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|---|-------------------------------|---|----------------------------|
| Document Title: Engine, description | Function Group: 200 | Information Type: Service Information | Date: 2014/11/28 |
| Profile: EXC, EC140C L [GB] | | | |

Engine, description

D4E - tier 3 compliant

The D4E configuration is a four stroke, straight four cylinder, turbocharged, direct injected diesel engine with charge air cooling and wet, replaceable cylinder liners.

The D4E engine uses a Common Rail Fuel System controlled by the engine electronic control (E-ECU) software.

Mechanically controlled IEGR (Internal Exhaust Gas Recirculation) reduces NO_x 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.

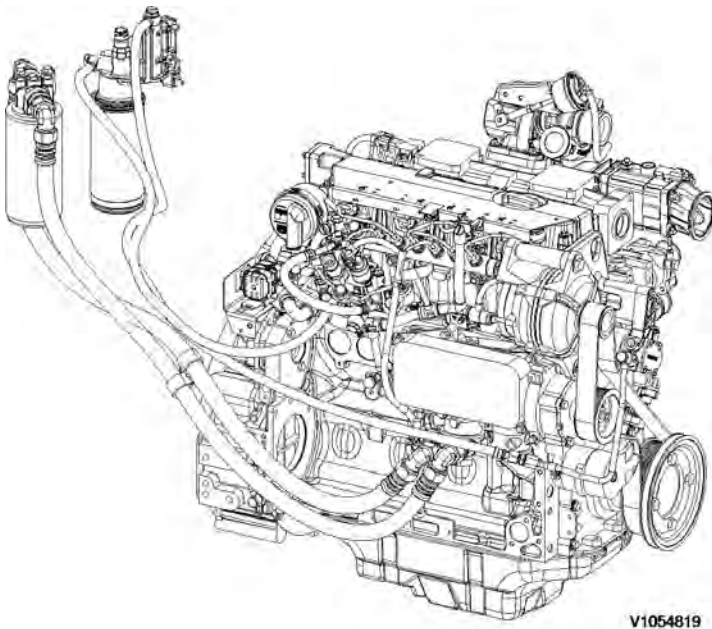


Figure 1
Engine, D4E

| | | | |
|--|-------------------------------|---|----------------------------|
| Document Title: Engine, identification | Function Group: 200 | Information Type: Service Information | Date: 2014/11/28 |
| Profile: EXC, EC140C L [GB] | | | |

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.

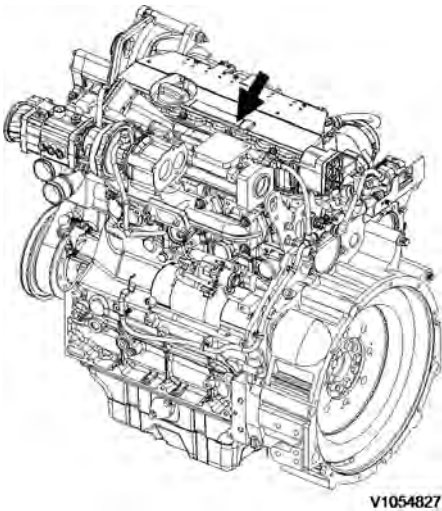


Figure 1
Engine identification, D4E

| | | | |
|--|-------------------------------|---|----------------------------|
| Document Title: Engine, tightening torques | Function Group: 200 | Information Type: Service Information | Date: 2014/11/28 |
| Profile: EXC, EC140C L [GB] | | | |

Engine, tightening torques

NOTICE

Regarding bolted joints which are not listed here, see "Volvo standard tightening torques"

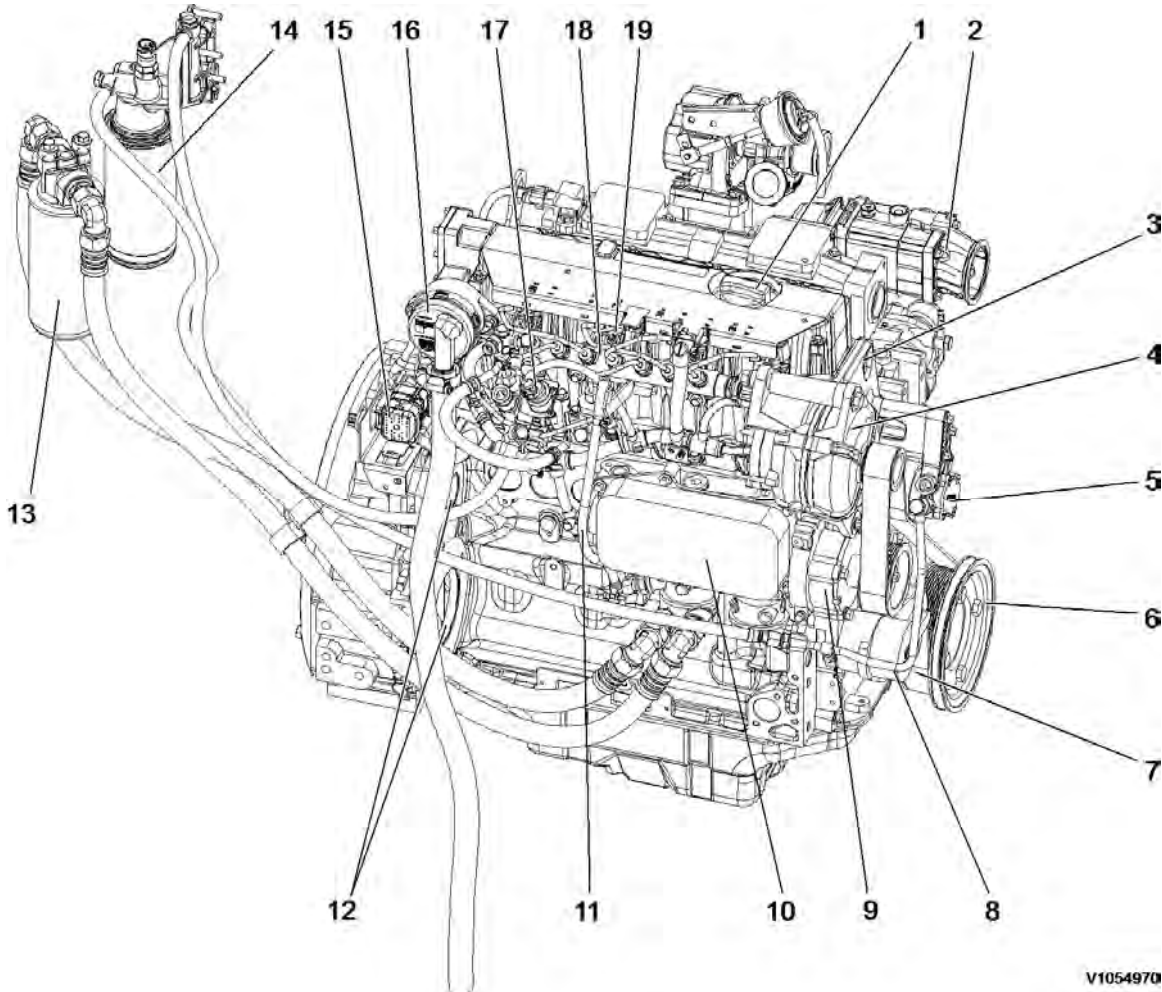
| Engine, tightening torque | |
|--|---|
| Rocker arm bracket on cylinder head | 30 Nm (22.2 lbf ft) |
| Cylinder head cover (M6) on cylinder head | 13 Nm (9.6 lbf ft) |
| Exhaust return module on cylinder head | Step 1: 10 Nm (7.4 lbf ft) Step 2: 30 Nm (22.2 lbf ft) |
| Lock nut, valve adjusting screw | 20 ±2 Nm (14.8 ±1.5 lbf ft) |
| Locking screw on cylinder head | 34 Nm (25.2 lbf ft) |
| Solenoid valve on cylinder head | 24 Nm (17.8 lbf ft) |
| Front cover on crankcase | Step 1: 3 Nm (2.2 lbf ft) Step 2: 21 Nm (15.5 lbf ft) |
| Drain plug on oil pan, M18 | 55 Nm (40.7 lbf ft) |
| Crankcase ventilation on cylinder head | 21 Nm (15.5 lbf ft) |
| Return line to return stop valve | 30 Nm (22.2 lbf ft) |
| Return stop valve to crankcase | 80 Nm (59.2 lbf ft) |
| Impulse transmitter (crankshaft) on holder on front cover | 9 Nm (6.7 lbf ft) |
| Impulse transmitter (camshaft) on gearcase | 9 Nm (6.7 lbf ft) |
| Turbocharger on exhaust manifold | 42 Nm (31.1 lbf ft) |
| Clamping shoe injector on cylinder head | 16 Nm (11.8 lbf ft) |
| Injection lines on rail and injector, high pressure line on high-pressure pump | 25 Nm (18.5 lbf ft) |
| Fuel supply pump on holder | 22 Nm (16.3 lbf ft) |
| Holder fuel supply pump on holder | 30 Nm (22.2 lbf ft) |
| V-belt pulley on fuel supply pump | 27 Nm (20.0 lbf ft) |
| High pressure pump on crankcase, M10 | Step 1: 10 Nm (7.4 lbf ft) Step 2: 50 Nm (37.0 lbf ft) |
| Fuel control valve | 30 Nm (22.2 lbf ft) |
| Fuel pipe on high pressure pump | 29 Nm (21.5 lbf ft) |
| Fuel pipe on control block | 39 Nm (28.9 lbf ft) |
| Rail on cylinder head | 30 Nm (22.2 lbf ft) |
| Pressure relief valve on rail | 100 Nm (74.0 lbf ft) |
| Rail pressure sensor on rail | 70 Nm (51.8 lbf ft) |
| Pipe clips, fuel line fastening | 30 Nm (22.2 lbf ft) |
| Fuel line on control block, fuel filter console and rail | 39 Nm (28.9 lbf ft) |
| Fuel pipe (return) on control block | 49 Nm (36.3 lbf ft) |
| Fuel pipe (return) on cylinder head | 29 Nm (21.5 lbf ft) |
| Fuel line on fuel filter8 | 39 Nm (28.9 lbf ft) |
| Fuel filter console/radiator tank on crankcase | 30 Nm (22.2 lbf ft) |

| | |
|---|---------------------|
| Fuel pressure sensor on fuel filter console | 30 Nm (22.2 lbf ft) |
| Cover plate on cylinder cover, M6 | 30 Nm (22.2 lbf ft) |

| | | | |
|---|-------------------------------|---|----------------------------|
| Document Title: Component locations | Function Group: 200 | Information Type: Service Information | Date: 2014/11/28 |
| Profile: EXC, EC140C L [GB] | | | |

Component locations

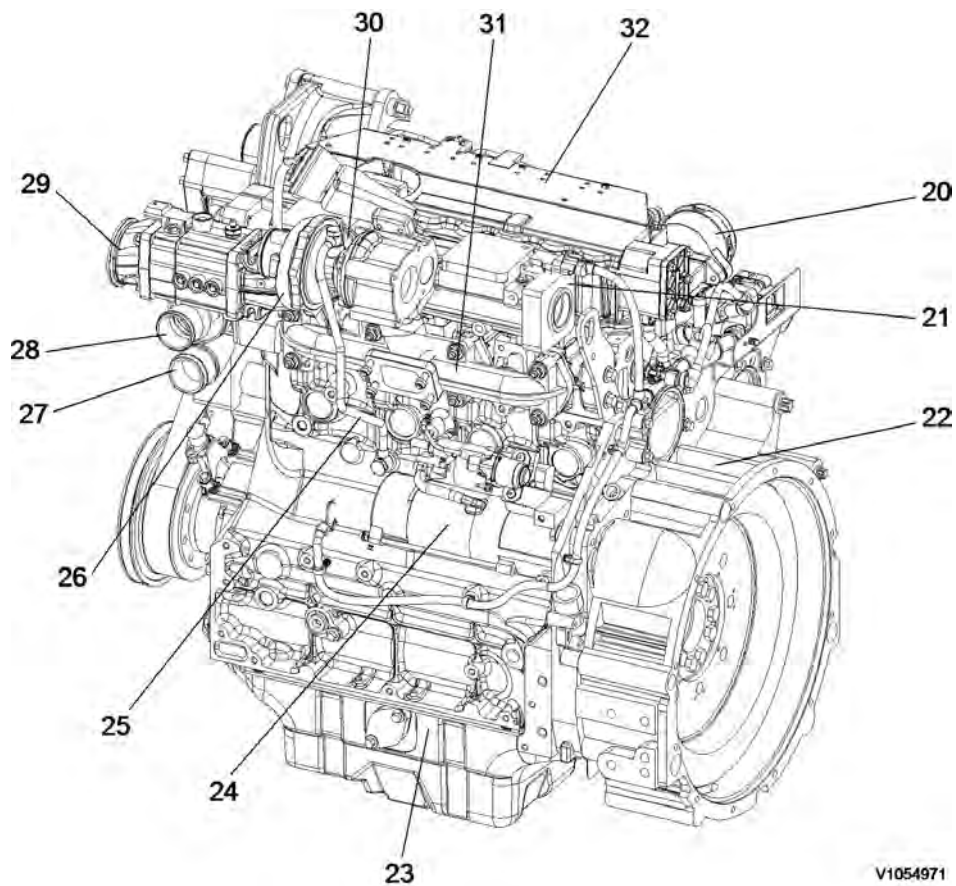
Component position, engine D4E. The following figures show the position of a number of components on engine D4E.



V1054970

Figure 1
Component locations, front side

| | | | |
|----|--------------------------------|----|--------------------------|
| 1 | Engine oil filler | 11 | Oil dipstick |
| 2 | Air inlet | 12 | Power take off |
| 3 | Transport eye | 13 | Engine oil filter |
| 4 | Alternator | 14 | Fuel filter |
| 5 | Fuel feed pump | 15 | Connection to E-ECU |
| 6 | V-rib belt drive on crankshaft | 16 | Crankcase bleeding valve |
| 7 | V-rib belt | 17 | High pressure fuel pump |
| 8 | Automatic belt tensioner | 18 | Common rail |
| 9 | Coolant pump | 19 | Injector |
| 10 | Engine oil cooler | | |



V1054971

Figure 2
Component locations, flywheel side

| | | | |
|----|-----------------------------------|----|------------------------------------|
| 20 | Crankcase bleeding valve | 27 | Coolant inlet |
| 21 | Charge air manifold | 28 | Coolant outlet |
| 22 | Flywheel housing | 29 | Air inlet (from charge air cooler) |
| 23 | Oil pan | 30 | Air outlet (to charge air cooler) |
| 24 | Start motor | 31 | Exhaust manifold |
| 25 | Oil return line from turbocharger | 32 | Cylinder rocker arm cover |
| 26 | Turbocharger | | |

| | | | |
|---|-------------------------------|---|----------------------------|
| Document Title: Valves, adjusting | Function Group: 214 | Information Type: Service Information | Date: 2014/11/28 |
| Profile: EXC, EC140C L [GB] | | | |

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.
3. Remove charge air cooler inlet hose (1).

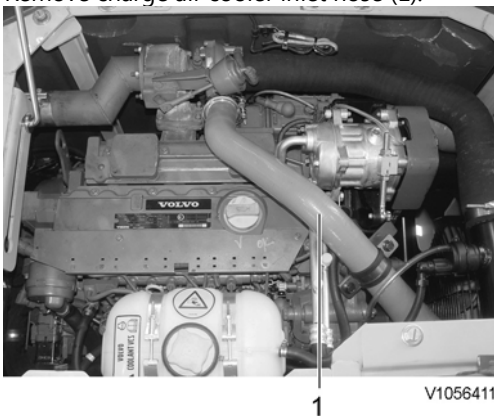


Figure 1

4. Remove cover plate (1).

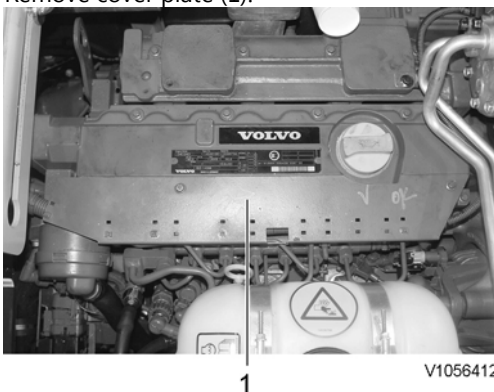


Figure 2

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

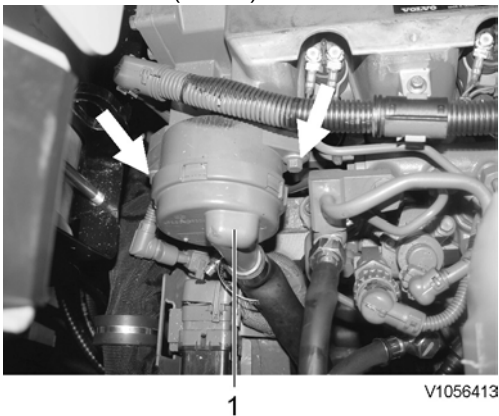


Figure 3

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



Figure 4

7. Remove the hydraulic tank upper cover.



Figure 5

8. Remove the timing gear cover and install turning tool (1).

NOTE!

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

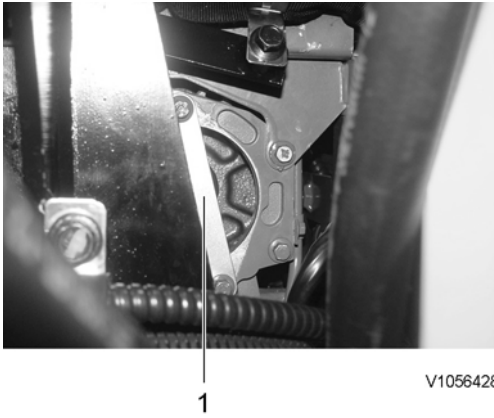


Figure 6

9. Rotate the engine to a position where the valves on cylinder 1 overlap. Mark the position on the vibration damper.

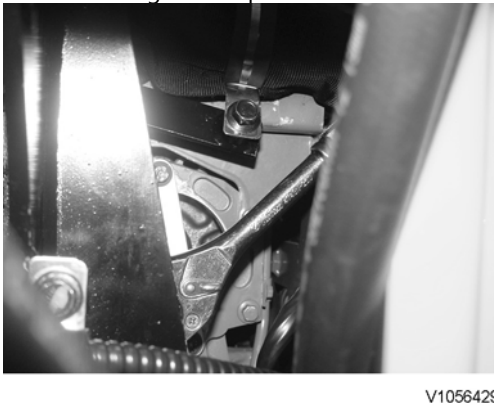


Figure 7

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.

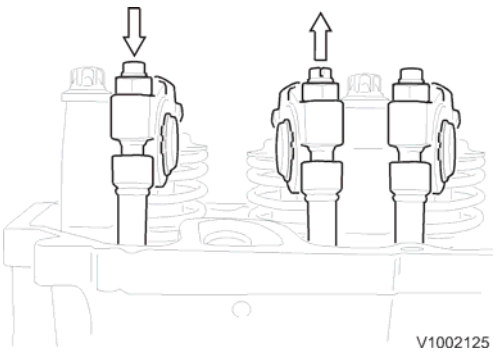


Figure 8
Overlapping

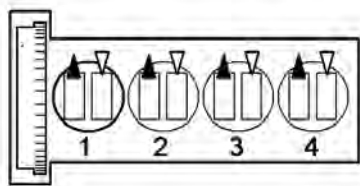


Figure 9
Cylinder orientation

- White arrows = inlet valves
- Black arrows = exhaust valves

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

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 according to [214 Valve system, specification](#).
5. Hold the adjusting screw and tighten the lock nut at the same time. Tightening torque: see [200 Engine, tightening torques](#).

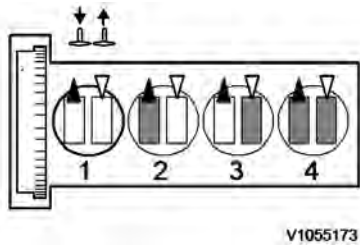


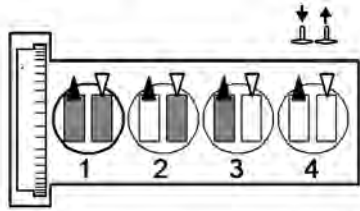
Figure 10
Grey-marked valves can be adjusted when valves for cylinder 1 overlap.



Figure 11

1. 885812 Timing tool
2. Adjusting screw

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



V1055174

Figure 12

Grey-marked valves can be adjusted when valves for cylinder 6 overlap.

12. For assembly, reverse disassembly procedure.

NOTE!

Do not reuse the O-rings and gasket.

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

| | | | |
|---|-------------------------------|---|----------------------------|
| Document Title: Engine timing gear, description | Function Group: 215 | Information Type: Service Information | Date: 2014/11/28 |
| Profile: EXC, EC140C L [GB] | | | |

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.

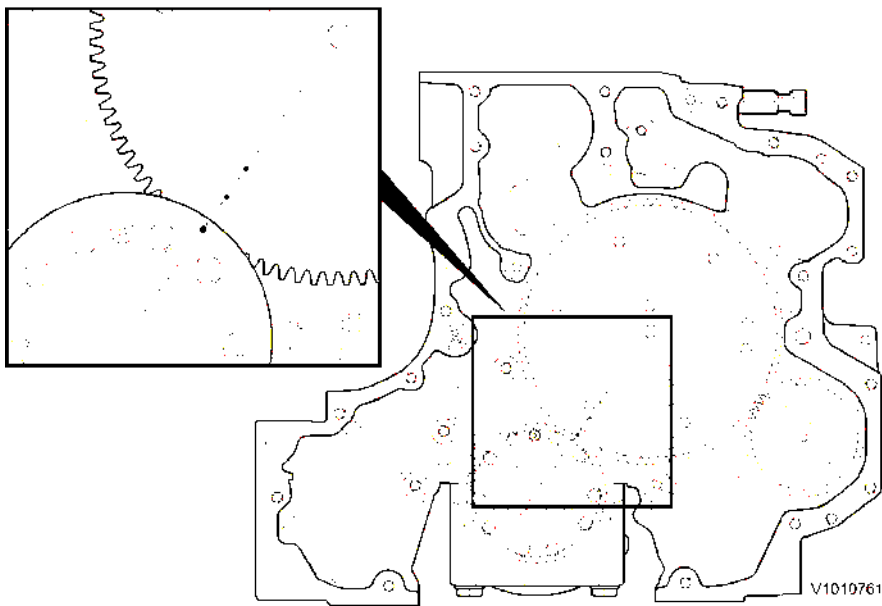


Figure 1

| | | | |
|---|-------------------------------|---|----------------------------|
| Document Title: Camshaft, description | Function Group: 215 | Information Type: Service Information | Date: 2014/11/28 |
| Profile: EXC, EC140C L [GB] | | | |

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.

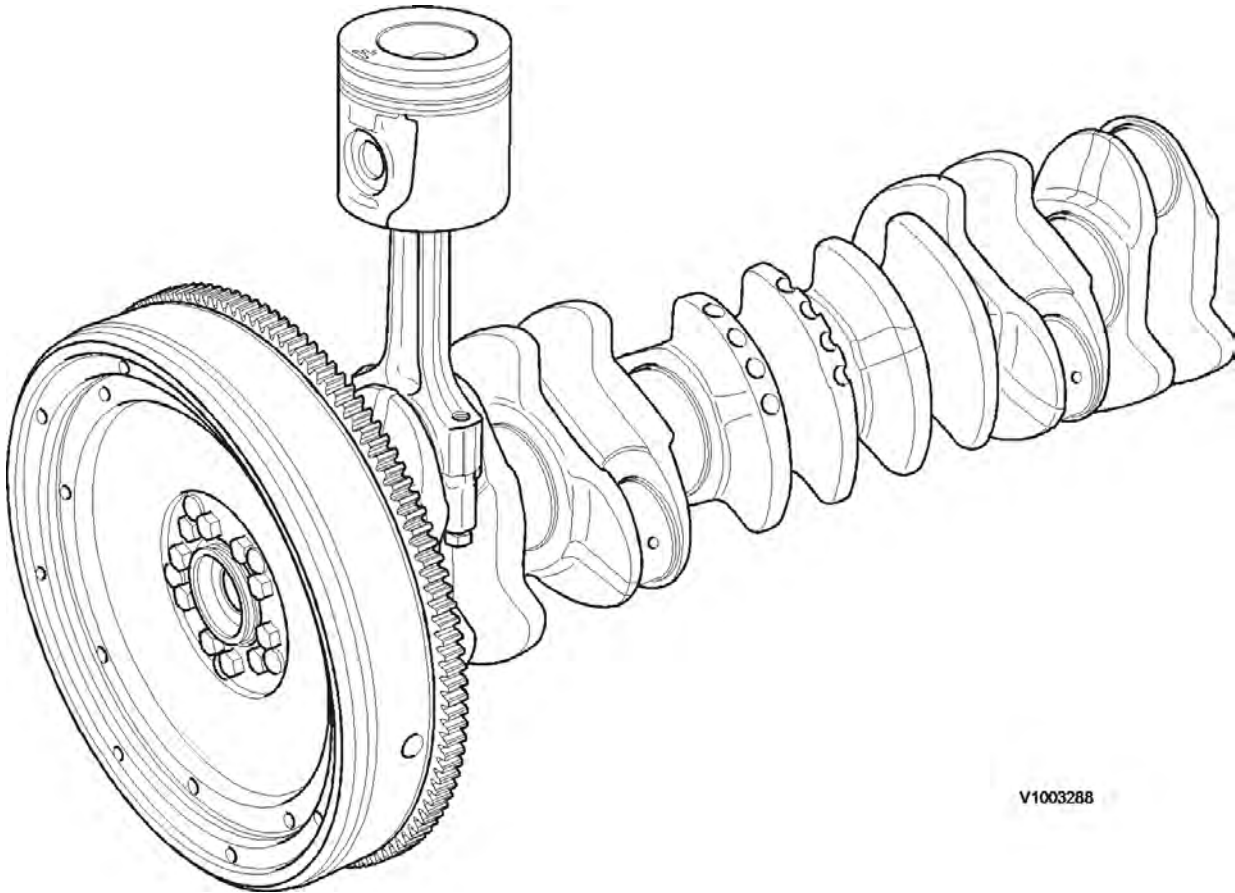


Figure 1

| | | | |
|---|-------------------------------|---|----------------------------|
| Document Title: Crankshaft, description | Function Group: 216 | Information Type: Service Information | Date: 2014/11/28 |
| Profile: EXC, EC140C L [GB] | | | |

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.



V1003288

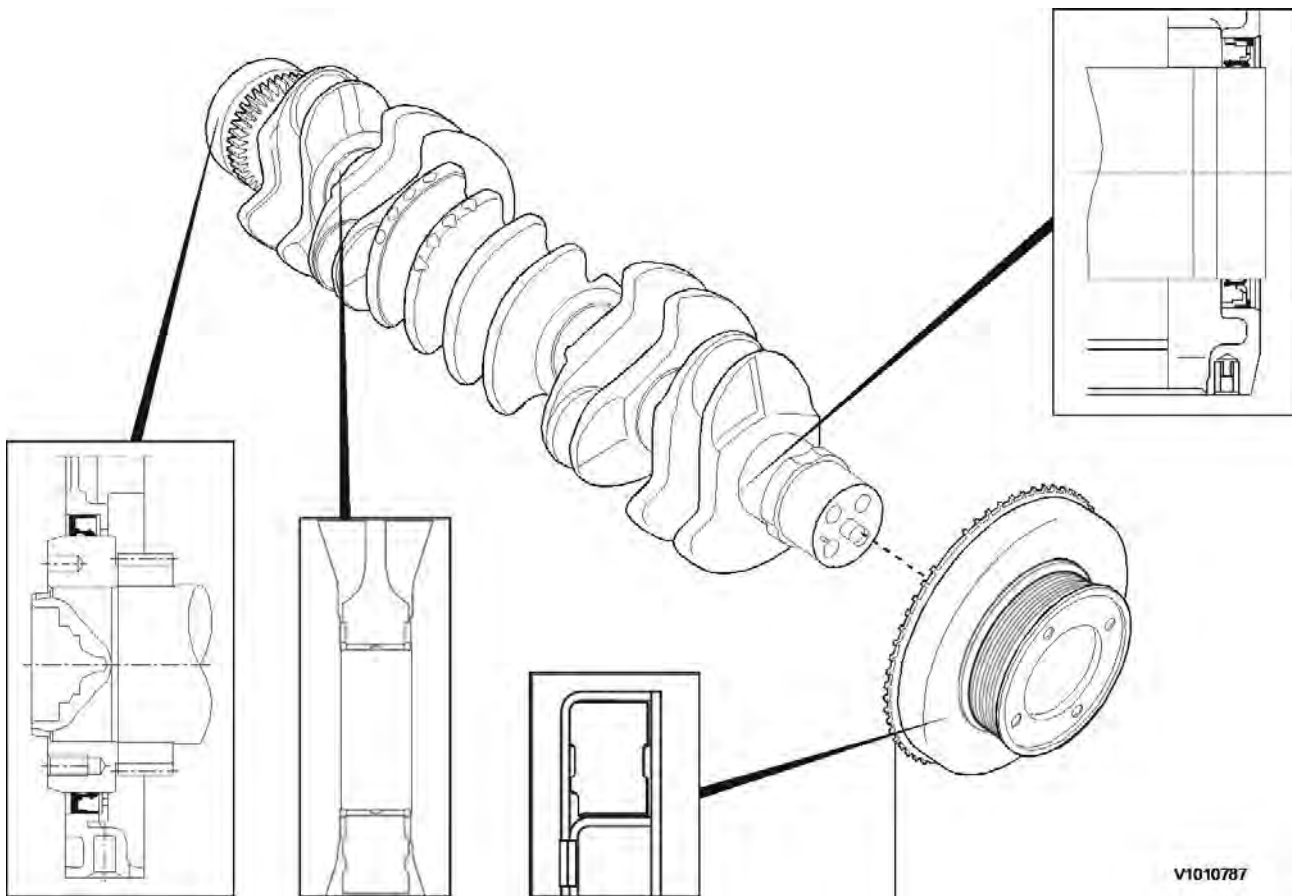
Figure 1

| | | | | |
|---|-----------------------|-----------------|---|----------------------------|
| Document Title: Vibration description | damper, 216 | Function Group: | Information Type: Service Information | Date: 2014/11/28 |
| Profile: EXC, EC140C L [GB] | | | | |

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.



V1010787

Figure 1
Principle illustration

| | | | |
|---|------------------------------------|---|----------------------------|
| Document Title: Connecting rod, description | Function Group: rod, 216 | Information Type: Service Information | Date: 2014/11/28 |
| Profile: EXC, EC140C L [GB] | | | |

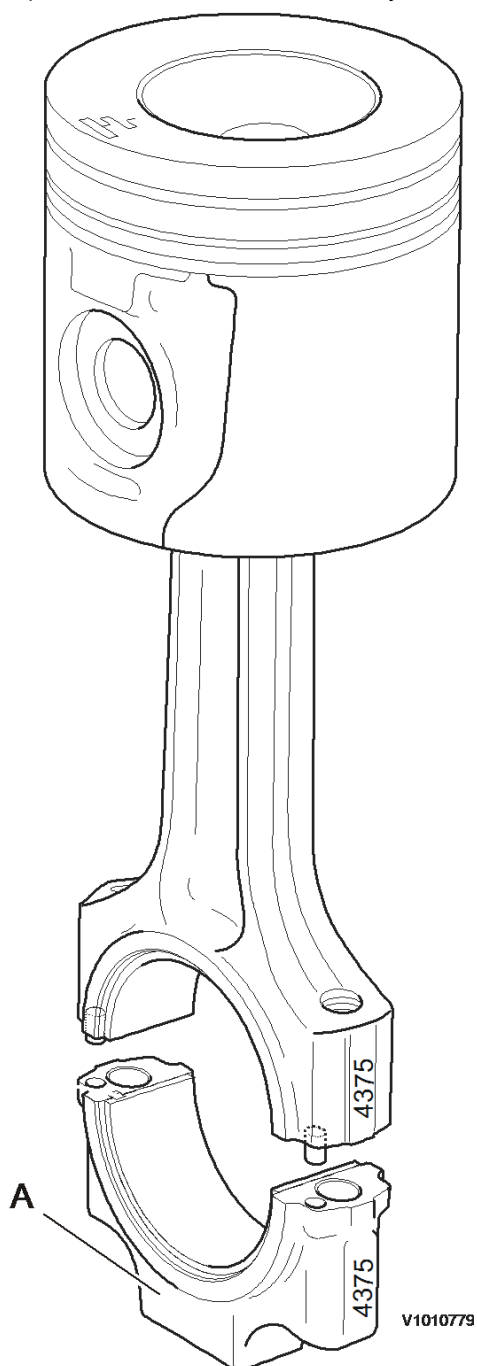
Connecting rod, description

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.



| | | | |
|---|-------------------------------|---|----------------------------|
| Document Title: Engine mounting | Function Group: 218 | Information Type: Service Information | Date: 2014/11/28 |
| Profile: EXC, EC140C L [GB] | | | |

Engine mounting

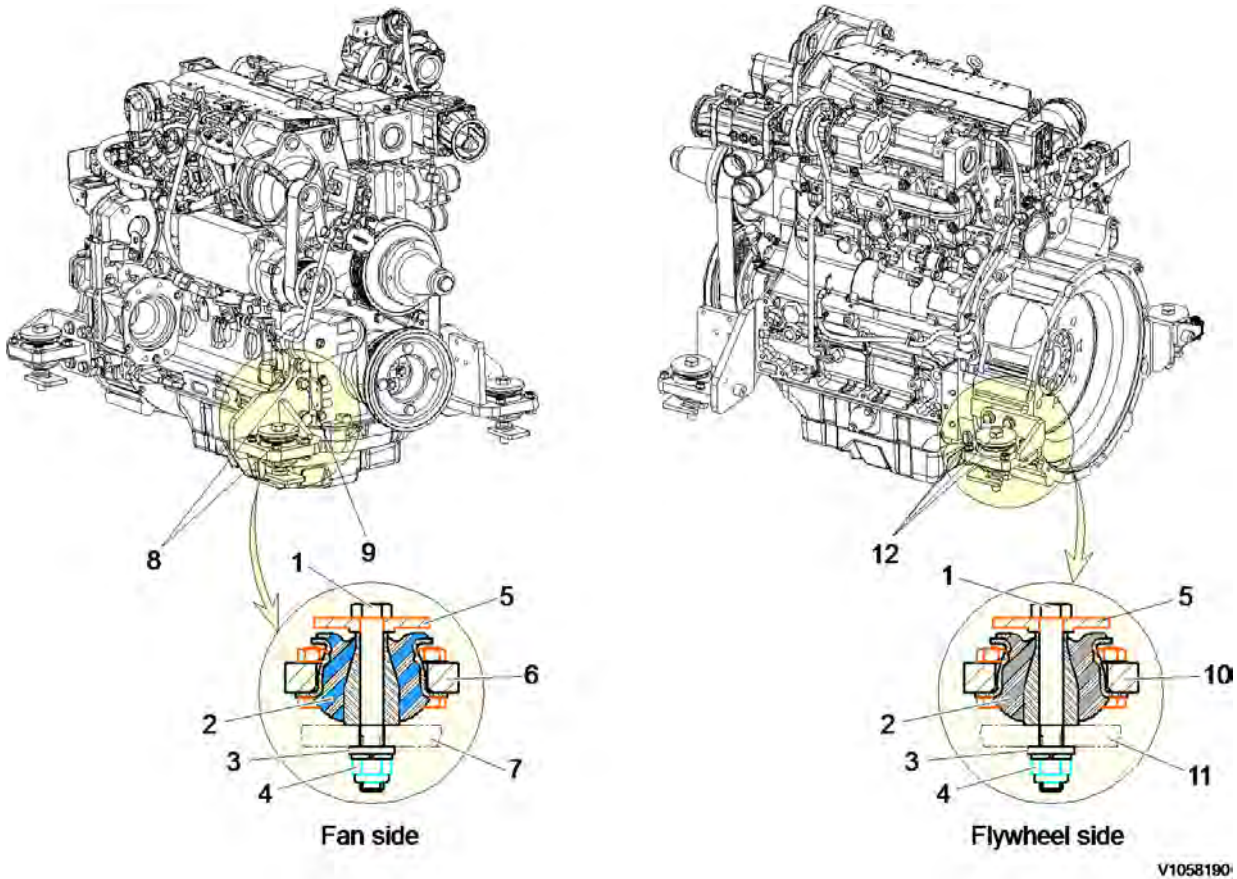


Figure 1
Engine mounting

- | | |
|-----------------------------------|-----------------------------------|
| 1 Screw | 7 Frame |
| 2 Cushion | 8 Screw |
| 3 Washer | 9 Screw |
| 4 Nut | 10 Engine mounting bracket (rear) |
| 5 Plate | 11 Frame |
| 6 Engine mounting bracket (front) | 12 Screw |

NOTE!

Check the color markings for cushion installation.

- Front (fan end): Blue color
- Rear (flywheel end): Beige color

Screw tightening torque, unit: Nm (kgf m, lbf ft)

| No. | Tightening torque |
|-----|-------------------|
|-----|-------------------|

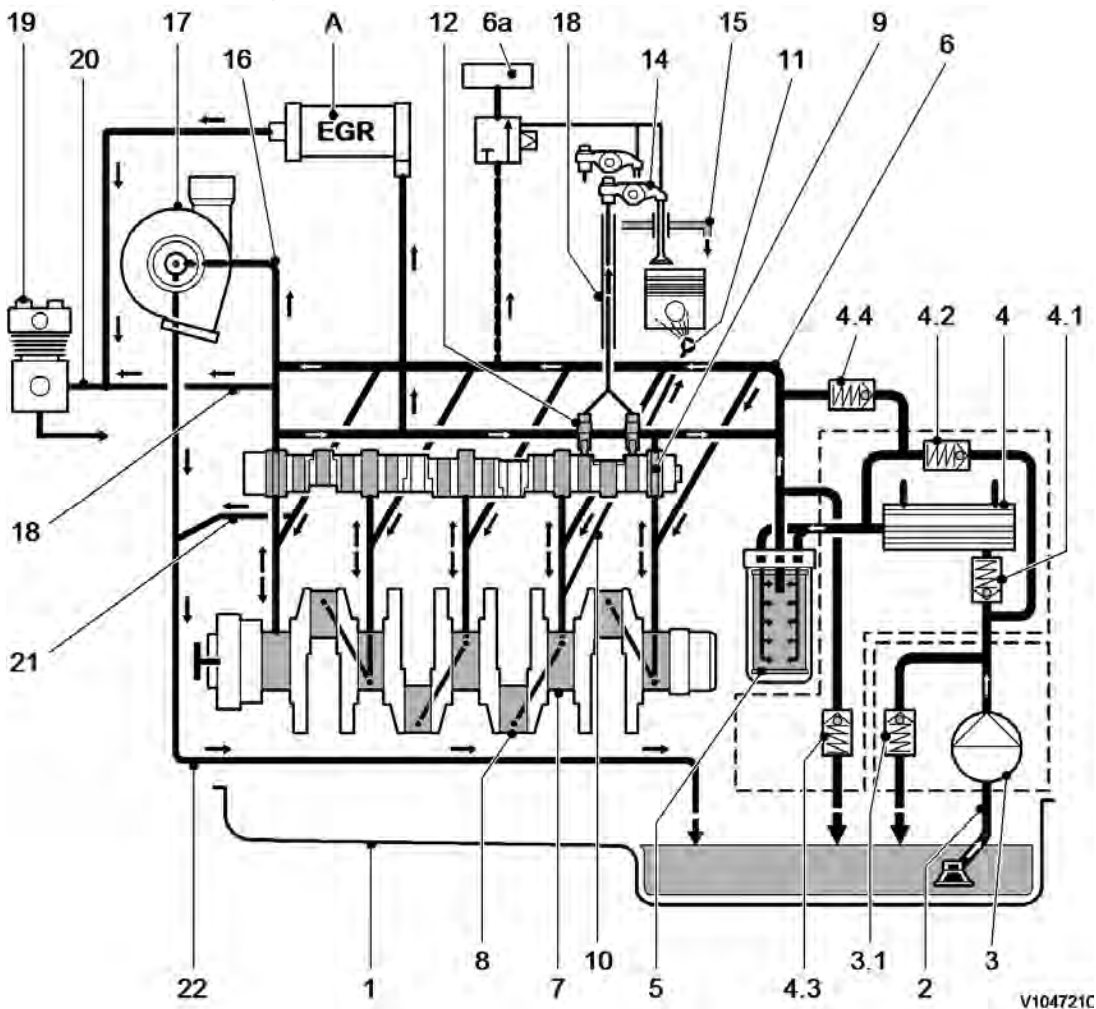
| | |
|----|--|
| 1 | 142 ±15 (14.5 ±1.5, 105 ±11) |
| 8 | 262 ±66 (26.7 ±6.7, 193 ±48) Assembling after coated with Loctite. |
| 9 | 110 ±12 (11.2 ±1.2, 81 ±8.5) |
| 12 | Assembling after coated with Loctite. |

| | | | | |
|---|-------------|-------------------------------|---|----------------------------|
| Document Title: Lubrication description | system, 220 | Function Group: 220 | Information Type: Service Information | Date: 2014/11/28 |
| Profile: EXC, EC140C L [GB] | | | | |

Lubrication system, description

Engine lubricating oil is supplied to the contact faces of rotating components such as turbocharger, crankshaft, camshaft, piston, inlet/exhaust valve, rocker arm and timing gear by means of forced lubrication from the oil pump.

Lubrication oil flow diagram



V104721C

Figure 1
Lubrication oil flow

| | | | |
|-----|--------------------|----|---|
| 1 | Oil pan | 9 | Camshaft bearing |
| 2 | Intake pipe | 10 | line to injection nozzle |
| 3 | Lube oil pump | 11 | Injection nozzle for piston cooling |
| 3-1 | Safety valve | 12 | Tappet with rocker arm pulse lubrication |
| 4 | Lube oil cooler | 13 | Stop rod, oil supply for rocker arm lubrication |
| 4-1 | Reverse lock valve | 14 | Rocker arm |
| 4-2 | Bypass valve | 15 | Return line to oil pan |

| | | | |
|-----|------------------------------|----|--|
| 4-3 | Bypass valve | 16 | Oil line to exhaust turbocharger |
| 4-4 | Control valve | 17 | Exhaust turbocharger |
| 5 | Exchangeable lube oil filter | 18 | Return line from hydraulic pump |
| 6 | Main oil pipe | 19 | Hydraulic pump |
| 6a | Engine brake lubrication | 20 | Oil line to hydraulic pump |
| 7 | Crankshaft bearing | 21 | Return line from cylinder head |
| 8 | Con rod spring | 22 | Exhaust turbocharger return to crankcase |

| | | | |
|--|-------------------------------|---|----------------------------|
| Document Title: Lubrication system, principle of operation | Function Group: 220 | Information Type: Service Information | Date: 2014/11/28 |
| Profile: EXC, EC140C L [GB] | | | |

Lubrication system, principle of operation

Lube oil ducts

The engine is provided with forced-fed circulation lubrication with lube oil cooler and lube oil filter arranged in full flow. The lube oil is supplied by the lube oil pump through the oil cooler to the oil filter. Both components are mounted to the lube oil cooler housing which is flanged to the crankcase. Downstream of the filter the lube oil flows into the main oil gallery and secondary oil gallery. From here the oil is ducted to the lubricating points.

The main oil gallery supplies:

- Crankshaft
- Camshaft
- Valve tappets
- Roller tappets

The secondary oil gallery supplies:

- Exhaust turbocharger

Lubrication of the rockers is effected via the tappets and the push rods.

Lube oil pump

The lube oil rotary pump is installed in the front cover. The inner rotor (1) is seated on the crankshaft and is driven by same. Its driver contour (4) has no 120° partition, i.e. the rotor can only be slid onto the crankshaft in a specific position. This is attributable to deviating rotor widths.

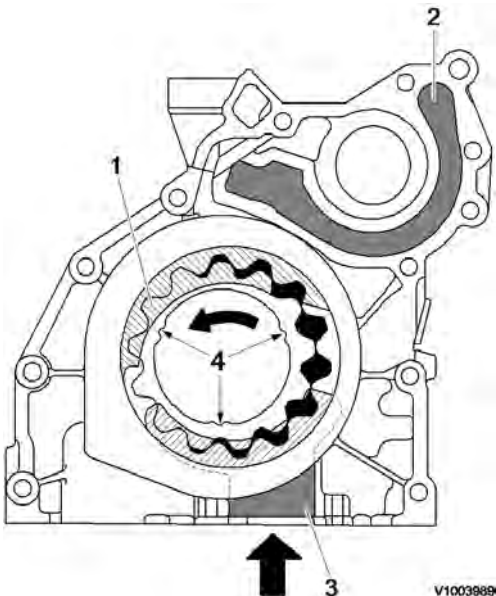


Figure 1
Lube oil pump, sectional view

| | | | |
|---|------------------------------------|---|-----------------|
| 1 | Inner rotor | 3 | Suction chamber |
| 2 | Delivery chamber towards crankcase | 4 | Driver contour |

| | Unit | Specification |
|-------------|---------|---------------|
| Rotor width | mm (in) | 12.3 (0.48) |

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Minimum oil pressure at 120 °C (248 °F) oil temperature, measured at oil filter bracket.

The lubrication oil pump is designed as a rotor pump and is mounted in the front cover. The inner rotor (1) is located on the crankshaft (4), by which it is driven.

Its flange profile has an irregular shape, that is, it can only be fitted on the crankshaft in a certain position.

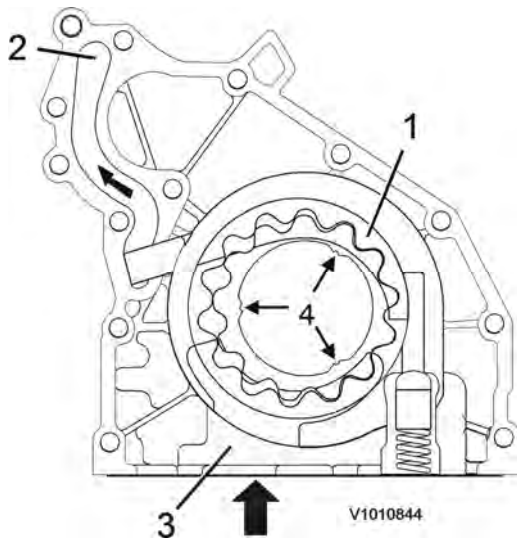


Figure 2

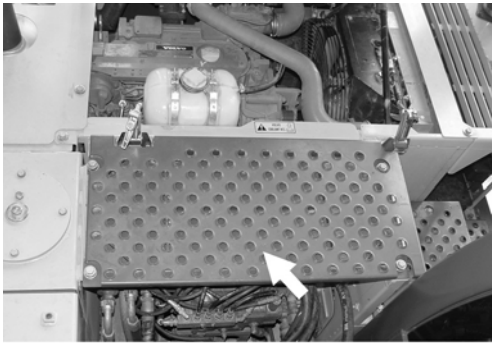
1. Rotor
2. Pressure chamber
3. Suction chamber
4. Crankshaft

| | | | |
|---|-------------------------------|---|----------------------------|
| Document Title: Oil cooler, replacing | Function Group: 223 | Information Type: Service Information | Date: 2014/11/28 |
| Profile: EXC, EC140C L [GB] | | | |

Oil cooler, replacing

Op nbr 223-006

1. Place the machine in service position, see [091 Service positions](#).
2. Open the engine hood.
3. Drain the coolant from the engine, see [261 Coolant changing](#).
4. Remove the MCV cover.



V1076671

Figure 1

5. Remove mounting screws (1) and put away expansion tank (2).



V1076661

Figure 2

6. Remove mounting screws (1) on the clamps.