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How do I choose the right RTD sensor (Pt100 or Pt1000) or thermocouple?

Practical advice to help you choose the right product for your application.

When you have a temperature measurement application, one of the main issues is selecting the appropriate temperature sensor to fit the purpose.

Sometimes it is simply a question of replacing the temperature sensor you have and you need to know whether you have a thermocouple or RTD. The easiest way to do this is to check the colours of the lead wire.

Normally RTD wires in the UK and Europe are red and white and more often than not there are 3 or 4 wires. Thermocouples have two wires with negative leg being white and the positive leg being many different colours, such as; green for type K and brown for type T thermocouples.

Advantages and disadvantages of thermocouples & RTD Sensors

Sensor	Advantages	Disadvantages
RTD Sensor	<ul style="list-style-type: none">• Linear output• Repeatability• Better stability	<ul style="list-style-type: none">• Self heating• Less sensitive• Cost
Thermocouple	<ul style="list-style-type: none">• Fast response• Wider temperature range• Durable	<ul style="list-style-type: none">• Less accurate• Wiring is more expensive• Less stable

Comparison chart of RTD sensors and Thermocouples

Comparison chart of RTD Sensors and Thermocouples		
Criteria	RTD Sensor (Pt100)	Thermocouple
Measurement range (max)	-200 to +850°C	-200 to +2600°C
Measurement range (typical)	-50 to 300 (Pt100 B)	0 to 1100°C (type K)
Long term stability	Good	Poor
Accuracy	Good	Poor
Repeatability	Good	Poor
Interchangeability	Excellent	Good
Tip sensitivity	Poor	Good
Signal strength	Higher – more resistant to EMI	Low – susceptible to EMI
Excitation	Yes	No
Cost	More expensive	Less expensive
Noise problems	No	Some
Extension cable	No	Yes – Must match Th/c
Best for	Consistent readings	High temperatures
Worst for	Surface readings	Long term stability
Hysteresis	Good	Excellent
Self-heating	Yes	No

Why use a Thermocouple?

There are a number of benefits to using thermocouple temperature sensors; this includes its wide temperature range. For example, the most popular type of thermocouple is type K as it can be used in a very wide temperature range of between 0 and 1100 °C continuously. However, some thermocouples have a much higher temperature range, measuring over 2000 °C. They are also very robust, especially when using mineral insulated cable. Thermocouples are a more simple device and versatile. You can have fast response versions or hand held probes, as well as types which are designed to be used in chemicals or harsh environments. Mineral insulated versions offer a very durable sensor which can withstand vibration and harsh environments

Why use an RTD Sensor?

The main benefits of an RTD sensor (Pt100, Pt1000) is the good accuracy over a fairly wide range and combined with excellent stability, this is in contrast to a thermocouple which is less accurate, less stable and can drift over time. RTD Sensors are more suitable for lower temperature ranges, where higher accuracy and repeatability is needed. They also need to be immersed in the media due to stem conduction errors. A practical benefit of RTDs over thermocouples is that they use standard electrical wiring, where thermocouples require compensated alloys and connectors over the entire length up to the connection of the instrument.

Most modern measuring instrumentation will have all the standard thermocouple input types such as Pt100 or Pt1000 for RTDs and K, T, J, N or R & S for thermocouple, although distance and positioning are more important when selecting a product.