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Technical Information
iTHERM TrustSens TM371

Compact thermometer in metric style for hygienic and aseptic applications
HART communication

Outstanding sensor technology with self-calibration function
100% Compliance - 0% Effort

Applications

- Specially designed for use in hygienic and aseptic applications in the Food & Beverages and Life Sciences industries
- Measuring range: −40 to +160 °C (−40 to +320 °F), optional up to 190 °C (374 °F)
- Pressure range up to 50 bar (725 psi)
- Degree of protection (of enclosure): IP65/67 or IP69
- Communication: Current output 4-20 mA, HART protocol

Your benefits

- Risk and cost reduction thanks to fully automated, traceable, in-situ self-calibration and Heartbeat Technology
- Automatized documentation, memory for 350 self-calibration points
- Printable calibration certificate - audit proof
- Elimination of nonconformity or undetected failures
- International certifications, regulations (EC/EU), approvals and declarations of conformity:
  - EHEDG, ASME BPE, FDA, 3-A, EC 1935/2004, EC 2023/2006, EU 10/2011
  - CE/EAC, CRN, CSA General Purpose
  - Explosion protection, e.g. ATEX/IECEx
- Industry 4.0: Provides long-term meta-data of process health
- Cloud-based asset management with Netilion integration

Endress+Hauser
People for Process Automation

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Function and system design

The iTHERM TrustSens thermometer incorporates a groundbreaking innovation – its self-calibration functionality. Under normal operation a standard Pt100 sensor element is being used. By means of a built-in, highly accurate reference sensor, the Pt100 measurement is automatically calibrated at a certain process temperature. This eliminates the need to remove the thermometer for calibration purposes. For more details please see chapter calibration.

Measuring principle

Resistance thermometer (RTD)

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

Thin film platinum resistance thermometers (TF): A ultrapure platinum layer, about 1 µm thick, is applied by vapor deposition 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.

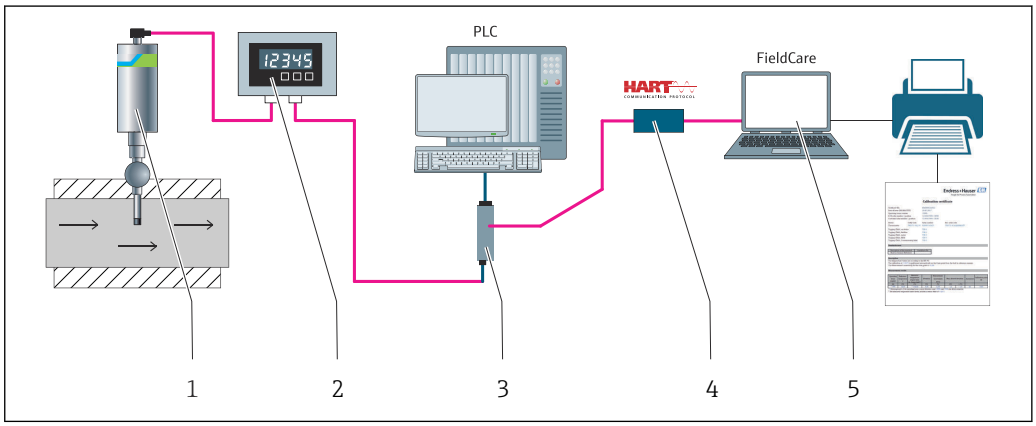
The primary advantages of thin film temperature sensors are their small sizes and good vibration resistance.

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

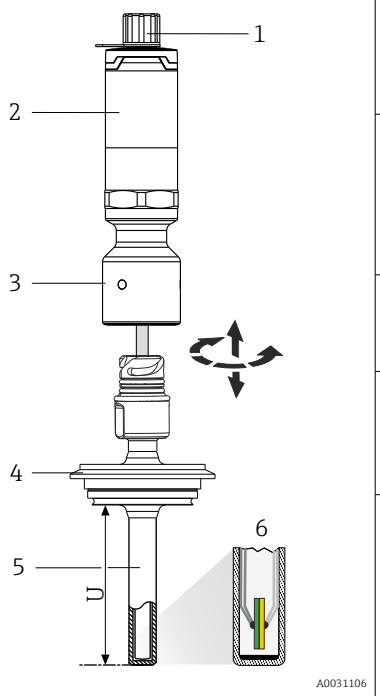
For more information, see the brochure 'System Products and Data Managers - Solutions to complete the measuring point' (FA00016K/EN)



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

1 *Installed iTHERM compact thermometer with HART communication protocol*
2 *RIA15 loop powered process display - It is integrated in the current loop and displays 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. More information on this can be found in the Technical Information, see "Supplementary documentation", → 40.*
3 *Active barrier RN42 – The active barrier is used for transmission and galvanic isolation of 4 to 20 mA/HART signals and supplying loop powered transmitters. The universal power supply works with an input supply voltage of 19.2 to 253 V DC/AC, 50/60 Hz, which means that it can be used in all international power grids. More information on this can be found in the Technical Information, see "Supplementary documentation", → 40.*
4 *Commubox FXA195 for intrinsically safe HART communication with FieldCare via the USB interface.*
5 *FieldCare is a FDT-based plant asset management tool from Endress+Hauser, more details see section 'accessories'. The acquired self-calibration data is stored in the device (1) and can be read using FieldCare. This also enables an auditable calibration certificate to be created and printed.*

Equipment architecture

Design		Options
	1: Wiring, electrical connection, output signal 2: Transmitter housing	**Your benefits:** ▪ Optimum protection even with high-pressure cleaning: As standard IP65/67, optional IP69 protection ▪ M12, 4pin connector: cost and time savings as well as incorrect wiring avoided ▪ Compact built-in transmitter (4 to 20 mA, HART)
	3: Extension neck	▪ Welded-in-place or removable ▪ Optional with iTHERM QuickNeck bayonet joint **Your benefits:** ▪ **iTHERM QuickNeck:** tool-free removal of the compact thermometer ▪ IP69 protection: safety under extreme process conditions
	4: Process connection → 🖹 24	More than 50 different versions.
	5: Protection tube	▪ Versions with and without protection tube (insert in direct contact with process). ▪ Various diameters ▪ Various tip shapes (straight or reduced)
	6: Insert	Sensor model: thin-film Pt100 sensor (TF) with iTHERM TrustSens technology. **Your benefits:** ▪ Risk and cost reduction thanks to Heartbeat technology ▪ Fully automated, traceable, inline self-calibration ▪ Automatized documentation, memory for the last 350 calibration points ▪ Printable calibration certificate - audit proof ▪ No risk of unconformity or undetected failures ▪ International certifications and approvals

Input

Measuring range

Pt100 thin-film (TF):
- −40 to +160 °C (−40 to +320 °F)
- Optional −40 to +190 °C (−40 to +374 °F)

Output

Output signal

Analog output	4 to 20 mA
Digital output	HART protocol (revision 7)

Failure information

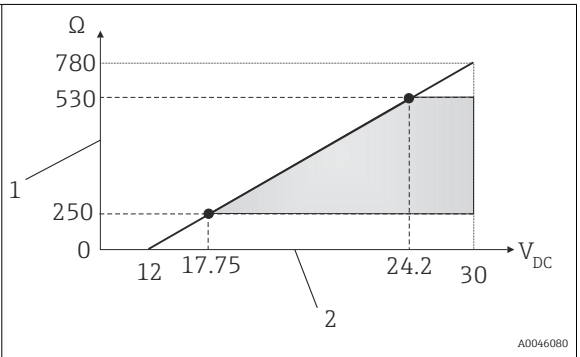
Failure information as per NAMUR NE43:

Failure information is created if the measuring information is missing or not valid. A complete list of all the errors occurring in the measuring system is created.

Underranging	Linear decrease from 4.0 to 3.8 mA
Overranging	Linear increase from 20.0 to 20.5 mA
Failure, e.g. sensor breakage, sensor short-circuit	≤ 3.6 mA ("low") or ≥ 21.5 mA ("high"), can be selected The "high" alarm setting can be set between 21.5 mA and 23 mA, thus providing the flexibility needed to meet the requirements of various control systems.

Load

Maximum possible HART communication resistance

$R_{b\ max.}$= ($U_{b\ max.}$ - 12 V) / 0.023 A (current output)	 *1 Load* *2 Supply voltage U_b*

Linearization/transmission behavior

Temperature-linear

Filter

1st order digital filter: 0 to 120 s, factory setting: 0 s (PV)

Protocol-specific data

HART

Manufacturer ID	17 (0x11)
Device type ID	0x11CF
HART revision	7
Device description files (DTM, DD)	Information and files at: ▪ www.endress.com/downloads ▪ www.fieldcommgroup.org
HART load	Min. 250 Ω
HART device variables	**Measured value for PV (primary value)** Temperature **Measured values for SV, TV, QV (secondary, tertiary and quaternary variable)** ▪ SV: Device temperature ▪ TV: Calibration counter ▪ QV: Calibration deviation
Supported functions	▪ Additional transmitter status ▪ NE107 diagnostics

Startup behavior / wireless HART data

Minimum start-up voltage	12 V_{DC}
Start-up current	3.58 mA
Start-up time	< 7 s, until the first valid measured value signal is present at the current output
Minimum operating voltage	12 V_{DC}
Multidrop current	4 mA
Lead time	0 s

Wiring

According to the 3-A Sanitary Standard and EHEDG electrical connecting cables must be smooth, corrosion-resistant and easy to clean.

Supply voltage

U_b = 12 to 30 V_{DC}

The device may only be powered by a power supply unit with a limited energy electric circuit in accordance with UL/EN/IEC 61010-1 chapter 9.4 or Class 2 according to UL 1310, "SELV or Class 2 cir-cuit".

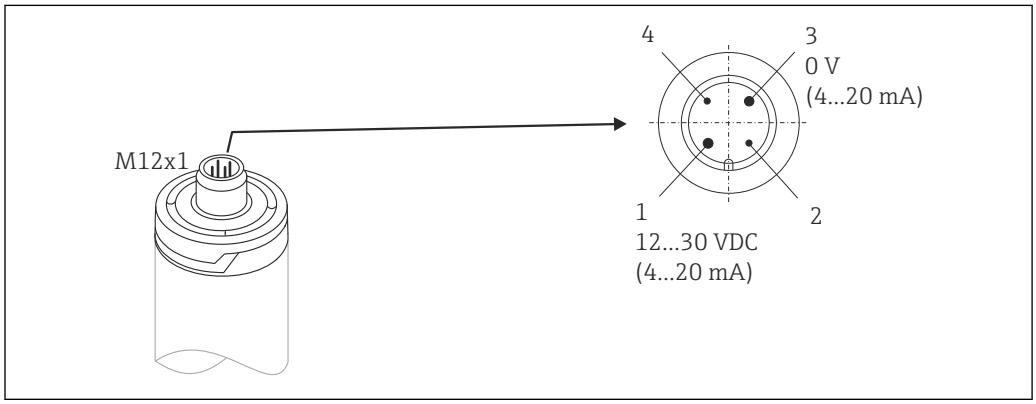
Current consumption

- I = 3.58 to 23 mA
- Minimum current consumption: I = 3.58 mA, multi-drop mode I =4 mA
- Maximum current consumption: I ≤ 23 mA

Electrical connection

To prevent any kind of damage from the device electronics, leave the pins 2 and 4 unconnected. They are reserved for the connection of the configuration cable.

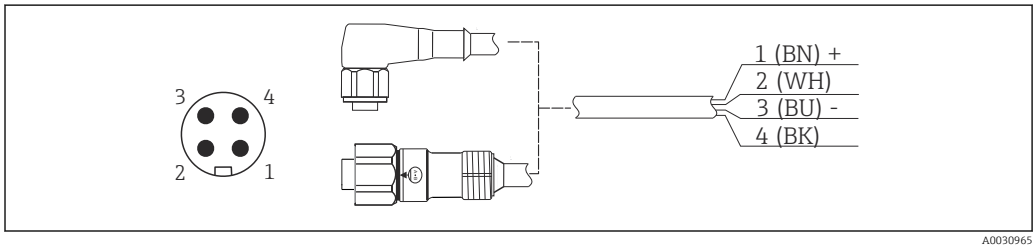
Do not tighten the M12 plug too much, in order to prevent damage to the device. Maximum torque: 0.4 Nm (M12 knurl)



2 *Pin assignment of the device connecting socket*

1 *Power supply 12 to 30 V_{DC}; current output 4 to 20 mA*
2 *Reserved for configuration cable*
3 *Power supply 0 V_{DC}; current output 4 to 20 mA*
4 *Reserved for configuration cable*

Device plug connection



3 *Pin assignment of the plug connector*

1 *Power supply +, wire color brown = BN*
2 *Connection of PC configuration cable, wire color white = WH*
3 *Power supply -, wire color blue = BU*
4 *Connection of PC configuration cable, wire color black = BK*

Appropriate cord sets with straight or angle plugs are available as accessory.

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.

For more information see the Technical Information 'HAW562 Surge arrester' TI01012K

Performance characteristics

Reference operating conditions

- Ambient temperature: 25 °C ± 5 °C (77 °F ± 9 °F)
- Supply voltage: 24 V_{DC}

Internal calibration points

118 °C (244.4 °F) +1.2 K / −1.7 K
▪ Lowest possible calibration point = 116.3 °C (241.3 °F) ▪ Highest possible calibration point = 119.2 °C (246.6 °F)

The individual calibration point of each iTHERM TrustSens device is indicated in the ex-works calibration certificate enclosed with the shipment.

Measurement uncertainty

The given uncertainty values includ non-linearity and non-repeatability and correspond to 2Sigma (95% confidence level according to tha Gaussian distribution curve).

Each iTHERM TrustSens is calibrated and matched by default before shipment to guarantee the given accuracy.

Uncertainty of self-calibration at the calibration point: [1]	
Option: 118 °C (244 °F); self-calibration with excellent uncertainty 118 °C (244 °F); self-calibration with standard uncertainty	Uncertainty: < 0.35 K (0.63 °F) < 0.55 K (0.99 °F)
Uncertainty of the temperature sensor inclusive digital output (HART value) at reference conditions in delivery state:	
Process temperature: +20 to +135 °C (+68 to +275 °F) +135 to +160 °C (+275 to +320 °F) +160 to +170 °C (+320 to +338 °F) +170 to +180 °C (+338 to +356 °F) +180 to +190 °C (+356 to +374 °F) 0 to +20 °C (+32 to +68 °F) −20 to 0 °C (−4 to +32 °F) −40 to −20 °C (−40 to −4 °F)	 < 0.22 K (0.4 °F) < 0.38 K (0.68 °F) < 0.5 K (0.90 °F) < 0.6 K (1.08 °F) < 0.8 K (1.44 °F) < 0.27 K (0.49 °F) < 0.46 K (0.83 °F) < 0.8 K (1.44 °F)
Uncertainty of D/A converter (analog output current)	0.03 % of the measurement range

1) The uncertainty of the self-calibration can be compared to the uncertainty of a manual on-site calibration with a mobile dry-block-calibrator. Depending on the used equipment and the qualification of the person who is performing the calibration an uncertainty of > 0.3 K (0.54 °F) is standard.

Long-term drift

Pt100 sensing element	< 1000 ppm/1000 h [1]
A/D converter (digital output - HART)	< 500 ppm/1000 h [1]
D/A converter (analog output - current)	< 100 ppm/1000 h

1) This would be detected by the self-calibration

Long-term drift decreases at an exponential rate over time. So it may not be extrapolated in a linear way for time spans longer than the above given values.

Influence of ambient temperature

A/D converter (digital output - HART) at typical operating conditions	< 0.05 K (0.09 °F)
A/D converter (digital output - HART) at maximum operating conditions	< 0.15 K (0.27 °F)
D/A converter (analog output - current)	≤ 30 ppm/°C (2σ), related to the deviation from the reference temperature

Typical operating conditions
- Ambient temperature: 0 to +40 °C (+32 to +104 °F)
- Process temperature: 0 to +140 °C (+32 to +284 °F)
- Power supply: 18 to 24 V_{DC}

Influence of supply voltage

According to IEC 61298-2:

A/D converter (digital output - HART) at typical operating conditions	< 15 ppm/V [1]
D/A converter (analog output - current)	< 10 ppm/V [1]

1) Related to the deviation from the reference supply voltage

Sample calculation with Pt100, measuring range +20 to +135 °C (+68 to +275 °F), ambient temperature +25 °C (+77 °F), supply voltage 24 V:

Measured error digital	0.220 K (0.396 °F)
Measured error D/A = 0.03 % x 150 °C (302 °F)	0.045 K (0.081 °F)
Measured error digital value (HART):	0.220 K (0.396 °F)
Measured error analog value (current output): √(Measured error digital² + Measured error D/A²)	0.225 K (0.405 °F)

Sample calculation with Pt100, measuring range +20 to +135 °C (+68 to +275 °F), ambient temperature +35 °C (+95 °F), supply voltage 30 V:

Measured error digital	0.220 K (0.396 °F)
Measured error D/A = 0.03 % x 150 °C (302 °F)	0.045 K (0.081 °F)
Influence of ambient temperature (digital)	0.050 K (0.090 °F)
Influence of ambient temperature (D/A) = (35 °C - 25 °C) x (30 ppm/°C x 150 °C)	0.045 K (0.081 °F)
Influence of supply voltage (digital) = (30 V - 24 V) x 15 ppm/V x 150 °C	0.014 K (0.025 °F)
Influence of supply voltage (D/A) = (30 V - 24 V) x 10 ppm/V x 150 °C	0.009 K (0.016 °F)
Measured error digital value (HART): √(Measured error digital² + Influence of ambient temperature (digital)² + Influence of supply voltage (digital)²	**0.226 K (0.407 °F)**
Measured error analog value (current output): √(Measured error digital² + Measured error D/A² + Influence of ambient temperature (digital)² + Influence of ambient temperature (D/A)² + Influence of supply voltage (digital)² + Influence of supply voltage (D/A)²	**0.235 K (0.423 °F)**

Response time

Tests in water at 0.4 m/s (1.3 ft/s), according to IEC 60751; 10 K temperature step change. t_{63} / t_{90} are defined as the time that passes until the instrument output reaches 63% / 90% of the new value.

Response time with heat transfer paste [1]

Protection tube	Shape of tip	Insert	t_{63}	t_{90}
Ø6 mm (0.24 in)	Reduced 4.3 mm (0.17 in) x 20 mm (0.79 in)	Ø3 mm (0.12 in)	2.9 s	5.4 s
Ø9 mm (0.35 in)	Straight	Ø6 mm (0.24 in)	9.1 s	17.9 s
	Reduced 5.3 mm (0.21 in) x 20 mm (0.79 in)	Ø3 mm (0.12 in)	2.9 s	5.4 s
Ø12.7 mm (½ in)	Straight	Ø6 mm (0.24 in)	10.9 s	24.2 s
	Reduced 5.3 mm (0.21 in) x 20 mm (0.79 in)	Ø3 mm (0.12 in)	2.9 s	5.4 s
	Reduced 8 mm (0.31 in) x 32 mm (1.26 in)	Ø6 mm (0.24 in)	10.9 s	24.2 s

1) Between the insert and the protection tube.

Response time without heat transfer paste

Protection tube	Shape of tip	Insert	t_{63}	t_{90}
Without protection tube	-	Ø6 mm (0.24 in)	5.3 s	10.4 s
Ø6 mm (0.24 in)	Reduced 4.3 mm (0.17 in) x 20 mm (0.79 in)	Ø3 mm (0.12 in)	7.4 s	17.3 s
Ø9 mm (0.35 in)	Straight	Ø6 mm (0.24 in)	24.4 s	54.1 s
	Reduced 5.3 mm (0.21 in) x 20 mm (0.79 in)	Ø3 mm (0.12 in)	7.4 s	17.3 s
Ø12.7 mm (½ in)	Straight	Ø6 mm (0.24 in)	30.7 s	74.5 s
	Reduced 5.3 mm (0.21 in) x 20 mm (0.79 in)	Ø3 mm (0.12 in)	7.4 s	17.3 s
	Reduced 8 mm (0.31 in) x 32 mm (1.26 in)	Ø6 mm (0.24 in)	30.7 s	74.5 s

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:

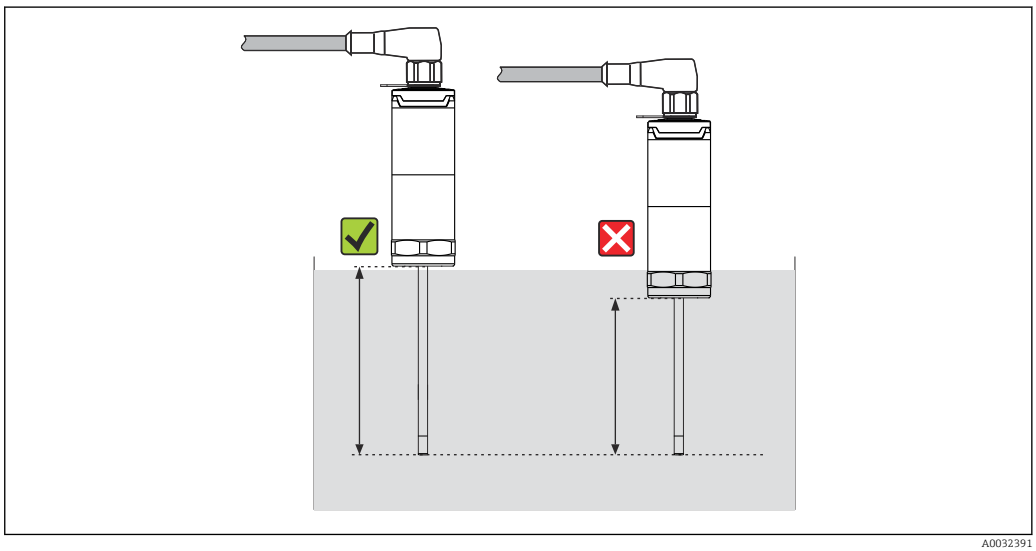
- Calibration at fixed-point temperatures, e.g. at the freezing point of water at 0 °C,
- Comparison calibration against a precise reference thermometer.

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 or special calibration furnaces with homogeneous distribution of temperature are typically used for thermometer calibrations. The DUT and the reference thermometer are placed closely together into the bath or furnace at a sufficient depth.

The measurement uncertainty can increase due to heat conduction errors and short immersion lengths. The existing measurement uncertainty is listed on the individual calibration certificate.

For accredited calibrations according to IEC/ISO 17025, the measurement uncertainty must not be twice as high as the accredited measurement uncertainty of the laboratory. If the limit value is exceeded, only a factory calibration can be carried out.

For manual calibration in calibration baths the maximum immersion length of the device ranges from the sensor tip to the lower part of the electronic housing. Do not immerse the housing into the calibration bath!



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Self-calibration

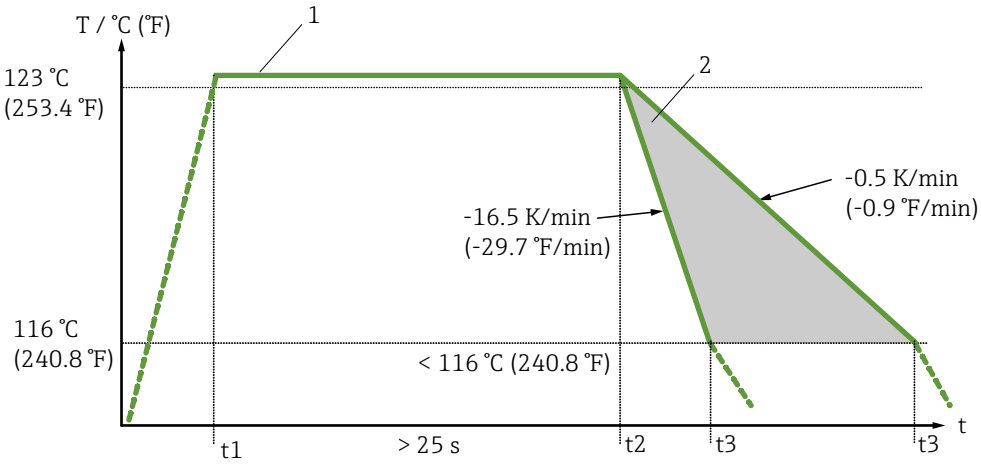
The self-calibration procedure uses the Curie temperature (Tc) of a reference material as a built-in temperature reference. A self-calibration is performed automatically, when the process temperature (Tp) falls below the nominal Curie Temperature (Tc) of the device. At the Curie temperature, a phase change of the reference material takes place, which is associated with a change in its electrical properties. The electronics automatically detects this change and simultaneously calculates the

deviation of the measured Pt100-temperature to the known, physically fixed Curie temperature. The iTHERM TrustSens thermometer is calibrated. A green flashing LED light indicates the ongoing self-calibration process. Subsequently the thermometer electronics stores the results of this calibration. The calibration data can be read via an asset management software like FieldCare or DeviceCare. A self-calibration certificate can be created automatically. This in-situ self-calibration allows a continuous and repeated monitoring of changes to the Pt100 sensor and to the electronics' characteristics. As the inline calibration is being performed under real ambient or process conditions (e.g. heating of electronics), the result is closer to reality than a sensor calibration under laboratory conditions.

Process criteria for self-calibration

To ensure a valid self-calibration within the given measurement accuracy, the process temperature characteristics needs to fulfil the criteria, which are checked by the device automatically. Based on this, the device is ready to perform a self-calibration under the following conditions:

Calibration point 118 °C (244.4 °F)
Process temperature > calibration temperature + 3 °C (5.4 °F) for 25 s before cooling down; t1 - t2.
Cooling rate: 0.5 to 16.5 K/min (0.9 to 29.7 °F/min), while the process temperature crosses the Curie temperature; t2 - t3 + 10 s. The process temperature ideally declines continuously below 116 °C (240.8 °F). A valid self-calibration process is done when the green LED flashes with a frequency 5 Hz for 5 s.



4 *Needed process temperature profile for self-calibration*

1 Process temperature 123 °C (253.4 °F)
2 Allowed self-calibration range

Calibration monitoring

Available in conjunction with Advanced Data Manager Memograph M (RSG45). → 40

Application package:
- Up to 20 devices can be monitored via the HART interface
- Self-calibration data displayed on screen or via the Web server
- Generation of a calibration history
- Creation of a calibration protocol as an RTF file directly at the RSG45
- Evaluation, analysis and further processing of the calibration data using "Field Data Manager" (FDM) analysis software

Insulation resistance

Insulation resistance ≥ 100 MΩ at ambient temperature, measured between the terminals and the outer jacket with a minimum voltage of 100 V_{DC}.

Installation

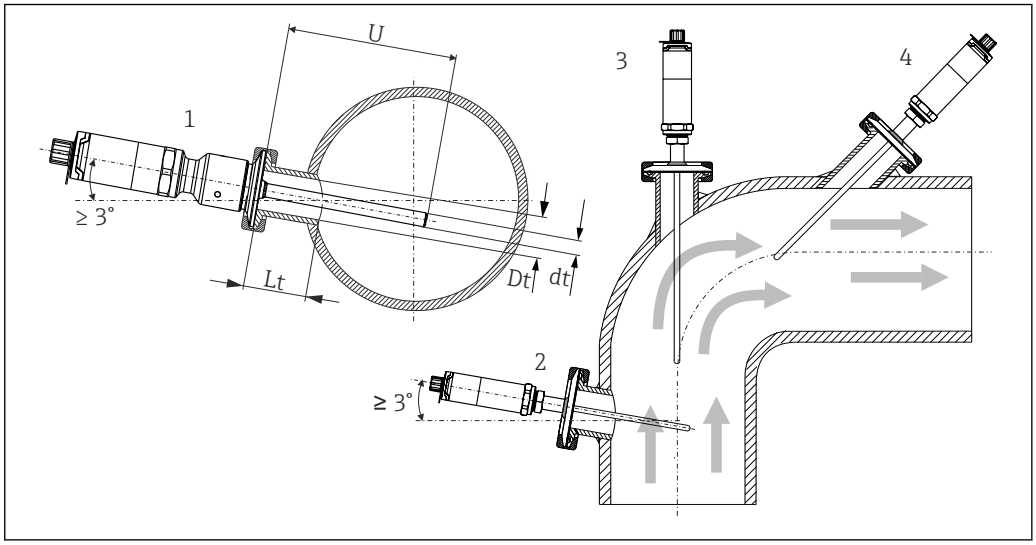
Orientation

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. 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



5 *Installation examples*

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

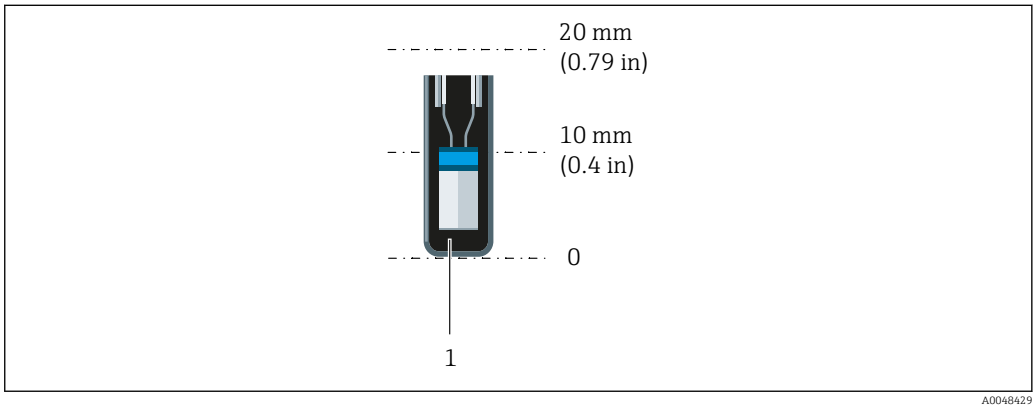
The requirements of the EHEDG and the 3-A Sanitary Standard must be adhered to.

Installation instructions EHEDG/cleanability: Lt ≤ (Dt-dt)

Installation instructions 3-A/cleanability: Lt ≤ 2 (Dt-dt)

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).

Pay attention to the exact position of the sensor element in the thermometer tip.

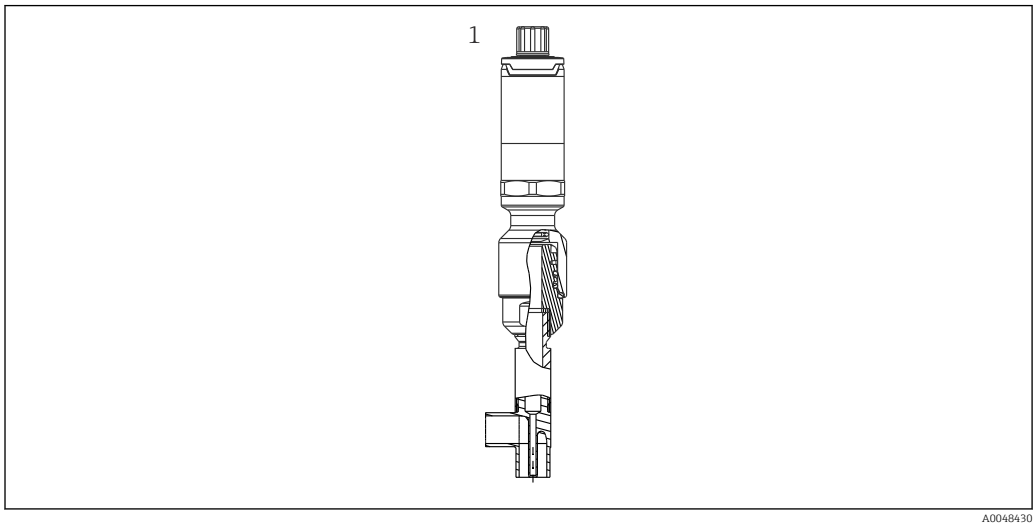


1 iTHERM TrustSens at 5 to 7 mm (0.2 to 0.28 in)

To keep the influence of heat dissipation to a minimum and to achieve the best possible measurement results, 20 to 25 mm (0.79 to 0.98 in) should be in contact with the medium in addition to the actual sensor element.

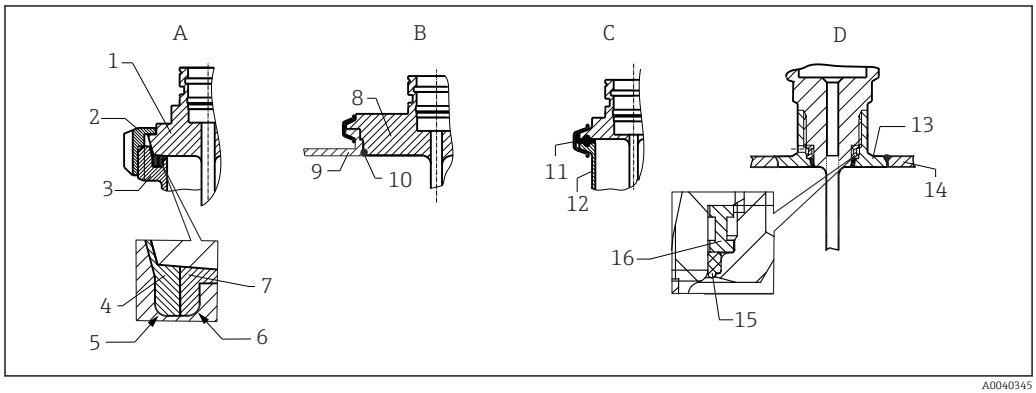
This results in the following recommended minimum immersion lengths
iTHERM TrustSens 30 mm (1.18 in)

It is particularly important to take this into consideration for tee thermowells, as the immersion length is very short on account of their design, and the measured error is higher as a result. It is therefore recommended to use elbow thermowells with iTHERM TrustSens sensors.



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

1 Elbow thermowell for weld-in as per DIN 11865 / ASME BPE 2012



7 Detailed installation instructions for hygiene-compliant installation

A Milk pipe connection according to DIN 11851, only in connection with EHEDG certified and self-centering sealing ring
1 Sensor with milk pipe connection
2 Groove slip-on nut
3 Counterpart connection
4 Centering ring
5 R0.4
6 R0.4
7 Sealing ring
B Varivent process connection for VARINLINE housing
8 Sensor with Varivent connection
9 Counterpart connection
10 O-ring
C Clamp according to ISO 2852
11 Molded seal
12 Counterpart connection
D Process connection Liquiphant-M G1", horizontal installation
13 Weld-in adapter
14 Vessel wall
15 O-ring
16 Thrust collar

NOTICE

The following actions must be taken if a sealing ring (O-ring) or seal fails:

- The thermometer must be removed.
- The thread and the O-ring joint/sealing surface must be cleaned.
- The sealing ring or seal must be replaced.
- CIP must be performed after 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.

In the case of weld-in connections, exercise the necessary degree of care when performing the welding work on the process side:

1. Use suitable welding material.
2. Flush-weld or weld with welding radius ≥ 3.2 mm (0.13 in).
3. Avoid crevices, folds or gaps.
4. Ensure the surface is honed and polished, Ra ≤ 0.76 µm (30 µin).

1. 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).
2. The Varivent and Liquiphant-M weld-in adapter and Ingold (+ weld-in adapter) connections enable flush-mounted installation.

Environment

Ambient temperature range

Ambient temperature T_a	–40 to +60 °C (–40 to +140 °F)
Maximum electronics temperature T	–40 to +85 °C (–40 to +185 °F)

Storage temperature range

T = –40 to +85 °C (–40 to +185 °F)

Climate class

As per IEC 60654-1, Class Dx

Degree of protection

- IP54 for the version without protection tube provided for installation in an existing protection tube
- IP65/67 for housing with LED status indication
- IP69 for housing without LED status indication and only if appropriate cord-set with M12x1 coupling is connected. → 🖹 38

The specified rating IP65/67 or IP69 for the compact thermometer is only assured when an approved M12 connector with a suitable IP rating is installed according to its manual.

Shock and vibration resistance

Endress+Hauser temperature sensors meet the requirements of IEC 60751 which specify shock and vibration resistance of 3g in the range from 10 to 500 Hz. This also applies for the quick-fastening iTHERM QuickNeck.

Electromagnetic compatibility (EMC)

EMC to all relevant requirements of the IEC/EN 61326 - series and NAMUR Recommendation EMC (NE21). For details, refer to the Declaration of Conformity. All tests were passed both with and without ongoing HART® communication.

All EMC measurements were performed with a turn down (TD) = 5:1. Maximum fluctuations during EMC- tests: < 1% of measuring span.

Interference immunity to IEC/EN 61326 - series, requirements for industrial areas.

Interference emission to IEC/EN 61326 - series, electrical equipment Class B.

Process

Process temperature range

- −40 to +160 °C (−40 to +320 °F)
- Optional −40 to +190 °C (−40 to +374 °F)

Reference sensor defective if temperature range of −45 to +200 °C (−49 to +392 °F) is exceeded. Temperature measurement continues, but selfcalibration is out of function.

Thermal shock

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

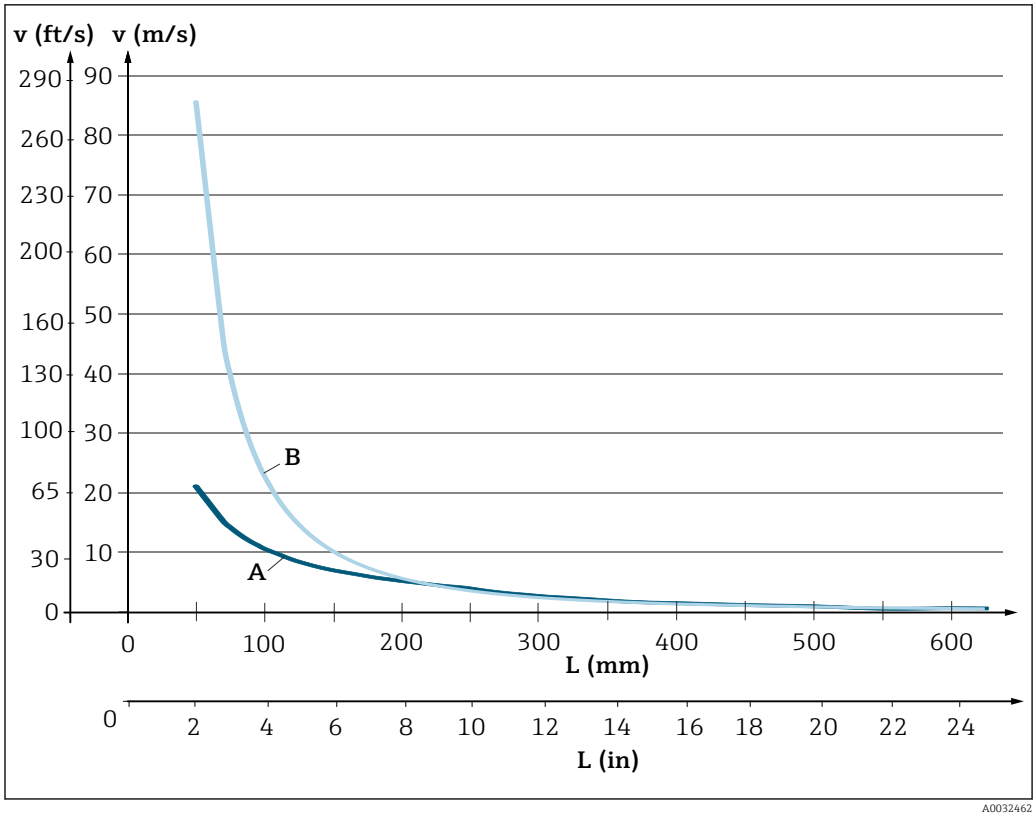
Process pressure range

The maximum static process pressure is limited by the process connection, see respective section. → 🖹 24

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. This is valid for DIN thermowell calculations. 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 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 process medium, on the process temperature and on the process pressure. The following figures exemplify the maximum permitted flow velocities in water at a process pressure of 40 bar (580 PSI) and superheated steam at a process pressure of 6 bar (87 PSI).



8 Permitted flow velocities, protection tube diameter 9 mm (0.35 in)

A Medium water at T = 50 °C (122 °F)
B Medium superheated steam at T = 160 °C (320 °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). The design of the thermometer depends on the protection tube version used:
- Thermometer without a protection tube
- Diameter 6 mm (0.24 in)
- Diameter 9 mm (0.35 in)
- Diameter 12.7 mm (½ in)
- Tee thermowell and elbow thermowell version as per DIN 11865 / ASME BPE 2012 for weld-in

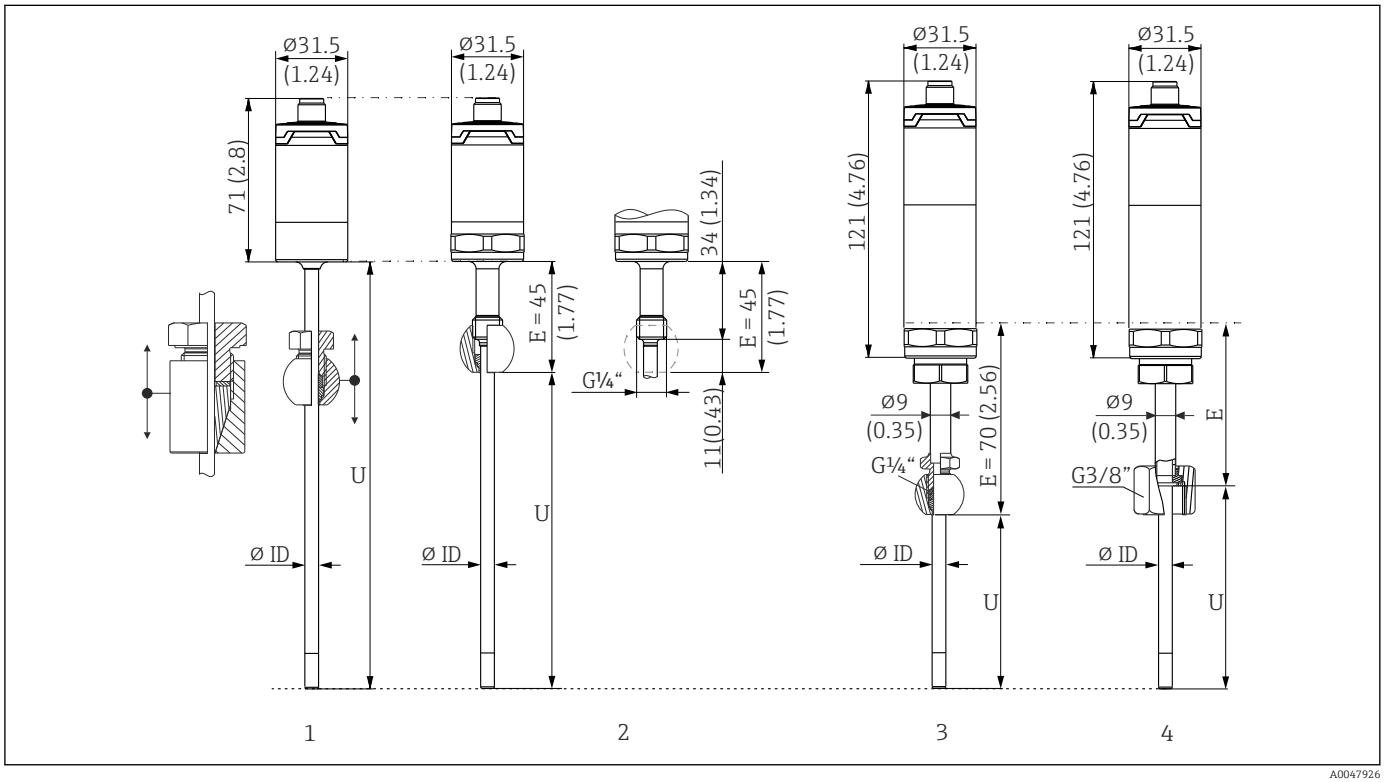
Various dimensions, such as the immersion length U for example, are variable values and are therefore indicated as items in the following dimensional drawings.

Variable dimensions:

Item	Description
E	Extension neck length, variable depending on the configuration or predefined for the version with iTHERM QuickNeck
L	Protection tube length (U+T)
B	Protection tube bottom 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) or 3 mm (0.12 in)

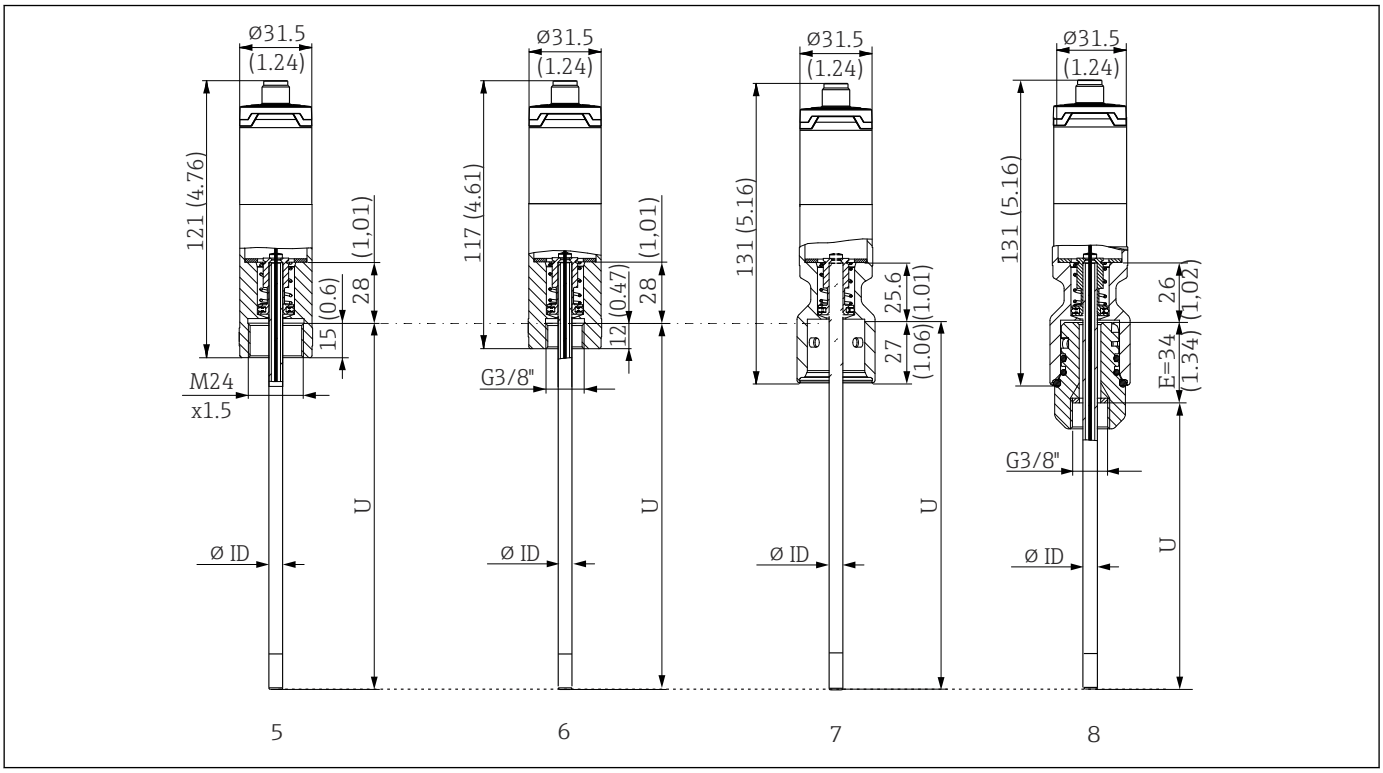
Without protection tube

For installation with compression fitting TK40 as process connection and the insert in direct contact with the process or in an existing protection tube.



A0047926

1 Thermometer without extension neck, for mounting with adjustable compression fitting TK40, spherically and cylindrically, only ØID = 6 mm
2 Thermometer with extension neck, for mounting with or in on-site existing compression fitting TK40 in fix position, only ØID = 6 mm
3 Thermometer with compression fitting TK40 fixed by extension neck, connection thread M24x1.5, ØID = 6 mm
4 Thermometer with neck tube TE411, G3/8" thread adapter nut



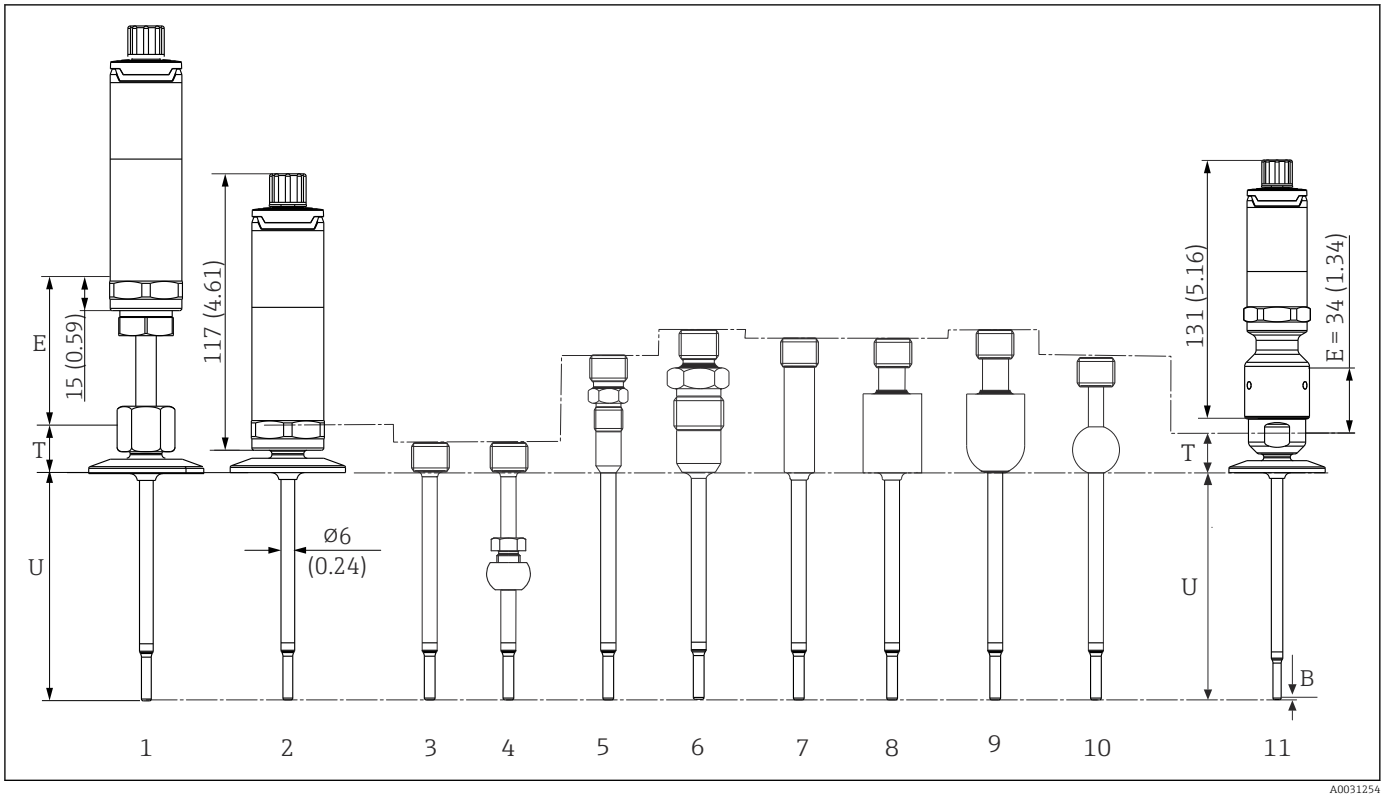
5 Thermometer with M24x1.5 female thread and spring load for protection tube connection, e.g. TT411, ØID = 3 mm or 6 mm
6 Thermometer with G3/8" female thread and spring load for protection tube connection, e.g. TT411, ØID = 3 mm or 6 mm
7 Thermometer with iTHERM QuickNeck top part and spring load for protection tube with iTHERM QuickNeck connection, ØID = 3 mm or 6 mm
8 Thermometer with iTHERM QuickNeck and spring load to mount in existing thermowell with G3/8" female thread

Item	Description
$U_{(protection\ tube)}$	Immersion length of the protection tube available at point of installation
$T_{(protection\ tube)}$	Shaft length of protection tube available at point of installation
E	Length of the extension neck at point of installation (provided one is available)
$B_{(protection\ tube)}$	Base thickness of protection tube

Pay attention to the following equations when calculating the immersion length U for immersion into a protection tube TT411 already available:

Version 5 and 7	$U = U_{(protection\ tube)} + T_{(protection\ tube)} + E + 3\ mm - B_{(protection\ tube)}$
Version 3, 4 and 6	$U = U_{(protection\ tube)} + T_{(protection\ tube)} + 3\ mm - B_{(protection\ tube)}$

With protection tube diameter 6 mm (0.24 in)



1 Thermometer with extension neck and process connection as clamp version
2 Thermometer without extension neck and process connection as clamp version
3 Without process connection
4 Process connection version as spherical compression fitting TK40
5 Process connection version as metal sealing system M12x1
6 Process connection version as metal sealing system G½"
7 Process connection version as cylindrical weld-in adapter Ø12 x 40 mm
8 Process connection version as cylindrical weld-in adapter Ø30 x 40 mm
9 Process connection version as spherical-cylindrical weld-in adapter Ø30 x 40 mm
10 Process connection version as spherical weld-in adapter Ø25 x mm
11 Thermometer with quick-fastening iTHERM QuickNeck and process connection as sanitary connection (clamp version)

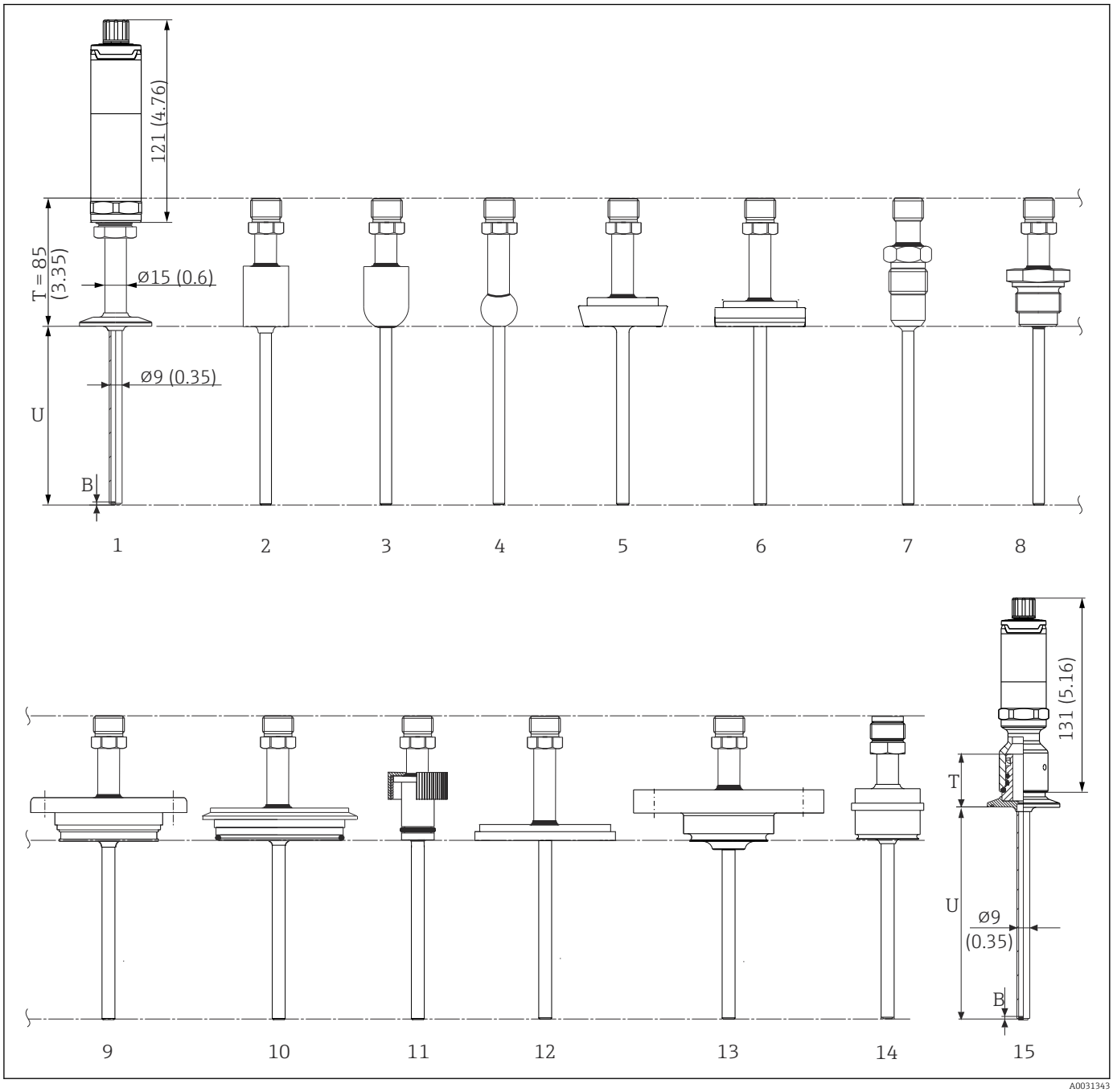
G3/8" thread for protection tube connection

Item	Version	Length
Extension neck E	Without extension neck	-
	Replaceable extenstion neck, Ø9 mm (0.35 in)	Variable, depending on the configuration
	iTHERM QuickNeck	34 mm (1.34 in)
Length of protection tube shaft T [1)]	Clamp DN12 according to ISO 2852	24 mm (0.94 in)
	Clamp DN25/DN40 according to ISO 2852	21 mm (0.83 in)
	Without process connection (only G3/8" thread), where necessary with compression fitting TK40	12 mm (0.47 in)
	Metal sealing system M12x1	46 mm (1.81 in)
	Metal sealing system G½"	60 mm (2.36 in)
	Cylindrical weld-in adapter Ø12 mm (0.47 in)	55 mm (2.17 in)
	Cylindrical weld-in adapter Ø30 mm (1.18 in)	55 mm (2.17 in)
	Spherical-cylindrical weld-in adapter	58 mm (2.28 in)

Item	Version	Length
	Spherical weld-in adapter	47 mm (1.85 in)
	Tri-clamp (0.5"-0.75")	24 mm (0.94 in)
	Microclamp (DN8-18)	23 mm (0.91 in)
	Sanitary connection DN25/DN32/DN40 according to DIN 11851	29 mm (1.14 in)
Immersion length U	Independent of the version	Variable, depending on the configuration
Bottom thickness B	Reduced tip Ø4.3 mm (0.17 in)	3 mm (0.12 in)

1) Variable, depending on the configuration

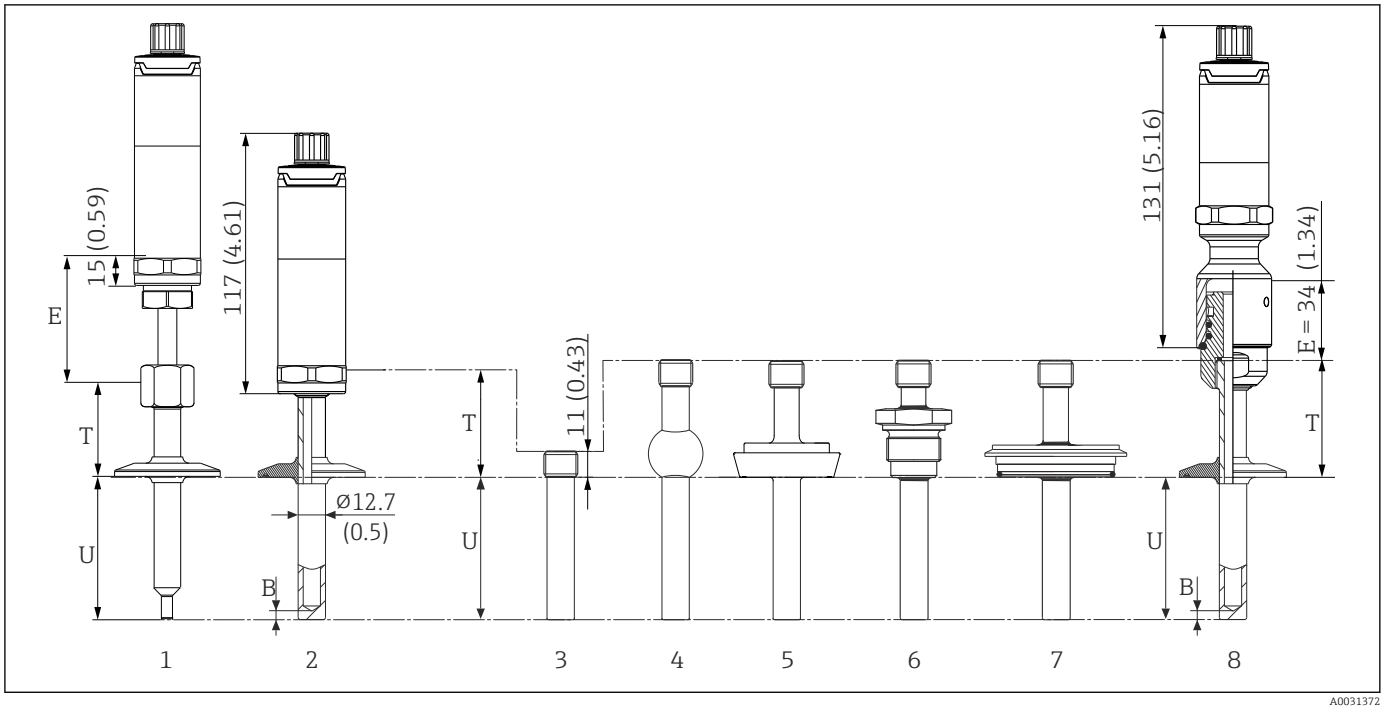
With protection tube diameter 9 mm (0.35 in)



1 Thermometer with extension neck, process connection as clamp version
2 Process connection version as cylindrical weld-in adapter Ø30 x 40 mm
3 Process connection version as spherical-cylindrical weld-in adapter Ø30 x 40 mm
4 Process connection version as spherical weld-in adapter Ø25 x mm
5 Process connection version as sanitary connection according to DIN 11851
6 Process connection version as aseptic pipe union according to DIN 11864-1 Form A
7 Process connection version as metal sealing system G½"
8 Process connection version as thread according to ISO 228 for Liquiphant weld-in adapter
9 Process connection version APV Inline
10 Process connection version Varivent®
11 Process connection version Ingold connection
12 Process connection to SMS 1147
13 Process connection version Neumo Biocontrol
14 Process adapter D45
15 Thermometer with quick-fastening iTHERM QuickNeck and process connection, as clamp version for example

Item	Version	Length
Extension neck E	No separate extension neck available	-
Length of protection tube shaft T	Without quick-fastening iTHERM QuickNeck independent of the process connection	85 mm (3.35 in)
	Without quick-fastening iTHERM QuickNeck in combination with Ingold connection Ø25 mm (0.98 in) x 46 mm (1.81 in)	100 mm (3.94 in)
	With quick-fastening iTHERM QuickNeck, depending on the process connection:	
	SMS 1147, DN25	40 mm (1.57 in)
	SMS 1147, DN38	41 mm (1.61 in)
	SMS 1147, DN51	42 mm (1.65 in)
	Varivent, type F, D = 50 mm (1.97 in) Varivent, type N, D = 68 mm (2.67 in)	52 mm (2.05 in)
	Varivent, type B, D = 31 mm (1.22 in)	56 mm (2.2 in)
	Thread G1" according to ISO 228 for Liquiphant weld-in adapter	77 mm (3.03 in)
	Spherical-cylindrical weld-in adapter	70 mm (2.76 in)
	Cylindrical weld-in adapter	67 mm (2.64 in)
	Aseptic pipe union according to DIN11864-A, DN25	45 mm (1.77 in)
	Aseptic pipe union according to DIN11864-A, DN40	
	Sanitary connection according to DIN 11851, DN32	47 mm (1.85 in)
	Sanitary connection according to DIN 11851, DN40	
	Sanitary connection according to DIN 11851, DN50	48 mm (1.89 in)
	Clamp according to ISO 2852, DN12	
	Clamp according to ISO 2852, DN25	37 mm (1.46 in)
	Clamp according to ISO 2852, DN40	39 mm (1.54 in)
	Clamp according to ISO 2852, DN63.5	
	Clamp according to ISO 2852, DN70	
	Microclamp (DN18)	47 mm (1.85 in)
	Tri-clamp (0.75")	46 mm (1.81 in)
	Ingold connection Ø25 mm (0.98 in) x 30 mm (1.18 in)	78 mm (3.07 in)
	Ingold connection Ø25 mm (0.98 in) x 46 mm (1.81 in)	94 mm (3.7 in)
	Metal sealing system G½"	77 mm (3.03 in)
	APV-Inline, DN50	51 mm (2.01 in)
Immersion length U	Independent of the version	Variable, depending on the configuration
Bottom thickness B	Reduced tip Ø5.3 mm (0.21 in)x 20 mm (0.79 in)	4 mm (0.16 in)
	Straight tip	2 mm (0.08 in)

With protection tube diameter 12.7 mm (½ in)

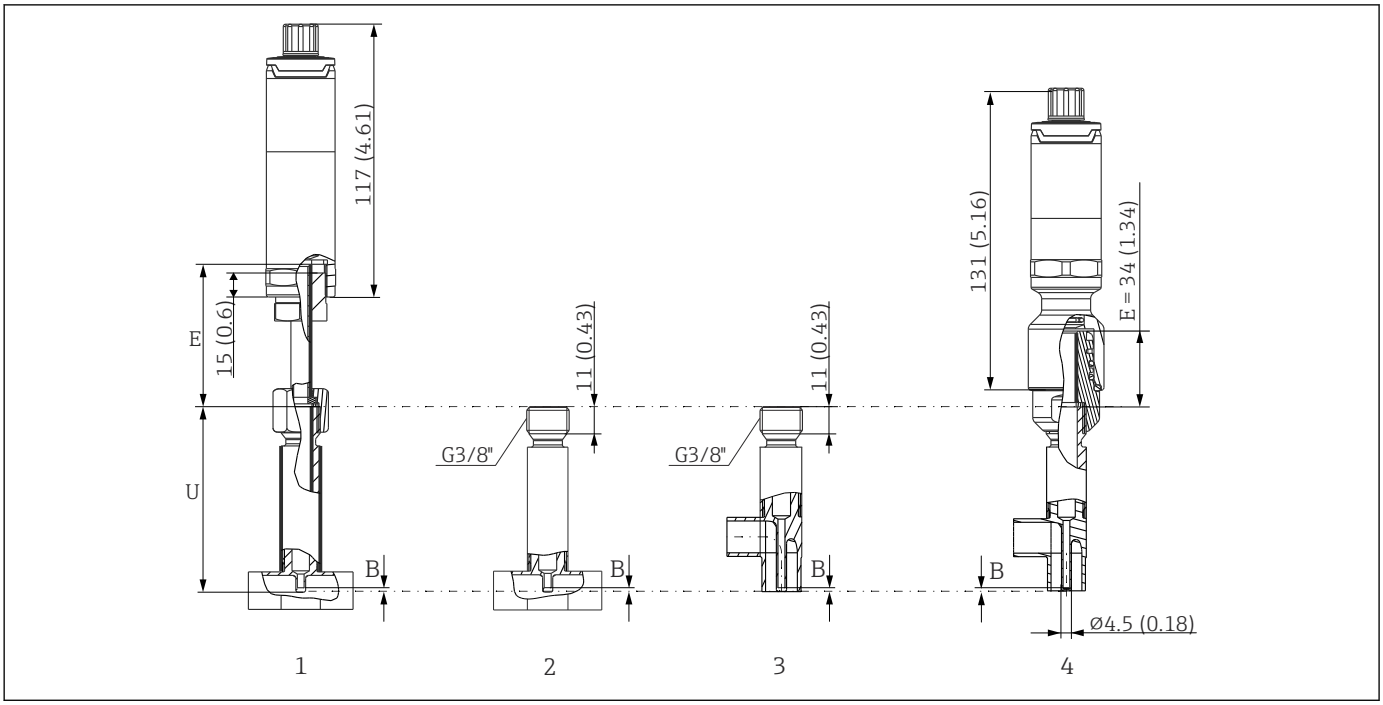


1 Thermometer with standard extension neck, thread and process connection as clamp version
2 Thermometer with extension neck and process connection as clamp version
3 Process connection version as cylindrical weld-in adapter Ø 12.7 mm (½ in)
4 Process connection version as spherical weld-in adapter Ø25 mm (1 in)
5 Process connection version as sanitary connection according to DIN 11851
6 Thread according to ISO 228 for Liquiphant weld-in adapter
7 Process connection version Varivent
8 Thermometer with quick-fastening iTHERM QuickNeck and process connection, as clamp version for example

- G3/8" thread for protection tube connection
- Protection tube made from solid bar stock drilled for L ≤ 200 mm (7.87 in)
- Welded protection tube for L > 200 mm (7.87 in)

Item	Version	Length
Extension neck E	Without extension neck	-
	Replaceable extension neck, Ø9 mm (0.35 in)	Variable, depending on the configuration
	iTHERM QuickNeck	34 mm (1.34 in)
Length of protection tube shaft T	Weld-in adapter, cylindrical, Ø12.7 mm (½ in)	12 mm (0.47 in)
	All other process connections	65 mm (2.56 in)
Immersion length U	Independent of the process connection	Variable, depending on the configuration
Bottom thickness B	Reduced tip Ø5.3 mm (0.21 in)x 20 mm (0.79 in)	2 mm (0.08 in)
	Reduced tip Ø8 mm (0.31 in)x 32 mm (1.26 in)	4 mm (0.16 in)
	Straight tip	6 mm (0.24 in)

With tee- or elbow thermowell version



1 Thermometer with extension neck and tee thermowell
2 Version with tee thermowell
3 Version with elbow thermowell
4 Thermometer with quick-fastening iTHERM QuickNeck and elbow thermowell

Item	Version	Length
Extension neck E	Without extension neck	-
	Replaceable extension neck, ø9 mm (0.35 in)	Variable, depending on the configuration
	iTHERM QuickNeck	34 mm (1.34 in) 71.05 mm (2.79 in)
Bottom thickness B	Independent of the version	0.7 mm (0.03 in)
Immersion length U	G3/8" connection QuickNeck connection	85 mm (3.35 in) 119 mm (4.7 in)

- Pipe sizes according to DIN11865 series A (DIN), B (ISO) and C (ASME BPE)
- Nominal diameters > DN25, with 3-A symbol
- IP69 protection class

- Material 1.4435+316L, Delta ferrite content <0.5%
- Temperature measurement range: −60 to +200 °C (−76 to +392 °F)
- Pressure range: PN25 according to DIN11865

As a general rule, the longer the immersion length U the better the accuracy. For small pipe diameters it is advisable to use elbow thermowells to enable a maximum immersion length U.

Suitable immersion lengths for the following thermometers with G3/8" thermometer connection:
- Easytemp TMR35: 83 mm (3.27 in)
- iTHERM TM411: 85 mm (3.35 in)
- iTHERM TM311: 85 mm (3.35 in)
- iTHERM TrustSens TM371: 85 mm (3.35 in)

Suitable immersion lengths for the following thermometers with iTHERM QuickNeck thermometer connection:
- Easytemp TMR35: 117 mm (4.6 in)
- iTHERM TM411: 119 mm (4.68 in)
- iTHERM TM311: 119 mm (4.68 in)
- iTHERM TrustSens TM371: 119 mm (4.68 in)

Weight

0.2 to 2.5 kg (0.44 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 (corresponds to 1.4404 or 1.4435)	X2CrNiMo17-13-2, X2CrNiMo18-14-3	650 °C (1202 °F) [1]	▪ Austenitic, stainless steel ▪ High corrosion resistance in general ▪ Particularly high corrosion resistance in chlorine-based and acidic, non-oxidizing atmospheres through the addition of molybdenum (e.g. phosphoric and sulfuric acids, acetic and tartaric acids with a low concentration) ▪ Increased resistance to intergranular corrosion and pitting ▪ The wetted part in a protective tube is made of 316L or 1.4435+316L passivated with 3% sulfuric acid.
1.4435+316L, delta ferrite < 1% or < 0.5%	With regard to analytical limits, the specifications of both materials (1.4435 and 316L) are met simultaneously. In addition, the delta ferrite content of the wetted parts is limited to <1% or <0.5% ≤3% at weldings (following Basel Standard II)		

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

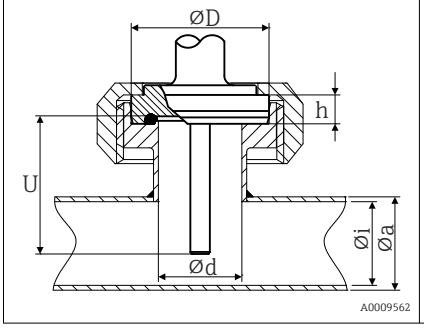
Values for process/product contact surfaces:

Standard surface, mechanically polished [1]	R_a ≤ 0.76 µm (30 µin)
Mechanically polished [1], buffed [2]	R_a ≤ 0.38 µm (15 µin)
Mechanically polished [1], buffed and electropolished	R_a ≤ 0.38 µm (15 µin)+ electropolished

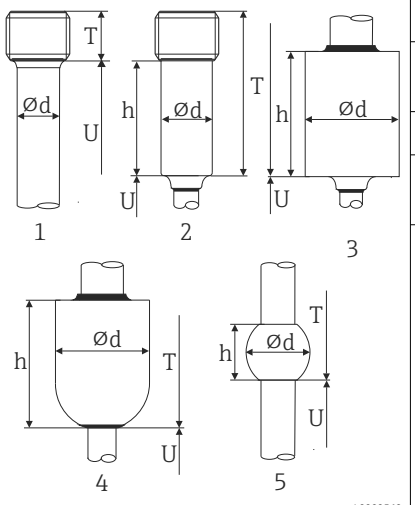
1) Or any other finishing method that meets the R_a max
2) Non-compliant with ASME BPE

Protection tube **Process connections**

All dimensions in mm (in).

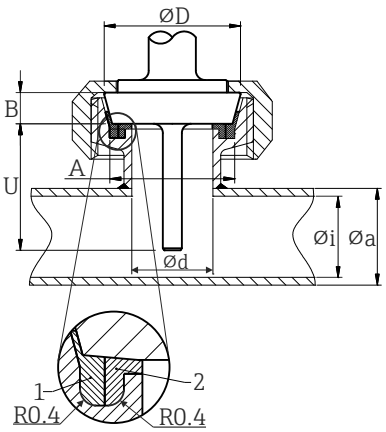
Type	Version	Dimensions					Technical properties
		Φd	ΦD	Φi	Φa	h	
Aseptic pipe union according to DIN 11864-1, Form A 	DN25	26 mm (1.02 in)	42.9 mm (1.7 in)	26 mm (1.02 in)	29 mm (1.14 in)	9 mm (0.35 in)	▪ $P_{max.}$ = 40 bar (580 psi) ▪ 3-A marked and EHEDG certified ▪ ASME BPE compliance
	DN40	38 mm (1.5 in)	54.9 mm (2.16 in)	38 mm (1.5 in)	41 mm (1.61 in)	10 mm (0.39 in)	

For welding in

Type	Version	Dimensions	Technical properties
Weld-in adapter 	1: Cylindrical [1]	Φd = 12.7 mm (½ in), U = immersion length from lower edge of thread, T = 12 mm (0.47 in)	▪ $P_{max.}$ depends on the weld-in process ▪ 3-A marked and EHEDG certified ▪ ASME BPE compliance
	2: Cylindrical [2]	Φd x h = 12 mm (0.47 in) x 40 mm (1.57 in), T = 55 mm (2.17 in)	
	3: Cylindrical	Φd x h = 30 mm (1.18 in) x 40 mm (1.57 in)	
	4: Spherical-cylindrical	Φd x h = 30 mm (1.18 in) x 40 mm (1.57 in)	
	5: Spherical	Φd = 25 mm (0.98 in) h = 24 mm (0.94 in)	

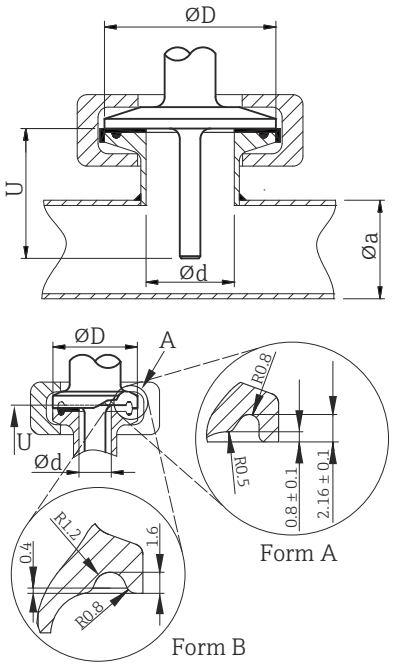
1) For protection pipe Φ12.7 mm (½ in)
2) For protection pipe Φ6 mm (¼ in)

Releasable process connection

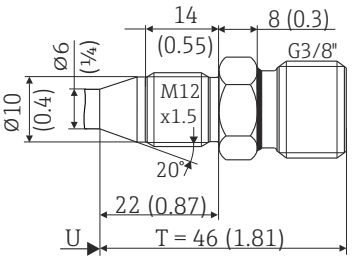
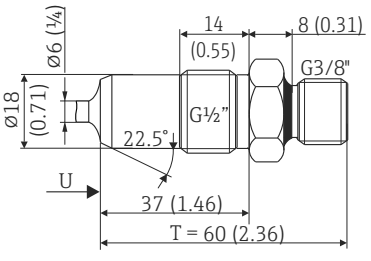
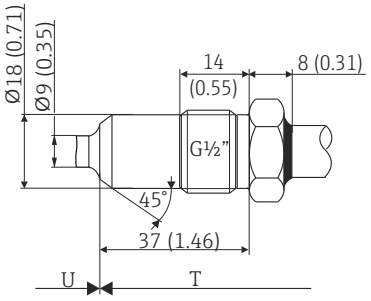
Type	Technical properties
Sanitary connection according to DIN 11851  A0009561 *1 Centering ring* *2 Sealing ring*	▪ 3-A marked and EHEDG certified (only with EHEDG-certified and self-centering sealing ring). ▪ ASME BPE compliance

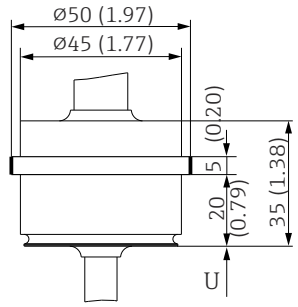
Version [1]	Dimensions					$P_{max.}$
	⌀D	A	B	⌀i	⌀a	
DN25	44 mm (1.73 in)	30 mm (1.18 in)	10 mm (0.39 in)	26 mm (1.02 in)	29 mm (1.14 in)	40 bar (580 psi)
DN32	50 mm (1.97 in)	36 mm (1.42 in)	10 mm (0.39 in)	32 mm (1.26 in)	35 mm (1.38 in)	40 bar (580 psi)
DN40	56 mm (2.2 in)	42 mm (1.65 in)	10 mm (0.39 in)	38 mm (1.5 in)	41 mm (1.61 in)	40 bar (580 psi)
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)

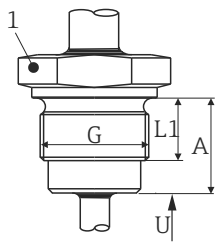
1) Pipes in accordance with DIN 11850

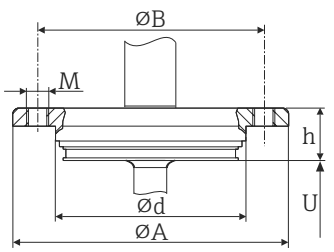
Type	Version	Dimensions		Technical properties	Conformity
	ϕd [1]	ϕD	ϕa		
Clamp according to ISO 2852  Form A: In compliance with ASME BPE Type A Form B: In compliance with ASME BPE Type B and ISO 2852	Microclamp [2] DN8-18 (0.5"-0.75") [3], Form A	25 mm (0.98 in)	-	▪ $P_{max.}$ = 16 bar (232 psi), depends on clamp ring and suitable seal ▪ 3-A marked	-
	Tri-clamp DN8-18 (0.5"-0.75") [3], Form B		-		Based on ISO 2852 [4]
	Clamp DN12-21.3, Form B	34 mm (1.34 in)	16 to 25.3 mm (0.63 to 0.99 in)		ISO 2852
	Clamp DN25-38 (1"-1.5"), Form B	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 ▪ 3-A marked and EHEDG certified (in connection with Combifit seal) ▪ Can be used with "Novaseptic Connect (NA Connect)" which enables flush-mount installation	ASME BPE Type B; ISO 2852
	Clamp DN40-51 (2"), Form B	64 mm (2.52 in)	44.8 to 55.8 mm (1.76 to 2.2 in)		ASME BPE Type B; ISO 2852
	Clamp DN63.5 (2.5"), Form B	77.5 mm (3.05 in)	68.9 to 75.8 mm (2.71 to 2.98 in)		ASME BPE Type B; ISO 2852
	Clamp DN70-76.5 (3"), Form B	91 mm (3.58 in)	> 75.8 mm (2.98 in)		ASME BPE Type B; ISO 2852

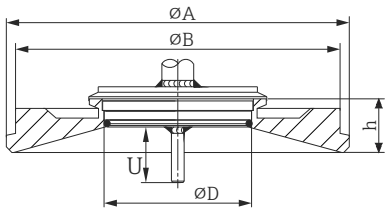
1) Pipes in accordance with ISO 2037 and BS 4825 Part 1
2) Microclamp (not in ISO 2852); no standard pipes
3) DN8 (0.5") only possible with protection pipe diameter = 6 mm (¼ in)
4) Groove diameter = 20 mm

Type		Version	Technical properties
Metal sealing system		Protection pipe diameter 6 mm (¼ in)	$P_{max.}$ = 16 bar (232 psi) Maximum torque = 10 Nm (7.38 lbf ft)
M12x1.5	**G½"**		
			
-		Protection pipe diameter 9 mm (0.35 in)	$P_{max.}$ = 16 bar (232 psi) Maximum torque = 10 Nm (7.38 lbf ft)

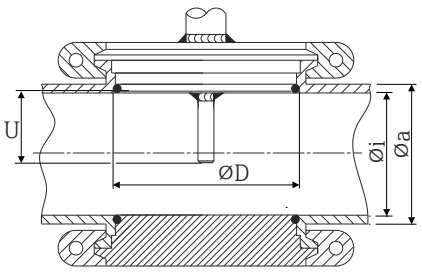
Type	Version	Technical properties
Process adapter 	D45	-

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 FTL20/31/33 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) ▪ Information about hygienic compliance in connection with FTL31/33/50 adapter see TI00426F
	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	M	h	
APV Inline 	DN50	69 mm (2.72 in)	99.5 mm (3.92 in)	82 mm (3.23 in)	2xM8	19 mm (0.75 in)	▪ $P_{max.}$ = 25 bar (362 psi) ▪ 3-A marked and EHEDG certified ▪ ASME BPE compliance

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)	▪ 3-A marked and EHEDG certified ▪ 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 N	68 mm (2.67 in)	165 mm (6.5 in)	155 mm (6.1 in)	24.5 mm (0.96 in)		

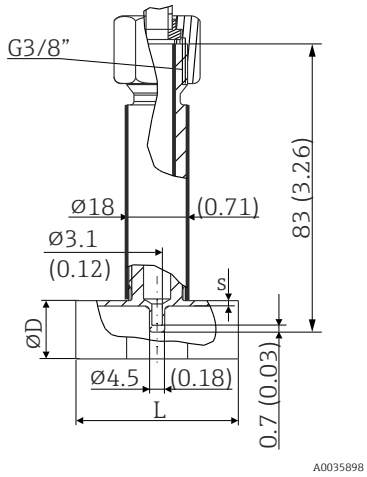
The VARINLINE® housing connection flange is suitable for welding into the conical or torispherical head in tanks or containers with a small diameter (≤ 1.6 m (5.25 ft)) and up to a wall thickness of 8 mm (0.31 in).

Type	Technical properties
Varivent® for VARINLINE® housing for installation in pipes 	▪ 3-A marked and EHEDG certified ▪ ASME BPE compliance

Version	Dimensions			$P_{max.}$
	ϕD	ϕi	ϕa	
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: 81 mm (3.2 in)	DN80: 85 mm (3.35 in)	DN80 to DN150: 10 bar (145 psi)
		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)	

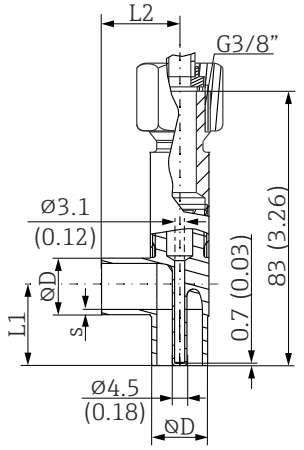
Type				Technical properties
		56.3 mm (2.22 in)	60.3 mm (2.37 in)	
		72.1 mm (2.84 in)	76.1 mm (3 in)	76.1 mm (3 in) to 114.3 mm (4.5 in): 10 bar (145 psi)
		82.9 mm (3.26 in)	42.4 mm (3.5 in)	
		108.3 mm (4.26 in)	114.3 mm (4.5 in)	
Type N, according to DIN 11866, series C	68 mm (2.67 in)	OD 1½": 34.9 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)	
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)	

T-piece, optimized (no welding, no dead legs)

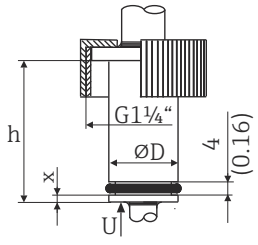
Type	Version		Dimensions in mm (in)			Technical properties
			ØD	L	s [1]	
T-piece for weld-in as per DIN 11865 (series A, B and C) 	Series A	DN10 PN25	13 mm (0.51 in)	48 mm (1.89 in)	1.5 mm (0.06 in)	▪ $P_{max.}$ = 25 bar (362 psi) ▪ 3-A marked [2] and EHEDG certified [2] ▪ ASME BPE compliance [2]
		DN15 PN25	19 mm (0.75 in)			
		DN20 PN25	23 mm (0.91 in)			
		DN25 PN25	29 mm (1.14 in)			
		DN32 PN25	32 mm (1.26 in)			
	Series B	DN13.5 PN25	13.5 mm (0.53 in)		1.6 mm (0.063 in)	
		DN17.2 PN25	17.2 mm (0.68 in)			
		DN21.3 PN25	21.3 mm (0.84 in)			
		DN26.9 PN25	26.9 mm (1.06 in)			
		DN33.7 PN25	33.7 mm (1.33 in)		2 mm (0.08 in)	
	Series C	DN12.7 PN25 (½")	12.7 mm (0.5 in)		1.65 mm (0.065 in)	
		DN19.05 PN25 (¾")	19.05 mm (0.75 in)			
		DN25.4 PN25 (1")	25.4 mm (1 in)			
		DN38.1 PN25 (1½")	38.1 mm (1.5 in)			

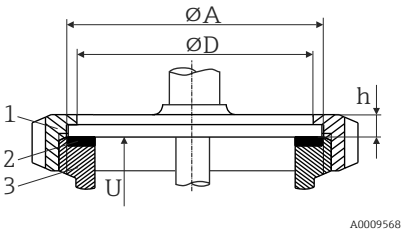
1) Wall thickness
2) Applies to ≥ DN25. The radius ≥ 3.2 mm (⅛ in) cannot be maintained for smaller nominal diameters.

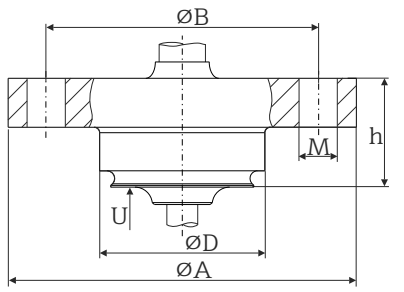
Elbow piece, optimized (no welding, no dead legs)

Type	Version		Dimensions				Technical properties
			⌀D	L1	L2	s [1]	
Elbow piece for weld-in as per DIN 11865 (series A, B and C) 	Series A	DN10 PN25	13 mm (0.51 in)	24 mm (0.95 in)		1.5 mm (0.06 in)	▪ $P_{max.}$ = 25 bar (362 psi) ▪ 3-A marked [2] and EHEDG certified [2] ▪ ASME BPE compliance [2]
		DN15 PN25	19 mm (0.75 in)	25 mm (0.98 in)			
		DN20 PN25	23 mm (0.91 in)	27 mm (1.06 in)			
		DN25 PN25	29 mm (1.14 in)	30 mm (1.18 in)			
		DN32 PN25	35 mm (1.38 in)	33 mm (1.3 in)			
	Series B	DN13.5 PN25	13.5 mm (0.53 in)	32 mm (1.26 in)		1.6 mm (0.063 in)	
		DN17.2 PN25	17.2 mm (0.68 in)	34 mm (1.34 in)			
		DN21.3 PN25	21.3 mm (0.84 in)	36 mm (1.41 in)			
		DN26.9 PN25	26.9 mm (1.06 in)	29 mm (1.14 in)			
		DN33.7 PN25	33.7 mm (1.33 in)	32 mm (1.26 in)		2.0 mm (0.08 in)	
	Series C	DN12.7 PN25 (½")	12.7 mm (0.5 in)	24 mm (0.95 in)		1.65 mm (0.065 in)	
		DN19.05 PN25 (¾")	19.05 mm (0.75 in)	25 mm (0.98 in)			
		DN25.4 PN25 (1")	25.4 mm (1 in)	28 mm (1.1 in)			
		DN38.1 PN25 (1½")	38.1 mm (1.5 in)	35 mm (1.38 in)			

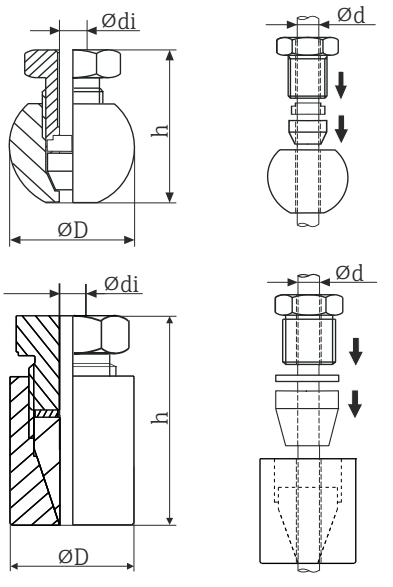
1) Wall thickness
2) Applies to ≥ DN25. The radius ≥ 3.2 mm (⅛ in) cannot be maintained for smaller nominal diameters.

Type	Version, dimensions ⌀D x h	Technical properties
Ingold connection 	⌀25 mm (0.98 in) x 30 mm (1.18 in) x = 1.5 mm (0.06 in)	$P_{max.}$ = 25 bar (362 psi) A seal is included in the scope of delivery. V75SR material: Complies with FDA, 3-A Sanitary Standard 18-03 Class 1 and USP Class VI
	⌀25 mm (0.98 in) x 46 mm (1.81 in) x = 6 mm (0.24 in)	

Type	Version	Dimensions			Technical properties
		ϕD	ϕA	h	
SMS 1147  *1 Coupling nut* *2 Sealing ring* *3 Counterpart connection*	DN25	32 mm (1.26 in)	35.5 mm (1.4 in)	7 mm (0.28 in)	$P_{max.}$ = 6 bar (87 psi)
	DN38	48 mm (1.89 in)	55 mm (2.17 in)	8 mm (0.31 in)	
	DN51	60 mm (2.36 in)	65 mm (2.56 in)	9 mm (0.35 in)	
The counterpart connection must fit the sealing ring and fix it in place.					

Type	Version	Dimensions					Technical properties
		ϕA	ϕB	ϕD	ϕd	h	
Neumo Biocontrol  	D25 PN16	64 mm (2.52 in)	50 mm (1.97 in)	30.4 mm (1.2 in)	7 mm (0.28 in)	20 mm (0.79 in)	▪ $P_{max.}$ = 16 bar (232 psi) ▪ 3-A marked
	D50 PN16	90 mm (3.54 in)	70 mm (2.76 in)	49.9 mm (1.97 in)	9 mm (0.35 in)	27 mm (1.06 in)	
	D65 PN25	120 mm (4.72 in)	95 mm (3.74 in)	67.9 mm (2.67 in)	11 mm (0.43 in)		

Compression fitting

Type	Version	Dimensions			Technical properties [1]
	Spherical or cylindrical	Φdi	ΦD	h	
Compression fitting TK40 for weld-in 	Spherical Material of sealing taper PEEK or 316L Thread G¼"	6.3 mm (0.25 in) [2]	25 mm (0.98 in)	33 mm (1.3 in)	▪ $P_{max.}$ = 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 compression fitting is EHEDG tested, 3-A marked
	Cylindrical Material of sealing taper ELASTOSIL® Thread G½"	6.2 mm (0.24 in) [2] 9.2 mm (0.36 in)	30 mm (1.18 in)	57 mm (2.24 in)	▪ $P_{max.}$ = 10 bar (145 psi) ▪ $T_{max.}$ for ELASTOSIL® sealing taper = +200 °C (+392 °F), tightening torque = 5 Nm ▪ The Elastosil® compression fitting is EHEDG tested and 3-A marked

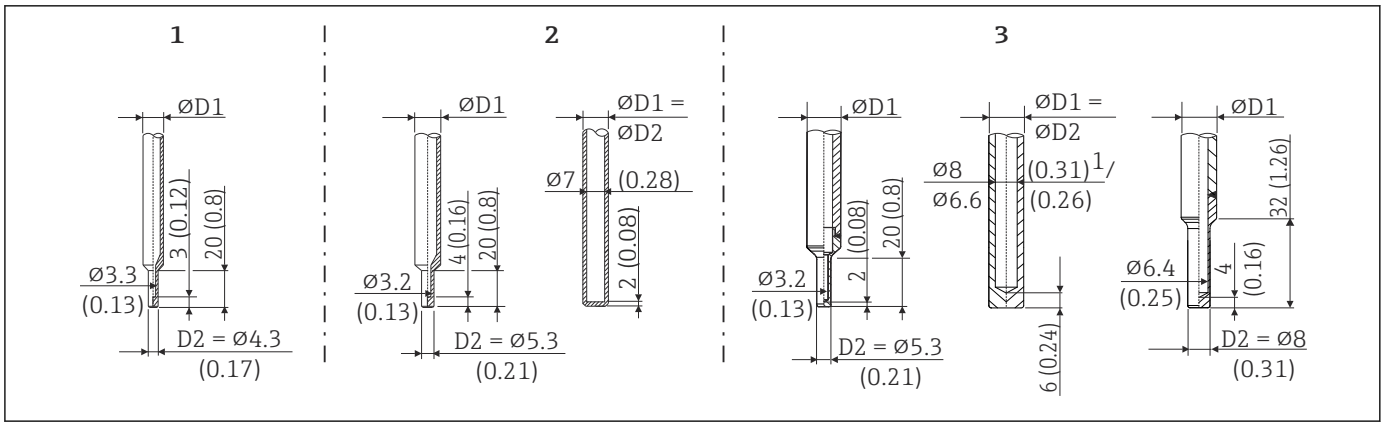
1) All the pressure specifications apply for cyclic temperature load
2) For insert or protection pipe diameter Ød = 6 mm (0.236 in).

The 316L compression fittings can only be used once due to deformation. This applies to all the components of the compression fittings! A replacement compression fitting must be attached in a different position (grooves in the protection pipe). PEEK compression fittings must never be used at a temperature that is lower than the temperature present when the compression fitting is secured. This is because the fitting would no longer be leak-tight as a result of heat contraction of the PEEK material.

SWAGELOCK or similar fittings are strongly recommended for higher requirements.

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 or tapered 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 thermowell.
- Endress+Hauser offers users a range of thermowell tips to meet every requirement:
  - Reduced tip with Ø4.3 mm (0.17 in) and Ø5.3 mm (0.21 in): walls of lower thickness significantly reduce the response times of the overall measuring point.
  - Reduced tip with Ø8 mm (0.31 in): walls of greater thickness are particularly well suited to applications with a higher degree of mechanical load or wear (e.g. pitting, abrasion etc.).



9 Thermowell tips available (reduced, straight or tapered)

Item No.	Thermowell (ØD1)		Insert (ØID)
1	Ø6 mm (¼ in)	Reduced tip	Ø3 mm (⅛ in)
2	Ø9 mm (0.35 in)	▪ Reduced tip with Ø5.3 mm (0.21 in) ▪ Straight tip	▪ Ø3 mm (⅛ in) ▪ Ø6 mm (¼ in) ▪ Ø3 mm (⅛ in)
3	Ø12.7 mm (½ in)	▪ Reduced tip with Ø5.3 mm (0.21 in) ▪ Straight tip ▪ Reduced tip with Ø8 mm (0.31 in)	▪ Ø3 mm (⅛ in) ▪ Ø6 mm (¼ in) ▪ Ø6 mm (¼ 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 thermowells in the Endress+Hauser Applicator software. See "Accessories" section.

Operability

Operating concept

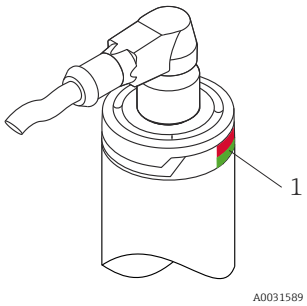
The configuration of device-specific parameters is done via the HART protocol or CDI interface (= Endress+Hauser Common Data Interface). There are specific configuration or operating programs from different manufacturers available to the user for this purpose. Both the DD (Device Description) as well as the DTM (Device Type Manager) files are being provided for the iTHERM TrustSens thermometers.

Self-calibration

A self-calibration certificate similar to laboratory calibration can be created with a DTM and can be printed on demand. The necessary measurement data is stored in the device and can be requested by the DTM.

Local operation

LED signals

Position	LEDs	Function description
 *1 LED for device status indication*	LED green (gn) is illuminated	Voltage supply is correct. The device is operational and the set limit values are met.
	LED green (gn) is flashing	With a frequency 1 Hz: self-calibration currently being performed. With a frequency 5 Hz for 5 s: self-calibration finished and valid, all process criteria were within specifications. Calibration data stored.
	LED red (rd) and green (gn) are flashing alternating	Self-calibration process finished but not valid, violation of necessary process criteria. Calibration data not stored.
	LED red (rd) is flashing	Presence of a diagnostic event: "Warning"
	LED red (rd) is illuminated	Presence of a diagnostic event: "Alarm"

Operating elements

To prevent manipulation, no operating elements are present directly on the device. The thermometer is configured only by remote operation.

Remote operation

Configuration

Configuration kits, e. g. Commubox FXA195 or TXU10, for PC-programmable thermometer with setup software and interface for PC with USB port.

HART® functions and device-specific parameters are configured by HART® communication or via the interface of the device. There are special configuration tools like FieldCare or DeviceCare by Endress +Hauser. For more information, contact your Endress+Hauser sales representative.

Operating tools

Operating tool	Sources for obtaining the required device descriptions (DD) or device type manager (DTM)
FieldCare (Endress+Hauser)	▪ www.endress.com → Download Area → Software ▪ DVD (contact Endress+Hauser)
DeviceCare (Endress+Hauser)	www.endress.com → Download Area → Software
FieldXpert SFX350, SFX370 (Endress+Hauser)	Use update function of handheld terminal

Certificates and approvals

Current certificates and approvals that are available for the product can be selected via the Product Configurator at www.endress.com:

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

Hygiene standard

- EHEDG certification, type EL CLASS I. EHEDG certified/tested process connections.
- 3-A authorization no. 1144, 3-A Sanitary Standard 74-07. Listed process connections.
- ASME BPE, certificate of conformity can be ordered for indicated options
- FDA-compliant
- All surfaces in contact with the medium are free of animal derived ingredients (ADI/TSE) and do not contain any materials derived from bovine or animal sources.

Materials in contact with food/product (FCM)

The materials of the thermometer in contact with food/product (FCM) 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.
- (EU) No. 10/2011 on plastic materials and articles intended to come into contact with food.

CRN approval

The CRN approval is only available for certain thermowell versions. These versions are identified and displayed accordingly during the configuration of the device.

Detailed ordering information is available for your nearest sales organization www.addresses.endress.com or in the Download Area under www.endress.com :

1. Select the country
2. Select Downloads
3. In the search area: select Approvals/approval type
4. Enter the product code or device
5. Start the search

Surface cleanliness

- Free from oil and grease for O_2 applications, optional
- PWIS-free (PWIS = paint-wetting impairment substances as per DIL0301), 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.

Ordering information

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

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

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

Application packages

Heartbeat Diagnostics

Available in all device versions.

Function
- Continuous self-monitoring of the device
- Diagnostic messages output to:
  - the local display
  - an asset management system (e.g. FieldCare/DeviceCare)
  - an automation system (e.g. PLC)

Advantages
- Device condition information is available immediately and processed in time.
- The status signals are classified in accordance with VDI/VDE 2650 and NAMUR recommendation NE 107 and contain information about the cause of the error and remedial action.

For detailed information on Heartbeat functions, see the Operating Instructions

Heartbeat Verification

Available in all device versions.

Device functionality checked on demand
- Verification of the correct functioning of the measuring device within specifications
- The verification result provides information about the condition of the device: "Passed" or "Failed"
- The results are documented in a verification report
- The automatically generated report supports the obligation to demonstrate compliance with internal and external regulations, laws and standards
- Verification is possible without interrupting the process

Advantages
- No onsite presence is required to use the function
- The DTM [1] triggers verification in the device and interprets the results. No specific knowledge is required on the part of the user.
- The verification report can be used to prove quality measures to a third party.
- Heartbeat Verification can replace other maintenance tasks (e.g. periodic check) or extend the test intervals.

For detailed information on Heartbeat functions, see the Operating Instructions

Heartbeat Monitoring

Available in all device versions.

Function
Calibration information is logged in addition to the verification parameters. 350 calibration points are saved in the device (FIFO memory).

Advantages
- Early detection of changes (trends) to ensure plant availability and product quality.
- Use of information for the proactive planning of measures (e.g. maintenance).

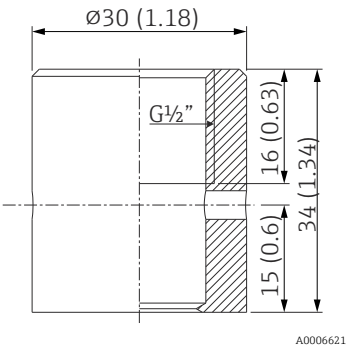
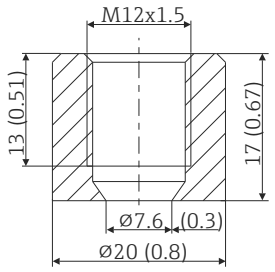
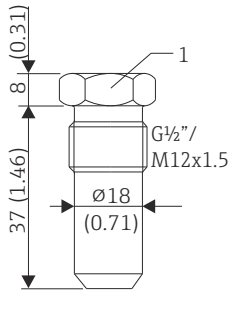
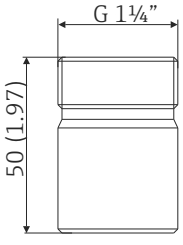
For detailed information on Heartbeat functions, see the Operating Instructions

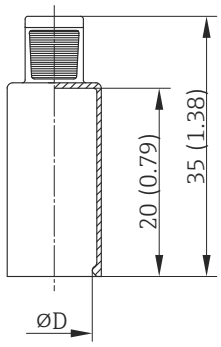
Accessories

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.

1) Device Type Manager: controls device operation via DeviceCare, FieldCare or a DTM-based process control system.

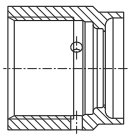
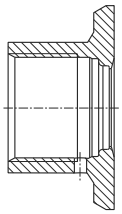
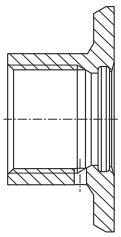
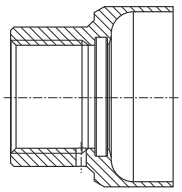
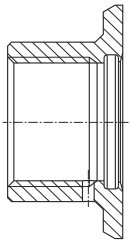
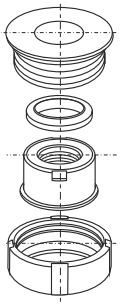
Device-specific accessories Device-specific accessories

Accessories	Description
Welding boss with sealing taper (metal - metal)  	Welding boss for G½" and M12x1.5 thread Metal-sealing; conical Material of wetted parts: 316L/1.4435 Max. process pressure 16 bar (232 PSI) **Order number:** ▪ 71424800 (G½") ▪ 71405560 (M12x1.5)
Dummy plug  *1 Size across flats SW22*	Dummy plug for G½" or M12x1.5 conical metal-sealing welding boss Material: SS 316L/1.4435 **Order number:** ▪ 60022519 (G½") ▪ 60021194 (M12x1.5)
Weld-in adapter for Ingold process connection (OD 25 mm (0.98 in) x 46 mm (1.81 in) 	Material of wetted parts: 316L/1.4435 Weight: 0.32 kg (0.7 lb) Order numbers: ▪ 71531585 - with 3.1 material certificate ▪ 71531588 O-ring seal set ▪ Silicone O-ring in accordance with FDA CFR 21 ▪ Maximum temperature: 230 °C (446 °F) ▪ **Order number:** 60018911

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

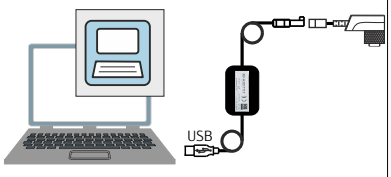
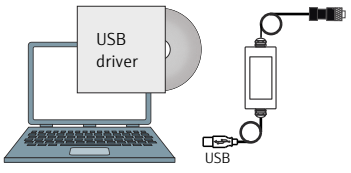
Weld-in adapter

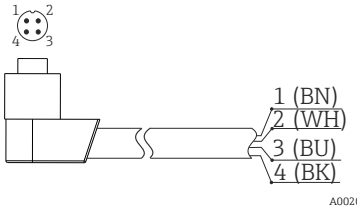
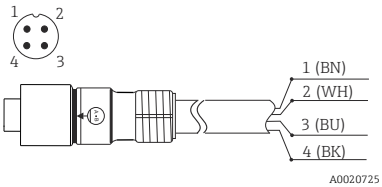
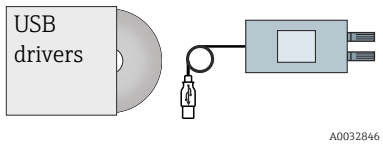
For more information about order codes and hygienic compliance of the adapters and spare parts, see Technical Information (TI00426F).

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)

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)

Communication-specific accessories

Configuration kit TXU10  A0028635	Configuration kit for CDI communication with PC-programmable devices. Includes interface cable for PC with USB port and M12x1 coupling (Non-Ex area). Order code: TXU10-BD
Commubox FXA291  A0034600	Connects Endress+Hauser field devices with a CDI interface (= Endress+Hauser Common Data Interface) and the USB port of a computer or laptop (Non-Ex area and Ex area). For details, see Technical Information TI00405C

Cordset M12x1, angle plug 	PVC cable, 4 x 0.34 mm² (22 AWG) with M12x1 coupling; angle plug; screw plug; length 5 m (16.4 ft); IP69K Order number: 71387767 Core colours: ▪ 1 = BN brown (+) ▪ 2 = WH white (nc) ▪ 3 = BU blue (-) ▪ 4 = BK black (nc)
Cordset M12x1, straight 	PVC cable, 4 x 0.34 mm² (22 AWG) with M12x1 coupling nut made of epoxy coated zinc; straight female connector type; screw plug; length 5 m (16.4 ft); IP69K Order number: 71217708 Core colors: ▪ 1 = BN brown (+) ▪ 2 = WH white (nc) ▪ 3 = BU blue (-) ▪ 4 = BK black (nc)
Commubox FXA195 HART 	For intrinsically safe HART communication with FieldCare via the USB interface. For details, see Technical Information TI00404F
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
Field Xpert SMT70	The Field Xpert SMT70 tablet PC for device configuration enables mobile plant asset management in hazardous (Ex Zone 2) and non-hazardous areas. It is suitable for commissioning and maintenance staff 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

Accessories	Description
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 at: 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.

Accessories	Description
W@M	Life cycle management for your plant W@M offers assistance 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 information is available for every measuring device over the entire life cycle, such as the device status, device-specific documentation, spare parts etc. 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
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

Advanced Data Manager Memograph M	The Advanced Data Manager Memograph M is a flexible and powerful system for organizing process values. The measured process values are clearly presented on the display and logged safely, monitored for limit values and analyzed. Via common communication protocols, the measured and calculated values can be easily communicated to higher-level systems or individual plant modules can be interconnected. For details, see Technical Information TI01180R/09
RN42	1-channel active barrier with wide range power supply for the safe separation of 0/4 to 20 mA standard signal circuits, HART-transparent For details, see Technical Information TI01584K
RNS221	Supply unit for powering two 2-wire measuring devices in the non-Ex area. Bidirectional communication is possible via the HART communication jacks. For details, see Technical Information TI00081R

Supplementary documentation

The following document types are available in the Downloads section of the Endress+Hauser website (www.endress.com/downloads):

For an overview of the scope of the associated Technical Documentation, refer to the following:
- *W@M Device Viewer* (www.endress.com/deviceviewer): Enter the serial number from the nameplate
- *Endress+Hauser Operations App*: Enter the serial number from the nameplate or scan the matrix code on the nameplate

Brief Operating Instructions (KA)

Guide that takes you quickly to the 1st measured value
The Brief Operating Instructions contain all the essential information from incoming acceptance to initial commissioning.

Operating Instructions (BA)	**Your reference guide** These Operating Instructions contain all the information that is required in various phases of the life cycle of the device: from product identification, incoming acceptance and storage, to mounting, connection, operation and commissioning through to troubleshooting, maintenance and disposal.
Safety Instructions (XA)	Depending on the approval, the following Safety Instructions (XA) are supplied with the device. They are an integral part of the Operating Instructions. The nameplate indicates the Safety Instructions (XA) that are relevant to the device.
Functional Safety Manual (FY/SD)	Depending on the SIL approval, the Functional Safety Manual (FY/SD) is an integral part of the Operating Instructions and applies in addition to the Operating Instructions, Technical Information and ATEX Safety Instructions. The different requirements that apply for the protective function are described in the Functional Safety Manual (FY / SD).

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