

QUICK RESPONSE THERMOCOUPLE

Thermocouples have long been in use for temperature measurement since the discovery of the Seebeck effect. The thermocouples are widely used in various industrial applications to measure wide ranging temperatures from cryogenic up-to as high as 1700 deg C. The governing standards popularly followed are the IEC 60584, IEC 1515 and ASTM E230.

WHAT IS A THERMOCOUPLE JUNCTION?

When 2 wires of dissimilar metals, are joined together, it forms a thermocouple junction. The dissimilar materials are defined in the above standards and are named as per the table given. A thermocouple comprising of a hot junction and a reference cold junction is capable of generating an output in millivolts which is directly proportional to the difference in the temperature of these junctions.

Model	Thermocouple	Tolerance value per	Class	Temperature range	Tolerance value
K	NiCr-NiAl (NiCr-Ni)	IEC 60584 part 2	1	-40 ... +1000 °C	±1.5 °C or 0.0040 • t ¹⁾²⁾
			2	-40 ... +1200 °C	±2.5 °C or 0.0075 • t
N	NiCrSi-NiSi	ASTM E230	Special	0 ... +1260 °C	±1.1 °C or ±0.4 %
			Standard	0 ... +1260 °C	±2.2 °C or ±0.75 %
J	Fe-CuNi	IEC 60584 part 2	1	-40 ... +750 °C	±1.5 °C or 0.0040 • t
			2	-40 ... +750 °C	±2.5 °C or 0.0075 • t
			Special	0 ... +760 °C	±1.1 °C or ±0.4 %
		ASTM E230	Standard	0 ... +760 °C	±2.2 °C or ±0.75 %
			1	-40 ... +800 °C	±1.5 °C or 0.0040 • t
			2	-40 ... +900 °C	±2.5 °C or 0.0075 • t
E	NiCr-CuNi	IEC 60584 part 2	Special	0 ... +870 °C	±1.0 °C or ±0.4 %
			Standard	0 ... +870 °C	±1.7 °C or ±0.5 %
			1	-40 ... +350 °C	±0.5 °C or 0.0040 • t
T	Cu-CuNi	IEC 60584 part 2	2	-40 ... +350 °C	±1.0 °C or 0.0075 • t
			3	-200 ... +40 °C	±1.0 °C or 0.015 • t
			Special	0 ... +370 °C	±0.5 °C or ±0.4 %
			Standard	-200 ... 0 °C	±1.0 °C or ±1.5 %
			Standard	0 ... +370 °C	±1.0 °C or ±0.75 %
R	Pt13%Rh-Pt	IEC 60584 part 2	1	0 ... +1600 °C	±1.0 °C or ±[1 + 0.003 (t - 1100)] °C
			2	0 ... +1600 °C	±1.5 °C or ±0.0025 • t
			Special	0 ... +1480 °C	±0.6 °C or ±0.1 %
S	Pt10%Rh-Pt	ASTM E230	Standard	0 ... +1480 °C	±1.5 °C or ±0.25 %
			2	+600 ... +1700 °C	±0.0025 • t
B	Pt30%Rh-Pt6%Rh	IEC 60584 part 2	3	+600 ... +1700 °C	±4.0 °C or ±0.005 • t
			Special	-	-
			Standard	+870 ... +1700 °C	±0.5 %

1) |t| is the value of the temperature in °C without consideration of the sign

2) The greater value applies

WHY IS QUICK RESPONSE THERMOCOUPLE REQUIRED:?

There are many applications in process plants wherein, the response time of thermocouples is of great importance. These are applications wherein any small change in temperature needs to be monitored for the efficiency of the process, and in many cases to ensure that no runaway reaction occurs.

In such cases, it is important to design a thermocouple which not only offers a fast response, but can also give reliable temperature measurement along-with a good life.

DESIGN CONSIDERATION:

There are various parameters based on which a thermocouple is designed. Some of the chief parameters are listed below

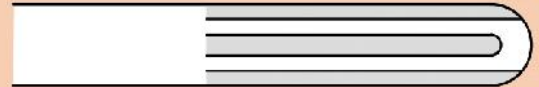
- A) Type of thermocouple to be selected based on design temperature
- B) Number of junctions within a thermocouple (one or two or three)
- C) Sheath of thermocouple to be selected based on process conditions
- D) Electrical Insulation material
- E) Grounded or ungrounded junction
- F) Accuracy Class whether Special or Standard

In order to achieve Quick response, the following design considerations are necessary:

- a) Reduced diameter of the thermocouple sheath
- b) Reduced tip diameter swaged down from higher diameter at the upper end typically used in GT exhaust or wheel space temperature measurement
- c) Exposed thermocouple junction or grounded junction
- d) Use of more efficient heat conducting electrical insulation
- e) Use of extension cables of the same thermocouple wire material.
- f) Minimum air gap between thermocouple and the measuring surface (in case of nonintrusive)
- g) Minimum air gap between thermocouple and thermowell in the event TC hot junction is not swaged down or exposed
- h) Reliable raw material properties to ensure:
 - proper accuracy
 - minimal drift
 - required mechanical strength in view of reduced geometry of thermocouple



Exposed Junction

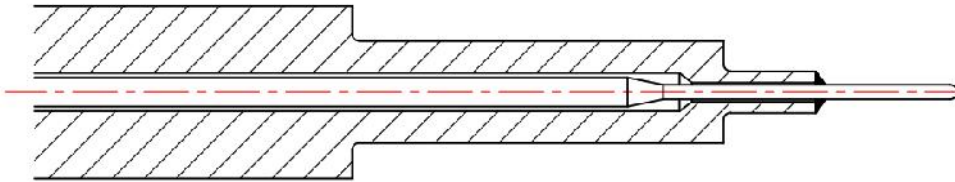


Grounded Junction

Thermocouples are supplied in diameters beginning from 0.5mm for operating at high response times. It is observed that response times ranging from less than 1 sec can be obtained for 50% step change by using one or more combinations of the above design criteria.

Below are typical arrangements of QRTs which have been supplied by Pyro Electric for some of the process applications.

- a) Reduced tip & exposed thermocouple with thermowell



- b) Reduced tip swaged down from higher diameter seamless construction



Pyro Electric manufactures Mineral Insulated Metal Sheathed cables at its facility in Bicholim Goa. Every MI cable undergoes stringent quality checks to deliver performance, finish & superior customer satisfaction.

Detailed design inputs can be obtained from our team at marketing@pyro-electric.in . Please write to us.