Alustatunnus

Polku
26/Description, Design and function//Cooling system

Malli
B10M

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Julkaisupäivämäärä
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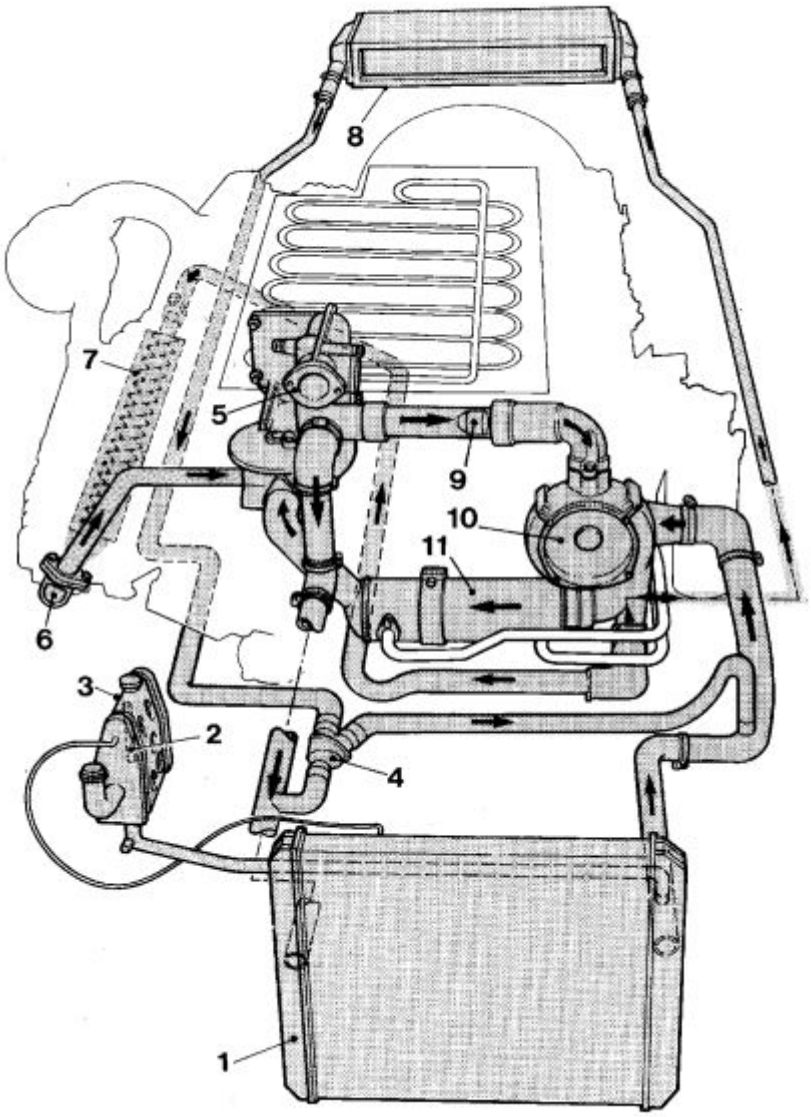
Tunnus/Käyttö

Cooling system

The function of the cooling system is to cool the engine, and if the bus has a separate hydraulic retarder or retarder built into the transmission, also the oil for the retarder and transmission. The engine is cooled by the cooling pump pumping coolant round the engine's cooling ducts and, due to the fact that the coolant not only flows through the oil cooler, and thus cools down the engine oil temperature, and on engines with intercooler it also goes through the intercooler where it lowers the intercooler temperature. A plunger type main thermostat regulates engine cooling temperature. The system has three additional thermostats: one for the heating system; one for the intercooler; and one for the retarder (or transmission) oil cooler. It is the thermostats that regulate coolant flow to the respective circuits to cope with the coolant temperature there. Not all engines have a thermostat for the intercooler.

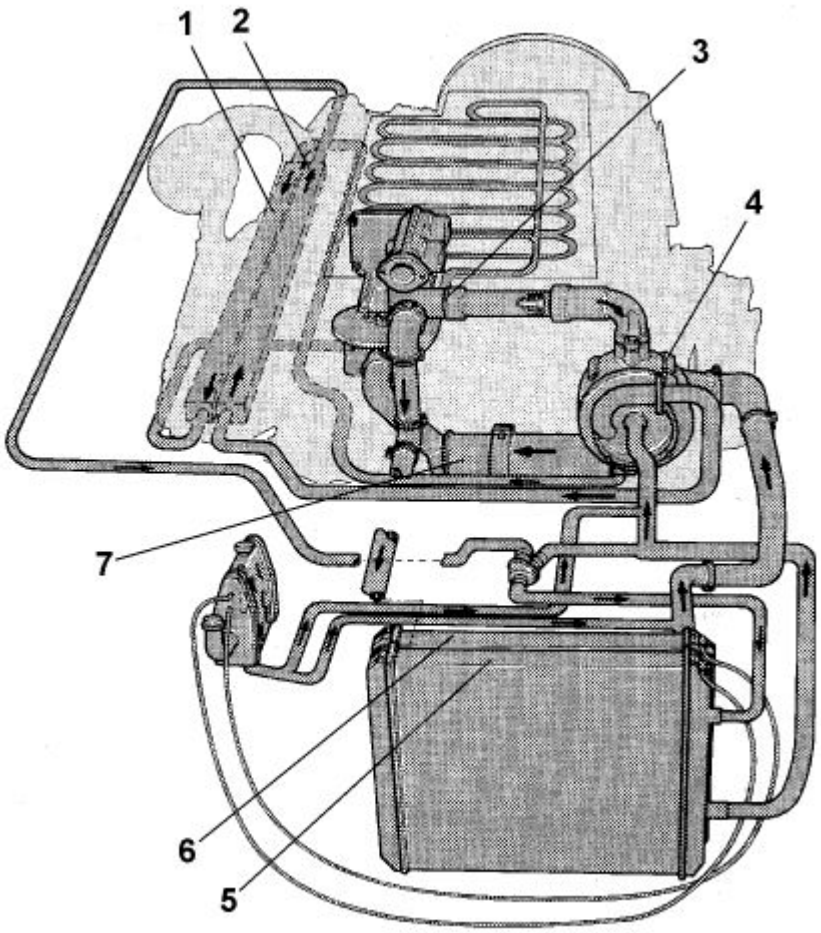
Concerning thermostats, refer also to Main thermostat THD 101/102.

Cooling system, engine THD 101 (excl. THD 101 KE)

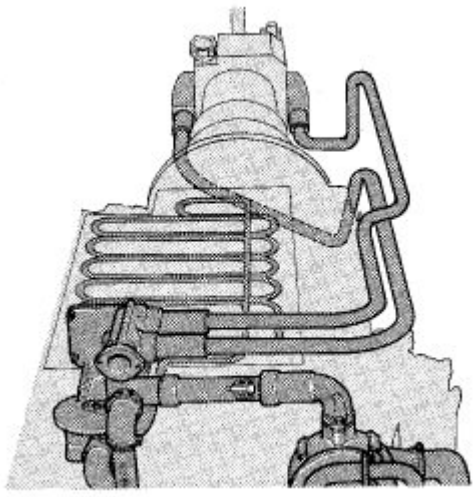


. Radiator
. Level indicator
. Expansion tank
. Thermostat, retarder/transmission circuit
. Thermostat housing
. Thermostat, intercooler (engine THD 101 K)
. Intercooler
. Oil cooler, retarder or automatic transmission
. Delivery valve
. Coolant pump
. Oil cooler, engine

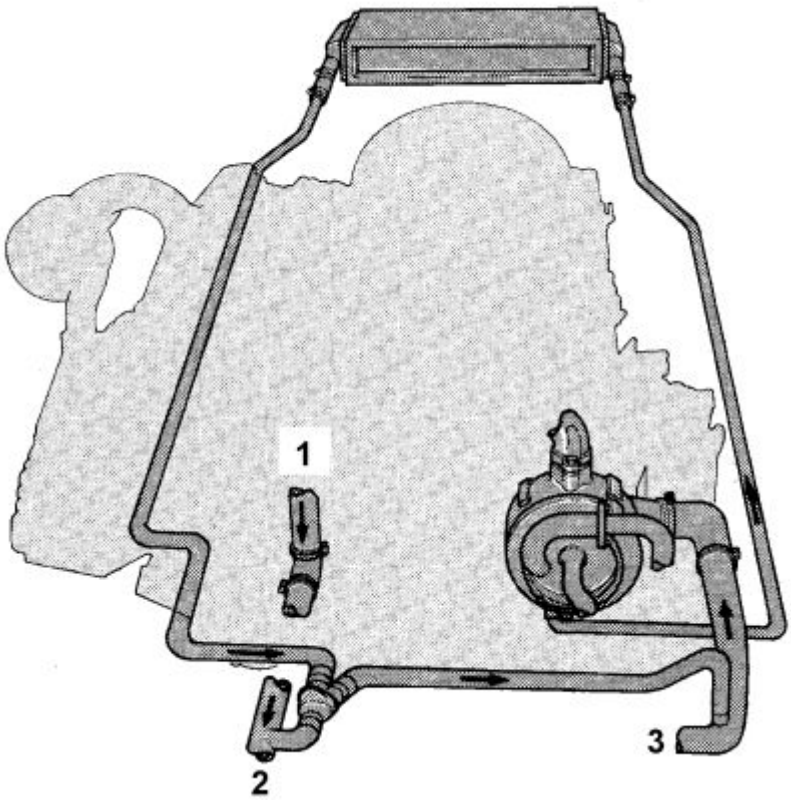
Cooling system, engines THD 102 and THD 101 KE



. Intercooler 1
. Intercooler 2
. Thermostat housing
. Coolant pump
. Radiator assembly for intercooler circuit 2
. Radiator assembly for cooling system
. Oil cooler, engine



Cooling circuit, oil cooler Voith retarder (combined with gearbox G/ EGS)



Cooling circuit, oil cooler, ZF automatic transmission

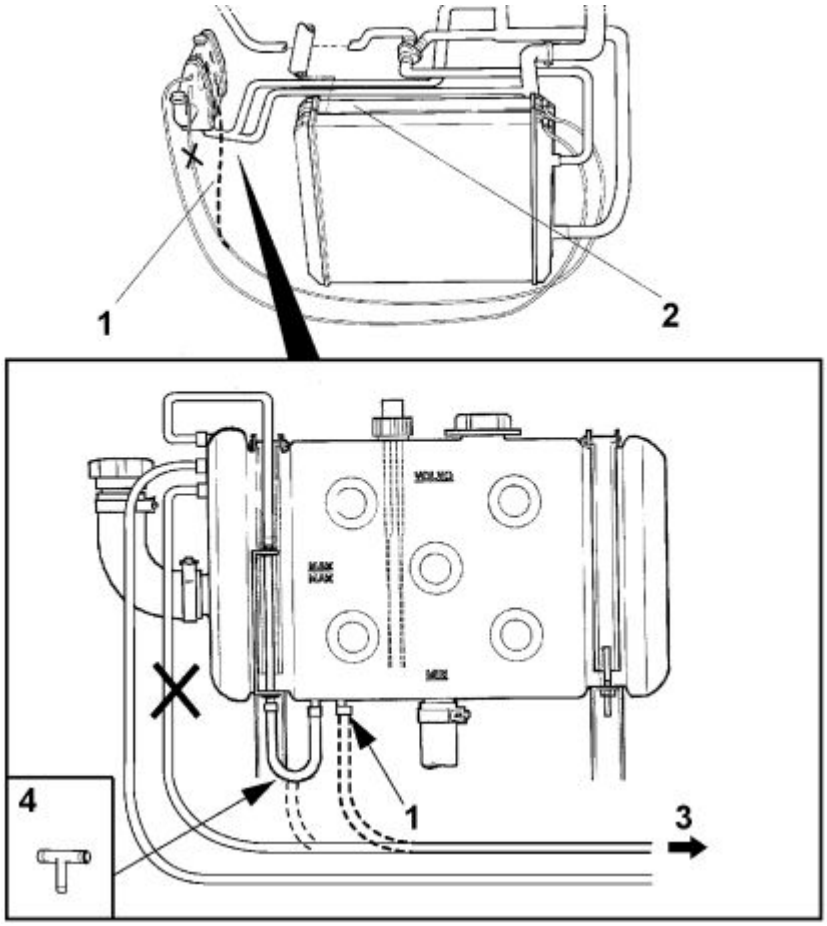
. From thermostat housing
. From radiator
. To radiator

Vent lines in cooling system, B10M

To prevent air from getting into the cooling system, the vent line from the radiator was moved, with effect from January, 1992, from the radiator to the bottom of the expansion tank, in other words below the coolant level. With this change venting from the expansion tank when filling an empty cooling system takes longer. Therefore, we recommend filling via the evacuation connection in the bottom of the radiator using filler unit 9812271-6.

If air gets into the cooling system it can cause cavitation and overheating. On earlier buses the risk of air getting in was reduced by moving the radiator's vent line to underneath the expansion tank, see fig. If there is not connection available for this, a T-piece can be jointed into the level glass hose.

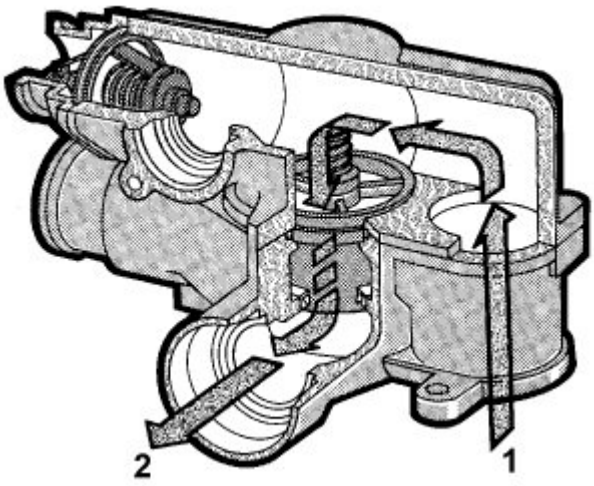
Note: The radiator's vent line must not be connected up to the other vent lines as this could result in air circulating in the system.



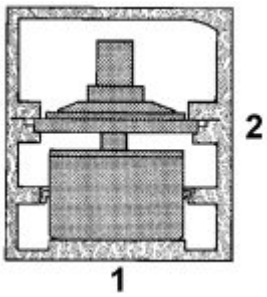
. Altered location
. Radiator, cooling system
. Radiator
. ALT.

Main thermostat THD 101/102

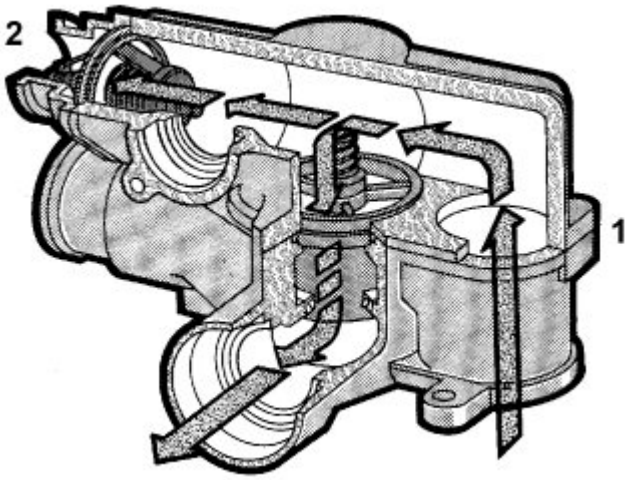
The cooling system's main thermostat is placed in the thermostat housing. Also in the housing is the thermostat for the heating system, in the heating system's discharge outlet. These thermostats regulate according to the opening temperature the coolant flow out into the system circuits or back to the engine. The other thermostats in the cooling system control coolant flow in their respective circuits. The intercooler circuit, which is connected to the intercooler, has a three-way thermostat. When coolant temperature goes below 25°C, the thermostat sees to that the coolant flows directly back to the intercooler system's own pump, which is integrally built with the cooling system's main pump. When coolant temperature is above 25°C, the coolant flows through the radiator cooler assembly that is placed in front of the bus's ordinary radiator. The automatic transmission cooling circuit has a similar thermostat, but with a considerably higher opening temperature. It opens first at 80°C, at which it directs the coolant through the radiator before it goes back to the pump.



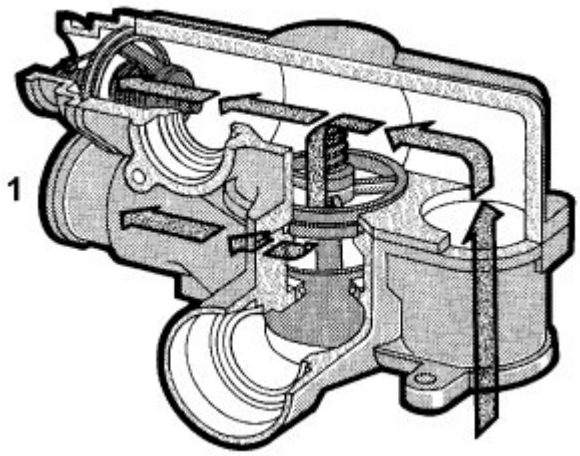
. From engine
. Return to coolant pump



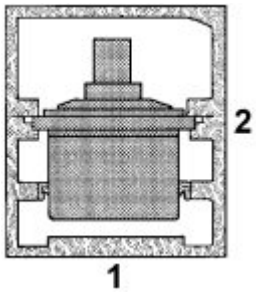
. Main thermostat
. Cold engine



. To heating system
. During warm-up



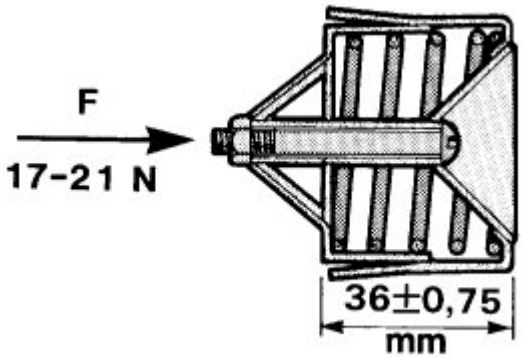
. To radiator



. Main thermostat
. Operating temperature

The thrust valve, which is located in the pipe between the thermostat housing and the coolant pump, increases the inner circuit pressure when the main thermostat is closed, especially at low engine speed. This improves the circulation in the heating system circuits.

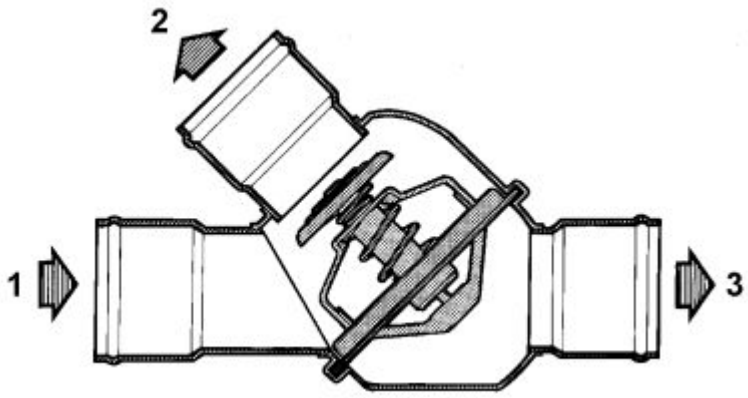
The fig. shows the valve's opening under load.



The three-way thermostat, automatic transmission, is mounted in a separate housing in the coolant line between the return line from the retarder/transmission oil cooler to the cooling system's cooler. The housing also has a return line that is connected to the coolant pump suction side.

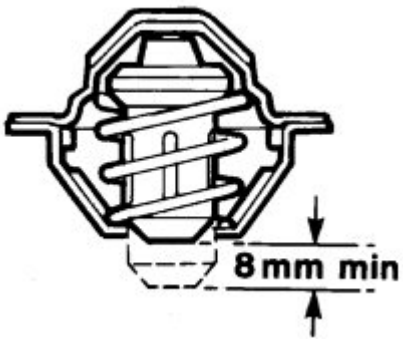
When coolant temperature is below 80°C, the thermostat directs the coolant back to the suction side of the coolant pump in order to prevent the engine from loosing too much heat. At more than about 95°C, the thermostat opens to let coolant pass through the radiator. At the same time the coolant pump return line closes.

By dividing the coolant flow into two circuits, it can be steered to achieve the required coolant flow necessary to keep down the coolant temperature when braking with the transmission retarder.



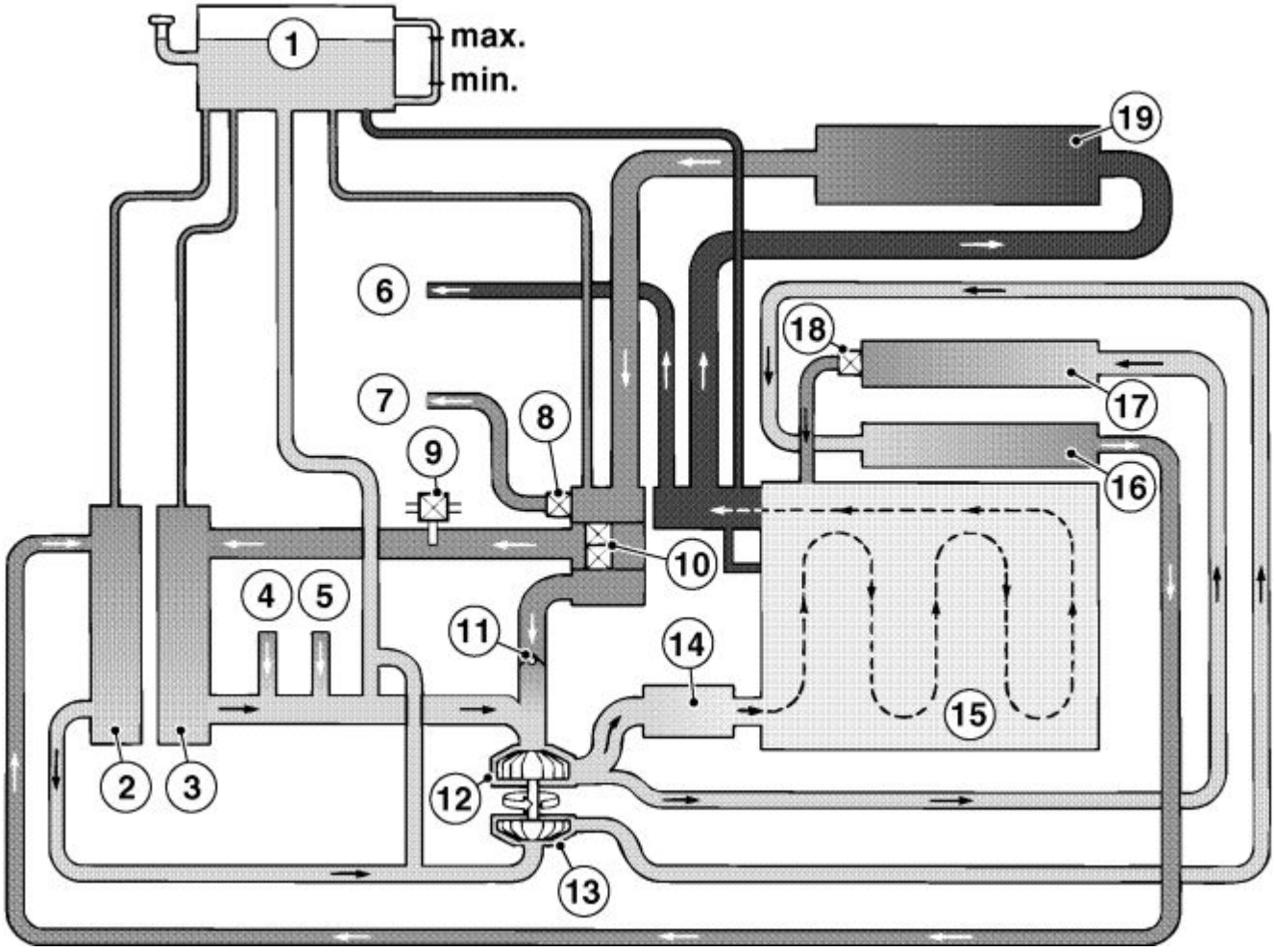
. From retarder/ transmission oil cooler
. Return to coolant pump
. To cooling system radiator

Thermostat, intercooler



To prevent the cold air flowing through the intercooler, especially at low idle, from lowering coolant temperature, the intercooler circuit (approx. 15 % of the flow) has a thermostat at the intercooler return line. Opening temperature is between 69-73°C. At 85°C the thermostat should have opened at least 8 mm.

Cooling system layout, engine THD 103



. Expansion tank
. Cooler for intercooler circuit 2
. Cooler for engine circuit and intercooler 1
. From bus interior radiators
. From windscreen defroster and lube oil tank (with heating if installed)
. To windscreen defroster and lube oil tank (with heating if installed)
. To bus interior radiators
. Thermostat, interior radiators
. Thermostat for regulating fan speed
. Thermostat, engine
. Pressure retaining valve
. Coolant pump, engine circuit and intercooler circuit 1
. Coolant pump, intercooler circuit 2
. Oil cooler, engine
. Engine
. Intercooler element 2
. Intercooler element 1
. Thermostat, intercooler circuit 1
. Oil cooler in transmission/retarder

The cooling system is a series-coupled system, which means that the engine cooling circuit is coupled in series with the retarder cooling circuit and has two main thermostats.

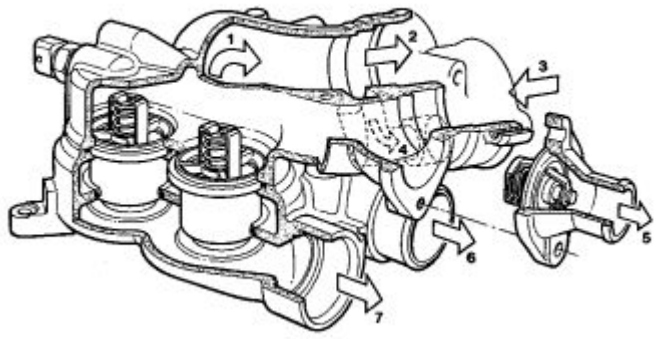
The cooling system main thermostats are located in the thermostat housing. Also housed here is the heating system thermostat, in the heating system outlet. Depending on the opening temperature, these thermostats regulate the coolant flow out to the system circuits or back to the engine.

Pos. 9 is the thermostat valve that controls the hydraulic pump and thereby the fan speed.

The thermostat housing contains two thermostats: one for regulating the temperature in the engine cooling circuit; and one for the bus interior heating circuit.

If the bus does not have an hydraulic retarder or automatic transmission, connections 2 and 3 on the thermostat housing are linked by a pipe bend and the thermostat housing has only a vent hose.

Path taken by coolant in thermostat housing:



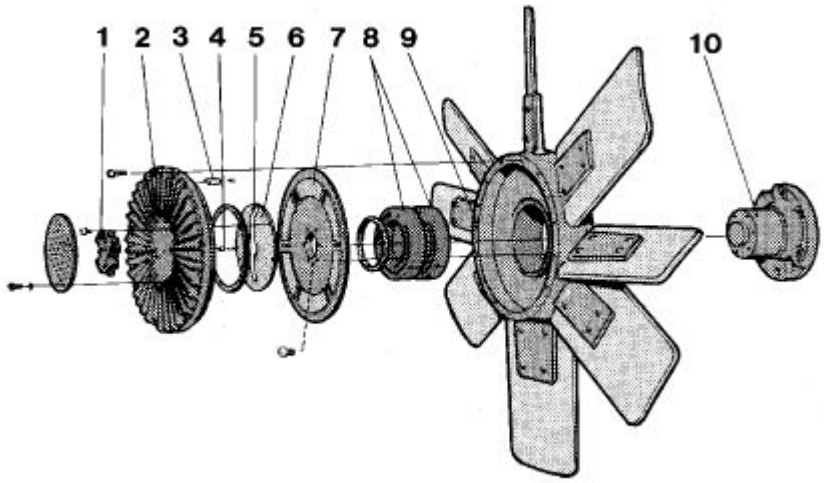
Thermostat housing, engines THD 103/104

. From engine
. To oil cooler in transmission/retarder
. From oil cooler in transmission/retarder
. To windscreen defrotank heating (if installed)
. To bus interior heating circuit
. To radiator
. To coolant pump

Cooling fan

Up front the temperature-controlled cooling fan has two temperature-sensitive bimetal washers. It is these that regulate fan cut-in/out.

The bimetal washers start bending when the cooling air has reached a temperature of about 40°C. The higher the temperature, the greater the bending. A control pin (4) transfers bimetal washer movement to a spring-loaded valve (5) in the fan hub.



. Temperature-sensitive bimetal washers
. Cover
. Oil scraper
. Control pin
. Spring-loaded valve
. Intermediate plate with valve arm
. Drive plate
. Fan bearings
. Coupling housing
. Drive shaft hub

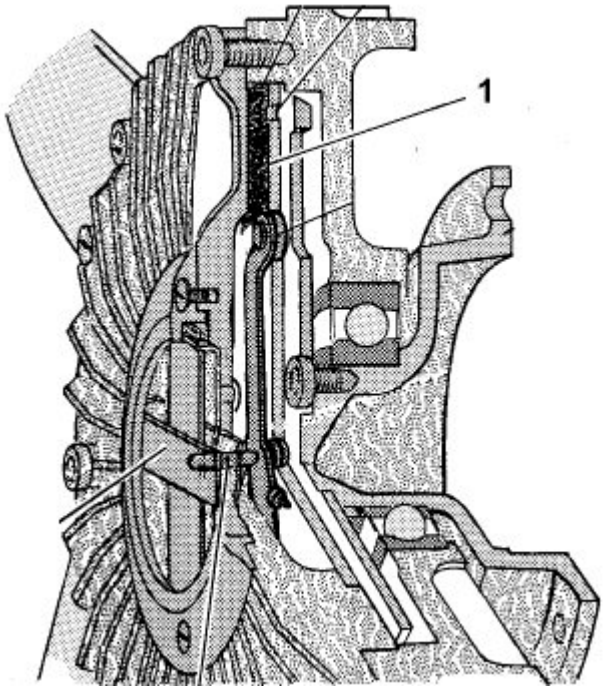
Engine THD 102 has two different types of cooling fans, depending on the oil used in the fan coupling. The oil for the cooling fans in KD engines has a higher viscosity. This has to do with the drive speed up-ratio. On the outside both fans look alike, but their part numbers differ: 3028707 for the KD engine; and 3028383 for the other THD 102 engines.

The fan coupling contains high viscosity silicone oil. At temperatures below approx. 40°C, the spring-loaded valve (5) is fully closed. This forces the oil to flow through a return duct from the coupling housing (9) to the oil chamber in the cover (2). Fan speed is thereby reduced to about 1/4 of the drive shaft (10) speed. This is the lowest cut-in speed.

As the temperature rises, the valve starts to open to increase the amount of cut-in. Full cut-in is reached at approx. 65° C, when the spring-loaded valve is fully open.

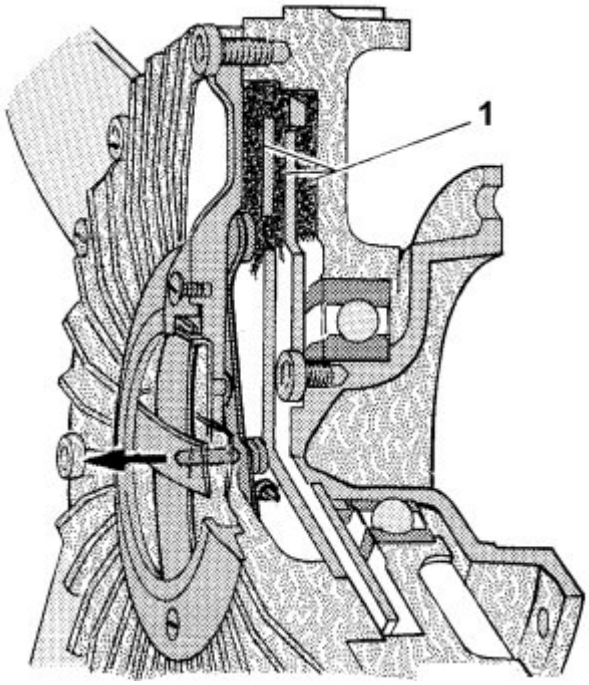
Because of slip achieved by the silicone oil, however, fan speed will never be higher than 95% of the drive shaft speed.

When cooling air temperature drops, the fan speed falls more rapidly between 60°C and 50° C. From 50°C down to 37° C fan speed drop is slower.



Closed control valve- reduced fan speed

. Oil



Open control valve- full fan speed

. Oil