MI Tube Skin Thermocouple Assembly

General indegenised the Skin Thermocouple assemblies first time in India. Tube Skin Thermocouples manufactured by us are reliable for measurement and control of tube surface temperature in fire heaters. Accurate temperature measurement is important for prolonging heater tube life, for ensuring safe and efficient operation. We have been supplying tube skin thermocouple assemblies in quantities to majority of the projects in India as well as exporting to various countries.

The basic thermocouple is normally of 12.7 mm OD with relatively higher sheath wall thickness, mineral insulated (compacted MgO) and in variety of sheath materials such as SS310, SS446, Inconel® 600, Incoloy® 800 etc. The Junction is generally grounded. However ungrounded junction also is offered, as customer requires. Mineral Insulated (MI) thermocouple is manufactured by Cold drawing and annealing (heat treatment) process in controlled atmosphere. The heat treatment (which is controlled within +/- 2^0C) is carried out in hydrogen atmosphere to avoid surface defects & partial oxidation of conductor.

Major user industries

- **Refineries & Petrochemical**
- **Oil & Gas**
- **Chemical**
- **Fertiliser**
- **Metal (ferrous/non ferrous)**

Different types available

a. Knife Edge Wedge Type
b. Washer Type
c. Retractable Type
d. Assemblies with Single or Multiple Expansion Loop

Technical Notes on Tube Skin Type Assembly

1. General was the first company to actually indigenise the product. Earlier the product was fully imported. The product was started in Technical Collaboration with M/s BICC - Pyrotenax of Hebburn UK. General has also supplied this assembly in very big quantities to several countries such as UK, Germany, Italy & Middle East. General has approval for this product from most consultants in India & abroad.

2. **Raw Materials:** There are basically three raw materials that go in to manufacturing of Tube Skin, Thermocouple, they are as given below.

   Basic Mother Tube: This is mostly SS310, SS446, Inconel® 600, Incoloy® 800 etc. This tube is required in seamless form and as it goes under several reduction, quality of input tube has to be very good. In view of this, tubes are procured only from established mills.

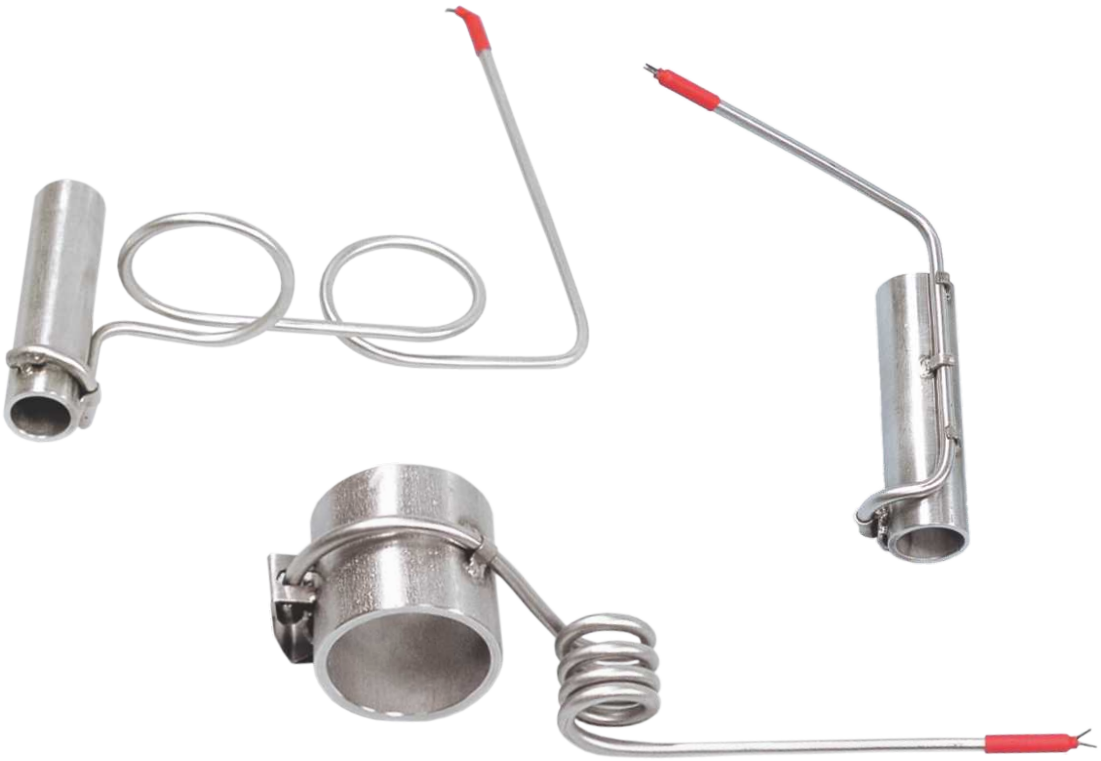
   Insulators: MgO is used as mineral insulation. The material is imported from a German company - Who are pioneers in this field worldwide. The purity is very important for long life of thermocouple. We use over 99% pure MgO.

   Conductor: Type K in most cases, conductors are of virgin quality. The initial conductor calibration as well as final calibration falls within half tolerance as a standard.

3. **Manufacturing Process of Mineral Insulated Thermocouple Thick-wall Cable (MITTC):** The manufacturing process involves cold drawing and heat treatment. The three raw materials are assembled as per requirement and are cold drawn on draw benches. The heat treatment process, in this case strand annealing, is the key area of concern as it decides the final quality of product. General has capability of drawing and annealing in very controlled conditions. The annealing is controlled within +/- 2^{0}C. The heat treatment is requirement to be carried out in hydrogen atmosphere to avoid surface defects as well as partial oxidation of conductor material.

4. Final product conforms to specification as given.

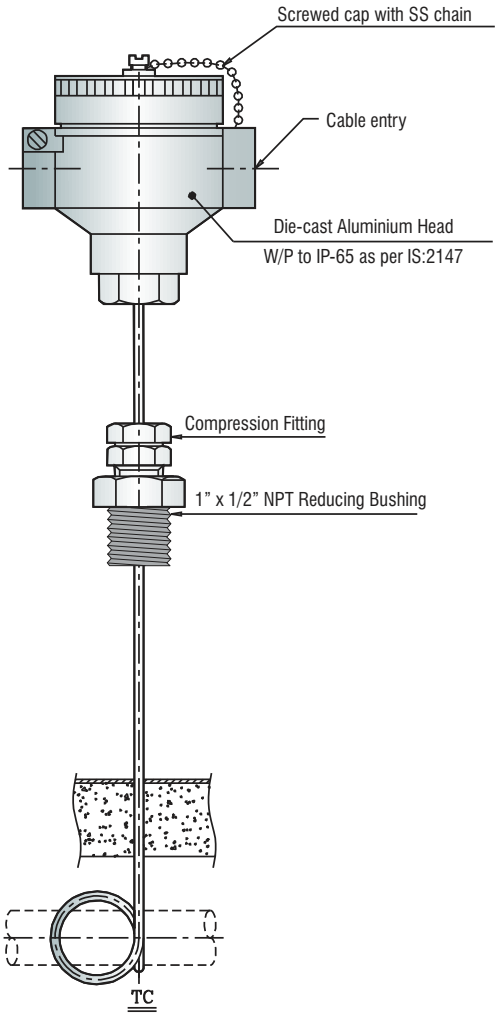
5. **Bending Process & Welding**: After the thick-wall cable is bent on automatic bending machines to get even circular diameters. The bends (D & 2D) are the expansion loops of the thermocouple.



MI Tube Skin Thermocouple Assembly

Specifications

Sheath Materials Offered	: SS446, Inconel® 600/601, SS310 (Other materials on request)
Sheath Diameter	: 9.5, 12.7 mm (½") (Higher diameter on request)
Thermocouple Types	: ANSI Type K, J, E, N
Conductor Diameter	: 1.8 mm (nominal) for 12.7 mm OD
Sheath Thickness	: 3.20 mm (nominal) for 12.7 mm OD
Insulation Material	: Compact mass of MgO (99% min Purity)
Insulation Resistance	: > 100 M Ohm @ 500VDC (Before grounding)
Calibration	: ANSI MC 96.1 / IEC 584 (Special Tolerance)
Response Time	: 10 seconds (after grounding)
Heat Shield	: Provided on request
Junction Type	: Grounded, Knife Edge Wedge Type
Expansion Loop	: Provided ex-factory (In accordance with customer requirement)



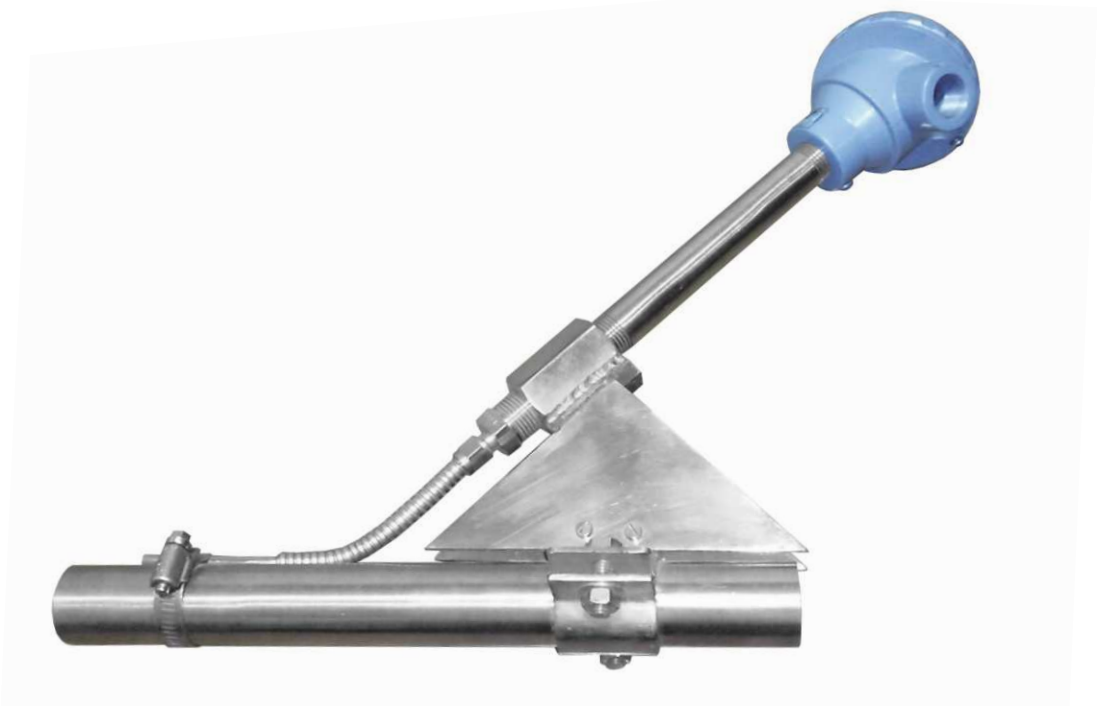
Welding Procedure

1. Grind the surface of heater tube in the area of thermocouple junction location for removing scale and rust. Clean the area.
2. Clamp the thermocouple in the desired location.
3. Center of the wedge type pad must be ensured to be in contact with the heater tube.
4. Perform root weld pass on both sides of the pad using 1.57 mm dia filler rod. Welds must overlap each other & run full length of the pad.
5. Perform secondary weld pass on both sides of the pad using 2.36 mm dia filler rod. Welds to run full length of the pad.
6. Perform final weld pass on both sides of the pads using 2.36mm dia filler rod. Welds must extend 9.5mm minimum above tube surface & run full length of the pad.
7. For transverse mounted thermocouple, locate the retaining clip at the tangent point of the thermocouple and tube & weld at both ends using 2.36 mm dia filler rod.
8. For Axial mounted thermocouple, locate the retaining clip as desired & weld as mentioned under point no. 7 above.

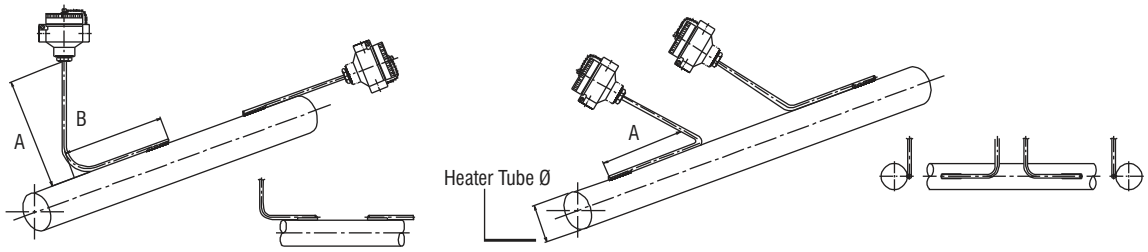
Recommended weld filler rod material for SS446 sheathed thermocouple

HEATER TUBE MATERIAL	FILLER ROD MATERIAL
ASTM A312 TP 304, TP 309, TP 310	SS309-AWS A5.9, Class ER 309
ASTM A321 (Ti Stabilised)	SS309-AWS A5.9, Class ER309
ASTM A3347 (Cb Stabilised)	SS309-AWS A5.9, Class ER309
ASTM A335 P11, P22, P5, P9, ASTM A106	Inconel® 82-AWS A5.14, Class ER Ni Cr 3
Incoloy® 800	Inconel® 82-AWS A5.14, Class ER Ni Cr 3

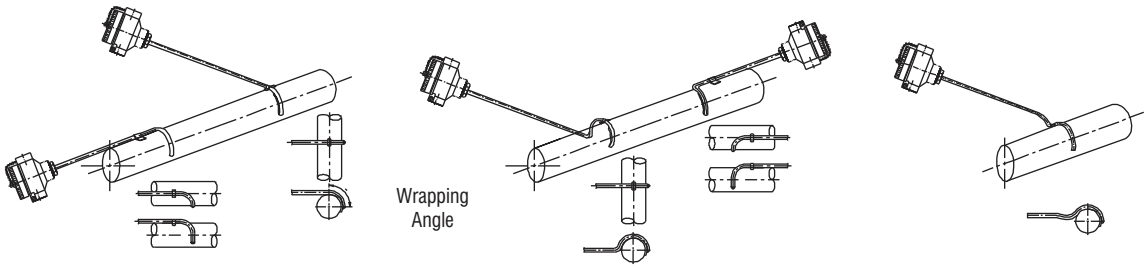
Note: Filler rods & welding procedures for other sheath materials, types of thermocouples will be furnished on request



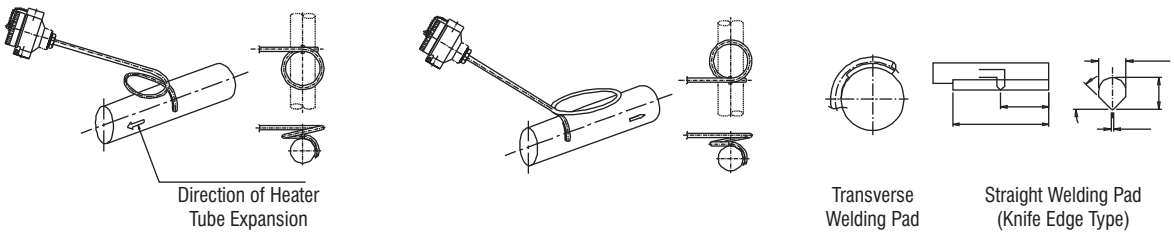
Typical Installations of Tube Skin Thermocouple



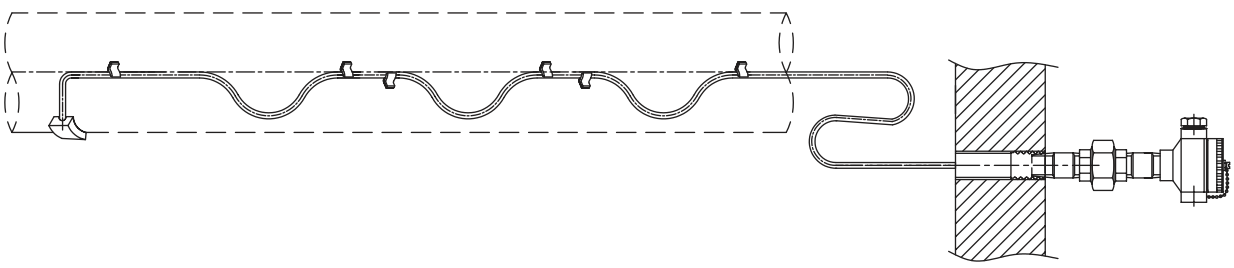
Right angle / Straight Mounting



Wrap up angular mounting



Mounting with expansion loop



Special Skin Type Thermocouple Assembly

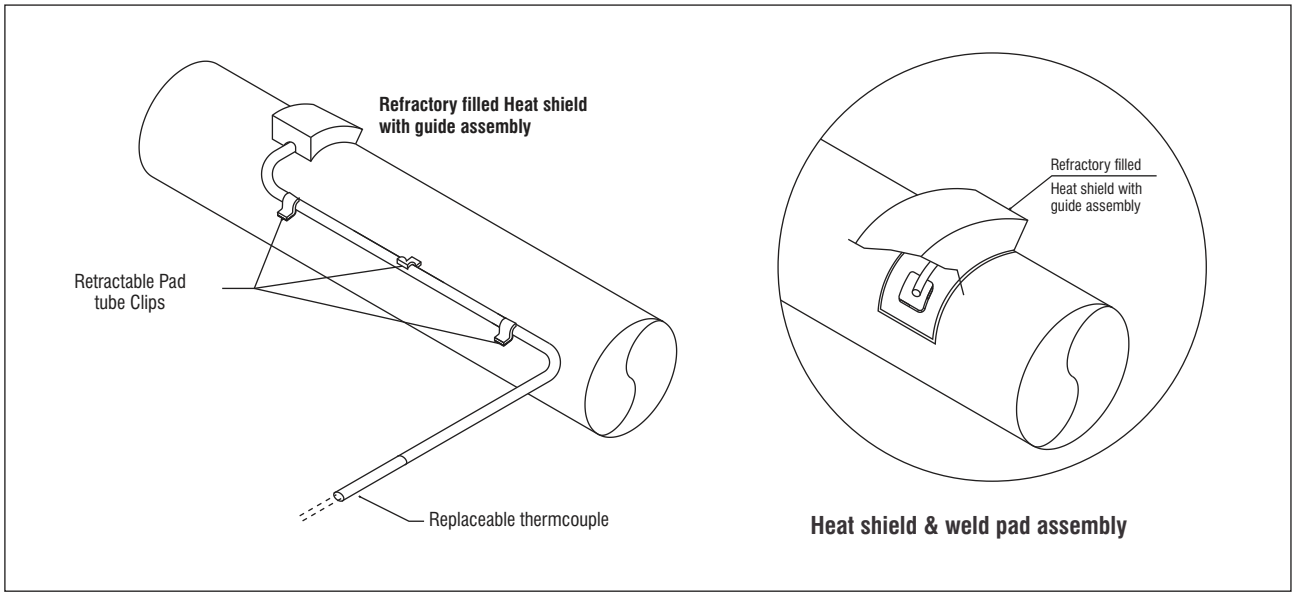
Retractable Type Tube Skin Thermocouples

Conventional Tube Skin Thermocouple are to be welded to the heater tube. As this is hot working on heater tube, it poses several problems in terms of maintenance and longer shut down time. Each and every time a conventional tube skin thermocouple is installed, the heater tubes are required to be pressure tested as it has undergone welding.

General's retractable type thermocouples make replacement of thermocouple possible without any welding or any hot work on the tube. This results in significant amount of saving in terms of time as well as shut down costs.

Major differences between conventional knife edge type thermocouple and retractable type thermocouple:

KNIFE EDGE TYPE	RETRACTABLE TYPE
■ Weld pad welded to thermocouple.	■ Weld pad fabricated has guide assembly.
■ Weld Clips hold thermocouple in place can be used only once.	■ Weld Clips can be reused.
■ Thermocouple cannot be removed without hot work on tube.	■ Thermocouples are replaceable without performing hot work on heater tube.



Typical Installation