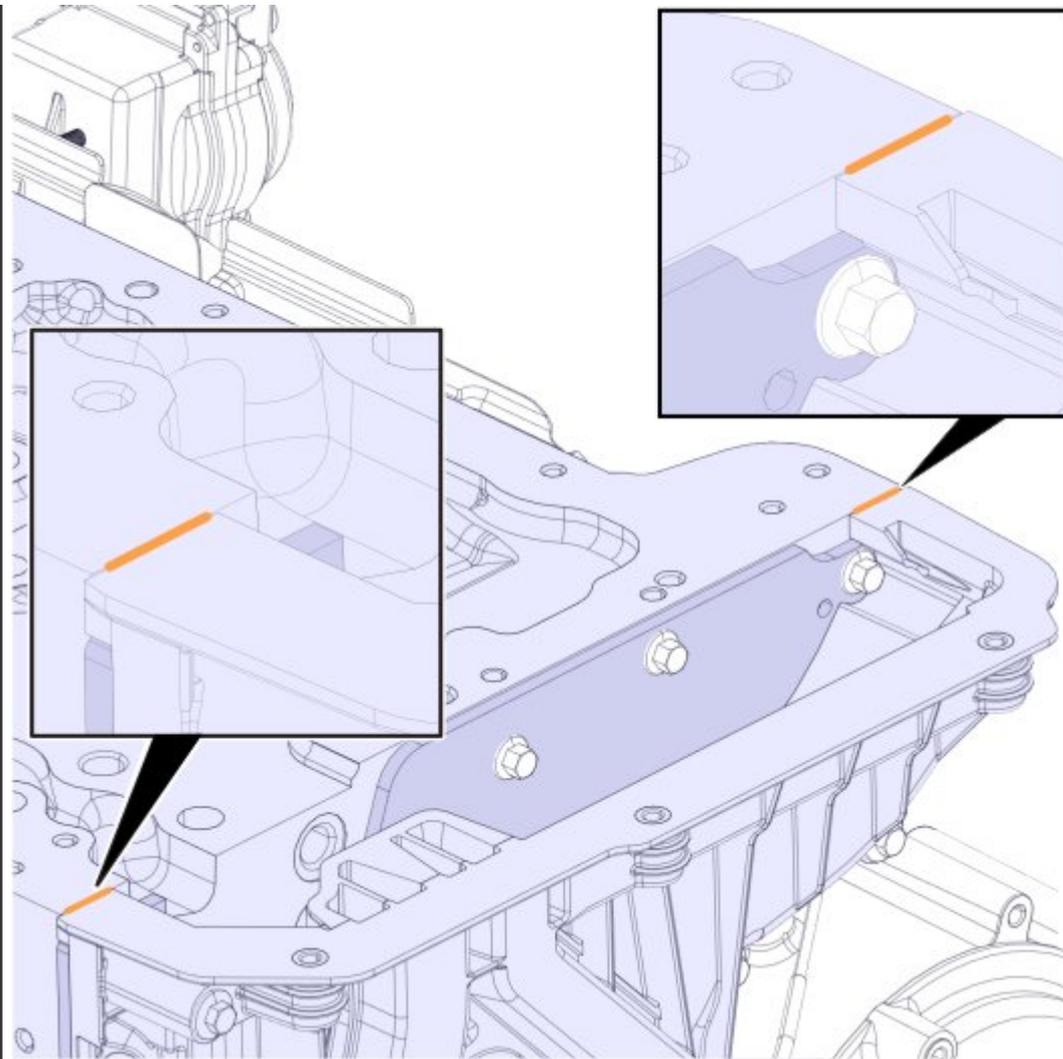
Lock nut, engine brake rocker arm..... $52 \pm 4$  Nm ( $38 \pm 3$  ft-lb)



Camshaft bearing cap spring tab (engine brake only)..... $25 \pm 3$  Nm ( $18 \pm 2$  ft-lb)

### Valve cover frame and valve cover

Sealant application before valve cover frame installation (engine without integral gasket timing gear plate)



Step 1: Remove any excess sealant from the contact surface of the cylinder head/timing gear cover (at the cylinder head to timing gear cover joint).

Step 2: Clean the contact surface of the cylinder head/timing gear cover.

Note: Use an appropriate cleaning agent. Ensure that the cleaning agent is completely evaporated before applying sealant.

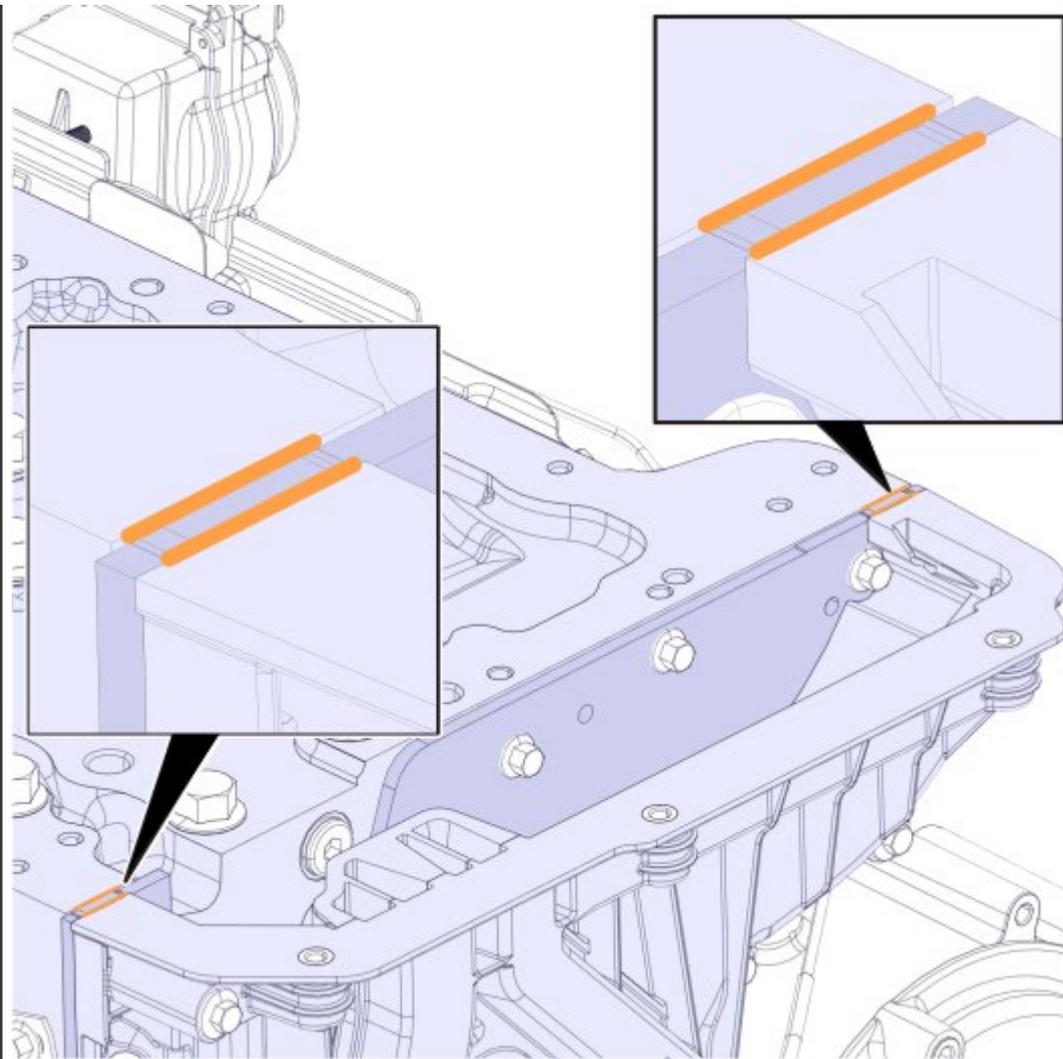
Step 3: Apply sealant at the following locations:

- cylinder head to timing gear cover (two places)

Note: Apply the sealant in a 2 mm (0.079 inch) thick bead as illustrated.

Note: The valve cover frame must be installed within 20 minutes after applying the sealant.

Sealant application before valve cover frame installation (engine with integral gasket timing gear plate)



Step 1: Remove any excess sealant from the contact surface of the cylinder head/timing gear cover (at the cylinder head to timing gear cover joint).

Step 2: Clean the contact surface of the cylinder head/timing gear cover.

Note: Use an appropriate cleaning agent. Ensure that the cleaning agent is completely evaporated before applying sealant.

Step 3: Apply sealant at the following locations:

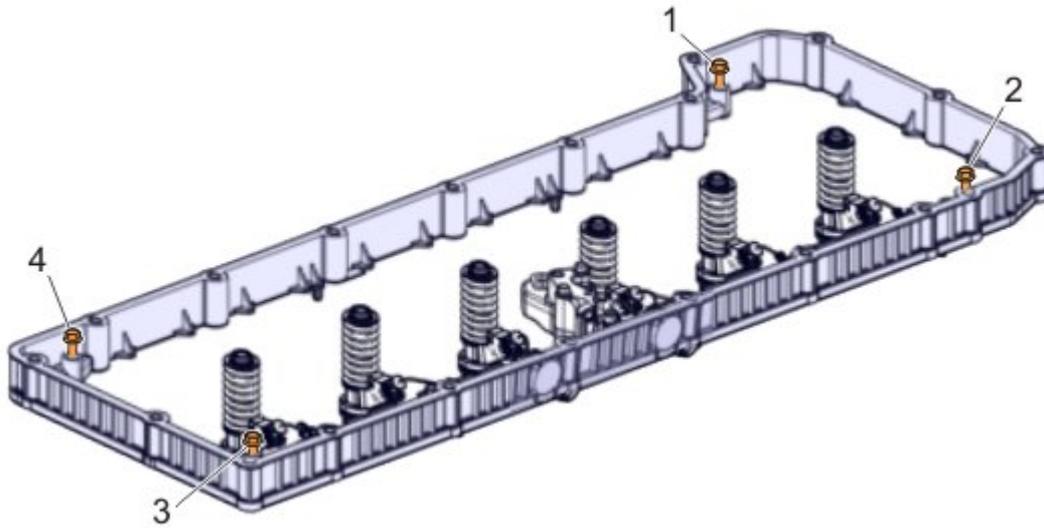
- cylinder head to timing gear plate (two places)
- timing gear plate to flywheel housing (two places)

Note: Apply the sealant in a 2 mm (0.079 inch) thick bead as illustrated.

Note: The valve cover frame must be installed within 20 minutes after applying the sealant.

#### Valve cover frame

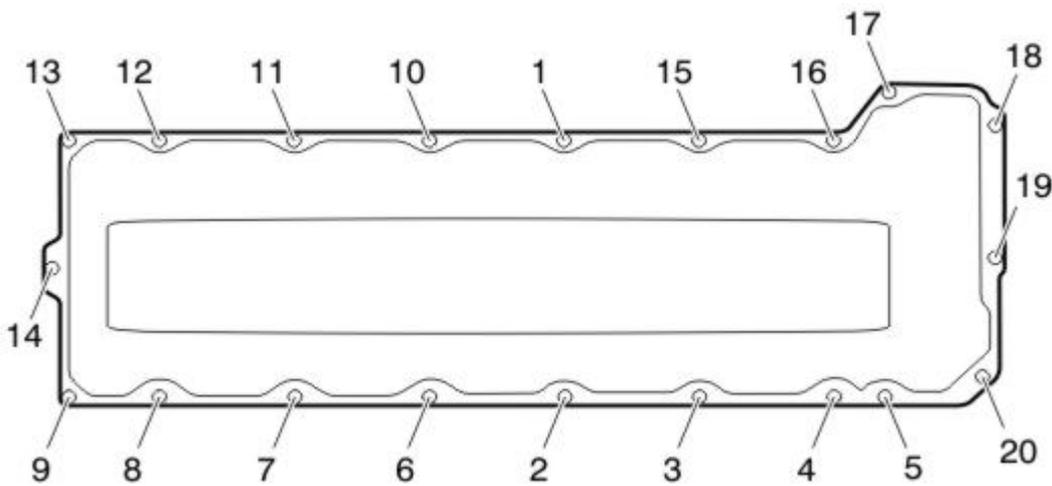




Valve cover frame.....24 ±4 Nm (18 ±3 ft-lb)

Note: Sealant must be applied to the joints between the cylinder head and the timing gear cover before installation of the valve cover frame. There are multiple configurations of this joint. Refer to Sealant Application Before Valve Cover Frame Installation (Engine Without Integral Gasket Timing Gear Plate) or Sealant Application Before Valve Cover Frame Installation (Engine With Integral Gasket Timing Gear Plate).

Valve cover



Valve cover.....24 ± 4 Nm (18 ±3 ft-lb)

Note: Tighten the screws in the numerical order shown.

Tightening torques function group 22

Oil pump, pickup tube.....24 ±4 Nm (18 ±3 ft-lb)

Oil pump attaching screws.....24 ±4 Nm (18 ±3 ft-lb)

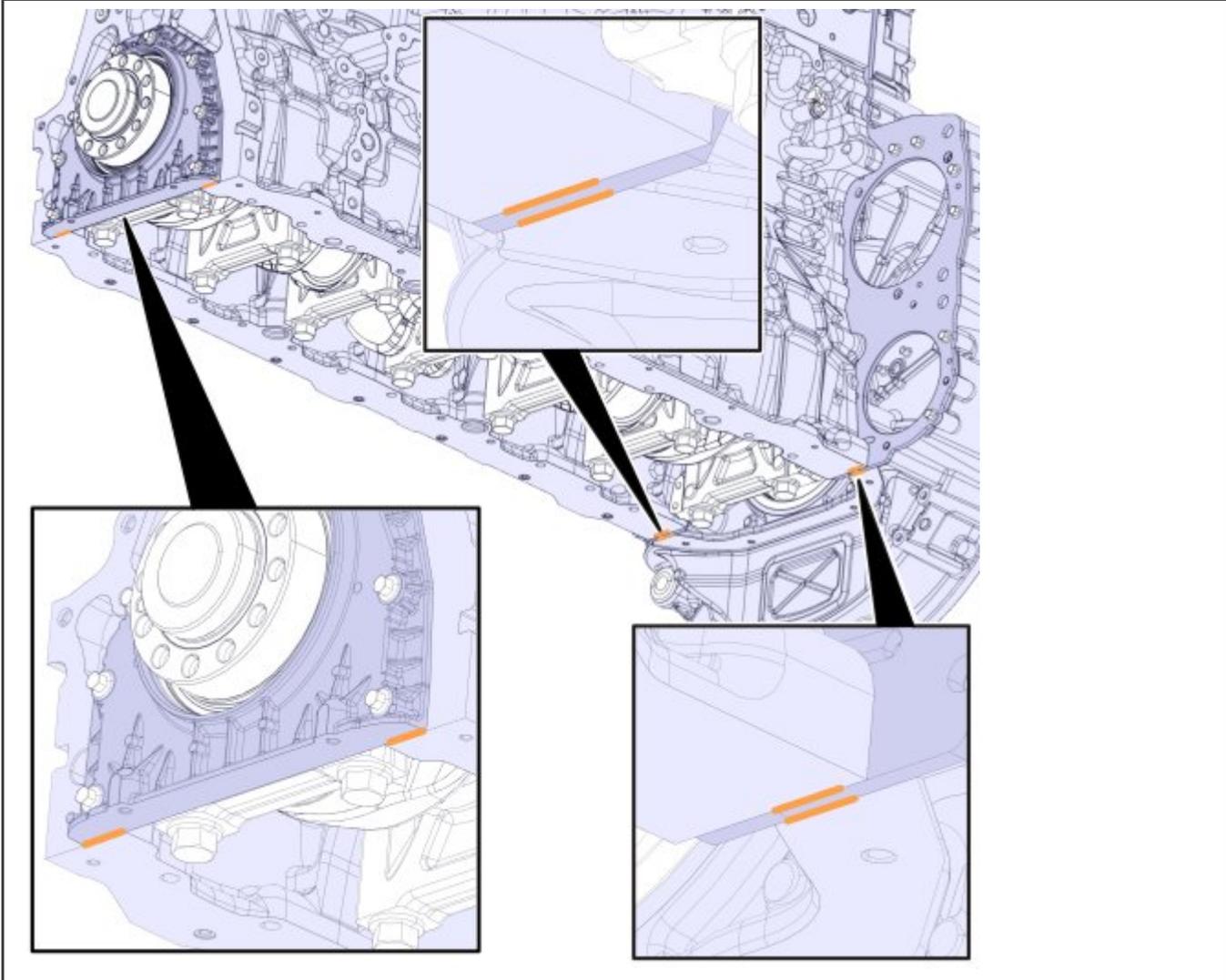
Oil pressure pipe coupling nut.....200 ±20 Nm (150 ±15 ft-lb)

Oil inlet pipe.....24 ±3 Nm (18 ±2 ft-lb)

Oil plug.....	135 ±13 Nm (100 ±10 ft-lb)
Oil filter housing.....	24 ±4 Nm (18 ±3 ft-lb)
Oil filter.....	25 - 30 Nm (18.5 - 22 ft-lb)

## Oil pan

### Application of sealant before oil pan installation



Step 1: Remove any excess sealant from the contact surface of the crankshaft seal cover/cylinder block/flywheel housing (at the crankshaft seal cover to cylinder block joints and at the cylinder block to flywheel housing joints).

Step 2: Clean the contact surface of the crankshaft seal cover/cylinder block/flywheel housing.

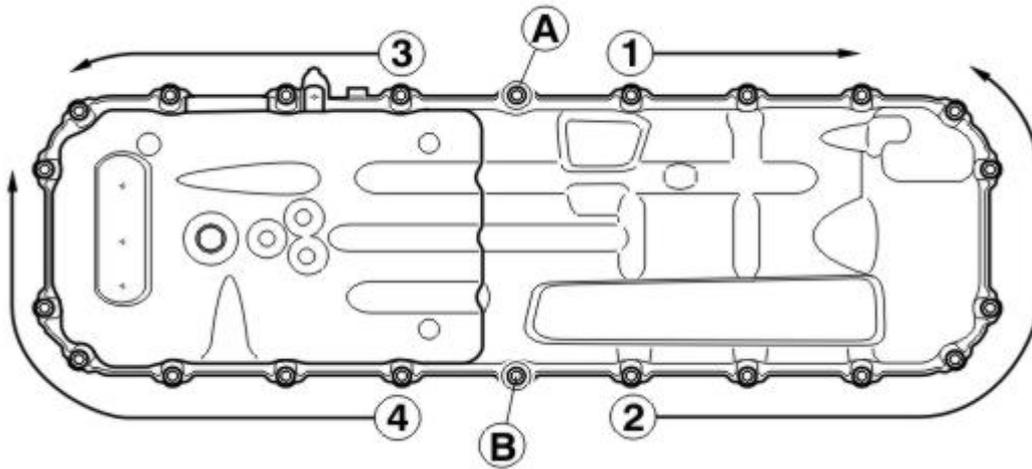
Note: Use an appropriate cleaning agent. Ensure that the cleaning agent is completely evaporated before applying sealant.

Step 3: Apply sealant at the following locations:

- crankshaft seal cover to cylinder block (two places)
- cylinder block to timing gear plate (two places)
- timing gear plate to flywheel housing (two places)

Note: Apply the sealant in a 2 mm (0.079 inch) thick bead as illustrated.

Note: The oil pan must be installed within 20 minutes after applying the sealant.



Oil pan (steel and plastic)..... $24 \pm 4$  Nm ( $18 \pm 3$  ft-lb)

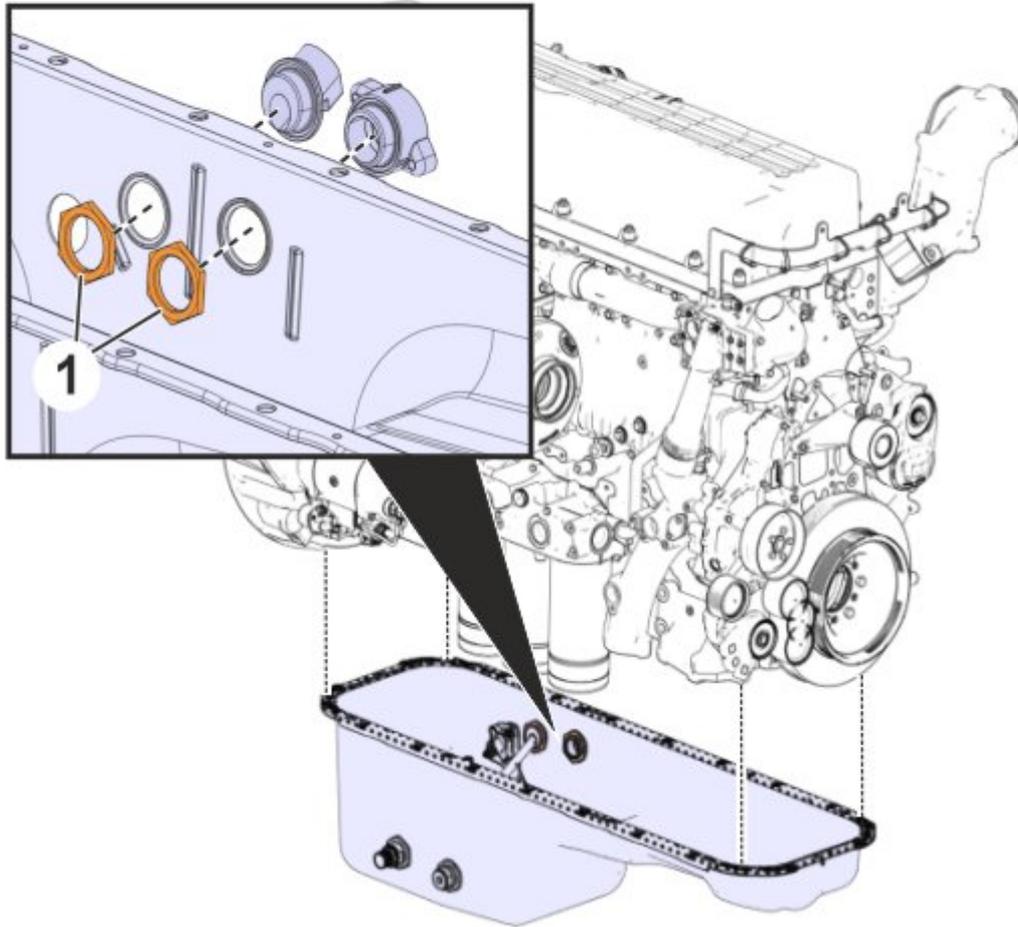
Install the oil pan bolts A and B, and tighten..... $24 \pm 4$  Nm ( $18 \pm 3$  ft-lb)

Tighten the bolts from the middle and outwards in order 1–4 as shown..... $24 \pm 4$  Nm ( $18 \pm 3$  ft-lb)

Finish by checking the torque for bolts A and B..... $24 \pm 4$  Nm ( $18 \pm 3$  ft-lb)

Note: Sealant must be applied to the joints between the crankshaft seal cover and the cylinder block. Sealant must also be applied to the joints between the cylinder block and the flywheel housing. Refer to Application of Sealant Before Oil Pan Installation.

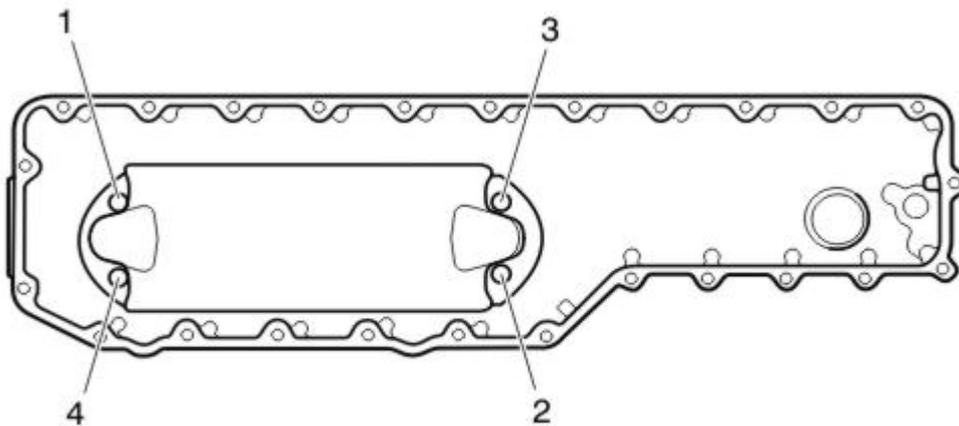
Drain plug, oil pan (steel and plastic)..... $60 \pm 10$  Nm ( $44 \pm 7$  ft-lb)



Oil pan fittings, (Oil fill tube adapter and dipstick adapter)

For aluminium fittings  
Nuts 1.....80 Nm (59 ft-lb)

For plastic fittings  
Nuts 1.....27 Nm (20 ft-lb)



Oil cooler, retaining bolts:

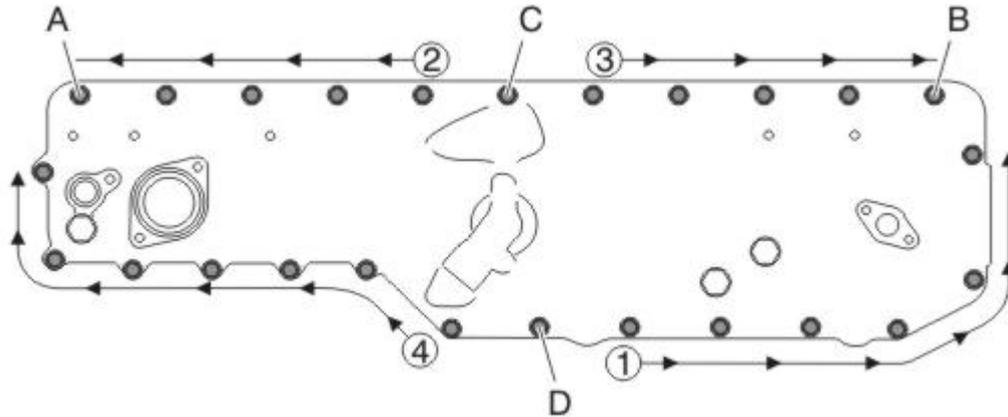
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Step 1..... $5 \pm 1$  Nm ( $44 \pm 9$  in-lb)

Step 2..... $27 \pm 4$  Nm ( $20 \pm 3$  ft-lb)

Note: Tighten the bolts diagonally and finish by tightening the first bolt again.



Oil cooler cover:

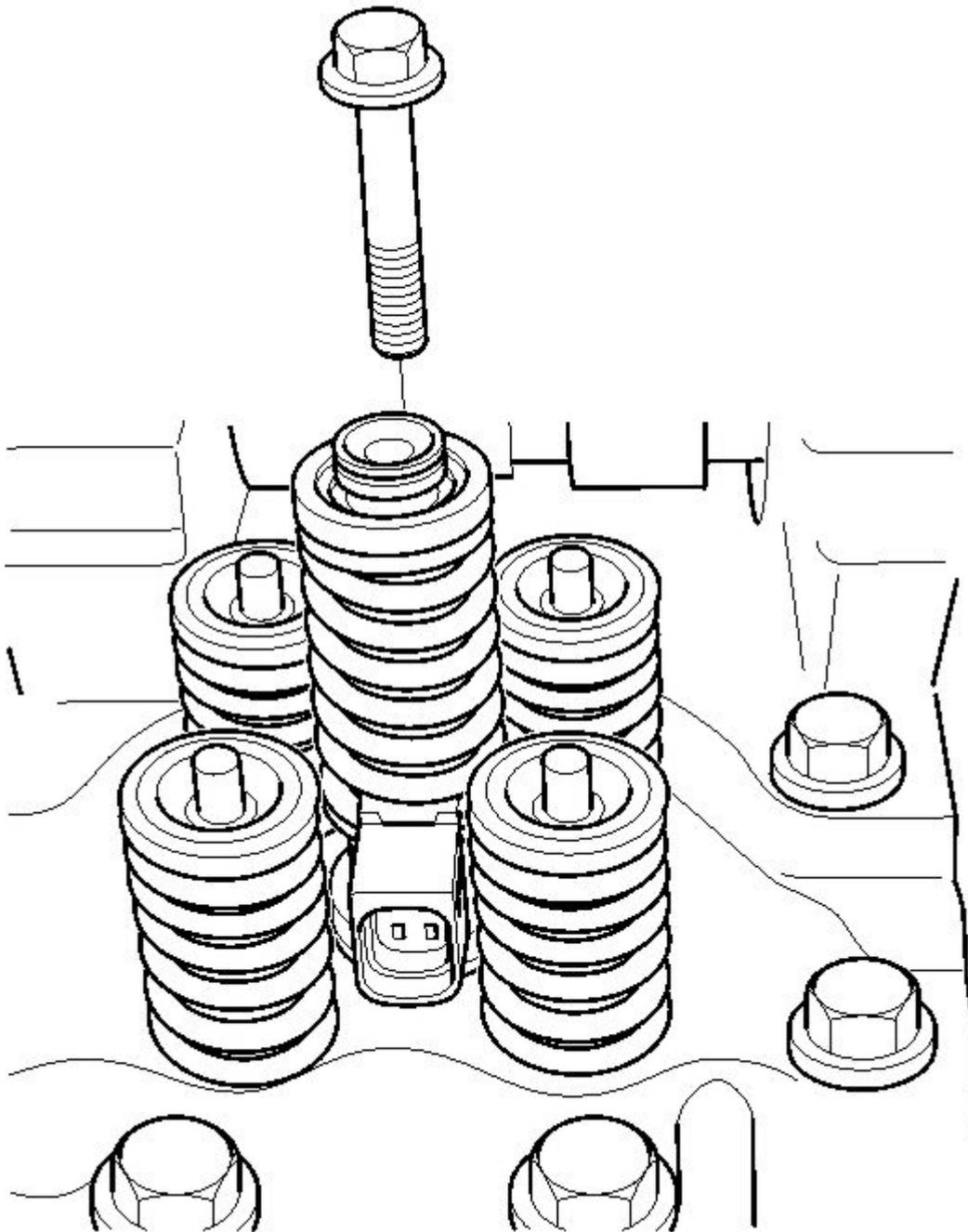
Position the cover to the engine block and install the bolt (A) into the oval hole. Press the cover against the water pump housing using an assembly tool and install the bolt (B). Check that the cover is positioned correctly.

Install bolts C and D and tighten..... $24 \pm 4$  Nm ( $18 \pm 3$  ft-lb)

Tighten the cover bolts from the middle and outwards in order 1–4 as shown..... $24 \pm 4$  Nm ( $18 \pm 3$  ft-lb)

Finish by checking the torque for bolts C and D..... $24 \pm 4$  Nm ( $18 \pm 3$  ft-lb)

## Tightening torques function group 23



Retainer, injector:

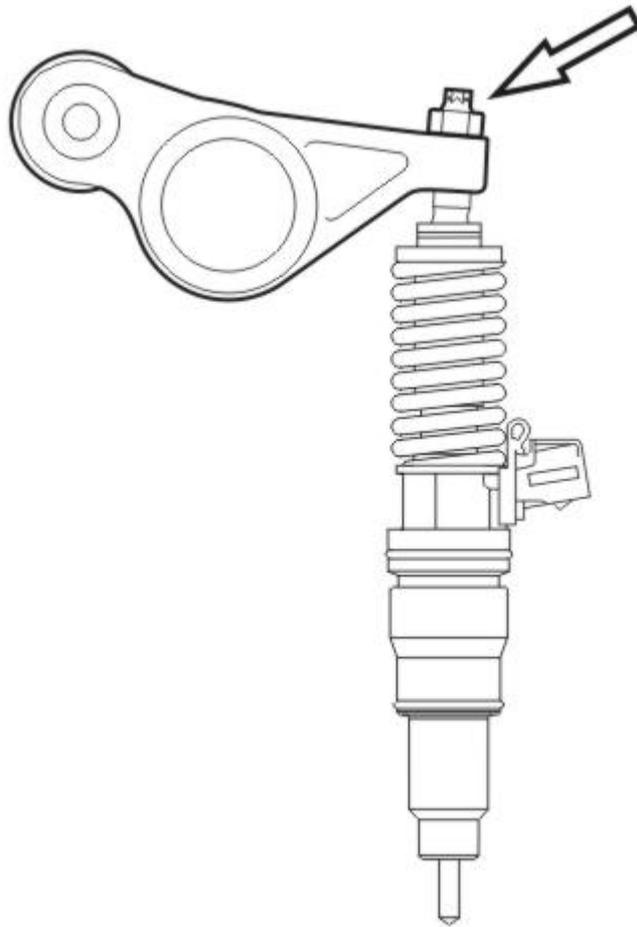
Step 1 Tighten .....20 +5/-0 Nm (15 +4/-0 ft-lb).

Step 2 Tighten .....180 ±5 degrees.

Step 3 Loosen the bolt until the torque is 10–15 Nm (7–11 ft-lb), back off approximately 150 degrees.

Step 4 Tighten .....25 +5/-0 Nm (18 +4/-0 ft-lb).

Step 5 Tighten .....90 ±5 degrees.



Lock nut, injector adjusting screw..... $52 \pm 4$  Nm ( $38 \pm 3$  ft-lb)

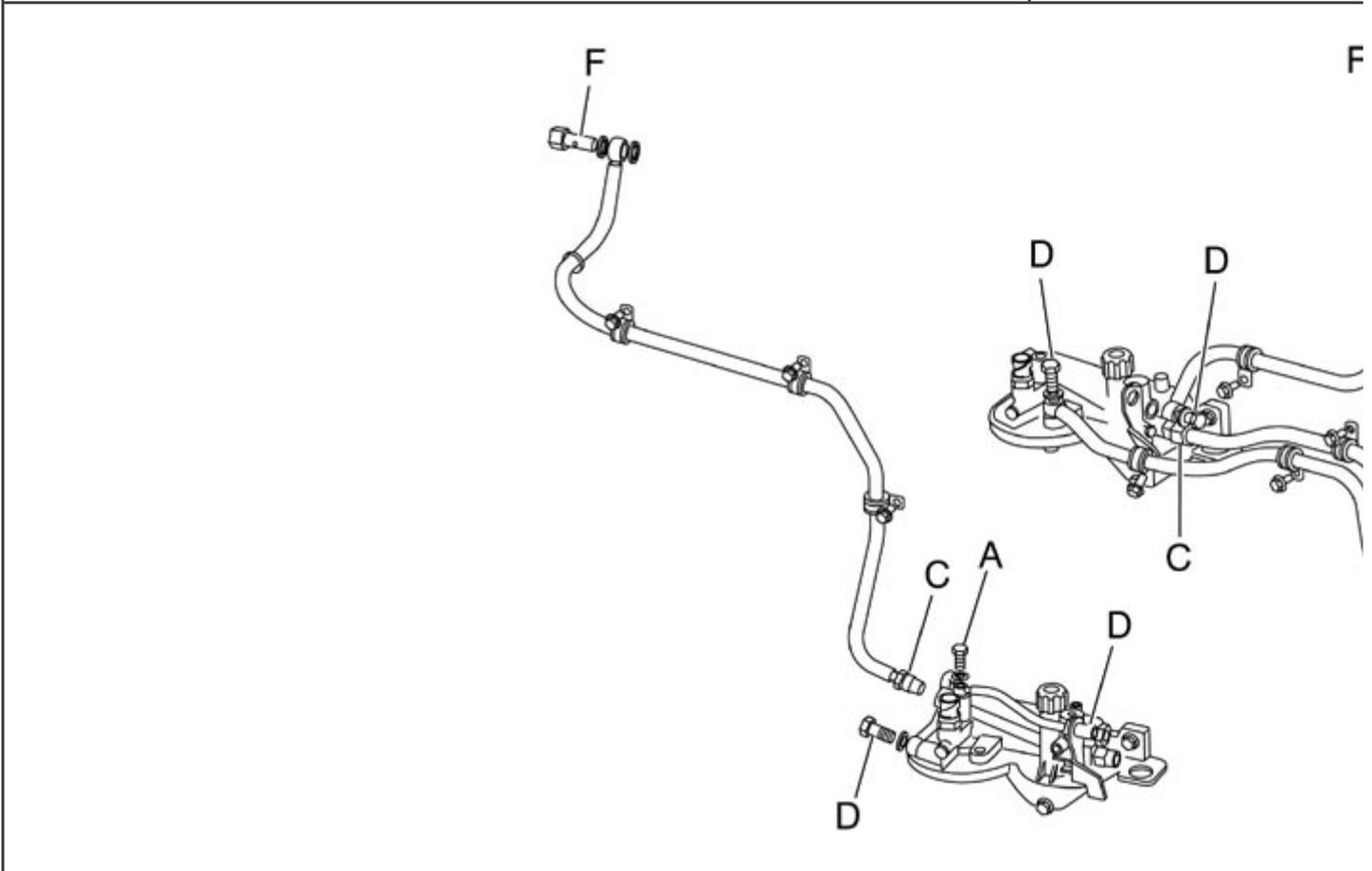
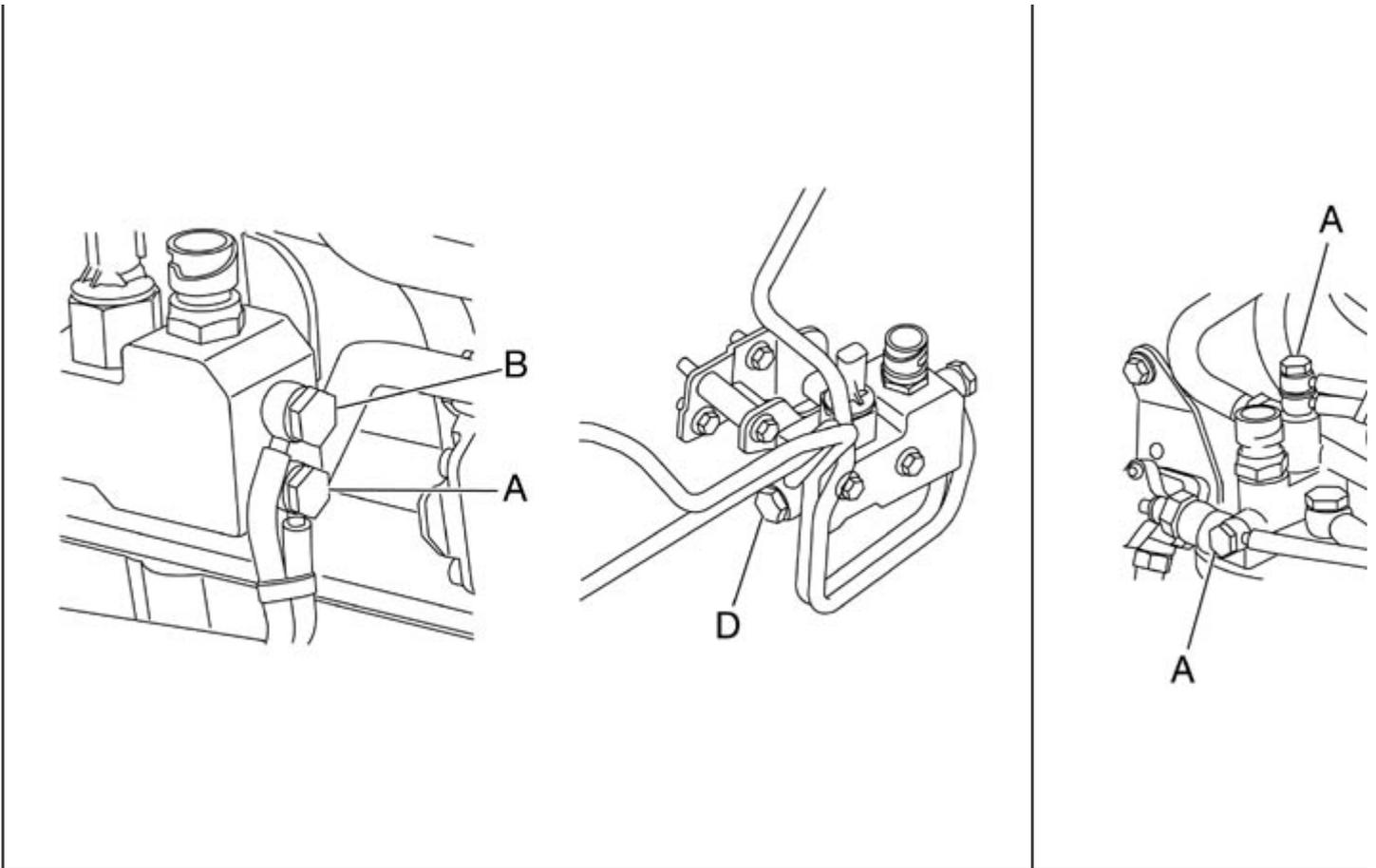
Tandem pump (power steering pump) mounting bolts..... $24 \pm 4$  Nm ( $18 \pm 3$  ft-lb)

Note: Torque all mounting nuts to specification twice.

Fuel pump (mounted on power steering pump)..... $8 +2/-0$  Nm ( $6 +1/-0$  ft-lb)

Fuel filter housing..... $24 \pm 4$  Nm ( $18 \pm 3$  ft-lb)

Fuel filter (primary, secondary)..... $18 \pm 3$  Nm ( $13 \pm 2$  ft-lb)



Fuel line fittings:

A..... $18 \pm 3$  Nm ( $13 \pm 2$  ft-lb)

B..... $28 \pm 4$  Nm ( $20.5 \pm 3$  ft-lb)

C..... $30 \pm 4$  Nm ( $22 \pm 3$  ft-lb)

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- D..... $35 \pm 5$  Nm ( $26 \pm 4$  ft-lb)  
 E..... $40 \pm 5$  Nm ( $29.5 \pm 4$  ft-lb)  
 F..... $48 \pm 5$  Nm ( $35 \pm 4$  ft-lb)

## Tightening torques function group 25

Intake manifold..... $24 \pm 4$  Nm ( $18 \pm 3$  ft-lb)

Note: Tighten the bolts diagonally from the centre outward.

Housing, intake air heater:

Step 1..... $10 \pm 2$  Nm ( $8 \pm 1$  ft-lb)

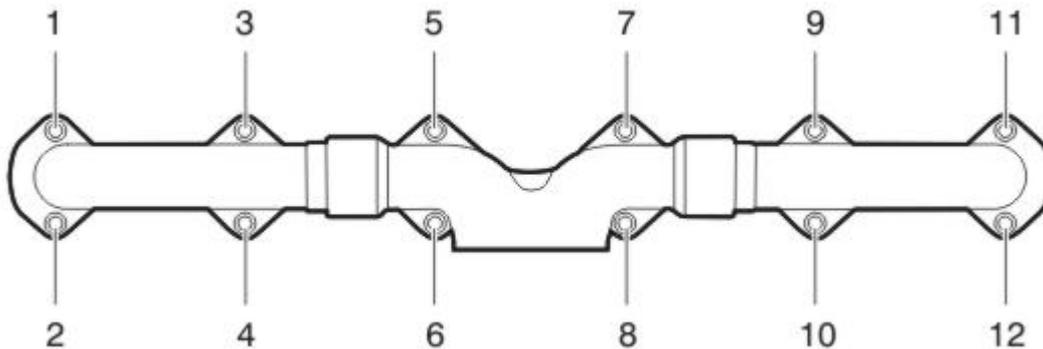
Step 2..... $24 \pm 3$  Nm ( $18 \pm 2$  ft-lb)

Note: Tighten the bolts diagonally.

Intake air heater terminal connections..... $10 \pm 1.5$  Nm ( $8 \pm 1$  ft-lb)

Plug, M10..... $20 \pm 3$  Nm ( $15 \pm 2$  ft-lb)

Pressure/temperature sensor, boost air..... $10 \pm 1$  Nm ( $88 \pm 9$  in-lb)



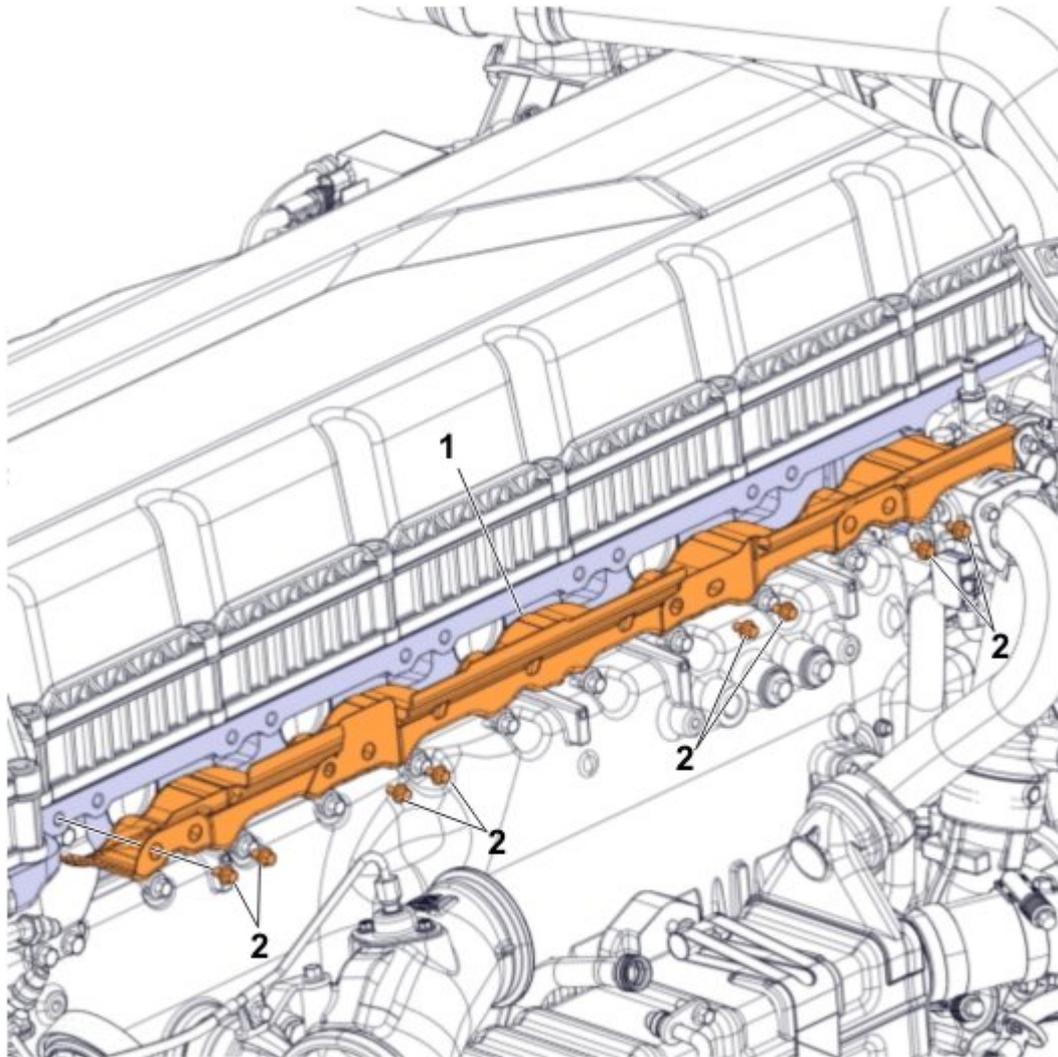
Exhaust manifold:

Step 1: Tighten bolts 1 through 12..... $5-10$  Nm ( $4-7$  ft-lb)

Step 2: Tighten bolts 1 through 12..... $30 \pm 4$  Nm ( $22 \pm 3$  ft-lb)

Step 3: Tighten bolts 1 through 12..... $52 \pm 4$  Nm ( $38 \pm 3$  ft-lb)

Note: Tighten the exhaust manifold bolts following the numbered sequence shown.



Exhaust manifold heat shield..... $48 \pm 8$  Nm ( $35 \pm 6$  ft-lb)

Exhaust gas recirculation (EGR):

EGR valve mounting bolts:

Step 1..... $20 \pm 4$  Nm ( $15 \pm 3$  ft-lb)

Step 2..... $52 \pm 4$  Nm ( $38 \pm 3$  ft-lb)

Note: Tighten the bolts diagonally.

EGR valve rear heat shield..... $24 \pm 4$  Nm ( $18 \pm 3$  in-lb)

EGR cooler mounting brackets..... $24 \pm 4$  Nm ( $18 \pm 3$  ft-lb)

EGR hot pipe clamps.....6 Nm (50 in-lb)

EGR cooler mounting screws and locknuts..... $12 \pm 4$  Nm ( $9 \pm 3$  ft-lb)

EGR cooler draincock mounting..... $15 \pm 3$  Nm ( $11 \pm 2$  ft-lb)

EGR cooler draincock valve..... $3 \pm 0.5$  Nm ( $27 \pm 4$  in-lb)

EGR cooler hexagon drain plug..... $40 \pm 6$  Nm ( $30 \pm 4$  in-lb)

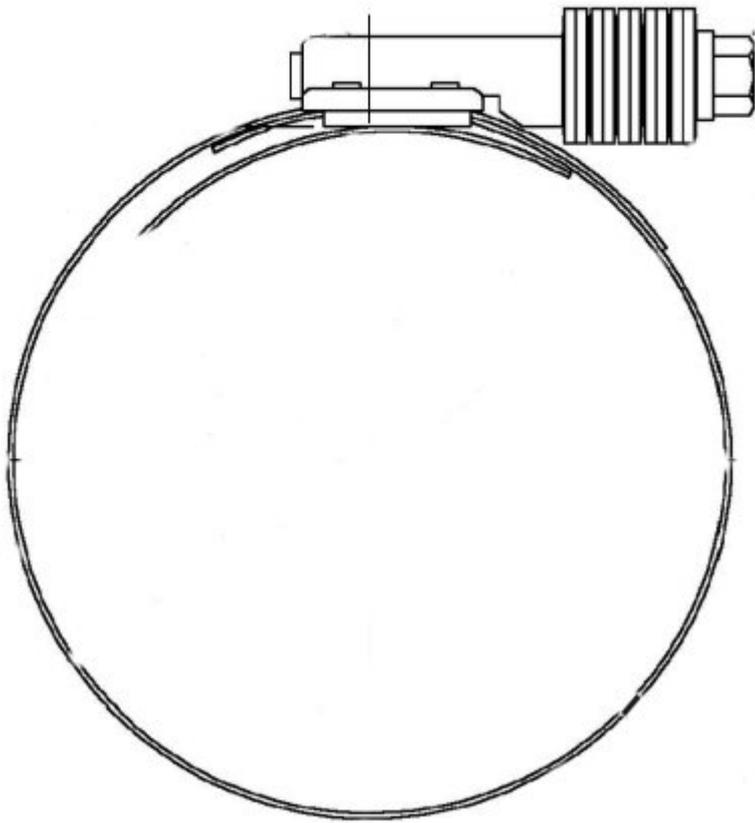
V-band clamps..... $20 \pm 4$  Nm ( $15 \pm 3$  ft-lb)

Starter heat shield..... $24 \pm 4$  Nm ( $18 \pm 3$  ft-lb)

Mixing chamber inlet tube..... $24 \pm 4$  Nm ( $18 \pm 3$  ft-lb)

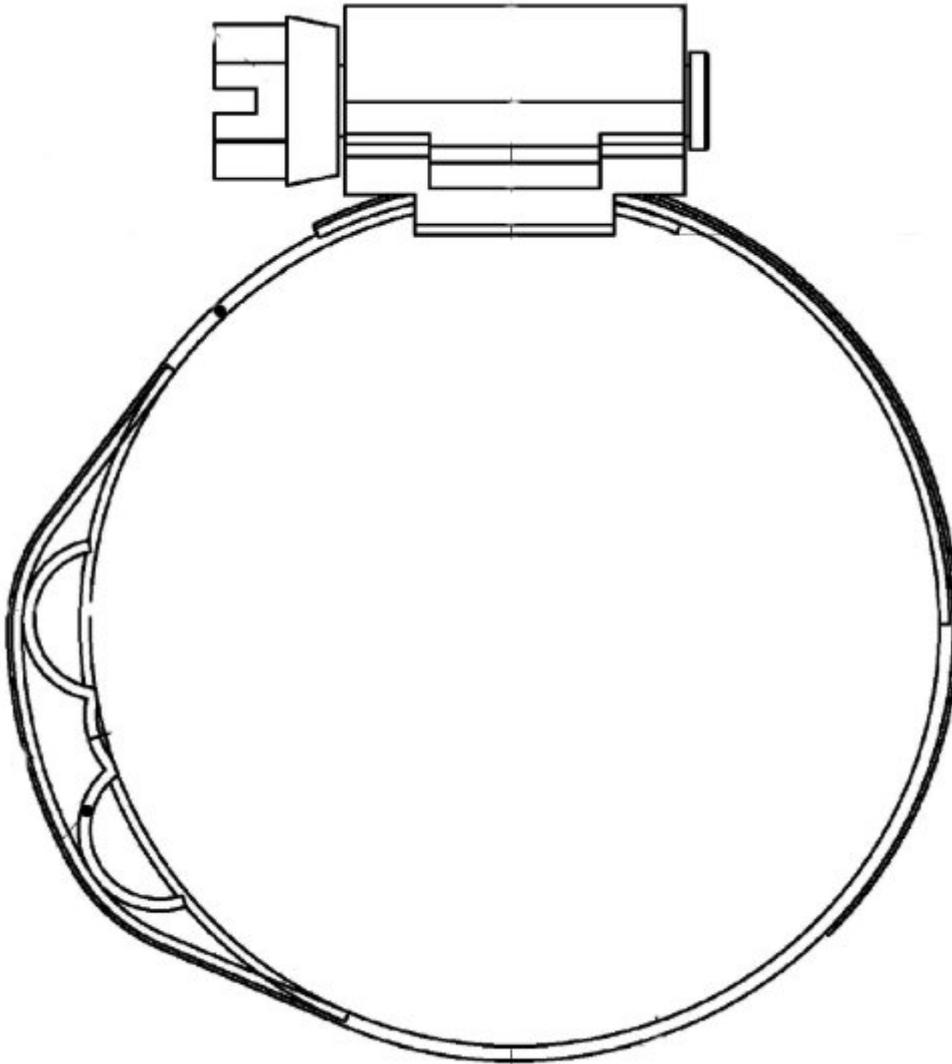
Venturi tube mounting fasteners..... $24 \pm 4$  Nm ( $18 \pm 3$  ft-lb)

Crossover pipe support bracket clamp screws..... $24 \pm 4$  Nm ( $18 \pm 3$  ft-lb)



clamps.....10 Nm (90 in-lb)

EGR spring hose



EGR worm-gear hose

clamps..... $4.5 \pm 0.5$  Nm ( $40 \pm 4$  in-lb)

#### Turbocharger:

Turbocharger mounting screws and nuts:

Step 1..... $20 \pm 4$  Nm ( $15 \pm 3$  ft-lb)

Step 2..... $48 \pm 8$  Nm ( $35 \pm 6$  ft-lb)

Note: Tighten diagonally.

Inlet elbow hose clamp..... $9 \pm 1$  Nm ( $80 \pm 9$  in-lb)

Charge air cooler V-clamp..... $7 \pm 1$  Nm ( $62 \pm 9$  in-lb)

Diffuser V-clamp..... $12 \pm 2$  Nm ( $9 \pm 1.5$  ft-lb)

Turbocharger oil supply and return..... $24 \pm 4$  Nm ( $18 \pm 3$  ft-lb)

Turbocharger coolant supply..... $48 \pm 5$  Nm ( $35 \pm 4$  ft-lb)

Turbocharger coolant return:

Hollow screw..... $48 \pm 5$  Nm ( $35 \pm 4$  ft-lb)

Fitting nut..... $60 \pm 6$  Nm ( $44 \pm 5$  ft-lb)

SRA coolant supply and return:

At turbocharger..... $12 \pm 3$  Nm ( $9 \pm 2$  ft-lb)

At block..... $48 \pm 5$  Nm ( $35 \pm 4$  ft-lb)

#### Closed crankcase ventilation (CCV):

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Mounting bolts.....24 ± 4 Nm (18 ± 3 ft-lb)  
 Hose clamps.....4 ± 0.6 Nm (35 ± 5 in-lb)

US2007–US2014 emissions

Diesel Particulate Filter (DPF):

Compact (under cab):

Lower mounting bracket.....48 ± 8 Nm (35 ± 6 ft-lb)  
 Mounting strap fastener.....27 ± 4 Nm (20 ± 3 ft-lb)

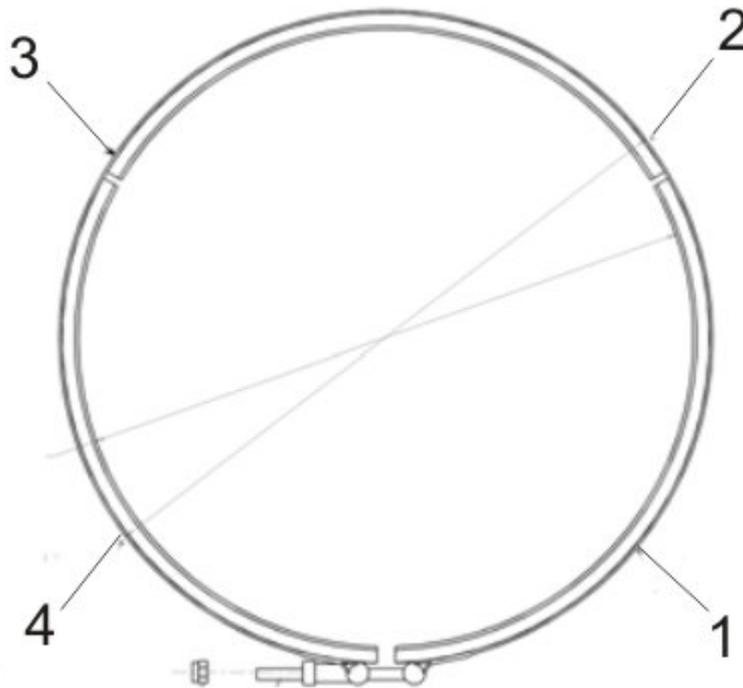
Vertical (back of cab):

Mounting bracket.....85 ± 15 Nm (63 ± 11 ft-lb)  
 Mounting strap fastener.....23 ± 1 Nm (17 ± 1 ft-lb)  
 Exhaust V-clamp.....7 ± 2 Nm (62 ± 18 in-lb)

DPF V-clamp:

Step 1 – Tighten to the specification listed below.

Step 2 – Using a plastic hammer, firmly tap around the clamp in 4 places in sequence shown.



Step 3 – Retighten to the specification listed below.

- 2007–2009: 15 ± 1 Nm (132 ± 9 in-lb)
- 2010–2016: 20 ± 1 Nm (177 ± 9 in-lb)

Note: Years listed are vehicle build dates, not model years.

US2010-2014 emissions

Selective Catalytic Reduction (SCR), vertical:

Mounting nuts .....271 Nm (200 ft-lb)  
 Cage fasteners .....68 Nm (50 ft-lb)  
 Heat shield fasteners .....24 ± 4 Nm (18 ± 3 ft-lb)  
 Exhaust V-band clamp.....7 ± 2 Nm (62 ± 18 in-lb)  
 V-band clamps (DPF to SCR pipe) .....7 ± 0.5 Nm (60 ± 5 in-lb)

Selective Catalytic Reduction (SCR), horizontal:  
 Mounting strap nuts .....45 ± 5 Nm (400 ± 45 in-lb)  
 Frame rail mounting bracket nuts .....140 ± 25 Nm (103 ± 18 ft-lb)  
 Heat shield screws .....24 ± 4 Nm (18 ± 3 ft-lb)  
 Exhaust V-band clamp.....7 ± 2 Nm (62 ± 18 in-lb)  
 V-band clamps (DPF to SCR pipe) .....7 ± 0.5 Nm (60 ± 5 in-lb)

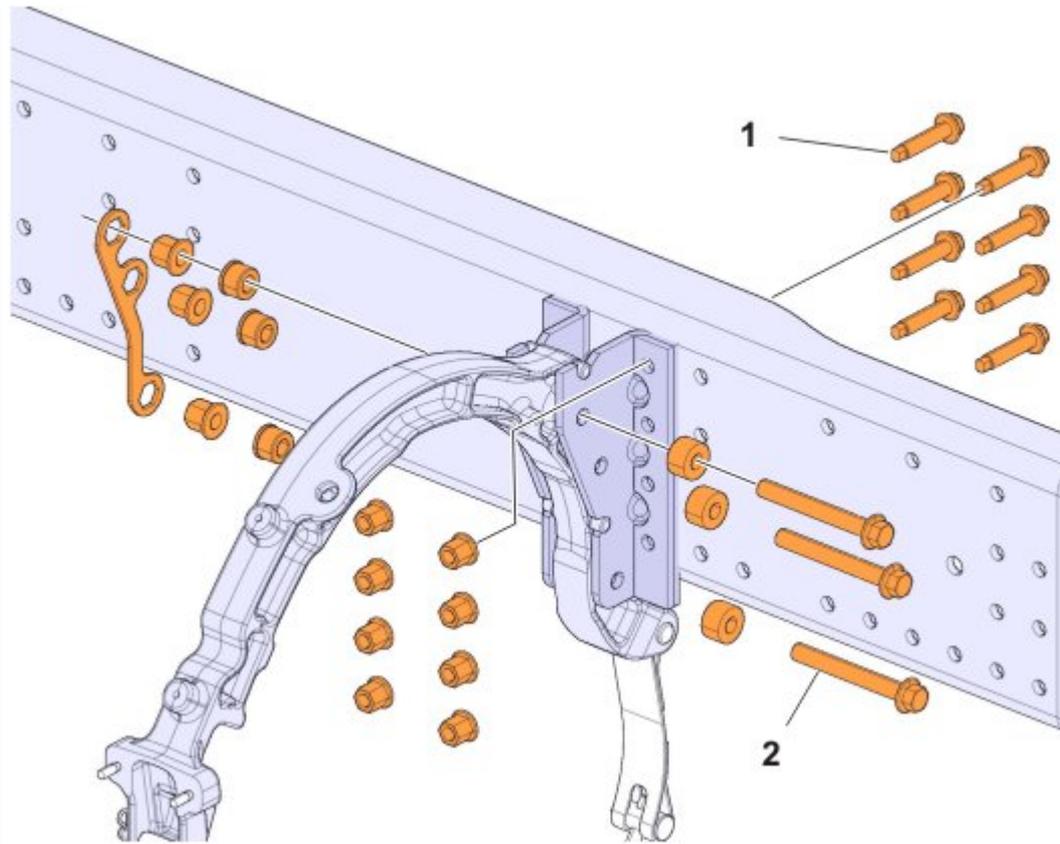
US2010– forward emissions

AdBlue tank:  
 AdBlue pump screws .....24 ± 4 Nm (18 ± 3 ft-lb)  
 ACM bracket screws .....24 ± 4 Nm (18 ± 3 ft-lb)  
 ACM mounting nuts .....24 ± 4 Nm (18 ± 3 ft-lb)  
 Solenoid valve mounting bracket screws .....3 ± 0.5 Nm (27 ± 4 in-lb)  
 Tank cover screws .....24 ± 4 Nm (18 ± 3 ft-lb)  
 goofTank bracket to bracket screws .....24 ± 4 Nm (18 ± 3 ft-lb)  
 Tank bracket to tank screws.....48 ± 8 Nm (35 ± 6 ft-lb)  
 Frame rail mounting bracket to tank bracket fasteners .....85 ± 15 Nm (63 ± 11 ft-lb)  
 Frame rail mounting bracket to frame fasteners .....140 ± 25 Nm (103 ± 18 ft-lb)

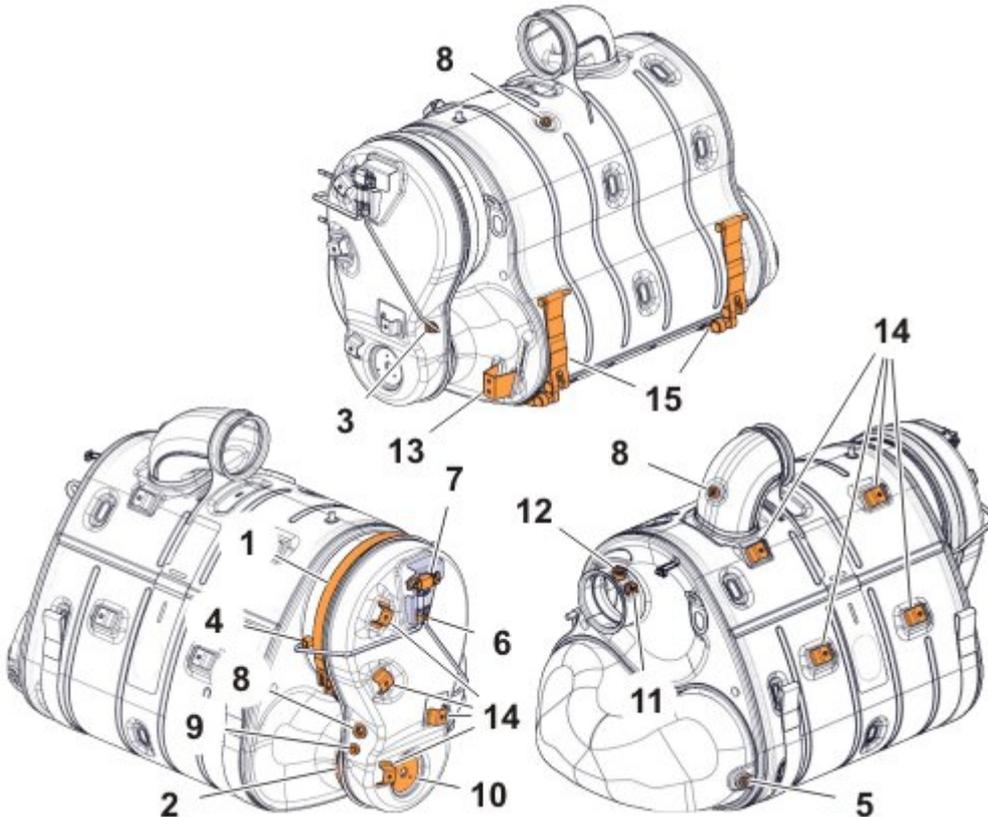
AdBlue pump  
 Filter cover .....22.5 ± 2.5 Nm (16.5 ± 2 ft-lb)  
 Coolant connector .....5.5 ± 0.5 Nm (50 ± 5 in-lb)  
 Inlet connector .....4 ± 0.5 Nm (35 ± 5 in-lb)  
 Backflow connector .....4.5 ± 0.5 Nm (40 ± 5 in-lb)  
 Outlet connector .....4 ± 0.5 Nm (35 ± 5 in-lb)

Note: When a connector is replaced, a new O-ring must be used.

US2017–forward emissions



- 1. Torque:  $200 \pm 30$  Nm ( $148 \pm 22$  ft-lb)
- 2. Torque:  $300 \pm 30$  Nm ( $221 \pm 22$  ft-lb)

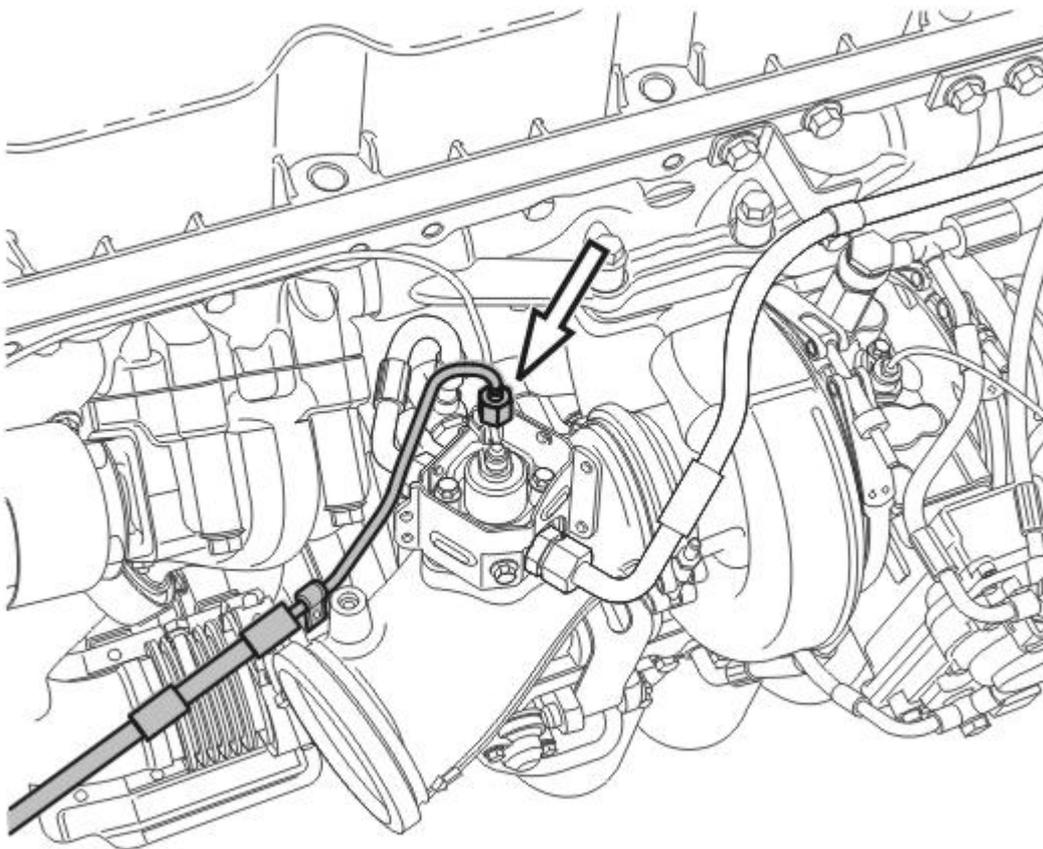


- 1. Large V-clamp for DPF service cover:  $15 \pm 1$  Nm ( $11 \pm 0.7$  ft-lb)
- 2. Small V-clamp for DPF service cover:  $15 \pm 1$  Nm ( $11 \pm 0.7$  ft-lb)

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3. Pressure pipe:  $30 \pm 5$  Nm ( $22 \pm 4$  ft-lb)
4. Pressure pipe:  $30 \pm 5$  Nm ( $22 \pm 4$  -lb) ft
5. Inspection plug:  $30 \pm 5$  Nm ( $22 \pm 4$  ft-lb)
6. Bracket for clamping pressure pipes:  $6 \pm 1$  Nm ( $4.4 \pm 0.7$  ft-lb)
7. Differential pressure sensor: :  $6 \pm 1$  Nm ( $4.4 \pm 0.7$  ft-lb)
8. Temperature sensors:  $45 \pm 5$  Nm ( $33 \pm 4$  ft-lb)
9. NOx sensors:  $50 \pm 10$  Nm ( $37 \pm 7$ ) ft-lb
10. Urea (DEF) injector:  $10 \pm 1$  Nm ( $7 \pm 0.7$  ft-lb)
11. PM sensor:  $50 \pm 10$  Nm ( $37 \pm 7$ ft-lb)
12. Ammonia sensor:  $50 \pm 10$  Nm ( $37 \pm 7$  ft-lb)
13. Bracket for urea (DEF) injector pipes:  $10 \pm 1.5$  Nm ( $7 \pm 1$ ft-lb)
14. Heat shield for wiring harness and sensor ECU bracket:  $24 \pm 4$  Nm ( $18 \pm 3$  ft-lb)
15. Mounting straps to chassis bracket:  $48 \pm 10$  Nm ( $35 \pm 7$  ft-lb)



Aftertreatment hydrocarbon doser (non-integrated):

Doser:

Aftertreatment hydrocarbon doser fasteners..... $6 \pm 2$  Nm ( $53 \pm 18$  in-lb)

Mounting bolts..... $14 \pm 0.5$  Nm ( $125 \pm 4.5$  in-lb)

Fuel line fitting (US10+6 to US16)..... $22 \pm 2$  Nm ( $195 \pm 18$  in-lb)

Cooling lines..... $48 \pm 5$  Nm ( $35 \pm 4$  ft-lb)

Two-way check valve..... $24$  Nm ( $18$  ft-lb)

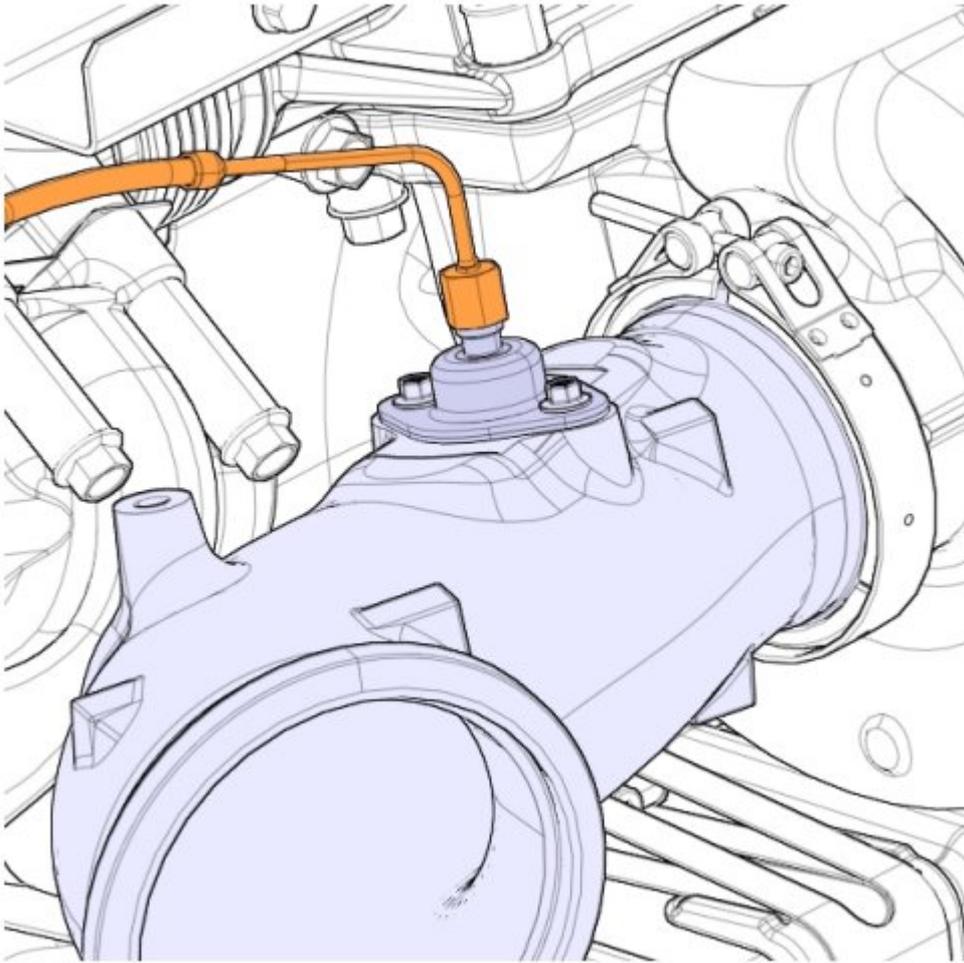
Air line..... $27$  Nm ( $20$  ft-lb)

Shut-off Valve:

Mounting..... $13.5 \pm 3$  Nm ( $120 \pm 24$  in-lb)

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#### Aftertreatment hydrocarbon doser (integrated)

##### Doser:

Mounting bolts..... $14 \pm 0.5$  Nm ( $125 \pm 4.5$  in-lb)

Air/Fuel line fitting..... $22 \pm 2$  Nm ( $195 \pm 18$  in-lb)

M10 P-clamp flange screw..... $28 \pm 4$  Nm ( $21 \pm 3$  ft-lb)

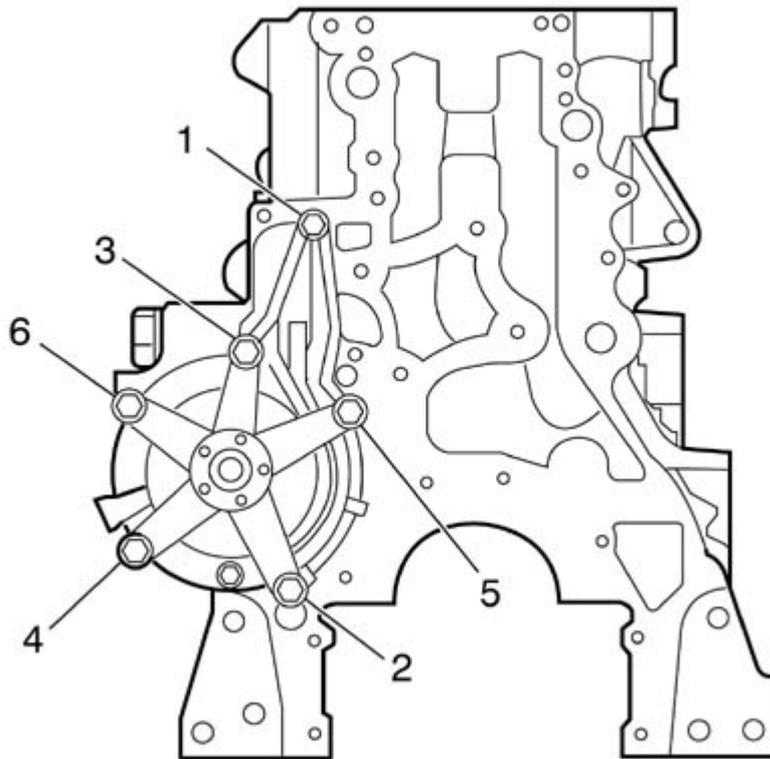
Connection joint between left and right fuel pipes..... $15 \pm 2$  Nm ( $135 \pm 18$  in-lb)

#### Aftertreatment hydrocarbon dosing module:

Air/Fuel line fitting (US17 to current)..... $25 \pm 6$  Nm ( $221 \pm 53$  in-lb)

Fuel line from housing to module fittings..... $21 \pm 3$  Nm ( $186 \pm 27$  in-lb)

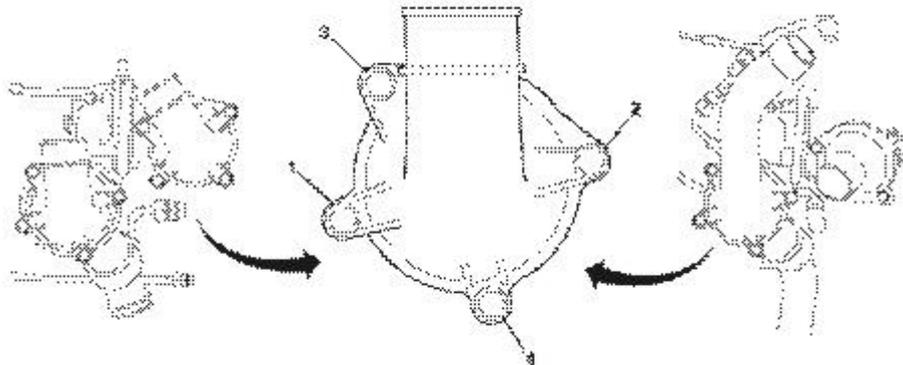
## Tightening torques function group 26



Coolant pump (Note: Tighten in sequence twice)..... $24 \pm 4$  Nm ( $18 \pm 3$  ft-lb)

Coolant pump pulley..... $24 \pm 4$  Nm ( $18 \pm 3$  ft-lb)

Coolant pump housing..... $48 \pm 8$  Nm ( $35 \pm 6$  ft-lb)



Front and side cover, thermostat housing..... $28$  Nm ( $21$  ft-lb)

Tensioner..... $48 \pm 8$  Nm ( $35 \pm 6$  ft-lb)

Drive belt idler..... $24 \pm 4$  Nm ( $18 \pm 3$  ft-lb)

Fan hub:

15mm hex (wrench size) nut..... $48 \pm 8$  Nm ( $35 \pm 6$  ft-lb)

VHD with 13L engine, 45mm stud length and 16mm hex (wrench size) nut..... $70 \pm 12$  Nm ( $52 \pm 9$  ft-lb)

Viscous fan drive:

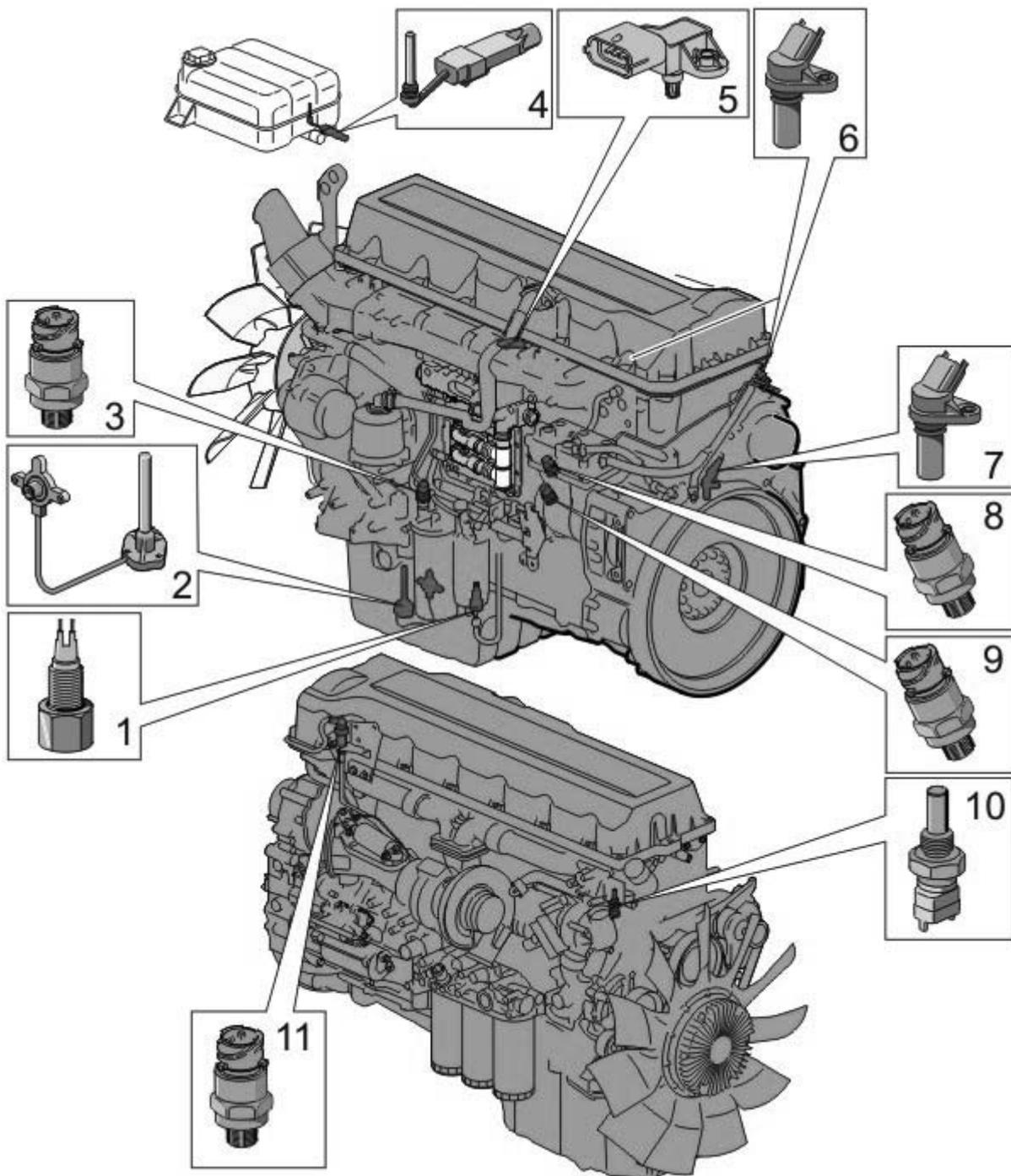
Drive-to-hub.....	24 ± 4 Nm (18 ± 3 ft-lb)
Upper radiator hose clamp:	
Screw-type band clamp.....	5 Nm (45 in-lb)
Screw-type band clamp with spring.....	10 Nm (90 in-lb)

## Tightening torques function group 28

Note: Sensors vary by engine.

Sensor and location.....	Specification
Flywheel position/speed, top of flywheel housing.....	8 ± 2 Nm (6 ± 1 ft-lb)
Camshaft position, timing gear cover.....	8 ± 2 Nm (6 ± 1 ft-lb)
Turbocharger speed, top middle of turbocharger.....	8.5 ± 2 Nm (75 ± 18 in-lb)
Turbocharger discharge temperature.....	45 ± 4.5 Nm (33 ± 3 ft-lb)
Oil level/temperature, inside sump.....	10 ± 1 Nm (89 ± 9 in-lb)
Oil pressure, block, front of air compressor.....	30 ± 5 Nm (22 ± 4 ft-lb)
Coolant level, surge tank.....	Plug-in
Coolant temperature, front right side cylinder head.....	22 ± 3 Nm (16 ± 2 ft-lb)
Fuel pressure, fuel filter housing.....	25 ± 3 Nm (18.5 ± 2 ft-lb)
Aftertreatment fuel injector fuel pressure, behind fuel filter housing.....	25 ± 3 Nm (18.5 ± 2 ft-lb)
Crankcase pressure, block, front of air compressor.....	25 ± 3 Nm (18.5 ± 2 ft-lb)
Charge air pressure, mixing chamber.....	10 ± 1 Nm (89 ± 9 in-lb)
Charge air temperature, intake manifold.....	10 ± 1 Nm (89 ± 9 in-lb)
Humidity, fresh air pipe.....	27 ± 3 Nm (20 ± 2 ft-lb)
Charge air temperature and pressure, intake manifold.....	10 ± 1 Nm (89 ± 9 in-lb)
EGR temperature, EGR venturi.....	45 ± 4.5 Nm (33 ± 3 ft-lb)
EGR differential pressure, EGR venturi.....	20 ± 3 Nm (15 ± 2 ft-lb)
Piston cooling jet pressure sensor.....	25 ± 3 Nm (18.5 ± 2 ft-lb)
DPF temperature, DPF inlet, catalyst, outlet modules.....	45 ± 4.5 Nm (33 ± 3 ft-lb)
DPF differential pressure, DPF inlet, catalyst, outlet modules:	
Box.....	6 ± 1 Nm (53 ± 9 in-lb)
Fitting nuts.....	16.3 ± 2.7 Nm (12 ± 2 ft-lb)
NOx sensor, exhaust pipe after DPF.....	50 ± 10 Nm (37 ± 7 ft-lb)
NOx sensor, exhaust pipe after SCR.....	50 ± 10 Nm (37 ± 7 ft-lb)
NOx module, frame bracket.....	24 ± 4 Nm (18 ± 3 ft-lb)

US2007, 2010, 2014 emissions



- |   |
|---|
| 1. Level sensor for water separator..... not replaceable, integrated in the cabling     |
| 2. Engine oil level/temperature sensor..... torque for standard screw                   |
| 3. Fuel pressure sensor..... 25 ± 3 Nm (18 ± 2 ft-lb)                                   |
| 4. Coolant level sensor..... plug-in model  |
| 5. Charge air pressure/temperature sensor..... M6 standard bolt, 8 ± 2 Nm (6 ± 1 ft-lb) |
| 6. Camshaft position sensor..... M6 standard screw, 8 ± 2 Nm (6 ± 1 ft-lb)              |
| 7. Flywheel position/speed sensor..... M6 standard screw, 8 ± 2 Nm (6 ± 1 ft-lb)        |
| 8. Oil pressure sensor..... 25 ± 3 Nm (18 ± 2 ft-lb)                                    |
| 9. Crankcase pressure sensor..... 25 ± 3 Nm (18 ± 2 ft-lb)                              |

10. Coolant temperature sensor.....	22 ± 3 Nm (16 ± 2 ft-lb)
11. Exhaust counter-pressure sensor.....	25 ± 3 Nm (18 ± 2 ft-lb)

### Tightening torques function group 3

Starter motor mounting nuts: M12 nuts.....85 ± 15 Nm (63 ± 11 ft-lb)	
Note: Torque all mounting nuts to specification twice.	
Starter cables (Bat+, E-): M12 nuts.....26 ± 1.5 Nm (19.2 ± 1 ft-lb)	
Starter control wire: M6 nuts.....4 ± 1 Nm (35 ± 9 in-lb)	
Alternator: Mounting bracket.....48 ± 8 Nm (35 ± 6 ft-lb) Pad mounts.....65.5 ± 7.5 Nm (48 ± 5.5 ft-lb) Pulley nut.....101.5 ± 6.5 Nm (75 ± 5 ft-lb) Battery terminal.....6.5 ± 0.25 Nm (57.5 ± 2.5 in-lb) Ground terminal.....6.2 ± 0.5 Nm (55 ± 5 in-lb) I, R terminals.....2.3 ± 0.5 Nm (20 ± 5 in-lb)	
AC refrigerant compressor mounting bolts.....24 ± 4 Nm (18 ± 3 ft-lb)	
Wiring harness conduit to block.....24 ± 3 Nm (18 ± 2 ft-lb)	
Wiring harness conduit cover.....3.5 ± 0.5 Nm (31 ± 4.4 in-lb)	
Cable channel cover.....3.5 ± 0.5 Nm (31 ± 4.4 in-lb)	

### Tightening torques function group 5

Air compressor mounting bolts.....85 ± 15 Nm (63 ± 11 ft-lb)	
Note: Torque all mounting nuts to specification twice.	
Air compressor out connection.....130 ± 20 Nm (96 ± 15 ft-lb)	
Non-Clutched air compressor gear.....200 ± 50 Nm (147 ± 37 ft-lb)	
Clutched air compressor gear.....12 ± 2 Nm (9 ± 1.5 ft-lb)	