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MAHLE AFTERMARKET
PRODUCT INFO

MAP-CONTROLLED THERMOSTATS



MAHLE[®]
ORIGINAL

Conventional temperature regulation: playing it safe

The combustion process in a passenger car engine runs optimally at an operating temperature of approximately 110°C. However, as the engine requires a certain power reserve in view of operation at full load, conventional thermostats start to kick in at an engine temperature of approximately 90°C by opening the coolant circuit. For safety reasons, the engine is thus permanently operated at a temperature level that is below the ideal temperature.

This technology—which still serves reliably to this day—has been in use for decades and is tailored to each type of engine.

Conventional thermostats have been further developed, however, to provide a better response to a wide variety of everyday driving situations and engine operating conditions. New technologies are pushing engine efficiency and combustion quality ever closer to optimum operating conditions.

The map-controlled thermostat: a safe choice for greater efficiency

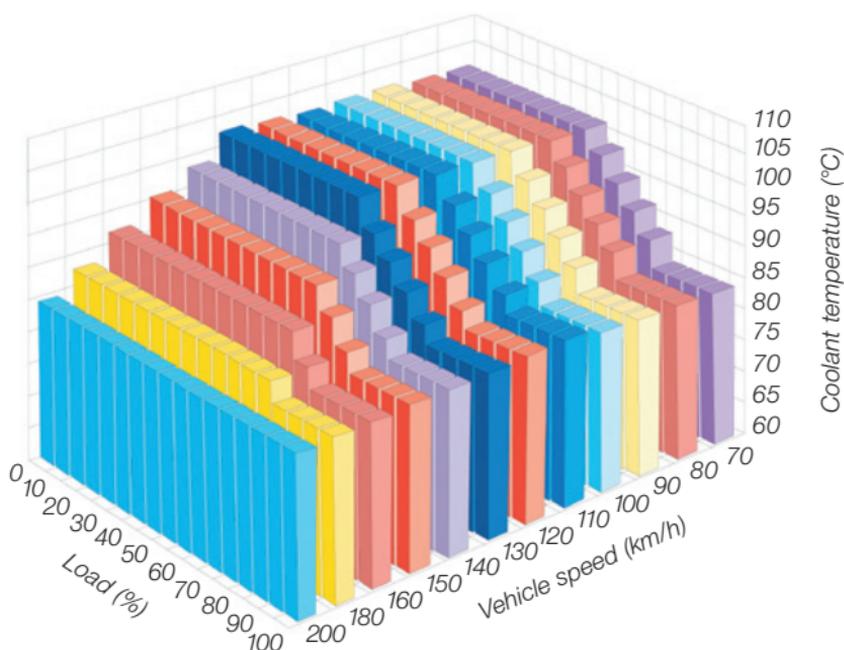
In order to safely raise the operating temperature of passenger cars to a constant higher level, and thus optimise combustion and all accompanying factors, a new thermostat technology was developed: the map-controlled thermostat. It supplements the conventional regulation of the coolant circuit with a wax element as expansion material by means of an electrically controlled, integrated heating element that is activated on demand. Consequently, the thermostat can influence the temperature considerably more quickly, allowing the engine to operate in various load and operating conditions within the corresponding optimum range.

This leads to several positive effects:

- Optimum combustion due to increased wall and component temperatures
- Reduced fuel consumption due to increased viscosity of the engine oil and consequently reduced frictional loss
- Lower pollution emissions due to improved combustion
- Improved power output at full load due to reduced coolant temperature
- More comfort due to higher coolant temperatures and, as a result, an improved interior heating performance

An operating map stored in the engine control unit defines when and how heat is added.

Operating map for a sports saloon



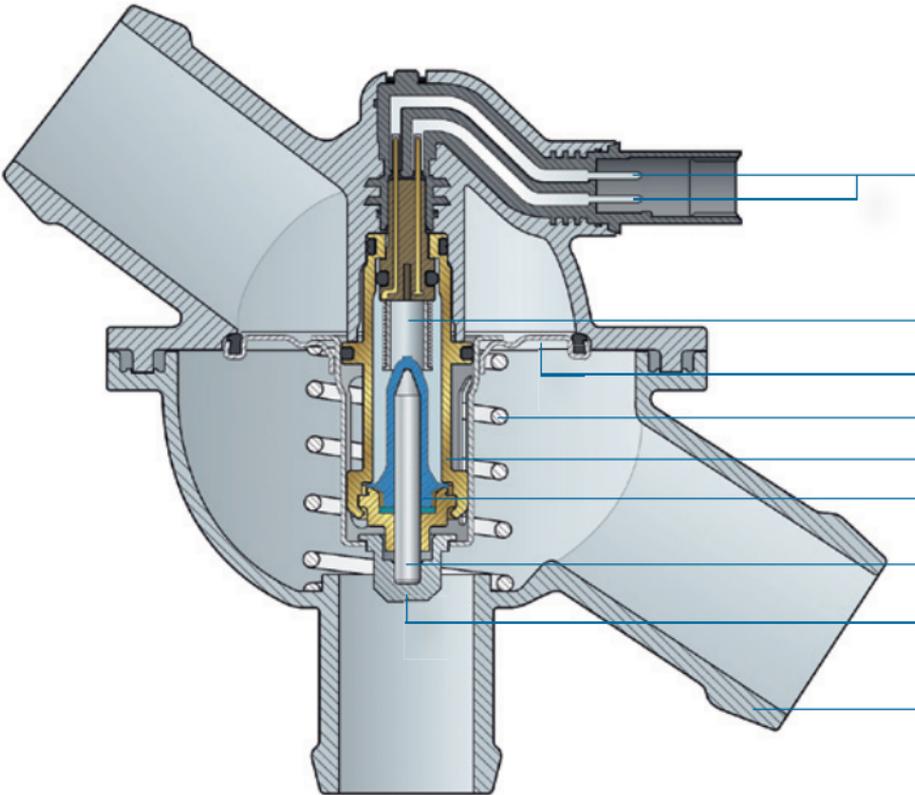
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Typical operating map for a sports saloon. To set the optimum coolant temperature for the corresponding operating condition, there are various predefined if-then constellations available in the engine control unit (set points): the ideal coolant temperature can be derived from the load and vehicle speed.

Two in one: how a map-controlled thermostat works

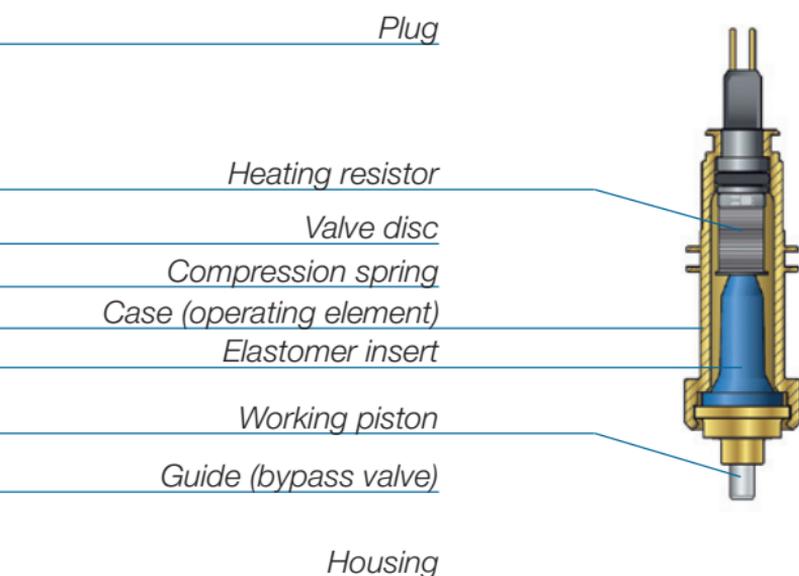
In standard operation, a map-controlled thermostat functions in the same manner as a conventional thermostat —just at a higher engine temperature. Coolant flows around the wax of the thermal expansion element. As the temperature rises, the expansion material increases in size and thus moves a piston, which in turn increases the flow volume of the coolant. If the temperature drops, a spring pushes the piston back to its starting position and thereby reduces the flow rate of the coolant or closes the coolant circuit altogether.

Design of a map-controlled thermostat



Cross section of a map-controlled thermostat with electrical connections and heating resistor integrated in the wax element.

When under load, an additional heat source comes into play with the map-controlled thermostat: once the conditions of the stored operating map have been fulfilled, a heating resistor integrated in the expansion material is enabled by the engine management system. This additional heat source allows the wax to expand even further; the coolant flow is increased once more and immediately regulates the engine to operate within the optimum temperature range.



Systematic simulation and misinformation

To prevent damage caused by overheating, the system simulates a higher coolant temperature preventatively in the event of a corresponding capacity demand (e.g. by heavily depressing the accelerator), even though the temperature has not actually risen yet. This intentional (mis-)information moves the expansion element and thermostat valve disc in advance to the correct position to increase the flow of coolant, thus creating the prerequisites to maintain the optimum temperature despite full load.

The system is also designed to deal with the reverse situation: in the event of the unwanted lowering of the temperature, e.g. driving downhill without actuating the accelerator or falling ambient temperature, the map-controlled thermostat kicks in by lowering the current flow through the heating resistor or even stopping it altogether.

How the aftermarket benefits from map-controlled thermostats

As is the case with conventional thermostats, map-controlled thermostats are not subjected to natural wear, they are maintenance-free and designed to last for the entire engine service life. However, external factors such as the use of low-grade coolant can lead to material fatigue. Other possible causes of failure include previous damage caused by thermal overloading or contamination due to work carried out on the cooling system, e.g. when replacing the coolant or water pump, the cooler, the coolant hose, timing belt, or V-belt.



When replacing faulty parts in the cooling system, thermostats should also always be replaced at the same time, because any loss of functionality or even complete failure can have severe consequences—even including engine damage.

How MAHLE Aftermarket proves to be your competent partner even in thermal management

With its strategic collaboration with Behr Group, MAHLE Aftermarket can access the product and production expertise of Behr Thermot-tronik. MAHLE Aftermarket customers stand to benefit from this development at the same time: various components are gradually being added to the MAHLE Original product range from the original equipment line of Behr Thermot-tronik.



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