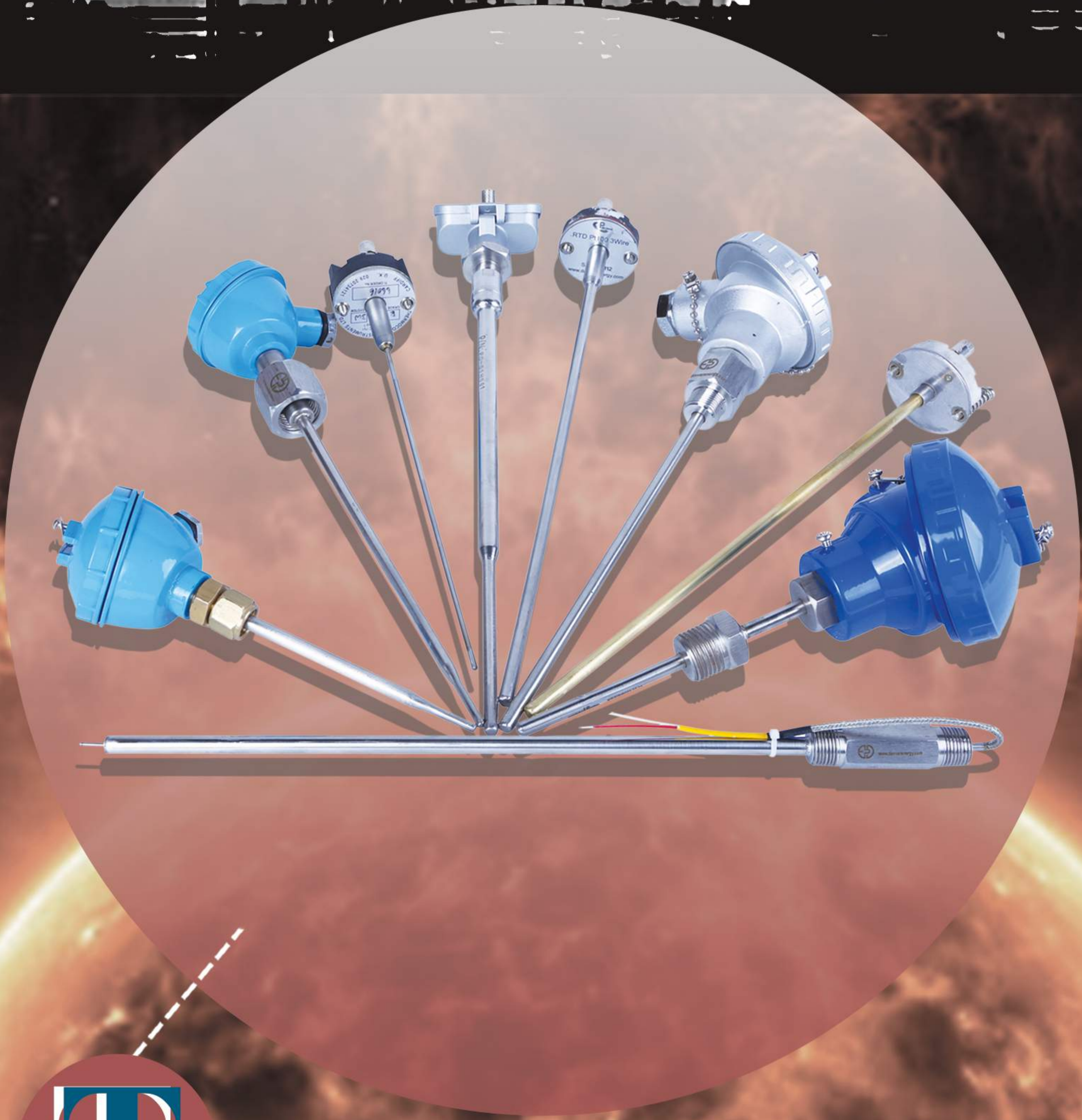
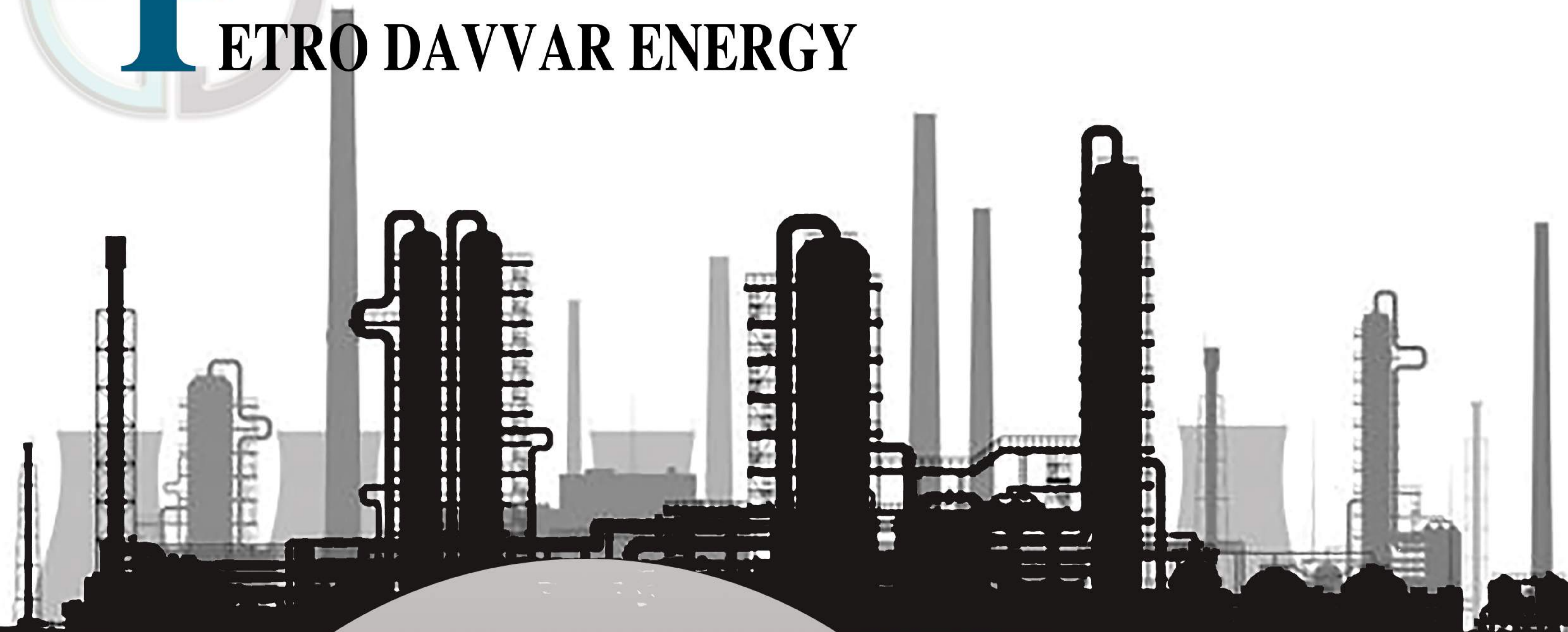




ETRO DAVVAR ENERGY



Thermocouple

Rev E
2021/09/05



If there is a will, there is a way...

Thermocouple

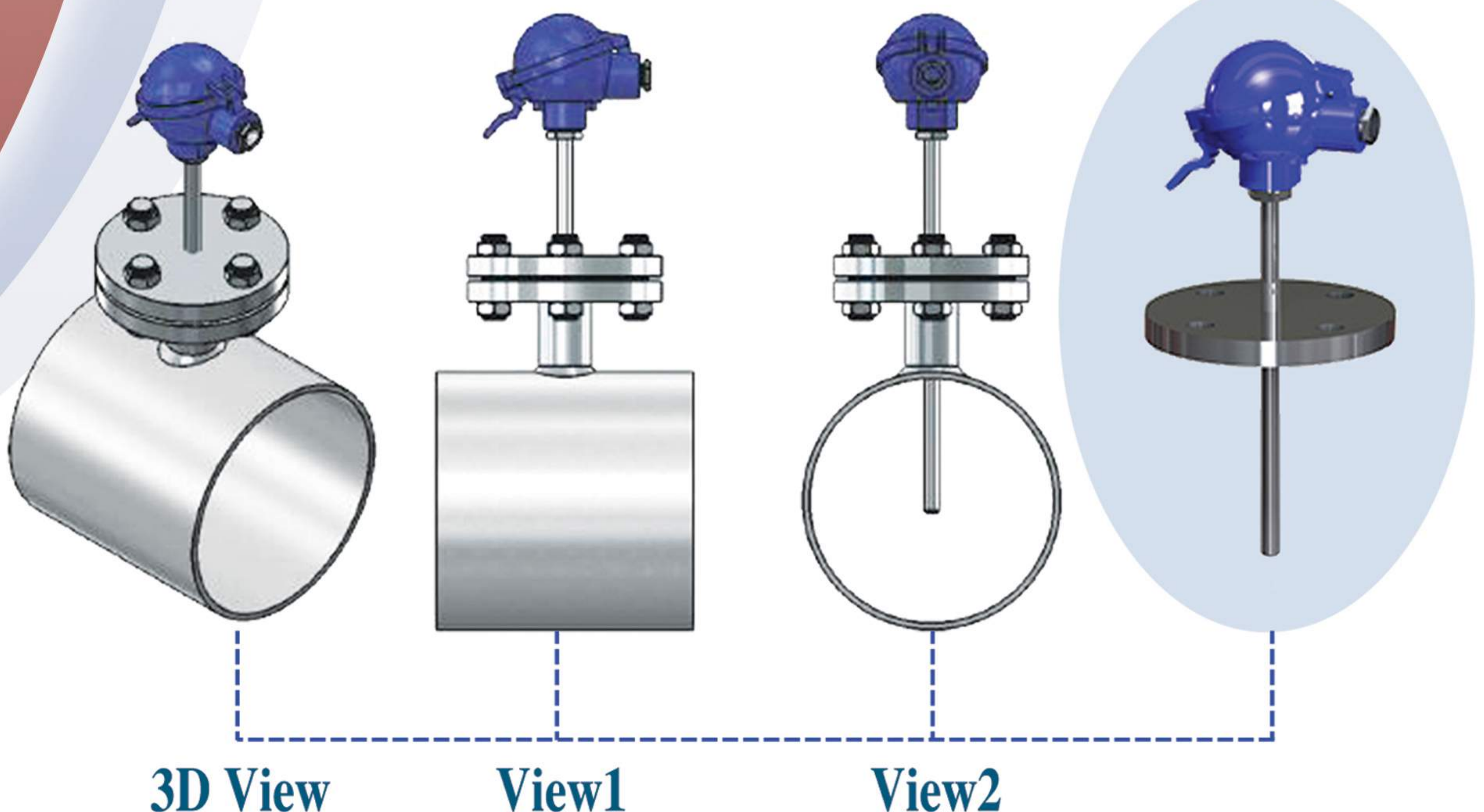
Introduction To Thermocouple

Temperature is one of the most measured of the physical quantities, so measuring it correctly is important. If there is temperature gradient in an electrical conductor, the energy (heat) flow is associated with an electron flow along the conductor, and an electromotive force (emf) is then generated in that region. Both the size and direction of the emf are dependent on the size and direction of the temperature gradient itself – and on the material forming the conductor. The voltage is a function of the temperature difference along the conductor length. For the historians among you, this effect was discovered by TJ seebeck in 1822. The output voltage of a single conductor, as shown, is not, however, normally measurable since the sum of the internal emfs around a completed circuit in any temperature situation is zero. So, in a practical thermocouple temperature sensor, the trick is to join two materials having different thermoelectric emf/ temperature characteristics in order to produce a usable net electron flow and a detectable net output voltage. Thus, two connected dissimilar conductors, a and b, are exposed to the same temperature gradients. basically, there is a net electron flow across the junction caused by the different thermoelectric emfs, in turn resulting from the interaction of the gradient with the two different conductors.



Thermocouple Types

Many combinations of materials have been used to produce acceptable thermocouples, each with its own particular application spectrum. However, the value of interchangeability and the economics of mass production have led to standardisation, with a few specific types now being easily available, and covering by far the majority of the temperature and environmental applications.



Style T1

Ceramic Insulated Thermocouple Element

These are suitable for general use and as replacement elements for industrial and high temperature thermocouples. Type 1 assemblies are available for thermocouple conductor combination codes K, T, J, N with insulators in Alumina. The length of insulators is 25mm, 50 mm or 100mm depending on the application and availability. Insulators with 4 bores are available for duplex applications, please consult us for further details.



Style No	Thermocouple Type (Table 1)	Number of wire (Table 2)	Sheath Material (Table 3)	Sheath Diameter (mm)	Length (mm)	Junction (Table 6)
----------	--------------------------------	-----------------------------	------------------------------	-------------------------	----------------	-----------------------

T1

How to Order

Sample: T1 -K-2Wires-304-6mm-500mm-UG

Style T2

Thermocouple without End Seal



Style No	Thermocouple Type (Table 1)	Number of wire (Table 2)	Sheath Material (Table 3)	Sheath Diameter (mm)	Length L1 (mm)	Length L2 (mm)	Lead Wire (Table 5)	Junction (Table 6)
----------	--------------------------------	-----------------------------	------------------------------	-------------------------	-------------------	-------------------	------------------------	-----------------------

T2

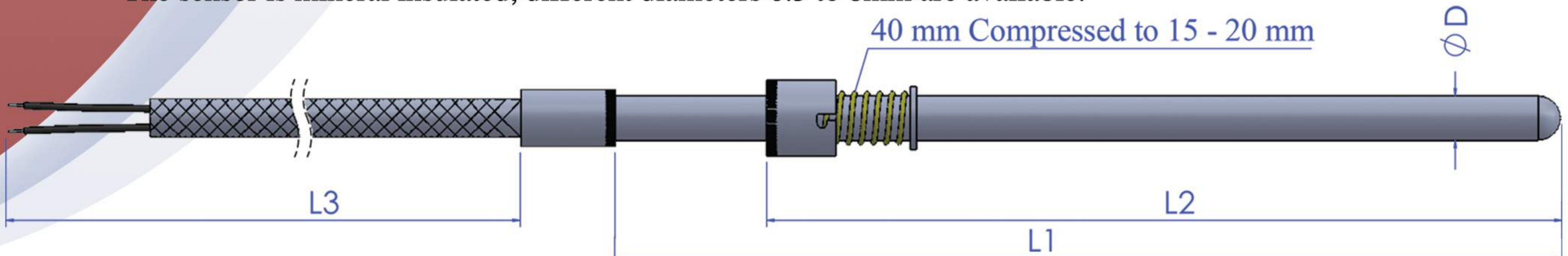
How to Order

Sample: T2 -E-2Wires-304-6mm-500mm-300mm-02-UG

Style T3

Bayonet Thermocouple

Suitable for different industries, these assemblies are available in thermocouple conductor combination codes K, T, J, N with an industry standard one slot adjustable bayonet cap fitting. The fitting can be finely tuned for positioning on site and is suitable where several applications in your plant require individual positioning of the assembly. The sensor is mineral insulated, different diameters 0.5 to 8mm are available.



Style No	Thermocouple Type (Table 1)	Number of wire (Table 2)	Sheath Material (Table 3)	Sheath Diameter D (mm)	Length L1 (mm)	Length L2 (mm)	Length L3 (mm)	Lead Wire (Table 5)	Junction (Table 6)
----------	--------------------------------	-----------------------------	------------------------------	---------------------------	-------------------	-------------------	-------------------	------------------------	-----------------------

T3

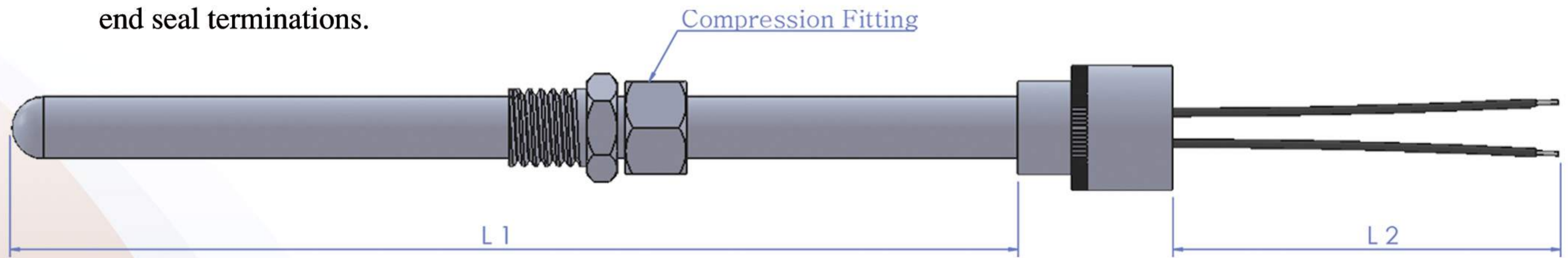
How to Order

Sample: T3 -K-4Wires-304-8mm-400mm-300mm-1200mm-06-UG

Style T4

Mineral Insulated Metal Sheathed Thermocouple

The most popular type of available thermocouples, they have a wide temperature operating range, can be bent, twisted or flattened without impairing performance and are available in a wide variety of sheath materials, diameters and end seal terminations.



Style No	Thermocouple Type (Table 1)	Number of wire (Table 2)	Sheath Material (Table3)	Sheath Diameter (mm)	Length L1 (mm)	Length L2 (mm)	Lead Wire (Table5)	Junction (Table6)
----------	-----------------------------	--------------------------	--------------------------	----------------------	----------------	----------------	--------------------	-------------------

T4

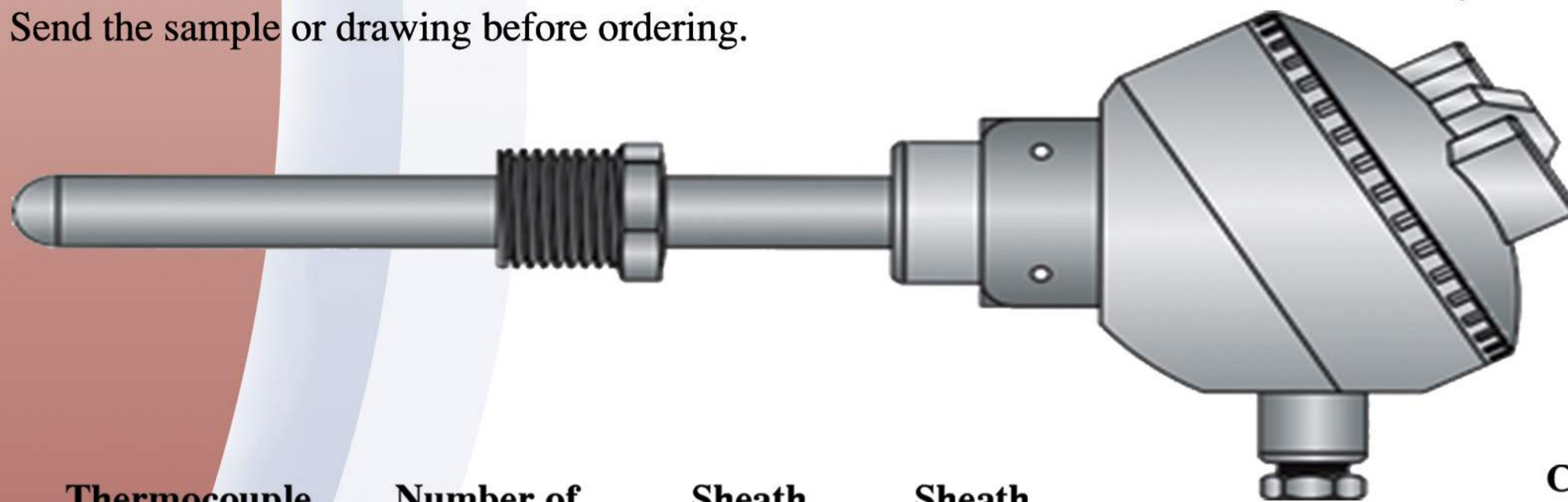
How to Order

Sample: T4 -K-4Wires-304-8mm-400mm-300mm-05-UG

Style T5

Heavy Duty Metal Sheathed Thermocouple

These assemblies are suited for use in different industrial environment such as oil and gas industries and furnaces. Send the sample or drawing before ordering.



Style No	Thermocouple Type (Table 1)	Number of wire (Table 2)	Sheath Material (Table3)	Sheath Diameter (mm)	Length (mm)	Junction (Table 6)	Compression Fitting or Nut Nipple Size (Table 7)
----------	-----------------------------	--------------------------	--------------------------	----------------------	-------------	--------------------	--

T5

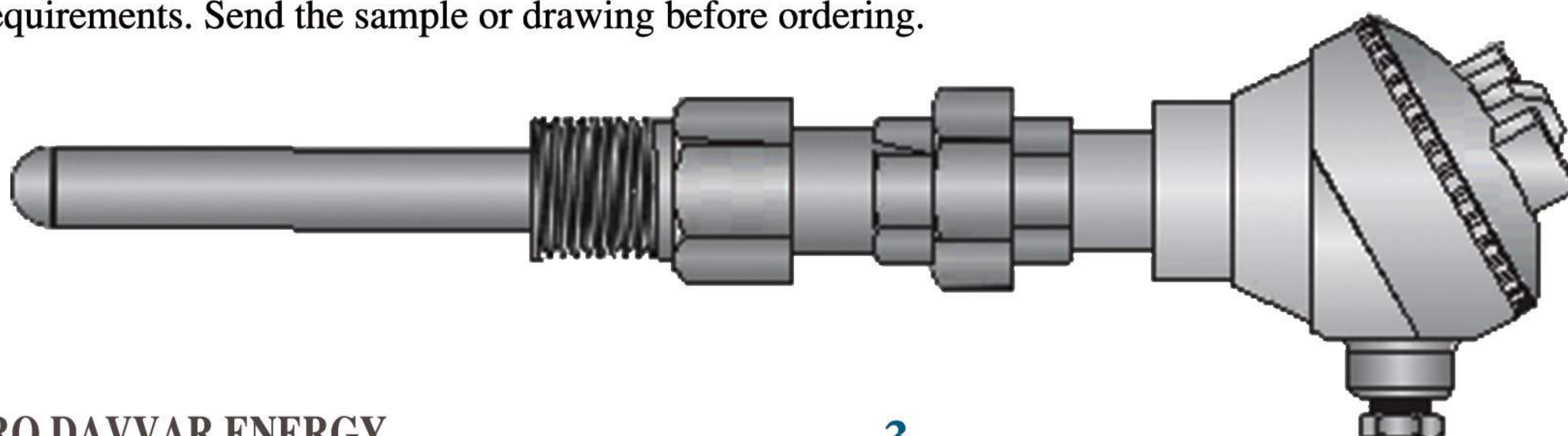
How to Order

Sample: T5 -J-4Wires-304-8mm-300mm-UG-M8

Style T6

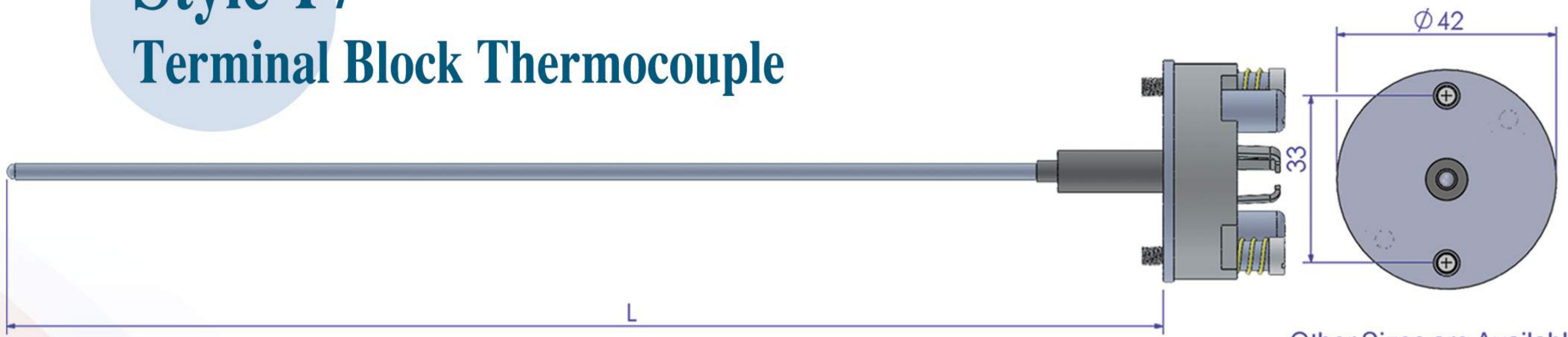
Thermocouple, Thermowell, Extension Piece & Terminal Head Assemblies

These thermocouples are available in a wide range of dimensions and materials, custom assembled to your exact requirements. Send the sample or drawing before ordering.



Style T7

Terminal Block Thermocouple



Other Sizes are Available

Style No	Thermocouple Type (Table 1)	Number of wire (Table 2)	Sheath Material (Table3)	Sheath Diameter (mm)	Length L (mm)	Junction (Table 6)
----------	-----------------------------	--------------------------	--------------------------	----------------------	---------------	--------------------

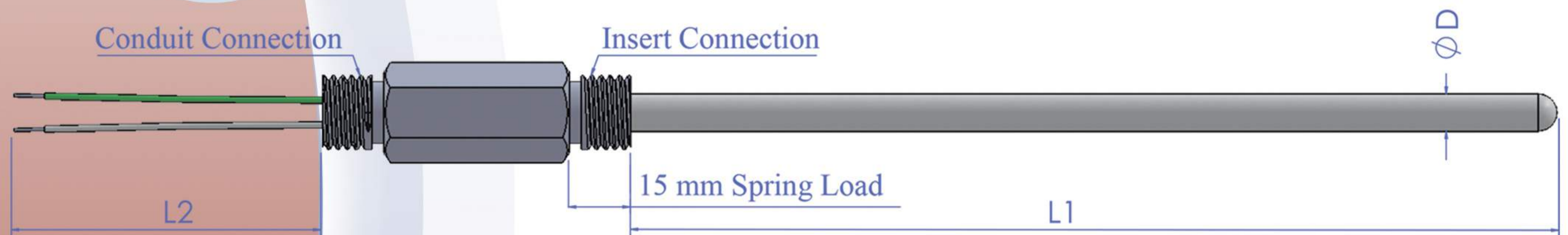
T7

How to Order

Sample: T7 -K-4Wires-304-5mm-110mm-UG

Style T8

Spring Load Thermocouple



Style NO	Thermocouple Type (Table 1)	Number of wire (Table 2)	Sheath Material (Table3)	Sheath Diameter (mm)	L ₁ (mm)	L ₂ (mm)	Conduit Connection Thread	Insert Connection Thread	Lead Wire (Table5)	Junctio (Table 6)
----------	-----------------------------	--------------------------	--------------------------	----------------------	---------------------	---------------------	---------------------------	--------------------------	--------------------	-------------------

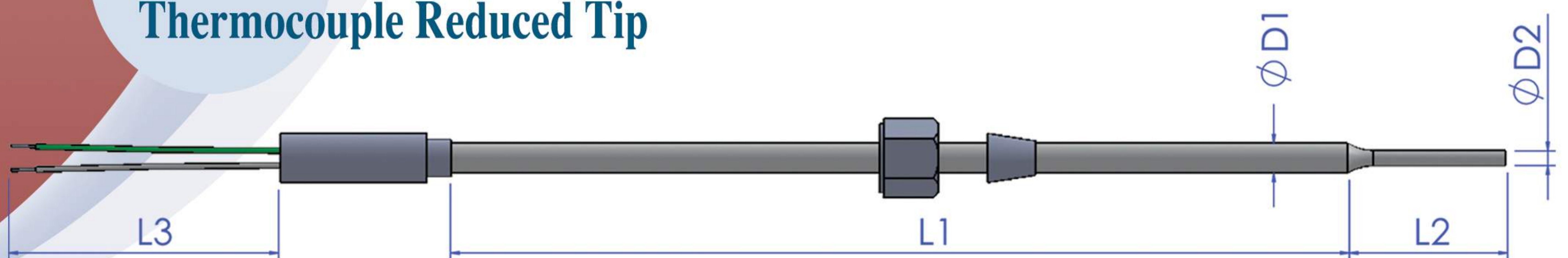
T8

How to Order

Sample: T8 -K-4Wires-304-8mm-400mm-150mm-M20 x 1.5-1/2" NPT-04-UG

Style T9

Thermocouple Reduced Tip



Style No	Thermocouple Type (Table 1)	Number of wire (Table 2)	Sheath Material (Table3)	Sheath Diameter D1	Sheath Diameter D2	L ₁ (mm)	L ₂ (mm)	End Seal	Wire Length L ₃ (mm)	Lead Wire (Table5)	Junction (Table6)	Compression Fitting or Nut Nipple (Table7)
----------	-----------------------------	--------------------------	--------------------------	--------------------	--------------------	---------------------	---------------------	----------	---------------------------------	--------------------	-------------------	--

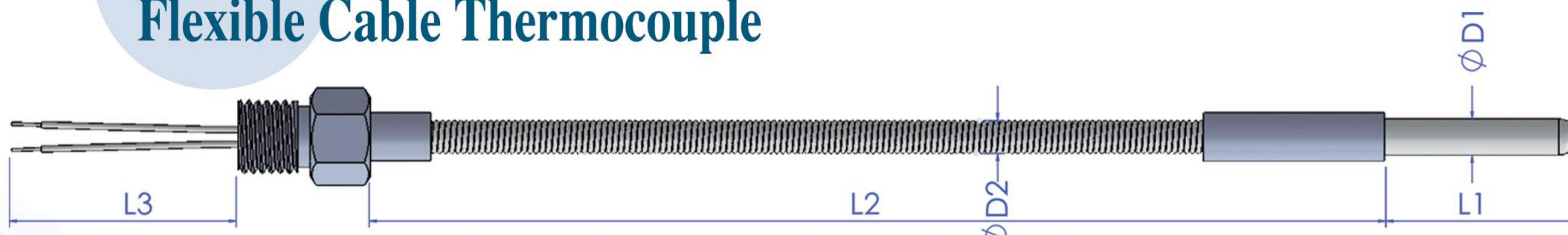
T9

How to Order

Sample: T9 -K-2Wires-304-6mm-3mm-120mm-25mm-P2 -50mm-04-UG-02

Style T10

Flexible Cable Thermocouple



Style No	Thermocouple Type (Table 1)	Number of wire (Table 2)	Sheath Material (Table3)	Sheath Diameter D1 (mm)	Probe Length L1 (mm)	Flexible Diameter (mm)	Flexible Length L2 (mm)	Connection Size	Cable Length L3 (mm)	Lead Wire (Table5)	Junction (Table 6)
----------	-----------------------------	--------------------------	--------------------------	-------------------------	----------------------	------------------------	-------------------------	-----------------	----------------------	--------------------	--------------------

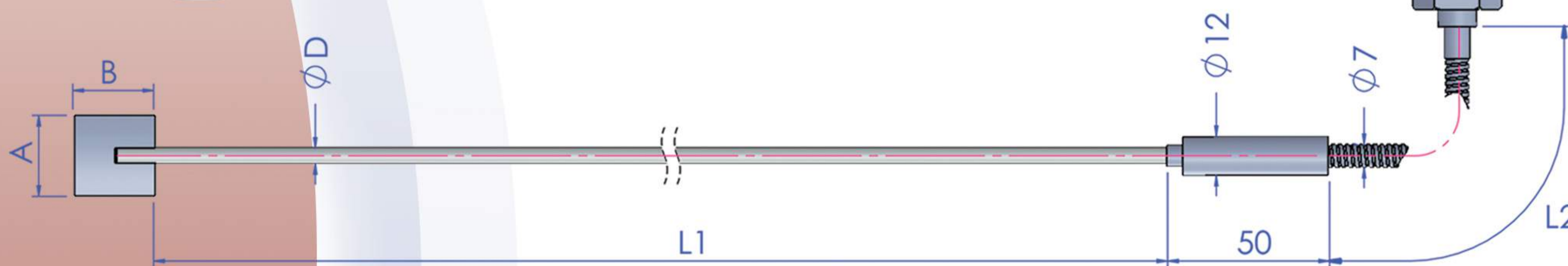
T10

How to Order

Sample: T10 -K-2Wires-304-8mm-35mm-6mm-1100mm-1/2" BSPP-150mm-UG

Style T11

Skin Thermocouple



Style No	Thermocouple Type (Table 1)	Number of Cable (Table 2)	Sheath Material (Table3)	Sheath Diameter D (mm)	Probe Length L1 (mm)	Flexible Length L2 (mm)	Plate Size (mm) (A x B x T*)	Junction (Table 6)
----------	-----------------------------	----------------------------	--------------------------	------------------------	----------------------	-------------------------	------------------------------	--------------------

T11

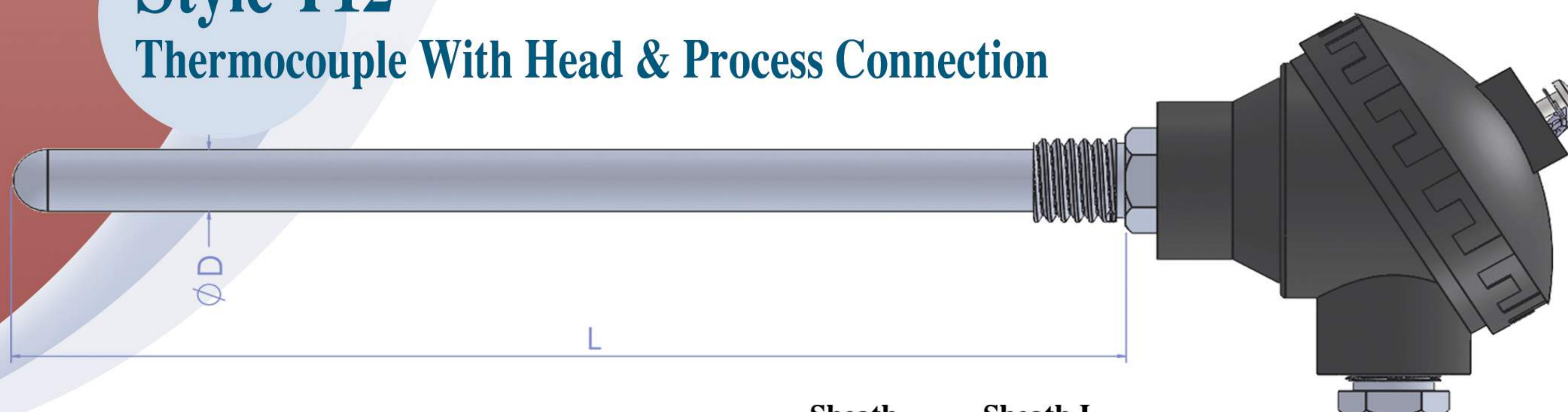
How to Order

Sample: T11 -K-2Wires-304-8mm-1000mm-2000mm-1100mm-25 x 25 x 3 -UG

Note *: T is the Thickness of the Plate

Style T12

Thermocouple With Head & Process Connection



Style No	Thermocouple Type (Table 1)	Number of Wire (Table 2)	Sheath Material (Table3)	Sheath Diameter D (mm)	Sheath Length L (mm)	Junction (Table 6)	Process Connection (Table 7)
----------	-----------------------------	--------------------------	--------------------------	------------------------	----------------------	--------------------	------------------------------

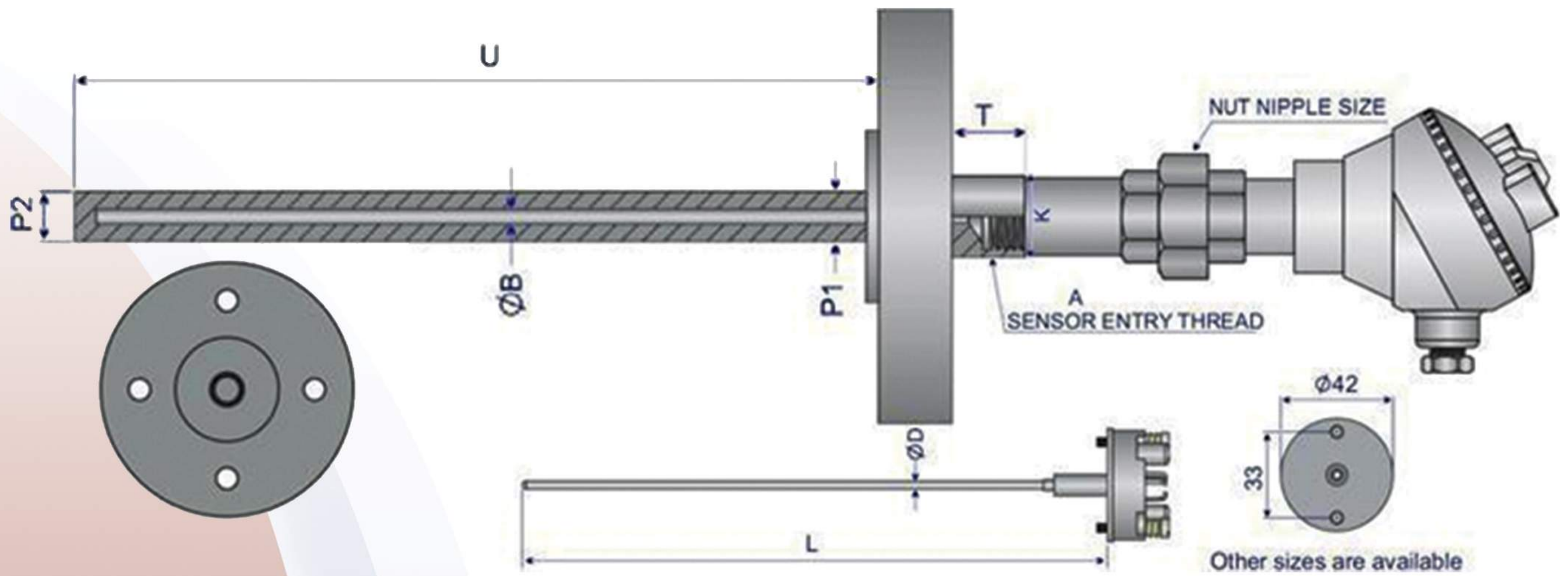
T12

How to Order?

Sample: T12 -K-2Wires-304-6mm-1100mm-UG-1/2 NPT

Style T13

Thermocouple With Flanged Thermowell



Thermocouple Style No	Thermocouple Type (Table 1)	Number of wire (Table 2)	Sheath Material (Table 3)		Sheath Diameter D (mm)	Sheath Length L (mm)	Junction (Table 6)	Compression Fitting or Nut Nipple (Table 7)	
T13									
Thermowell Cap	Flange size & class	Shea Material (Table 3)	Sensor Entry Thread (A)	Insertion Length (U)	Thermowell Bore diameter (B)	Hex Length (T)	Hex diameter (K)	Root diameter (P1)	Tip diameter (P2)
.....									

How to Order?

Sample: T13 -K-2Wires-316-6mm-900mm-UG-1/2 NPT

S-2"#150 RF-321-1/2 NPT-500mm-6mm-22mm-32mm-25mm-19mm

Thermocouple Wires

These thermocouples are made to conform to an emf/ temperature relationship specified in the form of tabulated values of emfs resolved normally to 1 μ V against temperature in 1°C intervals, and vice versa. Internationally, these reference tables are published as IEC 60584.1 (BS EN 60584.1). It is worth noting here, however, that the standards do not address the construction, or insulation of the cables themselves or other performance criteria. With the diversity to be found, manufacturers own standards must be relied upon in this respect. As a brief summary, thermocouple temperature ranges and material combinations are given in table 1.

Thermocouple grade wire is used in construction of a thermocouple temperature sensor. Thermocouple extension wire is used to carry the signal from the thermocouple sensor to the readout device while maintaining a high degree of accuracy. The extension wire material must match the material used in the positive and negative leg of the thermocouple type (e.g. type K) being used in the application. If a transmitter is installed within the thermocouple sensor assembly, copper wire is typically used in place of thermocouple extension wire to send the scalable (4 to 20) mA signal back to the process control equipment.


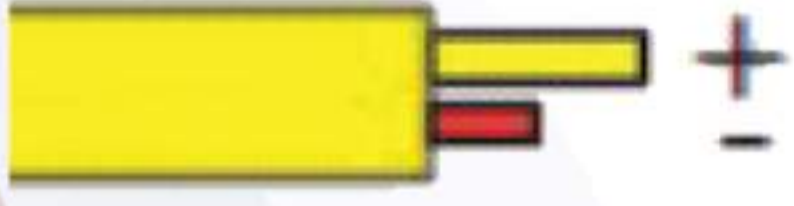
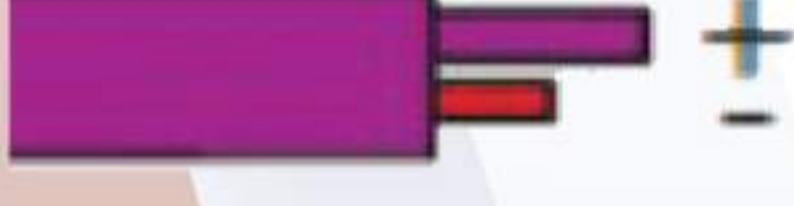



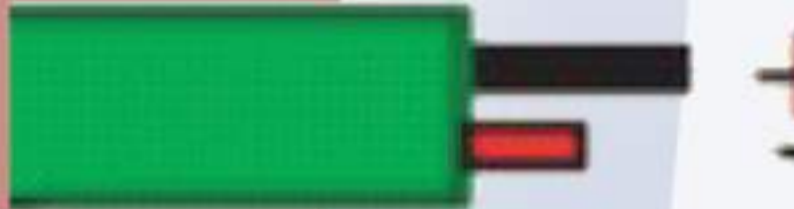

THERMO- COUPLE TYPE	U.S. & CANADIAN (ANSI/MC96.1, ANSI/ASTM E230)		International IEC 584-3	Czech British BS 1843	Netherlands German DIN 43710	Working Temperature CONTINUOUS °C	Tolerance for Class 1
	ALLOY COMBINATION	THERMOCOUPLE GRADE					
T	Copper	Brown Blue + Red -	Blue Blue + Red -	Brown Brown + White -	Blue White + Blue -	-185 to +300	-40°C to +125°C $\pm 0.5^\circ\text{C}$ 125°C to 350°C $\pm 0.004 \cdot t $
	Constantan (Copper-Nickel)						
J	Iron (magnetic)	Brown White + Red -	White Black + Red -	Black Black + White -	Black Yellow + Blue -	+20 to +700	-40°C to +375°C $\pm 1.5^\circ\text{C}$ 375°C to 750°C $\pm 0.004 \cdot t $
	Constantan (Copper-Nickel)						
E	Nickel - Chromium	Brown Purple + Red -	Purple Purple + Red -	Purple Purple + White -	Brown Brown + Blue -	0 to +800	-40°C to +375°C $\pm 1.5^\circ\text{C}$ 375°C to 800°C $\pm 0.004 \cdot t $
	Constantan (Copper-Nickel)						
K	Nickel - Chromium	Brown Yellow + Red -	Yellow Yellow + Red -	Green Green + White -	Red Brown + Blue -	0 to +1100	-40°C to +375°C $\pm 1.5^\circ\text{C}$ 375°C to 1000°C $\pm 0.004 \cdot t $
	Nickel - Aluminium (magnetic)						
N	Nicrosil (Nickel-Chromium-Silicon)	Brown Orange + Red -	Orange Orange + Red -	Pink Pink + White -	Orange Orange + Blue -	0 to +1150	-40°C to +375°C $\pm 1.5^\circ\text{C}$ 375°C to 1000°C $\pm 0.004 \cdot t $
	Nisil (Nickel-Silicon-Magnesium)						
S	Platinum Rhodium - 10%	None Established	Black Green + Red -	Orange Orange + White -	Green White + Blue -	0 to +1550	0°C to +1100°C $\pm 1.0^\circ\text{C}$ 1100°C to 1600°C $\pm (1+0.003 \cdot t)^\circ\text{C}$
	Platinum						
R	Platinum Rhodium - 13%	None Established	Black Green + Red -	Orange Orange + White -	Green White + Blue -	0 to +1600	0°C to +1100°C $\pm 1.0^\circ\text{C}$ 1100°C to 1600°C $\pm (1+0.003 \cdot t)^\circ\text{C}$
	Platinum						

Table 1: Guide To Thermocouple

2 Wires	4 Wires	6 Wires
Single	Duplex	Triplex

Table 2: Number of Thermocouple Wire

Thermocouple Wires

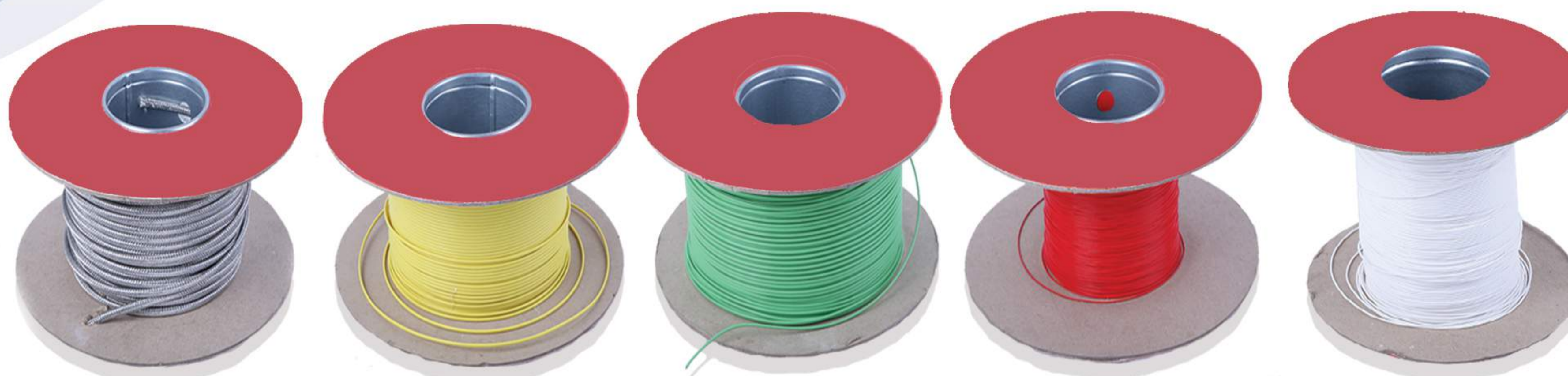
ANSI Code	ANSI Color Code	Positive (+) Leads	Negative (-) Leads	Temperature Range	Initial Calibration Tolerances	
					Standard	Special
JX		Iron	Constantan (45% Nickel, 55 % Cupper)	0~200°C	±2.2°C	±1.1°C
KX		Chromel (90%Nickel, 10%Chromium)	Alumel (95% Nickel, 2% Aluminum, 2% Manganese, 1% Silicone)	0~200°C	±2.2°C	±1.1°C
EX		Chromel (90%Nickel, 10%Chromium)	Constantan (45% Nickel, 55 % Cupper)	0~200°C	±1.7°C	±1.1°C
TX		Copper	Constantan (45% Nickel, 55 % Cupper)	0~100°C	±1.0°C	±0.5°C
NX		Nicrosil (84.6% Nickel, 4% Chromium, 1.4% Silicone)	Nisil (95.6% Nickel, 4.4% Silicone)	0~200°C	±2.2°C	±1.1°C
RX		Copper	Copper Alloy	0~200°C	±5.0°C	N/A
SX		Copper	Copper Alloy	0~200°C	±5.0°C	N/A
BX _t		Copper	Copper	0~100°C	±3.7°C	N/A

How to Order









Sample: THEC-KX-2 Wire-, 2 Wire, PTFE/PTFE Cable

Table 1.1: Type of Thermocouple Cable

THEC	Type of Thermocouple Cable (Table 1 & 1.1)	Number of Wire (Table 2)	Lead Wire Material (Table 3)
------	---	-----------------------------	---------------------------------



Thermocouple Wires

01	PVC/PVC Cable		PVC Sheathed Wire With PVC Jacket rated to 105 °C
02	PTFE/PTFE Cable		PTFE Sheathed Cable With PTFE Jacket rated to 250 °C
03	PTFE/Armor PTFE Cable		PTFE Sheathed Cable With Armor PTFE Jacket rated to 250 °C
04	PTFE/Armor Fiberglass Cable		PTFE Sheathed Wire With Overall Fiber Armor Jacket rated to 250 °C
05	Fiberglass/Fiberglass Cable		Fiberglass Sheathed Wire With Overall Fiber Jacket rated to 480 °C
06	Fiberglass/Armor Fiberglass Cable		Fiberglass Sheathed Wire With Overall Fiber Armor Jacket rated to 480 °C
07	Kapton/Kapton Cable		Kapton Sheathed Wire With Overall Kapton Jacket rated to 300 °C
08	Silicone Sheathed		Silicone Rubber Insulated up to 200 °C

Note 1: Standard AWG Size for Thermocouple Wire: AWG20 (2×7/0.3) (IF Not Please Specify)

Note 2: for Type of Thermocouple, type of Cable we have are KX, TX, JX, NX, EX.

Table 5 : Thermocouple Wires

Thermocouple Sheath Material

Code	Material Specifications	Operational Properties	Max. Temp.
304	Grade 304 Stainless Steel WN : 1.4304	Good Corrosion Resistance about Water	700 °C
321	Grade 321 Stainless Steel WN : 1.4321	Heat Resisting	900 °C
316 L	Grade 316L Stainless Steel WN : 1.4404	Very good corrosion resistance high ductility.	800 °C
310	Grade 310 Stainless Steel WN : 1.4845	Good high temperature corrosion resistance and suitable for use in Sulphur bearing atmospheres. High oxidation resistance.	1100 °C
600	Inconel 600 WN : 2.4816	Used in severely corrosive atmospheres to elevated temperatures. Good resistance to oxidation.	1100 °C
800	Incoloy 800 Iron/Nickel/Chromium alloy WN: 1.4876	Used in severely corrosive atmospheres to elevated temperatures. Good resistance to oxidation and carburisation. Resistant to Sulphur bearing atmospheres.	1100 °C
825	Incoloy 825 WN: 2.4858	Highly resistant to corrosion and oxidising conditions. useful when used In acidic environments.	1250 °C
900	Ceramic Alumina 99% (ker 710)	Highly resistant to high temperature	1400°C
950	Silicon Carbide	Good resistant to temperatures and higher chemical corrosion resistance than ceramic	1600°C

Table3 : Sheath Materials Description

Types of Thermocouple End Seal Configuration

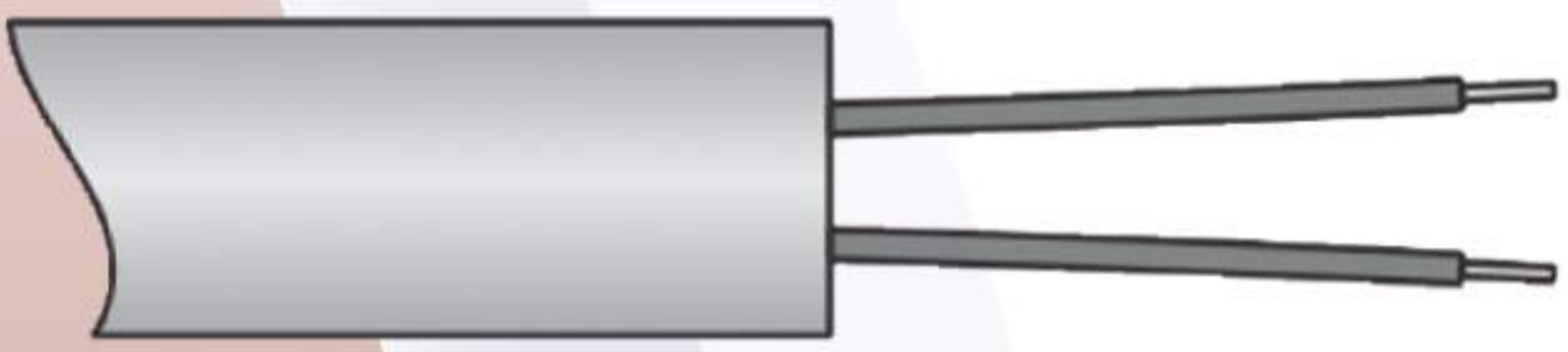
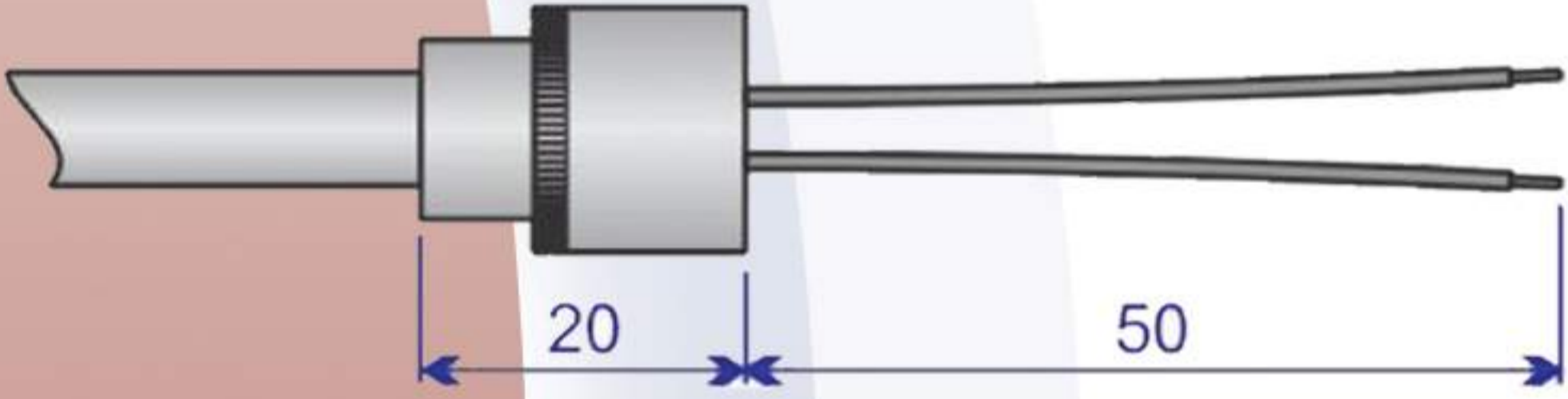
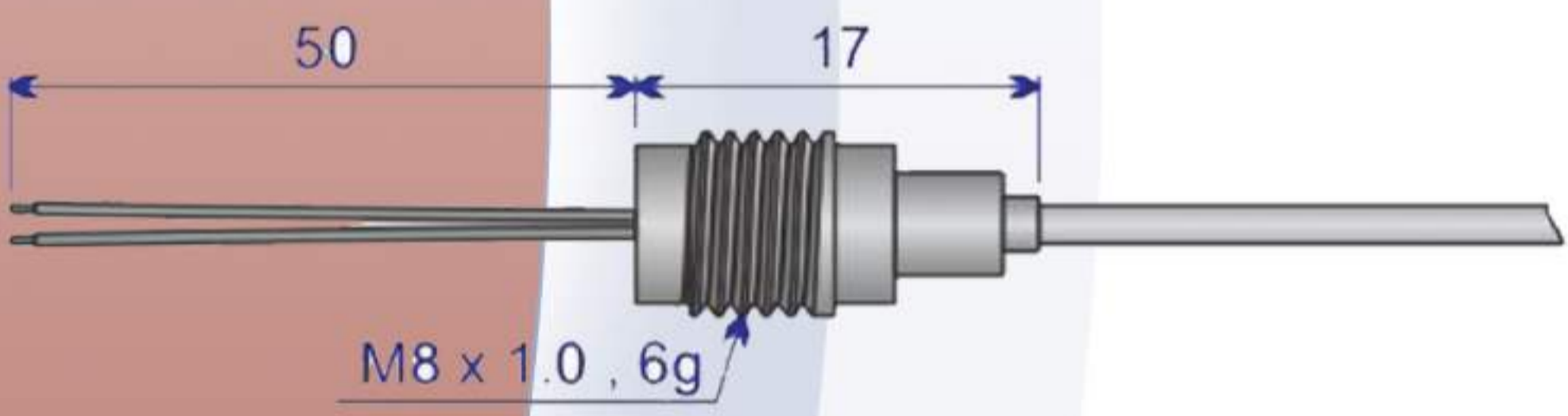
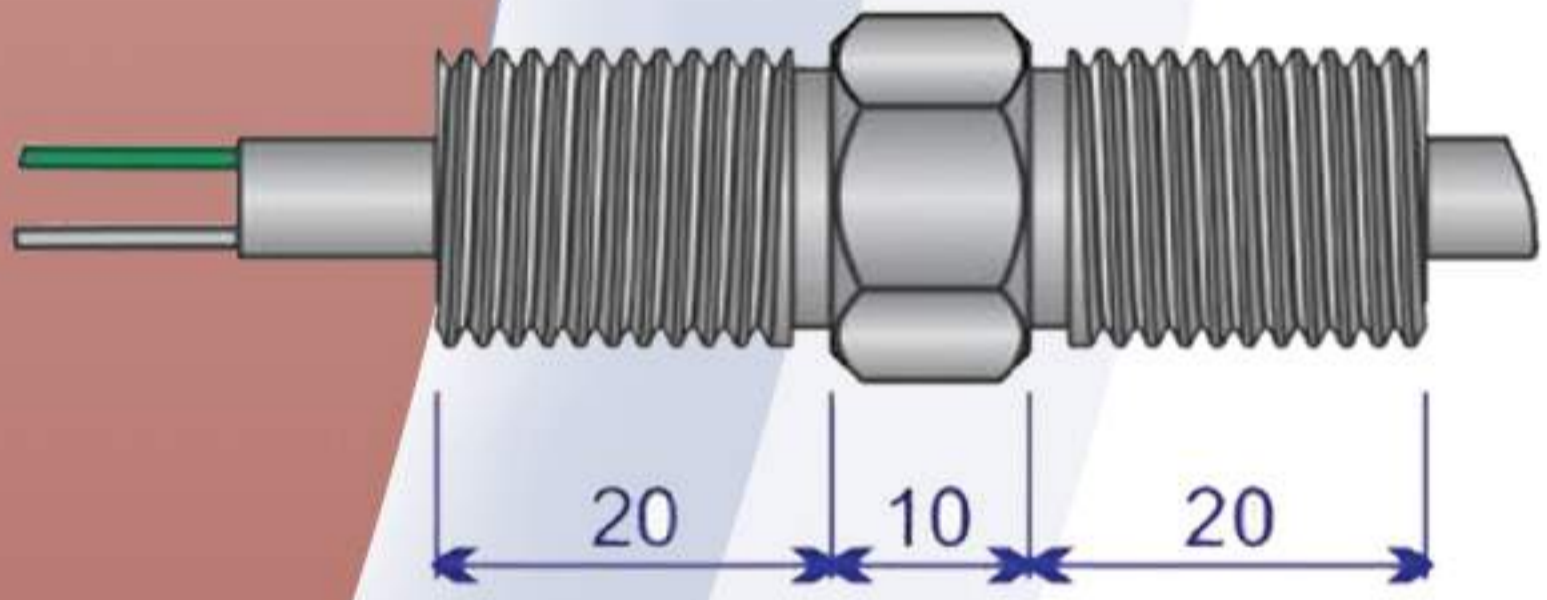
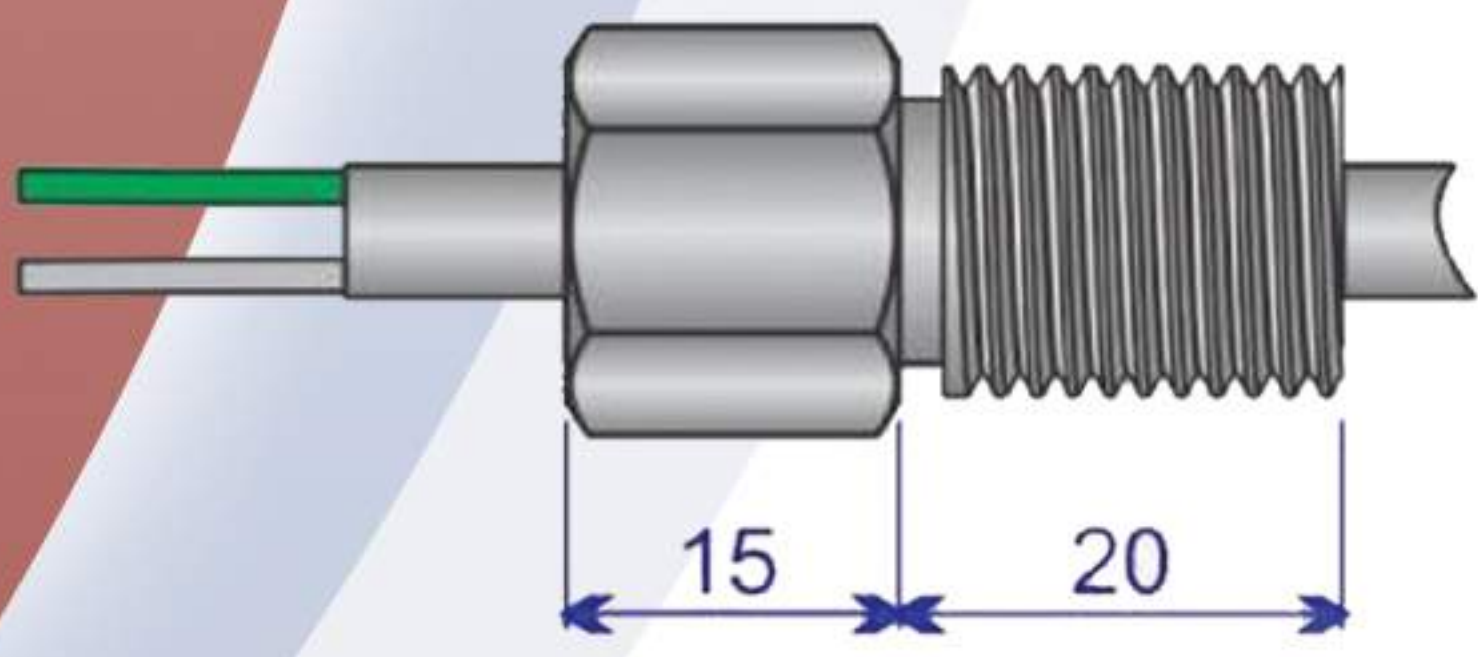
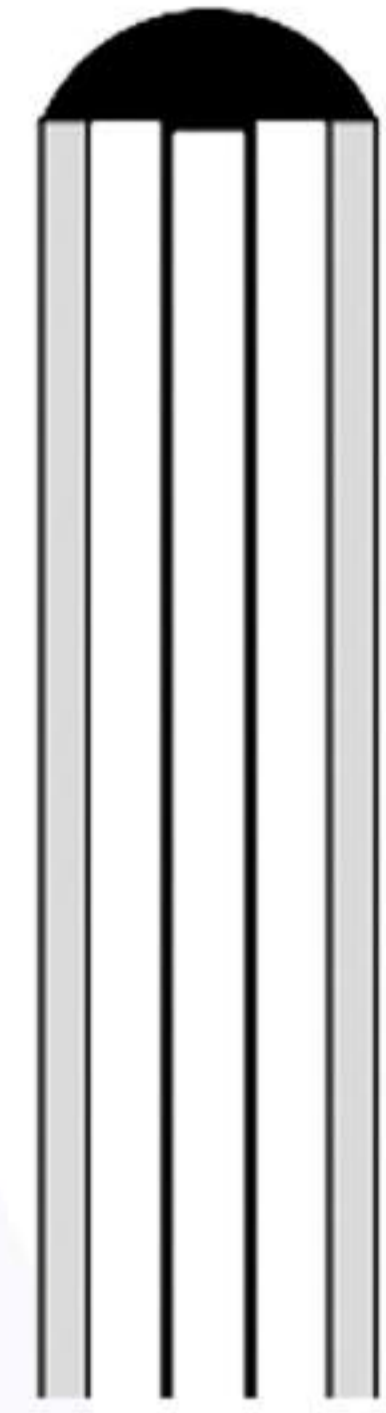
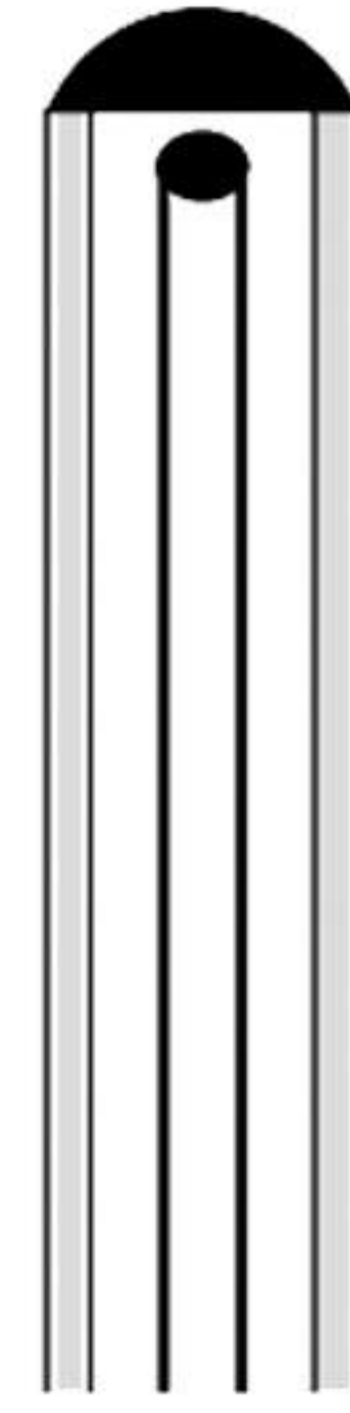
Code	Photo	Description
P1		Supplied as standard with bare conductors as long as customer needs. Plain internal epoxy resin seal.
P2		Crimp on stainless steel pot seal with PTFE sleeved solid tails 50 mm long. Potted with resin.
P3		Crimp on stainless steel pot seal (M8 x 1mm) with PTFE sleeved solid tails 50 mm long. Potted with resin.
P4		Stainless Steel Double Connection Welded Pot seal With Screw (1/2 x 1/2 Standard size With 50mm PTFE Cable)
P5		Stainless Steel Compression Gland Pot seal (Standard size 1/2 Inch With 50 mm PTFE Cable)

Table4: Types of End Seal Configuration

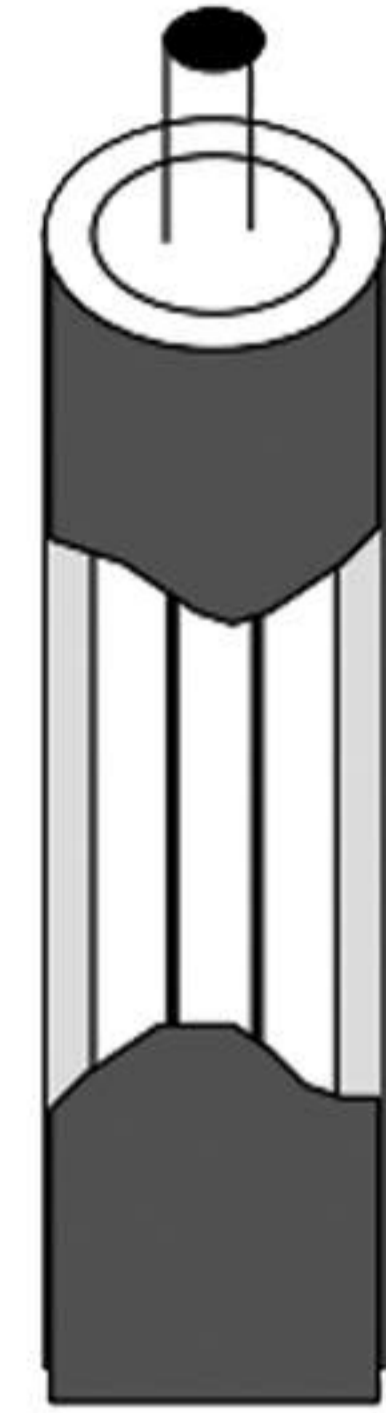
Thermocouple Junction



Grounded Thermocouple Junction



Ungrounded Thermocouple Junction



Exposed Thermocouple Junction

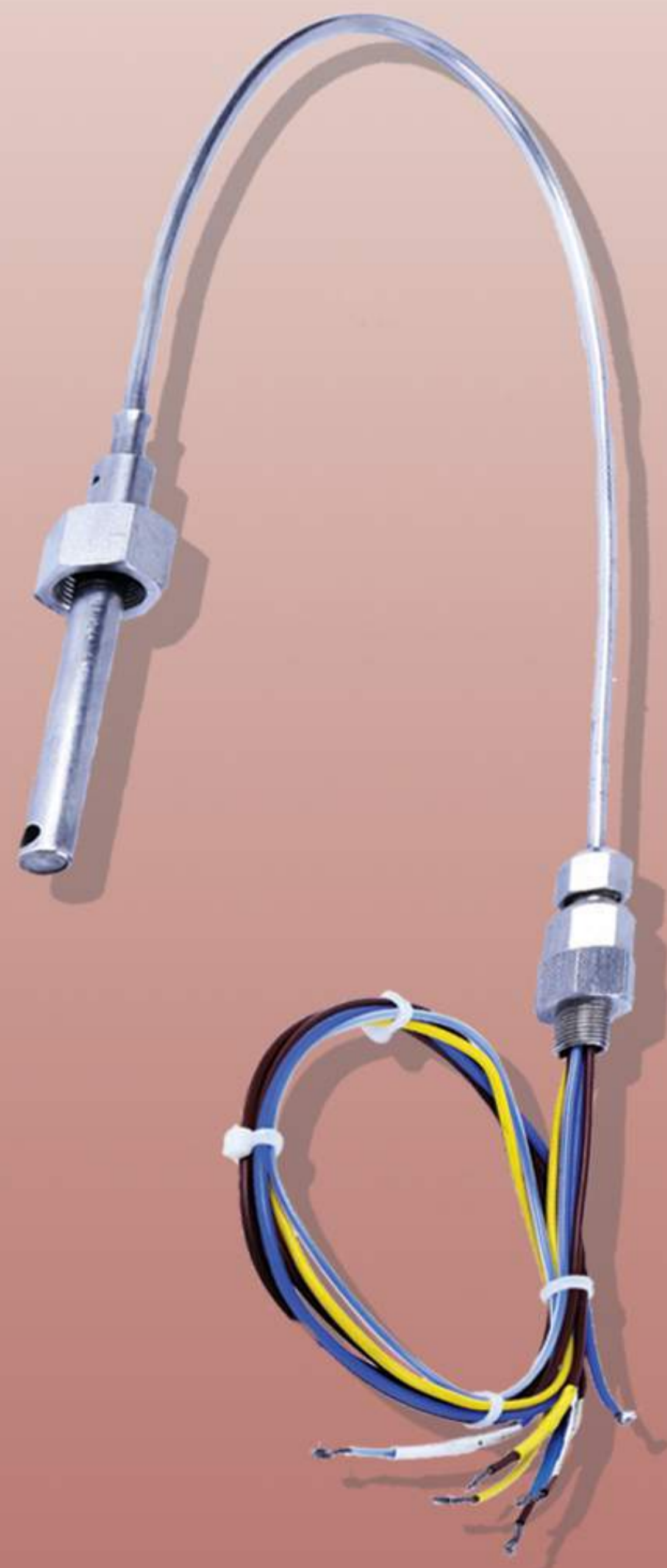



Table6 : Thermocouple Junction

Code	Compression fitting or nut & nipple
01	M8
02	M10
03	M12
04	M16
05	1/2 NPT

Table7: Compression Fitting

Calibration Report

	<h2>Thermocouple Calibration Report</h2>	Date: 1400/04/16
		Report No: 211041-C
		Page: 1

Part Name: Thermocouple Type K 4wire	Client: RAMINPOWE
Project No: PD-MF211041	Serial No: 191752
OEM P/N: ----	Order No.: 99/202

Calibration Range: 150 to 450 (°C)

Ambient Temperature: 21 (°C)

Measurement Standard Used: To IEC60584

Humidity: 10% RH

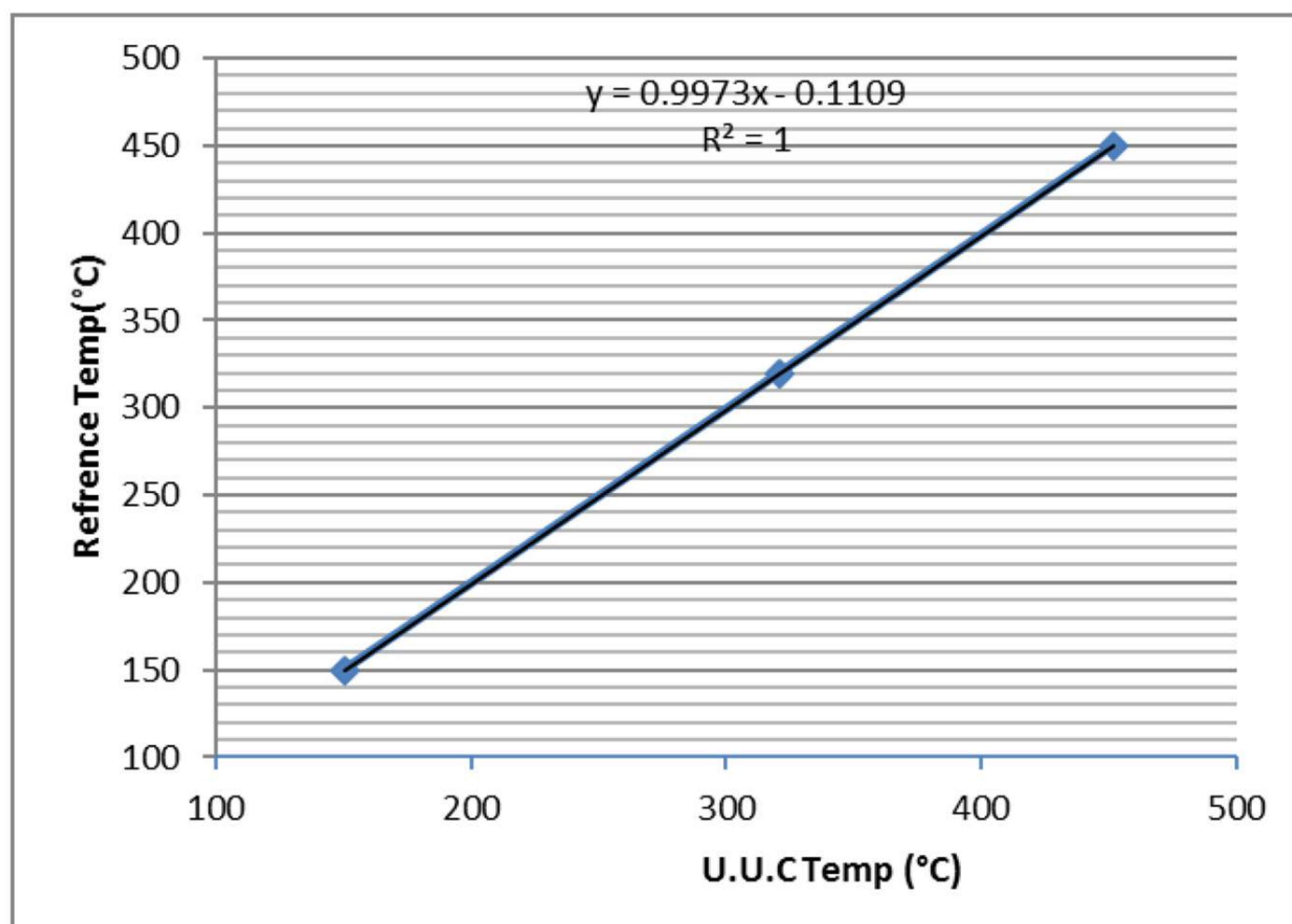
Calibration Device: Dry Block Calibrator BX-150
& Thermocouple Calibrator (UT 713) & INSTEC
GOM 801H

Measurement Uncertainty: Measurement
uncertainty is estimated according to EA-4/02

Traceability: To IEC60584.1:1995/BS EN
60584.1 Part 4: 1996 (ITS-90)

The International Temperature Scale of 1990
(ITS-90)

Set Point (°C)	Reference (°C)	U.U.C. (°C)	Error (°C)
150	150.1	150.6	0.5
320	320.0	320.9	0.9
450	450.1	451.4	1.3





ETRO DAVVAR ENERGY

If there is a will, there is a way...



www.davvarenergy.com



info@davvarenergy.com



+98 21 66578268



+98 21 66578375



Unit 13,4th Floor, 431 Building, Azadi Street, Tehran, Iran

