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THERMOCOUPLE
SELECTION GUIDE

THERMOCOUPLE & PLATINUM RESISTANCE THERMOMETRY - AT A GLANCE

Selecting sensor cables: Guide to insulation & covering

Which insulation material?	Useable 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.
Glass fibre (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 glass fibre	-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.
Glass fibre (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 unscreened? 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 60584-1 : 2013 / BS EN 60584-1 : 201

Fe-Con (J)	Class 1	-40°C - +750°C:	±0.004	.t	or ±1.5°C
	Class 2	-40°C - +750°C:	±0.0075	.t	or ±2.5°C
	Class 3	-	-		
Cu-Con (T)	Class 1	-40°C - +350°C:	±0.004	.t	or ±0.5°C
	Class 2	-40°C - +350°C:	±0.0075	.t	or ±1.0°C
	Class 3	-200°C - +40°C:	±0.015	.t	or ±1.0°C
NiCr -NI (K) and NiCrSi-NiSi (N)	Class 1	-40°C - +1000°C:	±0.004	.t	or ±1.5°C
	Class 2	-40°C - +1200°C:	±0.0075	.t	or ±2.5°C
	Class 3	-200°C - +40°C:	±0.015	.t	or ±2.5°C
NiCr-Con (E)	Class 1	-40°C - +800°C:	±0.004	.t	or ±1.5°C
	Class 2	-40°C - +900°C:	±0.0075	.t	or ±2.5°C
	Class 3	-200°C - +40°C:	±0.015	.t	or ±2.5°C
Pt10Rh-Pt (s) and Pt13Rh-Pt (R)	Class 1	0°C - +1600°C:	1 for t <1100°C, [1 + 0,003 × (t - 1100)] for t > 1100°C		or ±1.0°C
	Class 2	0°C - +1600°C:	±0.0025	.t	or ±1.5°C
	Class 3	-	-		
Pt30Rh-Pt6Rh (B)	Class 1	-	-		
	Class 2	+600°C - +1700°C:	±0.0025	.t	or ±1.5°C
	Class 3	+600°C - +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 +/-	Former Standard: British BS1843: 1952	Former Standard: American ANSI/MC 96.1	Former Standard: German DIN 43713 / 43714	IEC 60584-3(2007) BS EN60584-3(2008)	Cable Code
EX	Nickel chromium/Constantan (Nickel, Chromium/Copper Nickel, Chromel/Constantan, T1/Advance, NiCr/ Constantan)					**EX**
J	Iron*/Contantan (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** 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	76.37	-	-
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	7.95	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

COMPARISON OF SENSOR TYPES

	THERMOCOUPLE	PLATINUM RESISTANCE THERMOMETER	THERMISTOR
Sensor	Thermoelement, two dissimilar metals/alloys	Platinum-wire wound or flatfilm 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.

DIFFERENT THERMOCOUPLE JUNCTIONS

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 Junctions

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.

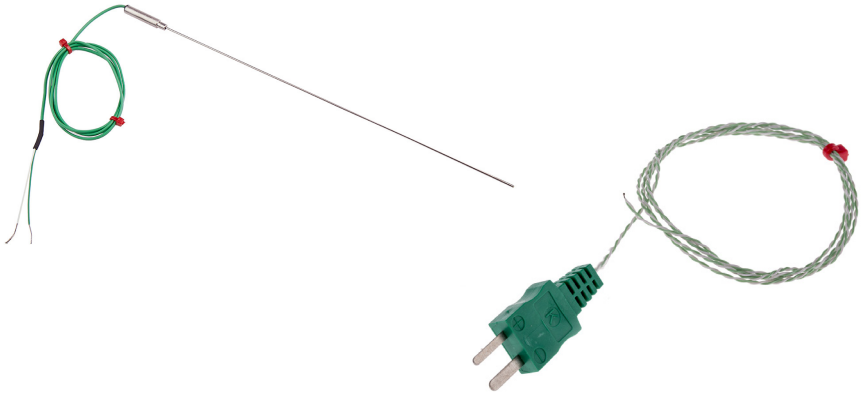
Type B – Platinum rhodium 30% Rh-Platinum rhodium 6% Rh: It allows measurements up to 1700°C. Very stable thermocouple but less sensitive in the lower range. (Output is negligible at room temperature).

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 OR SURFACE TEMPERATURE MEASUREMENT

Immersion

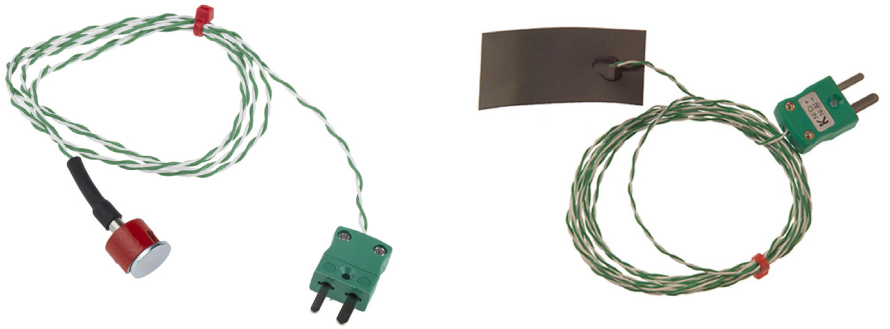
Thermocouple assemblies are “tip” sensing devices which lends them to both surface and immersion applications depending on their construction. However, immersion types must be used carefully to avoid errors due to stem conduction; this is heat flow to or from the sheath and into or away from the process 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 above.

COMPARISON OF SHEATH MATERIALS

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 and 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, incinerator, billet heating, slab heating, butt welding, soaking pits and 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 and 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 and 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 and 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 and 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 and 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.

RTD SENSOR OR THERMOCOUPLE?

RTD

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.

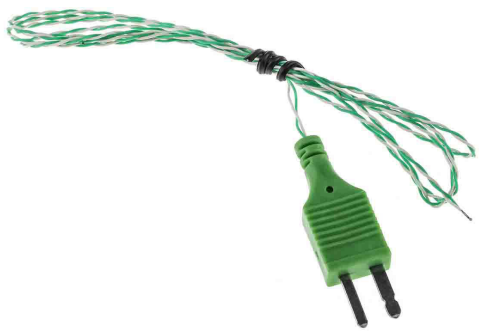
RTD's are, generally:

- 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)

Thermocouple

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.



Thermocouples are, generally:

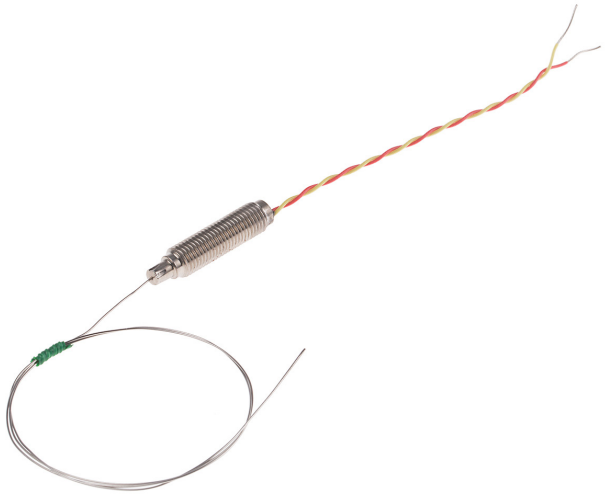
- Relatively inexpensive
- More rugged
- Less accurate
- More prone to drift
- More sensitive
- Tip sensing
- Available in smaller diameters
- Available with a wider temperature range
- More versatile

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

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

Plug Termination

TYPE	PROBE DIA. (MM)	PROBE LENGTH (MM)	SHEATH	JUNCTION	TERMINATION	TEMPERATURE RANGE	STOCK NO
K	0.5	150	310SS	Insulated	Miniature Plug	-40°C to +750°C	444-1275
K	1.0	250	310SS	Insulated	Miniature Plug	-40°C to +750°C	787-7765
K	3.0	500	310SS	Insulated	Miniature Plug	-40°C to +1100°C	787-7784

Plain Pot with Tails Termination

TYPE	PROBE DIA. (MM)	PROBE LENGTH (MM)	SHEATH	CABLE TYPE	CABLE LENGTH	CABLE COLOUR	TEMPERATURE RANGE	STOCK NO
K	1.5	250	310SS	PFA 7/0.2mm	1 metre		-40°C to +1100°C	397-1258
K	3.0	500	310SS	PFA 7/0.2mm	1 metre		-40°C to +1100°C	787-7734
J	1.5	150	321SS	PFA 7/0.2mm	1 metre		-40°C to +1100°C	455-4270
J	3.0	250	321SS	PFA 7/0.2mm	1 metre		-40°C to +1100°C	455-4309
J	6.0	250	321SS	PFA 7/0.2mm	1 metre		-40°C to +1100°C	455-4321

Threaded Pot with Tails Termination

TYPE	PROBE DIA. (MM)	PROBE LENGTH (MM)	SHEATH	CABLE TYPE	CABLE LENGTH	CABLE COLOUR	TEMPERATURE RANGE	STOCK NO
K	1.5	150	310SS	PFA T/T 7/0.2mm	100mm		-40°C to +1100°C	228-7445
K	3.0	250	310SS	PFA T/T 7/0.2mm	100mm		-40°C to +1100°C	228-7489
K	6.0	1000	310SS	PFA T/T 7/0.2mm	100mm		-40°C to +1100°C	219-4422

MINERAL INSULATED THERMOCOUPLES

Thermocouples with Compact KNS Terminal Head

TYPE	PROBE DIA. (MM)	LENGTH (MM)	SHEATH	HEAD TYPE	BLOCK	GLAND	TEMPERATURE RANGE	STOCK NO
K	6.0	100	310SS	KNS	2-way ceramic	M16 × 1.5mm Plated brass	-40°C to +1100°C	787-7804
K	6.0	150	310SS	KNS	2-way ceramic	M16 × 1.5mm Plated brass	-40°C to +1100°C	787-7813
K	6.0	200	310SS	KNS	2-way ceramic	M16 × 1.5mm Plated brass	-40°C to +1100°C	787-7816
K	6.0	250	310SS	KNS	2-way ceramic	M16 × 1.5mm Plated brass	-40°C to +1100°C	787-7810
K	6.0	300	310SS	KNS	2-way ceramic	M16 × 1.5mm Plated brass	-40°C to +1100°C	787-7829

Thermocouple with Ceramic Plug Termination

TYPE	PROBE DIA. (MM)	LENGTH (MM)	SHEATH	HEAD TYPE	TERMINATION	PROBE TEMPERATURE RANGE	PLUG TEMPERATURE RANGE	STOCK NO
K	1.0	150	310SS	KNS	Miniature ceramic plug + Socket	-40°C to +1100°C	650°C	872-2654
K	1.5	300	310SS	KNS	Miniature ceramic plug + Socket	-40°C to +1100°C	650°C	872-2660
K	3.0	150	310SS	KNS	Miniature ceramic plug + Socket	-40°C to +1100°C	650°C	872-2679
K	3.0	300	310SS	KNS	Miniature ceramic plug + Socket	-40°C to +1100°C	650°C	872-2672

STAINLESS STEEL FABRICATED THERMOPOCKETS

Thermocouples with Compact KNS Terminal Head

Stainless steel thermopockets of numerous sizes, designed for use with industrial style temperature probes to provide protection for the sheathing from corrosive media, and to facilitate probe replacement without disturbing the process.

- Fabricated 316 stainless steel thermopocket
- All welded construction
- Suitable with 3.0 or 6.0mm diameter probes
- 1/2" BSP parallel process thread
- 25.4mm across flats hex (pockets to suit 6.0mm probe)
- 22mm across flats hex (pockets to suit 3.0mm probe)
- Supplied complete with stainless steel compression fitting to suit probe

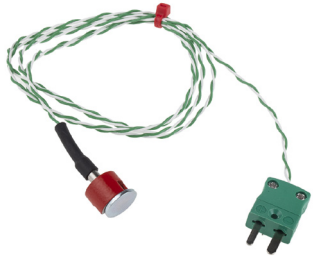
SUITE PROBE DIA	PROCESS THREAD	IMMERSION LENGTH	POCKET DIA	WITH FITTING TO SUIT	STOCK NO
6.0mm	1/2"BSP Parallel	25mm	11.1mm	6.0mm	178-0956
6.0mm	1/2"BSP Parallel	50mm	11.1mm	6.0mm	178-0957
6.0mm	1/2"BSP Parallel	75mm	11.1mm	6.0mm	178-0958
6.0mm	1/2"BSP Parallel	100mm	11.1mm	6.0mm	363-3007
6.0mm	1/2"BSP Parallel	150mm	11.1mm	6.0mm	286-923
6.0mm	1/2"BSP Parallel	350mm	11.1mm	6.0mm	286-939
6.0mm	1/2"BSP Parallel	550mm	11.1mm	6.0mm	286-945
3.0mm	1/2"BSP Parallel	25mm	8.0mm	3.0mm	178-0953
3.0mm	1/2"BSP Parallel	50mm	8.0mm	3.0mm	178-0954
3.0mm	1/2"BSP Parallel	75mm	8.0mm	3.0mm	178-0955
3.0mm	1/2"BSP Parallel	100mm	8.0mm	3.0mm	363-3029
3.0mm	1/2"BSP Parallel	150mm	8.0mm	3.0mm	363-3035

FABRICATED AND SPECIALIST THERMOCOUPLES

Magnet Thermocouple

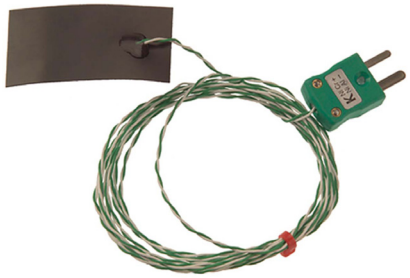
TYPE	LENGTH	CABLE	TERMINATION	TEMPERATURE RANGE	STOCK NO
K	1 Metre	PFA Teflon® insulated with stainless steel over-braid	Miniature Plug	-50°C to + 250°C	131-4735
K	2 Metre	PFA Teflon® insulated with stainless steel over-braid	Miniature Plug	-50°C to + 250°C	762-1115

Button Magnet



TYPE	LENGTH	CABLE	TERMINATION	TEMPERATURE RANGE	STOCK NO
K	1 Metre	PFA Teflon® insulated twin twisted	Miniature Plug	-50°C to + 250°C	236-4255
K	2 Metre	PFA Teflon® insulated twin twisted	Miniature Plug	-50°C to + 250°C	131-4736

Magnetic Strip



TYPE	LENGTH	CABLE	TERMINATION	TEMPERATURE RANGE	STOCK NO
K	1 Metre	PFA Teflon® insulated twin twisted	Miniature Plug	-50°C to +100°C	131-4737
K	2 Metre	PFA Teflon® insulated twin twisted	Miniature Plug	-50°C to +100°C	219-4545

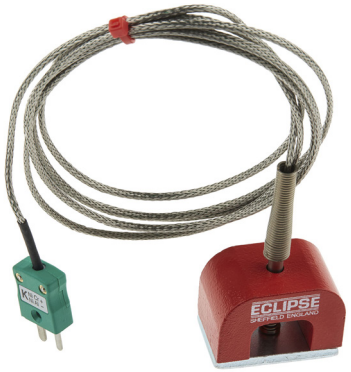
Crocodile Clip Thermocouple with Fiberglass Stainless Steel Overbraided Cable

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

TYPE	LENGTH	STOCK NO
K	1m	174-1669
K	3m	174-1670
J	1m	174-1671
J	3m	174-1672

Strong Magnet Thermocouple (9kg Pull)



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 × 25 × 40mm (HxWxL) with powerful 9kg pull
Temperature range: -50°C to + 250°C

TYPE	LENGTH	STOCK NO
K	1.5m	174-1663
K	3.0m	174-1664

FABRICATED AND SPECIALIST THERMOCOUPLES

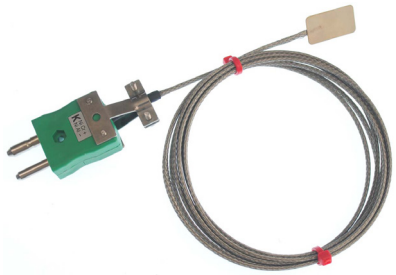
Washer Thermocouple

TYPE	LENGTH	CABLE	TERMINATION	TEMPERATURE RANGE	STOCK NO
K	2 Metre	Glassfibre insulated, stainless steel over braid	Standard Plug	-60°C to 350°C	131-4761
J	2 Metre	Glassfibre insulated, stainless steel over braid	Standard Plug	-60°C to 350°C	131-4744

Nozzle Thermocouple

TYPE	LENGTH	CABLE	TERMINATION	TEMPERATURE RANGE	STOCK NO
K	2 Metre	Glassfibre insulated, stainless steel over braid	Standard Plug	-60°C to 350°C	131-4745

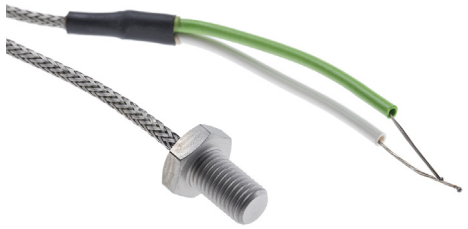
Leaf Thermocouple



TYPE	LENGTH	CABLE	TERMINATION	TEMPERATURE RANGE	STOCK NO
K	2 Metre	Glassfibre insulated, stainless steel over braid	Standard Plug	-60°C to 350°C	131-4746

FABRICATED AND SPECIALIST THERMOCOUPLES

Bolt Thermocouple



TYPE	THREAD PITCH	THREAD LENGTH	CABLE LENGTH	CABLE	TERMINATION	TEMPERATURE RANGE	STOCK NO
K	M8 × 1mm	13mm	2 Metre	Glassfibre stainless steel over braided	Tails	Up to +250°C	872-2581
K	M10 × 1mm	25mm	2 Metre	Glassfibre stainless steel over braided	Tails	Up to +250°C	872-2597
K	M12 × 1mm	13mm	2 Metre	Glassfibre stainless steel over braided	Tails	Up to +250°C	872-2607
J	M8 × 1mm	13mm	2 Metre	Glassfibre stainless steel over braided	Tails	Up to +250°C	872-2569
J	M8 × 1mm	25mm	2 Metre	Glassfibre stainless steel over braided	Tails	Up to +250°C	872-2578
J	M12 × 1mm	25mm	2 Metre	Glassfibre stainless steel over braided	Tails	Up to +250°C	872-2587

Bayonet Thermocouple

TYPE	LENGTH	CABLE	SPRING	TERMINATION	TEMPERATURE RANGE	STOCK NO
K	2 Metre	Glassfibre insulated, stainless steel over braid	170mm spring, adjustable cap	Standard Plug	-60°C to 350°C	131-4743
J	3 Metre	Glassfibre insulated, stainless steel over braid	170mm spring, adjustable cap	Standard Plug	-60°C to 350°C	131-4764

Silicone Rubber Patch Thermocouple

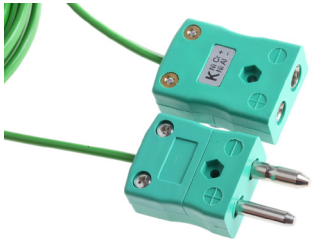
TYPE	LENGTH	CABLE	PATCH (MM)	TERMINATION	TEMPERATURE RANGE	STOCK NO
K	1 Metre	Teflon® insulated, twin twist	40×13×5 (LxWxH)	Tails	-50°C to +150°C	290-5036

THERMOCOUPLE EXTENSION LEADS WITH MINIATURE OR STANDARD THERMOCOUPLE CONNECTORS

PVC Extension Lead with Miniature Connectors

TYPE	LENGTH	CABLE	TERMINATION	CABLE TEMPERATURE RANGE	STOCK NO
K	2 Metre	PVC Insulated, 7/0.2mm	Miniature Plug + Socket	-10°C to 105°C	768-6581
K	5 Metre	PVC Insulated, 7/0.2mm	Miniature Plug + Socket	-10°C to 105°C	768-6585

PVC Extension Lead with C Standard Connectors



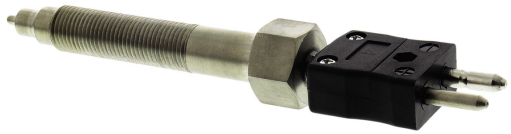
TYPE	LENGTH	CABLE	TERMINATION	CABLE TEMPERATURE RANGE	STOCK NO
K	2 Metre	PVC Insulated, 7/0.2mm	Standard Plug + Socket	-10°C to 105°C	768-6626
K	5 Metre	PVC Insulated, 7/0.2mm	Standard Plug + Socket	-10°C to 105°C	768-6620

Glassfibre Extension Lead with Miniature Connectors

TYPE	LENGTH	CABLE	TERMINATION	CABLE TEMPERATURE RANGE	STOCK NO
K	2 Metre	Glassfibre Insulated with SSOB, 7/0.2mm	Miniature Plug + Socket	-60°C to 350°C	779-9678
K	5 Metre	Glassfibre Insulated with SSOB, 7/0.2mm	Miniature Plug + Socket	-60°C to 350°C	779-9671

MELT BOLT THERMOCOUPLE

1/2”UNF-20 Melt Bolt Thermocouple with Type ‘J’ Thermocouple Plug



TYPE	THREAD	BOLT LENGTH	TIP IMMERSION LENGTH	TEMPERATURE RANGE	TERMINATION	STOCK NO
J	1/2"UNF-20	76mm (3” inch)	5.0mm (3.0mm diameter)	Up to +500°C	Standard plug	219-4731
J	1/2"UNF-20	152mm (6” inch)	5.0mm (3.0mm diameter)	Up to +500°C	Standard plug	353-4578

Twist Melt Bolt Thermocouple with Standard Thermocouple Plug

TYPE	THREAD	BOLT LENGTH	TIP IMMERSION LENGTH	TEMPERATURE RANGE	TERMINATION	STOCK NO
J	1/2"UNF-20	152mm (6” inch)	20.0mm	Up to +400°C	Standard plug	872-2783

PFA EXPOSED JUNCTION THERMOCOUPLES

Type K PFA Exposed Junction with Miniature Plug

TYPE	CONDUCTORS	1 METRE	2 METRE	5 METRE	10 METRE
K	1/0.315mm	123-6318	123-6319	762-1118	804-7886
K	1/0.2mm	123-6322	123-6323	804-7899	123-6324

Type J PFA Exposed Junction with Miniature Plug

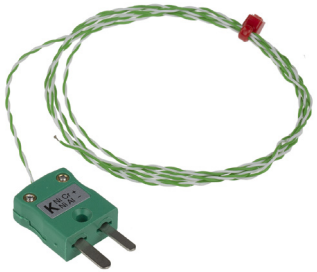
TYPE	CONDUCTORS	1 METRE	2 METRE	5 METRE	10 METRE
J	1/0.2mm	123-6325	123-6326	804-7883	123-6327

Type T PFA Exposed Junction with Miniature Plug

TYPE	CONDUCTORS	1 METRE	2 METRE	5 METRE	10 METRE
T	1/0.315mm	123-6328	123-6329	762-1121	804-7892
T	7/0.2mm	123-6330	123-6331	762-1124	804-7896
T	1/0.2mm	123-6332	123-6333	804-7906	123-6334

PTFE EXPOSED JUNCTION THERMOCOUPLES

Type K PTFE Exposed Junction with Miniature Plug

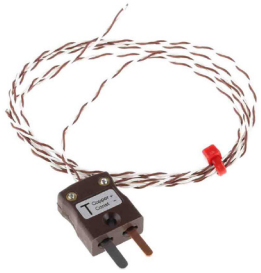


TYPE	CONDUCTORS	1 METRE	2 METRE	5 METRE	10 METRE
K	1/0.2mm	363-0250	110-4482	123-6306	123-6307

Type J PTFE Exposed Junction with Miniature Plug

TYPE	CONDUCTORS	1 METRE	2 METRE	5 METRE	10 METRE
J	1/0.2mm	363-0244	123-6308	123-6309	123-6310

Type T PTFE Exposed Junction with Miniature Plug



TYPE	CONDUCTORS	1 METRE	2 METRE	5 METRE	10 METRE
T	1/0.2mm	363-0266	123-6311	123-6312	123-6313

FINE GAUGE PFA EXPOSED JUNCTION THERMOCOUPLES

Type K PFA Fine Gauge Exposed Junction

TYPE	CONDUCTORS	0.5 METRE	1 METRE	2 METRE
K	1/0.076mm	804-7987	804-7981	804-7990

PFA EXPOSED JUNCTION THERMOCOUPLES WITH A FITTED CABLE TIDY

Type K PFA Fine Gauge Exposed Junction

TYPE	CABLE	1 METRE	2 METRE
K	PFA Twin Twist	110-4463	110-4467
T	PFA Twin Twist	110-4465	110-4469

Type T PFA Fine Gauge Exposed Junction

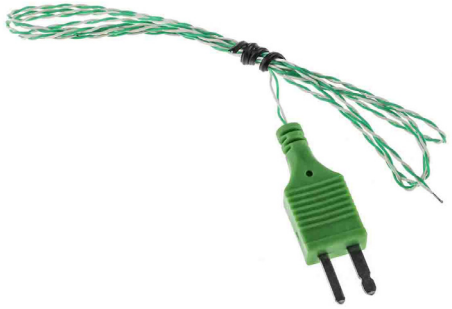
TYPE	CABLE	1 METRE	2 METRE
K	PFA Flat Pair	110-4464	110-4468
T	PFA Flat Pair	-	110-4470

PFA EXPOSED JUNCTION THERMOCOUPLES WITH A MOULDED-ON PLUG

PFA Twin Twist Exposed Junction with Miniature Plug

TYPE	CONDUCTORS	1 METRE	2 METRE	3 METRE
K	1/0.3mm	131-4752	131-4753	131-4753
K	1/0.5mm	131-4752	131-4756	131-4757

Type T PFA Fine Gauge Exposed Junction



TYPE	CABLE	1 METRE
K	1/0.2mm	363-0323
J	1/0.2mm	363-0317
T	1/0.2mm	363-0339

ROUND HANDLE STYLE TEMPERATURE SENSORS

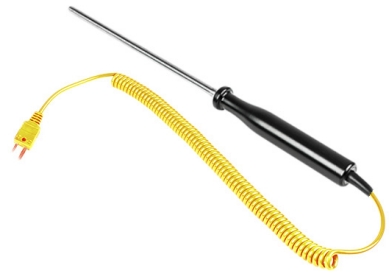
Stainless Steel Penetration Probe

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

TYPE	COLOUR CODE	DIAMETER	LENGTH	STOCK NO
K	IEC	3.3mm	300mm	174-1680
K	ANSI	3.3mm	300mm	174-1681

General Purpose Probes



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 K 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

TYPE	COLOUR CODE	DIAMETER	LENGTH	STOCK NO
K	IEC	1.5mm	100mm	174-1682
K	IEC	3.0mm	300mm	174-1683
K	ANSI	1.5mm	100mm	174-1684
K	ANSI	3.0mm	300mm	174-1685

ROUND HANDLE STYLE TEMPERATURE SENSORS

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 × 17mm tip with Ø4.5mm copper disc

TYPE	STOCK NO
K	174-1673

Stainless Steel Air Probe

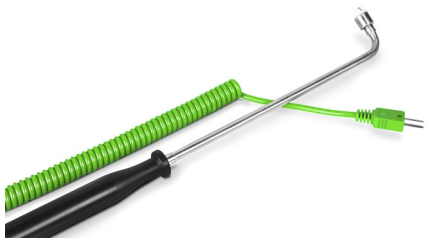
316 Stainless steel air probe with a vented sheath for general air temperature measurement. Comprising of a handle, 2 metre coiled cable and a mini plug.

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

TYPE	DIAMETER	LENGTH	STOCK NO
K	4.0mm	110mm	174-1674

ROUND HANDLE STYLE TEMPERATURE SENSORS

Right Angled Probe



Stainless steel sheath with a moulded handle and 1.5 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 Ø12mm Tip x 40mm Hot Leg and Ø6mm x 180mm Cold Leg
- Coiled element diameter 7mm

TYPE	STOCK NO
K	174-1675

Ceramic Tip and Coiled Element

Stainless steel sheath with a moulded handle and 1.5 metres of coiled extension cable terminated in a miniature thermocouple plug. Maximum Temperature 400°C.

- Surface temperature fast response thermocouple with ceramic tip and coiled element
- Ceramic Tip
- Maximum Temperature: +900°C
- Probe Ø6 × 90mm long stem with Ø12 × 10mm tip - Type K
- Coiled element diameter 7mm

TYPE	STOCK NO
K	174-1676

ROUND HANDLE STYLE TEMPERATURE SENSORS

Handheld Moving Air Probe

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

TYPE	STOCK NO
K	174-1678

Surface Probe

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

TYPE	STOCK NO
K	174-1679

THERMOCOUPLE WELDER & DIGITAL THERMOMETER

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

STOCK NO

363-0351

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.

STOCK NO

910-6817

FREQUENTLY ASKED QUESTIONS

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

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. 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 24V DC, 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.