TI01098T/09/EN/05.21
71528358
2021-05-28

Technical Information
TR88, TC88

Modular thermometer
TR88 with resistance insert (RTD)
TC88 with thermocouple insert (TC)

With extension neck and threaded connection for installation in an existing thermowell

Application
- Universal range of application
- Suitable for installation in already existing thermowells
- 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)
- 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
- Variable total length in suitable thermowells thanks to compression fitting on extension neck
- Types of protection for use in hazardous locations:
  - Intrinsic Safety (Ex ia)
  - Non-sparking (Ex nA)

Endress+Hauser
People for Process Automation

Table of contents

Function and system design

Measuring principle

Resistance thermometer (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 Ω at 0 °C (32 °F) and a temperature coefficient α = 0.003851 $°C^{-1}$.

There are generally two different kinds of platinum resistance thermometers:

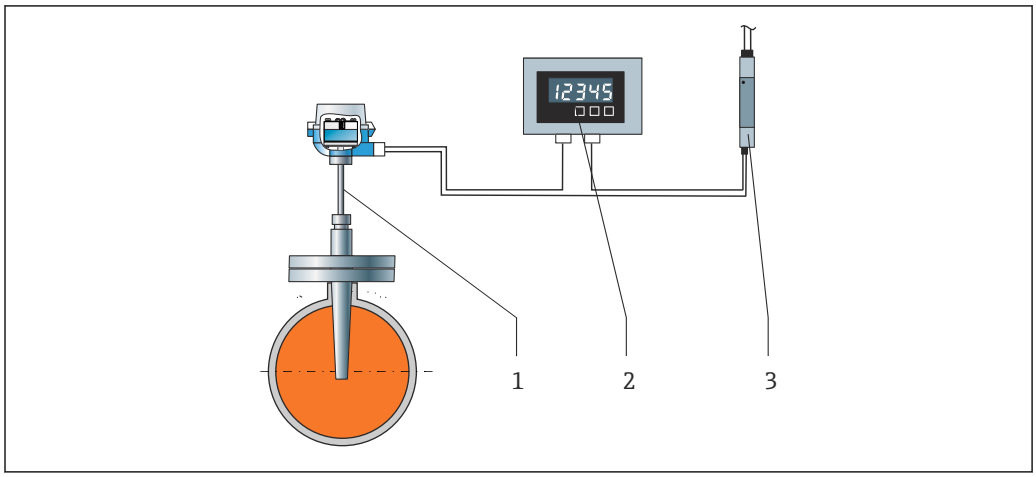
- **Wire wound (WW):** Here, a double coil of fine, high-purity platinum wire is located in a ceramic support. This is then sealed top and bottom with a ceramic protective layer. Such resistance thermometers not only facilitate very reproducible measurements but also offer good long-term stability of the resistance/temperature characteristic within temperature ranges up to 600 °C (1 112 °F). This type of sensor is relatively large in size and it 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 sizes and better vibration resistance. A relatively low principle-based deviation of the resistance/temperature characteristic from the standard characteristic of IEC 60751 can frequently be observed among TF sensors at high temperatures. As a result, the tight limit values of tolerance category 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.

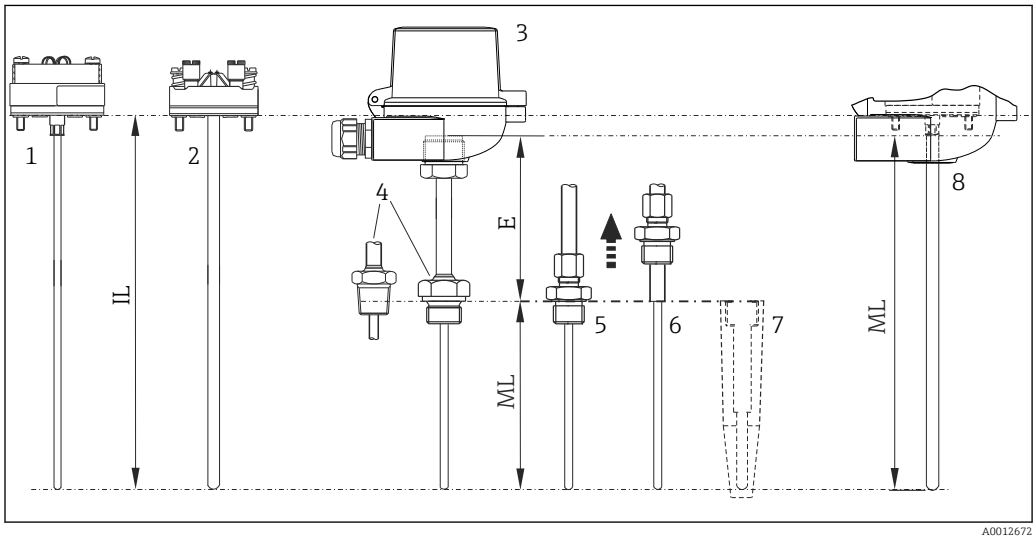
Measuring system



1 *Application example*

1 *Thermometer with built-in head transmitter installed in an existing onsite thermowell*
2 *RIA15 2-wire process indicator - The process indicator is incorporated into the current loop and displays the measuring signal or the HART® process variables in digital form. The process indicator does not require an external power supply. It is powered directly from the current loop. More information on this can be found in the technical documentation (see "Supplementary documentation").*
3 *RN22 barrier - 1- or 2-channel barrier or signal duplicator with transmission and galvanic isolation of analog 0/4 to 20 mA signals (optional intrinsically safe version [Ex-ia]), from the hazardous area. Supply of 2-wire transmitters, supply voltage > 16.5 V. More information on this can be found in the Technical Information (see "Supplementary documentation").*

Modular design



2 *Thermometer design*

1 *Insert with mounted head transmitter (example with Ø3 mm (0.12 in))*
2 *Insert with mounted ceramic terminal block (example with Ø6 mm (0.24 in))*
3 *Complete thermometer with terminal head*
4 *Thermowell connection: Threaded connection on extension neck*
5 *Thermowell connection: Movable compression fitting on extension neck. Maximum possible extension neck length E as basis for nominal calculation of the insert installation length IL*
6 *Thermowell connection: Movable compression fitting on extension neck. Length E can be adapted during installation.*
7 *Existing onsite thermowell located in the process*
8 *Version without extension neck if thermowell and extension neck are located onsite in the process (E = 0 mm)*
E *Extension neck length*
IL *Installation length of insert*
ML *Installation length of existing onsite components*

The thermometers have a modular design. The terminal head is used as a connection module 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. If the insert is installed in a thermowell, it can be

replaced or calibrated without interrupting the process. The insert has flying leads, a ceramic terminal block or mounted temperature transmitter. The thermometers are designed for installation in an existing onsite thermowell. Different threaded connections are available at the bottom of the extension neck for installation in the thermowell. The thermometer can also be mounted using a suitable extension neck compression fitting provided the thermowell is suitable. The insertion length ML of the thermometer is changed by moving the compression fitting. It can thus be installed in thermowells of different lengths. This guarantees optimum thermal contact between the insert tip and the bottom of the thermowell.

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

Generally, the measured value can be transmitted in one of two ways:

- Directly-wired sensors - sensor measured values forwarded without a transmitter.
- Via all common protocols by selecting an appropriate Endress+Hauser iTEMP temperature transmitter. All the transmitters listed below 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 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. More information can be found in the Technical Information.

HART® head transmitters
The 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 device configuration tools like FieldCare, DeviceCare or FieldCommunicator 375/475. Integrated Bluetooth® interface for the wireless display of measured values and configuration via E+H SmartBlue (app), optional. For more information, see the Technical Information.

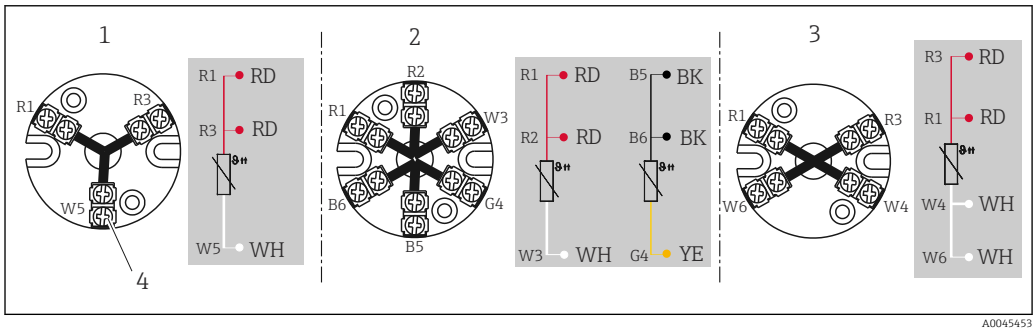
PROFIBUS® PA head transmitters
Universally programmable head transmitter with PROFIBUS® PA communication. Conversion of various input signals into digital output signals. High accuracy over the complete ambient temperature range. The configuration of PROFIBUS PA functions and of device-specific parameters is performed via fieldbus communication. For more information, see the Technical Information.

FOUNDATION Fieldbus™ head transmitters
Universally programmable head transmitter with FOUNDATION Fieldbus™ communication. Conversion of various input signals into digital output signals. High accuracy over the complete ambient temperature range. All transmitters are released for use in all important process control systems. The integration tests are performed in Endress+Hauser's "System World". For more information, see the Technical Information.

Advantages of the iTEMP transmitters:
- Dual or single sensor input (optionally for certain transmitters)
- Pluggable 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 for dual sensor input transmitters, based on Callendar/Van Dusen coefficients

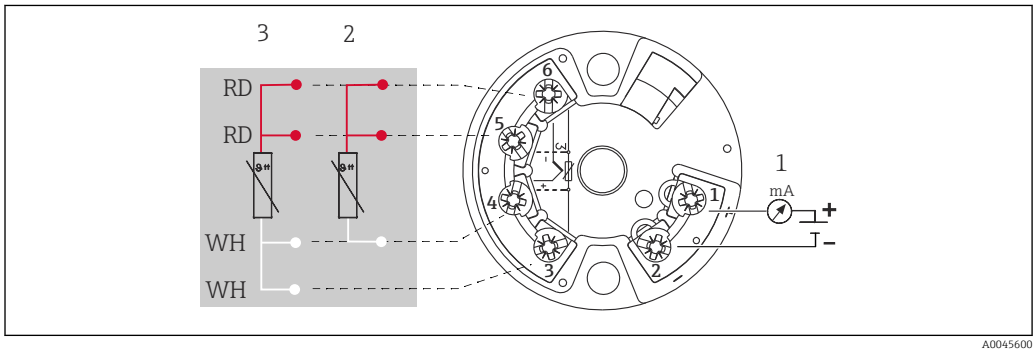
Power supply

Type of sensor connection RTD



3 Terminal block mounted

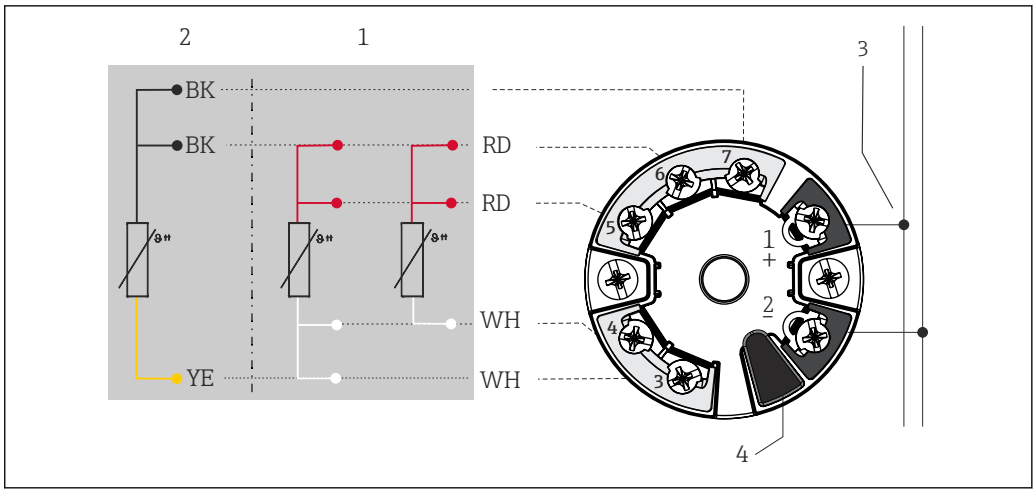
1 3-wire, single
2 2 x 3-wire, single
3 4-wire, single
4 Outside screw



4 Head mounted transmitter TMT18x (single input)

1 Power supply head transmitter and analog output 4 to 20 mA or fieldbus connection
2 RTD, 3-wire
3 RTD, 4-wire

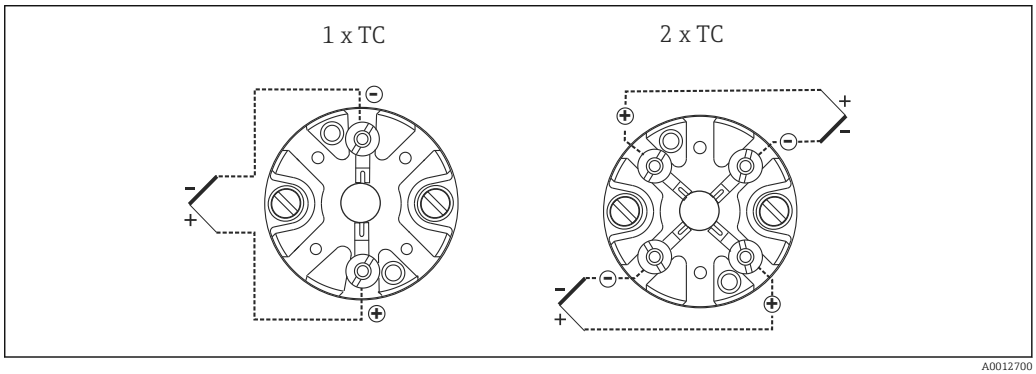
Only available with screw terminals



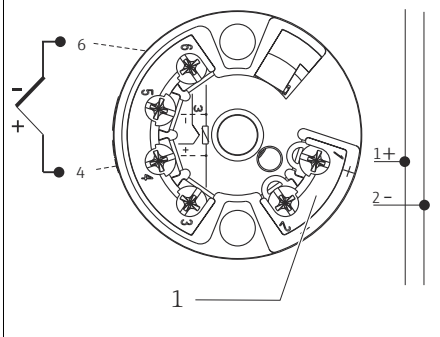
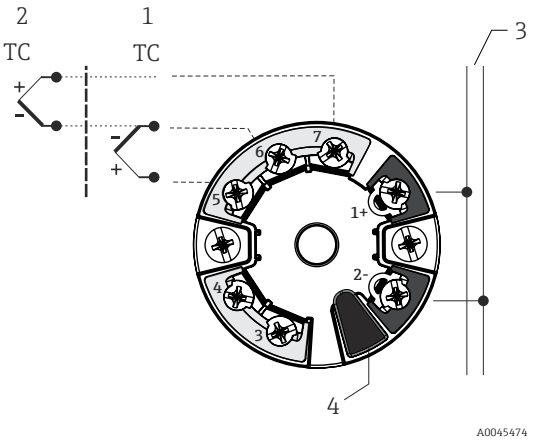
5 *Head mounted transmitter TMT8x (dual input)*

1 *Sensor input 1, RTD: 4- and 3-wire*
2 *Sensor input 2, RTD: 3-wire*
3 *Power supply or fieldbus connection*
4 *Display connection*

Type of sensor connection thermocouple (TC)



6 *Terminal block mounted*

Head mounted transmitter TMT18x (single input) [1]	Head mounted transmitter TMT8x (dual input) [2]
 *1 Supply voltage head transmitter and analog output 4 to 20 mA or fieldbus communication*	 *1 Sensor input 1* *2 Sensor input 2* *3 Fieldbus communication and supply voltage* *4 Display connection*

1) Fitted with screw terminals
2) Fitted with spring terminals if screw terminals are not specifically selected or a double sensor is installed.

Thermocouple wire colors

As per IEC 60584	As per ASTM E230
▪ Type J: black (+), white (-) ▪ Type K: green (+), white (-) ▪ Type N: pink (+), white (-)	▪ Type J: white (+), red (-) ▪ Type K: yellow (+), red (-) ▪ Type N: orange (+), red (-)

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

Accuracy

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

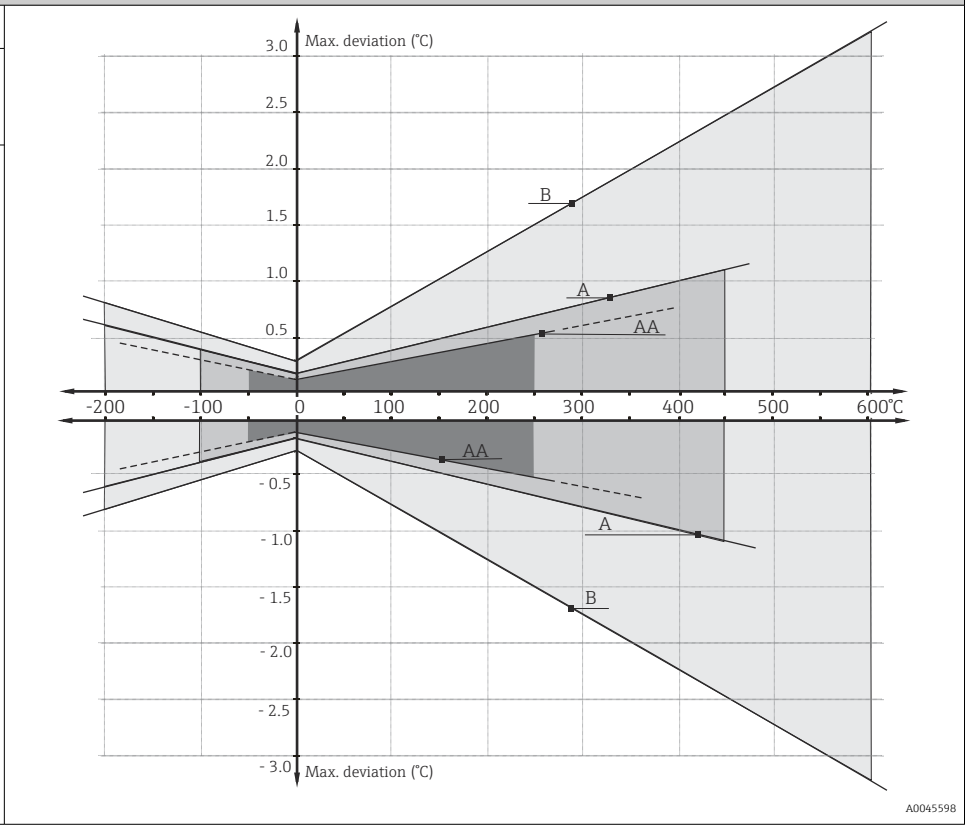
Standard	Type	Standard tolerance		Special tolerance	
IEC 60584		Class	Deviation	Class	Deviation
	J (Fe-CuNi)	2	±2.5 °C (−40 to 333 °C) ±0.0075 |t| [1] (333 to 750 °C)	1	±1.5 °C (−40 to 375 °C) ±0.004 |t| [1] (375 to 750 °C)
	K (NiCr-NiAl)	2	±2.5 °C (−40 to 333 °C) ±0.0075 |t| [1] (333 to 1200 °C)	1	±1.5 °C (−40 to 375 °C) ±0.004 |t| [1] (375 to 1000 °C)

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

Standard	Type	Standard tolerance	Special tolerance
ASTM E230/ANSI MC96.1		Deviation, the larger value applies in each case	
	J (Fe-CuNi)	±2.2 K or ±0.0075 |t| [1] (0 to 760 °C)	±1.1 K or ±0.004 |t| [1] (0 to 760 °C)
	K (NiCr-NiAl)	±2.2 K or ±0.02 |t| [1] (−200 to 0 °C) ±2.2 K or ±0.0075 |t| [1] (0 to 1260 °C)	±1.1 K or ±0.004 |t| [1] (0 to 1260 °C)

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

RTD resistance thermometer corresponding to IEC 60751

Class	Max. tolerances (°C)	Characteristics
RTD maximum error type TF		
Cl. A	± (0.15 + 0.002 · |t| [1])	
Cl. AA, formerly 1/3 Cl. B	± (0.1 + 0.0017 · |t|) [1]	
Cl. B	± (0.3 + 0.005 · |t| [1])	

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

For measurement errors in °F, calculate using equations 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

Tested in accordance with IEC 60751 in flowing water (0.4 m/s at 30 °C):

Insert:

Sensor type	Diameter ID	Response time	Thin-film TF
iTHERM StrongSens	6 mm (0.24 in)	t_{50}	< 3.5 s
		t_{90}	< 10 s
	6 mm (0.24 in) with sleeve 8 mm (0.31 in)	t_{50}	< 3.5 s
		t_{90}	< 14 s
TF sensor	3 mm (0.12 in)	t_{50}	2.5 s
		t_{90}	5.5 s
	6 mm (0.24 in)	t_{50}	5 s
		t_{90}	13 s
WW sensor	3 mm (0.12 in)	t_{50}	2 s
		t_{90}	6 s
	6 mm (0.24 in)	t_{50}	4 s
		t_{90}	12 s
Thermocouple (TPC100) Grounded	3 mm (0.12 in)	t_{50}	0.8 s
		t_{90}	2 s
	6 mm (0.24 in)	t_{50}	2 s
		t_{90}	5 s
Thermocouple (TPC100) Not grounded	3 mm (0.12 in)	t_{50}	1 s
		t_{90}	2.5 s
	6 mm (0.24 in)	t_{50}	2.5 s
		t_{90}	7 s

Response time for sensor design without transmitter.

Insulation resistance

- RTD:
  Insulation resistance according to IEC 60751 > 100 MΩ at 25 °C between terminals and sheath material measured with a minimum test voltage of 100 V DC
- TC:
  Insulation resistance according to IEC 1515 between terminals and sheath material with a test voltage of 500 V DC:
  - > 1 GΩ at 20 °C
  - > 5 MΩ at 500 °C

Dielectric strength

Tested at room temperature for 5 s:

- Φ6 mm (0.24 in): ≥ 1 000 V DC between terminals and insert sheath
- Φ3 mm (0.12 in): ≥ 250 V DC between terminals and insert sheath

Calibration

Calibration of thermometers

Calibration involves comparing the measured values of a device under test (DUT) with those of a more precise calibration standard using a defined and reproducible measurement method. The aim is to determine the deviation of the DUT's measured values from the true value of the measured variable. Two different methods are used for thermometers:

- Calibration at fixed-point temperatures, e.g. at the freezing point of water at 0 °C,
- Calibration compared against a precise reference thermometer.

The thermometer to be calibrated must display the fixed point temperature or the temperature of the reference thermometer as accurately as possible. Temperature-controlled calibration baths with very homogeneous thermal values, or special calibration furnaces into which the DUT and the reference thermometer, where necessary, can project to a sufficient degree, are typically used for

thermometer calibrations. The measurement uncertainty can increase due to heat dissipation errors and short immersion lengths. The existing measurement uncertainty is listed on the individual calibration certificate. For accredited calibrations according to ISO17025, the measurement uncertainty shouldn't be twice as high as the accredited measurement uncertainty. If this is exceeded, only a factory calibration can be performed.

Evaluation of thermometers
If a calibration with an acceptable uncertainty of measurement and transferable measurement results is not possible, Endress+Hauser offers customers a thermometer evaluation measurement service, if technically feasible. This is the case when:
- The process connections/flanges are too big or the immersion length (IL) is too short to allow the DUT to be immersed sufficiently in the calibration bath or furnace (see the following table), or
- Due to heat conduction along the thermometer tube, the resulting sensor temperature generally deviates significantly from the actual bath/furnace temperature.

The measured value of the DUT is determined using the maximum possible immersion depth and the specific measuring conditions and measurement results are documented on an evaluation certificate.

Sensor-transmitter matching
The resistance/temperature curve of platinum resistance thermometers is standardized but in practice it is rarely possible to keep to the values precisely over the entire operating temperature range. For this reason, platinum resistance sensors are divided into tolerance classes, such as Class A, AA or B as per IEC 60751. These tolerance classes describe the maximum permissible deviation of the specific sensor characteristic curve from the standard curve, i.e. the maximum temperature-dependent characteristic error that is permitted. The conversion of measured sensor resistance values to temperatures in temperature transmitters or other meter electronics is often susceptible to considerable errors as the conversion is generally based on the standard characteristic curve.

When using temperature transmitters from Endress+Hauser, this conversion error can be reduced significantly by sensor-transmitter matching:
- Calibration at three temperatures at least and determination of the actual temperature sensor characteristic curve,
- Adjustment of the sensor-specific polynomial function using Calendar-van Dusen (CvD) coefficients,
- Configuration of the temperature transmitter with the sensor-specific CvD coefficients for resistance/temperature conversion, and
- another calibration of the reconfigured temperature transmitter with connected resistance thermometer.

Endress+Hauser offers this kind of sensor-transmitter matching as a separate service. Furthermore, the sensor-specific polynomial coefficients of platinum resistance thermometers are always provided on every Endress+Hauser calibration certificate where possible, e.g. at least three calibration points, so that users themselves can also appropriately configure suitable temperature transmitters.

For the device, Endress+Hauser offers standard calibrations at a reference temperature of −80 to +600 °C (−112 to +1 112 °F) based on the ITS90 (International Temperature Scale). Calibrations in other temperature ranges are available from your Endress+Hauser sales center on request. Calibrations are traceable to national and international standards. The calibration certificate is referenced to the serial number of the device. Only the insert is calibrated.

Minimum insertion length (IL) for inserts required to perform a correct calibration

Due to restrictions of the furnace geometries, minimum immersion lengths must be maintained at high temperatures in order to be able to perform a calibration with acceptable measurement uncertainty. The same applies when a temperature head transmitter is used. Due to the heat dissipation, minimum immersion lengths must be maintained in order to ensure the functionality of the transmitter −40 to +85 °C (−40 to +185 °F).

Calibration temperature	Minimum immersion length (IL) in mm without head transmitter
−196 °C (−320.8 °F)	120 mm (4.72 in) [1]
−80 to 250 °C (−112 to 482 °F)	No minimum immersion length needed [2]
251 to 550 °C (483.8 to 1 022 °F)	300 mm (11.81 in)
551 to 600 °C (1 023.8 to 1 112 °F)	400 mm (15.75 in)

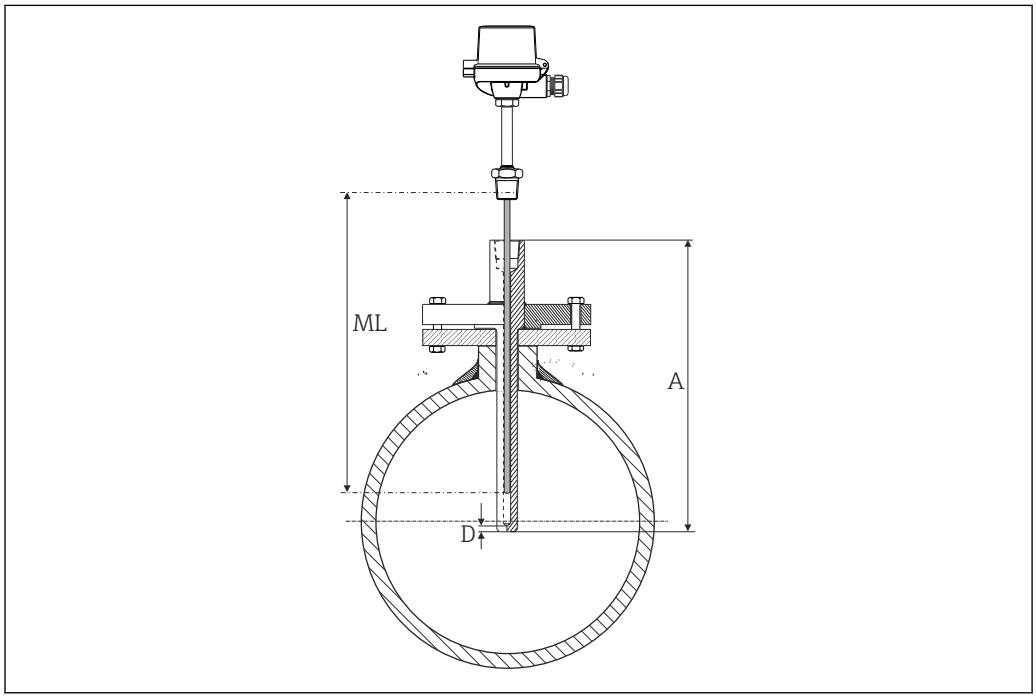
1) With TMT a minimum of 150 mm (5.91 in) is required
2) At a temperature of +80 to +250 °C (+176 to +482 °F) with TMT a minimum of50 mm (1.97 in) is required

Mounting

Orientation

No restrictions.

Installation instructions



7 Thermometer installation

The thermometer is designed for installation in an existing thermowell or in a thermowell which can be ordered separately. Different threaded connections to suit the thermowell are available on the thermometer's extension neck → 16. The necessary insertion length (ML) of the insert depends on the total length of the thermowell (A) and the type of thermowell used. It can be freely selected within the range of 100 to 5 000 mm (3.94 to 197 in). Longer insertion lengths are available on request. This also applies when ordering the insert as a spare part. More detailed information on determining the insertion length (ML) required in each case can be found in the following table, applies to Endress+ Hauser thermowells with standard base thicknesses (D).

Thermowell type	ML in mm (in)	Thermowell type	ML in mm (in)
TA550	ML = A - 3 (0.12)	TA565	ML = A - 3 (0.12)
TA555	ML = A - 2 (0.08)	TA566	ML = A - 3 (0.12)
TA557	ML = A - 2 (0.08)	TA571	ML = A - 3 (0.12)
TW15	ML = A	TA572	ML = A - 3 (0.12)
TA560	ML = A - 3 (0.12)	TA575	ML = A - 3 (0.12)
TA562	ML = A - 3 (0.12)	TA576	ML = A - 2 (0.08)

In the case of thermowells with a non-compliant standard base thickness (D), the following formula must be used: **ML = A - D + 3 (0.12)** in mm (in).

TL = threaded length, e.g. for NPT ½" TL = 8 mm (0.31 in)

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
With mounted head transmitter	–40 to 85 °C (–40 to 185 °F)
With mounted head transmitter and display	–20 to 70 °C (–4 to 158 °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 measurement 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/s² (3g)
Pt100 (TF), enhanced vibration resistance	> 40 m/s² (4g)
iTHERM StrongSens Pt100 (TF)	> 600 m/s² (60g)
Thermocouple inserts	> 30 m/s² (3g)

Electromagnetic compatibility (EMC)

Depends on the head transmitter used. For details see the Technical Information. → 22

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

The maximum process pressure depends on the thermowell into which the thermometer is screwed.

Permitted flow velocity depending on the immersion length

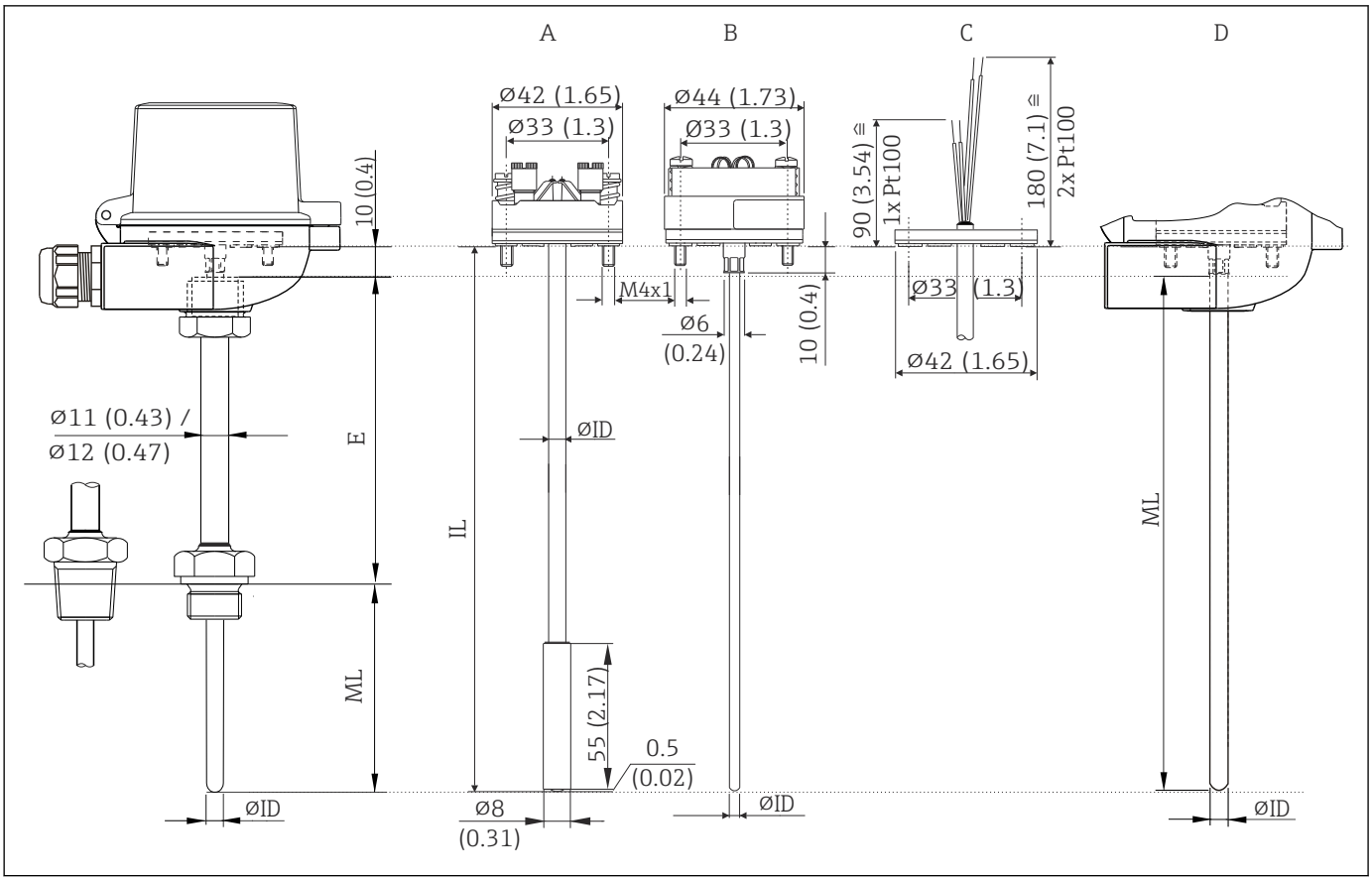
The maximum permitted flow rate to which the thermometer can be subjected reduces with the immersion depth of the thermowell in the flowing medium. In addition, it is dependent on the diameter of the tip of the thermowell, the medium type, process temperature and process pressure.

For an overview of the Endress+Hauser thermowells which may be used, see 'Supplementary documentation'. → 22

Mechanical construction

Design, dimensions

All dimensions in mm (in).



A Insert with head transmitter mounted and sleeve Ø8 mm (0.31 in)
B Insert with head transmitter mounted
C Insert with flying leads
D Model without extension neck, designed for installation in an existing onsite thermowell
E Extension neck length
IL Installation length of insert
ML Insertion length
ØID Insert diameter

The insertion length (ML) must be selected on the basis of the total length and the **type of thermowell used**.

Weight

0.5 to 2.5 kg (1 to 5.5 lbs) for standard options.

Material

Extension neck, insert and process connection.

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.

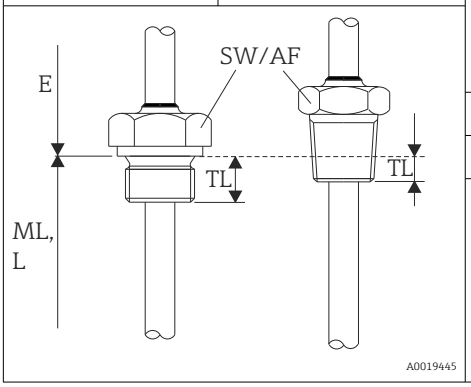
The maximum operating temperatures are reduced considerably in some cases where abnormal conditions such as high mechanical load occur or in aggressive media.

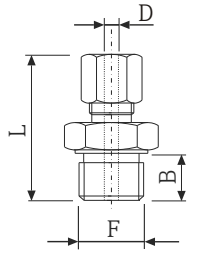
Description	Short formula	Recommended max. temperature for continuous use in air	Properties
AISI 316L/ 1.4404 1.4435	X2CrNiMo17-12-2 X2CrNiMo18-14-3	650 °C (1202 °F) [1]	▪ Austenitic, stainless steel ▪ High corrosion resistance in general ▪ Particularly high corrosion-resistance in chlorine-based and acidic, non-oxidizing atmospheres through the addition of molybdenum (e.g. phosphoric and sulfuric acids, acetic and tartaric acids with a low concentration) ▪ Increased resistance to intergranular corrosion and pitting ▪ Compared to 1.4404, 1.4435 has even higher corrosion resistance and a lower delta ferrite content
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
Alloy 600/2.4816	NiCr15Fe	1 100 °C (2 012 °F)	▪ A nickel/chromium alloy with very good resistance to aggressive, oxidizing and reducing atmospheres, even at high temperatures ▪ Resistance to corrosion caused by chlorine gases and chlorinated media as well as many oxidizing mineral and organic acids, sea water etc. ▪ Corrosion from ultrapure water ▪ Not to be used in sulfur-containing atmospheres

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 team for further information.

Process connection

The thermometer is designed for installation in an existing onsite thermowell or in a thermowell which can be ordered separately. The installation is done using the threaded connection on the bottom of the extension neck or with a compression fitting.

Threaded connection		Version		Thread length TL	Width across flats (SW/AF)
Cylindrical	Conical	M	M14x1.5	12 mm (0.47 in)	17
			M18x1.5		24
			M20x1.5	15 mm (0.6 in)	24
		G	G 1/2"	15 mm (0.6 in)	27
		NPT	NPT 1/2"	8 mm (0.32 in)	22
		R	R 3/4"	8.5 mm (0.33 in)	27
			R 1/2"		22

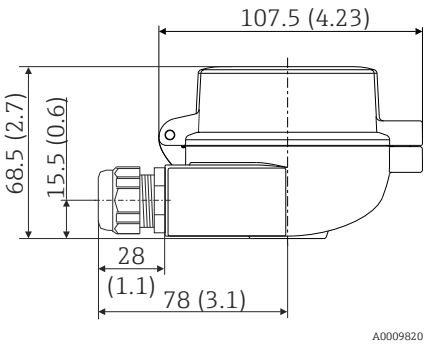
Threaded compression fitting (TA50)	F	L	B	Clamping ring material	Max. process temperature	Max. process pressure
	G1/2"	47 mm (1.85 in)	15 mm (0.6 in)	SS316 [1]	500 °C (932 °F)	40 bar at 20 °C (580 psi at 68 °F)

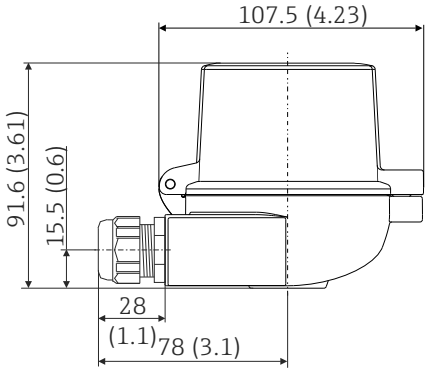
1) SS316 clamping ring: Can only be used once. Once released the compression fitting cannot be repositioned on the thermowell. Fully adjustable immersion length on initial installation.

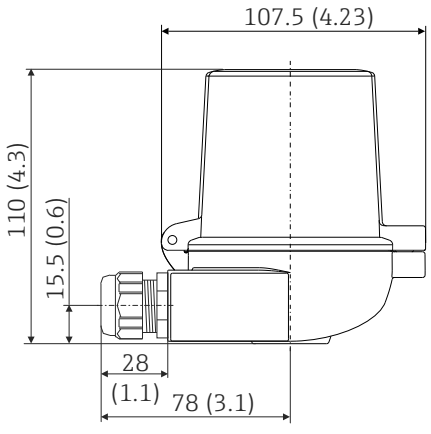
If a compression fitting is used, the thermometer is pushed through a coupling and secured using a metal clamping ring (cannot be released).

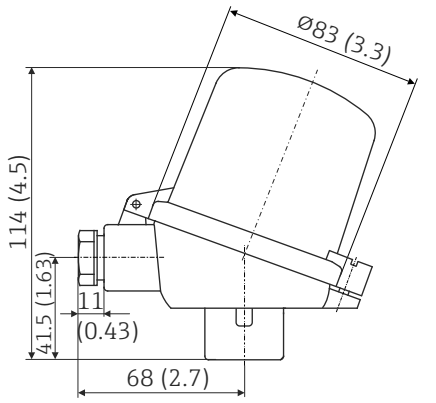
Terminal heads

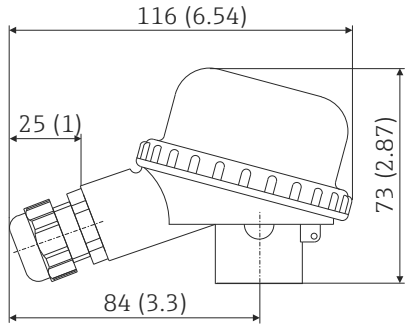
All terminal heads have an internal shape and size in accordance with DIN EN 50446, flat face and a thermometer connection with a M24x1.5, G½" or ½" NPT thread. All dimensions in mm (in). The cable glands in the diagrams correspond to M20x1.5 connections. Specifications without head transmitter installed. For ambient temperatures with built-in head transmitter, see the "Operating conditions" section.

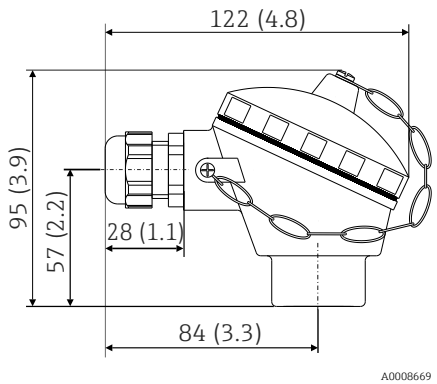
TA30A	Specification
	▪ Degree of protection: ▪ IP66/68 (NEMA Type 4x encl.) ▪ For ATEX: IP66/67 ▪ Temperature: −50 to +150 °C (−58 to +302 °F) without cable gland ▪ Material: aluminum, polyester powder coated Seals: silicone ▪ Cable entry thread: G ½", ½" NPT and M20x1.5; ▪ Protective fitting connection: M24x1.5 ▪ Color of head: blue, RAL 5012 ▪ Color of cap: gray, RAL 7035 ▪ Weight: 330 g (11.64 oz) ▪ Ground terminal, internal and external ▪ Available with sensors with 3-A® symbol

TA30A with display window in cover	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 ▪ Cable entry thread: G ½", ½" NPT and M20x1.5 ▪ Protective fitting connection: M24x1.5 ▪ Color of head: blue, RAL 5012 Color of cap: gray, RAL 7035 ▪ Weight: 420 g (14.81 oz) ▪ With TID10 display ▪ Ground terminal, internal and external ▪ Available with sensors with 3-A® symbol

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 ▪ Cable entry thread: G ½", ½" NPT and M20x1.5 ▪ Protective fitting connection: M24x1.5 ▪ 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. ▪ Color of head: blue, RAL 5012 ▪ Color of cap: gray, RAL 7035 ▪ Weight: 390 g (13.75 oz) ▪ Ground terminal, internal and external ▪ Available with sensors with 3-A® symbol

TA30P	Specification
	▪ Protection class: IP65 ▪ Max. temperature: −40 to +120 °C (−40 to +248 °F) ▪ Material: polyamide (PA), antistatic Seals: silicone ▪ Threaded cable entry: M20x1.5 ▪ Protection armature connection: M24x1.5 ▪ Two head transmitters can be mounted. In the standard version, one transmitter is mounted in the terminal head cover and an additional terminal block is installed directly on the insert. ▪ Head and cap color: black ▪ Weight: 135 g (4.8 oz) ▪ Types of protection for use in hazardous locations: Intrinsic Safety (G Ex ia) ▪ Ground terminal: only internal via auxiliary clamp ▪ With 3-A® symbol

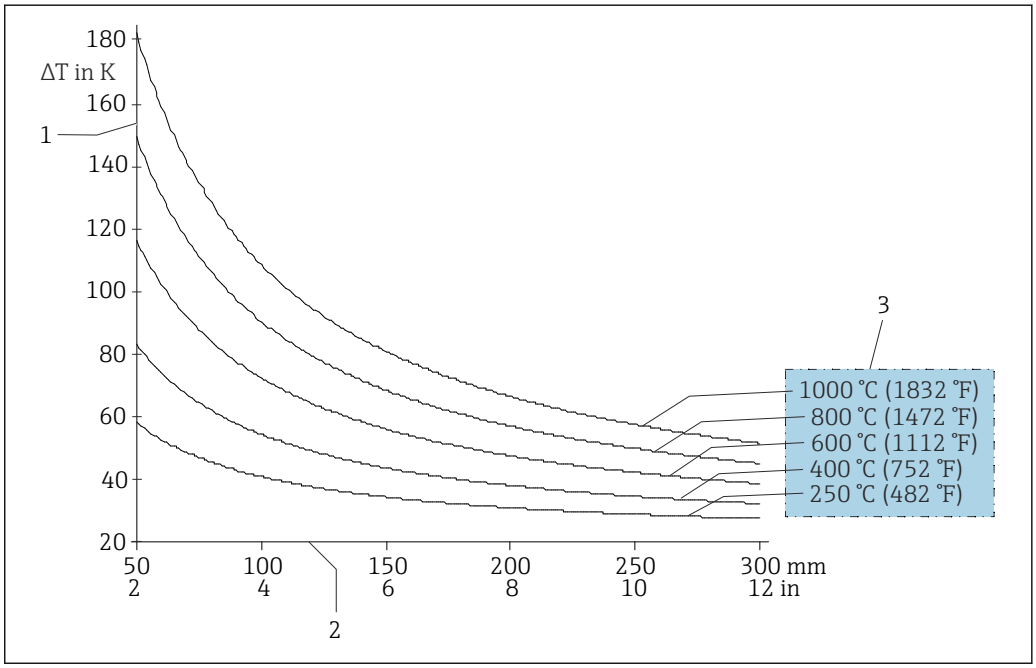
TA20B	Specification
	▪ Degree of protection: IP65 ▪ Max. temperature: −40 to +80 °C (−40 to +176 °F) without cable gland ▪ Material: polyamide (PA) ▪ Cable entry: M20x1.5 ▪ Head and cap color: black ▪ Weight: 80 g (2.82 oz) ▪ With 3-A® symbol

TA21E	Specification
	▪ Protection class: IP65 (NEMA Type 4x encl.) ▪ Temperature: −40 to 130 °C (−40 to 266 °F) silicone, up to 100 °C (212 °F) rubber seal without cable gland (observe max. permitted temperature of the cable gland!) ▪ Material: aluminum alloy with polyester or epoxy coating, rubber or silicone seal under the cover ▪ Cable entry: M20x1.5 or plug M12x1 PA ▪ Protection armature connection: M24x1.5, G 1/2" or NPT 1/2" ▪ Head color: blue, RAL 5012 ▪ Cap color: gray, RAL 7035 ▪ Weight: 300 g (10.58 oz) ▪ 3-A® marked

Maximum ambient temperatures for cable glands and fieldbus connectors	
Type	**Temperature range**
Cable gland ½" NPT, M20x1.5 (non Ex)	−40 to +100 °C (−40 to +212 °F)
Cable gland M20x1.5 (for dust ignition-proof area)	−20 to +95 °C (−4 to +203 °F)
Fieldbus connector (M12x1 PA, 7/8" FF)	−40 to +105 °C (−40 to +221 °F)

Extension neck

The extension neck is the part between the process connection and the terminal head. As illustrated in the following diagram, the extension neck length influences the temperature in the terminal head. This temperature must remain within the limit values defined in the "Operating conditions" section.



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

1 Temperature change in terminal head
2 Extension neck length E
3 Process temperatures

Insert

Different inserts are available for the thermometer depending on the application:

Sensor	Standard thin-film	iTHERM StrongSens	Wire wound	
Sensor design; connection method	1x Pt100, 3- or 4-wire, mineral insulated	1x Pt100, 3- or 4-wire, mineral insulated	1x Pt100, 3- or 4-wire, mineral insulated	2x Pt100, 3-wire, mineral insulated
Vibration resistance of the insert tip	Up to 3g	Enhanced vibration resistance > 60g	Up to 3g	
Measuring range; accuracy class	−50 to +400 °C (−58 to +752 °F), Class A or AA	−50 to +500 °C (−58 to +932 °F), Class A or AA	−200 to +600 °C (−328 to +1 112 °F), Class A or AA	
Diameter	3 mm (⅛ in), 6 mm (¼ in)	6 mm (¼ in)	3 mm (⅛ in), 6 mm (¼ in)	
Insert type	TPR100	iTHERM TS111	TPR100	

TC				
Selection in the order code	A	B	E	F
Sensor design; material	1x K; Alloy 600	2x K; Alloy 600	1x J; 316L	2x J; 316L
Measuring range according to:				
DIN EN 60584	−40 to 1 200 °C		−40 to 750 °C	
ANSI MC 96.1	0 to 1 250 °C		0 to 750 °C	
TC standard; accuracy	IEC 60584-2; Class 1 ASTM E230-03; special			
Insert type	TPC100			
Diameter	Ø3 mm (0.12 in) or Ø6 mm (0.24 in), depending on the thermowell selected			

Spare parts

- RTD insert TPR100 → 🖹 22
- iTHERM StrongSens TS111 → 🖹 22
- TC insert TPC100 → 🖹 22

The inserts are made from mineral insulated cable (MgO) with a sheath of AISI 316L/1.4404 (RTD) or Alloy 600 (TC).

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

Insertion length IL = E + L + 10 mm (0.4 in)

- Extension neck welded to terminal head with threaded connection. DIN form B (flat face), different connections for separate thermowell, **order code TN15-...**
- Compression fitting with thread, Ø12 mm (0.47 in), process connection thread G1/2", clamping ring from 316L stainless steel, **order code TA50-...**

Certificates and approvals

Current certificates and approvals for the product are available via the Product Configurator at www.endress.com.

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

The **Configuration** button opens the Product Configurator.

Other standards and guidelines

- IEC 60529: Degrees of protection provided by enclosures (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 EN 50446: Terminal heads

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 systems for liquids other than water"
- EN 12405-1/A2 Edition 2010 "Gas meters - Conversion devices - Part 1: Volume conversion"
- OIML R140-1 Edition 2007 (E) "Measuring systems for gaseous fuel"

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 for your nearest sales organization www.addresses.endress.com or in the Product Configurator under www.endress.com :

1. Click Corporate
2. Select the country
3. Click Products
4. Select the product using the filters and search field
5. Open the product page

The Configuration button to the right of the product image opens the Product Configurator.

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

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.

Communication-specific accessories

Configuration kit TXU10	Configuration kit for PC-programmable transmitter with setup software and interface cable for PC with USB port Order code: TXU10-....
Commubox FXA195 HART	For intrinsically safe HART communication with FieldCare via the USB interface. For details, see Technical Information TI00404F
Wireless HART adapter SWA70	Is used for the wireless connection of field devices. The WirelessHART adapter can be easily integrated into field devices and existing infrastructures, offers data protection and transmission safety and can be operated in parallel with other wireless networks with minimum cabling complexity. For details, see Technical Information TI00026S

Service-specific accessories

Applicator
Software for selecting and sizing Endress+Hauser measuring devices:
- Calculation of all the necessary data for identifying the optimum measuring device: e.g. pressure loss, accuracy or process connections.
- Graphic illustration of the calculation results

Administration, documentation and access to all project-related data and parameters over the entire life cycle of a project.

Applicator is available:
https://portal.endress.com/webapp/applicator

Configurator
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

The Configurator is available on the Endress+Hauser website: www.endress.com -> Click "Corporate" -> Select your country -> Click "Products" -> Select the product using the filters and the search field -> Open the product page -> The "Configure" button to the right of the product image opens the Product Configurator.

W@M
Life cycle management for your plant
W@M supports you with a wide range of software applications over the entire process: from planning and procurement, to the installation, commissioning and operation of the measuring

devices. All the relevant device information, such as the device status, spare parts and device-specific documentation, is available for every device over the entire life cycle.
The application already contains the data of your Endress+Hauser device. Endress+Hauser also takes care of maintaining and updating the data records.

W@M is available:
www.endress.com/lifecyclemanagement

System components

RN22
1- or 2-channel active barrier for separation of 0/4 to 20 mA standard signal circuits, optionally available as a signal duplicator, 24 V DC. HART-compatible (TI01515K)

For details, see Technical Information TI01515K

RIA15 field indicator
Loop-powered 4 to 20 mA process indicator with optional HART® communication. Compact process indicator with very low voltage drop for universal use to display 4 to 20 mA/HART® signals. The indicator records the measuring signal from the head transmitter and shows this on the display, option for up to 4 HART® process variables of a sensor in all industries.

For details, see Technical Information TI01043K

Supplementary documentation

Technical Information
- iTEMP temperature head transmitter:
  - TMT180, PC-programmable, single-channel, Pt100 (TI00088R)
  - HART® TMT82, 2-channel, RTD, TC, Ω, mV (TI01010T)
  - PROFIBUS® PA TMT84, 2-channel, RTD, TC, Ω, mV (TI00138R)
  - FOUNDATION Fieldbus™ TMT85, 2-channel, RTD, TC, Ω, mV (TI00134R)
- Inserts:
  - Omniset TPR100 resistance thermometer insert (TI00268T)
  - Omniset TPC100 thermocouple insert (TI00278T)
  - iTHERM TS111, TS211 insert for installation in thermometer (TI01014T)
- Application example:
  - RN22; 1- or 2-channel active barrier for separation of 0/4 to 20 mA standard signal circuits, optionally available as a signal duplicator, 24 V DC. HART-compatible (TI01515K)
  - RIA15 process indicator, loop-powered (TI01043K)

Technical Information on thermowells

Thermowell type			
TA550	TI00153T	TA565	TI00160T
TA555	TI00154T	TA566	TI00177T
TA557	TI00156T	TA571	TI00178T
TW15	TI00265T	TA572	TI00179T
TA560	TI00159T	TA575	TI00162T
TA562	TI00230T	TA576	TI00163T

Supplementary ATEX documentation
- TRxx, TCxx, TSTxxx, TxCxxx; TPR100, TET10x, TPC100, TEC10x, iTHERM TS111 ATEX II 3GD Ex nA (XA00044R)
- RTD/TC thermometer TRxx, TCxx, TxCxxx, ATEX II 1GD or II 1/2GD Ex ia IIC T6 - T1 (XA00072R)
- iTHERM TS111, TM211 TST310, TSC310, TPR100, TPC100 IECEx Ex ia IIC T6 - T1 (XA00100R)

www.addresses.endress.com

Endress+Hauser

People for Process Automation