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DEPARTMENT OF AUTOMOBILE ENGINEERING

COURSE NAME : 19AUB204 – AUTOMOTIVE ELECTRICAL AND ELECTRONICS ENGINEERING

II YEAR / IV SEMESTER

Unit 4 – Sensors and Actuators

Topic : Coolant Temperature and Exhaust Temperature Sensor

COOLANT TEMPERATURE SENSOR

- The coolant temperature sensor is a crucial component in a vehicle's engine management system.
- It measures the temperature of the engine coolant and sends this information to the engine control unit (ECU) or engine control module (ECM).
- The ECU uses this data to adjust fuel injection, ignition timing, and other engine parameters to ensure optimal performance, fuel efficiency, and emissions control.
- The coolant temperature sensor typically uses a thermistor—a type of resistor whose resistance varies with temperature—to detect changes in coolant temperature.

COMPONENTS

- **Thermistor**: The core component of the coolant temperature sensor is a thermistor, which is a type of resistor whose electrical resistance changes with temperature. This thermistor is usually made of ceramic material and is sensitive to changes in temperature. As the temperature of the coolant changes, the resistance of the thermistor also changes.
- **Probe or Sensor Body**: The thermistor is housed within a probe or sensor body. This body is often made of brass, aluminum, or plastic and is designed to be in direct contact with the engine coolant. It allows the sensor to accurately measure the temperature of the coolant as it flows through the engine.

COMPONENTS

- **Electrical Connector**: The coolant temperature sensor is connected to the vehicle's wiring harness via an electrical connector. This connector allows the sensor to transmit the temperature data it collects to the engine control unit (ECU) or engine control module (ECM) in the vehicle's onboard computer system.
- **Sealing O-Ring or Gasket**: To ensure a proper seal and prevent coolant leakage, the coolant temperature sensor is often equipped with a sealing O-ring or gasket. This component is typically made of rubber or silicone and is positioned between the sensor body and the mounting surface on the engine block or coolant passage.

PRINCIPLE USED

- The principle used in a coolant temperature sensor revolves around the concept of electrical resistance variation with temperature.
- This is typically achieved through the use of a thermistor—a type of resistor whose resistance changes with temperature.
- A thermistor, usually made of ceramic material, is employed.
- As the temperature of the engine coolant changes, the resistance of the thermistor also changes.
- This change in resistance is directly proportional to the change in temperature.

WORKING

- The core component of the coolant temperature sensor is a thermistor, typically made of ceramic material.
- This thermistor exhibits a change in its electrical resistance depending on the temperature of the surrounding environment.
- The sensor is placed in direct contact with the engine coolant, usually in the engine block or near the thermostat housing.
- As the engine runs, the coolant temperature rises due to the combustion process and heat generated by the engine.

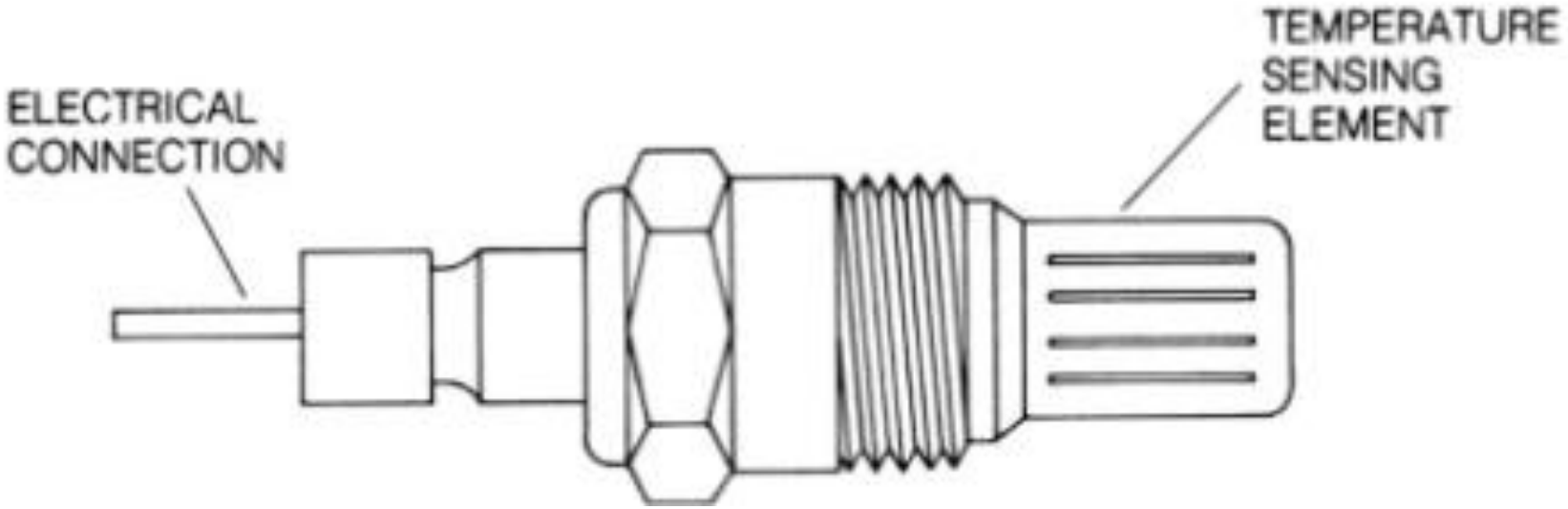
WORKING

- The temperature of the coolant affects the resistance of the thermistor.
- As the coolant temperature increases, the resistance of the thermistor decreases, and as the coolant temperature decreases, the resistance increases.
- This variation in resistance is proportional to the change in temperature.
- The coolant temperature sensor is connected to an electrical circuit within the vehicle.
- Typically, a voltage is applied across the thermistor, and the resulting current creates a voltage drop that is measured.

WORKING

- The voltage signal obtained from the sensor is then sent to the engine control unit (ECU) or engine control module (ECM) of the vehicle.
- The ECU uses this signal to determine the temperature of the engine coolant.
- Based on the coolant temperature data received from the sensor, the ECU adjusts various engine parameters such as fuel injection timing, ignition timing, and idle speed.
- These adjustments optimize engine performance, fuel efficiency, and emissions control, while also preventing issues such as overheating or cold start problems.

WORKING



ADVANTAGES AND DISADVANTAGES

ADVANTAGES

- Optimal Engine Performance
- Prevention of Engine Damage
- Fuel Efficiency

DISADVANTAGES

- Inaccurate Reading
- Dependency on Coolant Flow
- Limited Diagnostics Information

APPLICATIONS

- Automotive Engines
- Marine Engines
- Agricultural Machinery
- Constructional Equipments

EXHAUST TEMPERATURE SENSOR

- Exhaust temperature sensors, also known as exhaust gas temperature (EGT) sensors or exhaust gas temperature probes, are crucial components in modern vehicles with internal combustion engines.
- Exhaust temperature sensors measure the temperature of the exhaust gases exiting the engine.
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- High exhaust temperatures can lead to catalyst degradation and reduced efficiency in emissions reduction systems.

COMPONENTS

- **Thermocouple or Thermistor:** The core sensing element of the exhaust temperature sensor is usually a thermocouple or a thermistor. These components generate an electrical signal proportional to the temperature of the exhaust gases. Thermocouples utilize the Seebeck effect, where a temperature difference between two dissimilar metals produces a voltage, while thermistors change their resistance with temperature.

COMPONENTS

- **Temperature Probe:** The probe is positioned within the exhaust system, usually downstream of the exhaust manifold or turbocharger, where it comes into direct contact with the hot exhaust gases. The probe is designed to withstand high temperatures and corrosion from exhaust gases.
- **Wiring and Connector:** The sensor is connected to the vehicle's wiring harness via an electrical connector. The electrical signal generated by the thermocouple or thermistor is transmitted to the ECU for processing.

PRINCIPLE USED - THERMOCOUPLE

- In an exhaust temperature sensor, the hot junction is exposed to the high-temperature exhaust gases, while the cold junction is typically maintained at a reference temperature.
- The voltage generated by the thermocouple is measured and correlated with the temperature of the exhaust gases.

PRINCIPLE USED - THERMISTOR

- A thermistor is a type of resistor whose electrical resistance varies with temperature.
- In an exhaust temperature sensor, a thermistor with a negative temperature coefficient (NTC) is commonly used.
- This means that as the temperature increases, the resistance of the thermistor decreases.
- By measuring the electrical resistance of the thermistor, the temperature of the exhaus gases can be determined.
- The change in resistance is typically converted into a voltage signal that is proportiona to the temperature

WORKING

- The exhaust temperature sensor is positioned within the exhaust system, typically downstream of the exhaust manifold or turbocharger, where it comes into direct contact with the hot exhaust gases as they exit the engine.
- The core sensing element of the exhaust temperature sensor is either a thermocouple or a thermistor.
- These components are sensitive to changes in temperature and generate electrical signals in response to these changes.
- The thermocouple or thermistor reacts to the temperature of the exhaust gases.

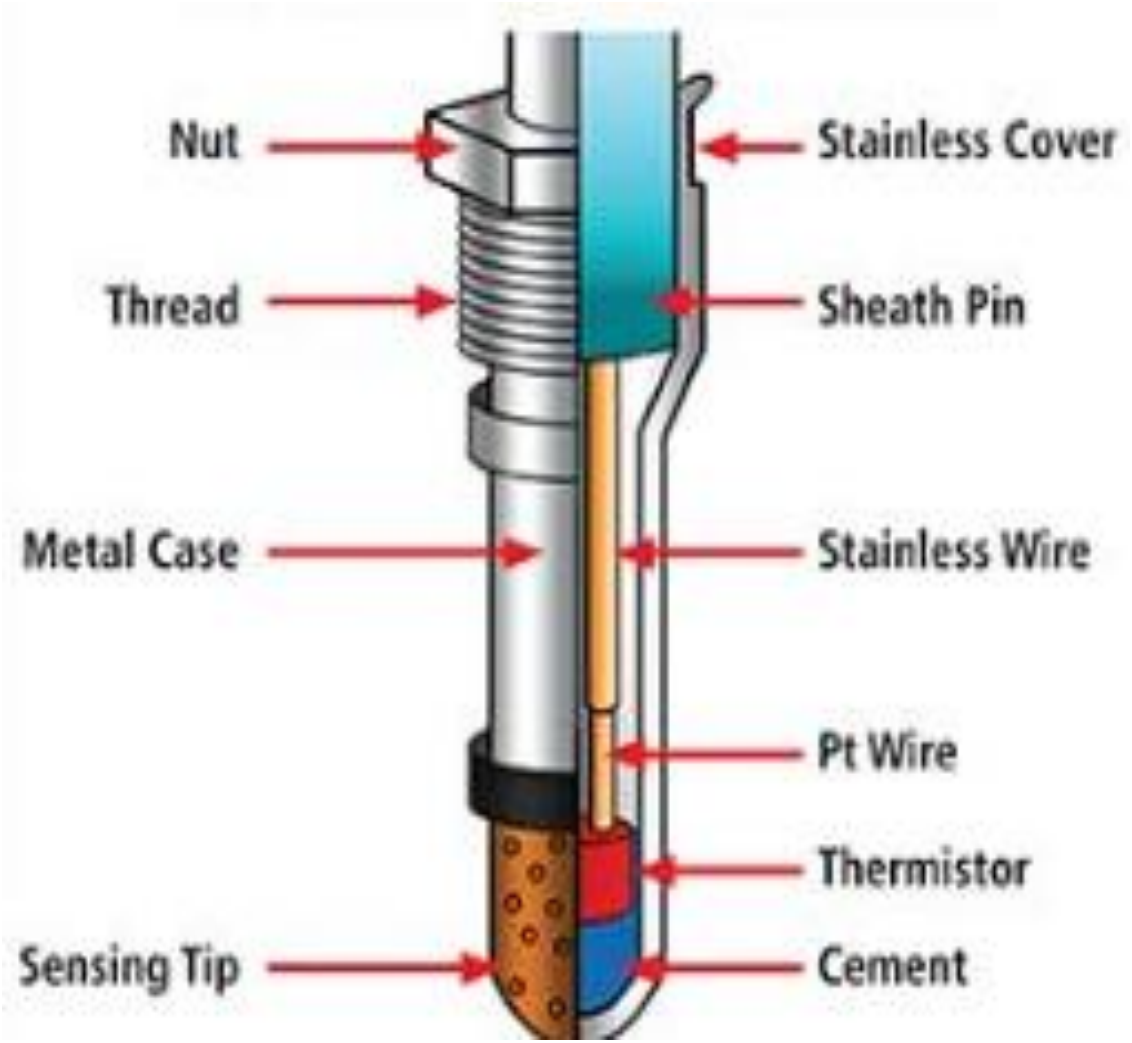
WORKING

- In the case of a thermocouple, it generates a voltage (Seebeck voltage) proportional to the temperature difference between the hot junction (exposed to the exhaust gases) and the cold junction (usually maintained at a reference temperature).
- For a thermistor, its electrical resistance changes in response to temperature variations.
- The electrical signals generated by the thermocouple or thermistor are transmitted to the vehicle's engine control unit (ECU) or engine control module (ECM) via electrical wiring and connectors.
- These signals represent the temperature of the exhaust gases.

WORKING

- The ECU processes the electrical signals received from the exhaust temperature sensor.
- Depending on the vehicle's design and engine management strategy, the ECU may use this temperature data for various purposes, such as optimizing fuel injection timing, controlling turbocharger boost pressure, or monitoring emissions control systems.
- Based on the exhaust temperature data and other sensor inputs, the ECU adjusts engine parameters to ensure optimal performance, fuel efficiency, and emissions compliance.

WORKING


Nut
Thread
Metal Case
Sensing Tip
Stainless Cover
Sheath Pin
Stainless Wire
Pt Wire
Thermistor
Cement

ADVANTAGES AND DISADVANTAGES

ADVANTAGES

- Emission Control
- Engine protection
- Performance optimization

DISADVANTAGES

- Sensor Failure
- Dependency on exhaust Flow
- Limited Diagnostics Information

APPLICATIONS

- Automotive Engines
- Aircraft Engine
- Turbodiesel Engine
- Marine Engines

THANK YOU !!!