

Technical Information

iTHERM ModuLine TST90

Industrial modular thermometer



Paired metric RTD thermometers for thermal energy measurements

Field of application

- Universally usable for thermal energy measurements
- Measuring range: -50 to 400 °C (-58 to 752 °F)
- Sensors paired in the range:
 - 0 to 120 °C (± 0.05 K)
 - -40 to 0 °C (± 0.1 K)
- Protection class: Up to IP68

Benefits

- Quick replacement of the insert
- High degree of insert compatibility and design as per DIN 43772
- Fast response time with reduced tip

Function and system design

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Resistance thermometer (RTD)

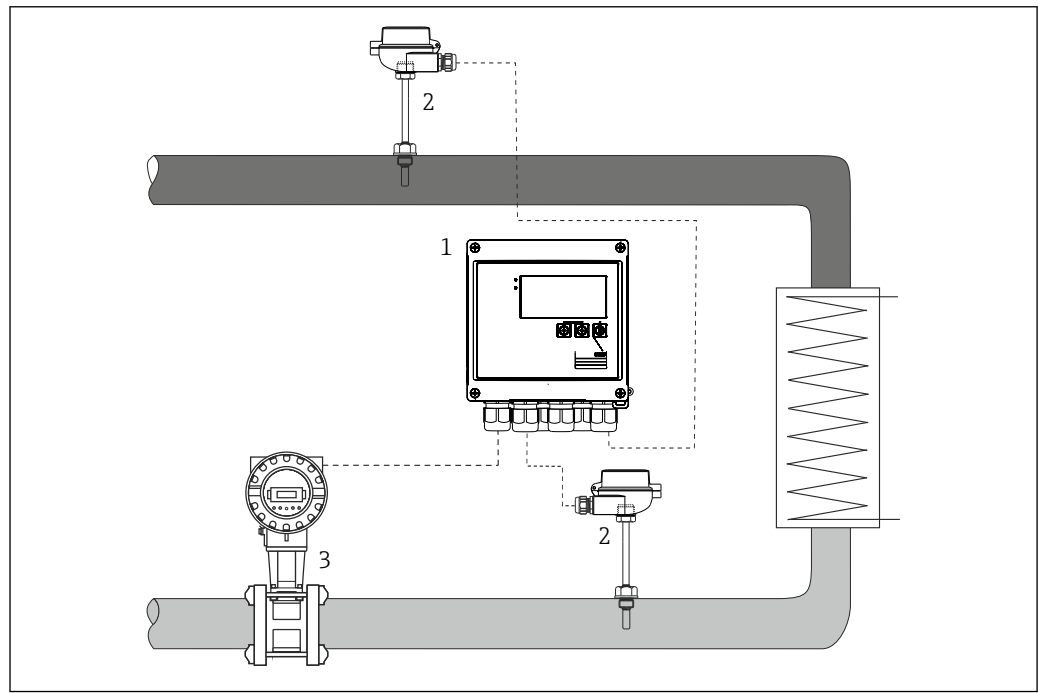
These resistance thermometers use a Pt100 element as the temperature sensor according to IEC 60751. The temperature sensor is a temperature-sensitive platinum resistor with a resistance of 100 Ω at 0 °C (32 °F) and a temperature coefficient $\alpha = 0.003851 \text{ } ^\circ\text{C}^{-1}$.

There are two different versions of platinum resistance thermometers:

- **Wire-wound (WW):**WW In these thermometers, a double coil of fine, high-purity platinum wire is accommodated in a ceramic support. This support is then sealed top and bottom with a ceramic protective layer. Such resistance thermometers not only facilitate highly reproducible measurements, but also exhibit good long-term stability in their resistance/temperature characteristic within temperature ranges up to 600 °C (1 112 °F). This type of sensor is relatively large in size and is comparatively sensitive to vibrations.
- **Thin-film platinum resistance thermometers (TF):** A very thin, ultrapure platinum layer, approx. 1 μm thick, is vaporized in a vacuum on a ceramic substrate and then structured photolithographically. The platinum conductor paths formed in this way create the measuring resistance. Additional covering and passivation layers are applied and reliably protect the thin platinum layer from contamination and oxidation, even at high temperatures.

The primary advantages of thin-film temperature sensors over wire-wound versions are their smaller dimensions and greater resistance to vibration. It should be noted that, due to the operating principle of TF sensors, they frequently exhibit a relatively small deviation in their resistance/temperature characteristic from the standard characteristic defined in IEC 60751 at higher temperatures. As a result, the narrow limit values of tolerance class A as per IEC 60751 can only be met by TF sensors at temperatures up to approx. 300 °C (572 °F).

Measuring system



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1 Application example

- 1 EngyCal® - BTU meter is used to measure heat and cold in systems with liquid heat carriers. It is easy to install and read. Thanks to its proven longterm stability and high-precision measurements, the device helps to optimize processes and control costs within the process. More information can be found in the Technical Information.
- 2 Mounted iTHERM ModuLine TST90 thermometer
- 3 Flowmeter

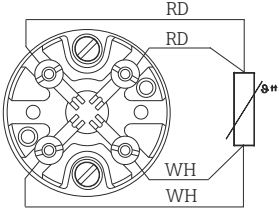
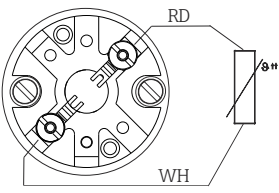
Input

Measuring range	Sensor type Pt100 (TF)	Tolerance	Measuring range	Connection type
	Matched sensor pairs	$\pm 0.05\text{ K}$ $\pm 0.1\text{ K}$	0 to 120 °C (32 to 248 °F) -40 to 0 °C (-40 to 32 °F)	2- or 4-wire 4-wire

Output

Output signal	Directly wired sensors: Sensor measured values forwarded without an iTEMP transmitter.
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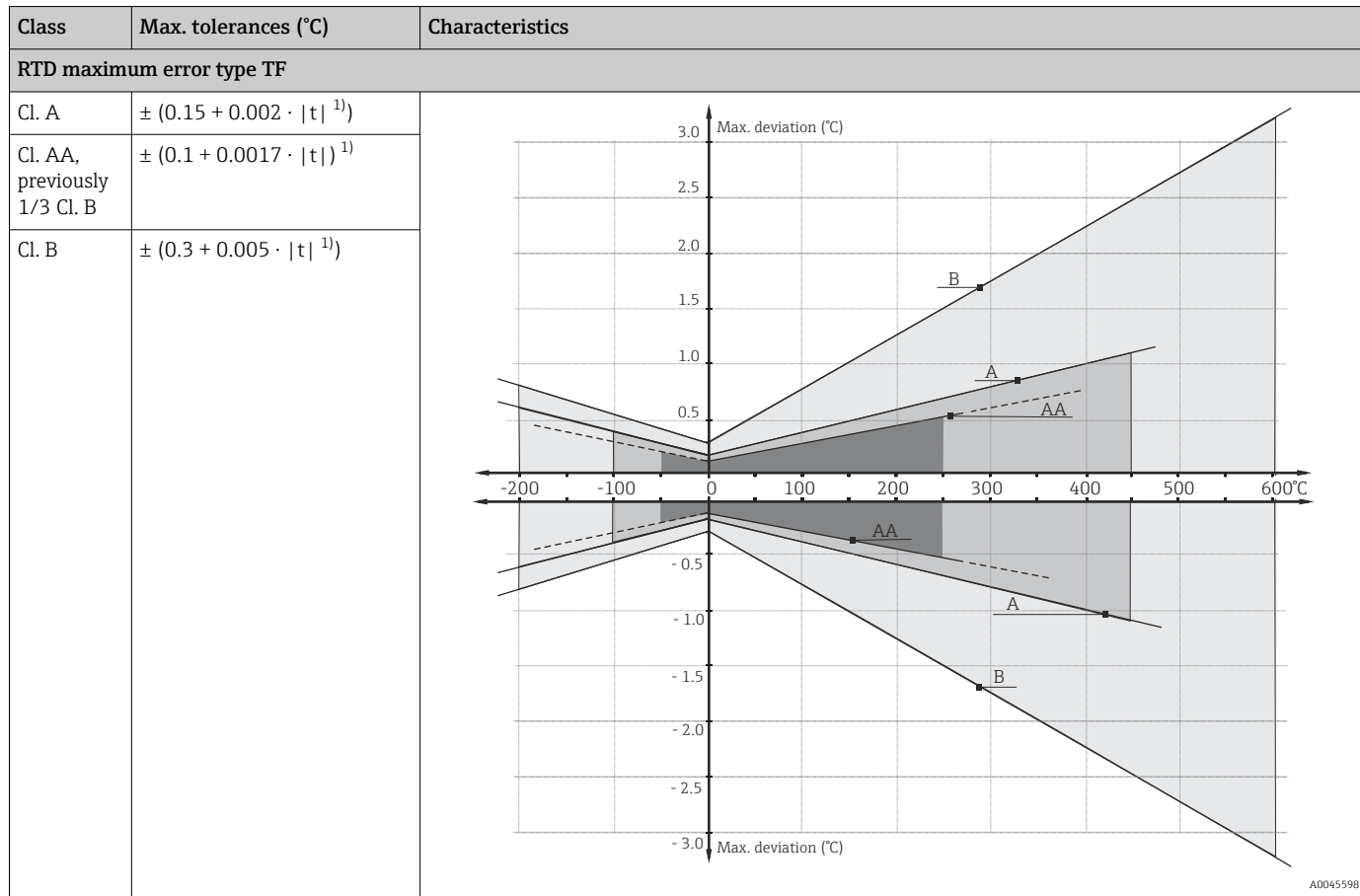
Electrical connection

Terminal assignment	Type of sensor connection
	Ceramic terminal block mounted 1 x Pt 100  A 1 x Pt 100  B A 4-wire B 2-wire A0062858

Performance characteristics

Maximum measurement error

RTD resistance thermometer as per IEC 60751



1) $|t|$ = Temperature absolute value in °C



To obtain the maximum tolerances in °F, multiply the results in °C by a factor of 1.8.

Response time

Calculated at an ambient temperature of approx. 23 °C by immersing in running water (0.4 m/s flow rate, 10 K excess temperature):

Type	$t_{(x)}$	Straight tip	Tapered tip
Resistance thermometer (measuring probe Pt100, TF/WW)	t_{50}	18 s	11 s
	t_{90}	55 s	37 s
TET90 insert	t_{50}	2.5 s	2 s
	t_{90}	5.5 s	5 s

Insulation resistance

Insulation resistance according to IEC 60751 > 100 MΩ at 25 °C, measured between the terminals and the extension neck with a minimum test voltage of 100 V DC

Self heating

RTD elements are passive resistances that are measured using an external current. This measurement current causes a self-heating effect in the RTD element itself which in turn creates an additional measurement error. In addition to the measurement current, the size of the measurement error is also affected by the temperature conductivity and flow velocity of the process. This self-

heating error is negligible when an Endress+Hauser iTEMP temperature transmitter (very small measurement current) is connected.

Calibration

Endress+Hauser provides a calibration at a comparison temperature of -80 to 600 °C (-110 to 1 112 °F) based on the International Temperature Scale (ITS90). Calibrations are traceable to national and international standards. The calibration certificate is referenced to the serial number of the thermometer. Only the insert is calibrated.

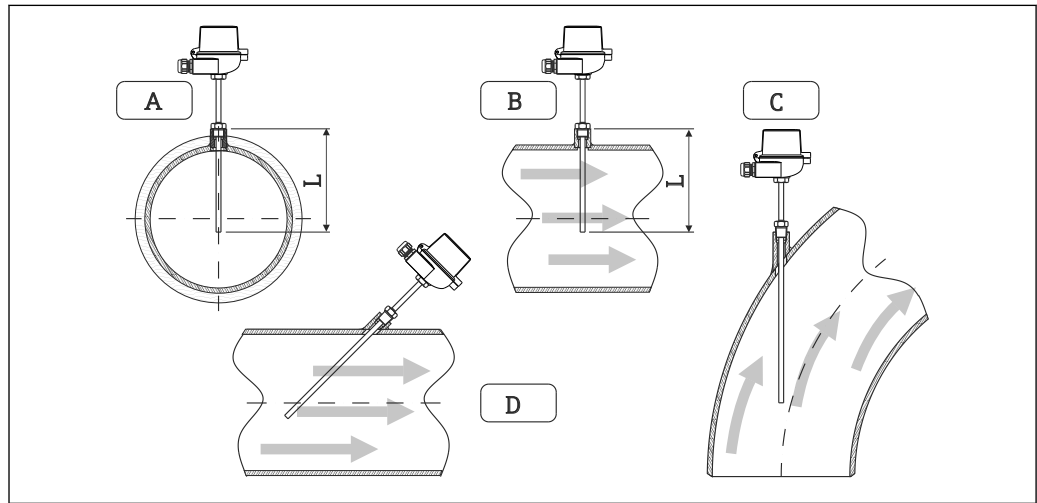
Insert: Ø6 mm (0.24 in) and 3 mm (0.12 in)	Minimum insertion length of insert in mm (in)	
Temperature range	without head transmitter	with head transmitter
-80 to -40 °C (-110 to -40 °F)	200 (7.87)	
-40 to 0 °C (-40 to 32 °F)	160 (6.3)	
0 to 250 °C (32 to 480 °F)	120 (4.72)	150 (5.91)
250 to 550 °C (480 to 1 020 °F)	300 (11.81)	
550 to 650 °C (1 020 to 1 202 °F)	400 (15.75)	

Installation

Orientation

No restrictions.

Installation instructions



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2 Installation examples

A - B In pipes with a small cross-section, the sensor tip should reach or extend slightly past the center axis of the pipe ($=L$).

C - D Slanted orientation.

The installation depth of the thermometer can influence the measurement accuracy. If the installation depth is insufficient, heat conduction via the process connection and the container wall can cause measurement errors. Therefore, if installing in a pipe the installation depth should ideally be half of the pipe diameter (see A and B). Installation at an angle (see C and D) could be another solution. When determining the immersion length or installation depth, all the parameters of the thermometer and of the process to be measured must be taken into account (e.g. flow velocity, process pressure).

- Installation options: Pipes, tanks or other plant components
- Recommended minimum immersion depth: 80 to 100 mm (3.15 to 3.94 in)
The immersion depth should correspond to at least 8 times the thermowell diameter. Example: Thermowell diameter 12 mm (0.47 in) $\times 8 = 96$ mm (3.8 in). A standard immersion depth of 120 mm (4.72 in) is recommended

Environment

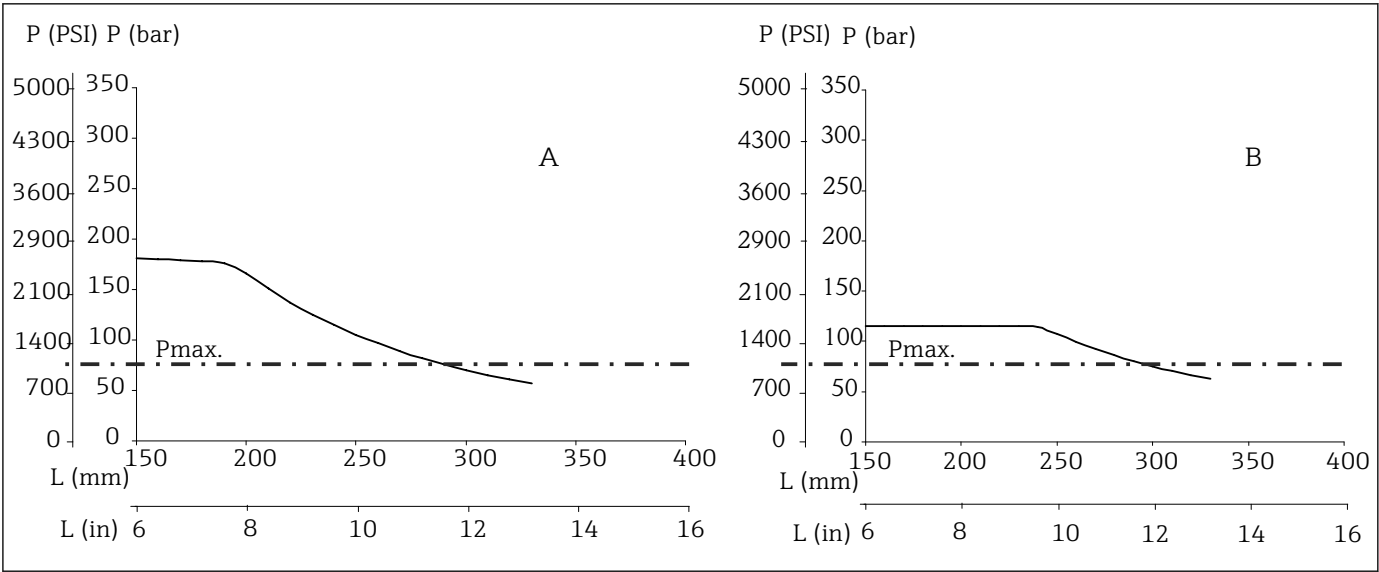
Shock and vibration resistance

The Endress+Hauser inserts exceed the requirements of IEC 60751, which specify shock and vibration resistance of 3 g in the range of 10 to 500 Hz.

Process

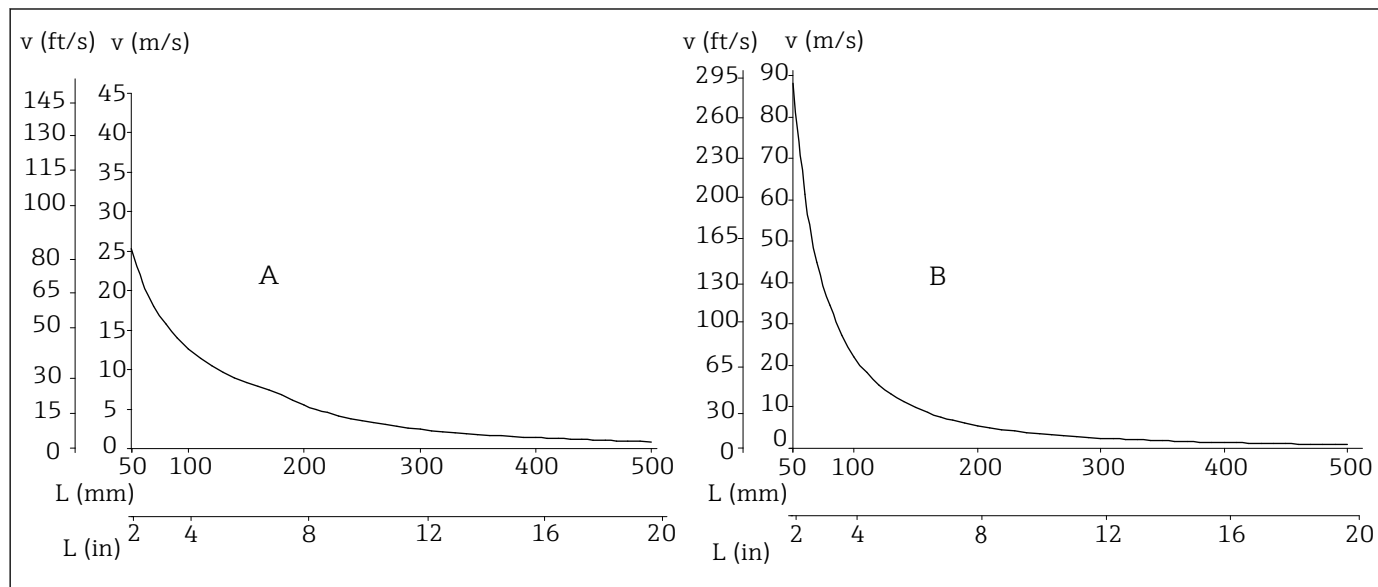
Process pressure range

The pressure values which the actual thermowell can be exposed to at the various temperatures and the maximum permitted flow velocity are illustrated in the figure below. The pressure loading capacity of the process connection can sometimes be considerably lower. The maximum permitted process pressure for a certain thermometer is derived from the lower pressure value of the thermowell and process connection!



Maximum flow velocity

The highest flow velocity tolerated by the thermometer diminishes with increasing sensor immersion depth exposed to the stream of the fluid. In addition, it is dependent on the diameter of the thermometer tip, the medium type, the process temperature and the process pressure. The following diagrams exemplify the maximum permitted flow velocities in water and superheated steam at a process pressure of 5 MPa (50 bar).



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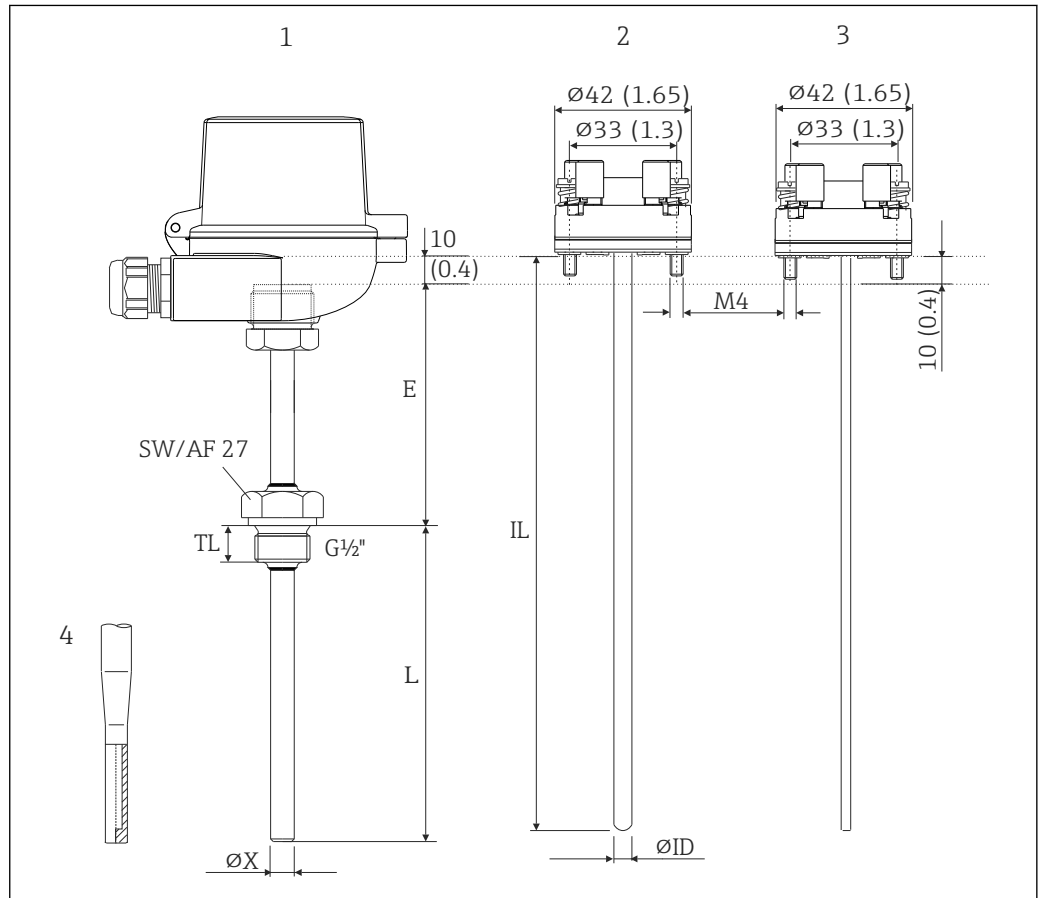
4 Permitted flow velocity

- A Medium water $T = 50\text{ °C}$ (122 °F)
- B Medium superheated steam at $T = 400\text{ °C}$ (752 °F)
- L Immersion length
- v Flow velocity
- Thermowell diameter $9 \times 1\text{ mm}$ (0.35 in)

Mechanical construction

Design and dimensions

All dimensions in mm (in)

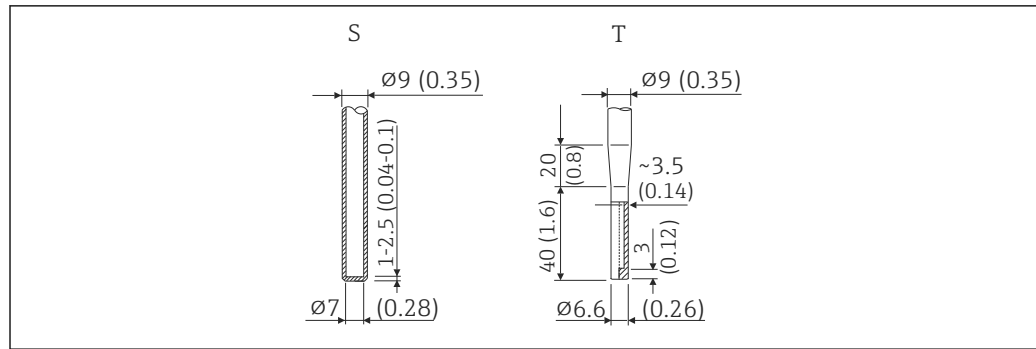


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5 Dimensions

- 1 Complete thermometer with terminal head
- 2 Insert with mounted terminal block (example with $\Phi 6$ mm (0.24 in))
- 3 Insert with mounted terminal block (example with $\Phi 3$ mm (0.12 in))
- 4 Tapered tip
- E Extension neck length $E = 145$ mm (5.71 in)
- ΦID Insert diameter
- IL Insertion length $= E + L + 10$ mm (0.4 in)
- L Immersion length
- AF Width across flats
- TL Thread length 15 mm (0.6 in)
- ΦX Thermowell diameter

Shape of tip



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6 Available tip shapes (straight or tapered). Maximum surface roughness $R_a \leq 0.8 \mu\text{m}$ (31.5 μin)

Item	Tip shape, L = immersion depth	insert ϕ	Outer diameter ϕD
S	Straight	6 mm (0.24 in)	9 mm (0.35 in)
T	Tapered, L $\geq$ 90 mm (3.54 in)	3 mm (0.12 in)	9 mm (0.35 in)

Terminal heads

All terminal heads have an internal shape and size in accordance with DIN EN 50446, flat face and a thermometer connection of M24x1.5, G 1/2" or 1/2" NPT thread. All dimensions in mm (in). The cable glands in the diagrams correspond to M20x1.5 connections. Specifications without head transmitter installed. For ambient temperatures with head transmitter installed, see the "Operating conditions" section.

TA30A	Specification
	- Degree of protection: - IP66/68 (NEMA Type 4x encl.) - For ATEX: IP66/67 - Temperature: -50 to 150 °C (-58 to 302 °F) without cable gland - Material: aluminum, polyester powder coated - Seals: silicone - Threaded cable entry: G 1/2", NPT 1/2" and M20x1.5; - Head color: blue, RAL 5012 - Cap color: gray, RAL 7035 - Weight: 330 g (11.64 oz) - Ground terminal, internal and external - Available with sensors with 3-A® symbol

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TA30D	Specification
	- Degree of protection: - IP66/68 (NEMA Type 4x encl.) - For ATEX: IP66/67 - Temperature: -50 to 150 °C (-58 to 302 °F) without cable gland - Material: aluminum, polyester powder coated - Seals: silicone - Threaded cable entry: G 1/2", NPT 1/2" and M20x1.5 - Two head transmitters can be mounted. In the standard configuration one transmitter is mounted in the terminal head cover and an additional terminal block is installed directly on the insert. - Head color: blue, RAL 5012 - Cap color: gray, RAL 7035 - Weight: 390 g (13.75 oz) - Ground terminal, internal and external - Available with sensors with 3-A® symbol

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Maximum ambient temperatures for cable glands	
Type	Temperature range
Cable gland ½" NPT, M20x1.5 (non Ex)	-40 to 100 °C (-40 to 212 °F)

Spare parts

- The thermowell is available as spare part iTHERM ModuLine TT131.
- The M21-G ½" seal, copper, is available as a spare part.
- The paired RTD inserts are available as spare part TET90.

If inserts are required as spare parts, please note the following equation:

$$\text{Insertion length IL} = E + L + 10 \text{ mm (0.4 in)}$$

Materials

Extension neck and thermowell.

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 under negligible compressive load. The maximum operating temperatures are reduced considerably in some cases where abnormal conditions such as high mechanical loads occur, or in aggressive media.

Designation	Short form	Recommended max. continuous operating temperature in air	Properties
AISI 316Ti/ 1.4571	X6CrNiMoTi17-12-2	700 °C (1292 °F) ¹⁾	■ Properties comparable with AISI 316L ■ The addition of titanium increases resistance to intergranular corrosion even after welding ■ Broad range of uses in the chemical, petrochemical and oil industries as well as in coal chemistry ■ Can only be polished to a limited extent, titanium streaks can form

- 1) Can be used to a limited extent up to 800 °C (1472 °F) for low compressive loads and in non-corrosive media. Please contact your Endress+Hauser Sales Center for further information.

Certificates and approvals

Current certificates and approvals for the product are available at www.endress.com on the relevant product page:

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Downloads**.

Ordering information

Detailed ordering information is available from your nearest sales organization www.addresses.endress.com or in the Product Configurator at www.endress.com:

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Configuration**.

Accessories

The accessories currently available for the product can be selected at www.endress.com:

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Spare parts & Accessories**.

Device-specific accessories

- Heat sink compound HSC 340, 100 g
- FDA-compliant heat sink compound 30 g

Service-specific accessories

Configurator

Product Configurator - the tool for individual product configuration

- Up-to-the-minute configuration data
- Depending on the device: direct input of information specific to the measuring point, such as the 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

The Configurator is available at www.endress.com on the relevant product page:

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Configuration**.

Documentation



For an overview of the scope of the associated Technical Documentation, refer to the following:

- *Device Viewer* (www.endress.com/deviceviewer): Enter the serial number from the nameplate
- *Endress+Hauser Operations App*: Enter the serial number from the nameplate or scan the matrix code/QR code on the nameplate

The following document types are available in the Downloads area of the Endress+Hauser website (www.endress.com/downloads), depending on the device version:

Document type	Purpose and content of the document
Technical Information (TI)	Planning aid This document contains all the technical data on the product and provides an overview of everything that can be ordered with the product.
Brief Operating Instructions (KA)	Guide that takes you quickly to the 1st measured value The Operating Instructions contain all the essential information about the product from incoming acceptance to initial commissioning.
Operating Instructions (BA)	Reference document The Operating Instructions contain the information that is required in the various phases of the life cycle of the product: From product identification, incoming acceptance and storage, to mounting, connection, operation and commissioning through to troubleshooting, maintenance and disposal.
Description of Device Parameters (GP)	Reference for parameters The document contains detailed explanations of readable or configurable parameters in the product. The description is aimed at those who work with the product over its entire life cycle and perform specific configurations.

Document type	Purpose and content of the document
Safety Instructions (XA)	Safety Instructions for electrical equipment in hazardous areas are supplied with the product depending on the approval. These are an integral part of the Operating Instructions.  The nameplate indicates the Safety Instructions (XA) that are relevant to the product.
Supplementary device-dependent documentation (SD/CY/ FY)	Always comply strictly with the instructions in the relevant supplementary documentation. The supplementary documentation is an integral part of the product documentation.



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