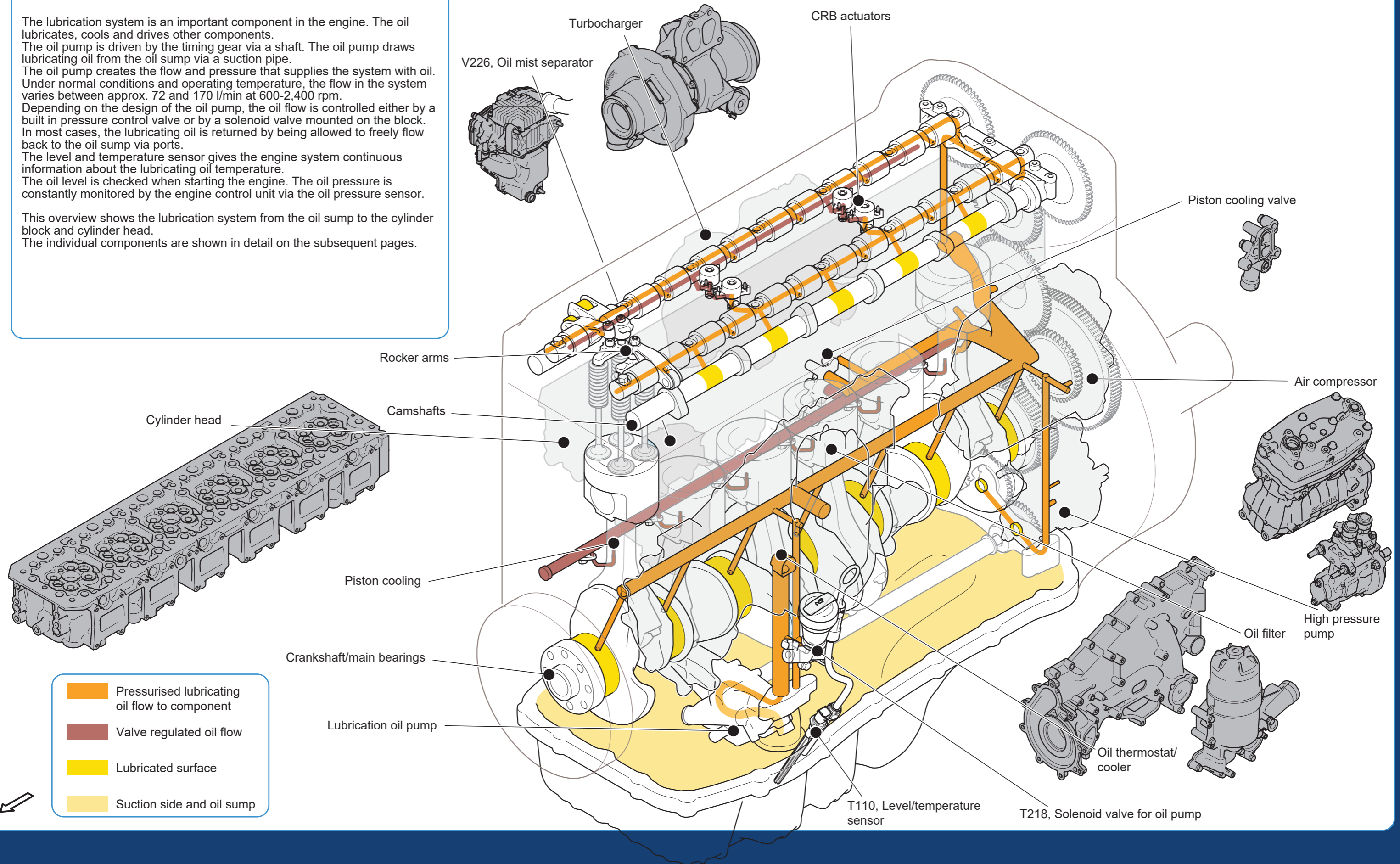


LUBRICATION SYSTEM Overview

13 litre engines with cylinder block generation 3

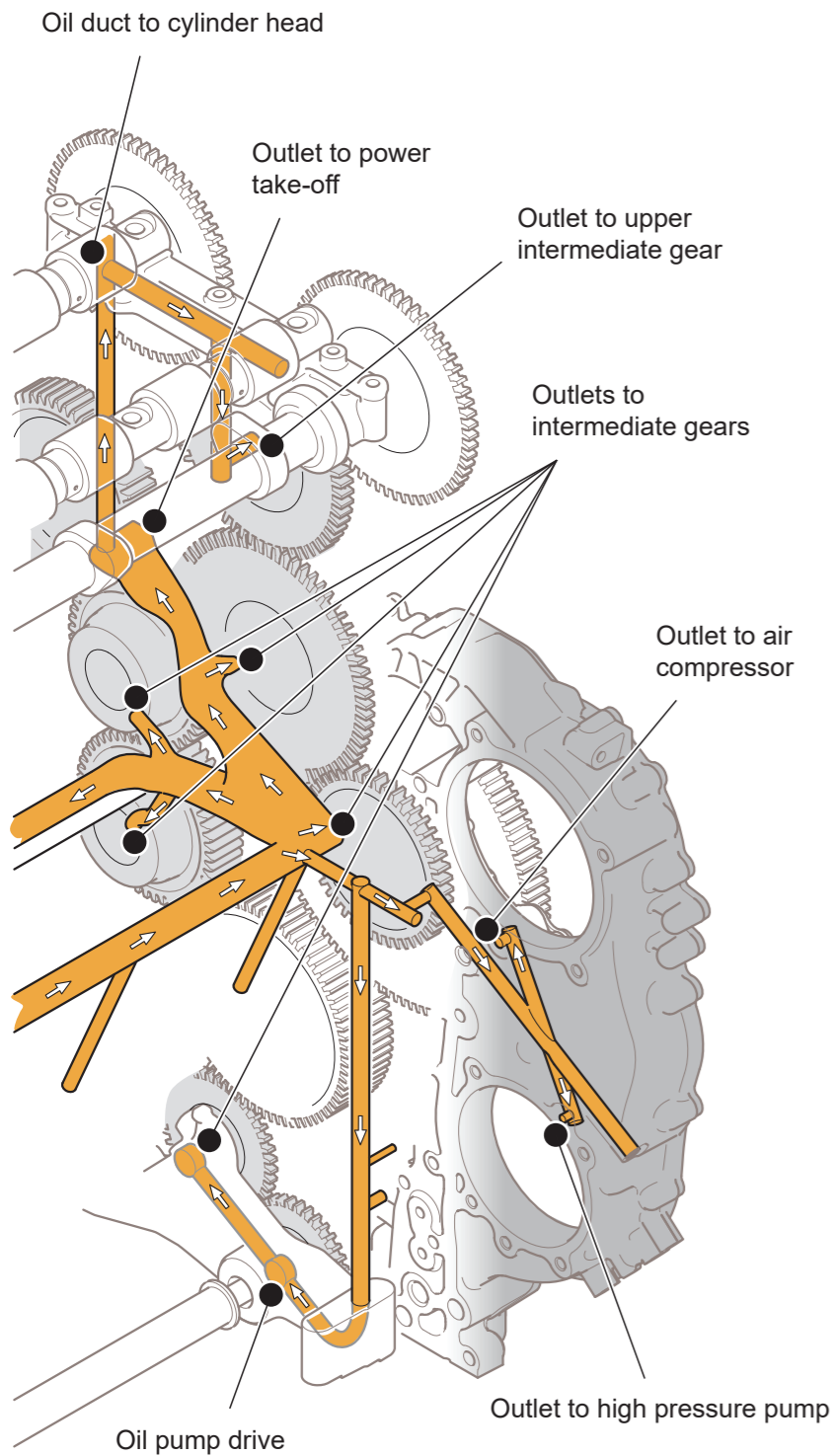
The lubrication system is an important component in the engine. The oil lubricates, cools and drives other components. The oil pump is driven by the timing gear via a shaft. The oil pump draws lubricating oil from the oil sump via a suction pipe. The oil pump creates the flow and pressure that supplies the system with oil. Under normal conditions and operating temperature, the flow in the system varies between approx. 72 and 170 l/min at 600-2,400 rpm. Depending on the design of the oil pump, the oil flow is controlled either by a built in pressure control valve or by a solenoid valve mounted on the block. In most cases, the lubricating oil is returned by being allowed to freely flow back to the oil sump via ports. The level and temperature sensor gives the engine system continuous information about the lubricating oil temperature. The oil level is checked when starting the engine. The oil pressure is constantly monitored by the engine control unit via the oil pressure sensor.

This overview shows the lubrication system from the oil sump to the cylinder block and cylinder head. The individual components are shown in detail on the subsequent pages.

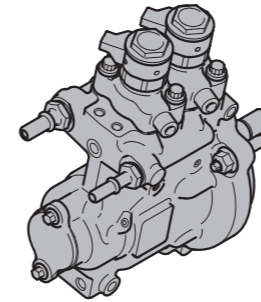


LUBRICATION SYSTEM High pressure pump and air compressor

13 litre engines with cylinder block generation 3



High pressure pump (oil lubricated)



There are also high pressure pumps that are fuel lubricated; these are not part of the lubrication system.

The oil-lubricated high pressure pump is driven by the engine crankshaft via the gear transmission.

The lubricating oil flows from the oil gallery in the cylinder block to the high pressure pump via an oil duct in the timing gear casing.

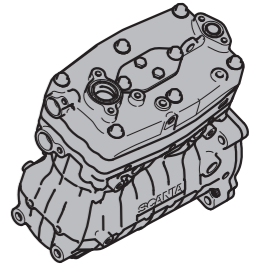
The lubricating oil is returned back to the rear crankshaft bearing in the pump housing via a port.

Once pistons, cams, other components and surfaces are lubricated, the oil collects in the bottom of the pump housing.

The oil runs back to the oil sump from the high pressure pump via the timing gear casing.

The flow (depending on rpm) to the high pressure pump is approx. 2-8 l/min.

Air compressor



The air compressor is driven via a gear wheel in the engine timing gear. The air compressor is fluid-filled and connected to the engine cooling system.

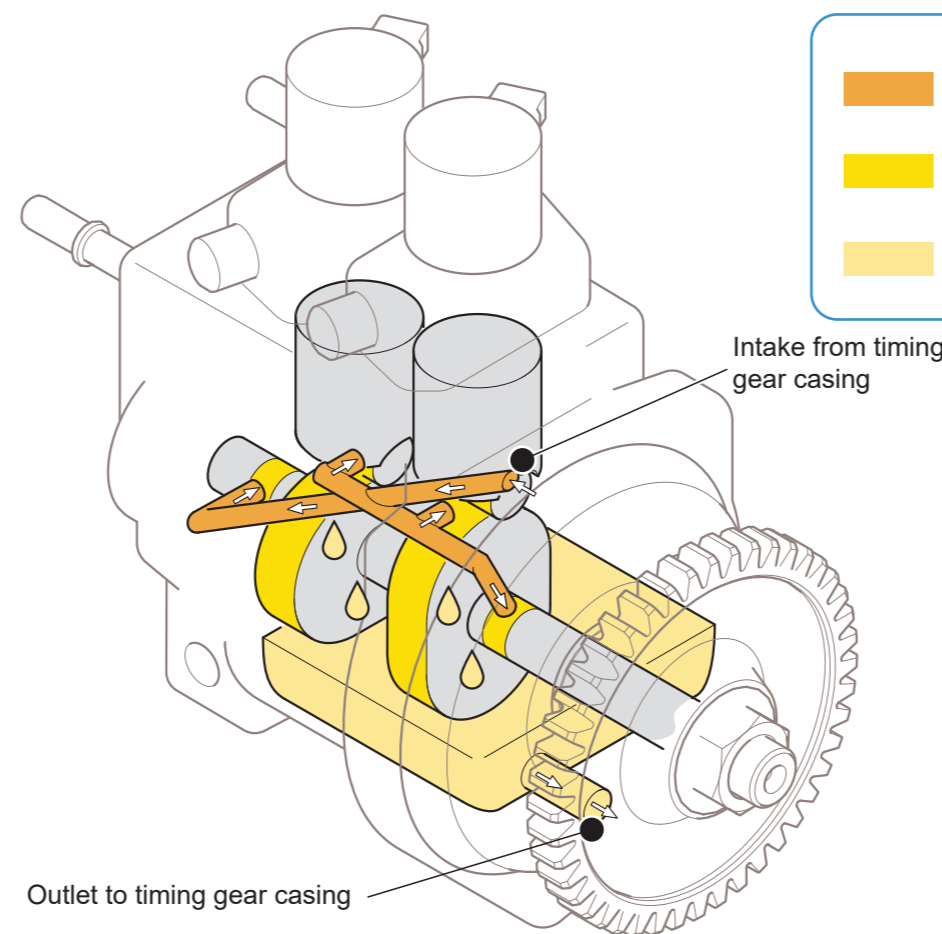
The air compressor is lubricated via the engine lubrication system.




The lubricating oil flows from the oil gallery in the cylinder block to the air compressor via an oil duct in the timing gear casing.

The crankshaft bearing is lubricated via ports in the crankshaft. After the rear crankshaft bearing, the lubricating oil runs down into the compressor housing and other surfaces and components are splash lubricated.

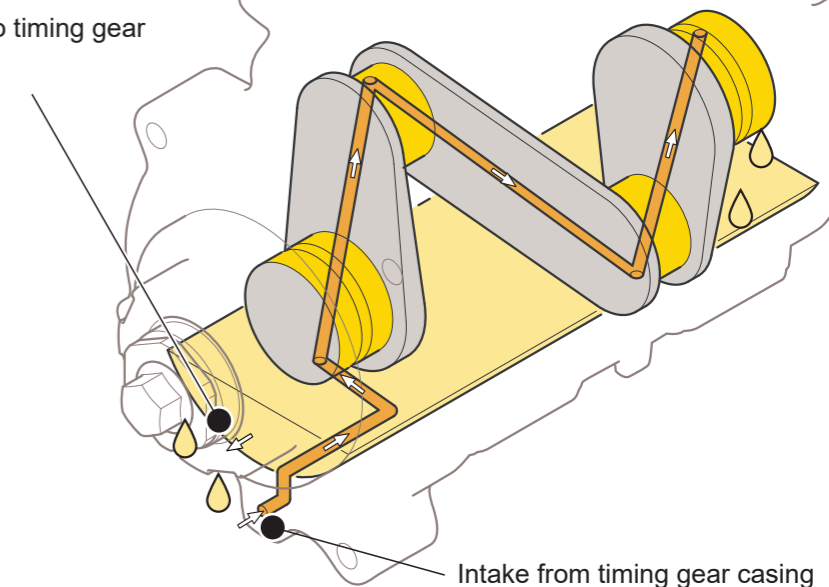
The lubricating oil is drained via an opening in the air compressor to the timing gear casing where the lubricating oil runs down to the oil sump.

The flow (depending on rotational speed) to the air compressor is approx. 3-6 l/min.



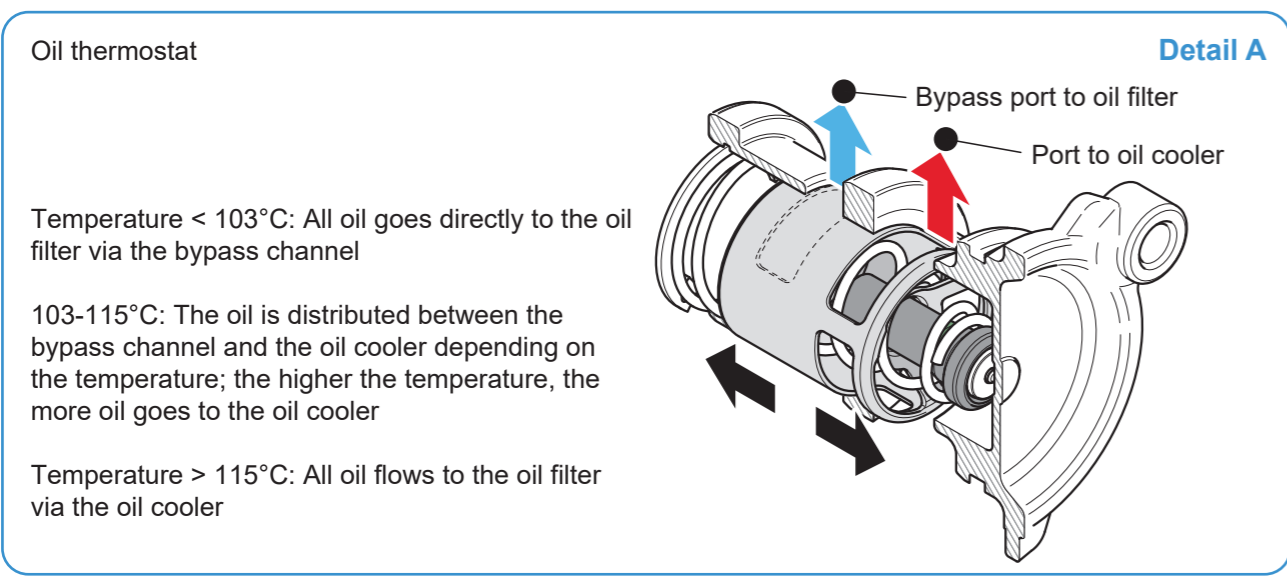
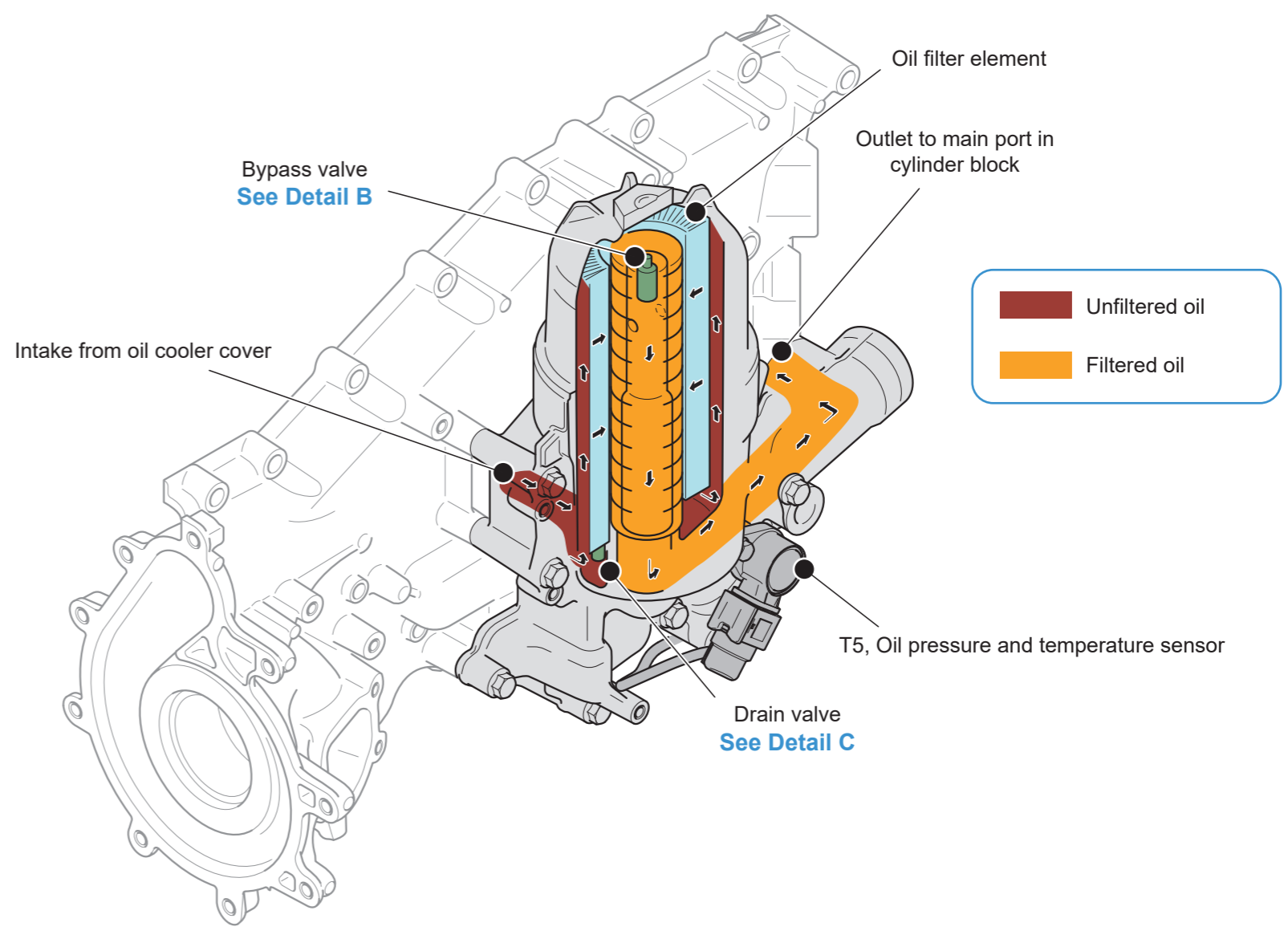
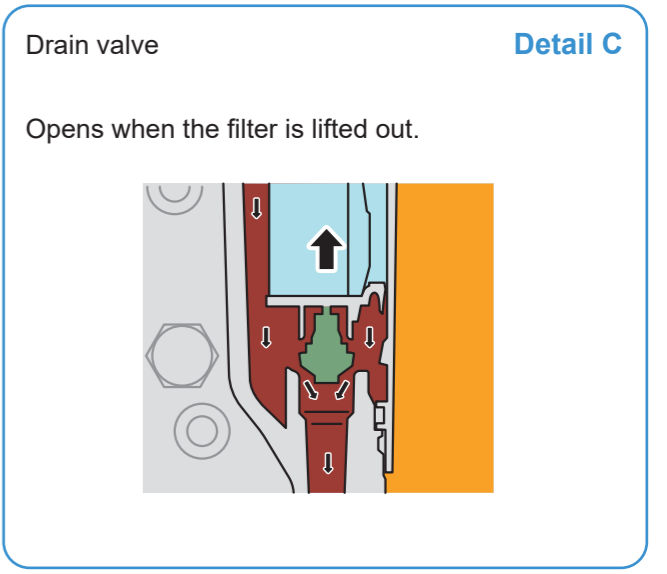
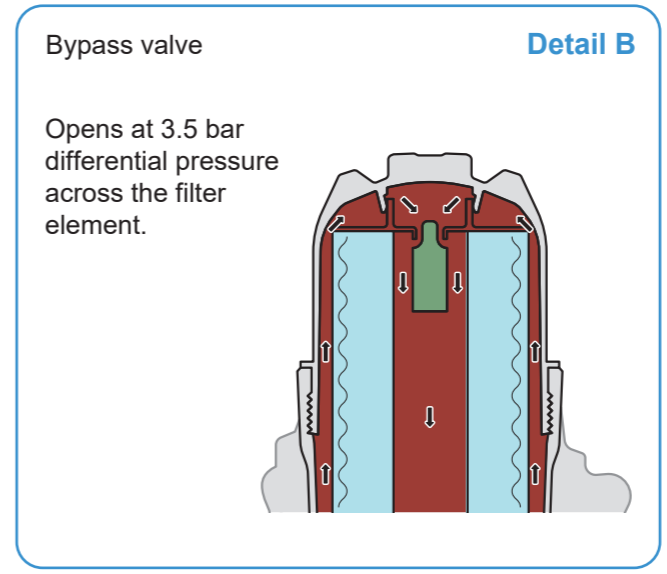
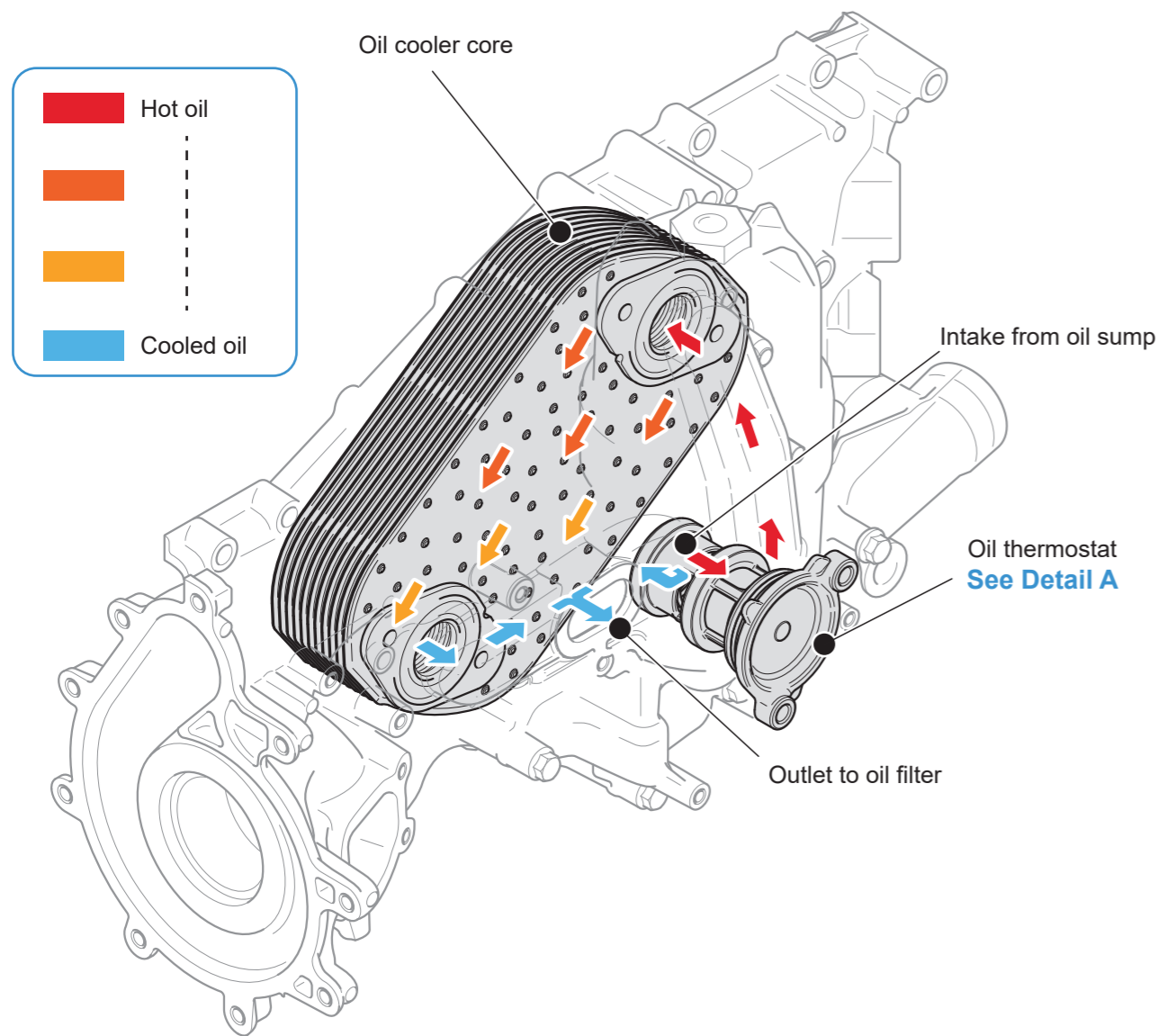
-  Pressurised lubricating oil flow to component
-  Lubricated surface
-  Oil sump

Outlet to timing gear casing



LUBRICATION SYSTEM Oil cooler, oil thermostat and oil filter

13 litre engines with cylinder block generation 3



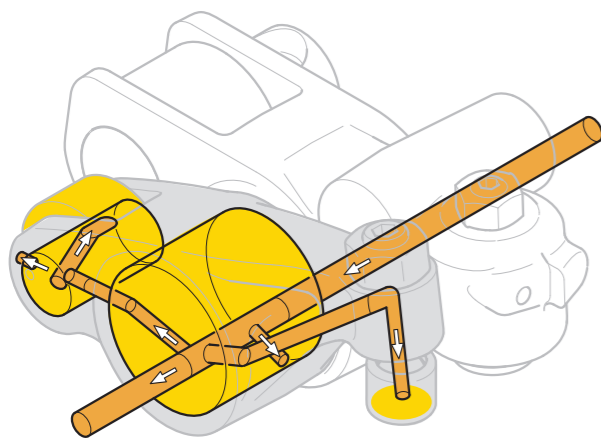
LUBRICATION SYSTEM Valve components and compression release brake

13 litre engines with cylinder block generation 3

The camshaft frame is located on top of the cylinder head. The camshaft frame contains camshafts, rocker arm shafts and valve components. The lubricating oil comes up via a port in the cylinder head. From there, the oil flows out into the rocker arm shafts and from the rocker arm shafts to other components for lubrication. The compression release brake uses the oil to control the flow of oil to the compression release brake rocker arms using solenoid valves, thus braking the vehicle.

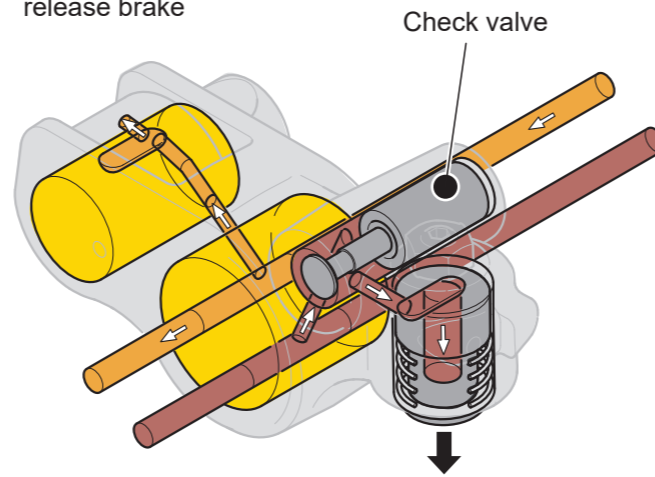
Rocker arm, exhaust valve

Detail B



Rocker arm, compression release brake

Detail A



Rocker arm, compression release brake
See Detail A

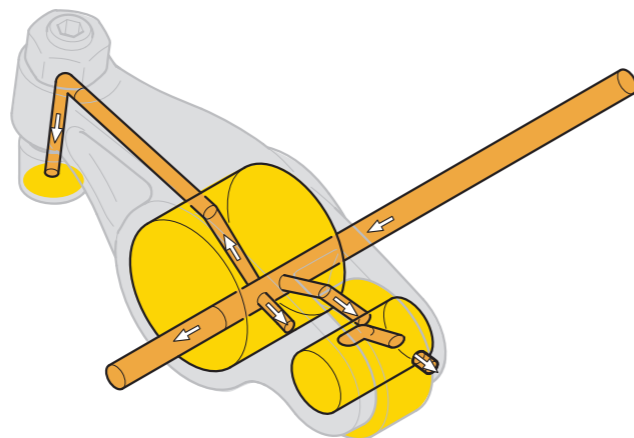
Rocker arm, exhaust valve
See Detail B

Exhaust camshaft

Exhaust valve rocker arm shaft

Rocker arm, intake valve

Detail C



Intake valve rocker arm shaft

Rocker arm, intake valve
See detail C

Intake camshaft

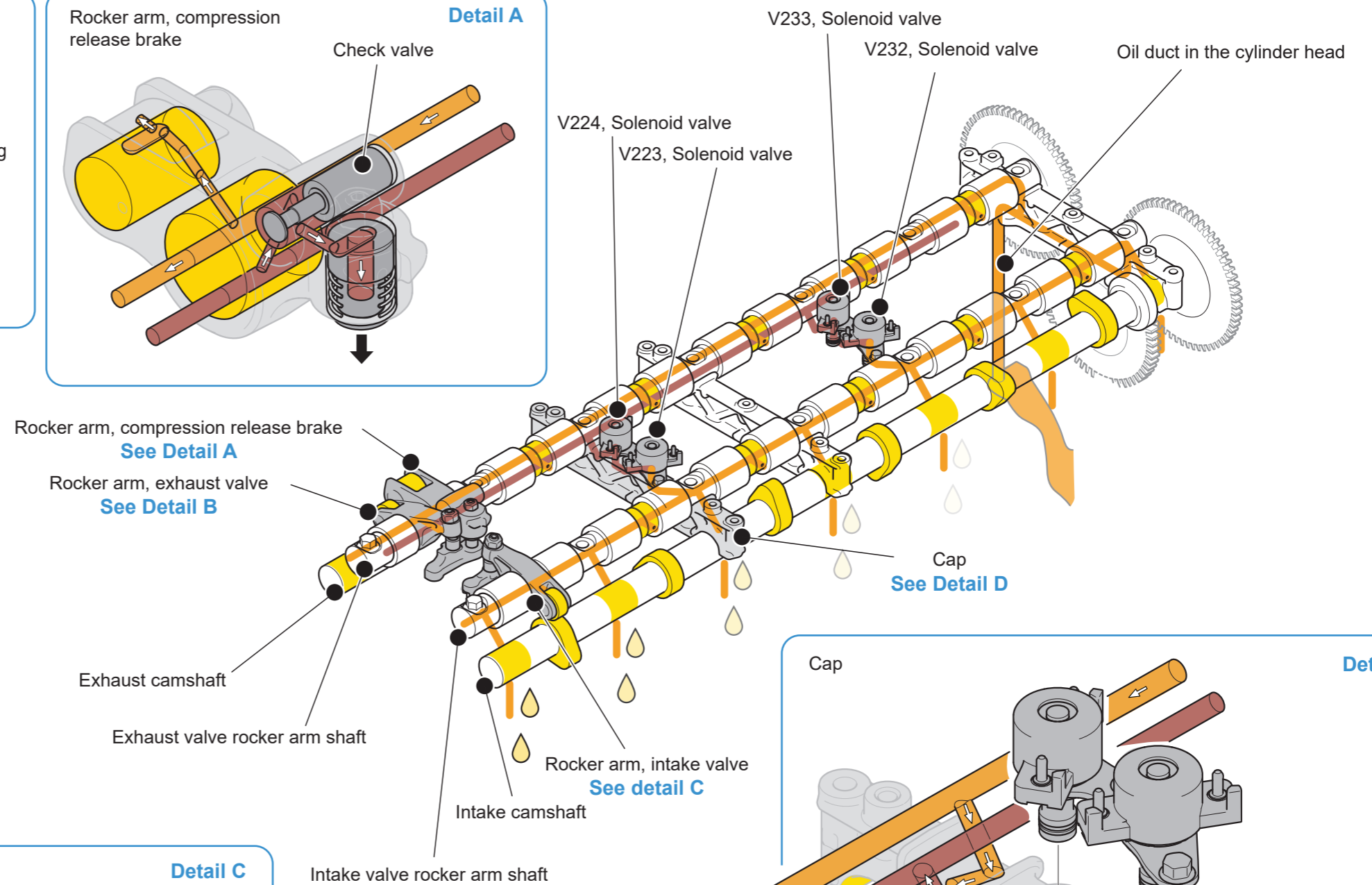
V233, Solenoid valve

V232, Solenoid valve

Oil duct in the cylinder head

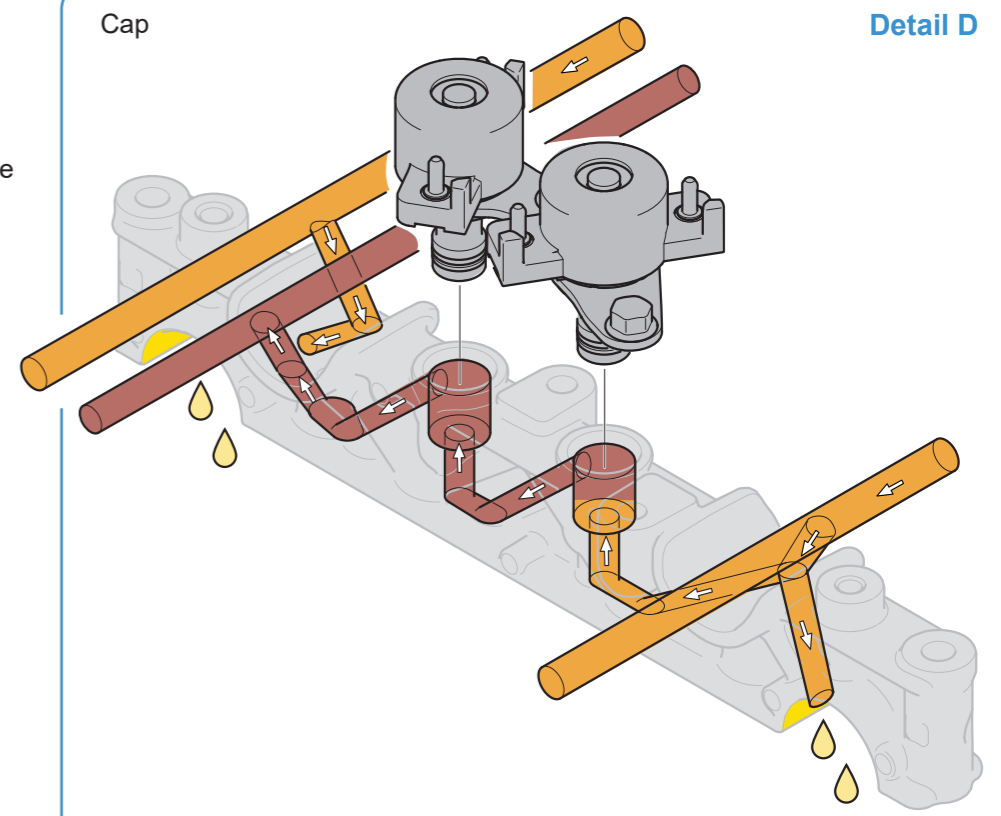
V224, Solenoid valve




V223, Solenoid valve



Cap

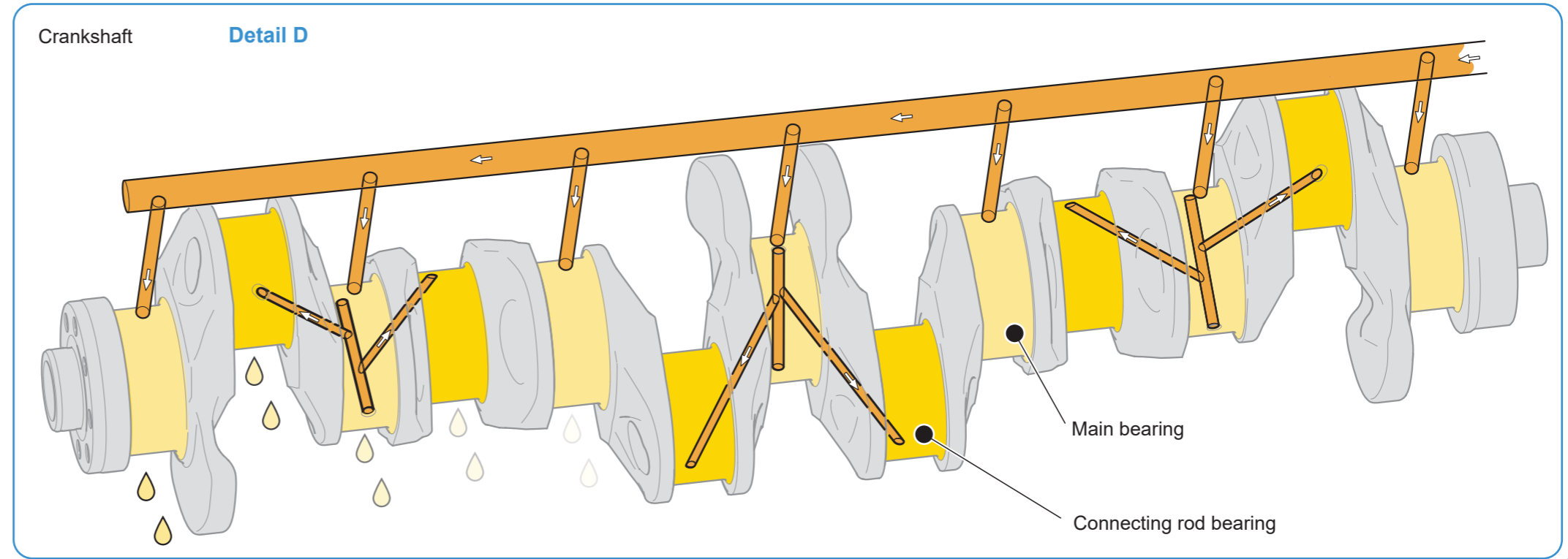
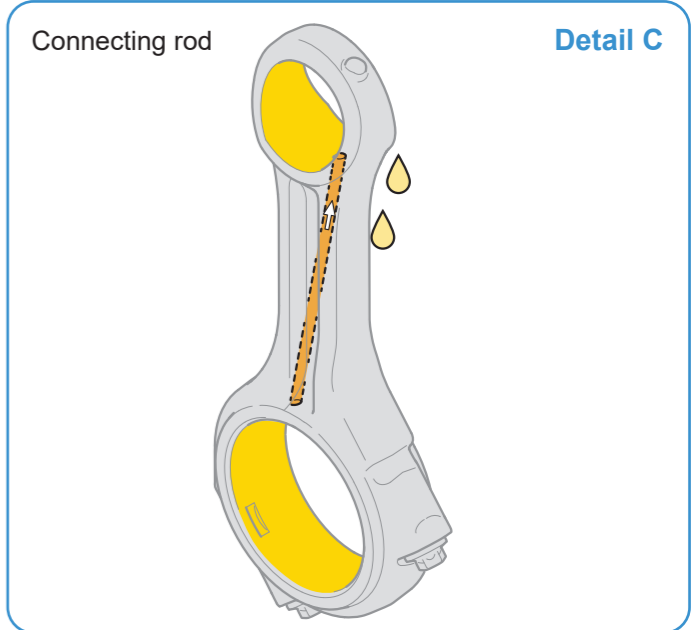
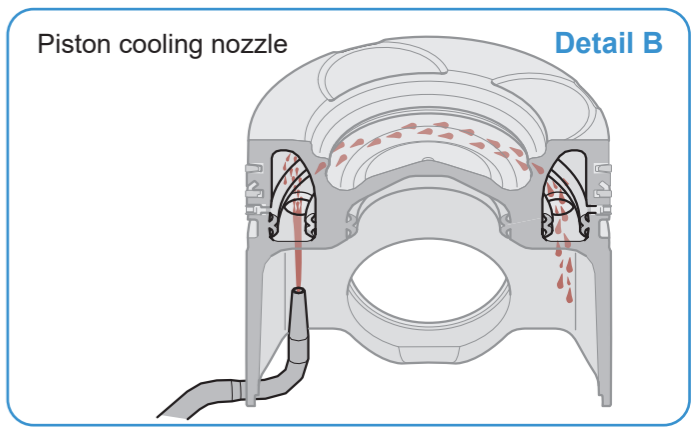
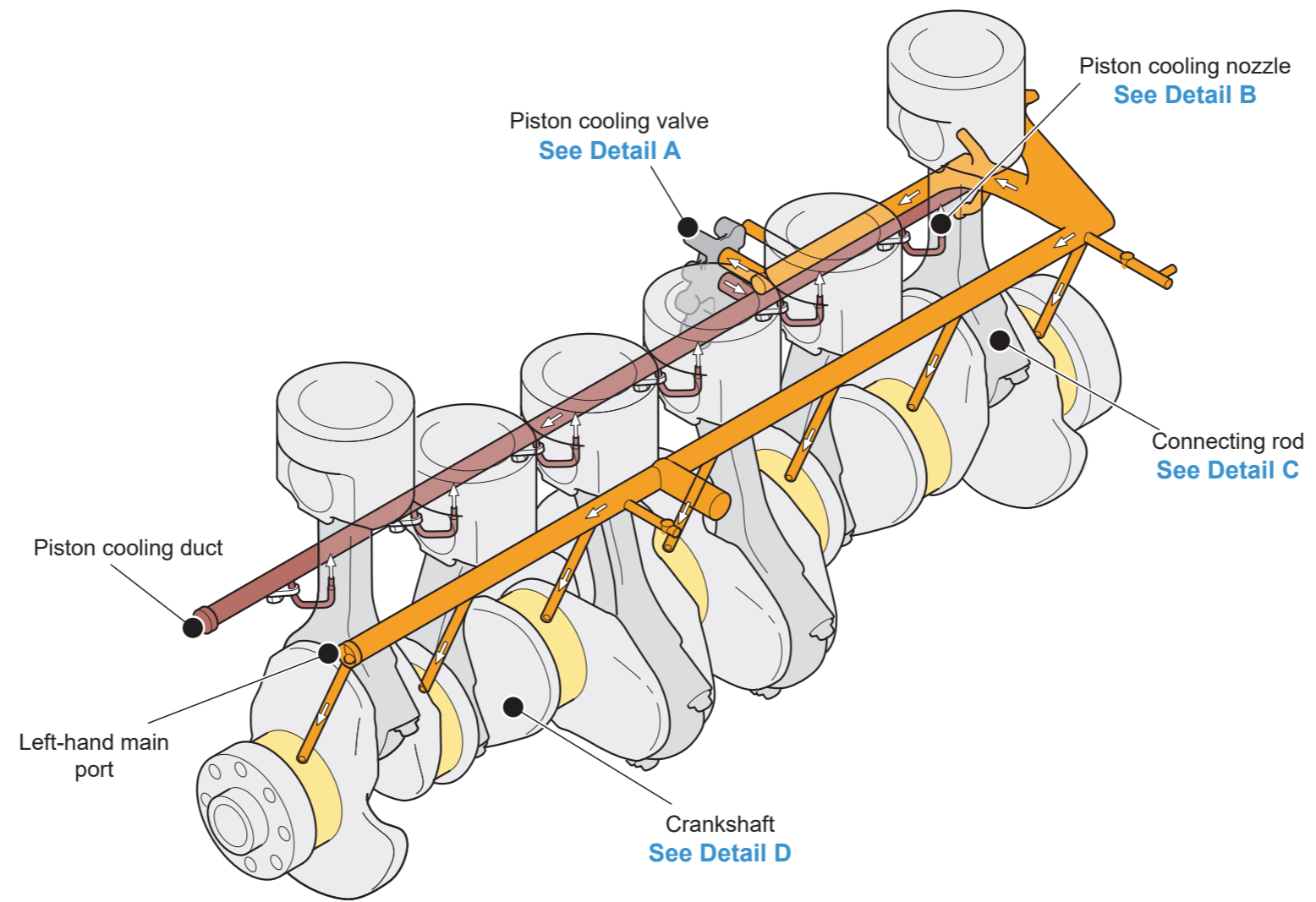
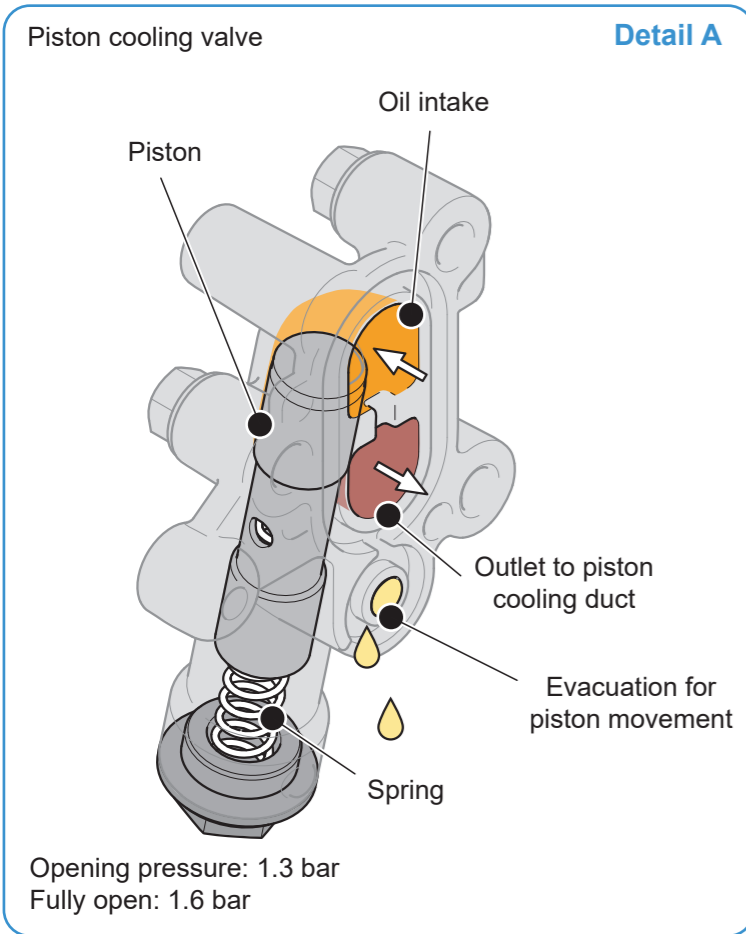
Detail D



-  Pressurised lubricating oil flow to component
-  Valve regulated oil flow
-  Lubricated surface

LUBRICATION SYSTEM Crankshaft, connecting rods and pistons

13 litre engines with cylinder block generation 3



- Pressurised lubricating oil flow to component
- Valve regulated oil flow
- Lubricated surface, main bearing
- Lubricated surface, e.g. connecting rod bearing

LUBRICATION SYSTEM Oil mist separator and turbocharger

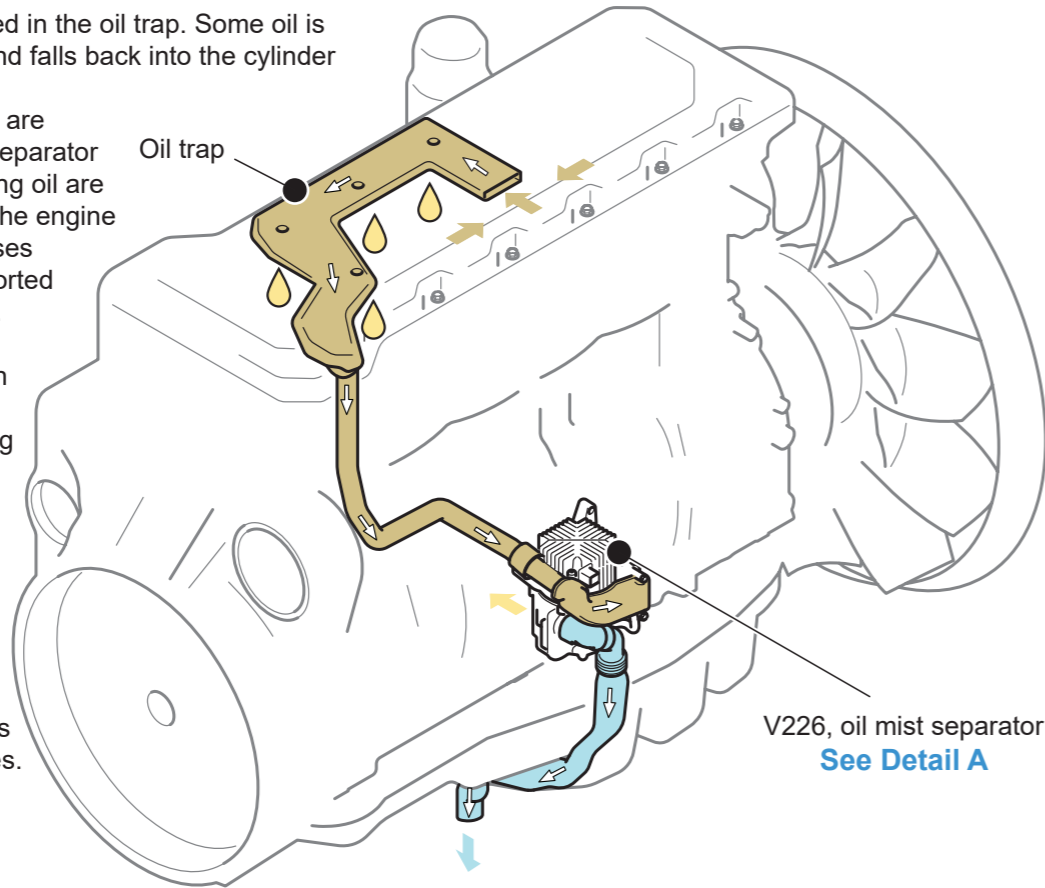
13 litre engines with cylinder block generation 3

The crankcase gases are collected in the oil trap. Some oil is separated from the gases here and falls back into the cylinder head.

From the rocker cover, the gases are transported down to the oil mist separator where the gases and the remaining oil are separated. The oil is returned to the engine crankcase and the crankcase gases separated from the oil are transported down and out under the oil sump.

The oil mist separator contains an impactor that separates oil and oil mist from the gases by allowing them to make contact with a surface where they are converted into larger drops.

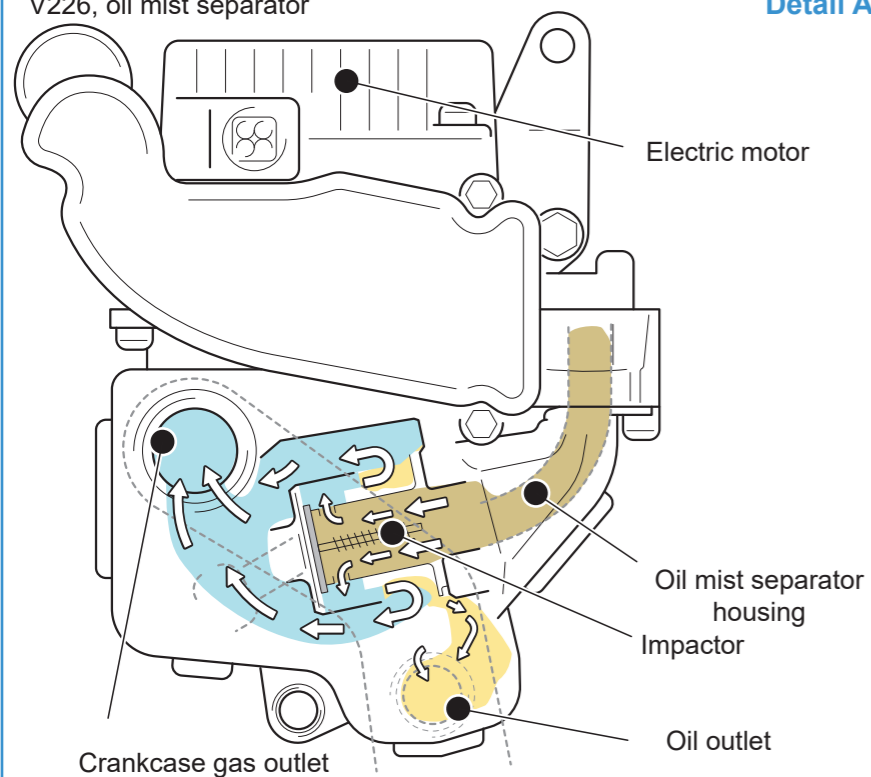
The electric motor is controlled by a pressure and rotational speed sensor, which makes sure that the pressure is -5 mbar under normal operating conditions and warns if the pressure changes.






V226, oil mist separator
See Detail A

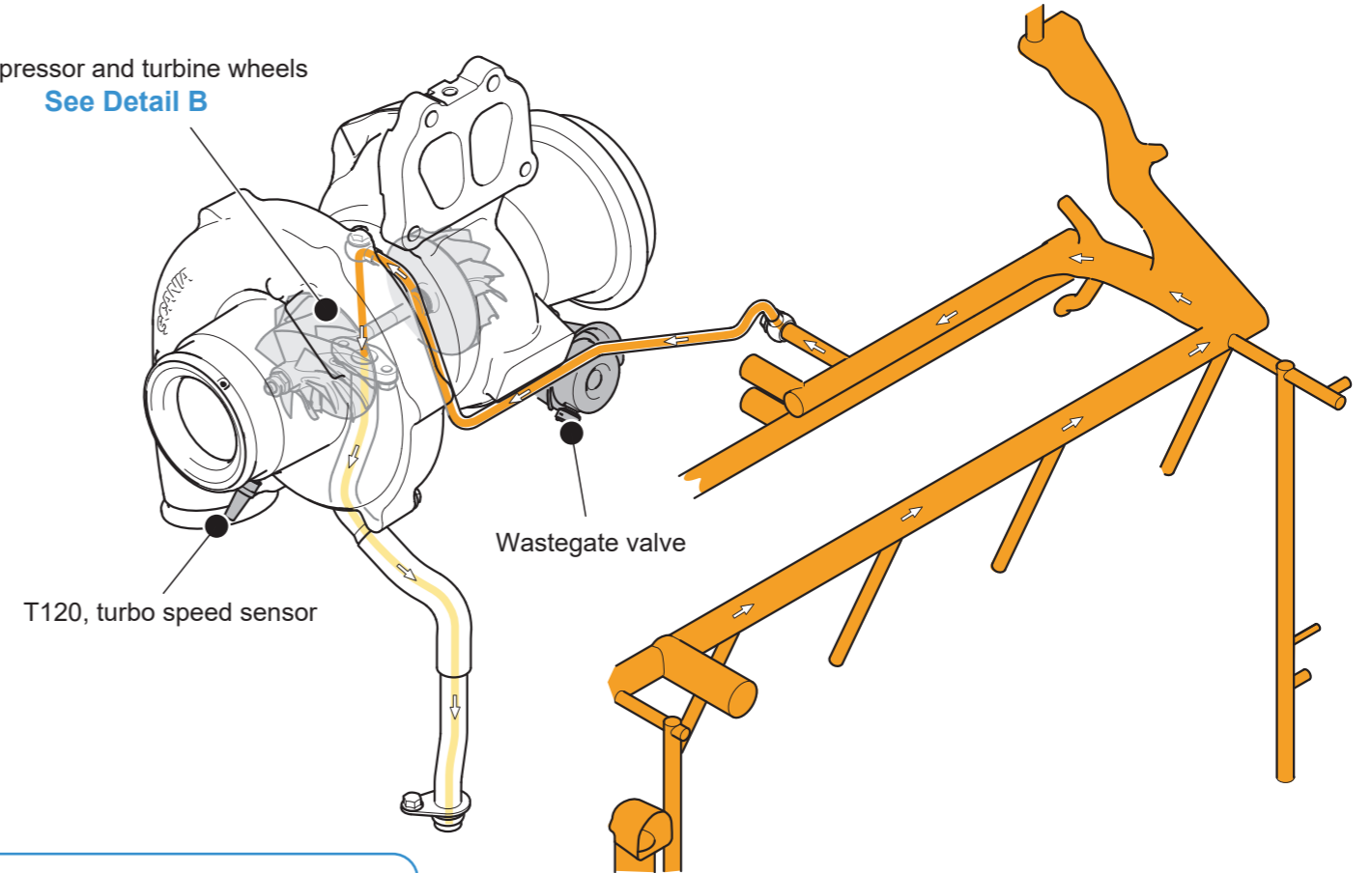
V226, oil mist separator



Detail A



-  Crankcase gases
-  Oil separated crankcase gases
-  Separated oil to the oil sump

Compressor and turbine wheels
See Detail B



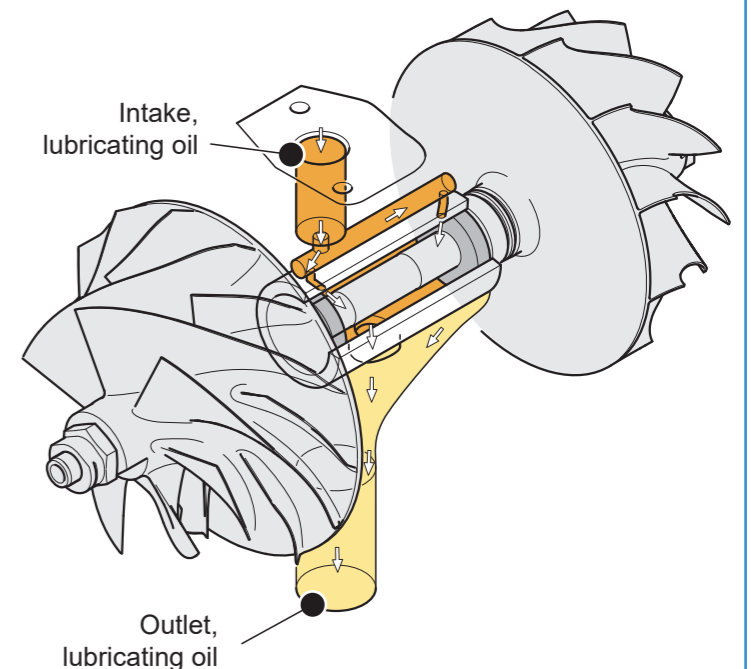
-  Pressurised lubricating oil flow to component
-  Lubricating oil to the oil sump

There is an oil pipe leading from the cylinder block that transports the lubricating oil to the turbocharger. The compressor and turbine wheels rotate very rapidly. At full power, rotational speed is approx. 100,000 rpm. At the same time, the temperature at the turbine wheel is above 600°C.

This places high demands on the rotating parts, on balance, cooling, lubrication and cleanliness. The flow (depending on rotational speed) to the turbocharger is approx. 2-4 l/min. The shaft between the turbine and the compressor is, depending on the type of turbocharger, either mounted in 2 radial bearings that rotate freely (in a thin oil film) and 1 thrust bearing in the bearing housing or 1 double-row ball bearing with an oil damper. After the turbocharger, the lubricating oil goes to the oil sump via 1 return oil pipe.

Compressor and turbine wheels

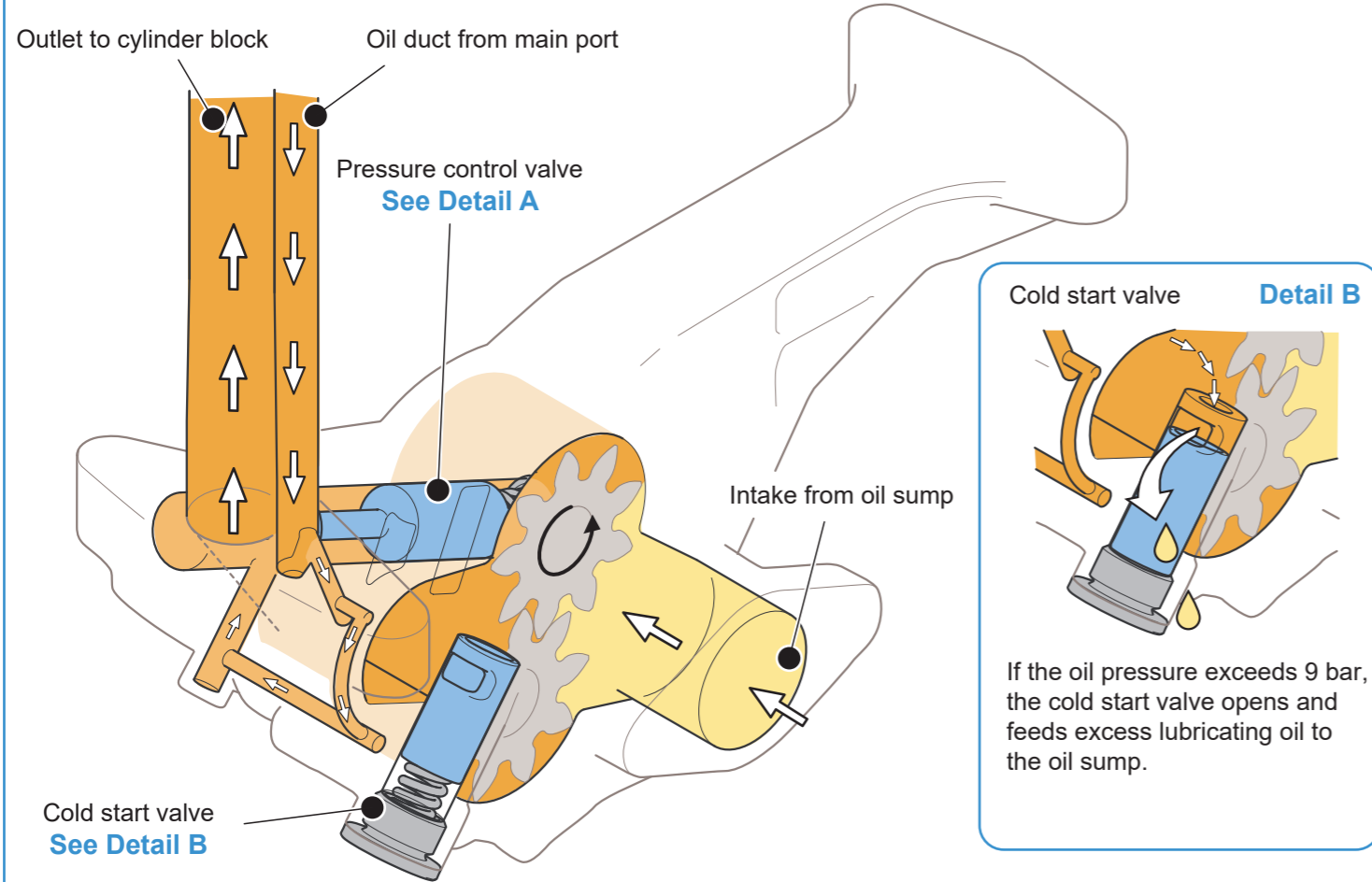
Detail B



LUBRICATION SYSTEM Oil pump

13 litre engines with cylinder block generation 3

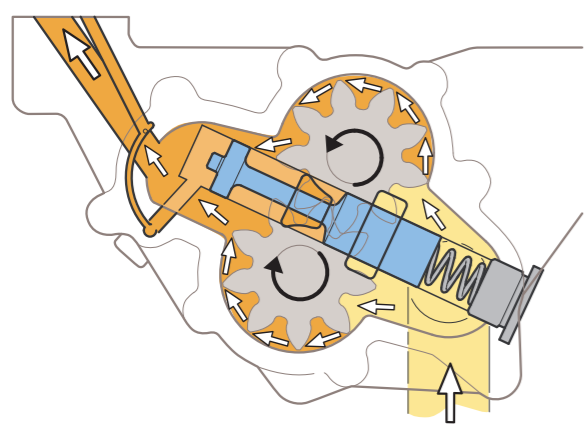
Pilot-controlled oil pump



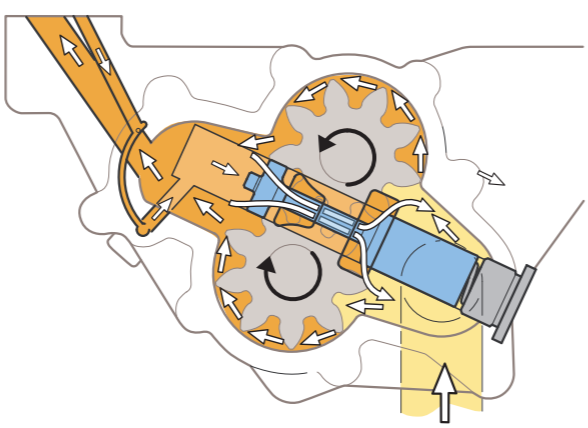
Pressurised lubricating oil flow to component

Lubricating oil from the oil sump

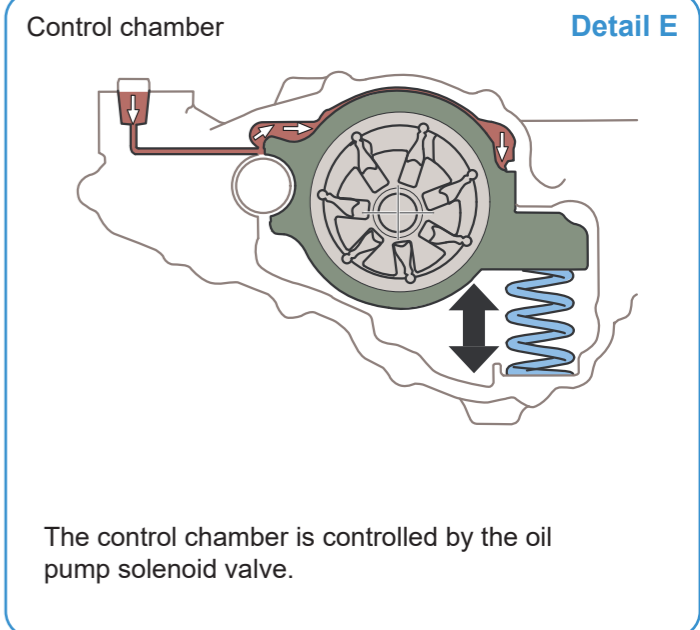
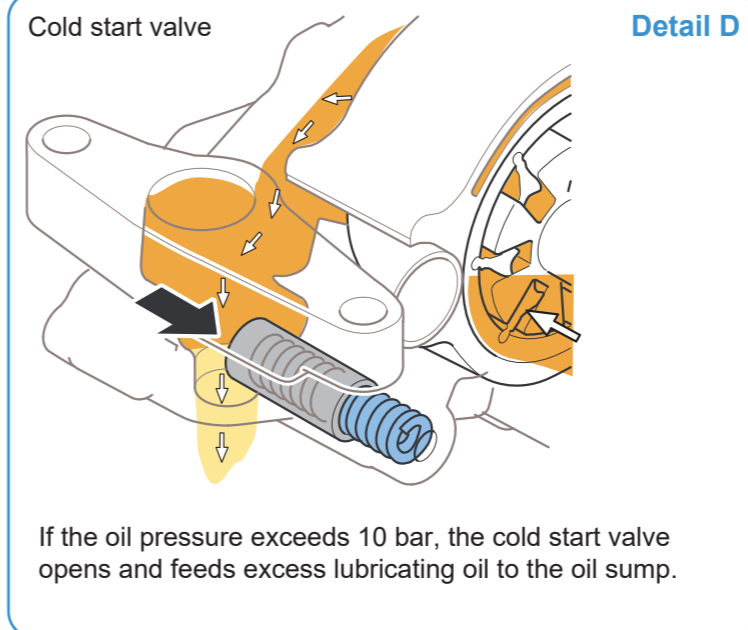
Pressure control valve closed Detail A



Pressure control valve open Detail A



Variable oil pump



The solenoid valve is used to control the engine oil flow. Control can take place actively with PWM signals or passively at temperatures below 40°C and in the event of electrical faults in the solenoid valve. Passive control opens the valve at 4.5 bar and fills the oil pump control chamber with oil, which reduces the pump displacement.

Pressurised lubricating oil flow to component

Valve regulated oil flow

Lubricating oil from the oil sump

The oil pump is driven via a shaft by the timing gear.

