



TECHNICAL INFORMATION

THE REFRIGERATION OF INTERNAL COMBUSTION ENGINES

Less than a quarter of the calorific energy consumed in the internal combustion engine is transformed in useful force. The rest of the heat must be dissipated so that no engine part warms up to the point of preventing its correct functioning.

At full throttle, about 36 % of the heat is lost due to internal friction and heating of the lubricating oil. Another 33 % dissipates through the cooling system.

There are two types of cooling: direct and indirect. In the system of direct cooling the air circulates between the external cylinder wings and the cylinder head.

In the indirect system a coolant liquid, usually also antifreeze, circulates through leads inside the engine which is also cooled in the radiator.

The cooling circuit of internal combustion engines currently consists of:

A covering that surrounds the warm parts of the engine; a radiator where the warm water coming from the engine is cooled by air; a ventilator which forces air towards the radiator; a pump which forces water circulation across the cooling system and a thermostat, placed at the engine vent, which regulates the flow of water from the engine to the radiator.

FUNCTION OF THE WATER IN THE COOLING AND WARMING OF THE ENGINE

The dimensions of the radiator and of the fan are calculated so that they allow the cooling of the engine in the most rigorous environmental conditions. For this reason, in winter months and at cold start, the cooling of the engine might be excessive, preventing from reaching the ideal operating temperature. Hence the need to intervene in the system of refrigeration in order to reduce as much as possible the time needed to reach the regime temperature of the engine. Moreover the possibility exists, in areas of extreme climate, of supporting the temperature of the refrigeration water between 70°C and 90°C, which are ideal limits for the proper working of the engine.

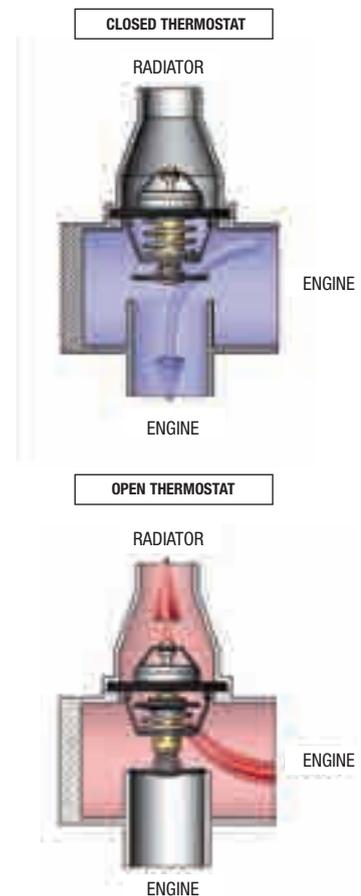
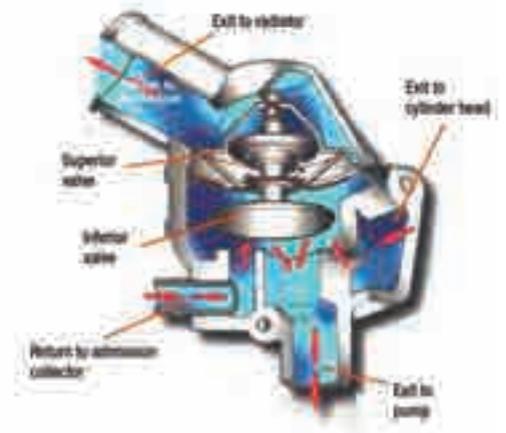
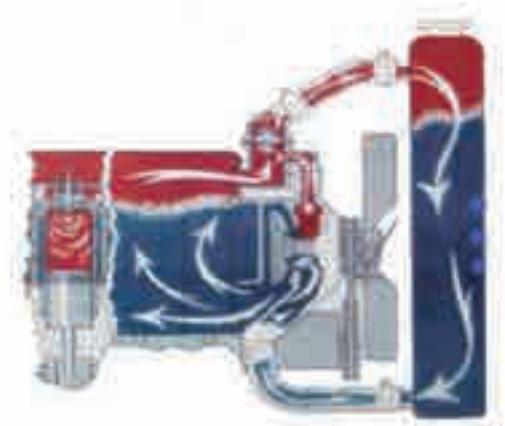
To achieve this, it is enough to reduce properly the efficiency of the cooling circuit, reducing the circulation of the coolant or even suppressing it and making it circulate only inside the engine block

The part which does this function is the THERMOSTAT, which is a valve usually inserted in the leads between the engine and the radiator.

In addition to its function as a valve which regulates water flow, the thermostat is sometimes used to open or close electrical contacts when certain temperature limits are exceeded. These switches are normally to detect dangerous temperatures and to illuminate a red light in the dashboard, or to activate a fan. In this case the parts are called THERMOCONTACTS.

All thermostats inserted in the water circuit must have a small passage for air bubbles, which remains open, even with a cold engine when the valve of the thermostat is closed, to avoid the formation of air bubbles in contact with the sensitive element of the thermostat, since it takes much more time to conduct heat through air compared to water, and in case the engine is too warm, the thermostat would not open the passage towards the radiator in the precise moment.

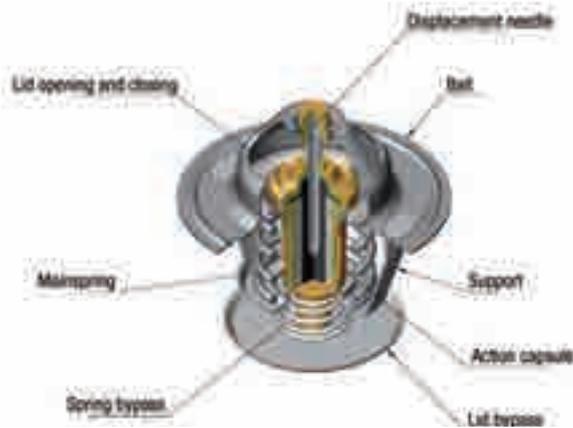
Moreover, in order avoid detaining the circulation of water to the pump, it is necessary that the chamber where the thermostat is placed communicates with the water pump through a BY-PASS (second passage). When the engine is cold, this by-pass, is open and closes once the engine is warm and the thermostatic valve opens the cooling circuit.



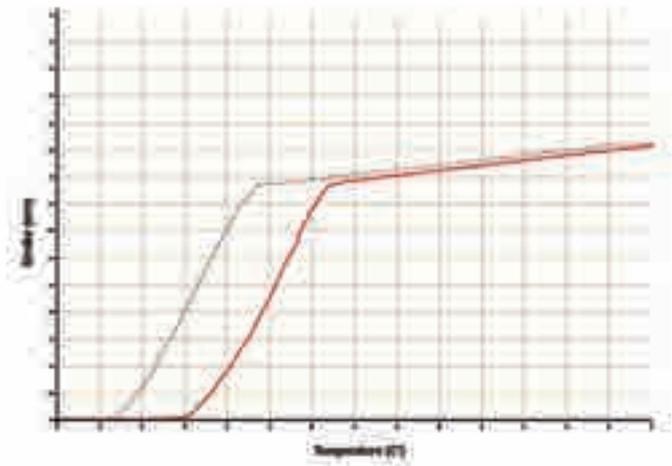


TYPES AND CHARACTERISTICS OF FAE THERMOSTATS

WAX Thermostats. These are based on the characteristics of special waxes with a high dilation coefficient. This type of thermostat possesses a rubber diaphragm surrounded with wax and an elongated rod. The wax is closed in a metallic capsule in contact with the water. When the wax is cold, the valve is closed and blocks the way of the water to the radiator. When the wax warms up it expands, expelling the rod and due to the action-reaction phenomenon, the valve opens. The closing takes place by means of a spring after the wax cools down. This kind of thermostat is the most widely used type of thermostats at present and is mounted originally in all internal combustion engines.



Displacement of the lid in function of the temperature of the FAE THERMOSTAT



CAUSES OF AN EXCESSIVE HEATING OF THE ENGINE

Although the cooling circuit is calculated in such a way that it maintains the engine at ideal temperature, sometimes the temperature of the engine increases in excess due to different reasons, some of them are:

- a) Lack of circulation of cooling liquid due to poor condition of the pump blades.
- b) Incorrect tuning of the ignition, thus increasing of the temperature in the cylinder.
- c) Loose fan belt, which causes it to slip and thus the pump does not impulse the liquid with the necessary pressure.
- d) Dirty radiator. The radiator is one of the elements that most influence the correct working of the cooling. If the leads are dirty, the liquid does not flow with the appropriate cadence and does not discharge the necessary calories to cool down. In this case the replacement of the radiator is needed.
- e) In case of engines equipped with an electro fan, when changing the thermostat for one whit lower operating temperature, the THERMOCONTACT OR FAN OF VISCOUS CONNECTION must also be replaced since it is necessary to connect the fan to a lower temperature. In case this is not done, the thermostat opens completely his valve but the radiator does not cool since the fan does not push the air across the panel at the suitable temperature.

For all above reasons it can be appreciated that the thermostat is not always responsible of the overheating of the engine. If for whatever reason the cooling circuit of an engine is opened, the cooling liquid goes out. When filled again, it is necessary to bear in mind that the circuit is obstructed by the thermostat, which while being cold, is closed and the filling is not the appropriate as air chambers are remained in the interior.

TO FILL CORRECTLY FOLLOW THESE STEPS:

- 1) Fill the radiator slowly.
- 2) Once full turn the engine on without ACCELERATING.
- 3) From this moment on the pump starts circulating the liquid through the whole circuit and filling the empty areas. At the same time it is heating up and the thermostat opens its passage; as a result the level in the radiator decreases. This is the appropriate moment to add more liquid and let the radiator "bubble" (a sign that air is expelling).
- 4) Next, the expansion deposit has to be filled up until reaching the ideal level. (Some engines have a dipstick).

If these steps are not followed, the engine will suffer large temperature oscillations given that temperature will increase greatly and will cause an excess of pressure, which will turn into a violent air expulsion giving the impression that the circuit enters into a boiling point. Once the air eliminated, its space is filled and lowers the level of liquid in the radiator which remains very low, being this another cause of excessive warming of the engine.

All the above produces excesses of temperature, which in some, cases can even destroy the thermostat.

On the dashboard there are indicators which warn the driver of excess of temperature by a thermometer or a warning light (in some vehicles both simultaneously) before coming to all these possible damages.