Technical Information
iTHERM TM412

Trend-setting, modular resistance thermometer
for hygienic and aseptic applications

Easy-to-use imperial version with outstanding sensor technology

Applications

- Specially designed for use in hygienic and aseptic applications in the Food & Beverages and Life Sciences industries
- Measuring range: −200 to +600 °C (−328 to +1 112 °F)
- Pressure range up to 40 bar (580 psi)
- Protection class: up to IP69K

Temperature 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™
- Field transmitters with HART® or FOUNDATION Fieldbus™ protocol for highest reliability in harsh industrial environments. Backlit display with large measured value, bargraph and fault condition indication for ease of reading.

Your benefits

- User-friendly and reliable from product selection to maintenance
- iTHERM inserts: globally unique, automated production. Full traceability and consistently high product quality for reliable measured values
- iTHERM QuickSens: fastest response times (t_{90s}: 1.5 s) for optimum process control
- iTHERM StrongSens: all-time vibration resistance (> 60g) for ultimate plant safety
- iTHERM QuickNeck – cost and time savings thanks to simple, tool-free recalibration
- iTHERM TA30R: 316L terminal head for easy handling and low installation and maintenance costs, with highest IP69K rating
- International certification: explosion protection e.g. ATEX/IECEx/FM/CSA and in compliance with hygiene standards according to 3-A®, EHEDG, ASME BPE, FDA, TSE Certificate of Suitability

Endress+Hauser [EH]

People for Process Automation

Table of contents

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

TM4x**1**	TM4x**2**
Metric version	Imperial version
↓	↓

TM41x 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

TM411

mm

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TM412

inch

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↓ ↓
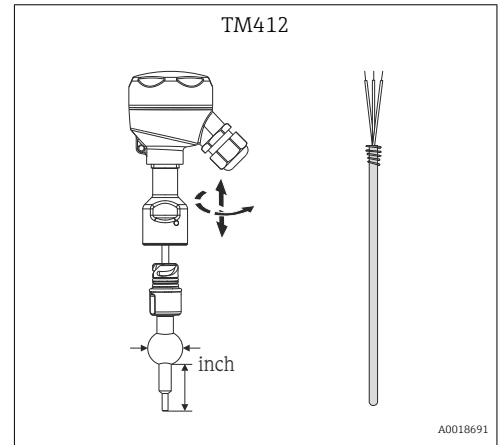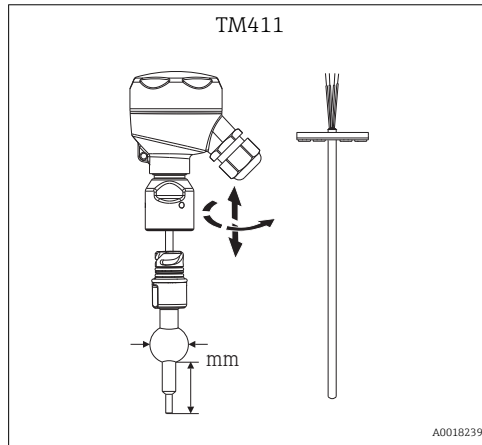
TM40x characterizes the device that uses basic technology, with features such as a fixed, non-replaceable insert, application in non-hazardous areas, standard extension neck, low-cost unit

TM401

mm

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TM402

inch

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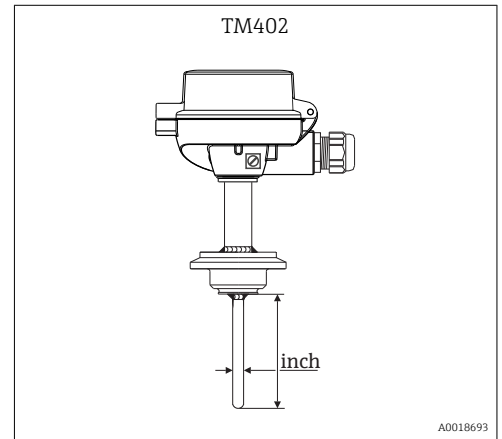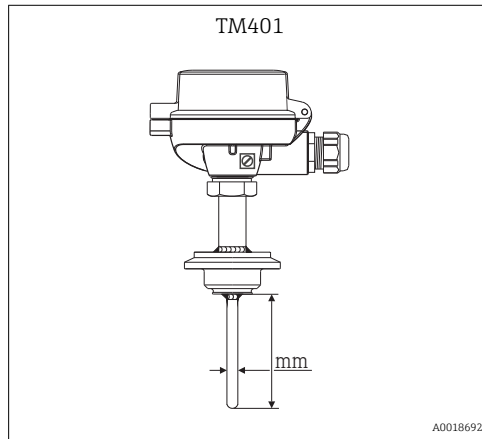
Measuring principle

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
- Data managers
- Overvoltage protection

For more information, see the brochure 'System Products and Data Managers - Solutions for the loop' (FA00016K)
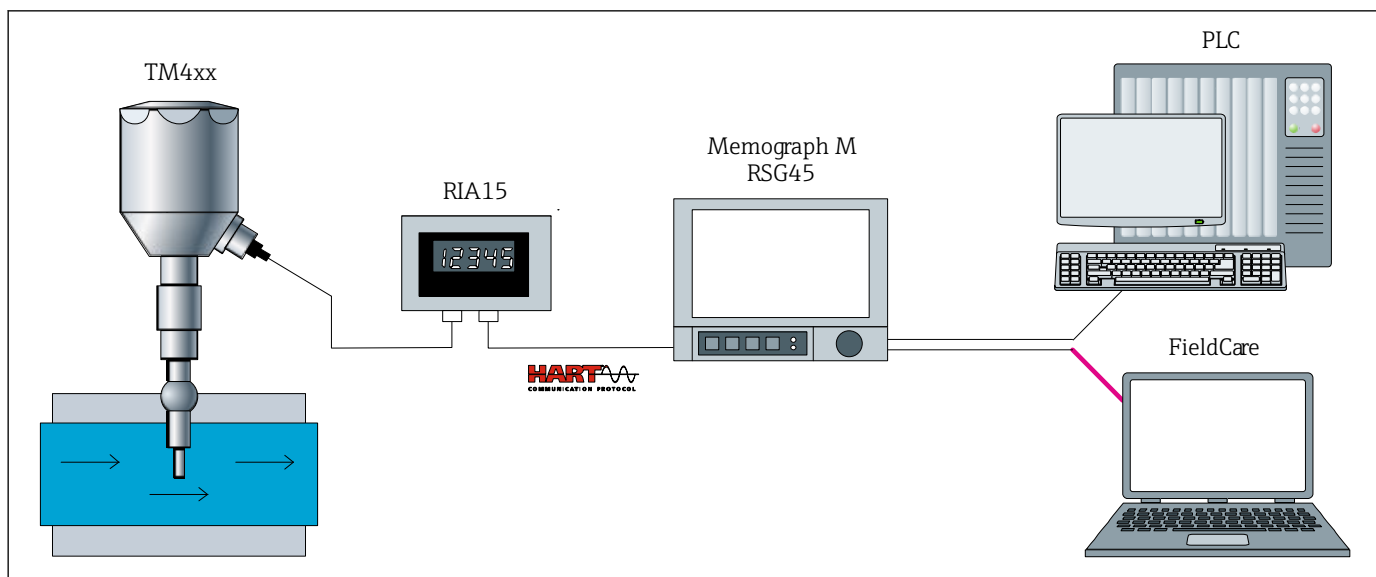
□ *1*   *Example of application, measuring point layout with additional Endress+Hauser components*

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- iTHERM TM4x2: Installed RTD thermometer with integrated HART® head transmitter
- Display unit RIA15:
  - Display of 4 to 20 mA measured values or HART® process variables
  - Loop-powered
  - Voltage drop ≤1 V (HART® ≤1.9 V)
- Data Management Memograph M RSG45:
  - Tamper-proof data storage and access (FDA 21 CFR 11)
  - HART® gateway functionality; Up to 40 HART® devices connected at a time
  - Communication capabilities: Modbus, Profibus DP, PROFINET, EtherNet/IP
- PLC / FieldCare: Field Data Manager Software MS20 - Automatic service for report generation, printing reports, read out of data, storing of data, secure export, pdf generation Read out measured data via online interface or from mass storage Online visualization of instantaneous values ("live data") . More information on this can be found in the Technical Information, see "Documentation".

Modular design

Design		Options

	1: Terminal head, housing → 🕮 24	• 316L, high or low head, optionally with display window
		• Aluminum, high or low head, with or without display window
		• Polypropylene, low head
		• Polyamide, high head, without display window
		• Field transmitter with display, as option
		
		ℹ **Your benefits:**
		• Optimum terminal access thanks to low housing edge of bottom section:
		  – Easier to use
		  – Lower installation and maintenance costs
		• Optional display: local process display unit for added reliability
		• IP69K protection: optimum protection even with high-pressure cleaning

	2: Wiring, electrical connection, output signal → 🕮 6	• Ceramic terminal block • Flying leads • Head transmitter (4 to 20 mA, HART®, PROFIBUS® PA, FOUNDATION™ Fieldbus), single-channel or two-channel • Attachable display (optional) • Field transmitter (HART®, PROFIBUS® PA, FOUNDATION™ Fieldbus), two-channel input
	3: Connector or cable gland → 🕮 28	• PROFIBUS® PA / FOUNDATION™ Fieldbus connector, 4-pin • 8-pin connector • Polyamide cable glands

	4: Extension neck → 🕮 28	Quick fastener iTHERM QuickNeck or NPT 1/2"
		
		ℹ **Your benefits:**
		• **iTHERM QuickNeck:** tool-free removal of the insert:
		  – Saves time/costs on frequently calibrated measuring points
		  – Wiring mistakes avoided
		• IP69K protection: safety under extreme process conditions

	5: Process connection → 🕮 29	Wide range of different versions.
	6: Thermowell	• Various diameters • Various tip shapes (straight or reduced)

	7: Insert → 🕮 23	Sensor models: wire wound (WW) or thin-film sensor (TF).
		
		ℹ **Your benefits:**
		• **iTHERM QuickSens** - insert with the world's fastest response time:
		  – Insert: ϕ3 mm (0.12 in) or ϕ6 mm (0.24 in)
		  – Fast, highly accurate measurements, delivering maximum process safety and control
		  – Quality and cost optimization
		  – Minimization of necessary immersion length: better product protection thanks to improved process flow
		• **iTHERM StrongSens** - insert with unbeatable durability:
		  – Vibration resistance > 60g: lower life cycle costs thanks to longer operating life and high plant availability
		  – Automated, traceable production: top quality and maximum process safety
		  – High long-term stability: reliable measured values and high level of system safety

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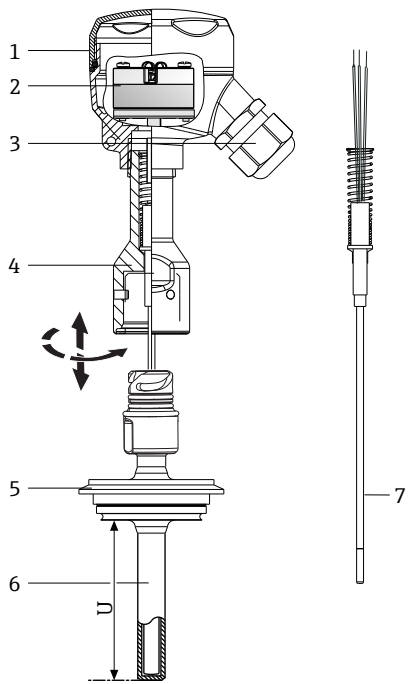
Input

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 +200 ℃ (–58 to +392 ℉)
Pt100 thin-film, iTHERM StrongSens, vibration-resistant > 60g	–50 to +500 ℃ (–58 to +932 ℉)
Pt100 thin-film, iTHERM QuickSens, fast-response	–50 to +200 ℃ (–58 to +392 ℉)
Pt100 wire wound, extended measuring range	–200 to +600 ℃ (–328 to +1 112 ℉)

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 or as field transmitter 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. → 🗎 38

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 using universal device configuration tools like FieldCare, DeviceCare or FieldCommunicator 375/475. For more information, see the Technical Information. → 🗎 38

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. → 🗎 38

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. → 🗎 38

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

Field transmitters

Field transmitter with HART® communication and backlit display. Can be read easily from a distance, in sunlight and at night. Large measurement value, bargraph and fault indication displayed. Benefits are: dual sensor input, highest reliability in harsh industrial environments, mathematic functions, thermometer drift monitoring and sensor back-up functionality, corrosion detection.

Power supply

Wiring diagrams for RTD   Type of sensor connection

Head mounted transmitter TMT18x (single input)

A0016433-EN

Head mounted transmitter TMT8x (dual input)

A0034449-EN

Terminal block mounted

3-wire single | 2 x 3-wire single | 4-wire single

R1 = Red1
R3 = Red3
W5 = White5
Outside screw

R1 = Red1
R2 = Red2
W3 = White3
B5 = Black5
B6 = Black6
G4 = Green4

R3 = Red3
R1 = Red1
W4 = White4
W6 = White6

A0034451-EN

Head mounted field transmitter TMT162 (dual input)

Sensor 1
Sensor 2

Power supply
field transmitter and
analog output
4 to 20 mA,
or bus connection

Sensor 1
3-wire
RTD
(white)   (red)
3   2   1

4-wire
RTD
(white)   (red)
4   3   2   1

Sensor 2
RTD
(green) 4

(black) 5
(black) 6

A0034450-EN

Cable entries   See the 'Terminal head' section

Connectors   Endress+Hauser offers a wide variety of connectors for the simple and fast integration of the thermometer into a process control system. The following tables show the PIN assignments of the various plug connector combinations.

Abbreviations

#1	Order: first transmitter/insert	#2	Order: second transmitter/insert
i	Insulated. Wires marked 'i' are not connected and are insulated with heat shrink tubes.	YE	Yellow
GND	Grounded. Wires marked 'GND' are connected to the internal grounding screw in the terminal head.	RD	Red
BN	Brown	WH	White
GNYE	Green-yellow	PK	Pink
BU	Blue	GN	Green
GY	Gray	BK	Black

Terminal head with one cable entry

Plug	1x PROFIBUS PA								1x FOUNDATION™ Fieldbus (FF)				8-pin							
Plug thread	M12				7/8"				7/8"				M12							
PIN number	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	5	6	7	8

Electrical connection (terminal head)

Plug	1x PROFIBUS PA								1x FOUNDATION™ Fieldbus (FF)				8-pin							
Flying leads	Not connected (not insulated)																			
3-wire terminal block (1x Pt100)	RD	RD	WH	WH	RD	RD	WH	WH	RD	RD	WH	WH	RD	RD	WH	WH				i
4-wire terminal block (1x Pt100)	RD	RD	WH	WH	RD	RD	WH	WH	RD	RD	WH	WH	RD	RD	WH	WH				i
6-wire terminal block (2x Pt100)	RD (#1)[1]	RD (#1)[1]	WH (#1)[1]	WH (#1)[1]	RD (#1)[1]	RD (#1)[1]	WH (#1)[1]	WH (#1)[1]	RD (#1)[1]	RD (#1)[1]	WH (#1)[1]	WH (#1)[1]	RD	RD	WH	BK	BK	YE		
1x TMT 4 to 20 mA or HART	+	i	-	i	+	i	-	i	+	i	-	i	i							
2x TMT 4 to 20 mA or HART in the terminal head with a high cover	+(#1)	+(#2)	-(#1)	-(#2)	+(#1)	+(#2)	-(#1)	-(#2)	+(#1)	+(#2)	-(#1)	-(#2)	+(#1)	i	-(#1)	i	+(#2)	i	-(#2)	i
1x TMT PROFIBUS PA	+	i	-	GND[2]	+	i	-	GND[2]	Cannot be combined				Cannot be combined							
2x TMT PROFIBUS PA	+(#1)	i	-(#1)	+	+	i	-		Cannot be combined				Cannot be combined							
1x TMT FF	Cannot be combined				Cannot be combined				-	+	GND	i	Cannot be combined							
2x TMT FF	Cannot be combined				Cannot be combined				-(#1)	+(#1)	GND	i	Cannot be combined							
PIN position and color code	1 BN; 2 GNYE; 3 BU; 4 GY (A0018929)				1 BN; 2 GNYE; 3 BU; 4 GY (A0018930)				1 BU; 2 BN; 3 GY; 4 GNYE (A0018931)				3 GN; 2 BN; 1 WH; 8 RD; 4 YE; 5 GY; 6 PK; 7 BU (A0018927)							

1) Second Pt100 is not connected
2) If a plastic housing TA30S or TA30P is used, insulated 'i' instead of grounded GND

Terminal head with two cable entries

Plug	2x PROFIBUS® PA								2x FOUNDATION™ Fieldbus (FF)			
Plug thread (#1 ◯◯ #2) (A0021706)	M12(#1) / M12(#2)				7/8"(#1) / 7/8"(#2)				7/8"(#1) / 7/8"(#2)			
PIN number	1	2	3	4	1	2	3	4	1	2	3	4
Electrical connection (terminal head)												
Flying leads	Not connected (not insulated)											
3-wire terminal block (1x Pt100)	RD/i	RD/i	WH/i	WH/i	RD/i	RD/i	WH/i	WH/i	RD/i	RD/i	WH/i	WH/i
4-wire terminal block (1x Pt100)	RD/i	RD/i	WH/i	WH/i	RD/i	RD/i	WH/i	WH/i	RD/i	RD/i	WH/i	WH/i
6-wire terminal block (2x Pt100)	RD/BK	RD/BK	WH/YE	WH/YE	RD/BK	RD/BK	WH/YE	WH/YE	RD/BK	RD/BK	WH/YE	WH/YE
1x TMT 4 to 20 mA or HART	+/i	i/i	-/i	i/i	+/i	i/i	-/i	i/i	+/i	i/i	-/i	i/i
2x TMT 4 to 20 mA or HART in the terminal head with a high cover	+(#1)/+(#2)	i/i	-(#1)/-(#2)	i/i	+(#1)/+(#2)	i/i	-(#1)/-(#2)	i/i	+(#1)/+(#2)	i/i	-(#1)/-(#2)	i/i
1x TMT PROFIBUS® PA	+/i	i/i	-/i	GND/GND	+/i	i/i	-/i	GND/GND	Cannot be combined			

Plug	2x PROFIBUS® PA					2x FOUNDATION™ Fieldbus (FF)			
2x TMT PROFIBUS® PA	+(#1)/ +(#2)		-(#1)/ -(#2)		+(#1)/ +(#2)	-(#1)/ -(#2)			
1x TMT FF							-/i	+/i	i/i	GND/GND
2x TMT FF	Cannot be combined			Cannot be combined			-(#1)/ -(#2)	+(#1)/ +(#2)	i/i	GND/GND
PIN position and color code	1 BN 2 GNYE 3 BU 4 GY A0018929				1 BN 2 GNYE 3 BU 4 GY A0018930		1 BU 2 BN 3 GY 4 GNYE A0018931		

Connection combination: insert - transmitter

Insert	Transmitter connection [1]			
	1x 1-channel	2x 1-channel [2]	1x 2-channel	2x 2-channel [2]
1x Pt100, flying leads	Pt100 (#1) : transmitter (#1)	Pt100 (#1) : transmitter (#1) (Transmitter (#2) not connected)	Pt100 (#1) : transmitter (#1)	Pt100 (#1) : transmitter (#1) Transmitter (#2) not connected
2x Pt100, flying leads	Pt100 (#1) : transmitter (#1) Pt100 (#2) insulated	Pt100 (#1) : transmitter (#1) Pt100 (#2): transmitter (#2)	Pt100 (#1) : transmitter (#1) Pt100 (#2) : transmitter (#1)	Pt100 (#1) : transmitter (#1) Pt100 (#2) : transmitter (#1) (Transmitter (#2) not connected)
1x Pt100 with terminal block [2]	Pt100 (#1) : transmitter in cover	Cannot be combined	Pt100 (#1) : transmitter in cover	Cannot be combined
2x Pt100 with terminal block [2]	Pt100 (#1) : transmitter in cover Pt100 (#2) not connected		Pt100 (#1) : transmitter in cover Pt100 (#2) : transmitter in cover	

1) If 2 transmitters are selected in a terminal head, transmitter #1 is installed in the high cover. A TAG cannot be ordered for the 2nd transmitter as standard. The bus address is set to the default value and, if necessary, must be changed manually before commissioning.
2) Only in the terminal head with a high cover, only 1 transmitter possible. A ceramic terminal block is automatically fitted on the insert.

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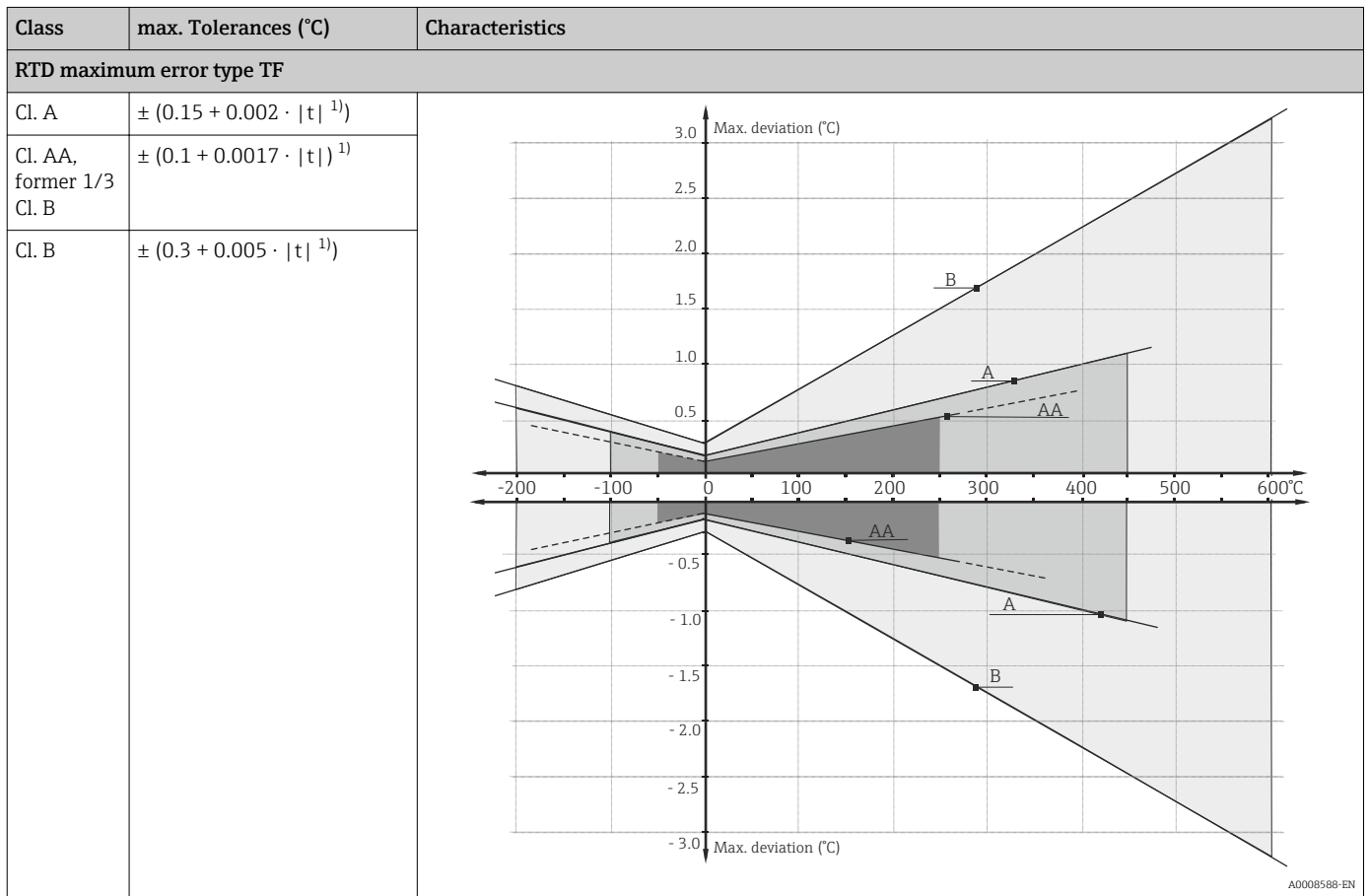
For more information see the Technical Information 'HAW562 Surge arrester' TI01012K and 'HAW569 Surge arrester' TI01013K.

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.

Maximum measured error   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, former 1/3 Cl. B	± (0.1 + 0.0017 · |t|) [1]	
Cl. B	± (0.3 + 0.005 · |t| [1])	

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1)   \|t\| = absolute value °C

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

Temperature ranges

Sensor type	Operating temperature range	Class B	Class A	Class AA
iTHERM StrongSens	−50 to 500 °C (−58 to 932 °F)	-	−30 to 300 °C (−22 to 572 °F)	0 to 200 °C (32 to 392 °F)
iTHERM QuickSens	−50 to 200 °C (−58 to 392 °F)	-	−30 to 200 °C (−22 to 392 °F)	0 to 200 °C (32 to 392 °F)
Pt100 thin film sensor (TF)	−50 to 200 °C (−58 to 392 °F)	−50 to 200 °C (−58 to 392 °F)	−30 to 200 °C (−22 to 392 °F)	-
Pt100 wire-wound sensor (WW)	−200 to 600 °C (−328 to 1 112 °F)	-	−100 to 450 °C (−148 to 842 °F)	−50 to 250 °C (−58 to 482 °F)

Influence of ambient temperature   Depends on the head transmitter used. For details, see Technical Information. → 🖺 38

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.

Response time without heat transfer paste [1]

Protection tube	Shape of tip	Insert	1x Pt100 iTHERM QuickSens, TF		1x Pt100 iTHERM StrongSens, TF		1x Pt100 wire wound WW		2x Pt100 wire wound WW		1x Pt100 standard thin-film TF		2x Pt100 standard thin-film TF	
			t_{50}	t_{90}	t_{50}	t_{90}	t_{50}	t_{90}	t_{50}	t_{90}	t_{50}	t_{90}	t_{50}	t_{90}
ϕ6.35 mm (¼ in)	Reduced 4.76 mm (³⁄₁₆ in) x 19.05 mm (0.75 in)	ϕ3 mm (0.12 in)	1.6 s	5.9 s	-	-	7.8 s	21.8 s	7.8 s	21.8 s	-	-	-	-
ϕ9.53 mm (⅜ in)	Straight	ϕ6 mm (0.24 in)	8.5 s	47 s	25.9 s	80.9 s	-	-	-	-	-	-	-	-
	Straight	ϕ6.35 mm (¼ in)	-	-	-	-	23.6 s	67 s	21.8 s	65.2 s	18.4 s	55.8 s	18.4 s	55.8 s
	Reduced 4.76 mm (³⁄₁₆ in) x 19.05 mm (0.75 in)	ϕ3 mm (0.12 in)	1.5 s	5.5 s	-	-	8.4 s	23 s	8.4 s	23 s	-	-	-	-
ϕ12.7 mm (½ in)	Straight	ϕ6 mm (0.24 in)	8.2 s	34.8 s	23.4 s	70.6 s	-	-	-	-	-	-	-	-
	Straight	ϕ6.35 mm (¼ in)	-	-	-	-	20.1 s	55.4 s	21.3 s	61.8 s	17.9 s	51.5 s	17.9 s	51.5 s
	Reduced 4.76 mm (³⁄₁₆ in) x 19.05 mm (0.75 in)	ϕ3 mm (0.12 in)	1.8 s	6.2 s	-	-	8.8 s	24.1 s	8.8 s	24.1 s	-	-	-	-

1)   If using a protection tube.

Response time for directly wired insert 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.

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 −20 to +500 °C (−4 to +932 °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 bath 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 ℃ (−40 to +185 ℉).

Minimum insertion length (IL):

Calibration temperature	Minimum immersion length (IL)
−196 ℃ (−320.8 ℉)	120 mm (4.72 in) [1]
+80 to +250 ℃ (+112 to +482 ℉)	No minimum immersion length needed
+251 to +550 ℃ (+483 to +1 022 ℉)	300 mm (11.8 in)
+551 to +600 ℃ (+1 023 to +1 112 ℉)	400 mm (15.8 in)

1) with temperature head transmitter min. 150 mm (5.91 in) needed
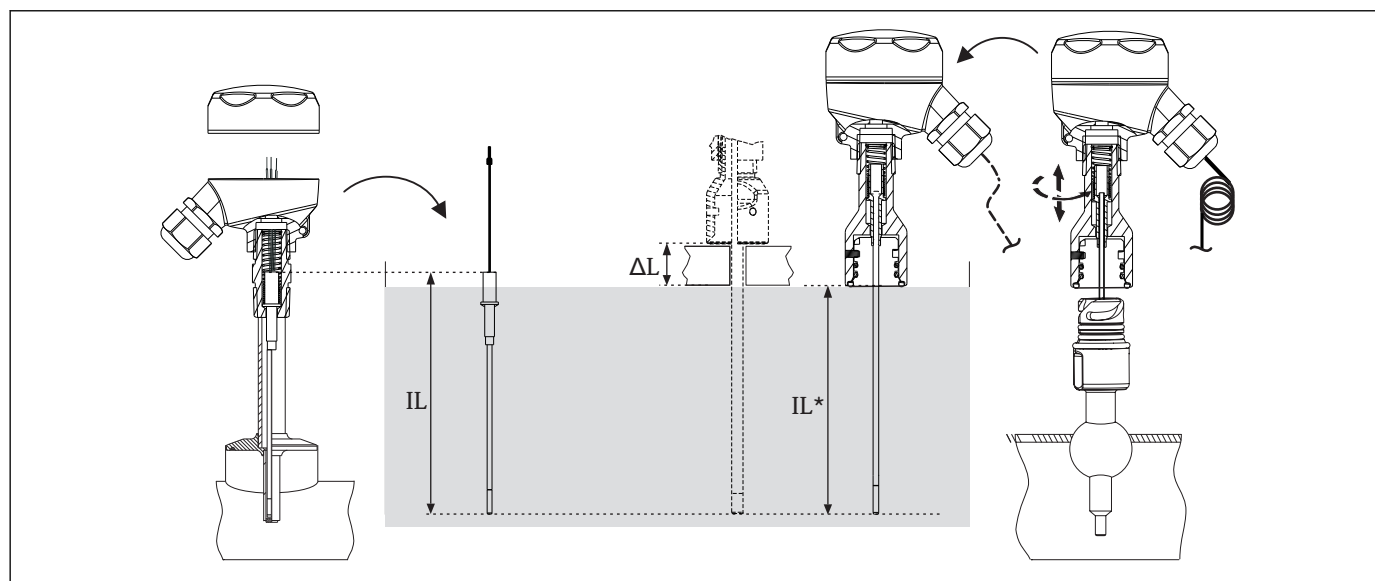
A0033648

🖼 *2   Insertion lengths for sensor calibration*

IL   Insertion length for factory calibration or recalibration onsite without the iTHERM QuickNeck extension neck
IL   Insertion length for recalibration onsite with the iTHERM QuickNeck extension neck*
ΔL   Additional length, depending on the calibration unit, if the insert cannot be fully immersed

- To check the actual accuracy rating of the thermometers installed, a cyclic calibration of the installed sensor needs to be performed frequently. The insert is normally removed for comparison with a precise reference thermometer in the calibration bath (see graphic, left part).
  A reproducible calibration requires the insert to have a minimum insertion length IL. If the insert is shorter than this minimum length, this reproducibility cannot be guaranteed.
- The iTHERM QuickNeck enables quick, tool-free removal of the insert for calibration purposes. The entire upper part of the thermometer is released by turning the terminal head. The insert is removed from the protection tube and directly immersed into the calibration bath (see graphic, right part). Make sure that the cable is long enough to be able to reach the mobile calibration bath with the cable connected. If this is not possible for the calibration, it is advisable to use a connector. → 🕮 28

Advantages of iTHERM QuickNeck:
- Considerable time savings when recalibrating the device (up to 20 minutes per measuring point)
- Wiring mistakes avoided when re-installing
- Minimum plant downtime, thereby saving costs

The minimum immersion length is the length of the insert that is fully immersed in the calibration bath. For a valid recalibration, the value selected for the length IL* must be at least the value of the previously defined minimum insertion lengths (IL) of the specific types of insert. For more detailed values, see the previous tables, values without head transmitter.
If the calibration unit used does not allow the insert to be fully immersed as far as the bottom edge of the top part of the iTHERM QuickNeck, it might be necessary to add an additional length (ΔL) to IL*. → 🖺 13

Formulas for calculating the IL when recalibrating onsite with iTHERM QuickNeck*

Thermowell version	Formula
Protection tube diameter 6.35 mm (¼ in)	
Protection tube diameter 9.53 mm (⅜ in)	IL* = U + T + 19.05 mm (0.75 in)
Protection tube diameter 12.7 mm (½ in)	

Insulation resistance

Insulation resistance ≥ 100 MΩ 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 is recommended depending on the type of sensor used and the design of the insert. This immersion depth corresponds to the minimum insertion length for the calibration. → 🖺 13
- ATEX certification: Observe the installation instructions in the Ex documentation! → 🖺 38
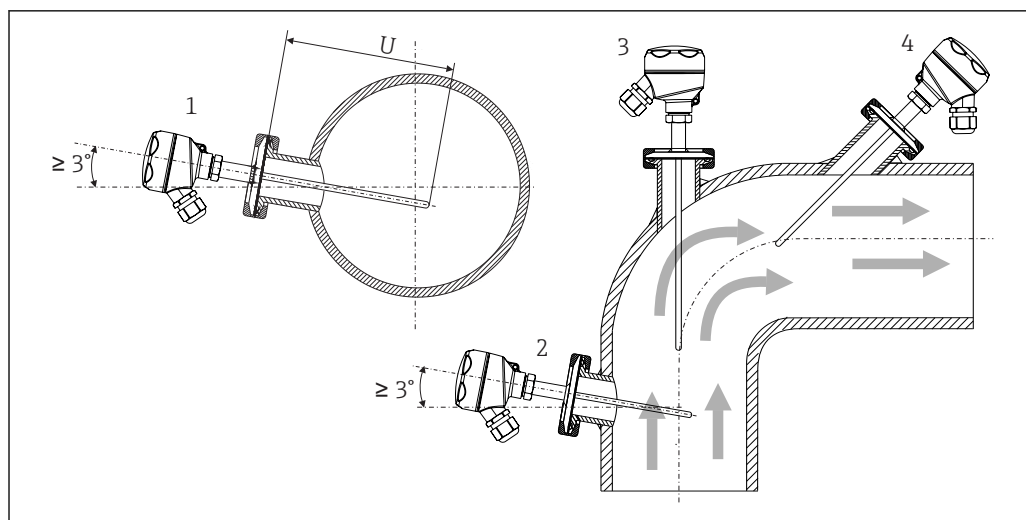
⊞ 3   Installation examples

1, 2 Perpendicular to 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

ℹ️ 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).

The use of iTHERM QuickSens inserts is recommended for immersion lengths U < 70 mm (2.75 in).
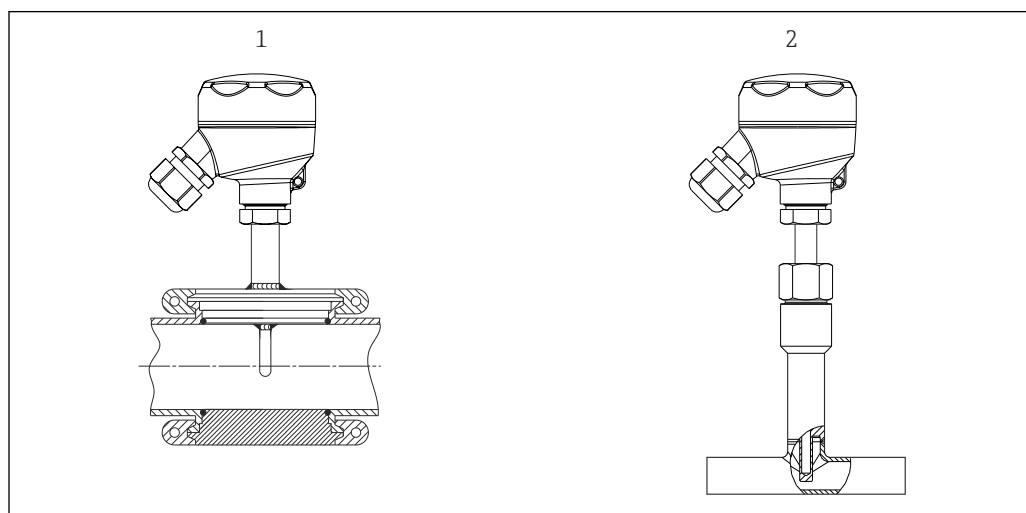
⊞ 4   Process connections for thermometer installation in pipes with small nominal diameters

1   Varivent® process connection type N for DN40
2   Tee or elbow thermowell (illustrated) for weld-in as per DIN 11865 / ASME BPE
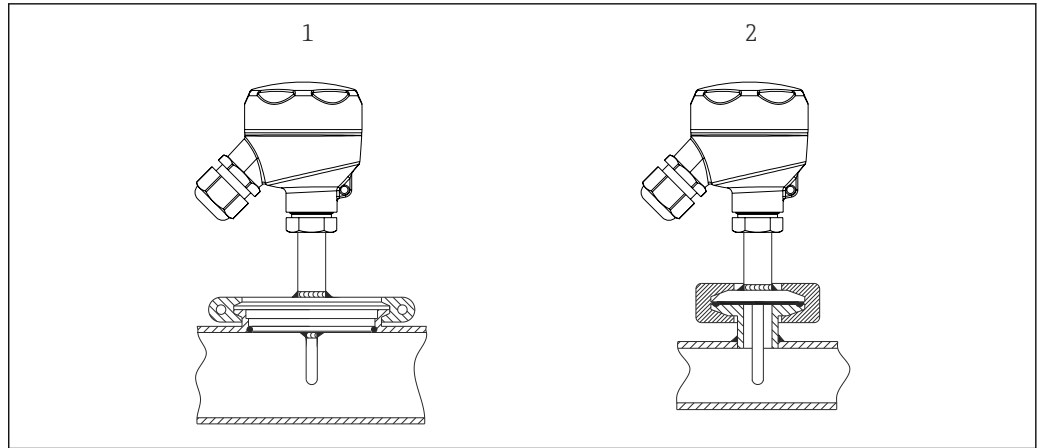
5   *Process connections for thermometer installation in pipes with small nominal diameters*

1   *Varivent® - process connection D = 50 mm for DN25 pipes*
2   *Clamp or micro-clamp*
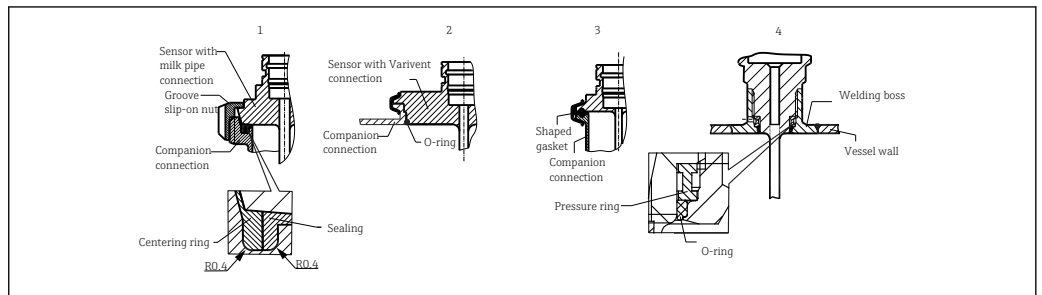
6   *Detailed installation instructions for hygiene-compliant installation*

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, only in connection with seal according to EHEDG position paper*
4   *Liquiphant-M G1" process connection*

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.

Procedure in case of seal failure:
• Disassembling of the thermometer, validated cleaning procedure of thread and sealing ring groove
• Replacement of the seal or sealing ring
• CIP after re-assembly

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, Ra ≤ 0.76 μm (30 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 Sanitary Standard must be observed). The Varivent® and Liquiphant-M weld-in adapter enable flush-mounted installation.

Environment

Ambient temperature range

Terminal head	Temperature in ℃ (℉)
Without mounted head transmitter	Depends on the terminal head used and the cable gland or fieldbus connector, see 'Terminal heads' section → 🖻 24
With mounted head transmitter	−40 to 85 ℃ (−40 to 185 ℉) SIL mode (HART 7 transmitter): −40 to 70 ℃ (−40 to 158 ℉)
With mounted head transmitter and display	−20 to 70 ℃ (−4 to 158 ℉)
With mounted field transmitter	• Without display: −40 to 85 ℃ (−40 to 185 ℉) • With display: −40 to +80 ℃ (−40 to +176 ℉) • SIL mode: −40 to +75 ℃ (−40 to +167 ℉)

Extension neck	Temperature in ℃ (℉)
iTHERM QuickNeck	−50 to +140 ℃ (−58 to +284 ℉)

Storage temperature

For information, see the ambient temperature.

Humidity

Depends on the transmitter used. If Endress+Hauser iTEMP head transmitters are used:
• Condensation permitted as per IEC 60 068-2-33
• Maximum relative 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 (WW or TF)	30 m/s² (3g) [1]
iTHERM StrongSens Pt100 (TF) iTHERM QuickSens Pt100 (TF), version: Ø6 mm (0.24 in)	> 600 m/s² (60g)

1) Vibration resistance also applies for the quick-fastening iTHERM QuickNeck.

Electromagnetic compatibility (EMC)

Depends on the head transmitter used. For details see the Technical Information. → 🖻 38

Process

Process temperature range

Depends on the type of sensor used, maximum −200 to +600 ℃ (−328 to +1 112 ℉).

Thermal shock

Thermal shock resistance in CIP/SIP process with a temperature increase from +5 to +130 ℃ (+41 to +266 ℉) within 2 seconds.

Process pressure range

The maximum possible process pressure depends on various influencing factors, such as the design, process connection and process temperature. For information on the maximum possible process pressures for the individual process connections, see the 'Process connection' section. → 🖻 29

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

Example of the permitted flow velocity depending on the immersion length and process medium

The highest flow velocity tolerated by the thermometer diminishes with increasing insert 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).
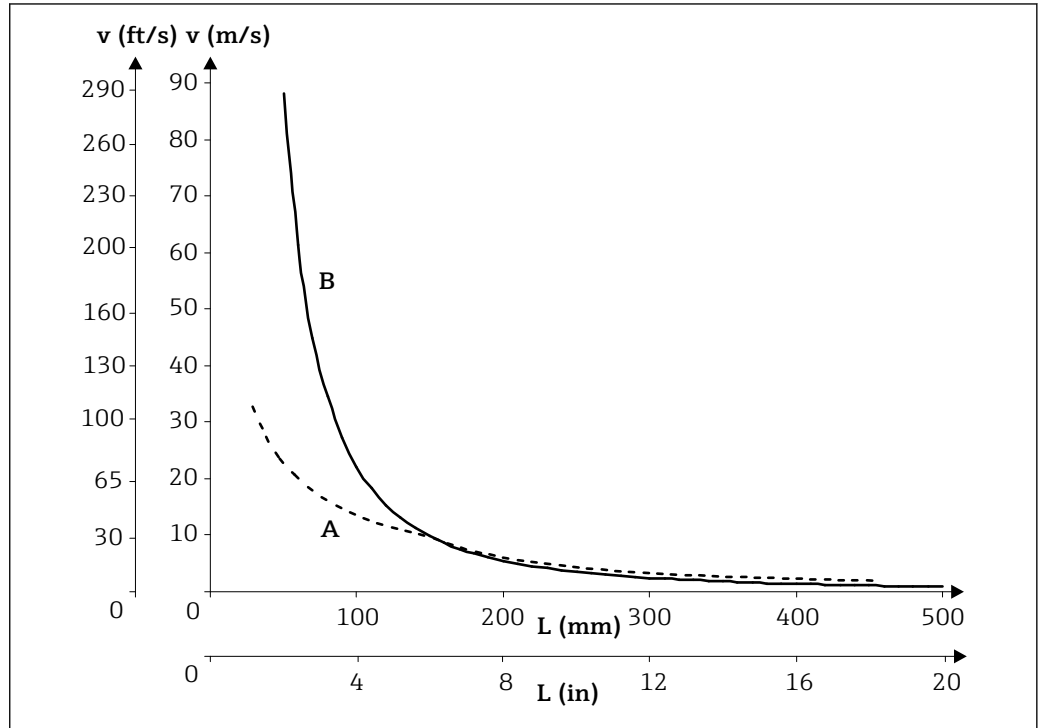
🖻 *7   Permitted flow velocities, protection tube diameter 9.53 mm (3/8 in)*

A   Medium water at T = 50 ℃ (122 ℉)
B   Medium superheated steam at T = 400 ℃ (752 ℉)
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). The design of the thermometer depends on the protection tube version used:

- Thermometer without protection tube - for installation in an existing protection tube
- Diameter 6.35 mm (¼ in)
- Diameter 9.53 mm (⅜ in)
- Diameter 12.7 mm (½ in)

 Various dimensions, such as the immersion length U for example, are variable values and are therefore indicated as items in the following dimensional drawings.

Variable dimensions:

Item	Description
E	Extension neck length, variable depending on the configuration or predefined for the version with iTHERM QuickNeck
IL	Insert length
L	Protection tube length (U+T)
B	Protection tube base thickness: predefined, depends on protection tube version (see also the individual table data)
T	Length of protection tube shaft: variable or predefined, depends on protection tube version (see also the individual table data)
U	Immersion length: variable, depending on the configuration
ØID	Insert diameter 6 mm (0.24 in), 3 mm (0.12 in) or 6.35 mm (¼ in)

Without protection tube

For installation in an existing protection tube (all dimensions in inch)

A0034489

1 Thermometer with extension hex nipple, for connection thread ½" NPT
2 Thermometer with extension nipple union nipple (NUN), for connection thread ½" NPT
3 Thermometer with quick-fastening iTHERM QuickNeck, upper part
4 Thermometer with quick-fastening iTHERM QuickNeck complete, for connection thread ½" NPT
5 Thermometer with 1¼" x 18 UNEF thread
IL Insert length
ILa Insert length (without nipple)
E Length of the extension neck available at point of installation (provided one is available)

Pay attention to the following equations when calculating the insert length ILa for immersion into a protection tube TT412 already available:

Version 1, 2, 4 and 5	ILa = U + T +38.1 mm (1.5 in) [1]
Version 3	ILa = U + T +19.05 mm (0.75 in) [1]

1)   ILa = Insert length (without nipple); U = Protection tube immersion length; T = Protection tube shaft length

With protection tube (1/4", 3/8", 1/2")
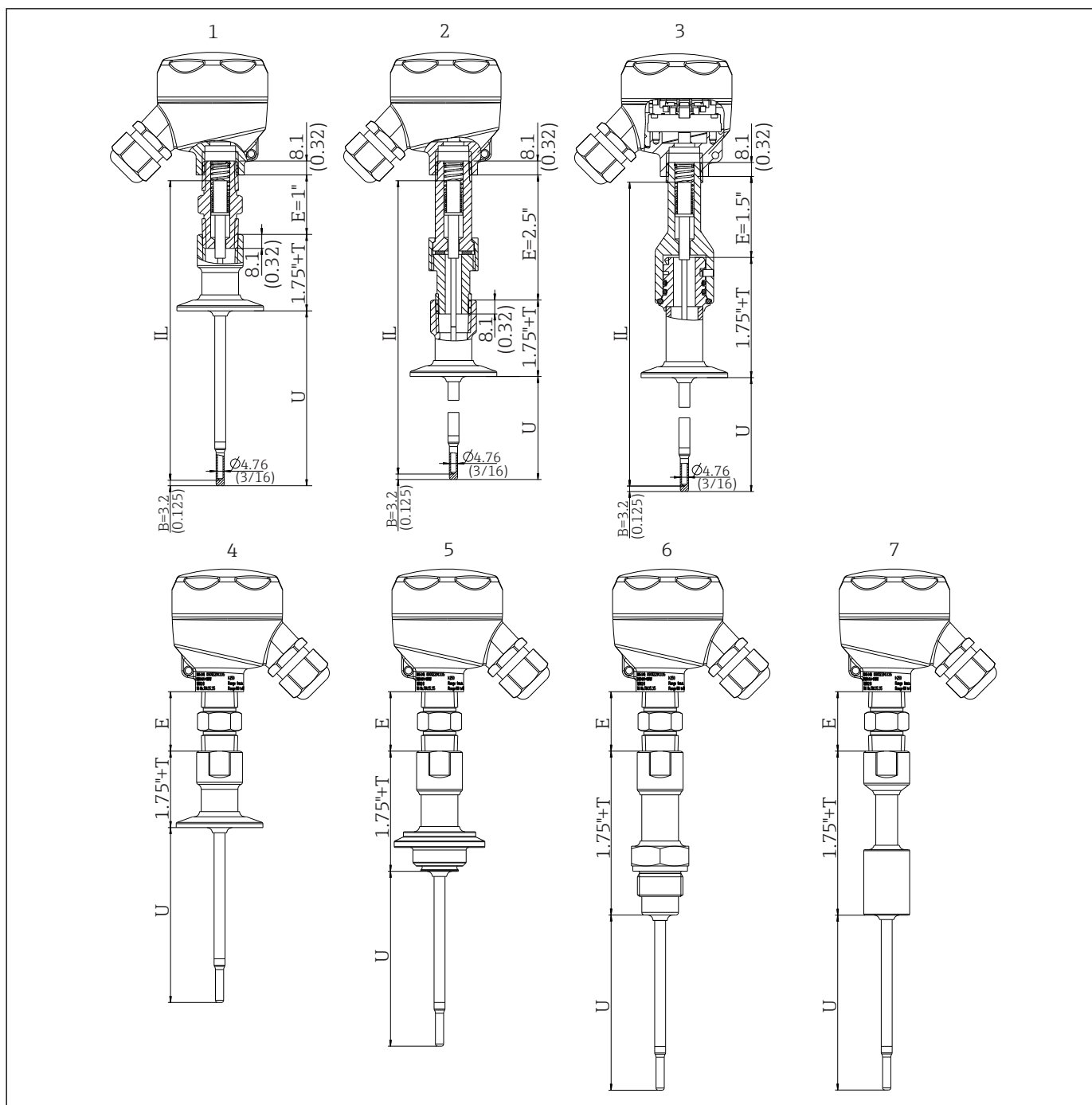
8 Protection tube with neck connection NPT ½" and various process connection versions:

1 Thermometer with extension hex nipple and Tri-clamp process connection
2 Thermometer with extension nipple union nipple (NUN) and Tri-clamp process connection
3 Thermometer with quick-fastening iTHERM QuickNeck and Tri-clamp process connection
4 Thermometer with extension hex nipple and Tri-clamp process connection
5 Thermometer with extension hex nipple and Varivent® process connection
6 Thermometer with extension hex nipple and Liquiphant adapter
7 Thermometer with cylindrical weld-in adapter
IL Insert length
U Protection tube immersion length

E   *Length of the extension neck available at point of installation (provided one is available)*
T   *Protection tube shaft length*
B   *Base thickness*

ℹ️ For diameter ½" not available: Tri-clamp 3/4"

Item	Version	Length
Length of protection tube shaft T [1]	Version 1, 2, 4: Tri-clamp with NPT Version 3: Tri-clamp with QuickNeck Version 5: Varivent® with NPT Version 5: Varivent® with QuickNeck Version 6: Thread ISO 228 for Liquiphant, with NPT Version 6: Thread ISO 228 for Liquiphant, with QuickNeck Version 7: Cylindrical weld-in with NPT Version 7: Cylindrical weld-in with QuickNeck	0-6" 1-6" 1-6" 1.5-6" 2-6" 2-6" 2-6" 2-6"
Immersion length U	Independent of the version	Variable, depending on the configuration
Base thickness B	**6.35 mm (¼ in) Protection tube:** Reduced tip ϕ4.76 mm (³⁄₁₆ in)	3.2 mm (0.125 in)
	9.53 mm (³⁄₈ in) Protection tube: Reduced tip ϕ4.76 mm (³⁄₁₆ in) Straight tip	3.2 mm (0.125 in) 3 mm (0.12 in)
	12.7 mm (½ in) Protection tube: Reduced tip ϕ4.76 mm (³⁄₁₆ in) Straight tip	3 mm (0.12 in) 6.3 mm (0.25 in)
Extension neck length E	**Version 1:** Thermometer with extension hex nipple and Tri-clamp process connection	E = 25.4 mm (1 in)
	Version 2: Thermometer with extension nipple union nipple (NUN) and Tri-clamp process connection	E = 63.5 mm (2.5 in)
	Version 3: Thermometer with quick-fastening iTHERM QuickNeck and Tri-clamp process connection	E = 38.1 mm (1.5 in)

1)   Depends on the process connection

Insert

Depending on the application, iTHERM TS212 inserts with different RTD sensors are available for the thermometer:

Sensor	Standard thin-film		iTHERM StrongSens	iTHERM QuickSens [1]		Wire wound	
Sensor design; connection method	1x Pt100, 3- or 4-wire, PTFE insulated	2x Pt100, 2x3-wire, PTFE insulated	1x Pt100, 3- or 4-wire, mineral insulated	1x Pt100, 3- or 4-wire, mineral insulated	1x Pt100, 3- or 4-wire, PTFE insulated	1x Pt100, 3- or 4-wire, mineral insulated	2x Pt100, 2x3-wire, mineral insulated
Vibration resistance of the insert tip	Up to 3g		Enhanced vibration resistance > 60g	> 60g	3g	Up to 3g	
Measuring range; accuracy class	−50 to +200 ℃ (−58 to +392 ℉), Class A or B		−50 to +500 ℃ (−58 to +932 ℉), Class A or AA	−50 to +200 ℃ (−58 to +392 ℉), Class A or AA		−200 to +600 ℃ (−328 to +1 112 ℉), Class A or AA	
Diameter	6.35 mm (¼ in)		6 mm (0.24 in)	6 mm (0.24 in)	3 mm (0.12 in)	6.35 mm (¼ in); 3 mm (0.12 in)	

1)   Recommended for immersion lengths U < 70 mm (2.75 in)

The iTHERM TS212 insert is available as a spare part. The insert length (IL) depends on the immersion length of the protection tube (U), the length of the extension neck (E) and the length of the protection tube shaft (T). The insertion length (IL) must be taken into consideration when replacing the unit.

This can be calculated by means of the following formula: IL = U + T + E + 38.1 mm (1.5 in)

For more information on the deployed insert iTHERM TS212 with enhanced vibration resistance and fast-response sensor, see the Technical Information.

Spare parts currently available for your product can be found online at: http://www.products.endress.com/spareparts_consumables, product root: TM412. Always quote the serial number of the device when ordering spare parts! The insertion length IL is automatically calculated using the serial number.

Weight	Depending on the configuration

Material

Extension neck and thermowell, insert, 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 can be reduced considerably in cases where abnormal conditions such as high mechanical load occur or in aggressive media.

Designation	Recommended max. temperature for continuous use in air	Properties
AISI 316L	650 °C (1 202 °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 • The wetted part from a 316L or 1.4435+316L thermowell withstand a passivation process with a 3% sulphuric acid

[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	$R_a \le 0.76$ µm (30 µin)
Finely honed surface [1]	$R_a \le 0.38$ µm (15 µin)
Finely honed surface and electropolished	$R_a \le 0.38$ µm (15 µin)+ electropolished
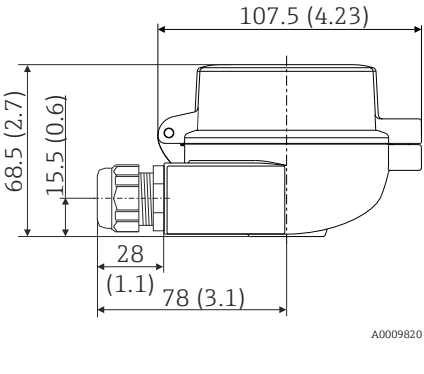
[1]   Not compliant with ASME BPE
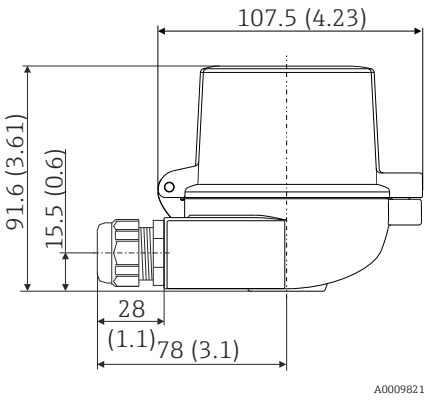
Terminal heads
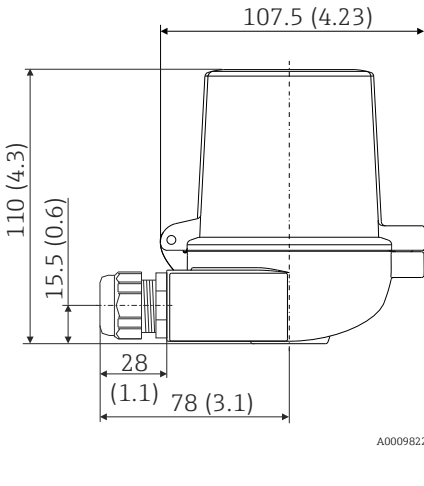
All terminal heads have an internal shape and size in accordance with DIN EN 50446, flat face and a thermometer connection with a ½" NPT or M24x1.5 thread. All dimensions in mm (in). The sample cable glands in the diagrams correspond to M20x1.5 connections with non-Ex polyamide cable glands. Specifications without head transmitter installed. For ambient temperatures with head transmitter installed, see the 'Environment' section. → 🖺 18
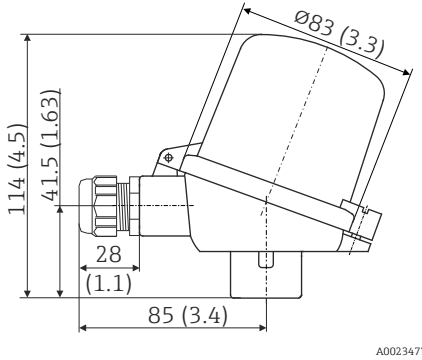
As a special feature, Endress+Hauser offers terminal heads with optimized terminal accessibility for easy installation and maintenance.
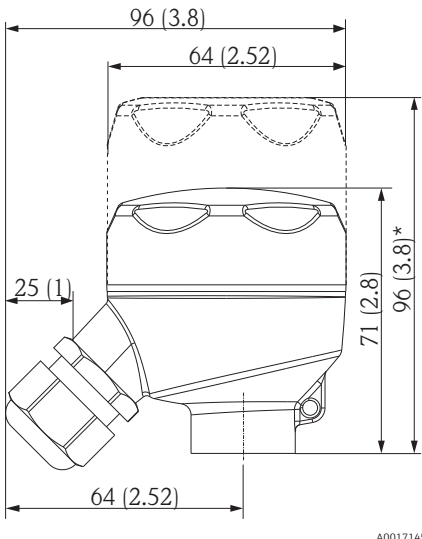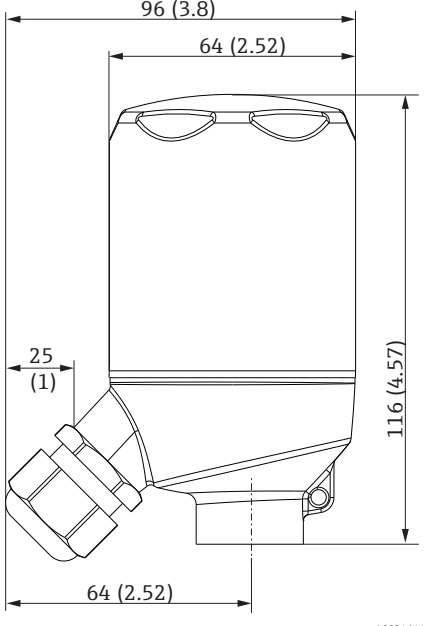
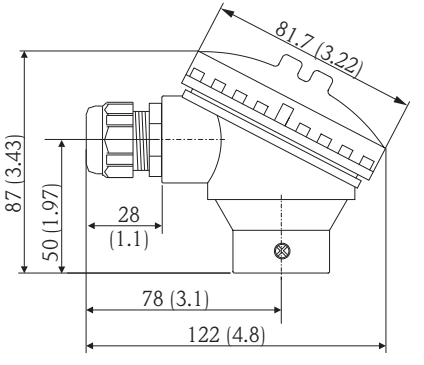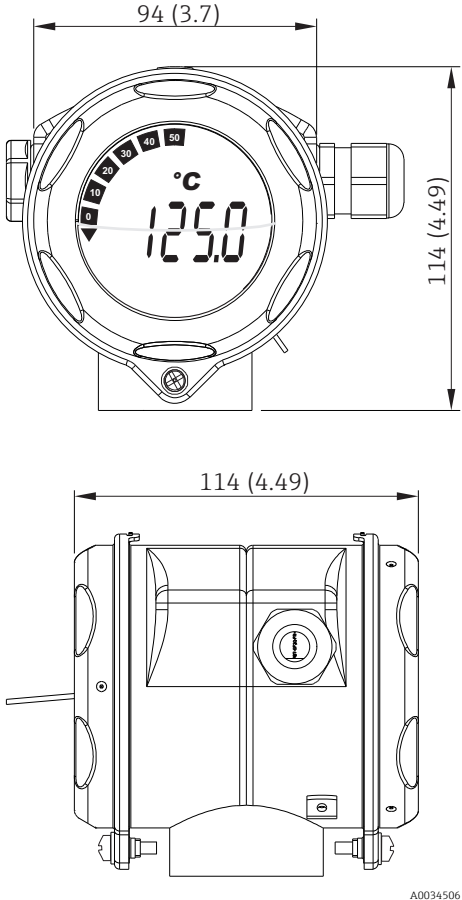| TA30A	Specification

107.5 (4.23)
68.5 (2.7)
15.5 (0.6)
28 (1.1)
78 (3.1)
A0009820
	• Protection class:
	  – IP66/68 (NEMA Type 4x encl.)
	  – For ATEX: IP66/67
	• Temperature: −50 to +150 °C (−58 to +302 °F) without cable gland
	• Material: aluminum, polyester powder coated
	  Seals: silicone
	• Threaded cable entry: G ½", ½" NPT and M20x1.5;
	• Protection armature connection: ½" NPT, M24x1.5
	• Head color: blue, RAL 5012
	• Cap color: gray, RAL 7035
	• Weight: 330 g (11.64 oz)
	• Ground terminal, internal and external
	• Available in conjunction with 3-A marked sensors

TA30A	Specification

107.5 (4.23)
91.6 (3.61)
15.5 (0.6)
28 (1.1)
78 (3.1)
A0009821
	• Protection class:
	  – IP66/68 (NEMA Type 4x encl.)
	  – For ATEX: IP66/67
	• Temperature: −50 to +150 °C (−58 to +302 °F) without cable gland
	• Material: aluminum, polyester powder coated
	  Seals: silicone
	• Threaded cable entry: G ½", ½" NPT and M20x1.5
	• Protection armature connection: ½" NPT, M24x1.5
	• Head color: blue, RAL 5012
	  Cap color: gray, RAL 7035
	• Weight: 420 g (14.81 oz)
	• With TID10 display
	• Ground terminal, internal and external
	• Available in conjunction with 3-A marked sensors

TA30D	Specification

107.5 (4.23)
110 (4.3)
15.5 (0.6)
28 (1.1)
78 (3.1)
A0009822
	• Protection class:
	  – IP66/68 (NEMA Type 4x encl.)
	  – For ATEX: IP66/67
	• Temperature: −50 to +150 °C (−58 to +302 °F) without cable gland
	• Material: aluminum, polyester powder coated
	  Seals: silicone
	• Threaded cable entry: G ½", ½" NPT and M20x1.5
	• Protection armature connection: ½" NPT, 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 color: blue, RAL 5012
	• Cap color: gray, RAL 7035
	• Weight: 390 g (13.75 oz)
	• Ground terminal, internal and external
	• Available in conjunction with 3-A marked sensors

TA30P	Specification
A0023477	• Protection class: IP65 • Max. temperature: −40 to +120 °C (−40 to +248 °F) • Material: polyamide (PA), antistatic Seals: silicone • Threaded cable entry: ½" NPT and M20x1.5 • Protection armature connection: M24x1.5 or ½" NPT • 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

TA30R (optionally with display window in cover)	Specification

A0017145
 	
* Dimensions of version with display window in cover
	• Degree of protection - standard version: IP69K (NEMA Type 4x encl.)
	  Degree of protection - version with display window: IP66/68 (NEMA Type 4x encl.)
	• Temperature: −50 to +130 °C (−58 to +266 °F) without cable gland
	• Material: stainless steel 316L, abrasive-blasted or polished
	  Seals: EPDM
	  Display window: polycarbonate (PC)
	• Cable entry thread ½" NPT and M20x1.5
	• Weight
	  – Standard version: 360 g (12.7 oz)
	  – Version with display window: 460 g (16.23 oz)
	• Display window in cover optionally for head transmitter with display TID10
	• Protection armature connection: M24x1.5 or ½" NPT
	• Ground terminal: internal in standard version; external terminal optionally available
	• Available in conjunction with 3-A marked sensors

TA30R (high version for two transmitters)	Specification
	• Degree of protection: IP69K (NEMA Type 4x encl.) • Temperature: −50 to +130 °C (−58 to +266 °F) without cable gland • Material: stainless steel 316L, abrasive-blasted or polished Seals: EPDM • Cable entry thread ½" NPT and M20x1.5 • Weight: 460 g (16.23 oz) • For two head transmitter • Protection armature connection: M24x1.5 or ½" NPT • Ground terminal: internal in standard version; external terminal optionally available • Available in conjunction with 3-A marked sensors

TA30S	Specification
	• Degree of protection: IP65 (NEMA Type 4x encl.) • 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 • Available in conjunction with 3-A marked sensors

Field housing T17 for TMT162	Specification

94 (3.7) 114 (4.49) 114 (4.49) A0034506	• Protection class:
	  – IP66
	  – IP68
	• Temperature:
	  – Without display: −40 to +85 ℃ (−40 to +185 ℉)
	  – With display: −40 to +80 ℃ (−40 to +80 ℉)
	• Material: Stainless steel 1.4404/316L for hygienic applications
	• Threaded cable entry: 1x or 2x M20x1.5, G½" or ½" NPT
	• Protection armature connection: ½" NPT
	• Display rotatable in 90° increments
	• Brilliant backlit display with ease of visibility in bright sunshine or pitch darkness
	• Separate electronics compartment and connection compartment
	• Gold plated terminals to avoid corrosion and additional measurement errors
	• Weight: 1.25 kg (2.76 lb)
	• Available in conjunction with 3-A marked sensors

Cable glands and fieldbus connectors

Type	Suitable for cable entry	Degree of protection	Temperature range
Cable gland, polyamide	½" NPT, ¾" NPT, M20x1.5 (optionally 2x cable entry)	IP68	−40 to +100 ℃ (−40 to +212 ℉)
	½" NPT, M20x1.5	IP69K	−20 to +95 ℃ (−4 to +203 ℉)
Cable gland for dust ignition-proof area, polyamide	½" NPT, M20x1.5 (optionally 2x cable entry)	IP68	−20 to +95 ℃ (−4 to +203 ℉)
Fieldbus connector (M12x1 PA, 7/8" PA, FF)	½" NPT, M20x1.5	IP67, NEMA Type 6	−40 to +105 ℃ (−40 to +221 ℉)
Fieldbus connector (M12, 8-pin)	M20x1.5	IP67	−30 to +90 ℃ (−22 to +194 ℉)

Extension neck   Standard version of extension neck, or optionally with the quick-fastening iTHERM QuickNeck.
• Tool-free removal of the insert:
  – Saves time/costs on frequently calibrated measuring points
  – Wiring mistakes avoided
• IP69K protection class
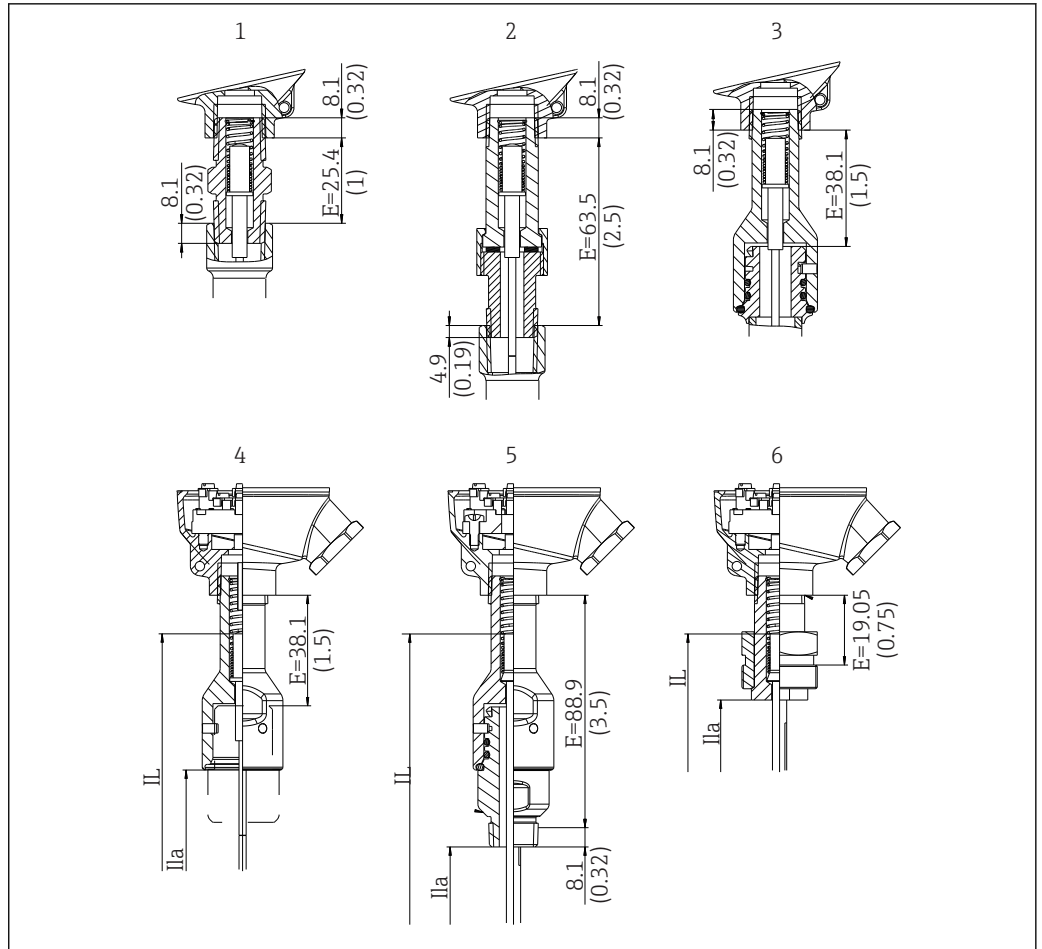
9   Dimensions of extension neck, different versions, each with NPT ½" thread to the terminal head

1   Extension hex nipple
2   Extension nipple union nipple (NUN)
3   Quick-fastening iTHERM QuickNeck
4   Quick-fastening iTHERM QuickNeck - upper part, for installation in an existing thermowell with iTHERM QuickNeck
5   Quick-fastening iTHERM QuickNeck complete, for mounting in existing thermowell with NPT ½" connection
6   1¼" x 18 UNEF thread, for mounting in existing protection tube
IL   Insert length
ILa   Insert length (without nipple)
E   Length of the extension neck available at point of installation (provided one is available)
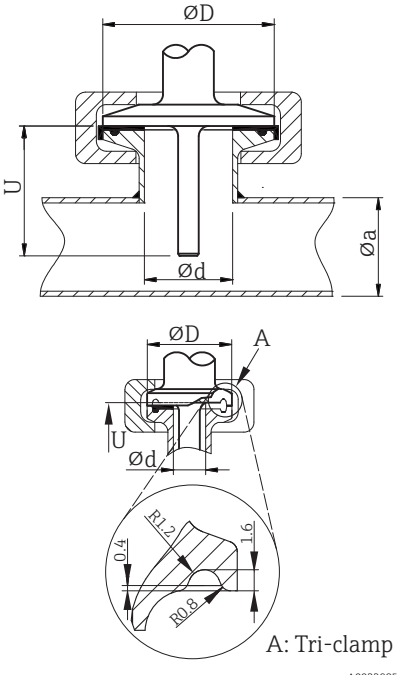
Process connections   All dimensions in mm (in).

For welding in

Type	Version	Dimensions	Technical properties
Weld-in adapter	Cylindrical ½" NPS	ϕd = ½" NPS, h = 38.1 mm (1.5 in), U = immersion length from lower edge of thread, T = min. 50.8 mm (2 in)	• P$_{max.}$ depends on the weld-in process • With 3-A symbol and EHEDG certification • ASME BPE compliance
	Cylindrical ¾" NPS	ϕd = ¾" NPS, h = 38.1 mm (1.5 in), U = immersion length from lower edge of thread, T = min. 50.8 mm (2 in)	
	Cylindrical 1" NPS	ϕd = 1" NPS, h = 38.1 mm (1.5 in), U = immersion length from lower edge of thread, T = min. 50.8 mm (2 in)	

Releasable process connection
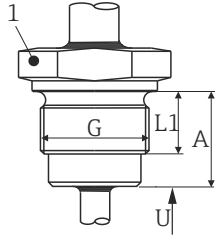
Type	Version	Dimensions		Technical properties
	ϕd: [1]	ϕD	ϕa	
Clamp according to ASME BPE or ISO 2852 *A Different seal geometries for Tri-clamp*	Tri-clamp ¾" (DN18) [2]	25 mm (0.98 in)	-	• $P_{max.}$ = 16 bar (232 psi), depends on clamp ring and suitable seal • With 3-A symbol
	Clamp ISO 2852 ½" (DN12 - 21.3)	34 mm (1.34 in)	16 to 25.3 mm (0.63 to 0.99 in)	
	Tri-clamp 1" - 1½" (DN25 - 38)	50.5 mm (1.99 in)	29 to 42.4 mm (1.14 to 1.67 in)	• $P_{max.}$ = 16 bar (232 psi), depends on clamp ring and suitable seal • With 3-A symbol and EHEDG certification (sealing according to EHEDG position paper, DN25, DN40, DN63,5) • ASME BPE compliance [3]
	Tri-clamp 2" (DN40 - 51)	64 mm (2.52 in)	44.8 to 55.8 mm (1.76 to 2.2 in)	
	Tri-clamp 2½" (DN63.5)	77.5 mm (3.05 in)	68.9 to 75.8 mm (2.71 to 2.98 in)	
	Tri-clamp 3" (DN70-76.5)	91 mm (3.58 in)	> 75.8 mm (2.98 in)	• $P_{max.}$ = 16 bar (232 psi), depends on clamp ring and suitable seal • With 3-A symbol • ASME BPE compliance [4]

1) Pipes in accordance with ISO 2037 and BS 4825 Part 1
2) Tri-clamp ¾" only possible with protection tube diameter 6.35 mm (¼ in) or 9.53 mm (⅜ in)
3) Not for DN12-21.3
4) Not for DN12-21.3
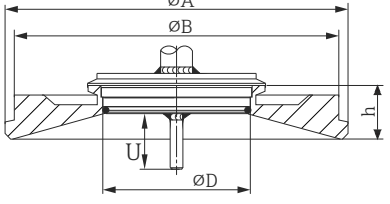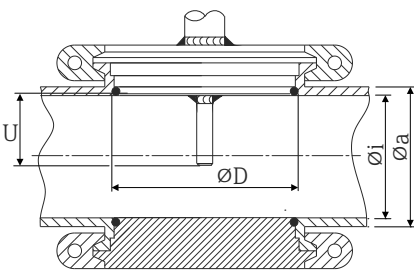
Type	Version G	Dimensions			Technical properties
		L1 thread length	A	1 (SW/AF)	
Thread according to ISO 228 (for Liquiphant weld-in adapter)	G¾" for FTL20 adapter	16 mm (0.63 in)	25.5 mm (1 in)	32	• $P_{max.}$ = 25 bar (362 psi) at max. 150 °C (302 °F) • $P_{max.}$ = 40 bar (580 psi) at max. 100 °C (212 °F) • In connection with FTL31/33/50 adapter 3-A symbol and EHEDG certification • ASME BPE compliance • Minimum extension neck lengths: ≥ 76.2 mm (3 in)
	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	$P_{max.}$	
Varivent®	Type B	31 mm (1.22 in)	105 mm (4.13 in)	-	22 mm (0.87 in)	10 bar (145 psi)	• With 3-A symbol and EHEDG certification • ASME BPE compliance
	Type F	50 mm (1.97 in)	145 mm (5.71 in)	135 mm (5.31 in)	24 mm (0.95 in)		

Type	Version	Dimensions				Technical properties	
		ΦD	ΦA	ΦB	h	P_max.	
	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	• With 3-A symbol and EHEDG certification • ASME BPE compliance

Version	Dimensions			P_max.
	ΦD	Φi	Φa	
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)	
Type N, according to DIN 11866, series C	68 mm (2.67 in)	OD 3": 73 mm (2.87 in)	OD 3": 76.2 mm (3 in)	OD 3" to OD 4": 10 bar (145 psi)
		OD 4": 97.6 mm (3.84 in)	OD 4": 101.6 mm (4 in)	
Type F, according to DIN 11866, series C	50 mm (1.97 in)	OD 1": 22.2 mm (0.87 in)	OD 1": 25.4 mm (1 in)	16 bar (232 psi)

ℹ Due to the small immersion length U, the use of iTHERM QuickSens inserts is recommended.

Tip shape

The thermal response time, the reduction of the flow cross-section and the mechanical load that occurs in the process are the criteria that matter when selecting the shape of the tip. Advantages of using reduced thermometer tips:
• A smaller tip shape has less impact on the flow characteristics of the pipe carrying the medium.
• The flow characteristics are optimized, thereby increasing the stability of the protection tube.
• Endress+Hauser offers users a range of protection tube tips to meet every requirement:
  – Straight tip
  – Reduced tip with ϕ4.76 mm ($^3/_{16}$ in): walls of lower thickness significantly reduce the response times of the overall measuring point
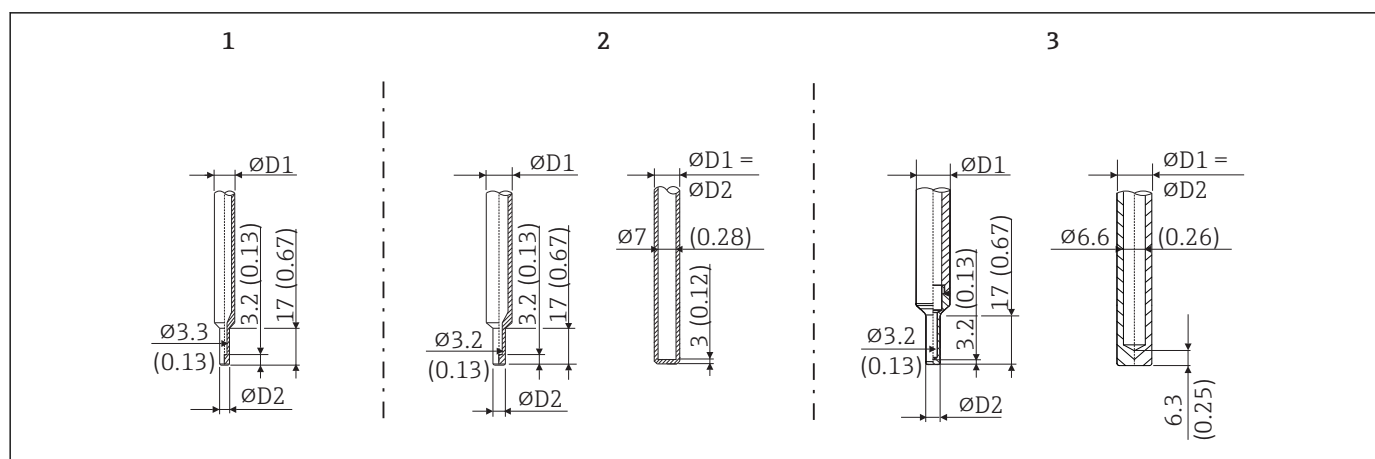
🖻 *10   Protection tube tips available (reduced or straight)*

A0033991

Item No.	Protection tube (ΦD1)	Tip (ΦD2)	Insert (ΦID)
1	Φ6.35 mm (¼ in)	Reduced tip with Φ4.76 mm (³⁄₁₆ in)	Φ3 mm (0.12 in)
2	Φ9.53 mm (³⁄₈ in)	• Reduced tip with Φ4.76 mm (³⁄₁₆ in) • Straight tip	• Φ3 mm (0.12 in) • Φ6.35 mm (¼ in) or 6 mm (0.24 in)
3	Φ12.7 mm (½ in)	• Reduced tip with Φ4.76 mm (³⁄₁₆ in) • Straight tip	• Φ3 mm (0.12 in) • Φ6.35 mm (¼ in) or 6 mm (0.24 in)

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 protection tubes in the Endress+Hauser Applicator software. See 'Accessories' section. → 🖺 35

Certificates and approvals

CE mark	The product meets the requirements of the harmonized European standards. As such, it complies with the legal specifications of the EC directives. The manufacturer confirms successful testing of the product 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 → 🕮 29 • 3-A authorization no. 1144, 3-A sanitary standard 74-06. Permitted process connections in accordance with 3-A, see 'Process connections' section → 🕮 29 • ASME BPE 2009, certificate of conformity can be ordered for indicated options
Ex approval	Information about currently available Ex versions (ATEX, FM, CSA, etc.) can be supplied by your E+H Sales Center on request. All explosion protection data are given in separate documentation which is available upon request.
Other standards and guidelines	• EN 60079: ATEX certification for hazardous areas • 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 • ASTM E 1137/E1137M-2008: Standard Specification for Industrial Platinum Resistance Thermometers • EN 50281-1-1: Electrical apparatus protected by enclosures • DIN 43772: Protection tubes • DIN EN 50446: Terminal heads • IEC 61326-1: Electromagnetic compatibility (electrical equipment for measurement, control and laboratory use - EMC requirements)
Parts in contact with the medium	Parts of the thermometer in contact with the medium comply with the following European regulations: • (EC) No. 1935/2004, Article 3, paragraph 1, Articles 5 and 17 on materials and articles intended to come into contact with food. • (EC) No. 2023/2006 on good manufacturing practice for materials and articles intended to come into contact with food. • (EC) No. 10/2011 on plastic materials and articles intended to come into contact with food. • FDA-compliant • All product contact surfaces are produced without animal derived ingredients (ADI/TSE)
CRN approval	The CRN approval is only available for certain options of protection tubes. These will be marked and shown during the configuration of this device.
Surface purity	Free from oil and grease, optional
Material resistance	Material resistance - including housing - to the following cleaning agents/disinfectants from the company Ecolab: P3-topax 66, P3-topactive 200, P3-topactive 500 and P3-topactive OKTO as well as demineralized water.
Material certification	The material certificate 3.1 (according to standard EN 10204) can be requested separately.
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.

Protection tube testing and load capacity calculation	• Protection tube pressure tests are carried out in accordance with the specifications in DIN 43772. With regard to protection tubes with reduced tip that do not comply with this standard, these are tested using the pressure of corresponding straight protection tubes. Tests according to other specifications can be carried out on request. The liquid penetration test verifies that there are no cracks in the welded seams of the protection tube. • PMI test, dye penetration test, TW welding, internal hydrostatic pressure, etc. each with inspection certificate • Load capacity calculation for the protection tube as per DIN43772

Ordering information

Detailed ordering information is available from the following sources:
• In the Product Configurator on the Endress+Hauser website: www.endress.com -> Click "Corporate" -> Select your country -> Click "Products" -> Select the product using the filters and search field -> Open product page -> The "Configure" button to the right of the product image opens the Product Configurator.
• From your Endress+Hauser Sales Center: www.addresses.endress.com
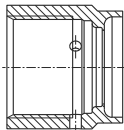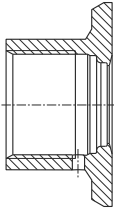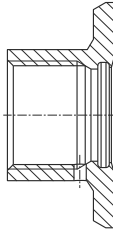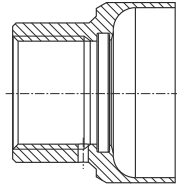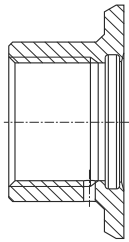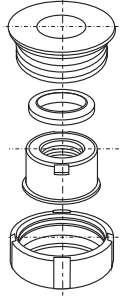
> **Product Configurator - the tool for individual product configuration**
> • Up-to-the-minute configuration data
> • Depending on the device: Direct input of measuring point-specific information such as measuring range or operating language
> • Automatic verification of exclusion criteria
> • Automatic 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.
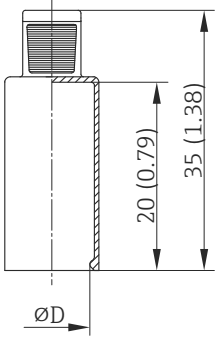
Device-specific accessories

Weld-in adapter						
	A0008246	A0008251	A0008256	A0011924	A0008248	A0008253
	G ¾", d=29 for pipe-mounting	G ¾", d=50 for vessel-mounting	G ¾", d=55 with flange	G 1", d=53 without flange	G 1", d=60 with flange	G 1" adjustable
Material	316L (1.4435)	316L (1.4435)	316L (1.4435)	316L (1.4435)	316L (1.4435)	316L (1.4435)
Roughness μm (μin) process side	≤1.5 (59.1)	≤0.8 (31.5)	≤0.8 (31.5)	≤0.8 (31.5)	≤0.8 (31.5)	≤0.8 (31.5)
Order number weld-in adapter	71258357	71258355	52001052	71258358	52001051 [1]	52001221 [2]
Order number weld-in adapter with inspection certificate [3] [4]	52028295	52018765	52011897	71093129	52011896 [1]	52011898 [2]
Order number for seal replacement (5 pieces) [5]	Silicone O-ring 52021717	Silicone O-ring 52021717	Silicone O-ring 52014473	Silicone O-ring 52014472	Silicone O-ring 52014472	Silicone profile gasket 52014424
Order number welding dummy [6]	71174959	71174959	71168889	71166879	71166879	71181945
Order number blind plug [6]	71167850	71167850	71177193	71173810	71173810	71166366
Order number blind plug with inspection certificate [4] [6]	-	-	71190074	71167291	71167291	71196853

1) Replace the weld-in adapter with order number 917969-1000.
2) Replace the weld-in adapter with order number 215159-0000.
3) AD2000: The material 316L (in contact with process) corresponds to AD2000 – W0/W2.
4) Inspection certificate EN10204-3.1 material
5) One seal is included in scope of delivery.
6) TSP modification number. Can be ordered only FTSP, PTSP or NTSP.

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

Flexible handle cap to cover the QuickNeck bottom part	Diameter ØD: 24 to 26 mm (0.94 to 1.02 in) Material: Thermoplastic polyolefin - elastomer (TPE), free from plasticizers Maximum temperature: +150 ℃ (+302 ℉) **Order number:** 71275424
35 (1.38) 20 (0.79) ØD A0027201	

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

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
	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 BA00061S
	Fieldgate FXA42	Gateway for remote monitoring of connected 4 to 20 mA analog as well as digital field devices. 📖 For details, see Technical Information TI01297S and Brief Operating Instructions KA01246S
	Field Xpert SFX350	Field Xpert SFX350 is a mobile computer for commissioning and maintenance. It enables efficient device configuration and diagnostics for HART and FOUNDATION Fieldbus devices in the **non-Ex area**. 📖 For details, see Operating Instructions BA01202S
	Field Xpert SFX370	Field Xpert is an industrial PDA with integrated touchscreen for commissioning and maintaining field devices in explosion hazardous and safe areas. It allows efficient configuration of FOUNDATION fieldbus, HART 5/6/7 and WirelessHART devices via Bluetooth and/or Wifi interfaces. 📖 For details, see Technical Information TI01114S and Operating Instructions BA01202S
	Field Xpert SMT70	The Field Xpert SMT70 is an out-of-the box tablet PC for universal device configuration that has pre-installed devices libraries. It supports devices with protocols such as HART, PROFIBUS DP/PA, FOUNDATION Fieldbus, Modbus, and Endress+Hauser service protocols. 📖 For details, see Technical Information TI01342S

Service-specific accessories

Accessories	Description
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: • Via the Internet: https://portal.endress.com/webapp/applicator • On CD-ROM for local PC installation.

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: • Via the Internet: www.endress.com/lifecyclemanagement • On CD-ROM for local PC installation.

FieldCare SFE500	FDT-based plant asset management tool from Endress+Hauser. 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. 📖 For details, see Operating Instructions BA00027S and BA00065S

DeviceCare SFE100	Configuration tool for devices via fieldbus protocols and Endress+Hauser service protocols. DeviceCare is the tool developed by Endress+Hauser for the configuration of Endress+Hauser devices. All smart devices in a plant can be configured via a point-to-point or point-to-bus connection. The user-friendly menus enable transparent and intuitive access to the field devices. 📖 For details, see Operating Instructions BA00027S

System components

Accessories	Description
Display RIA15	It is integrated in the 4 to 20 mA or HART® loop and transmits the measuring signal or HART® process variables in digital form. The process display unit does not require an external power supply. It is powered directly from the current loop. 📖 For details, see the "Technical Information" document TI01043K
Memograph M, RSG45	Advanced Data Manager with tamper-proof data storage and access (FDA 21 CFR 11) HART® gateway functionality; Up to 40 HART® devices connected at a time Communication capabilities: Modbus, Profibus DP, PROFINET, EtherNet/IP. 📖 For details, see the "Technical Information" document TI01180R
Active barrier RN221N	Active barrier with power supply for safe separation of 4-20 mA standard signal circuits. Offers bidirectional HART transmission. 📖 For details, see "Technical Information" TI00073R and Operating Instructions BA00202R
Power supply RNS221	Supply unit for powering two 2-wire measuring devices solely in the non-Ex area. Bidirectional communication is possible via the HART communication jacks. 📖 For details, see "Technical Information" TI00081R and Brief Operating Instructions KA00110R

Documentation

Technical information:

📖 Resistance thermometer for hygienic and aseptic applications iTHERM TM402: TI01349T

📖 Modular resistance thermometer for hygienic and aseptic applications iTHERM TM412: TI01348T

📖 Insert for thermometer installation iTHERM TS212: TI01336T

📖 Thermometer protection tube for hygienic and aseptic applications iTHERM TT412: TI01350T

📖 Process Indicator RIA15: TI01043K

📖 Advanced Data Manager Memograph M RSG45: TI01180R

📖 Field Data Manager Software MS20, MS21: TI01022R

Hazardous area supplementary documentation:

📖 iTHERM TM412 Intrinsically safe Ex ia IIC: XA01024T
iTHERM TM412 Dust-explosion protection Ex ta/tb: XA01023T

iTEMP temperature head transmitter:

📖 TMT80, PC-programmable, single-channel, RTD and TC: TI00153R

📖 TMT180, PC-programmable, single-channel, Pt100: TI00088R

📖 TMT181, PC-programmable, single-channel, RTD, TC, Ω, mV: TI00070R

📖 HART® TMT182, single-channel, RTD, TC, Ω, mV: TI00078R

📖 HART® TMT82, two-channel, RTD, TC, Ω, mV: TI01010T

📖 PROFIBUS® PA TMT84, two-channel, RTD, TC, Ω, mV: TI00138R

📖 FOUNDATION Fieldbus™ TMT85, two-channel, RTD, TC, Ω, mV: TI00134R

iTEMP temperature field transmitter:

📖 TMT162, dual input temperature field transmitter with HART® protocol: TI01344T

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