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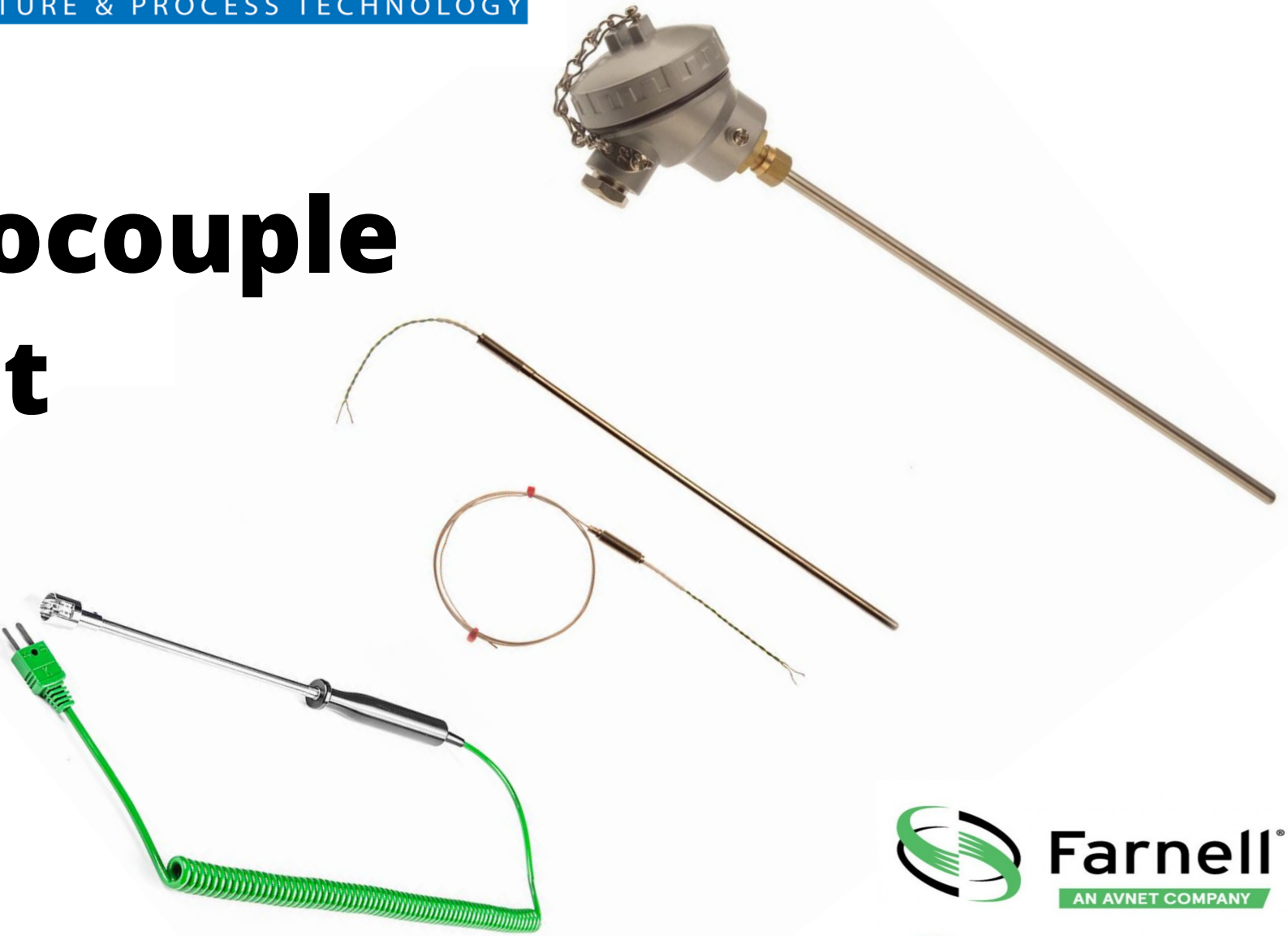
TEMPERATURE & PROCESS TECHNOLOGY

Thermocouple Product Guide



Farnell
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Comparison of Sensor Types

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	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 to1750°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 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.

Thermocouple or RTD Sensor?

Choosing between a Thermocouple and RTD Sensor

Thermocouples comprise a thermoelement which is a junction of two specifield, 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

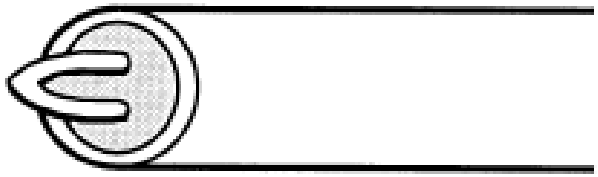
RTD's are, generally:

- 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.

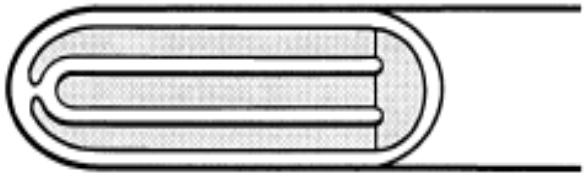
Sheathed Thermocouples – Measuring Junctions

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.

Different Thermocouple Types

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.

Comparison of Sheath Materials

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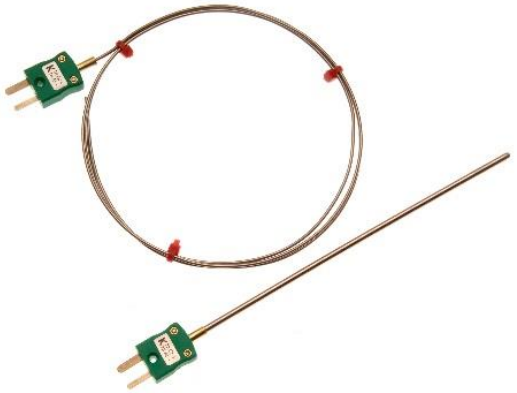
Sheath Material	Max Continuous Temperature	Notes	Applications
Refractory Oxide recrystallised, e.g. Alumina Impervious	1750°C	Good choice for rare metal thermocouples. Good resistance to chemical attack. Mechanically strong but severe thermal shock should be avoided.	Forging iron & steel. Incinerators 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.

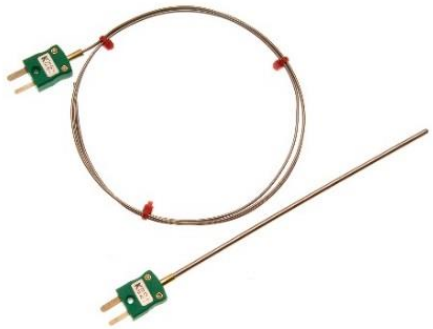
Advantages of Mineral Insulated Thermocouples

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

Mineral Insulated Thermocouples



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	Farnell Order Code	Newark Order Code
A	K	0.5	150	310SS	Insulated	Miniature Plug	-40°C to +750°C	4248296	19J1162
A	K	1.0	250	310SS	Insulated	Miniature Plug	-40°C to +750°C	2420277	53X3224
A	K	3.0	500	310SS	Insulated	Miniature Plug	-40°C to +1100°C	2420269	53X3246

Image	Type	Probe Dia. (mm)	Probe Length(mm)	Sheath	Cable Type	Cable Length	Cable Colour	Temperature Range	Farnell Order Code	Newark Order Code
B	K	1.5	250	310SS	PFA 7/0.2mm	1 metre	Green	-40°C to +1100°C	4248200	19J1153
B	J	1.5	150	321SS	PFA 7/0.2mm	1 metre	Black	-40°C to +1100°C	2771989	28AC5795
B	J	3.0	250	321SS	PFA 7/0.2mm	1 metre	Black	-40°C to +1100°C	2771992	28AC5798
B	J	6.0	250	321SS	PFA 7/0.2mm	1 metre	Black	-40°C to +1100°C	2771994	28AC5800

Image	Type	Probe Dia. (mm)	Probe Length(mm)	Sheath	Cable Type	Cable Length	Cable Colour	Temperature Range	Farnell Order Code	Newark Order Code
C	K	1.5	150	310SS	PFA T/T 7/0.2mm	100mm	Green/White	-40°C to +1100°C	7078146	67C7309
C	K	3.0	250	310SS	PFA T/T 7/0.2mm	100mm	Green/White	-40°C to +1100°C	7078195	67C7317
C	K	4.5	500	310SS	PFA T/T 7/0.2mm	100mm	Green/White	-40°C to +1100°C	2420289	53X3357
C	K	6.0	1000	310SS	PFA T/T 7/0.2mm	100mm	Green/White	-40°C to +1100°C	2771983	28AC5811

Mineral Insulated Thermocouples

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	Farnell Order Code	Newark Order Code
A	K	6.0	150	310SS	KNS	2-way ceramic	M16 x 1.5mm Plated brass	-40°C to +1100°C	2420304	53X3252
A	K	6.0	200	310SS	KNS	2-way ceramic	M16 x 1.5mm Plated brass	-40°C to +1100°C	2420305	53X3253
A	K	6.0	300	310SS	KNS	2-way ceramic	M16 x 1.5mm Plated brass	-40°C to +1100°C	2420307	53X3255

Image	Type	Probe Dia. (mm)	Length (mm)	Sheath	Head Type	Termination	Probe Temperature Range	Plug Temperature Range	Farnell Order Code	Newark Order Code
B	K	1.0	150	310SS	KNS	Miniature ceramic plug + Socket	-40°C to +1100°C	650°C	2772035	28AC5825
B	K	1.5	300	310SS	KNS	Miniature ceramic plug + Socket	-40°C to +1100°C	650°C	2772036	28AC5826
B	K	3.0	300	310SS	KNS	Miniature ceramic plug + Socket	-40°C to +1100°C	650°C	2772037	28AC5827

Thermocouple Extension Leads with Miniature or Standard Thermocouple Connectors

A **PVC Extension Lead with Miniature Connectors**

B **PVC Extension Lead with Standard Connectors**

Image	Type	Length	Cable	Termination	Cable Temperature Range	Farnell Order Code	Newark Order Code
A	K	2 Metre	PVC Insulated, 7/0.2mm	Miniature Plug + Socket	-10°C to 105°C	2420256	53X3152
A	K	5 Metre	PVC Insulated, 7/0.2mm	Miniature Plug + Socket	-10°C to 105°C	2420257	53X3156

Image	Type	Length	Cable	Termination	Cable Temperature Range	Farnell Order Code	Newark Order Code
B	K	2 Metre	PVC Insulated, 7/0.2mm	Standard Plug + Socket	-10°C to 105°C	2420261	-

Melt Bolt Thermocouple

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	Farnell Order Code	Newark Order Code
A	J	1/2"UNF-20	76mm (3" inch)	5.0mm (3.0mm diameter)	Up to +500°C	Standard plug	2816490	44AC8638
A	J	1/2"UNF-20	152mm (6" inch)	5.0mm (3.0mm diameter)	Up to +500°C	Standard plug	2816491	44AC8639

Image	Type	Thread	Bolt Length	Tip Immersion Length	Temperature Range	Termination	Farnell Order Code	Newark Order Code
B	J	1/2"UNF-20	152mm (6" inch)	20.0mm	Up to +400°C	Standard plug	2749474	15AC8979
B	K	1/2"UNF-20	152mm (6" inch)	20.0mm	Up to +400°C	Standard plug	2749475	15AC8980

PFA Exposed Junction Thermocouples

A **Type K PFA Exposed Junction with Miniature Plug**

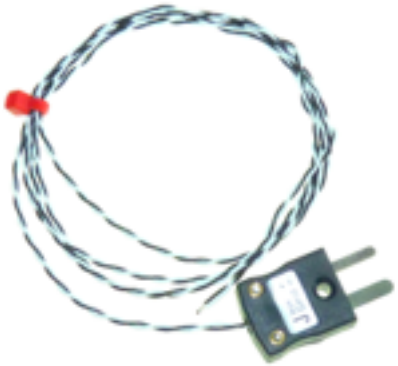
B **Type T PFA Exposed Junction with Miniature Plug**

Image	Type	Conductors	Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code
			2 Metre		5 Metre		10 Metre	
A	K	1/0.315mm	2785043	37AC1023	2420294	53X3727	2420263	-
A	K	7/0.2mm	2785044	37AC1024	2420295	53X3728	2420264	-
A	K	1/0.2mm	2785045	37AC1025	-	-	2785046	37AC1026

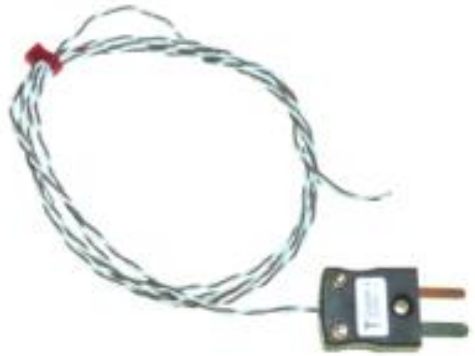
Image	Type	Conductors	Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code
			1 Metre		2 Metre		5 Metre		10 Metre	
B	T	1/0.315mm	2785048	37AC1028	2785049	37AC1029	2420297	53X3729	2420265	-
B	T	7/0.2mm	2785050	37AC1030	2785051	37AC1031	2420298	-	2420266	-

PTFE Exposed Junction Thermocouples

A **Type K PTFE Exposed Junction with Miniature Plug**



B **Type J PTFE Exposed Junction with Miniature Plug**



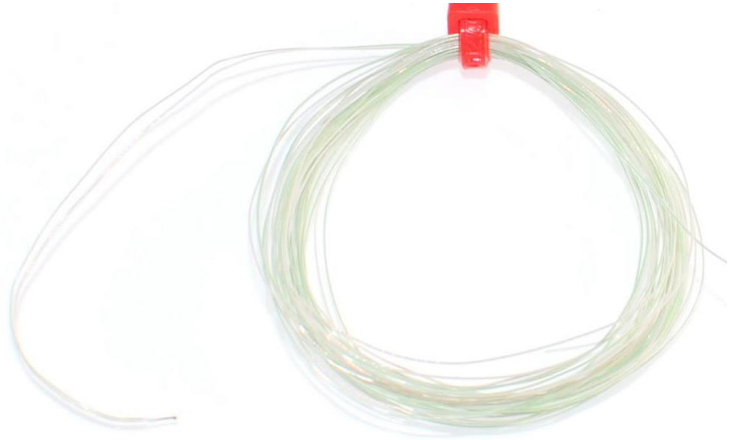
C **Type T PTFE Exposed Junction with Miniature Plug**

Image	Type	Conductors	Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code
			1 Metre		2 Metre		5 Metre		10 Metre	
A	K	1/0.2mm	4100748	15J1022	2785062	37AC1000	2785063	37AC1013	2785064	37AC1014

Image	Type	Conductors	Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code
			1 Metre		2 Metre		5 Metre		10 Metre	
B	J	1/0.2mm	2785061	37AC1001	2785065	37AC1015	2785066	37AC1016	2785067	-

Image	Type	Conductors	Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code
			1 Metre		2 Metre		5 Metre	
C	T	1/0.2mm	4100750	15J1023	2785068	37AC1018	2785069	37AC1019

Fine Gauge PFA Exposed Junction Thermocouples



A **Type K PFA Fine Gauge Exposed Junction with Miniature Plug**

B **Type T PFA Fine Gauge Exposed Junction with Miniature Plug**

Image	Type	Conductors	Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code
			0.5 Metre		1 Metre		2 Metre	
A	K	1/0.076mm	2420342	-	2420343	-	2420344	-

Image	Type	Conductors	Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code	Farnell Order Code	Newark Order Code
			0.5 Metre		1 Metre		2 Metre	
B	T	1/0.076mm	2420345	-	2420346	-	2420347	-

Round Handle Style Temperature Sensors

Image	Type	Farnell Order Code	Newark Order Code
A	K	7081182	67C3626

Spring Loaded Thermocouple with Copper Disc Tip

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

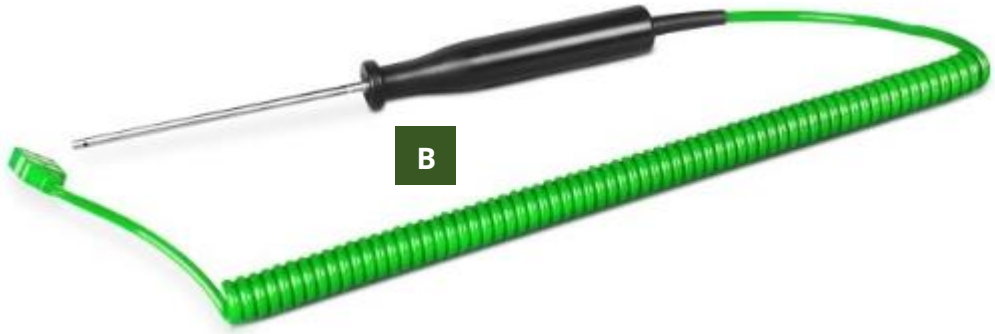
- Type K IEC
- Surface temperature spring loaded thermocouple with copper disc tip
- Maximum Temperature: +600°C
- Probe 4.7mmØ x 63mm long stem, Ø8 x 17mm tip with Ø4.5mm copper disc

Image	Type	Diameter	Length	Farnell Order Code	Newark Order Code
B	K	4.0mm	110mm	2918836	72AC6992

Stainless Steel Air Probe

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



Round Handle Style Temperature Sensors

Image	Type	Colour Code	Diameter	Length	Farnell Order Code	Newark Order Code
A	K	IEC	3.3mm	300mm	2918839	72AC6995
B	K	ANSI	3.3mm	300mm	2918841	72AC6997

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

Stainless Steel Penetration Probe

Image	Type	Colour Code	Diameter	Length	Farnell Order Code	Newark Order Code
C	K	IEC	1.5mm	100mm	2918842	72AC6998
C	K	IEC	3.0mm	300mm	2918833	72AC6989
D	K	ANSI	1.5mm	100mm	2918835	72AC6991
D	K	ANSI	3.0mm	300mm	2918834	72AC6990

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. A semi flexible construction allows the probe to be bent or shaped for hard to reach applications. 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

General Purpose Probes

Thermocouple Welder & Digital Thermometer / Data Logger

L60 Thermocouple & Fine Wire Welder

The Thermocouple Welder is a compact, simple-to-use instrument designed for thermocouple and fine wire welding

It is primarily designed for use by sensor manufacturers to produce commercial grade thermocouple junctions; it is ideal for producing large numbers of exposed junction thermocouples for test and development laboratories. The L60 Thermocouple Welder is ideally suited to transducer and RTD extension lead attachment

Use of the Thermocouple Welder does not require special skills and most operatives will be capable of producing quality work with little practice. The instrument is supplied with a full range of user accessories.

- Simple to use Thermocouple Welder
- Designed for the production of commercial grade thermocouple junctions
- Also suitable for other fine wire work
- Front panel or footswitch operation
- Argon gas shield facility

Farnell Order Code	Newark Order Code
2897470	62AC8741

Digital Thermometer & Data Logger

The L200 thermocouple thermometer can be used in conjunction with a PC to provide accurate, versatile 8 channel thermocouple temperature measurement, scanning and logging of measured values. It can also be used as a “stand alone” indicator/logger and incorporates a digital display of measured temperature.

The in-built, self-calibration facility for the thermocouple version is a rapid and convenient method for on-site calibration and does not require any additional equipment other than a special, external link.

The L200 is designed to provide exceptional stability with high measurement resolution and represents an ideal crossover between plant practicality and laboratory performance at a very competitive price.

Farnell Order Code	Newark Order Code
1894550	-

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 ± 2.5°C for popular thermocouples, ±0.5°C for PRT. Higher accuracy sensors can be supplied to order, e.g. ±0.5°C for type T thermocouple, ±0.2°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.

FREQUENTLY ASKED QUESTIONS

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, Nicrobell and Ceramics offer alternatives.

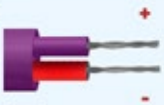
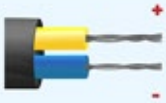
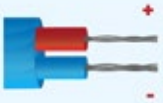
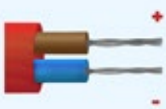
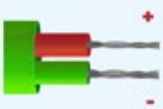
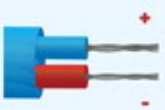
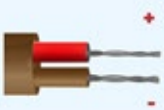
Information given here is for general guidance only and is not definitive – it is not intended to be the basis for product installation or decision making.

Colour Codes: Thermocouple Extension and Compensating Wires and Cables

INSULATION COLOUR CODES

Extension and Compensating leads

◀ FORMER STANDARD ▶

TYPE	CONDUCTORS +/-	BRITISH BS1843:1952	AMERICAN ANSI/MC 96.1	GERMAN DIN 43713/43714	IEC 60584-3(2007) BS ENG60584-3(2008)	Cable Code
EX	NICKEL CHROMIUM/CONSTANTAN (Nickel/Chromium/Copper Nickel, Chrome/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' and 'R' respectively) (Copper/Cupronic Cu/CuNi, Copper/No.11 Alloy)					RCA SCA

* Magnetic

FOR THERMOCOUPLE CONNECTORS
body colours are similar to outer sheath colours