NRF TECHNICAL ARTICLE

AUTOMOTIVE SENSORS AND ITS IMPORTANCE NOWADAYS

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Since the implementation of the Euro regulations in 1993, governmental requirements on pollutant emissions have become increasingly restrictive. With the increase in the number of vehicles in all countries, air quality has been reduced, especially in large population centers.

These regulations cover three main points:
- **Nitrogen oxides (NOx):** These are produced by combustion at high temperatures in the presence of oxygen. They are gases that, in aqueous solution (rain), generate acids that are very harmful to cities in the form of acid rain.
- **Carbon dioxide (CO2):** The main cause of the greenhouse effect. This gas is generated due to the combustion of hydrocarbons, such as fuels.
- **Particulate matter:** It is generated due to combustion rich in fuel, especially in older diesel vehicles.

The more restrictive Euro 7 standard aims to reduce pollutants by between 60% and 90% and to limit or eliminate pollutants that were previously tolerated, such as ammonia (from the SCR catalytic filters of diesels with AdBlue), methane and nitrous oxide.

Today, the need to reduce emissions has also led to another need: electronic control of engine management. To monitor the combustion process, it is necessary to know precisely what temperature the engine is at, what pressure and temperature the exhaust gases are at, what pressure and temperature the intake manifold is at, the fuel pressure and the position of the various engine components.

An electronic engine control unit is nothing more than a small computer that receives and processes a signal in order to elaborate an action process with respect to that signal. For example, if the engine is overheating, the ECU can give the order to turn on the electric fans.
Devices called sensors are involved in this reading process. These sensors are actually "transformers of physical quantities into electrical quantities". A coolant temperature sensor transforms the heat coming from the engine into a resistance value thanks to special resistors called thermistors.

A control unit cannot read physical quantities, but it can read electrical (voltage, resistance...) and digital (square wave signals) quantities and use these measurements to act on the engine to achieve greater efficiency. In practice, the temperature parameters are not only to know when to turn on the electric fans, but can also be used to optimize fuel injection, because when the engine reaches its optimum working temperature is when less fuel flow is needed (Photo 1.).

(Photo 1) Coolant Temperature Sensor NRF 727011

Inside any modern engine there is an injection system that feeds it with fuel. As revolutions increase, injection and ignition times are reduced, needing to know the exact position of the engine. This is achieved thanks to sensors called Crankshaft Position or Camshaft Position Sensors, which "report" the position of the engine in order to optimize injection times. Together with the information provided by the Coolant Temperature Sensor, the ECU is able to accurately adjust the amount of fuel injected, minimizing fuel consumption and vehicle emissions.
Due to the greater restriction of the Euro regulations on particulate emissions, it is necessary to implement the so-called Anti-Particulate Filters or APF (both in diesel and gasoline vehicles). In this type of device it is necessary to know how full it is so that the control unit can determine when to regenerate it.

For this purpose, an Exhaust Gas Pressure Sensor is used. This sensor transforms a pressure value into an electrical signal that indicates to the unit how full the FAP is. Its operation can be of the "differential" type, in which the pressure at the inlet and outlet of the FAP is compared (so the sensor has two tubes) (Photo 2.) or of the "absolute" type, which measures the

pressure at a specific point (so the sensor has only one tube) (Photo 3.). Working together with this sensor are the Exhaust Gas Temperature Sensors, which indicate to the unit the temperature of these gases (Photo 4.).

Photo 2. Exhaust Gas Pressure Sensor "Differential" type NRF 708011

Photo 3. Exhaust Gas Pressure Sensor "absolute" type NRF 708004

Photo 4. Exhaust Gas Temperature Sensor NRF 707325

When these sensors, working side by side, yield specific values, the unit can undertake the "regeneration" action, sending signals to the injectors to perform "post injections" that will cause the FAP to increase its temperature, burning all the stored soot.

In addition to all the engine control sensors, it is also worth mentioning those that are responsible for improving driving comfort and safety. In the European Union, ABS became mandatory in 2004, for which the control unit needed to "know" the speed of the wheels. With this, the use of sensors in the braking system became common.

This type of sensor sends an electrical signal when a metal gear wheel passes a tooth through the sensor. A sensor picks up the signal from each wheel and the unit compares them to see if there is a large variation in their speeds. Later, this type of information was also used in stability systems (ESP) and even in electronically controlled all-wheel drive systems.

Therefore, due to the many new technologies implemented in today's vehicles, we must be prepared for the future of the automotive industry.

NRF offers more than 500 references of Coolant Temperature, Exhaust Gas Pressure, Exhaust Gas Temperature and Coolant Level sensors for both passenger cars and commercial vehicles.