



Keystone Thermometrics

High Temperature Sensor

Background:

Environmental concerns have driven legislative bodies in the U.S. and Europe to set and enforce stricter regulations on exhaust emissions of gasoline and diesel powered vehicles.

Studies have shown that cold start and warm-up stages account for a large percentage of polluting emissions. In order to meet LEV/ULEV [Low Emission Vehicle/ Ultra Low Emission Vehicle] requirements, technologies had to be developed to monitor and control the catalytic conversion process. Among several options, the heated catalyst technology is emerging as the most viable solution.

Lowered catalytic efficiency in aging catalysts and malfunctioning of exhaust systems control components also contribute to higher pollutant emissions during run time. In addition, OBD [On-Board Diagnostics] Systems regulations require monitoring of catalytic converter deterioration to maintain conversion efficiency in aging catalysts.

LEV/ULEV and OBD solutions require sensors capable of monitoring high temperatures in the order of 500°C – 750°C. This range extends to the maximum temperature of ~870°C, the upper limit on an efficient catalytic conversion process. These sensors are also required to withstand and detect high temperatures in the order of 1000°C – 1100°C, where total failure of the catalyst would occur.

There are various high-temperature sensing solutions. Of these, thermocouples, RTD's, and thermistors are considered primary options. Automotive standards and specifications drive one end of the selection process, while technological advances, manufacturing capability, and cost control the other end.

Automotive Industry standards focus on electronic interfacing, resolution, output characteristics [R or V vs. T], stability, response time, and physical properties including performance under all automotive environments.

Of the three solutions offered above, a thermistor-based high temperature sensor emerges superior to the others in meeting the standards at a comparable cost. The major automotive applications in temperature sensing – coolant, air intake, cylinder head, cabin HVAC – use a thermistor. In addition, automotive electronic circuits use thermistors for temperature compensation. In an environment where the thermistor is dominant, adding another sensor of the same family would be a logical selection. Thermistor electronic interfacing is a simple pull-up resistor/voltage divider circuit and an A/D converter. Thermocouples require cold junction voltage-compensation circuit and the use of thermocouple extension wires. Also, thermocouples have an output signal of $\mu\text{Volts}/^\circ\text{C}$. Thermistors offer a large change in R as a function of temperature, translating into an output signal of $\text{mV}/^\circ\text{C}$. Because of their low signal input, thermocouples and RTD's require a higher resolution A/D converter.

Thermistor Solution

Continued development in high temperature material systems produced sensors suitable for operation from -40°C to 1000°C . This is done with a high degree of accuracy and repeatability that match or exceed automotive industry standards.

Description:

The high temperature sensor is composed of an NTC bead thermistor encapsulated in stainless steel or Inconel housing with flexible lead wires. (See *Figures 1 & 2*).



Figure 1

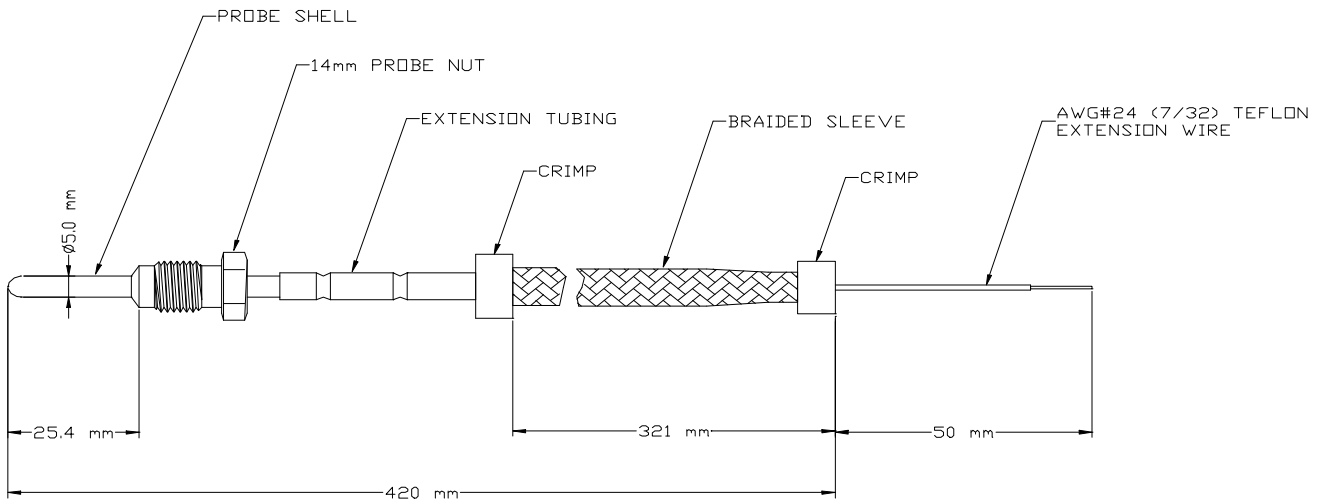


Figure 2

Features:

- Reliable operation up to 1100°C
- High sensitivity to temperature change
- Corrosion resistance housing
- Probe configuration designed for automotive and appliance applications

Options:

- Other mechanical configurations
- Alternative temperature tolerances

Data:

- Continuous operating temperature: -40°C to +750°C
- Maximum operating temperature: 1000°C for 50 hrs. with 1-hr. excursion to 1100°C
- Tolerance: $\pm 5^\circ\text{C}$ @ 300°C
- Time Constant: 12s nominal

Resistance vs. Temperature Characteristics:

