VOLVO
Volvo Trucks North America
Greensboro, NC USA

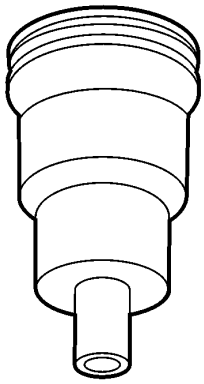
Service Bulletin Trucks

This service bulletin replaces SB 237-46, “Copper Sleeve, Unit Injector, Replacement” dated 6.2007, publication no. PV776-20177417.

Date	Group	No.	Page
3.2008	**237**	**46**	1(37)

Copper Sleeve, Unit injector
Replacement
D16F

Copper Sleeve, Unit Injector, Replacement



W2004183

This information covers the proper procedure for replacing the copper sleeves for the unit injectors on the Volvo D16F engine.

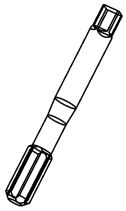
Contents

Note: Information is subject to change without notice.
Illustrations are used for reference only, and may differ slightly from the actual engine version. However, key components addressed in this information are represented as accurately as possible.

Tools

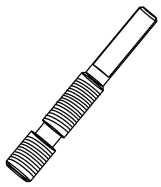
Special Tools

For special tools ordering instructions, refer to Tools Information, group 08.



T0010736

9809667
Tap, M9



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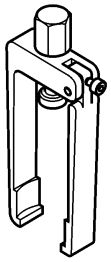
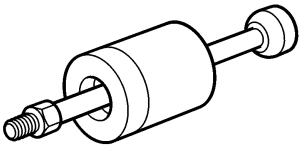
9809668
Bolt, M9



T2018914

9990006
Injector Puller

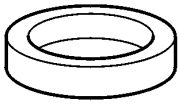


T2018915

9990013
Slide Hammer

C0000228

9998249
Protection Sleeve

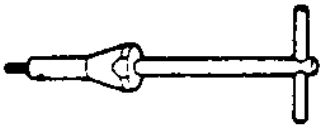


C0000723

9998250
Fuel Bore Sealing Ring

C0000229

9998251
Sealing Plug

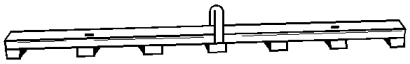


C0001250

9998252
Tapping Tool

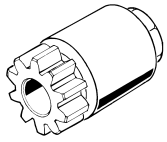
C0001242

9998253
Extractor



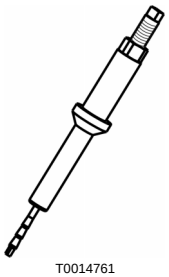
W0001405

85109035
Rocker Shaft Lift Tool



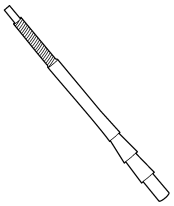
T0012612

88800014
Flywheel Turning Tool



T0014761

88800196
Flaring Tool



W2004289
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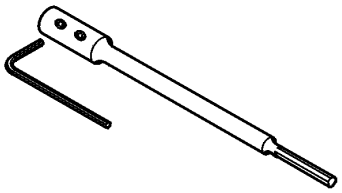
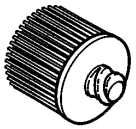
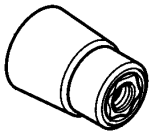
Swedging Bit



C0001224
J42885-1
Extension



C0001222
J42885-2
Brush



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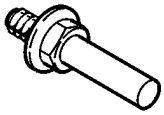
Holder



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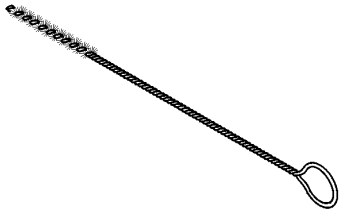
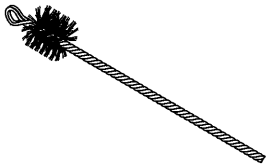
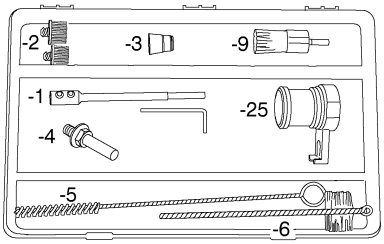
J42885-4
Threaded Shaft



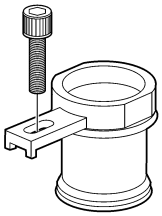
C0001319
J42885-5
Brush



C0001204
J42885-6
Brush

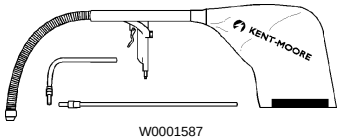


W0002416
J42885
Injector Bore Cleaning Kit

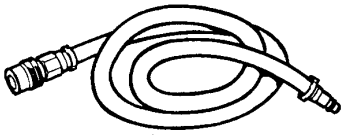


W0002215
J42885-25
Fuel Bore Protector

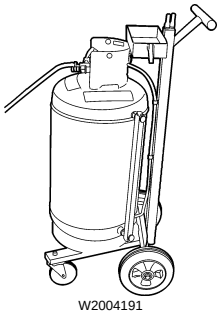
Other Special Equipment



W0001587
PT2900
Chip Vacuum



C0000264
9996049
Drain Hose



W2004191
DBT2V700
Coolant Extractor

Service Procedures

2379-03-02-02
Copper Sleeve, Unit Injector, Replacement (One)

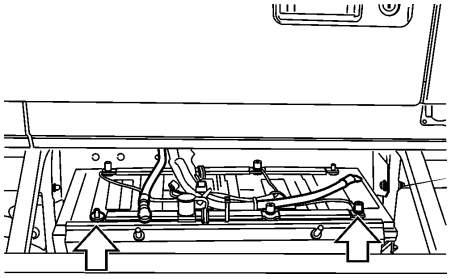
You must read and understand the precautions and guidelines in Service Information, group 20, “General Safety Practices, Engine” before performing this procedure. If you are not properly trained and certified in this procedure, ask your supervisor for training before you perform it.

Special tools: 9809667, 9809668, 9990006, 9990013, 9996049, 9998249, 9998250, 9998251, 9998252, 9998253, J42885-1, J42885-2, J42885-3, J42885-4, J42885-5, J42885-6, J42885-25, J42885, 85109035, 88800014, 88800196, 88880010, PT2900, DBT2V700,

Removal

1
Apply the parking brake and place the shift lever in neutral.

2
Remove all cables from ground (negative) battery terminals to prevent personal injury from electrical shock.

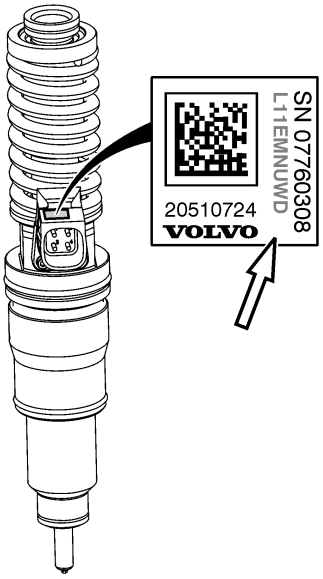


W2003815

3
Drain the coolant from the radiator and engine using the coolant extractor.

Note: An alternate method is to connect the drain hose to the drain fitting and drain the coolant.

DBT2V700, 9996049

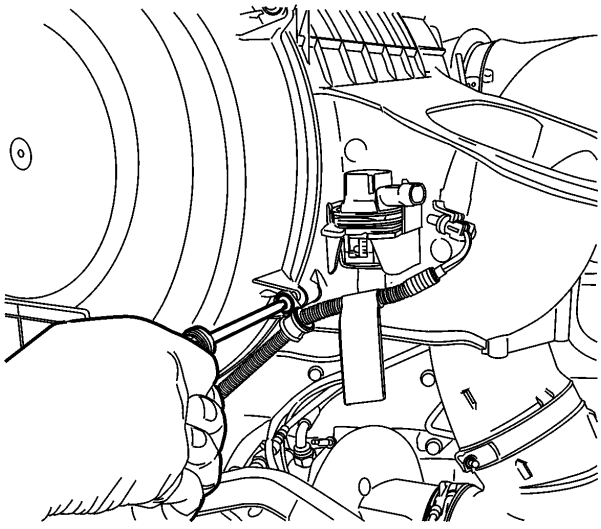


W2004684

4
When replacing unit injectors, the engine control unit must be programmed with the new injector's trim code. Programming is performed using VCADS Pro.

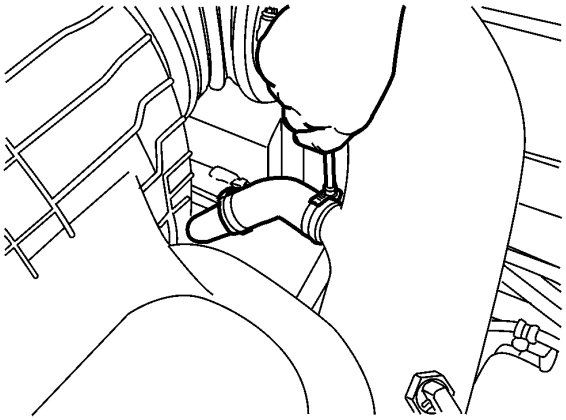
Note: When reusing unit injectors, they must be reinstalled in the same cylinder from which they were removed due to the trim codes. Switching injector locations on reinstallation will result in performance issues.

5
Clean around the fuel supply line fitting on the filter housing. Loosen the fuel line at the filter housing to allow fuel to drain from the cylinder head. Allow the fuel to drain into a suitable container.



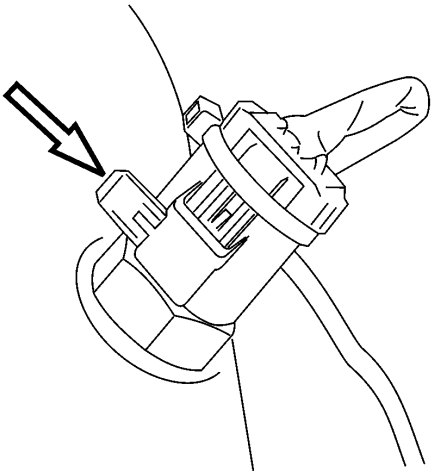
W2003861

6
Disconnect and remove the air filter restriction gauge wiring harness from air filter housing.



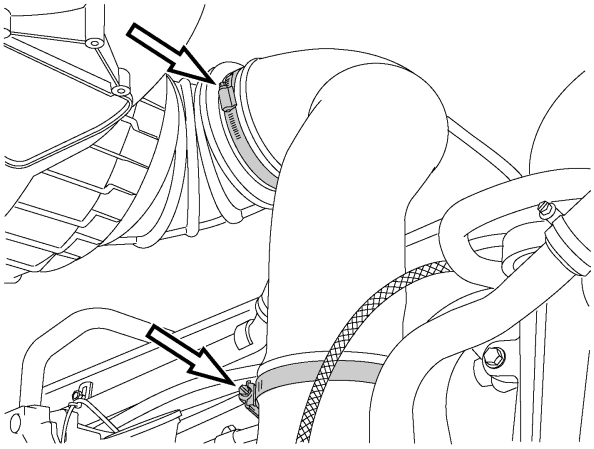
W2004719

7
Loosen the fresh air pipe-to-air compressor hose clamp and position the clamp out of the way.



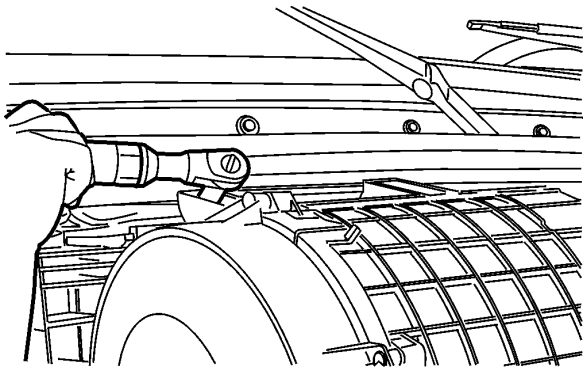
W2004720

8
Disconnect the air temperature sensor wiring harness connector. First, remove the lock tab, then cut the tie strap and separate the connector from the sensor. Also, remove the sensor harness bolt and P-clamp securing the sensor harness to the fresh air pipe.



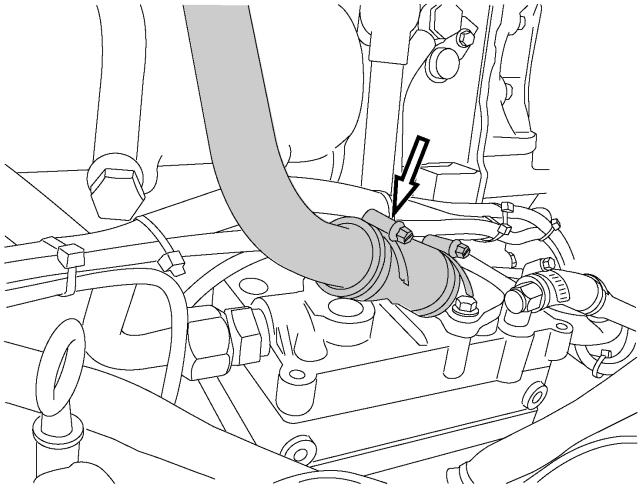
W2006005

9
Loosen the clamps and remove the main fresh air pipe from the air compressor fresh air hose, the air filter housing and the turbocharger air inlet elbow.



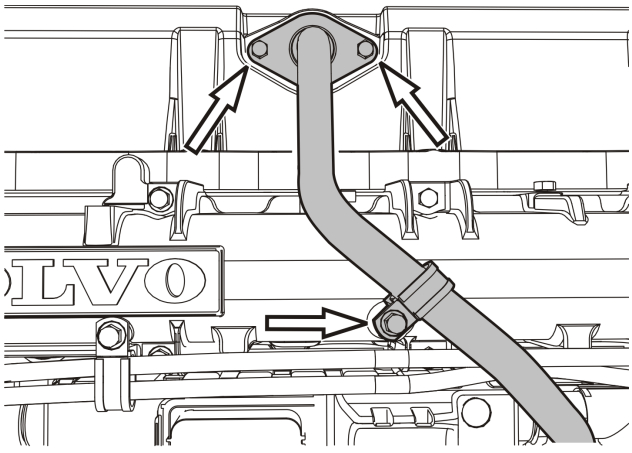
W2003858

10
Remove the fasteners and lift the air filter housing away from the cab.



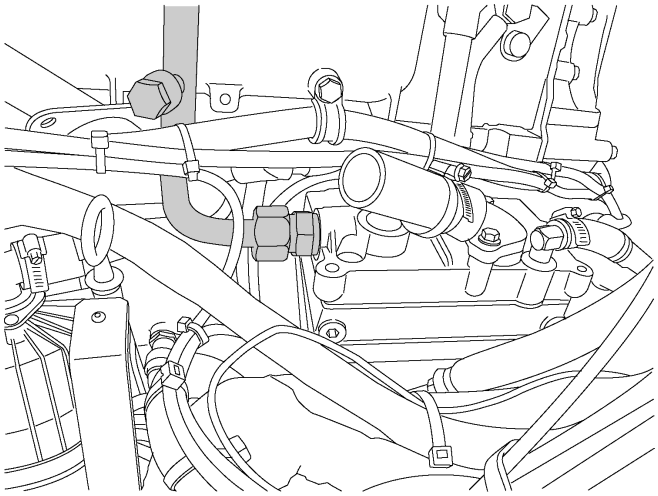
W5001571

11
Remove the coupling hose clamp securing the air inlet pipe at the air compressor. Remove the bracket bolts at the cylinder head and remove the air compressor air inlet pipe from the engine.



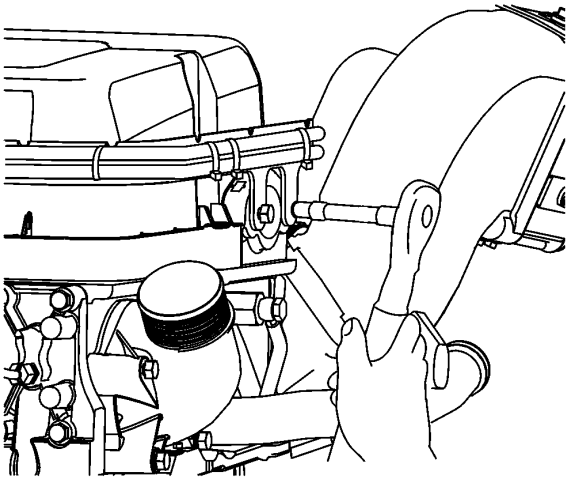
W2005747

12
Remove the crankcase ventilation tube from the side of the valve cover. Disconnect the P-clamp securing the tube to the intake manifold and position the tube out of the way.



W5001572

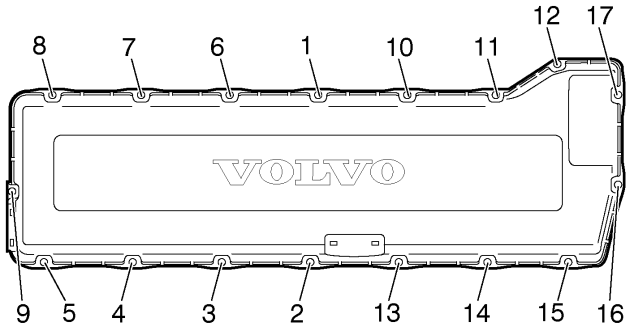
13
Disconnect the air discharge pipe at the air compressor and remove the clamp bracket securing the pipe to the intake manifold. Position the pipe out of the way.



W2004679

14
Remove the engine wiring harness support bracket from the front of the valve cover.

15
Remove the spring-loaded attaching bolts from the valve cover.



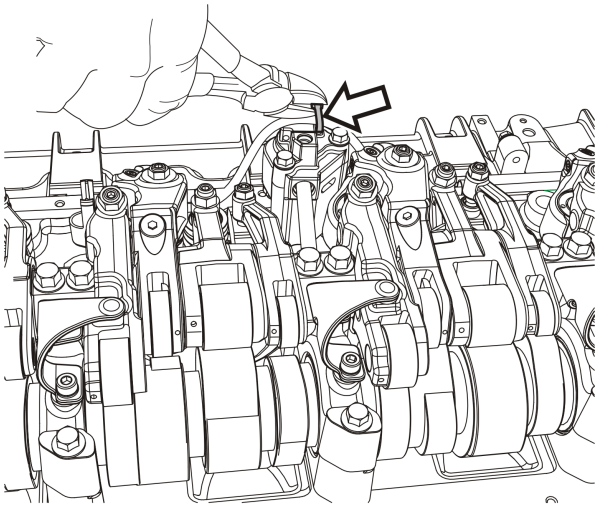
W2005984

16
Lift and remove the valve cover.

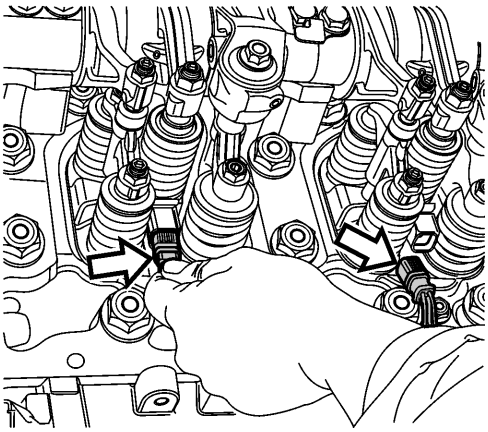
Note: Rotate the valve cover as needed, to clear the camshaft gear and damper.

Note: Dependent upon chassis, engine cover may need to be removed for clearance to remove valve cover.

17
Cut the nylon tie straps securing the injector's electrical wiring harness to the Volvo Engine Brake (VEB) valve.

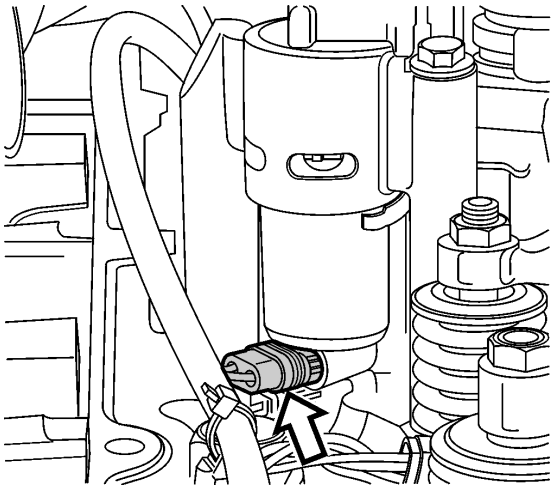


W2005846



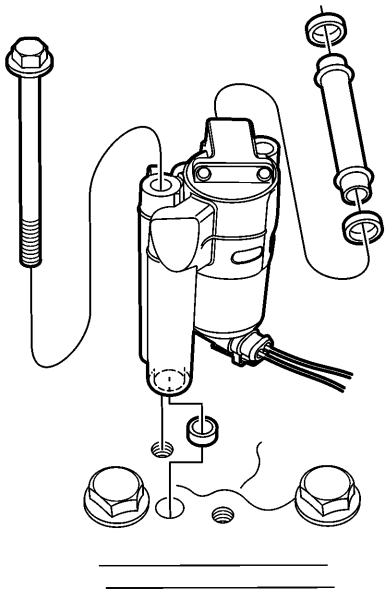
W2005106

18
Remove the unit injector's electrical connection.



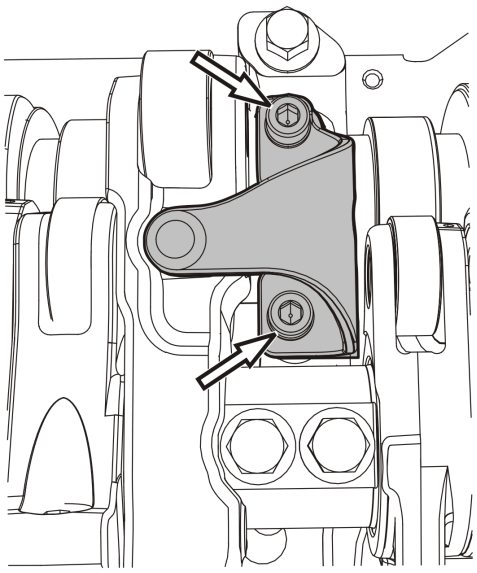
W2004837

19
Clean around the VEB control valve and remove the control valve electrical connector.



W2004869

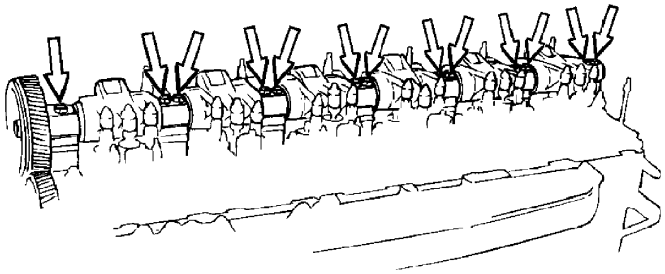
20
Remove the VEB control valve bolts. Remove the control valve and the oil pipe between the valve and the rocker arm shaft.



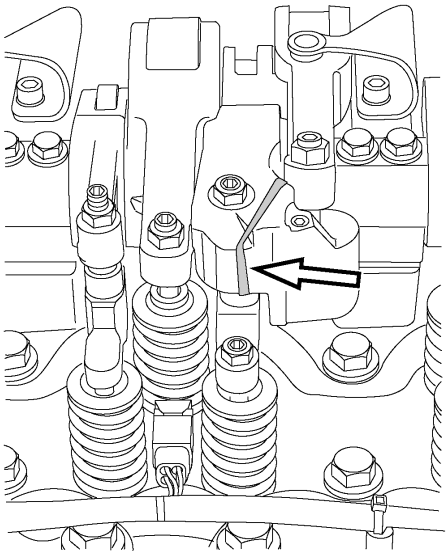
W2005845

21
Using an Allen wrench, remove all mounting fasteners for the leaf spring on the brake rockers, then remove the leaf springs.

22
Evenly loosen the rocker arm shaft bolts along the entire length of the shaft until there is no valve or injector spring pressure exerted on the assembly.



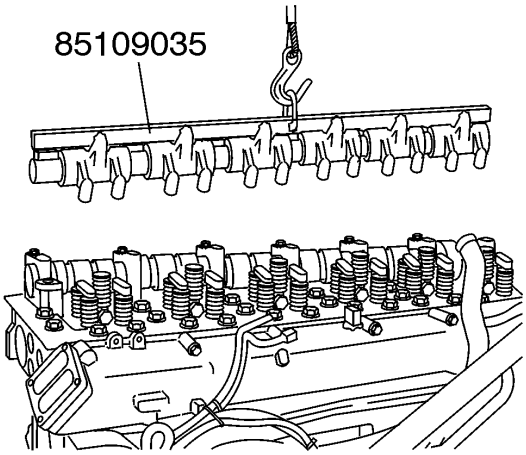
W2006220



W2006218

23
On VEB-equipped engines, secure the pistons in the exhaust rocker arms with elastic bands or similar, to prevent the pistons from falling out when the rocker arm assembly is removed.

Note: Pistons and rocker arms are matched together and should not be mixed.



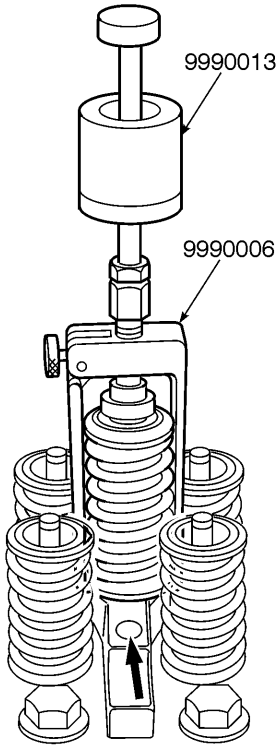
W2005077

24
Remove the bolts on the rocker arm shaft and install the rocker arm lifting tool. Using a suitable lifting device, remove the rocker arm assembly.

85109035

25
Mark the valve bridges so they can be installed in the same location during reassembly. Remove the valve bridges.

Note: Also, mark the location of the injectors for installation. Injectors must be installed in the same order as removed.



W2005170

26
Note: Thoroughly clean around the unit injectors that are to be removed.

Remove the unit injector's hold down bolt. Install the puller onto the unit injector. Position the puller fork in the groove on the unit injector and lock the arm using the thumb screw on the side. Secure the puller by screwing down the screw toward the inner cup of the unit injector. Install the slide hammer and pull the injector free from the cylinder head.

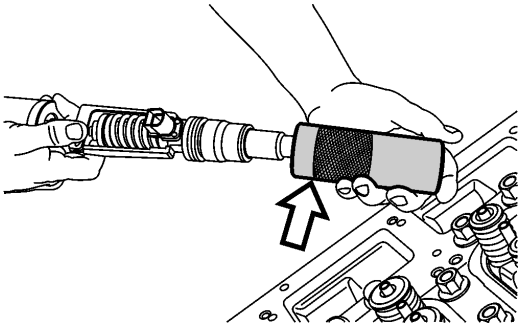
Note: Use care when removing the unit injector because the injector hold down is not secure and could fall off if not held in place.

9990006, 9990013

27
Remove and discard the injector nozzle gasket (flat washer) from the injector tip or copper sleeve bore.

Note: An injector nozzle gasket (flat washer) is used for the seal joint between the injector copper sleeve and the injector, discard the used gasket immediately after the injector is removed. A used gasket must not be reused. When the injector is removed, this gasket may come out attached to the injector or it may remain in the bottom of the injector sleeve.

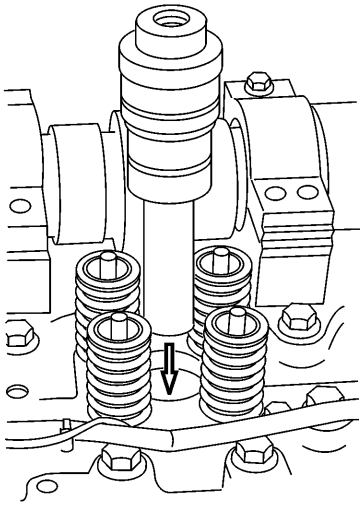
Note: If the nozzle gasket (flat washer) is attached to the injector, loosen it with gentle prying from a thin flat gasket scrapper blade. If the gasket is in the bottom of the injector sleeve, initially attempt to remove it with a magnet. If this is unsuccessful, use a standard flat blade screwdriver with a long thin shank and narrow width blade to loosen the gasket. Locate the blade in the recess between the outside of the gasket and the injector sleeve. Use the blade to apply force on the outside of the gasket at different locations around the gasket. Continue this until the gasket separates from the sleeve.



W2005112

28
Install the protective sleeve over the unit injector to prevent damage.

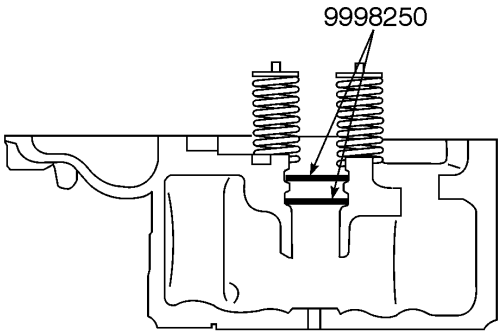
9998249



W2005172

29
If the injector sleeve is not being removed immediately, install the protective plug into the unit injector bore of the cylinder head to protect it from debris.

9998251

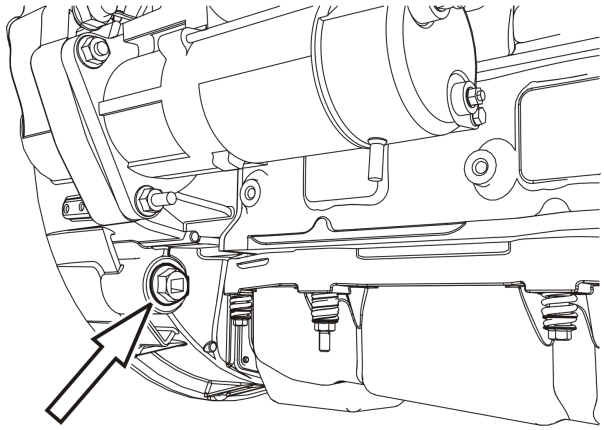


W2005171

30
Install two sealing rings to prevent dirt from entering the fuel gallery when the copper sleeve is removed.

Note: Two sealing rings are required to cover the fuel gallery.

9998250



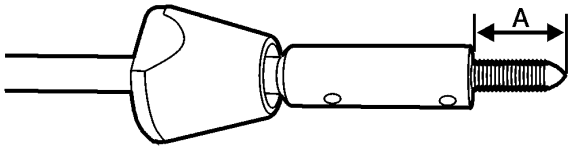
W0002368

31
Remove the plug from the lower rear side of the flywheel housing and install the flywheel turning tool. Turn the flywheel until the piston is at its lowest position in the cylinder.

Note: This is to ensure that the copper sleeve tapping tool does not damage the piston due to tool length.

Note: Ensure the turning tool is well greased before attempting to turn the flywheel.

88800014



W2004179

32
Adjust the 9 mm tap so that it extends a minimum of 25 mm or 1 inch (dimension A) from the end of the tapping tool.

Note: This ensures that the tip of the copper sleeve is tapped all the way through.

CAUTION

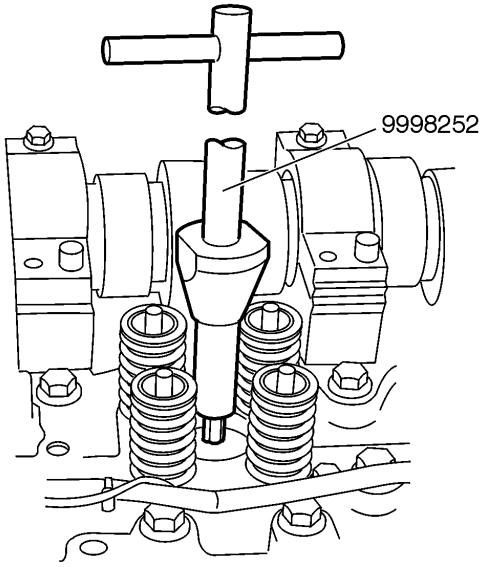
If the copper sleeve is not completely tapped through to the opening of the tip, an end piece of the tip can break off and fall into the cylinder during removal.

9809667, 9998252

33
Lubricate the tip of the 9 mm tap with grease.

Note: Applying grease will capture copper cuttings and prevent them from falling down into the cylinder.

9809667



W2005078

34
Thread the tap in small increments. Remove the tap and wipe off the grease and copper sleeve shavings. Apply fresh grease, reinstall the tapping tool and thread more of the copper sleeve. Continue this process to thread the tap all the way through the copper sleeve until no resistance is felt and the tap turns freely. Tapping in small increments and removing the shavings minimizes the chance of shavings falling into the cylinder and the sleeve turning in the cylinder head. Ensure that the tap is completely through the copper sleeve.

CAUTION

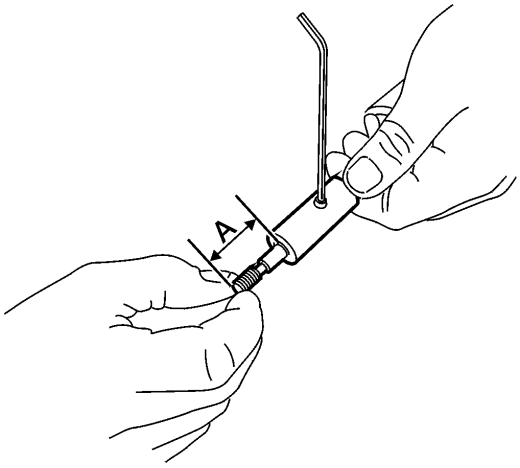
If threads are not cut completely through the tip of the copper sleeve, the tip can break off and fall into the cylinder. This can result in damage to the cylinder, piston, valves or turbocharger.

9998252, 9809667

35
Remove the tap and tapping tool.

36
Using the chip vacuum, remove any remaining shavings from the copper sleeve.

PT2900

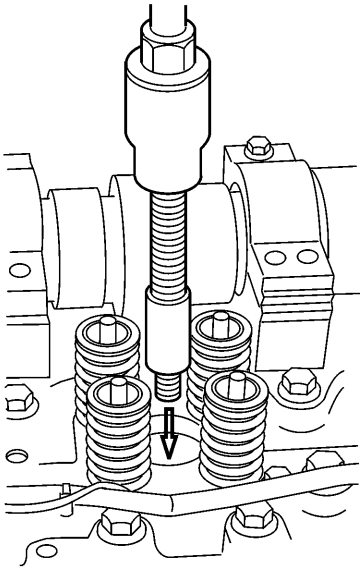


W2003433

37
Install the extractor bolt into the end of the extractor tool. Adjust the bolt until it extends approximately 22 mm (0.9 inch) beyond the end of the tool (dimension A).

9809668, 9998253

38
Tighten the set screw of the extractor tool to secure the bolt. Make sure that the set screw is seated against the flat part of the extractor bolt.



W2005079

39
Place the extractor tool with the bolt into the injector bore. Make sure the nut on the spindle is backed off so that the threaded end can be completely installed through the copper sleeve tip. Hand tighten until the bolt bottoms out in the sleeve.

CAUTION

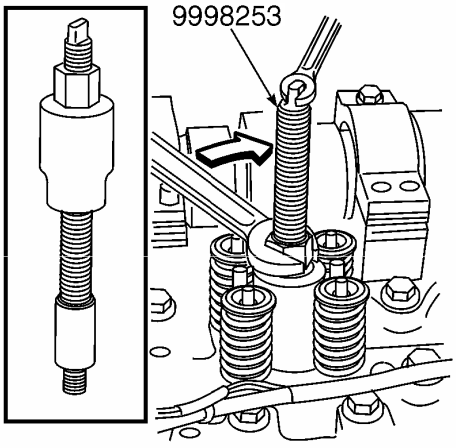
Make sure the extractor bolt is threaded completely into the copper sleeve before attempting to remove it or the tip of the sleeve may break off as it is removed. This broken sleeve tip can seriously damage the piston, valves or turbocharger.

40
While holding the top of the tool stationary, turn the large nut clockwise to extract the copper sleeve.

Note: When the copper sleeve is removed, make sure that the extractor bolt is extended at least one thread beyond the copper sleeve. If not, make sure that no part of the copper sleeve has broken off and fallen into the cylinder.

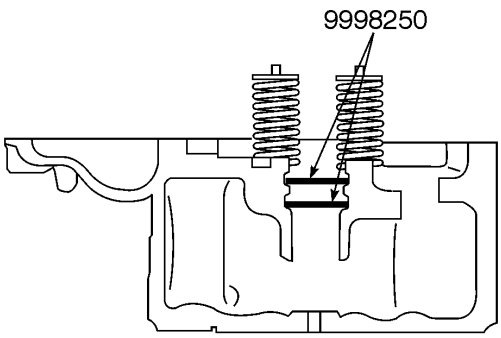
CAUTION

Do not use air tools to remove copper sleeves, or damage to the injector bore can result.



W2005442

9998253



W2005171

41
Remove the two sealing rings from the fuel passage. Using the chip vacuum, remove any remaining debris from the injector bore.

9998250, PT2900

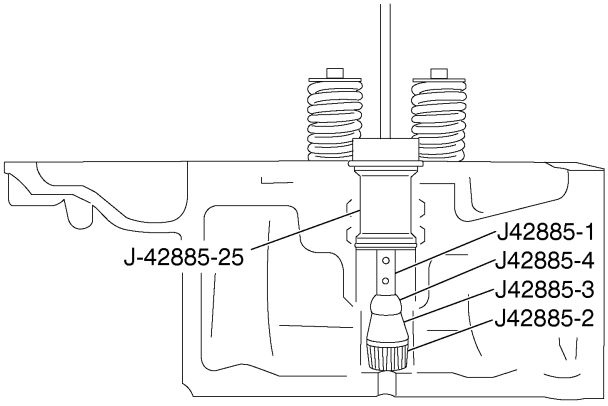
42
Install the injector bore sealing tool to protect the fuel passage area and prevent debris from entering. Use the unit injector hold down bolt to secure the tool in the cylinder head.

J-42885-25

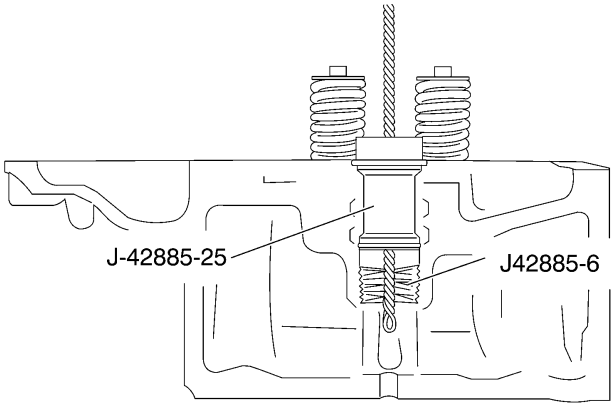
43
Using the cleaning kit, clean the copper sleeve seat of the cylinder head.

Note: The injector bore sealing tool must be used to prevent dirt from entering the fuel passage.

J42885-1, J42885-2, J42885-3, J42885-4, J-42885-25



W2006260

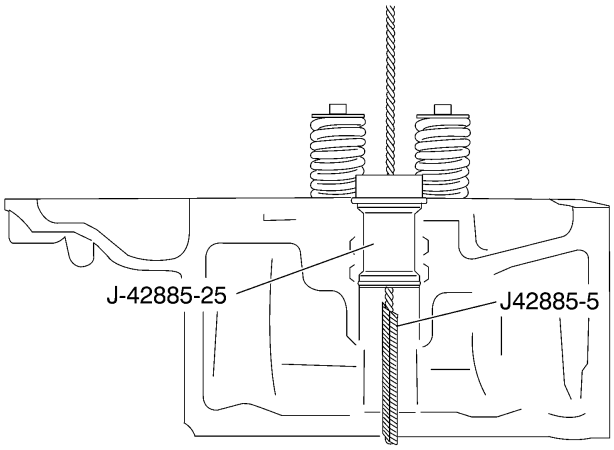


W2005616

44
Using the brush, clean the cylinder head injector bore walls for the copper sleeve.

Note: The injector bore sealing tool must be used to prevent debris from entering the fuel passage.

J42885-6, J42885-25



W2005617

45
Using the brush, clean the copper sleeve opening in the cylinder head.

Note: The injector bore sealing tool must be used to prevent debris from entering the fuel passage.

Note: When replacing the copper sleeves, it is important to check that the sleeve bore in the cylinder head is free from any carbon deposits or other residue (i.e., pieces of O-ring, etc.) before installing a new copper sleeve. Reclean if necessary.

J42885-5, J-42885-25

46

WARNING

Do not attempt to blow away debris using compressed air. Doing so can result in eye injury.

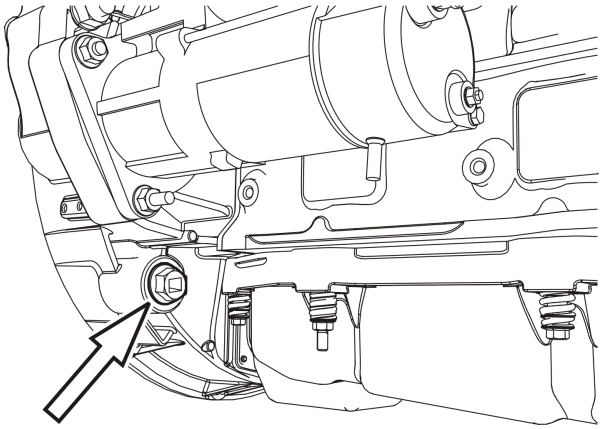
Using the chip vacuum, remove all debris from the copper sleeve bore.

PT2900

47
Remove the injector bore sealing tool from the cylinder head. Using the chip vacuum, remove any remaining debris.

PT2900, J-42885-25

Installation

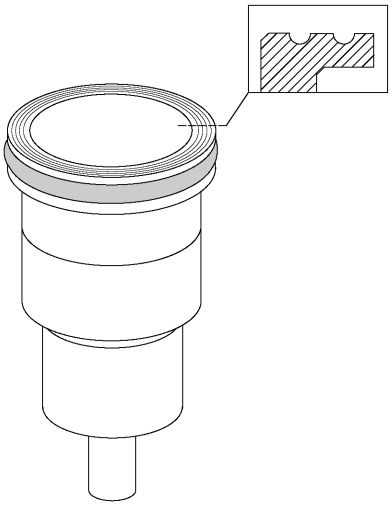


W0002368

1
Ensure the piston is at the lowest position in the cylinder. If not, use the flywheel turning tool to place the piston at its lowest position.

Note: This is to ensure that the copper sleeve installation tool does not damage the piston due to tool length.

88800014

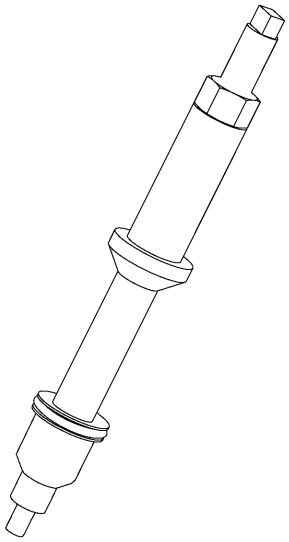


W2006261

2
Before installing the copper sleeve, inspect it to ensure that it is the correct part. The correct sleeve is identified by two concentric circular grooves machined into the top surface.

3
Lubricate a new copper sleeve O-ring with soapy water. Install the O-ring on the copper sleeve and lubricate again with soapy water.

Note: Always use a new O-ring.



W2006234

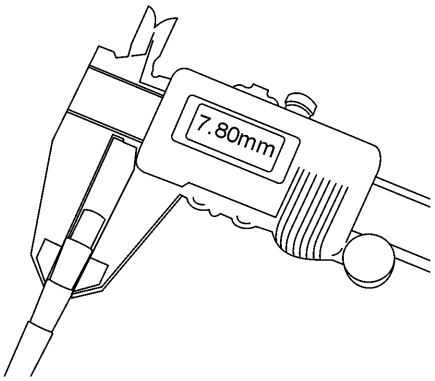
4
Place the new copper sleeve on the installation tool.

Note: Do not place the injector nozzle gasket (flat washer) in the copper sleeve, as this will damage the swedging bit.

CAUTION

Before installing the sleeve on the installation tool, inspect the tool to ensure that it is the correct tool. The correct tool is identified by a bottom surface that is perfectly flat with no machined circular recess. Use of a tool with a machined circular recess on the bottom may result in damage to the copper sleeve.

88800196



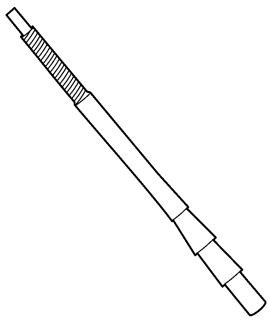
W2004583

5
Using calipers, measure the swedging bit to make sure that the proper swedging tool is used. Measurement should read approximately 7.8 mm. Also, verify that the length of the swedging bit is 108 mm.

CAUTION

Failure to use the proper bit can result in the bit breaking off into the cylinder head.

88880010

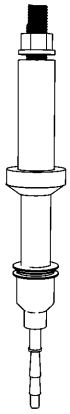


W2004289

6
Thread the swedging bit completely into the flaring tool until it stops (finger tight).

Note: Swedging bit can be ordered as a spare part if the bit is worn or broken.

88880010



W2004485

7
Loosen the swedging bit 180° before installing the tool in the cylinder head.

CAUTION

Failure to loosen the swedging bit can result in the bit being twisted or broken.

8
Lubricate the swedging bit and the threads on the tool with oil.

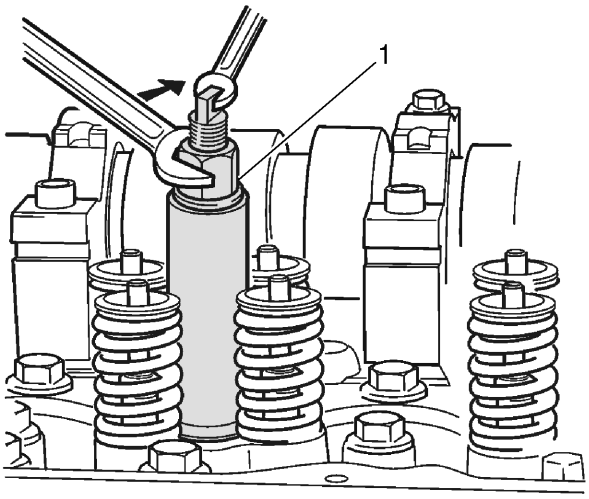
9
Carefully place the sleeve installation tool and new copper sleeve into the unit injector bore of the cylinder head. Carefully move the copper sleeve downward into the injector bore so that the swedging bit is guided into the injector tip bore in the cylinder head. Push downward on the installation tool using hand force to move the copper sleeve downward until it bottoms out on the injector sleeve seat in the bottom of the injector bore. Use the unit injector hold down and bolt to hold the tool in position. To ensure that the copper sleeve is bottomed in the cylinder head, tighten the unit injector hold down bolt to 80 Nm (59 ft-lb).

Note: Remove any oil from the injector hold down bolt holes to avoid hydraulic lock for this step and when the injector is installed.

10
Flare the copper sleeve by turning the nut clockwise while holding the spindle until the swedging bit has been pulled completely through the copper sleeve.

CAUTION

Failure to hold the spindle can result in a twisted or broken swedging bit.



W2006221

1 Flaring Tool 88800196

11
Remove sleeve installation tool from the injector bore.

Note: If the injector is not being installed immediately, install the protective plug into the injector bore to protect it from debris.

9998251

12
Before reusing an injector, cleaning is required to ensure suitability for reuse. Before doing any cleaning, the injector fuel inlet and outlet ports and the electrical connector opening must be covered to prevent contamination from the cleaning process. Also, there must be no lower O-ring installed in the injector.

CAUTION

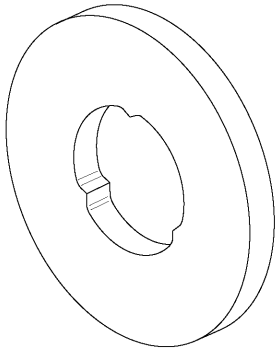
A brass wire brush must be used for cleaning the injector capnut and tip. Never use a steel wire brush.

13
Using a brass wire brush, thoroughly clean the injection nozzle gasket (flat washer) sealing surface at the bottom of the injector to remove all contamination that could affect the sealability of the injector seal joint.

14
Install new O-rings on the unit injector as follows:

- Upper ring — large diameter, violet
- Lower ring — small diameter, violet

15
Lubricate both sealing O-rings with clean engine oil.



W2006259

16
Preassemble the new injection nozzle gasket (flat washer) to the injector. Three small projections (grippers) on the inside diameter of this gasket provide the means to retain the gasket to the injector on preassembly. Using hand force, push the gasket over the injector tip until it becomes fully seated against the bottom of the injector.

Note: Before installing the gasket, inspect it to ensure that it is the correct part. The correct gasket is identified by three small projections on the inside diameter and a gray coating over the entire gasket to enhance the ability to seal.

Note: This gasket must be installed dry. Do not use grease or any other materials to secure this gasket to the injector for installation.

17
Slip the injector hold down and bolt onto the unit injector.

18
Center the unit injector between the valve springs and then push down on the unit injector using hand pressure to seat the O-rings. Clamp the injector in position with the injector hold down by tightening the injector hold down bolt. Tighten the hold down bolt using the following five step procedure:

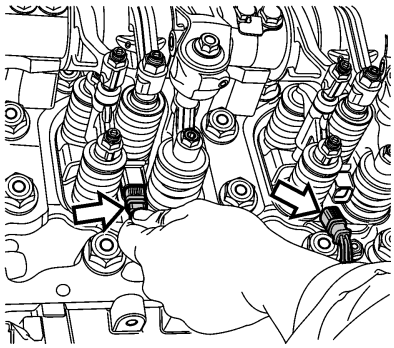
1 Tighten 20 + 5-0 Nm (15 + 4-0 ft-lb).
2 Tighten 120 ± 5 degrees angle of tightening.
3 Loosen the hold down bolt until torque is 10 to 15 Nm (7.0 to 11.0 ft-lb), then:

Note: This should be achieved by loosening with an angle of 100-110 degrees. Do not completely loosen the bolt to prevent components from moving after the previous seating process.

4 Tighten 20 + 5-0 Nm (15 + 4-0 ft-lb).
5 Tighten 90 ± 5 degrees angle of tightening.

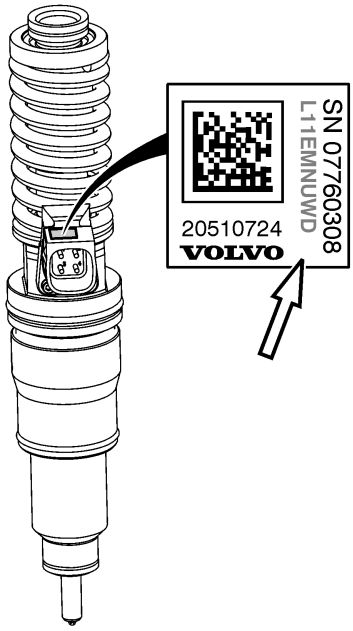
Note:

- Assembly with a new injection nozzle gasket always requires that the five (5) step injector hold down bolt tightening process be used.
- The injector hold down bolt can be reused only four (4) times. After the initial installation, every additional application of the five step injector hold down bolt tightening process requires that a punch mark be applied to the head of the bolt. After four (4) punch marks have been accumulated, the bolt cannot be reused again and must be replaced.



W2005106

19
Plug in the unit injector electrical connector until fully engaged. Push in the connector until you hear a distinct “click.”



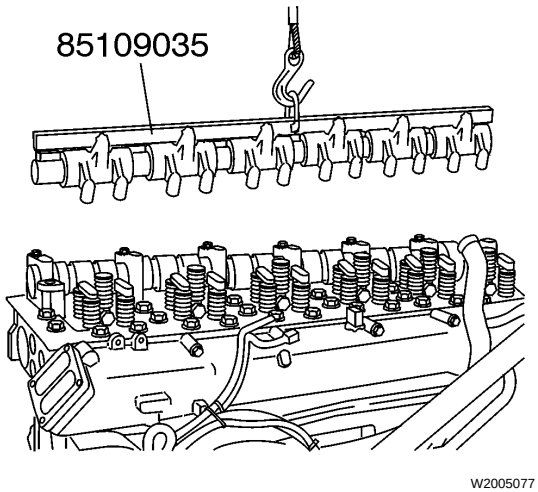
W2004684

20
When replacing unit injectors, the control unit must be programmed with the new injector’s trim codes. The code is printed on top of the unit injector electrical connector. The programming is performed using VCADS and is necessary to ensure that engine timing and emission levels are correct.

Note: Due to the Engine Electronic Control Unit (EECU) self learning capability, it is necessary to reset learned EECU parameters after servicing some engine related components. This allows the EECU to learn the new components behavior. After servicing is complete, perform the “Learned Data Reset” using the PC tool. This is located in the Function Group 1 menu.

Note: If reinstalling an original injector into the same location, reprogramming is not required.

21
Reinstall the valve bridges onto the same cylinders as marked at disassembly. Lubricate the valve bridges and camshaft lobes with engine oil.

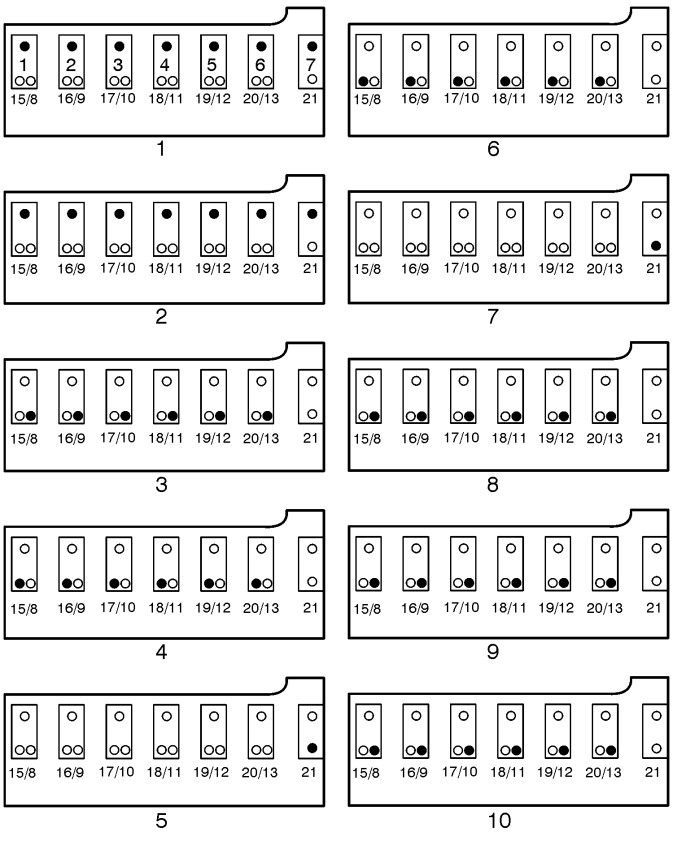


W2005077

22
Using the lifting tool and an assistant, place the shaft with rocker arms and springs in position on the inboard side of the camshaft bearing caps. Install and tighten the rocker arm shaft bolts a little at a time, evenly across the entire shaft so that the shaft does not become distorted, bent or fractured.

Note: Make sure that the rocker arm shaft is seated properly in the guide dowels of the camshaft bearing caps. On engines equipped with the VEB, remove the restraints (rubber bands or tie straps) securing the exhaust rocker arm pistons.

85109035



W2005266

23
Torque-tighten the rocker arm shaft in stages, so that the rocker arm shaft does not bend. Check that the guide pins come into the correct bearing brackets. Torque the rocker arm shaft according to the following specification:

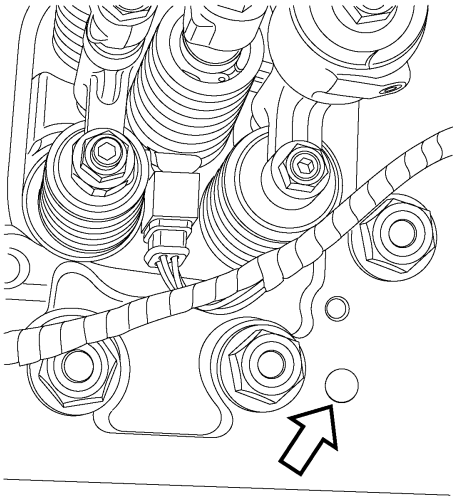
Note: Tighten bolts in the following steps to ensure that the rocker arm shaft is fully seated without bending.

Discard removed bolts with four marks and substitute new bolts.

1 Tighten bolts 1-7 to 15±3 **Nm** (11±2 **ft-lb**).
2 Angle tighten bolts 1-7 to 90±5 degrees **Angle of tightening.**
3 Tighten bolts 8-13, begin with bolt 11 to 100±10 **Nm** (74±7 **ft-lb**).
4 Tighten bolts 15-20 to 50±5 **Nm** (37±4 **ft-lb**).
5 Tighten bolt 21 to 60±5 **Nm** (44±4 **ft-lb**).
6 Angle tighten bolts 15-20 to 120±5 degrees **Angle of tightening.**
7 Angle tighten bolt 21 to 100±5 degrees **Angle of tightening.**
8 Loosen bolts 8-13.
9 Tighten bolts 8-13 to 50±5 **Nm** (37±4 **ft-lb).**
10 Angle tighten bolts 8-13 to 120±5 degrees **Angle of tightening.**

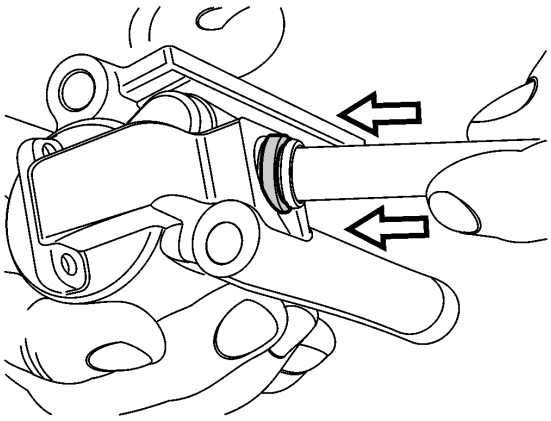
CAUTION

Gradually tighten the bolts in two or three steps to avoid damaging the rocker arm shaft.



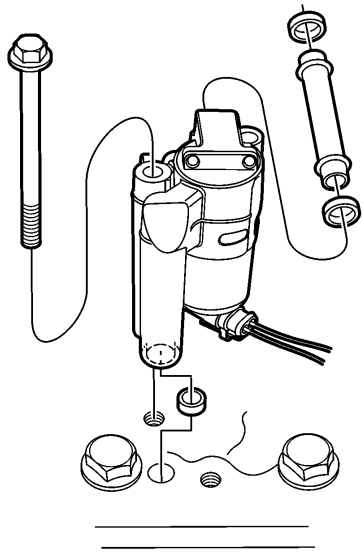
W2006227

24
Clean the cylinder head sealing surface for the VEB control valve. Check that there is no dirt in the cylinder head oil gallery.



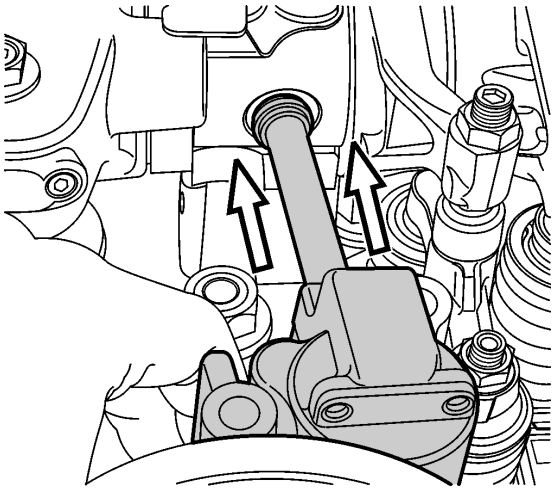
W2004871

25
Install new sealing rings on each end of the oil pipe and lubricate with fresh engine oil. Install the oil pipe into the VEB control valve.



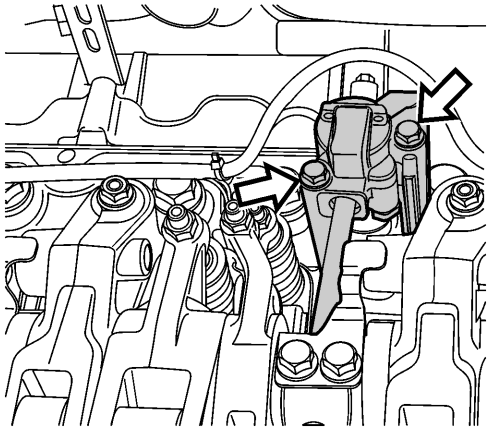
W2004869

26
Position the VEB control valve on the cylinder head.



W2004870

27
Position the VEB valve and at the same time, press the oil pipe into the rocker arm shaft. Make sure the seal remains correctly located during oil pipe installation into the rocker arm.



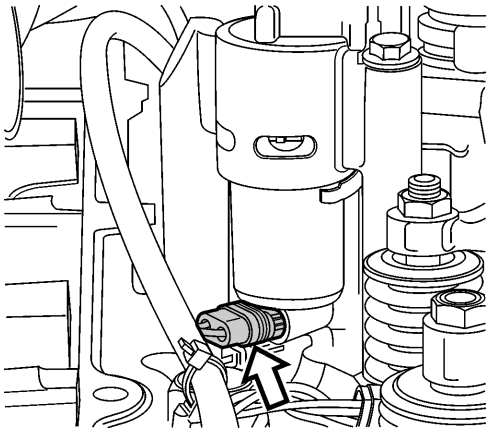
W2004838

28
Install the VEB control valve bolts and torque-tighten to 20 ± 3 Nm (15 ± 2 ft-lb).

Note: Make sure the VEB oil pipe O-ring is fully seated.

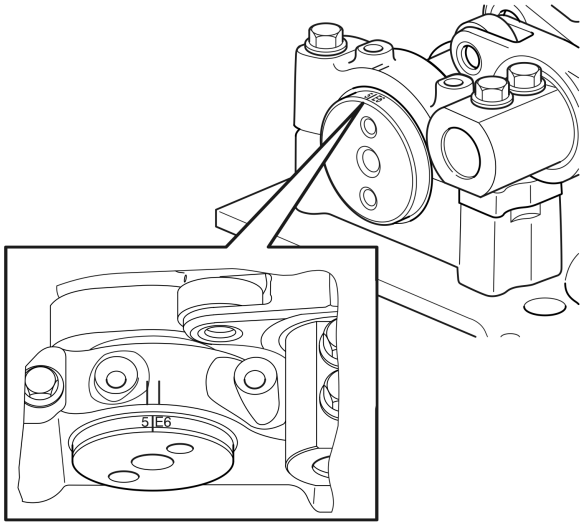
20 ± 3 Nm
(15 ± 2 ft-lb)

29
Reposition the fuel injector harness over the VEB control valve and secure with tie straps.



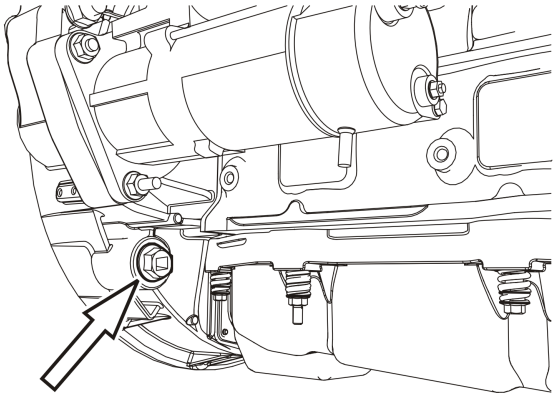
W2004837

30
Plug in the VEB connector. Push in the connector until you hear a distinct “click.”



T2022952

31
When adjusting the valves, make sure to start with the camshaft cylinder alignment marks between the two lines on the front camshaft.



W0002368

32
Adjust the inlet, exhaust and unit injectors using the pattern outlined in the chart below. Use flywheel turning tool 88800014 to advance the engine to the next setting.

Note: Ensure the flywheel turning tool is well greased before attempting to rotate the flywheel.
Camshaft markings for setting of valves and unit injectors:

- **Without VEB:** Markings 1–6 apply to adjustment of inlet valves, exhaust valves and unit injectors.
- **With VEB:** Markings 1–6 apply to adjustment of inlet valves and unit injector.

Markings E1–E6 apply to adjustment of exhaust valves.

Valve and Injector Settings

Cam Position	Injector	Intake Exhaust	Exhaust (VEB)	VEB
5	X	X		
E6			X	X
3	X	X		
E2			X	X
6	X	X		
E4			X	X
2	X	X		
E1			X	X
4	X	X		
E5			X	X
1	X	X		
V3			X	X

For the camshaft setting in this example (5 | E6), the inlet valves and unit injector can be adjusted for cylinder No. 5, and the exhaust valves (including VEB rockers) for cylinder No. 6.

33
Adjust the valves and unit injectors to the lash settings below:

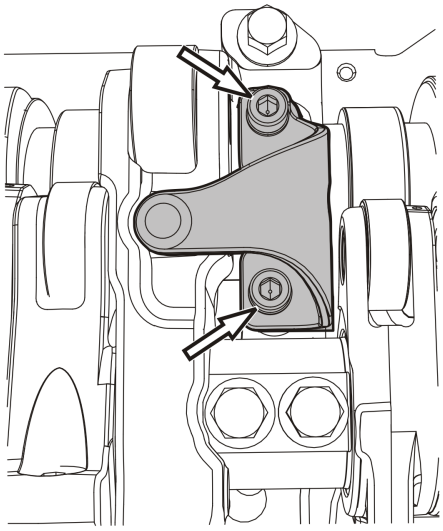
- Inlet Valve Clearance: 0.30 ± 0.05 mm (0.012 ± 0.002 inch)
- Exhaust Valve Clearance, VEB: 0.60 ± 0.05 mm (0.024 ± 0.002 inch)
- Exhaust Brake Rocker Clearance, VEB: 4.2 ± 0.10 mm (0.165 ± 0.004 inch)
- Adjust the unit injector to zero lash and then turn 4 flats (240° CW).

Note: Torque-tighten valve adjustment locknuts to specification following each valve adjustment.

If further instructions on adjusting valves and unit injectors are required, refer to group 21.

34
After all unit injectors and valves have been checked and adjusted, install and secure the VEB rocker leaf springs. Torque-tighten the screws to specification, 25 ± 3 Nm (19 ± 2 ft-lb), using an Allen wrench and suitable torque wrench.

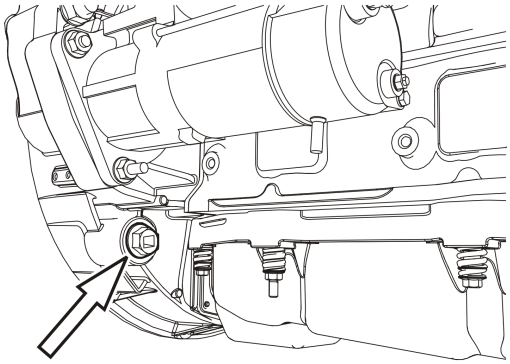
25 ± 3 Nm
(19 ± 2 ft-lb)



W2005845

35
Remove the flywheel turning tool, 88800014, and reinstall the dust plug.

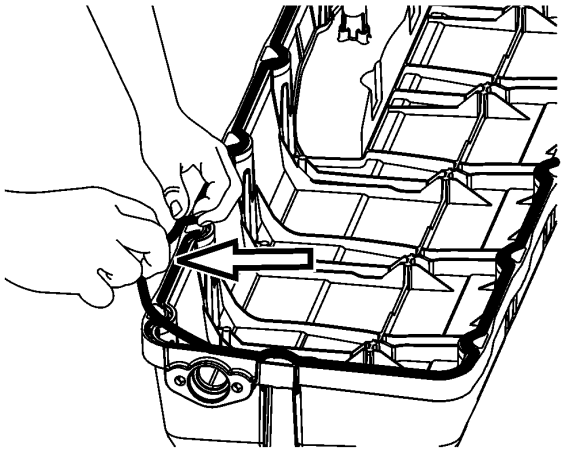
88800014



W0002368

36
Clean the gasket channel and gasket sealing surface of the valve cover. The channel and sealing surface should be clear of any dirt or debris and free of grease and oil.

37
Carefully inspect the valve cover gasket for damage and replace with a new gasket if necessary. Make sure that the gasket is properly seated and follows the contour of the channel.



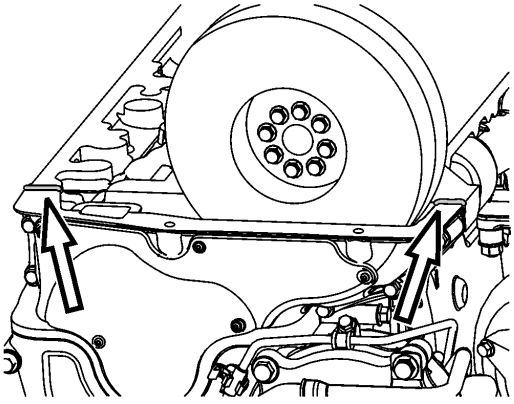
W2005162

38
Clean the valve cover contact surface of the cylinder head and the timing cover. All surfaces should be completely free of grease and oil.

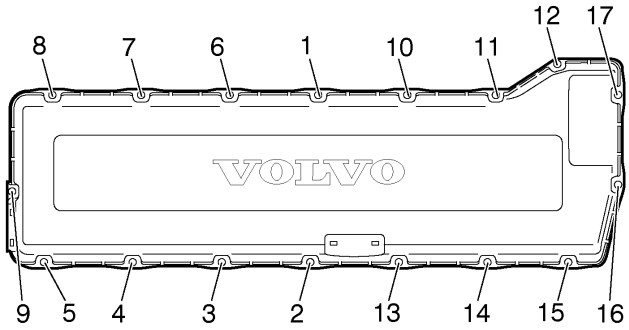
39
Apply a 2 mm (0.079 inch) bead of Volvo sealant to the area where the timing cover and the cylinder head meet. This parting line is on both sides of the cylinder head. Carefully position the valve cover on the cylinder head and make sure that the seal remains properly seated.

Note: This step is very critical to ensure no oil leaks occur.

Note: The valve cover must be installed within 20 minutes of applying sealant to the parting line areas.



W2005157



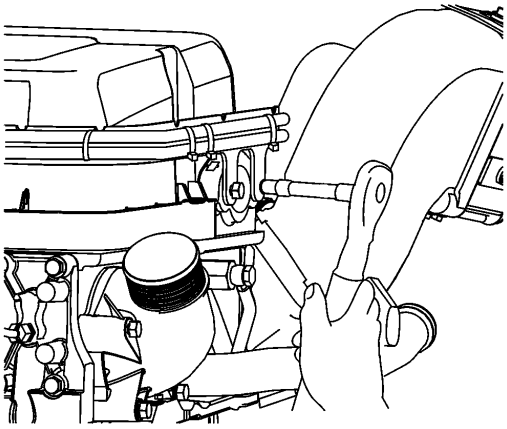
W2005984

40
Install the spring-loaded bolts in the valve cover. Torque-tighten the valve cover bolts to 24 ± 4 Nm (18 ± 3 ft-lb) in the sequence shown.

Note: The bolt springs provide even tension on the valve cover gasket.

24 ± 4 Nm
(18 ± 3 ft-lb)

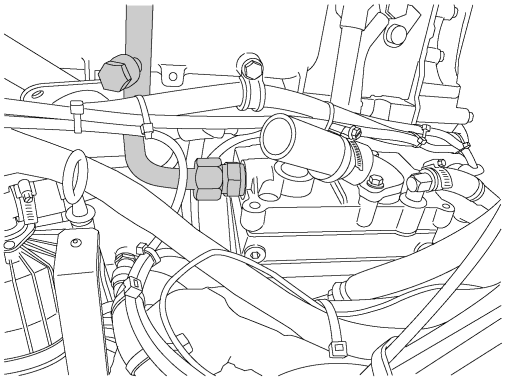
41
Install the engine cover, if removed for clearance during valve cover removal.



W2004679

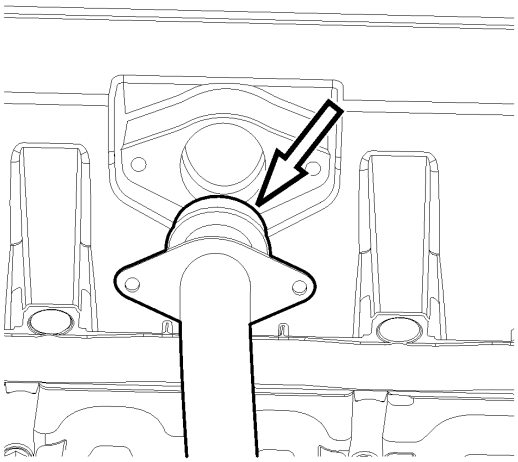
42
Place the engine electrical wiring harness in position at the front of the valve cover and install the harness support brackets. Securely tighten the bolts.

Note: Ensure the same bolts removed at disassembly are reinstalled in their respective bracket locations. Damage to the valve cover will result if bolts that are too long are installed in the wrong locations.



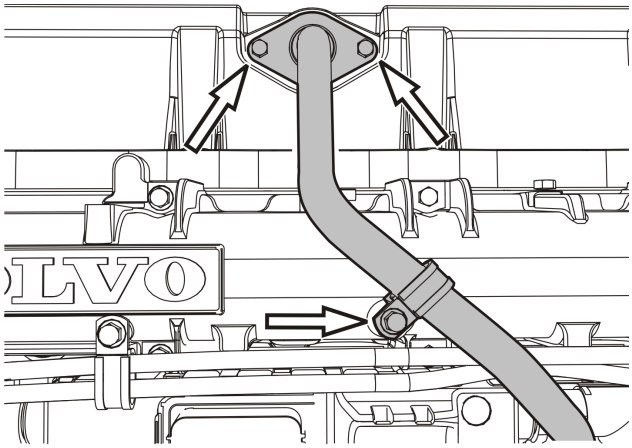
W5001572

43
Connect the air discharge line to the air compressor and install the clamp bracket securing the line to the intake manifold.



W2004681

44
Inspect the crankcase ventilation tube O-ring and replace if necessary.

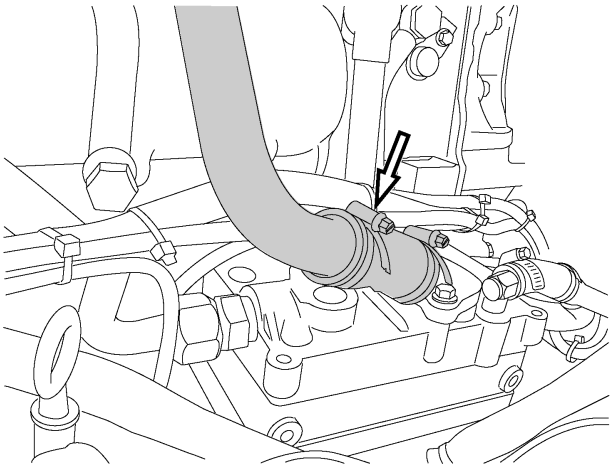


W2005747

45
Place the ventilation tube in position at the side of the valve cover and install the mounting bolts in the tube flange. Tighten the bolts to 24 ± 3 Nm (18 ± 2 ft-lb). Install the P-clamp to secure the tube to the intake manifold.

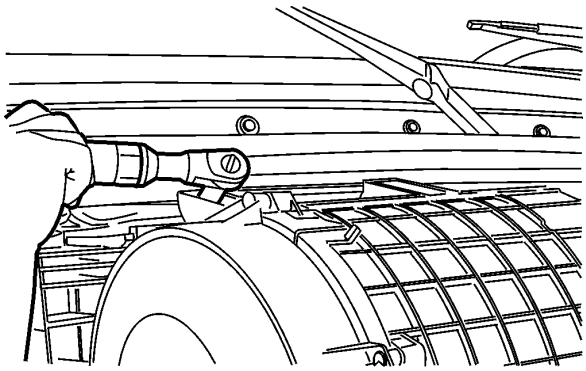
Note: Ensure that the bolts removed at disassembly are reinstalled in the same location. Damage to the valve cover will result if the bolts installed are too long.

24 ± 3 Nm
(18 ± 2 ft-lb)



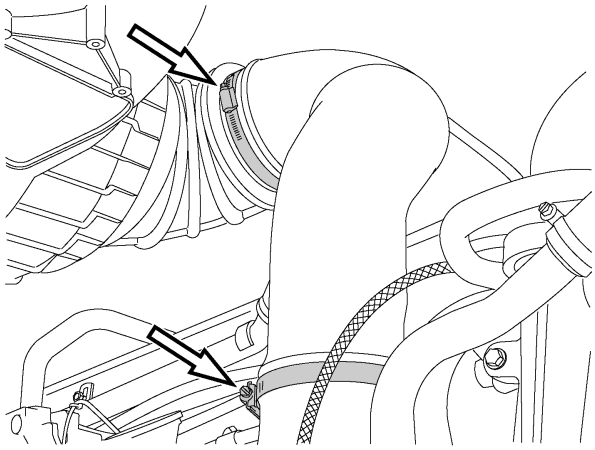
W5001571

46
Place the air compressor fresh air inlet pipe in position over the valve cover and connect the pipe to the coupling hose at the compressor. Tighten the coupling hose clamp and secure the pipe to the cylinder head.



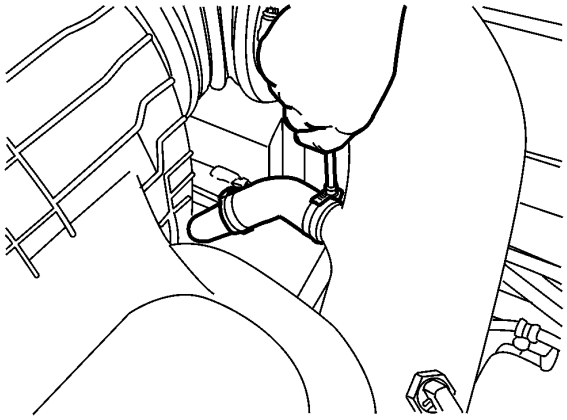
W2003858

47
Position the air filter housing against the cab and install fasteners to secure.



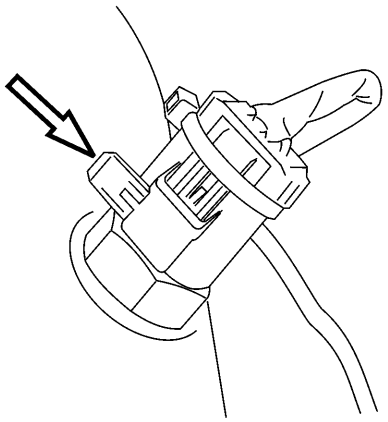
W2006005

48
Install the main fresh air pipe between the air filter housing and the turbocharger air inlet elbow. Position the clamps and tighten to secure.



W2004719

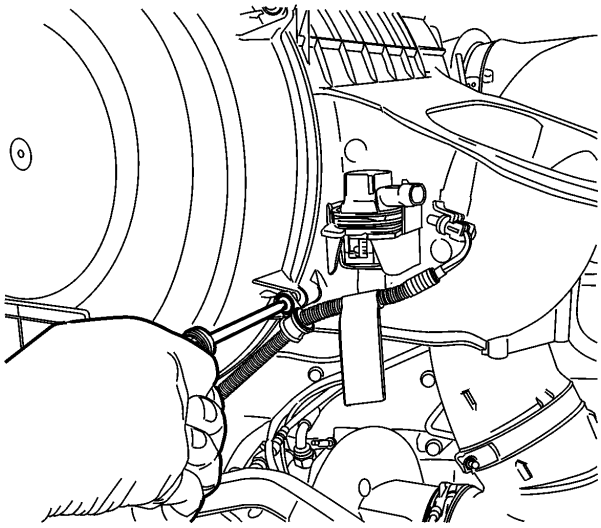
49
Install the air compressor fresh air hose to the main fresh air pipe, reposition the clamp and tighten to secure.



W2004720

50
Install the air temperature sensor connector to the sensor. Insert the connector lock tab, push in place and secure with a tie strap. Install the P-clamp to secure the harness to the main fresh air pipe. Torque-tighten the P-clamp bolt to 8 ± 1.2 Nm (6 ± 1 ft-lb).

8 ± 1.2 Nm
(6 ± 1 ft-lb)

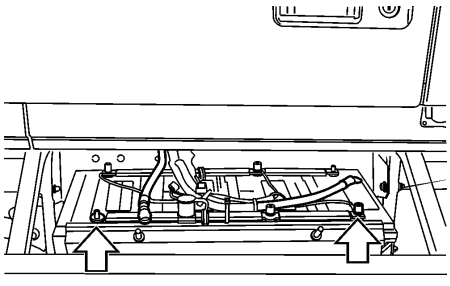


W2003861

51
Connect and secure the air filter restriction gauge wiring harness to air filter housing.

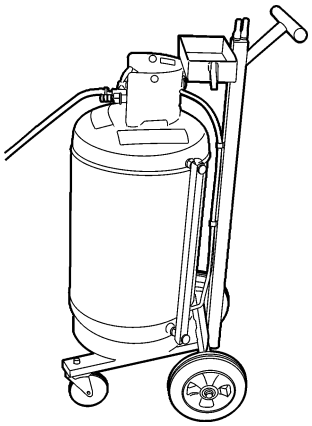
52
Check all clamp connections at the air filter housing, turbocharger and air compressor hose.

53
Secure the fuel supply line fitting at the fuel filter housing (loosened earlier to drain fuel from the cylinder head). Clean any fuel that remains around the fitting.



W2003815

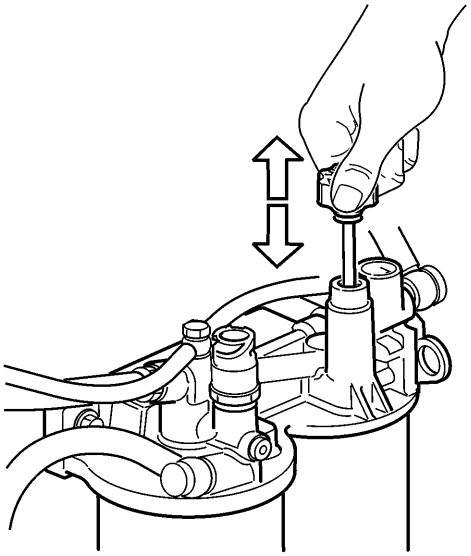
54
Install all previously removed cables to the ground (negative) battery terminals.



W2004191

55
Using coolant extractor DBT2V700, fill the system with approved coolant per specifications.

DBT2V700



T2021565

56
Prime the fuel system by pumping the hand priming pump on the fuel filter housing until resistance is felt indicating that the system is full of fuel.

57
Start the engine and run until the engine clears and runs without stumbling. This procedure may need to be repeated once or twice to get the fuel system completely free of air.

Note: If the engine does not start on the first attempt, prime the fuel system again, and refer to the previous step. Engine priming may need to occur several times in order to get the engine to start.

58
Allow the engine to run at low idle for about 5 minutes. Check for any fuel leaks and correct if necessary.

Note: The engine speed should **not** be increased as any air pockets can be forced into the cylinder head which can result in the engine stopping.