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# Technical Information
# iTHERM MultiSens Linear TMS11
# Multipoint thermometer

RTD/TC Multipoint thermometer for linear temperature profiling with primary thermowell for oil, gas and petrochemical applications



## Applications

- For use in the oil & gas and petrochemical industries
- Ideal for measuring a linear temperature profile
- For installation with flanged process connections on vessels, reactors, and tanks

## Your benefits

- Superior mechanical strength due to a primary thermowell for protection of the temperature sensors
- Increased safety thanks to continuous thermowell leak monitoring
- Easy installation, process integration, and maintenance thanks to modular product design and replaceable, standardized measuring elements
- International certifications: explosion protection in accordance with ATEX, IECEx, EAC, for example

Endress+Hauser
People for Process Automation

# Function and system design

## 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 assemblies)

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:

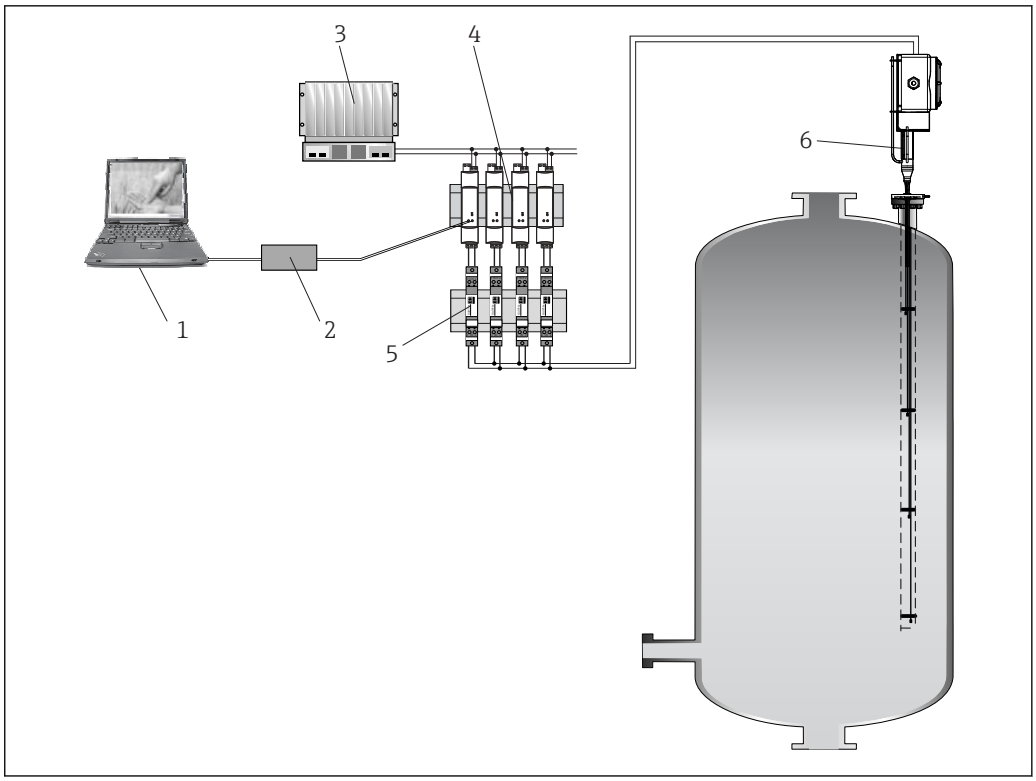
- **Wire-wound (WW):** In these thermometers, a double coil of fine, high-purity platinum wire is located in a ceramic support. This support is then sealed top and bottom with a ceramic protective layer. These resistance thermometers not only facilitate very reproducible measurements but also offer good 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. It should be noted that, due to the operating principle of TF sensors, they frequently exhibit a relatively slight deviation in their resistance/temperature characteristic from the standard characteristic defined in IEC 60751 at higher 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 needed 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.*

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 *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. Further information is available in the corresponding Technical Information.*
6 *Mounted multipoint thermometer with its own primary thermowell, 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.*

## Device architecture

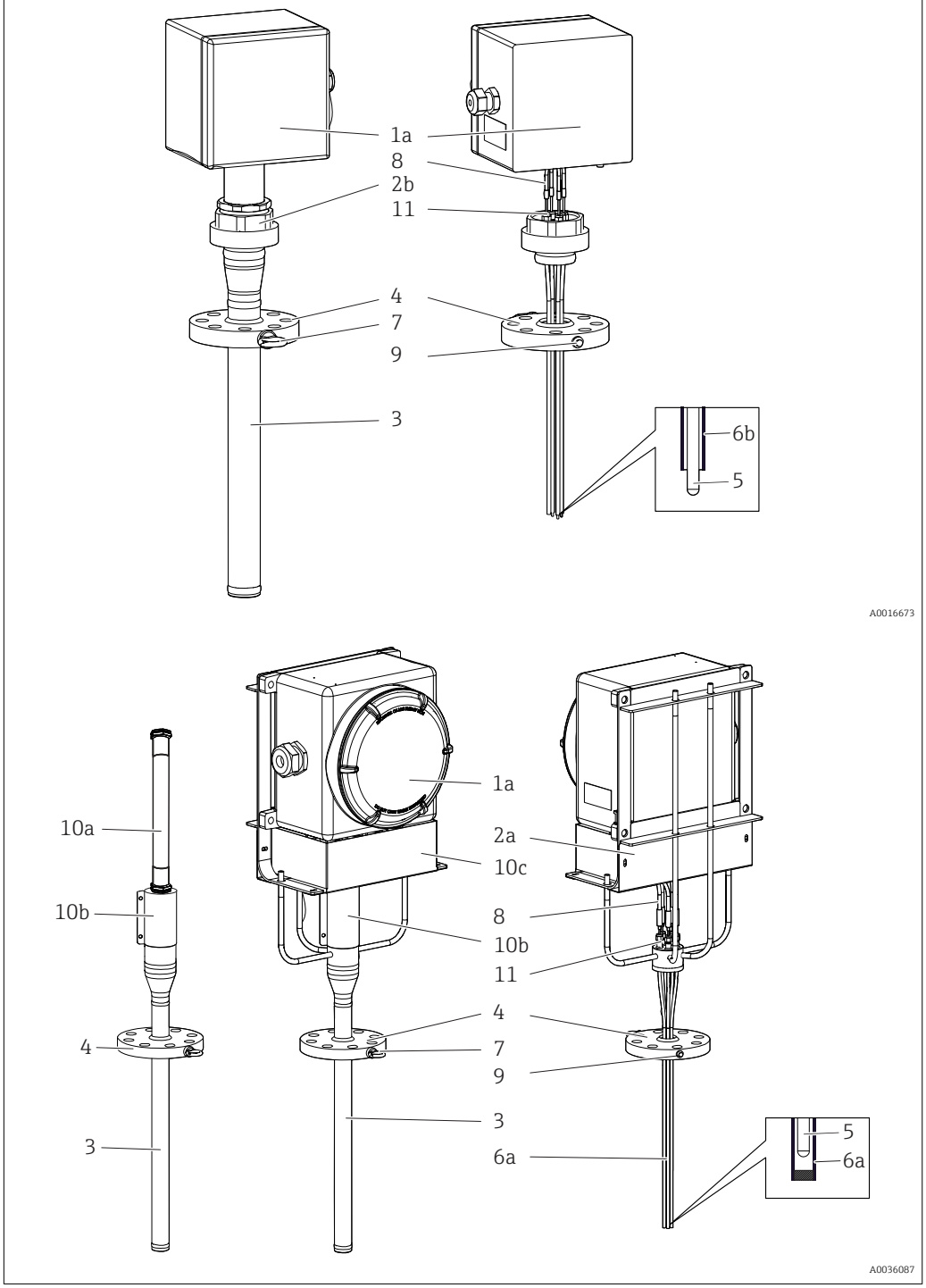
The multipoint thermometer is one of a series of modular products for multipoint temperature measurement. The design enables the individual use of subassemblies and components, making maintenance and spare parts management easy.

It consists of the following main subassemblies:

- **Insert:** Composed of individual metal sheathed measuring elements (thermocouples or RTD resistance sensors) protected by the primary thermowell welded to the process connection. In addition, individual conduits or thermowells allow inserts to be replaced during operating conditions. In this case, the inserts can be treated as individual spare parts and ordered via standard product structures (e.g. TSC310, TST310) or as special inserts. For the specific product structure, please contact your Endress+Hauser specialist.
- **Process connection:** Configured as an ASME or EN flange. It can include a pressure connection and eybolts for lifting the device.
- **Head:** Includes a junction box with the relevant components such as cable glands, draining valves, earth screws, terminals, head transmitters etc.
- **Junction box support frame:** Designed to support the junction box. Two different types are available:
  - Direct mounted support frame
  - Three-part joint
- **Additional accessories:** Can be ordered for any configuration and is particularly recommended for a configuration with replaceable measuring inserts (such as pressure measuring cells, manifolds, valves and connectors).
- **Primary thermowell:** Directly welded to the process connection, designed to ensure a high degree of mechanical protection and corrosion resistance.

In general, the system measures a linear temperature profile inside the process environment. It is also possible to obtain a three-dimensional temperature profile by installing more than one Multisens Linear (either horizontally, vertically or obliquely).

**Structure**



| Description, available options and materials | |
|---|---|
| 1: Head<br>1a: Directly mounted<br>1b: Remote | Junction box with hinged or screwed cover for electrical connections It includes components such as electrical terminals, transmitters and cable glands.<br>▪ 316/316L<br>▪ Aluminum alloys<br>▪ Other materials on request |
| 2: Support system<br>2a: With rods and protection cover | Support frame for explosion proof requirements.<br>316/316L |
| 2b: With three-part joint | Support frame for intrinsically safe requirements.<br>316/316L |
| 3: Primary thermowell | The primary thermowell consists of a tube whose wall thickness is calculated and selected according to international standards. It is designed to protect the sensors against harsh process conditions such as dynamic and static loads and corrosion.<br>It is composed of two main zones, one inside the process and the other one outside of the process (thermowell head). The main thermowell runs through the process connection. At the top end, there is a compression fitting, which enables the replacement of the measuring insert (if possible).<br>▪ 316/316L<br>▪ 321<br>▪ 304/304L<br>▪ 310L |
| 4: Process connection, flanged according to ASME, or EN standards | Represented by a flange according to international standards, or engineered to satisfy specific process requirements→ 16.<br>▪ 316 + 316L<br>▪ 304/304L<br>▪ 310L<br>▪ 321<br>▪ Other materials on request |
| 5: Insert | Mineral-insulated grounded and ungrounded thermocouples or RTDs (Pt100)<br>For details, refer to the 'Ordering information' table. |
| 6 Tip design of:<br>6a: Thermowells | There are thermowells with closed ends that ensure the sensors are held in the correct measuring position in the primary thermowell. The ends of these thermowells can be designed as follows:<br>▪ Welded thermal block discs to ensure optimum heat transfer through the primary thermowell wall and the temperature sensors. The inserts are replaceable.<br>▪ Individual thermal blocks pressed against the internal wall to ensure optimum heat transfer between the primary thermowell and the replaceable temperature sensor.<br>▪ Straight tip.<br>For details, refer to the 'Ordering information' table. |
| 6b: Conduits | There are conduits with open ends that ensure the sensors are held in the correct measuring position in the primary thermowell. The ends of these conduits can be designed as follows:<br>▪ Bimetallic strips that press the sensor against the inner wall of the main thermowell. This contact results in a shorter response time. The inserts are not replaceable.<br>▪ Bent tip. |
| 7: Eyebolt | Lifting device for easy handling during installation phase.<br>SS 316 |
| 8: Extension cables | For electrical connections between the inserts and junction box.<br>▪ Shielded PVC<br>▪ Shielded FEP<br>▪ Unshielded PVC flying leads |
| 9: Optional connection (threaded pressure connection) | Auxiliary connections and fittings for pressure detection. |

| Description, available options and materials | |
|---|---|
| 10: Protections<br>10a: Cable conduit (in case of remote head)<br>10b: Cable conduit cover<br>10c: Extension cable cover | Cable conduit system: made by flexible polyamide to connect the top of the primary thermowell and the remote junction box.<br>Cable conduit cover: consists of two half shields installed between the top of the primary thermowell and the junction box.<br>Extension cable cover: consists of a shaped stainless steel plate fixed to the junction box frame in order to protect the cable connections. |
| 11: Compression fitting | High-performance sleeves to ensure tightness between the upper part of the thermowell and the outside environment. Ideal for a large range of media and rough conditions with high temperatures and pressures. |

# Input

**Measured variable**

Temperature (temperature-linear transmission behavior)

**Measuring range**

*RTD:*

| Input | Description | Measuring range limits |
|---|---|---|
| RTD | WW | −200 to +600 °C (−328 to +1 112 °F) |
| RTD | TF 3 mm | −50 to +250 °C (−58 to +482 °F) |

*Thermocouple:*

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

# 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 measurement accuracy and reliability, when compared to direct wired sensors, as well as reducing both wiring and maintenance costs.

**4 to 20 mA head transmitters**
They offer a high degree of flexibility, thereby supporting universal application with low inventory storage. The iTEMP transmitters can be configured quickly and easily at a PC. Endress+Hauser offers free configuration software which can be downloaded from the Endress+Hauser Website.

**HART® head transmitters**
The iTEMP transmitter is a 2-wire device with one or two measuring inputs and one analog output. The device not only transfers converted signals from resistance thermometers and thermocouples, it also transfers resistance and voltage signals using HART® communication. Swift and easy operation, visualization and maintenance using universal configuration software like FieldCare, DeviceCare or FieldCommunicator 375/475. Integrated Bluetooth® interface for the wireless display of measured values and configuration via Endress +Hauser SmartBlue (app), optional.

**PROFIBUS® PA head transmitters**
Universally programmable iTEMP transmitter with PROFIBUS® PA communication. Conversion of various input signals into digital output signals. High measurement accuracy over the complete ambient temperature range. PROFIBUS PA functions and device-specific parameters are configured via fieldbus communication.

**FOUNDATION Fieldbus™ head transmitter**
Universally programmable iTEMP transmitter with FOUNDATION Fieldbus™ communication. Conversion of various input signals into digital output signals. High measurement accuracy over the complete ambient temperature range. All iTEMP are approved for use in all the main process control systems. The integration tests are performed in Endress+Hauser's 'System World'.

**Head transmitter with PROFINET® and Ethernet-APL™**
The iTEMP 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 iTEMP 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.

**Head transmitter with IO-Link®**
The iTEMP transmitter is an IO-Link® device with a measurement input and an IO-Link® interface. It offers a configurable, simple and cost-effective solution thanks to digital communication via IO-Link®. The device is mounted in a terminal head form B (flat face) as per DIN EN 5044.

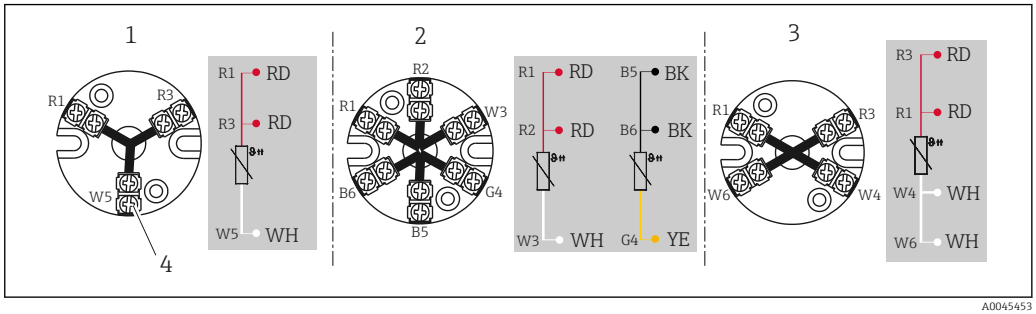
**Advantages of the iTEMP transmitters:**
- Double or single sensor input (optionally for certain transmitters)
- Attachable display (optionally for certain transmitters)
- Unsurpassed reliability, accuracy and long-term stability in critical processes
- Mathematical functions
- Monitoring of the thermometer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

# Power supply

- Electrical connecting cables must be smooth, corrosion resistant, easy to be cleaned and inspected, robust against mechanical stresses, no-humidity sensitivity.
- Grounding or shielding connections are possible via ground terminals on the junction box.

## Wiring diagrams

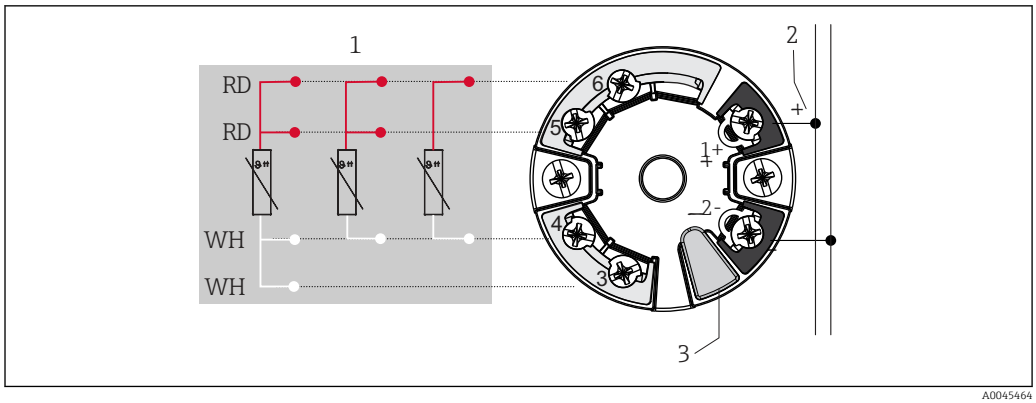
**RTD sensor connection type**




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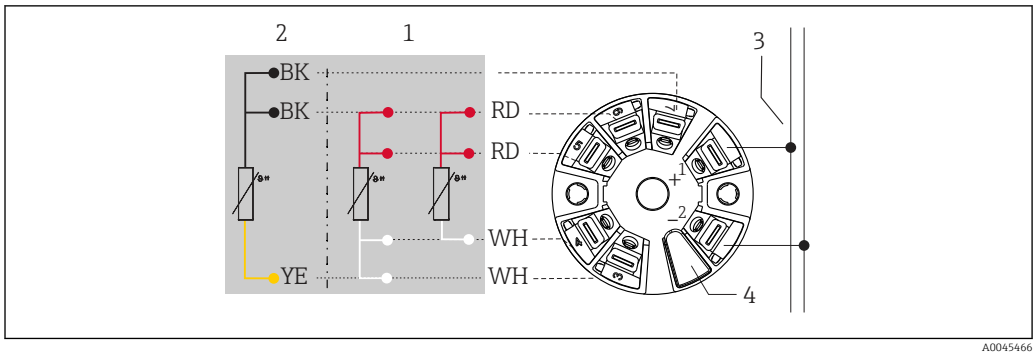
2 *Mounted terminal block*

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




3 *Head-mounted transmitter TMT7x or TMT31 (single input)*

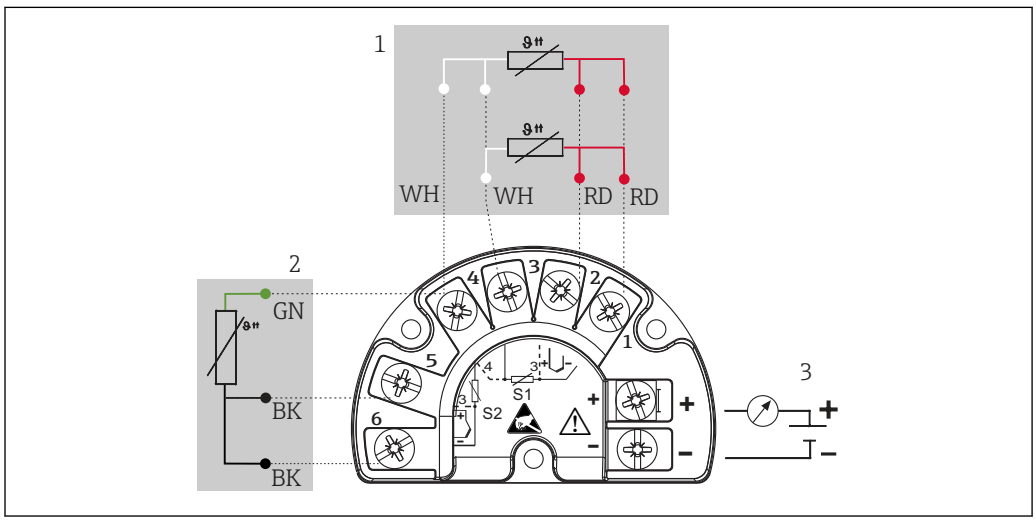
1 *Sensor input, RTD and Ω: 4-, 3- and 2-wire*
2 *Power supply or fieldbus connection*
3 *Display connection/CDI interface*




4 *Head-mounted transmitter TMT8x (dual input)*

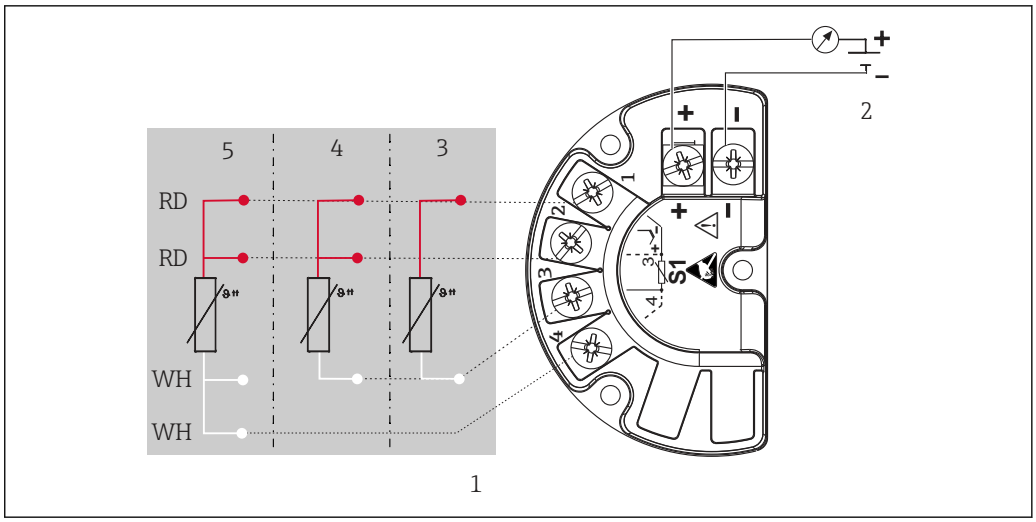
1 *Sensor input 1, RTD: 4- and 3-wire*
2 *Sensor input 2, RTD: 3-wire*
3 *Power supply or fieldbus connection*
4 *Display connection*

**Mounted field transmitter:** Fitted with screw terminals




5 *TMT162 (dual input)*

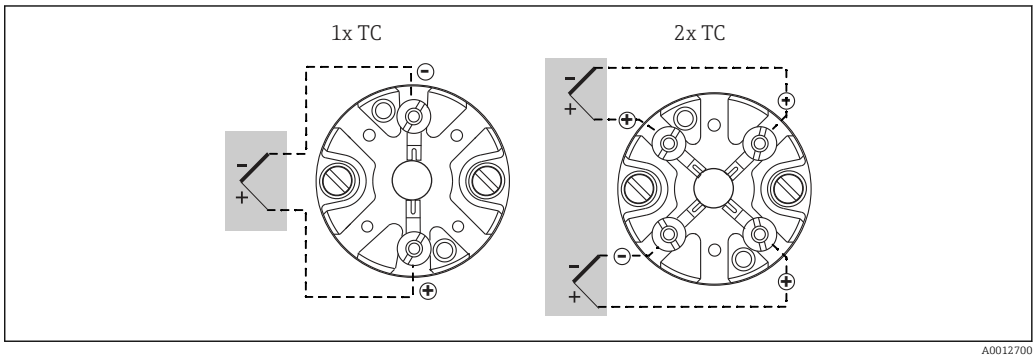
1 *Sensor input 1, RTD: 3- and 4-wire*
2 *Sensor input 2, RTD: 3-wire*
3 *Power supply, field transmitter and analog output 4 to 20 mA or fieldbus connection*




6 *TMT142B (single input)*

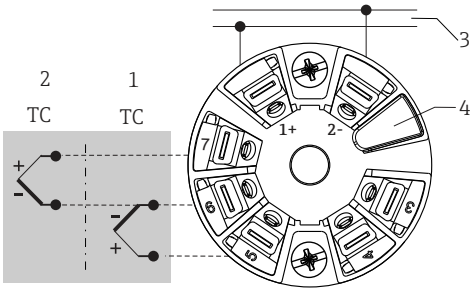
1 *Sensor input RTD*
2 *Power supply, field transmitter and analog output 4 to 20 mA, HART® signal*
3 *2-wire*
4 *3-wire*
5 *4-wire*

### Thermocouple (TC) sensor connection type



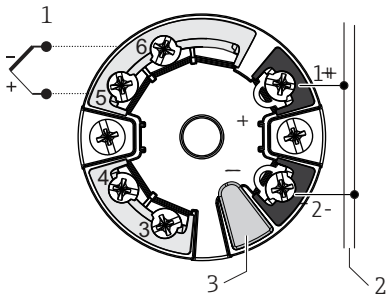

7 *Mounted terminal block*

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



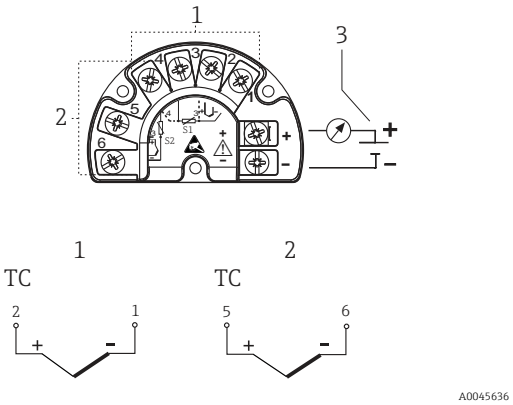

*1 Sensor input 1*
*2 Sensor input 2*
*3 Fieldbus communication and power supply*
*4 Display connection*

**Head-mounted transmitter TMT7x or TMT31 (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 analog output 4 to 20 mA or fieldbus communication*

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

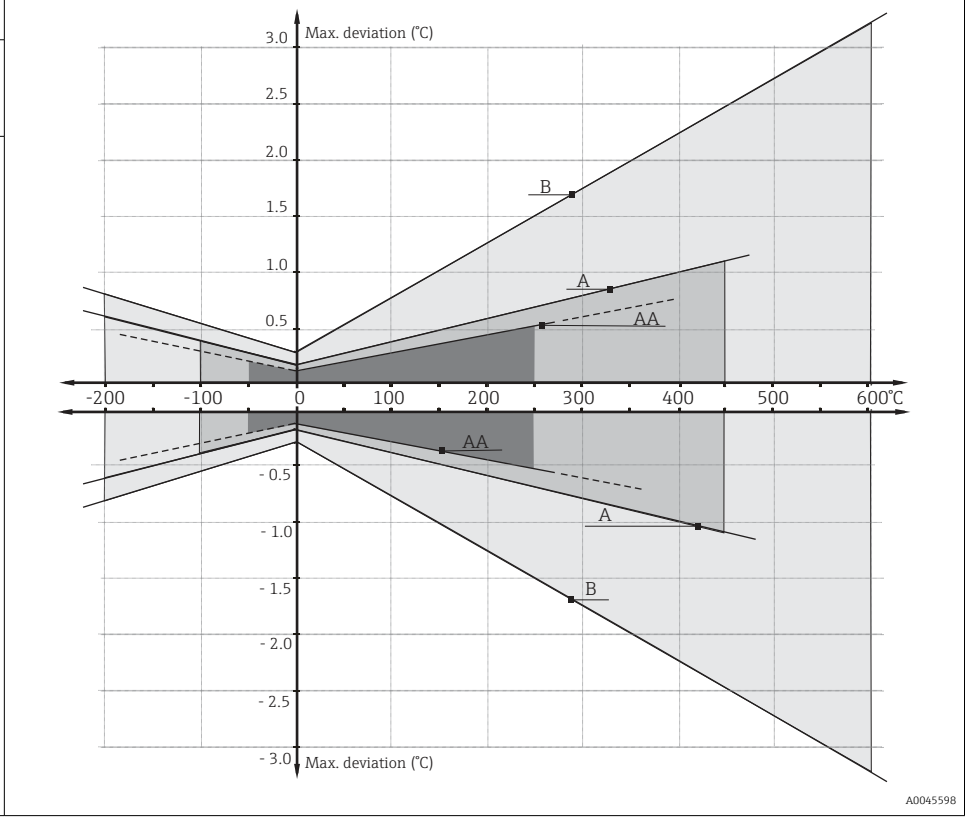
*Thermocouple wire colors*

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

# Performance characteristics

**Maximum measurement error**

RTD resistance thermometer according to IEC 60751

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



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

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

*Temperature ranges*

| Sensor type [1] | Operating temperature range | Class B | Class A | Class AA |
|---|---|---|---|---|
| Pt100 (TF) Standard | −50 to +400 °C (−58 to +752 °F) | 3 mm: −50 to +250 °C (−58 to +482 °F) | −30 to +250 °C (−22 to +482 °F) | 0 to +150 °C (+32 to +302 °F) |
| Pt100 (WW) | −200 to +600 °C (−328 to +1 112 °F) | −200 to +600 °C (−328 to +1 112 °F) | −100 to +450 °C (−148 to +842 °F) | −50 to +250 °C (−58 to +482 °F) |

1) Options depend on product and configuration

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)<br>±0.0075 \|t\| [1] (333 to 750 °C) | 1 | ±1.5 °C (−40 to +375 °C)<br>±0.004 \|t\| [1] (375 to 750 °C) |
| | K (NiCr-NiAl)<br>N (NiCrSi-NiSi) | 2 | ±0.0075 \|t\| [1] (333 to 1200 °C)<br>±2.5 °C (−40 to +333 °C)<br>±0.0075 \|t\| [1] (333 to 1200 °C) | 1 | ±1.5 °C (−40 to +375 °C)<br>±0.004 \|t\| [1] (375 to 1000 °C) |

1) |t| = absolute value in °C

Thermocouples made of base metals are generally supplied so that they comply with the manufacturing tolerances specified in the tables for temperatures > −40 °C (−40 °F). These materials are generally not suitable for temperatures < −40 °C (−40 °F). The tolerances of Class 3 cannot be met. A separate material must be selected for this temperature range. This cannot be handled via the standard product.

| Standard | Type | Tolerance class: Standard | Tolerance class: Special |
|---|---|---|---|
| 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)<br>N (NiCrSi-NiSi) | ±2.2 K or ±0.02 \|t\| [1] (−200 to 0 °C)<br>±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 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 handled via the standard product.

## Response time

Response time for the sensor assembly without transmitter. When response time of the complete assembly is requested (including primary thermowell), a dedicated calculation depending on the sensor layout will be preformed.

### RTD

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

| Insert diameter | Response time | |
|---|---|---|
| Example: with a thermowell thickness of 3.6 mm (0.14 in), bent conduit design | $t_{90}$ | 108 s |

### Thermocouple (TC)

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

| Insert diameter | Response time | |
|---|---|---|
| Example: with a thermowell thickness of 3.6 mm (0.14 in), bent conduit design | $t_{90}$ | 52 s |

**Shock and vibration resistance**

- RTD: 3G/10 to 500 Hz in accordance with IEC 60751
- TC: 4G/2 to 150 Hz in accordance with IEC 60068-2-6

**Calibration**

Calibration is a service that can be performed on each individual insert, either during the ordering phase or after installation of the multipoint thermometer (only in case of replaceable sensors).

If calibration is to be performed after the multipoint thermometer is installed, please contact the Endress+Hauser service to get full 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 forbidden to unscrew any threaded components at the process connection under operating conditions (running process), without knowing the pressure inside the primary thermowell.

During calibration, the measured values recorded by the measuring elements of the multipoint inserts (DUT = device under test) are compared with the measured values of a more precise calibration standard, using a defined and repeatable measuring procedure. The aim is to determine the deviation of the DUT measured values from the true value of the measured variable.

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

**Evaluation of inserts**

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

# Installation

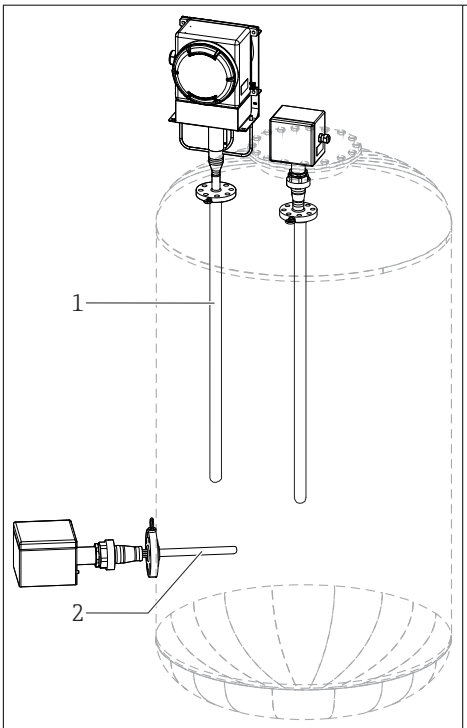
**Installation location**

The installation location must meet the requirements listed in this document – such as 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 horizontally, at an angle or vertically. Three-dimensional temperature profiling can be achieved in various ways:

- longitudinally (1) into the reactor
- by installing the multipoint thermometer system in a horizontal (2) or angled direction.



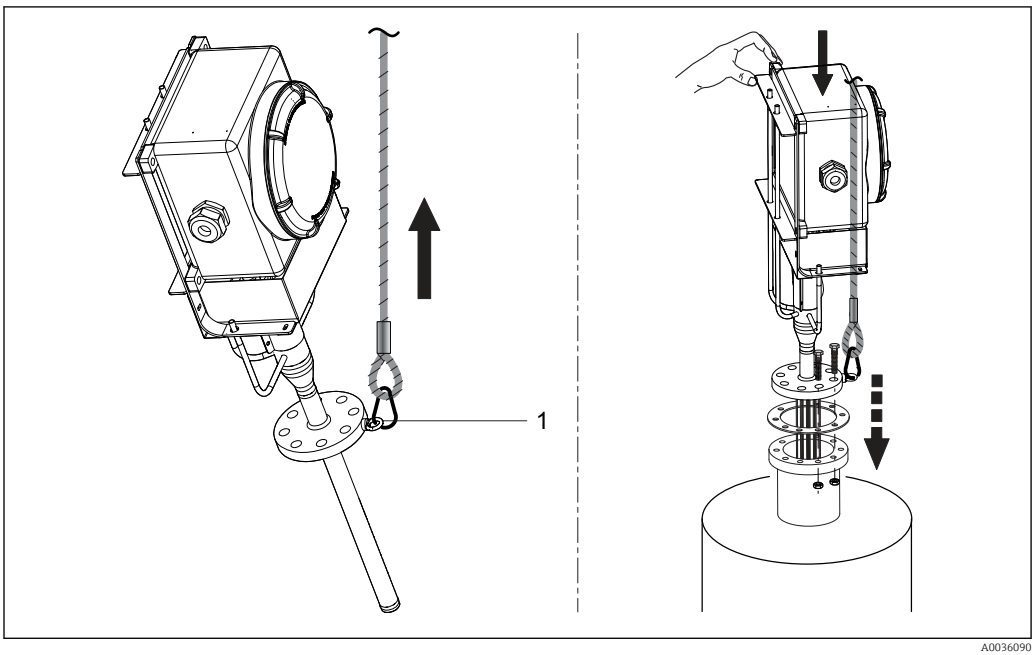

Vertical configuration (1):
The individual inserts are arranged in a straight line corresponding to the longitudinal axis of the vessel (linear multipoint measurement).
Radial configuration (2):
The individual inserts are arranged in a straight line running horizontally inside the vessel (at the level of the process connection). Adequate support systems must be provided.
Angled orientation:
The individual inserts are arranged in a straight line running horizontally inside the vessel (at the level of the process connection). Adequate support systems must be provided.

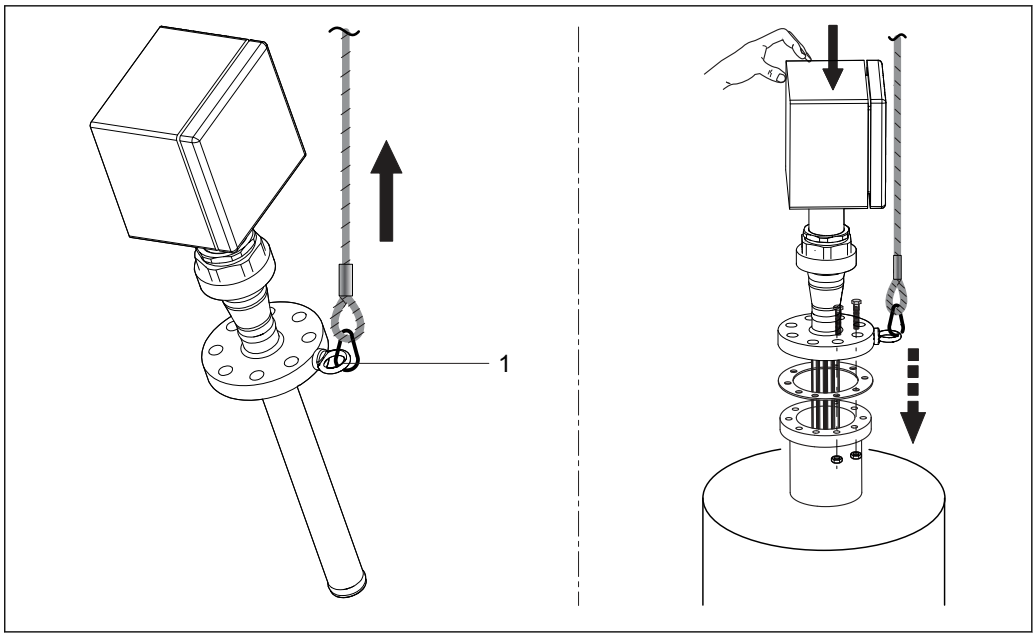
**Installation instructions**

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 must be handled with care. During installation, any lifting and insertion of the device must be performed through the existing nozzle, and the following must be avoided:

- Misalignment with the nozzle axis
- Any load on the welded or threaded parts caused by the weight of the device
- Deformation or crushing of the threaded components, bolts, nuts, cable glands and compression fittings
- Friction between the primary thermowell and the components inside the reactor
- Attaching the primary thermowell to the reactor structure in a way that prevents axial displacement or movement

If the existing reactor structure cannot be used for attachment, Endress+Hauser can provide special support components with minimal dimensions to achieve the desired measuring points.






During installation, the complete thermometer may only be lifted or moved using ropes that are properly attached to the flange eye bolt (1) or carefully to the thermowell.

# Environment

**Ambient temperature range**

| Junction box | Non-hazardous area | Hazardous area |
|---|---|---|
| Without mounted transmitter | −50 to +85 °C (−58 to +185 °F) | −50 to +60 °C (−58 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. |
| With mounted multi-channel transmitter | −40 to +85 °C (−40 to +185 °F) | −40 to +70 °C (−40 to +158 °F) |

**Storage temperature**

| Junction box | |
|---|---|
| With head transmitter | −50 to +100 °C (−58 to +212 °F) |
| With multi-channel transmitter | −40 to +80 °C (−40 to +176 °F) |
| With DIN rail transmitter | −40 to +100 °C (−40 to +212 °F) |

**Humidity**

Condensation according to IEC 60068-2-33:
- 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

**Electromagnetic compatibility (EMC)**

Depending on the head 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 +816 °C (+1 501 °F) (Based on standard process connection materials).

Process connection flanges with their specific ratings, selected according to the plant requirements, define the maximum process conditions, which the device has to operate.

**Process pressure range**

0 to 240 bar (0 to 3 481 psi)

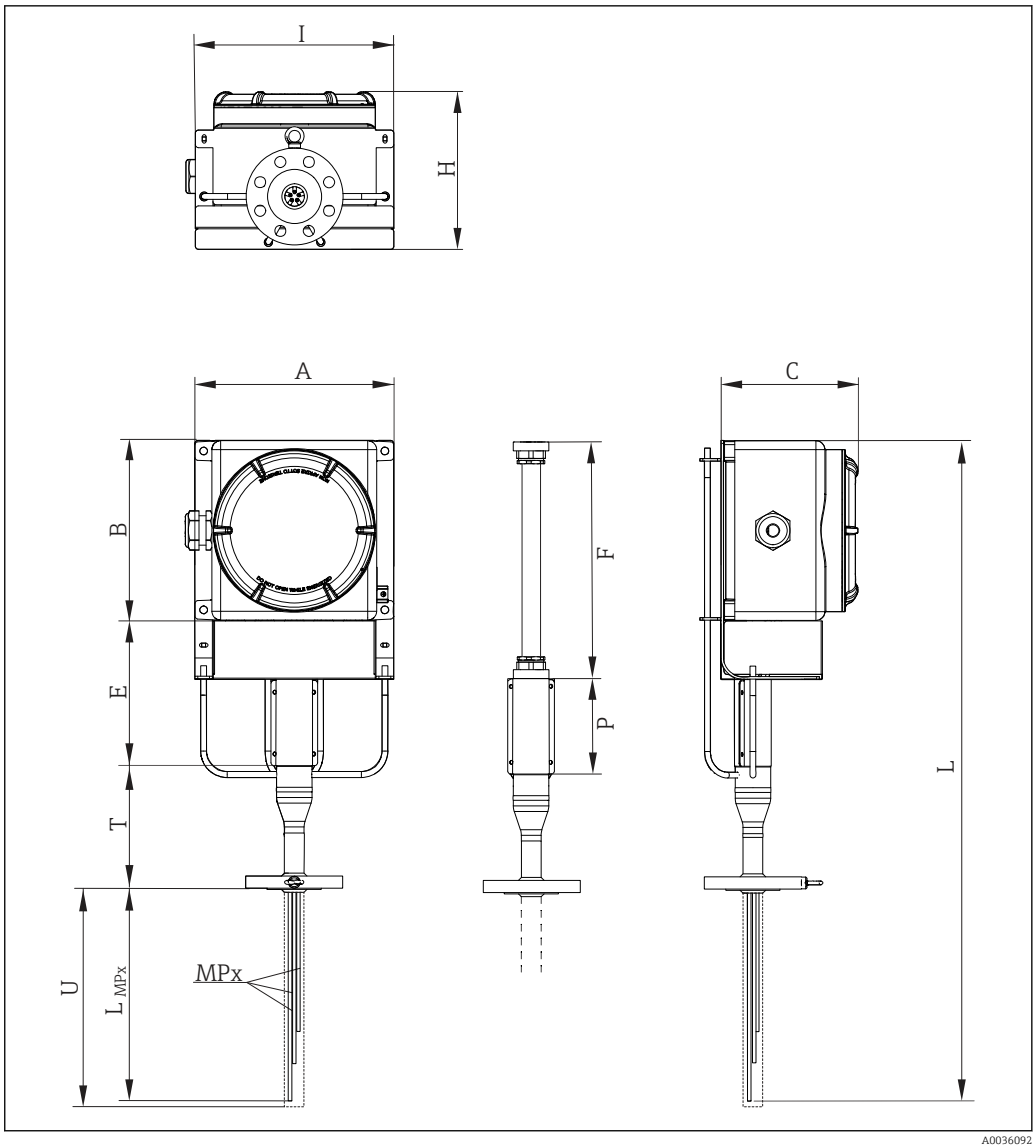
Anyhow, the maximum required process pressure has to be combined with the maximum design process temperature. Process connections like compression fittings, flanges with their specific ratings, thermowells, selected according to the plant requirements, define the maximum process conditions at which the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

Process applications:
- Atmospheric/Vacuum Distillation
- Catalytic Cracking/Hydrocracking
- Catalytic reforming
- Hydrodesulphurization
- N-based inorganics
- Ammonia
- Urea
- NGTL
- Distillation units and hydrogenation

# Mechanical construction

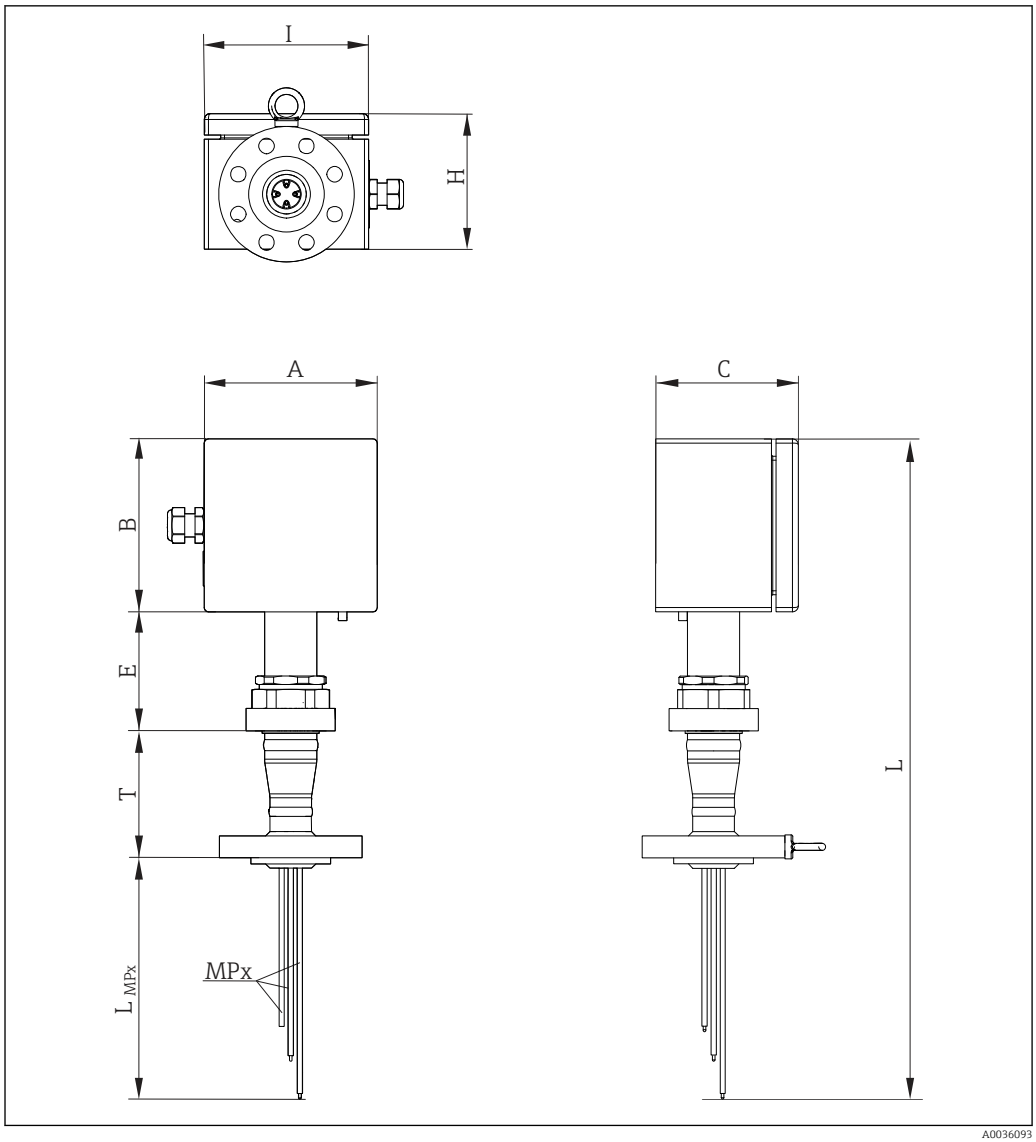
**Design, dimensions**

The multipoint thermometer is composed of different sub-assemblies. Different inserts are available for specific process conditions to ensure maximum accuracy and long service life. The primary thermowell should be selected accordingly in order to increase mechanical strength and corrosion resistance. Associated shielded extension cables are available 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 achieved using specially sealed bushings, thus ensuring the specified degree of protection.




8 *Design of the modular multipoint thermometer, with support frame. All dimensions in mm (in)*

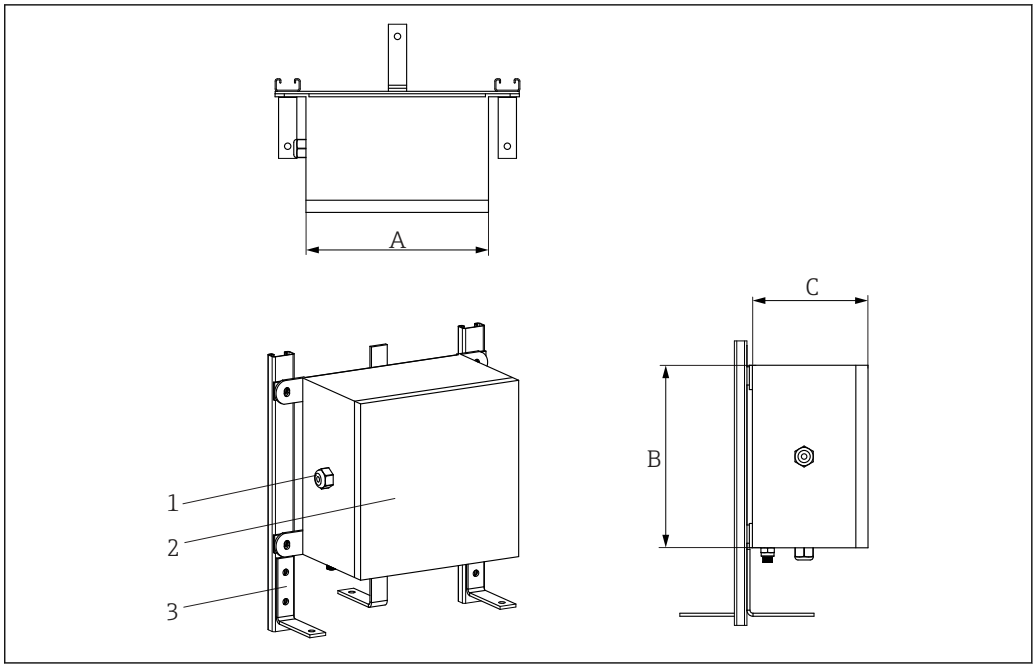
*A, B, Dimensions of the junction box, see following figure*
*C*
*MPx Number and distribution of measuring points: MP1, MP2, MP3 etc.*
*$L_{MPx}$ Immersion length of measuring elements or thermowells*
*I, H Frame of the junction box and support system*
*E Extension length*
*L Device length*
*T Lag length*
*U Immersion length*
*P Protection: 250 mm*
*F Flexible hose length*




*9 Design of the modular multipoint thermometer, with tube neck design. All dimensions in mm (in)*

*A, B, Dimensions of the junction box, see following figure*
*C*
*MPx Number and distribution of measuring points: MP1, MP2, MP3 etc.*
*$L_{MPx}$ Immersion length of measuring elements or thermowells*
*I, H Frame of the junction box and support system*
*E Extension length*
*L Device length*
*T Lag length*
*U Immersion length*

**Junction box**




*1 Cable glands*
*2 Junction box*
*3 Frame*

The junction box is suitable for environments in which chemical substances are used. Sea water corrosion resistance and extreme temperature variation stability is guaranteed. Ex-e, Ex-i terminals can be installed.

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

| A | B | C |
|---|---|---|
| 150 (5.9) | 150 (5.9) | 100 (3.93) |
| 200 (7.87) | 200 (7.87) | 160 (6.29) |
| 270 (10.6) | 270 (10.6) | 160 (6.29) |
| 270 (10.6) | 350 (13.78) | 160 (6.29) |
| 350 (13.78) | 350 (13.78) | 160 (6.3) |
| 350 (13.78) | 500 (19.68) | 160 (6.3) |
| 500 (19.68) | 500 (19.68) | 160 (6.3) |
| 280 (11.02) | 305 (12) | 228 (8.98) |
| 420 (16.53) | 420 (16.53) | 285 (11.22) |
| 332 (13.07) | 332 (13.07) | 178 (7) |
| 330 (12.99) | 495 (19.49) | 171 (6.73) |

| Type of specification | Junction box | Cable glands |
|---|---|---|
| Material | AISI 316/aluminum | NiCr-coated brass<br>AISI 316/316L |
| Degree of protection (IP) | IP66/67 | IP66 |
| Ambient temperature | −50 to +60 °C<br>(−58 to +140 °F) | −52 to +110 °C (−61.1 to +140 °F) |
| Device approvals | ATEX approval for use in hazardous area | ATEX approval for use in hazardous area |

| Type of specification | Junction box | Cable glands |
|---|---|---|
| Identification | ▪ ATEX II 2GD Ex e IIC/ Ex ia Ga IIC Ex tb IIIC Db T6/T5/T4<br>▪ IECEX II 2GD Ex e IIC/ Ex ia Ga IIC Ex tb IIIC Db T6/T5/T4<br>▪ IECEX II 2GD Ex e IIC/ Ex ia Ga IIC Ex tb IIIC Db T6/T5/T4<br>▪ ATEX II 2GD Ex d IIC T6-T3/Ex tDA21 IP66 T85oC-T200oC<br>▪ IECEX II 2GD Ex d IIC T6-T3/ Ex tDA21 IP66 T85oC-T200oC<br>▪ UL913 Class I, Division 1 Groups B, C, D T6/T5/T4<br>▪ FM3610 Class I, Division 1 Groups B, C, D T6/T5/T4<br>▪ CSA C22.2 No. 157 Class I, Division 1 Groups B, C, D T6/T5/T4 | → 21 |
| Cover | Hinged and threaded | - |
| Maximum sealing diameter | - | 6 to 12 mm (0.24 to 0.47 in) |

### Support system

For a directly mounted junction box, a modular system or a union nut is provided.

This ensures the connection between the head of the primary thermowell and the junction box. The system design ensures easy access for monitoring and maintaining inserts and extension cables. Rods and a protective cover provide a rigid connection for the junction box and are vibration-resistant. No closed volumes are present in the frame design although it allows protection to the cables. This avoids the accumulation of waste and potentially dangerous fluids coming from the environment that can damage the instrumentation allowing continuous ventilation.

For the design with a three-piece gland, the junction box can be aligned. The extension cables also remain accessible, as the connection can be removed.

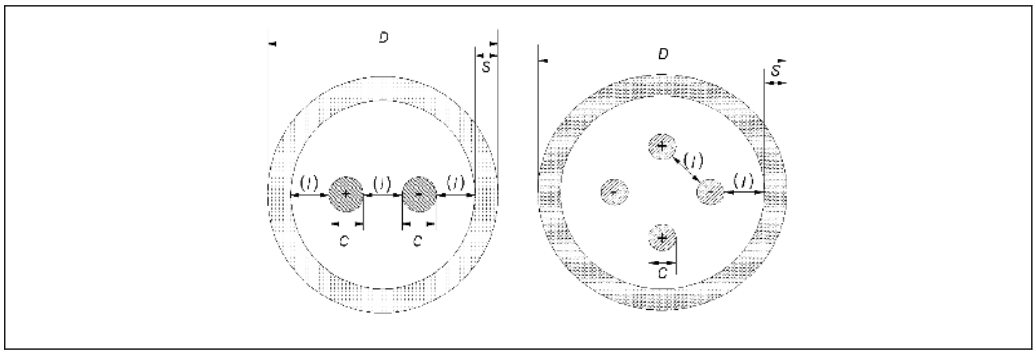
### Inserts, conduits and thermowells

*Thermocouple*

| Diameter in mm (in) | Type | Standard | Measuring point type | Sheath material |
|---|---|---|---|---|
| 3 (0.12) | 1x type K<br>2x type K<br>1x type J<br>2x type J<br>1x type N<br>2x type N | IEC 60584 /ASTM E230 | Grounded/Ungrounded | Alloy600 / AISI 316L / Pyrosil |

*Conductor thickness*

| Sensor type | Diameter in mm (in) | Wall thickness | Min. sheath wall thickness (S) | Min. conductor diameter (C) |
|---|---|---|---|---|
| Single thermocouple | 3 mm (0.11 in) | Standard | 0.3 mm (0.01 in) | 0.45 mm = 25 AWG |
| Double thermocouple | 3 mm (0.11 in) | Standard | 0.27 mm (0.01 in) | 0.33 mm = 28 AWG |




A0035318

*RTD*

| Diameter in mm (in) | Type | Standard | Sheath material |
|---|---|---|---|
| 3 (0.12) | 1x Pt100 WW/TF | IEC 60751 | AISI 316L |

*Thermowells or conduits*

| External diameter in mm (in) | Sheath material | Type | Thickness in mm (in) |
|---|---|---|---|
| 6 (0.24) | AISI 316L | Closed or open | 0.5 (0.02)or<br>1 (0.04) |
| 8 (0.32) | AISI 316L | Closed or open | 1 (0.04) |

### Sealing components

The sealing components (compression fittings) are welded on the thermowell head to guarantee proper tightness under all the foreseen operating conditions and to allow the maintenance/ replacement of the sensors (when applicable).

Material: AISI 316/AISI 316H

### Cable glands

Installed cable glands provide the proper level of reliability under the mentioned ambient and operating conditions.

| Material | Identification | IP protection class | Ambient T range | Max. sealing diameter |
|---|---|---|---|---|
| NiCr-coated brass | Atex II 2/3 GD Ex d IIC, Ex e II, Ex nR II, Ex tD A21 IP66 | IP66 | −52 to +110 °C<br>(−61.6 to +230 °F) | 6 to 12 mm<br>(0.23 to 0.47 in) |
| AISI 316/ AISI 316L | Atex II 2G, II 1D, Ex d IIC Gb, Ex e IIC Gb, Ex ta IIIC Da, II 3G Ex nR IIC Gc | IP66 | −52 to +110 °C<br>(−61.6 to +230 °F) | 6 to 12 mm<br>(0.23 to 0.47 in) |

### Diagnostic function

Reactors in which the multipoint assembly operates are typically subject to harsh conditions in terms of pressure, temperature, corrosion, and dynamics of the process fluids. Thanks to the pressure port, possible leaks (or the permeation of gases) that pass the primary thermowell can be detected and monitored. This enables planning for maintenance.

## Weight

The weight can vary based upon the configuration, depending on the junction box and the frame design. The approximate weight of a typically configured multipoint thermometer (number of inserts = 12, main body = 3", medium size junction box) = 30 kg (66.1 lb).

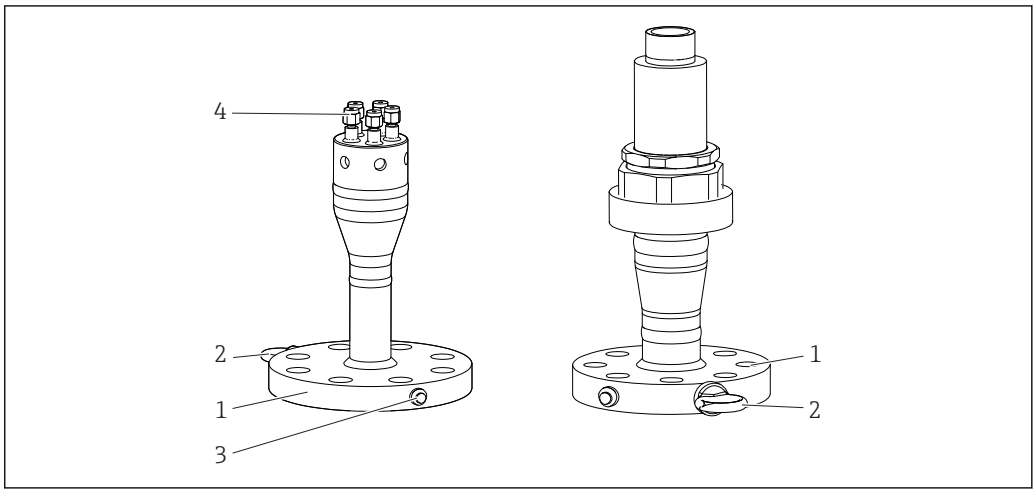
The device must only be lifted and moved using the eyebolt, which is part of the process connection.

**Materials**

The listed material properties have to be taken into account when selected for wetted parts:

| Material name | Short form | Recommended max. temperature for continuous use in air | Properties |
|---|---|---|---|
| AISI 316/1.4401 | X2CrNiMo17-12-2 | 650 °C (1 202 °F) | ▪ Austenitic stainless steel<br>▪ High corrosion resistance in general<br>▪ 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<br>▪ High corrosion resistance in general<br>▪ 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)<br>▪ Increased resistance to intergranular corrosion and pitting<br>▪ Compared to 1.4404, 1.4435 has even higher corrosion resistance and a lower delta ferrite content |
| INCONEL® 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.<br>▪ Resistant to corrosion caused by chlorine gas and chlorinated media as well as many oxidizing mineral and organic acids, sea water etc.<br>▪ Corrosion from ultrapure water.<br>▪ Not to be used in a sulfur-containing atmosphere. |
| AISI 304/1.4301 | X5CrNi18-10 | 850 °C (1 562 °F) | ▪ Austenitic stainless steel<br>▪ Suitable for use in water and wastewater with low contamination<br>▪ Resistant to organic acids, saline solutions, sulphates, alkaline solutions, etc. at relatively low temperatures only |
| AISI 316Ti/ 1.4571 | X6CrNiMoTi17-12-2 | 700 °C (1 292 °F) | ▪ Properties comparable to AISI316L.<br>▪ Addition of titanium means increased resistance to intergranular corrosion even after welding<br>▪ Broad range of uses in the chemical, petrochemical and oil industries as well as in coal chemistry<br>▪ Can only be polished to a limited extent, titanium streaks can form |
| AISI 321/1.4541 | X6CrNiTi18-10 | 815 °C (1 499 °F) | ▪ Austenitic stainless steel<br>▪ High resistance to intergranular corrosion even after welding<br>▪ Good welding characteristics, suitable for all standard welding methods<br>▪ It is used in many sectors of the chemical industry, petrochemical, and pressurized vessels |
| AISI 347/1.4550 | X6CrNiNb10-10 | 800 °C (1 472 °F) | ▪ Austenitic stainless steel<br>▪ High resistance in a wide variety of environments in the chemical, textile, oil refining, dairy and food industries<br>▪ Added niobium makes this steel impervious to intergranular corrosion<br>▪ Good weldability<br>▪ Main applications are furnace fire walls, pressure vessels, welded structures, turbine blades |

## Process connection




*10 Flange as process connection*

*1 Flange*
*2 Eyebolt*
*3 Pressure port*
*4 Compression fittings*

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

| Standard [1] | Size | Rating | Material |
|---|---|---|---|
| ASME | 1 1/2", 2", 3" | 150#, 300#, 400#, 600#, 900# | AISI 316/L, 304/L, 310L, 321 |
| EN | DN40, DN50, DN80 | PN10, PN16, PN25, PN 40, PN 63, PN100, PN150 | 316/1.4401, 316L/1.4404, 321/1.4541, 310L/1.4845, 304/1.4301, 304L/ 1.4307 |

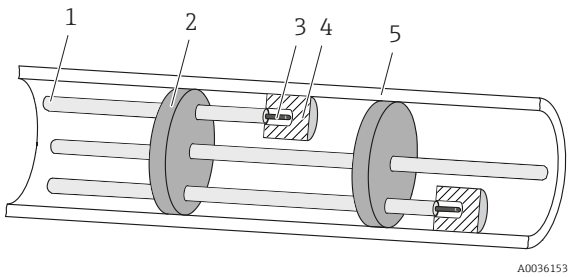
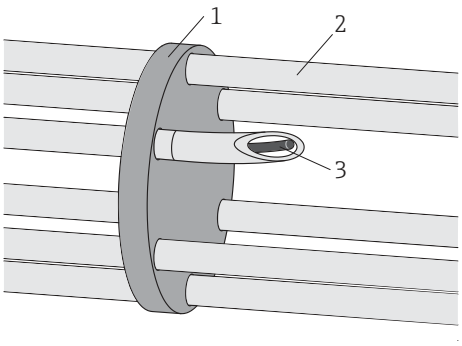
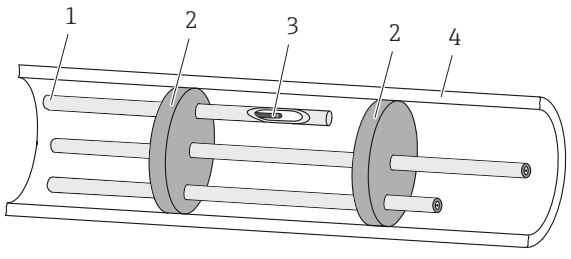
1) Flanges according to GOST standard are available on request.

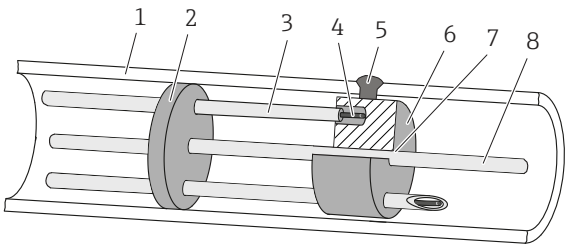
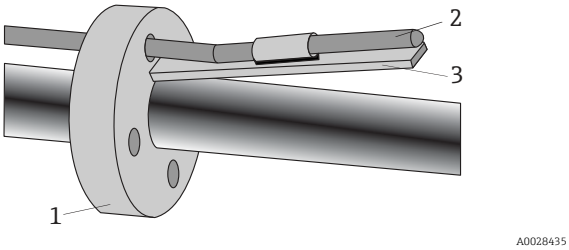
## Compression fittings

The compression fittings are welded onto the thermowell head to enable sensor replacement. Dimensions correspond to the insert dimensions. Compression fittings comply with the highest standards of reliability in terms of materials and performance required.

| | |
|---|---|
| **Material** | AISI 316/316H |

**Thermal contact components**

| | |
|---|---|
| A: Thermal contact block<br><br><br>A0036153<br>*1 Conduit*<br>*2 Centering stars*<br>*3 Insert*<br>*4 Thermal block*<br>*5 Primary thermowell wall* | The thermal blocks are forced against the internal wall to ensure the optimal heat transfer between the primary thermowell and the replaceable temperature sensor |
| B: Bent conduits and spacers<br><br><br>A0028783<br>*1 Centering stars*<br>*2 Conduit*<br>*3 Insert* | ▪ Allow sensor replacement<br>▪ Ensures thermal contact between the sensor tip and the thermowell |
| C: Thermowells and centering stars<br><br><br>A0036632<br>*1 Thermowell*<br>*2 Centering stars*<br>*3 Insert*<br>*4 Primary thermowell wall* | Each sensor is protected by its thermowell with straight tip. |

| | |
|---|---|
| D: Thermal block disc (welded to the primary thermowell)<br><br><br>*1 Primary thermowell wall*<br>*2 Centering stars*<br>*3 Conduit*<br>*4 Insert*<br>*5 Welded contact*<br>*6 Thermal block disc*<br>*7 Welding seam*<br>*8 Supporting rod* | ▪ Ensure the optimal heat transfer thorough the primary thermowell wall and the temperature sensors. The inserts are replaceable.<br>▪ The inserts are replaceable. |
| E: Bimetallic stripes<br><br><br>*11 Bimetallic strips with or without conduits*<br>*1 Conduit*<br>*2 Insert*<br>*3 Bimetallic strips* | ▪ Does not allow sensor replacement<br>▪ Ensures thermal contact between the sensor tip and the thermowell by means of bimetallic strips that are activated by temperature difference<br>▪ No friction during installation, even with sensors already installed |

# 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

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**.

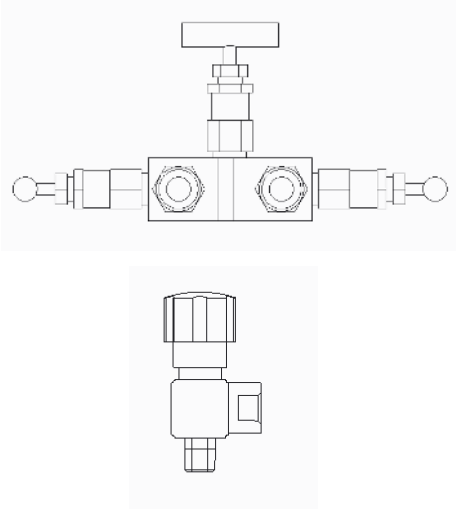
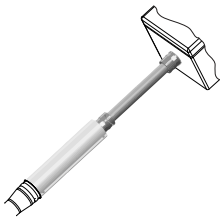
**Product Configurator - the tool for individual product configuration**
- Up-to-the-minute configuration data
- Depending on the device: direct input of information specific to the measuring point, such as the measuring range or operating language
- Automatic verification of exclusion criteria
- Automatic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

# 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 |
|---|---|
| Tags | Nameplate can be applied to identify each measuring point and the whole thermometer. Tags can be placed on the extension cables in the extension area and/or in to the junction box on individual wires or on other device. |
| Pressure transducer | Digital or analog pressure transmitter with welded metallic measuring cell for measurement in gases, steam or liquids.<br>Refer to the Endress+Hauser PMP sensor family |
| <br>Fitting/manifolds/valves | Fitting, manifolds and valves are available for mounting the pressure transmitter on the pressure port, and for continuous monitoring of the device under operating conditions. |
| <br>Remote cable conduit system | Consists of a polyamide cable conduit to connect the top end of the thermowell with the detached junction box, which already has a molded stainless steel cover. This is secured to the frame of the junction box, to protect the cable connections. |

## Communication-specific accessories

| | |
|---|---|
| Configuration kit TXU10 | Configuration kit for PC-programmable transmitter with setup software and interface cable for PC with USB port<br>Order code: TXU10-xx |
| Commubox FXA195 HART | For intrinsically safe HART communication with FieldCare via the USB interface.<br>For details, see "Technical Information" TI00404F |
| Commubox FXA291 | Connects Endress+Hauser field devices with a CDI interface (= Endress+Hauser Common Data Interface) and the USB port of a computer or laptop.<br>For details, see "Technical Information" TI00405C |

| | |
|---|---|
| HART loop converter HMX50 | Is used to evaluate and convert dynamic HART process variables to analog current signals or limit values.<br>For details, see "Technical Information" TI00429F and Operating Instructions BA00371F |
| Wireless HART adapter SWA70 | Is used for the wireless connection of field devices.<br>The WirelessHART adapter can be easily integrated into field devices and existing infrastructures, offers data protection and transmission safety and can be operated in parallel with other wireless networks with minimum cabling complexity.<br>For details, see Operating Instructions BA061S |
| Fieldgate FXA320 | Gateway for the remote monitoring of connected 4-20 mA measuring instruments via a web browser.<br>For details, see "Technical Information" TI00025S and Operating Instructions BA00053S |
| Fieldgate FXA520 | Gateway for the remote diagnostics and remote configuration of connected HART measuring instruments via a Web browser.<br>For details, see "Technical Information" TI00025S and Operating Instructions BA00051S |
| Field Xpert SFX100 | Compact, flexible and robust industry handheld terminal for remote configuration and for obtaining measured values via the HART current output (4-20 mA).<br>For details, see Operating Instructions BA00060S |

### Service-specific accessories

| Accessories | Description |
|---|---|
| Applicator | Software for selecting and sizing Endress+Hauser devices:<br>▪ Calculation of all the necessary data for identifying the optimum device: e.g. pressure loss, accuracy or process connections.<br>▪ Graphic illustration of the calculation results<br>Administration, documentation and access to all project-related data and parameters over the entire life cycle of a project.<br>Applicator is available:<br>Via the Internet: https://portal.endress.com/webapp/applicator |
| FieldCare SFE500 | FDT-based plant asset management tool from Endress+Hauser.<br>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.<br>For details, see Operating Instructions BA00027S and BA00065S |

# Documentation

The following document types are available in the Downloads area of the Endress+Hauser website (www.endress.com/downloads), depending on the device version:

| Document type | Purpose and content of the document |
|---|---|
| Technical Information (TI) | **Planning aid for your device**<br>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**<br>The Brief Operating Instructions contain all the essential information from incoming acceptance to initial commissioning. |

| Document type | Purpose and content of the document |
|---|---|
| Operating Instructions (BA) | **Your reference document**<br>The 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. |
| Description of Device Parameters (GP) | **Reference for your parameters**<br>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. |
| Safety instructions (XA) | Depending on the approval, safety instructions for electrical equipment in hazardous areas are also supplied with the device. These are an integral part of the Operating Instructions.<br>The nameplate indicates which Safety Instructions (XA) apply to the device. |
| 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. |




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