Ultra-High Temperature Thermocouples

NexTherm Sensing offers its customers its know-how in extreme environment measurement, by proposing a range of ultra-high temperature thermocouples, between 1600°C and 2200°C (continuous). The S, R, B, C or D type thermocouples are based on noble metal couples, giving them an outstanding resistance. Our sensors have an exceptional resistance to reacting environments.

SENSOR ARCHITECTURE

Ultra-high temperature thermocouples are made of noble metal conductors embedded in an insulating ceramic. They are also sheathed to ensure a high resistance to aggression. To obtain an optimized thermocouple for your application, it is therefore necessary to carefully choose the right conductor/insulator/sheath trio. This choice depends on the environment of your process, the operating temperature and the constraints of implementation (flexibility of the sheath).

Ultra-high temperature thermocouples are available in many sheath diameters, from 1mm to 6mm. Please contact us for availability.

AVAILABLE TYPES OF THERMOCOUPLES

Conductors couple

Above its recommended operating temperature, there is a risk of incorrect operation of the sensor due to the diffusion of the metals (rhenium and rhodium) in the alloy. It is therefore imperative to respect the temperature values listed below:

Thermocouple type	Operating temperature	
(according to IEC standard)	Continuous	Peak
S : Platinum 10% Rhodium / Platinum	0-1550°C	-50-1700°C
R = Platinum 13% Rhodium / Platinum	0-1600°C	-50-1750°C
B = Platinum 30% Rhodium / Platine 6% Rhodium	100-1600°C	100-1820°C
C = Tungsten 5% Rhenium / Tungsten 26% Rhenium	0-2200°C	0-2300°C
D = Tungsten 3% Rhenium / Tungsten 25% Rhenium	0-2200°C	0-2300°C

Insulation

Insulation materials used for sheathed sensor are not numerous, due to the need for both thermal resistance and structural stability:

Insulation material	Elements of choice	Maximum operating temperature (cont.)
Magnesium oxide (MgO)	Highly hygroscopic Mainly used in compressed sheath	1700°C
Aluminum oxide (alumina : Al_2O_3)	Good compromise with platinum-based thermocouples	1550°C
Hafnium oxide (Hafnia : HfO_2)	Rare-earth oxide, for the most demanding applications	2200°C

Sheath

At first glance, the sheath appears to provide only mechanical reinforcement to the sensor. However, it also has an important effect in protecting the thermocouple metals from chemical attack that can change the composition of the alloys and make the measurement incorrect (modification of the electromotive force):

Sheath material	Properties	Implementation	Maximum operating temperature (cont.)
Inconel 600®	Minimal bend radius : 5x sheath diameter -	Semi-rigid with MgO insulation Rigid with Al_2O_3 insulation	1175°C
Platinum 10% Rhodium	Minimal bend radius : 10x sheath diameter Not for reducing media	Semi-rigid with MgO insulation	1550°C
Tantalum	Minimal bend radius : 5x sheath diameter Not for oxidizing media	Semi-rigid with any insulation	2200°C
Niobium 1% Zirconium	Minimal bend radius : 10x sheath diameter Not for oxidizing media	Semi-rigid with any insulation	2200°C
Molybdenum	- Not for oxidizing media	Rigid with any insulation	2000°C

To summarize, HfO_2 insulation is recommended in use with type C or D thermocouples, along with tantalum or niobium sheath, when operating temperature exceeds 2000°C. Below 2000°C, molybdenum sheath can be retained. Below 1600°C, there is a large number of combinations between type S, R and B thermocouples, MgO and Al_2O_2 insulations and sheath materials. At this stage, everything depends on both your environment and implementation constraints.

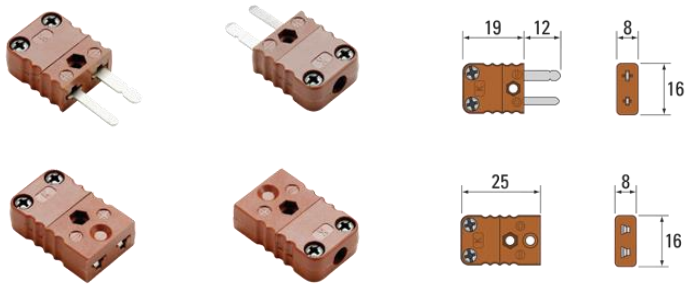
ACCURACY

According to their type, thermocouples demonstrate distinct accuracy levels:

Thermocouple type	Usual accuracy
S : Platinum 10% Rhodium / Platinum	+/-1.0°C below 1100°C +/-2.5°C between 1100 and 1700°C
R = Platinum 13% Rhodium / Platinum	+/-1.0°C below 1100°C +/-2.5°C between 1100 and 1750°C
B = Platinum 30% Rhodium / Platine 6% Rhodium	+/- 0.0025xT(°C)
C = Tungsten 5% Rhenium / Tungsten 26% Rhenium	+/-4.5°C below 425°C +/-1.0% between 425 and 2200°C
D = Tungsten 3% Rhenium / Tungsten 25% Rhenium	+/-4.5°C below 400°C +/-1.0% between 425 and 2200°C

ELECTRICAL INTERFACE

Ultra high temperature thermocouples can be provided with male or female miniature connectors. We recommend the use of charged thermoplastic connectors, which can withstand up to 350°C (continuous).



CALIBRATION

Each sensor can be provided with a calibration certificate. Calibration is carried out in our laboratory using high accuracy refractory furnace, equipped with a reference probe, under inert atmosphere.

SALES CONTACT

NexTherm Sensing
6, Impasse Louis Bentajou
31410 Longages, France

contact@nextherm-sensing.com

+33 (0)6.45.13.04.71

www.nextherm-sensing.com