

Thermocouple Product Guide



SELECTING SENSOR CABLES: GUIDE TO INSULATION & COVERING

Which insulation Material?	usable temperature range	Application Notes
PVC	-10°C to 105°C	Good general purpose insulation for 'light' environments. Waterproof and very flexible.
PFA (extruded)	-75°C to 250°C	Resistant to oils, acids other adverse agents and fluids. Good mechanical strength and flexibility. PTFE better for steam/elevated pressure environments
PTFE (taped & wrapped)	-75°C to 250/300°C	Resistant to oils, acids other adverse agents and fluids. Good mechanical strength and flexibility.
Glassfibre (varnished)	-60°C to 350/400°C	Good temperature range but will not prevent ingress of fluids. Fairly flexible but does not provide good mechanical protection.
High temperature glassfibre	-60°C to 700°C	Will withstand temperature up to 700°C but will not prevent ingress of fluids. Fairly flexible, not good protection against physical disturbance.
Ceramic Fibre	0 to 1000°C	Will withstand high temperature, up to 1000°C. Will not protect against fluids or physical disturbance.
Glassfibre (varnished) stainless steel overbraid	-60°C to 350/400°C	Good resistance to physical disturbance and high temperature (up to 400°C). Will not prevent ingress of fluids.

Screened or unshielded? With long cable runs, the cable may need to be screened and earthed at one end (at the instrument) to minimise noise pick-up (interference) on the measuring circuit. Alternative types of screened cable construction are available and these include the use of copper or mylar screening. Twisted pair configurations are offered and these can incorporate screening as required.

THERMOCOUPLE ACCURACIES

Tolerance classes for thermocouples to IEC 60584-2(1982) (Amend 1-1989) BS EN60584-2(1993)

Fe-Con (J)	Class	Temperature Range	Accuracy	Symbol	Alternative
Fe-Con (J)	Class 1	- 40 +750°C:	±0.004	. t	or ±1.5°C
	Class 2	- 40 +750°C:	±0.0075	. t	or ±2.5°C
	Class 3	- -	-	-	-
Cu-Con (T)	Class 1	- 40 +350°C:	±0.004	. t	or ±0.5°C
	Class 2	- 40 +350°C:	±0.0075	. t	or ±1.0°C
	Class 3	-200 + 40°C:	±0.015	. t	or ±1.0°C
NiCr -Ni (K) and NiCrSi-NiSi (N)	Class 1	- 40 +1000°C:	±0.004	. t	or ±1.5°C
	Class 2	- 40 +1200°C:	±0.0075	. t	or ±2.5°C
	Class 3	-200 + 40°C:	±0.015	. t	or ±2.5°C
NiCr-Con (E)	Class 1	- 40 +800°C:	±0.004	. t	or ±1.5°C
	Class 2	- 40 +900°C:	±0.0075	. t	or ±2.5°C
	Class 3	-200 + 40°C:	±0.015	. t	or ±2.5°C
Pt10Rh-Pt (S) and Pt13Rh-Pt (R)	Class 1	0 +1600°C:	±[1+(t-1000).0.003]	-	or ±1.0°C
	Class 2	- 40 +1600°C:	±0.0025	. t	or ±1.5°C
	Class 3	- -	-	-	-
Pt30Rh-Pt6Rh (B)	Class 1	- -	-	-	-
	Class 2	+600 +1700°C:	±0.0025	. t	or ±1.5°C
	Class 3	+600 +1700°C:	±0.005	. t	or ±4.0°C

Note: t = actual temperature Use the larger of the two deviation values

COLOUR CODES: THERMOCOUPLE CONNECTORS, EXTENSION AND COMPENSATING WIRES AND CABLES

TYPE	CONDUCTORS +/-	INSULATION COLOUR CODES Extension & Compensating Leads			CABLE CODE
		FORMER STANDARD			
		BRITISH BS1843: 1952	AMERICAN ANSI/MC 96.1	GERMAN DIN 43713 / 43714	
EX	NICKEL CHROMIUM/CONSTANTAN (Nickel Chromium/Copper Nickel, Chromel/Constantan, T1/Advance, NiCr/Constantan)				EX
J	IRON*/CONSTANTAN (Iron/Copper Nickel, Fe/Konst Iron/Advance, Fe/Constantan I/C)				JX
K	NICKEL CHROMIUM/NICKEL ALUMINIUM* (NC/NA, Chromel/ Alumel, C/A, T1/T2, NiCr/Ni, NiCr/ NIAL)				KX
N	NICROSIL/NISIL				NX NC
T	COPPER/CONSTANTAN (Copper/Copper Nickel, Cu/Con, Copper/Advance)				TX
Vx	COPPER/CONSTANTAN (LOW NICKEL) (Cu/Constantan) Compensating for K (Cu/Constantan)				KCB
U	COPPER/COPPER NICKEL Compensating for Platinum 10% or 13% Rhodium/Platinum (Codes S & R respectively) (Copper/Cupronic Cu/CuNi, Copper/No. 11 Alloy)				RCA SCA
* Magnetic, () Alternative & Trade Name		FOR THERMOCOUPLE CONNECTORS body colours are similar to outer sheath colours		FOR THERMOCOUPLE CONNECTORS body colours are similar to outer sheath colours	

CALIBRATION GUIDE

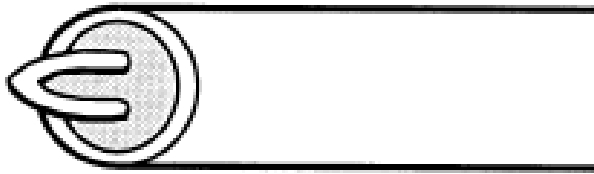
Thermocouple Type	emf in absolute millivolts (IEC 584)					
	100°C	400°C	800°C	1000°C	1200°C	1500°C
T	4.279	20.872	-	-	-	-
E	6.319	28.946	61.017	76.373	-	-
J	5.269	21.848	45.494	57.953	69.553	-
K	4.096	16.397	33.275	41.276	48.838	-
N	2.774	12.974	28.455	36.256	43.846	-
R	0.647	3.408	7.950	10.506	13.228	17.451
S	0.646	3.259	7.345	9.587	11.951	15.582
B	0.033	0.787	3.154	4.834	6.786	10.099

	Thermocouple	Platinum Resistance	Thermistor
Sensor	Thermoelement, two dissimilar metals/alloys	Platinum-wire wound or flat-film resistor	Ceramic (metal oxides)
Accuracy (typical values)	0.5 to 5.0°C	0.1 to 1.0°C	0.1 to 1.5°C
Long term Stability	Variable, Prone to ageing	Excellent	Good
Temperature range	-200 to 1750°C	-200 to 650°C	-100 to 300°C
Thermal response	Sheathed – slow Exposed tip – fast 0.1 to 10 secs typical	Wirewound – slow Film – faster 1-50 secs typical	generally fast 0.05 to 2.5 secs typical
Excitation	None	Constant current required	None
Characteristic	Thermovoltage	PTC resistance	NTC resistance (some are PTC)
Linearity	Most types non-linear	Fairly linear	Exponential
Lead resistance effect	Short cable runs satisfactory	3 & 4 wire – low. 2 wire – high	Low
Electrical “pick-up”	susceptible	Rarely susceptible	Not susceptible
Interface	Potentiometric input. Cold junction compensation required	Bridge 2,3 or 4 wire	2 wire resistance
Vibration effects/ shock	Mineral insulated types suitable	wirewound – not suitable. Film – good	Suitable
Output/ characteristic	From 10µV/°C to 40µV/°C depending on type	approx. 0.4 W/°C	-4% / °C
Extension Leads	Compensating cable	Copper	Copper
Cost	Relatively low cost	Wirewound – more expensive Film – cheaper	Inexpensive to moderate

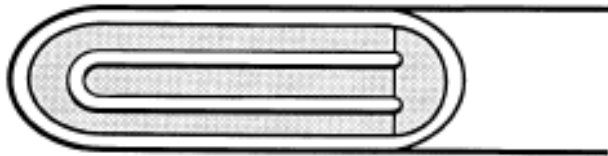
Comments and values shown in this chart are generalised and nominal. They are not intended to be definitive but are stated for general guidance.

Sheathed Thermocouples – Measuring Junctions

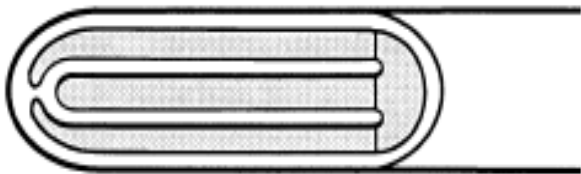
Many alternative sheath materials are used to protect thermoelements, three alternative tip configurations are usually offered:



An exposed (measuring) junction is recommended for the measurement of flowing or static non-corrosive gas temperature when the greatest sensitivity and quickest response is required.



An insulated junction is more suitable for corrosive media although the thermal response is slower. In some applications where more than one thermocouple connects to the associated instrumentation, insulation may be essential to avoid spurious signals occurring in the measuring circuits.



An earthed (grounded) junction is also suitable for corrosive media and for high pressure applications. It provides faster response than the insulated junction and protection not afforded by the exposed junction.

The materials are made according to internationally accepted standards as laid down in IEC 584 1,2 which is based on the international Practical Temperature scale ITS 90. Operating temperature maxima are dependent on the conductor thickness of the thermoelements. The thermocouple types can be subdivided in 2 groups, base metal and rare (noble) metal:

-200°C up to 1200°C – These thermocouples use base metals

Type K – Chromel-Alumel: The best known and dominant thermocouple belonging to the group chromium-nickel aluminium is type K. Its temperature range is extended (-200 up to 1100°C). Its e.m.f./ temperature curve is reasonably linear and its sensitivity is 41µV/°C

Type J – Iron-Constantan: Though in thermometry the conventional type J is still popular it has less importance in Mineral Insulated form because of its limited temperature range, - 200C to +750°C. Type J is mainly still in use based on the widespread applications of old instruments calibrated for this type. Their sensitivity rises to 55µV/°C.

Type E – Chromel-Constantan: Due to its high sensitivity (68µV/°C) Chromel-Constantan is mainly used in the cryogenic low temperature range (-200 up to +900°C). The fact that it is non magnetic could be a further advantage in some special applications.

Type N – Nicrosil-Nisil: This thermocouple has very good thermoelectric stability, which is superior to other base metal thermocouples and has excellent resistance to high temperature oxidation.

The Nicrosil-Nisil thermocouple is ideally suited for accurate measurements in air up to 1200°C. In vacuum or controlled atmosphere, it can withstand temperatures in excess of 1200°C. Its sensitivity of 39µV/°C at 900°C is slightly lower than type K (41µV/°C). Interchangeability tolerances are the same as for type K.

Type T – Copper-Constantan: This thermocouple is used less frequently. Its temperature range is limited to -200°C up to +350°C. It is however very useful in food, environmental and refrigeration applications. Tolerance class is superior to other base metal types and close tolerance versions are readily obtainable. The e.m.f./temperature curve is quite non-linear especially around 0°C and sensitivity is 42µV/°C.

0°C up to +1600°C – Platinum-Rhodium (Noble metal) Thermocouples

Type S – Platinum rhodium 10% Rh-Platinum: They are normally used in oxidising atmosphere up to 1600°C. Their sensitivity is between 6 and 12 µV/°C.

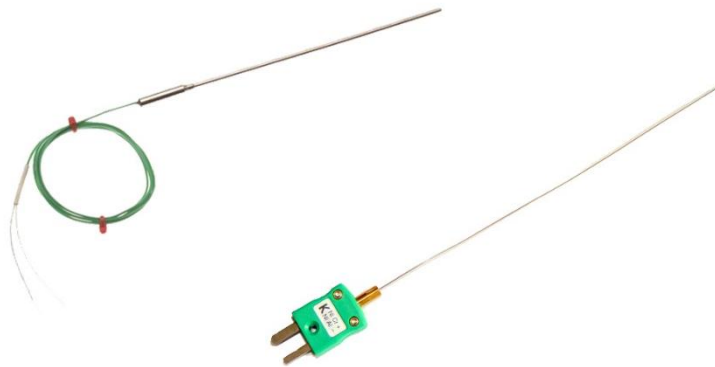
Type R – Platinum rhodium 13% Rh-Platinum: Similar version to type S with a sensitivity between 6 and 14µV/°C.

Type B – Platinum rhodium 30% Rh-Platinum rhodium 6% Rh: It allows measurements up to 1700°C. Very stable thermocouple but less sensitive in the lower range. (Output is negligible at room temperature).

Historically these thermocouples have been the basis of high temperature in spite of their high cost and their low thermoelectric power. Until the launching of the Nicrosil-Nisil thermocouples, type N, they remained the sole option for good thermoelectric stability.

Immersion

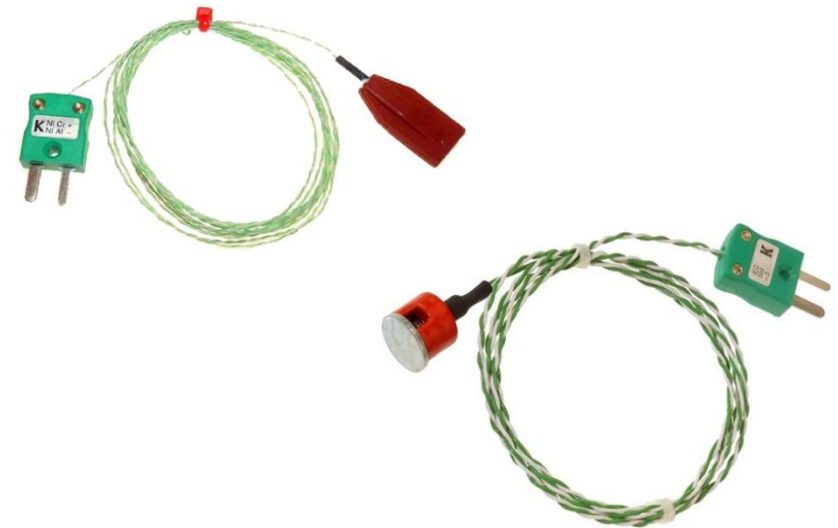
Thermocouple assemblies are “tip” sensing devices which lends them to both surface and immersion applications depending on their construction. However, immersion types must be used carefully to avoid errors due to stem conduction; this is heat flow to or from the sheath and into or away from the process which can result in a high or low reading respectively. A general rule is to immerse into the medium to a minimum of 4 times the outside diameter of the sheath; no quantitative data applies but care must be exercised in order to obtain meaningful results (e.g. have regard for furnace wall thickness and such like).



The ideal immersion depth can be achieved in practice by moving the probe into or out of the process medium incrementally; with each adjustment, note any apparent change in indicated temperature. The correct depth will result in no change in indicated temperature.

Surface Temperature Measurement

Although thermocouple assemblies are primarily tip sensing devices, the use of protection tubes (sheaths) renders surface sensing impractical. Physically, the probe does not lend itself to surface presentation and stem conduction would cause reading errors. If a thermocouple is to be used reliably for surface sensing, it must be in either exposed, welded junction form with very small thermal mass or be housed in a construction which permits true surface contact whilst attaching to the surface.



Locating a thermocouple on a surface can be achieved in various ways including the use of an adhesive patch, a washer and stud, a magnet for ferrous metals and pipe clips. Examples of surface sensing thermocouples are shown below:

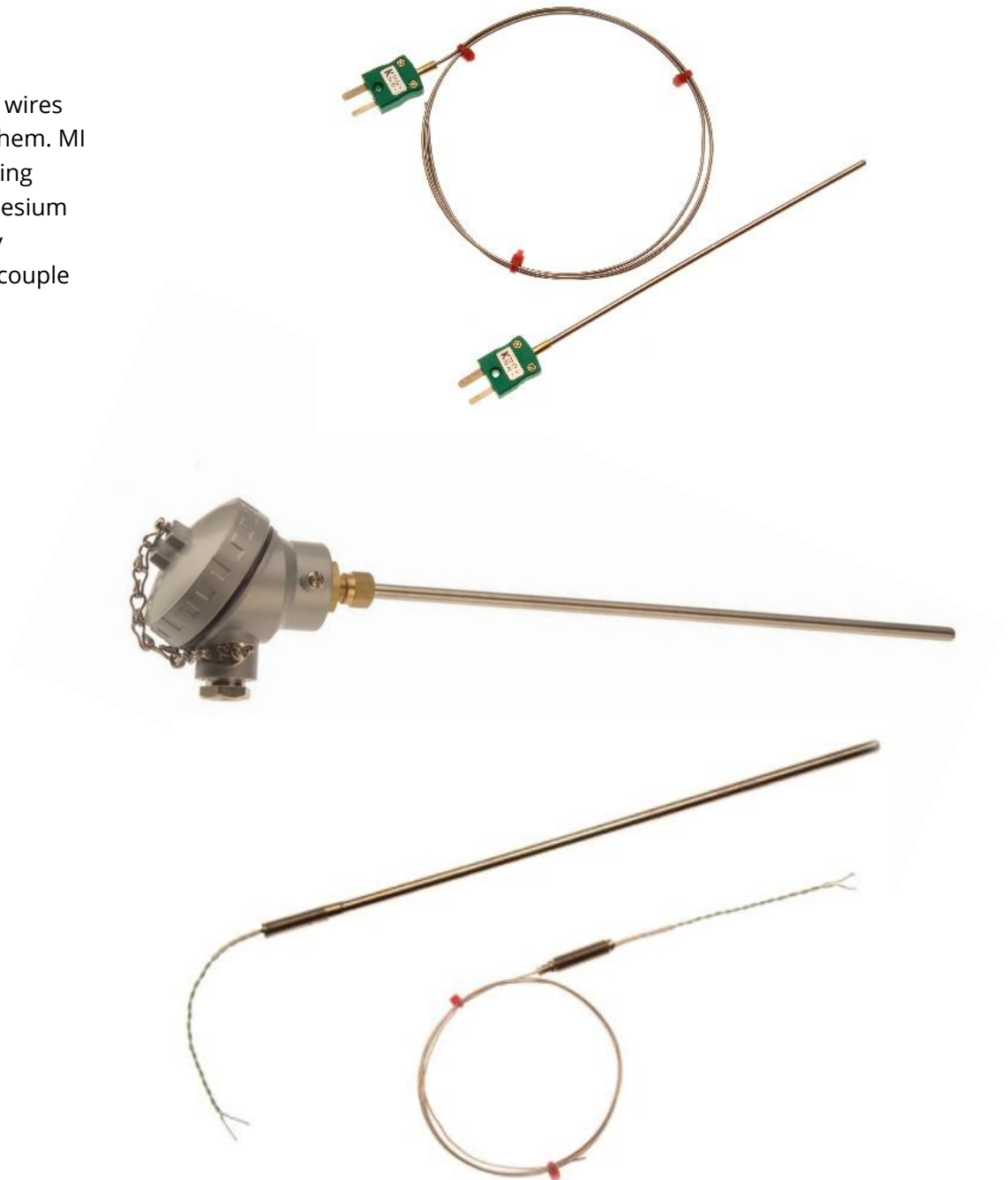
Sheath Material	Max Continuous Temperature	Notes	Applications
Refractory Oxide recrystallised, e.g. Alumina Impervious	1750°C	Good choice for rare metal thermocouples. Good resistance to chemical attack. Mechanically strong but severe thermal shock should be avoided.	Forging iron & steel. Incinerators carburizing and hardening in heat treatment. Continuous furnaces. Glass Lehrs.
Silicon Carbide (Porous)	1500°C	Good level of protection even in severe conditions. Good resistance to reasonable levels of thermal shock. Mechanically strong when thick wall is specified but becomes brittle when aged. Unsuitable for oxidising atmospheres but resists fluxes.	Forging iron & steel. Incinerators Billet heating, slab heating, butt welding. Soaking pits ceramic dryers.
Impervious Mullite	1600°C	Good choice for rare metal thermocouples under severe conditions. Resists Sulphurous and carbonaceous atmospheres. Good resistance to thermal shock should be avoided.	Forging iron & steel. Incinerators. Heat treatment. Glass flues. Continuous furnaces.
Mild Steel (cold drawn seamless)	600°C	Good physical protection but prone to rapid corrosion.	Annealing up to 500°C. Hardening pre-heaters. Baking ovens.
Stainless steel 25/20	1150°C	Resists corrosion even at elevated temperature. Can be used in Sulphurous atmospheres.	Heat treatment annealing, flues, many chemical processes. Vitreous enamelling. Corrosion resistant alternative to mild steel.
Inconel 600/800*	1200°C	Nickel-Chromium-Iron alloy which extends the properties of stainless steel 25/20 to higher operating temperatures. Excellent in Sulphur free atmospheres; superior corrosion resistance at higher temperatures. Good mechanical strength.	Annealing, carburizing, hardening. Iron and steel hot blast. Open hearth flue & stack. Waste heat boilers. Billet heating, slab heating. Continuous furnaces. Soaking pits. Cement exit flues & kilns. Vitreous enamelling. Glass flues and checkers. Gas superheaters. Incinerators up to 1000°C. Highly sulphurous atmospheres should be avoided above 800°C.
Chrome Iron	1100°C	Suitable for very adverse environments. Good mechanical strength. Resists severely corrosive and sulphurous atmospheres.	Annealing, carburizing, hardening. Iron & steel hot blast. Open hearth flue and stack. Waste heat boilers. Billet heating, slab heating. Continuous furnaces. Soaking pits. Cement exit flues & kilns. Vitreous enamelling. Glass flues and checkers. Gas superheaters. Incinerators up to 1000°C.
Nicrobell*	1300°C	Highly stable in vacuum and oxidising atmospheres. Corrosion resistance generally superior to stainless steels. Can be used in Sulphurous atmospheres at reduced temperatures. High operating temperature.	As Inconel plus excellent choice for vacuum furnaces and flues.

* Tradenames

Sheath materials range from mild and stainless steels to refractory oxides (ceramics, so called) and a variety of exotic materials including rare metals. The choice of sheath must take account of operating temperature, media characteristics, durability and other considerations including the material relationship to the type of sensor.

M.I. (Mineral Insulated) cable is used to insulate thermocouple wires from one another and from the metal sheath that surrounds them. MI Cable has two (or four when duplex) thermocouple wires running down the middle of the tube. The tube is then filled with magnesium oxide powder and compacted to ensure the wires are properly insulated and separated. MI cable helps to protect the thermocouple wire from corrosion and electrical interference.

- * Long stable life
- * Small size
- * Rapid response
- * Great mechanical strength
- * Water, oil & gas tight
- * Ease of installation
- * Adaptability
- * High insulation resistance
- * Low cost



Choosing between a Thermocouple and RTD Sensor

Thermocouples comprise a thermoelement which is a junction of two specified, dissimilar alloys and a suitable two wire extension lead. The junction is a short circuit only, the EMF is generated in the temperature gradient between the hot junction and the 'cold' or reference junction. This characteristic is reasonably stable and repeatable and allows for a family of alternative thermocouple types (e.g. J,K,T,N) to be used.

The alternative types are defined by the nature of the alloys used in the thermoelements and each type displays a different thermal EMF characteristic.

Resistance Thermometers utilise a high precision sensing resistor, usually platinum, the resistance value of which increases with temperature. The dominant standard adopted internationally is the Pt100 which has a resistance value of 100.0 Ohms at 0°C and a change of 38.50 Ohms between 0 and 100°C (the fundamental interval).

The platinum sensing resistor is highly stable and allows high accuracy temperature sensing. Resistance thermometer sensing resistors are 2 wire devices but the 2 wires will usually be extended in a 3 or 4 wire configuration according to the application, the associated instrumentation and accuracy requirements.

Thermocouples are, generally:

- Relatively inexpensive
- More rugged
- Less accurate
- More prone to drift
- More sensitive
- Tip sensing
- Available in smaller diameters
- Available with a wider temperature range
- More versatile

RTD's are, generally:

- More expensive
- More accurate
- Highly stable (if used carefully)
- Capable of better resolution
- Restricted in their range of temperature
- Stem, not tip sensitive
- Rarely available in small diameters (below 3mm)

In both cases, the choice of thermocouple or RTD must be made to match the instrumentation and to suit the application.



A Plug Termination



B Plain Pot with Tails Termination



C Threaded Pot with Tails Termination

Image	Type	Probe Dia. (mm)	Probe Length(mm)	Sheath	Junction	Termination	Temperature Range	Order Code
A	K	0.5	150	310SS	Insulated	Miniature Plug	-40°C to +750°C	XE-3205-001
A	K	1.0	250	310SS	Insulated	Miniature Plug	-40°C to +750°C	XE-3217-001
A	K	3.0	500	310SS	Insulated	Miniature Plug	-40°C to +1100°C	XE-3232-001

Image	Type	Probe Dia. (mm)	Probe Length(mm)	Sheath	Cable Type	Cable Length	Cable Colour	Temperature Range	Order Code
B	K	1.5	250	310SS	PFA 7/0.2mm	1 metre	Green	-40°C to +1100°C	XE-3102-001
B	K	3.0	500	310SS	PFA 7/0.2mm	1 metre	Green	-40°C to +1100°C	XE-3113-001
B	K	6.0	1000	310SS	PFA 7/0.2mm	1 metre	Green	-40°C to +1100°C	XE-3124-001
B	J	1.5	150	321SS	PFA 7/0.2mm	1 metre	Black	-40°C to +1100°C	XE-3147-001
B	J	3.0	250	321SS	PFA 7/0.2mm	1 metre	Black	-40°C to +1100°C	XE-3152-001
B	J	6.0	250	321SS	PFA 7/0.2mm	1 metre	Black	-40°C to +1100°C	XE-3157-001

Image	Type	Probe Dia. (mm)	Probe Length(mm)	Sheath	Cable Type	Cable Length	Cable Colour	Temperature Range	Order Code
C	K	1.5	150	310SS	PFA T/T 7/0.2mm	100mm	Green/White	-40°C to +1100°C	XE-3311-001
C	K	3.0	250	310SS	PFA T/T 7/0.2mm	100mm	Green/White	-40°C to +1100°C	XE-3332-001
C	K	4.5	500	310SS	PFA T/T 7/0.2mm	100mm	Green/White	-40°C to +1100°C	XE-3339-001
C	K	6.0	1000	310SS	PFA T/T 7/0.2mm	100mm	Green/White	-40°C to +1100°C	XE-3343-001

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A Thermocouples with Compact KNS Terminal Head

B Thermocouple with Ceramic Plug Termination

Image	Type	Probe Dia. (mm)	Length (mm)	Sheath	Head Type	Block	Gland	Temperature Range	Order Code
A	K	6.0	100	310SS	KNS	2-way ceramic	M16 x 1.5mm Plated brass	-40°C to +1100°C	XE-3320-001
A	K	6.0	150	310SS	KNS	2-way ceramic	M16 x 1.5mm Plated brass	-40°C to +1100°C	XE-3321-001
A	K	6.0	200	310SS	KNS	2-way ceramic	M16 x 1.5mm Plated brass	-40°C to +1100°C	XE-3322-001
A	K	6.0	250	310SS	KNS	2-way ceramic	M16 x 1.5mm Plated brass	-40°C to +1100°C	XE-3323-001
A	K	6.0	300	310SS	KNS	2-way ceramic	M16 x 1.5mm Plated brass	-40°C to +1100°C	XE-3324-001

Image	Type	Probe Dia. (mm)	Length (mm)	Sheath	Head Type	Termination	Probe Temperature Range	Plug Temperature Range	Order Code
B	K	1.0	150	310SS	KNS	Miniature ceramic plug + Socket	-40°C to +1100°C	650°C	XE-2000-001
B	K	1.5	300	310SS	KNS	Miniature ceramic plug + Socket	-40°C to +1100°C	650°C	XE-2001-001
B	K	3.0	150	310SS	KNS	Miniature ceramic plug + Socket	-40°C to +1100°C	650°C	XE-2005-001
B	K	3.0	300	310SS	KNS	Miniature ceramic plug + Socket	-40°C to +1100°C	650°C	XE-2004-001

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A Plug Termination



B Plain Pot with Tails Termination



C Threaded Pot with Tails Termination

Image	Type	Probe Dia. (mm)	Probe Length(mm)	Sheath	Junction	Termination	Temperature Range	Order Code
A	K	0.5	150	310SS	Insulated	Miniature Plug	-40°C to +750°C	XE-3008-001
A	K	1.0	250	310SS	Insulated	Miniature Plug	-40°C to +750°C	XE-3011-001
A	K	3.0	500	310SS	Insulated	Miniature Plug	-40°C to +1100°C	XE-3017-001
A	K	3.0	1000	310SS	Insulated	Standard Plug	-40°C to +1100°C	XE-3021-001

Image	Type	Probe Dia. (mm)	Probe Length(mm)	Sheath	Cable Type	Cable Length	Cable Colour	Temperature Range	Order Code
B	K	1.0	150	310SS	PFA 7/0.2mm	1 metre	Yellow	-40°C to +750°C	XE-3022-001
B	K	1.5	250	310SS	PFA 7/0.2mm	1 metre	Yellow	-40°C to +1100°C	XE-3026-001
B	K	3.0	500	310SS	PFA 7/0.2mm	1 metre	Yellow	-40°C to +1100°C	XE-3030-001
B	K	4.5	250	321SS	PFA 7/0.2mm	1 metre	Yellow	-40°C to +1100°C	XE-3032-001
B	K	6.0	150	321SS	PFA 7/0.2mm	1 metre	Yellow	-40°C to +1100°C	XE-3034-001

Image	Type	Probe Dia. (mm)	Probe Length(mm)	Sheath	Cable Type	Cable Length	Cable Colour	Temperature Range	Order Code
C	K	1.0	1000	Inconel 600	PFA T/T 7/0.2mm	100mm	Yellow/Red	-40°C to +750°C	XE-3042-001
C	K	3.0	3000	Inconel 600	PFA T/T 7/0.2mm	100mm	Yellow/Red	-40°C to +1100°C	XE-3047-001
C	K	1.5	250	310SS	PFA T/T 7/0.2mm	100mm	Yellow/Red	-40°C to +1100°C	XE-3059-001
C	K	6.0	500	310SS	PFA T/T 7/0.2mm	100mm	Yellow/Red	-40°C to +1100°C	XE-3069-001

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A Magnet Thermocouple



B Button Magnet



C Magnetic Strip

Image	Type	Length	Cable	Termination	Temperature Range	Order Code
A	K	1 Metre	PFA Teflon® insulated with stainless steel over-braid	Miniature Plug	-50°C to + 250°C	XE-5616-001
A	K	2 Metre	PFA Teflon® insulated with stainless steel over-braid	Miniature Plug	-50°C to + 250°C	XE-3470-001

Image	Type	Length	Cable	Termination	Temperature Range	Order Code
B	K	1 Metre	PFA Teflon® insulated twin twisted	Miniature Plug	-50°C to + 250°C	XE-3460-001
B	K	2 Metre	PFA Teflon® insulated twin twisted	Miniature Plug	-50°C to + 250°C	XE-5617-001

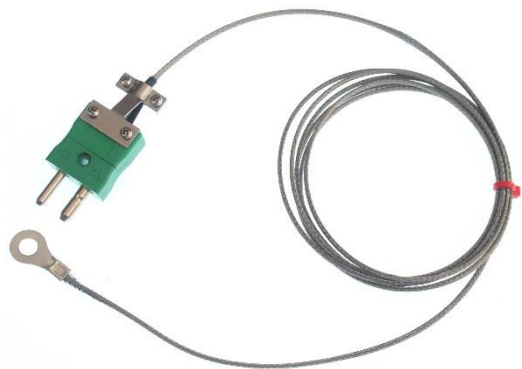
Image	Type	Length	Cable	Termination	Temperature Range	Order Code
C	K	1 Metre	PFA Teflon® insulated twin twisted	Miniature Plug	-50°C to +100°C	XE-5618-001
C	K	2 Metre	PFA Teflon® insulated twin twisted	Miniature Plug	-50°C to +100°C	XE-3455-001

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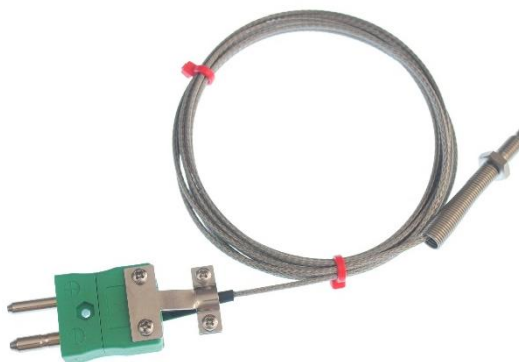
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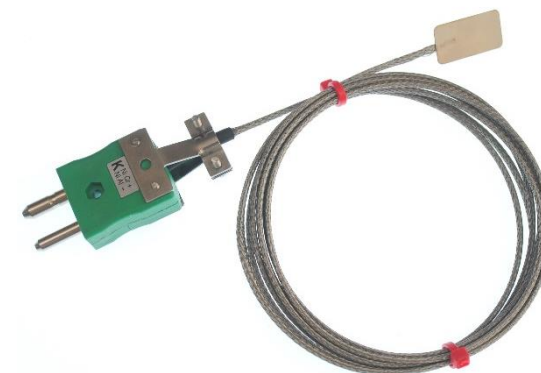
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A Washer Thermocouple



B Nozzle Thermocouple



C Leaf Thermocouple

Image	Type	Length	Cable	Termination	Temperature Range	Order Code
A	K	2 Metre	Glassfibre insulated, stainless steel over braid	Standard Plug	-60°C to 350°C	XE-5633-001
A	J	2 Metre	Glassfibre insulated, stainless steel over braid	Standard Plug	-60°C to 350°C	XE-5625-001

Image	Type	Length	Cable	Termination	Temperature Range	Order Code
B	K	2 Metre	Glassfibre insulated, stainless steel over braid	Standard Plug	-60°C to 350°C	XE-5626-001

Image	Type	Length	Cable	Termination	Temperature Range	Order Code
C	K	2 Metre	Glassfibre insulated, stainless steel over braid	Standard Plug	-60°C to 350°C	XE-5627-001

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A Bolt Thermocouple



B Bayonet Thermocouple



C Silicone Rubber Patch Thermocouple

Image	Type	Thread Pitch	Thread Length	Cable Length	Cable	Termination	Temperature Range	Order Code
A	K	M8 x 1mm	13mm	2 Metre	Glassfibre stainless steel over braided	Tails	Up to +250°C	XE-5563-001
A	K	M10 x 1mm	25mm	2 Metre	Glassfibre stainless steel over braided	Tails	Up to +250°C	XE-5566-001
A	K	M12 x 1mm	13mm	2 Metre	Glassfibre stainless steel over braided	Tails	Up to +250°C	XE-5567-001
A	J	M8 x 1mm	13mm	2 Metre	Glassfibre stainless steel over braided	Tails	Up to +250°C	XE-5557-001
A	J	M10 x 1mm	25mm	2 Metre	Glassfibre stainless steel over braided	Tails	Up to +250°C	XE-5560-001
A	J	M12 x 1mm	13mm	2 Metre	Glassfibre stainless steel over braided	Tails	Up to +250°C	XE-5561-001

Image	Type	Length	Cable	Spring	Termination	Temperature Range	Order Code
B	K	2 Metre	Glassfibre insulated, stainless steel over braid	170mm spring, adjustable cap	Standard Plug	-60°C to 350°C	XE-5624-001
B	J	3 Metre	Glassfibre insulated, stainless steel over braid	170mm spring, adjustable cap	Standard Plug	-60°C to 350°C	XE-5636-001

Image	Type	Length	Cable	Patch (mm)	Termination	Temperature Range	Order Code
C	K	1 Metre	Teflon® insulated, twin twist	40 x 13 x 5 (L x W x H)	Tails	-50°C to +150°C	XE-3450-001

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A Crocodile Clip Thermocouple with Fiberglass Stainless Steel Over-braided Cable

Image	Type	Length	Order Code
A	K	1m	XE-5652-001
A	K	3m	XE-5653-001
A	J	1m	XE-5650-001
A	J	3m	XE-5651-001

1 or 3 metres stainless steel over-braided PFA Teflon® cable fitted with miniature plug

Sensor type: Type K or J thermocouple to IEC 584
 Construction: Thermo-element located in crocodile clip
 Cable: PFA Teflon® insulated with stainless steel over-braid
 Termination: Miniature plug termination
 T/C junction: Grounded on crocodile clip
 Temperature range: -50°C to + 250°C



B Strong Magnet Thermocouple (9kg Pull)

Image	Type	Length	Order Code
B	K	1.5m	XE-5640-001
B	K	3.0m	XE-5641-001

Strong 9kg pull magnet housing type K thermocouple.

Sensor type: Type K thermocouple to IEC 584
 Construction: Thermo-element located in magnet
 Cable: PFA Teflon® insulated with stainless steel over-braid
 Termination: Miniature plug termination
 T/C junction: Grounded at tip
 Magnet: 25 x 25 x 40mm (H x W x L) with powerful 9kg pull
 Temperature range: -50°C to + 250°C

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A PVC Extension Lead with Miniature Connectors



B PVC Extension Lead with Standard Connectors



C Glassfibre Extension Lead with Miniature Connectors

Image	Type	Length	Cable	Termination	Cable Temperature Range	Order Code
A	K	2 Metre	PVC Insulated, 7/0.2mm	Miniature Plug + Socket	-10°C to 105°C	XE-7000-001
A	K	5 Metre	PVC Insulated, 7/0.2mm	Miniature Plug + Socket	-10°C to 105°C	XE-7001-001
A	K	10 Metre	PVC Insulated, 7/0.2mm	Miniature Plug + Socket	-10°C to 105°C	XE-7002-001

Image	Type	Length	Cable	Termination	Cable Temperature Range	Order Code
B	K	2 Metre	PVC Insulated, 7/0.2mm	Standard Plug + Socket	-10°C to 105°C	XE-7012-001
B	K	5 Metre	PVC Insulated, 7/0.2mm	Standard Plug + Socket	-10°C to 105°C	XE-7013-001
B	K	10 Metre	PVC Insulated, 7/0.2mm	Standard Plug + Socket	-10°C to 105°C	XE-7014-001

Image	Type	Length	Cable	Termination	Cable Temperature Range	Order Code
C	K	2 Metre	Glassfibre Insulated with SSOB, 7/0.2mm	Miniature Plug + Socket	-60°C to 350°C	XE-7038-001
C	K	5 Metre	Glassfibre Insulated with SSOB, 7/0.2mm	Miniature Plug + Socket	-60°C to 350°C	XE-7036-001

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A PVC Extension Lead with Miniature Connectors



B PVC Extension Lead with Standard Connectors

Image	Type	Length	Cable	Termination	Cable Temperature Range	Order Code
A	K	2 Metre	PVC Insulated, 7/0.2mm	Miniature Plug + Socket	-10°C to 105°C	XE-7024-001
A	K	5 Metre	PVC Insulated, 7/0.2mm	Miniature Plug + Socket	-10°C to 105°C	XE-7025-001
A	K	10 Metre	PVC Insulated, 7/0.2mm	Miniature Plug + Socket	-10°C to 105°C	XE-7050-001

Image	Type	Length	Cable	Termination	Cable Temperature Range	Order Code
B	K	2 Metre	PVC Insulated, 7/0.2mm	Standard Plug + Socket	-10°C to 105°C	XE-7026-001
B	K	5 Metre	PVC Insulated, 7/0.2mm	Standard Plug + Socket	-10°C to 105°C	XE-7027-001

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A Type K PFA Exposed Junction with Miniature Plug



B Type J PFA Exposed Junction with Miniature Plug



C Type T PFA Exposed Junction with Miniature Plug

Image	Type	Conductors	Order Code	Order Code	Order Code	Order Code
			1 Metre	2 Metre	5 Metre	10 Metre
A	K	1/0.315mm	XE-3529-001	XE-0400-001	XE-3530-001	XE-3535-001
A	K	7/0.2mm	XE-0401-001	XE-0402-001	XE-3531-001	XE-3534-001
A	K	1/0.2mm	XE-0403-001	XE-0404-001	XE-3538-001	XE-0405-001

Image	Type	Conductors	Order Code	Order Code	Order Code	Order Code
			1 Metre	2 Metre	5 Metre	10 Metre
B	J	1/0.2mm	XE-0406-001	XE-0407-001	XE-3540-001	XE-0408-001

Image	Type	Conductors	Order Code	Order Code	Order Code	Order Code
			1 Metre	2 Metre	5 Metre	10 Metre
C	T	1/0.315mm	XE-0409-001	XE-0410-001	XE-3532-001	XE-3536-001
C	T	7/0.2mm	XE-0411-001	XE-0412-001	XE-3533-001	XE-3537-001
C	T	1/0.2mm	XE-0413-001	XE-0414-001	XE-3539-001	XE-0415-001

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A Type K PTFE Exposed Junction with Miniature Plug



B Type J PTFE Exposed Junction with Miniature Plug



C Type T PTFE Exposed Junction with Miniature Plug

Image	Type	Conductors	Order Code	Order Code	Order Code	Order Code
			1 Metre	2 Metre	5 Metre	10 Metre
A	K	1/0.2mm	XE-3505-001	XE-3506-001	XE-0416-001	XE-0417-001

Image	Type	Conductors	Order Code	Order Code	Order Code	Order Code
			1 Metre	2 Metre	5 Metre	10 Metre
B	J	1/0.2mm	XE-0418-001	XE-0419-001	XE-0420-001	XE-0421-001

Image	Type	Conductors	Order Code	Order Code	Order Code	Order Code
			1 Metre	2 Metre	5 Metre	10 Metre
C	T	1/0.2mm	XE-3525-001	XE-3526-001	XE-0422-001	XE-0423-001

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A

PFA Twin Twist Exposed Junction with Miniature Plug + Cable Tidy



B

PFA Flat Pair Exposed Junction with Miniature Plug + Cable Tidy

Image	Type	Cable	Order Code	
			1 Metre	2 Metre
A	K	PFA Twin Twist	XE-5598-001	XE-7028-001
A	T	PFA Twin Twist	XE-5600-001	XE-5604-001

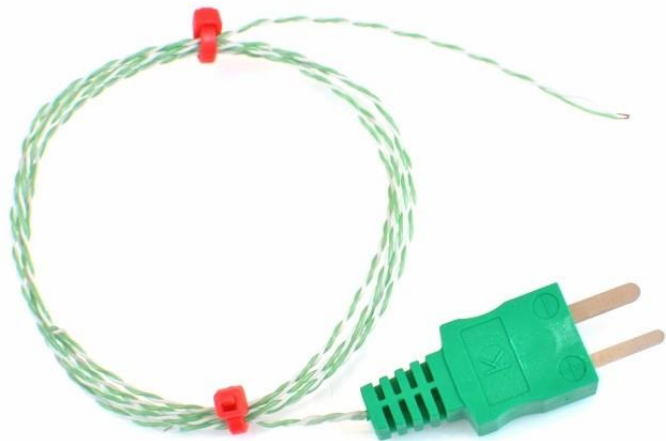
Image	Type	Cable	Order Code	
			1 Metre	2 Metre
B	K	PFA Flat Pair	XE-5599-001	XE-5603-001
B	T	PFA Flat Pair	XE-5601-001	XE-5605-001

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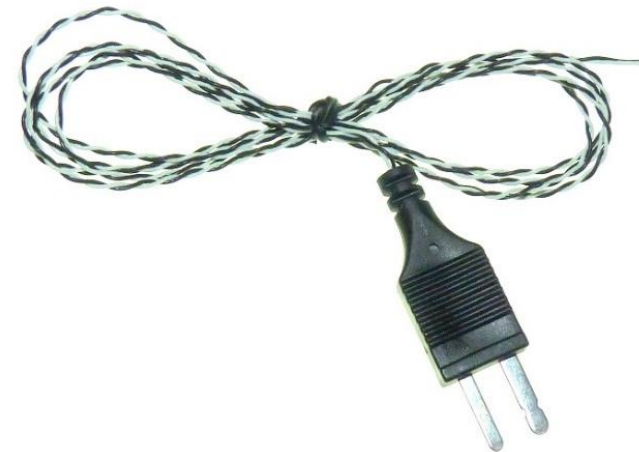
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A PFA Twin Twist Exposed Junction with Miniature Plug + Cable Tidy



B PFA Twin Twist Exposed Junction with Miniature Plug + Cable Tidy

Image	Type	Conductors	Order Code		
			1 Metre	2 Metre	3 Metre
A	K	1/0.3mm	XE-0015-001	XE-0020-001	XE-0021-001
A	K	1/0.5mm	XE-0022-001	XE-0023-001	XE-0024-001

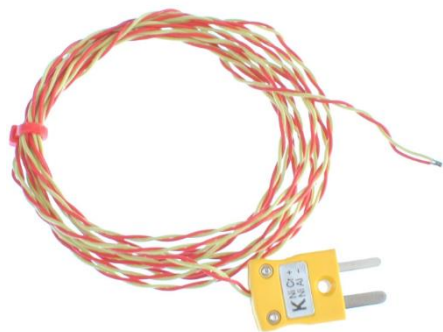
Image	Type	Conductors	Order Code
			1 Metre
B	K	1/0.2mm	XE-0028-001
B	T	1/0.2mm	XE-0029-001

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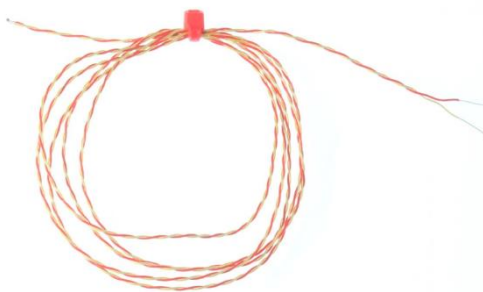
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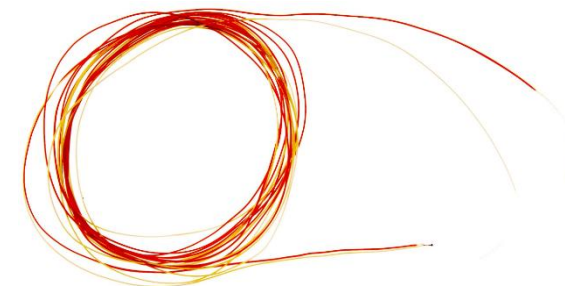
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A PFA Exposed Junction with Miniature Plug



B PFA Exposed Junction with Bare Tails



C PFA Fine Gauge Exposed Junction (0.076mm conductors)

Image	Type	Conductors	Order Code	Order Code	Order Code	Order Code
			1 Metre	2 Metre	5 Metre	10 Metre
A	K	1/0.3mm	XE-3580-001	XE-3582-001	XE-3560-001	XE-3572-001
A	K	1/0.2mm	XE-3583-001	XE-3581-001	XE-3559-001	XE-3570-001
-	T	1/0.3mm	XE-3589-001	XE-3587-001	XE-3563-001	XE-3574-001

Image	Type	Conductors	Order Code	Order Code	Order Code	Order Code
			1 Metre	2 Metre	5 Metre	10 Metre
B	K	7/0.2mm	XE-3549-001	XE-3550-001	XE-3558-001	XE-3569-001
-	T	1/0.3mm	XE-3548-001	XE-3547-001	XE-3557-001	XE-3568-001

Image	Type	Conductors	Order Code
			1 Metre
C	K	0.076mm	XE-2006-001

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A High Temperature Glassfibre Twin Twisted Exposed Welded Tip Thermocouples with Standard Plug Termination



B Glassfibre insulated Exposed Junction Thermocouple with Bare Tails



C Glassfibre insulated Exposed Junction Thermocouple with Miniature Plug Termination

Image	Type	Conductors	Order Code	Order Code	Order Code
			5 Metre	10 Metre	20 Metre
A	K	1/0.711mm (21 AWG)	XE-5630-001	XE-5631-001	XE-5632-001

Image	Type	Conductors	Order Code	Order Code	Order Code	Order Code
			1 Metre	2 Metre	5 Metre	10 Metre
B	K	1/0.3mm	XE-3545-001	XE-3546-001	XE-3556-001	XE-3567-001

Image	Type	Conductors	Order Code	Order Code	Order Code	Order Code
			1 Metre	2 Metre	5 Metre	10 Metre
C	K	1/0.315mm	XE-3586-001	XE-3588-001	XE-3562-001	XE-3573-001

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A

Spring Loaded Thermocouple Probe with Copper Disc Tip

Image	Type	Order Code
A	K	XE-3816-001

Stainless steel sheath with a moulded handle and 2 metres of coiled extension cable terminated in a miniature thermocouple plug.

- Type K IEC
- Surface temperature spring loaded thermocouple with copper disc tip
- Maximum Temperature: +600°C
- Probe 4.7mmØ x 63mm long stem, Ø8 x 17mm tip with Ø4.5mm copper disc



B

Stainless Steel Air Probe

Image	Type	Diameter	Length	Order Code
B	K	4.0mm	110mm	XE-3800-001
B	T	4.0mm	110mm	XE-3801-001

316 Stainless Steel Air Probe with a vented sheath for general air temperature measurement. Comprising of a handle, 2 metre coiled cable and a mini plug.

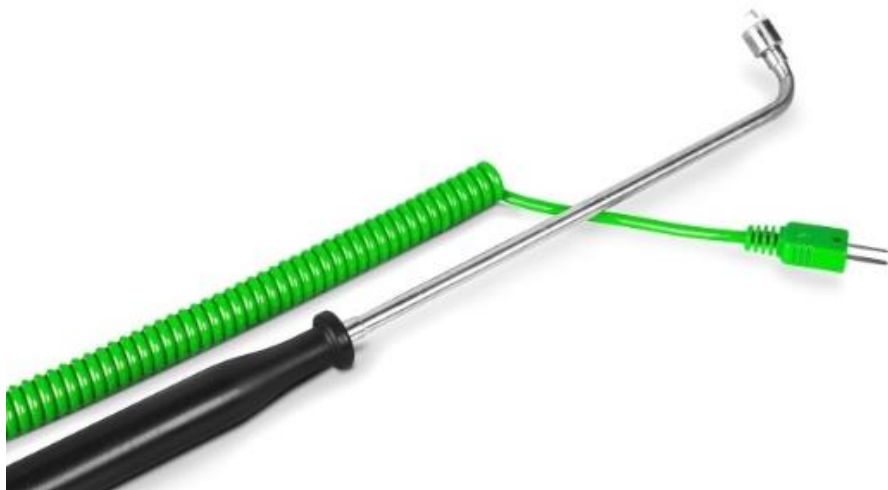
- Maximum Temperature 400°C
- Supplied with Handle, 2m Coiled Cable

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A Right Angled Thermocouple Probe

Image	Type	Order Code
A	K	XE-3819-001

Stainless steel sheath with a moulded handle and 2 metres of coiled extension cable terminated in a miniature thermocouple plug.

- Surface temperature fast response thermocouple
- Ceramic Tip
- Coiled Element
- Maximum Temperature: +900°C
- Probe \varnothing 12mm Tip x 40mm Hot Leg and \varnothing 6mm x 180mm Cold Leg
- Coiled element diameter 7mm



B Ceramic Tip and Coiled Element Temperature Probe

Image	Type	Order Code
B	K	XE-3818-001

Stainless steel sheath with a moulded handle and 2 metres of coiled extension cable terminated in a miniature thermocouple plug.

- Surface temperature fast response thermocouple with ceramic tip and coiled element
- Ceramic Tip
- Maximum Temperature: +900°C
- Probe \varnothing 6 x 90mm long stem with \varnothing 12 x 10mm tip - Type K
- Coiled element diameter 7mm

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A Moving Air Thermocouple Probe

Image	Type	Order Code
A	K	XE-3845-001
A	T	XE-3846-001

Stainless steel sheath with a moulded handle and 2 metres of coiled extension cable terminated in a miniature thermocouple plug.

Thermocouple air probes are ideal for measuring the temperature of still or moving air and gases.

- 120mm x 30mm
- Ideal for the measurement of air and gases
- Funnelled shield allows for maximum airflow across measuring junction



B Surface Thermocouple Probe

Image	Type	Order Code
B	K	XE-3840-001

Stainless steel sheath with a moulded handle and 2 metres of coiled extension cable terminated in a miniature thermocouple plug.

- 170mm x 15mm
- Used to measure the surface temperature

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Penetration Thermocouple Probe

Image	Type	Colour Code	Diameter	Length	Order Code
A	K	IEC	3.3mm	300mm	XE-3804-001
B	K	ANSI	3.3mm	300mm	XE-3867-001
-	T	IEC	3.3mm	300mm	XE-3805-001
-	T	ANSI	3.3mm	300mm	XE-3868-001

316 Stainless Steel Penetration Probe with a pointed tip for liquid and semi-solid temperature measurement. Comprising of a handle, 2 metre coiled cable and a mini plug.

- IEC, ANSI Calibration
- Probe Length 300mm
- Diameter 3.3mm
- Maximum Temperature 400°C

General Purpose Thermocouple Probe

Image	Type	Colour Code	Diameter	Length	Order Code
C	K	IEC	1.5mm	100mm	XE-3806-001
C	K	IEC	3.0mm	300mm	XE-3812-001
D	K	ANSI	1.5mm	100mm	XE-3855-001
D	K	ANSI	3.0mm	300mm	XE-3861-001
-	T	IEC	1.5mm	100mm	XE-3807-001
-	T	ANSI	3.0mm	300mm	XE-3813-001

Mineral Insulated Immersion Probe with a rounded tip suitable for semi solid and liquid temperature measurement. Comprising of a handle, 2 metre coiled cable and Type mini plug. They are suitable for use in corrosive material tests and high temperature molten metal measurements.

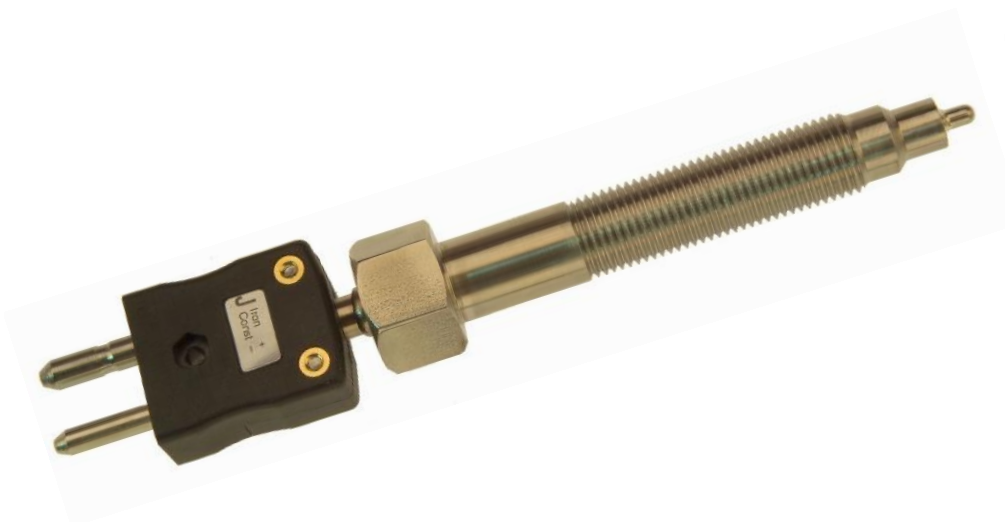
- IEC, ANSI Calibration
- Probe Length 100mm, 300mm
- Diameter 1.5mm, 3.0mm
- Maximum Temperature 850°C

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A 1/2"UNF-20 Melt Bolt Thermocouple with Type 'J' Thermocouple Plug



B Twist Melt Bolt Thermocouple with Standard Thermocouple Plug

Image	Type	Thread	Bolt Length	Tip Immersion Length	Temperature Range	Termination	Order Code
A	J	1/2"UNF-20	76mm (3" inch)	5.0mm (3.0mm diameter)	Up to +500°C	Standard plug	XE-3920-001
A	J	1/2"UNF-20	152mm (6" inch)	5.0mm (3.0mm diameter)	Up to +500°C	Standard plug	XE-3921-001
-	K	1/2"UNF-20	76mm (3" inch)	5.0mm (3.0mm diameter)	Up to +500°C	Standard plug	XE-3922-001
-	K	1/2"UNF-20	152mm (6" inch)	5.0mm (3.0mm diameter)	Up to +500°C	Standard plug	XE-3923-001

Image	Type	Thread	Bolt Length	Tip Immersion Length	Temperature Range	Termination	Order Code
B	J	1/2"UNF-20	152mm (6" inch)	20.0mm	Up to +400°C	Standard plug	XE-5531-001
B	K	1/2"UNF-20	152mm (6" inch)	20.0mm	Up to +400°C	Standard plug	XE-5532-001

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A

Ceramic Kiln Thermocouples for High Temperature (1400°C) with Aluminous Porcelain sheaths

Image	Type	Ceramic Sheath Dia	Support Tube O.D.	Support Tube Length	Temperature Range	Length	Order Code
A	K	12mm	21mm	100mm	Up to +1400°C	300mm	XE-6950-001
A	K	12mm	21mm	100mm	Up to +1400°C	450mm	XE-6951-001
A	K	12mm	21mm	100mm	Up to +1400°C	600mm	XE-6952-001
A	N	12mm	21mm	100mm	Up to +1400°C	300mm	XE-6953-001
A	N	12mm	21mm	100mm	Up to +1400°C	450mm	XE-6954-001
A	N	12mm	21mm	100mm	Up to +1400°C	600mm	XE-6955-001

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The Temperature Handbook - A comprehensive guide to Temperature Measurement by Labfacility



The Labfacility Temperature Handbook is a comprehensive text for users of thermocouples, PRTs and thermistors and associated instrumentation. Detailed enough for engineers it is also suitable for technicians and students. Written with a practical bias, the handbook contains considerable reference data and basic theory and is therefore of great value as a training aid for those entering the field of temperature measurement and control.

The handy A5 size book contains 140 pages, 40 of them being reference data and uses 65 illustrations. The current revised thermocouple and Pt100 tables based on ITS90 are featured and the new IEC colour codes for thermocouple insulations are included in full colour in addition to the former ANSI, DIN and BS codes.

The broadened scope of the handbook includes detailed temperature sensor selection guidance, sensor theory and practice and comprehensive applications guidance. Practical aspects treated in depth include thermocouple installation and application, alternative thermocouple types and construction, accuracy and response and interconnection configurations; thermistors; sheath materials and thermowells for the different sensors and temperature calibration.

Additional enhanced chapters describe temperature control, transmitters and instrumentation. The 40 page reference section carries comprehensive data on thermocouple and platinum resistance thermometry, thermocouple and PRT tables, general thermometry data and other reference information including °C/°F conversion tables, fixed points and specification standards.

An installation problem solving guide, comprehensive 9 page glossary of terms and "Frequently Asked Questions" add to the practical value of the text for laboratory and industrial users.

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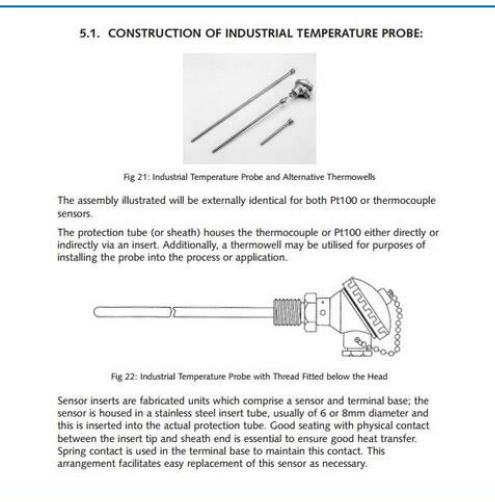
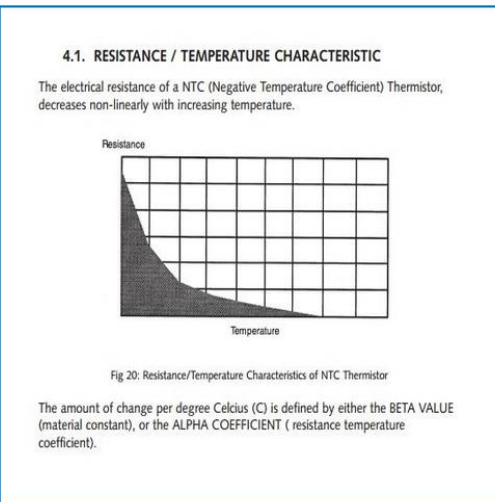
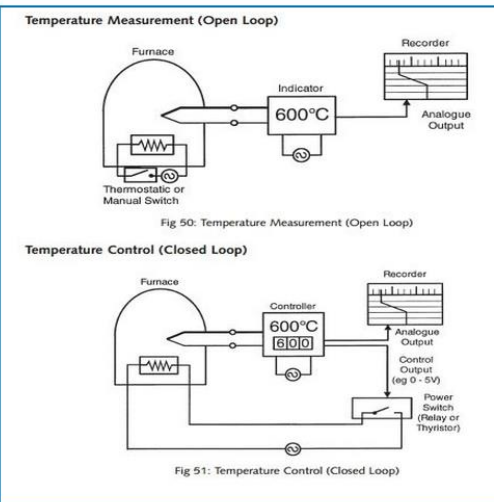
9.1 THERMOCOUPLE THERMOMETRY

9.1.1. Thermocouple Accuracies

Tolerance classes for thermocouples to IEC 584-2 : 1982.

Fe-Con (J)	Class 1	-40 +750°C: ±0.004 . t	or ±1.5°C
	Class 2	-40 +750°C: ±0.0075 . t	or ±2.5°C
	Class 3	-	-
Cu-Con (T)	Class 1	-40 +350°C: ±0.004 . t	or ±0.5°C
	Class 2	-40 +350°C: ±0.0075 . t	or ±1.0°C
	Class 3	-200 + 40°C: ±0.015 . t	or ±1.0°C
NiCr -Ni (K) and NiCrSi-NiSi (N)	Class 1	-40 +1000°C: ±0.004 . t	or ±1.5°C
	Class 2	-40 +1200°C: ±0.0075 . t	or ±2.5°C
	Class 3	-200 + 40°C: ±0.015 . t	or ±2.5°C
NiCr-Con (E)	Class 1	-40 +800°C: ±0.004 . t	or ±1.5°C
	Class 2	-40 +900°C: ±0.0075 . t	or ±2.5°C
	Class 3	-200 + 40°C: ±0.015 . t	or ±2.5°C
Pt10Rh-Pt (S) and Pt13Rh-Pt (R)	Class 1	0 +1600°C: ±[1+(t-1000).0.003]	or ±1.0°C
	Class 2	-40 +1600°C: ±0.0025 . t	or ±1.0°C
	Class 3	-	-
Pt30Rh-Pt6Rh (B)	Class 1	-	-
	Class 2	+600 +1700°C: ±0.0025 . t	or ±1.5°C
	Class 3	+600 +1700°C: ±0.005 . t	or ±4.0°C

Note: t = actual temperature
Use the larger of the two deviation values





Need Your Temperature Sensor calibrated?

Traceable to ISO17025 (UKAS) calibration standards, Labfacility offer a choice of a 3 or 5 point traceable calibration using our in-house calibration facility, you can select any temperature points between -10°C & +200°C.

Please be aware that if you add a calibration option to your order, this will add 2-3 days lead time to your order.

Information given here is for general guidance only and is not definitive – it is not intended to be the basis for product installation or decision making.

Q. What is the difference between a Mineral Insulated (MI) and a fabricated sheath?

A. An MI is flexible, a fabricated sheath is rigid.

Q. How accurately can I measure temperature using a standard sensor?

A. To published, internationally specified tolerances as standard, typically $\pm 2.5^{\circ}\text{C}$ for popular thermocouples, $\pm 0.5^{\circ}\text{C}$ for PRT. Higher accuracy sensors can be supplied to order, e.g. $\pm 0.5^{\circ}\text{C}$ for type T thermocouple, $\pm 0.2^{\circ}\text{C}$ for PRT. All of these values are temperature dependent. A close tolerance, 4-wire PRT will give best absolute accuracy and stability.

Q. How do I choose between a thermocouple and a PRT?

A. Mainly on the basis of required accuracy, probe dimensions, speed of response and the process temperature.

Q. My thermocouple is sited a long way from my controller, is this a problem?

A. It could be; try to ensure a maximum sensor loop resistance of 100 Ohms for thermocouples and 4-wire PRTs. Exceeding 100 Ohms could result in a measurement error. Note By using a 4-20mA transmitter near the sensor, cable runs can be much longer and need only cheaper copper wire. The instrument must be suitable for a 4-20mA input though.

Q. Should I choose a Type K or Type N thermocouple?

A. Generally, Type N is more stable and usually lasts longer than Type K; N is a better choice for high temperature work depending on the choice of sheath material.

Q. Does it matter what type of steel I specify for the thermocouple sheath?

A. Often no, sometimes yes. In some cases, reliability depends on the ideal choice of material.

Q. Are there other types of temperature sensor apart from thermocouple and PRT Types?

A. Several, but these two groups are the most common. Alternatives include thermistors, infra-red (non-contact), conventional thermometers (stem & dial types) and many others.

Q. Why are so many different types of thermocouple used?

A. They have been developed over many years to suit different applications world-wide.

Q. What is a duplex sensor?

A. One with two separate sensors in a single housing

Q. Why use a thermowell?

A. To protect the sensor from the process medium and to facilitate its replacement if necessary.

Q. I use many thermocouples in testing and experiments, can I make my own thermocouple junctions?

A. Yes, using a benchtop welder and fine thermocouple wires – it is easy and inexpensive to make unsheathed thermocouples.

Q. Why should I use actual thermocouple connectors instead of ordinary electrical connectors?

A. Good quality thermocouple connectors use thermocouple alloys, polarized connections and colour coded bodies to guarantee perfect, error-free interconnections.

Q. I need to measure quickly changing temperature; what type of sensor should I use?

A. A fast-response (low thermal mass) thermocouple.

Q. There are several different types of extension cable construction; is the choice important?

A. Yes; some are waterproof, some mechanically stronger, some suitable for high or low temperature.

Q. Is a sensor with a calibration certificate more accurate than an uncalibrated one?

A. No. However, the errors and uncertainties compared with a reference sensor are published and corrected values can be used to obtain better measurement accuracy.

Q. How long will my sensor last in the process?

A. Not known but predictable in some cases; this will be a function of sensor type, construction, operating conditions and handling.

Q. Which thermocouple type do I need for my application?

A. This depends on several factors including the nature of the process, heated medium and temperature.

Q. What is the longest thermocouple I can have without losing accuracy?

A. Try to ensure a maximum sensor loop resistance of 100 Ohms for thermocouples and 4 wire PRTs. Exceeding 100 Ohms could result in a measurement error. Note By using a 4-20mA transmitter near the sensor, cable runs can be much longer and need only cheaper copper wire. The instrument must be suitable for a 4-20mA input though.

Q. Do I need a power supply when using a transmitter, and what length of extension lead can I run with a transmitter fitted?

A. A 24Vdc, 20mA supply will be needed if this is not incorporated in the measuring instrument. Long runs of copper cable can be used.

Q. What sensor will I need to work in molten metal or a corrosive atmosphere?

A. There is no simple answer but special grades of Stainless Steel, Inconel 600, Microbell and Ceramics offer alternatives.

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