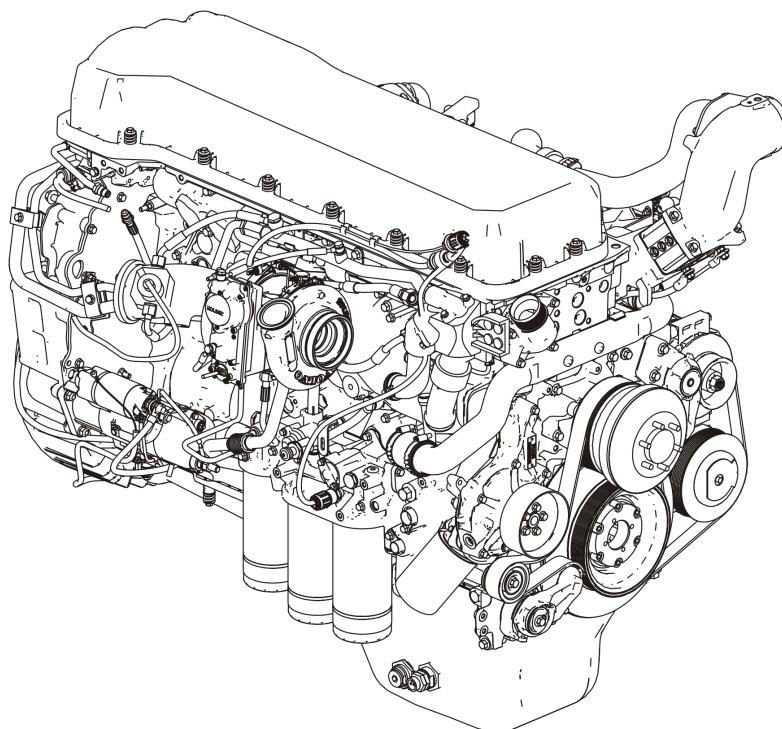


Engine Brake  
Design and Function  
D11F

## Engine Brake, Design and Function



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This information covers the design and function of the Volvo Engine Brake (VEB) on the Volvo D11F engine.

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

# Design and Function

## Engine Brake

The Volvo Engine Brake (VEB) is provided to assist in slowing the vehicle when necessary. The system includes:

- Wiring Harness
- Camshaft Altered Lobe Profile
- VEB Control Valve
- Exhaust Rocker Arm Pistons
- Exhaust Valve Bridges

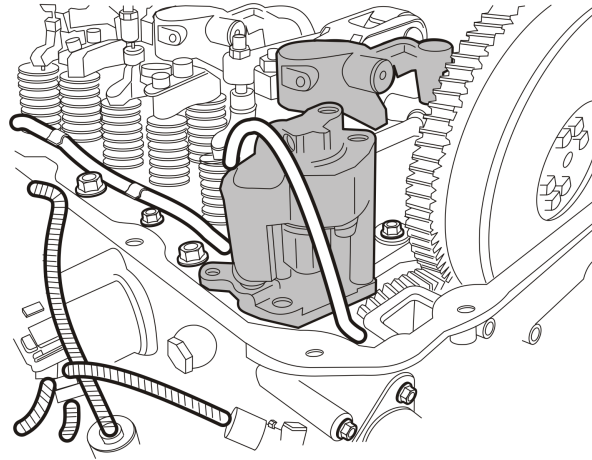
During the engine compression stroke and combustion (operating) stroke, the controlled opening of the exhaust valves creates an overpressure in the combustion chamber. This, in turn, produces a braking effect on the crankshaft.

On D11F engines with the VEB, the camshaft has two extra lobes on each exhaust cam profile. The lift height of the extra lobes is very low compared to that of normal exhaust lobes. To enable the extra lobes to open the exhaust valves, the exhaust rocker arms are arranged in a manner which reduces valve clearance during the braking sequence.

## Shims

A complete range of individual adjustment shims is available in thickness increments of 0.05 mm (0.002 in) from 2.0–3.95 mm (0.08–0.156). The thickness is stamped on each shim.

An adjustment shim kit is available containing the most often used shim sizes. The kit contains a range of 16 different thickness shims from 2.0–2.4 mm (0.08–0.094 in) and from 3.2–3.95 mm (0.126–0.156 in). The kit includes a storage drawer and a feeler gauge.



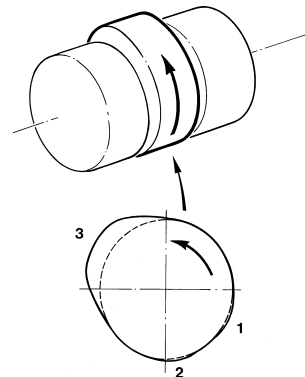
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## System Components

### VEB Camshaft

On D11F engines with a compression brake, the camshaft has an induction lobe (1) and decompression lobe (2) in addition to the normal exhaust lobe (3) on each cam profile for the exhaust valves. The induction and decompression lobe lift height is 0.8 mm (0.032 inch) above the basic circle, which is equivalent to about 1.1 mm (0.043 inch) at the valve bridge. The induction lobe is positioned to open the exhaust valves at the end of the intake stroke. The decompression lobe is positioned to open the exhaust valves at the end of the compression stroke.

The valve clearance must be zero for the induction and decompression lobes to open the exhaust valves.



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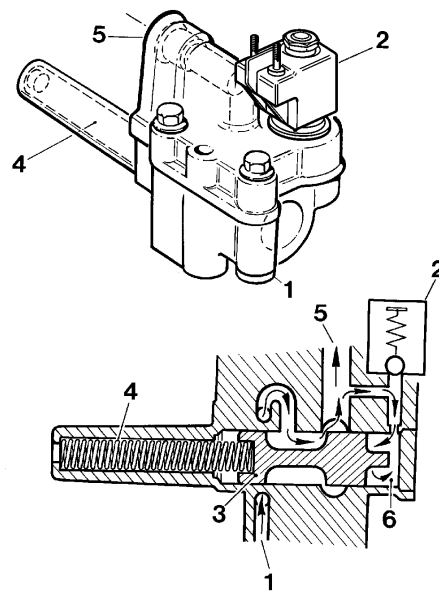
- 1 Induction Lobe
- 2 Decompression Lobe
- 3 Exhaust Lobe

### VEB Control Valve

The control valve is mounted on the cylinder head under the valve cover and is connected to the oil system and the rocker arm shaft. The purpose of the control valve is to reduce oil pressure to the rocker arms while the engine is operating. There is always full system oil pressure to the control valve inlet (1). A spacer connects the inlet to the lube oil gallery in the cylinder block. Oil pressure to the rocker arm shaft can be increased by a solenoid valve (2) mounted on the control valve, from about 100 kPa (14.5 psi) while the engine is operating to over 200 kPa (29 psi) during compression braking.

During engine operation, the force of the spring and oil pressure in the oil chamber hold the control valve plunger in balance. This action reduces oil pressure.

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) and the oil pressure to the rocker arm shaft is increased.



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- 1 Oil Inlet
- 2 Solenoid Valve
- 3 Plunger
- 4 Spring
- 5 Oil Outlet
- 6 Oil Chamber

## VEB Exhaust Rocker Arms

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

The rocker arm is equipped with a non-return valve and a plunger with a pressure-limiting valve. Its purpose is to regulate oil flow during compression braking.

Spring-tab pressure holds the rocker arm at the rest position against the valve bridge.

Valve clearance is greater on an engine without a compression brake, because the induction and decompression lobes must not open the exhaust valves while the engine is operating.

Shims are placed on the exhaust valve bridge to adjust the valve clearance.

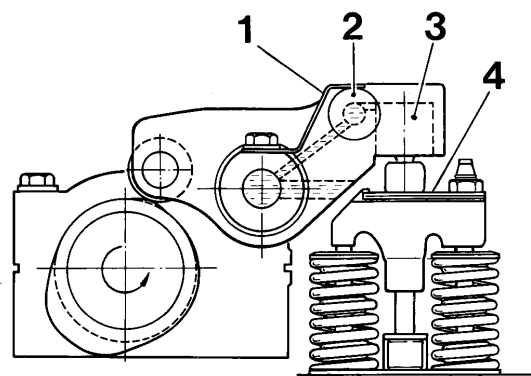
**Note:** Do not use more than two shims to obtain proper valve clearance.

## VEB Non-Return Valve

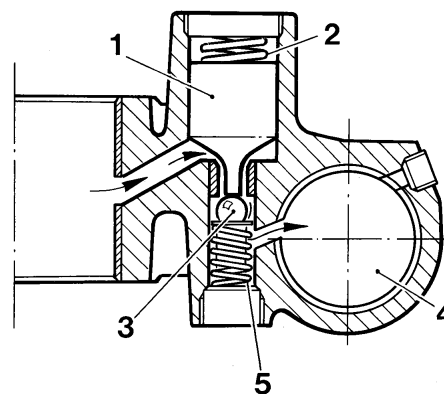
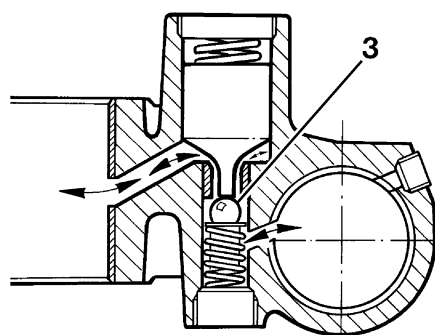
There is a non-return valve consisting of a plunger (1), spring (2) and ball (3) in the rocker arm. When oil from the rocker arm shaft is forced into the valve, the spring force and the oil pressure determine movement of the plunger.

When the oil pressure is low, about 100 kPa (14.5 psi), the control valve is in its engine operating position. During this time, the plunger (1) will not move out of its rest position because the oil pressure cannot overcome the spring force. The plunger pin prevents the ball (3) from seating and the oil can flow freely through the valve in both directions.

When the control valve is in position for compression braking, oil pressure to the non-return valve increases. The spring force in the non-return valve is such that when the oil pressure exceeds about 200 kPa (29 psi), it overcomes the spring force and moves the plunger (1) to where it no longer controls the ball (3). The spring (5) forces the ball against its seat and the oil contained above the plunger (4) cannot flow past the ball (3). As a result, high oil pressure is formed above the plunger (4).



- 1 Spring Tab
- 2 Non-Return Valve
- 3 Rocker Arm Plunger
- 4 Shims



- 1 Plunger
- 2 Spring
- 3 Ball
- 4 Rocker Arm Plunger
- 5 Spring

## Rocker Arm Plunger

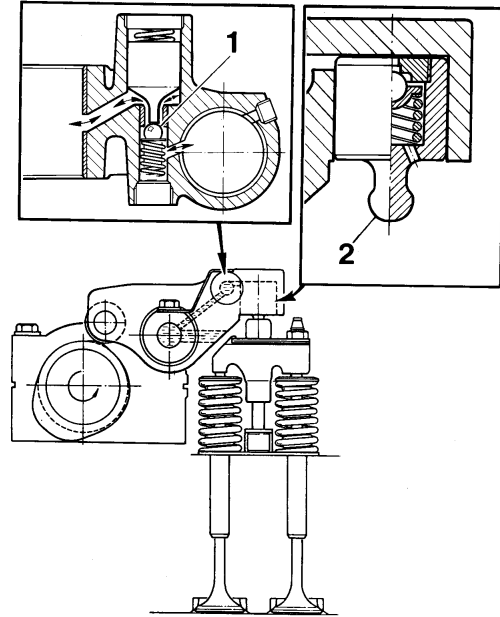
The purpose of the plunger is to eliminate all valve clearance during compression braking.

### Engine Operation

When the engine is operating, there is reduced oil pressure, approximately 100 kPa (14.5 psi), through the control valve to the rocker arm shaft. 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 an engine without a compression brake; in other words, only the exhaust lobe opens the exhaust valves.



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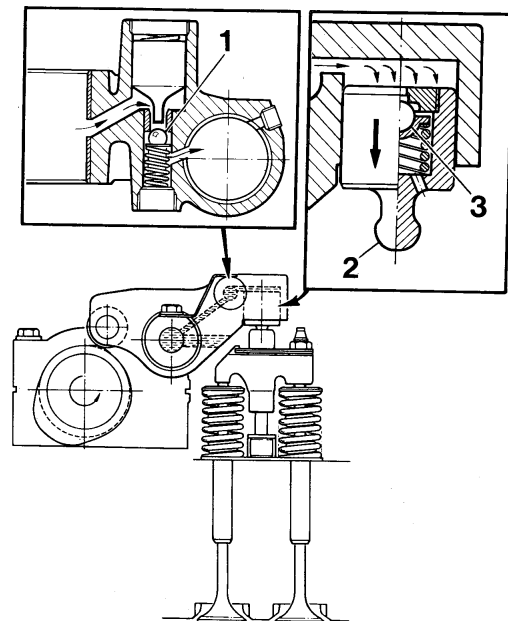
- 1 Non-Return Valve
- 2 Rocker Arm Plunger

### 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. 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.



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- 1 Non-Return Valve
- 2 Rocker Arm Plunger
- 3 Pressure-Limiting Valve

## Control System

The engine brake is associated with the accelerator pedal and is activated when the pedal is completely released, based on 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.

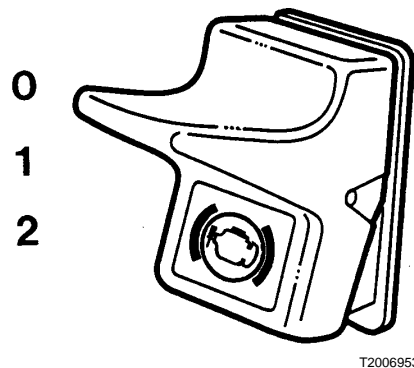
**Note:** The engine brake functions as long as the engine control system has received signals from engine sensors indicating that the required preconditions for engine braking have been met. For example, the engine speed must be greater than 1100 rpm, the vehicle speed must be greater than 12 km/h (7.5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

## Switch

The engine brake is controlled by a 3-position switch located on the dash.

The three position switch has the following selection:

- 1 No Engine Brake Engaged
- 2 LO — Half Engine Braking Power
- 3 HI — Full Engine Braking Power



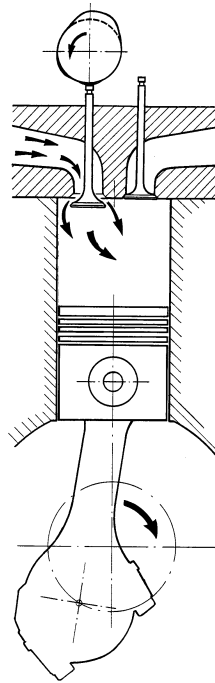
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## Induction Phase

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

The piston travels downward toward bottom dead center and the camshaft induction lobe opens the exhaust valves long enough to fill the cylinder with the backpressure in the exhaust manifold.

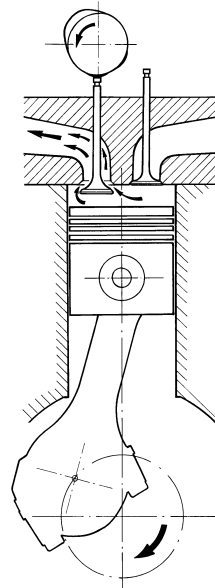
When the induction lobe closes the exhaust valves, the cylinder has a backpressure at the start of the compression stroke. This backpressure helps increase compression during the compression stroke which in turn, creates a more effective engine braking as the piston moves upward.



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## Decompression Phase

At the end of the compression stroke, as the piston approaches top dead center, the camshaft decompression lobe opens the exhaust valves and releases the pressure from the cylinder. Shortly before bottom dead center, the ordinary exhaust lobe opens the exhaust valves. During the exhaust stroke, backpressure is created in the exhaust manifold.



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