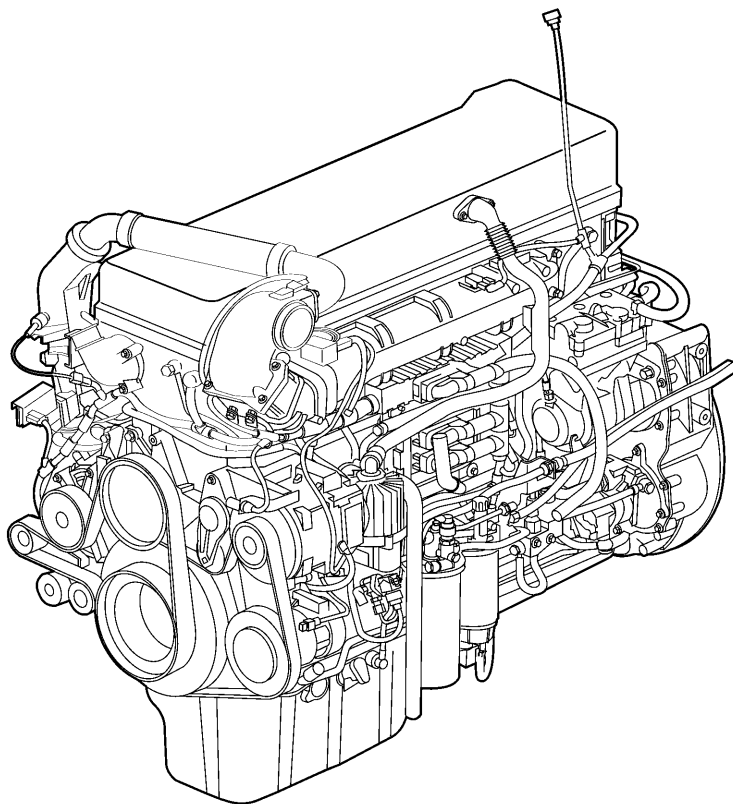


Valves and Unit injectors
Adjustment
D13F**Valves and Unit Injectors, Adjustment**

W2005941

This information covers the correct procedure for adjusting the valves and unit injectors on the Volvo D13F engine.

Contents

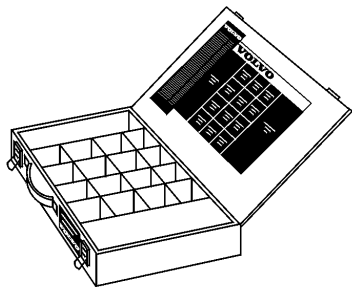
- "Special Tools" page 2
- "Valves and Unit Injectors, Adjustment" page 3

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.

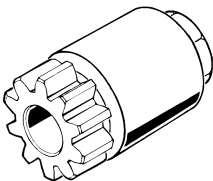
Tools

Special Tools

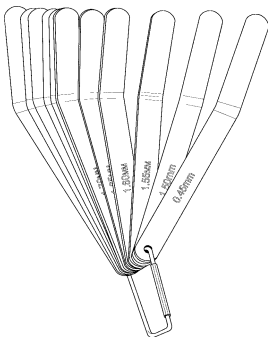
For special tools ordering instructions, refer to Tool Information, group 08.



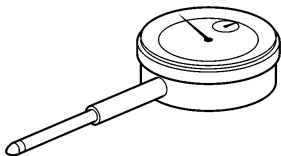
W0001924
3949521
VEB Shim Kit



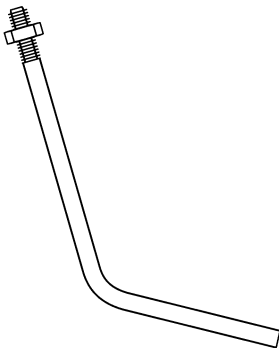
T0012612
88800014
Flywheel Turning Tool



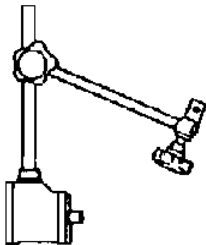
W0000416
85111377
Feeler Gauge Set



T0010788
9989876
Dial Indicator (or Equivalent)



W0002414
85111493
Dial Indicator Angled Extension
(or Equivalent)



W0001790
9999696
Magnetic Stand (or Equivalent)

Service Procedures

Valves and Unit Injectors, Adjustment

See also:

- "Valves and Unit Injectors, Adjustment" 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.

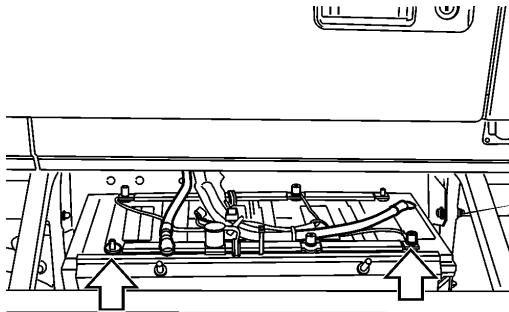
Special tools: 3949521, 9989876, 9999696, 85111493, 85111377, 88800014

1

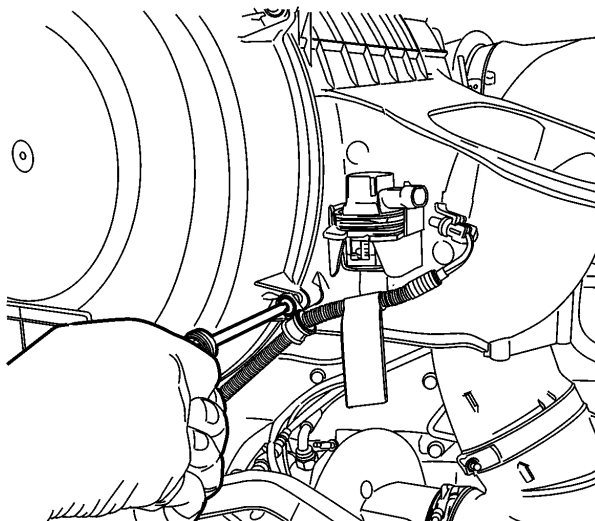
Apply the parking brake and place the shift lever in neutral.

2

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



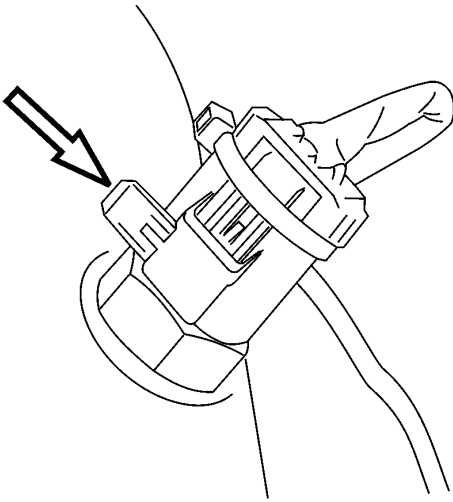
W2003815



W2003861

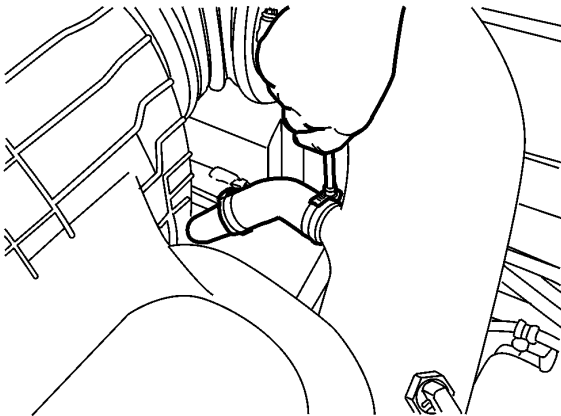
3

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



W2004720

- 4**
Unplug the air temperature sensor wiring harness connector. Remove the lock tab and separate the connector from the sensor. Remove the sensor harness clamp from the main fresh air pipe.

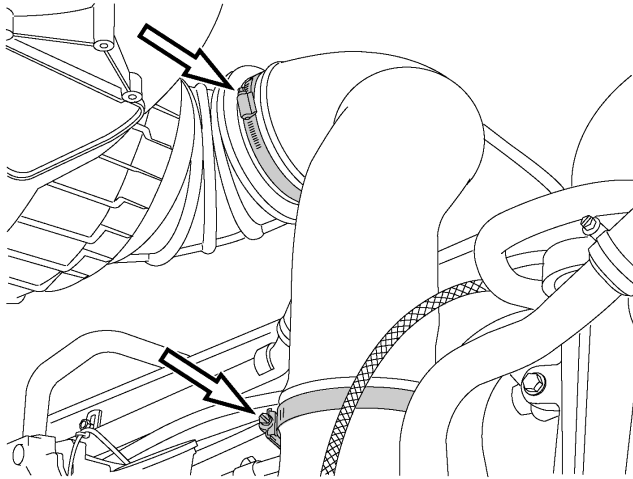


W2004719

- 5**
Loosen the air compressor fresh air hose clamp.

6

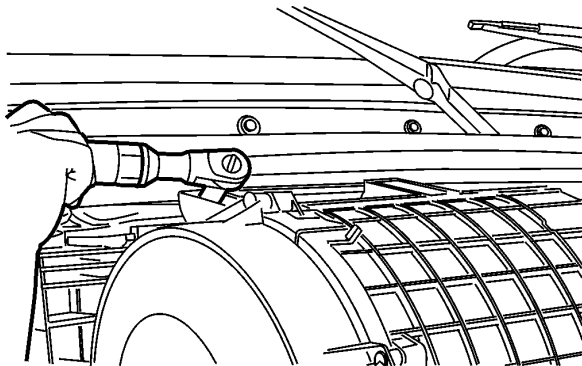
Loosen the clamps and remove the main fresh air pipe from the air compressor fresh air hose, the air filter housing and the turbocharger air inlet elbow.



W2006005

7

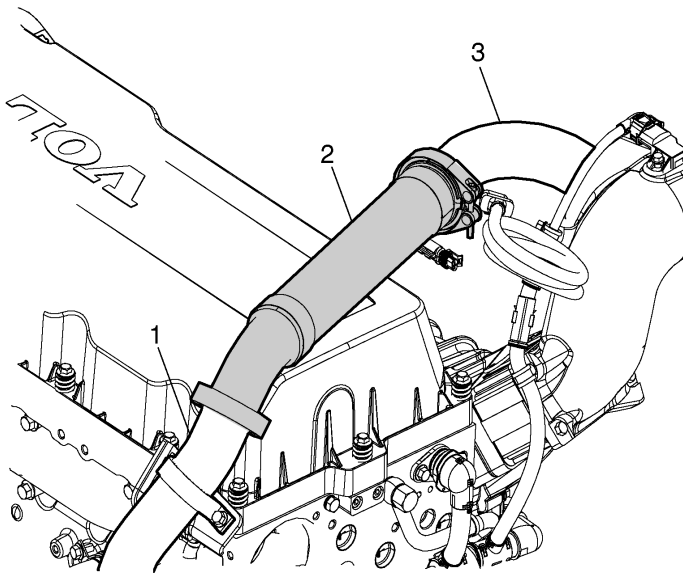
Remove the fasteners and lift the air filter housing away from the cab.



W2003858

8

Loosen the V-clamps and remove the EGR crossover pipe.



W2005960

- 1 Venturi Outlet Pipe
- 2 Crossover Pipe
- 3 Mixer Inlet Pipe

9

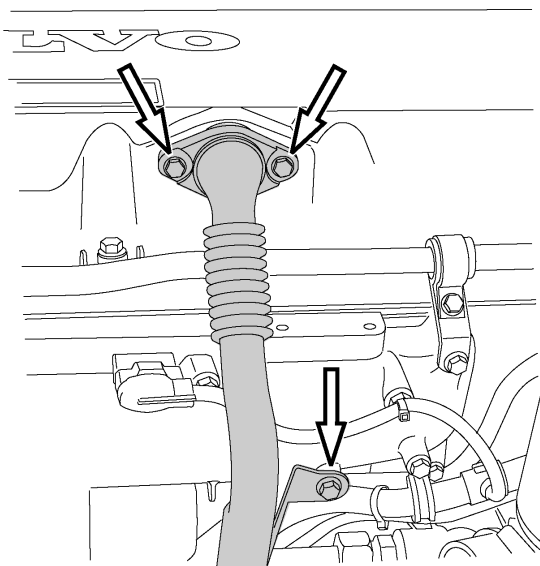
Loosen the clamp and mounting brackets to allow air compressor fresh air pipe to be removed.

10

Remove the aftertreatment fuel injector harness clips at the valve cover.

11

Remove the fasteners which secure crankcase ventilation tube and bracket to valve cover and intake manifold. Relocate the tube away from the manifold.



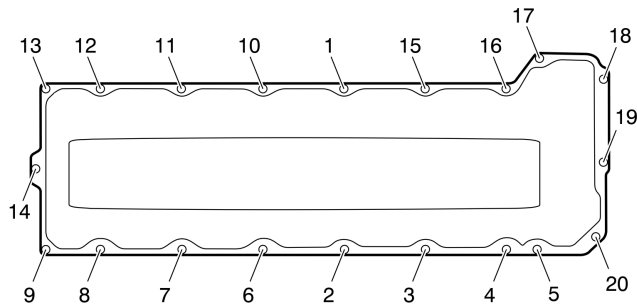
W2006122

12

Disconnect the discharge line and mounting brackets from the air compressor. Move the discharge air line out of the way and strap in place.

13

Remove the spring-loaded bolts from the valve cover.



T2022732

14

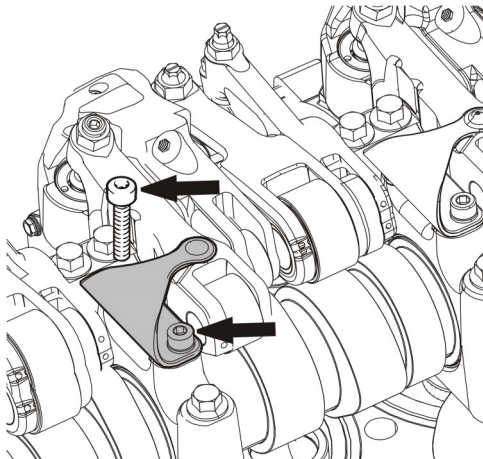
Lift and remove the valve cover.

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

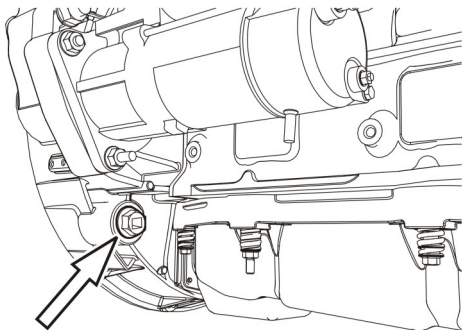
Note: Dependent upon chassis, engine cover may need to be removed for clearance to remove valve cover.

15

Loosen the fasteners retaining the leaf springs to release spring tension on the Volvo Engine Brake (VEB) rocker arms.



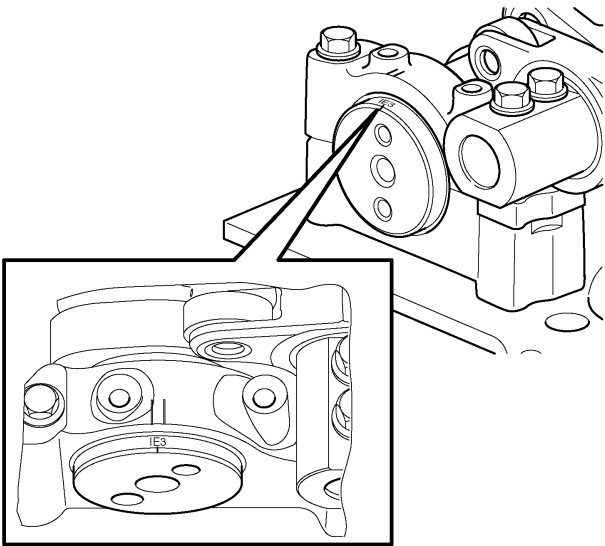
W2005753



W0002368

16
Remove the plug from the lower right side of the flywheel housing and install the flywheel turning tool (88800014).

88800014



W2006171

17
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 Rocker
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		
E3			X	X

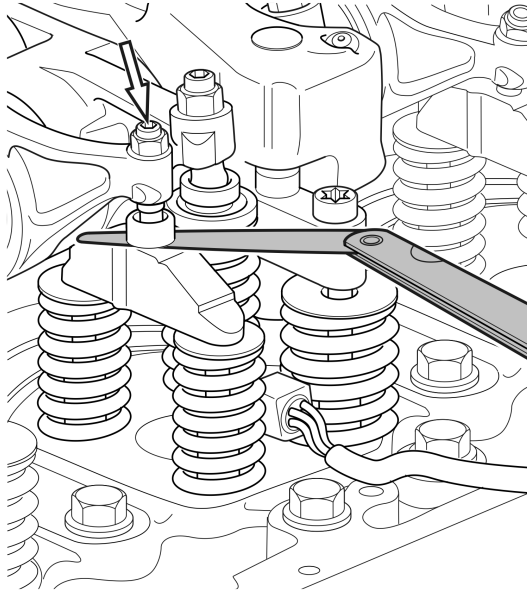
Intake Valves, Adjustment (with or without VEB)

18

Using the flywheel turning tool, rotate the engine to the next camshaft marking for adjustment of the intake valve. Rotate the engine until the valve and injector mark on the front end of the camshaft aligns with the stamped mark on the camshaft front bearing cap.

19

With the engine cold (140°F or less), check the intake valve clearance. Push down on the back of the rocker and insert a feeler gauge of the proper specification, $0.20 \pm 0.05 \text{ mm}$ ($0.008 \pm 0.002 \text{ inch}$), between the bridge and the adjustment screw. If the inlet rocker requires adjustment, loosen the locknut on the rocker and adjust the plunger.



T2023322

20

Tighten the locknut on the plunger by holding the adjusting screw in place and torque-tighten the locknut to $38 \pm 4 \text{ Nm}$ ($28 \pm 3 \text{ ft-lb}$).

$38 \pm 4 \text{ Nm}$
($28 \pm 3 \text{ ft-lb}$)

21

Recheck the valve clearance after the nut is tightened.

Note: Mark the rocker arm when the valve has been adjusted.

Unit Injector, Adjustment

22

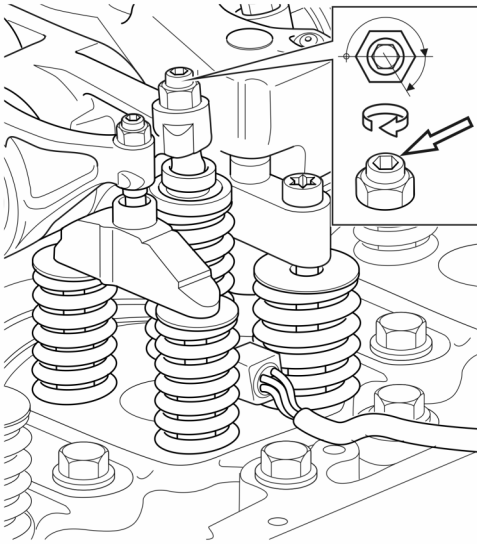
To adjust the injector on the same cylinder location, loosen the locknut and back off the adjusting screw until it no longer makes contact.

23

Adjust the unit injector's rocker arm to zero clearance.

24

Tighten the adjusting screw four flats or 240 degrees of clockwise rotation.

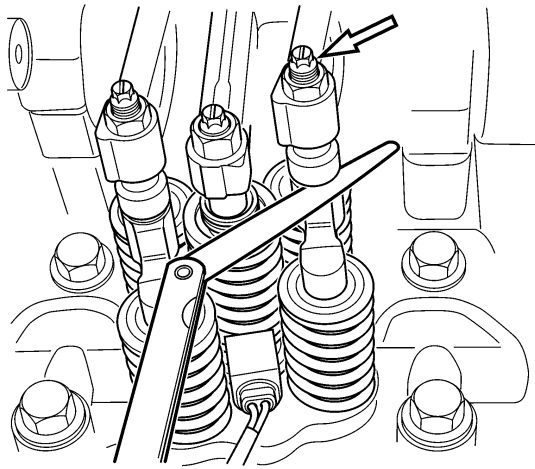


T2023323

25

Torque-tighten the adjusting screw locknut to 52 ± 4 Nm (38 ± 3 ft-lb).

52 ± 4 Nm
(38 ± 3 ft-lb)



T2022277

Exhaust Valves (without VEB), Adjustment

26

Continue adjustment on the same cylinder location by checking the exhaust rocker valve clearance. Push down on the back of the exhaust rocker and insert a feeler gauge of the proper specification of 0.80 mm (0.031 inch) between the bridge and the adjustment screw. If the exhaust rocker requires adjustment, loosen the locknut on the rocker and adjust the plunger.

27

Tighten the locknut on the plunger by holding the adjusting screw in place and torque-tighten the locknut to 38 ± 4 Nm (28 ± 3 ft-lb).

38 ± 4 Nm
(28 ± 3 ft-lb)

28

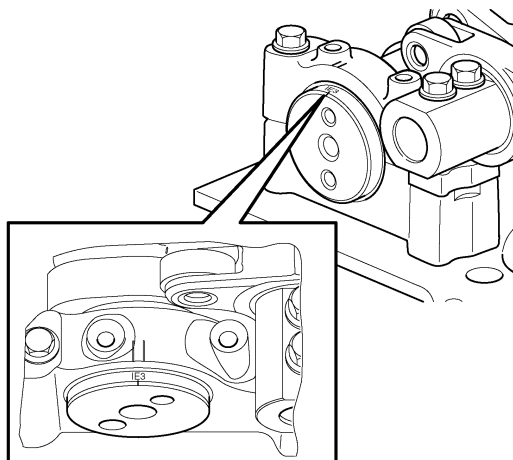
Recheck valve clearance after the locknut is tightened.

Note: Mark the rocker arm when the valve has been adjusted.

Exhaust Valves (VEB), Adjustment

29

Using the flywheel turning tool, rotate the engine to the next camshaft marking (number plus "E") for the adjustment of the exhaust valves.

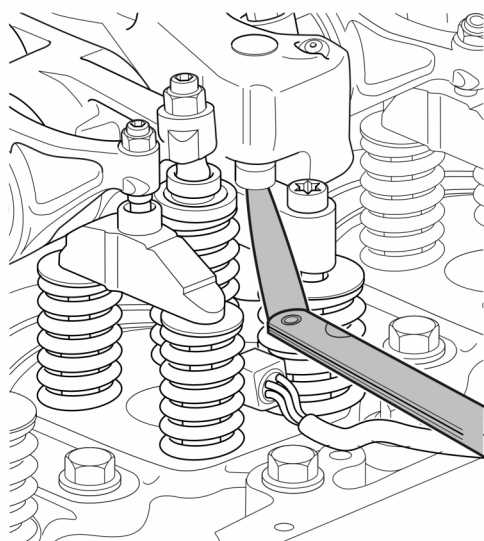


W2006171

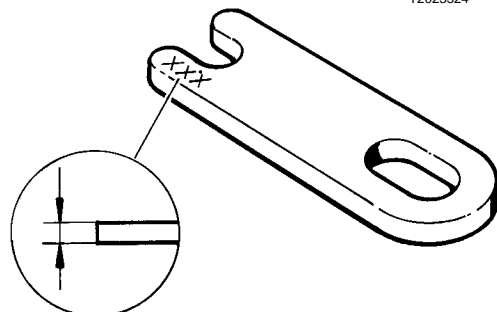
30

VEB Exhaust Bridge Shim Check:

- Push down on the back of the exhaust rocker and insert a feeler gauge of the proper specification of 1.00 ± 0.05 mm (0.039 ± 0.002 inch) between the bridge and the brake plunger.
- If clearance is not within specification, adjust the clearance as required, using shims placed on top of the valve bridge.
 - Remove the shim retaining screw and remove the shim.
 - Make sure that the valve bridge and shim(s) are clean.



T2023324

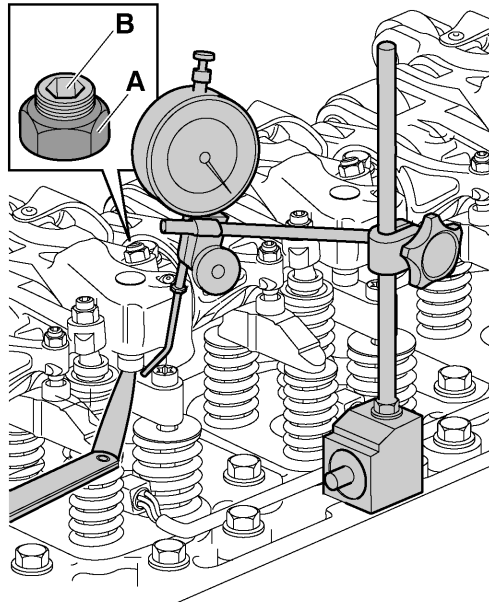


T2009008

- Determine the thickness of the shim(s) required to match the measured clearance
 - Place the shim(s) in position on the valve yoke, install the retaining screw and tighten to 38 ± 4 Nm (28 ± 3 ft-lb).
- DO NOT use more than two shims. Shims are available (shim kit No. 3949521) in 0.05 mm (0.002 inch) increments with the thickness marked on the surface. If two shims are required to take up the clearance, the shims should be of nearly equal thickness.

Allow feeler gauge to remain in place between the rocker arm and the valve bridge during the following brake rocker check.

3949521
 38 ± 4 Nm
(28 ± 3 ft-lb)



W2006212

31

Engine Brake Rocker Adjust:

- Loosen the locknut on the brake rocker arm "A".
- Assemble the dial indicator angled extension onto the dial indicator and tighten the extension locknut.
- Position a magnetic stand and dial indicator with angled extension to allow the shaft of indicator extension to set onto the valve bridge as close to the brake rocker plunger as possible.
- Tighten the adjusting screw "B" clockwise until the dial indicator shows that the valve bridge has been pressed down by 0.60 ± 0.05 mm (0.024 ± 0.002 inch).
- Loosen the adjusting screw "B" counterclockwise 720 degrees (two revolutions).
- Torque-tighten retention locknut "A" to 52 ± 4 Nm (38 ± 3 ft-lb).
- Remove the dial indicator, magnetic stand and feeler gauge.

9989876, 85111493, 9999696

52 ± 4 Nm
(38 ± 3 ft-lb)

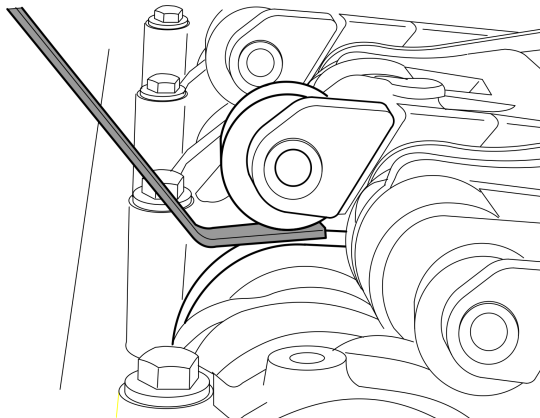
32

VEB Engine Brake Check:

Check the engine brake rocker arm clearance between the rocker arm roller and the camshaft with the 3.6 mm feeler gauge 85111377.

- With the dial indicator, magnetic stand and feeler gauge removed, insert a shim and feeler gauge between the camshaft lobe and the rocker arm roller.
- Clearance between the camshaft and rocker roller should meet a specification of 3.60 ± 0.10 mm (0.142 ± 0.004 inch).
- If the clearance is not within the specification, the adjustment must be repeated per the previous adjustment.

85111377



W2005815

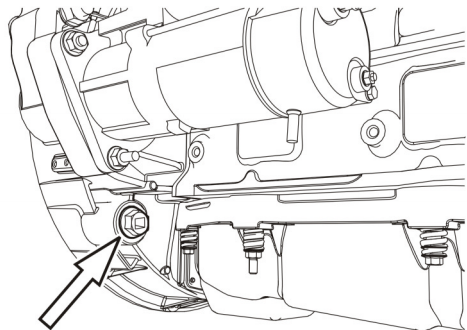
33

Recheck valve clearance after the locknut is tightened.

Note: Mark the rocker arm when the valve has been adjusted.

34

Repeat the above procedure to adjust all other unit injectors and valve locations by rotating the engine to the next nearest camshaft mark.



W0002368

35
Adjust the inlet, exhaust and unit injectors using the pattern outlined in the chart below. Use the flywheel turning tool (88800014) to advance the engine to the next setting.

Valve and Injector Settings

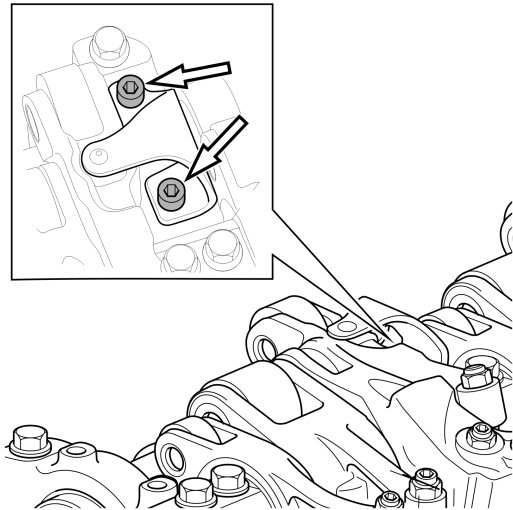
Cam Position	Injector	Intake/ Exhaust	Exhaust (VEB)	VEB Rocker
5	X	X		
E6			X	X
3	X	X		
E2			X	X
6	X	X		
E4			X	X
2	X	X		
E1			X	X
4	X	X		
E5			X	X
1	X	X		
E3			X	X

88800014

36
After all unit injectors and valves have been checked and adjusted if necessary, clean the valve cover contact surface on the cylinder head.

37
For engines with VEB, tighten the leaf spring retaining screws on the exhaust rocker arms to 25 ± 3 Nm (18 ± 2 ft-lb).

25 ± 3 Nm
(18 ± 2 ft-lb)



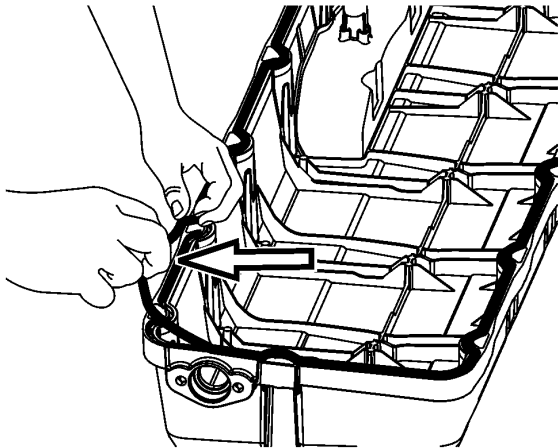
T2022951

38

Clean the gasket sealing surface of the valve cover and the cylinder head. The surfaces should be clear of any dirt or debris and free of any oil.

39

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.

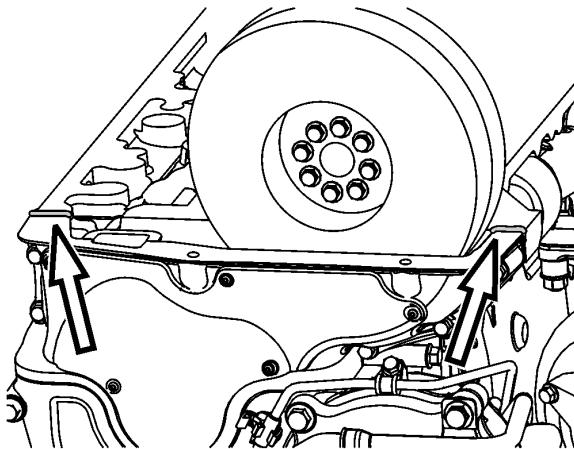


W2005162

40

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.



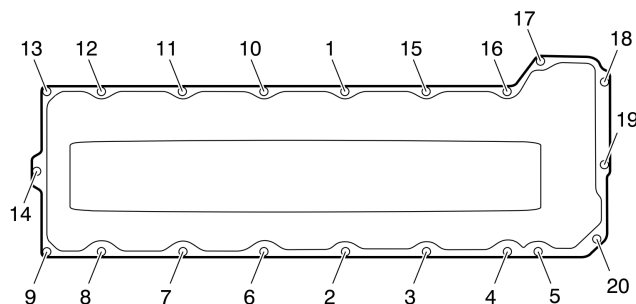
W2005157

41

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.

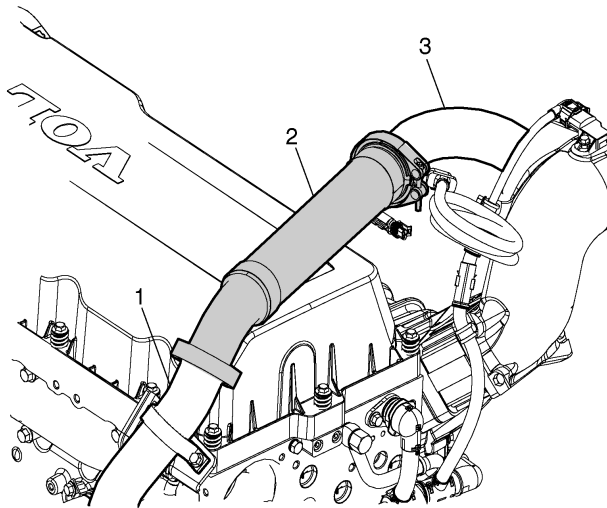
Note: The bolt springs provide even tension on the valve cover gasket.

Note: Install the engine cover if removed for clearance.



T2022732

24 ± 4 Nm
(18 ± 3 ft-lb)



W2005960

- 1 Venturi Outlet Pipe
- 2 Crossover Pipe
- 3 Mixer Inlet Pipe

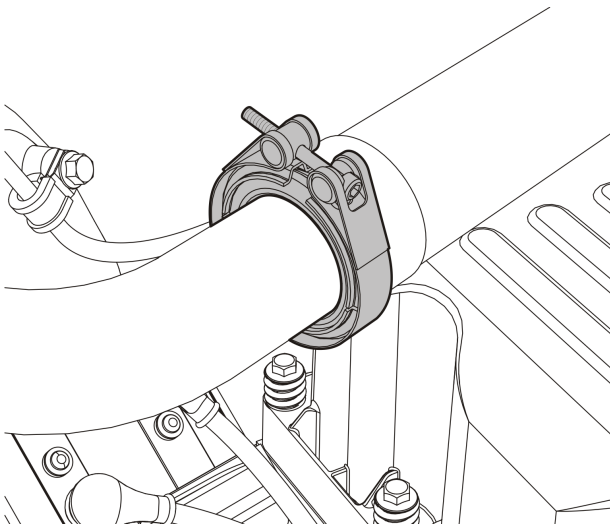
42

Inspect the crossover pipe V-band clamps for wear or damage, replace as necessary. Position the crossover pipe (with new O-rings) between the venturi outlet pipe and the mixer inlet pipe. Lubricate V-band clamp threads and v-inserts.

43

Secure the V-band clamp at each end of the crossover pipe and tighten the clamps to specification.

Note: Make sure the O-rings remain in place while positioning the pipe.



W2005804

44

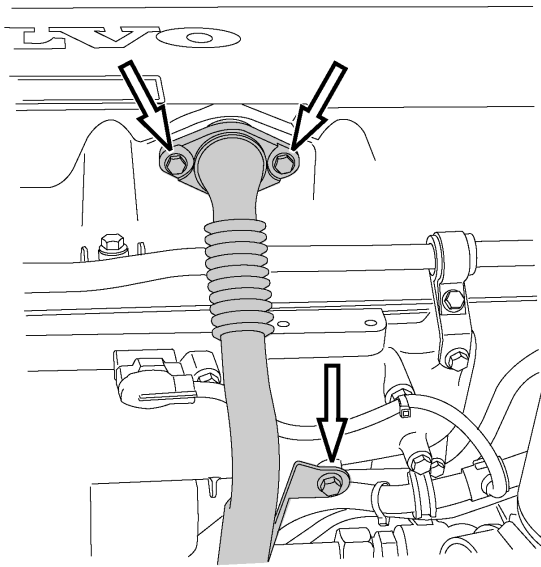
Remove the strap used to temporarily hold the air compressor discharge line. Connect the discharge line to the air compressor and secure the pipe mounting brackets to the cylinder head.

45

Install the air compressor fresh air pipe to the air compressor. Secure the mounting brackets to the cylinder head.

46

Install the aftertreatment fuel injector harness clips on the valve cover.



W2006122

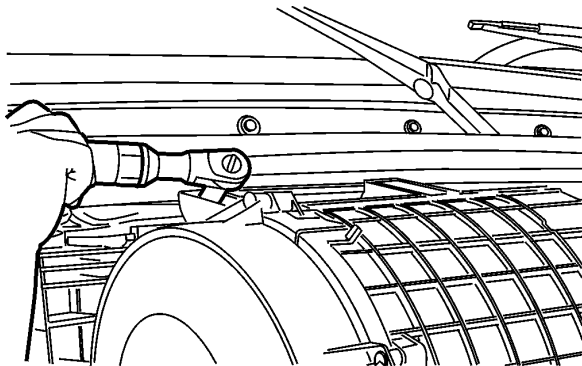
47

Install the fasteners securing crankcase ventilation tube and bracket to valve cover and intake manifold. Torque-tighten fasteners to 24 ± 4 Nm (18 ± 3 ft-lb).

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

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

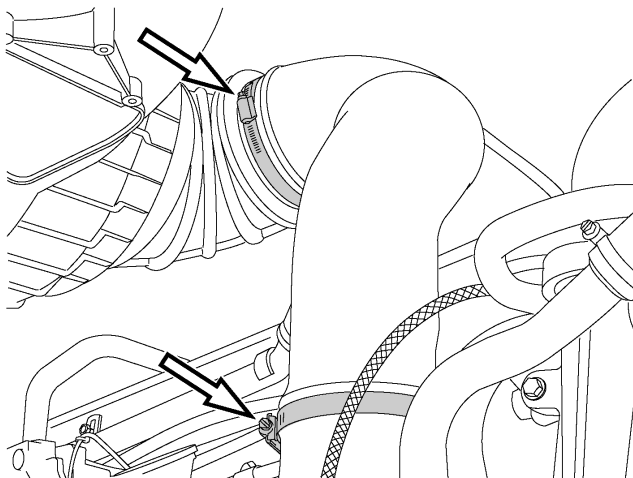
24 ± 4 Nm
(18 ± 3 ft-lb)



W2003858

48

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



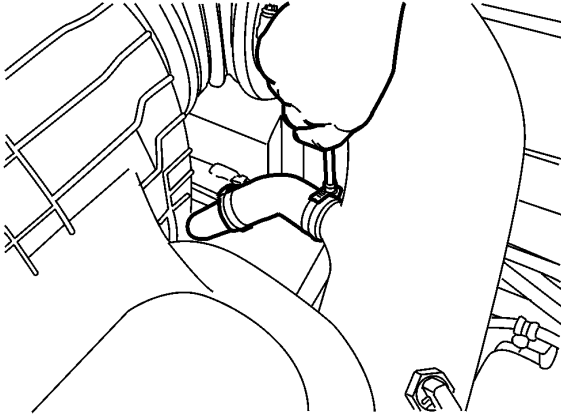
W2006005

49

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

50

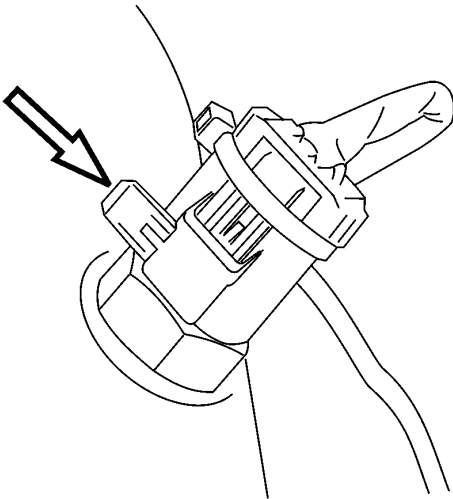
Install the air compressor fresh air hose to the main fresh air pipe, position the clamp and tighten to secure.



W2004719

51

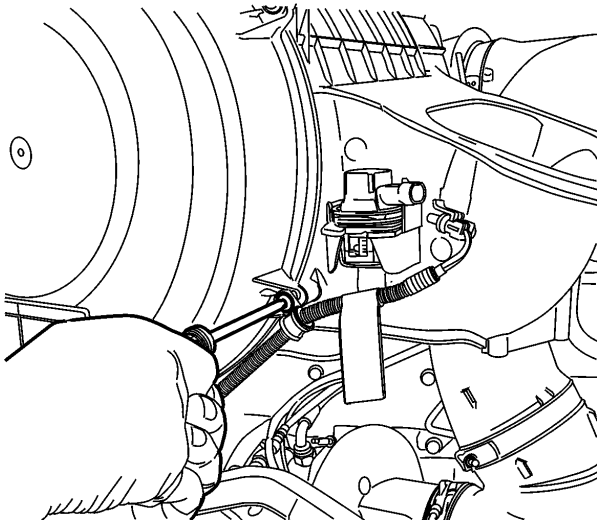
Install the air temperature sensor connector to the sensor. Insert and secure the connector lock tab. Install the sensor harness clamp to the main fresh air pipe.



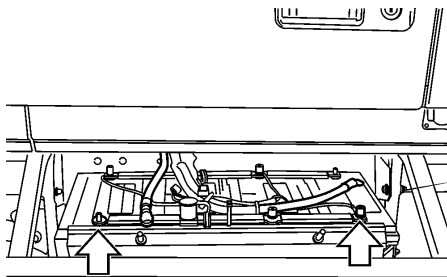
W2004720

52

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



W2003861



W2003815

53

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

54

Start the engine, check for leaks and proper operation.

55

Bring the engine to normal operating temperature. Let the engine idle for approximately 5 minutes; the system performs its own cylinder balancing in order to attain even idling.

Note: During cylinder balancing, do not use any form of power-consuming equipment, such as power take-off or air conditioning.