

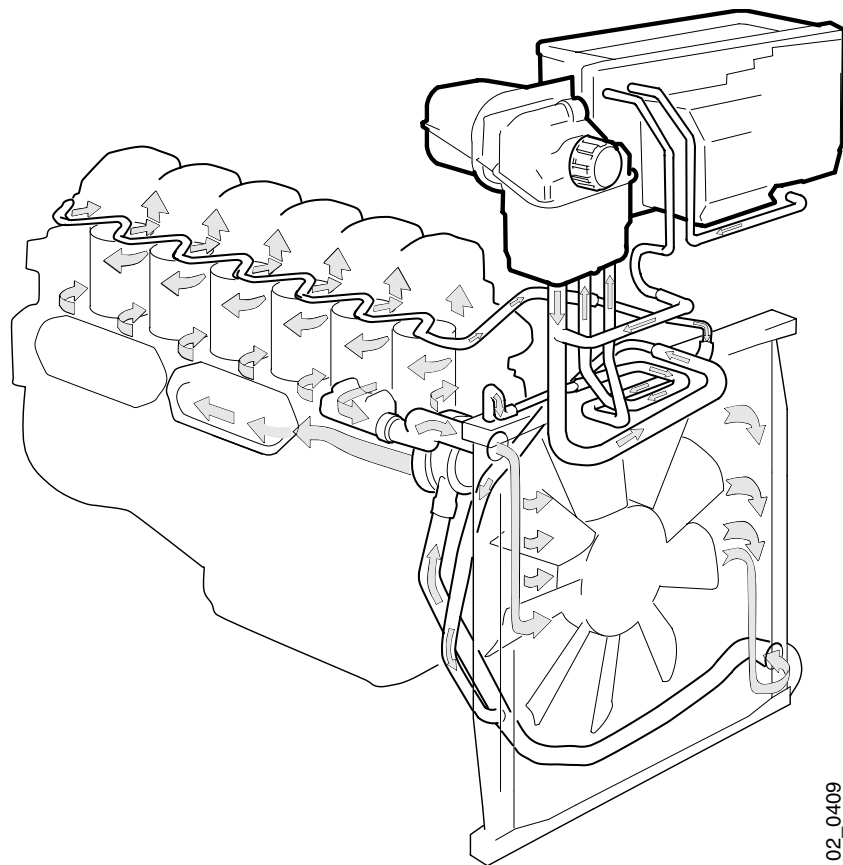
SCANIA

02:01-02

Issue 2 en

Cooling system

Function description



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Cooling system

This function description describes the cooling system for all engine types. There are two types of 11 litre engine. The old design, the DSC11, which has 2 valves/cylinder and the new design, the DC11, which has 4 valves/cylinder.

General

The cooling system maintains the operating temperature of the engine at a suitable level. This is extremely important for the operating cost and service life of the engine.

The cooling system works with an over-pressure, which results in an increase in the boiling point of the coolant.

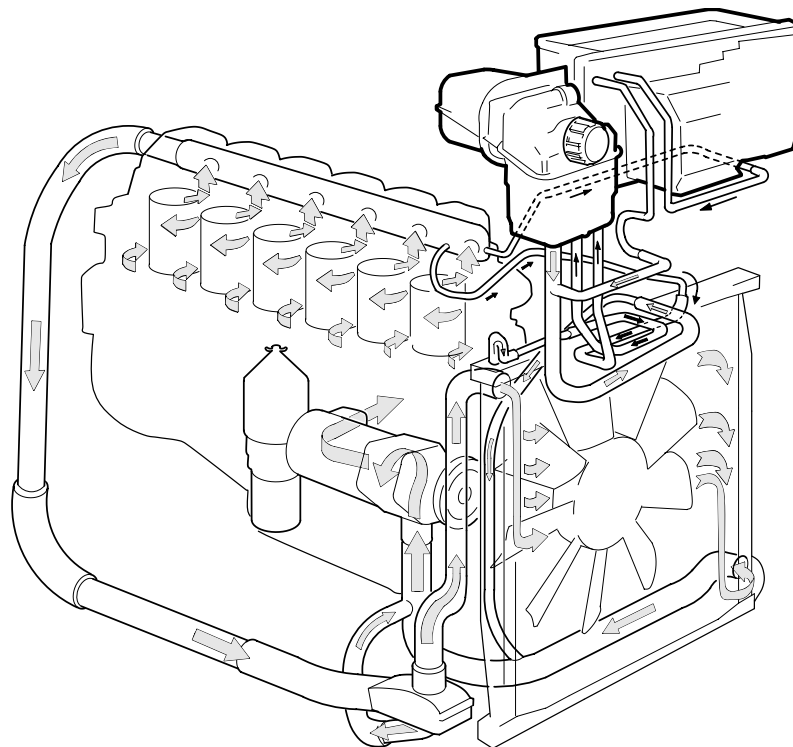
When the thermostat opens, the coolant is fed into the tank on the inlet side of the radiator and then flows horizontally through the radiator unit and is cooled by the air which flows through the radiator unit with the help of the fan and the flow of air caused by the forward motion of the vehicle.

Coolant circulation

9 litre engine

The coolant pump forces the coolant through the oil cooler into the cylinder block. The coolant then passes through passages in the cylinder block, flows around the cylinder liners and on up into the cylinder heads.

From the cylinder heads, the coolant is collected in a coolant manifold. The coolant then passes through the coolant manifold to the thermostat housing in the frame at the front of the engine.



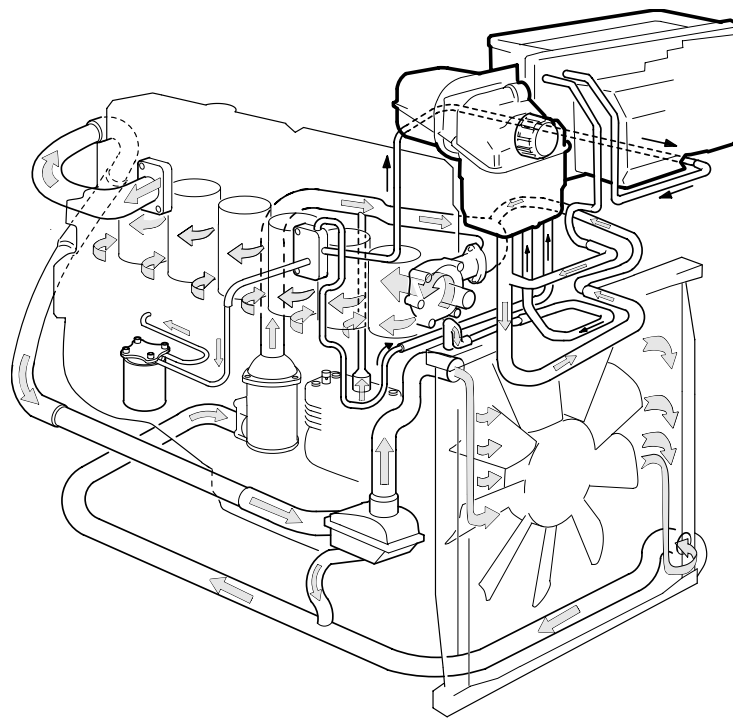
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Schematic view of the coolant circulation in a 9 litre engine without a Scania Retarder.

11 litre engine (DSC11)

The coolant pump forces the coolant into the cylinder block. The coolant then passes through passages in the cylinder block, flows around the cylinder liners and on up into the cylinder heads.

From the rear cylinder head, the coolant is fed through a coolant manifold and a hose in the frame to the thermostat housing in the frame at the front of the engine.

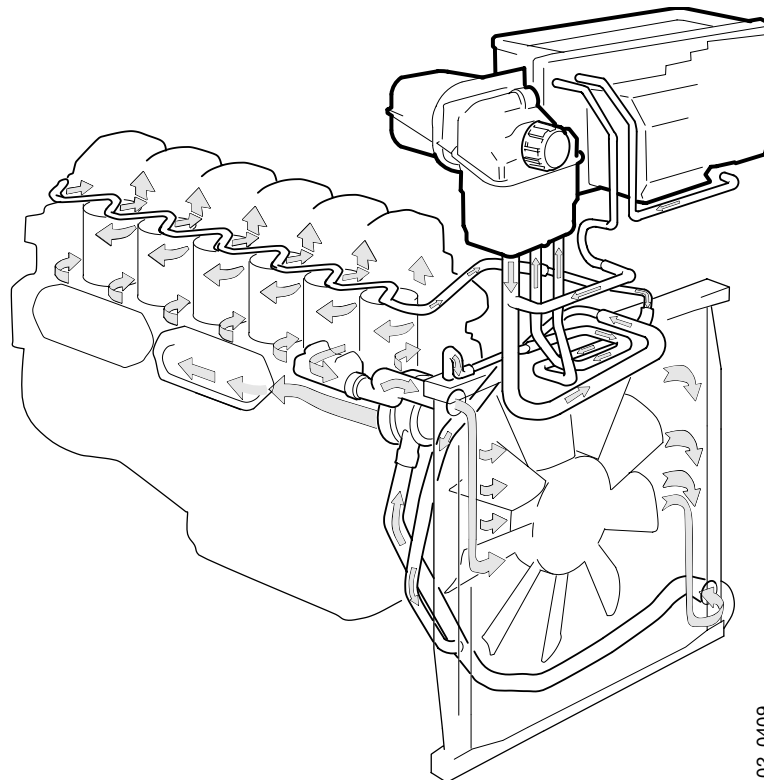


Schematic view of the coolant circulation in an 11 litre engine (DSC11) without a Scania Retarder.

11 litre engine (DC11) and 12 litre engine

The coolant pump forces the coolant into the longitudinal distribution channels of the cylinder block. The coolant passes through the oil cooler and on through passages in the cylinder block, around the cylinder liners and up into the cylinder heads.

From the cylinder heads, the coolant is collected in the cylinder block. The coolant is then fed forwards through a channel in the cylinder block to the thermostat housing at the front of the engine.



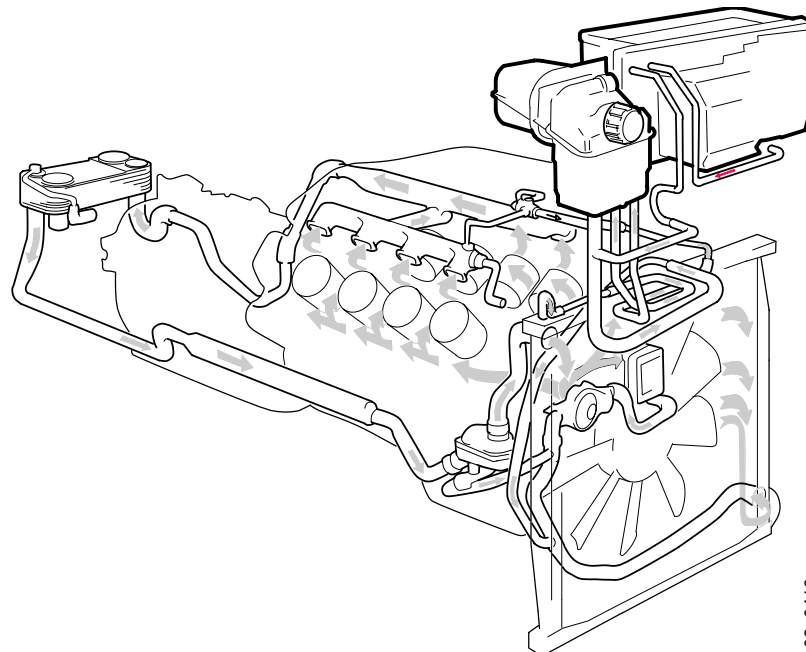
Schematic view of the coolant circulation in an 11 litre engine (DC11) and a 12 litre engine without a Scania Retarder.

14 litre engine

The coolant pump forces the coolant into the distribution channels of the cylinder block via channels in the timing gear housing.

From the distribution channels, the coolant is forced into the cylinder block and then flows around the cylinder liners and on up into the cylinder heads.

From the cylinder heads, the coolant is forced into two coolant manifolds. It then flows to the retarder oil cooler and on to the thermostat housing.

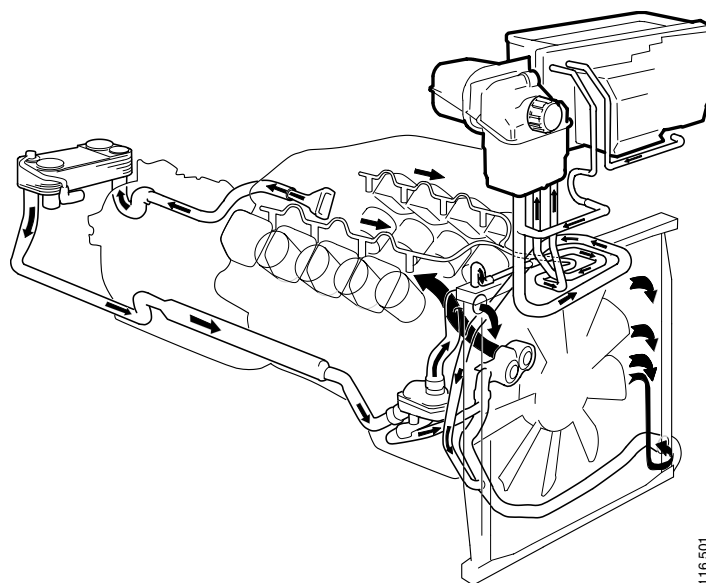


Schematic view of the coolant circulation in a 14 litre engine with a Scania Retarder.

16 litre engine

The coolant pump forces the coolant upwards into the cylinder block, through the oil cooler. The coolant is then pumped to the channels in the cylinder block, flows around the cylinder liners and on up into the cylinder heads.

From the cylinder heads, the coolant is collected in collection channels on the outside of the cylinder block on both sides. The coolant in the right-hand collection channel flows via a channel at the front of the cylinder block to the left-hand collection channel. The coolant then flows to the retarder oil cooler and on to the thermostat housing.



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Schematic view of the coolant circulation in a 16 litre engine with a Scania Retarder.

Coolant by-pass

At low coolant temperatures, the thermostat is closed and all coolant circulates via the by-pass channel without passing through the radiator.

When the coolant has reached engine working temperature, the thermostat opens and the water circulates through the radiator. The thermostat will normally operate in an intermediate position, which means that both the by-pass channel and the thermostat are open.

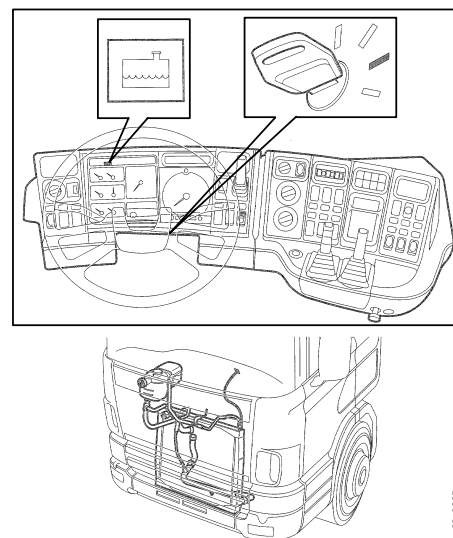
If the coolant temperature is higher than the temperature required for a fully open thermostat, all fluid will pass through the thermostat on to the radiator. The outlet to the by-pass channel will then be fully closed.

Level indicator

A level indicator provides a warning when the coolant level is too low. The indicator consists of a level sensor fitted in the expansion tank and a warning lamp on the instrument panel.

If the coolant level falls well below the minimum level, the warning lamp on the instrument panel will come on.

The connection of the level indicator (T8) to the electrical system is shown in wiring diagram 16:02-01.



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Radiator and expansion tank

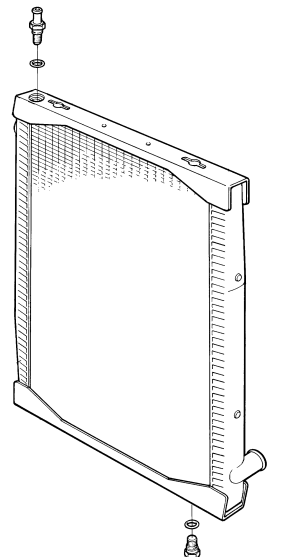
Radiator

The radiator consists of two radiator tanks and the radiator core which links them.

The radiator core is constructed of horizontal rows of thin-walled aluminium pipes. Between the pipes are thin corrugated aluminium plates which are designed to maximise the heat dissipation capacity of the radiator.

The inlet of the radiator is connected to the thermostat housing.

The outlet of the radiator is connected to the suction side of the coolant pump.



Expansion tank

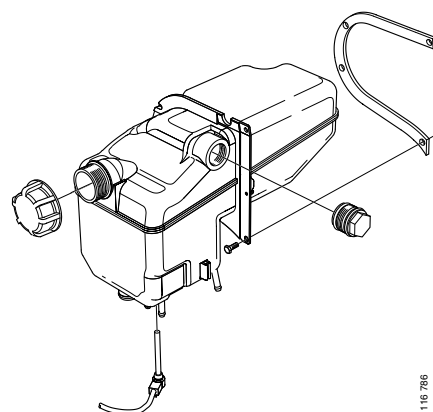
The coolant will expand as it warms up.

To prevent any fluid loss when the volume increases, an expansion tank is fitted. The expansion tank is connected to the engine and the radiator via a ventilation pipe, which means that it also acts as a vent for the cooling system.

The expansion tank connection from the radiator contains a check valve which prevents flow through the radiator if an auxiliary heater is used, e.g. a Webasto heater.

The expansion tank is positioned above the highest points of the radiator and the engine and is fitted with a filler pipe with a cap.

The expansion tank contains a pressure-regulation valve which begins to open at 0.7 bar. When the engine cools down after running and the pressure falls, a check valve opens so that the pressure difference is equalised.



Between the suction side of the water pump and the expansion tank is the static line pipe. The static line gives the water pump a constant over-pressure and therefore reduces the risk of cavitation damage.

Level marks are shown on the expansion tank indicating the minimum and maximum levels when the engine is cold.

Fan

Thermostat controlled fan

When the forward motion of the vehicle is not sufficient for the airflow through the radiator to provide satisfactory cooling, the fan increases the airflow.

To increase the effectiveness of the fan, it has a tight-fitting fan ring around it. There is also a fan cowling between the radiator and the fan ring to ensure that all air from the fan passes through the radiator.

The fan is temperature-regulated and is engaged when the temperature of the air passing through the radiator reaches a certain level.

The temperature-regulated fan works only when the coolant temperature needs to be kept at a normal level. This type of fan therefore enables quicker warming up of the engine coolant and requires less energy, which results in lower fuel consumption.

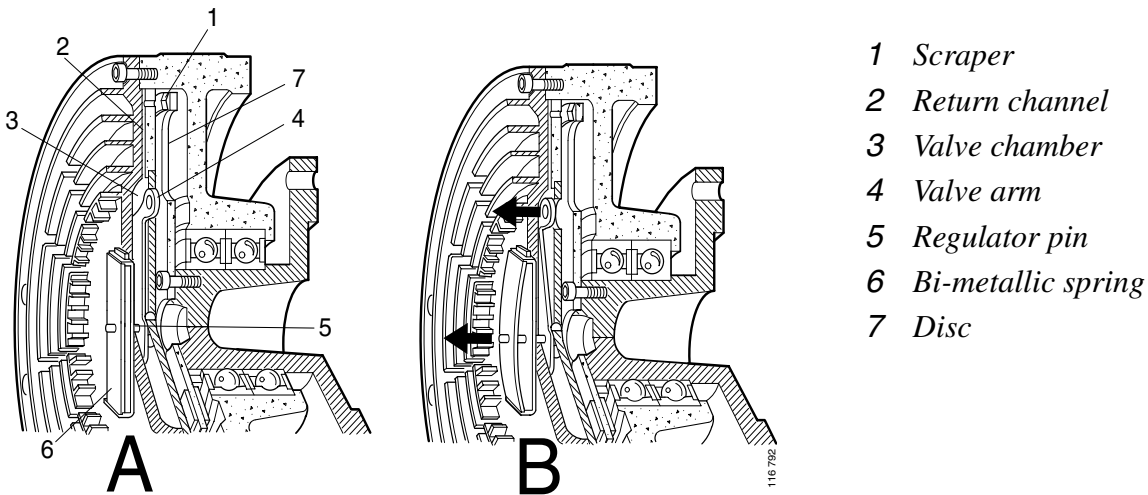
The fan is driven by friction in the silicone oil in the viscous clutch of the fan.

The slipping is determined by the quantity of silicone oil between the clutch disc and the clutch housing. More oil reduces the slipping.

When the engine is running, the oil is forced to the outer edge of the clutch where scraper 1 directs the oil into return channel 2 in the clutch cover and back to valve chamber 3 at the centre of the cover. Valve arm 4 opens and closes the valve using the regulator pin which is controlled by a bi-metallic spring 6.

The bi-metallic spring is closed when the temperature of the air which hits the bi-metallic springs is low. The clutch is then emptied of oil and the fan rotates slowly.

When the temperature of the air from the radiator rises, the bi-metallic springs begin to bend outward, the valve opens and more oil is released into the clutch. The friction in the clutch then increases and the fan begins to rotate with the disc.

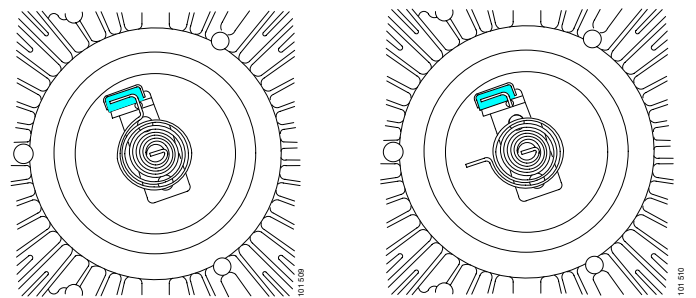


A Valve closed – a lot of slippage

B Valve open – little slippage

Some fan hubs have a spiral-shaped bi-metallic spring at the front instead of the plates that are shown in the picture above. By altering the position of the spiral-shaped bi-metallic spring, the fan can be set to run continually if necessary.

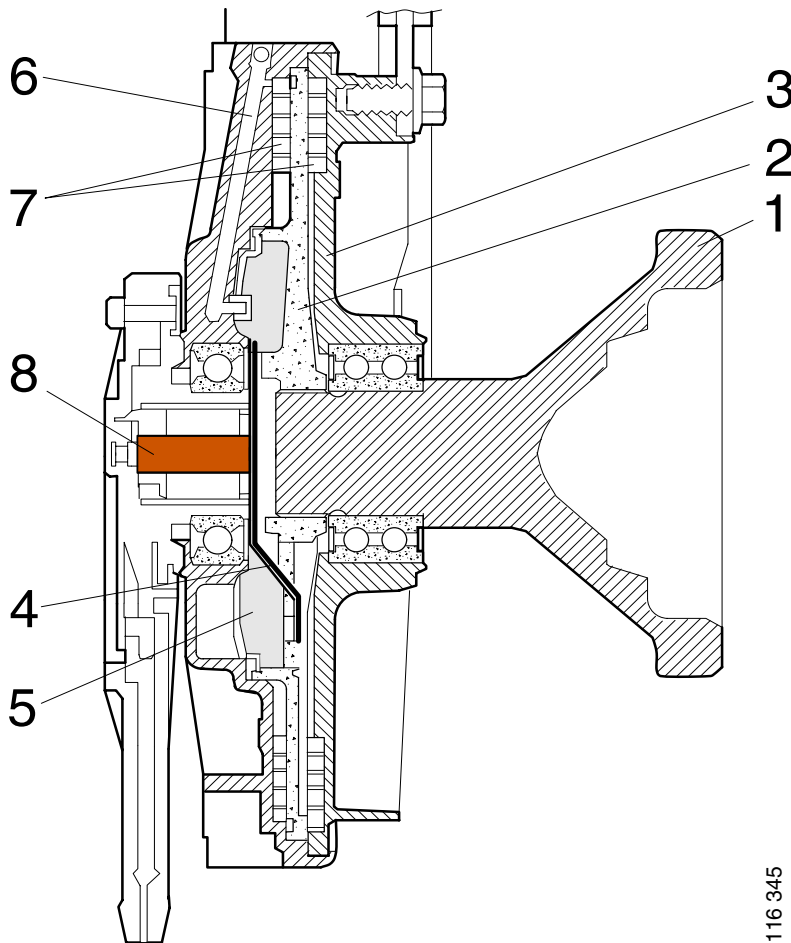
Note: This function should only be used in an emergency.



Thermostat controlled fan

The fan will continuously run fully engaged

Electrically controlled fan



Primary parts

- 1 Flange
- 2 Primary disc

Secondary parts

- 3 Housing
- 4 Control valve
- 5 Oil chamber
- 6 Oil return channel
- 7 Working chamber
- 8 Solenoid valve

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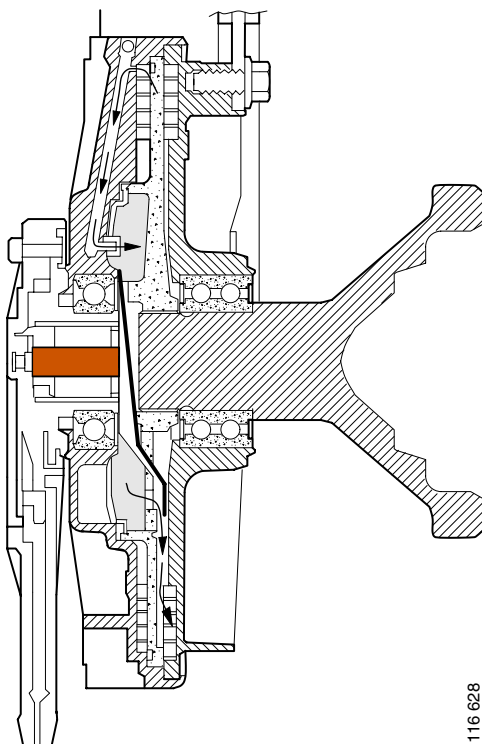
The electrically controlled fan is controlled by signals from the EDC control unit. The EDC control unit receives signals from the coolant temperature sensor, the charge air temperature sensor and the retarder control unit and then controls the rotational speed of the fan using a current-regulated PWM (Pulse-Width Modulated) signal. The PWM signal works at a voltage of +24V.

The primary parts of the fan, i.e. flange 1 and primary disc 2, are driven by the crankshaft via the outer belt transmission. The drive ratio relative to the engine speed is 1:1.1.

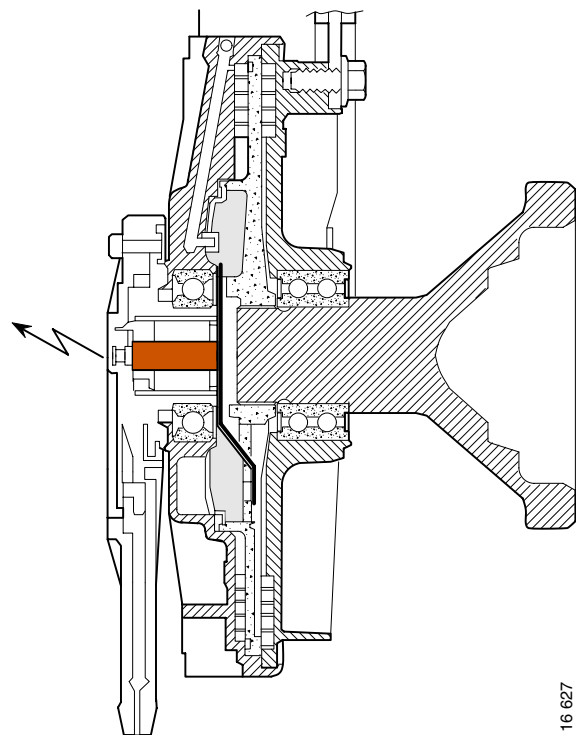
The secondary parts of the fan are driven by the friction in the silicone oil in the fan. The flow of silicone oil is controlled by regulator valve 4. Regulator valve 4 is in turn controlled by solenoid valve 8. When regulator valve 4 is in the closed position, the oil will be retained in oil chamber 5. When regulator valve 4 opens, the centrifugal force pushes the oil out into working chamber 7 and in between the discs. The circulation of the oil is driven by primary disc 2 at the engine speed $\times 1.1$, independently of the speed of the fan.

The speed of the secondary parts of the fan are controlled by the EDC control unit. If the EDC control unit does not send a signal to the solenoid valve, the regulator valve will be fully open and the fan will be fully engaged, i.e. it rotates at the engine speed $\times 1.1$. The speed of the fan is adjusted by the EDC control unit sending signals of different pulse lengths. At the maximum pulse length, the fan will run at idle speed, ca. 200-300 rpm. The idle speed depends on the speed of the engine.

If the electrical connection is broken, the fan will run fully engaged in order to protect the engine.



When the solenoid valve has no voltage across it, the regulator valve will be in the open position.



When the solenoid valve has a voltage across it, the regulator valve will be in the closed position.

The electrically controlled fan has a lower idle speed than the thermostat controlled fan. As the fan clutch is controlled electrically by signals from the coolant temperature sensor, the charge air temperature sensor and the retarder, the speed of the fan can be controlled more quickly and more accurately depending on the cooling requirement. The control of the fan will be more precise, which means that the fan speed can be optimised for each operating situation. This helps to reduce fuel consumption. This also means that the performance of the retarder can be better exploited.

With the electrically controlled fan, the coolant temperature will be slightly higher, between 5-10 degrees Celsius higher compared with a thermostat controlled fan.

Thermostat

Function

The thermostat is a double thermostat. The thermostat regulates the working temperature of the engine.

When the coolant temperature is below the opening temperature of the thermostat, the coolant circulates in the engine only in order to enable it to warm up quickly.

When the working temperature has been reached, the thermostat opens and the coolant circulates through the radiator.

Cold truck

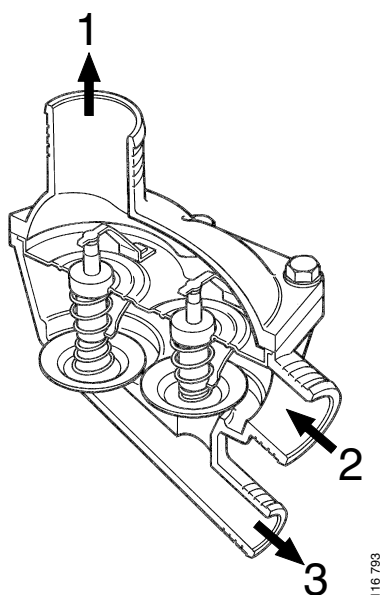
The thermostat is closed, the coolant circulates in the engine.

Working temperature

The thermostat maintains the correct engine temperature by regulating the quantity of coolant passing through the radiator.

Warm truck

The thermostat is fully open and all coolant circulates through the radiator.



- 1 To the water pump
- 2 From the engine
- 3 By-pass pipe to the water pump

Double thermostat for trucks with Scania Retarder.

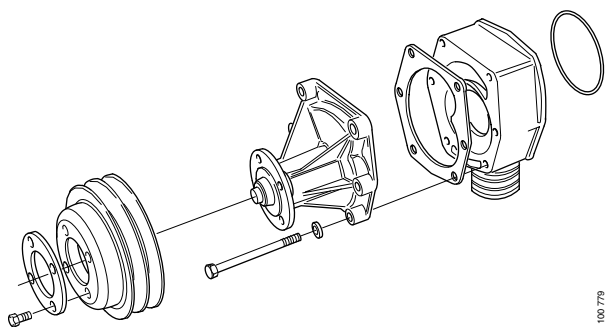
Coolant pump

Function

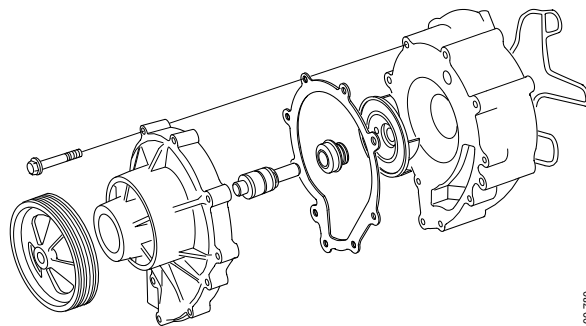
The coolant pump is positioned at the front of the engine and is driven by the crankshaft via the belt transmission.

The pump is a centrifugal type and consists of a spiral-shaped pump housing with an impeller which sits directly on the drive shaft. The shaft is mounted in the drive housing and is permanently greased.

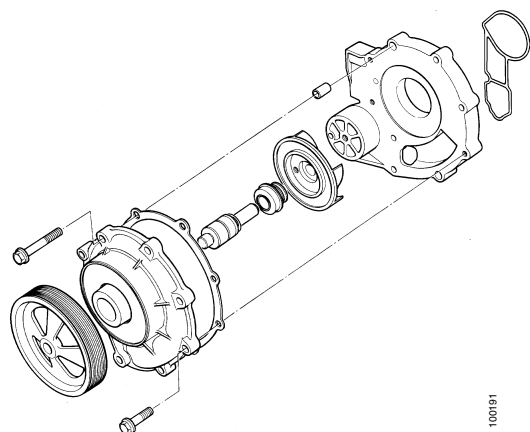
The pump shaft bearing is sealed against coolant with a sprung axial seal.



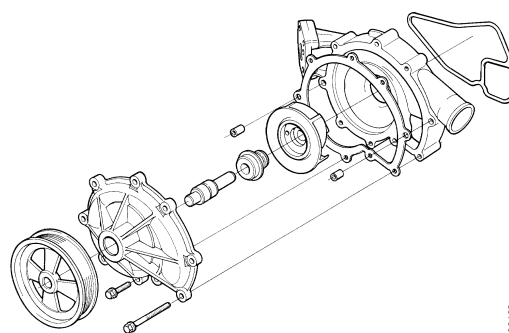
Coolant pump for the 9 litre engine



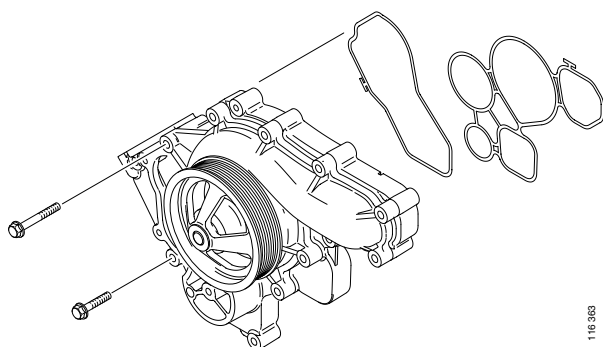
Coolant pump for the 11 litre engine (DSC)



Coolant pump for the 12 litre engine and 11 litre engine (DC)



Coolant pump for the 14 litre engine



Coolant pump for the 16 litre engine

Charge air cooler

General

The maximum engine output depends among other things on the amount of fuel that can be efficiently combusted in the engine.

Cold air has a higher density and contains more oxygen by volume than heated air. The temperature of the intake air increases when passing through the turbocharger. If the air then is cooled, the density of the air increases and more oxygen is provided to the engine. This means that more fuel can be combusted.

This gives increased power, lower fuel consumption and lower emissions. The cooled air lowers the combustion temperature as well as the temperature of the parts affected by the combustion, resulting in lower thermal stress in spite of the increased engine output.

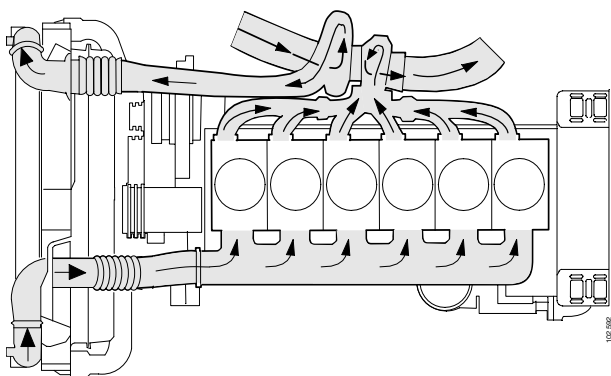
Noise damper

On certain types of the 14 litre engine, there is a damper in the pipe between the charge air cooler and the inlet manifold. The valve is closed in order to reduce the suction sound during exhaust braking. The valve is controlled by the exhaust brake control unit.

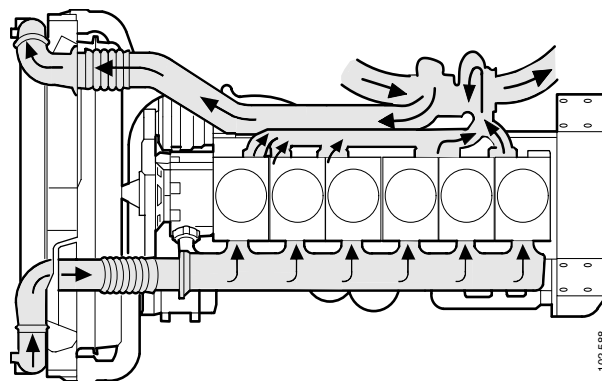
Intake system

Function

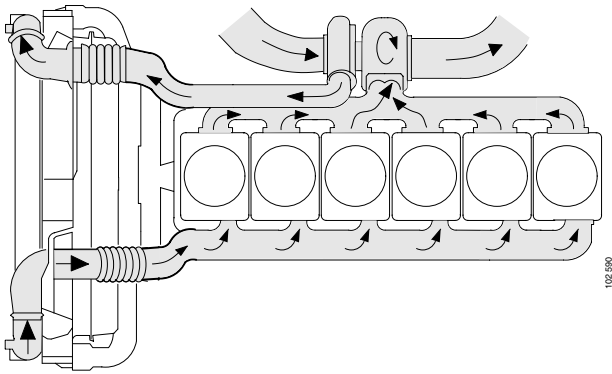
The intake system has a pipe which feeds the air after the turbocharger to the charge air cooler. The charge air cooler is positioned in front of the engine coolant radiator. The charge air is cooled by the air which passes over the outside of the charge air cooler. After cooling, the inlet air is fed to the inlet manifold which distributes the air to the cylinders.



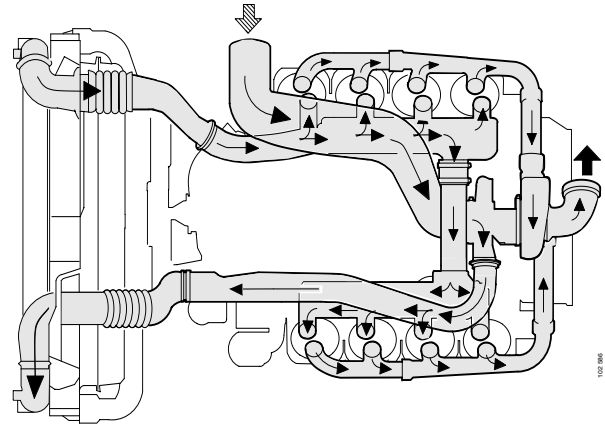
Air circulation, 9 litre engine.



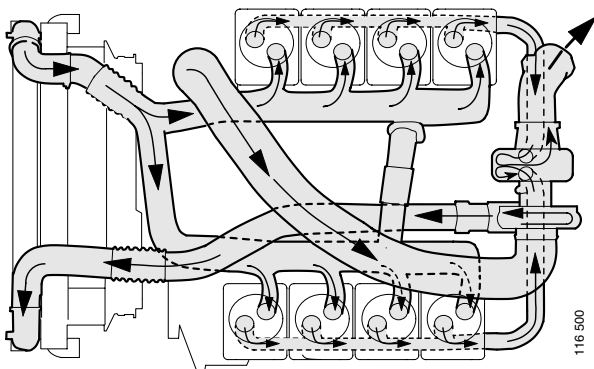
Air circulation, 11 litre engine (DSC).



Air circulation, 11 litre engine (DC) and 12 litre engine.



Air circulation, 14 litre engine.



Air circulation, 16 litre engine.