Temperature °Controls Pty Ltd

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RTD vs. Thermocouple comparison chart

Attributes of the Temperature Sensor		
Parameter/Criteria	**Thermocouple**	**RTD**
Typical Measurement Range	-450 ºF (-267 ºC) to +4200 ºF (2316 ºC)	-400 ºF (-240 ºC) to +1200 ºF (649 ºC)
Interchangeability	Good	Excellent
Long-term Stability	Poor to Fair	Excellent
Accuracy	Medium	High
Repeatability	Poor to Fair	Excellent
Sensitivity (output)	Low	Good
Response	Medium to Fast	Good
Linearity	Fair	Good
Self Heating	No	Low
Tip (end) Sensitivity	Excellent	Fair
Lead Effect	High	Medium
Size/Packaging	Small to Large	Medium to Small

Advantages and Disadvantages		
Sensor	**Advantages**	**Disadvantages**
Thermocouple	• Inexpensive • No resistance leadwire problems • Fastest response • Simple and rugged • High temperature operation • Tip (end) temperature sensing	• Least sensitive • Non-linear • Low voltage • Least stable, repeatable
RTD	• Good stability • Excellent accuracy • Contamination resistant • Good linearity • Area temperature sensing • Very repeatable temperature measurement	• Marginally higher cost • Current source required • Self-heating • Slower response time • Medium sensitivity to small temperature changes

Resistance Temperature Detectors (RTDs)

Resistance Temperature Detectors (RTDs) are sensors that measure temperature by correlating the resistance of the RTD element with temperature. Most RTD elements consist of a length of fine coiled wire wrapped around a ceramic or glass core. The element is typically relatively fragile, so it is generally installed inside a sheath to protect it. The RTD element is constructed from a pure material, the resistance of which, at various temperatures, has been documented by various international standards institutes. The material has a predictable change in resistance as the temperature varies; it is this change that is used to determine temperature.

RTDs are generally considered to be among the most accurate temperature sensors available. In addition to offering very good accuracy, they provide excellent stability and repeatability. RTDs also feature high immunity to electrical noise and are, therefore, well suited for applications in process and industrial automation environments, especially around motors, generators and other high voltage equipment.

Thermocouples

A thermocouple consists of two dissimilar metals, joined together at one end. When the junction of the two metals is cooled or heated a voltage is produced that can be correlated back to the temperature. Most thermocouple alloys are commonly available as wire.

Thermocouples are manufactured in different combinations of metals and/or calibrations. The calibrations most regularly specified by NSPI customers are J, K, T and E. High temperature calibrations include R, S, C and GB. Each calibration has a different temperature range and environment, although the maximum temperature varies with the diameter of the wire used in the thermocouple. While the thermocouple calibration defines the temperature range, the maximum range will also be a factor the diameter of the thermocouple wire. Therefore, a very thin thermocouple may not reach the full temperature range

Since thermocouples measure wide temperature ranges and are relatively rugged, they are very often used industrial and process applications where accuracy may be a less important factor. In selecting a thermocouple, the following criteria are key considerations:

- Temperature range
- Chemical resistance of the thermocouple or sheath material
- Abrasion and vibration resistance
- Installation requirements (may need to be compatible with existing equipment; existing holes may determine probe diameter)