Technical Information
TC insert
TPC200

With ceramic isolator
For installation in high temperature assemblies of TAF series

Thermocouple sensor types J, K, R, S, B

Application

- Replaceable insert for installation in high temperature assemblies TAF11 and TAF16
- Thermocouple sensors measuring range up to +1700 °C (+3092 °F)

Your benefits

- Customized immersion length
- Single or double measurement junction
- Selection of different TC wire diameters

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Function and system design

Measuring principle

Thermocouples are comparatively simple, robust temperature sensors which use the Seebeck effect for temperature measurement: If two electrical conductors made of different materials are connected at a point, a weak electrical voltage can be measured between the two open conductor ends if the conductors are subjected to a thermal gradient. This voltage is called thermoelectric voltage or electromotive force (emf.). Its magnitude depends on the type of conducting materials and the temperature difference between the "measuring point" (the junction of the two conductors) and the "cold junction" (the open conductor ends). Accordingly, thermocouples primarily only measure differences in temperature. The absolute temperature at the measuring point can be determined from these if the associated temperature at the cold junction is known or is measured separately and compensated for. The material combinations and associated thermoelectric voltage/temperature characteristics of the most common types of thermocouple are standardized in the IEC 60584 and ASTM E230/ANSI MC96.1 standards.

Input	Designation	Measuring range limits
Thermocouples (TC)[1] as per IEC 60584	Type J (Fe-CuNi) Type K (NiCr-Ni) Type S (PtRh10-Pt) Type R (PtRh13-Pt) Type B (PtRh30-PtRh6)	-210... +1200 °C (-346... +2192 °F), typical sensitivity ≈ 55 µV/K -270... +1372 °C (-454... +2502 °F), typical sensitivity ≈ 40 µV/K -50... +1768 °C (-58... +3214 °F), typical sensitivity ≈ 11 µV/K -50... +1768 °C (-58... +3214 °F), typical sensitivity ≈ 13 µV/K 0...+1820 °C (+32... + 3308 °F), typical sensitivity ≈ 9 µV/K

1) Typical sensitivity above 0 °C (+32 °F)

Performance characteristics

Accuracy

Permissible deviation limits of thermoelectric voltages from standard characteristic for thermocouples as per IEC 60584 or ASTM E230/ANSI MC96.1:

Standard	Type	Standard tolerance		Special tolerance	
		Class	Deviation	Class	Deviation
IEC 60584	J (Fe-CuNi)	2	±2.5 °C (-40...333 °C) ±0.0075 |t|[1] (333...750 °C)	1	±1.5 °C (-40...375 °C) ±0.004 |t|[1] (375...750 °C)
	K (NiCr-Ni)	2	±2.5 °C (-40...333 °C) ±0.0075 |t|[1] (333...1200 °C)	1	±1.5 °C (-40...375 °C) ±0.004 |t|[1] (375...1000 °C)
	R (PtRh13-Pt) and S (PtRh10-Pt)	2	±1.5 °C (0...600 °C) ±0.0025 |t|[1] (600...1600 °C)	1	±1 °C (0...1100 °C) ±[1 + 0.003(|t|[1]-1100)] (1100 °C...1600 °C)
	S (PtRh13-Pt)	2		1	
	B (PtRh30-PtRh6)	2	±1.5 °C or ±0.0025 |t|[1] (600...1700 °C)	-	-

1) \|t\| = Absolute temperature value in °C

Standard	Type	Standard tolerance	Special tolerance
ASTM E230/ ANSI MC96.1		Deviation, the larger respective value applies	
	J (Fe-CuNi)	±2.2 K or ±0.0075 |t| [1] (0…760 °C)	±1.1 K or ±0.004 |t| [1] (0…760 °C)
	K (NiCr-Ni)	±2.2 K or ±0.02 |t| [1] (-200 … 0 °C) ±2.2 K or ±0.0075 |t| [1] (0…1260 °C)	±1.1 K or ±0.004 |t| [1] (0…1260 °C)
	R (PtRh13-Pt) and S (PtRh10-Pt)	±1.5 K or ±0.0025 |t| [1] (0…1480 °C)	±0.6 K or ±0.001 |t| [1] (0…1480 °C)
	S (PtRh13-Pt)		
	B (PtRh30-PtRh6)	±0.005 |t| [1] (870…1700 °C)	±0.0025 |t| [1] (870…1700 °C)

1) |t| = absolute temperature value in °C

In order to obtain the maximum tolerances in °F, the results in °C must be multiplied by a factor of 1.8.

Calibration specifications

Endress+Hauser provides comparison temperature calibration from -80 to +1400 °C (-110 °F to 2552 °F) based on the International Temperature Scale (ITS90). Calibrations are traceable to national and international standards. The calibration report is referenced to the serial number of the insert.

Temperature range	Minimum insertion length IL in mm (in)
-80 °C to -40 °C (-110 °F to -40 °F)	200 (7.87)
-40 °C to 0 °C (-40 °F to 32 °F)	160 (6.3)
0 °C to 250 °C (32 °F to 480 °F)	120 (4.72)
250 °C to 550 °C (480 °F to 1020 °F)	300 (11.81)
550 °C to 1400 °C (1020 °F to 2552 °F)	450 (17.75)

Material

Sheath materials.
The temperatures for continuous operation specified in the following table are only intended as reference values for use of the various materials in air and without any significant compressive load. The maximum operation temperatures are reduced considerably in some cases where abnormal conditions such as high mechanical load occur or in aggressive media.

Material name	Short form	Recommended max. temperature for continuous use in air	Properties
Ceramic material types according to DIN VDE0335			
C610		1500 °C (2732 °F)	▪ Al_2O_3-content approx. 60 %, alkali-content 3 % ▪ The most economic non porous ceramic material ▪ Highly resistant to hydrogen fluoride, temperature shocks and mechanical influences, normally used for internal and external thermowells as well as insulators
C799		1800 °C (3272 °F)	▪ Al_2O_3-content approx. 99.7 % ▪ Can be used for both internal and external thermowells and insulators ▪ Resistance to hydrogen fluoride gases and alkaline vapors, to oxydizing, reducing and neutral atmospheres as well as temperature changes ▪ This material is very pure and has a very low porosity (gas tight) compared to all other types of ceramics

Mechanical construction

Design, dimensions

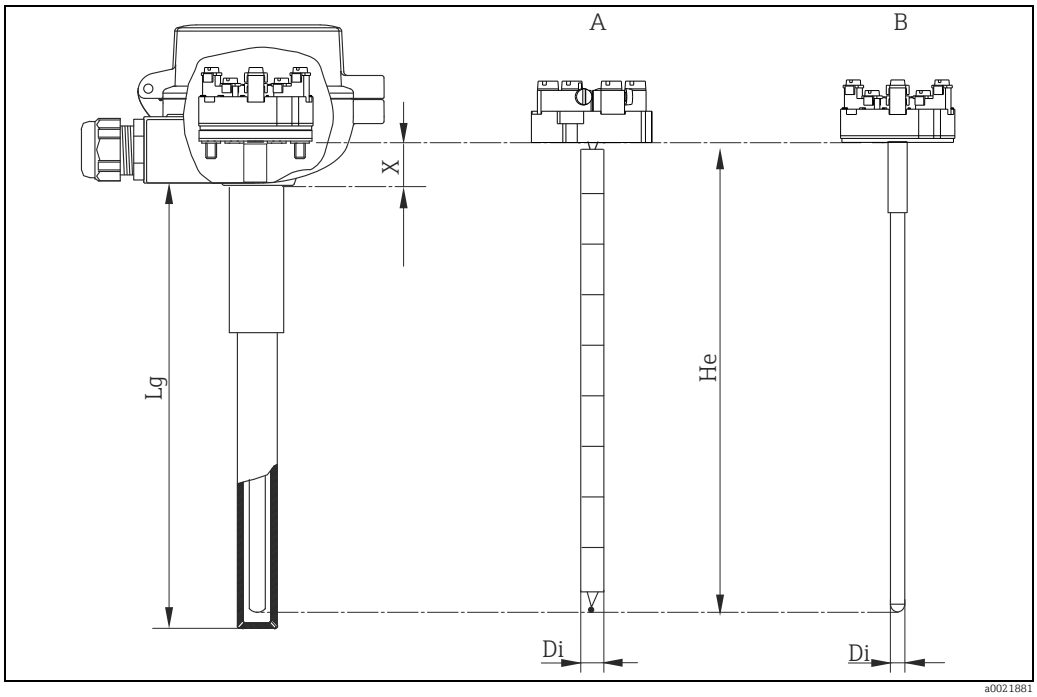


Fig. 1: All dimensions in mm (in).

A Measuring insert with TC type J or K, ceramic segment isolator and mounted terminal block (DIN B)
B Measuring insert with TC type R, S or B, with external ceramic sheath and mounted terminal block (DIN B)
Lg Immersion length of the assemblies thermowell
X Additional length, see table below
He Insert length (He = Lg + X)
Di Diameter insert

Insert length He calculation rules (He = Lg + X) TPC200		
Material high temperature assembly	Terminal head DIN B	Terminal head DIN A
TAF11 thermowell:		
▪ C610 + sleeve	He = Lg + 15 mm (0.6 in)	He = Lg + 30 mm (1.2 in)
▪ Sinterized silicon carbide SIC + sleeve	He = Lg + 5 mm (0.2 in)	He = Lg + 20 mm (0.8 in)
▪ Special silicon nitride ceramic SiN + sleeve	He = Lg + 10 mm (0.4 in)	He = Lg + 25 mm (1.0 in)
TAF16 thermowell:		
▪ NiCo special nickel/cobalt alloy (metal cap)	He = Lg + 5 mm (0.2 in)	He = Lg + 20 mm (0.8 in)
▪ All metal thermowells, e. g. 310, 446, 316, etc.	He = Lg + 15 mm (0.6 in)	He = Lg + 30 mm (1.2 in)
▪ Bar stock tip thermowells NiCo and INCOLOY800HT	He = Lg + 10 mm (0.4 in)	He = Lg + 25 mm (1.0 in)
▪ Kanthal Super	He = Lg + 10 mm (0.4 in)	He = Lg + 25 mm (1.0 in)
▪ SiN (special silicon nitride ceramic)	He = Lg + 10 mm (0.4 in)	He = Lg + 25 mm (1.0 in)
▪ Kanthal AF	He = Lg + 10 mm (0.4 in)	He = Lg + 25 mm (1.0 in)

The measuring point of the thermocouple is located close to the tip of the insert. The operating temperature ranges (→ 2) and permissible deviation limits of the thermoelectric voltages from the standard characteristic (→ 2) vary according to the type of thermocouple used. The thermocouple wires are inserted in appropriate high-temperature-resistant ceramic isolators.

When configuring the high temperature assemblies of the TAF family the thermocouple wire diameter also needs to be defined. The higher the temperature the larger the wire diameter needs to be selected. A large wire diameter will also increase the lifetime of the sensor.

Type of insert	Wire diameter in mm (in)	Insert diameter in mm (in)
1x K, 2x K, 1x J, 2x J	1.63 (0.06)	8 (0.31)
1x K, 2x K, 1x J, 2x J	2.3 (0.09)	8 (0.31)
1x K, 1x J	3.26 (0.13)	12 (0.47), 14 (0.55)
2x K, 2x J	3.26 (0.13)	12 (0.47), 14 (0.55)
1x S, 2x S	0.35 (0.014)	6 (0.24)
1x S, 2x S, 1x R, 2x R, 1x B, 2x B	0.5 (0.02)	6 (0.24)

Weight

Depending on length and diameter, e. g. 0.1 kg (3.53 oz) for Lg = 580 mm (22.8 in) and diameter 8 mm (0.3 in).

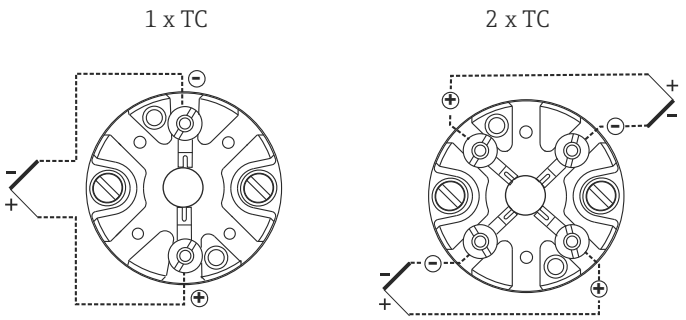
Wiring

Wiring diagrams

Thermocouple wire colors

As per IEC 60584	
▪ Type J: black (+), white (-) ▪ Type K: green (+), white (-)	▪ Type B: grey (+), white (-) ▪ Type R: orange (+), white (-) ▪ Type S: orange (+), white (-)

Terminal block mounted



Installation conditions

Orientation

No restrictions.

Installation instructions

Observe the insert length calculation rules. → 4

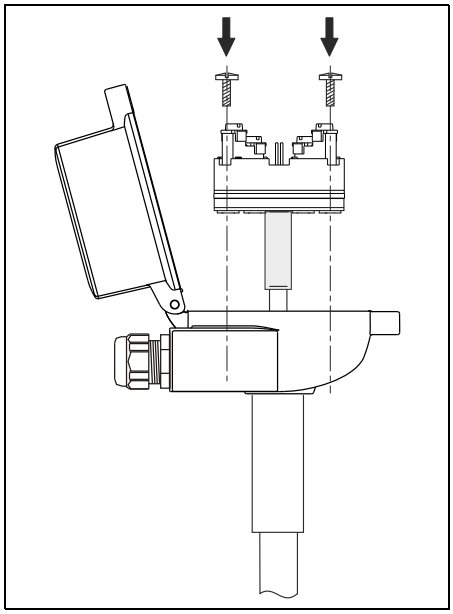


Fig. 2: Insert installation

The TPC200 insert is mounted in high temperature assemblies of the TAF1x series with a flat face terminal head as per DIN EN 50446.

Certificates and approvals

CE Mark

The device meets the legal requirements of the EC directives if applicable. Endress+Hauser confirms that the device has been successfully tested by applying the CE mark.

Other standards and guidelines

- IEC 60584:
  Thermocouples
- DIN EN 50446:
  Straight thermocouple assembly with metal or ceramic protection tube and accessories, including terminal heads

Test report and calibration

The "Factory calibration" is carried out according to an internal procedure in a laboratory of Endress+Hauser accredited by the European Accreditation Organization (EA) to ISO/IEC 17025.
A calibration which is performed according to EA guidelines (SIT/Accredia or DKD/DAkks calibration) may be requested separately. The calibration is performed on the replaceable insert of the thermometer. In the case of thermometers without a replaceable insert, the entire thermometer - from the process connection to the tip of the thermometer - is calibrated.

Ordering information

Detailed ordering information is available from the following sources:
- In the **Product Configurator** on the Endress+Hauser website:
  www.endress.com → Select country → Instruments → Select device → Product page function:
  Configure this product
- From your Endress+Hauser Sales Center:
  www.endress.com/worldwide

Product Configurator - the tool for individual product configuration:
- Up-to-the-minute configuration data
- Depending on the device: Direct input of measuring point-specific information such as measuring range or operating language
- Automatic verification of exclusion criteria
- Automatic creation of the order code and its breakdown in PDF or Excel output format
- Ability to order directly in the Endress+Hauser Online Shop

Documentation

Technical information:
High temperature assemblies
Omnigrad S TAF11, TAF12x, TAF16 (TI00251T/09/en)

www.addresses.endress.com

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