

# TEMPERATURE SENSORS



## THEMOCOUPLS

A thermocouple consists of two dissimilar metallic wires joined at one end, known as hot junction. When the hot junction is heated, an emf is produced which corresponds to the temperature difference between the hot junction and free ends known as cold junction. This thermo emf is measured by galvanometric/potentiometer metric/digital instruments, to display temperature.

### FEATURES:

- Most common, convenient and versatile devices used to measure temperature.
- Sensing devices for measurement, control and recording of temperature from -200°C to +1800°C.
- These are available in two basic designs: Straight type & Angle Type
- Angle type Thermocouples are used when it is not convenient to use Straight Type Thermocouples or Thermocouple connecting head is desired to be kept away from the place of insertion of Thermocouple so as to avoid attack of harmful fumes and vapors or high temperature.

### SPECIFICATIONS:

#### THEMOCOUPLS ELEMENTS

Thermocouple wires welded at one end are called elements. Both the positive and negative legs of the thermocouple elements are insulated by ceramic insulators (beads) to avoid short-circuiting. A full-length long multi hole insulating tube insulates rare metal thermocouple elements. Depending on the use, a thermocouple assembly has one (simplex), two (duplex) or more number of elements. These elements have temperature-emf characteristics as per ANSI MC 96.1/ DIN IEC 584/IS and are available in various types and diameters. The selection of element depends on the continuous operating and maximum peak temperatures as thicker elements withstand higher temperature and have longer life. Table given hereunder gives the selection guidelines:-

Thermocouple element	ANSI Type	Wire dia. (mm)	Continuous temp. range °C	Max. Peak temp. °C	Standard limits of error
Fe. /Constn.	J	1.38/1.5 2.5 3.2	-150.... 600 -150.... 600 -150.... 700	950	± 2.2°C or ± 0.75% whichever is higher
Chromel /Alumel or NiCr/Ni	K	1.38 1.63/2.0 2.5/3.2	-150....900 -150....1100 -150....1200	1260	
PL.10% Rh. /Pt. Pt. 13% Rh. /Pt.	S R	0.33 0.45 0.50	0....1300 0....1500 0....1600	1600	± 1.5 °C/ 0.25% whichever is higher

Pt.30% Rh. /Pt 6% Rh	B	0.33	100....1500	1800	± 0.5% above 800°C
		0.45	100....1600		
		0.50	100....1700		

Note: 1) Limits of error are as per ANSI MC 96.1

2) Elements with special limits of error, other diameters and ANSI types e.g. T,E, N also available.

3) Calibration report for each thermocouple with traceability to NABL is optionally available at additional cost to meet ISO 9001 requirements.

## CONNECTING HEAD

The connecting head is cast aluminum or cast iron with detachable cover and is fixed on open end of protecting sheath. Thermocouple wires are terminated on a ceramic terminal block with bass Terminals inside the head. From these terminals, compensating/ extension leads are taken for connections to the measuring or controlling instruments. Various type of heads are available such as standard (non-weatherproof), weatherproof (with threaded cap and cable entry(specify – e.g. 3/4” ET/1/2” BSP/NPT(F)) and gasket-IP65 protection -Fig.5) or flameproof . In addition special heads with double cable entry, single/double compression cable glands, miniature type etc is also available.

## PROTECTING SHEATHS

Metallic and /or ceramic sheaths (tubes closed at one end) are put over the thermocouple elements for protection against corrosive atmosphere and harmful chemical action, which may be present at the place of use. When the corrosive atmosphere is too severe, an additional, inner gas tight ceramic sheath is provided for protecting the elements from corrosion, especially for the expensive rare metal thermocouples. In the case of angle type thermocouple, this ceramic tube is provided in the hot arm only. The measuring accuracy is, in no way, affected by protecting sheaths. The sheath diameter and wall thickness are selected to accommodate the elements and inner ceramic tube (if used) and the conditions of use/ tolerable life as a thin sheath will deteriorate faster than a thick one. Proper selection of the material of the protecting sheath is also important. General guidelines for protecting sheath for different applications are given in the table below:

Protecting sheath	Composition (approx.)	Application Guidelines	Standard sheath dimensions. (wall thickness), mm
Mild steel	Carbon steel	For use up to 550°C in non-oxidizing environments main area of usage include non-corrosive liquids and gases. Melting point 1525°C.	21.3/22(2)
Stainless steel 304	18-20% Cr. 8-11% Ni., ≤2% Mn balance iron	Up to 900°C in oxidizing conditions. Has good resistance to oxidation and corrosion. Generally used in process applications such as steam lines, oil refineries, and chemical solutions. Resists nitric acids well, halogen acids poorly and the sulphur acids moderately. Subject to carbide precipitation in the 480-870°C range. Not recommended for use in reducing atmospheres. Melting Point 1400°C	21.3/22(2) 18(2)
Stainless steel 316	16-18% Cr, 10-14% Ni, 2-3% Mo, balance Iron	For use upto 900°C in oxidizing conditions. Superior to SS304 in corrosion resistance. Resists pitting in phosphorous & acetic acids. Subject to carbide precipitation in the 430-815°C range. Not recommended for use in reducing atmospheres. Melting point 1400°C	16(1.6), 14(1.6) 12.7/12(1.6)
Heat resistance steel 446	23-27% Cr, balance iron	Upto 1100°C in oxidizing conditions. Excellent resistance to oxidizing & reducing flames containing sulphur. For sulphurous atmosphere salt baths & molten metal. Melting 1400°C.	21.3/22(2)
Stainless steel 310	24-26% Cr,19-22% Ni, ≤2% Mn., balance iron	Upto 1100°C High resistance to corrosive & nitrogenous atmosphere. Provides goods resistance to both carburizing & reducing environments. Deficient in oxygen. Subject to carbide precipitation in the 490-870° range. Suitable for carburizing, annealing/ hardening furnaces, cyanide & salt bath. Melting point 1410°C.	21.3/22(2)
Inconel 600	72%(min.) Ni, 14-17% Cr.	Upto 1150°C under oxidizing conditions, goods resistance in corrosive atmosphere at high temp. Not recommended for use in	21.3/22(2)

	Balance iron.	sulphur or reducing atmospheres. Suitable for carburizing. Annealing and hardening furnaces, cyanide salt bath etc.	
Impervious Ceramic 610	Alumina silicate (sillimanite)	Upto 1500°C. Fair resistance to thermal shock and fair mechanical strength.	24(2.5), 15(2)
Sintered Alumina 710	Pure Alumina	Upto 1800°C. Nonporous with good resistance to thermal & mechanical shock.	24(2.5), 15(2)
Silicon Carbide	90% Sic	Upto 1650°C. Can withstand flame impingement, has fair thermal shock resistance.	45(10), 26(8)

Note: 1) Protective sheaths of other materials, such as Cast Iron (for molten Aluminium) etc. and other diameters and wall thickness are also available.

2) Operating temperature varies, depending on the atmospheres.

3) These data are shown to serve only as a general suggestion and not as a guarantee. Final selection must be based on actual evaluation of the metal in the corrosive medium under study.

### SPECIAL COATINGS/THIMBLES

Metallic protective sheaths are also offered with coatings of Tungsten Carbide, Teflon, Ceramic etc. for special process applications. Platinum Thermocouples with Pure Platinum, PtRh, DPH or ZGH Thimbles are offered for Molten Glass temperature measurement. Tri level Platinum Thermocouples and Platinum level probe for Molten Glass application are also offered.

### PROCESS CONNECTIONS

Flange or screwed bush is used for mounting the Thermocouple at the place of its use. Flange is normally adjustable over the protecting sheath or holding tube of ceramic sheath. Apart from the standard cast aluminum oval flange, standard ANSI/BS flanges in different materials (CS, SS 304/SS 316) and pressure rating, either fixed (welded) or adjustable by screws (for non-pressure application-) or by compression fitting (for pressure applications) are also available. Alternatively various types of standard screw-in threaded bushes (e.g. 3/4" /1" BSP/NPT or m33 x 2) either fixed (welded) or adjustable by screws (for non-pressure application) or by compression fitting (for pressure applications) are available for mounting. Counter flange (for flange mounting) and stub with female threads (for screw mounting) are also available.

### ORDERING INFORMATION:

#### STRAIGHT TYPE THERMOCOUPLE

Element type J/K/R/S/B/other, simplex/duplex, element dia .....mm, protection sheath of .... (Material), dia.....mm, wall thickness.....mm, with/without inner ceramic sheath, nominal length (below head) .....mm, immersion length .....mm (only for welded mountings), complete with terminal block and standard /weatherproof/explosion proof head. Mounting: Adjustable cast aluminium oval flange/specify (if any other). Special features (if any) : .....

#### ANGLE TYPE THERMOCOUPLE

Element type J/K/R/S/B/other, simplex/duplex, element dia.....mm, hot arm length .....mm of ..(material), cold arm length .....mm of mild steel, with/without inner ceramic sheath, complete with terminal block and standard/ weatherproof/explosion proof head. Mounting: None /adjustable cast aluminium oval flange/specify (if any other) on cold (optionally hot) arm. Special features (if any).....

### APPLICATION:

They are used in industries, power plants, and metal melting furnaces, salt baths, industrial process control, laboratories and numerous other applications as

Salt Bath : Neutral/Cyanide/Borax/HSS/Chloride/other

Molten Metal : Zinc/Magnesium/Aluminium/Copper/Brass/Ferrous Alloys/other

Process Furnaces : Glass melting/Cracking/Roasting/Blast/Calcining/Hydrogenising/ High Pressure Stoves. (specify process material).

Ovens & Furnace with : Reducing/Oxidizing/Sulphurous/Carbonizing gaseous atmosphere (Specify gas details)

Plating : Galvanizing/ Tinning.

## MI THERMOCOUPLES:



Mineral Insulated Thermocouples & Resistance Temperature Detectors comprise of a metal sheath in which the thermo-electric elements/RTD element with conductors are embedded in highly compressed magnesium Oxide (MgO) insulation, thus providing the elements complete protection against oxidation and corrosion.

Thermocouples are available in type K, J, T, E, R, S, W, W3 and W5, simplex or duplex, in sheath diameters from 1mm to 8.00mm and length from a few cm to 200 meters or more. The hot junction is TIG welded and could be grounded (element hot junction welded to sheath tip giving faster response) or ungrounded (element insulated from sheath), one of which can be used as per control system requirement.

## FEATURES:

- High Integrity construction suited to arduous operating conditions.
- High accuracy and stability maintained throughout operating life.
- Fast response & high insulation resistance.
- Sheath can be bent and retains its form after bending to suit particular installation.
- Excellent shock & vibration resistance.
- RTD are available with Platinum element, R=100 ohms, temp.coeff.0.385 ohm/°C, simplex or duplex, in sheath diameter from 3mm to 8mm and in lengths from 10 cm to several meters as per order.

## SPECIFICATIONS

LIMITS OF ERROR FOR THERMOCOUPLES					LIMITS OF ERROR FOR RTD Pt 100				
Element	Type	Temp. Range °C	Accuracy Standard	Accuracy Special	Temp. °C	Class 'B'		Class 'A'	
						±°C	±Ω	±°C	± Ω
Fe/Const.	J	0...700	±2.2°C/0.75%	±1.1°C/0.4%	0	0.3	0.12	0.15	0.06
NiCr/Ni(Cr/Al)	K	0...1200	±2.2°C/0.75%	±1.1°C/0.4%	100	0.8	0.30	0.35	0.13
Cu/Const.	T	0.....350	±1.0°C/0.75%	±0.5°C/0.4%	200	1.3	0.48	0.55	0.20
Cr/Const.	E	0....900	±1.7°C/0.50%	±1.1°C/0.4%	300	1.8	0.64	0.75	0.27
Nicrosil/Nisil	N	0....1280	±2.5°C/0.75%	±1.5°C/0.4%	400	2.3	0.79	0.95	0.33
Pt10%Rh/Pt	S	0.....1600	±1.5°C/0.25%	-	500	2.8	0.93	1.15	0.38
Pt13%Rh/Pt	R	0....1600	±1.5°C/0.25%	-					

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Salt Bath : Neutral/Cyanide/Borax/HSS/Chloride/other

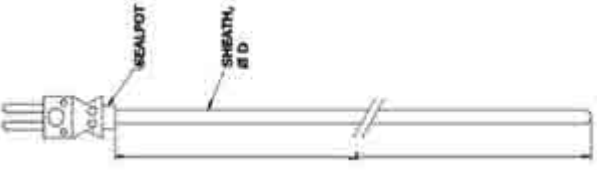
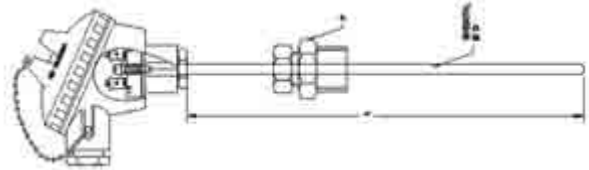
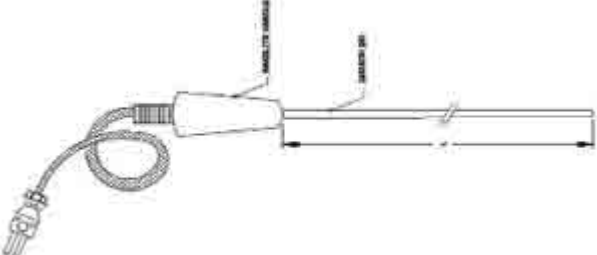
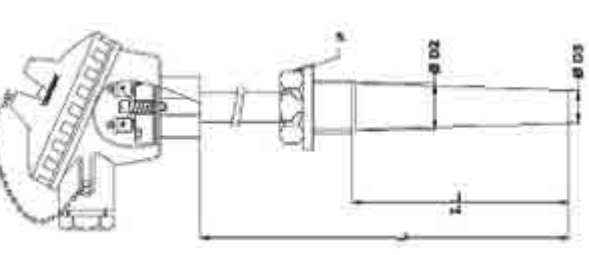
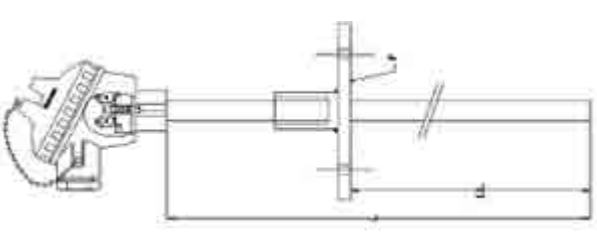
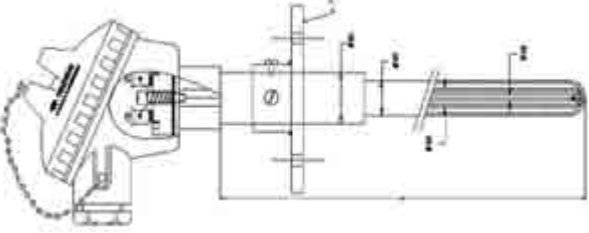
Molten Metal : Zinc/Magnesium/Aluminium/Copper/Brass/Ferrous Alloys/other

Process Furnaces : Glass melting/Cracking/Roasting/Blast/Calcining/Hydrogenising/ High Pressure Stoves. (specify process material).

Ovens & Furnace with : Reducing/Oxidizing/Sulphurous/Carbonizing gaseous atmosphere (Specify gas details)

Plating : Galvanizing/ Tinning.

## STANDARD THERMOCOUPLES DESIGNS

 <p>MI Thermocouple with either Quick-Disconnecting Connector or Thermocouple Head</p>	 <p>MI Thermocouple with either Quick-Disconnecting Connector or Thermocouple Head with mounting Bush</p>
 <p>MI Thermocouple with handle for air temperature</p>	 <p>Thermocouple with Thermo-well and mounting Bush</p>
 <p>Thermocouple with Thermo-well and mounting F lange</p>	 <p>Thermocouple with Single/Double Ceramic Protection Tube</p>

FOR MODIFICATION PURPOSES DESIGN/SPECIFICATIONS ARE SUBJECT TO CHANGE WITHOUT NOTICE

Manufactured & Marketed by:



An ISO 9001:2008 Company

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