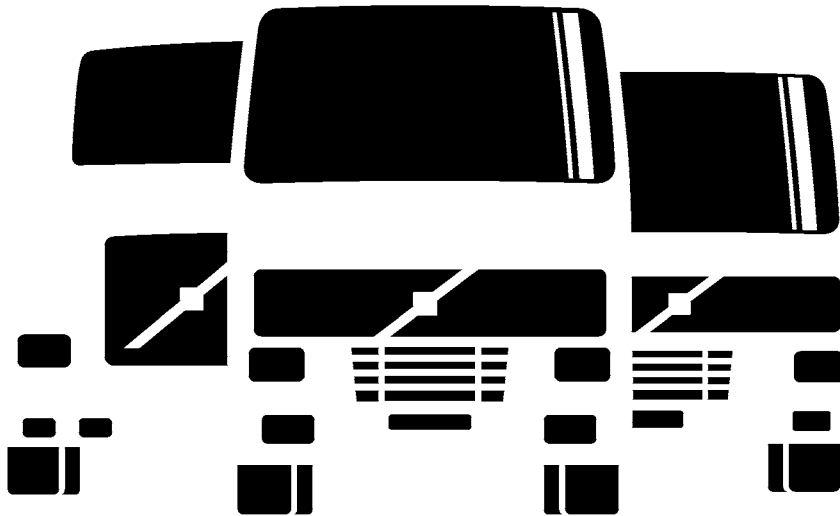


Service Manual Trucks

Group **250–600**

Intake and Exhaust System
D12, D12A, D12B, D12C



Foreword

The descriptions and service procedures contained in this manual are based on designs and methods studies carried out up to August 2000.

The products are under continuous development. Vehicles and components produced after the above date may therefore have different specifications and repair methods. When this is believed to have a significant bearing on this manual, supplementary service bulletins will be issued to cover the changes.

The new edition of this manual will update the changes.

In service procedures where the title incorporates an operation number, this is a reference to an S.R.T. (Standard Repair Time).

Service procedures which do not include an operation number in the title are for general information and no reference is made to an S.R.T.

The following levels of observations, cautions and warnings are used in this Service Documentation:

Note: Indicates a procedure, practice, or condition that must be followed in order to have the vehicle or component function in the manner intended.

Caution: Indicates an unsafe practice where damage to the product could occur.

Warning: Indicates an unsafe practice where personal injury or severe damage to the product could occur.

Danger: Indicates an unsafe practice where serious personal injury or death could occur.

Volvo Trucks North America, Inc.
Greensboro, NC USA

Order number: PV776-TSP144524

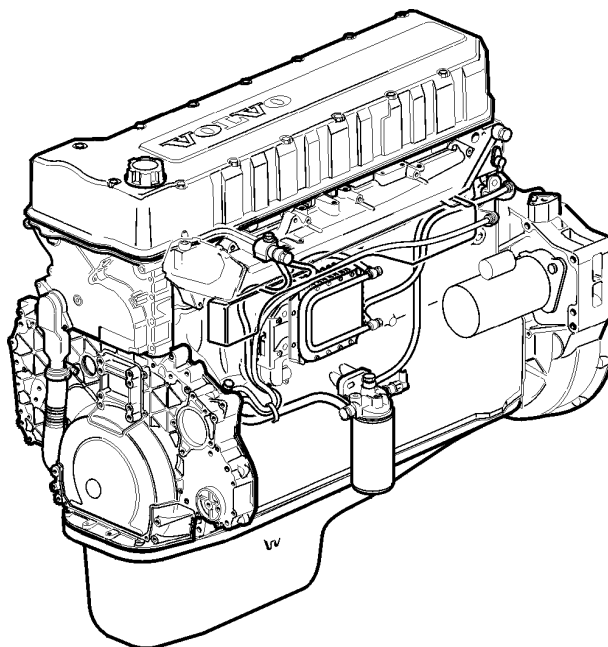
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General



D12C Engine

W2003244

This information covers the Intake and Exhaust System for the D12, D12A, D12B, and D12C engines.

Specifications

Intake and Exhaust System

Maximum Restriction (Rated speed full load) 6.2 kPa (H₂O) (25 in.)

Air Cleaner torque

Plastic 9 ± 2 Nm (7 ± 2 ft-lbs)

Metal 20 ± 2 Nm (15 ± 2 ft-lbs)

For Specifications, including torques, refer to:

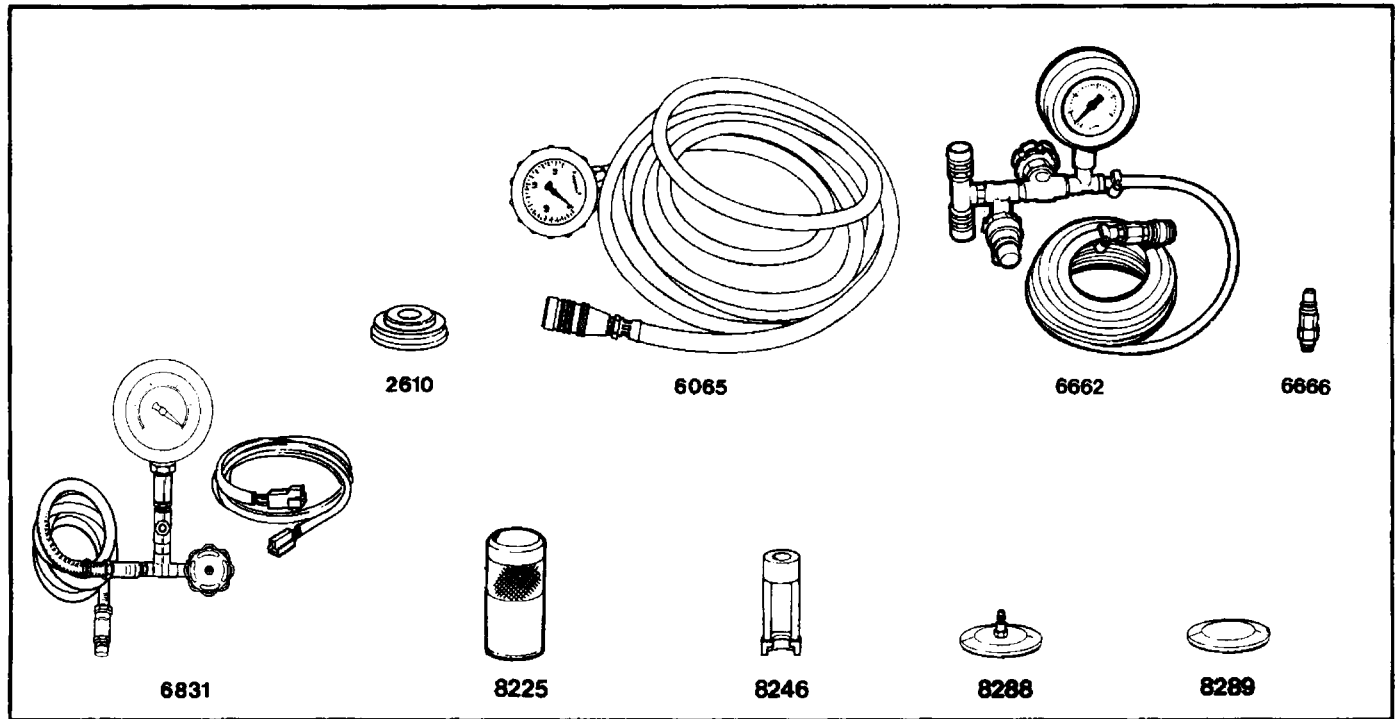
Service Manuals 200–890, Specifications, D12C
 200–850, Specifications, D12B
 200–820, Specifications, D12A

IMPACT Function Group 25
 Info Type: Specifications

Tools

Special Tools

Servicing the VE D12 intake and exhaust systems requires the following special tools. The tools are available from parts departments of Volvo Trucks North America, Inc. When requesting tools, provide the appropriate number, preceded by "999", for example, 9992610.



9992610 Drift for overhauling exhaust pressure governor

9996065 Gauge for checking boost pressure

9996666 Union for checking boost pressure

9996662 Pressure gauge

9996831 Vacuum gauge for checking pressure drop indicator

9998225 Hollow drift for overhauling exhaust pressure governor

9998246 Drift for overhauling exhaust pressure governor

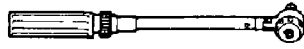
9998288 Connecting washer for leakage test of charge air cooler

9998289 Sealing washer for leakage test of charge air cooler

W0000406

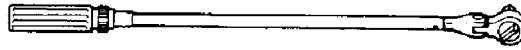
Special Equipment

Like the special tools, the following are available from the parts department of Volvo Trucks North America, Inc.. When requesting tools, provide the appropriate part number.



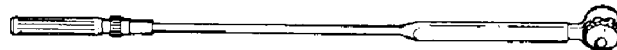
W0001840

1159794 Torque wrench 10–100 Nm (7–73 ft-lb)



W0001841

1159795 Torque wrench 40–340 Nm (30–250 ft-lb)



W0001842

1159796 Torque wrench 150–800 Nm (110–590 ft-lb)

Design and Function

Intake and Exhaust System

Preheater

Selected versions of the D12 are equipped with a preheater. Its purpose is to warm air in the intake manifold when starting the engine. This heated air eases starting at very low temperatures and reduces engine smoking when starting a cold engine. The following conditions are required to engage the preheater:

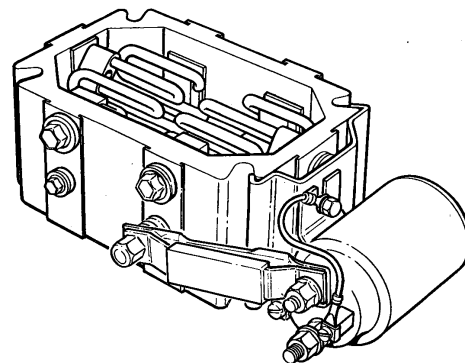
- The parking brake must be applied.
- The power take-off must not be engaged.

The preheater does not engage at coolant temperatures over 10°C (50°F). At a coolant temperature of 10°C (50°F), the preheating time is 25 seconds. At coolant temperatures below -15°C (5°F), the preheating time is 55 seconds. Preheating time increases linearly between 10°C (50°F) and -15°C (5°F).

The post-heating time is always the same as the pre-heating time.

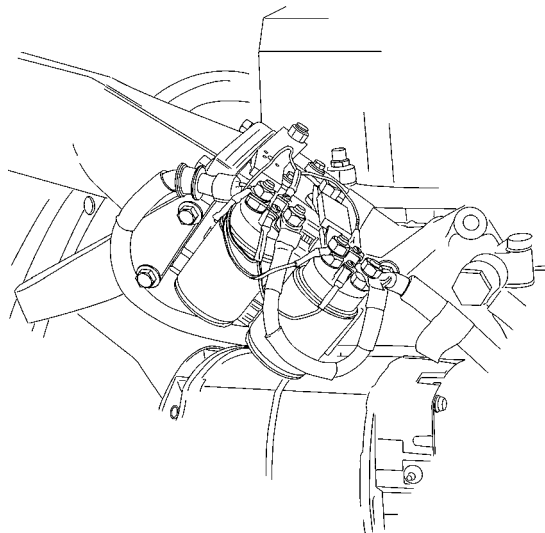
D12C

The D12C is equipped with a new preheater. The function of the starting heater is similar for both vehicle variants, but the location of the relay differs. The preheater on both engine variants is grounded to the engine block through the intake manifold.



T2006975

Fig. 1: Preheater



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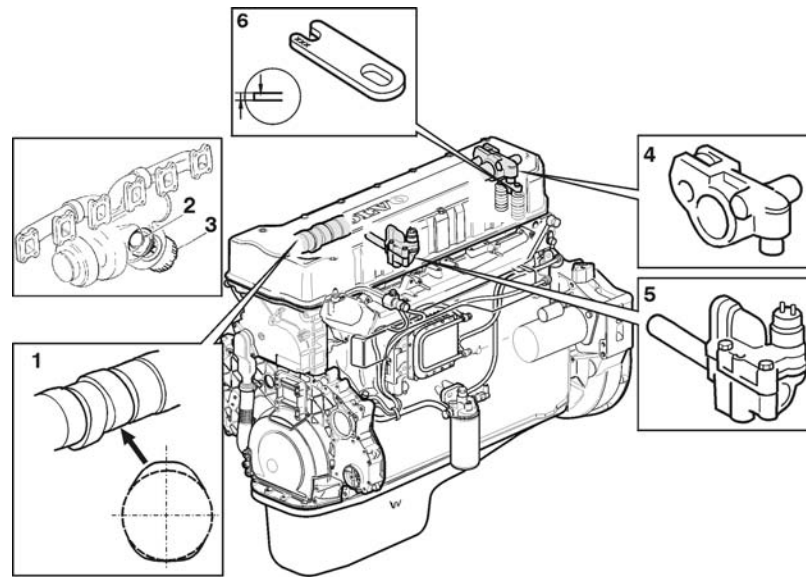
Fig. 2: Preheater, D12C

Engines without Preheater

On engines not equipped with a preheater, engine coolant temperature determines the point at which fuel injection begins while starting. The crankshaft rotates an extra number of turns to increase cylinder temperature before fuel injection begins. This gives more reliable starting and reduces exhaust emissions during cold starts down to about -15°C (5°F). This means that the crankshaft may need to rotate about 3–4 rotations before fuel injection begins and the engine fires.

An exhaust pressure governor is activated during start-up.

Engine Brake



W2003501

Fig. 3: D12 Engine

- | | | | |
|---|---------------------------|---|---------------|
| 1 | Camshaft | 4 | Rocker arm |
| 2 | Shutter | 5 | Control valve |
| 3 | Exhaust pressure governor | 6 | Shim |

The Volvo Engine Brake (VEB) is a combination of two brake systems: the exhaust brake and the compression brake.

Exhaust brake

The exhaust pressure governor uses a shutter mounted in the exhaust outlet from the turbocharger. This shutter, connected to the exhaust pressure governor plunger, can restrict the exhaust gas flow. This creates a braking effect during the exhaust stroke when the exhaust gases cannot evacuate freely and create an overpressure between the pistons and the shutter.

Compression brake

During the engine compression stroke and combustion (operating) stroke, the controlled opening of the exhaust valves creates an overpressure in the combustion chamber. This, in turn, produces a braking effect on the crankshaft.

The camshaft on an engine with a compression brake has two extra lobes on each exhaust cam profile. The lifting height of the extra lobes is very low when compared to the normal exhaust lobes. To enable the extra lobes to open the exhaust valves, the exhaust rocker arms are arranged in a manner by which the valve clearance can be reduced during the braking sequence.

Shim Shims are available in thickness intervals of 0.05 mm (0.002 in). Sizes range from 2.0–2.4 mm (0.08–0.094 in) and from 3.2–3.95 mm (0.126–0.156 in). Thickness is stamped on the shims.

D12C

The VEB solenoid has been moved to the center of the rocker shaft. The oil supply is internal, rather than having the external piping visible.

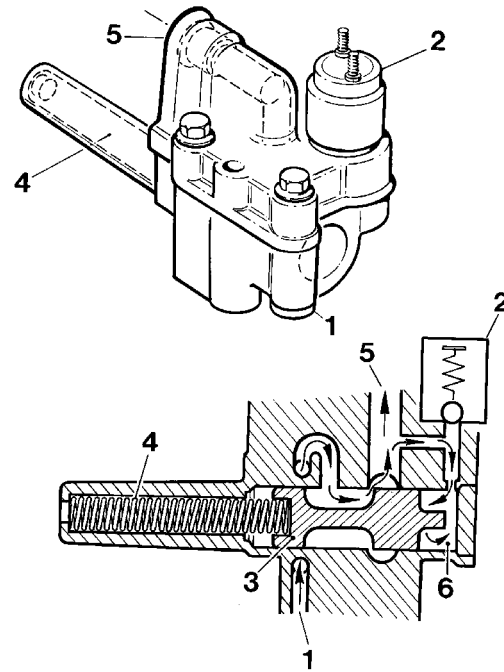
Control Valve

The control valve is mounted on the cylinder head under the valve cover, and is connected to the oil system ahead of the rocker arm shaft. Its purpose is to reduce the oil pressure to the rocker arms while the engine is operating (compression brake not activated).

There is always full system oil pressure to the control valve intake (1) because the intake is connected via a pipe to the lube oil gallery in the cylinder block. The oil pressure to the rocker arm shaft can be increased via a solenoid valve (2) mounted on the control valve, from approximately 100 kPa (14.5 psi) while the engine is operating, to more than 200 kPa (29 psi) during compression braking.

While the engine is operating, the oil pressure is reduced after the control valve by the plunger (3) being held in balance by the force of a spring (4) and the oil pressure in the oil chamber (6) on the opposite side of the plunger.

When the solenoid valve is activated, the oil chamber (6) is drained and the spring (4) presses the plunger (3) to its end position. The plunger completely opens the oil outlet (5) to increase oil pressure to the rocker arm shaft.



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Fig. 4: Control Valve

- 1 Oil inlet
- 2 Solenoid valve
- 3 Plunger
- 4 Spring
- 5 Oil outlet
- 6 Oil chamber

Camshaft on Engine with Compression Brake

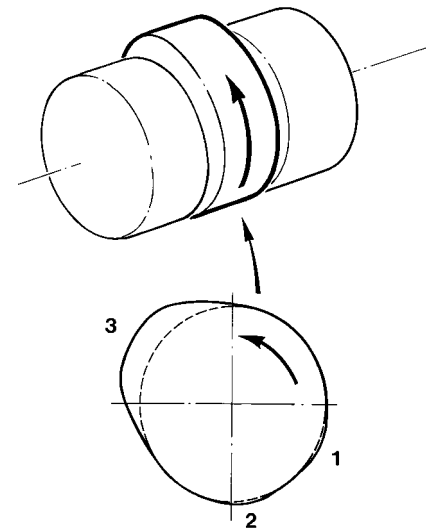
The camshaft on an engine with a compression brake has an induction lobe (1) and a decompression lobe (2) — in addition to the normal exhaust lobe (3) — on each cam profile for the exhaust valves.

The induction and decompression lobe lifting height is 0.8 mm (0.032 in.) above the basic circle, which is equivalent to approximately 1.1 mm (0.043 in.) at the valve bridge.

The induction lobe is positioned so that it opens the exhaust valves at the end of the intake stroke and holds them open until the beginning of the compression stroke.

The decompression lobe is positioned so that it opens the exhaust valves at the end of the compression stroke.

In order for the induction and decompression lobes to open the exhaust valves, the valve clearance must be reduced to zero by the activation of the non-return valve and plunger located in the rocker arm for the exhaust valves.



T2006826

Fig. 5: Cam Shaft Profile

- 1 Induction lobe
- 2 Decompression lobe
- 3 Exhaust lobe

Exhaust Rocker Arms

The exhaust rocker arms on an engine with a compression brake are larger than those on a conventional engine.

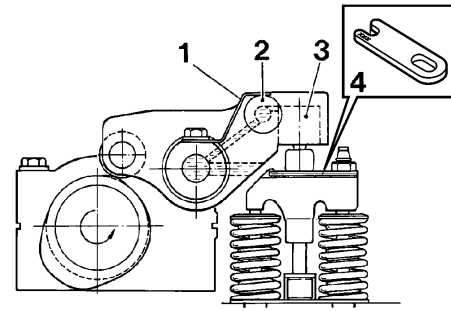
The rocker arm includes a non-return valve (2) and a plunger (3) with a pressure limiting valve, the purpose of which is to regulate the oil flow during compression braking.

The rocker arm is held in its position against the valve bridge with the help of a spring tab (1).

The valve clearance is greater than that on an engine without a compression brake, because the induction and decompression lobes must not open the exhaust valves while the engine is in normal operating mode (compression brake not activated).

Valve adjustment is carried out with shims which are placed on the valve bridge.

Note: A maximum of two shims are allowed to obtain proper valve clearance.



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Fig. 6: Rocker arm assembly, side view:

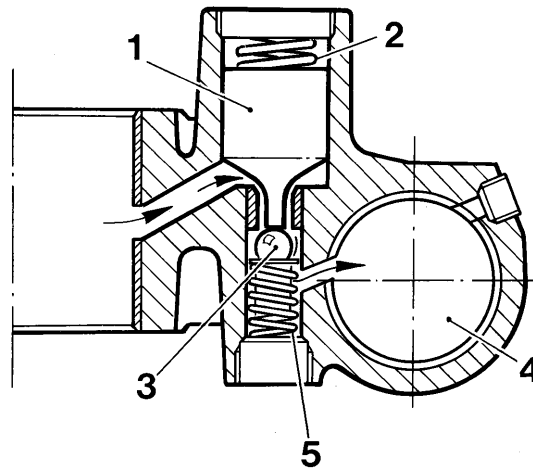
- 1 Spring tab
- 2 Non-return valve
- 3 Rocker arm plunger
- 4 Shims

Non-Return Valve

The engine brake has a non-return valve, consisting of a plunger (1), spring (2) and a ball (3) in the rocker arm. When oil from the rocker arm shaft enters the valve, the movement of the plunger is determined by the spring force and the oil pressure.

When the oil pressure is low — approximately 100 kPa (14.5 psi); the control valve is in its normal engine operating position — the plunger (1) will not move out of its rest position because the oil pressure is not sufficient to overcome the spring force. The plunger pin prevents the ball (3) from entering the seating area, and the oil can then flow freely through the valve in both directions.

When the control valve takes up the position for compression braking, the oil pressure increases to the non-return valve. The spring force in the non-return valve is such that when the oil pressure exceeds approximately 200 kPa (29 psi), the spring force is overcome and the plunger (1) moves so that it no longer influences the ball (3). The spring (5) presses the ball (3) against the seat and prevents the oil contained above the plunger (4) from flowing past the ball (3). This forms high oil pressure above the plunger (4).



T2006834

Fig. 7: Rocker arm assembly, top view:

- 1 Plunger
- 2 Spring
- 3 Ball
- 4 Rocker arm plunger
- 5 Spring

Rocker Arm Plunger

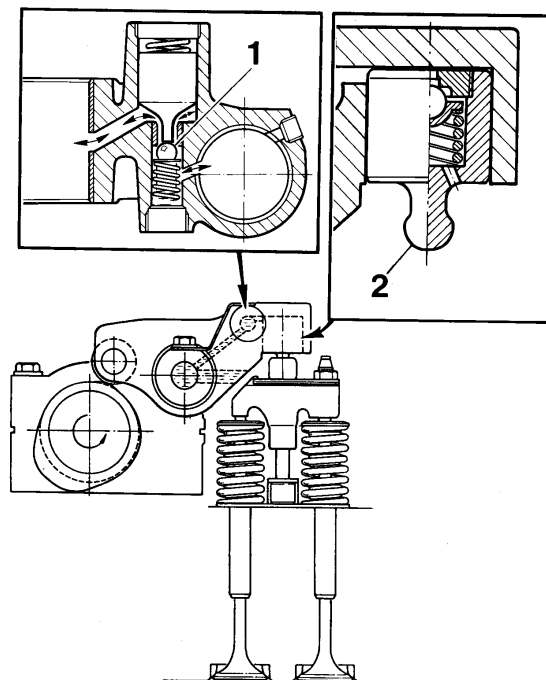
The purpose of the rocker arm plunger is to eliminate all valve clearance during the compression braking.

Engine Operation

When the engine is operating (compression brake not activated), there is reduced oil pressure — approx. 100 kPa (14.5 psi) — via the control valve to the rocker arm shaft and the rocker arm non-return valve (1) is open. Oil can flow freely through the non-return valve in both directions. As a result, no oil pressure is built up between the rocker arm plunger (2) and the rocker arm.

The set valve clearance is great enough to prevent the camshaft induction and decompression lobes from opening the exhaust valves.

The valve mechanism operates the same as on an engine without a compression brake; in other words, only the exhaust lobe opens the exhaust valves.



T2006828

Fig. 8: Rocker Arm Plunger

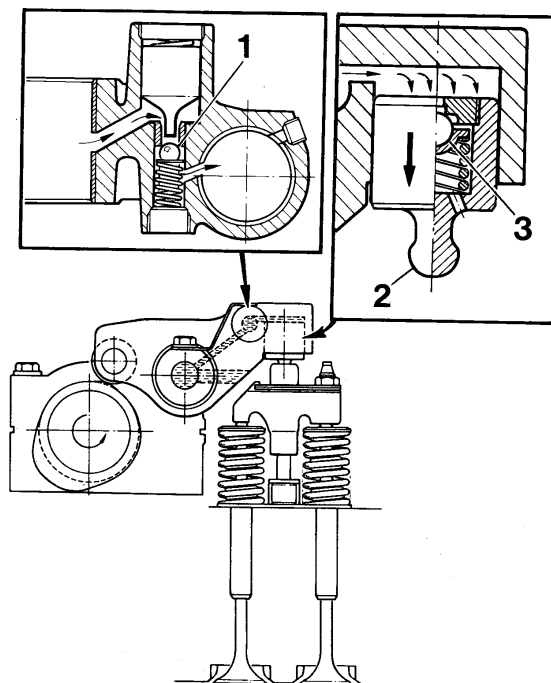
- 1 Non-return valve
- 2 Rocker arm plunger

Compression Braking

During compression braking, the control valve does not reduce the oil pressure, so an oil pressure of at least 200 kPa (29 psi) is delivered to the rocker arm shaft.

The pressure in the rocker arm non-return valve (1) becomes so great that the plunger in the non-return valve is moved out of its rest position, and the ball now functions as a non-return valve. Pressure is built up between the rocker arm plunger (2) and the rocker arm. The plunger is pressed out and presses the rocker arm roller against the lobes on the camshaft. In this way, the valve clearance is eliminated and the lifting height on the induction and decompression lobes is sufficient to open the exhaust valves.

The rocker arm plunger is fitted with a pressure limiting valve (3). When the oil pressure between the rocker arm plunger and the rocker arm becomes too great, the pressure limiting valve opens and oil can exit through the hole in the bottom of the plunger. The opening pressure of the pressure limiting valve is governed by the force of the valve spring.



T2006836

Fig. 9: Rocker Arm Plunger

- 1 Non-return valve
- 2 Rocker arm plunger
- 3 Pressure limiting valve

Control System

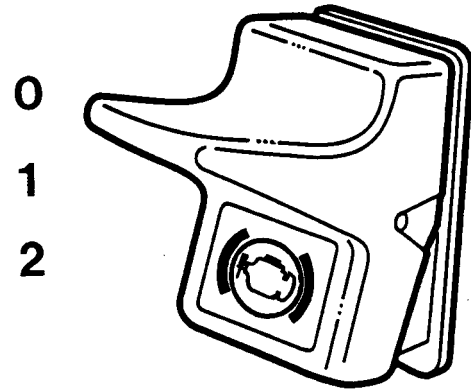
The engine brake is connected to the throttle pedal and is activated when the pedal is completely released, according to the selection made with the engine brake switch on the instrument panel.

The selection made with this switch also regulates engine braking activated by the cruise control.

Note: The engine brake functions as long as the engine control system has received signals from engine sensors indicating that the required preconditions for engine braking have been met. For example, the engine speed must be greater than 1100 rpm, the vehicle speed must be greater than 12 km/h (7.5 mph), and the engine temperature must be above 70° C (160° F).

The switch has three positions:

- 0 No engine brake engaged
- 1 Exhaust brake, EPG
- 2 Exhaust brake and compression brake, VEB



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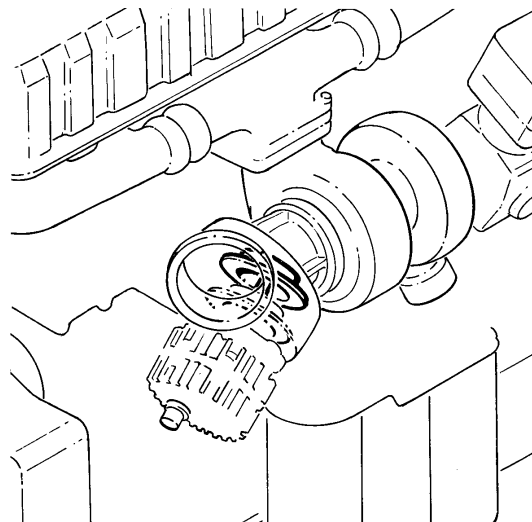
Fig. 10: Switch for engine brake

Exhaust Brake

When exhaust braking, the exhaust pressure governor (EPG) is activated with a control pressure of approximately 750 kPa (110 psi). At this point, the shutter is forced out of the EPG and into the shutter housing. This restricts the flow of exhaust gases out of the cylinders, as the shutter blocks the outlet from the turbocharger.

Restricting the flow of exhaust gases forms an air cushion between the shutter and the piston crowns. During the exhaust stroke, this air cushion provides a braking effect on the pistons as the exhaust valves are then opened.

The higher the engine speed during the exhaust braking, the greater the braking effect.



T2006832

Fig. 11: Exhaust pressure governor

Compression Brake

The exhaust brake is always engaged in conjunction with the compression brake. In the compression brake induction phase, the exhaust brake creates an overpressure in the exhaust manifold, making the compression brake more efficient.

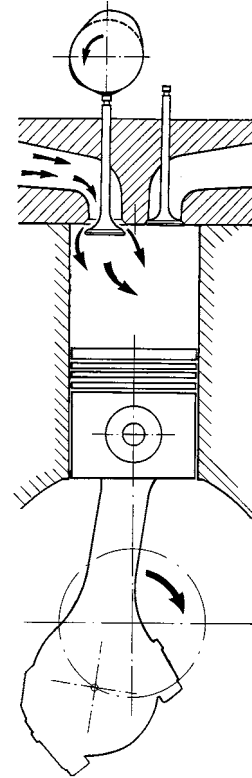
Induction phase

The induction phase begins at the end of the intake stroke and continues slightly into the compression stroke.

The piston travels towards its bottom dead center position and the camshaft induction lobe opens the exhaust valves for the time required to fill the cylinder with the overpressure created by the exhaust brake in the exhaust manifold.

When the induction lobe closes the exhaust valves, the cylinder has an overpressure at the start of the compression stroke.

This overpressure considerably increases the compression during the compression stroke, which in turn creates a powerful braking effect during the upward movement of the piston.



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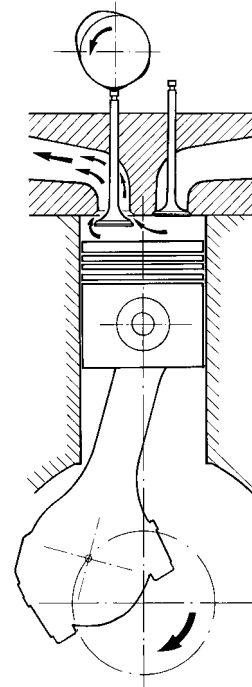
Fig. 12: Charging phase

Decompression phase

At the end of the compression stroke, when the piston is nearing its top dead center position, the camshaft decompression lobe opens the exhaust valves and releases the pressure out of the cylinder.

Shortly before the bottom dead center position, the exhaust valves are opened by the ordinary exhaust lobe.

During the exhaust stroke, the counterpressure is created in the exhaust manifold which, in turn, has a braking effect because the exhaust pressure governor shutter is still restricting the flow of exhaust gases out of the turbocharger.



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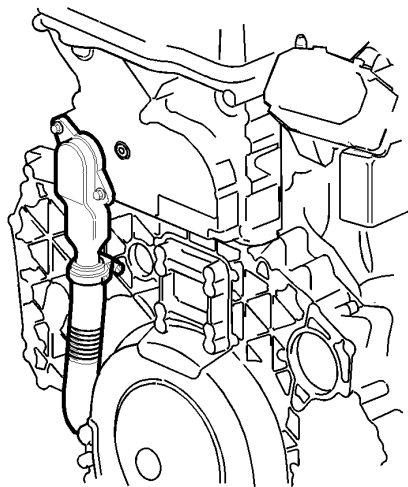
Fig. 13: Decompression phase

Crankcase Ventilation

D12C

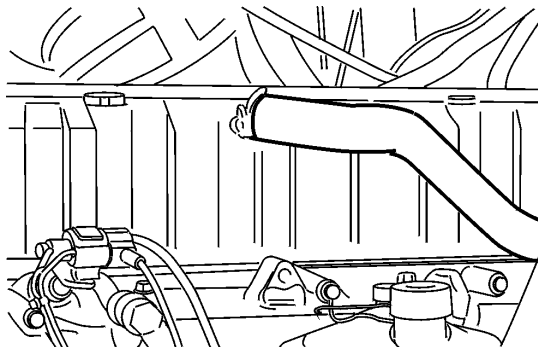
The D12C has new crankcase ventilation with its outlet from the upper timing gear cover.

The timing gear cover is designed with an oil trap to prevent oil from escaping through the ventilation tube.



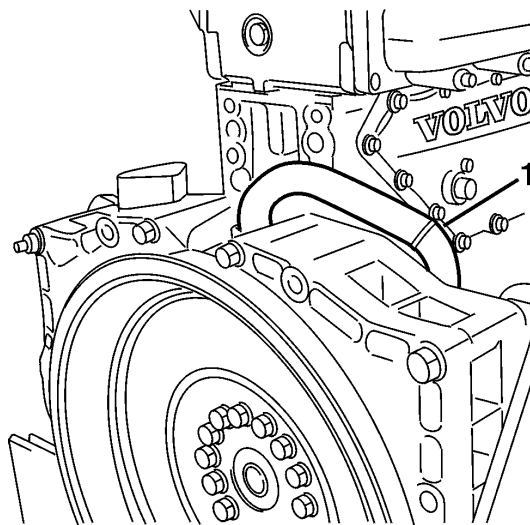
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Fig. 14: Crankcase Ventilation, D12C



W2003503

Fig. 15: Crankcase Ventilation, D12B and D12C



W2003504

Fig. 16: Crankcase Ventilation, D12A

Exhaust Pressure Governor

The exhaust pressure governor (EPG) acts as an exhaust brake when slowing the vehicle down. It also speeds engine warm-up by applying a load to the engine during idle and warm-up. Engine load is created by the (EPG) throttling the flow of exhaust gases, causing the engine to work against a backpressure. This increases combustion temperature and shortens the warm-up period.

On engines without a pre-heater, the (EPG) is activated before the starter motor is engaged. For engines with a pre-heater, the (EPG) is activated after pre-heating, start-up and post-heating have taken place.

The (EPG) is activated by a control pressure of about 200 kPa (29 psi), by a combi relay when it is used during starting and warm-up. When used for engine braking, the exhaust pressure governor is controlled by a single two-position switch if the engine is equipped with an exhaust brake only, and by dual two-position switches if the engine is equipped with a Volvo Engine Brake, or VEB (both exhaust brake and compression brake).

Engines with Exhaust Brake Only

Two-position switch (**ON/OFF**)

With the switch in the **ON** position, the exhaust pressure governor is activated by a control pressure of approx. 750 kPa (110 psi) subject to the following conditions:

- Accelerator pedal fully up.
- Clutch pedal fully up.
- Engine speed above 1100 rpm.
- Boost pressure below 52 kPa (7.5 psi).
- When using cruise control and preselected road speed is exceeded by 7 km/h (4 mph) (disengagement at 4 km/h (3 mph) over preselected speed).
- ABS not activated (continuous control).

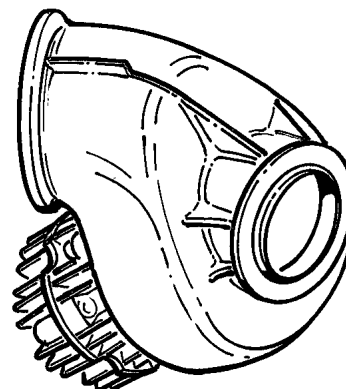


Fig. 17: Exhaust pressure governor (EPG)

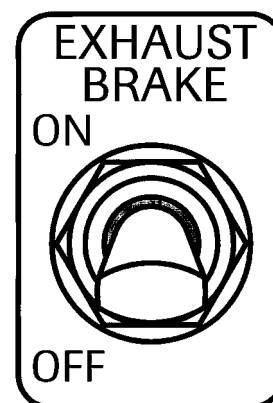


Fig. 18: Exhaust brake switch for WX, WG and AC

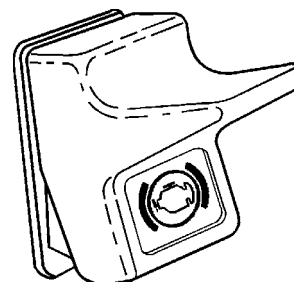


Fig. 19: Exhaust brake switch for VN/VHD

Engines with VEB

When the engine brake **ON/OFF** switch is in the **ON** position, the engine brake is activated according to the position of the engine brake HI/LO switch.

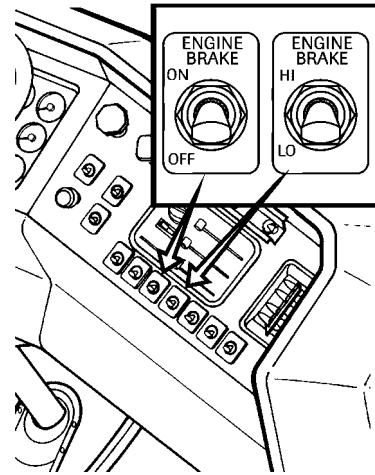
With the HI/LO switch in the **LO** position, only the exhaust pressure governor is activated and is subject to the same conditions as for engines with an exhaust brake only.

With the HI/LO switch in the **HI** position, the VEB is activated (both the exhaust pressure governor and compression brake are switched on).

In addition to satisfying exhaust brake prerequisites, the following conditions must be met:

- Coolant temperature above 70°C (158°F).
- Vehicle speed must be greater than 12 km/h (7.5 mph).
- Engine temperature must be above 43°C (110°F).

For VN/VHD, engine exhaust brake switches are located on the dash (5); see Fig. 21: Engine brake switches for VN/VHD, page 20.

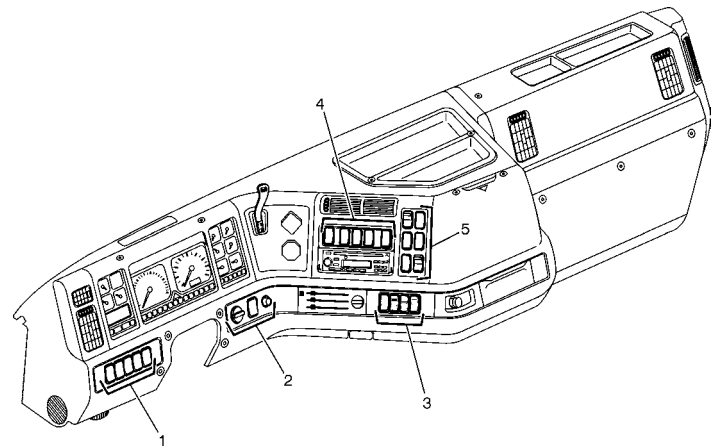


W2001002

Fig. 20: Engine brake switches for WG and AC

Dual two-position switches:

- 1 **ON/OFF**
- 2 **HI (VEB)/LO (exhaust brake)**



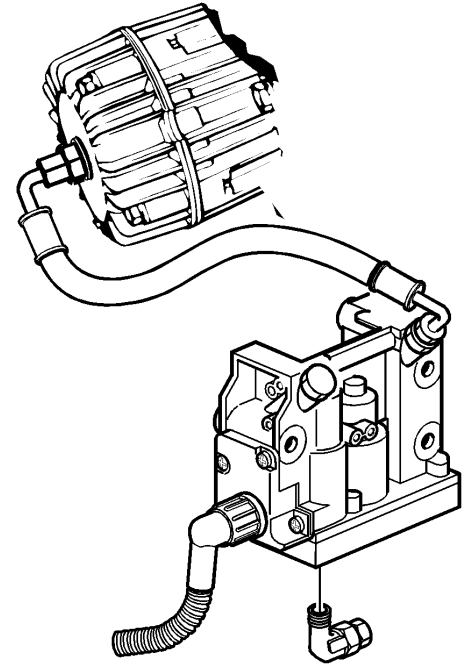
W3004361

Fig. 21: Engine brake switches for VN/VHD

- 1 Left Dash Switches
- 2 Driving Light Switches
- 3 Pneumatic Switches
- 4 Auxiliary Switches
- 5 Right Dash Switches

D12C

The EPG on the D12C has a new air valve. The valve is located on the right, rear edge of the engine block and is controlled by current from the EECU. There are two on/off valves and two reduction valves in the valve body.



T2012788

Fig. 22: Exhaust Pressure Governor, D12C

EPG Control Valve

The exhaust pressure governor is controlled by a valve that regulates air pressure to the EPG.

The exhaust pressure governor operates using two different pressures:

- When the exhaust pressure governor is activated during starting and keeping the engine warm, the control valve provides a control pressure of approximately 200 kPa (29 psi).
- When the exhaust pressure governor is activated for engine braking, the control valve provides a control pressure of approximately 750 kPa (110 psi).

D12A

The D12A is provided with two solenoid valves, one for controlling the starting and engine warming pressure and one for controlling the pressure for engine braking. Both solenoid valves are located in a bracket on the cylinder head.

D12B

The D12B is provided with an EPG control valve that controls both the starting and engine warming pressure, and the pressure for engine braking. The valve is located at the lower rear edge on the right-hand side of the cylinder block.

The EPG control valve on the D12B replaces the two solenoid valves on the D12A to perform the same function.

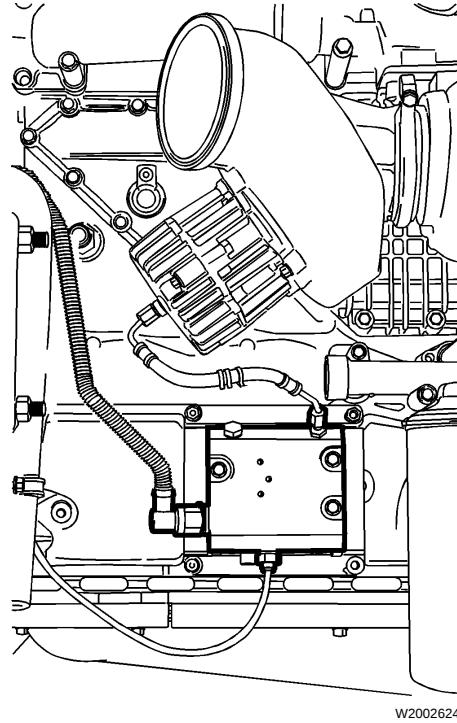


Fig. 23: EPG control valve, D12B

Air Restriction Indicator

There are several types of restriction indicators which can be mounted in certain locations, such as on the air cleaner duct or on/above the instrument panel. The air restriction indicator mounted on the instrument panel permits continuous monitoring of the gauge.

When either the flag or piston-type restriction gauge is mounted directly on the air cleaner, the piston is usually drawn downward into view as the element loads with dirt. It locks into full view only after the restriction (caused by a dirty element) reaches the rated value of the indicator.

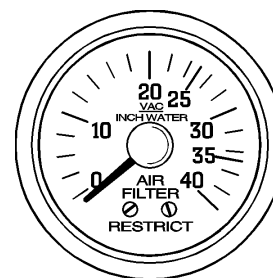


Fig. 24: Air restriction indicator WX, WG , AC(dash mounted)

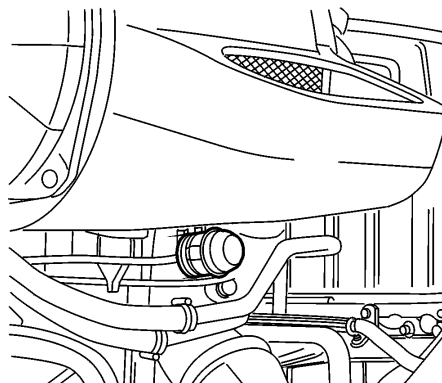


Fig. 25: Air restriction indicator VN, VHD, VNM (located beneath the air box)

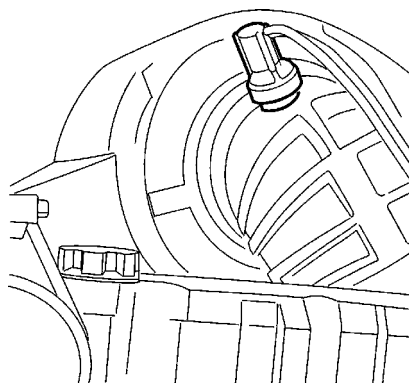


Fig. 26: Air restriction indicator VN, VHD (located on the air pipe)

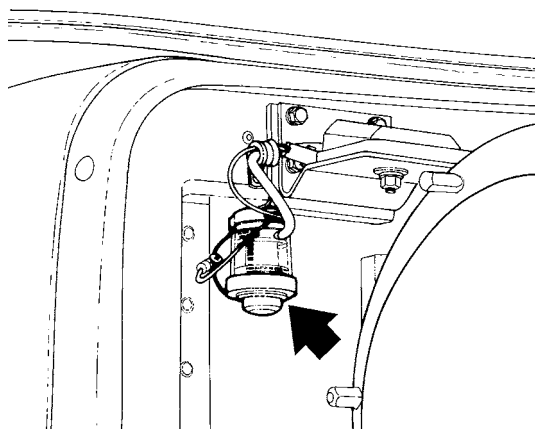


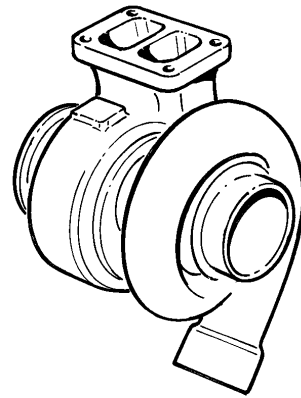
Fig. 27: Piston-type air restriction indicator-WG

Turbocharger

The turbocharger is driven by the exhaust gases from the engine passing through the turbine housing on their way out into the exhaust system.

The flow of exhaust gases causes the turbine wheel inside the turbine housing to rotate. On the same shaft as the turbine wheel is a compressor wheel. The compressor wheel is mounted in a housing which is connected between the air cleaner and the intake manifold.

When the compressor wheel starts to rotate, air is drawn in from the air cleaner, compressed and forced into the cylinders of the engine — but not before it has been cooled down after passing through the charge air cooler.



T2006949

Fig. 28: Turbocharger

D12A

The turbo used on the D12A engine is **NOT** interchangeable with turbos on other D12 engine versions.

Exhaust Manifold

New design of exhaust manifold sections

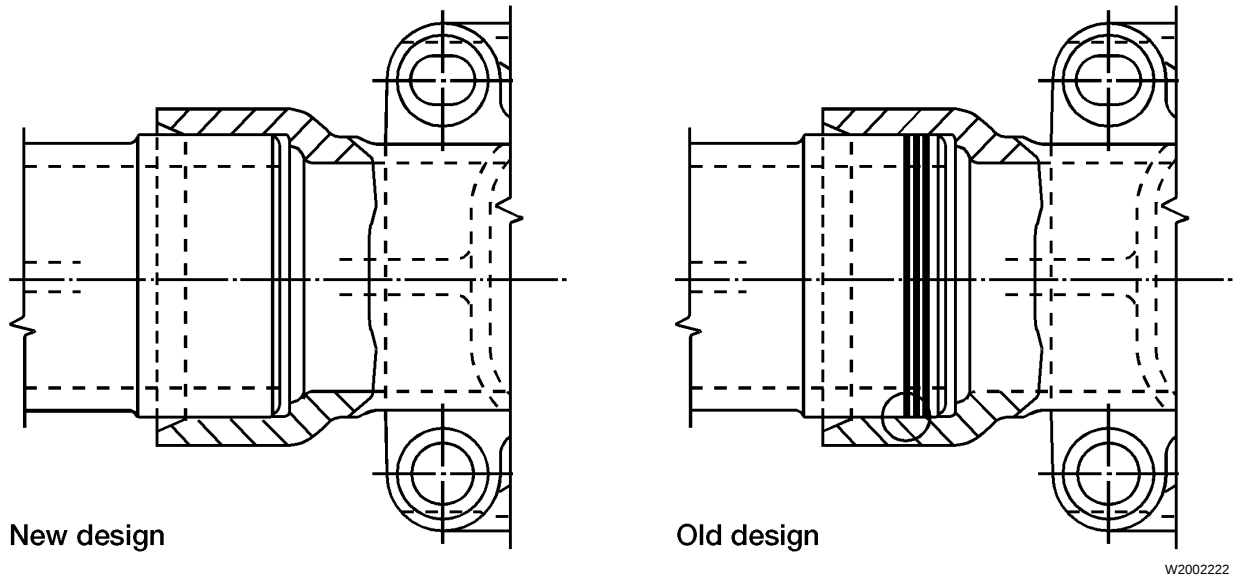


Fig. 29: Manifold designs

Description	New design P/N	Qty	Old design P/N	Qty
Side section	3964707	2	1547521	2
Middle section	3964708	1	1547520	1
Complete	3964706	1	1677205	1

Improved gasket

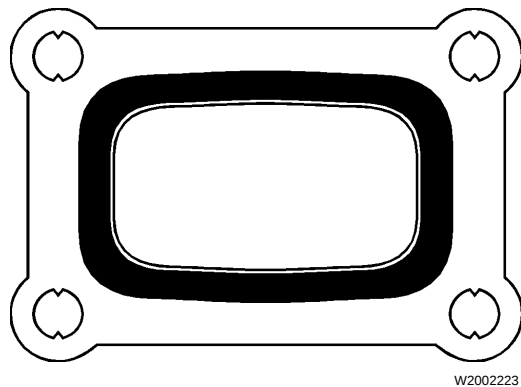
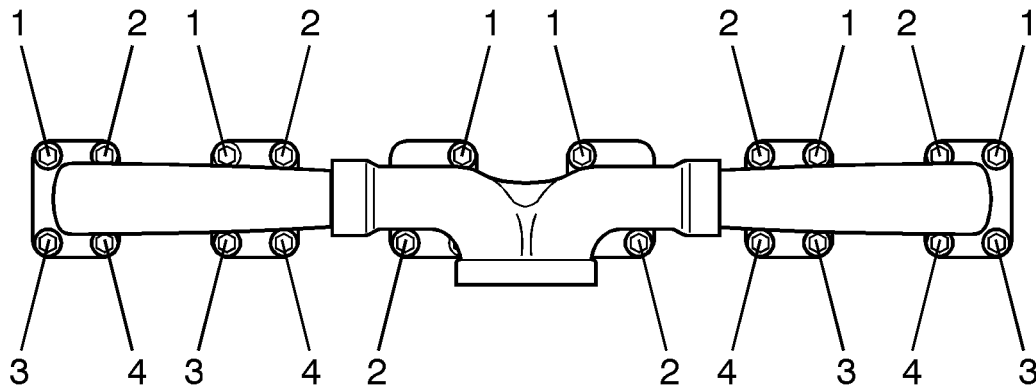


Fig. 30: Gasket

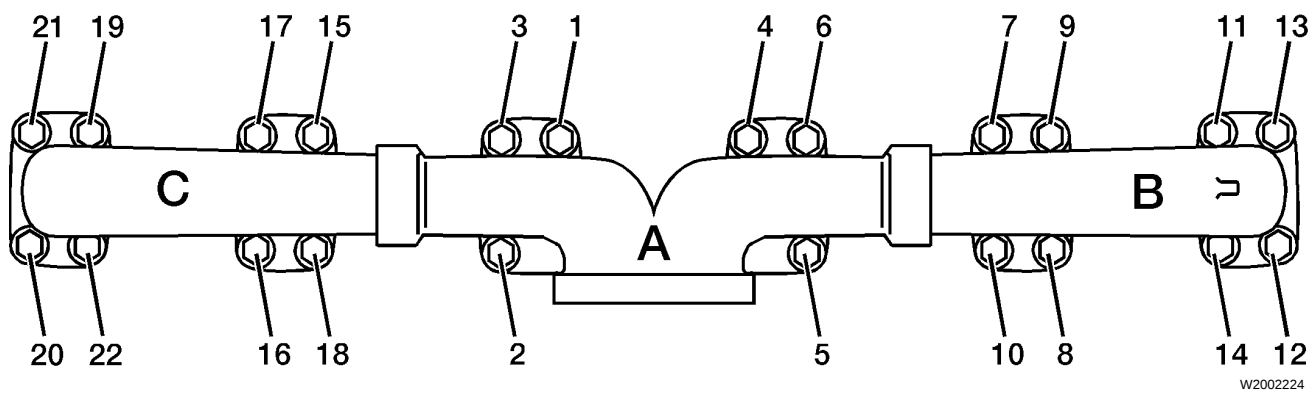
Note: The gaskets are marked "MANIFOLD SIDE" to aid in installation.

Tightening Sequence

Old Style Manifold.



New Style Manifold



W2002224

Troubleshooting

Air Restriction Indicator, Checking

Low restriction readings may be difficult to identify. They can result from a damaged element gasket, ruptured element, incorrectly installed element or a leak in the engine air intake ducts and piping. When servicing the air cleaner, make sure to check for these. A water manometer may also be used to check for service. A maximum of 25 in. of water (20 in. of water measured at air cleaner body outlet) is the limit of element service and indicates a need for replacement.

On turbocharged engines, connect the manometer to the air intake pipe, one to two pipe diameters upstream from the turbocharger inlet, in a straight section of pipe. Turbocharged engines should be under full load long enough to allow the turbocharger to reach maximum speed.

Note: Dust conditions and accumulated mileage determine the interval for replacing the air cleaner element. The air cleaner should be inspected every 24,000 km (15,000 miles) and replaced as necessary. The air cleaner element should be replaced at least once a year regardless of service or restriction indicator readings.

Service Procedures

2562-03-02-01**Air Filter Element, Replacement****DANGER**

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

**WARNING**

HOT ENGINE! Keep yourself and your test equipment clear of all moving parts or hot engine parts and/or fluids. A hot engine and/or fluids can cause burns or can permanently damage test equipment.

**CAUTION**

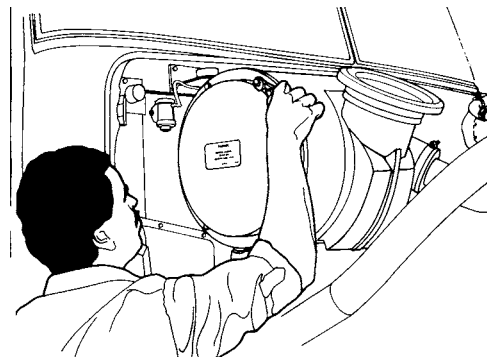
When removing and installing the intake manifold on engines equipped with VEB, keep the work area as clean as possible to prevent impurities from entering the oil system. This also applies to the compression brake oil delivery pipe between the cylinder block and intake manifold.

Removal**1**

Apply parking brakes. make sure the shift lever is in neutral.

2

Tilt hood.

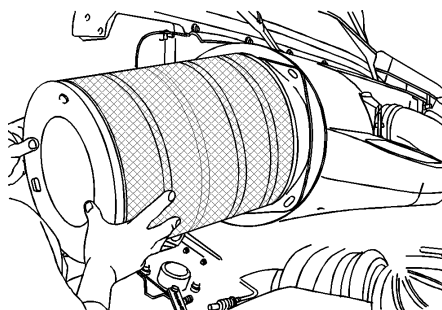
3

W2000940

Fig. 31: Removing the endcap,(WG, AC)

Remove the endcap by removing the hardware (depending on the type of endcap) that attaches the endcap to the air filter.

Note: The type of hardware used to hold the endcap varies, depending on the style of air cleaner and air cleaner assembly.

4

W2002051

Fig. 32: Removing the air filter (VN,VHD and VNM)

Remove the air filter.

5

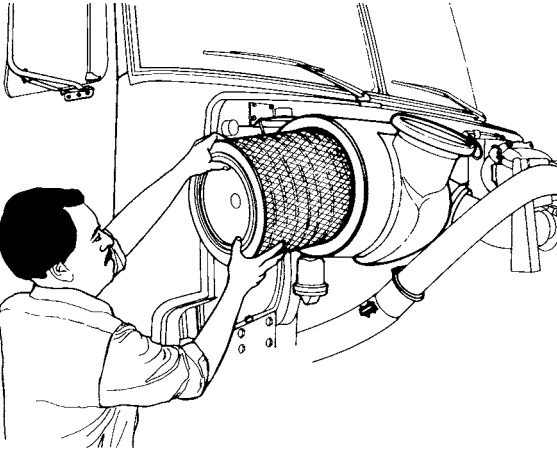


Fig. 33: Remove the air filter (WG, AC)

W2000941

Remove the element from the canister. If the element is held by a wing nut, remove the wing nut before removing the element.

Installation

6

Clean and inspect the inside of the housing and endcap.

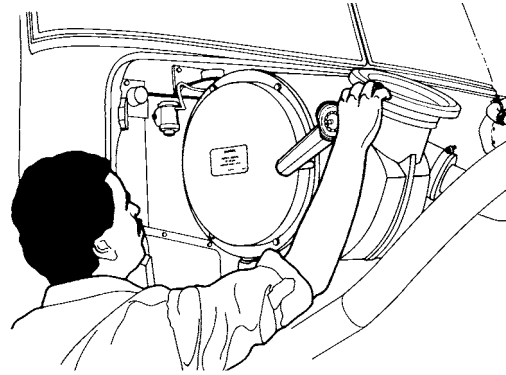
7

Lubricate the rear seal on the new filter with Vaseline or the like.

8

Install the new filter. Make sure that it is correctly positioned in the filter housing.

9



W2000746

Fig. 34: Endcap reinstall

Reinstall the endcap and attach, using the necessary hardware. Tighten to a torque of 24 ± 2 Nm (18 ± 2 ft-lb).

Note: Refer to the label attached inside the endcap on some models.

2512-03-02-01

Intake Manifold Gasket(s), Replacement



DANGER

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.



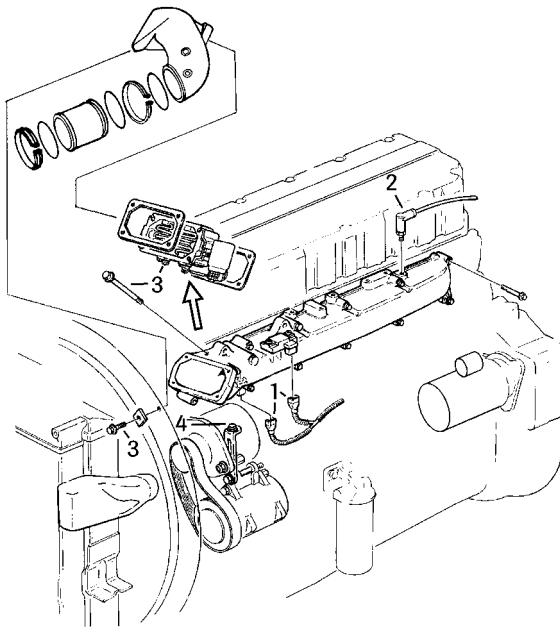
WARNING

HOT ENGINE! Keep yourself and your test equipment clear of all moving parts or hot engine parts and/or fluids. A hot engine and/or fluids can cause burns or can permanently damage test equipment.



CAUTION

When removing and installing the intake manifold on engines equipped with VEB, keep the work area as clean as possible to prevent impurities from entering the oil system. This also applies to the compression brake oil delivery pipe between the cylinder block and intake manifold.



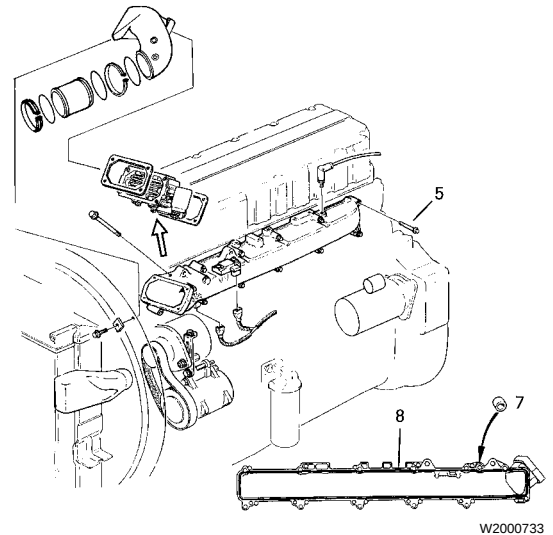
W2000732

Fig. 35: Replacing intake manifold gasket

Removal

- 1**
Remove the plastic ties from the electric cables under the intake manifold. Disconnect the terminals from the sensors for the charge air pressure and the charge air temperature on the intake manifold.
- 2**
Remove the boost pressure gauge connection from the intake manifold.
- 3**
Remove the bolt for the pre-heater, or the spacer, from the fan shroud bracket.
Remove the pre-heater, or the spacer, from the intake manifold and set aside.
- 4**
Loosen the alternator drive belt and remove the nut for the gear lever bracket. Remove the alternator.

5



W2000733

Fig. 36: Replacing intake manifold gasket

Remove the intake manifold bolts and carefully tap the manifold loose, using a plastic-headed mallet.

- 6**
Clean the sealing surfaces of the intake manifold and the cylinder head. Install a new gasket.

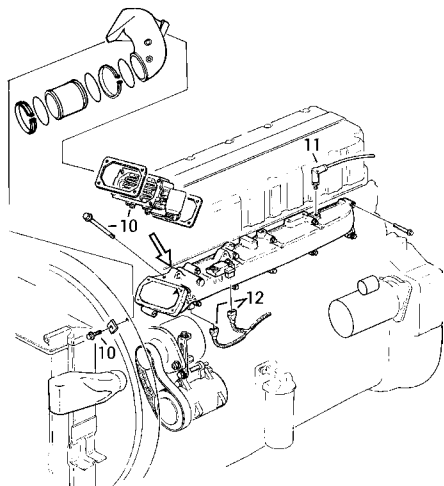
Installation

- 1**
Install a new seal on the compression brake oil duct.
- 2**
Apply a 2 mm (1/16 in.) bead of sealant to the intake manifold. The manifold must be installed and tightened within 20 minutes after applying sealant.

2 mm
(1/16 in.)

Note: Do not allow the sealant to enter the oil duct of the compression brake.

3



W2000734

Fig. 37: Replacing intake manifold gasket

Adjust the alternator, A/C refrigerant compressor, drive belt tension if so equipped.

4

Install the pre-heater (if equipped) or the spacer, using new gaskets, and bolt the mounting to the fan shroud.

5

Install the boost air gauge connections to the intake manifold.

6

Reconnect the terminals to the sensors for the boost air pressure and the boost air temperature on the intake manifold. Tie the electrical cables.

2551-03-02-02

Turbocharger, Replacement



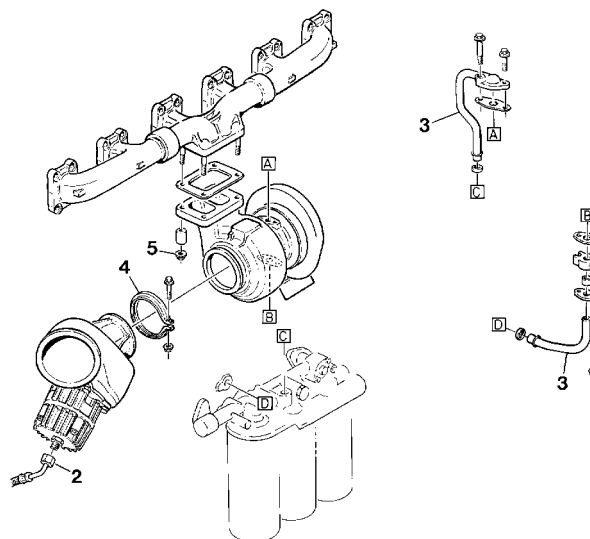
DANGER

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.



WARNING

HOT ENGINE! Keep yourself and your test equipment clear of all moving parts or hot engine parts and/or fluids. A hot engine and/or fluids can cause burns or can permanently damage test equipment.



W2000943

Fig. 38: Turbocharger assembly

- 1 n/a
- 2 Exhaust pressure governor
- 3 Oil delivery and return pipes
- 4 Clamp
- 5 Nuts

General Guidelines and Precautions

Always determine the reasons for replacing a turbocharger before making the repair. Correct any noted defects before replacing.

When replacing a turbocharger, always thoroughly read and carefully follow the procedures.

After degreasing, wipe the cooler clean and dry it with compressed air. Also check the air pipes and charge air hose. If contaminated with oil, replace the charge air hose to prevent damage to the rubber.

The engine oil system and intake system must be kept in good condition to ensure proper turbocharger operation. That is, change oil and filters at specified times, use the correct engine oil and properly care for the air cleaner.

When replacing a turbocharger, use compressed air to remove any rust or carbon flakes from the exhaust manifold. Carbon flakes can damage the turbine of the new unit. It is also important to clean the intake pipe from the air filter. Pieces of broken components can remain in the pipe and cause immediate turbocharger failure.

Also, always check to be sure that the injection equipment is in good condition.

Note: Once the turbocharger is installed put oil in oil supply port to ensure proper turbo lubrication. Once turbo is sufficiently lubricated you can crank the engine.

Removal

1

Remove the air cleaner hose from the turbocharger.

2

Remove the bolts holding the charge air pipe to the mounting bracket. Pull the charge air pipe off the turbocharger.

3

Remove the air line from the exhaust pressure governor.

4

Remove the turbocharger oil delivery and return pipes. Install a protective plug into the connection for the oil delivery pipe on the oil filter bracket.

5

Loosen the clamp between the turbocharger and the shutter housing. Remove the shutter housing from the turbocharger.

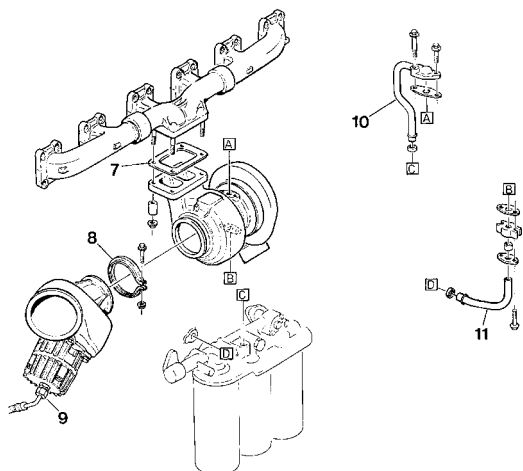
6

Remove the nuts and lift the turbocharger off.

7

Clean the sealing surfaces of the exhaust manifold, shutter housing and oil-pipe connections.

Installation



W2000739

Fig. 39: Turbocharger assembly

- 7 Gasket
- 8 Clamp
- 9 Air line
- 10 Oil delivery pipe
- 11 Oil return pipe

1

Before installing the new turbocharger, check the engine oil and change the oil filters, if required. Then, run the engine a few minutes before installing the new turbocharger. When running the engine without a turbocharger, be sure to plug the oil delivery line. As a precaution to prevent the oil from entering the new turbocharger, a strainer can be temporarily installed into the oil entry point. Then run the engine for at least a half hour.

Note: After this test, remove the strainer to prevent strainer blockage that may occur if the oil system is not properly maintained.

2

Before installing a new turbocharger, pre-lubricate the bearing system. This will ensure adequate lubrication of the turbocharger at start-up. Install a new gasket and install the new turbocharger.

3

Apply sealant to the shutter housing sealing surface and install the housing to the turbocharger. Mate the shutter housing flange with the heel of the turbocharger. Retighten the clamp.

4

Connect the air line to the exhaust pressure governor.

5

Install the turbocharger oil delivery pipe using new seals.

Note: Be sure to remove the delivery oil plug if used to run the engine without the turbocharger.

6

Install the turbocharger oil return pipe to the cylinder block using a new seal. Do not attach the oil return pipe to the turbocharger at this time.

7

Install the charge air pipe into the turbocharger using new sealing rings. Attach the charge air pipe.

8

Reconnect the air cleaner hose to the turbocharger.

9

Attach the turbocharger oil return pipe, using new seals.

10

Apply parking brake and place shift lever in neutral. Start the engine and check for proper operation and leaks.

2516-03-04-01 Exhaust Manifold Gasket(s), Replacement

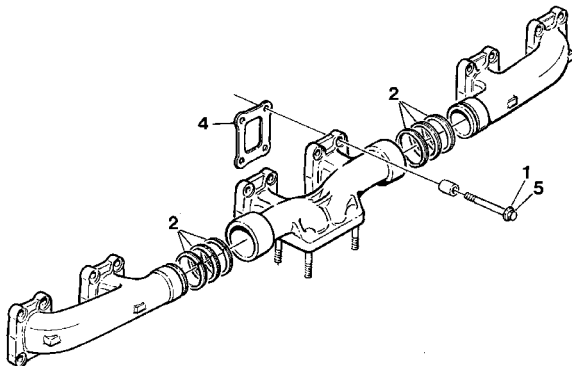
(Turbocharger Removed)

DANGER

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

WARNING

HOT ENGINE! Keep yourself and your test equipment clear of all moving parts or hot engine parts and/or fluids. A hot engine and/or fluids can cause burns or can permanently damage test equipment.



T2006979

Fig. 40: Exhaust manifold

Note: It is easy to get the wrong impression from exhaust manifold leakage (mixture of moisture and soot). This mixture may drip down on the turbo and could easily be mistaken for an oil leak from the turbo.

Removal

1

Remove the bolts holding the exhaust manifold and lift off the manifold.

2

Disassemble the exhaust manifold and remove all sealing rings. Clean the exhaust manifold and the cylinder head.

Installation

3

Use compressed air to blow any carbon out of the manifold. Then assemble the manifolds.

CAUTION

Wear appropriate eye protection.

Note: Three sealing rings must be installed at each side. Install the sealing ring with the smallest diameter in the middle.

4

Install the exhaust manifold using new gaskets. Begin by lining up all three manifold sections onto the cylinder head, starting with section A.

Note: Make sure that the sleeves fit correctly into the milling of the exhaust manifold and install the gaskets with the graphite surface facing the cylinder head.

5

After applying anti-sieze to the manifold bolts and turbo studs, screw the bolts in by hand, starting with section A and then sections B and C.

6

Tighten the bolts cross-wise starting with section A, and then sections B and C. Torque to 25 Nm (18 ft-lb). See illustration, page 26

25 Nm
(18 ft-lb)

7

Begin the tightening sequence again; however, raise the torque to 48 ± 8 Nm (35 ± 6 ft-lb).

48 ± 8 Nm
(35 ± 6 ft-lb)

8

Start the engine and run until it reaches operating temperature.

9

Verify the torque at 48 ± 8 Nm (35 ± 6 ft-lb).

2538-03-02-01 Exhaust Pressure Governor, Replacement



DANGER

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

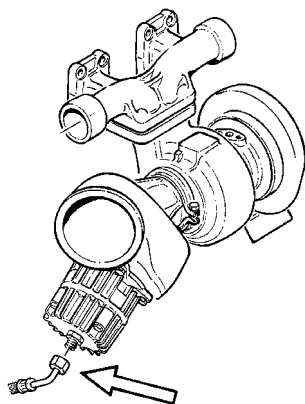


WARNING

HOT ENGINE! Keep yourself and your test equipment clear of all moving parts or hot engine parts and/or fluids. A hot engine and/or fluids can cause burns or can permanently damage test equipment.

Removal

1

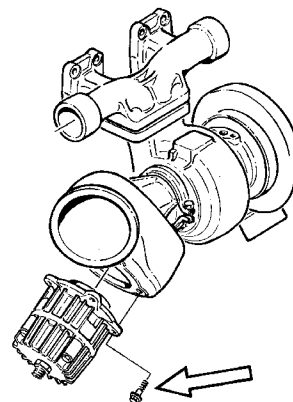


T2006942

Fig. 41: Removing air line

Remove the air line from the exhaust pressure governor.

2



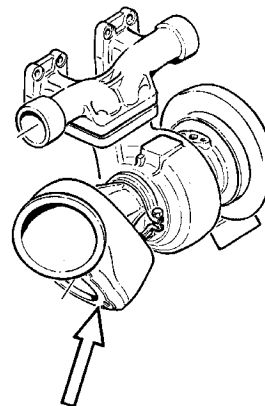
T2006940

Fig. 42: Removing air pressure governor

Remove the bolts and lift off the exhaust pressure governor.

Installation

3



T2006941

Fig. 43: Cleaning shutter housing

Clean the sealing surface of the shutter housing.

4

Install the new exhaust pressure governor. Install the air line.

5

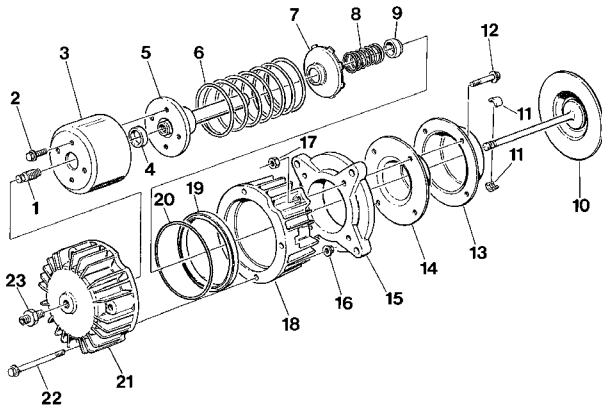
Apply parking brake and place shift lever in neutral. Start the engine and check for proper operation and leaks.

2538-04-04-01**Exhaust Pressure Governor,
Overhaul****(Unit Removed)****DANGER**

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

**WARNING**

HOT ENGINE! Keep yourself and your test equipment clear of all moving parts or hot engine parts and/or fluids. A hot engine and/or fluids can cause burns or can permanently damage test equipment.



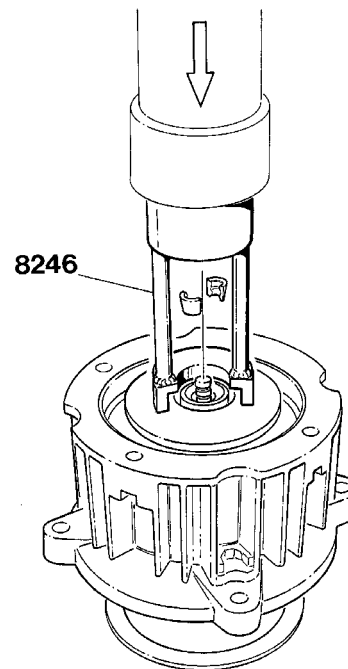
T2006749

Fig. 44: Exhaust pressure governor

1-Setscrew	11-Valve Collets
2-Bolts	12-Bolts
3-Plunger	13-Cover
4-Seazls	14-Heat shield
5-Plunger Rod	15-Securing flange
6-Spring	16-Nut
7-Spring holder	17-Nut
8-Spring	18-Housing
9-Seal	19-Seals
10-Shutter	20-Seals
	21-End cover

Disassembly

- 1**
Remove the end cover from above the plunger.
- 2**
Remove the bolts and take out the plunger.
- 3**
Remove the seals (4, 20 and 19, Fig. 44: Exhaust pressure governor, page 36).
- 4**
Remove the set screw on the plunger rod.
- 5**



T2006747

Fig. 45: Removing collets

Place the exhaust pressure governor into a press. Compress the spring enough to remove the valve collets

Note: Do not press more than necessary to remove the collets. Compressing the spring fully can damage the cover.

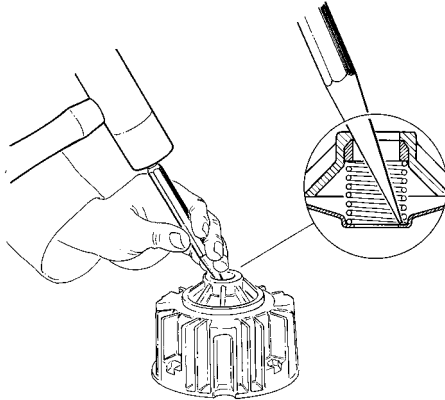
- 6**
Remove the plunger rod, spring and shutter.

Special tools: 999 2610, 999 8225, 999 8246

7

Remove the bolts holding the cover, the heat shield and the securing flange.

8



T2006744

Fig. 46: Removing spring holder

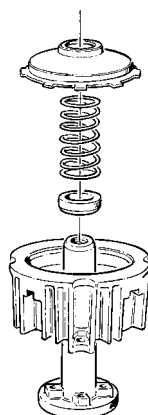
Carefully tap out the spring holder that secures the spring and the seal (9, Fig. 44: Exhaust pressure governor, page 36).

9

Clean all parts and replace any that are damaged or worn.

Assembly

1

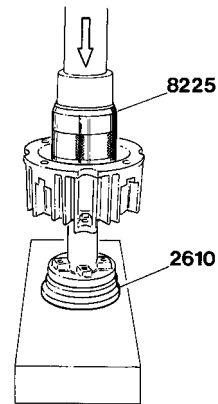


T2006745

Fig. 47: Assembly

Install the plunger rod into the housing from behind so as to center the spring holder. Install a new seal with the beveled edge facing inside the housing. Install the spring and a new spring holder.

2



T2006746

Fig. 48: Plunger rod installation

Put the plunger rod onto drift 9992610 in a press. Using drift 9998225, press on the spring holder until it bottoms in the housing. Remove the plunger rod. Check to make sure that the spring holder is correctly centered.

9992610
9998225

3

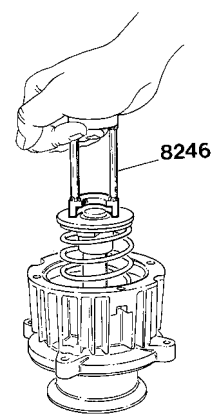
Install the securing flange, the heat shield and the cover. Tighten the bolts to 13 ± 2 Nm (10 ± 2 ft-lb).

13 ± 2 Nm
(10 ± 2 ft-lb)

4

Install the shutter, spring and plunger rod into the housing.

5



T2006748

Fig. 49: Depressing spring

Compress the spring by hand, making sure that the shutter shaft and plunger rod fit together and that the plunger rod fits correctly into the seal. Stop applying pressure if undue resistance is felt. Install the valve collets.

6

Install the set screw into the plunger rod. Apply sealant to the set screw before installing. Tighten the set screw to 40 ± 5 Nm (30 ± 4 ft-lb).

40 ± 5 Nm
(30 ± 4 ft-lb)

7

Install a new seal into the plunger rod and install the plunger. Apply sealant to the bolts and tighten them to 13 ± 2 Nm (10 ± 2 ft-lb).

13 ± 2 Nm
(10 ± 2 ft-lb)

8

Install the end cover using new seals. Make sure that the seal bottoms in the housing. Install the seal with the flat side facing the housing. Tighten the bolts (22) to 24 ± 2 Nm (18 ± 2 ft-lb).

24 ± 2 Nm
(18 ± 2 ft-lb)

2651-06-04-01

Charge Air Cooler Leak Test, Checking

If the turbocharger fails on an intercooled engine, it is essential to check the charge air cooler. When considerable oil loss or the presence of foreign material (for example, broken compressor wheel parts forced into the charge air cooler) is suspected, take the following measures:

Check the charge air cooler hoses up to the cooler. If there are traces of oil at the charge air cooler, remove the cooler and clean it internally, using a low-aroma, white-spirit type degreasing agent.

If turbocharger failure results in a broken compressor wheel, pressure-test the charge air cooler to see if it has been damaged by broken compressor wheel pieces.

Special tools: 9996662, 9998288, 9998289

Note: Check the function of pressure gauge 9996662 before using it. Attach it to an air supply and set the pressure to 100 kPa (14.5 psi) with the regulator valve.



DANGER

Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.



WARNING

HOT ENGINE! Keep yourself and your test equipment clear of all moving parts or hot engine parts and/or fluids. A hot engine and/or fluids can cause burns or can permanently damage test equipment.



WARNING

Never disconnect an air system component unless all system pressure has been depleted. Failure to deplete system pressure before disconnecting hoses or components may result in their violent separation and can cause serious bodily injury.



WARNING

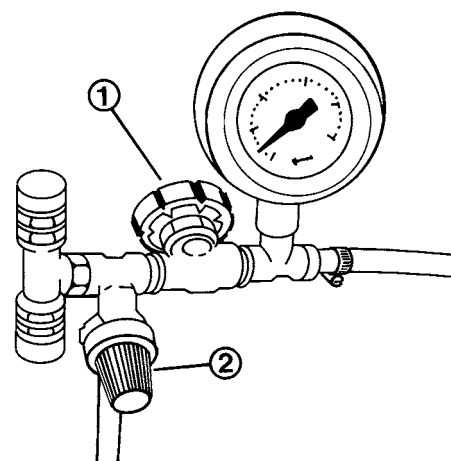
Make sure that the gauge pressure never exceeds 100 kPa (14.5 psi). Failure to do so can result in personal injury.



WARNING

—Always wear appropriate eye protection to prevent the risk of eye injury due to contact with engine debris or fluids.

1



W2000715

Fig. 50: Pressure gauge

- 1 Shut-Off Valve
- 2 Reduction Valve

Connect the pressure gauge to outside air source and set the gauge reading to 100 kPa (14.5 psi) using the reduction valve. The knob of the reduction valve is locked by a ring which is engaged by pulling up on the ring, and pushing down to release.

2

Close the shut-off valve. For the pressure gauge to be considered reliable, the pressure reading must not drop during a period of two minutes.

3

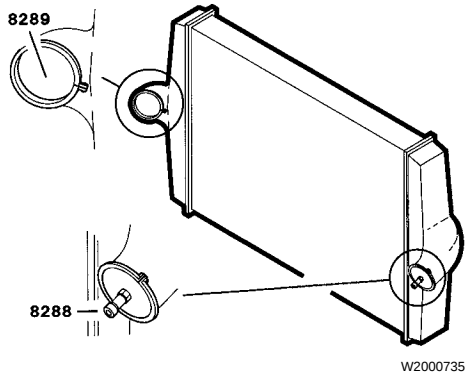


Fig. 51: Removing charge air hoses

Remove the air hoses from the charge air cooler. Install connecting washer 9998288, sealing washer 9998289 and new O-rings.

4

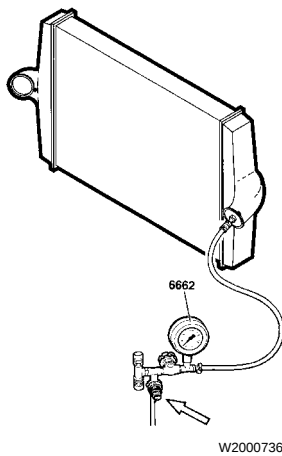


Fig. 52: Connecting pressure gauge

Remove the pressure gauge reduction valve and check that the gauge reading is "0." Connect the pressure gauge to the charge air cooler.

5

Open the shut-off valve and set the pressure gauge to 100 kPa (14.5 psi), using the reduction valve.

6

Close the shut-off valve. For the charge air cooler to be serviceable, the pressure reading must not drop more than 50 kPa (7 psi) during 30 seconds.

7

If a leak is found, repeat the test a few times. Also check pressure gauge hoses and connections.

System Check

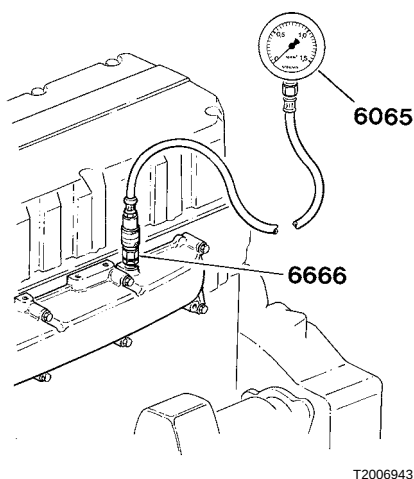
2559-06-02-02

Boost Pressure, Checking

Note: This operation number covers only the installation and removal of test equipment.

Special tools: 9996065, 9996666

1



Boost pressure gauge installation

Clean around the plug for the boost pressure gauge on the intake manifold. Remove the plug and install union 9996666. Connect pressure gauge 9996065 to the 9996666 union. Make sure the pressure gauge hose is long enough to reach the driver's seat in the cab.

Note: Secure the hose so that it does not contact any moving parts.

2

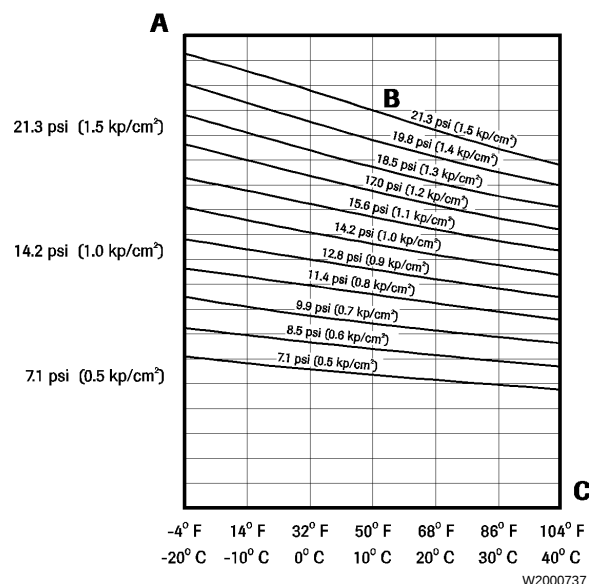
The measurement should be carried out:

- with a fully loaded vehicle
- driving up an incline at full acceleration (full load)
- while engine revs (rpm), slowly pass the speed specified for boost pressure.

Note: For a reliable result, engine load must be maintained long enough for the pressure to stabilize. Boost pressure specifications at 28.3 r/s (1700 rpm):

- VE D12-370 125–170 kPa (18–24.7 psi)
- VE D12-415 145–175 kPa (21–25.4 psi)

3



Boost pressure at various temperatures

- A measured boost pressure
- B correction curves
- C intake air temperature

The specifications state engine speed and boost pressure at +20°C (68°F). If reading at any other temperature, use the chart above to correct the resulting boost pressure.

Example:

A pressure of 80 kPa (12 psi) measured at -10°C (14°F) is equivalent to about 70 kPa (10 psi) +20°C (68°F). That is, pressure drops as temperature rises.

If boost pressure does not reach specified levels, check the following:

- properly tightened bolts on intake and exhaust manifolds
- exhaust brake
- backpressure in exhaust system
- air cleaner element
- fuel pressure

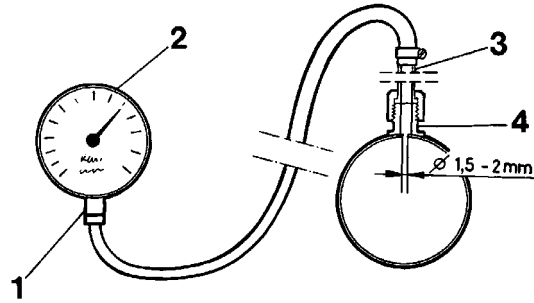
Exhaust Backpressure, Checking

Pressure gauge: Of indicating or U-tube type, graded to 24 kPa or 2,440 mm water column (3.5 psi) and equipped with damper.

Steel pipe: About 200 mm (8 in.) long and able to connect to a union.

Union: The union must be brazed onto the exhaust pipe as shown. Then drill a 1.5 – 2.0 mm (0.06 – 0.08 in) hole through the center of the union and the side of the exhaust pipe.

Hose: The hose is installed between the pressure gauge and steel pipe and must be long enough for the gauge to be read inside the cab.



T2006988

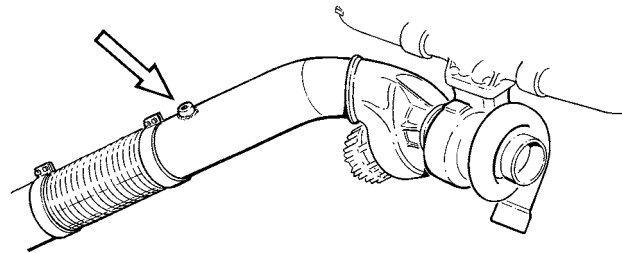
Measuring equipment

- 1 Damper
- 2 Pressure gauge
- 3 Steel pipe
- 4 Union

Pressure Testing Outlet Location

The pressure-testing fitting should be located on as straight a section of the pipe as possible, two-thirds after and one-third before a bend in the pipe.

The test fitting must not be located on an outer or inner bend of the exhaust pipe.



T2006983

Outlet location

Backpressure Measuring Techniques

Using a chassis dynamometer is the best way to measure backpressure. If such equipment is not available, the vehicle can be driven up a long hill. The accelerator pedal must be kept fully floored with the vehicle accelerating up the hill until the engine reaches specified rpm.

Note the highest backpressure reading and compare it with specifications.

After the test, make sure to block off the union in the exhaust pipe with a plug, or in some other suitable manner.

Feedback

One of our objectives is that workshop personnel should have access to correct and appropriate service manuals where it concerns fault tracing, repairs and maintenance of Volvo trucks.
In order to maintain the high standards of our literature, your opinions and experience when using this manual would be greatly appreciated.
If you have any comments or suggestions, make a copy of this page, write down your comments and send them to us, either via telefax or mailing directly to the address listed below.

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Comments/proposals

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Concerns Service Manual:

Operation Numbers

2512-03-02-01	Intake Manifold Gasket(s), Replacement	30
2516-03-04-01	Exhaust Manifold Gasket(s), Replacement	34
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