

Document Title: <b>Engine, description</b>	Function Group: <b>200</b>	Information Type: <b>Service Information</b>	Date: <b>2014/11/7</b>
Profile: <b>EXC, EC210C L [GB]</b>			

## Engine, description

### D6E - tier 3 compliant

The D6E configuration is a four stroke, straight six cylinder, turbocharged, direct injected diesel engine with charge air cooling and wet, replaceable cylinder liners.

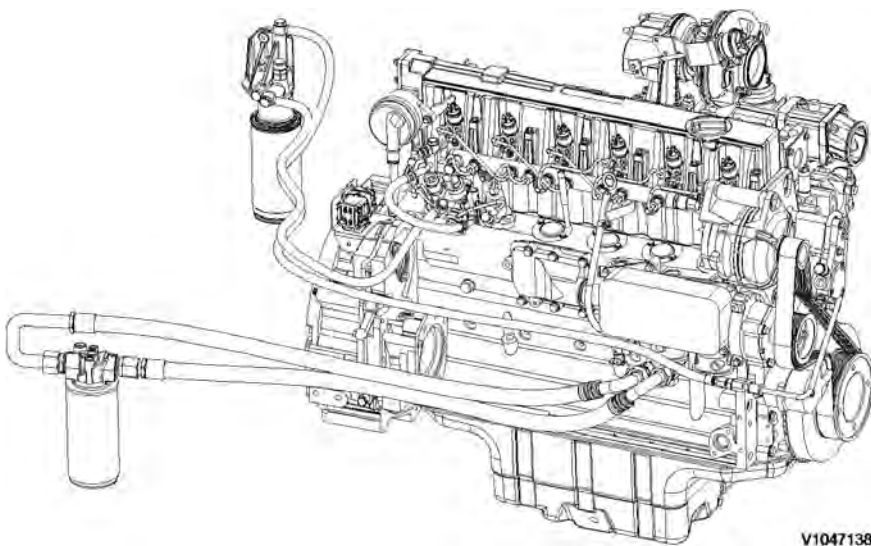
The D6E engine uses a Common Rail Fuel System controlled by the engine electronic control (E-ECU) software.

Electronically controlled IEGR (Internal Exhaust Gas Recirculation) reduces NO<sub>x</sub> formation and lowers emissions without the need for exhaust after treatment. Volvo's latest engine management system, E-ECU is used to control all engine electronic functions.

The cylinders are numbered consecutively beginning at the flywheel end. Engine rotational direction is counterclockwise as seen from the flywheel end.

### NOTE!

This figure is for the EC210CL/LR/N machines. Turbocharger mounting position of the EC210CNL is different from EC210CL/LR/N ones.



V1047138

**Figure 1**  
**Engine, D6E**

Document Title: <b>Engine, identification</b>	Function Group: <b>200</b>	Information Type: <b>Service Information</b>	Date: <b>2014/11/7</b>
Profile: <b>EXC, EC210C L [GB]</b>			

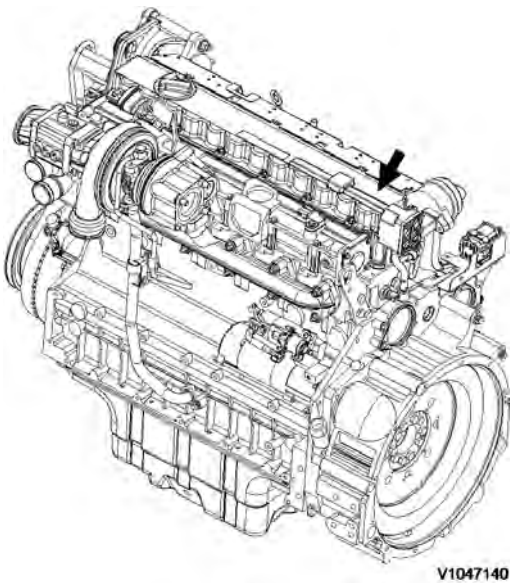
## Engine, identification

### Identification plate

The engine model, serial number and performance data are stamped on an identification plate which is attached on the cylinder head cover. The engine model designation and serial number must be indicated when ordering spare parts.

### NOTE!

This figure is for the EC210CL/LR/N machines. Turbocharger mounting position of the EC210CNL is different from EC210CL/LR/N ones.



**Figure 1**  
**Engine identification, D6E**

Document Title: <b>Troubleshooting</b>	Function Group: <b>210</b>	Information Type: <b>Service Information</b>	Date: <b>2014/11/7</b>
Profile: <b>EXC, EC210C L [GB]</b>			

## Troubleshooting

### General about troubleshooting

When a malfunction is suspected or has been confirmed, it is important to identify the cause as soon as possible.

The starting point for all troubleshooting is that there is some type of trouble symptom or malfunction.

Malfunctions can be indicated by:

- generation of error codes
- detection of a malfunction symptom.

### Troubleshooting work

The first step in troubleshooting is to gather information from the operator concerning the malfunction symptoms, see Electrical and information system, Collection of basic data. Then, attempt to pin-point the cause by checking in a certain order, for more information, see Electrical and information system, troubleshooting strategy.

The different checking steps are:

- Check error codes
- Check parameters
- Perform basic check

### Troubleshooting information

The following is included in Electrical and information system and is used when troubleshooting:

1. **Troubleshooting strategy**  
Describes troubleshooting work, step by step.
2. **Troubleshooting, assistive devices**  
Brief summary of the assistive devices that are available for troubleshooting.
3. **Functional checks and tests, VCADS Pro**  
Brief description of VCADS Pro. For a detailed description, see VCADS Pro User's Manual.
4. **Error code information**  
Contains information regarding error code design, lists of all error codes and error code information about each error code.
5. **Components, troubleshooting and specifications**  
Contains methods and measuring values for troubleshooting of components. Also includes wiring diagrams and certain specifications.
6. **Parameters**  
Incorrectly set parameters may cause malfunction symptoms. The parameter list includes all limit and command values for parameters.
7. **Control units, functional description**  
Describes the functions of the control units, inputs and outputs as well as communication between the various control units.
8. **Control units, active and passive measuring**  
Contains measuring values for active and passive measuring of the ECUs.
9. **Software functions**  
Describes the pre-requisite conditions for the control and monitoring functions that are performed by the software in the ECUs.

Document Title: <b>Internal Exhaust Gas Recirculation description</b>	Function Group: <b>214</b>	Information Type: <b>Service Information</b>	Date: <b>2014/11/7</b>
Profile: <b>EXC, EC210C L [GB]</b>			

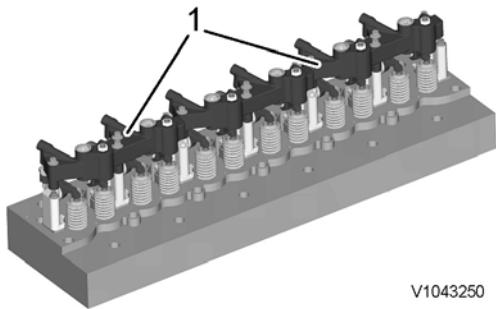
## Internal Exhaust Gas Recirculation (IEGR), description

A system for IEGR (**I**nternal **E**xhaust **G**as **R**ecirculation) is used as part of V-ACT (Volvo Advanced Combustion Technology). On D6E and D7E this takes place by an IEGR-opening piston, controlled by the lubrication oil's system pressure, acting on the exhaust rocker arm which enables a second opening of the exhaust valves. When activated, the secondary piston will give a limited valve opening of the exhaust valves during the induction phase, which leads exhausts back into the cylinder.

### Included components

#### IEGR-unit

The hydraulic mechanism is housed in two interconnected IEGR-units, located on the rocker arm holders. Lubrication oil is routed from the cylinder head via the solenoid valve to the high-pressure channel in the IEGR-unit through a channel in one of the rocker arm holders.

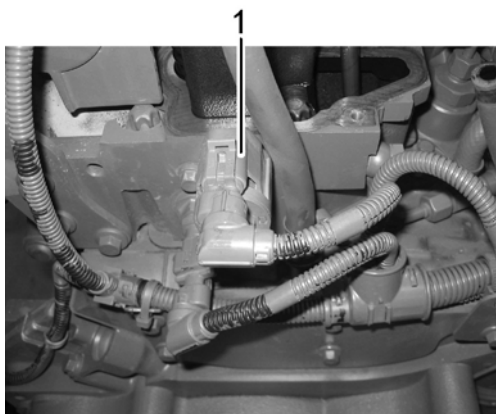


**Figure 1**

1. IEGR-unit

#### Solenoid valve

The solenoid valve is located in the cylinder head on the flywheel side and is activated by the EECU via the control system EMS 2. When IEGR is not activated, the solenoid valve is closed and no oil flow is allowed into the IEGR-unit. At activation of IEGR, the solenoid valve opens the channel from the engine's lubrication system to the IEGR-unit.

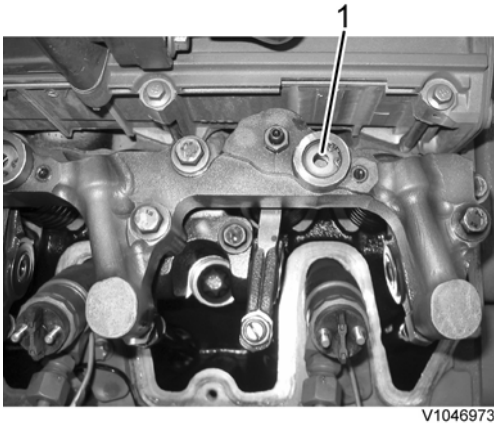


**Figure 2**

1. Solenoid valve

**Control valve**

The control valve is located in the IEGR-unit between the high-pressure circuit and low-pressure circuit. When the low-pressure circuit is supplied from the lubrication oil system, the control valve is lifted and closes the high-pressure circuit. The ball in the control valve enables filling of the high-pressure circuit when IEGR is activated. The lubrication oil is drained through the control valve.

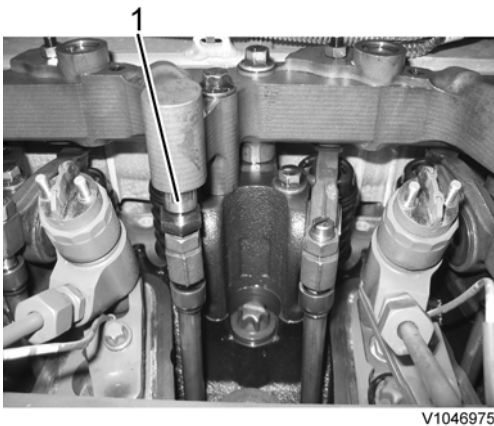


**Figure 3**

1. Control valve

**Main piston**

The main piston is acted on by the adjusting screw on the inlet valve's rocker arm, and affects the oil pressure in the IEGR-unit's high-pressure channel. At the end of the IEGR-phase, a pressure of 100 bar is generated in the high-pressure circuit.

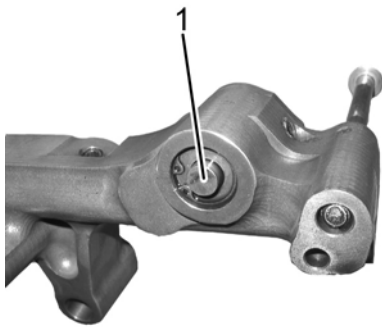


**Figure 4**

1. Main piston

**Servo piston**

The servo piston is activated by the hydraulic pressure from the main piston via a channel in the IEGR-unit when the IEGR-function is active/on (solenoid valve in open position). Then the servo piston opens the exhaust valves via the rocker arm an extra time during the induction stroke.



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**Figure 5**

1. Servo piston

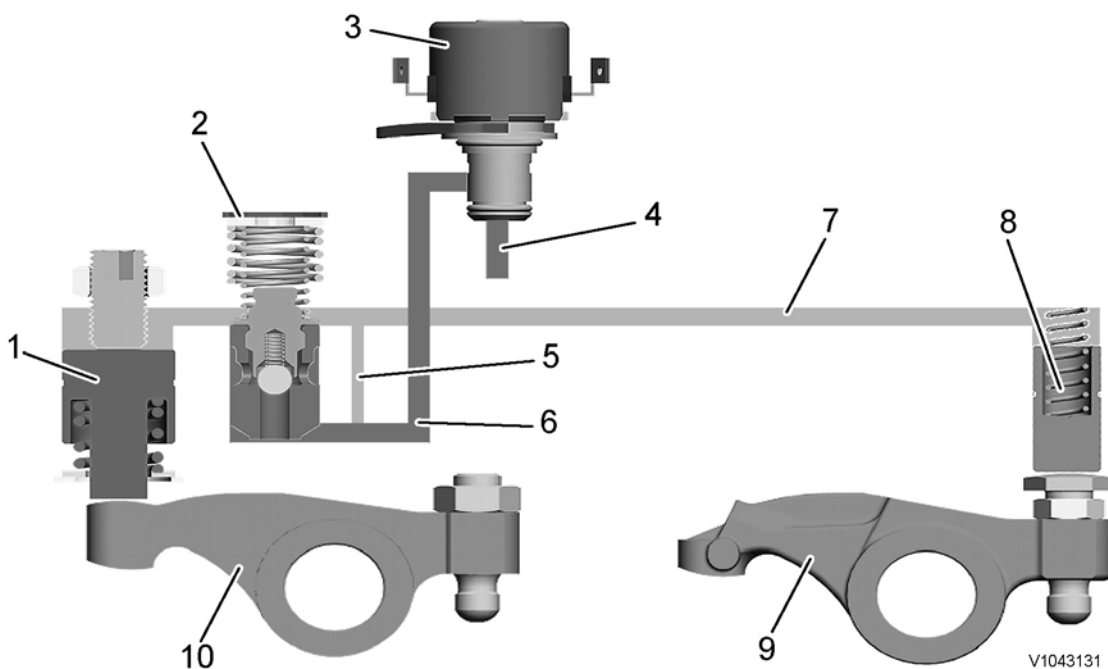
**Function**

IEGR is activated by the system being supplied with full lubrication oil system pressure via the solenoid valve. The solenoid valve is activated by the E-ECU.

The control valve closes the high-pressure circuit and the ball inside the valve enables filling of the system.

With the same movement as the inlet valve's rocker arm opens the valve, the main piston is forced upward. The pressure in the IEGR-unit's high-pressure channel (up to 100 bar) overcomes the spring force in the servo piston. The servo piston forces down the rocker arm, which results in the exhaust valve being open for a short time at the end of the induction stroke.

Exhausts from the exhaust manifold are sucked into the cylinder by vacuum from the other cylinders. The breather hole between the low-pressure channel and the high-pressure channel in the IEGR-unit enables longer exhaust recirculation at high engine speed.

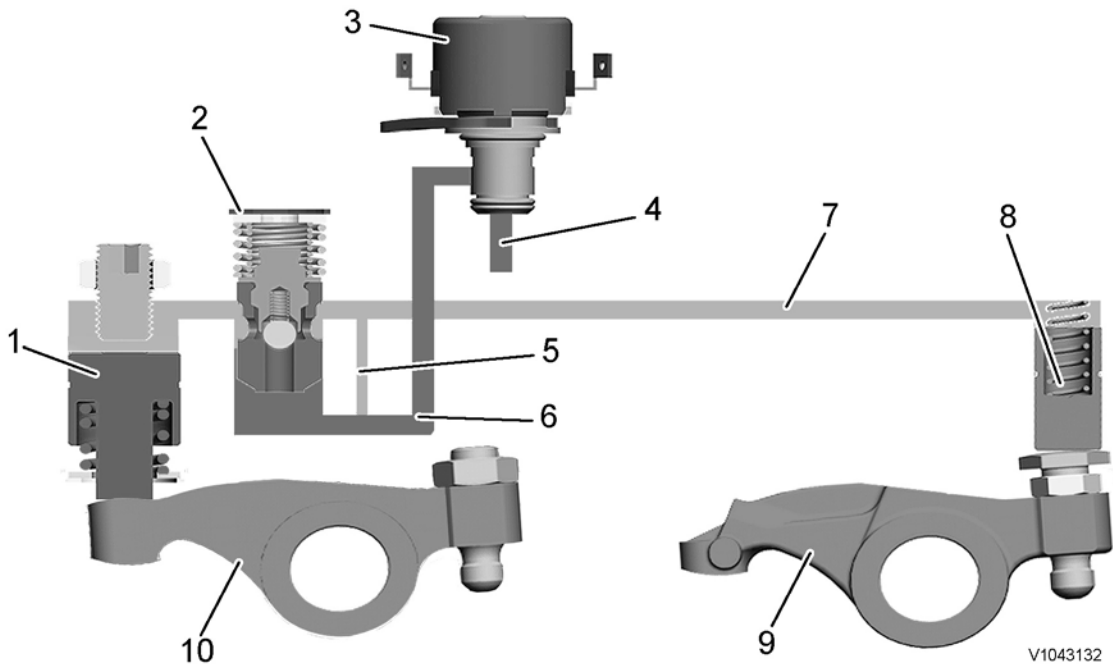


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**Figure 6**  
**IEGR-system (inactive)**

1. Servo piston
2. Control valve
3. Solenoid valve
4. 2–5 Bar lubrication oil pressure
5. Breather hole
6. Oil channel, low-pressure

- 7. Oil channel, high-pressure
- 8. Main piston
- 9. Induction rocker arm
- 10. Exhaust rocker arm



**Figure 7**  
**IEGR-system activated**

- 1. Servo piston
- 2. Control valve
- 3. Solenoid valve
- 4. 2–5 Bar lubrication oil pressure
- 5. Breather hole
- 6. Oil channel, low-pressure
- 7. Oil channel, high-pressure
- 8. Main piston
- 9. Induction rocker arm
- 10. Exhaust rocker arm

#### Checking and adjusting

Checking and adjusting of the IEGR-opening piston's clearance against the exhaust rocker arm should be done in connection with checking and adjusting valves according to [214 Valves, adjusting](#).

#### Software

The function monitors the EGR valve for return of combustion gases and informs the operator if the function is not ensured or if there is a system malfunction.

The function is also used as input signal for Engine protection.

Document Title: <b>Valves, adjusting</b>	Function Group: <b>214</b>	Information Type: <b>Service Information</b>	Date: <b>2014/11/7</b>
Profile: <b>EXC, EC210C L [GB]</b>			

## Valves, adjusting

Op nbr 214-012

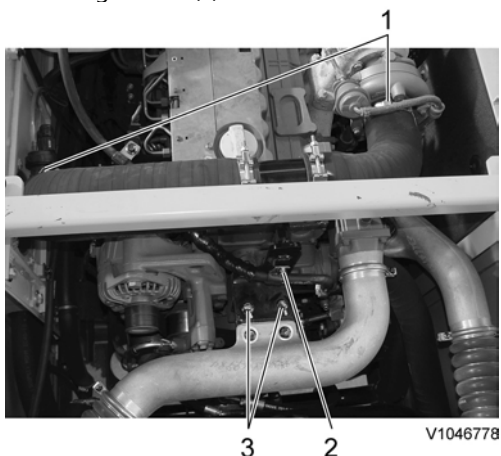
[9998681 Rotation tool](#)

[885812 Timing tool](#)

### **WARNING**

**Risk of burns - stop the diesel engine and allow it to cool down before starting any work.**

1. Place the machine in service position B. See [091 Service positions](#)
2. Open the engine hood and right side cover.
3. Remove turbocharger inlet hose clamping screws (1), coolant air ventilation hose clamping screw (2) and bracket mounting screws (3).



**Figure 1**

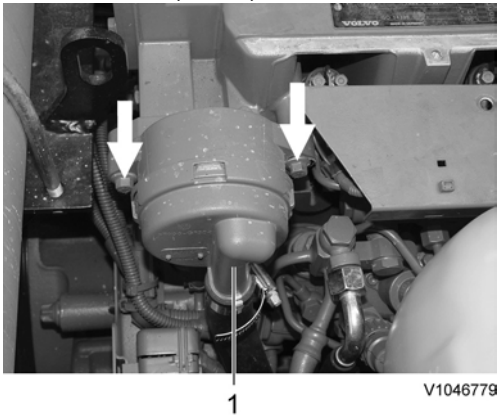
4. Remove cover plate (1).





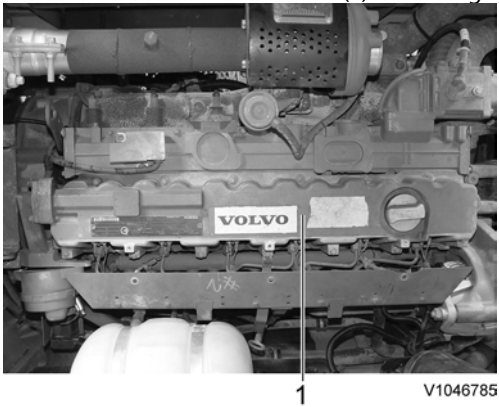
**Figure 2**

5. Remove screws (arrows) and remove crankcase ventilation duct (1).



**Figure 3**

6. Remove rocker arm valve cover (1) with the gasket.

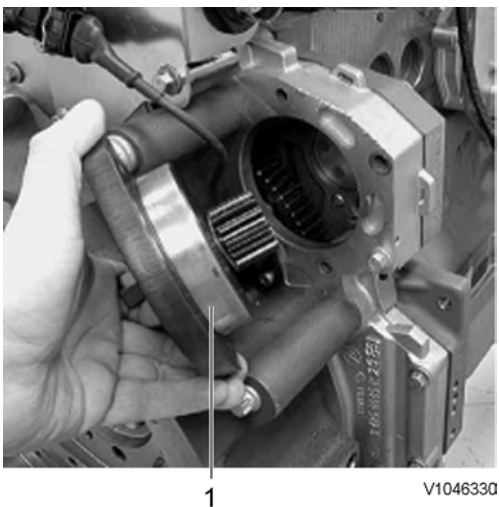


**Figure 4**

7. Remove the camshaft gear cover and install turning gear (1).

**NOTE!**

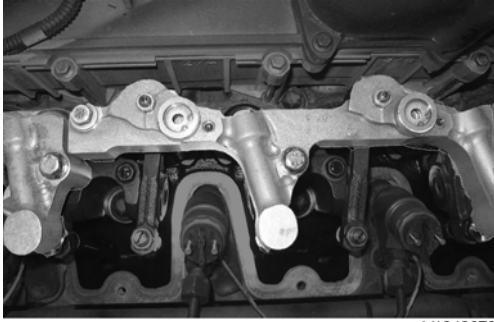
The teeth of the turning gear must mesh fully with the teeth of the camshaft gear.



**Figure 5**

8. Remove the IEGR unit.

Install M 8 x 75 mm – 10.9 screws in the holes for the IEGR unit on the rocker arm holders.

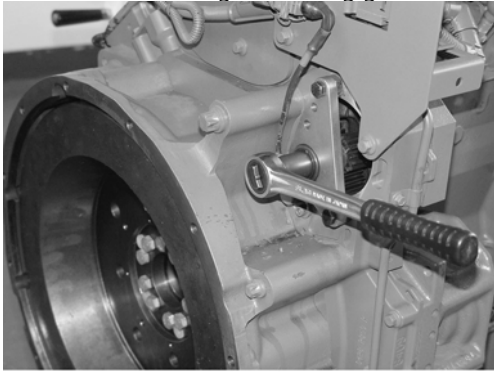


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**Figure 6**

9. **Setting engine to valve overlap**

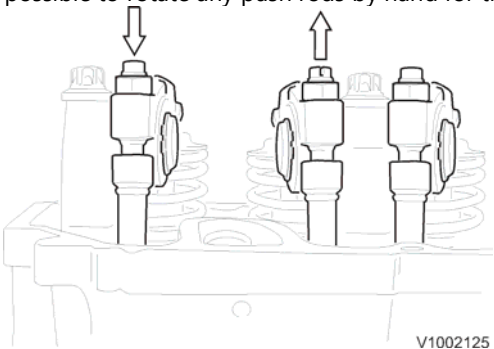
Turn crankshaft using the turning gear until the valve overlap of cylinder 1 is reached.



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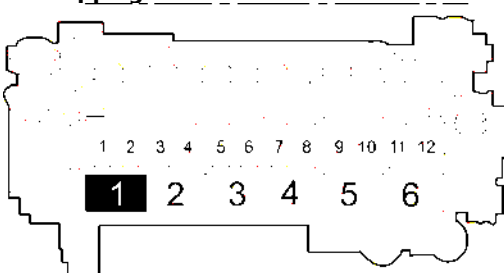
**Figure 7**

Overlapping means that the exhaust valve is about to open and the inlet valve is about to close. It should not be possible to rotate any push rods by hand for the cylinder in question in this position.



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**Figure 8**  
**Overlapping**

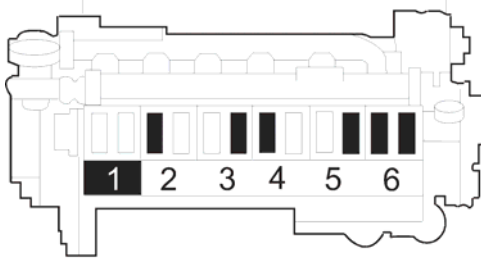


V1003317

**Figure 9**

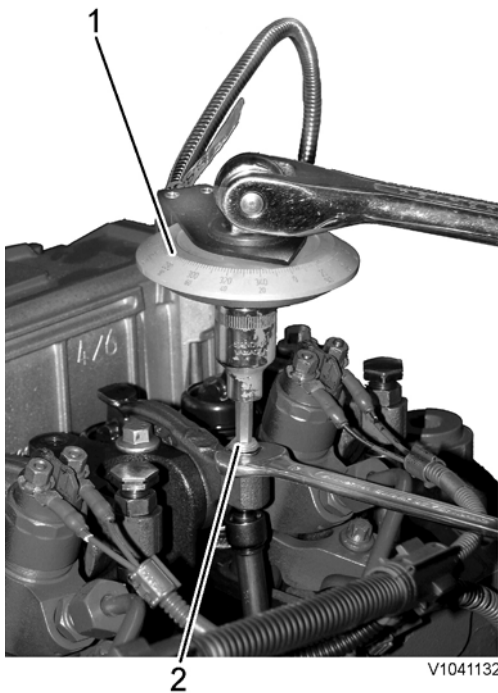
1, 3, 5, 7, 9 and 11 are exhaust valves  
2, 4, 6, 8, 10 and 12 are inlet valves

10. Adjust the valve clearance for each cylinder according to the black markings in the figure. Procedure for adjusting:



V1003318

**Figure 10**



V1041132

**Figure 11**

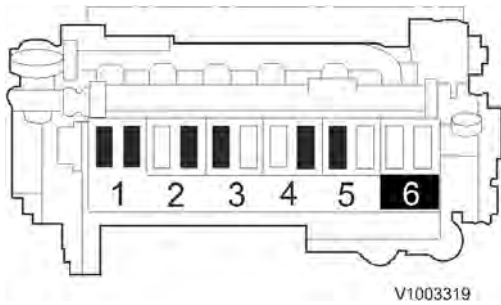
1. 885812 Timing tool
2. Adjusting screw

1. Loosen the adjusting screw's lock bolt on the rocker arm.
2. Install the protractor on the adjusting screw.
3. Turn the adjusting screw until zero clearance is obtained between rocker arm and valve. Reset the protractor to zero.
4. Turn the adjusting screw counterclockwise 75° for inlet valve and 120° for exhaust valve.
5. Hold the adjusting screw and tighten the lock nut at the same time. Tightening torque: see [200 Engine tightening torques](#)

11. Rotate the crankshaft another full turn until the valves for cylinder 6 overlap. Adjust the valve clearance for each cylinder according to the black markings in the figure.

**NOTE!**

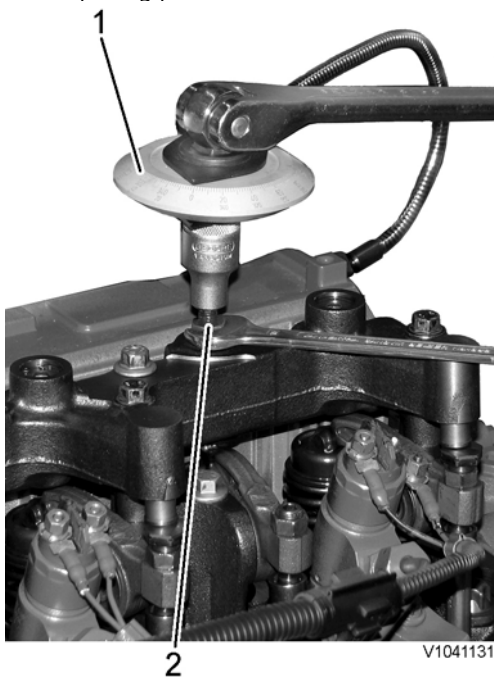
When all valves are adjusted, do not rotate the engine. Continue directly with installing and adjusting the IEGR unit.



**Figure 12**

### Installing and adjusting IEGR unit

12. Change the O-rings on the pipe between the two IEGR sections. Lubricate the O-rings.
13. Remove the replacement bolts from the IEGR unit's installation holes.
14. Install the IEGR unit.
15. With overlapping valves for cylinder 6, adjust IEGR-opening piston for cylinder 1, 3 and 5. Procedure for adjusting IEGR-opening piston:



**Figure 13**

1. 885812 Timing tool
2. Adjusting screw

1. Loosen the adjusting screw's lock bolt on the IEGR unit.
2. Install the protractor on the adjusting screw.
3. Turn the adjusting screw until zero clearance is obtained between the IEGR-opening piston and exhaust rocker arm. Reset the protractor to zero.
4. Turn the adjusting screw counterclockwise 144°.
5. Hold the adjusting screw and tighten the lock nut at the same time. Tightening torque: see [200 Engine, tightening torques](#)

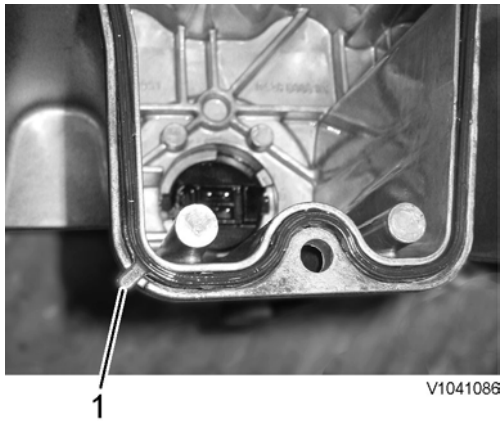
16. Rotate the crankshaft another full turn until the valves for cylinder 1 overlap. Adjust IEGR-opening piston for

cylinder 2, 4 and 6.

17. Install the new gasket on the valve cover.

**NOTE!**

Make sure that the tab (1) on the gasket is positioned correctly.



**Figure 14**

### **Assembly**

18. For assembly, reverse disassembly procedure.

**NOTE!**

Do not reuse the O-rings and gasket.

19. After the completion of the work, start the engine and check for leaks and operating condition.

Document Title: <b>Engine timing gear, description</b>	Function Group: <b>215</b>	Information Type: <b>Service Information</b>	Date: <b>2014/11/7</b>
Profile: <b>EXC, EC210C L [GB]</b>			

## Engine timing gear, description

On the engines, the timing gears are located at the flywheel end for the camshaft and power take-off. Stamped markings on the crankshaft and camshaft gears are used to facilitate correct setting.



**Figure 1**

Document Title: <b>Camshaft, description</b>	Function Group: <b>215</b>	Information Type: <b>Service Information</b>	Date: <b>2014/11/7</b>
Profile: <b>EXC, EC210C L [GB]</b>			

## Camshaft, description

The camshaft is carried in seven bearings. The axial stop for the camshaft is located in the timing gear casing's cover.

On the camshaft gear there are seven teeth pressed in for the cylinder position sensor.

Each bearing runs in a bearing bushing which is pressed into the cylinder block. There is an inlet cam and an exhaust cam for each cylinder. There are also two cams (1) with three cam lobes for the injection pumps.

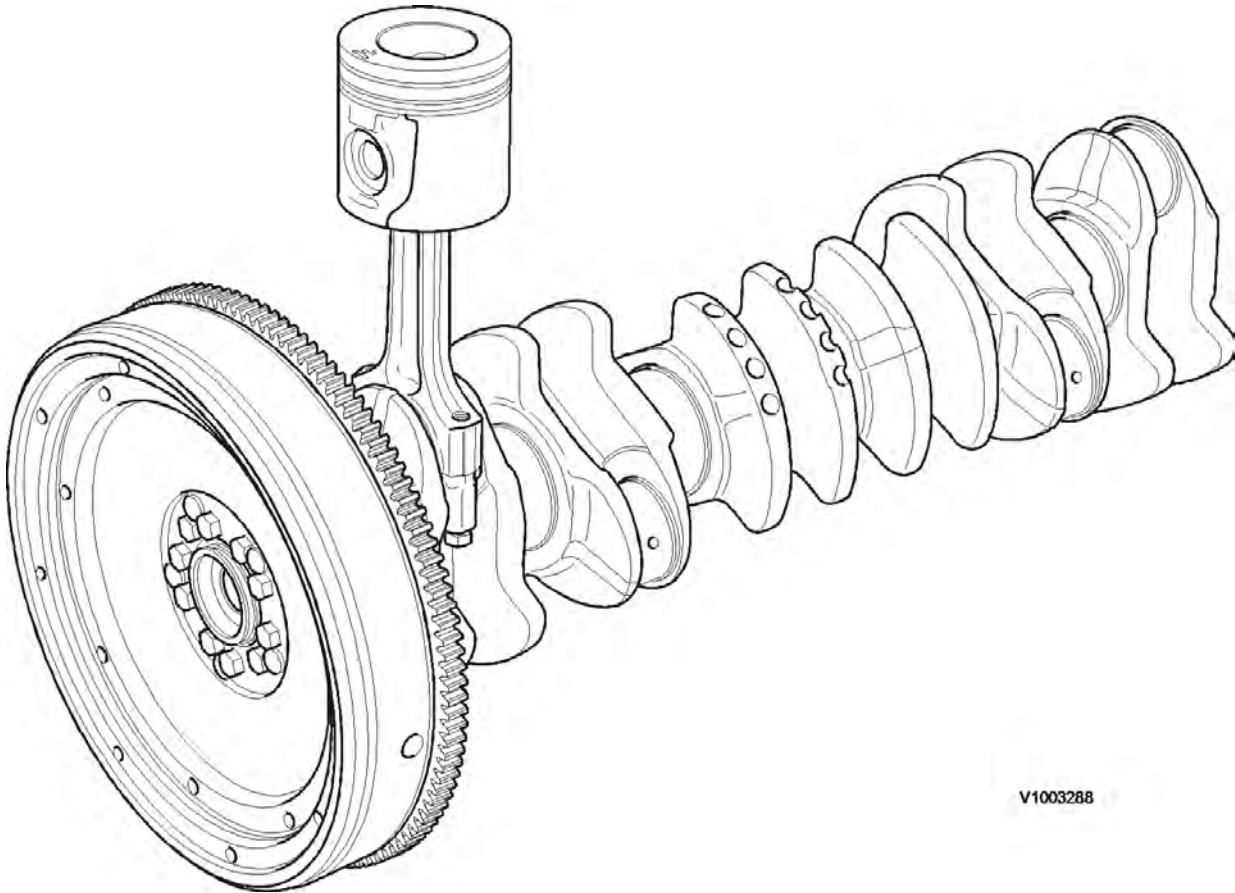


**Figure 1**

Document Title: <b>Crankshaft, description</b>	Function Group: <b>216</b>	Information Type: <b>Service Information</b>	Date: <b>2014/11/7</b>
Profile: <b>EXC, EC210C L [GB]</b>			

## Crankshaft, description

The forged crankshaft is provided with integrated balancing weights. The gear that drives the engine's timing gear and the flange for the flywheel are shrink-mounted on the crankshaft.



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**Figure 1**

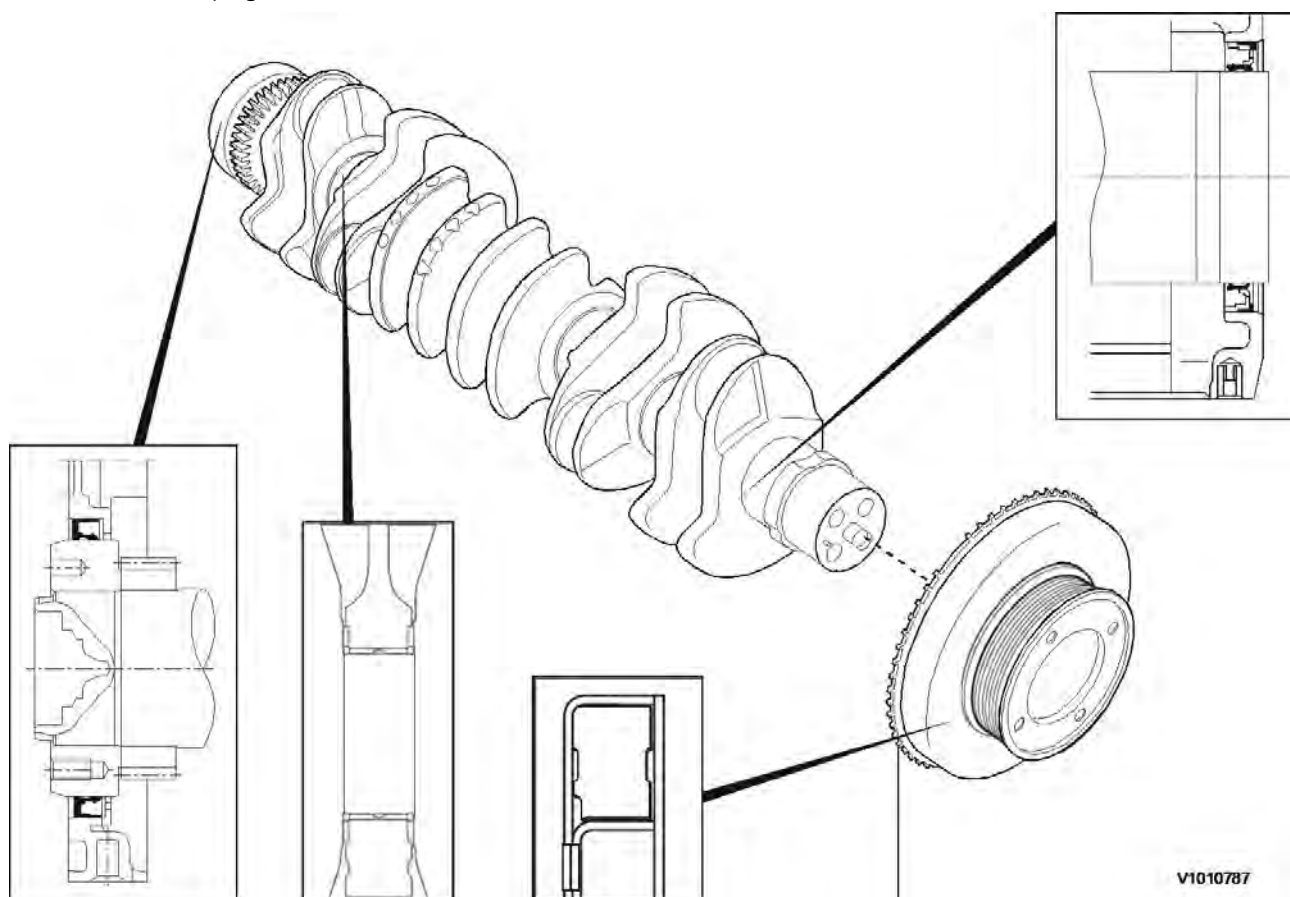


Document Title: <b>Vibration description</b>	damper, <b>216</b>	Function Group:	Information Type: <b>Service Information</b>	Date: <b>2014/11/7</b>
Profile: <b>EXC, EC210C L [GB]</b>				

## Vibration damper, description

The engines are standard-equipped with a vibration damper.

The vibration damper is hydraulic and has a steel ring damper body. The damper's steel ring is not mechanically connected to the damper's housing and thus rotates freely. The space between the steel ring and the housing is filled with viscous oil. When the shaft rotates, the force pulses are transmitted from the pistons and converted to vibrations (oscillations) in the crankshaft. The viscous oil achieves an equalization of the crankshaft's pulsing rotation. The uniform rotation of the steel ring contributes to damping the vibrations.



**Figure 1**  
**Principle illustration**

Document Title: <b>Connecting rod, description</b>	Function Group: <b>rod, 216</b>	Information Type: <b>Service Information</b>	Date: <b>2014/11/7</b>
Profile: <b>EXC, EC210C L [GB]</b>			

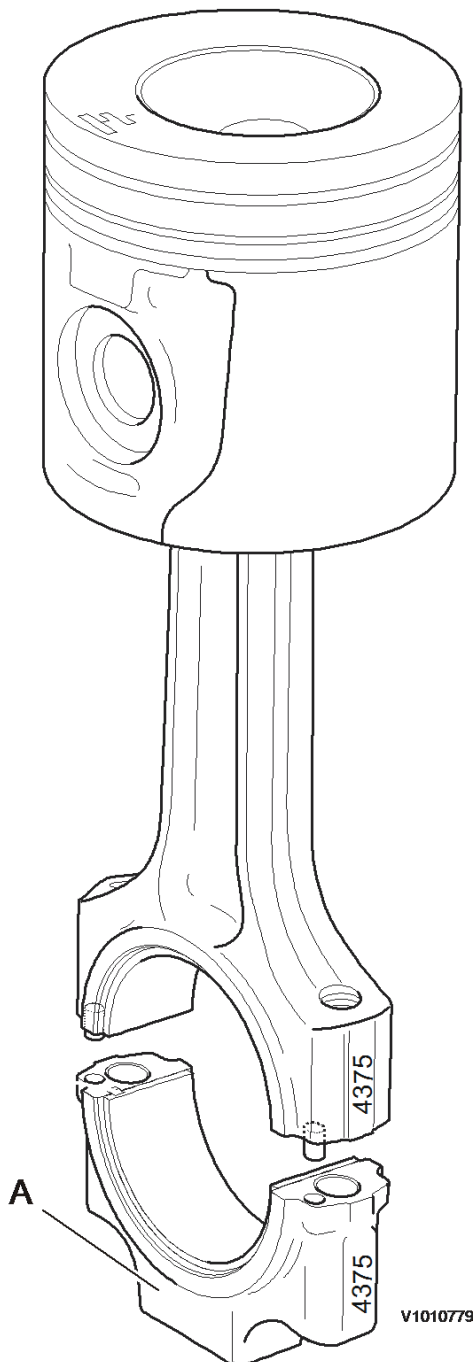
## Connecting rod, description

The connecting rod, made of forged steel, is provided with a balancing weight (A) at the crankshaft bearing (big-end) to compensate for manufacturing tolerances with regards to weight and the position of the centre of gravity.

The number markings at the crankshaft (big-end) bearing end and on the crankshaft bearing cap must face in the same direction and must have the same number.

Guide lugs in the upper and lower bearing shells prevent rotation in the bearing position.

The piston must be fitted so that the flywheel symbol on the piston top faces the flywheel.



**Thank you very much for reading.**

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Document Title: <b>Oil sump, description</b>	Function Group: <b>217</b>	Information Type: <b>Service Information</b>	Date: <b>2014/11/7</b>
Profile: <b>EXC, EC210C L [GB]</b>			

## **Oil sump, description**

### **Oil pan, description**

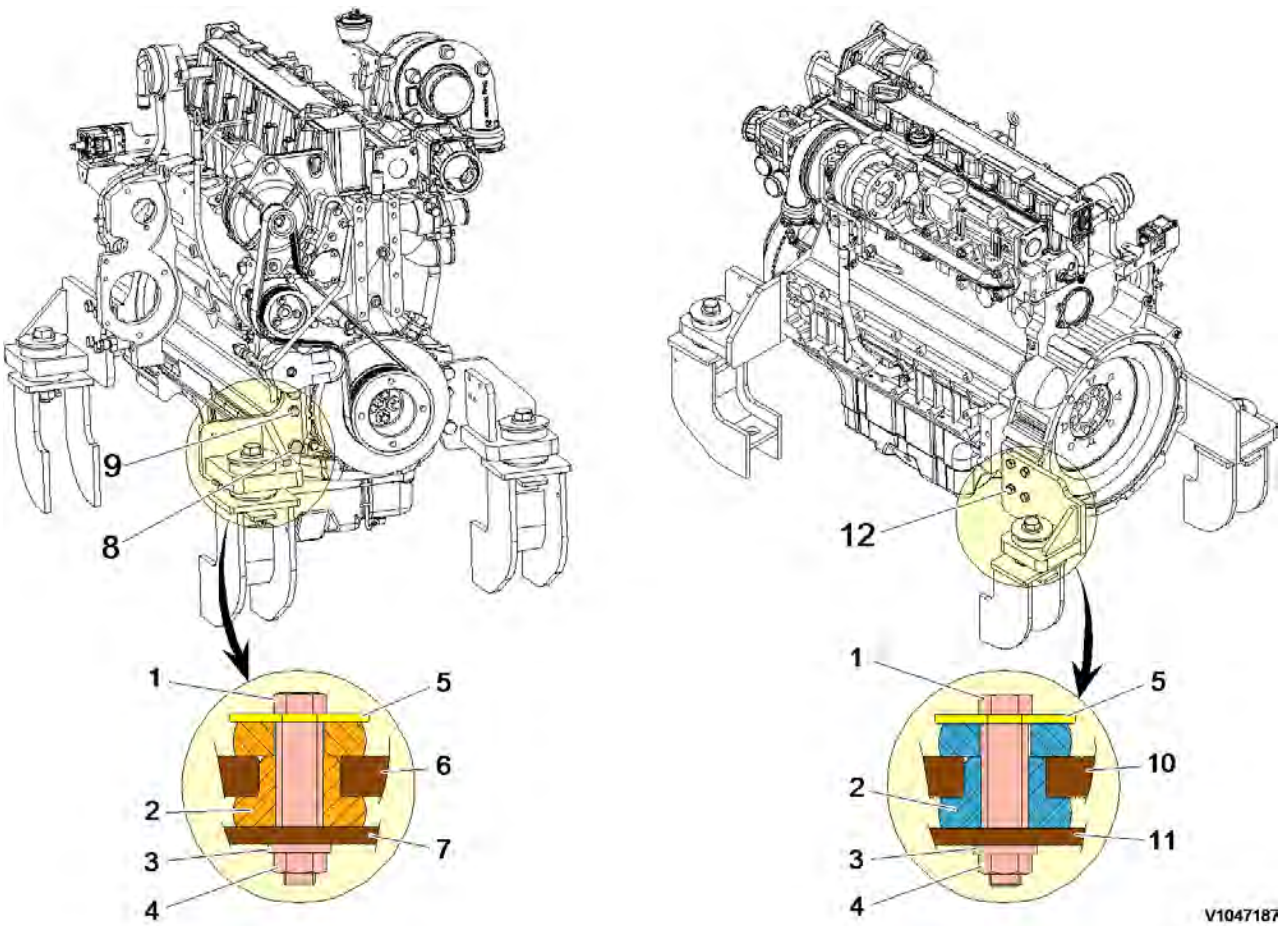
The oil pan has a central sump configuration with quick drain valve and oil level sensor. A gasket and a sealant are used to provide the crankcase to oil pan seal.

Document Title: <b>Engine mounting</b>	Function Group: <b>218</b>	Information Type: <b>Service Information</b>	Date: <b>2014/11/7</b>
Profile: <b>EXC, EC210C L [GB]</b>			

## Engine mounting

**NOTE!**

This figure is for the EC210CL/LR/N machines. Turbocharger mounting position of the EC210CNL is different from EC210CL/LR/N but engine mounting is the same as the EC210CL/LR/N machines.



**Figure 1**  
**Engine mounting**

Fan side : yellow and white  
Flywheel side : blue and white

**Tightening torque, unit: kgf·m (lbf·ft)**

No.	Mounting position	Tightening torque
1	Screw (fan and flywheel side)	70 ±7 (505 ±51)
2	Cushion	-
3	Washer	-
4	Nut	-
5	Plate	-

6	Engine mounting bracket (fan side)	-
7	Frame (fan side)	-
8	Screw	26 ±0.5 (188 ±14)
9	Screw	11.5 ±0.5 (83 ±4)
10	Engine mounting bracket (flywheel side)	-
11	Frame (flywheel side)	-
12	Screw	11.5 ±0.5 (83 ±4)