

# Technical Information

## TR66, TC66

Modular thermometer, explosion-protected,  
barstock thermowell, with thread or flange



TR66 Resistance thermometer (RTD)  
TC66 Thermometer with thermocouple (TC)

### Applications

- Heavy duty applications
- Oil & Gas processing industry
- Measuring range:
  - Resistance insert (RTD): -200 to 600 °C (-328 to 1 112 °F)
  - Thermocouple (TC): -40 to 1 100 °C (-40 to 2 012 °F)
- Static pressure range up to 100 bar (1 450 psi)
- Degree of protection up to IP68

### Head transmitter

All Endress+Hauser transmitters are available with enhanced accuracy and reliability compared to directly wired sensors. Easy customizing by choosing one of the following outputs and communication protocols:

- Analog output 4 to 20 mA
- HART®
- PROFIBUS® PA
- FOUNDATION Fieldbus™

### Your benefits

- High degree of flexibility thanks to modular design with standard terminal heads as per DIN EN 50446 and customer-specific immersion lengths
- High degree of insert compatibility and design as per DIN 43772
- Extension neck, nipple union version, to protect the head transmitter from overheating
- Types of protection for use in hazardous locations:
  - Intrinsic Safety (Ex ia)
  - Flameproof (Ex d)
  - Non-sparking (Ex nA)
  - Dust ignition proof (protection by enclosure)

## Function and system design

### Measuring principle

#### Resistance thermometers (RTD)

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

**There are generally two different kinds of platinum resistance thermometers:**

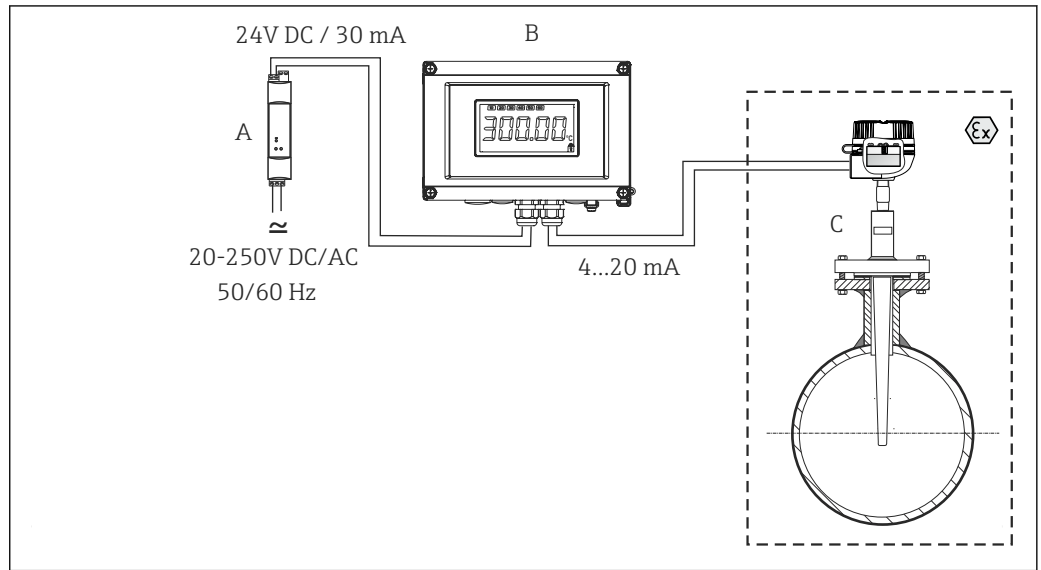
- **Wire-wound (WW):**WW In these thermometers, a double coil of fine, high-purity platinum wire is accommodated in a ceramic support. This support is then sealed top and bottom with a ceramic protective layer. Such resistance thermometers not only facilitate very reproducible measurements but also offer good long-term stability of the 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  $\mu\text{m}$  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 sizes and better vibration resistance. It should be noted that, due to the operating principle of TF sensors, they frequently exhibit a relatively slight deviation in their resistance/temperature characteristic from the standard characteristic defined in IEC 60751 at higher temperatures. As a result, the tight limit values of tolerance class A as per IEC 60751 can only be observed with TF sensors at temperatures up to approx. 300 °C (572 °F).

#### Thermocouples (TC)

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.

## Measuring system

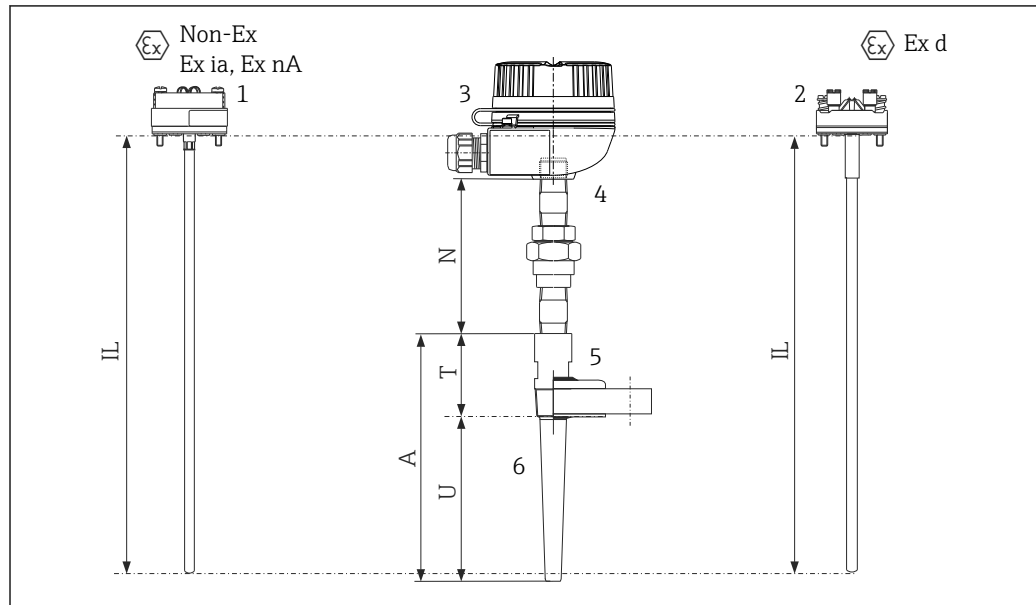


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1 Application example

- A The RN221N active barrier (24 V DC, 30 mA) has a galvanically isolated output for powering 2-wire transmitters. The universal power supply works with an input supply voltage of 20 to 250 V DC/AC, 50/60 Hz, which means that it can be used in all international power grids. More information on this can be found in the Technical Information (see "Supplementary Documentation").
- B RIA16 field display unit - The display unit records the analog measuring signal from the head transmitter and shows this on the display. The LC display shows the current measured value in digital form and as a bar graph indicating a limit value violation. The indicator is looped into the 4 to 20 mA circuit and gets the required energy from there. More information on this can be found in the Technical Information (see "Supplementary Documentation").
- C Mounted thermometer with head transmitter installed.

## Modular design



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2 Thermometer design

- 1 Insert with mounted head transmitter (example)
- 2 Insert with mounted ceramic terminal block (example)
- 3 Terminal head
- 4 Extension neck
- 5 Threaded or flanged process connection
- 6 Thermowell from round barstock material
- N Extension neck length
- T Thermowell lagging
- U Immersion length
- A Thermowell length
- IL Insertion length

The terminal head is used as a connection module for the extension neck and for the mechanical and electrical connection of the insert. The position of the actual thermometer sensor in the insert ensures that it is mechanically protected. The insert can be replaced or calibrated without interrupting the process. Either a ceramic block or a transmitter can be fitted on the internal terminal block. If required, the thermowell can be supplied with a flanged or threaded process connection.

## Input

### Measured variable

Temperature (temperature-linear transmission behavior)

### Measuring range

Depends on the type of sensor used

Sensor type	Measuring range
Pt100 thin-film	-50 to +400 °C (-58 to +752 °F)
Pt100 thin-film, iTHERM StrongSens, vibration-resistant > 60g	-50 to +500 °C (-58 to +932 °F)
Pt100 wire wound, extended measuring range	-200 to +600 °C (-328 to +1 112 °F)
Thermocouple TC, type J	-40 to +750 °C (-40 to +1 382 °F)
Thermocouple TC, type K	-40 to +1 100 °C (-40 to +2 012 °F)

## Output

### Output signal

The measured values can be transmitted in two ways:

- Via directly-wired sensors: sensor measured values are forwarded without an iTEMP transmitter.
- By selecting the appropriate iTEMP transmitter via all common protocols.



All iTEMP transmitters are mounted directly in the terminal head and wired with the sensory mechanism.

### Family of temperature transmitters

Thermometers fitted with iTEMP transmitters are an installation-ready complete solution to improve temperature measurement by significantly increasing measurement accuracy and reliability, when compared to direct wired sensors, as well as reducing both wiring and maintenance costs.

#### 4 to 20 mA head transmitters

They offer a high degree of flexibility, thereby supporting universal application with low inventory storage. The iTEMP transmitters can be configured quickly and easily at a PC. Endress+Hauser offers free configuration software which can be downloaded from the Endress+Hauser Website.

#### HART® head transmitters

The iTEMP transmitter is a 2-wire device with one or two measuring inputs and one analog output. The device not only transfers converted signals from resistance thermometers and thermocouples, it also transfers resistance and voltage signals using HART® communication. Swift and easy operation, visualization and maintenance using universal configuration software like FieldCare, DeviceCare or FieldCommunicator 375/475. Integrated Bluetooth® interface for the wireless display of measured values and configuration via Endress +Hauser SmartBlue (app), optional.

#### PROFIBUS® PA head transmitters

Universally programmable iTEMP transmitter with PROFIBUS® PA communication. Conversion of various input signals into digital output signals. High measurement accuracy over the complete ambient temperature range. PROFIBUS PA functions and device-specific parameters are configured via fieldbus communication.

#### FOUNDATION Fieldbus™ head transmitter

Universally programmable iTEMP transmitter with FOUNDATION Fieldbus™ communication. Conversion of various input signals into digital output signals. High measurement accuracy over the complete ambient temperature range. All iTEMP are approved for use in all the main process control systems. The integration tests are performed in Endress+Hauser's 'System World'.

#### Head transmitter with PROFINET® and Ethernet-APL™

The iTEMP transmitter is a 2-wire device with two measuring inputs. The device not only transfers converted signals from resistance thermometers and thermocouples, it also transfers resistance and voltage signals using the PROFINET® protocol. Power is supplied via the 2-wire Ethernet connection according to IEEE 802.3cg 10Base-T1. The iTEMP can be installed as an intrinsically safe electrical apparatus in Zone 1 hazardous areas. The device can be used for instrumentation purposes in the terminal head form B (flat face) according to DIN EN 50446.

#### Head transmitter with IO-Link®

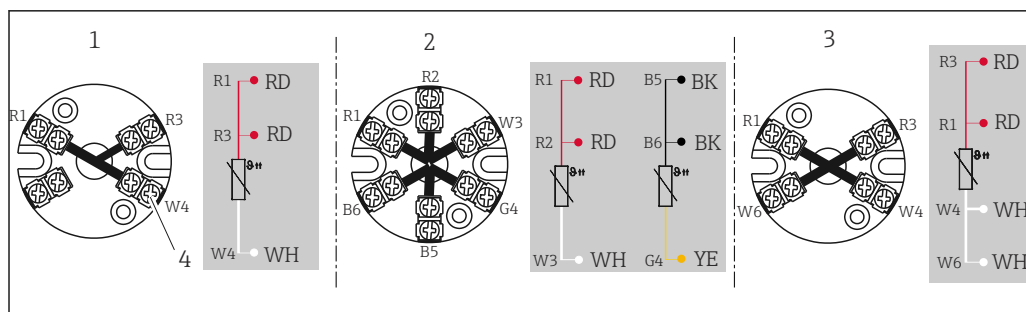
The iTEMP transmitter is an IO-Link® device with a measurement input and an IO-Link® interface. It offers a configurable, simple and cost-effective solution thanks to digital communication via IO-Link®. The device is mounted in a terminal head form B (flat face) as per DIN EN 5044.

#### Advantages of the iTEMP transmitters:

- Double or single sensor input (optionally for certain transmitters)
- Attachable display (optionally for certain transmitters)
- Unsurpassed reliability, accuracy and long-term stability in critical processes
- Mathematical functions
- Monitoring of the thermometer drift, sensor backup functionality, sensor diagnostic functions
- Sensor-transmitter-matching based on the Callendar van Dusen coefficients (CvD).

## Power supply

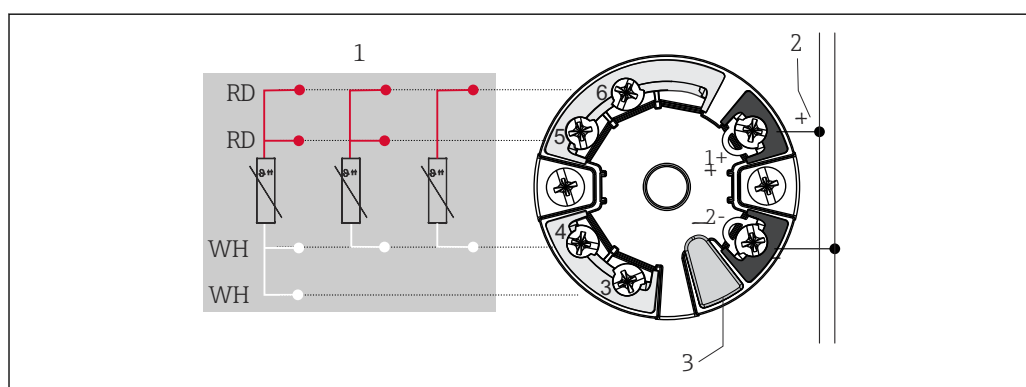
### RTD sensor connection type



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3 Ceramic terminal block mounted

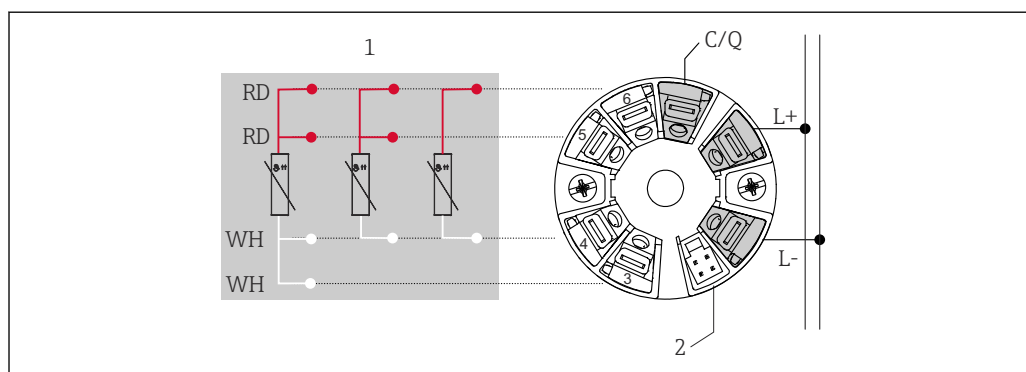
- 1 3-wire, single
- 2 2 x 3-wire, single
- 3 4-wire, single
- 4 Outside screw



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4 Head-mounted iTEMP TMT7x transmitter or iTEMP TMT31 (single sensor input)

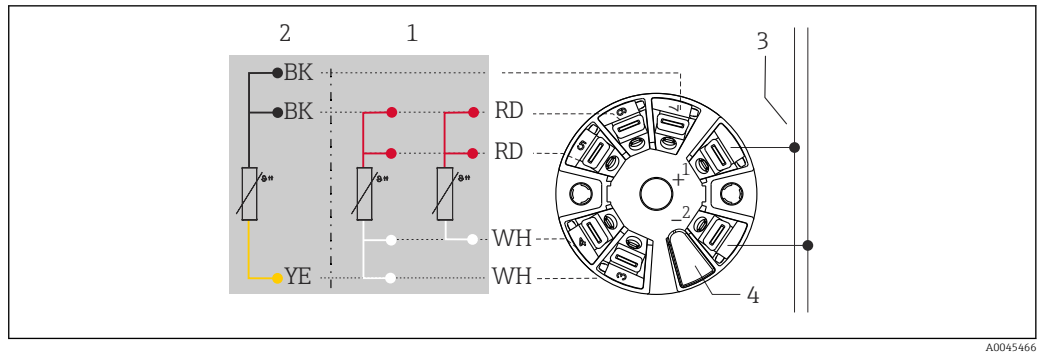
- 1 Sensor input, RTD, 4-, 3- and 2-wire
- 2 Power supply/bus connection
- 3 Display connection/CDI interface



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5 Head-mounted iTEMP TMT36 transmitter (single sensor input)

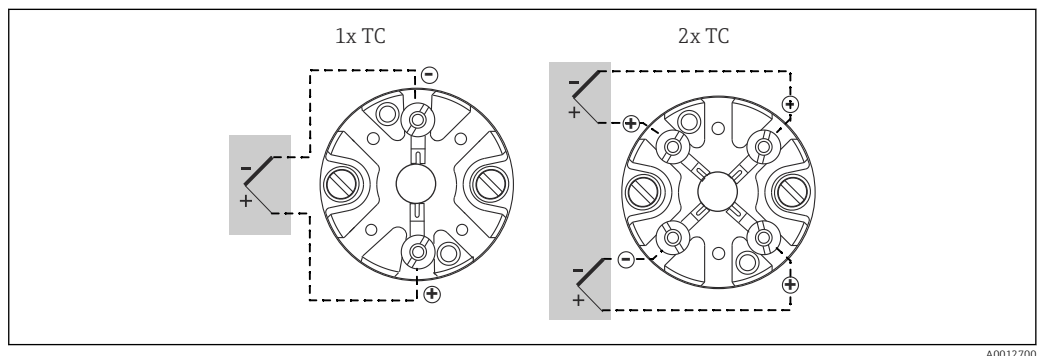
- 1 RTD sensor input: 4-, 3- and 2-wire
- 2 Display connection
- L+ 18 to 30 V<sub>DC</sub> power supply
- L- 0 V<sub>DC</sub> power supply
- C/Q IO-Link or switch output



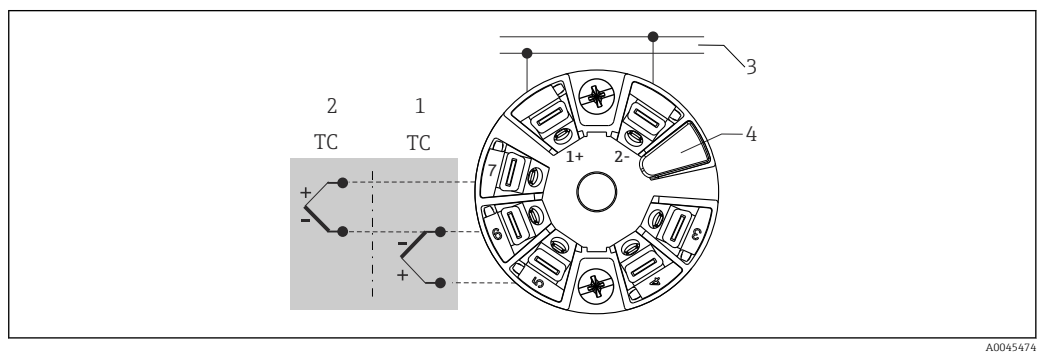
6 Head-mounted iTEMP TMT8x transmitter (dual sensor input)

- 1 Sensor input 1, RTD, 4- and 3-wire
- 2 Sensor input 2, RTD, 3-wire
- 3 Fieldbus connection and power supply
- 4 Display connection

### Thermocouple (TC) sensor connection type



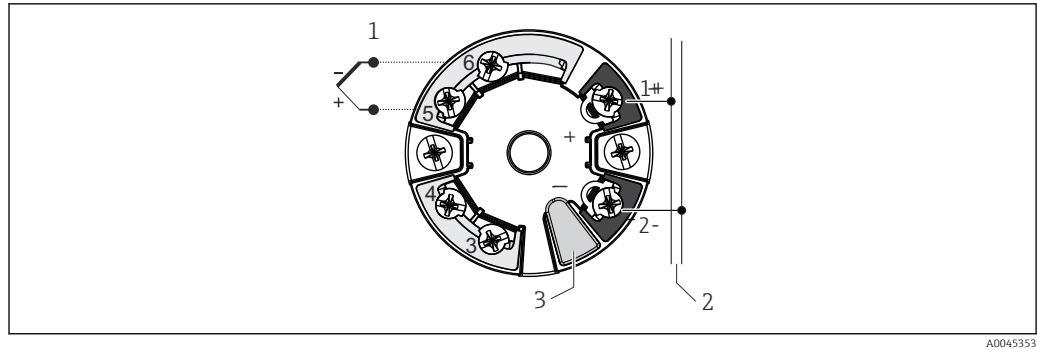
7 Terminal block mounted



8 Head-mounted transmitter TMT8x (dual sensor input)

- 1 Sensor input 1
- 2 Sensor input 2
- 3 Fieldbus communication and power supply
- 4 Display connection

Fitted with push-in terminals unless screw terminals are selected separately or a dual sensor is installed.

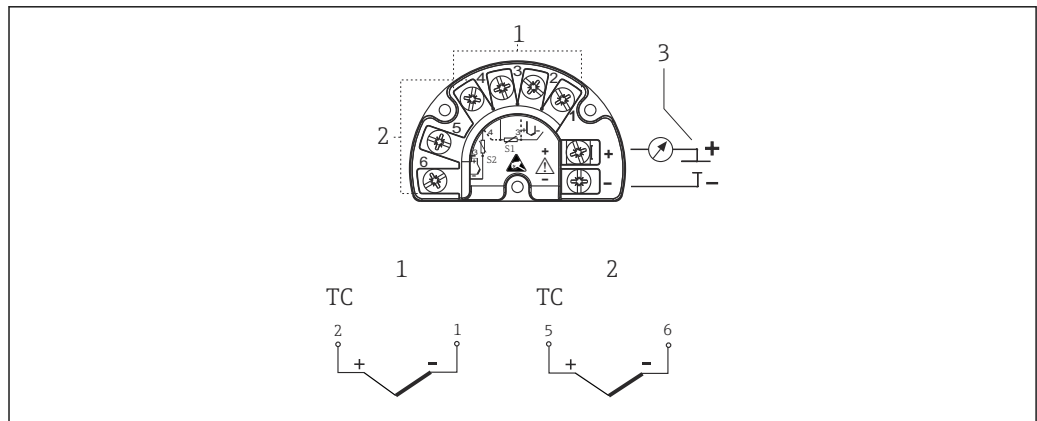


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9 Head-mounted transmitter TMT7x (single input)

- 1 Sensor input TC, mV
- 2 Power supply, bus connection
- 3 Display connection/CDI interface

Fitted with push-in terminals unless screw terminals are selected separately or a dual sensor is installed.



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10 Mounted field transmitter TMT162 or TMT142B

- 1 Sensor input 1
- 2 Sensor input 2 (not TMT142B)
- 3 Supply voltage for field transmitter and analog output 4 to 20 mA or fieldbus communication

#### Thermocouple wire colors

As per IEC 60584	As per ASTM E230
<ul style="list-style-type: none"> <li>■ Type J: black (+), white (-)</li> <li>■ Type K: green (+), white (-)</li> <li>■ Type N: pink (+), white (-)</li> </ul>	<ul style="list-style-type: none"> <li>■ Type J: white (+), red (-)</li> <li>■ Type K: yellow (+), red (-)</li> <li>■ Type N: orange (+), red (-)</li> </ul>

#### Overvoltage protection

To protect against overvoltage in the power supply and signal/communication cables for the thermometer electronics, Endress+Hauser offers the HAW562 surge arrester for DIN rail mounting and the HAW569 for field housing installation.



For more information see the Technical Information "HAW562 Surge arrester" TI01012K and "HAW569 Surge arrester" TI01013K.



# Performance characteristics

## Measurement accuracy

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

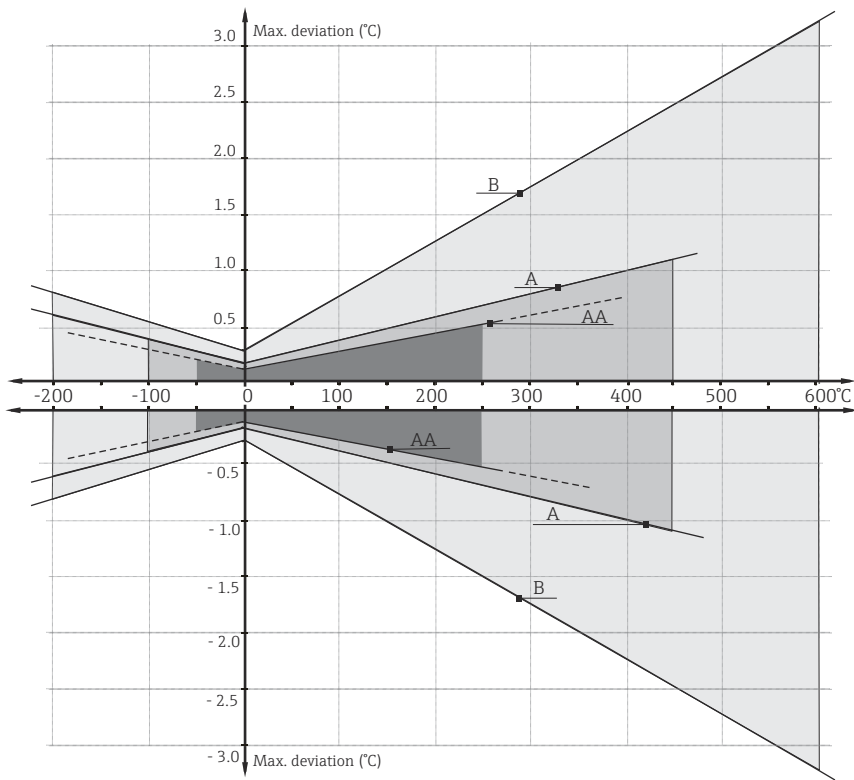
Standard	Type	Standard tolerance		Special tolerance	
IEC 60584		Class	Deviation	Class	Deviation
	J (Fe-CuNi)	2	$\pm 2.5^{\circ}\text{C}$ ( $-40$ to $333^{\circ}\text{C}$ ) $\pm 0.0075  t ^{1)}$ ( $333$ to $750^{\circ}\text{C}$ )	1	$\pm 1.5^{\circ}\text{C}$ ( $-40$ to $375^{\circ}\text{C}$ ) $\pm 0.004  t ^{1)}$ ( $375$ to $750^{\circ}\text{C}$ )
	K (NiCr-NiAl)	2	$\pm 2.5^{\circ}\text{C}$ ( $-40$ to $333^{\circ}\text{C}$ ) $\pm 0.0075  t ^{1)}$ ( $333$ to $1200^{\circ}\text{C}$ )	1	$\pm 1.5^{\circ}\text{C}$ ( $-40$ to $375^{\circ}\text{C}$ ) $\pm 0.004  t ^{1)}$ ( $375$ to $1000^{\circ}\text{C}$ )

1)  $|t|$  = temperature absolute value in  $^{\circ}\text{C}$

Standard	Type	Standard tolerance	Special tolerance
ASTM E230/ANSI MC96.1		Deviation; the larger value applies in each case	
	J (Fe-CuNi)	$\pm 2.2\text{ K}$ or $\pm 0.0075  t ^{1)}$ ( $0$ to $760^{\circ}\text{C}$ )	$\pm 1.1\text{ K}$ or $\pm 0.004  t ^{1)}$ ( $0$ to $760^{\circ}\text{C}$ )
	K (NiCr-NiAl)	$\pm 2.2\text{ K}$ or $\pm 0.02  t ^{1)}$ ( $-200$ to $0^{\circ}\text{C}$ ) $\pm 2.2\text{ K}$ or $\pm 0.0075  t ^{1)}$ ( $0$ to $1260^{\circ}\text{C}$ )	$\pm 1.1\text{ K}$ or $\pm 0.004  t ^{1)}$ ( $0$ to $1260^{\circ}\text{C}$ )

1)  $|t|$  = absolute temperature value in  $^{\circ}\text{C}$

RTD resistance thermometer as per IEC 60751

Class	Max. tolerances ( $^{\circ}\text{C}$ )	Characteristics
RTD maximum error type TF		
Cl. A	$\pm (0.15 + 0.002 \cdot  t ^{1)})$	
Cl. AA, previously 1/3 Cl. B	$\pm (0.1 + 0.0017 \cdot  t ^{1)})$	
Cl. B	$\pm (0.3 + 0.005 \cdot  t ^{1)})$	

1)  $|t|$  = Temperature absolute value in  $^{\circ}\text{C}$



For measurement errors in °F, calculate using equation above in °C, then multiply the outcome by 1.8.

### 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.

### Response time

Calculated according to IEC 60751 at an ambient temperature of approx. 23 °C by immersing in running water (0.4 m/s flow rate, 10 K excess temperature):

Ø Q1 thermowell	Ø Q2 tapered tip	Response time	
20 mm (0.79 in)	14 mm (0.55 in)	t <sub>50</sub> t <sub>90</sub>	34 s 105 s
25 mm (0.98 in)	18 mm (0.71 in)	t <sub>50</sub> t <sub>90</sub>	37 s 115 s



Response time for insert without transmitter.

### Calibration

Endress+Hauser provides a calibration at a comparison temperature of –80 to +1 400 °C (–110 to +2 552 °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: Ø 6 mm (0.24 in)	Minimum insertion length of insert in mm (in)	
Temperature range	without head transmitter	with head transmitter
–80 to 250 °C (–110 to 480 °F)	No minimum immersion length required	
250 to 550 °C (480 to 1020 °F)	300 (11.81)	
550 to 1400 °C (1020 to 2 552 °F)	450 (17.72)	

### Insulation resistance

Insulation resistance  $\geq 100 \text{ M}\Omega$  at ambient temperature.

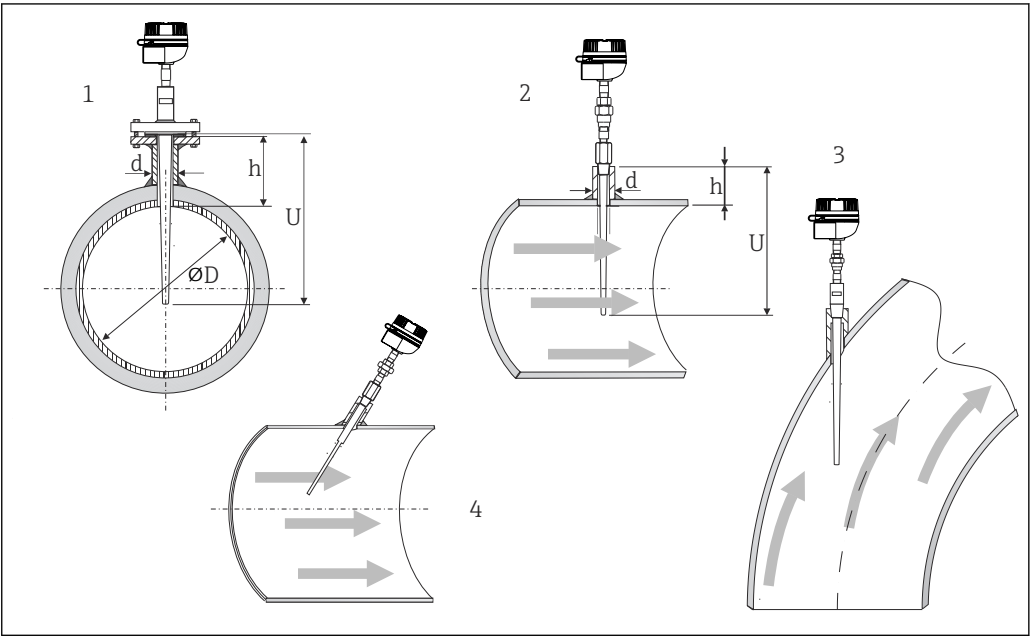
Insulation resistance between the terminals and the tube is measured with a voltage of 100 V DC.

## Installation

### Orientation

No restrictions.

Installation instructions



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11 Installation examples

- 1 - 2 In pipes with a small cross-section, the sensor tip should reach or extend slightly past the center axis of the pipe ( $=U$ ).
- 3 - 4 Slanted orientation.

The immersion length of the thermometer influences the measurement accuracy. If the immersion length is too small, measurement errors are caused by heat conduction via the process connection and the container wall. If installing into a pipe then the immersion length should be at least half of the pipe diameter. Installation at an angle (see item 3 and 4) 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).

For the best installation, apply the following rule:  $h \sim d$ ;  $U > D/2 + h$ . As far as corrosion is concerned, the base material for parts in contact with the fluid is able to withstand the most common corrosive media up to the high temperature range. For further information on specific applications, please contact the Endress+Hauser sales organization.

The counterparts for process connections and seals are not supplied with the thermometer and must be ordered separately if needed.

Environment

Ambient temperature range	Terminal head	Temperature in °C (°F)
	Without mounted head transmitter	Depends on the terminal head used and the cable gland or fieldbus connector; see "Terminal heads" section. → 17
	With mounted iTEMP head transmitter	-40 to +85 °C (-40 to +185 °F)
	With mounted iTEMP head transmitter and display	-30 to +85 °C (-22 to 185 °F)

**Shock and vibration resistance**

The Endress+Hauser inserts exceed the requirements of IEC 60751 with regard to shock and vibration resistance of 3g in a range of 10 to 500 Hz. The vibration resistance of the measuring point depends on the sensor type and design. Refer to the following table:

Sensor type	Vibration resistance for the sensor tip
Pt100 (WW)	> 30 m/s <sup>2</sup> (3g)
Pt100 (TF), enhanced vibration resistance	> 40 m/s <sup>2</sup> (4g)
iTHERM StrongSens Pt100 (TF)	> 600 m/s <sup>2</sup> (60g)
Thermocouple inserts	> 30 m/s <sup>2</sup> (3g)

**Electromagnetic compatibility (EMC)**

Depends on the head transmitter used. For details see the Technical Information.

## Process

**Process temperature range**

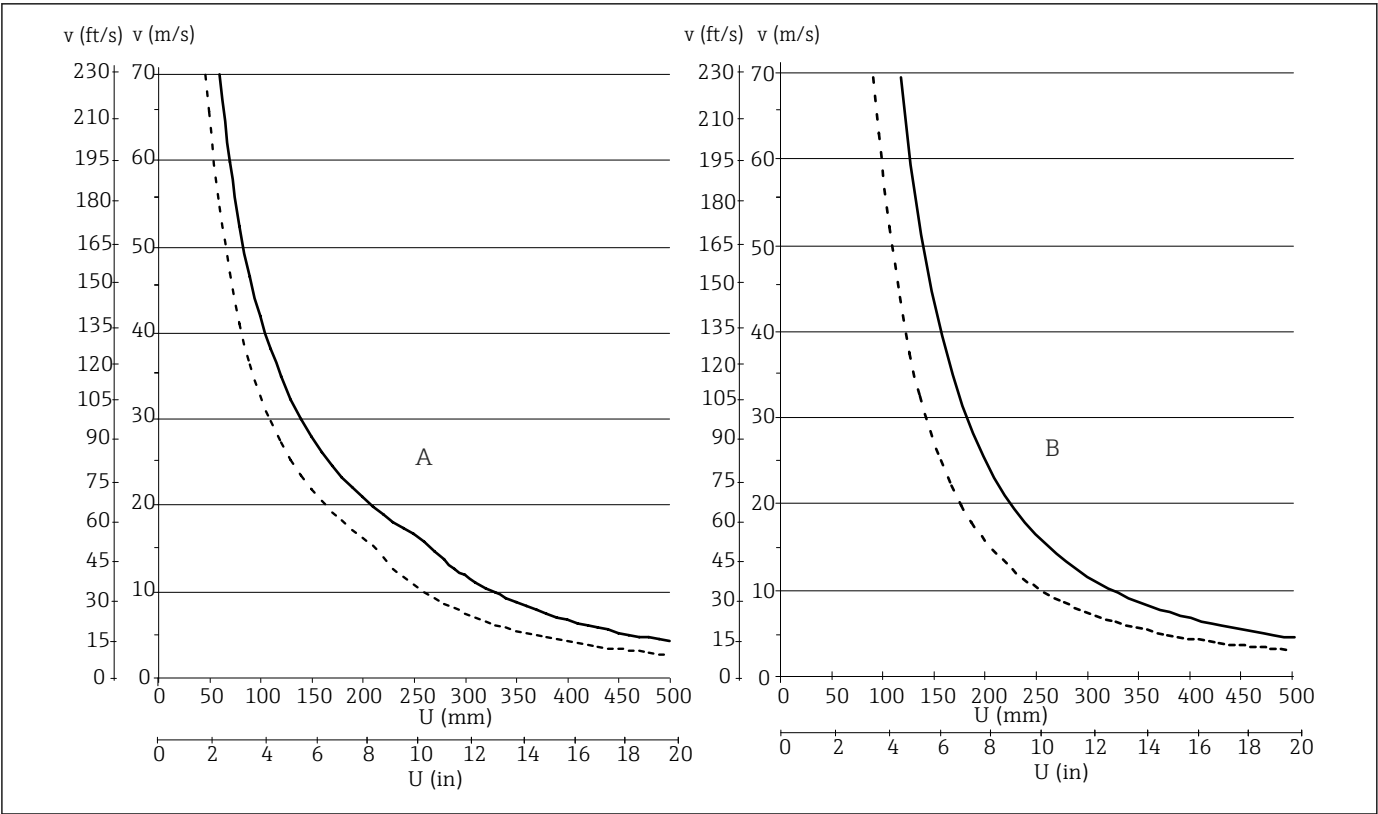
Depends on the sensor type and the material of the thermowell used, max.  
-200 to +1 100 °C (-328 to +2 012 °F)

**Process pressure range**

Process connection	Standard	Max. process pressure
Thread	ANSI B1.20.1	75 bar (1 088 psi)
Flange	ASME B16.5	Depending on flange pressure rating 150, 300 or 600 lb

**Permitted flow velocity depending on the immersion length**

The highest flow velocity tolerated by the thermometer diminishes with increasing sensor immersion length 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 4 MPa (40 bar).



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12 Permitted flow velocity

A Medium water at  $T = 50\text{ °C}$  ( $122\text{ °F}$ )

B Medium superheated steam at  $T = 400\text{ °C}$  ( $752\text{ °F}$ )

$U$  Immersion length of the thermowell, material 1.4401 (316)

$v$  Flow velocity

----- Thermowell diameter with  $\phi D1 = 35\text{ mm}$  ( $1.38\text{ in}$ ),  $\phi Q1 = 25\text{ mm}$  ( $0.98\text{ in}$ ),  $\phi Q2 = 18\text{ mm}$  ( $0.71\text{ in}$ )

- - - Thermowell diameter with  $\phi D1 = 30\text{ mm}$  ( $1.18\text{ in}$ ),  $\phi Q1 = 20\text{ mm}$  ( $0.8\text{ in}$ ),  $\phi Q2 = 14\text{ mm}$  ( $0.55\text{ in}$ )

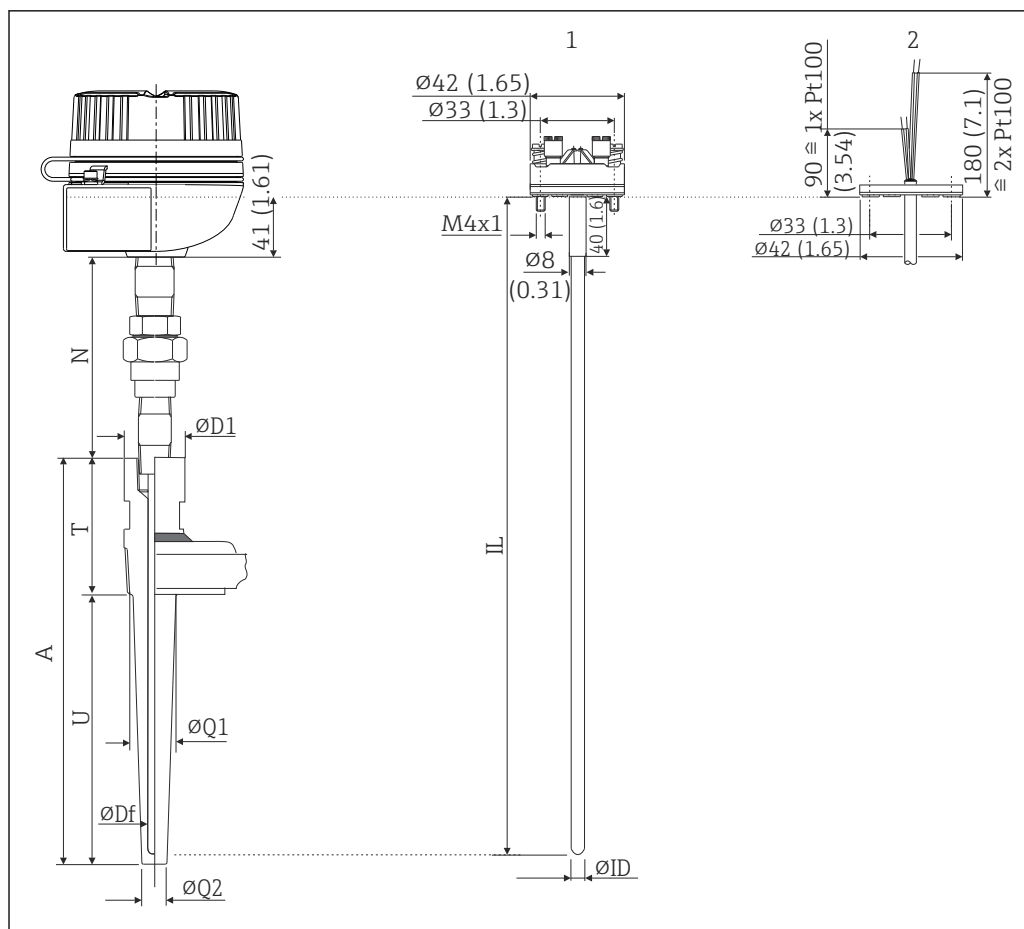


Information on the thermowell dimensions  $\phi Q1$ ,  $\phi Q2$ ,  $\phi D1$ ,  $\phi Df$  and  $U$ ,

## Mechanical construction

### Design, dimensions

All dimensions in mm (in).



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13 Dimensions of the TX66

1 Insert with terminal block mounted

2 Insert with flying leads

Ø ID Insert diameter

N Extension length

T Thermowell lagging

A Thermowell length

U Immersion length

IL Insertion length

Ø D1 Thermowell diameter at extension neck connection

Ø Df Thermowell internal diameter

Ø Q1 Thermowell outer diameter at flanged or threaded process connection

Ø Q2 Thermowell tip outer diameter

In the process, the thermowell is the component of the thermometer that is exposed to the highest mechanical load. It is made from round barstock and can be supplied in different materials and dimensions to fit the different chemical/physical properties of the process: corrosion, temperature, pressure and flow velocity.

The thermowell consists of three parts:

- The cylindrical thermowell lagging (with a standard diameter of 30 or 35 mm (1.18 or 1.38 in) and lengths of 70/100 mm (2.76/3.94 in)) constitutes the outer part of the thermowell and is connected to the terminal head via an extension neck (nipple, type N or nipple-union-nipple, type NUN).
- The conical or cylindrical part (U) that is in contact with the medium (wetted part) is located below the process connection. The standard diameter (Ø Q1) below the process connection is 20 or 25 mm (0.79 or 0.98 in).
- The threaded or flanged process connection is the part between the thermowell extension and the wetted part. It is the interface to the plant and guarantees the sealing between the thermometer and the environment.

The surface of the wetted part of the thermowell is available with a standard surface roughness rating of  $R_a = 1.6 \mu\text{m}$  (other surface versions available on request).



The maximum total length A of the thermowell (maximum drilling length) is 1 200 mm (47.3 in). Lengths of more than 1 200 mm (47.3 in) are only available on request.

**Weight** 1.5 to 5.5 kg (3.3 to 12.1 lbs) for standard versions.

## Materials

Extension neck and thermowell, insert

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 operating temperatures are reduced considerably in cases where process conditions such as high mechanical load occur or in aggressive media.

Name	Short formula	Recommended max. temperature for continuous use in air	Properties
AISI 316/1.4401	X5CrNiMo 17-12-2	650 °C (1 202 °F) <sup>1)</sup>	<ul style="list-style-type: none"> <li>▪ Austenitic stainless steel</li> <li>▪ High corrosion resistance in general</li> <li>▪ Particularly high corrosion resistance in chlorine-based and acidic, non-oxidizing atmospheres through the addition of molybdenum (e.g. phosphoric and sulfuric acids, acetic and tartaric acids with a low concentration)</li> </ul>
AISI 316L/ 1.4404	X2CrNiMo17-12-2	650 °C (1 202 °F) <sup>1)</sup>	<ul style="list-style-type: none"> <li>▪ Austenitic stainless steel</li> <li>▪ High corrosion resistance in general</li> <li>▪ Particularly high corrosion resistance in chlorine-based and acidic, non-oxidizing atmospheres through the addition of molybdenum (e.g. phosphoric and sulfuric acids, acetic and tartaric acids with a low concentration)</li> <li>▪ Increased resistance to intergranular corrosion and pitting</li> <li>▪ Compared to 1.4404, 1.4435 has even higher corrosion resistance and a lower delta ferrite content</li> </ul>
AISI 316Ti/ 1.4571	X6CrNiMoTi17-12-2	700 °C (1 292 °F) <sup>1)</sup>	<ul style="list-style-type: none"> <li>▪ Properties comparable with AISI 316L</li> <li>▪ The addition of titanium increases resistance to intergranular corrosion even after welding</li> <li>▪ Broad range of uses in the chemical, petrochemical and oil industries as well as in coal chemistry</li> <li>▪ Can only be polished to a limited extent, titanium streaks can form</li> </ul>
AISI A105/1.0460	C22.8	450 °C (842 °F)	<ul style="list-style-type: none"> <li>▪ Heat-resistant steel</li> <li>▪ Resistant to atmospheres which contain nitrogen and are low in oxygen; not suitable for acids or other aggressive media</li> <li>▪ Often used for steam generators, water and steam pipes, pressure vessels</li> </ul>

Name	Short formula	Recommended max. temperature for continuous use in air	Properties
Alloy 600/2.4816	NiCr15Fe	1 100 °C (2 012 °F)	<ul style="list-style-type: none"> <li>■ A nickel/chromium alloy with very good resistance to aggressive, oxidizing and reducing atmospheres, even at high temperatures</li> <li>■ Resistance to corrosion caused by chlorine gases and chlorinated media as well as many oxidizing mineral and organic acids, sea water, etc.</li> <li>■ Corrosion from ultrapure water</li> <li>■ Not to be used in sulfur-containing atmospheres</li> </ul>
Alloy 400	NiCu30Fe	500 °C (932 °F)	<ul style="list-style-type: none"> <li>■ A nickel/copper alloy with good resistance to hydrofluoric acid, non-oxidizing diluted acids, bases, saline solutions and organic acids.</li> <li>■ Largely immune to stress corrosion cracking.</li> <li>■ Particularly reliable in flowing sea water, suitable for chemical processes and gas and water tanks.</li> </ul>

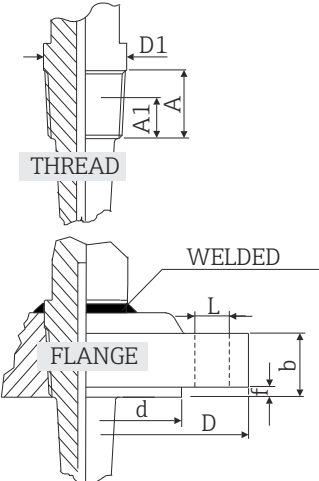
- 1) Can be used to a limited extent up to 800 °C (1472 °F) for low compressive loads and in non-corrosive media. Please contact your Endress+Hauser Sales Center for further information.

### Process connections

The standard process connections are threaded or flanged connections. When the process connection is threaded, the connection material used is the same as that of the thermowell. Standard flange material: SS 316/1.4401 or ASTM A105.

Other materials, surface finishes and connections can be supplied on request.

Type and dimensions of the process connections (ASME B16.5, ANSI B1.20.1). All dimensions in mm (in).

Type			Ø	Ø D	Ø L	No. drillings	f	b	Ø D1	A	A1
  A0058934	Flange	1" ANSI 150 RF SO <sup>1)</sup>	50.8 (2)	107.9 (4.25)	15.7 (0.62)	4	1.6 (0.06)	14.2 (0.56)	-	-	-
		1" ANSI 300 RF SO		124 (4.9)	19.1 (0.75)			17.5 (0.69)	-	-	-
		1" ANSI 600 RF SO						6.4 (0.25)	-	-	-
		1½" ANSI 150 RF SO	73 (2.9)	127 (5)	15.7 (0.62)	4	1.6 (0.06)	17.5 (0.69)	-	-	-
		1½" ANSI 300 RF SO		155.4 (6.1)	22.4 (0.85)			20.6 (0.81)	-	-	-
		1½" ANSI 600 RF SO						6.4 (0.25)	-	-	-
		2" ANSI 150 RF SO	91.9 (3.62)	152.4 (6)	19.1 (0.75)	4	1.6 (0.06)	19.1 (0.75)	-	-	-
		2" ANSI 300 RF SO	92.1 (3.6)	165.1 (6.5)	8	22.4 (0.88)		-	-	-	
		2" ANSI 600 RF SO				6.4 (0.25)		25.4 (1)	-	-	-

A0058934

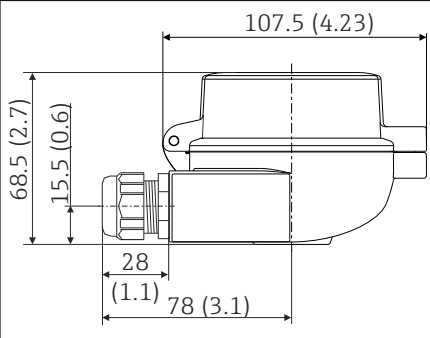


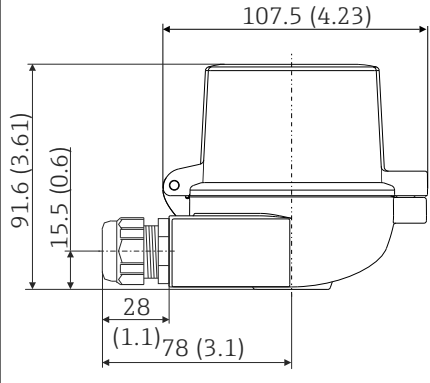
Type			Ø	Ø D	Ø L	No. drillings	f	b	Ø D1	A	A1
	Thread	¾" NPT	-	-	-	-	-	-	≥ 21.4 (0.84)	19.9 (0.78)	8.1 (0.32)
		1" NPT	-	-	-	-	-	-	≥ 26.7 (1.1)	20.2 (0.79)	8.6 (0.34)

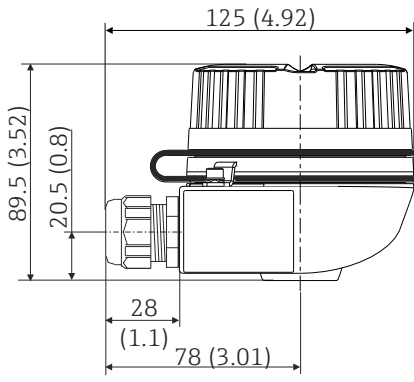
1) RF SO: "Raised Face Slip On" flange (flat flange with sealing face).

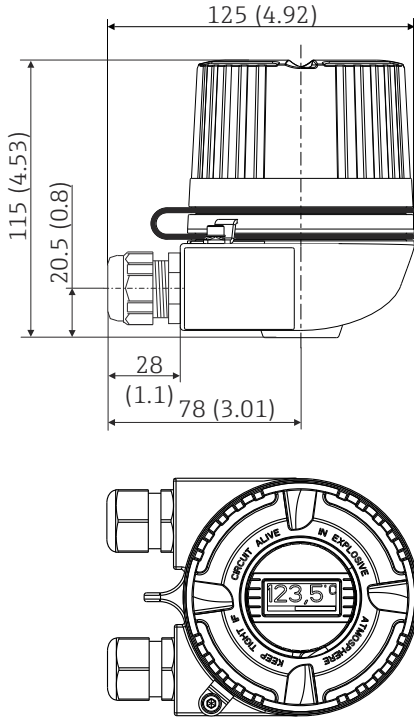
### Terminal heads

All terminal heads have an internal shape and size in accordance with DIN EN 50446, flat face and a thermometer connection with a M24x1.5, G½" or ½" 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 "Operating conditions" section.

TA30A	Specification
	<ul style="list-style-type: none"> <li>Protection degree: <ul style="list-style-type: none"> <li>IP66/68 (NEMA Type 4x encl.)</li> <li>For ATEX: IP66/67</li> </ul> </li> <li>Temperature: -50 to +150 °C (-58 to +302 °F) without cable gland</li> <li>Material: aluminum, polyester powder coated</li> <li>Seals: silicone</li> <li>Threaded cable entry: G ½", NPT ½" and M20x1.5;</li> <li>Head color: blue, RAL 5012</li> <li>Cap color: gray, RAL 7035</li> <li>Weight: 330 g (11.64 oz)</li> <li>Ground terminal, internal and external</li> <li>Available with sensors with 3-A® symbol</li> </ul>

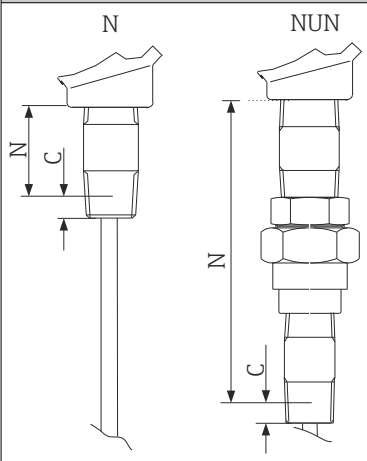
TA30A with display window in cover	Specification
	<ul style="list-style-type: none"> <li>Protection degree: <ul style="list-style-type: none"> <li>IP66/68 (NEMA Type 4x encl.)</li> <li>For ATEX: IP66/67</li> </ul> </li> <li>Temperature: -50 to +150 °C (-58 to +302 °F) without cable gland</li> <li>Material: aluminum, polyester powder coated</li> <li>Seals: silicone</li> <li>Threaded cable entry: G ½", NPT ½" and M20x1.5</li> <li>Head color: blue, RAL 5012</li> <li>Cap color: gray, RAL 7035</li> <li>Weight: 420 g (14.81 oz)</li> <li>Display window: single-pane safety glass according to DIN 8902</li> <li>Display window in cover for head transmitter with TID10 display</li> <li>Ground terminal, internal and external</li> <li>Available with sensors with 3-A® symbol</li> </ul>

TA30H	Specification
 <p>A0009832</p>	<ul style="list-style-type: none"> <li>Flameproof (XP) version, explosion-protected, captive screw cap, available with one or two cable entries</li> <li>Degree of protection: IP 66/68, NEMA Type 4x Encl. Ex-version: IP 66/67</li> <li>Temperature: -50 to +150 °C (-58 to +302 °F) for rubber seal without cable gland (observe max. permitted temperature of cable gland!)</li> <li>Material: <ul style="list-style-type: none"> <li>Aluminum, with polyester powder coating</li> <li>Stainless steel 316L without coating</li> <li>Dry lubricant Klüber Syntheso Glep 1</li> </ul> </li> <li>Thread: NPT 1/2", NPT 3/4", M20x1.5, G1/2"</li> <li>Color of aluminum head: blue, RAL 5012</li> <li>Color of aluminum cap: gray, RAL 7035</li> <li>Weight: <ul style="list-style-type: none"> <li>Aluminum: approx. 640 g (22.6 oz)</li> <li>Stainless steel: approx. 2 400 g (84.7 oz)</li> </ul> </li> </ul> <p><b>i</b> When the housing cover is unscrewed: Before fastening, clean the threads in the cover and on the lower part of the housing and lubricate if necessary (recommended lubricant: Klüber Syntheso Glep 1)</p>

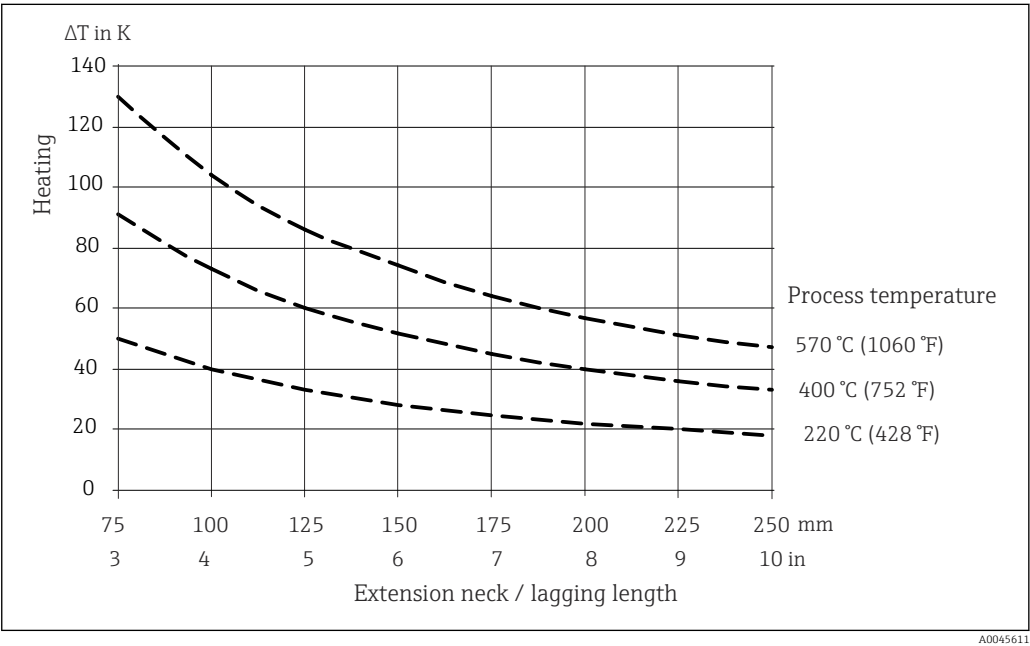
TA30H with display window in cover	Specification
 <p>A0009831</p>	<ul style="list-style-type: none"> <li>Flameproof (XP) version, explosion-protected, captive screw cap, available with one or two cable entries</li> <li>Degree of protection: IP 66/68, NEMA Type 4x Encl. Ex-version: IP 66/67</li> <li>Temperature: -50 to +150 °C (-58 to +302 °F) for rubber seal without cable gland (observe max. permitted temperature of cable gland!)</li> <li>Material: <ul style="list-style-type: none"> <li>Aluminum; polyester powder coated</li> <li>Stainless steel 316L without coating</li> <li>Dry lubricant Klüber Syntheso Glep 1</li> </ul> </li> <li>Display window: single-pane safety glass according to DIN 8902</li> <li>Thread: NPT 1/2", NPT 3/4", M20x1.5, G1/2"</li> <li>Color of aluminum head: blue, RAL 5012</li> <li>Color of aluminum cap: gray, RAL 7035</li> <li>Weight: <ul style="list-style-type: none"> <li>Aluminium approx. 860 g (30.33 oz)</li> <li>Stainless steel approx. 2 900 g (102.3 oz)</li> </ul> </li> <li>Head transmitter optionally available with TID10 display</li> </ul> <p><b>i</b> When the housing cover is unscrewed: Before fastening, clean the threads in the cover and on the lower part of the housing and lubricate if necessary (recommended lubricant: Klüber Syntheso Glep 1)</p>

**Extension neck**

The extension neck is the part between the process connection and the terminal head. The use of a union (see NUN) allows the terminal head to be aligned. The standard extension neck comprises a composite tube with appropriate connections (nipples or joints) to adapt the sensor to the various thermowells.

Extension neck	Material	Extension neck length N	Thread	Screw-in length C
	AISI 316 or A105	69 mm (2.72 in)	½" NPT M	8 mm (0.31 in)
		109 mm (4.3 in)		
		148 mm (5.83 in)		

As illustrated in the following diagram, the extension neck length influences the temperature in the terminal head. This temperature must remain within defined limits .



14 Heating of the terminal head as a function of the process temperature. Temperature in terminal head = ambient temperature 20 °C (68 °F) + ΔT

**Spare parts**

- The thermowells (TA550, TA555, TA557) and the iTHERM ModuLine TT151 thermowell are available as spare parts
  - The RTD insert is available as spare part TS111
  - The TC insert is available as spare part TPC100/TPC300
- The inserts are made from mineral insulated cable (MgO) with a sheath of AISI316/1.4401 or Alloy 600. An insertion length (IL) within the standard range of 50 to 1000 mm (1.97 to 39.4 in) can be selected for the insert. Inserts with an insertion length > 1000 mm (39.4 in) can be supplied after an Endress+Hauser sales office has conducted a technical analysis of the specific application.

If the insert is being replaced, it is necessary to refer to the following table to obtain the correct insertion length (IL), (only applies to thermowells with a standard bottom thickness). The insertion length of the replacement insert (IL) is calculated from the total thermowell length (immersion length U + extension T) up to the extension neck used (N).

Universal or ATEX certification						
Insert	Ø mm	Connection type	Extension neck lengths in mm (in)	Material	IL in mm (in) for TA30H	IL in mm (in) for TA30A
TPC100 / TPC300 TS111	6	N	69 (2.72)	RTD: 316/1.4401 or A105/1.0460 TC: Alloy 600/2.4816 or 316L/1.4404	IL = U + T + N + 36 (1.42)	IL = U + T + N + 21 (0.83)
TPC100 / TPC300 TS111		N	109 (4.3)	RTD: 316/1.4401 or A105/1.0460 TC: Alloy 600/2.4816 or 316L/1.4404		
TPC100 / TPC300 TS111		NUN	148 (5.83)	RTD: 316/1.4401 or A105/1.0460 TC: Alloy 600/2.4816 or 316L/1.4404		

## Certificates and approvals



For the approvals available, see the Configurator on the specific product page:  
[www.endress.com](http://www.endress.com) → (search for device name)

### Other standards and guidelines

- IEC 60529: Degree of protection of housing (IP code)
- IEC/EN 61010-1: Safety requirements for electrical equipment for measurement, control and laboratory use
- IEC 60751: Industrial platinum resistance thermometers
- IEC 60584 and ASTM E230/ANSI MC96.1: Thermocouples
- DIN 43772: Thermowells
- DIN EN 50446: Terminal heads

### Thermowell testing

Thermowell pressure tests are carried out in accordance with the specifications in DIN 43772. Thermowells with tapered or reduced tips that do not comply with this standard are tested using the pressure of the corresponding straight thermowell. Sensors for use in hazardous areas are also always subjected to a comparative pressure during the tests. Tests according to other specifications can be carried out on request. The liquid penetration test verifies that there are no cracks in the welded seams of the thermowell.

### 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) 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.

### MID

- Test certificate (only in SIL mode). In compliance with:
- WELMEC 8.8: "Guide on the general and administrative aspects of the voluntary system of modular evaluation of measuring instruments"
  - OIML R117-1, Edition 2007 (E), "Dynamic measuring system for liquids other than water"
  - EN 12405-1/A2, Edition 2010, "Gas meters - Converters - Part 1: Volume conversion"
  - OIML R140-1, Edition 2007 (E), "Measuring systems for gaseous fuels"

### Calibration according to GOST

Russian Metrology Test, +100/+300/+500/+700 °C + transmitter factory calibration, 6 points (fixed)

## Ordering information

Detailed ordering information is available from your nearest sales organization [www.addresses.endress.com](http://www.addresses.endress.com) or in the Product Configurator at [www.endress.com](http://www.endress.com):

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



### 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

## Accessories


Various accessories, which can be ordered with the device or subsequently from Endress+Hauser, are available for the device. Detailed information on the order code in question is available from your local Endress+Hauser sales center or on the product page of the Endress+Hauser website: [www.endress.com](http://www.endress.com).

### Service-specific accessories

Accessories	Description
Applicator	<p>Software for selecting and sizing Endress+Hauser devices:</p> <ul style="list-style-type: none"> <li>■ Calculation of all the necessary data for identifying the optimum device: e.g. pressure loss, accuracy or process connections.</li> <li>■ Graphic illustration of the calculation results</li> </ul> <p>Administration, documentation and access to all project-related data and parameters over the entire life cycle of a project.</p> <p>Applicator is available: Via the Internet: <a href="https://portal.endress.com/webapp/applicator">https://portal.endress.com/webapp/applicator</a></p>
DeviceCare SFE100	<p>Configuration tool for devices via fieldbus protocols and Endress+Hauser service protocols.</p> <p>DeviceCare is the tool developed by Endress+Hauser for the configuration of Endress+Hauser devices. All smart devices in a plant can be configured via a point-to-point or point-to-bus connection. The user-friendly menus enable transparent and intuitive access to the field devices.</p> <p> For details, see Operating Instructions BA00027S</p>
FieldCare SFE500	<p>FDT-based plant asset management tool from Endress+Hauser.</p> <p>It can configure all smart field units in your system and helps you manage them. By using the status information, it is also a simple but effective way of checking their status and condition.</p> <p> For details, see Operating Instructions BA00027S and BA00065S</p>

## Documentation

The following types of documentation are available on the product pages and in the Download Area of the Endress+Hauser website ([www.endress.com/downloads](http://www.endress.com/downloads)) (depending on the selected device version):

Document	Purpose and content of the document
Technical Information (TI)	<b>Planning aid for your device</b> The document contains all the technical data on the device and provides an overview of the accessories and other products that can be ordered for the device.
Brief Operating Instructions (KA)	<b>Guide that takes you quickly to the 1st measured value</b> The Brief Operating Instructions contain all the essential information from incoming acceptance to initial commissioning.
Operating Instructions (BA)	<b>Your reference document</b> These Operating Instructions contain all the information that is required in the various life cycle phases of the device: from product identification, incoming acceptance and storage, to mounting, connection, operation and commissioning, through to troubleshooting, maintenance and disposal.
Description of Device Parameters (GP)	<b>Reference for your parameters</b> The document provides a detailed explanation of each individual parameter. The description is aimed at those who work with the device over the entire life cycle and perform specific configurations.
Safety Instructions (XA)	Safety Instructions (XA) are supplied with the device, depending on the approval. These are an integral part of the Operating Instructions.  The nameplate indicates which Safety Instructions (XA) apply to the device.
Supplementary device-dependent documentation (SD/FY)	Always comply strictly with the instructions in the relevant supplementary documentation. The supplementary documentation is an integral part of the device documentation.

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[www.addresses.endress.com](http://www.addresses.endress.com)

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