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Technical Information
iTHERM
MultiSens Flex TMS01

Modular TC or RTD multipoint thermometer for direct contact with the medium for oil & gas and petrochemical applications

Application

- User-friendly thermometer in modular and flexible design. For installation with a flanged process connection in a vessel, reactor or tank with direct medium contact or in an existing thermowell.
- Measuring range:
  - RTD insert (resistance thermometer): −200 to 600 °C (−328 to 1 112 °F)
  - Thermocouple (TC): −40 to 1 150 °C (−40 to 2 102 °F)
- Static pressure range: Up to 100 bar (1 450 psi). Specific maximum process pressure achievable depending on thermometer design and process temperature.
- Degree of protection: IP66/67

Head transmitter

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

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

Your benefits

- Infinite possibilities for the 3D arrangement of sensors to monitor any process.
- High density of measuring points possible if ProfileSens sensors are used.
- High degree of customization thanks to modular product design for easy installation, process integration and maintenance.
- Compliance with different types of protection for use in explosive atmospheres to enable comprehensive and easy process integration.
- Option to replace the sensing elements.
- SIL certification as per IEC 61508:2010.

Endress+Hauser
People for Process Automation

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Measuring principle

Thermocouples (TC)

Thermocouples are comparatively simple, robust temperature sensors which use the Seebeck effect for temperature measurement: if two electrical conductors made of different materials are connected at a point, a weak electrical voltage can be measured between the two open conductor ends if the conductors are subjected to a thermal gradient. This voltage is called thermoelectric voltage or electromotive force (emf.). Its magnitude depends on the type of conducting materials and the temperature difference between the "measuring point" (the junction of the two conductors) and the "cold junction" (the open conductor ends). Accordingly, thermocouples primarily only measure differences in temperature. The absolute temperature at the measuring point can be determined from these if the associated temperature at the cold junction is known or is measured separately and compensated for. The material combinations and associated thermoelectric voltage/temperature characteristics of the most common types of thermocouple are standardized in the IEC 60584 and ASTM E230/ANSI MC96.1 standards.

Resistance thermometers (RTD)

Resistance thermometers use a Pt100 temperature sensor in accordance with IEC 60751. This temperature sensor is a temperature-sensitive platinum resistor with a resistance of 100 Ω at 0 °C (32 °F) and a temperature coefficient α = 0.003851 °C-1.

There are generally two different kinds of platinum resistance thermometers:

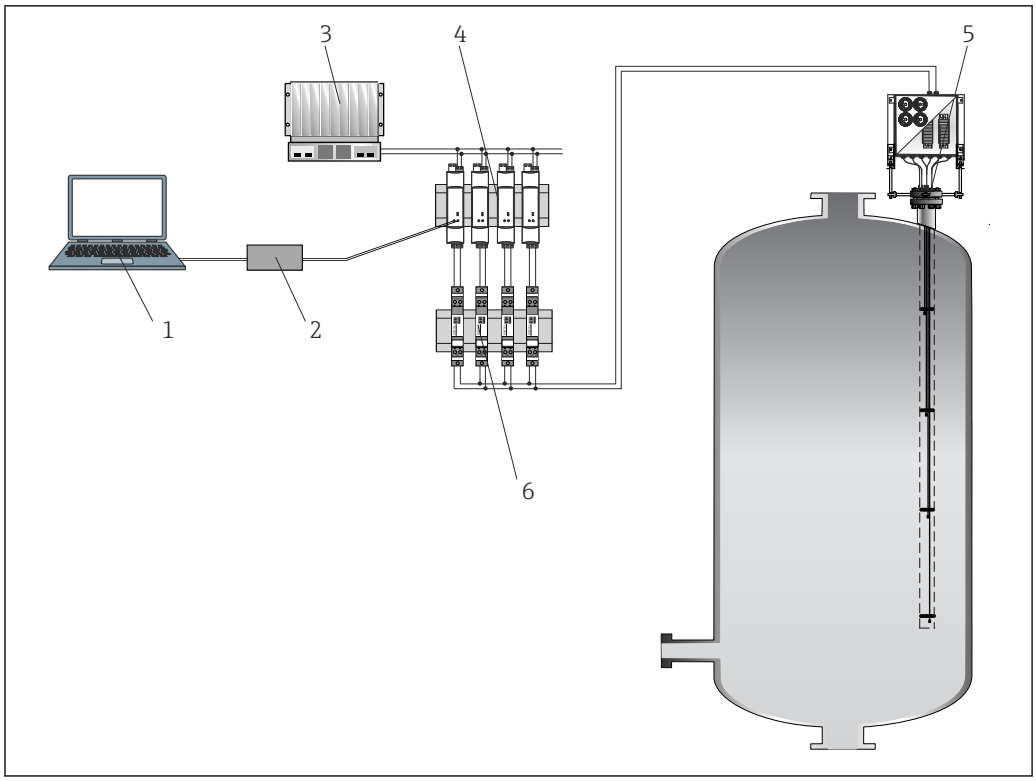
- **Wire-wound (WW):** In these thermometers, a double coil of fine, high-purity platinum wire is located in a ceramic support. This support is then sealed top and bottom with a ceramic protective layer. Such resistance thermometers not only facilitate very reproducible measurements but also offer good long-term stability of the resistance/temperature characteristic within temperature ranges up to 600 °C (1 112 °F). This type of sensor is relatively large in size and is comparatively sensitive to vibrations.
- **Thin-film platinum resistance thermometers (TF):** A very thin, ultrapure platinum layer, approx. 1 µm thick, is vaporized in a vacuum on a ceramic substrate and then structured photolithographically. The platinum conductor paths formed in this way create the measuring resistance. Additional covering and passivation layers are applied and reliably protect the thin platinum layer from contamination and oxidation, even at high temperatures. The primary advantages of thin film temperature sensors over wire wound versions are their smaller sizes and better vibration resistance. A relatively low principle-based deviation of the resistance/temperature characteristic from the standard characteristic of IEC 60751 can frequently be observed among TF sensors at high temperatures. As a result, the tight limit values of tolerance class A as per IEC 60751 can only be observed with TF sensors at temperatures up to approx. 300 °C (572 °F). For this reason, thin-film sensors are generally only used for temperature measurements in ranges below 400 °C (752 °F).

Measuring system

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

These include:
- Power supply unit/active barrier
- Configuration units
- Overvoltage protection

For more information, see the brochure 'System Components - Solutions for a Complete Measuring Point' (FA00016K/09)



1 *Application example in a reactor, mounted multipoint thermometer in a thermowell available on site with four measurement points and four built-in transmitters or terminal blocks.*

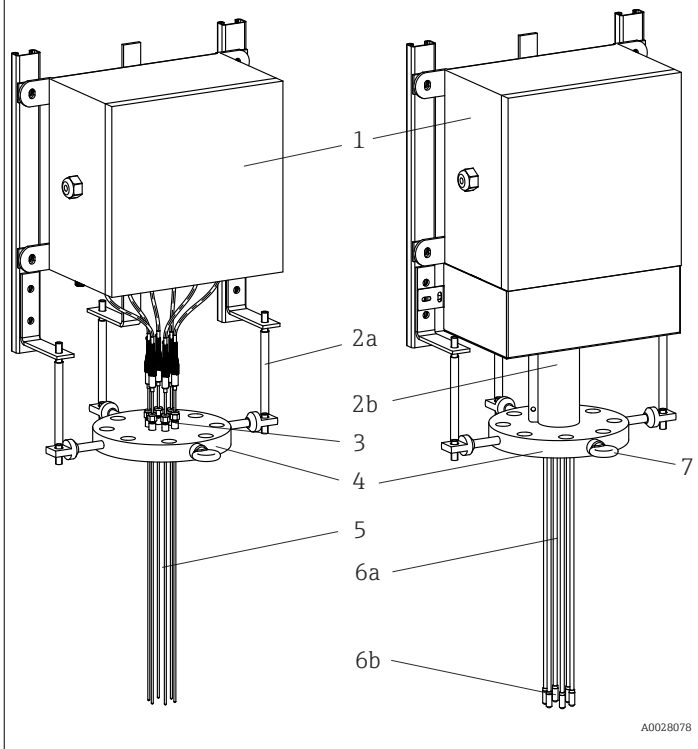
1 *Device configuration with application software FieldCare*
2 *Commubox*
3 *PLC*
4 *Active barrier of the RN series (24 V_{DC}, 30 mA) with galvanically isolated output for the power supply of loop-powered transmitters. The universal power supply works with an input supply voltage of 20 to 250 V DC/AC; 50/60 Hz, which means that it can be used in all international power grids.*
5 *Mounted multipoint thermometer in a thermowell available on site, optionally with built-in transmitters in the junction box for 4 to 20 mA, HART, PROFIBUS® PA and FOUNDATION Fieldbus™ communication or with terminal blocks for remote wiring.*
6 *Overvoltage protection devices from the HAW product family for protection of signal lines and components in hazardous areas, e.g. 4 to 20 mA, PROFIBUS® PA and FOUNDATION Fieldbus™ signal lines. More information can be found in the associated Technical Information.*

Equipment architecture

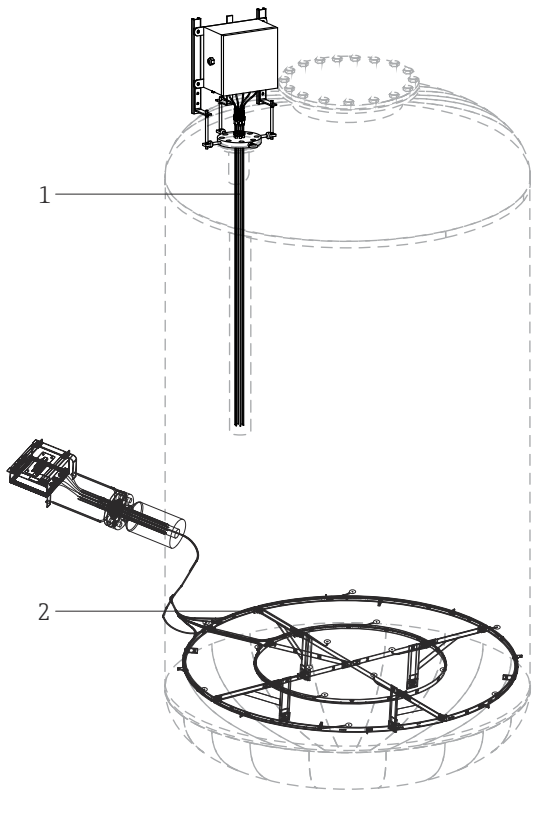
The multipoint thermometer belongs to a series of modular products for multiple temperature measurements. The design enables the individual replacement of subassemblies and components, making maintenance and spare parts management easier.

It consists of the following main sub-assemblies:
- **Single-point insert:** Consisting of a sensing element with metal sheathing (thermocouple or resistance thermometer), extension cable and bushing. If necessary, each insert can be handled as an individual spare part that can be replaced by releasing the compression fitting on the process connection. They can be ordered via specific standard product order codes (e.g. TSC310, TST310) or special codes. For the specific order code please contact the Endress+Hauser service department.
- **Multi-point insert:** Consisting of a number of independent thermocouple cables with metal sheathing in a probe, each of which is fitted with a potting seal and the relevant extension cable, resulting in a double-sealed design (Endress+Hauser ProfileSens).
- **Process connection:** An ASME or EN flange; it can be supplied with eyebolts for lifting the device.
- **Head:** It is composed of a junction box provided with its components such as cable glands, draining valves, earth screws, terminals, head transmitters, etc.
- **Neck:** It is designed to support the junction box by components such as supporting rods and plates or tube extension.
- **Additional accessories:** Components that can be ordered independently of the selected product configuration, e.g. clips, weld-on plates or blocks, sealing sleeves, spacers and labels for sensor measuring point identification.
- **Thermowells:** They are directly welded on the process connection and designed to guarantee a higher degree of mechanical protection and corrosion resistance for each sensor.

In general, the system measures the temperature profile in the process environment using multiple sensors. These are connected to an appropriate process connection that ensures the integrity of the process. Externally, the extension cables are wired into the junction box, which can be directly mounted or remote.

Design		Description, available options and materials
	1: Head	Hinged cover junction box for electrical connections. It includes components such as electrical terminals, transmitters and cable glandes. ▪ 316/316L ▪ Other materials on request
	2a: Support frame	Modular frame support that is adjustable for all available junction boxes. 316/316L
	2b: Tube neck	Modular tube support that is adjustable for all available junction boxes and ensures extension cable inspection. 316/316L
	3: Compression fitting	High-performance compression fitting to ensure leak-tightness between the process and external environment. For many process fluids and various combinations of high temperatures and pressures. ▪ 316L ▪ 316H
	4: Process connection	A flange according to international standards, or customized to satisfy specific process requirements. → 🖹 22 ▪ 304/304L ▪ 316/316L ▪ 316Ti ▪ 321 ▪ 347 ▪ Other materials on request
	5: Insert	▪ Mineral-insulated grounded and ungrounded thermocouples or RTDs (Pt100) ▪ Mineral-insulated non-grounded multipoint cable insert with thermocouples (ProfileSens) For details, refer to the Ordering information table.
	6a: Thermowells 6b: Tip closure, thermowells	The thermometer can be equipped: ▪ either with protecting thermowells for increased mechanical strength and corrosion resistance ▪ or open guiding tubes for installation in an existing thermowell ▪ 316/316L ▪ 321 ▪ 347 ▪ Alloy 600 ▪ Other materials on request
	7: Eyebolt	Lifting device for easy handling during installation phase. 316

The modular multipoint thermometer is characterized by the following possible main configurations:



2 Main configuration possibilities

1 Linear configuration
2 3D configuration

- **Linear configuration**
  The different sensors are aligned along the straight direction coinciding with the longitudinal axis of the multipoint assembly itself (linear multipoint measurement). This configuration can be used to install the multipoint either in an existing thermowell as part of the reactor or in direct contact with the process.
- **3D distribution configuration**
  Where there are multiple measuring points, each multipoint cable sensor can be bent and arranged and secured by means of clips or equivalent accessories to produce a three-dimensional configuration. This configuration is commonly used to reach several measurement points distributed at different cross sections and levels. Specific support frames can be provided and installed on request if they are not already available on site.

Input

Measured variable

Temperature (temperature-linear transmission behavior)

Measuring range

RTD:

Input	Designation	Measuring range limits
RTD as per IEC 60751	Pt100	−200 to +600 °C (−328 to +1 112 °F)

Thermocouple:

Input	Designation	Measuring range limits
Thermocouples (TC) as per IEC 60584, part 1 - using an Endress+Hauser - iTEMP temperature head transmitter	Type J (Fe-CuNi) Type K (NiCr-Ni) Type N (NiCrSi-NiSi)	−40 to +720 °C (−40 to +1 328 °F) −40 to +1 150 °C (−40 to +2 102 °F) −40 to +1 100 °C (−40 to +2 012 °F)
	Internal cold junction (Pt100) Accuracy of cold junction: ± 1 K Max. sensor resistance: 10 kΩ	

Input	Designation	Measuring range limits
Thermocouples (TC) - flying leads - as per IEC 60584 and ASTM E230	Type J (Fe-CuNi)	−40 to +720 °C (−40 to +1 328 °F), typical sensitivity above 0 °C ≈ 55 µV/K
	Type K (NiCr-Ni)	−40 to +1 150 °C (−40 to +2 102 °F) [1], typical sensitivity above 0 °C ≈ 40 µV/K
	Type N (NiCrSi-NiSi)	−40 to +1 100 °C (−40 to +2 012 °F), typical sensitivity above 0 °C ≈ 40 µV/K

1) Restricted by the material of the insert outer sheath

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 junction box 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 directly wired sensors, as well as reducing both wiring and maintenance costs.

PC programmable head transmitters
They offer a high degree of flexibility, thereby supporting universal application with low inventory storage. The iTEMP transmitters can be configured quickly and easily at a PC. Endress+Hauser offers free configuration software which can be downloaded from the Endress+Hauser website. More information can be found in the Technical Information.

HART programmable head transmitters
The transmitter is a 2-wire device with one or two measuring inputs and one analog output. The device not only transfers converted signals from resistance thermometers and thermocouples, it also transfers resistance and voltage signals using HART communication. It can be installed as an intrinsically safe apparatus in Zone 1 hazardous areas and is used for instrumentation in the terminal head (flat face) as per DIN EN 50446. Quick and easy operation, visualization and maintenance using universal configuration software such as FieldCare, DeviceCare or FieldCommunicator 375/475. More information can be found in the Technical Information.

PROFIBUS PA head transmitter
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. PROFIBUS PA functions and device-specific parameters are configured via fieldbus communication. For more information, see the Technical Information.

FOUNDATION fieldbus head transmitter
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 approved for use in all the main distributed control systems. The integration tests are performed in Endress+Hauser's 'System World'. For more information, see the Technical Information.

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

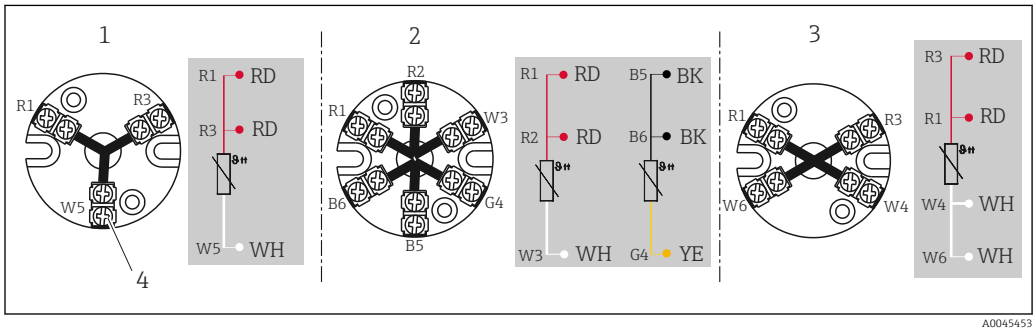
Advantages of the iTEMP transmitters:
- Dual or single sensor input (optionally for certain transmitters)
- Unsurpassed reliability, accuracy and long-term stability in critical processes
- Mathematical functions
- Monitoring of the thermometer drift, sensor backup functionality, sensor diagnostic functions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

Power supply

- Electrical connecting cables must be smooth, corrosion resistant, easily cleaned and inspected, robust against mechanical stresses and not susceptible to moisture.
- Grounding or shielding connections are possible via ground terminals on the junction box.

Wiring diagrams

RTD sensor connection type



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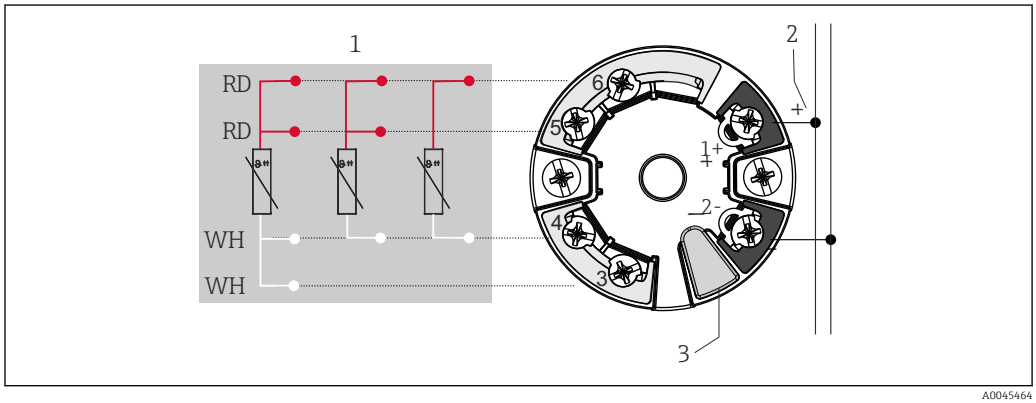
3 *Mounted terminal block*

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



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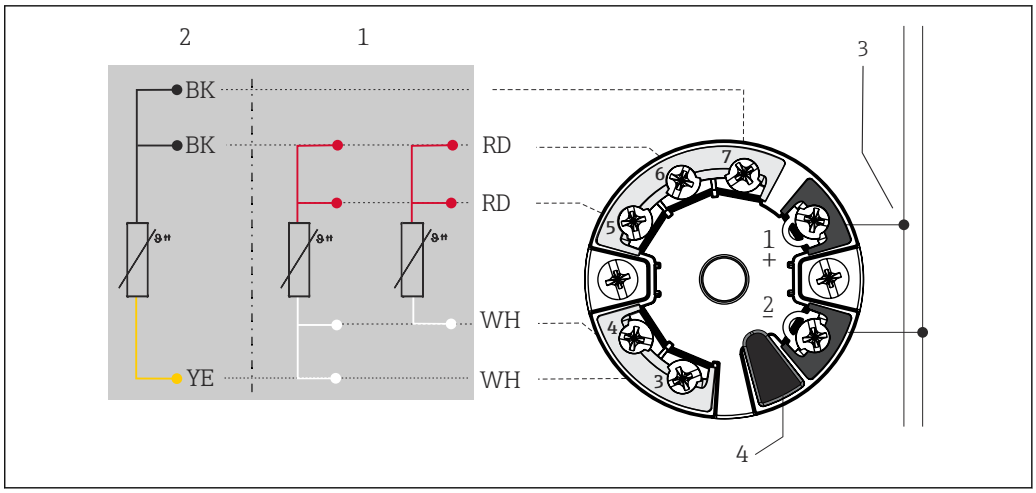
4 *Head mounted transmitter TMT7x or TMT31 (single input)*

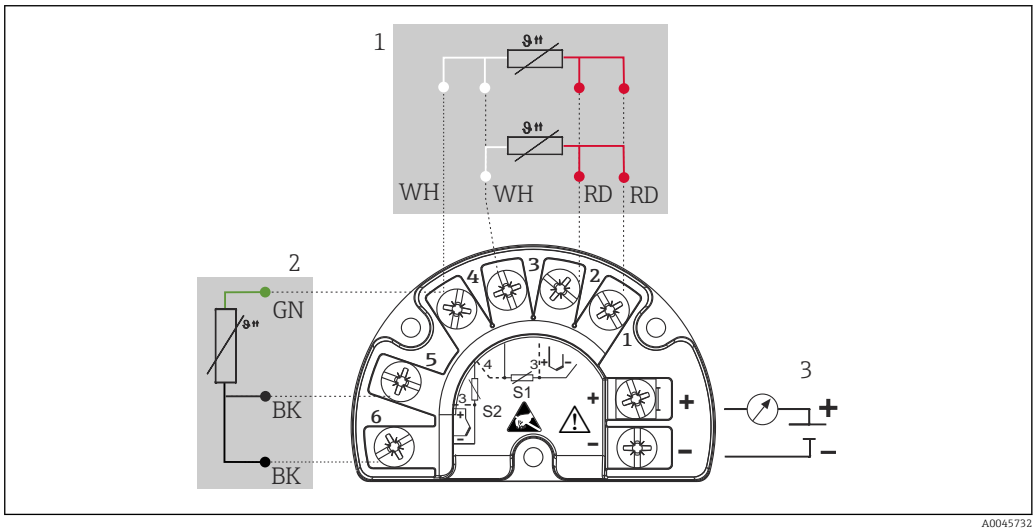
1 *Sensor input, RTD and Ω: 4-, 3- and 2-wire*
2 *Power supply or fieldbus connection*
3 *Display connection/CDI interface*



5 *Head mounted transmitter TMT8x (dual input)*

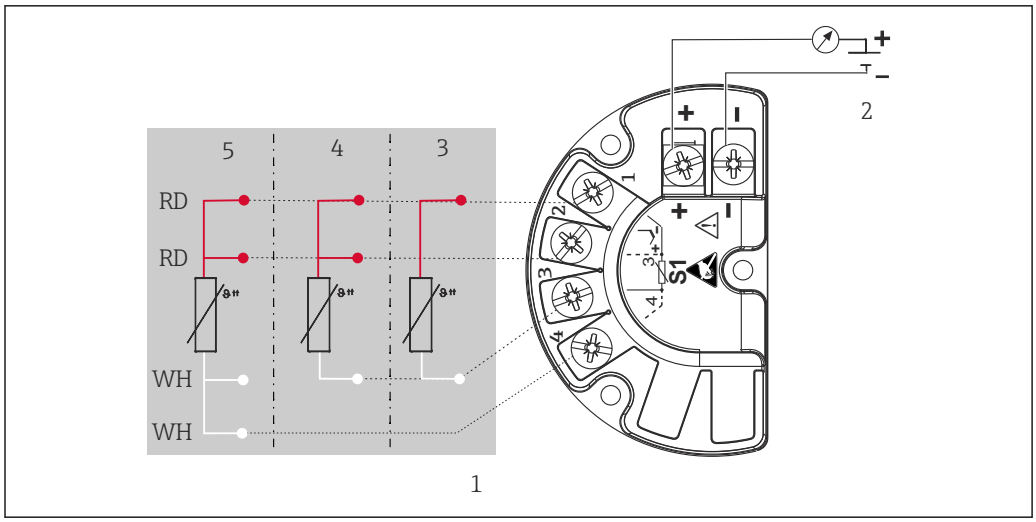
1 *Sensor input 1, RTD: 4- and 3-wire*
2 *Sensor input 2, RTD: 3-wire*
3 *Power supply or fieldbus connection*
4 *Display connection*

Mounted field transmitter: Fitted with screw terminals



6 *TMT162 (dual input)*

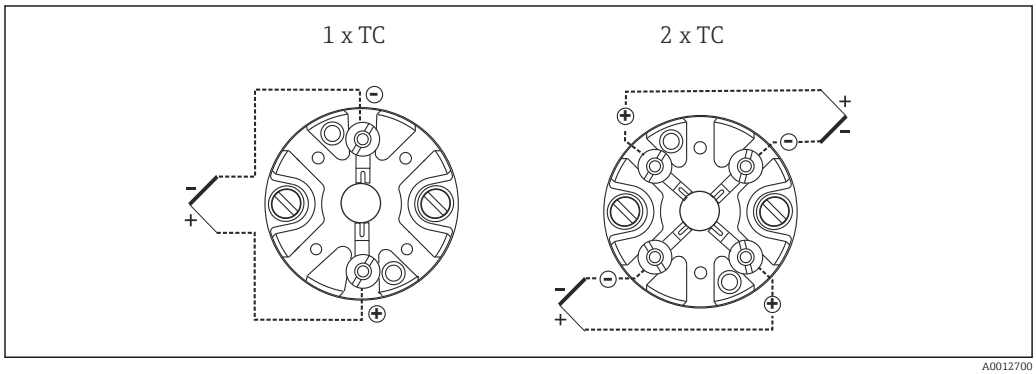
1 *Sensor input 1, RTD: 3- and 4-wire*
2 *Sensor input 2, RTD: 3-wire*
3 *Power supply, field transmitter and analog output 4 to 20 mA or fieldbus connection*



7 *TMT142B (single input)*

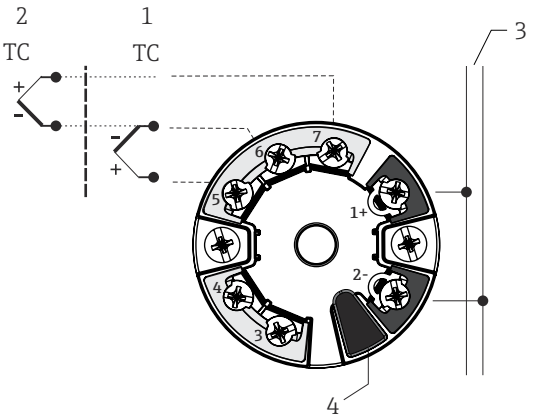
1 *Sensor input RTD*
2 *Power supply, field transmitter and analog output 4 to 20 mA, HART® signal*
3 *2-wire*
4 *3-wire*
5 *4-wire*

Thermocouple (TC) sensor connection type



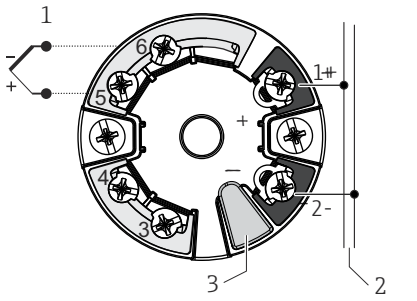
8 *Mounted terminal block*

Head mounted transmitter TMT8x (dual sensor input) [1)]



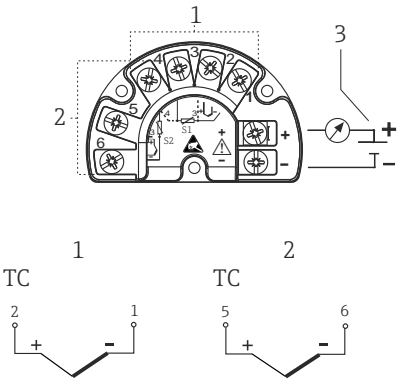
1 Sensor input 1
2 Sensor input 2
3 Fieldbus communication and power supply
4 Display connection

Head mounted transmitter TMT7x (single input) [1)]



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

Mounted field transmitter TMT162 or TMT142B



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

1) Fitted with spring terminals if screw terminals are not explicitly selected or a dual sensor is installed.

Thermocouple wire colors

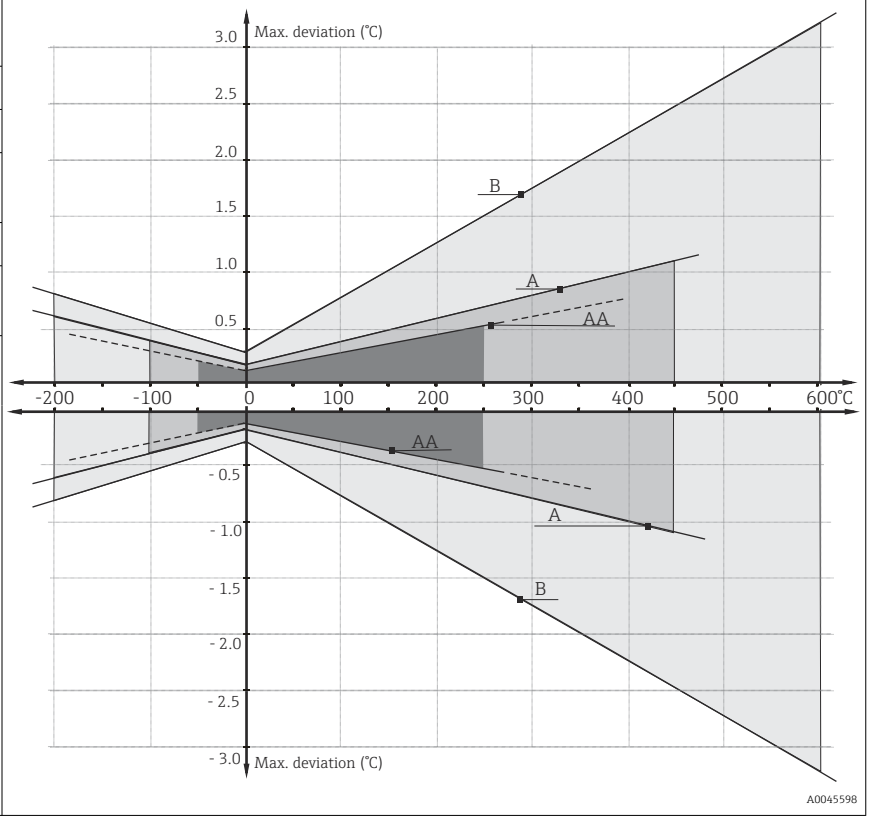
As per IEC 60584	As per ASTM E230
▪ Type J: black (+), white (-) ▪ Type K: green (+), white (-) ▪ Type N: pink (+), white (-) ▪ Type T: brown (+), white (-)	▪ Type J: white (+), red (-) ▪ Type K: yellow (+), red (-) ▪ Type N: orange (+), red (-) ▪ Type T: blue (+), red (-)

Performance characteristics

Accuracy RTD resistance thermometer as per IEC 60751

Class	Max. tolerances (°C)	
Cl. AA, formerly 1/3 Cl. B	± (0.1 + 0.0017 · |t| [1])	
Cl. A	± (0.15 + 0.002 · |t| [1])	
Cl. B	± (0.3 + 0.005 · |t| [1])	
Temperature ranges for compliance with the tolerance classes		
Wire-wound sensor (WW):	Cl. A	Cl. AA
	– 100 to +450 °C	−50 to +250 °C
Thin-film version (TF):	Cl. A	Cl. AA
Standard	−30 to +300 °C	0 to +150 °C

Characteristics



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

To obtain the maximum tolerances in °F, multiply the results in °C by a factor of 1.8.

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

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

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

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

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

The materials for thermocouples are generally supplied in such a way that they comply with the tolerances specified in the table for temperatures >0 °C (32 °F). These materials are generally not suitable for temperatures <0 °C (32 °F). The specified tolerances cannot be satisfied. A separate material must be selected for this temperature range. This cannot be processed via the standard product.

Reaction time

Response time for the sensor assembly without transmitter. It refers to inserts in direct contact with process. When thermowells are selected specific evaluation should be done.

RTD

Calculated at an ambient temperature of approx. 23 °C by immersing the insert in flowing water (0.4 m/s flow rate, 10 K excess temperature):

Insert diameter	Reaction time	
Mineral-insulated cable, 3 mm (0.12 in)	t_{50}	2 s
	t_{90}	5 s
StrongSens RTD insert, 6 mm (¼ in)	t_{50}	< 3.5 s
	t_{90}	< 10 s

Thermocouple (TC)

Calculated at an ambient temperature of approx. 23 °C by immersing the insert in flowing water (0.4 m/s flow rate, 10 K excess temperature):

Insert diameter	Reaction time	
Grounded thermocouple: 3 mm (0.12 in), 2 mm (0.08 in)	t_{50}	0.8 s
	t_{90}	2 s
Ungrounded thermocouple: 3 mm (0.12 in), 2 mm (0.08 in)	t_{50}	1 s
	t_{90}	2.5 s
Grounded thermocouple 6 mm (¼ in)	t_{50}	2 s
	t_{90}	5 s
Ungrounded thermocouple 6 mm (¼ in)	t_{50}	2.5 s
	t_{90}	7 s

Cable sensor diameter (ProfileSens)	Reaction time	
8 mm (0.31 in)	t_{50}	2.4 s
	t_{90}	6.2 s
9.5 mm (0.37 in)	t_{50}	2.8 s
	t_{90}	7.5 s
12.7 mm (½ in)	t_{50}	3.8 s
	t_{90}	10.6 s

Shock and vibration resistance

- RTD: 3 G/10 to 500 Hz according to IEC 60751
- RTD iTHERM StrongSens Pt100 (TF, vibration resistant): Up to 60G
- TC: 4 G/2 to 150 Hz according to IEC 60068-2-6

Calibration

Calibration is a service that can be performed on each individual insert, either during the multipoint production phase in the factory or after multipoint installation in the plant.

If calibration is to be performed after the multipoint is installed, please contact the Endress +Hauser service team for support. Together with the Endress+Hauser service team, any further measures can be arranged to complete the calibration of the target sensor. In any case, it is not permitted to unscrew any threaded component on the process connection under operating conditions (i.e. while the process is running).

Calibration involves comparing the measured values of the sensing elements of the multipoint inserts (DUT device under test) 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 measured values from the true value of the measured variable.

In the case of a multipoint cable sensor, temperature-controlled calibration baths from −80 to 550 °C (−112 to 1022 °F) can be used for a factory calibration or an accredited calibration for the last measuring point only (if NL-L_{MPx} < 100 mm (3.94 in)). Special boreholes in the calibration furnaces are used for factory calibration of the thermometers, which ensure even distribution of the temperature from 200 to 550 °C (392 to 1022 °F) on the corresponding section.

Two different methods are used for the inserts:
- Calibration at fixed-point temperatures, e.g. at the freezing point of water at 0 °C (32 °F).
- Calibration compared against a precise reference thermometer.

Evaluation of inserts

If a calibration with an acceptable uncertainty of measurement and transferable measurement results is not possible, Endress+Hauser offers an insert evaluation measurement service, if technically feasible.

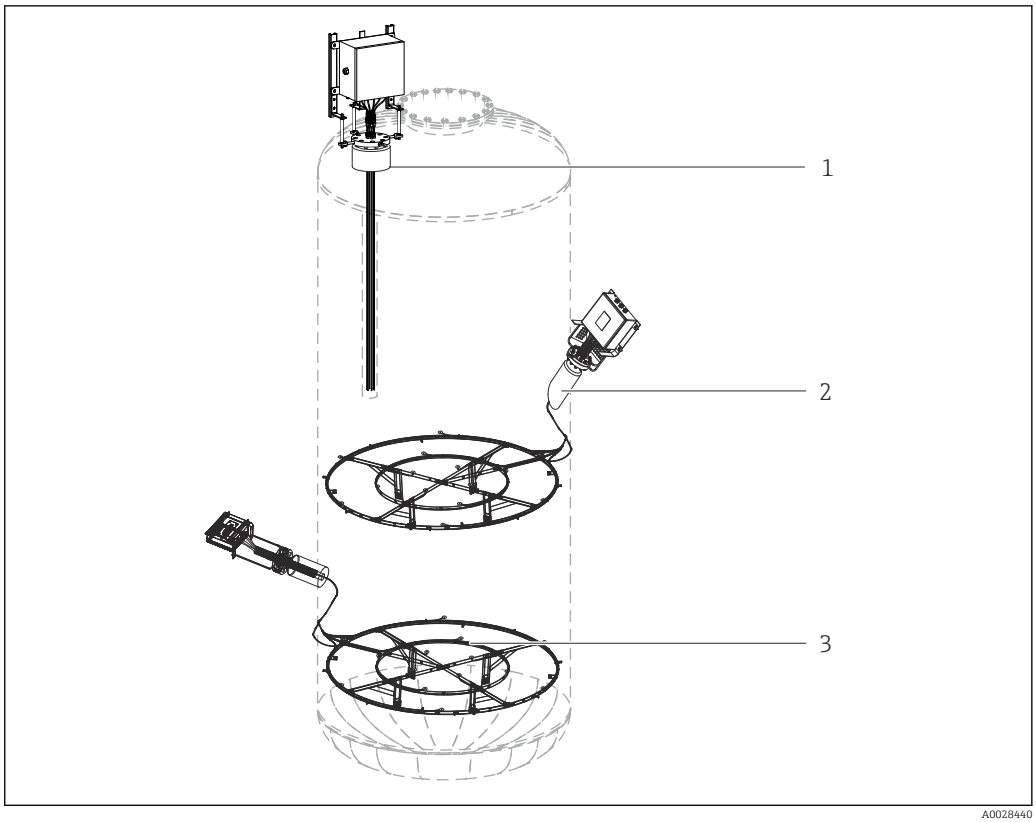
Mounting

Mounting location

The mounting location must meet the requirements listed in this document, e.g. ambient temperature, protection class, climate class etc. Care should be taken when checking the sizes of possible existing support frames or brackets welded on the reactor's wall (usually not included in the scope of delivery) or of any other existing frame in the installation area.

Orientation

No restrictions. The multipoint thermometer can be installed either in horizontal, oblique or in vertical configuration, related to the reactor or vessel vertical axis.



9 *Installation examples - no restrictions to the orientation*

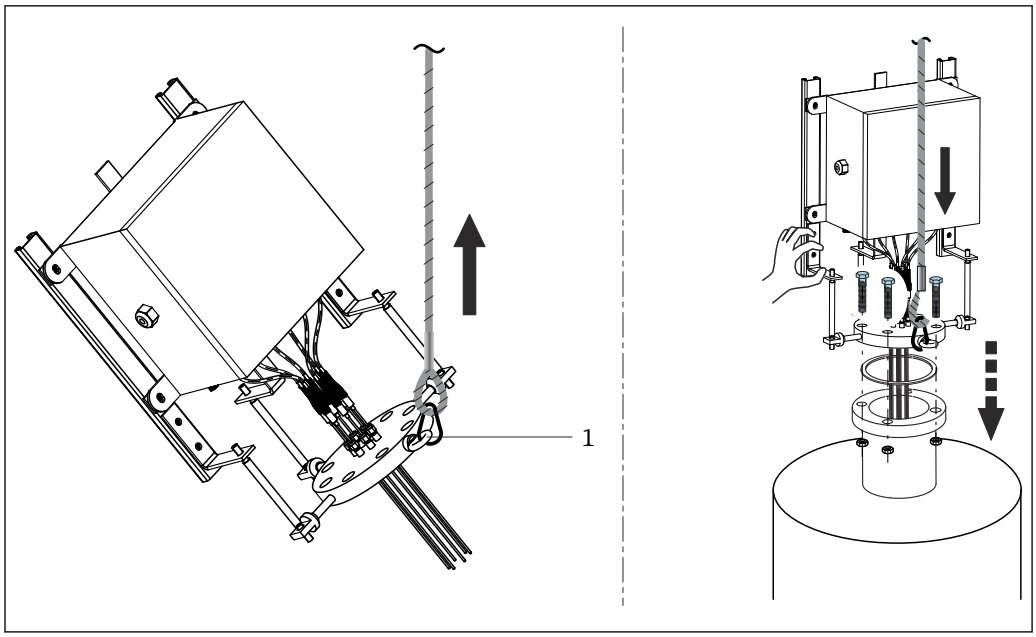
1 Vertical installation with linear configuration
2 Oblique installation with 3D distribution configuration
3 Horizontal installation with 3D distribution configuration

Installation Instructions

The modular multipoint thermometer is designed to be installed with a flanged process connection into a vessel, reactor, tank or similar environment. All parts and components have to be handled with care. Avoid the following during installation, lifting and introduction of the device through the nozzle provided:

- Misalignment with the nozzle axis.
- Any load on the welded or threaded parts due to the weight of the device.
- Deformation or crushing of the threaded components, bolts, nuts, cable glands and compression fittings.
- Bending radius of the thermowells smaller than 20 times the diameter of the thermowell.
- Friction between the temperature probes and the internals of the reactor.
- Fixing the temperature probes to the reactor's infrastructures without allowing axial displacements or movements.
- Bending radius of the sheathed cable (inserts) with a radius smaller than 5 times the outer diameter of the sheathed cable.

Vessel’s internals have to be kept into consideration for the interaction with the multipoint inserts. These internals can be considered as the interface between multipoint and the process, when they are used to fix the tips of the inserts, or constraints when the route of the thermocouples has to be performed as per installation instructions. If the internal fixtures cannot be used as an interface for the insert, the manufacturer can provide special support frames that have minimal impact on the process and allow the implementation of the desired measuring points. Frame components are always designed to be mechanically jointed without any thermal effect and impact on the material internals.



10 Multipoint thermometer installation in a reactor nozzle via flange process connection.

During installation the whole thermometer must only be lifted and moved by using ropes properly mounted on the eyebolt of the flange (1).

Environment

Ambient temperature range

Junction box	Non-hazardous area	Hazardous area
Without mounted transmitter	−40 to +85 °C (−40 to +185 °F)	−40 to +60 °C (−40 to +140 °F)
With mounted head transmitter	−40 to +85 °C (−40 to +185 °F)	Depends on the respective hazardous area approval. Details see Ex documentation.

Storage temperature

Junction box	
With head transmitter	−40 to +95 °C (−40 to +203 °F)
With DIN rail transmitter	−40 to +95 °C (−40 to +203 °F)

Humidity

Condensation according to IEC 60068-2-14:
- Head transmitter: Permitted
- DIN rail transmitter: Not permitted

Maximum relative humidity: 95% according to IEC 60068-2-30

Climate class

Determined when the following components are installed into the junction box:
- Head transmitter: Class C1 according to EN 60654-1
- Multi-channel transmitter: Tested as per IEC 60068-2-30, meets the requirements regarding class C1-C3 in accordance with IEC 60721-4-3
- Terminal blocks: Class B2 according to EN 60654-1

Degree of protection

- Specification for conduit: IP68
- Specification for the junction box: IP66/67

Electromagnetic compatibility (EMC)

Depending on the transmitter used. For detailed information see the related Technical Information, listed at the end of this document.

Process

The process temperature and process pressure are the minimum input parameters for the selection of the right product configuration. If special product features are requested, additional data such as process fluid type, phases, concentration, viscosity, stream and turbulences, corrosion rate have to be considered as mandatory for the whole product definition.

Process temperature range

Up to +1 150 °C (+2 102 °F). Depends on the configuration.

The flanges for the process connection define the maximum process conditions under which the devices can work based on their specific pressure classes, which are designed according to the requirements of the plant.

Process pressure range

0 to 100 bar (0 to 1 450 psi)

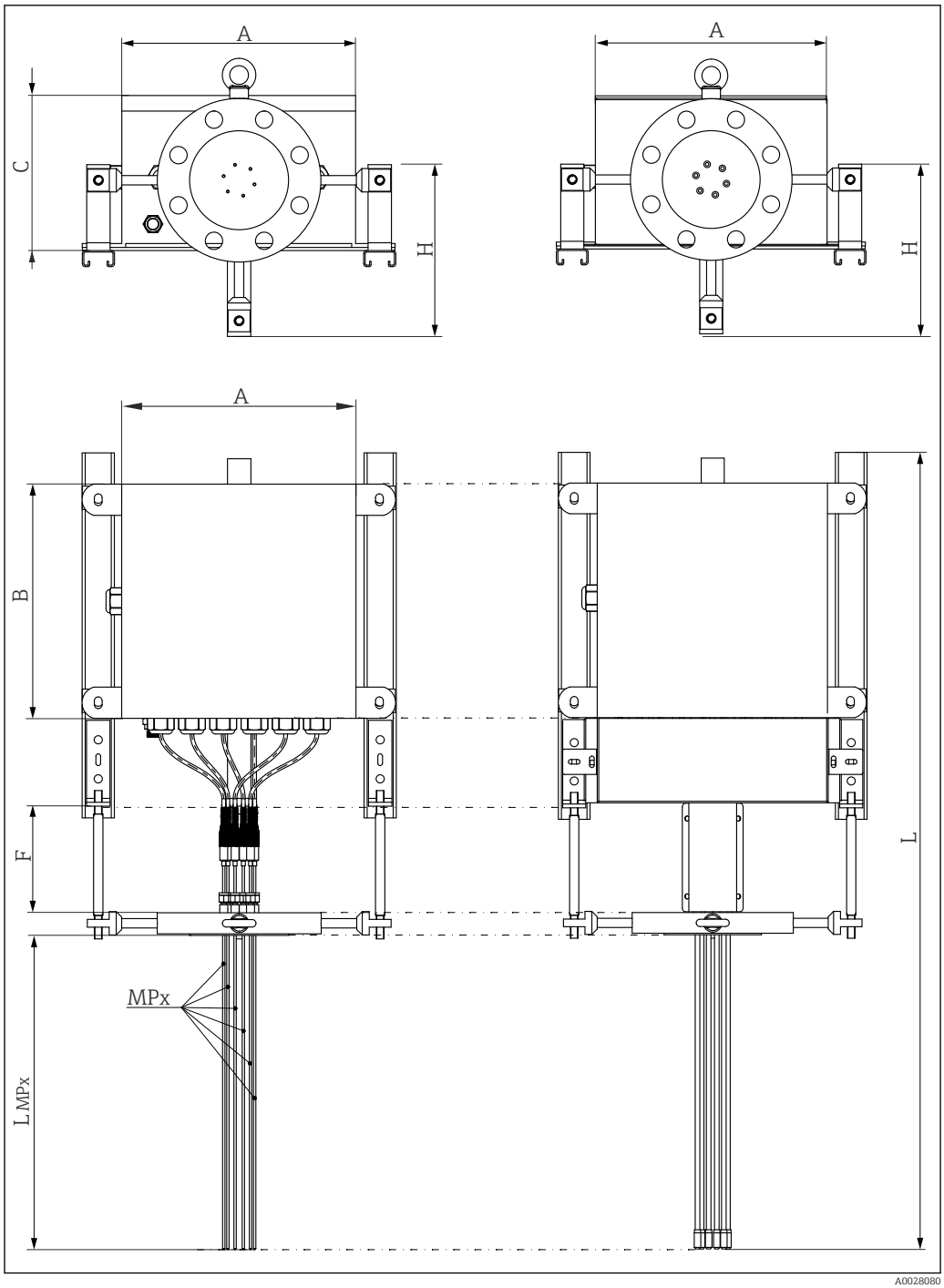
Anyhow, the maximum required process pressure has to be combined according to the maximum allowable process temperature. Process connections like compression fittings, flanges with their specific ratings, thermowells, selected according to the plant requirements, define the maximum process conditions at which the device has to operate. Endress+Hauser experts can support the customer on any related questions.

Process applications:
- Olefins
- Ethylene
- Propylene
- Aromatics
- Benzene
- N-based inorganics
- Ammonia
- Urea
- NGTL production
- Distillation units and hydrogenation

Mechanical construction

Design, dimensions

The overall multipoint assembly is composed of different sub-assemblies. Both linear and 3D configurations have the same features, dimensions and materials. Different inserts are available, based upon specific process conditions, in order to have the highest accuracy and an extended lifetime. In addition, protecting thermowells can be selected to further increase mechanical performances and corrosion resistance, and to allow insert replacement. Associated shielded extension cables are provided with high resistance sheath materials to withstand different environmental conditions and to ensure steady and noiseless signals. The transition between the inserts and the extension cable is obtained by the usage of specially sealed bushings, ensuring the declared IP degree protection.



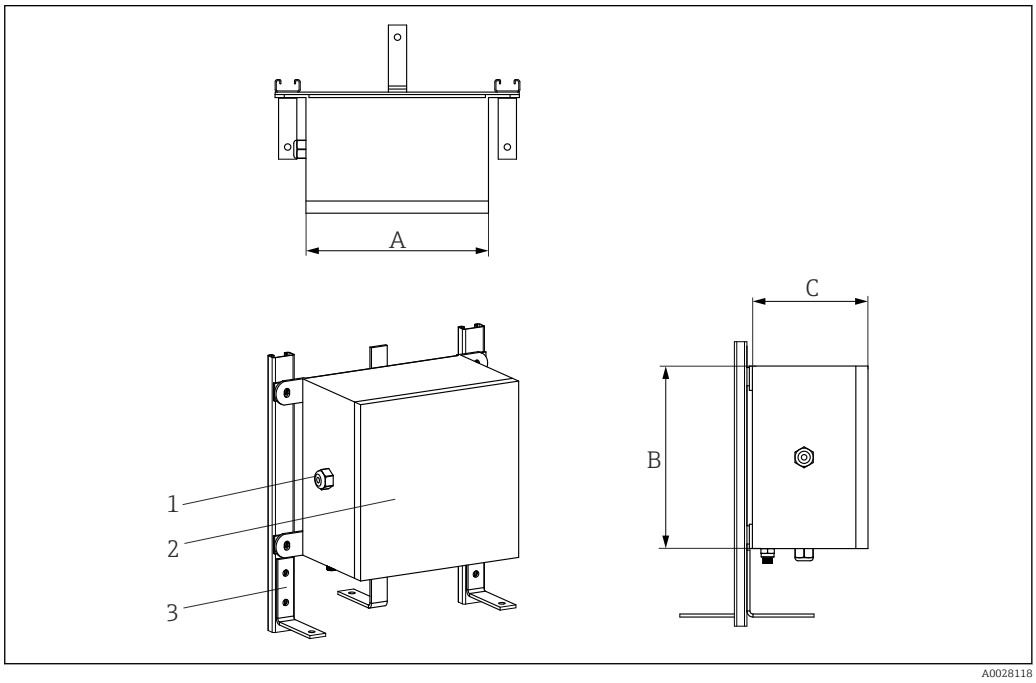
11 Design of the modular multipoint thermometer, with frame neck on the left side or with frame neck and covers on the right side. All dimensions in mm (in)

A, B, Dimensions of the junction box, see following figure
C
MPx Numbers and distribution of measuring points: MP1, MP2, MP3 etc.
L_{MPx} Different immersion length of sensing elements or thermowells
H Dimensions of the frame of the junction box and support system
F Tube neck length
L Overall device length

Tube neck F in mm (in)
Standard 250 (9.84) Specifically customized tube necks are available on request.

Immersion lengths MPx of sensing elements/thermowells:
Based on customer requirements

Junction box



1 Cable gland
2 Junction box
3 Frame

The junction box is suited for chemical agents environments. Sea water corrosion resistance and extreme temperature variation stability is guaranteed. Ex e-/Ex i connections can be installed.

The multipoint thermometer can be fitted with ground terminals and shielding connections. Please observe the system guidelines for correct connection of the cables.

Possible junction box dimensions (A x B x C) in mm (in):

		A	B	C
Stainless steel	Min.	170 (6.7)	170 (6.7)	130 (5.1)
	Max.	500 (19.7)	500 (19.7)	240 (9.5)
Aluminum	Min.	100 (3.9)	150 (5.9)	80 (3.2)
	Max.	330 (13)	500 (19.7)	180 (7.1)

Type of specification	Junction box	Cable glands
Material	AISI 316	NiCr-coated brass AISI 316 / 316L
Degree of protection (IP)	IP66/67	IP66
Ambient temperature range (ATEX)	−55 to +110 °C (−67 to +230 °F)	
Approvals	ATEX, IECEx, UL, CSA, EAC approval for use in hazardous areas	

Type of specification	Junction box	Cable glands
Labeling	▪ ATEX II 2GD Ex e IIC T6/T5/T4 Gb Ex ia IIC T6/T5/T4 Ga Ex tb IIIC T85°C/T100°C/ T135°C Db IP66 ▪ IECEx Ex e IIC T6/T5/T4 Gb/ Ex ia IIC T6/T5/T4 Ga Ex tb IIIC T85°C/T100°C/ T135°C Db IP66 ▪ UL913 Class I, Zone 1, AEx e IIC; Zone 21, AEx tb IIIC IP66 ▪ CSA C22.2 No.157 Class I, Zone 1 Ex e IIC; Class II, Groups E, F and G	According to the junction box approval
Cover	Hinged	-
Maximum sealing diameter	-	6 to 12 mm (0.24 to 0.47 in)

Tube neck

The neck extension ensures the connection between the flange and the junction box. The design was developed to facilitate different installation options and to address potential obstacles and restrictions that are present in all plants. This includes the infrastructure of the reactor, for example, (platforms, load-bearing structures, support rails, stairs, etc.) and the thermal insulation of the reactor. The neck extension design ensures easy access for monitoring and maintaining inserts and extension cables. It provides a very firm (rigid) connection for the junction box and vibration loads. No closed volumes are present in the neck extension. On the one hand, this prevents residual substances and potentially hazardous fluids from the environment from accumulating and damaging the appliance, while ensuring continuous ventilation on the other.

Insert and thermowells

Different insert and thermowell types are available. For other requirements not listed here, please contact the manufacturer's sales department.

In the case of a multipoint cable insert (ProfileSens), see Technical Information TI01346T

Thermocouple

Diameter in mm (in)	Type	Standard	Measuring point type	Sheath material
6 (0.24) 3 (0.12) 2 (0.08) 1.5 (0.06)	1x type K 2x type K 1x type J 2x type J 1x type N 2x type N 1x type T 2x type T	IEC 60584/ ASTM E230	Grounded/Ungrounded	Alloy 600/AISI 316L/Pyrosil

RTD

Diameter in mm (in)	Type	Standard	Sheath material
3 (0.12) 6 (¼)	1x Pt100 WW 2x Pt100 WW 1x Pt100 TF 2x Pt100 TF	IEC 60751	AISI 316L

Thermowells

External diameter in mm (in)	Sheath material	Type	Thickness in mm (in)
6 (0.24)	AISI 316/316L AISI 316Ti AISI 321 AISI 347 Alloy 600	closed or open	1 (0.04) or 1.5 (0.06)
8 (0.32)	AISI 316/316L AISI 316Ti AISI 321 AISI 347 Alloy 600	closed or open	1 (0.04) or 1.5 (0.06) or 2 (0.08)
10.2 (⅛)	AISI 316/316L AISI 316Ti AISI 321 AISI 347 Alloy 600	closed or open	1.73 (0.068)

Weight

The weight can vary depending on the configuration: Dimension and content of the junction box, neck length, dimensions of process connection and the number of inserts. The approximate weight of a typically configured multipoint thermometer (number of inserts = 12, flange size = 3", medium size junction box) = 40 kg (88 lb)

Materials

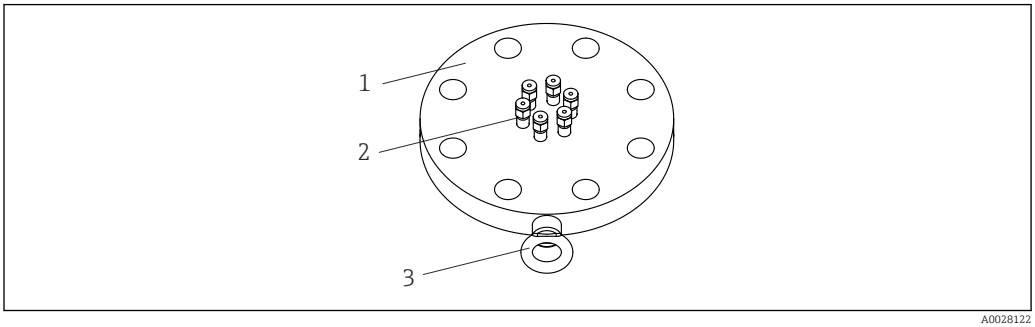
It refers to insert sheath, neck extension, junction box and all wetted parts.

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

Material name	Short form	Recommended max. temperature for continuous use in air	Properties
AISI 316/1.4401	X5CrNiMo 17-12-2	650 °C (1 202 °F)	▪ 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)
AISI 316L/ 1.4404 1.4435	X2CrNiMo17-12-2 X2CrNiMo18-14-3	650 °C (1 202 °F)	▪ Austenitic, stainless steel ▪ High corrosion resistance in general ▪ Particularly high corrosion resistance in chlorine-based and acidic, non-oxidizing atmospheres through the addition of molybdenum (e.g. phosphoric and sulfuric acids, acetic and tartaric acids with a low concentration) ▪ Increased resistance to intergranular corrosion and pitting ▪ Compared to 1.4404, 1.4435 has even higher corrosion resistance and a lower delta ferrite content
Alloy 600/2.4816	NiCr15Fe	1 100 °C (2 012 °F)	▪ A nickel/chromium alloy with very good resistance to aggressive, oxidizing and reducing atmospheres, even at high temperatures ▪ Resistance to corrosion caused by chlorine gases and chlorinated media as well as many oxidizing mineral and organic acids, sea water etc. ▪ Corrosion from ultrapure water ▪ Not to be used in sulfur-containing atmospheres

Material name	Short form	Recommended max. temperature for continuous use in air	Properties
AISI 304/1.4301	X5CrNi18-10	850 °C (1562 °F)	▪ Austenitic, stainless steel ▪ Usable in water and slightly polluted waste water ▪ Resistant to organic acids, saline solutions, sulphates, alkaline solutions, etc. at relatively low temperatures only
AISI 304L/ 1.4307	X2CrNi18-9	850 °C (1562 °F)	▪ Good welding properties ▪ Impervious to intergranular corrosion ▪ High ductility, excellent drawing, forming, and spinning properties
AISI 316Ti/ 1.4571	X6CrNiMoTi17-12-2	700 °C (1292 °F)	▪ Addition of titanium means increased resistance to intergranular corrosion even after welding ▪ Broad range of uses in the chemical, petrochemical and oil industries as well as in coal chemistry ▪ Can only be polished to a limited extent, titanium streaks can form
AISI 321/1.4541	X6CrNiTi18-10	815 °C (1499 °F)	▪ Austenitic, stainless steel ▪ High resistance to intergranular corrosion even after welding ▪ Good welding characteristics, suitable to all standard welding methods ▪ It is used in many sectors of the chemical industry, petrochemical, and pressurized vessels
AISI 347/1.4550	X6CrNiNb10-10	800 °C (1472 °F)	▪ Austenitic, stainless steel ▪ Good resistance to a wide variety of environments in the chemical, textile, oil refining, dairy and food industries ▪ Added niobium makes this steel impervious to intergranular corrosion ▪ Good weldability ▪ Main applications are furnace fire walls, pressure vessels, welded structures, turbine blades

Process connection



12 Flange as process connection

1 Flange
2 Compression fittings
3 Eyebolt

Standard process connection flanges are designed according to the following standards:

Standard [1]	Size	Design	Material
ASME	1½", 2", 3", 4", 6", 8"	150#, 300#, 400#, 600#	AISI 316, 316L, 304, 304L, 316Ti, 321, 347
EN	DN40, DN50, DN80, DN100, DN150, DN200	PN10, PN16, PN25, PN40, PN63, PN100	

1) Flanges according to GOST standard are available on request.

Compression fittings

The compression fittings are welded or threaded into the flange to ensure tightness to the process connection. Dimensions correspond to the insert dimensions. Compression fittings comply with the highest standards of reliability in terms of materials and performances required.

Material	AISI 316/316H

Operation

For details of operability, see the Technical Information of the Endress+Hauser temperature transmitters or the manuals of the related operating software.

Certificates and approvals

Current certificates and approvals for the product are available at www.endress.com on the relevant product page:

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

Ordering information

For an overview of the scope of delivery see the configuration table below.

Detailed ordering information is available from your Endress+Hauser Sales Center:
www.addresses.endress.com

Process connection: flange		
Standard	▪ ASME B16.5 ▪ EN 1092-1 Others on request	☐ ☐
Material	316 + 316L, 316Ti, 304, 304L, 321, 347 Others on request	_____
Face	▪ RF ▪ RTJ Others on request	☐ ☐
Size	▪ 1½", 2", 3", 4", 6", 8" ▪ DN40, DN50, DN80, DN100, DN150, DN200 Others on request	_____ _____

The values reported in the table below are indicative, based on calculations for nozzles with standard dimensions. So the maximum number of measurement points can differ from the maximum number of the configuration table. It depends on the dimensions of the nozzle used on location.

Flange size (considering a schedule 40 nozzle)	Maximum number of thermowells with insert Ø:1.5 mm (0.06 in) or 2 mm (0.08 in)			Maximum number of inserts			
	Thermowell diameter			Insert diameter			
	10.24 mm (⅛ in)	6 mm (0.24 in)	8 mm (0.32 in)	3 mm (0.12 in)	4.8 mm (0.19 in)	6 mm (0.24 in)	ProfileSens 8 mm (0.31 in), 9.5 mm (0.37 in) or 12.7 mm (½ in)
1½"	3			3			1
2"	5			5			1
3"	8			8			2
4"	16			16			4
6"	30			30			11
8"	48			48			20

Insert, sensor		
Measuring principle	▪ Thermocouple (TC) ▪ Resistance temperature detector (RTD) ▪ Multipoint cable sensor ProfileSens (TC)	☐ ☐ ☐
Type	TC: J, K, N, T RTD: Pt100	_____
Design	▪ TC: Single, duplex ▪ RTD: 3-wire, 4-wire, 2x3-wire	☐ ☐
Version	▪ TC: Grounded, ungrounded ▪ RTD: Wire wound (WW); Thin film (TF)	☐ ☐
Sheath material	316L, Alloy 600, Pyrosil®	_____
Approvals	▪ Intrinsic safety ▪ Non-hazardous	_____

Insert, sensor		
Insert diameter	▪ 1.5 mm (0.06 in) ▪ 2 mm (0.08 in) ▪ 3 mm (0.12 in) ▪ 4.8 mm (0.19 in) ▪ 6 mm (0.24 in) ▪ ProfileSens 8 mm (0.31 in) ▪ ProfileSens 9.5 mm (0.37 in) ▪ ProfileSens 12.7 mm (½ in) Others on request	☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐
Standard/Class	IEC/Class 1 for TC ASTM/Class special for TC IEC/Class A for RTD IEC/Class AA for RTD Others on request	_____

Measuring point distribution		
Positioning	▪ Equi-spaced ▪ Customized	☐ ☐
Number	2, 4, 6, 8, 10, 12 to 48 [1]	_____

Insertion length [2]	TAG (description)	(L_{MPx}) in mm (in)
MP_1	_____	_____
MP_2	_____	_____
MP_3	_____	_____
MP_4	_____	_____
MP_5	_____	_____
MP_6	_____	_____
MP_x	_____	_____

1) Different numbers/configurations are available on request
2) If the multipoint cable insert (ProfileSens) is used, see TI01346T

Junction box (head)		
Material	▪ Stainless steel (standard) ▪ Aluminum (to be specified) Others on request	☐ ☐
Electrical connection	Terminal block wiring: ▪ Terminal block - standard/number ▪ Terminal block - compensated/number ▪ Terminal block - spare/number Transmitter wiring: ▪ HART protocol, e. g.: TMT182, TMT82 ▪ PROFIBUS PA protocol, e. g.: TMT84 ▪ FOUNDATION Fieldbus protocol, e. g.: TMT85, TMT125 (multi-channel transmitter) ▪ Quantity	 ☐ / _____ ☐ / _____ ☐ / _____ ☐ ☐ ☐ _____
Approvals	Ex e / Ex ia / Ex d Others on request	_____
Cable entries (process side)	Single or multiple, type: M20, NPT ½", Quantity Others on request	_____ / _____ _____ / _____
Cable entries (user side)	Single or multiple, type: M20, M25, NPT ½", NPT 1" / Quantity Others on request	_____ / _____ _____ / _____

Tube neck		
Length F in mm (in)	250 mm (9.84 in) Or as specified	☐ _____

Label (TAG)		
Device information	Refer to customer specification As specified	☐ ☐ (table)
Measuring point information If the multipoint cable sensor (ProfileSens) is used, multiple labels (TAGs) are supplied with the probe.	Refer to customer specification Location, as specified: ▪ Tagging (TAG), on extension wires insert ▪ Tagging (TAG), RFID ▪ Tagging (TAG), on tip ▪ Tagging (TAG), on insert bushing ▪ Tagging (TAG), on device ▪ Tagging (TAG), by customer ▪ Tagging (TAG), on transmitter Special version, to be specified	☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Additional requests		
Extension wire length, only for remote head	Specification in mm:	_____
Extension wires sheath material	▪ PVC ▪ FEP Others on request	☐ ☐
On-site existing thermowell	Yes No	☐ ☐

Test, certificate, declaration	
Inspection certificate 3.1, EN10204 (material certificate wetted parts) [1]	☐
Inspection certificate 3.1, short form, EN10204, (material certificate wetted parts)	☐
Internal pressure test according to Endress+Hauser procedure, test report (in case of thermowells)	☐
Internal helium leak test according to Endress+Hauser procedure, test report (in case of thermowells) [1]	☐
PMI test, Endress+Hauser procedure, (wetted parts), test report	☐
Final assembly functional test, test report [1]	☐
Final inspection report [1]	☐
External pressure test according to Endress+Hauser procedure, test report (max. length 10 m)	☐
Routing design including 3D drawing [1]	☐
2D dimensional drawing	☐
Welding book (including welding map)	☐
Radiographic inspection certificate for thermowell welds	☐
Radiographic inspection certificate on measuring points/tips for sensors [1]	☐
Manufacturer declarations	☐
Penetrant testing, thermowell welding, test report	☐
Inspection test report (Sensor/TMT), inspection certificate [1]	☐
Quality control plan	☐

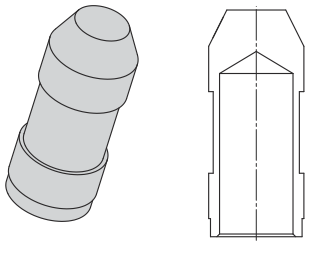
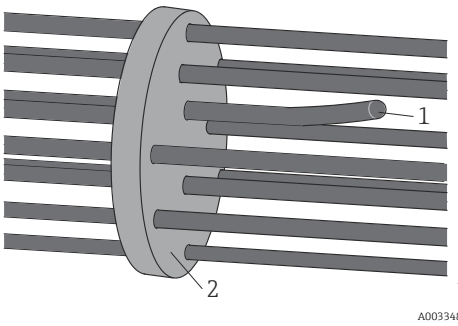
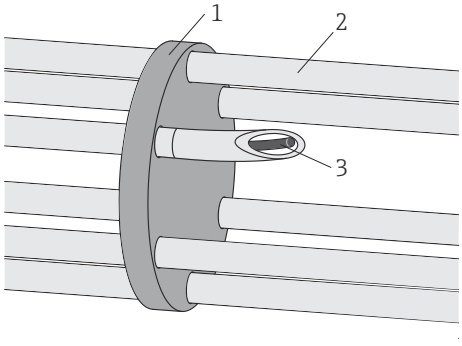
1) (recommended)

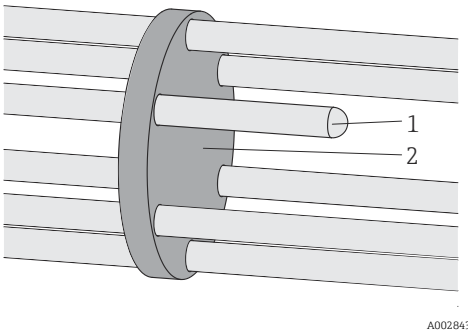
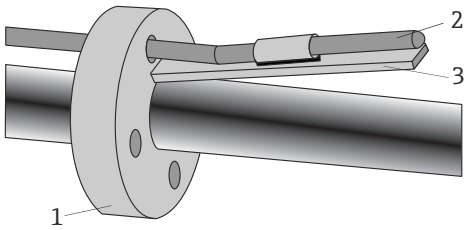
Accessories

The accessories currently available for the product can be selected at www.endress.com:

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Spare parts & Accessories**.

Device-specific accessories

Accessories	Description
Tip end  A0028427	Terminal closure welded at the tip end of the probe in order to protect the insert (or the thermowell) from aggressive process conditions and to facilitate its fixing by means of metallic tie wraps.
Thermal contact system	
Insert and spacers  A0033485 *1 Insert* *2 Spacer*	▪ Used on straight configurations and in case of an existing thermowell for axial centering of the insert bundle ▪ Prevents the twisting of the inserts ▪ Gives flexural stiffness to the sensor bundle
Guiding tubes and spacers  A0028783 *1 Spacer* *2 Guiding tube* *3 Insert*	▪ Used on straight configurations and in case of an existing thermowell for axial centering of the insert bundle ▪ Gives flexural stiffness to the sensor bundle ▪ The inserts can be replaced ▪ Guarantees thermal contact between the sensor tip and the existing thermowell ▪ Modular design [1)]

Accessories	Description
Thermowells and spacers  A0028434 *1 Thermowell* *2 Spacer*	Used on straight configurations and inside existing thermowells Prevents the sensor cables from twisting Gives flexural stiffness to the sensor bundle Enables sensor replacement
Bimetallic strips  A0028435 *13 Bimetallic strips with or without guiding tubes* *1 Spacer* *2 Guiding tube* *3 Bimetallic strips*	▪ Used on straight configurations and inside existing thermowells ▪ Guarantee thermal contact between the sensor tip and the thermowell due to bimetallic strips activated by temperature difference ▪ No friction during installation even with sensors already installed

1) Can be mounted in-house or on-site

Service-specific accessories

Accessories	Description
Applicator	Software for selecting and sizing Endress+Hauser devices: ▪ Calculation of all the necessary data for identifying the optimum 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 information specific to the measuring point, such as the measuring range or operating language ▪ Automatic verification of exclusion criteria ▪ Automatic creation of the order code and its breakdown in PDF or Excel output format ▪ Ability to order directly in the Endress+Hauser Online Shop The Product Configurator is available on the Endress+Hauser website: www.endress.com-> 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.

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

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

Documentation

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

The following documentation may be available depending on the device version ordered:

Document type	Purpose and content of the document
Technical Information (TI)	**Planning aid for your device** The document contains all the technical data on the device and provides an overview of the accessories and other products that can be ordered for the device.
Brief Operating Instructions (KA)	**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 document** These Operating Instructions contain all the information that is required in the various life cycle phases of the device: from product identification, incoming acceptance and storage, to mounting, connection, operation and commissioning, through to troubleshooting, maintenance and disposal.
Description of Device Parameters (GP)	**Reference for your parameters** The document provides a detailed explanation of each individual parameter. The description is aimed at those who work with the device over the entire life cycle and perform specific configurations.

Document type	Purpose and content of the document
Safety Instructions (XA)	Depending on the approval, safety instructions for electrical equipment in hazardous areas are also supplied with the device. The Safety Instructions are a constituent part of the Operating Instructions. Information on the Safety Instructions (XA) that are relevant for the device is provided on the nameplate.
Supplementary device-dependent documentation (SD/FY)	Always comply strictly with the instructions in the relevant supplementary documentation. The supplementary documentation is a constituent part of the device documentation.

www.addresses.endress.com

Endress+Hauser

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