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Technical Information
iTHERM TMS11 MultiSens Linear

Modular linear TC and RTD multipoint thermometer with primary thermowell

Application

- Easy-to-use thermometer with modular design, provided with its own primary thermowell and ready to be installed
- Specifically designed for Oil & Gas and Petrochemical processing industries
- Measuring range:
  - RTD insert (RTD): −200 to 600 °C (−328 to 1 112 °F)
  - Thermocouple (TC): −270 to 1 100 °C (−454 to 2 012 °F)
- Static pressure range: Up to 240 bar (3 481 psi). Specific maximum pressure achievable depending on process type and temperature
- Degree of protection: IP66/67
- For installation in a container, reactor, tank, or similar

Your benefits

- High degree of customization thanks to a modular product design for easy installation, process integration and maintenance
- Easy integration due to inserts according to standards as per standard IEC 60584, ASTM E230 and IEC 60751
- Electrical and Pressure Directive compliance for an easy and fast process integration
- Compliance to different types of protection for use in hazardous locations for a wide and easy process integration
- Possibility to individually replace inserts, even in operating conditions
- Superior mechanical strength thanks to a primary thermowell for temperature sensors protection in a wide range of process conditions
- Increased safety due to the possibility to continuously monitor the integrity of the thermowell thanks to a pressure port during operating conditions

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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 temperature detector (RTD)

The resistance temperature detectors 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 RTD assemblies:

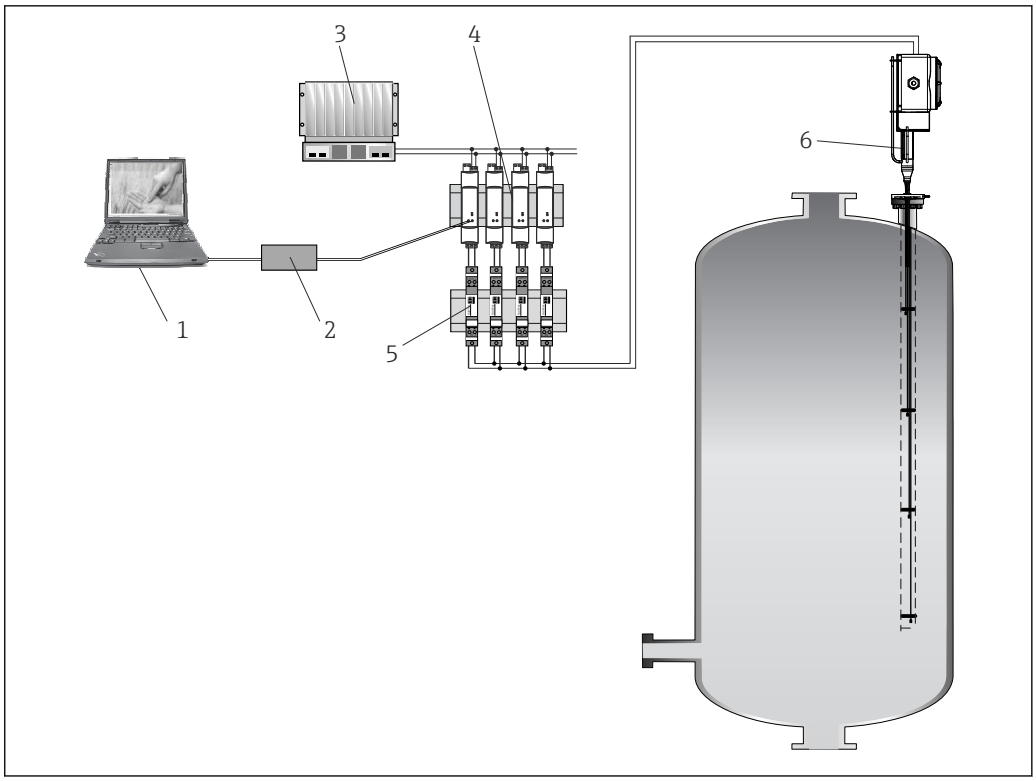
- **Wire-wound (WW):** In these thermometers, a double coil of fine, high-purity platinum wire is located in a ceramic support. This support is then sealed top and bottom with a ceramic protective layer. Such RTD assemblies not only facilitate very reproducible measurements but also offer good long-term 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).

Measurement 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.

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

Device architecture

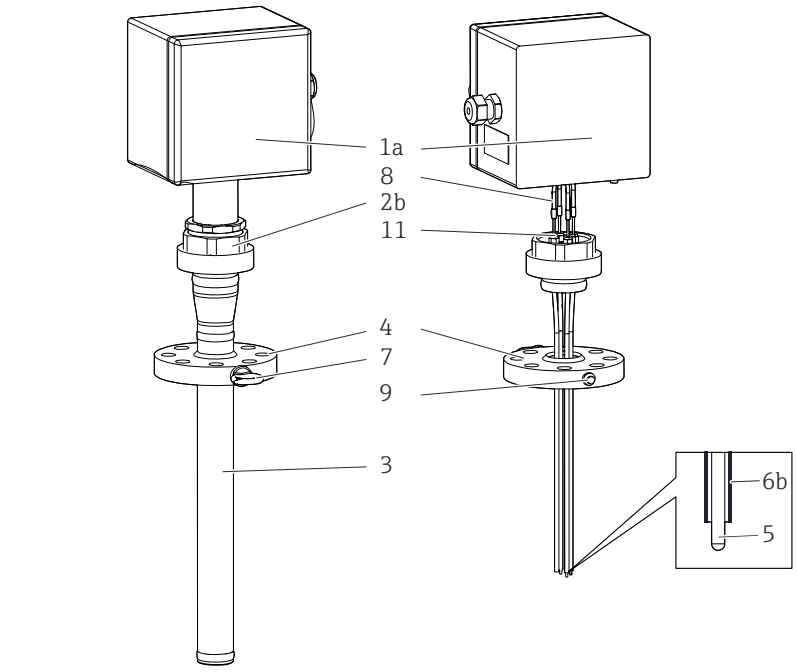
The multipoint thermometer is one of a series of modular products for multipoint temperature measurement. The design enables the individual use of subassemblies and components, making maintenance and spare parts management easy.

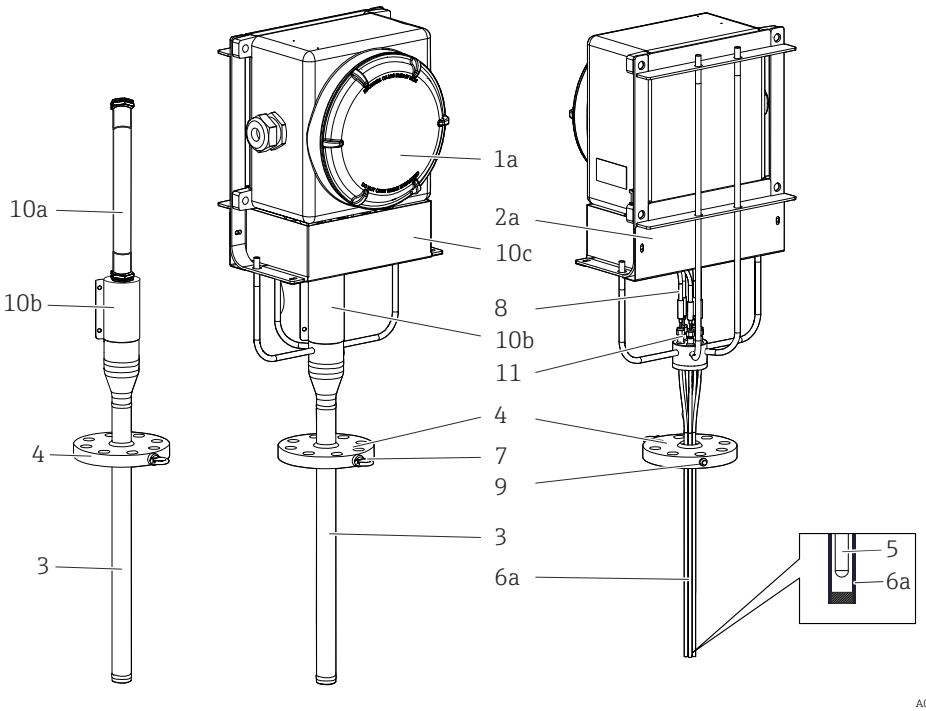
It consists of the following main sub-assemblies:

- **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 themowells allow inserts to be replaced during operating conditions. In this case, the measuring inserts can be treated as individual spare parts and ordered using standard ordering structures (e.g. TSC310, TST310) or as special measuring inserts. For the specific order code please contact your Endress+Hauser specialist.
- **Process connection:** Represented by an ASME or EN flange. It can be provided with pressure port and it might be provided with ring bolts 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.
- **Junction box support frame:** It is designed to support the junction box. Two different types are available:
  - Direct mounted support frame
  - Three-piece joint
- **Additional accessories:** Can be ordered for any configuration and is particularly recommended for a configuration with replaceable measuring inserts (such as pressure sensors, manifolds, valves and connectors).
- **Primary thermowell:** It is directly welded to the process connection, designed to guarantee 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).

Design





Description, available options and materials	
1: Head 1a: Directly mounted 1b: Remote	Hinged or screwed cover junction box for electrical connections. It includes components such as electrical terminals, transmitters and cable glandes. ▪ 316/316L ▪ Aluminum alloys ▪ Other materials on request
2: Support system 2a: With rods and protection cover	Support frame for explosion proof requirements. 316/316L
2b: With three-piece joint	Support frame for intrinsically safe requirements. 316/316L
3: Primary thermowell	The primary thermowell consists of a tube with calculated and selected thickness according to reference international standards. It is designed to protect the sensors against harsh process conditions such as dynamic and static loads and corrosion. 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). ▪ 316/316L ▪ 321 ▪ 304/304L ▪ 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. ▪ 316 + 316L ▪ 304/304L ▪ 310L ▪ 321 ▪ Other materials on request
5: Insert	Mineral insulated grounded and ungrounded thermocouples or RTD (Pt100 wire wound). For details, refer to the Ordering information table.
6 Tip design of: 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: ▪ Welded thermal block discs to ensure the optimal heat transfer thorough the primary thermowell wall and the temperature sensors. Sensors are replaceable. ▪ Individual thermal blocks pressed against the internal wall to ensure the optimal heat transfer between the primary thermowell and the replaceable temperature sensor. ▪ Straight tip. 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: ▪ 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. ▪ Bent tip.
7: Ring bolt	Lifting device for easy handling during installation phase. SS 316
8: Extension cables	For electrical connections between the inserts and junction box. ▪ Shielded PVC ▪ Shielded FEP ▪ Unshielded PVC flying leads
9: Optional connection (Pressure Port threaded hole)	Auxiliary connections and fittings for pressure detection.

Description, available options and materials	
10: Safeguards 10a: Cable conduit (in case of remote head) 10b: Cable conduit cover 10c: Extension cable cover	Cable conduit system: made by flexible polyamide to connect the top of the primary thermowell and the remote junction box. Cable conduit cover: composed of two half shields installed between the top of the primary thermowell and the junction box. Extension cable cover: made by 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	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)	−210 to +720 °C (−346 to +1 328 °F) −270 to +1 150 °C (−454 to +2 102 °F) −270 to +1 100 °C (−454 to +2 012 °F)
	Internal cold junction (Pt100) Cold junction accuracy: ± 1 K 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.

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) according to DIN EN 50446. Quick and easy operation, visualization and maintenance using universal configuration software like FieldCare, DeviceCare or FieldCommunicator 375/475. For more information, see 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 measurement 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 measurement accuracy over the complete ambient temperature range. All transmitters are approved for use in all the main process control systems. The integration tests are performed in Endress+Hauser's 'System World'. For more information, see the Technical Information.

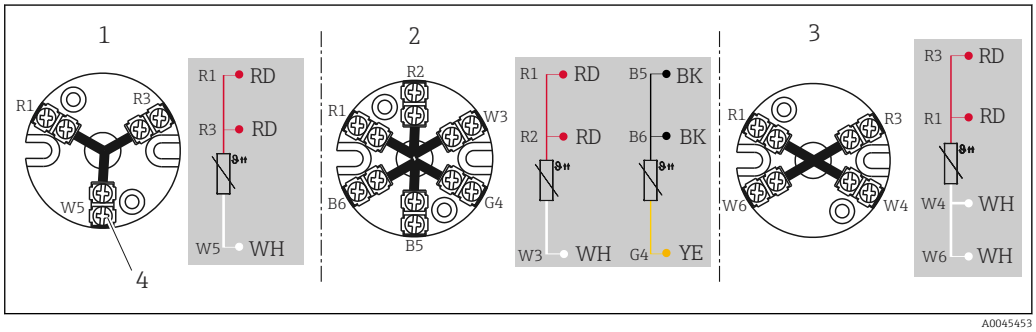
Advantages of the iTEMP transmitters:
- Double or single sensor input (optionally for certain transmitters)
- Unsurpassed reliability, accuracy and long-term stability in critical processes
- Mathematical functions
- Monitoring of the thermometer drift, sensor backup functionality, sensor diagnostic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

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

Type of sensor connection RTD



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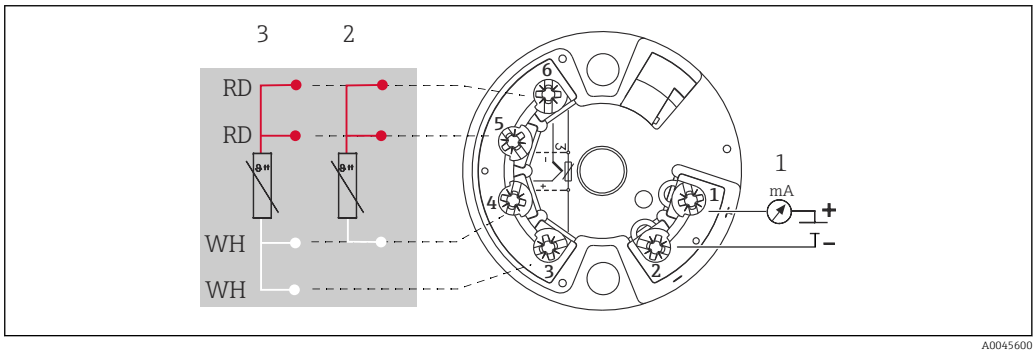
2 *Mounted terminal block*

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



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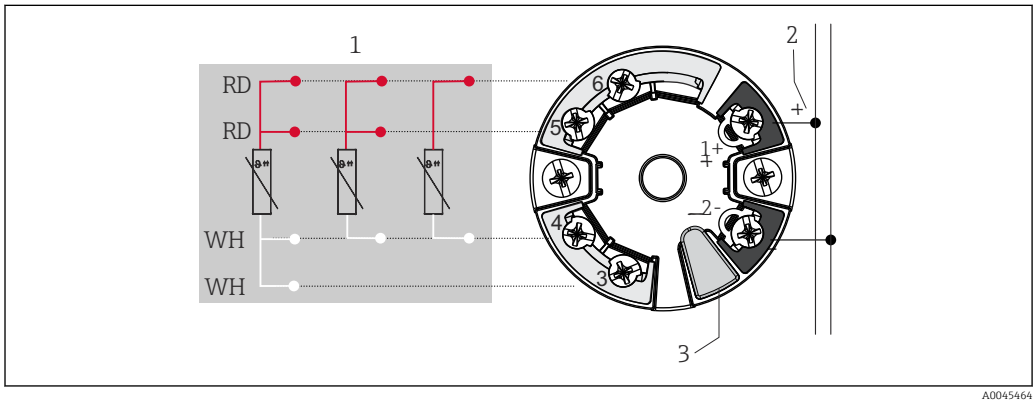
3 *Head mounted transmitter TMT18x (single sensor input)*

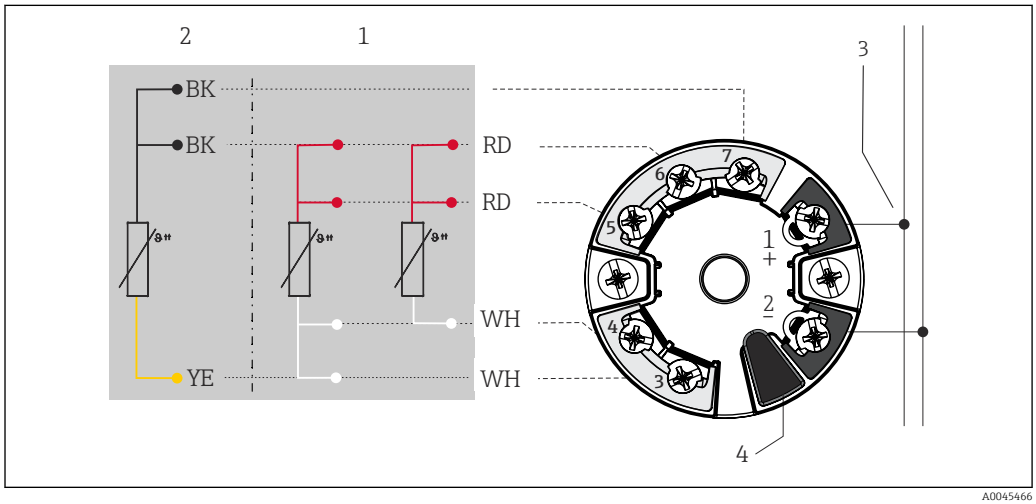
1 Power supply for head transmitter and analog output 4 to 20 mAor fieldbus connection
2 RTD, 3-wire
3 RTD, 4-wire

Only available with screw terminals



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

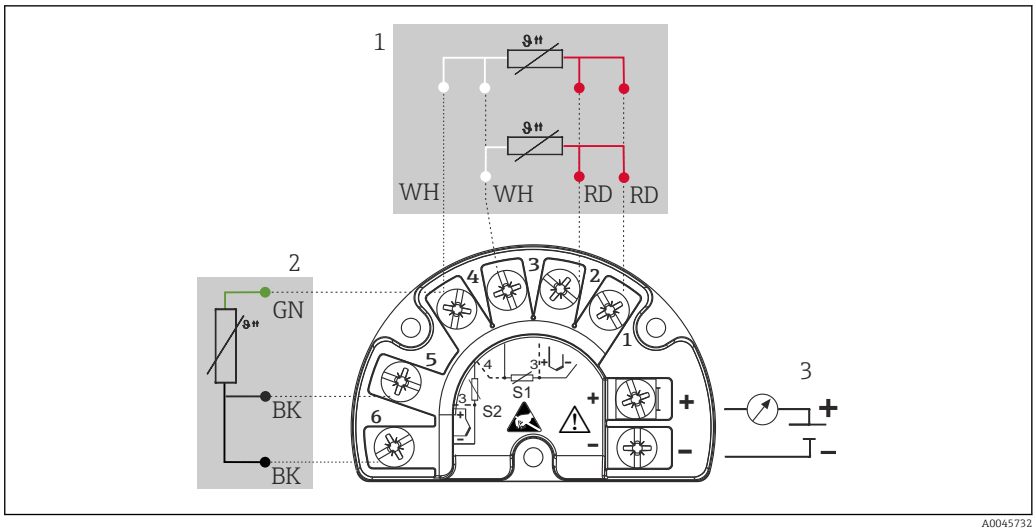
1 *Sensor input, RTD and Ω: 4-, 3- and 2-wire*
2 *Power supply or fieldbus connection*
3 *Display connection/CDI interface*



5 *Head mounted transmitter TMT8x (double sensor input)*

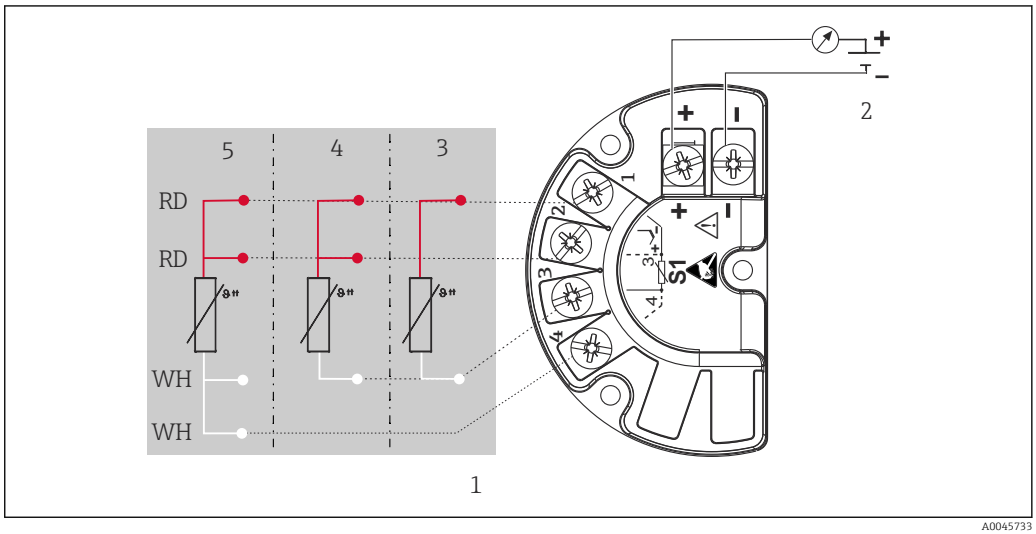
1 *Sensor input 1, RTD: 4- and 3-wire*
2 *Sensor input 2, RTD: 3-wire*
3 *Power supply or fieldbus connection*
4 *Display connection*

Mounted field transmitter: Fitted with screw terminals



6 *TMT162 (dual input)*

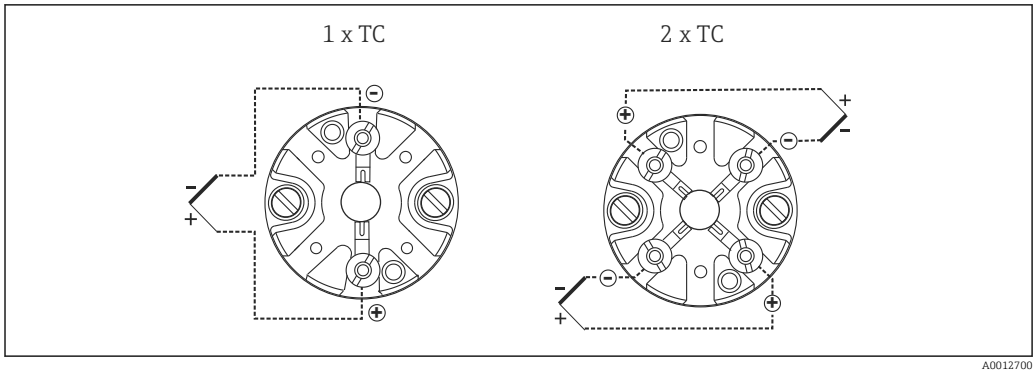
1 *Sensor input 1, RTD: 3- and 4-wire*
2 *Sensor input 2, RTD: 3-wire*
3 *Power supply, field transmitter and analog output 4 to 20 mA or bus connection*



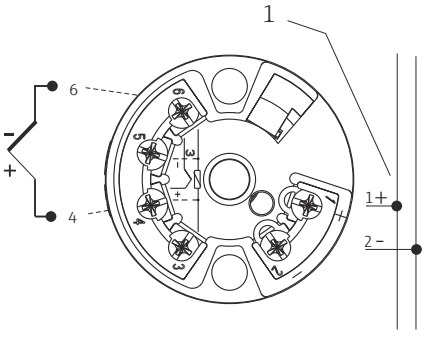
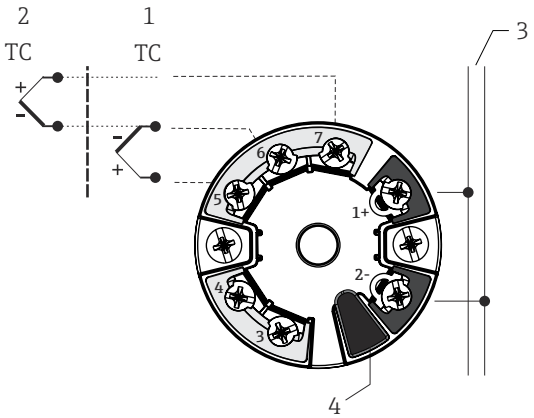
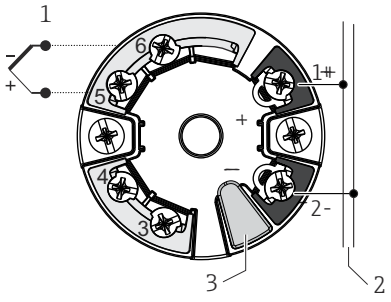
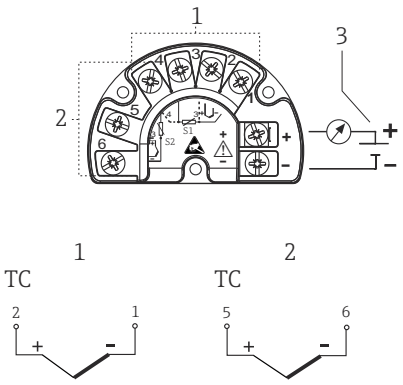
7 *TMT142B (single input)*

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*

Type of sensor connection thermocouple (TC)



8 Mounted terminal block

Head mounted transmitter TMT18x (single sensor input) [1]	Head mounted transmitter TMT8x (double sensor input) [2]
 A0045467 *1 Power supply, head transmitter and analog output 4 to 20 mA or fieldbus communication*	 A0045474 *1 Sensor input 1* *2 Sensor input 2* *3 Fieldbus communication and power supply* *4 Display connection*
Head mounted transmitter TMT7x (single sensor input) [2]	**Mounted field transmitter TMT162 or TMT142B [1]**
 A0045353 *1 Sensor input TC, mV* *2 Power supply, bus connection* *3 Display connection/CDI interface*	 A0045636 *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 screw terminals
2) Fitted with spring terminals if screw terminals are not explicitly selected or a double sensor is installed.

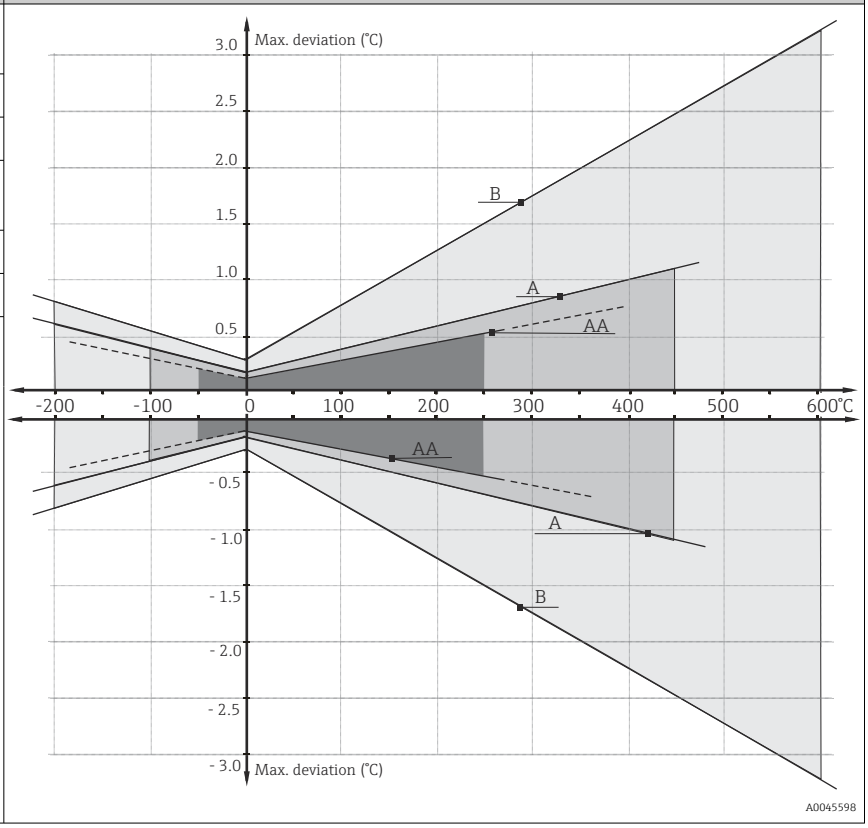
Thermocouple wire colors

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 corresponding to IEC 60751

Class	Max. tolerances (°C)		Characteristics
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	

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	Model	Standard tolerance		Special tolerance	
IEC60584		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) N (NiCrSi-NiSi)	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

Thermocouples made of non-precious metals are generally supplied such that they meet the manufacturing tolerances for temperatures > −40 °C (−40 °F) as specified in the table. These materials are not usually suitable for temperatures < −40 °C (−40 °F). The tolerances for Class 3 cannot be observed. For this temperature range, a separate material selection is required. This cannot be processed using the standard product.

Standard	Model	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) N (NiCrSi-NiSi)	±2.2 K or ±0.02 |t| [1] (−200 to 0 °C) ±2.2 K or ±0.0075 |t| [1] (0 to 1 260 °C)	±1.1 K or ±0.004 |t| [1] (0 to 1 260 °C)

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

The materials for thermocouples are generally supplied such that they meet the tolerances for temperatures > 0 °C (32 °F) as specified in the table. These materials are not usually suitable for temperatures < 0 °C (32 °F). The specified tolerances cannot be observed. For this temperature range, a separate material selection is required. This cannot be processed using 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	
As an example, in case of thermowell thickness, 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	
As an example, in case of thermowell thickness, 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, any further measures can be organized to achieve the calibration of the planned 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.

Calibration involves comparing the measured values of the measuring 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.

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

Installation

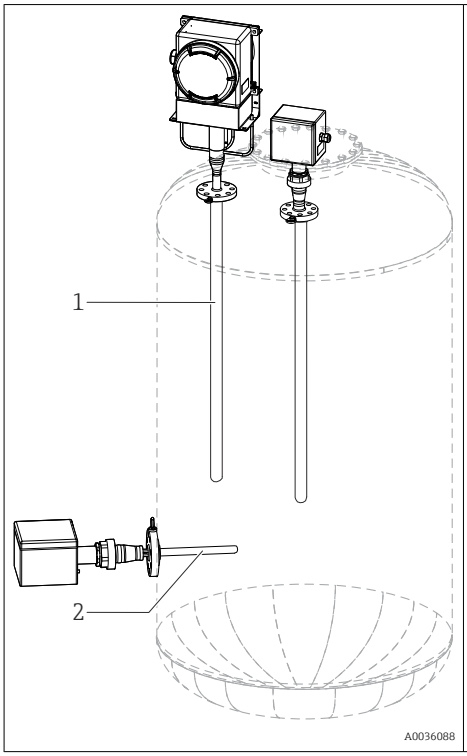
Mounting location

The installation location must meet the requirements listed in this documentation, such as ambient temperature, protection classification, climatic 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. The measurement of a threedimensional temperature profile can be achieved in different ways:

- by installing several vertical multipoint thermometers in the longitudinal direction (1) of the reactor.
- by installing the multipoint thermometer systems in horizontal (2) or inclined direction.



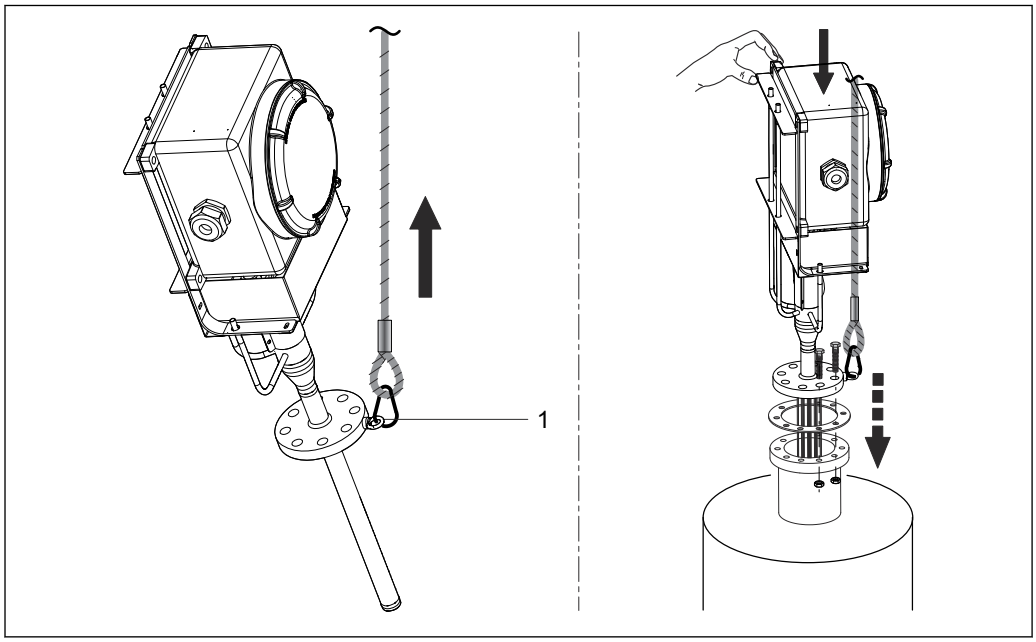
Vertical configuration (1):
The different sensors are aligned along the straight direction coinciding with the longitudinal axis of the vessel (linear multipoint measurement).
Radial configuration (2):
The different sensors are aligned along the straight direction coinciding with an horizontal diameter of the vessel (in combination with a nozzle entry). Adequate support systems have to be foreseen.
Inclined configuration:
The different sensors are mounted obliquely along a straight direction coinciding with an inclined vessel entry. Adequate support have to be foreseen.

Installation instructions

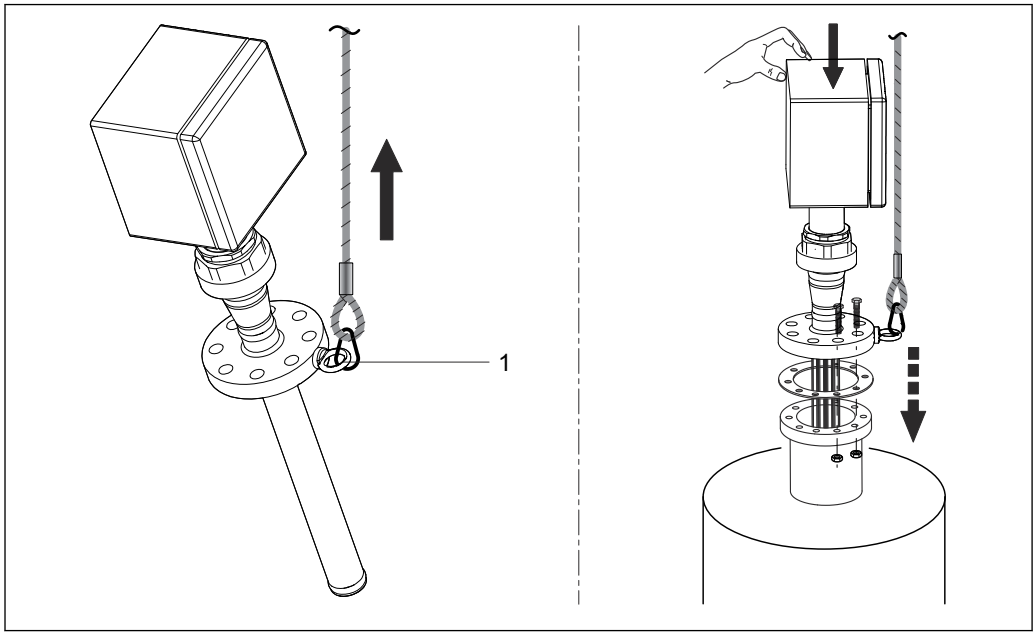
The modular multipoint thermometer is designed to be installed with a flanged process connection into a vessel, reactor, tank or similar environment. All parts and components have to be handled with care. During the installation phase, lifting and introduction of the equipment through the preset nozzle, the following must be avoided:

- Misalignment with the nozzle axis.
- Any load on the welded or threaded parts due to the action of 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 internals of the reactor.
- Fixing the primary thermowell to the reactor's infrastructures without allowing axial displacements or movements.

When internals are not usable as interface, Endress + Hauser provides dedicated support components with minimum process invasiveness to achieve the desired measuring points.



A0036090



A0036091

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

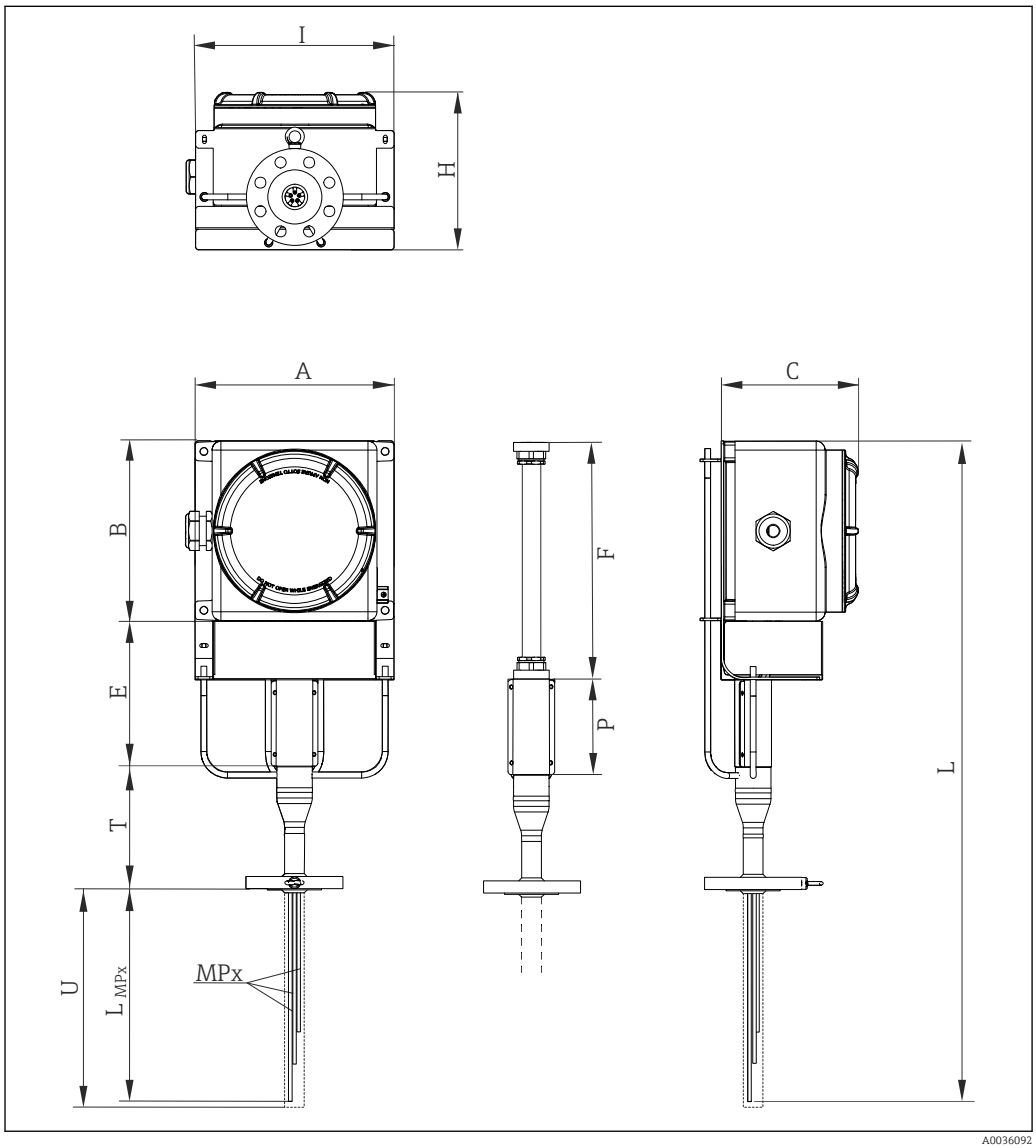
Anyhow, the maximum required process pressure has to be combined with the maximum design process temperature. Process connections like compression fittings, flanges with their specific ratings, thermowells, selected according to the plant requirements, define the maximum process conditions at which the 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

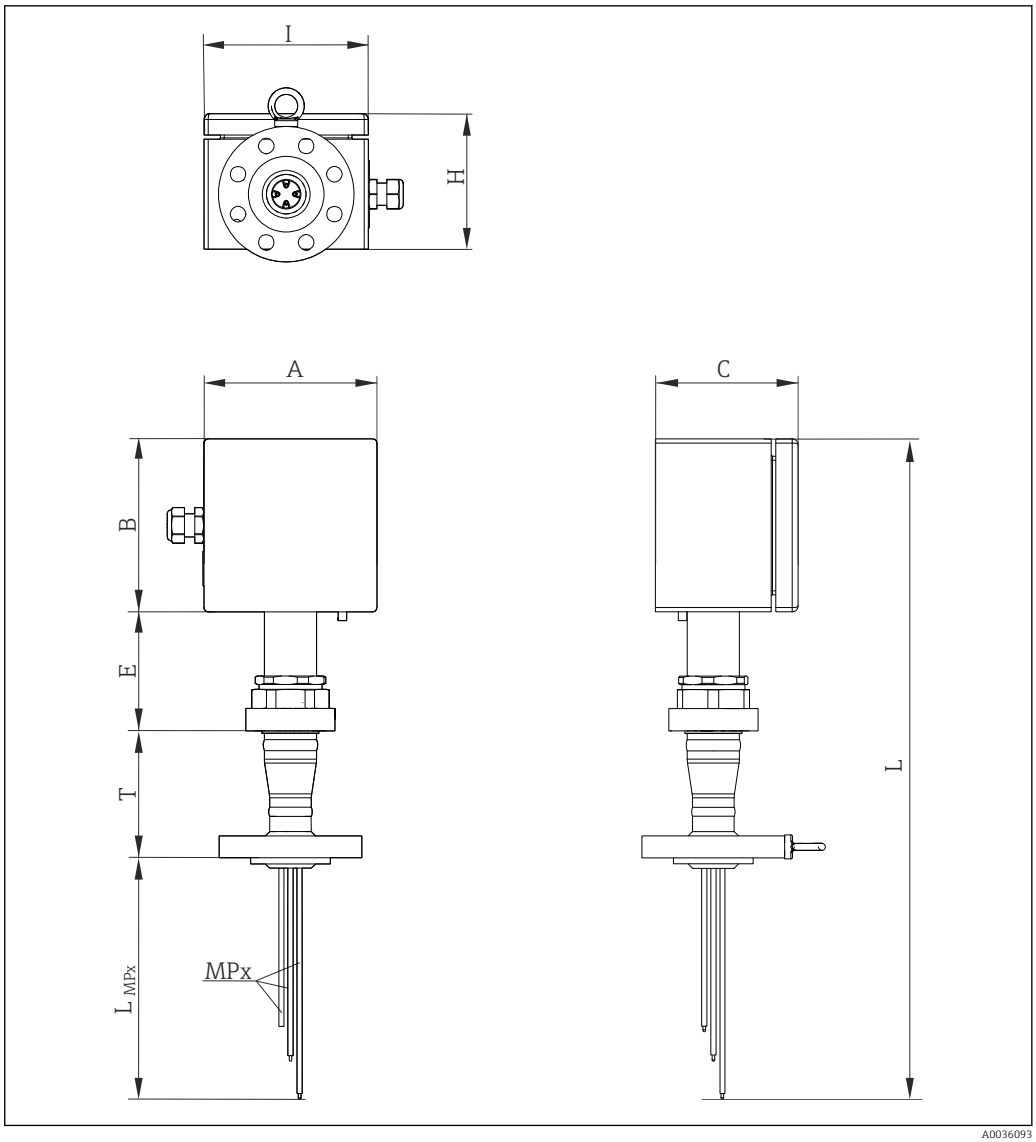
Design, dimensions

The multipoint thermometer is composed of different sub-assemblies. Different inserts are available, based upon specific process conditions, in order to have the highest accuracy and an extended lifetime. The primary thermowell should be selected to increase mechanical performance 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 obtained by the usage of specially sealed bushings, ensuring the declared IP degree of protection.



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

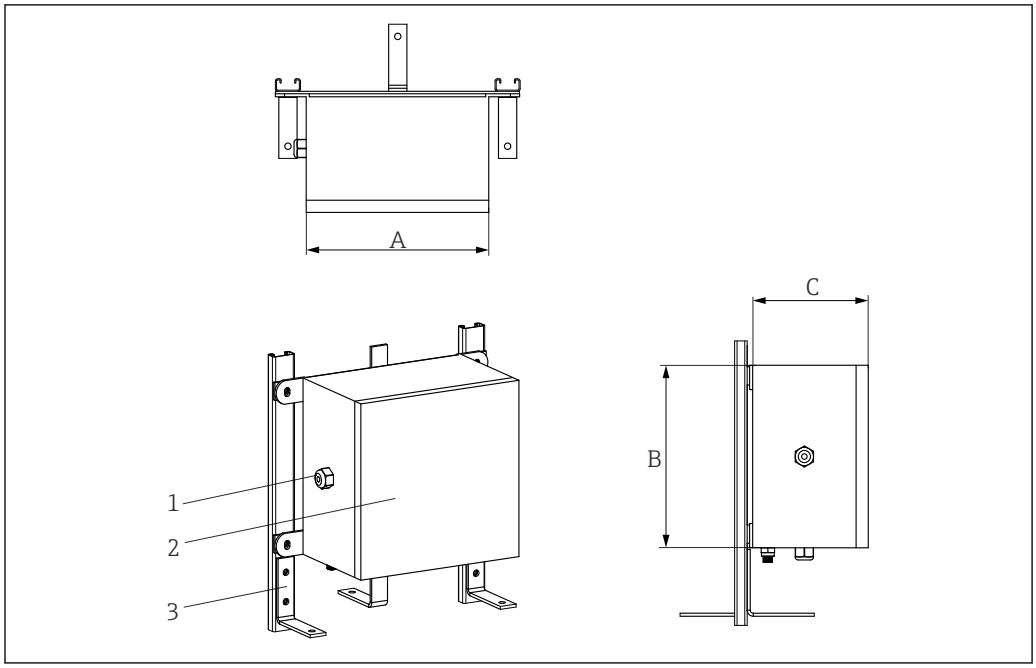
A, B, Dimensions of the junction box, see following figure
C
MPx Quantity and distribution of measuring points: MP1, MP2, MP3 etc.
L_{MPx} Immersion length of measuring elements or thermowells
I, H Frame of the junction box and support system
E Extension length
L Device length
T Lag length
U Immersion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



10 *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 Quantity 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 Plated brass AISI 316 / 316L
Ingress protection (IP)	IP66/67	IP66
Ambient temperature range	−50 to +60 °C (−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 ▪ IECEX II 2GD Ex e IIC/ Ex ia Ga IIC Ex tb IIIC Db T6/T5/T4 ▪ IECEX II 2GD Ex e IIC/ Ex ia Ga IIC Ex tb IIIC Db T6/T5/T4 ▪ ATEX II 2GD Ex d IIC T6-T3/Ex tDA21 IP66 T85oC-T200oC ▪ IECEX II 2GD Ex d IIC T6-T3/ Ex tDA21 IP66 T85oC-T200oC ▪ UL913 Class I, Division 1 Groups B, C, D T6/T5/T4 ▪ FM3610 Class I, Division 1 Groups B, C, D T6/T5/T4 ▪ CSA C22.2 No. 157 Class I, Division 1 Groups B, C, D T6/T5/T4	→ 🖹 20
Cover	Hinged and threaded	-
Maximum sealing diameter	-	6 to 12 mm (0.24 to 0.47 in)

Support system

A modular system or a union joint is provided for in case of a directly mounted junction box.

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 protection cover guarantee a high stiffness connection for the junction box and vibration loads. 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.

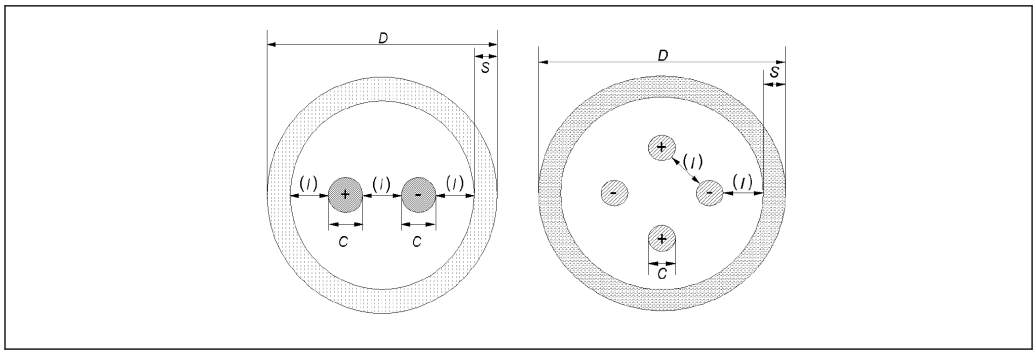
Inserts, conduits and thermowells

Thermocouple

Diameter in mm (in)	Model	Standard	Measuring point type	Sheath material
3 (0.12)	1x type K 2x type K 1x type J 2x type J 1x type N 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



RTD

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

Thermowells or conduits

External diameter in mm (in)	Sheath material	Model	Thickness in mm (in)
6 (0.24)	AISI 316L	Closed or open	0.5 (0.02)or 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 Rating	Ambient T range	Max. sealing diameter
NiCr Plated brass	Atex II 2/3 GD Ex d IIC, Ex e II, Ex nR II, Ex tD A21 IP66	IP66	−52 to +110 °C (−61.6 to +230 °F)	6 to 12 mm (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 (−61.6 to +230 °F)	6 to 12 mm (0.23 to 0.47 in)

Diagnostic function

The reactors where the multipoint assembly operates are usually characterized by severe 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).

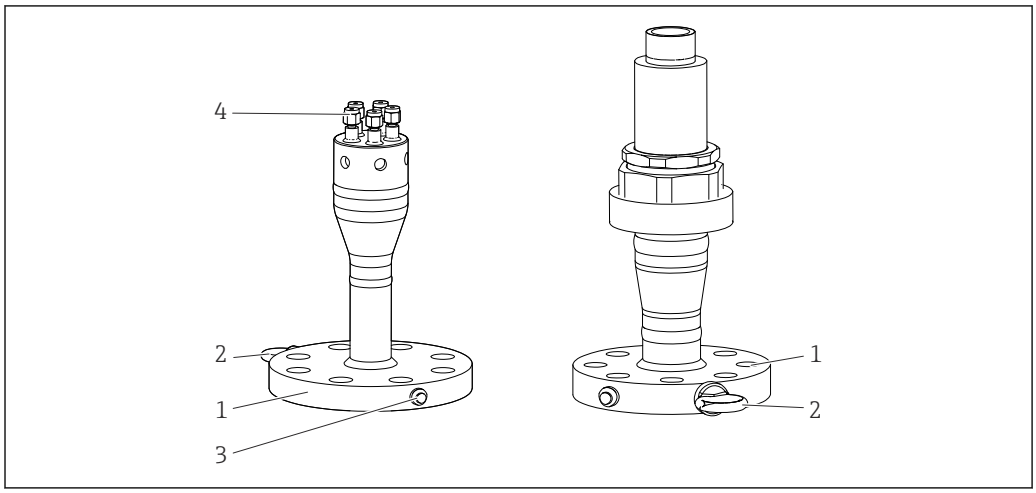
The eye bolt, which is part of the process connection, must be used as the only lifting component to move the entire device.

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 ▪ 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
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. ▪ Resistant to corrosion caused by chlorine gas and chlorinated media as well as many oxidizing mineral and organic acids, sea water etc. ▪ Corrosion from ultrapure water. ▪ Not to be used in a sulfur-containing atmosphere.
AISI 304/1.4301	X5CrNi18-10	850 °C (1 562 °F)	▪ Austenitic stainless steel ▪ Can be used well in water and wastewater with low level of pollution ▪ Only at relatively low temperatures resistant to organic acids, saline solutions, sulphates, alkaline solutions, etc.
AISI 316Ti/ 1.4571	X6CrNiMoTi17-12-2	700 °C (1 292 °F)	▪ Properties comparable to AISI316L. ▪ 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 (1 499 °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 (1 472 °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



11 Flange as process connection

1 Flange
2 Ring bolt
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

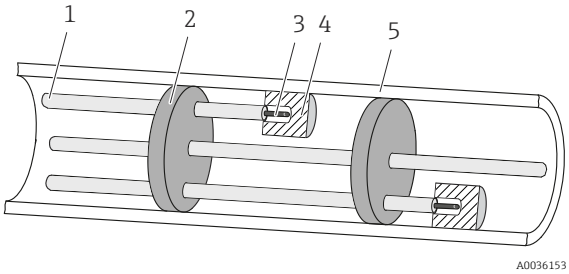
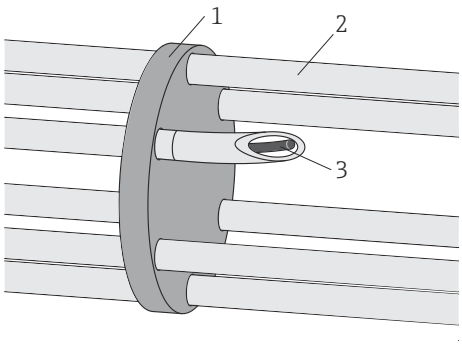
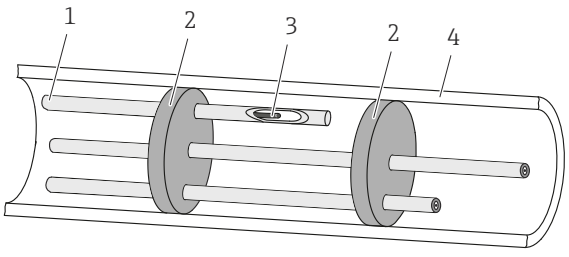
1) Flanges according to GOST standard are available on request.

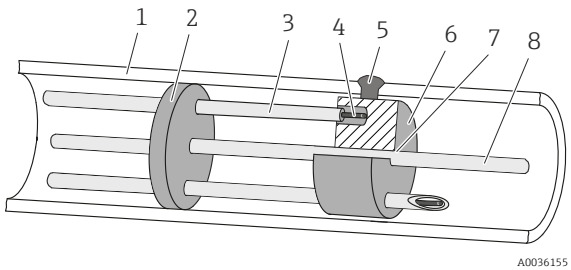
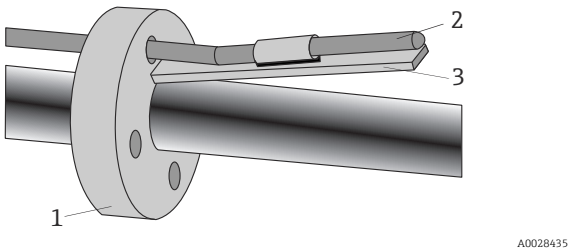
Compression fittings

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

Material	AISI 316/316H

Thermal contact components

A: Thermal contact block  A0036153 *1 Conduit* *2 Spacer* *3 Insert* *4 Thermal block* *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  A0028783 *1 Spacer* *2 Conduit* *3 Insert*	▪ Allow sensor replacement ▪ Guarantee thermal contact between the sensor tip and the existing thermowell
C: Thermowells and spacers  A0036632 *1 Thermowell* *2 Spacer* *3 Insert* *4 Primary thermowell wall*	Each sensor is protected by its protecting thermowell with straight tip

D: Thermal block disc (welded to the primary thermowell)  *1 Primary thermowell wall* *2 Spacer* *3 Conduit* *4 Insert* *5 Welded contact* *6 Thermal block disc* *7 Welding seam* *8 Supporting rod*	▪ Ensure the optimal heat transfer thorough the primary thermowell wall and the temperature sensors. Sensors are replaceable ▪ Sensors are replaceable
E: Bimetallic stripes  *12 Bimetallic strips with or without conduits* *1 Conduit* *2 Insert* *3 Bimetallic stripe*	▪ Doesn't allow sensor replacement ▪ Guarantee thermal contact between the sensor tip and the thermowell due to bimetallic strips activated by temperature difference ▪ No friction during installation even with already installed sensors

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**.

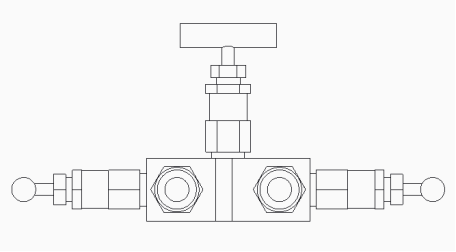
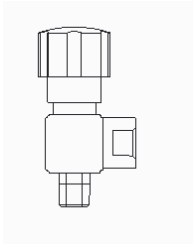
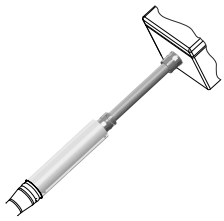
Product Configurator - the tool for individual product configuration
- Up-to-the-minute configuration data
- Depending on the device: Direct input of measuring point-specific information such as measuring range or operating language
- Automatic verification of exclusion criteria
- Automatic creation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

Accessories

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. See Endress+Hauser PMP sensors range
  A0034865 Fittings / manifolds / valves	Fittings, manifolds and valves are available for installing the pressure transmitter on the pressure port connection, and so allow the continuous monitoring of the device under the operating conditions.
 A0036534 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 Order code: TXU10-xx
Commubox FXA195 HART	For intrinsically safe HART communication with FieldCare via the USB port. For details, see "Technical Information" TI00404F
Commubox FXA291	Connects Endress+Hauser field devices with a CDI interface (= Endress+Hauser Common Data Interface) and the USB port of a computer or laptop. For details, see "Technical Information" TI00405C

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

Service-specific accessories

Accessories	Description
Applicator	Software for selecting and sizing Endress+Hauser measuring devices: ▪ Calculation of all the necessary data for identifying the optimum measuring device: e.g. pressure loss, accuracy or process connections. ▪ Graphic illustration of the calculation results Administration, documentation and access to all project-related data and parameters over the entire life cycle of a project. Applicator is available: Via the Internet: https://portal.endress.com/webapp/applicator
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

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.

Document function

The following documentation may be available depending on the 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** The Operating Instructions contain all the information that is required in the 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** 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. The Safety Instructions are an integral part of the Operating Instructions. Information on the Safety Instructions (XA) relevant to 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 an integral part of the device documentation.

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