

This Service Bulletin replaces SB 211-54, "Cylinder Head Replacement, D12D" (11.02), publication no. PV776-TSP177420.

Date

3.2003

Group

211

No.

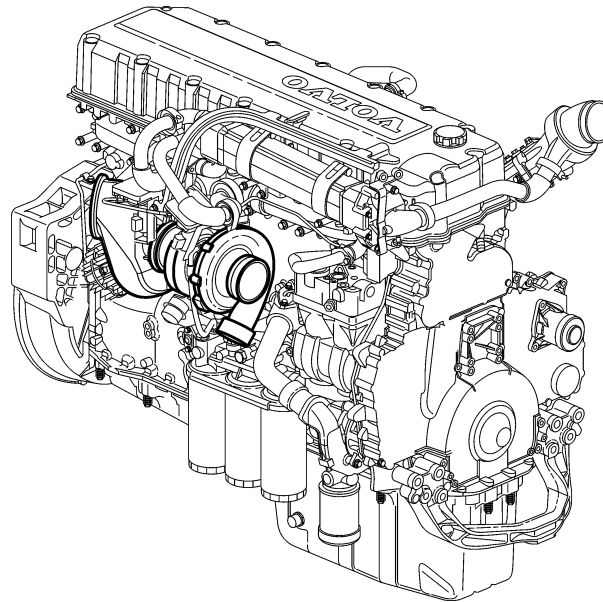
54

Page

1(33)

Cylinder Head Replacement D12D

Cylinder Head Replacement



W2003779

This information covers the proper procedure for replacing the cylinder head on the VOLVO D12D engine.

Contents

- ["Special Tools" page 2](#)
- ["Cylinder Head, Replacement" page 4](#)
- ["Cylinder Head Parts, Transferring" page 32](#)

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

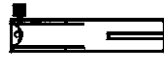
For special tools ordering information, refer to Tool Information, group 08.



998 9876

9989876

Dial gauge



9992479

Dial gauge block



9996966

Cylinder liner press tool



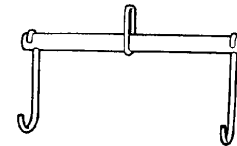
9998255

Rocker arm bridge lifting tool



9998258

Cylinder head adapter (use with stand)



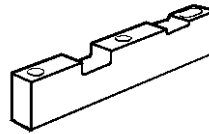
9998264

Camshaft removal tool



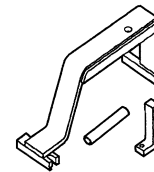
9998511

Lever tool



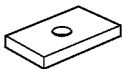
9998601

Cylinder head alignment tool



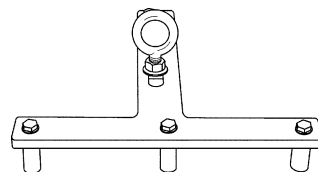
9998602-6/2

Upper front cover alignment tool



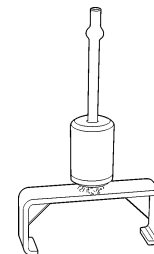
9998624

Cylinder head alignment tool



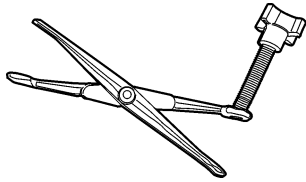
J41503

Cylinder head lifting fixture



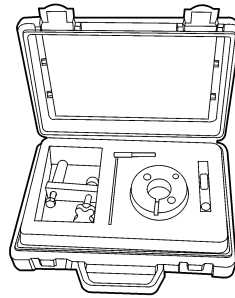
J44457

Camshaft bearing cap puller



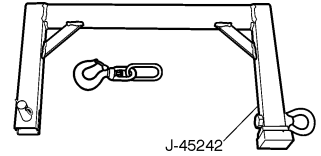
J44772

Thermostat housing installation tool



J44514

Camshaft alignment tool



J-45242

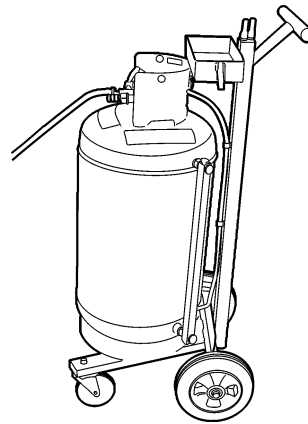
J45242

Lifting bracket



9996049

Coolant drain hose



DBT2V900

Coolant extraction tool

Service Procedures

2111-03-02-01 Cylinder Head, Replacement

See also:

- "Cylinder Head Replacement" page 1

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: 9996049, 9996966, 9998255, 9998258, 9998264, 9998601, 9998602-6/2, 9998624, J41503, J44457, J44514, J45242, DBT2V700

Removal

1



WARNING

When disconnecting battery cables, disconnect the ground (negative) battery first to prevent personal injury from electrical shock.

Turn ignition key to OFF position. Disconnect ground wiring from electrical equipment connected directly to the batteries, such as ECUs, satellite systems, etc. Disconnect the main ground cable(s); refer to Service Information, group 31.

NOTE: If vehicle is equipped with master switch, battery cable removal is not necessary. If equipped, turn OFF master switch.

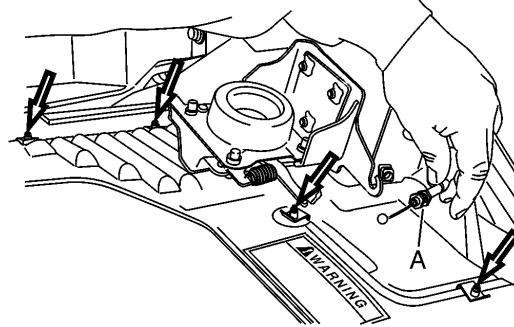
2

Install coolant extraction tool DBT2V700 to drain fitting at bottom of radiator. Drain coolant.

DBT2V700
996049

NOTE: An alternate method is to connect coolant drain hose 996049 to fitting and drain coolant into an approved container.

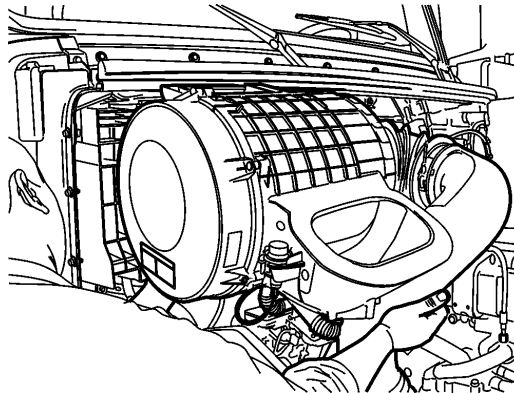
3



W2004243

Remove inner fender and bracket on left and right sides. Remove hood cable release (A).

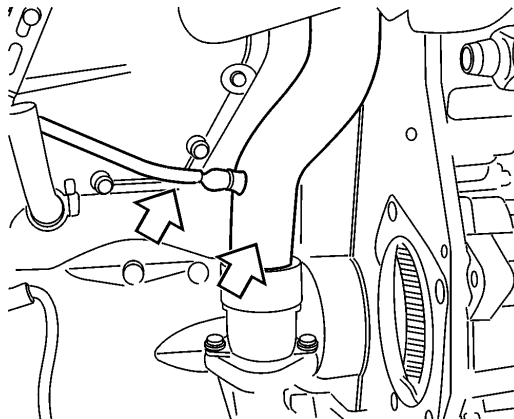
4



W2003859

Remove air filter housing from cab and main fresh air pipe to turbocharger; refer to Service Information, group 25.

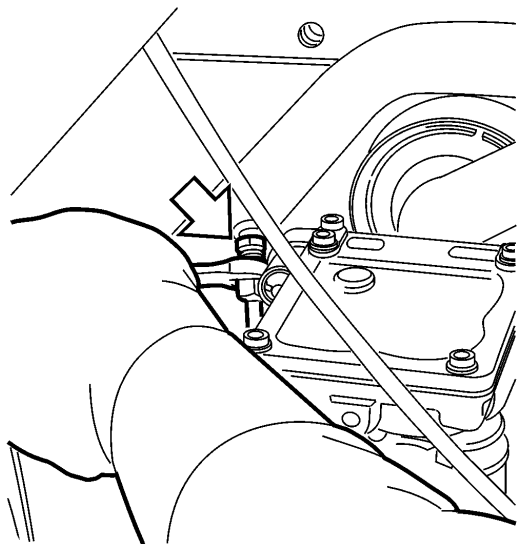
5



W2004225

Disconnect coolant line from front EGR valve to coolant pump bypass pipe.

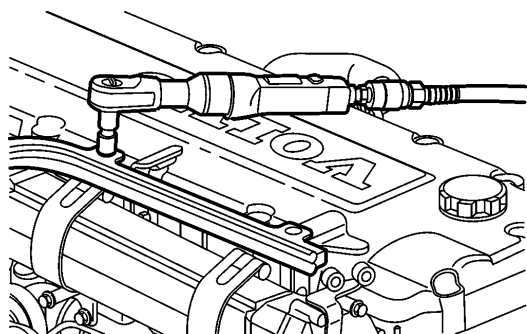
6



W2003821

Disconnect small coolant line from rear EGR valve to pipe between oil cooler housing and EGR cooler.

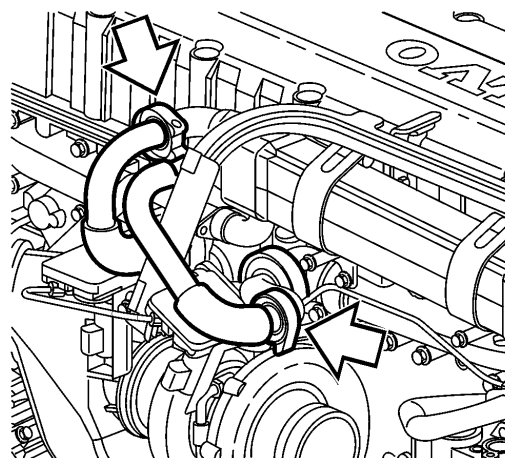
7



W2003828

Remove EGR wiring harness rail bolts from top of EGR cooler.

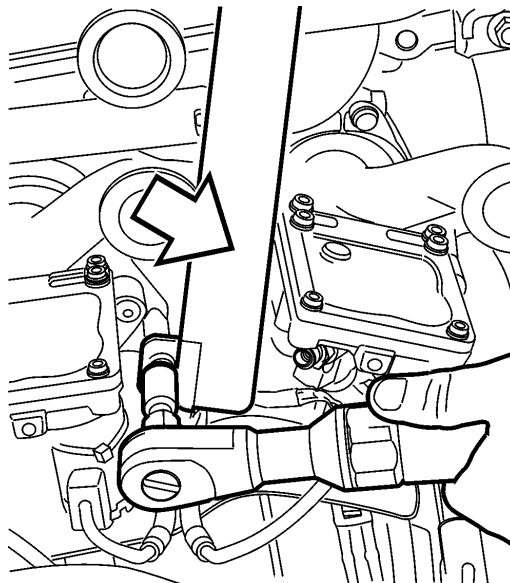
8



W2004257

Remove EGR valve exhaust pipes and clamps to EGR cooler.

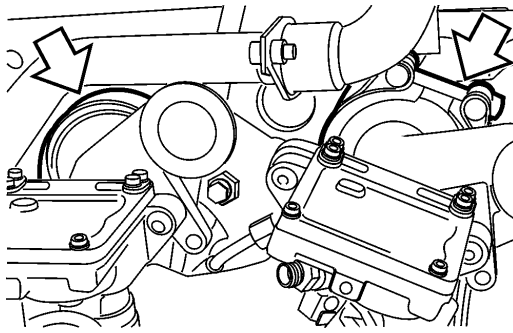
9



W2004216

Remove wiring harness rail from EGR valve assembly.

10



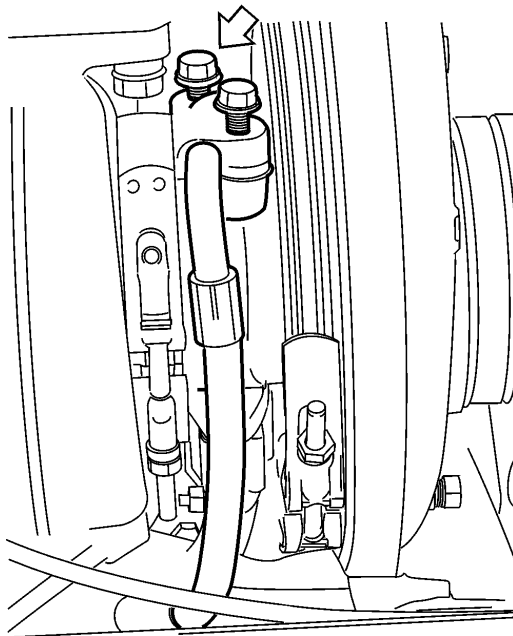
W2003822

Remove EGR valve clamps from the exhaust manifold.

11

Remove the EGR valve assembly from the exhaust manifold. Carefully pull the assembly away and lay it across the front of the engine.

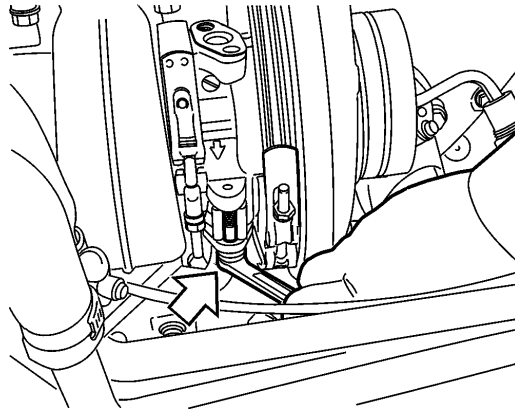
12



W2003864

Remove turbocharger oil supply line (upper).

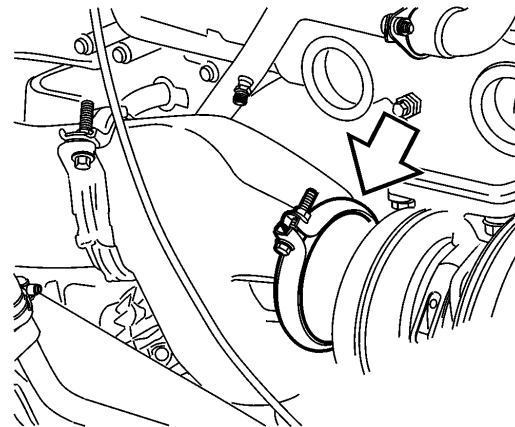
13



W2003865

Remove oil return line (lower).

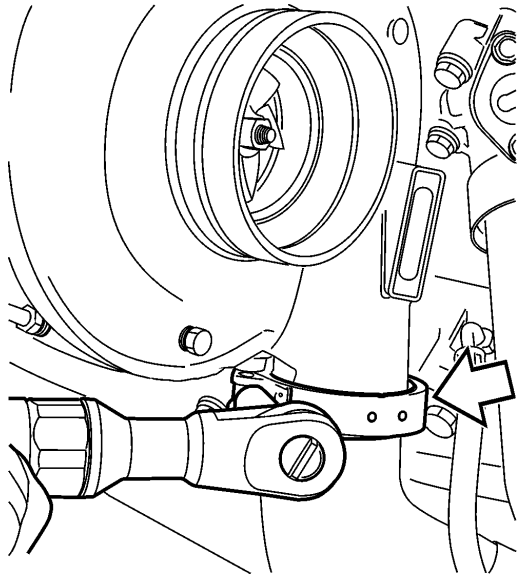
14



W2003871

Remove exhaust clamp from EPG to turbocharger. Separate turbocharger from EPG housing.

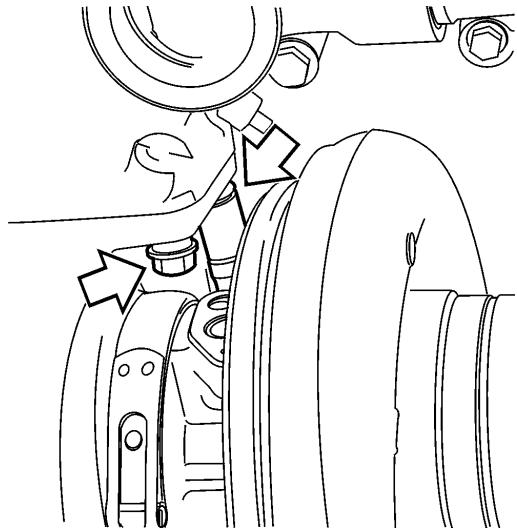
15



W2003866

Remove lower charge air pipe from turbocharger.

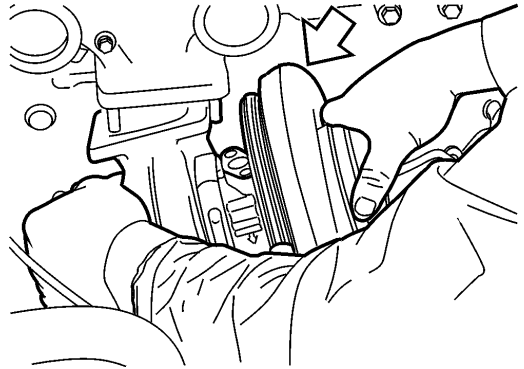
16



W2003867

Remove turbocharger flange nuts to exhaust manifold.

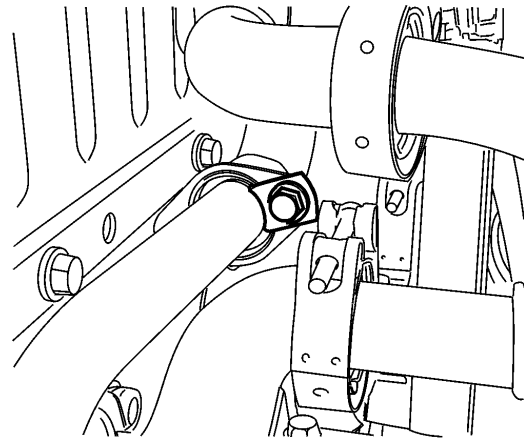
17



W2003868

Lower turbocharger and gaskets away from exhaust manifold and lift out.

18



W2003852

Remove locking clamp for rear coolant pipe from EGR cooler to oil cooler housing.

19



W2004259

Remove coolant pipe from EGR cooler to thermostat housing.

20
Remove heater pipe from the thermostat housing.

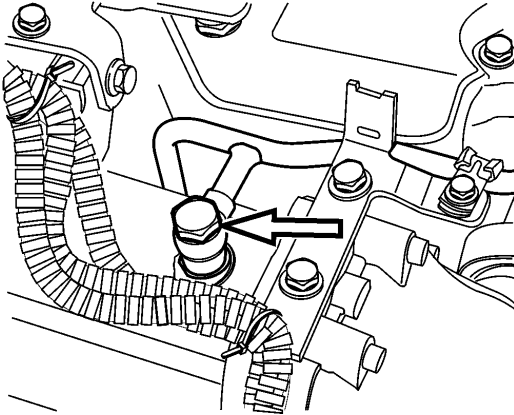
21



W2004258

Cut tie straps holding EGR wiring harness to rail next to EGR cooler.

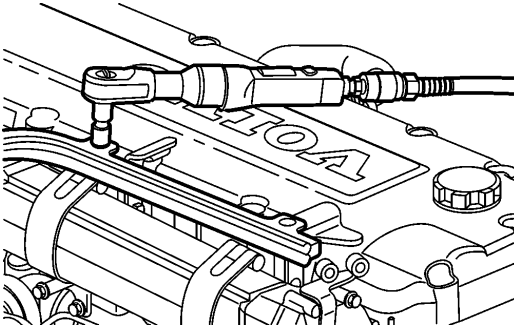
22



W2003857

Remove static fill pipe from top of the EGR cooler.

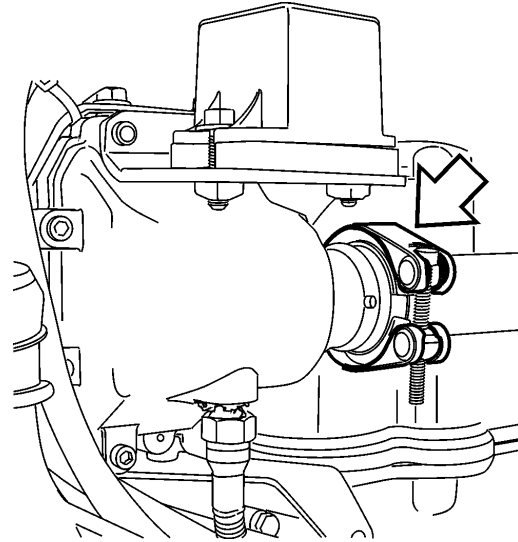
23



W2003828

Remove wiring harness rail from top of EGR cooler.

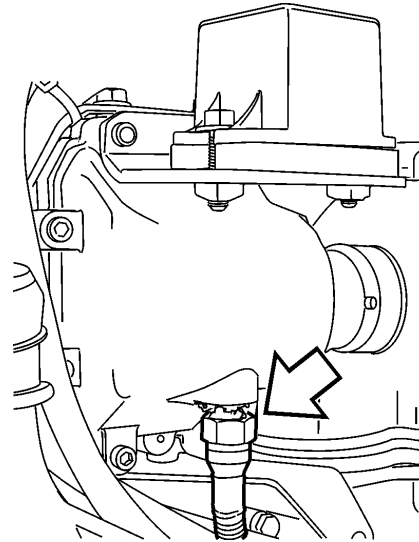
24



W2004260

Remove clamp from EGR cooler to mixing chamber.

25

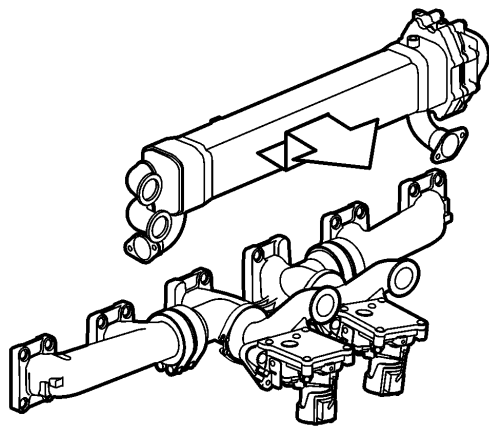


W2004256

Cut tie straps holding EGR temperature sensor wiring harness. Carefully remove temperature sensor from reed valve housing.

NOTE: Sensor wiring harness must be disconnected from the cable box on intake side of engine to permit temperature sensor to turn freely.

26



W2003856

Remove EGR cooler bracket bolts from valve cover and exhaust manifold. Lift off cooler and bracket assembly.

27

Remove fan ring from upper radiator coolant neck.

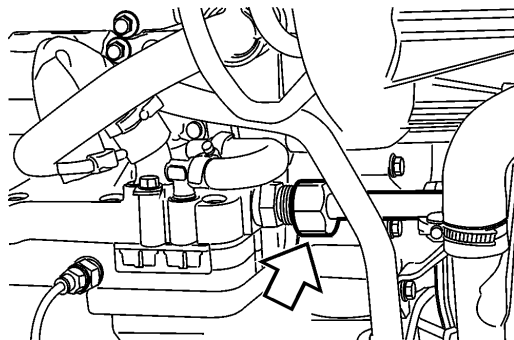
28

Remove top radiator hose.

29

Remove cooler neck from front of cylinder head.

30



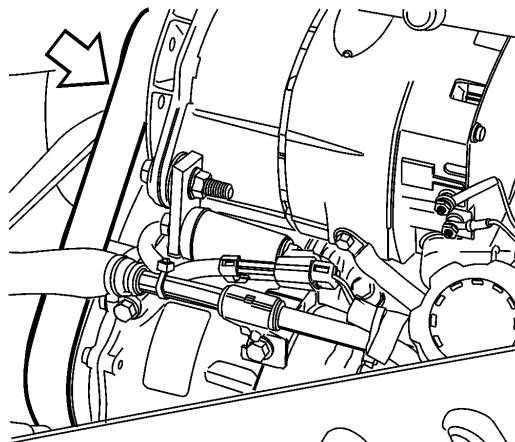
W2003816

Remove main discharge line from air compressor.

31

Remove charge air pipe to EGR mixing chamber.

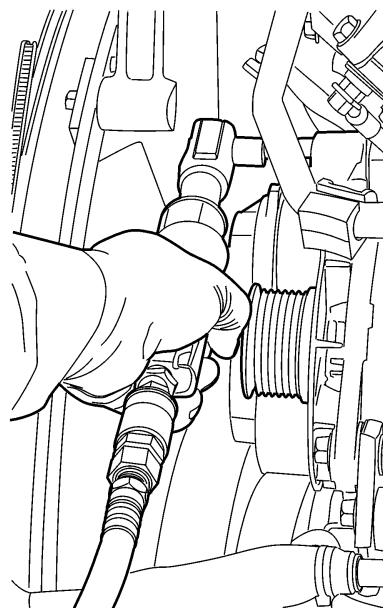
32



W2003814

Remove alternator A/C belt.

33



W2003825

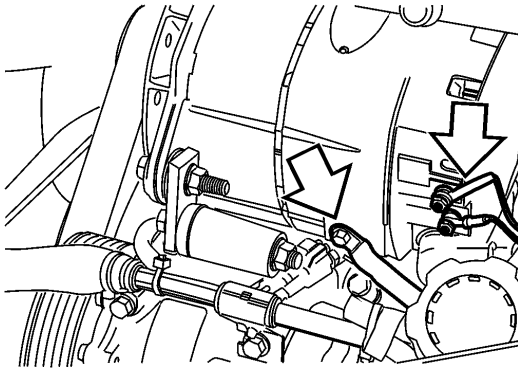
Remove belt tensioner.

34

Remove wires from the alternator.

NOTE: Mark their location to help during reinstallation.

35



Loosen alternator mounting bolts and remove alternator.

36

Disconnect cables from preheater element.

37

Remove wiring harness brackets from top of intake manifold.

38

Remove the mixing chamber from the intake manifold.

39

Remove the discharge line from the air compressor.

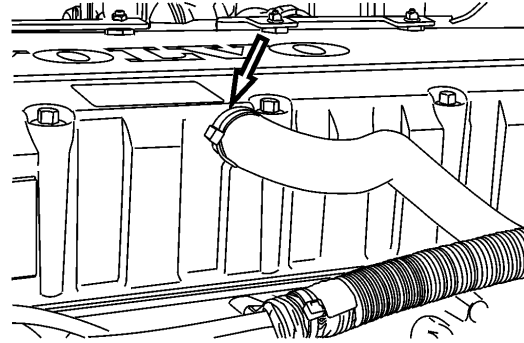
40

Remove the intake manifold pressure sensor from the intake manifold.

41

Remove the fuel return lines from left front of cylinder head and fuel line support from intake manifold.

42



Remove the crankcase breather hose from the valve cover and intake manifold.

43

Disconnect the wiring harness from the coolant sensor.

44

Loosen drain fitting on fuel filter housing and drain fuel from the cylinder head into an approved container.

45

Remove the wiring harness bracket from the rear of the cylinder head.

46

Remove the transmission coolant pipe from the rear of the cylinder head.

47

Remove the valve cover.

NOTE: On VNM and VHD models, engine cover should be removed to permit valve cover removal.

48

Disconnect the wiring harness for the VEB control valve.

49

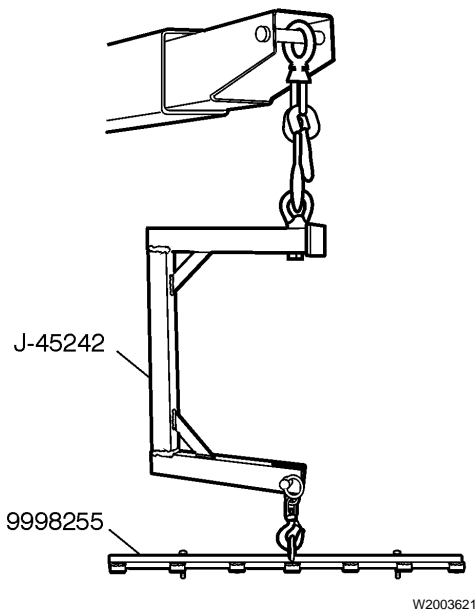
Remove the VEB control valve.

NOTE: Install rubber bands on VEB plungers to keep them from accidentally separating during rocker arm removal.

50
Remove the rocker arm assembly bolts.

NOTE: Gradually loosen the bolts to avoid distorting the rocker arm shaft.

51



Install lifting tool 9998255. Using a suitable lift, remove rocker arm assembly.

NOTE: Lifting bracket J45242 should also be used on VNM and VHD models.

52
Remove camshaft sensor (and shim, if used).

53
Remove camshaft gear and damper.

54
Remove front crankshaft breather tube from upper front cover.

55
Remove wiring harness clamps from upper front cover.

56
Remove mounting bolts in upper front cover and remove cover.

57
Remove coolant hose from air compressor to the cylinder head.

58
Disconnect wiring harness connectors to injectors. Remove wiring harness pass-through bolt and carefully remove wiring harness from cylinder head to avoid damage to connector and wiring.

59
Remove the outer camshaft bearing cap bolts and studs. (Note the position of the studs for the valve cover.)

60
Using tool J44457, remove the camshaft bearing caps. J44457

NOTE: Mark each bearing caps for its respective bearing housing before removal.

61
Using camshaft lifting tool 9998264, remove camshaft from the cylinder head. 9998264
J45242

NOTE: Lifting bracket J45242 should also be used on VNM and VHD models.

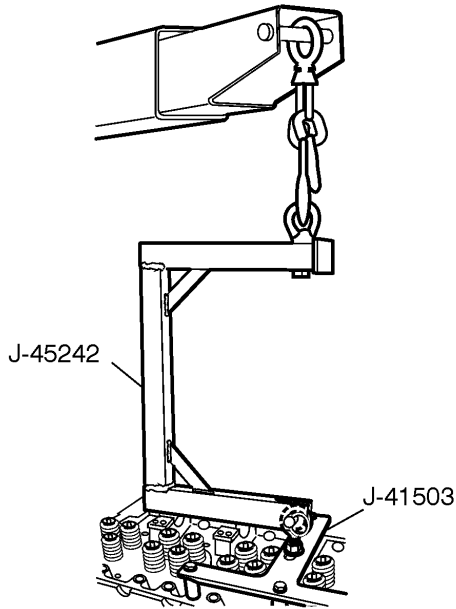
62
Remove all cylinder head bolts.

NOTE: Loosen outer bolts first and work toward center of head.

63
Remove the no. 4 lower camshaft bearing cap (center of head).

NOTE: This is required to permit installation of the lifting tool.

64



W0002015
Install cylinder head lifting tool J41503 and carefully lift cylinder head from engine. J41503 J45242

NOTE: Lifting bracket J45242 should also be used on VNM and VHD models.

65
Install cylinder liner hold-down tools 9996966 9996966

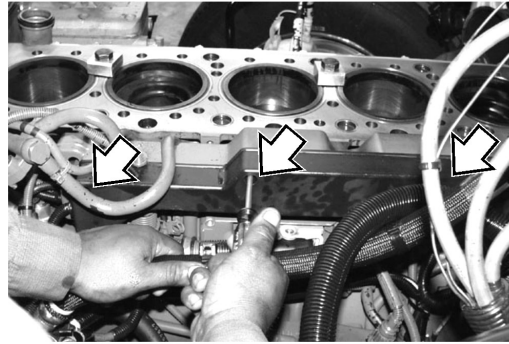
66
Remove the intake manifold.

67
Bolt adapter plate J44546 to intake manifold side of cylinder head. J44546

NOTE: This will permit the cylinder head to be mounted to a stand.

68
Attach the cylinder head to holding stand.

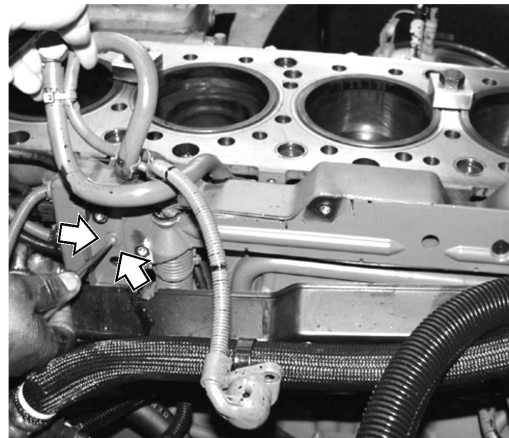
69



W2003986

Remove the cable harness box outer cover.

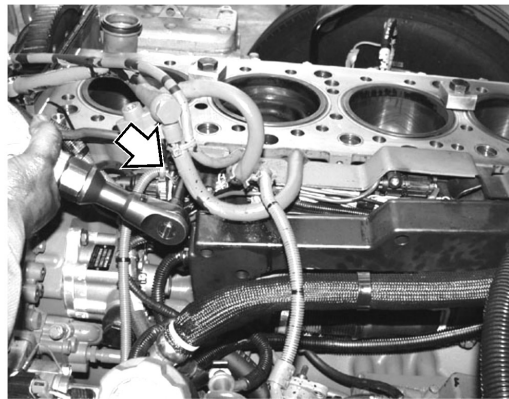
70



W2003987

Remove the cable harness box intermediate cover.

71

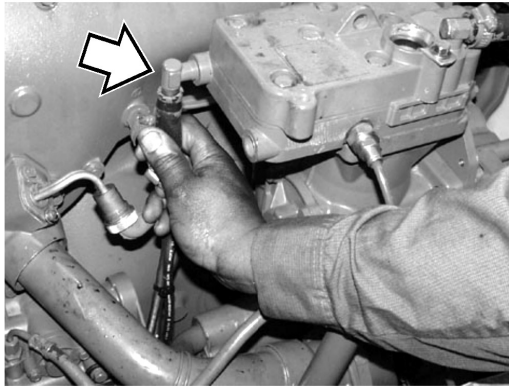


W2003988

Loosen mounting bolts and pull cable harness box away from cylinder block.

NOTE: The harness box may need to be secured against the frame rail to be kept out of the way.

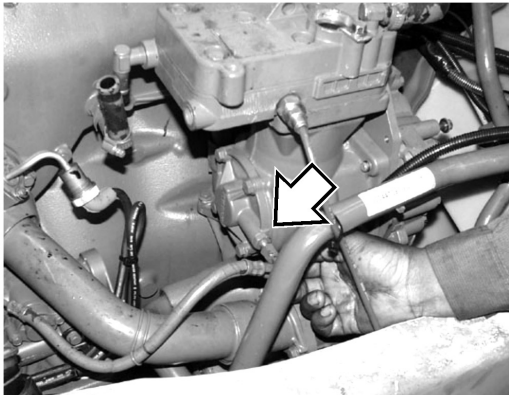
72



W2003989

Remove coolant line from compressor to cylinder block.

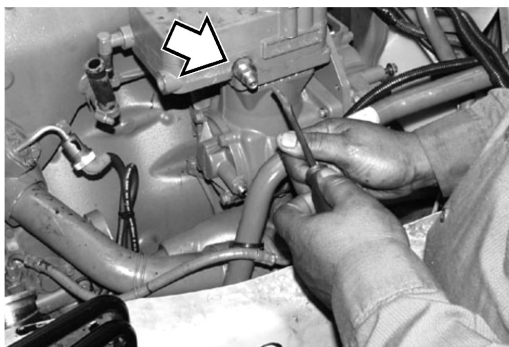
73



W2003990

Remove compressor oil supply line.

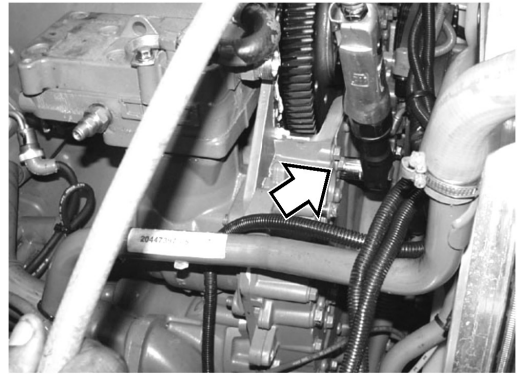
74



W2003991

Remove air compressor unloader line.

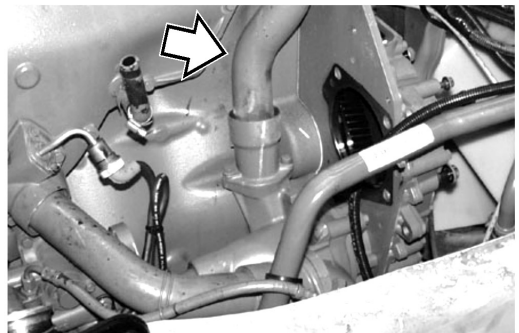
75



W2003992

Loosen compressor mounting bolts and remove air compressor.

76



W2003993

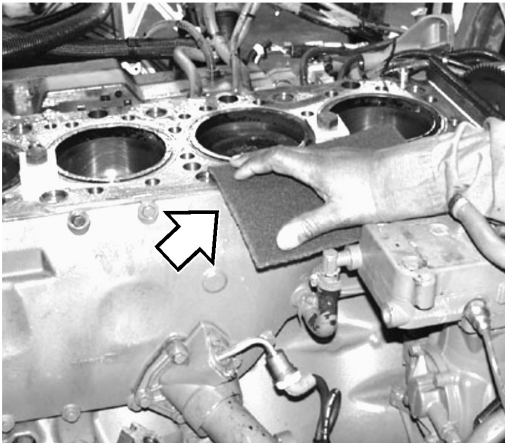
Remove coolant pipe from water pump.

NOTE: Place a rag over pipe opening to prevent debris from falling into cooling system.

Installation

NOTE: If you need to transfer parts from the old cylinder head to a new one before it is installed, see "Cylinder Head Parts, Transferring" page 32.

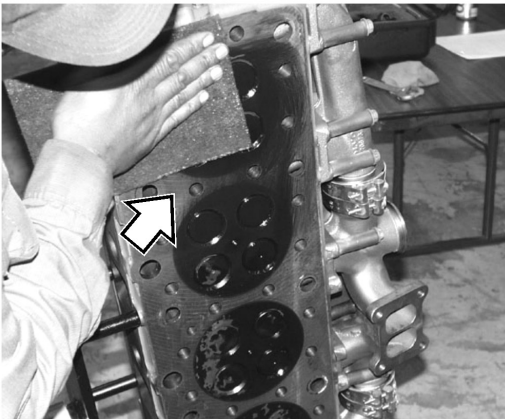
1



W2003985

Using a plastic scouring pad (such as a Scotch-Brite pad), clean the cylinder block surface.

2



W2003997



CAUTION

Be careful when cleaning around injectors (if still installed) so that injector tips are not damaged.

Clean the contact surfaces on the cylinder head for the head gasket and intake manifold.

NOTE: Cylinder head surface must be free from carbon, oil, and other debris before installing to the engine.

3

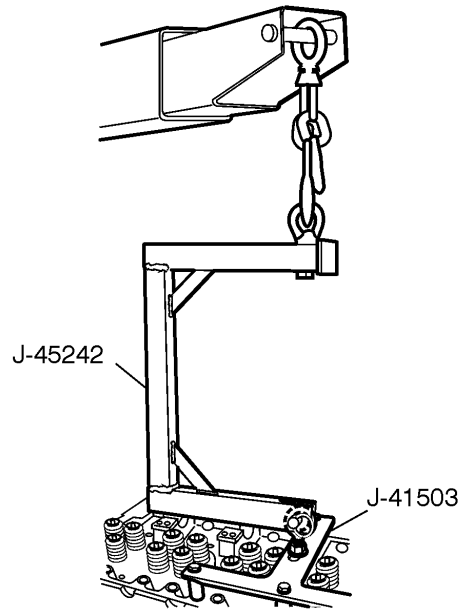
Clean the contact surface on the cylinder head for the alignment blocks.

NOTE: Surface must be free from paint, silicone, oil, or other debris where the alignment blocks are bolted to the cylinder head.

4

After cylinder head has been cleaned, check the gasket surface for flatness. Maximum permitted unevenness is 0.1 mm (0.004 in.).

5



W0002015

Attach cylinder head lifting tool J41503. Using engine lift, raise cylinder head and remove from cylinder head holding stand.

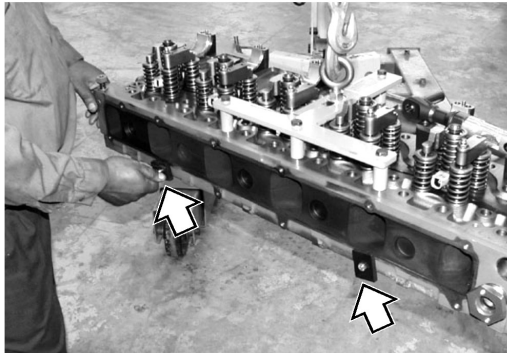
J41503
J45242

NOTE: Lifting bracket J45242 should also be used on VNM and VHD models.

6

Remove cylinder head holding bracket.

7



W2003999

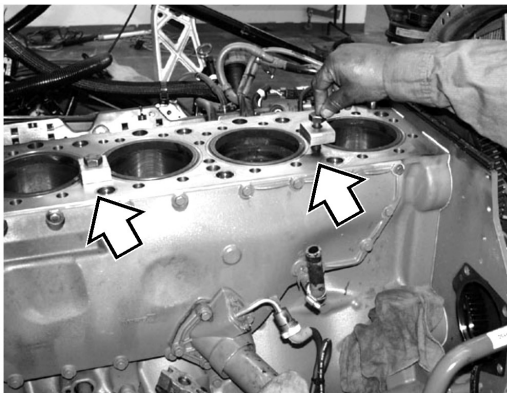


CAUTION

Make sure that alignment plates are completely flat with the cylinder head and block. If not, the cylinder head will not be correctly installed and damage to the engine can occur.

Install 2 side cylinder head alignment blocks 9998624. Install 1 toward the back and the other toward the front of the cylinder head.

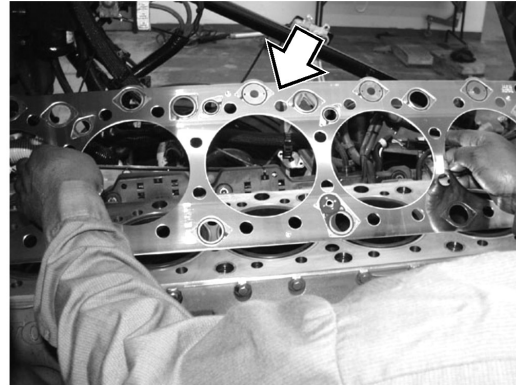
8



W2003994

Remove cylinder liner hold-down tools 9996966.

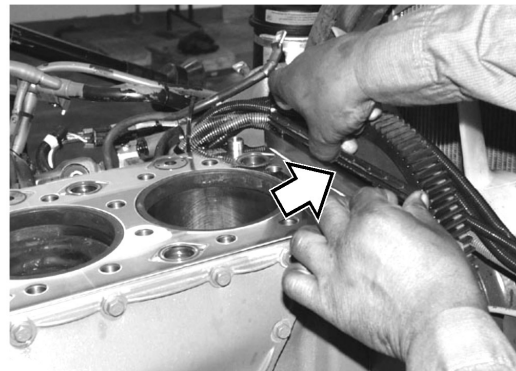
9



W2003995

Install cylinder head gasket.

10



W2003996

Install a new rubber seal on top of the intermediate plate.

11



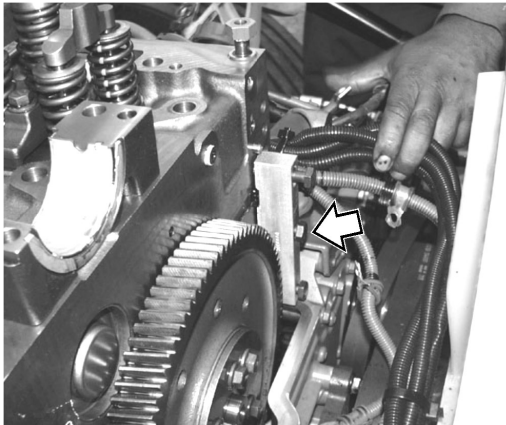
W2004000

Carefully lower cylinder head onto cylinder block, letting the alignment blocks help position the cylinder head.

NOTE: Push cylinder head towards engine block so that alignment blocks are in contact with alignment surface on block as close as possible.

NOTE: Check that the rubber seal on the intermediate plate is positioned correctly after the cylinder head is in place.

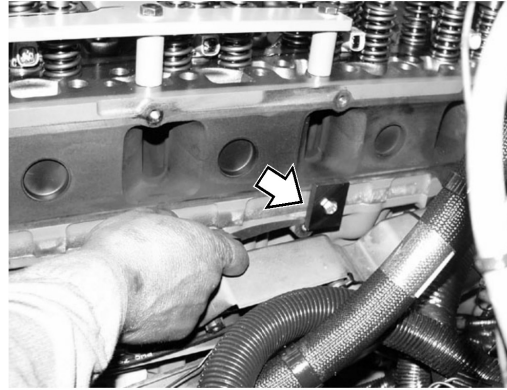
12



W2004001

Place front alignment block 9998601 in position and tighten bolts to properly align front of head.

13

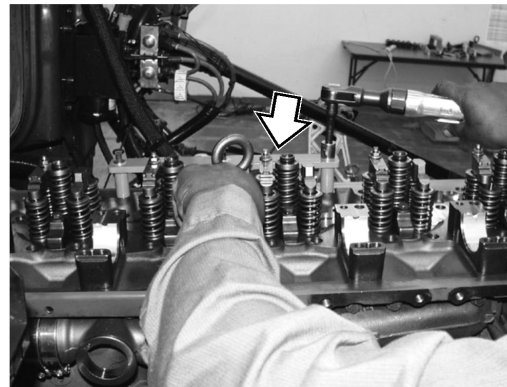


W2004002

Place 0.10 mm feeler gauge at side cylinder head alignment block. Feeler gauge should not be able to fit in space between tool and cylinder block.

NOTE: A gap of 0 – 0.10 mm is acceptable.

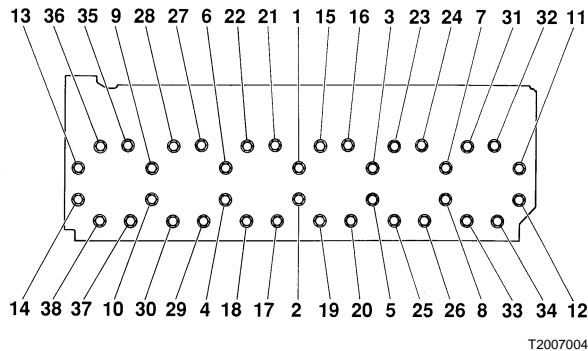
14



W2004003

Remove cylinder head lifting fixture J41503.

15



Cylinder head, tightening sequence

Lubricate cylinder head bolts with engine oil and place bolts in cylinder head. Using proper tightening sequence, torque-tighten cylinder head bolts as follows.

Step 1:* 60 ± 10 Nm
(44 ± 7 ft-lb)

Step 2 (check tighten): 60 ± 10 Nm
(44 ± 7 ft-lb)

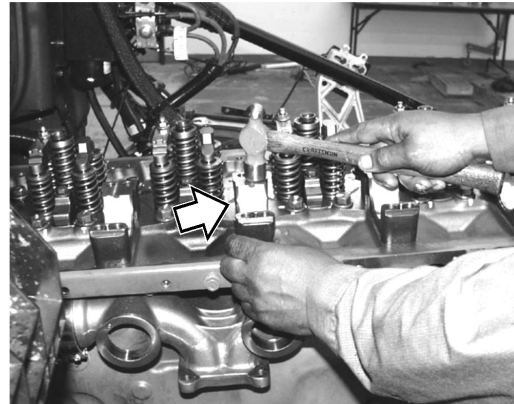
Step 3: 90 ± 5°

Step 4 (check tighten): 90 ± 5°

NOTE: *Repeat the check in step 13 before cylinder head is tightened to the final torque. If a gap greater than 0.10 mm exists, the bolts must be loosened so that the cylinder head can be repositioned.

16
Remove alignment blocks from cylinder head.

17



W2004005

Install no. 4 lower camshaft bearing cap. Tap into place.

18
Clean camshaft with solvent and compressed air. Inspect for excessive wear or damage.

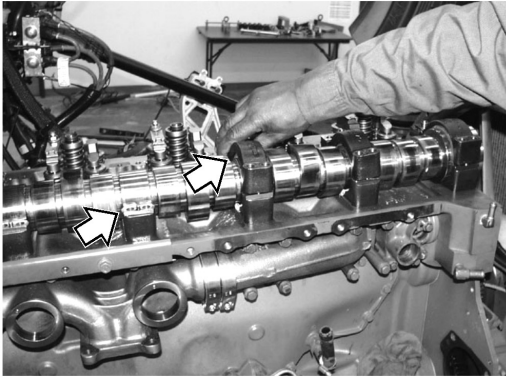
19
Install lower camshaft bearings to lower bearing caps. Lubricate bearings with oil or lithium grease.

20
Using camshaft lifting tool 9998264, carefully lower camshaft into place without gear attached. Remove lifting tool. 9998264
J45242

NOTE: Lifting bracket J45242 should also be used on VNM and VHD models.

21
Install bearings to their corresponding upper camshaft bearing caps.

22



W2004006

Install all 7 upper camshaft bearing caps to their respective positions. Gently tap into place using a deadblow hammer.

23

Install outer camshaft bearing cap bolts and studs. Hand-tighten only.

24



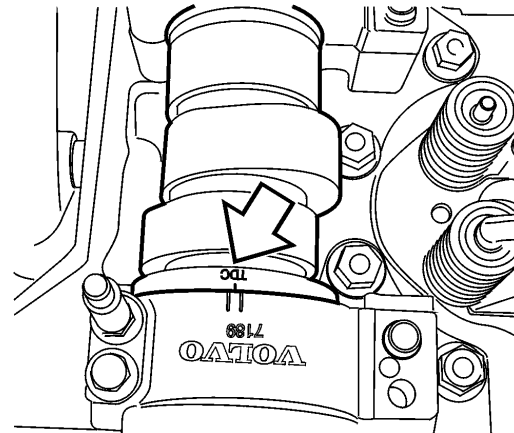
W2004008

Using a rag to protect the camshaft, hand-turn the camshaft to make sure that it rotates freely and does not bind. Axial play should be no more than 0.35 mm (0.014 in.).

25

Remove flywheel inspection cover.

26

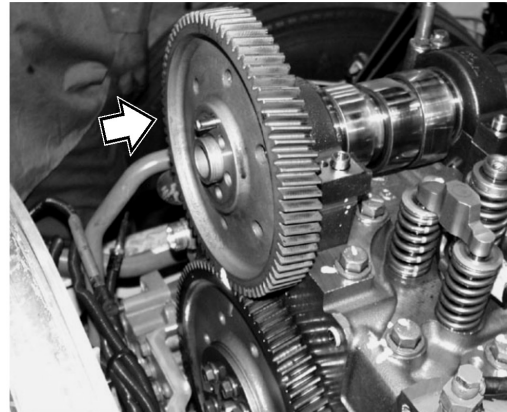


W2003493

Install flywheel turning tool 9996956 and rotate engine to 0° TDC.

NOTE: Make sure TDC mark on camshaft is between the two hash marks on front cam bearing cap before gear is installed.

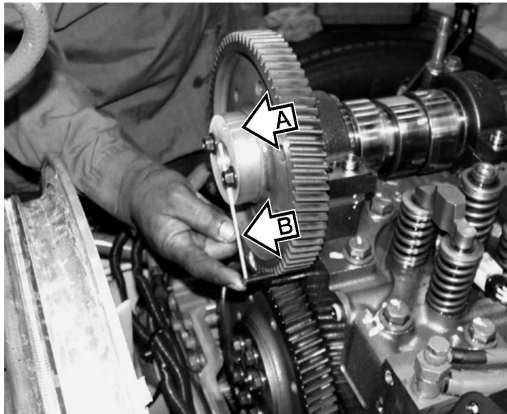
27



W2004022

Position camshaft gear against camshaft.

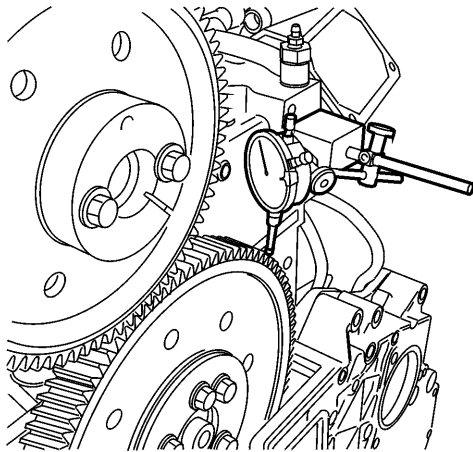
28



W2004023
J44514

Using alignment kit J44514, install camshaft alignment collar (A) to front of gear. Install camshaft alignment tool (B) to verify that camshaft is aligned at TDC.

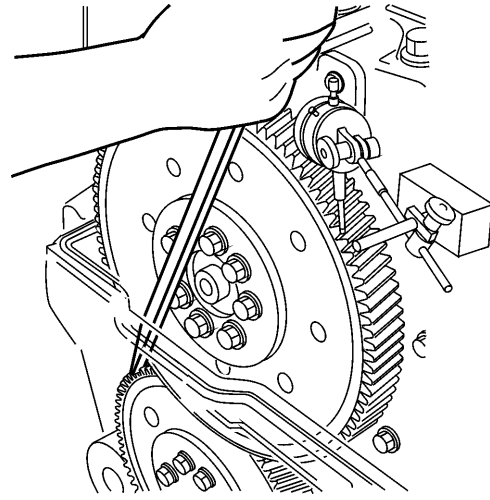
29



W2003495

Set up a dial indicator on the adjustable idler gear.

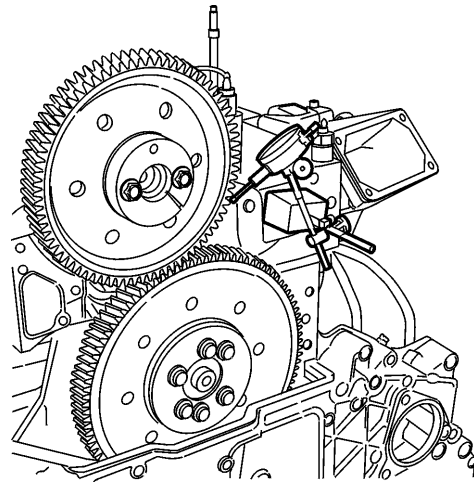
30



W2004075

Use a pry bar or long screwdriver to hold the intermediate idler gear in place. Measure the gearlash between the intermediate-to-adjustable idler gears by rocking the adjustable idler gear back and forth. Acceptable gear backlash is between 0.05 – 0.17 mm (0.002 – 0.007 in.).

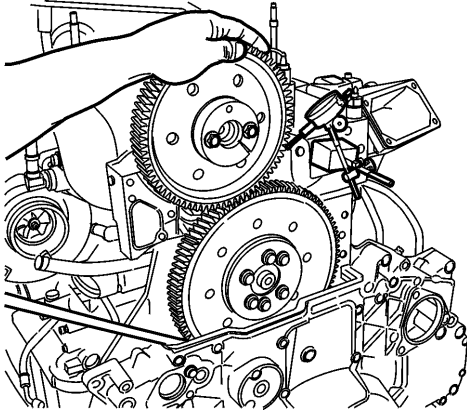
31



W2003497

Set up a dial indicator on the camshaft gear; use a pry bar or long screwdriver to hold the adjustable idler gear in place.

32



W2003498

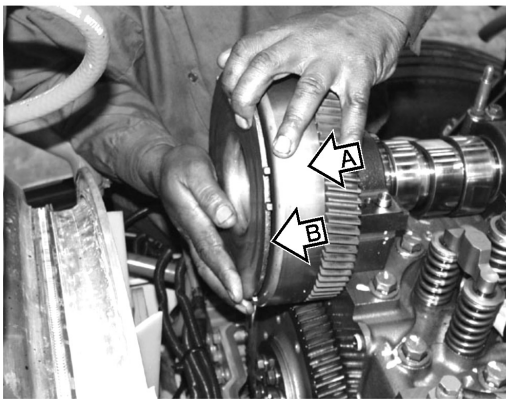
Measure the gearlash between the camshaft gear and the adjustable idler gear by rocking the camshaft gear back and forth. Acceptable gear backlash is between 0.05 – 0.17 mm (0.002 – 0.007 in.).

NOTE: If either backlash is out of specification, the adjustable idler gear must be adjusted; refer to Service Information, group 21.

33

Remove camshaft alignment collar.

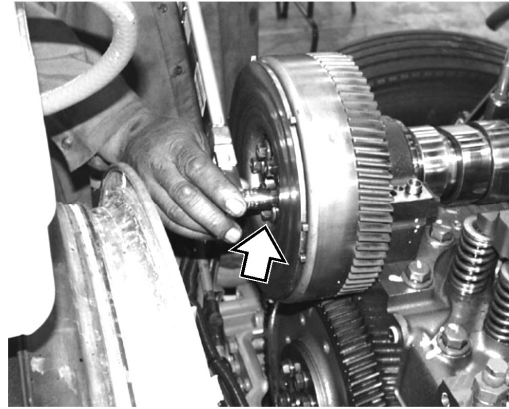
34



W2004024

Install camshaft damper (A) and cam sensor tooth wheel (B).

35



W2004025

Install spacer and new bolts. Using proper tightening sequence, torque-tighten bolts to 35 ± 3 Nm (26 ± 2 ft-lb), then turn an additional $90 \pm 5^\circ$.

35 ± 3 Nm
(26 ± 2 ft-lb);
then $90 \pm 5^\circ$

NOTE: Do not reuse bolts.

36

Using lifting tool 9998255, install rocker arm shaft to cylinder head.

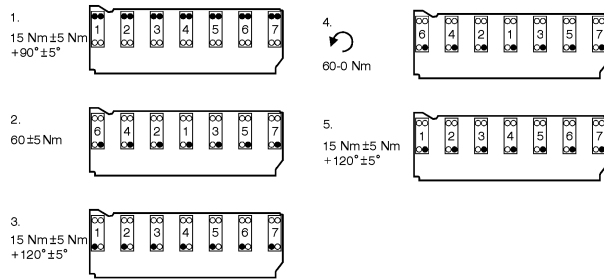
9998255
J45242

NOTE: Lifting bracket J45242 should also be used on VNM and VHD models.

37

Using a crossover pattern, tighten the rocker arm shaft bolts just until the rocker arm shaft bottoms out against the bearing housings.

38



T2012850

Rocker arm shaft, tightening sequence

Using the proper tightening sequence and the following steps, torque-tighten the rocker arm bolts:

- Step 1** 15 ± 5 Nm (11 ± 4 ft-lb), then 90 ± 5°
- Step 2** 60 ± 5 Nm (44 ± 4 ft-lb)
- Step 3** 15 ± 5 Nm (11 ± 4 ft-lb), then 90 ± 5°
- Step 4** Loosen bolts
- Step 5** 15 ± 5 Nm (11 ± 4 ft-lb), then 120 ± 5°

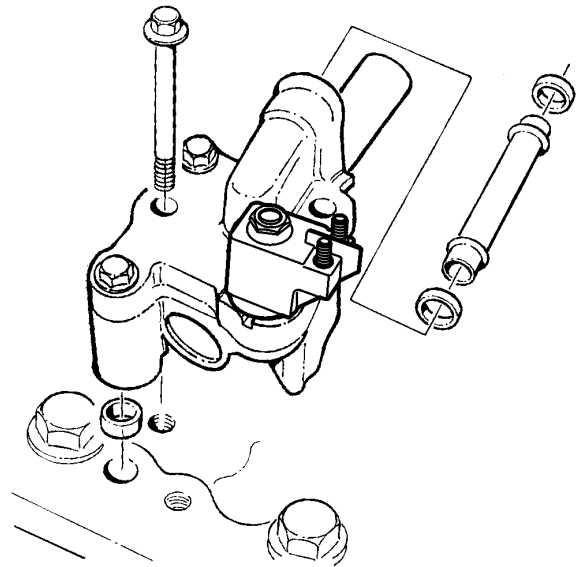
NOTE: Bolts must be tightened in stages to ensure that the rocker arm shaft is not distorted when bolted down.

39

If needed, verify camshaft timing. Check camshaft settings with cold engine and valve clearance = 0.

Intake valve for cylinder 1 for flywheel position 6° after TDC must be open 1.6 ± 0.3 mm (0.063 ± 0.001 in.). When checking, timing gears must only be turned in the correct direction (clockwise when viewed from front) to eliminate any backlash. For more information, refer to Service Information, group 21.

40



W2004053

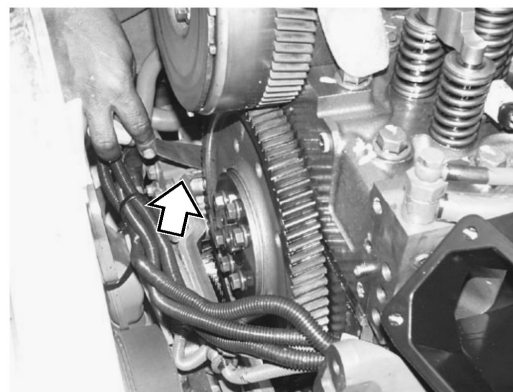
Install VEB valve to the rocker arm shaft, using new O-ring seals. Torque-tighten bolts to 24 ± 4 Nm (18 ± 3 ft-lb).

NOTE: Remove all rubber bands from VEB plungers.

41

Adjust the valves and injectors according to specifications; refer to Service Information, group 21. Also check the VEB exhaust valve clearances.

42



W2004026

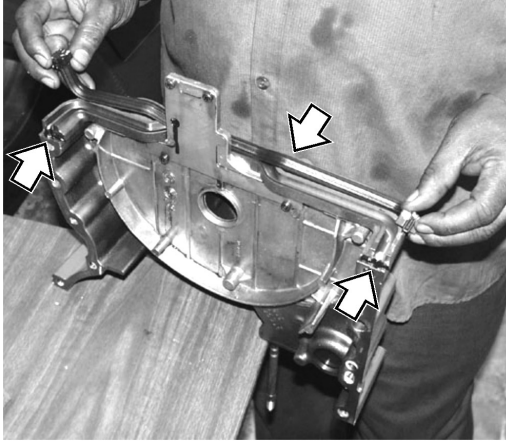
Clean sealing surface on cylinder head and top of lower front cover.

NOTE: Cover opening to prevent debris from entering engine.

43

Clean sealing surface of upper front cover. Using pressurized air, blow off any debris (wear appropriate eye protection).

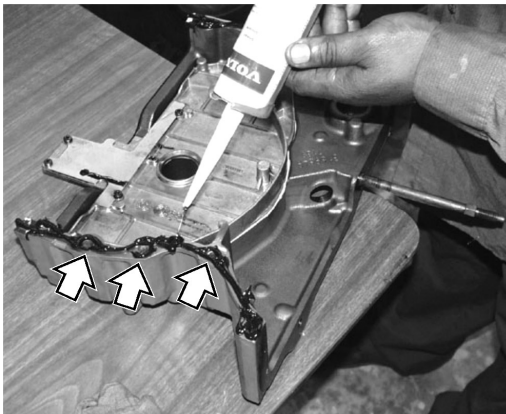
44



W2004027

Install gasket between upper and lower front covers. Note: sealant must be placed at front corners of upper cover and at indentation along side of cover to prevent leaks.

45



W2004028

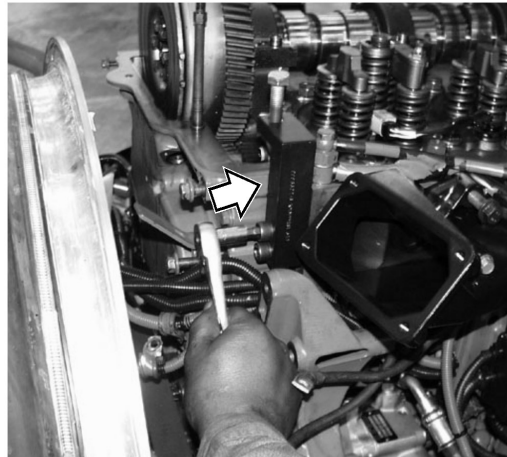
Apply a 2 mm bead of sealant to the contact surface of the upper front cover. Make sure that the sealant completely surrounds the bolt holes.

NOTE: Cover should be torque-tightened within 20 minutes after applying sealant.

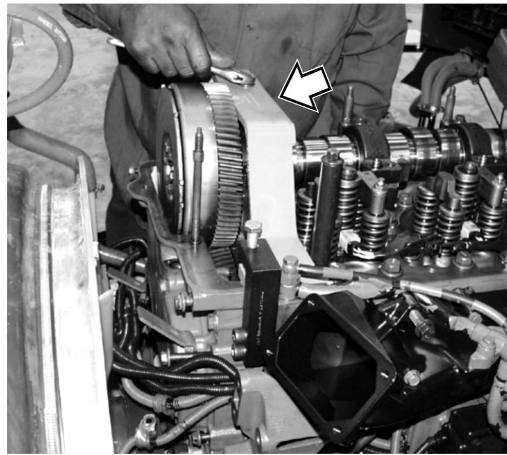
46

Install the upper front cover. Position bolts, but do not tighten.

47



W2004029

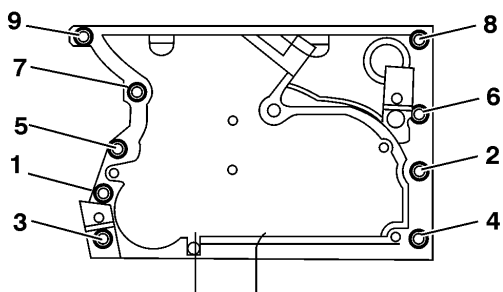
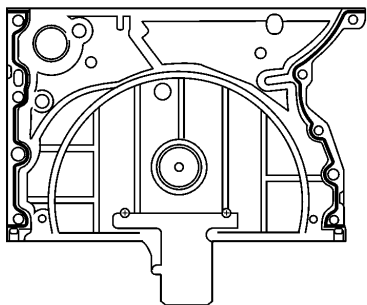


W2004030

Install front cover alignment tool 9998602-6/2. Tighten bolts to align the front cover.

NOTE: Tighten until upper front cover is flush with cylinder head on both sides.

48



T2019925

Torque-tighten upper front cover bolts in order as follows:

M8: 24 ± 4 Nm
(18 ± 3 ft-lb)

M10: 48 ± 8 Nm
(36 ± 6 ft-lb)

49

Remove upper front cover alignment tool.

50

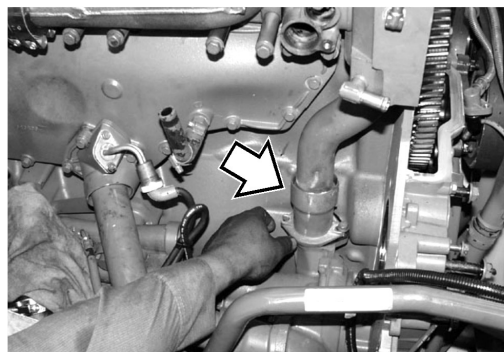
Install camshaft sensor to upper front cover.

NOTE: The distance between sensor and sensor tooth wheel should be 0.3 – 1.0 mm (0.012 – 0.039 in.)

51

Install wiring harness and clamps to upper front cover.

52

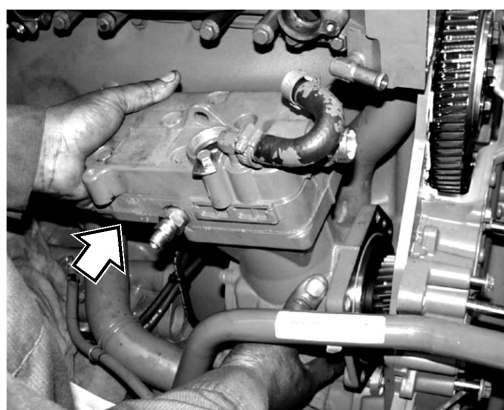


W2004009

Install coolant tube from water pump to cylinder head.

NOTE: Use new O-rings and gasket.

53



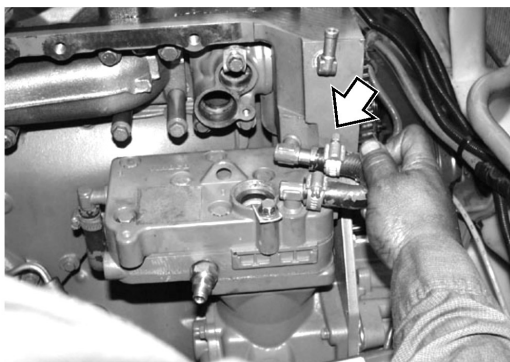
W2004010

Install air compressor with new mounting O-ring. Torque-tighten mounting bolts to 85 ± 15 Nm (63 ± 11 ft-lb).

54

Install oil supply line to air compressor.

55



W2004011

Connect air compressor coolant hoses to cylinder head and oil cooler housing. Tighten hose clamps.

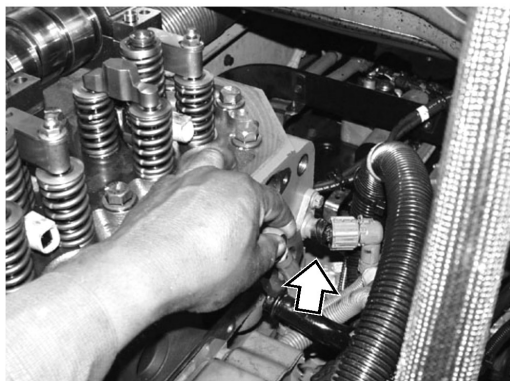
56

Install air governor line and secure with tie straps.

57

Install cable harness box mounting bolts (do not install covers at this time).

58



W2004012

Connect coolant sensor.

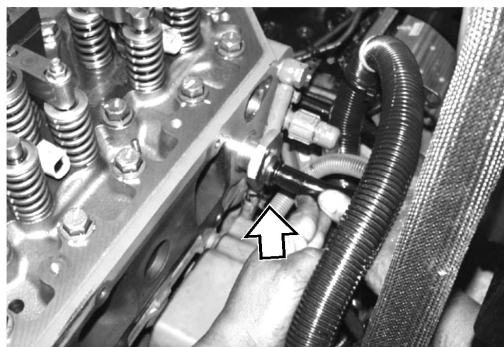
59



W2004013

Install fuel line at rear of cylinder head using new copper washers.

60

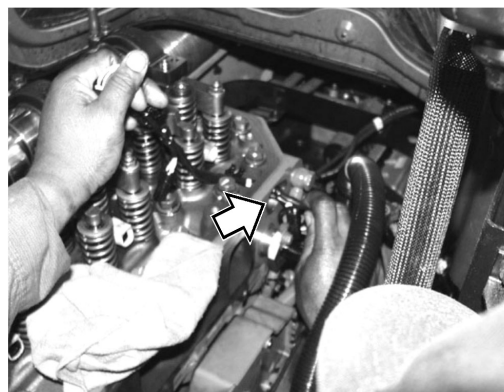


W2004015

Install transmission oil cooler pipe.

NOTE: Use new O-ring seal.

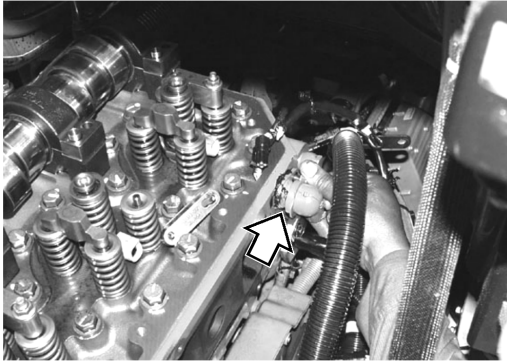
61



W2004014

Carefully feed injector harness through pass-through into cylinder head.

62

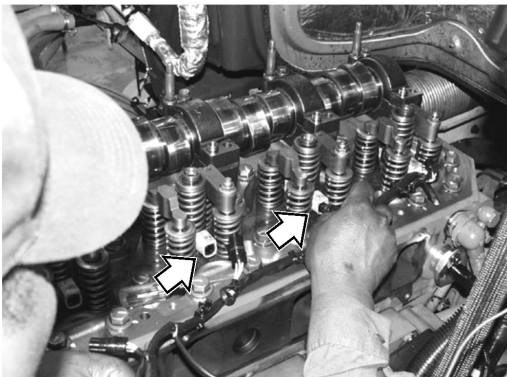


W2004016

Install cable holder and tighten cap bolt.

NOTE: Apply a thin bead of silicone around the sealing edge before installing.

63



W2004017

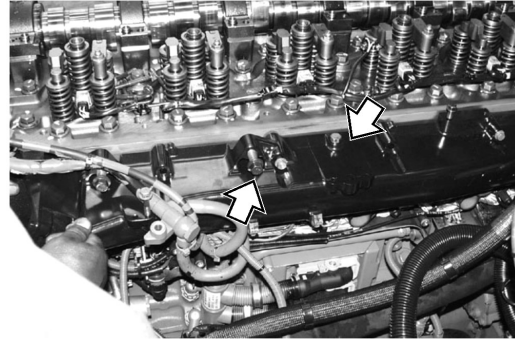
Connect injector harness cable to injectors.

NOTE: Make sure that connectors are locked into place on each injector.

64

Clean intake manifold and place new seal into groove on manifold.

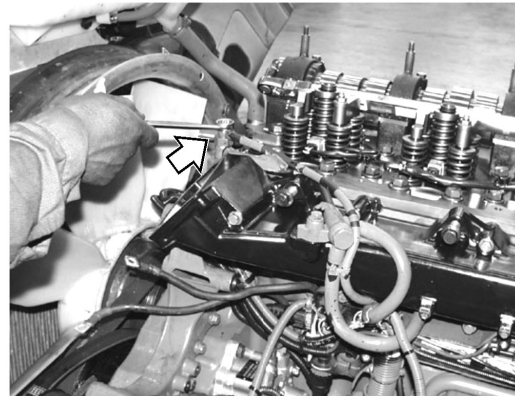
65



W2004018

Install intake manifold. Using crossover pattern, torque-tighten bolts to 52 ± 4 Nm (38 ± 3 ft-lb).

66



W2004019

Install fuel lines to top of intake manifold and cylinder head.

67

Install intake manifold pressure/temperature sensor.

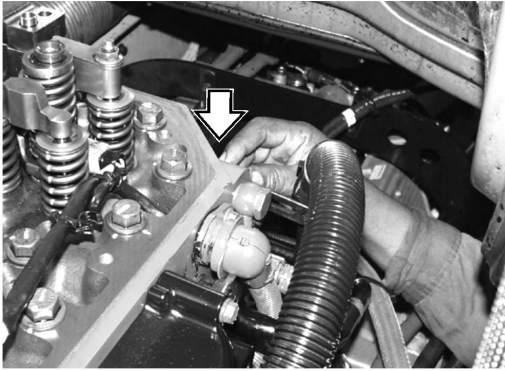
68

Install cable box intermediate cover.

69

Install cable box outer cover.

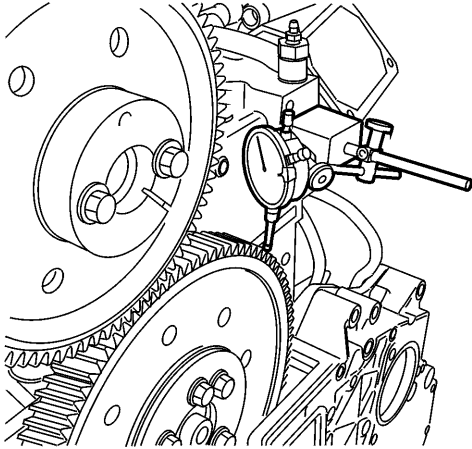
70



W2004021

Install cable box harness bracket at rear of engine.

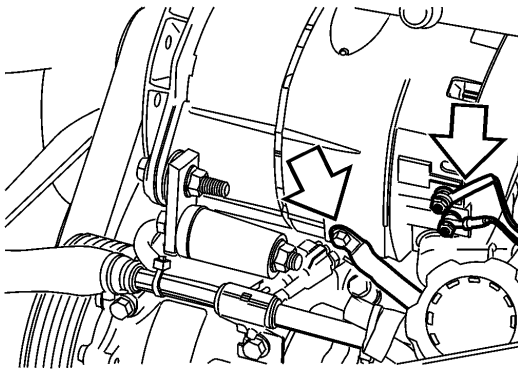
71



W2003495

Set up a dial indicator on the adjustable idler gear.

72



W2003813

Install alternator. Torque-tighten mounting bolts to 48 ± 8 Nm (35 ± 6 ft-lb).

73

Connect all wires to alternator.

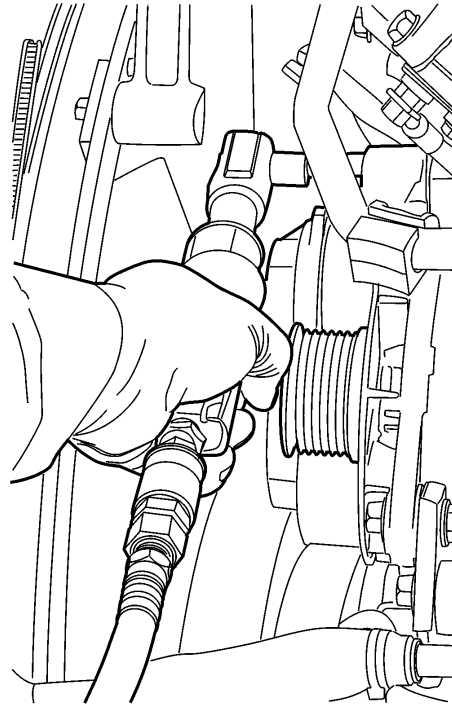
74

Install preheater wires to top of intake manifold.

75

Install main air compressor line.

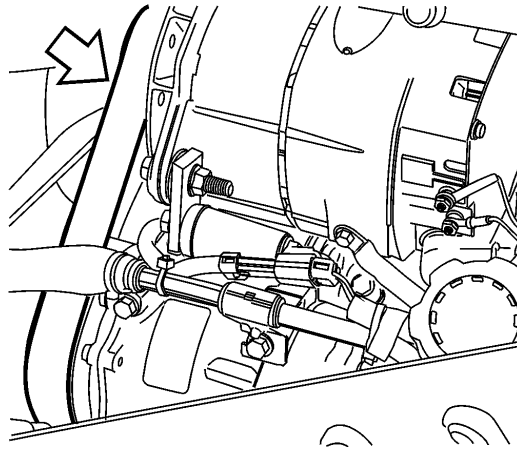
76



W2003825

Install belt tensioner and tighten bolts.

77



W2003814

Install alternator/AC belt.

78

Remove the fuel drain tube from the fuel filter housing.

79

Install preheater and mixing chamber to the intake manifold.

80

Install wiring harness to top of pre-heater.

81

Install ground wires to bottom of pre-heater.

82

Install fan ring to mixing chamber bracket.

83

Install charge air pipe from charge air cooler to mixing chamber.

84

Install crankcase breather tube to top of intake manifold.

85

Install heat shield and blow-out strip for valve cover.

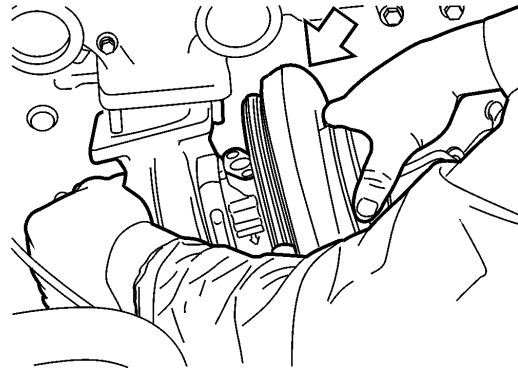
86

Install heater hose coolant pipe to thermostat housing.

87

Install crankcase breather tube to upper front cover.

88

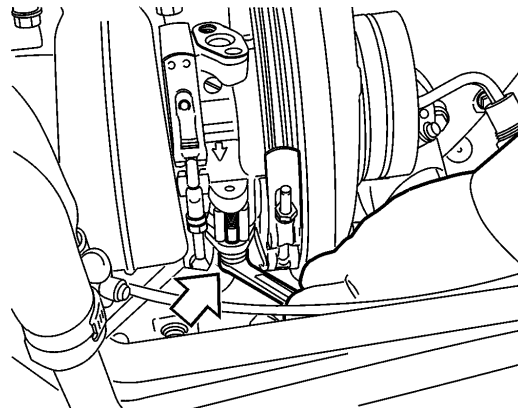


W2003868

Place turbocharger into position. Install spacers and flange nuts. Tighten nuts.

NOTE: The EGR system requires that the exhaust restriction plate be installed between turbocharger and exhaust manifold.

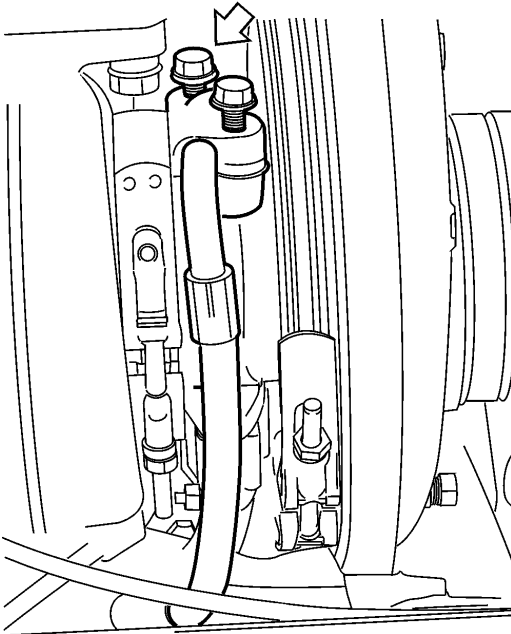
89



W2003865

Install turbocharger oil return tube (lower).

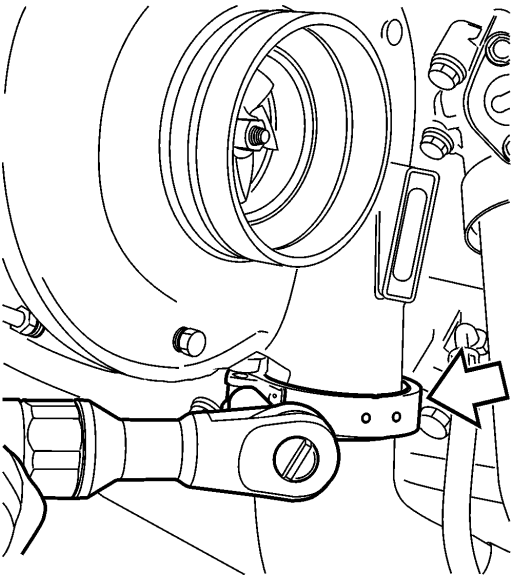
90



W2003864

Install turbocharger oil supply tube (upper).

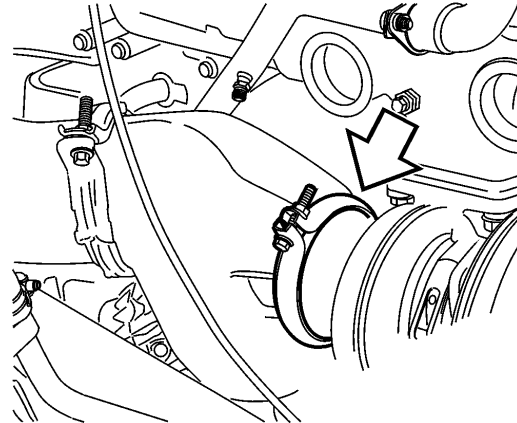
91



W2003866

Install charge air cooler pipe to the turbocharger.

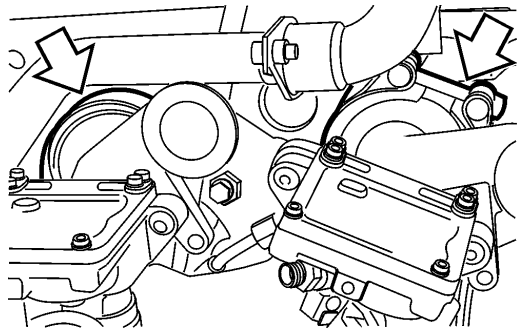
92



W2003871

Install EPG housing to the turbocharger.

93



W2003822

Install EGR valves to exhaust manifold. Torque-tighten clamps to 13 ± 3 Nm (10 ± 2 ft-lb).

NOTE: Use new clamps and sealing rings.

94

Install coolant pipe from oil cooler housing to EGR cooler.

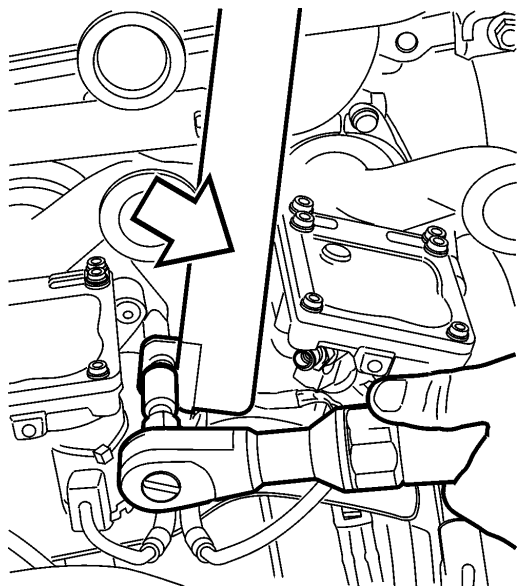
95

Install EGR cooler and brackets.

96

Install coolant line from EGR valve.

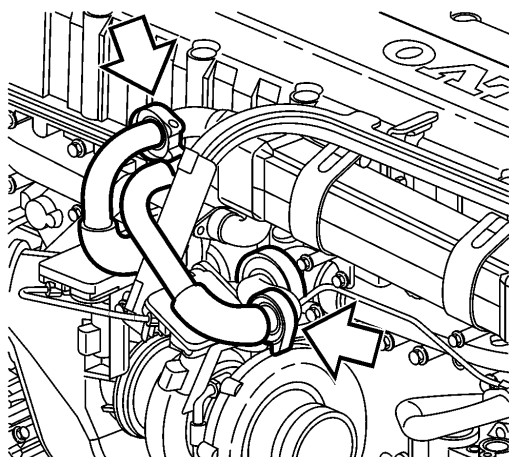
97



W2004216

Install wiring harness rail to EGR valve. Do not tighten.

98

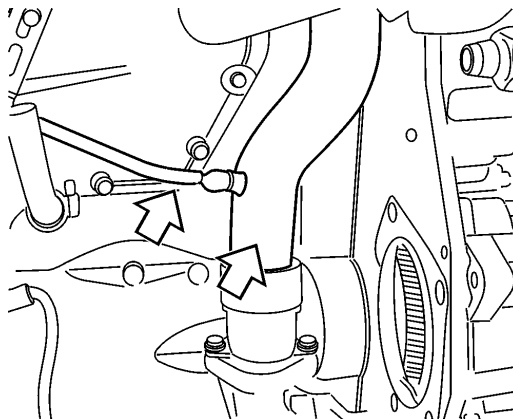


W2004257

Install EGR exhaust pipes from EGR valve to EGR cooler. Torque-tighten clamps to 10 ± 2 Nm (7 ± 1 ft-lb).

NOTE: Use new clamps and sealing rings.

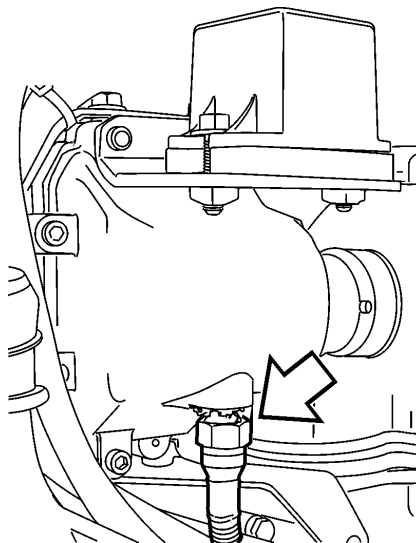
99



W2004225

Install coolant pipe from EGR cooler to thermostat housing. Also connect coolant line from front EGR valve to coolant pump bypass pipe.

100



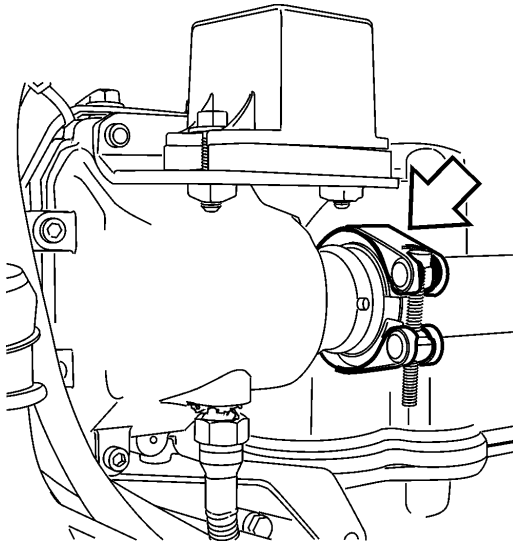
W2004256

Carefully install reed valve housing temperature sensor.

101

Connect temperature sensor wiring harness to cable box; secure harness using tie straps.

102



W2004260

Install clamp from reed valve housing to mixing chamber.

NOTE: Use new O-ring seal.

103

Install static fill pipe from radiator coolant pipe to EGR cooler.

104

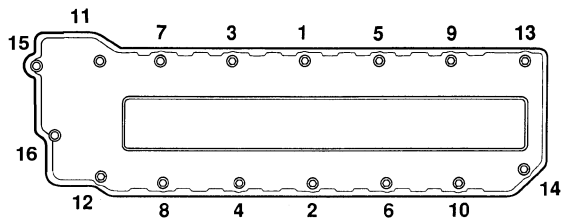
Install the valve cover gasket.

105

Clean the valve cover sealing surface and install the valve cover.

NOTE: If new valve cover is being installed, a new engine certification label must be printed and affixed to the cover.

106



T2012845

Valve cover, tightening sequence

Install the valve cover nuts. Using the proper tightening sequence, torque-tighten to 20 ± 2 Nm (15 ± 1.5 ft-lb).

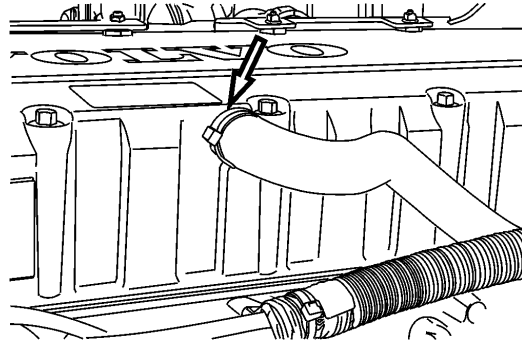
107

Install EGR cooler bracket studs.
Torque-tighten to 40 ± 3 Nm (29 ± 2 ft-lb).

108

Install the EGR cooler brackets to the valve cover.

109



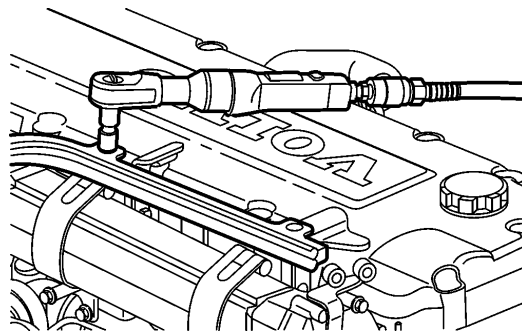
W2004182

Install breather tube to side of valve cover.

110

Install heat shield brackets to top of valve cover.

111



W2003828

Install wiring harness rail to top of EGR brackets.

112

Install upper radiator coolant neck.

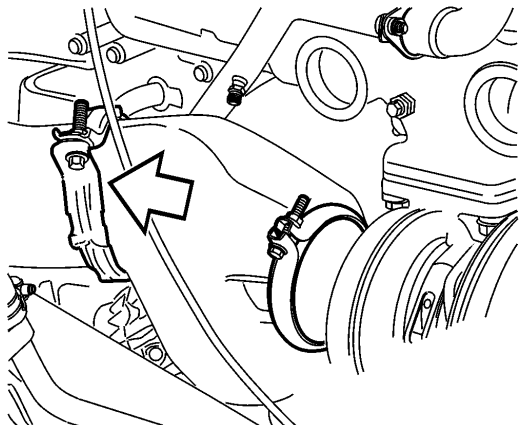
113

Install fan ring to upper coolant neck.

114

Install upper coolant hose from radiator to cylinder block.

115



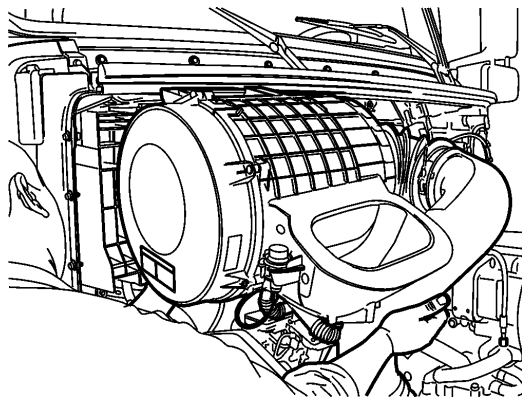
W2004218

Install pipe from EGR cooler to mixing chamber and tighten clamp.

116

Install exhaust pipe to EPG housing.

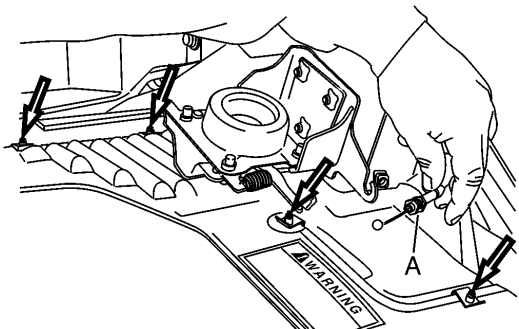
117



W2003859

Install air filter housing against cab and main fresh air pipe to turbocharger; refer to Service Information, group 25.

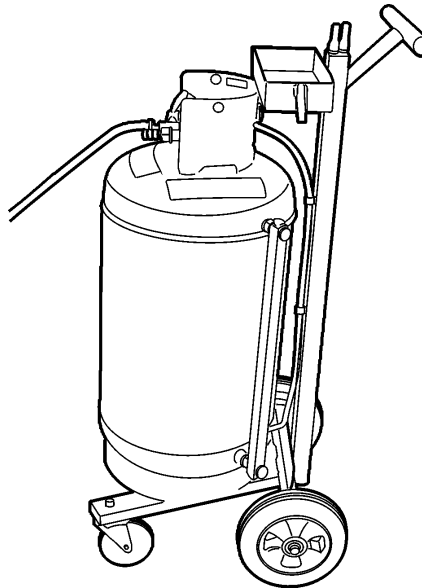
118



W2004243

Install left and right inner fenders.

119



W2004191

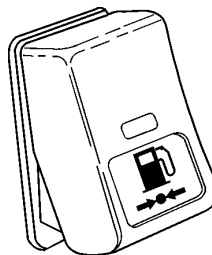
Using coolant extraction tool DBT2V700, fill cooling system with approved coolant to specified level.

DBT2V700

120

Turn on master switch (if equipped), or reconnect battery cables; refer to Service Information, group 31.

121



W3005378

Turn ignition key to ON position and activate the fuel priming switch. Wait until the fuel primer pump stops priming the fuel system.

NOTE: The fuel primer pump will pump for approximately 5 minutes.

122

Start engine and check for leaks.

Cylinder Head Parts, Transferring

See also:

- "Cylinder Head Replacement" page 1

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.

NOTE: Camshaft bearing journals should be numbered 1–7, with matching upper and lower halves. Be sure to note and mark the corresponding journal numbers and install them in the correct sequence with matched upper and lower halves.

Removal of Parts

- 1 Remove all cross bridges.
- 2 Remove exhaust manifold.
- 3 Remove all valve cover studs.
- 4 Remove valve cover blow-out strip.
- 5 Remove the thermostat housing and thermostat.
- 6 Remove the coolant fittings from the front of the cylinder head.
- 7 Remove all 6 injector hold-downs.
- 8 Using tools 9990013 and 9990006, remove all 6 injectors. Once injectors are removed, place protective covers 9998249 on all 6 injectors.

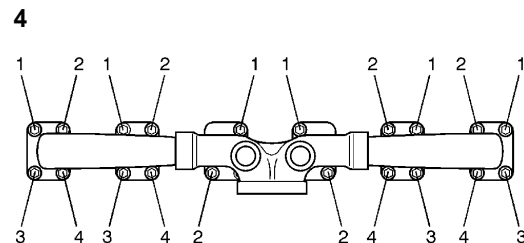
NOTE: Mark the injectors to identify the cylinder from which the injector was removed. If injectors are not installed into the same cylinder, the injector trim codes will have to be re-programmed in the EECU.

- 9 Remove coolant sensor.
- 10 Remove transmission coolant pipe adapter.
- 11 Remove cylinder head from packaging crate and attach to holding stand.

Installation of Parts

NOTE: Observe the greatest possible cleanliness when working on the cylinder head. It should be cleaned internally and externally before it is installed. All components should also be cleaned prior to installation.

- 1 Using pressurized steam, clean cosmoline from cylinder head. Use compressed air to thoroughly blow out the cylinder head before assembling components.
- 2 Install coolant sensor to the cylinder head using a new seal.
- 3 Install transmission coolant pipe adapter to the cylinder head



W2003906

Apply anti-sieze to exhaust manifold bolts. Position exhaust manifold and gaskets against cylinder head and install mounting bolts. Using the recommended tightening sequence, torque-tighten bolts as follows:

- (1) Bolts 1 – (max) 10 Nm (7 ft-lb)
- (2) Bolts 2 – (max) 10 Nm (7 ft-lb)
- (3) Bolts 3 – 52 ± 4 Nm (38 ± 3 ft-lb)
- (4) Bolts 2 – 52 ± 4 Nm (38 ± 3 ft-lb)
- (5) Bolts 4 – 52 ± 4 Nm (38 ± 3 ft-lb)
- (6) Bolts 1 – 52 ± 4 Nm (38 ± 3 ft-lb)

5
Using seal installation tool 9998619 9998511
and lever 9998511, install new thermo- 9998619
stat seal.

6
Place new thermostat in position.

7
Place thermostat housing in position
with gasket and seal. Using drift
J44772 to line up bolt holes, tighten
bolts.

8
Install coolant pipe fittings to the front
of the cylinder head.

9
Install valve cover blow-out strip.

10
Remove injectors from protective
sleeves.

11
Install new O-rings on injectors.

NOTE: Lubricate prior to installation.

12
Install injectors into cylinder from
which they were removed. Torque-
tighten injector hold-down bolt; refer to
Specifications, group 20.

13
Install all floating cross bridges.