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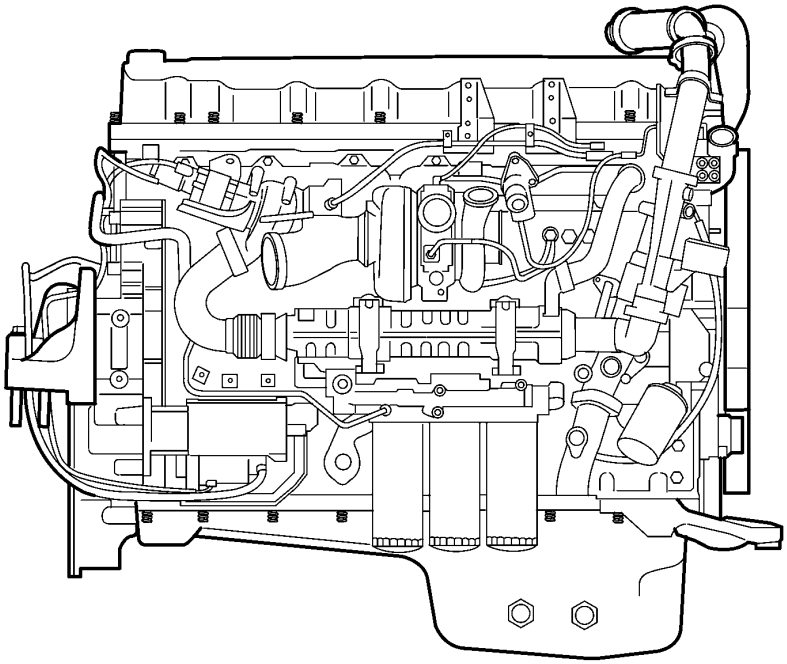
Lubrication and Oil System
Design and Function
D13F

Lubrication and Oil System, Design and Function



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This information covers the design and function of the lubrication and oil system on the Volvo D13F engine.

Contents

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.

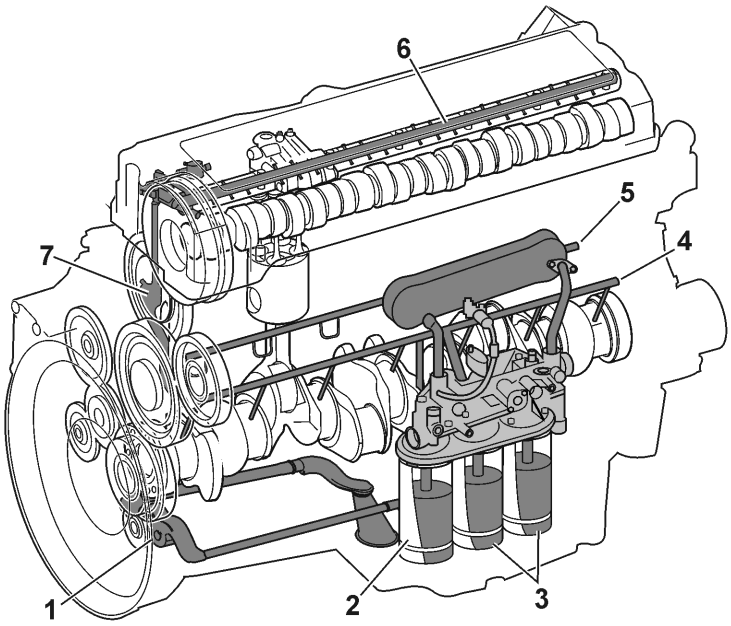
Design and Function

Lubrication and Oil System

General

A gear-type pump at the rear of the engine, driven by the crankshaft gear, draws lubricant from the oil pan and supplies the system. Oil flows from the pump through the distribution housing to the filters. The oil moves to the gallery at the right side of the engine to service the crankshaft journals and to a gallery at the left side of the engine to service the piston lubrication and cooling circuit. The oil also flows to the cylinder head and rocker shaft duct for valve rocker arm and camshaft lubrication and back to the oil pan.

Two full-flow filters and a bypass filter maintain clean lubricant. A sensor in the oil pan monitors fluid level. There is an oil cooler immersed in engine coolant inside the coolant jacket on the right side of the engine block.



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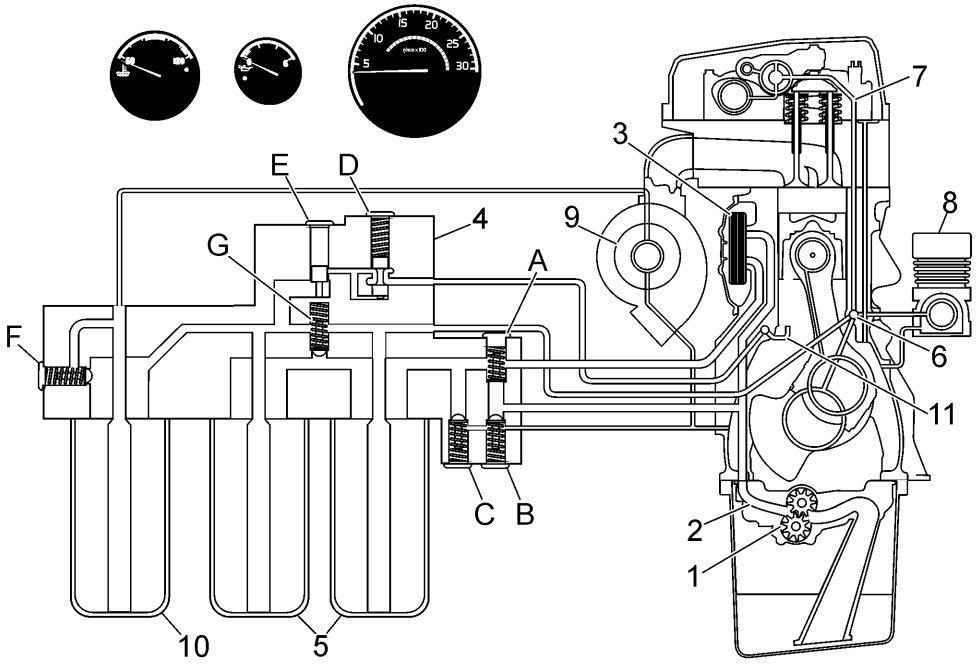
1 Oil Pump
2 Bypass Filter
3 Full-Flow Filters
4 Crankshaft Gallery
5 Piston Cooling Passage
6 Rocker Arm Shaft Duct
7 Rocker Arm Shaft Supply Duct

Lubrication System Operating Principles



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A. Oil Cooler Bypass Valve
B. Safety Valve (Marked Violet)
C. Reduction Valve (Marked Blue)
D. Piston Cooling Control Valve
E. Piston Cooling Opening Valve
F. Bypass Filter Overflow Valve
G. Full-Flow Filter Bypass Valve

The lubrication oil pump (1) forces the oil through the pressure pipe (2) to the drilled channels in the cylinder block. The oil is then channeled to the oil cooler (3) and to the filter housing (4). After being filtered in both full-flow filters (5), the oil is channeled to the cylinder block main lubrication channel (6) for distribution to all engine lubrication points. The lubrication of the cylinder head is through a drilled channel up to the VCB valve (7).

The air compressor (8) and the turbocharger (9) are lubricated through external braided oil lines. The turbocharger oil is filtered by the bypass filter (10). The piston cooling oil is filtered by the full-flow filters and is forced into the cylinder block piston cooling channel. From the piston cooling channel, the oil is sprayed toward the underside of the piston through a piston cooling nozzle (11).

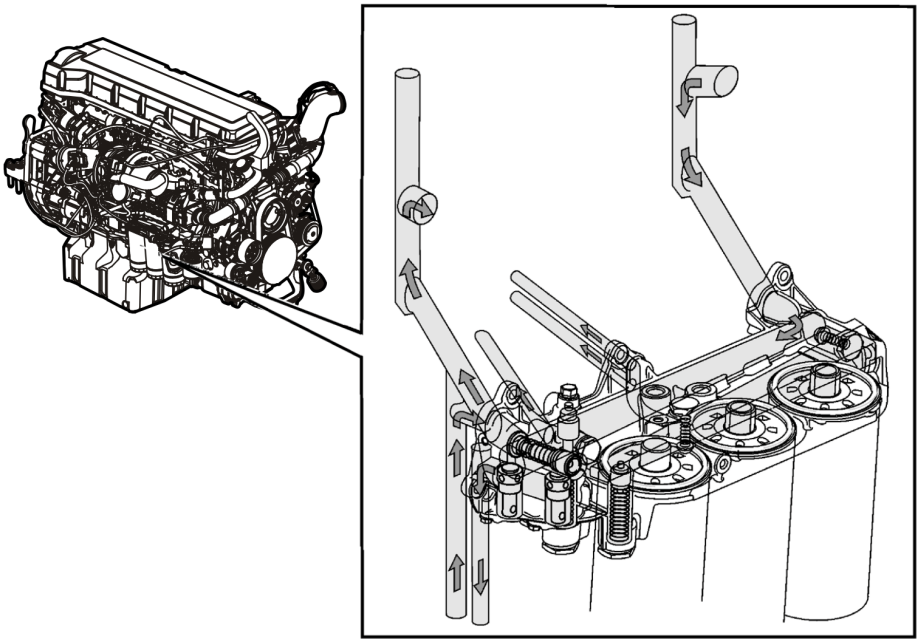
Extreme Cold Start
Extreme cold start is considered to be when starting the engine at temperatures below -20°C (-4°F). The safety valve (B) opens to protect the oil pump against the high pressure that occurs when the oil viscosity is too high. The reduction valve (C), bypass valve (A) and piston cooling valve (E) open due to the high viscosity.

Driving at Low Engine RPM
When driving at low engine rpm at operating temperature, the reduction valve (C) partly opens to maintain the oil pressure within the correct values. The piston cooling valve (E) is open. The piston cooling control valve (D) has begun to control the flow to the piston cooling channel.

Driving at High Engine RPM
When driving at high rpm at operating temperature, valves (C) and (E) are open. In addition, the piston cooling control valve (D) is lifted and opened slightly by the increased oil pressure.

Blocked Oil Filters
If a full-flow filter becomes blocked, the bypass valve (G) opens and unfiltered oil is pumped into the engine lubrication system. If the bypass filter becomes blocked, valve (F) opens so that the turbocharger is supplied with oil filtered through the full-flow filters.

Idling, Hot Engine
At low engine rpm and with the engine at operating temperature, all valves are closed.



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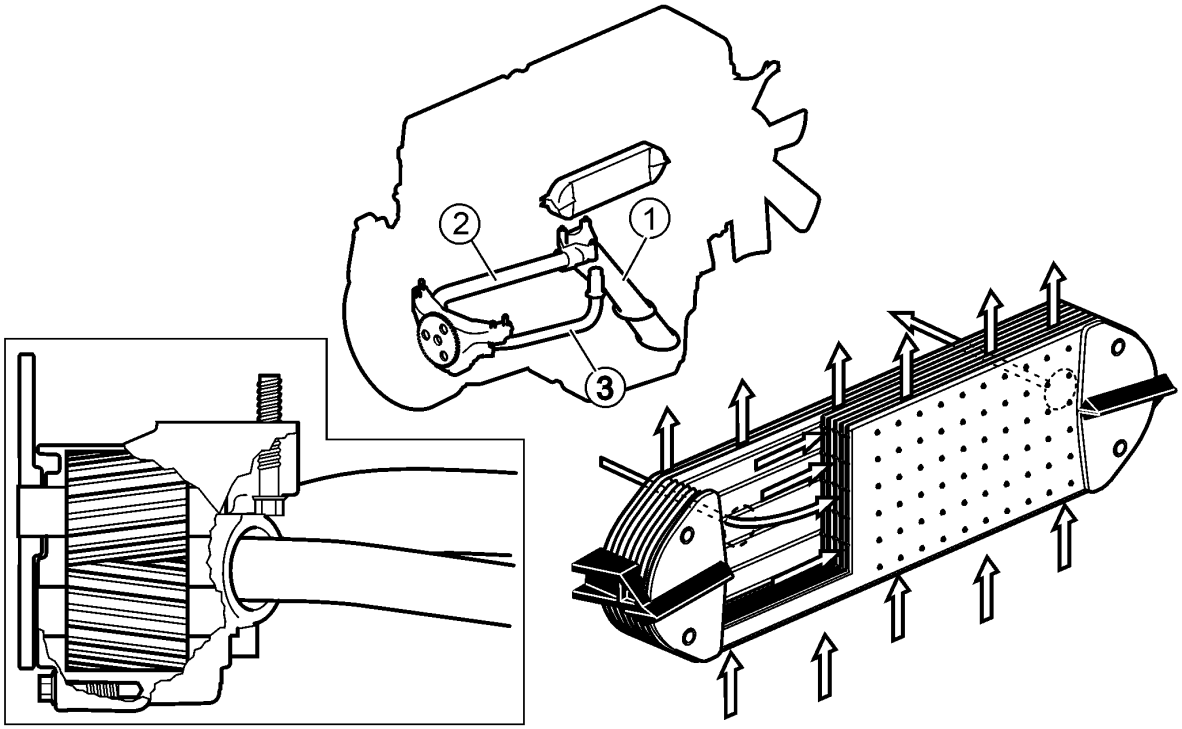
A more detailed picture of the filter housing and valve locations is shown. The arrows in the channels show the oil flow direction between the oil filter housing and the cylinder block.

Oil Pump and Cooler



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The oil pump is located at the rear of the engine and is bolted to the cylinder block lower surface. It is driven by a gear directly from the crankshaft gear. The pump gear is beveled for low noise levels and the shafts are mounted in bearings directly in the pump housing, which is manufactured of aluminum.

The strainer (1) is made of plastic and is bolted on the engine stiffening frame. The suction pipe (2) is made of steel and is sealed at the ends with rubber seals. The pressure pipe (3) is manufactured of steel and is attached to the cylinder block with a fitting.

The oil cooler is bolted directly to the cylinder block under the oil cooler side cover and is completely surrounded by coolant.

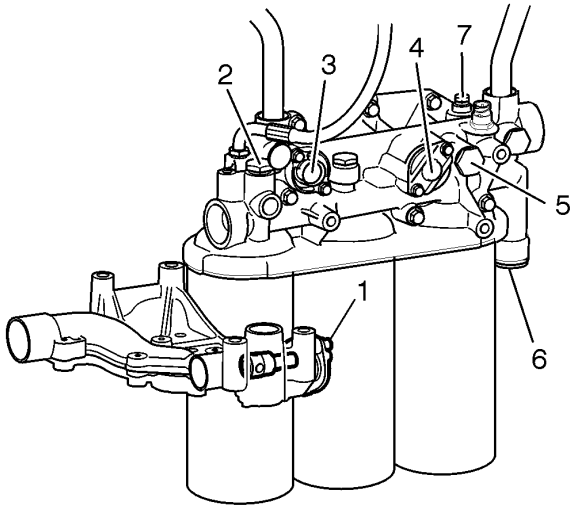
Oil Filtration

One of the designs of the oil lubrication system is to clean out impurities in the oil to prevent them from entering the engine lubrication points and bearing surfaces. As the engine operates, the oil accumulates dirt that needs to be cleaned up before it returns to the lubrication points. The oil is roughly filtered while passing through the oil manifold filter.

The engine lubrication system is equipped with three filters to get rid of the dirt particles. The oil filters are the replaceable spin-on type.

All oil coming through the pump passes through the filters before entering the engine.

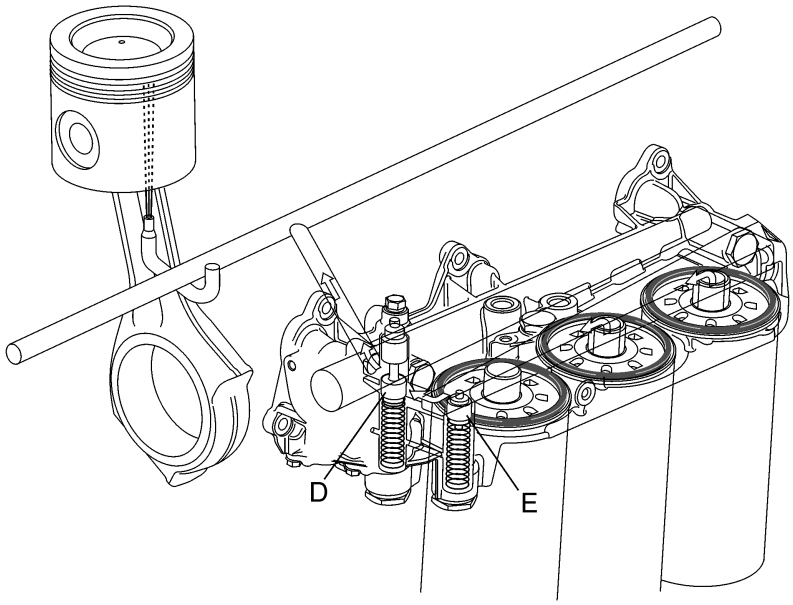
The oil filter housing assembly is mounted on the right side of the cylinder block. Three filter elements attach to the underside of the housing.



T2019191

1 Pump Pressure Relief Valve
2 Bypass Filter Overflow Valve
3 Oil Cooler Overflow Valve
4 Pressure Reduction Valve
5 Full-Flow Filters Overflow Valve
6 Piston Cooling Valve
7 Oil Cooling Control Valve

Piston Cooling System



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Shown is the oil flow for the piston cooling system when the valve (E) has opened and valve (D) balances the oil flow to the piston cooling channel. The piston cooling nozzle is aligned so that the oil jet hits the underside of the piston crown.

By regulating the piston cooling flow using a control valve, an optimized piston cooling system can be achieved with a constant flow of oil regardless of engine rpm.