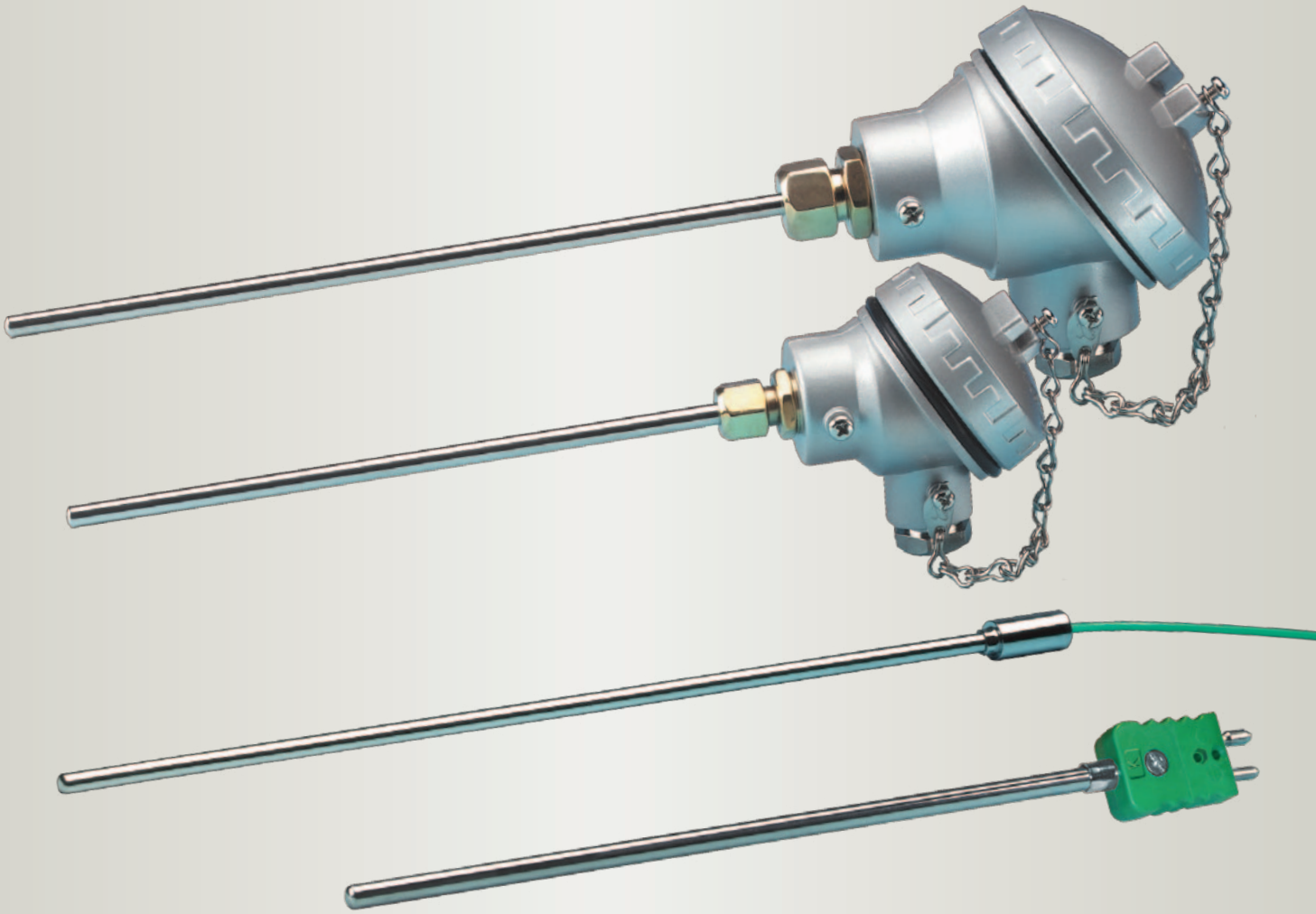
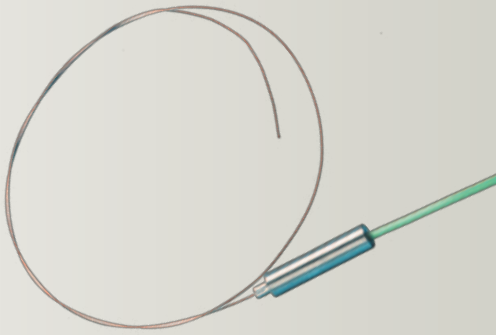
Mineral Insulated Thermocouples - Type 12





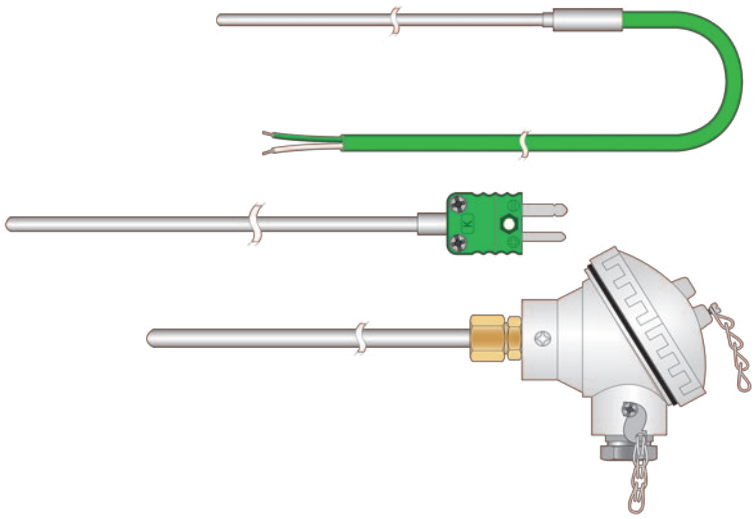
A range of semi flexible mineral insulated thermocouples, suited to a wide variety of industrial applications up to 1400°C.

Custom built to your specification and terminated in a large choice of end seal terminations and sheath materials from 0.25mm to 10.8mm diameter.

TC Ltd for Temperature Sensing, Measurement and Control

Type 12 Mineral Insulated Thermocouples

- **High integrity construction suited to arduous operating conditions at temperatures from -200°C to +1400°C**
- **High accuracy and stability maintained throughout operating life**
- **Fast response and high insulation resistance**
- **UKAS calibration is available for our range of Mineral Insulated thermocouple assemblies**
- **The cable used to manufacture these assemblies conforms to BS EN 61515: 1996 / IEC 61515: 1995 and BS EN 60584 class 2, other tolerances are available on request**
- **Available in K, T, J, N, E, R, S, & B with sheath diameters from 0.25mm to 10.8mm and lengths from a few millimetres to 200 metres or more dependent on the sheath diameter selected**
- **Sheaths can generally be bent, twisted and flattened to suit particular installations without impairing performance**
- **Swaged end assemblies are available where fast response high strength sheaths or low displacement are a necessity**



Typical Construction

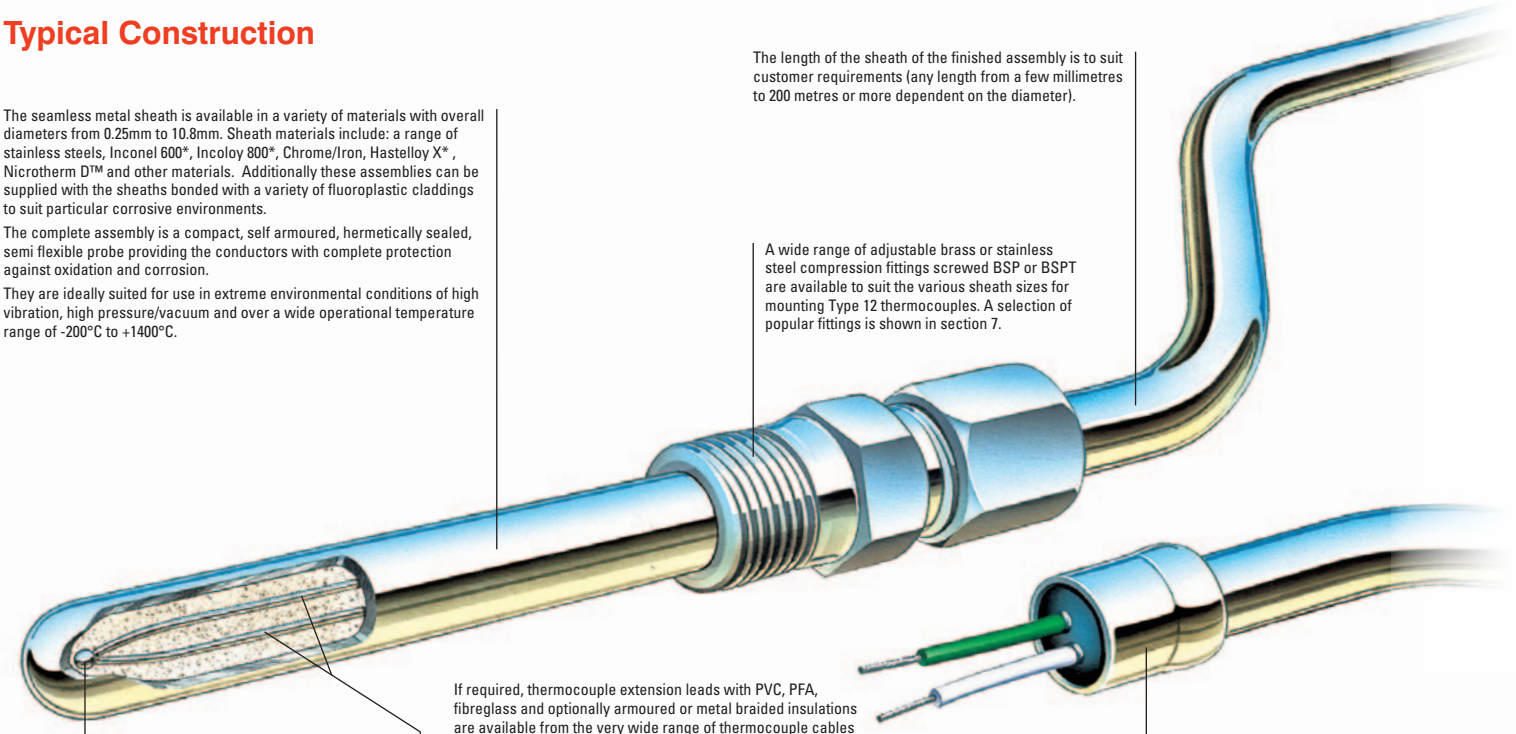
The seamless metal sheath is available in a variety of materials with overall diameters from 0.25mm to 10.8mm. Sheath materials include: a range of stainless steels, Inconel 600*, Incoloy 800*, Chrome/Iron, Hastelloy X* , Nicrotherm D™ and other materials. Additionally these assemblies can be supplied with the sheaths bonded with a variety of fluoroplastic claddings to suit particular corrosive environments.

The complete assembly is a compact, self armoured, hermetically sealed, semi flexible probe providing the conductors with complete protection against oxidation and corrosion.

They are ideally suited for use in extreme environmental conditions of high vibration, high pressure/vacuum and over a wide operational temperature range of -200°C to +1400°C.

The length of the sheath of the finished assembly is to suit customer requirements (any length from a few millimetres to 200 metres or more dependent on the diameter).

A wide range of adjustable brass or stainless steel compression fittings screwed BSP or BSPT are available to suit the various sheath sizes for mounting Type 12 thermocouples. A selection of popular fittings is shown in section 7.



If required, thermocouple extension leads with PVC, PFA, fibreglass and optionally armoured or metal braided insulations are available from the very wide range of thermocouple cables offered by TC Ltd.

A wide range of end seal terminations are available within which the hermetic seal is effected.

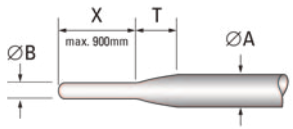
The thermocouple junction is arc welded in an inert atmosphere. The junction may be insulated from the sheath, grounded to it or may be exposed from the sheath depending upon the application.

The conductors are insulated from one another and the sheath by very tightly compacted magnesium oxide powder. With an insulated junction, the insulation resistance between the conductors and sheath is in excess of 100 MΩ.

Quality Control. All materials and assemblies are subject to rigorous quality checks during manufacture through to final test and inspection in accordance with our approval to ISO 9001 : 2008.

UKAS calibration is available as an additional service for our range of Mineral Insulated Thermocouple assemblies.

Swaged Reduced Tip



Swaged end reduced tip temperature sensors provide a unique fast response, high strength, low displacement, homogenous solution to many problematical temperature measurement applications. The technique combines the advantages of having a rugged large diameter metal sheath over most of its length with a low thermal mass, fast response, reduced diameter tip.

The length of the reduced tip (X) can be any length up to 900mm and virtually any diameter between 0.5mm and 5.2mm with the most popular sizes are shown in the table. Please contact us for other sizes.

	Approximate Transition Lengths ('T' mm) for given Ø 'A' mm						
ØB	**6.0mm**	**4.5mm**	**3.0mm**	**2.0mm**	**1.5mm**	**1.0mm**	**0.5mm**
6.0mm	–	–	–	–	–	–	–
4.5mm	6	–	–	–	–	–	–
3.0mm	12	6	–	–	–	–	–
2.0mm	16	10	4	–	–	–	–
1.5mm	18	12	6	2	–	–	–
1.0mm	20	14	8	4	2	–	–
0.5mm	–	–	–	6	4	2	–

Mineral Insulated Thermocouples Type 12

SECTION 1	Thermocouple Type	Temperature Range* (continuous)	(short term)
K	Nickel Chromium vs Nickel Aluminium	0 to +1100°C	-180 to +1350°C
T	Copper vs Constantan	-185 to +300°C	-250 to +400°C
J	Iron vs Constantan	+20 to +700°C	-180 to +750°C
N	Nicrosil vs Nisil	0 to +1100°C	-270 to +1300°C
E	Nickel Chromium vs Constantan	0 to +800°C	-40 to +900°C
R	Platinum - 13% Rhodium vs Platinum	0 to +1600°C	-50 to +1700°C
S	Platinum - 10% Rhodium vs Platinum	0 to +1550°C	-50 to +1750°C
B	Platinum - 30% Rhodium vs Platinum - 6% Rhodium	+100 to +1600°C	+100 to +1820°C

**Depending on sheath material.*

SECTION 2		Sheath Materials: Sheath Specifications	Operational Properties	Max. Temp.
Standard	321	**Grade 321 Stainless Steel** 18/8/1 Ni/Cr/Titanium Stabilised To BS EN 10088, Werkstoff No : 1.4541	Very good corrosion resistance throughout the operating temperature range. Suited to a wide range of industrial applications. Enjoys high ductility.	800°C
	316	**Grade 316 Stainless Steel** 18/8/1 Ni/Cr/Molybdenum Stabilised To BS EN 10088, Werkstoff No : 1.4401	Good high temperature corrosion resistance and suitable for use in sulphur bearing atmospheres. 316 stainless steel has high oxidation resistance.	800°C
	310	**Grade 310 Stainless Steel** 25/20 Nickel/Chromium To BS EN 10088, Werkstoff No : 1.4845	Good high temperature corrosion resistance and suitable for use in sulphur bearing atmospheres. 310 stainless steel has high oxidation resistance.	1100°C
	600	**Inconel 600*** Nickel/Chromium/Iron alloy To BS EN 10095, Werkstoff No : 2.4816	Used in severely corrosive atmospheres to elevated temperatures. Has good resistance to oxidation. Not recommended for use above 800°C when used with Type R, S or B thermocouples. Do not use in sulphur bearing atmospheres above 550°C.	1100°C
Specialized	800	**Incoloy 800*** Iron/Nickel/Chromium alloy To BS EN 10095, Werkstoff No : 1.4876	Suitable for use in severely corrosive atmospheres to elevated temperatures. Enjoys a good resistance to oxidation and carburisation. Incoloy 800 is resistant to sulphur bearing atmospheres.	1100°C
	825	**Incoloy 825*** Iron/Nickel/Chromium alloy To BS EN 10204, Werkstoff No : 2.4858	Iron/Nickel/Chromium alloy with additions of molybdenum, copper, and titanium. Exceptional resistance to many corrosive environments. Resistant to chloride-ion stress-corrosion cracking.	1250°C
	446	**AISI 446** Chrome/Iron ASTM TP446, AISI 446, To BS EN 10095, DIN X18CrN28, Werkstoff No : 1.4762	Suitable for use in severely corrosive atmospheres to elevated temperatures. Particularly suited for use in high concentration sulphur bearing atmospheres at high temperature. Sensor should be mounted vertically at temperatures above 700°C.	1150°C
	156	**Hastelloy X*** Nickel/Chromium/Iron/Molybdenum 51/22/18/9 Werkstoff No : 2.4665	For use in reducing, neutral and inert atmospheres. Has improved high temperature resistance to oxidation and attack by sulphur. At high temperature it has excellent tensile strength and develops a tightly adherent oxide film which does not spall.	1220°C
	276	**Hastelloy C276*** Nickel/Chromium/Iron/Molybdenum To ASTM B574, Werkstoff No : 2.4819	Excellent corrosion resistance to both oxidizing and reducing media and excellent resistance to localized corrosion attack. Excellent resistance to sulphur compounds and chloride ions.	1250°C
	114	**Nicrotherm D™** Nickel/Chromium/Silicon/Molybdenum 73/22/1.4/3	For high temperature Type 'K' and almost all Type 'N' applications (optimum benefits with Type 'N'). Very good high temperature strength. Excellent in oxidising, carburising, reducing and vacuum atmospheres. Do not use in sulphur containing atmospheres.	1250°C
	160	**Haynes HR160** Solid solution strengthened Nickel/Cobalt/Chromium-Silicon alloy ASTM B626, Werkstoff No : 2.4880	Resistant to various forms of high temperature corrosion attack. Excellent resistance to sulphur and chloride attack. Resistant to oxidation, hot corrosion, carburization, metal dusting, nitridation, and corrosion attack by low melting point compounds.	1200°C
	P10R	**Platinum 10% Rhodium**	Primarily for use with thermocouple types R, S and B. Suitable for high temperature oxidizing atmospheres and inert atmospheres.	1400°C

Other sheath materials are available upon request. * Trade Names

SECTION 3	Sheath Diameter (mm)	Sheath Diameter (inches)
Standard Sizes	0.25mm	0.010"
	0.5mm	0.020"
	0.75mm	0.030"
	1.0mm	0.039"
	1.5mm	0.059"
	1.6mm (1/16")	0.063"
	2.0mm	0.079"
	3.0mm	0.118"
	3.2mm (1/8")	0.125"
	4.5mm	0.177"
	5.5mm*	0.216"
	6.0mm	0.236"
	6.35mm (1/4")	0.250"
	8.0mm	0.315"
	9.5mm	0.374"
	10.8mm*	0.425"

For types R, S, B, C and D a more limited range of sheath diameters is available.
** 5.5mm and 10.8mm diameter are thick wall, heavy duty constructions.*

SECTION 4	Types of Sensing Junction	
2I		**Insulated** Hot junction insulated from sheath. Gives floating output with typical insulation resistance in excess of 100 megohms (or 2ID if Duplex element is required and 2IT if triplex element is required).
2G		**Grounded** Hot junction welded to sheath tip giving earthed output and faster response to temperature changes (or 2GD if Duplex element is required and 2GT if triplex element is required).
2X		**Exposed** Fastest response mainly for the measurement of air temperature in ducts. Restricted to a maximum operating temperature of 650°C (or 2XD if Duplex element is required and 2XT if Triplex element is required).

To suit particular attachment requirements thermocouples with measuring junction configurations 2I or 2G can be supplied with an extended tip or welding pad. (Contact the company for details of standard welding pad and extension tip configurations.)
Other special measuring junction configuration requirements can be met upon request.

Typical Response Times: Ømm	Time	Ømm	Time
0.25mm	0.015 seconds	3.2mm (1/8")	0.880 seconds
0.5mm	0.030 seconds	4.5mm	1.400 seconds
0.75mm	0.090 seconds	5.5mm*	4.000 seconds
1.0mm	0.150 seconds	6.0mm	3.000 seconds
1.5mm	0.300 seconds	6.35mm (1/4")	3.450 seconds
1.6mm (1/16")	0.320 seconds	8.0mm	5.500 seconds
2.0mm	0.400 seconds	9.5mm	6.750 seconds
3.0mm	0.800 seconds	10.8mm*	9.000 seconds

Response times for these assemblies are governed by and vary with the environmental conditions of particular applications. The information above refers to typical response times for assemblies with insulated Type 2I junctions being plunged into boiling water from air at 20°C. The figures refer to the times taken for the thermocouple junctions to achieve 63.2% of this instantaneous step change. For assemblies with grounded Type 2G junctions the response times are approximately 50% of those listed. ** thick wall*

Type 12 Mineral Insulated Thermocouples

SECTION 5

Types of End Seal Configuration

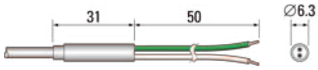
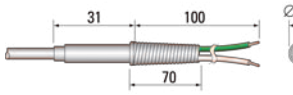
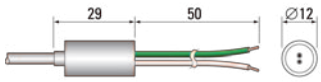
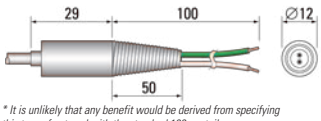
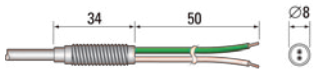
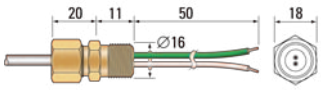
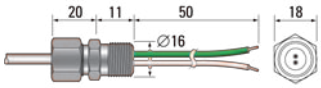
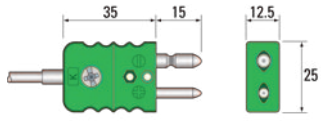
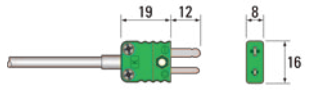
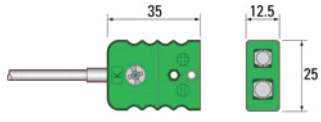
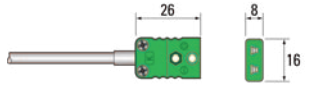
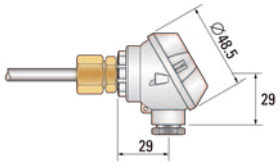
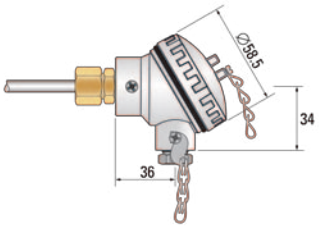
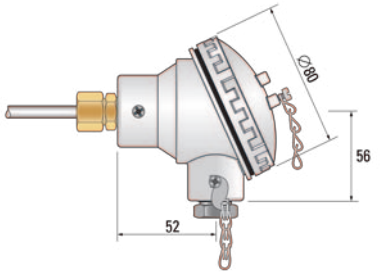
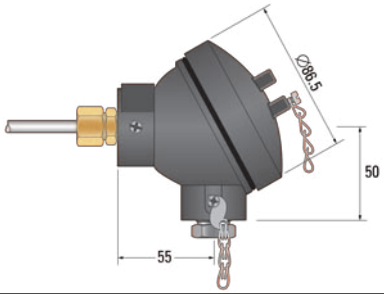
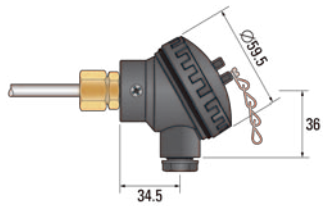
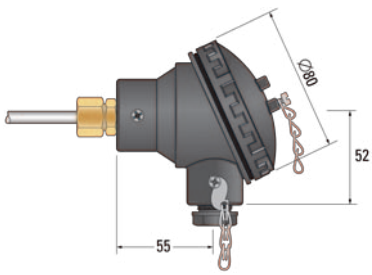
	Diagram	Specification
3P1		**Internal Seal with Bare Conductors** for all sheath diameters 3P1 Maximum end seal temperature **135**°C 3P1B Maximum end seal temperature **300**°C 3P1C Maximum end seal temperature **650**°C *Note: Only suitable as a temporary seal for applications adding an alternative seal later*
3P2L		**Crimp on Stainless Steel Pot Seal** for sheath diameters up to 3.0mm 3P2L Pot Seal rated to **135**°C 3P2LA Pot Seal rated to **235**°C 3P2LB Pot Seal rated to **300**°C *see section 6 if extension leads are required*
3P2 TRL	 ** It is unlikely that any benefit would be derived from specifying this type of pot seal with the standard 100mm tails.*	**Stainless Steel Pot Seal with Anti Chafe Spring** for sheath diameters up to 3.0mm 3P2TRL Pot Seal rated to **135**°C 3P2TRLA Pot Seal rated to **235**°C 3P2TRLB Pot Seal rated to **300**°C *see section 6 if extension leads are required*
3P4CL		**Crimp on Stainless Steel Pot Seal** for sheath diameters between 3.0mm & 8.0mm 3P4CL Pot Seal rated to **135**°C 3P4CLA Pot Seal rated to **235**°C 3P4CLB Pot Seal rated to **300**°C *see section 6 if extension leads are required*
3P4 CTRL	 ** It is unlikely that any benefit would be derived from specifying this type of pot seal with the standard 100mm tails.*	**Stainless Steel Pot Seal with Anti Chafe Spring** for sheath diameters between 3.0mm & 8.0mm 3P4CTRL Pot Seal rated to **135**°C 3P4CTRLA Pot Seal rated to **235**°C 3P4CTRLB Pot Seal rated to **300**°C *see section 6 if extension leads are required*
3P3L	 *Lock nuts are available in stainless steel to suit the 3P3L series and should be ordered separately as LN08S.*	**8mm ISO x 1mm Threaded Stainless Steel Pot Seal** for sheath diameters up to 3.0mm 3P3L Pot Seal rated to **135**°C 3P3LA Pot Seal rated to **235**°C 3P3LB Pot Seal rated to **300**°C *see section 6 if extension leads are required*
3P5		**16mm ISO x 1.5mm Brass Compression Gland Pot Seal** for sheath diameters 1.0mm to 8.0mm 3P5 Pot Seal rated to **135**°C 3P5A Pot Seal rated to **235**°C *see section 6 if extension leads are required*
3P5S		**16mm ISO x 1.5mm St. Steel Compression Gland Pot Seal** for sheath diameters 1.0mm to 8.0mm 3P5S Pot Seal rated to **135**°C 3P5SA Pot Seal rated to **235**°C 3P5SB Pot Seal rated to **300**°C *see section 6 if extension leads are required*
3P6	 *3P6 illustrated*	**Standard 2-pin (round) Plug** for sheath diameters between 1.0mm & 6.35mm 3P6 Plug rated to **220**°C 3P6H Plug rated to **300**°C 3P6UH Plug rated to **425**°C 3P6C Plug rated to **600**°C
3P6M	 *3P6M illustrated*	**Miniature 2-pin (flat) Plug** for sheath diameters between 0.25mm & 3.2mm 3P6M Plug rated to **220**°C 3P6MH Plug rated to **300**°C 3P6MUH Plug rated to **425**°C 3P6MC Plug rated to **600**°C
3P7	 *3P7 illustrated*	**Standard 2-pin (round) Socket** for sheath diameters between 1.0mm & 6.35mm 3P7 Socket rated to **220**°C 3P7H Socket rated to **300**°C 3P7UH Socket rated to **425**°C 3P7C Socket rated to **600**°C
3P7M	 *3P7M illustrated*	**Miniature 2-pin (flat) Socket** for sheath diameters between 0.25mm & 3.2mm 3P7M Socket rated to **220**°C 3P7MH Socket rated to **300**°C 3P7MUH Socket rated to **425**°C 3P7MC Socket rated to **600**°C

	Diagram	Specification
MAA		**Micro Die Cast Alloy Head** for diameters 3.0mm to 6.0mm Weatherproof die cast alloy, epoxy coated, screw down terminal head with tube entry and cable entry at a right angle to each other, with a ceramic terminal block. Suitable for simplex and duplex assemblies. Supplied with a 16mm x 1.5mm ISO metal pinch gland on the cable entry for cables from 4mm to 9.5mm diameter.
3P10		**Miniature Die Cast Alloy Head** for diameters 3.0mm to 8.0mm Weatherproof die cast alloy, epoxy coated, screw top terminal head with the tube entry and cable entry at a right angle to each other, with a ceramic terminal block. Suitable for simplex and duplex assemblies. Supplied with a 16mm x 1.5mm ISO metal pinch gland on the cable entry for cables from 3mm to 8mm diameter.
3P11		**Standard Die Cast Alloy Head** for diameters 4.5mm to 10.8mm Weatherproof die cast alloy, epoxy coated, screw top terminal head with the tube entry and cable entry at a right angle to each other, with a ceramic terminal block. Suitable for simplex, duplex and triplex assemblies. Supplied with a 20mm x 1.5mm ISO metal pinch gland on cable entry for cables from 6mm to 14mm diameter.
3P12		**Heavy Duty Cast Iron Head** for diameters 4.5mm to 10.8mm Weatherproof cast iron, screw top terminal head with the tube entry and cable entry at a right angle to each other, with ceramic terminal block. Suitable for simplex, duplex and triplex assemblies. Supplied with a 20mm x 1.5mm ISO metal pinch gland on cable entry for cables from 6mm to 14mm diameter.
3P16		**Miniature Plastic Head** for diameters 3.0mm to 8.0mm Weatherproof plastic, screw top terminal head with the tube entry and cable entry at a right angle to each other, with a plastic terminal block. Suitable for simplex and duplex assemblies. Supplied with a 16mm x 1.5mm ISO plastic pinch gland on cable entry for cables from 3mm to 8mm diameter.
3P17		**Standard Plastic Head** for diameters 4.5mm to 10.8mm Weatherproof plastic, screw top terminal head with the tube entry and cable entry at a right angle to each other, with a plastic terminal block. Suitable for simplex, duplex and triplex assemblies. Supplied complete with a 20mm x 1.5mm ISO plastic pinch gland on the cable entry for cables from 6mm to 14mm diameter.

continued

Mineral Insulated Thermocouples Type 12

SECTION 5 — Types of End Seal Configuration (continued)

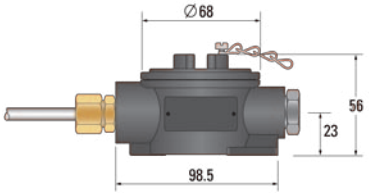
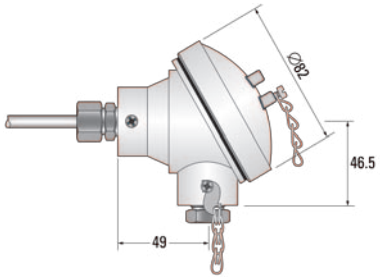
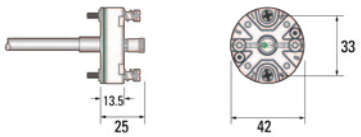
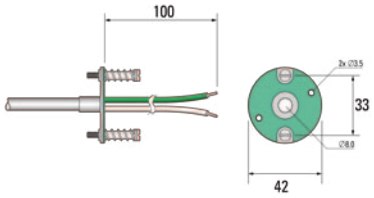
	Diagram	Specification
3P18		**Alloy Straight Through Head** for diameters 4.5mm to 10.8mm Die cast alloy straight through terminal head with a bakelite terminal block. Suitable for simplex or duplex assemblies. Supplied with a 20mm x 1.5mm pitch ISO pinch gland on the cable entry for cables from 6mm to 14mm diameter. **If supported at fixing holes, suitable for diameters of 1mm and above.*
3P19		**Stainless Steel Head** for diameters 4.5mm to 10.8mm Weatherproof stainless steel, screw top terminal head with the tube entry and cable entry at a right angle to each other, with a ceramic terminal block. Suitable for simplex, duplex and triplex assemblies. Supplied with a 20mm x 1.5mm ISO metal pinch gland on cable entry for cables from 6mm to 14mm diameter.

	Diagram	Specification
3P20		**Spring Loaded Terminal Block** for diameters 3.0mm to 8.0mm Spring loaded insert assemblies. The end seal is incorporated into a terminal block suitable for mounting into a 3P11, 3P12, 3P17 or any other standard terminal head. Suitable for use with 3mm, 4.5mm, 6mm and 8mm sheaths only. The ceramic terminal block has 2 x 33mm spaced mounting holes. Suitable for simplex, duplex and triplex assemblies.
3P20/ BP		**DIN Mounting Plate** for diameters 3.0mm to 8.0mm Spring loaded mounting plate assemblies. The end seal is incorporated into a mounting plate suitable for mounting into a 3P11, 3P12, 3P17 or any other standard terminal head. Suitable for use with 3mm, 4.5mm, 6mm and 8mm sheaths only. 100mm tails allows for connection to a head mounting transmitter or other suitable terminal block.

SECTION 6 — Extension Cables

	Diagram	Specification
A30		**HR PVC Flat Twin (105°C)** One pair of 7/0.2mm stranded conductors HR PVC insulated. Pair laid flat and HR PVC sheathed overall.
A27		**HR PVC Twisted Pair with Screen (105°C)** One pair of 7/0.2mm stranded conductors HR PVC insulated. Pair twisted, screened with Mylar® aluminium tape and drain wire. HR PVC sheathed overall.
B50		**PFA Flat Twin (250°C)** One pair of 7/0.2mm stranded conductors PFA insulated. Pair laid flat. PFA sheathed overall.
BM 0702		**PFA 2-pair for duplex sensors (250°C)** Two pairs of 7/0.2mm dia stranded conductors PFA insulated. Pairs twisted and bunched and screened with Mylar® aluminium tape with a drainwire. PFA sheathed.
BM 0702/ SSB		**PFA 2-pair for duplex sensors with Stainless Steel braid (250°C)** Two pairs of 7/0.2mm stranded conductors PFA insulated. Pairs twisted and bunched and screened with Mylar® aluminium tape with a drainwire. PFA sheathed with overall stainless steel braid.

	Diagram	Specification
B80		**PFA Twisted Pair with Screen (250°C)** One pair of stranded conductors PFA insulated. Pair twisted, screened with Mylar® aluminium tape and drain wire. PFA sheathed overall.
B40		**PFA Twisted with Ni Plated Cu Braid (250°C)** One pair of 7/0.2mm stranded conductors PFA insulated. Pair twisted with overall nickel plated copper braid and PFA sheathed.
SR30		**Silicone Rubber, Twisted Pair (200°C)** One pair of 7/0.2mm stranded conductors PFA insulated. Silicone rubber sheathed.
C40		**Fibreglass Flat Twin (480°C)** One pair of 7/0.2mm stranded conductors double glass fibre lapped, braided and varnished. Pair laid flat, glass fibre braided and varnished.
C60		**Fibreglass Flat Twin with Steel Braid (480°C)** One pair of 7/0.2mm stranded conductors double glass fibre lapped, braided and varnished. Pair laid flat, glass fibre braided and varnished. Stainless steel wire braided overall.

If no cable is required, leave this section of the order code blank and the sensor will be supplied with PFA tails. Other cables are available on request.

'HR' = Heat Resistant

SECTION 7 — Optional Stainless Steel Compression Fittings

Dia.	1/8" BSPT	1/4" BSPT	1/2" BSPT	Dia.	1/8" BSPT	1/4" BSPT	1/2" BSPT
0.5mm	SFS18T05	–	–	3.0mm	SFS18T30	SFS14T30	SFS12T30
0.75mm	SFS18T75	–	–	4.5mm	SFS18T45	SFS14T45	SFS12T45
1.0mm	SFS18T10	SFS14T10	SFS12T10	6.0mm	SFS18T60	SFS14T60	SFS12T60
1.5mm	SFS18T15	SFS14T15	SFS12T15	8.0mm	–	SFS14T80	SFS12T80

Other sizes and materials are available, please contact us for details.

SECTION 8 — Optional 4 to 20mA Head Mounted Transmitter (please specify range in °C)

TXLTC

Fully Linearised

Suitable for use with the following terminal heads: **3P11, 3P12, 3P17, 3P18** and **3P19** and other standard heads with 33mm fixing.

Typical Order Code: **TXLTC (0/200°C)**

Order Code - Example

Style No.	Thermocouple Type (see section 1)	Sheath Length	Sheath Material (see section 2)	Sheath Diameter (see section 3)	Sensing Junction (see section 4)	End Seal Termination (see section 5)	Extension Cable (see section 6)	Optional Compression Fitting (see section 7)	Reduced Tip Dimensions (if required)	Optional Transmitter (see section 8)
12	K	450	310	6.0	2I	3P4CL	2 MTRS A30KX	SFS18T30	REDUCED TIP: 3.0mm x 50mm LONG	

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Issue Number: 0319

TC Ltd for Temperature Sensing, Measurement and Control