

What does a car's outdoor thermometer actually measure?

Questions should be of general interest and be about temperature measurement techniques and/or heat transfer.

QUESTIONS?
ANSWERS!

QUESTION: Inside my car is a thermometer that shows the outdoor temperature. Sometimes it seems as if the temperature is being affected by the car's speed. What temperature am I actually measuring?

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ANSWER: A temperature sensor always measures its own temperature. In turn, this temperature is influenced by the air temperature plus the temperature of the car and its surroundings. The sensor's location varies between the different makes and models of cars. In this answer we will discuss a sensor that is located underneath one of the outdoor rear-view mirrors, but a similar discussion can be held for other sensor locations.

The sensor's heat exchange with the air occurs via convection. A heat exchange via radiation occurs between the sensor and its surroundings, that is, primarily the road and the side of the car. The sensor and its attachment will also be influenced by the heat exchange with the rear-view mirror via heat conduction. The higher the velocity of the car, the greater the influence of the convection process. This means that at higher speeds, the air temperature will have a dominating influence on the sensor temperature.

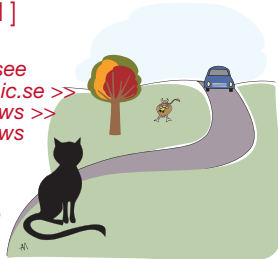
Unfortunately, there are many sources of interference that affect the measurement process. The air temperature often varies according to the height above the road. As a result, the sensor's location affects the temperature readings. In traffic jams and heavy traffic, hot exhaust gas and warm air blowing from car engine cooling systems are two factors that interfere with temperature measurement. Rain and dirt can also influence temperature readings.

Warning for the risk of skidding

The outdoor temperature can be used to judge the risk of skidding but in this context it is necessary to be very careful. The road's temperature is only one of the factors influencing the sensor. Both the air temperature at the height of the sensor above the road and the sensor temperature itself can very well be above 0 °C, even though the temperature of the road is below 0 °C. As a result, the road could be slippery. Car manufacturers often solve this problem by warning the driver with a light or some other appropriate symbol when the temperature reading is, for instance, + 3 °C or lower. After that, it is the driver's responsibility to judge whether there is a risk of skidding.

The sensor's response time is another factor that should be carefully considered. The temperature of both the air and the road normally vary along a road. On cold autumn nights with clear skies, the temperature on a road bridge can be lower than 0 °C even though the road's temperature both before and after the bridge is higher than 0 °C. Unfortunately, changes of temperature will always be measured with some delay. The response time is affected by such factors as the sensor's construction and the car's velocity. [Ref 1]

References: see www.pentronic.se >>
Pentronic News >>
Pentronic News Archive
[Ref 1] See Pentronic News 2010-2 p. 4.



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