

Technical Information

iTHERM[®] TM401

Resistance thermometer for hygienic and aseptic applications

Metric version with basic technology for all standard applications, fixed, non-replaceable insert



Applications

- Specially designed for use in hygienic and aseptic applications in the Food & Beverages and Life Sciences industries
- Measuring range: -50 to +200 °C (-58 to +392 °F)
- Pressure range up to 50 bar (725 psi)
- Protection class: up to IP69K
- Can be used in non-hazardous areas

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[®]

Your benefits

- Excellent value for money and fast delivery
- User-friendly and reliable from product selection to maintenance
- International certification: hygiene standards as per 3-A[®], EHEDG, ASME BPE, FDA, TSE Certificate of Suitability
- Wide range of process connections

Function and system design

iTHERM® Hygiene line

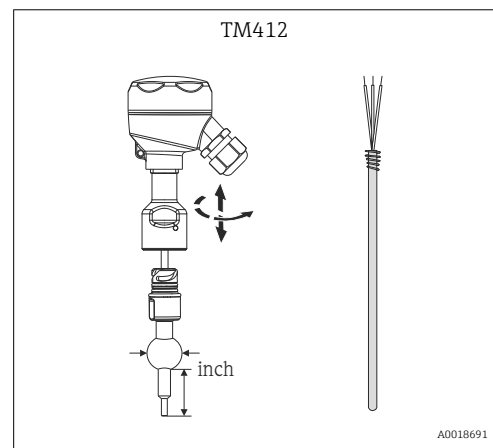
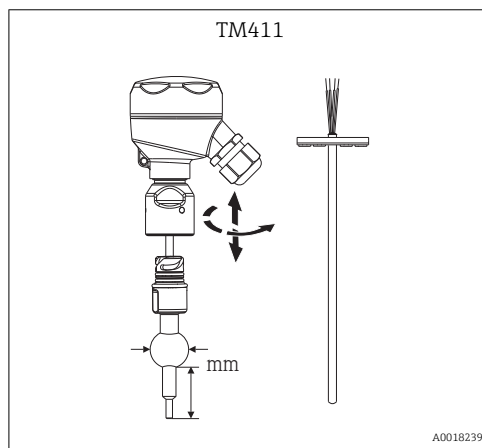
This thermometer is part of the product line of modular thermometers for hygienic and aseptic applications.

Differentiating factors when selecting a suitable thermometer

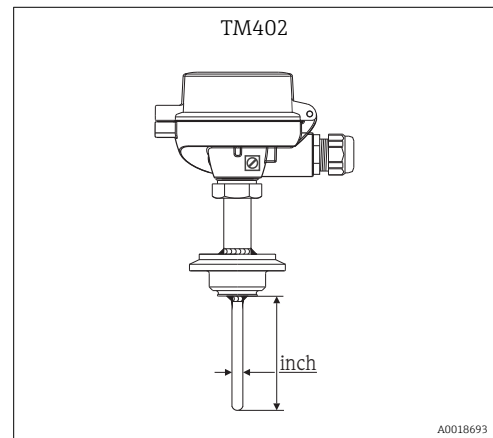
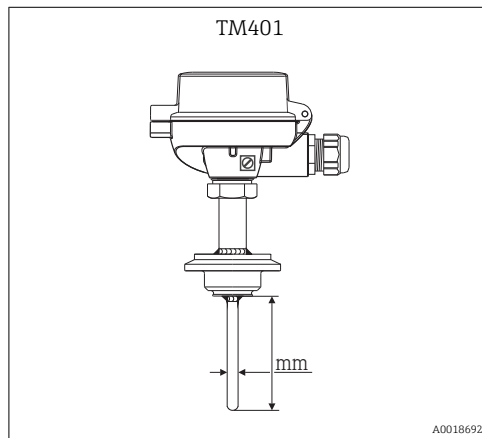
TM4x1	TM4x2
Metric version	Imperial version



TMx1x characterizes the device that uses cutting-edge technology, with features such as a replaceable insert, quick-fastening extension neck (iTHERM® QuickNeck), vibration-resistant and fast-response sensor technology (iTHERM® StrongSens and QuickSens) and approval for use in hazardous areas



TMx0x characterizes the device that uses basic technology, with features such as a fixed, non-replaceable insert, application in non-hazardous areas, standard extension neck, low-cost unit



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 $\alpha = 0.003851 \text{ } ^\circ\text{C}^{-1}$.

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.

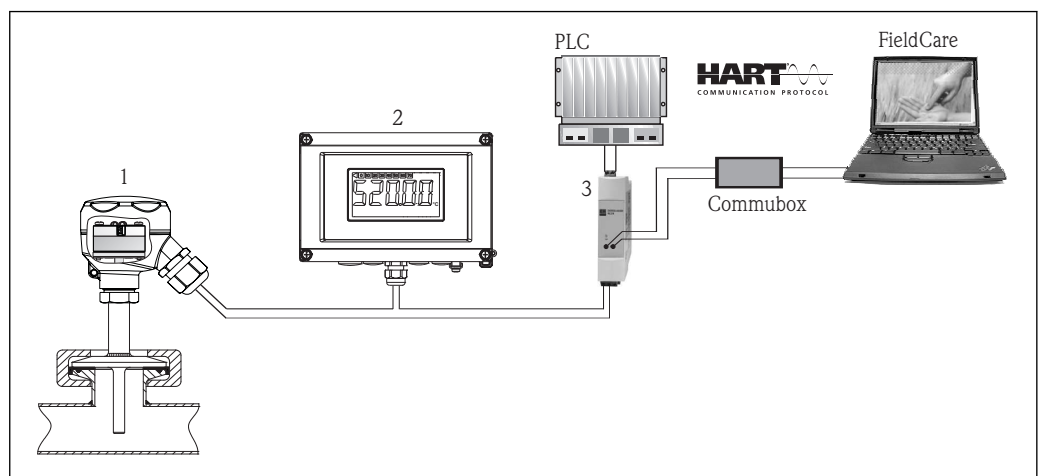
The primary advantages of thin film temperature sensors over wire wound versions are their smaller sizes and better vibration resistance. A relatively low principle-based deviation of the resistance/temperature characteristic from the standard characteristic of IEC 60751 can frequently be observed among 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). For this reason, thin-film sensors are generally only used for temperature measurements in ranges below 400 °C (752 °F).

Measuring system


Endress+Hauser offers a complete portfolio of optimized components for the temperature measuring point – everything you need for the seamless integration of the measuring point into the overall facility. This includes:



- Power supply unit/barrier
- Display units
- Overvoltage protection

 For more information, see the brochure 'System Components - Solutions for a Complete Measuring Point' (FA00016K/EN)



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 1 Example of application, measuring point layout with additional Endress+Hauser components

- 1 Installed iTHERM® resistance thermometer with integrated HART® head transmitter
- 2 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 display unit 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 "Documentation", (→  25).
- 3 Active barrier RN221N - The RN221N (24 V DC, 30 mA) active barrier has a galvanically isolated output for supplying voltage to loop-powered 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 "Documentation", (→  25).

Input

Measured variable Temperature (temperature-linear transmission behavior)

Measuring range

Sensor type	Measuring range
Pt100 thin-film	-50 to +200 °C (-58 to +392 °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.

PC programmable 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® programmable 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. It can be installed as an intrinsically safe apparatus in Zone 1 hazardous areas and is used for instrumentation in the terminal head (flat face) as per DIN EN 50446. Swift and easy operation, visualization and maintenance by PC using operating software, Simatic PDM or AMS. For more information, see the Technical Information.

Advantages of the iTEMP® transmitters:

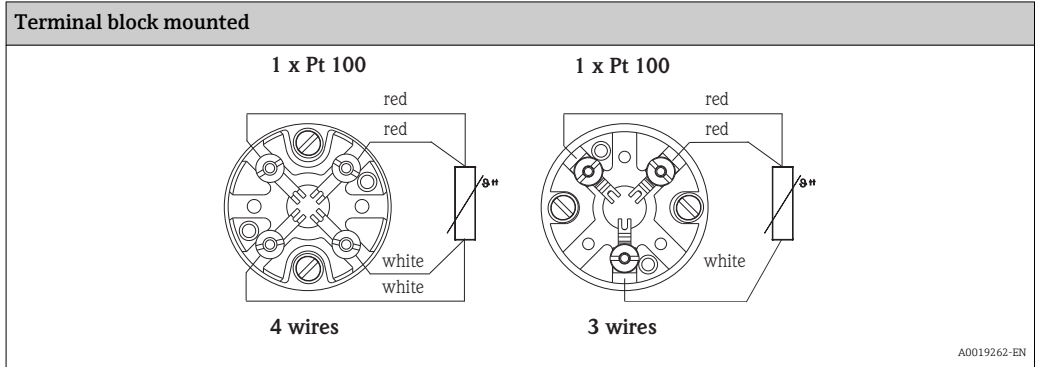
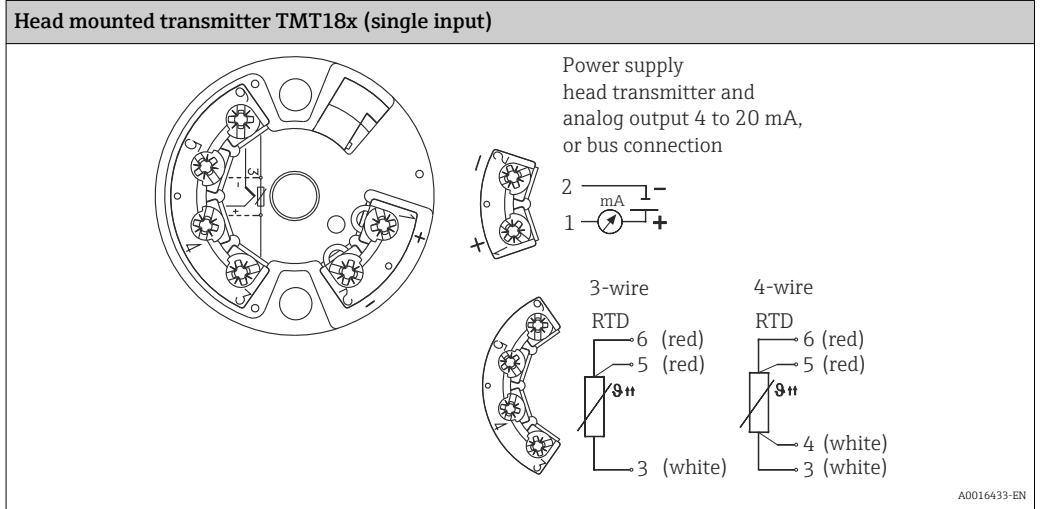
- Dual or single sensor input (optionally for certain transmitters)
- Unsurpassed reliability, accuracy and long-term stability in critical processes
- Mathematical functions
- Monitoring of the thermometer drift, sensor backup functionality, sensor diagnostic functions
- Sensor-transmitter matching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

Wiring

-  According to the 3-A® Standard electrical connecting cables must be smooth, corrosion-resistant and easy to clean.
- Grounding or shield connections are possible via special ground terminals on the terminal head. (→  14)

Wiring diagrams for RTD

Type of sensor connection



Cable entries

See the 'Terminal head' section (→ 14)

Connector

PIN assignment of the M12 connector, connection combinations

Connector	M12 connector 4-pin			
PIN number	1	2	3	4
Electrical connection (terminal head)				
Flying leads	Not connected (not insulated)			
3-wire terminal block (1x Pt100)	RD	RD	WH	
4-wire terminal block (1x Pt100)			WH	WH
1x TMT 4 to 20 mA or HART®	+	i	-	i
PIN position and color code	<p>1 BN 2 GNYE 3 BU 4 GY</p>			

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Abbreviations

i	RD	WH	BN	GNYE	BU	GY
Insulated ¹⁾	Red	White	Brown	Greenyellow	Blue	Gray


1) Wires marked 'i' are not connected and are insulated with heat shrink tubes.

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.

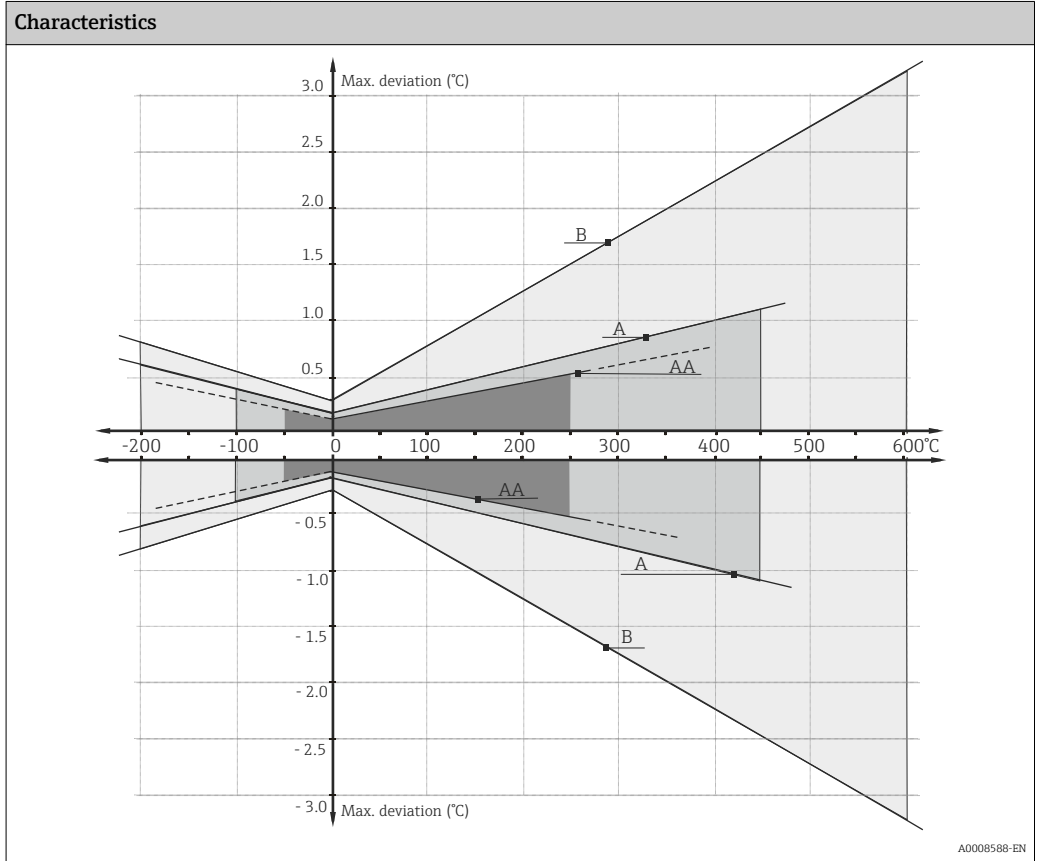
Performance characteristics**Reference conditions**

These data are relevant for determining the accuracy of the temperature transmitters used. More information on this can be found in the Technical Information of the iTEMP® temperature transmitters. (→  25)

Accuracy

RTD resistance thermometer as per IEC 60751

Class	Max. tolerances (°C)
Cl. AA, former 1/3 Cl. B	$\pm (0.1 + 0.0017 \cdot t ^{1.5})$
Cl. A	$\pm (0.15 + 0.002 \cdot t)$
Cl. B	$\pm (0.3 + 0.005 \cdot t)$
Temperature range for compliance with the tolerance classes	
Thin-film version (TF): Cl. A -30 to +200 °C	



1) |t| = absolute value °C

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

Influence of ambient temperature

Depends on the head transmitter used. For details, see Technical Information. (→ 25)

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

Tests in water at 0.4 m/s (1.3 ft/s), according to IEC 60751; 10 K temperature step change.

Pipe diameter	Shape of tip	1x Pt100 thin-film sensor	
		Response time	
		t ₅₀	t ₉₀
ø6 mm (¼ in)	Straight	5 s	11 s
	Reduced 4.5 mm (0.18 in)x 18 mm (0.71 in)	3.5 s	9 s
ø8 mm (0.31 in)	Reduced 5.3 mm (0.21 in)x 20 mm (0.79 in)	5 s	10.5 s

i Response time without transmitter.

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.

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.

For the device, Endress+Hauser offers standard calibrations at a reference temperature of -50 to +200 °C (-58 to +392 °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 thermometer.

Minimum immersion length U required to perform a correct calibration:

Measuring range	-50 to +200 °C (-58 to +392 °F)		
	without head transmitter	with head transmitter and extension neck	with head transmitter without extension neck
-50 to +200 °C (-58 to +392 °F)	120 mm (4.72 in)		150 mm (5.9 in)

Insulation resistance

Insulation resistance \geq 100 M Ω at ambient temperature.

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

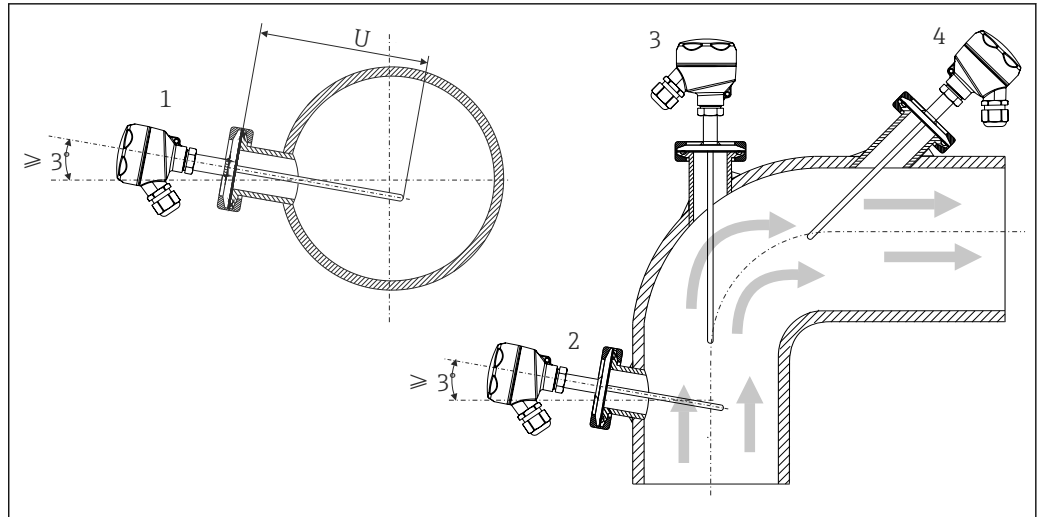
Installation**Orientation**

No restrictions. However, self-draining in the process must be guaranteed. If there is an opening to detect leaks at the process connection, this opening must be at the lowest possible point.

Installation instructions

The immersion length of the thermometer can influence the accuracy. If the immersion length is too small then errors in the measurement are caused by heat conduction via the process connection and the container wall. If installing into a pipe then the immersion length should ideally be half of the pipe diameter.

- Installation possibilities: Pipes, tanks or other plant components
- To minimize the error caused by heat conduction, a minimum immersion length, which corresponds to the calibration, is recommended depending on the type of sensor used.

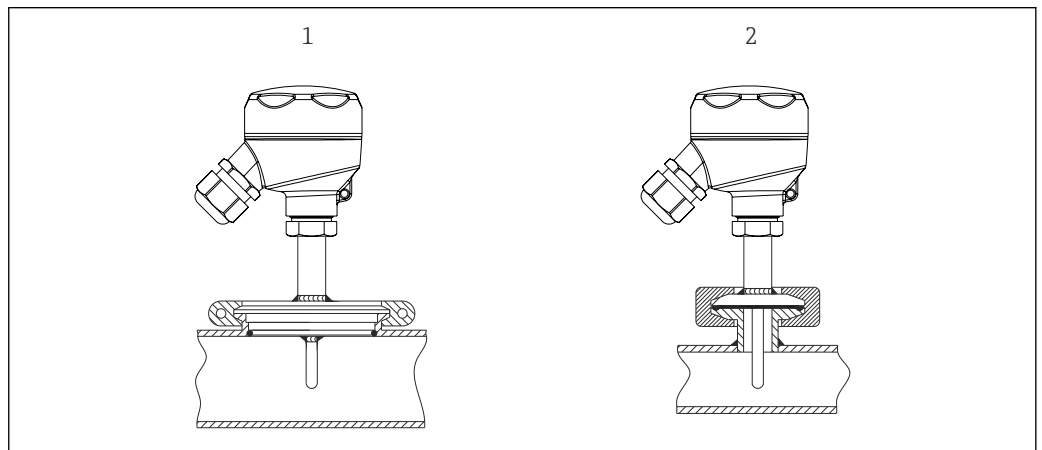


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2 Installation examples

- 1, 2 Perpendicular to the flow direction, installed at a minimum angle of 3° to ensure self-draining
- 3 On elbows
- 4 Inclined installation in pipes with a small nominal diameter
- U Immersion length

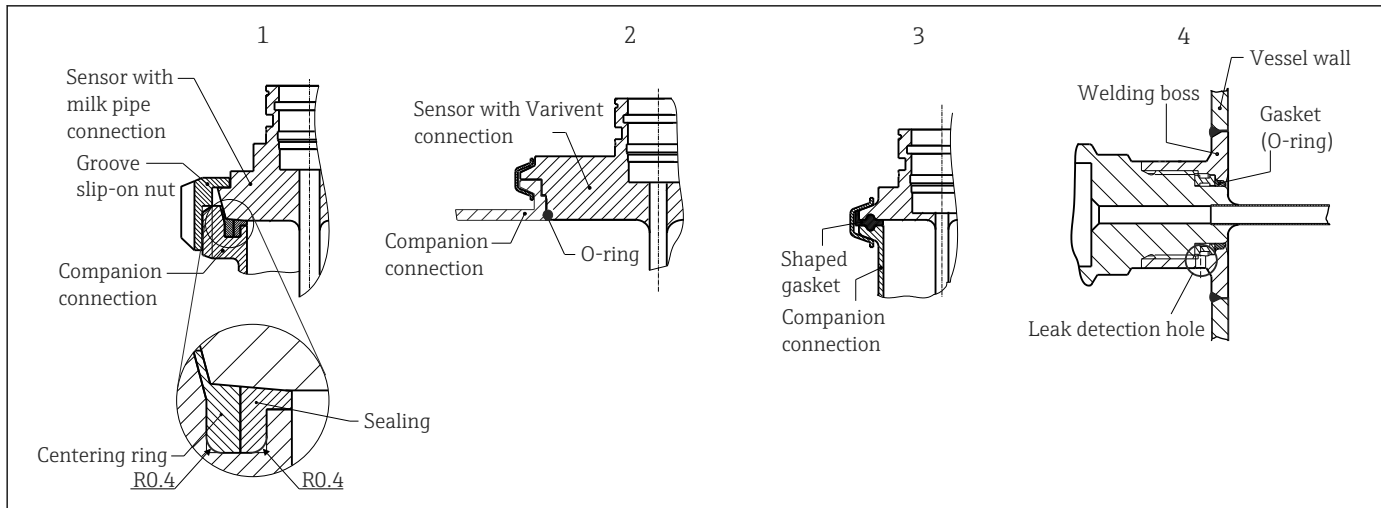
i In the case of pipes with a small nominal diameter, it is advisable for the tip of the thermometer to project well into the process so that it extends past the pipe axis. Installation at an angle (4) could be another solution. When determining the immersion length or installation depth all the parameters of the thermometer and of the medium to be measured must be taken into account (e.g. flow velocity, process pressure).




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3 Process connections for thermometer installation in pipes with small nominal diameters



- 1 Varivent® - Prozessanschluss D = 50 mm für Rohre DN25
- 2 Clamp oder Micro-Clamp



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 4 Detailed installation instructions for hygiene-compliant installation


- 1 Sanitary connection according to DIN 11851, only in connection with EHEDG-certified and self-centering sealing ring
- 2 Varivent® process connection for VARINLINE® housing
- 3 Clamp according to ISO 2852
- 4 Liquiphant-M G1" process connection, horizontal installation

 The counterpieces for the process connections and the seals or sealing rings are not included in the scope of supply for the thermometer. Liquiphant M weld-in adapters with associated seal kits are available as accessories. (→  21) In the case of weld-in connections, exercise the necessary degree of care when performing the welding work on the process side:

- Suitable welding material
- Flush-welded or with welding radius > 3.2 mm (0.13 in)
- No recesses, folds or gaps
- Honed and polished surface, $R_a \leq 0.76 \mu\text{m}$ (0.03 μin)

As a general rule, the thermometers should be installed in such a way that does not impact their ability to be cleaned (the requirements of the 3-A® Standard must be observed). The Varivent® and Liquiphant-M weld-in adapter connections enable flush-mounted installation.

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 (→  14)
	With mounted head transmitter	-40 to 85 °C (-40 to 185 °F)
Storage temperature	For information, see the ambient temperature.	
Humidity	Depends on the transmitter used. If Endress+Hauser iTEMP® head transmitters are used: <ul style="list-style-type: none"> ▪ Condensation permitted as per IEC 60 068-2-33 ▪ Max. rel. humidity: 95% as per IEC 60068-2-30 	
Climate class	As per EN 60654-1, Class C	
Degree of protection	Max. IP69K, depending on the design (terminal head, connector, etc.)	

Shock and vibration resistance

The Endress+Hauser inserts meet the requirements of IEC 60751 which specify shock and vibration resistance of 3g in the range from 10 to 500 Hz. The vibration resistance at the measuring point depends on the sensor type and design, see the following table:

Version	Vibration resistance for the sensor tip
Pt100 (TF)	30 m/s ² (3g)

Electromagnetic compatibility (EMC)

Depends on the head transmitter used. For details see the Technical Information. (→  25)

Process


Process temperature range

Maximum -50 to +200 °C (-58 to +392 °F)


Thermal shock

Thermal shock resistance in CIP/SIP process (temperature increase within 2 seconds from +5 to +130 °C (+41 to +266 °F)).

Process pressure range

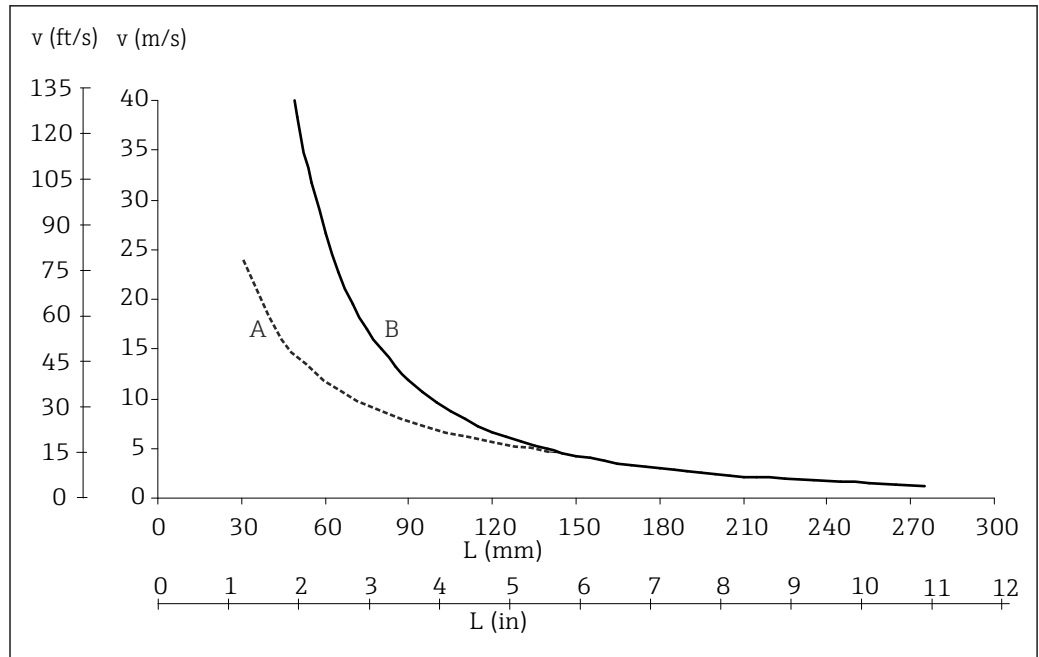
The maximum possible process pressure depends on various influencing factors, such as the thermometer design, process connection and process temperature. For information on the maximum possible process pressures for the individual process connections, see the 'Process connection' section. (→  16)



It is possible to check the mechanical loading capacity as a function of the installation and process conditions online in the TW Sizing Module for thermowells in the Endress+Hauser Applicator software. See also the 'Accessories' section. (→  24)

Example of the permitted flow rate as a function of the immersion length and medium

The highest flow velocity tolerated by the thermometer diminishes with increasing thermometer immersion length exposed to the stream of the fluid. In addition it is dependent on the diameter of the thermometer tip, on the kind of measuring medium, on the process temperature and on the process pressure. The following figures exemplify the maximum permitted flow velocities in water and superheated steam at a process pressure of 40 bar (580 PSI).



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5 Permitted flow velocities, thermowell diameter 6 mm (1/4 in)

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

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

L Immersion length exposed to flow

v Flow velocity

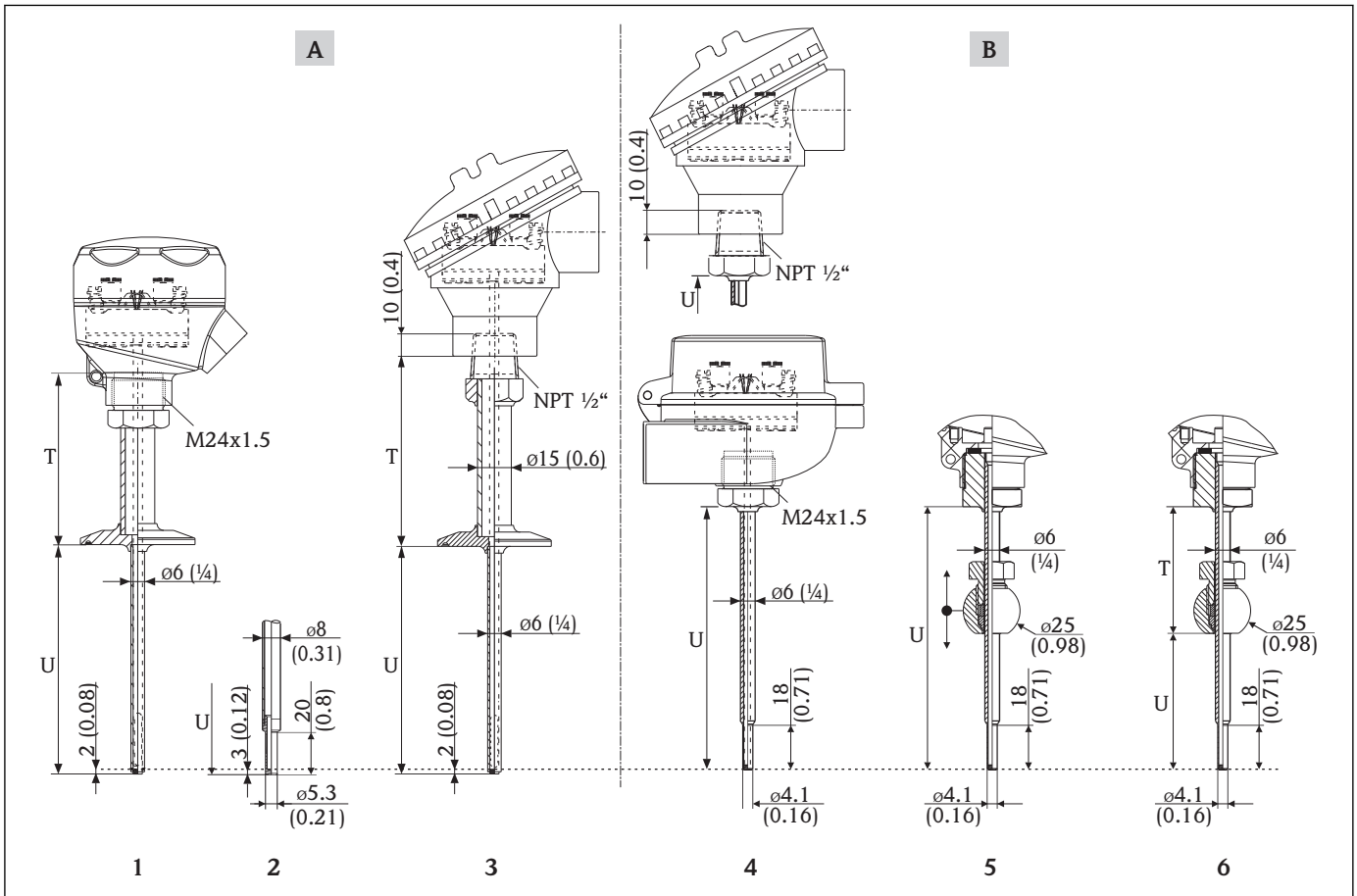
Medium - state of
aggregation

Gaseous or liquid (also with high viscosity, e.g. yogurt).

Mechanical construction

Design, dimensions

All dimensions in mm (in).



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A Version with process connection

B Version without process connection or optionally with compression fitting

1 Thermometer with process connection and M24x1.5 thread to terminal head - shape of tip $\phi 6$ mm (1/4 in) straight or

2 Optional shape of tip: $\phi 8$ mm (0.31 in) reduced to 5.3 mm (0.21 in)

3 Thermometer with process connection and NPT 1/2" thread to the terminal head

4 Thermometer without process connection with M24x1.5 thread (optional NPT 1/2" thread) to terminal head - shape of tip $\phi 6$ mm (1/4 in) reduced

5 Thermometer with spherical, movable TK40 compression fitting for weld-in - shape of tip $\phi 6$ mm (1/4 in) reduced

6 Thermometer with spherical, fixed TK40 compression fitting for weld-in - shape of tip $\phi 6$ mm (1/4 in) reduced

T Length of extension neck (T = 0, for version without process connection or for version with movable compression fitting)

U Immersion length

Weight

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

Material

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 can be reduced considerably in cases where abnormal conditions such as high mechanical load occur or in aggressive media.

Designation	Short form	Recommended max. temperature for continuous use in air	Properties
AISI 316L, complies with 1.4404 or 1.4435	X2CrNiMo17-13-2, X2CrNiMo18-14-3	650 °C (1 202 °F) ¹⁾	<ul style="list-style-type: none"> ▪ 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

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


Surface roughness

Values for wetted surfaces:

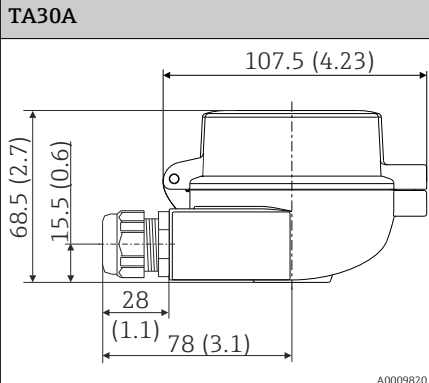
Standard surface	$R_a \leq 0.76 \mu\text{m}$ (0.03 μin)
Finely honed surface ¹⁾	$R_a \leq 0.38 \mu\text{m}$ (0.015 μin)

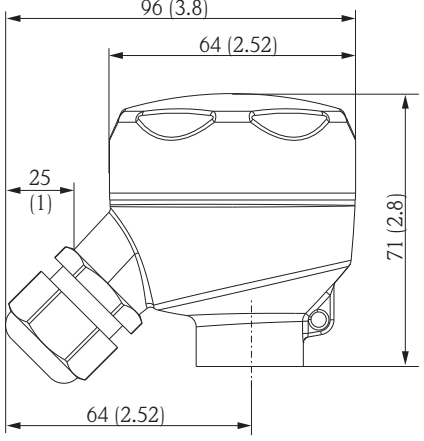
1) Not compliant with ASME BPE

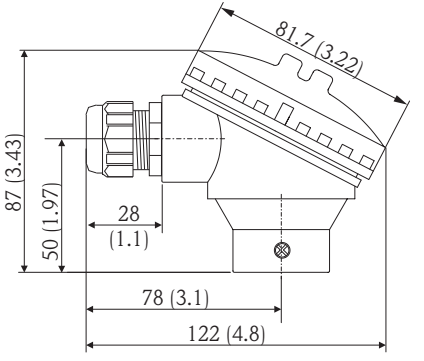
Terminal heads

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 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 the 'Environment' section. (→  10)

As a special feature, Endress+Hauser offers terminal heads with optimized terminal accessibility for easy installation and maintenance.

TA30A	Specification
	<ul style="list-style-type: none"> ▪ Available with one or two cable entries ▪ Protection class: IP66/68 (NEMA Type 4x encl.) ▪ Temperature: -50 to +150 °C (-58 to +302 °F) without cable gland ▪ Material: aluminum, polyester powder coated Seals: silicone ▪ Threaded cable entry: G ½", ½" NPT and M20x1.5; ▪ Protection armature connection: M24x1.5 ▪ Head color: blue, RAL 5012 ▪ Cap color: gray, RAL 7035 ▪ Weight: 330 g (11.64 oz) ▪ Ground terminal, internal and external ▪ With 3-A[®] symbol

TA30R	Specification
 <p style="text-align: right; font-size: small;">A0018914</p>	<ul style="list-style-type: none"> ▪ Degree of protection - standard version: IP69K (NEMA Type 4x incl.) ▪ Temperature: -50 to +130 °C (-58 to +266 °F) without cable gland ▪ Material: stainless steel 316L/1.4404, abrasive-blasted or hand-polished Seals: silicone, optional EPDM for applications free from paint-wetting impairment substances ▪ Cable entry thread ½" NPT and M20x1.5 ▪ Weight: 360 g (12.7 oz) ▪ Protection armature connection: M24x1.5 or ½" NPT ▪ Ground terminal: internal in standard version; external terminal optionally available ▪ With 3-A® symbol

TA30S	Specification
 <p style="text-align: right; font-size: small;">A0017146</p>	<ul style="list-style-type: none"> ▪ Degree of protection: IP65 (NEMA Type 4x incl.) ▪ Temperature: -40 to +85 °C (-40 to +185 °F) without cable gland ▪ Material: polypropylene (PP), FDA-compliant, seals: O-ring EPDM ▪ Cable entry thread: ¾" NPT (with adapter for ½" NPT), M20x1.5 ▪ Protective assembly connection: ½" NPT ▪ Color: white ▪ Weight: approx. 100 g (3.5 oz) ▪ Ground terminal: only internal via auxiliary terminal ▪ With 3-A® symbol

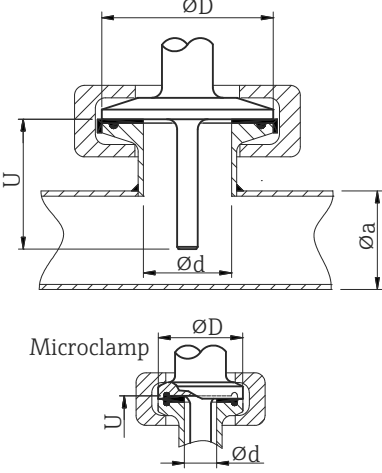
Cable glands and fieldbus connectors

Type	Suitable for cable entry	Degree of protection	Temperature range
Cable gland, polyamide	½" NPT, ¾" NPT, M20x1.5	IP68	-40 to +100 °C (-40 to +212 °F)
	½" NPT, M20x1.5	IP69K	
Fieldbus connector (M12, 4-pin)	½" NPT, M20x1.5	IP67, NEMA Type 6	-30 to +90 °C (-22 to +194 °F)

Process connections

All dimensions in mm (in).

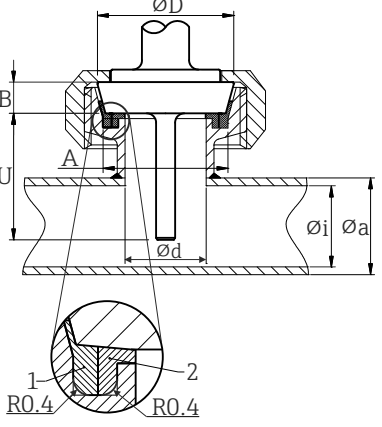
Releasable process connection

Type	Version	Dimensions		Technical properties
	ϕd ¹⁾	ϕD	ϕa	
Clamp according to ISO 2852 	Microclamp ²⁾ DN8-18 (0.5"-0.75")	25 mm (0.98 in)	-	<ul style="list-style-type: none"> ■ $P_{max.} = 16$ bar (232 psi), depends on clamp ring and suitable seal ■ With 3-A[®] symbol
	Tri-clamp DN8-18 (0.5"-0.75")		-	
	DN12-21.3	34 mm (1.34 in)	16 to 25.3 mm (0.63 to 0.99 in)	<ul style="list-style-type: none"> ■ $P_{max.} = 16$ bar (232 psi), depends on clamp ring and suitable seal ■ With 3-A[®] symbol and EHEDG certification (combined with Hyjoin PEEK/(stainless steel seal or Dupont de Nemours Kalrez/ stainless steel seal) ■ Compliant with ASME BPE³⁾
	DN25-38 (1"-1.5")	50.5 mm (1.99 in)	29 to 42.4 mm (1.14 to 1.67 in)	
	DN40-51 (2")	64 mm (2.52 in)	44.8 to 55.8 mm (1.76 to 2.2 in)	

1) Pipes in accordance with ISO 2037 and BS 4825 Part 1

2) Microclamp (not in ISO 2852); no standard pipes

3) Not for DN12-21.3

Type	Version ¹⁾	Dimensions					$P_{max.}$	Technical properties
		ϕD	A	B	ϕi	ϕa		
Sanitary connection according to DIN 11851 	DN25	44 mm (1.73 in)	30 mm (1.18 in)	10 mm (0.39 in)	26 mm (1.02 in)	29 mm (1.14 in)	<ul style="list-style-type: none"> ■ With 3-A[®] symbol and EHEDG certification (only with EHEDG-certified and self-centering sealing ring). ■ ASME BPE compliance 	
	DN32	50 mm (1.97 in)	36 mm (1.42 in)		32 mm (1.26 in)	35 mm (1.38 in)		
	DN40	56 mm (2.2 in)	42 mm (1.65 in)		38 mm (1.5 in)	41 mm (1.61 in)		
	DN50	68 mm (2.68 in)	54 mm (2.13 in)	11 mm (0.43 in)	50 mm (1.97 in)	53 mm (2.1 in)		25 bar (363 psi)

1) Pipes in accordance with DIN 11850

Type	Version	Technical properties
Metal sealing system		
<p>M12x1.5</p>	<p>G½"</p>	<p>Protection tube diameter 6 mm (¼ in)</p> <ul style="list-style-type: none"> ▪ P_{max.} = 16 bar (232 psi) ▪ EHEDG certified
-		<p>Protection tube diameter 8 mm (0.31 in)</p> <ul style="list-style-type: none"> ▪ P_{max.} = 16 bar (232 psi) ▪ EHEDG certified

Type	Version G	Dimensions			Technical properties
		A	L1 thread length	1 (SW/AF)	
<p>Thread according to ISO 228 (for Liquiphant weld-in adapter)</p>	G¾" for FTL20 adapter	16 mm (0.63 in)	25.5 mm (1 in)	32	<ul style="list-style-type: none"> ▪ P_{max.} = 25 bar (362 psi) at max. 150 °C (302 °F) ▪ P_{max.} = 40 bar (580 psi) at max. 100 °C (212 °F) ▪ With 3-A® symbol and EHEDG certification ▪ ASME BPE compliance
	G¾" for FTL50 adapter				
	G1" for FTL50 adapter	18.6 mm (0.73 in)	29.5 mm (1.16 in)	41	

Type	Version	Dimensions				Technical properties	
		φD	φA	φB	h	P _{max.}	
<p>Varivent®</p>	Type F	50 mm (1.97 in)	145 mm (5.71 in)	135 mm (5.31 in)	24 mm (0.95 in)	10 bar (145 psi)	<ul style="list-style-type: none"> ▪ With 3-A® symbol and EHEDG certification ▪ ASME BPE compliance
	Type N	68 mm (2.67 in)	165 mm (6.5 in)	155 mm (6.1 in)	24.5 mm (0.96 in)		

i The VARINLINE® housing connection flange is suitable for weld-in into the conical or torispherical head in tanks or containers with a small diameter (≤ 1.6 m (5.25 ft)) and up to a wall thickness of 8 mm (0.31 in).

Type		Technical properties		
Varivent® for VARINLINE® housing for installation in pipes 		<ul style="list-style-type: none"> With 3-A® symbol and EHEDG certification ASME BPE compliance 		
		A0009564		
Version	Dimensions			P _{max.}
	ØD	Øi	Øa	
Type N, according to DIN 11866, series A	68 mm (2.67 in)	DN40: 38 mm (1.5 in)	DN40: 41 mm (1.61 in)	DN40 to DN65: 16 bar (232 psi)
		DN50: 50 mm (1.97 in)	DN50: 53 mm (2.1 in)	
		DN65: 66 mm (2.6 in)	DN65: 70 mm (2.76 in)	
		DN80 to DN150: 10 bar (145 psi)	DN80: 81 mm (3.2 in)	DN80: 85 mm (3.35 in)
			DN100: 100 mm (3.94 in)	DN100: 104 mm (4.1 in)
			DN125: 125 mm (4.92 in)	DN125: 129 mm (5.08 in)
			DN150: 150 mm (5.9 in)	DN150: 154 mm (6.06 in)
Type N, according to EN ISO 1127, series B	68 mm (2.67 in)	38.4 mm (1.51 in)	42.4 mm (1.67 in)	42.4 mm (1.67 in) to 60.3 mm (2.37 in): 16 bar (232 psi)
		44.3 mm (1.75 in)	48.3 mm (1.9 in)	
		56.3 mm (2.22 in)	60.3 mm (2.37 in)	
		76.1 mm (3 in) to 114.3 mm (4.5 in): 10 bar (145 psi)	72.1 mm (2.84 in)	76.1 mm (3 in)
			82.9 mm (3.26 in)	82.4 mm (3.5 in)
			108.3 mm (4.26 in)	114.3 mm (4.5 in)
Type N, according to DIN 11866, series C	68 mm (2.67 in)	OD 1½": 34.9 mm (1.37 in)	OD 1½": 38.1 mm (1.5 in)	OD 1½" to OD 2½": 16 bar (232 psi)
		OD 2": 47.2 mm (1.86 in)	OD 2": 50.8 mm (2 in)	
		OD 2½": 60.2 mm (2.37 in)	OD 2½": 63.5 mm (2.5 in)	
		OD 3" to OD 4": 10 bar (145 psi)	OD 3": 73 mm (2.87 in)	OD 3": 76.2 mm (3 in)
			OD 4": 97.6 mm (3.84 in)	OD 4": 101.6 mm (4 in)

Type	Version	Dimensions			Technical properties
		ØD	ØA	h	
SMS 1147 	DN25	32 mm (1.26 in)	35.5 mm (1.4 in)	7 mm (0.28 in)	P _{max.} = 25 bar (362 psi)
	DN38	48 mm (1.89 in)	55 mm (2.17 in)	8 mm (0.31 in)	
		A0009568			
1 Thread adapter nut 2 Sealing ring 3 Counterpart connection					

Type	Version	Dimensions			Technical properties
		φD	φA	h	
	DN51	60 mm (2.36 in)	65 mm (2.56 in)	9 mm (0.35 in)	

i The counterpart connection must fit the sealing ring and fix it in place.

Without process connection (for compression fitting)

Type	Version	Dimensions			Technical properties ¹⁾
		φdi	φD	h	
<p>Compression fitting TK40 for weld-in</p> <p>1 Movable 2 Fixed</p> <p>A0018912</p>	Spherical Ferrule material PEEK or 316L	6.3 mm (0.25 in) for protection tube diameter φd = 6 mm (0.236 in)	25 mm (0.98 in)	33 mm (1.3 in)	<ul style="list-style-type: none"> ▪ P_{max.} = 10 bar (145 psi), T_{max.} = +150 °C (+302 °F) for PEEK material, tightening torque = 10 Nm ▪ P_{max.} = 50 bar (725 psi), T_{max.} = +200 °C (+392 °F) for 316L material, tightening torque = 25 Nm ▪ PEEK ferrule is 3-A® certified

1) All the pressure specifications apply for cyclic temperature load

Minimum extension neck lengths, dependent on respective process connection



Process connection	Extension next length T
<ul style="list-style-type: none"> ▪ None ▪ Compression fitting, movable 	Predefined (cannot be selected, T = 0)
<ul style="list-style-type: none"> ▪ Thread according to ISO 228 ▪ Compression fitting, fixed ▪ Metal sealing system 	≥82 mm (3.23 in)
<ul style="list-style-type: none"> ▪ Clamp according to ISO 2852 ▪ Sanitary connection according to DIN 11851 ▪ Varivent® ▪ SMS 1147 	≥55 mm (2.17 in)

Certificates and approvals

CE mark

The measuring system meets the legal requirements of the EC Directives. Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.

Hygiene standard

- EHEDG certification, type EL CLASS I. Permitted process connections in accordance with EHEDG, see 'Process connections' section (→  16)
- 3-A® authorization no. 1144, 3-A® sanitary standard 74-05. Permitted process connections in accordance with 3-A®, see 'Process connections' section (→  16)
- ASME BPE, certificate of conformity can be ordered for indicated options

Other standards and guidelines

- IEC 60529: Degrees of protection provided by enclosures (IP code)
- IEC 61010-1: Safety requirements for electrical equipment for measurement, control and laboratory use
- IEC 60751: Industrial platinum resistance thermometers
- EN 50281-1-1: Electrical apparatus protected by enclosures
- DIN EN 50446: Terminal heads
- IEC 61326-1: Electromagnetic compatibility (electrical equipment for measurement, control and laboratory use - EMC requirements)

Surface roughness

Free from oil and grease for oxygen service, optional

Material certification

The material certificate 3.1 (according to standard EN 10204) can be requested separately. The "short form" certificate includes a simplified declaration with no enclosures of documents related to the materials used in the construction of the single sensor and guarantees the traceability of the materials through the identification number of the thermometer. The data related to the origin of the materials can subsequently be requested by the client if necessary.

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.

Ordering information

Detailed ordering information is available from the following sources:

- In the Product Configurator on the Endress+Hauser website: www.endress.com → Select country → Instruments → Select device → Product page function: Configure this product
- From your Endress+Hauser Sales Center: www.endress.com/worldwide



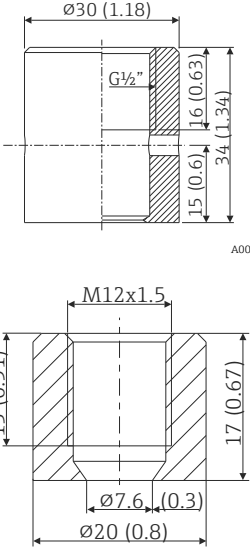
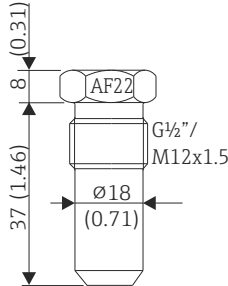
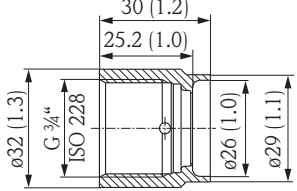
Product Configurator - the tool for individual product configuration

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

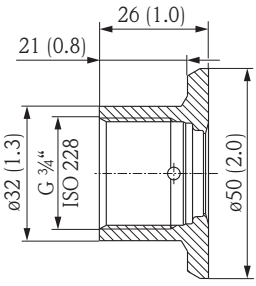
Accessories

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.

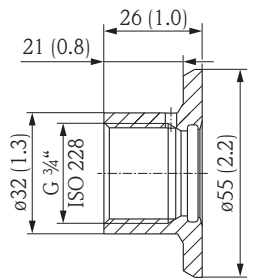
Device-specific accessories

Accessories	Description
<p data-bbox="523 468 820 519">Welding boss with sealing taper (metal - metal)</p>  <p data-bbox="783 790 836 804">A0006621</p> <p data-bbox="783 1104 836 1117">A0018236</p>	<p data-bbox="850 468 1251 573">Welding boss for G$\frac{1}{2}$"- and M12x1.5 thread Metal-sealing; conical Material of wetted parts: 316L/1.4435 Max. process pressure 16 bar (232 PSI)</p> <p data-bbox="850 586 995 607">Order number:</p> <ul data-bbox="850 611 1078 663" style="list-style-type: none"> ■ 60021387 (G$\frac{1}{2}$") ■ 71190468 (M12x1.5)
<p data-bbox="612 1133 730 1153">Dummy plug</p>  <p data-bbox="767 1485 836 1498">A0009213-EN</p>	<p data-bbox="850 1133 1485 1187">Dummy plug for G$\frac{1}{2}$" or M12x1.5 conical metal-sealing welding boss Material: SS 316L/1.4435</p> <p data-bbox="850 1200 995 1220">Order number:</p> <ul data-bbox="850 1225 1078 1276" style="list-style-type: none"> ■ 60022519 (G$\frac{1}{2}$") ■ 60021194 (M12x1.5)
<p data-bbox="564 1568 778 1588">Weld-in adapter FTL20</p>  <p data-bbox="783 1823 836 1836">A0008265</p>	<p data-bbox="850 1568 1134 1621">G$\frac{3}{4}$", d=29 mm, without flange Material: 316L Roughness in μm (μin): 1.5 (59.1)</p> <p data-bbox="850 1648 1481 1700">Order number: 52028295 (with inspection certificate EN10204-3.1 material)</p> <p data-bbox="850 1704 1453 1756">Order number seal (5-pc. set): silicone O-ring 52021717 ¹⁾, FDA-compliant</p>

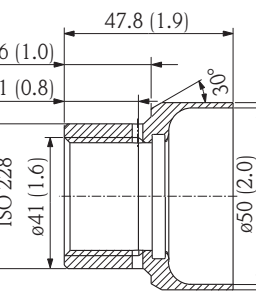
1) A seal is included in the delivery.

<p>Weld-in adapter FTL20</p>  <p>A0008810</p>	<p>G$\frac{3}{4}$", d=50 mm, with flange Material: 316L Roughness in μm (μin): 0.8 (31.5) Order number: 52018765 (with inspection certificate EN10204-3.1 material) Order number seal (5-pc. set): silicone O-ring 52021717¹⁾, FDA-compliant With EHEDG certification and 3-A[®] symbol</p>
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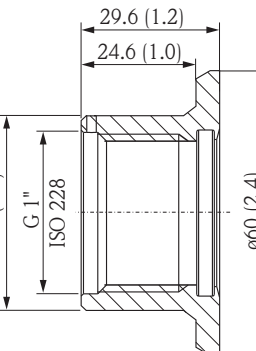
1) A seal is included in the delivery.

<p>Weld-in adapter FTL50</p>  <p>A0008274</p>	<p>G$\frac{3}{4}$", d=55 mm, with flange Material: 316L Roughness in μm (μin): 0.8 (31.5) Order number: 52001052 (without inspection certificate EN10204-3.1 material) Order number: 52011897 (with inspection certificate EN10204-3.1 material) Order number seal (5-pc. set): silicone O-ring 52014473¹⁾, FDA-compliant Order number weld-in dummy: MVT2L0692 With EHEDG certification and 3-A[®] symbol</p>
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1) A seal is included in the delivery.

<p>Weld-in adapter FTL50</p>  <p>A0011927</p>	<p>G1", d=53 mm, without flange Material: 316L Roughness in μm (μin): 0.8 (31.5) Order number: 71093129 (with inspection certificate EN10204-3.1 material) Order number seal (5-pc. set): silicone O-ring 52014472¹⁾, FDA-compliant Order number weld-in dummy: MVT2L0691</p>
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1) A seal is included in the delivery.

<p>Weld-in adapter FTL50</p>  <p>A0008267</p>	<p>G1", d=60 mm, with flange Material: 316L Roughness in μm (μin): 0.8 (31.5) Order number: 52001051 (without inspection certificate EN10204-3.1 material) Order number: 52011896 (with inspection certificate EN10204-3.1 material) Order number seal (5-pc. set): silicone O-ring 52014472¹⁾, FDA-compliant Order number weld-in dummy: MVT2L0691 With EHEDG certification and 3-A[®] symbol</p>
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1) A seal is included in the delivery.







<p>Weld-in adapter FTL50</p> <p style="text-align: right; font-size: small;">A0008272</p>	<p>G1", can be aligned Material: 316L Roughness in μm (μin): 0.8 (31.5) Order number: 52001221 (without inspection certificate EN10204-3.1 material) Order number: 52011898 (with inspection certificate EN10204-3.1 material) Order number seal (5-pc. set): silicone O-ring 52014424 ¹⁾, FDA-compliant Order number weld-in dummy: M40167</p>
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1) A seal is included in the delivery.

-  Maximum process pressure for the weld-in adapters:
- 25 bar (362 PSI) at maximum 150 °C (302 °F)
 - 40 bar (580 PSI) at maximum 100 °C (212 °F)


 For more information on the weld-in adapters FTL20, FTL50, see Technical Information (TI00426F/00).

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-xx
Commubox FXA195 HART	For intrinsically safe HART communication with FieldCare via the USB interface.  For details, see "Technical Information" TI00404F
Commubox FXA291	Connects Endress+Hauser field devices with a CDI interface (= Endress+Hauser Common Data Interface) and the USB port of a computer or laptop.  For details, see "Technical Information" TI00405C
HART Loop Converter HMX50	Is used to evaluate and convert dynamic HART process variables to analog current signals or limit values.  For details, see "Technical Information" TI00429F and Operating Instructions BA00371F
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 Operating Instructions BA061S
Fieldgate FXA320	Gateway for the remote monitoring of connected 4-20 mA measuring devices via a Web browser.  For details, see "Technical Information" TI00025S and Operating Instructions BA00053S
Fieldgate FXA520	Gateway for the remote diagnostics and remote configuration of connected HART measuring devices via a Web browser.  For details, see "Technical Information" TI00025S and Operating Instructions BA00051S

Field Xpert SFX100	<p>Compact, flexible and robust industry handheld terminal for remote configuration and for obtaining measured values via the HART current output (4-20 mA).</p> <p> For details, see Operating Instructions BA00060S</p>
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Service-specific accessories

Accessories	Description
Applicator	<p>Software for selecting and sizing Endress+Hauser measuring devices:</p> <ul style="list-style-type: none"> 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 <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:</p> <ul style="list-style-type: none"> Via the Internet: https://wapps.endress.com/applicator On CD-ROM for local PC installation.
Konfigurator ^{temperature}	<p>Software for selecting and configuring the product depending on the measuring task, supported by graphics. Includes a comprehensive knowledge database and calculation tools:</p> <ul style="list-style-type: none"> For temperature competence Quick and easy design and sizing of temperature measuring points Ideal measuring point design and sizing to suit the processes and needs of a wide range of industries <p>The Konfigurator is available: On request from your Endress+Hauser sales office on a CD-ROM for local PC installation.</p>
W@M	<p>Life cycle management for your plant</p> <p>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.</p> <p>The application already contains the data of your Endress+Hauser device. Endress+Hauser also takes care of maintaining and updating the data records.</p> <p>W@M is available:</p> <ul style="list-style-type: none"> Via the Internet: www.endress.com/lifecyclemanagement On CD-ROM for local PC installation.
FieldCare	<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 BA00059S</p>

System components

Accessories	Description
Field display unit RIA16	<p>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 display unit is looped into the 4 to 20 mA circuit and gets the required energy from there.</p> <p> For details, see the "Technical Information" document TI00144R/09/en</p>
RN22.1N	<p>Active barrier with power supply for safe separation of 4-20 mA standard signal circuits. Offers bidirectional HART transmission.</p> <p> For details, see "Technical Information" TI00073R and Operating Instructions BA00202R</p>
RNS221	<p>Supply unit for powering two 2-wire measuring devices solely in the non-Ex area. Bidirectional communication is possible via the HART communication jacks.</p> <p> For details, see "Technical Information" TI00081R and Brief Operating Instructions KA00110R</p>

Documentation

Technical Information

iTEMP® temperature head transmitter:

- TMT80, PC-programmable, single-channel, RTD and TC (TI153R/09/en)
- TMT180, PC-programmable, single-channel, Pt100 (TI088R/09/en)
- TMT181, PC-programmable, single-channel, RTD, TC, Ω , mV (TI00070R/09/en)
- HART® TMT182, single-channel, RTD, TC, Ω , mV (TI078R/09/en)



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