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LENNTECH
WATER TREATMENT SOLUTIONS

Technical Information
iTHERM MultiSens Linear TMS12
Multipoint thermometer

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

Applications

- Ideal for measuring a linear temperature profile
- For use in the oil & gas and petrochemical industries
- 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
- Enhanced safety through a diagnostic chamber
- Easy installation, process integration, and maintenance thanks to modular product design and replaceable, standardised measuring elements
- Long product life time thanks to integrated electronic heat protection
- International certifications: explosion protection in accordance with ATEX, IECEx, EAC, for example

Endress+Hauser
People for Process Automation

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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:

There are two different versions of platinum resistance thermometers:

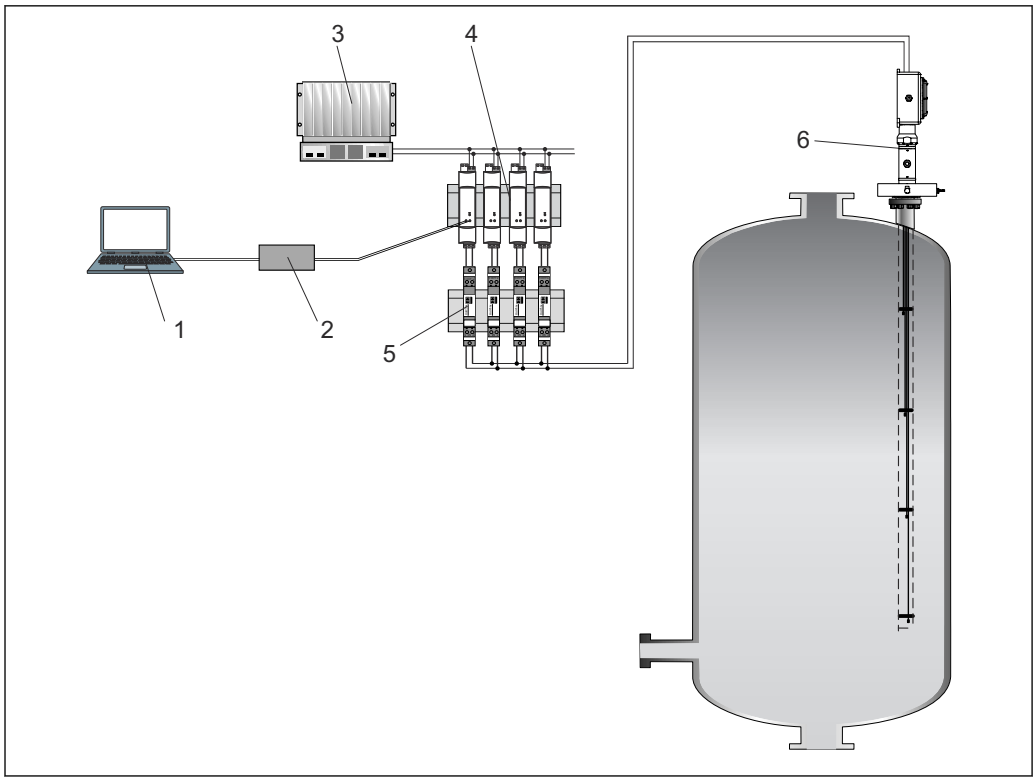
- **Wire-wound (WW):WW** In these thermometers, a double coil of fine, high-purity platinum wire is accommodated in a ceramic support. This support is then sealed top and bottom with a ceramic protective layer. These resistance thermometers not only facilitate very reproducible measurements but also 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.

Measuring system

The manufacturer provides a complete portfolio of optimized components for the temperature measuring point – everything needed for seamless integration of the measuring point into the overall facility.

These include:

- Power supply unit/active barrier
- Configuration units
- Overvoltage protection



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. 4-20 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-, FOUNDATION Fieldbus™ communication or terminal blocks for remote wiring.*

Equipment architecture

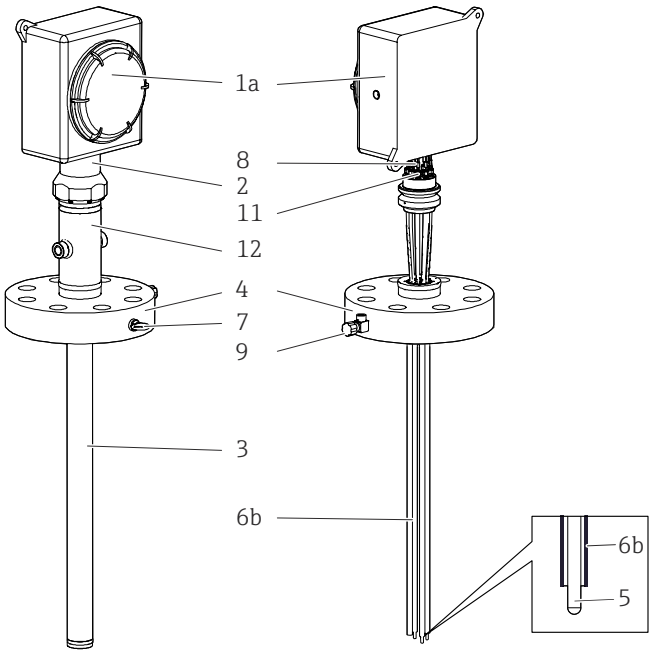
The device is one of a series of modular products for multiple temperature measurement. The design allows for the replacement of individual subassemblies and components, making maintenance and spare parts management easier.

The device consists of the following subassemblies:
- **Insert:** Composed of individual metal sheathed measuring elements (thermocouples or RTD resistance sensors) They are protected by the primary thermowell welded to the process connection. In addition, individual conduits or thermowells allow inserts to be replaced under operating conditions. In this case, the inserts can be treated as individual spare parts and ordered via the standard product structures (iTHERM CableLine TSC310 or iTHERM CableLine TST310) or as special inserts. For the specific product structure, contact the manufacturer.
- **Process connection:** Represented by an ASME or EN flange. The process connection is equipped with a pressure port and can be supplied with eyebolts for lifting the device.
- **Head:** Composed of a junction box with the relevant components such as cable glands, draining valves, earth screws, terminals, head transmitters etc.
- **Support system:** Designed to support the junction box via a pivoting joint.

- **Additional accessories:** Can be ordered for any configuration, and are recommended in case of a configuration with replaceable inserts. They include pressure measuring cells, manifolds, valves and connectors.
- **Primary thermowell:** Directly welded to the process connection and designed to ensure a high degree of mechanical protection and corrosion resistance.
- **Diagnostic chamber:** This subassembly consists in a closed housing that ensures the continuous monitoring of the device status during its operating life and safe leakage containment. The chamber comprises integrated connections for accessories (such as valves, manifolds). A wide range of accessories is available to get the highest level of system information (pressure, temperature, fluids composition and next maintenance step).

The system measures a temperature profile along a line within the process environment. It is also possible to obtain a three-dimensional temperature profile by installing more than one thermometer (either horizontally, vertically or obliquely).

Construction



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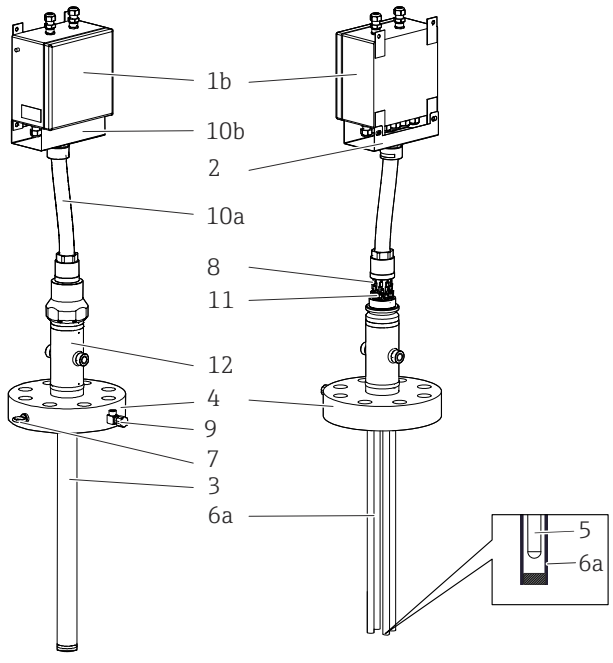

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Description, available options and materials	
1: Head 1a: Directly mounted 1b: Remote	Junction box with hinged or screwed cover for electrical connections. It includes components such as electrical terminals, transmitters and cable glandes. ▪ 316/316L ▪ Aluminum alloys ▪ Other materials on request
2: Support system	Swiveling support joint for junction box orientation. Material: 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. ▪ 316/316L ▪ 321 ▪ 304/304L ▪ 310L
4: Process connection, flanged according to ASME, or EN standards	Flange according to international standards or customer-specific flange to meet specific process requirements. ▪ 316 + 316L ▪ 304 ▪ 310 ▪ 321 ▪ Other materials on request
5: Insert	Mineral-insulated grounded and ungrounded thermocouples or RTDs (Pt100 wire wound). For details, refer to the 'Ordering information' table.
6 Measuring insert tip design of sensor thermal contacts 6a: For 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 optimum 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 measuring tip. ▪ Straight tip. For details, refer to the 'Ordering information' table.
6b: For 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 sensors are not replaceable. ▪ Bent tip.
7: Eyebolt	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: Pressure port (threaded connection)	Auxiliary connections and fittings for pressure detection.
10: Protections 10a: Cable conduit system (in case of remote head) 10b: Extension cables cover	Cable conduit: made by flexible polyamide to connect the top of the diagnostic chamber and the remote junction box. Extension cable cover: consists of a shaped stainless steel plate fixed to the junction box frame in order to protect the cable connections.

Description, available options and materials	
11: Compression fitting	High-performance sleeves to ensure tightness between the upper part of the diagnostic chamber and the outside environment. Ideal for a large range of media and rough conditions with high temperatures and pressures.
12: Diagnostic chamber 12a: Basic chamber 12b: Advanced chamber	Diagnostic chamber for leakage detection and safe containment. System behavior monitoring thanks to a continuous pressure detection of the contained media. Basic configuration: Non-replaceable inserts. Extension cables replaceable in case of accidental damages (through the replacement of the insert stump). Advanced configuration: Complete insert replacement allowed.

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) Type K (NiCr-Ni) Type N (NiCrSi-NiSi)	−40 to +720 °C (−40 to +1 328 °F) −40 to +1 150 °C (−40 to +2 102 °F) −40 to +1 100 °C (−40 to +2 012 °F)
	Internal cold junction (Pt100) Accuracy of cold junction: ± 1 K Max. sensor resistance: 10 kΩ	

Output

Output signal

The measured values are transmitted in 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.

4-20 mA head transmitter
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 transmitter
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 transmitter
Universally programmable iTEMP head transmitter with PROFIBUS PA communication. Conversion of various input signals into digital output signals. High measurement accuracy over the complete operating temperature range. PROFIBUS PA functions and device-specific parameters are configured via fieldbus communication.

FOUNDATION Fieldbus™ head transmitters
Universally programmable iTEMP head transmitter with FOUNDATION Fieldbus™ communication. Conversion of various input signals into digital output signals. High measurement accuracy over the complete operating temperature range. All iTEMP transmitters 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 transmitter can be installed as an intrinsically safe electrical apparatus in Zone 1 hazardous areas. The device can be used for instrumentation purposes in the terminal head form B (flat face) according to DIN EN 50446.

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.

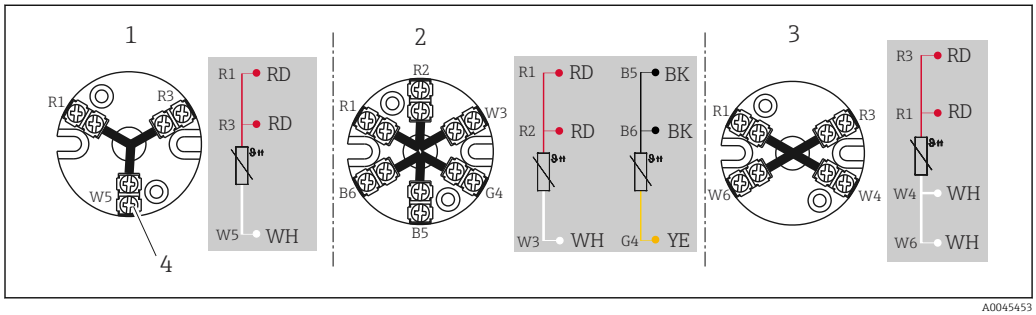
Advantages of the iTEMP transmitters:
- Dual or single sensor input (optionally for certain transmitters)
- Attachable display (optionally for certain transmitters)
- Unsurpassed reliability, accuracy and long-term stability in critical processes
- Mathematical functions
- Monitoring of the thermometer 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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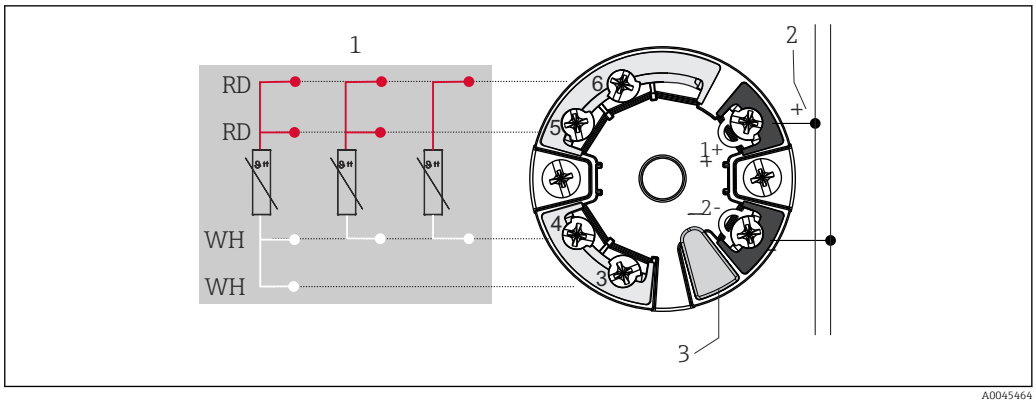
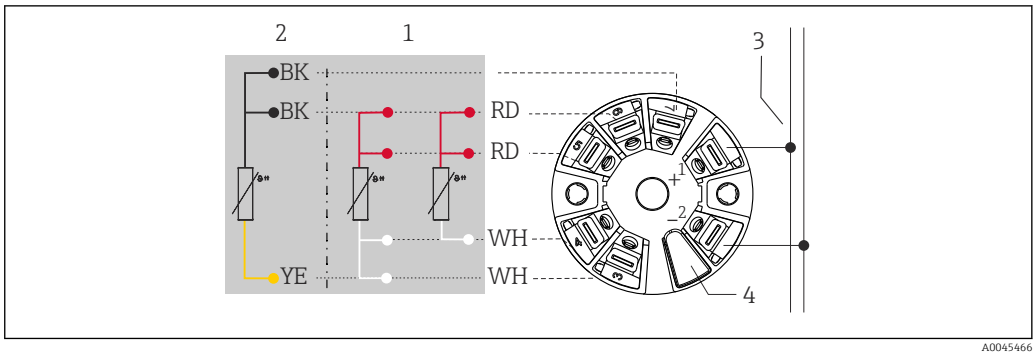
2 *Mounted terminal block*

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)*

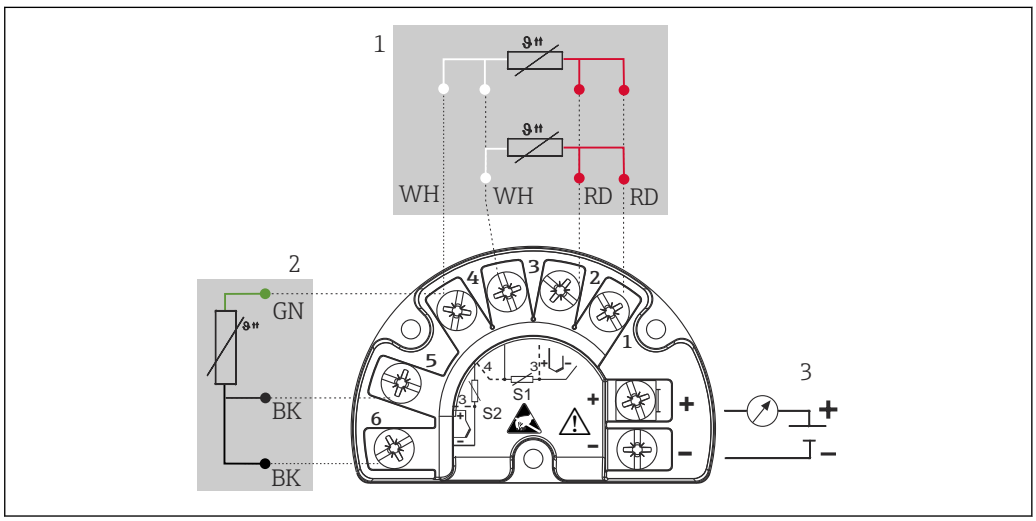
1 *Sensor input, RTD and Ω: 4-, 3- and 2-wire*
2 *Power supply or fieldbus connection*
3 *Display connection/CDI interface*



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

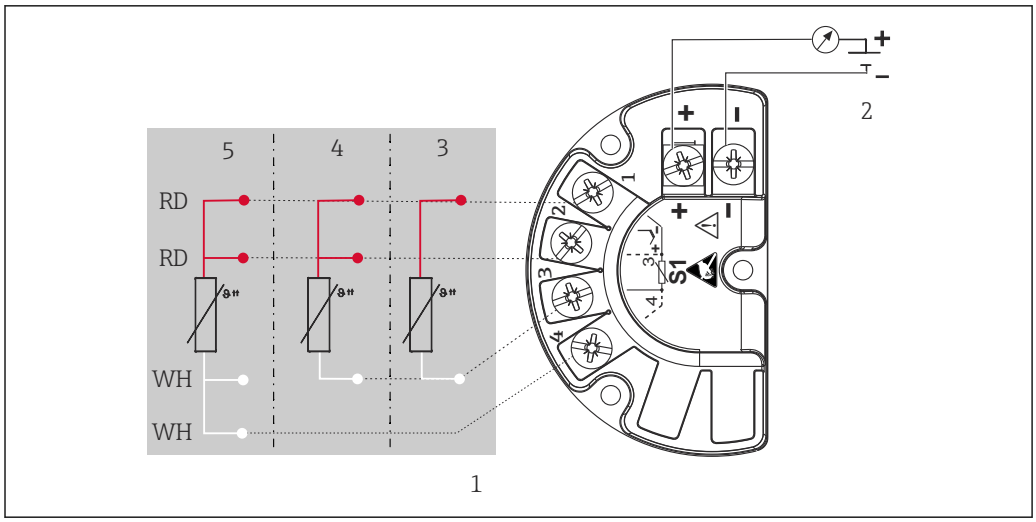
1 *Sensor input 1, RTD: 4- and 3-wire*
2 *Sensor input 2, RTD: 3-wire*
3 *Power supply or fieldbus connection*
4 *Display connection*

Mounted field transmitter: Fitted with screw terminals



5 *TMT162 (dual input)*

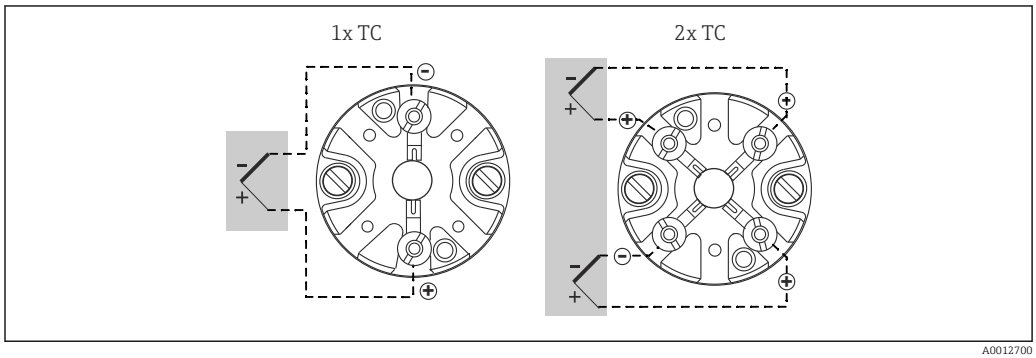
1 *Sensor input 1, RTD: 3- and 4-wire*
2 *Sensor input 2, RTD: 3-wire*
3 *Power supply, field transmitter and analog output 4 to 20 mA or fieldbus connection*



6 TMT142B (single input)

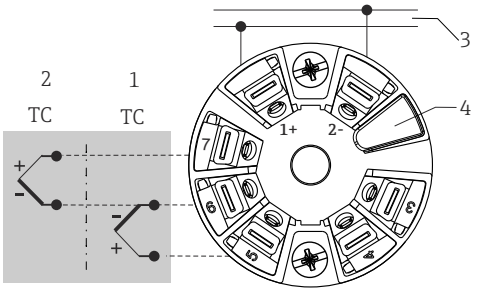
1 *Sensor input RTD*
2 *Power supply, field transmitter and analog output 4 to 20 mA, HART® signal*
3 *2-wire*
4 *3-wire*
5 *4-wire*

Thermocouple (TC) sensor connection type



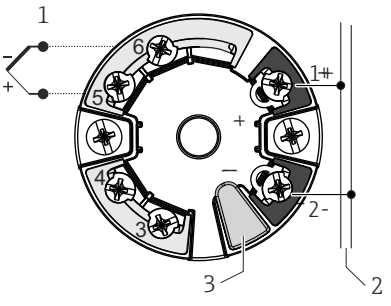
7 Mounted terminal block

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



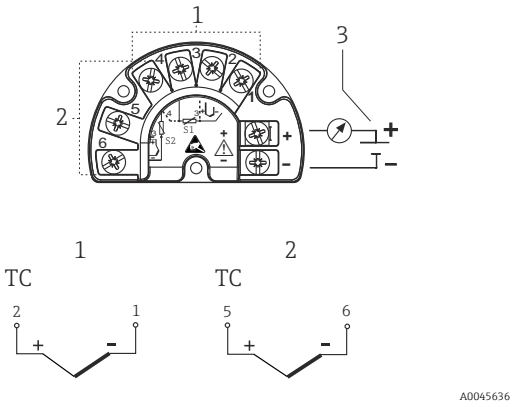
1 Sensor input 1
2 Sensor input 2
3 Fieldbus communication and power supply
4 Display connection

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.

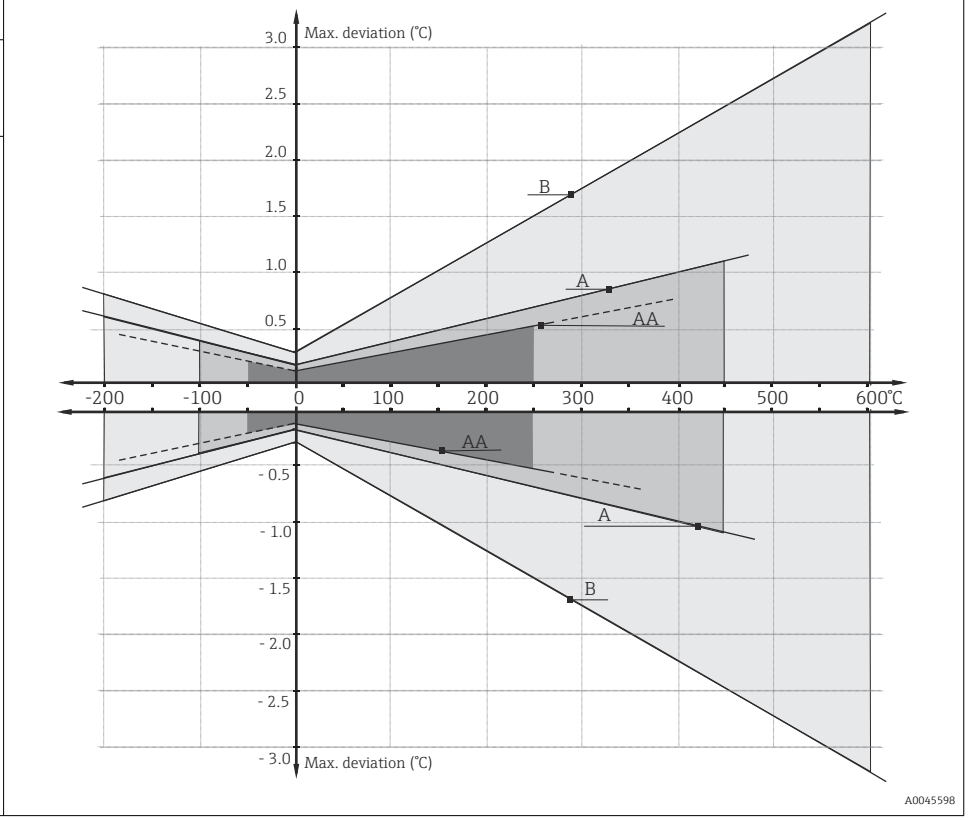
Thermocouple wire colors

As per IEC 60584	As per ASTM E230
▪ Type J: black (+), white (-) ▪ 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

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) ±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	±0.0075 |t| [1] (333 to 1 200 °C) ±2.5 °C (−40 to +333 °C) ±0.0075 |t| [1] (333 to 1 200 °C)	1	±1.5 °C (−40 to +375 °C) ±0.004 |t| [1] (375 to 1 000 °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) 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 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.

Resistance sensor (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 flowing 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 the device is installed (only applicable to replaceable inserts).

If calibration is to be performed after the device is installed, please contact the manufacturer's service team for support. The manufacturer's service team can assist in organizing all additional activities required for calibration of the intended sensor. Components screwed to the process connection must not be loosened while the process is running if the pressure inside the primary thermowell is unknown.

During calibration, the measured values of the sensor elements of a multipoint insert (UUT = unit under test) are compared with the reference values of a calibration standard. The measuring method is defined and repeatable. The aim of calibration is to determine the measurement error between the UUT reading and the true value of the measured variable.

Two methods are used for the inserts:
- Calibration at fixed points: 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, the manufacturer offers verification measurements (evaluation) of the insert as a service.

Installation

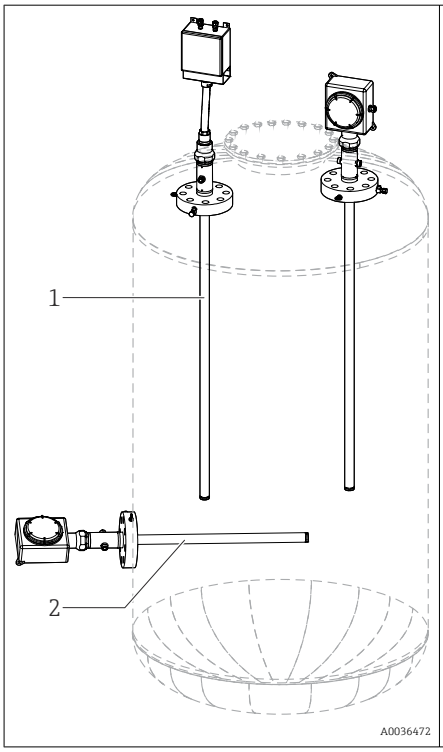
Installation location

The installation location must meet the requirements specified in this document. These include ambient temperature, degree of protection and climate class. The dimensions of possible existing support frames or brackets welded on the reactor's wall or of any other existing frame in the installation area must be carefully checked.

Orientation

No restrictions. The device can be installed horizontally, at an angle or vertically in relation to the vertical axis of the reactor or vessel. Three-dimensional temperature profiling can be achieved in various ways:

- along the longitudinal direction (1) of the reactor
- by installing the multipoint thermometer system in a horizontal (2) or angled direction



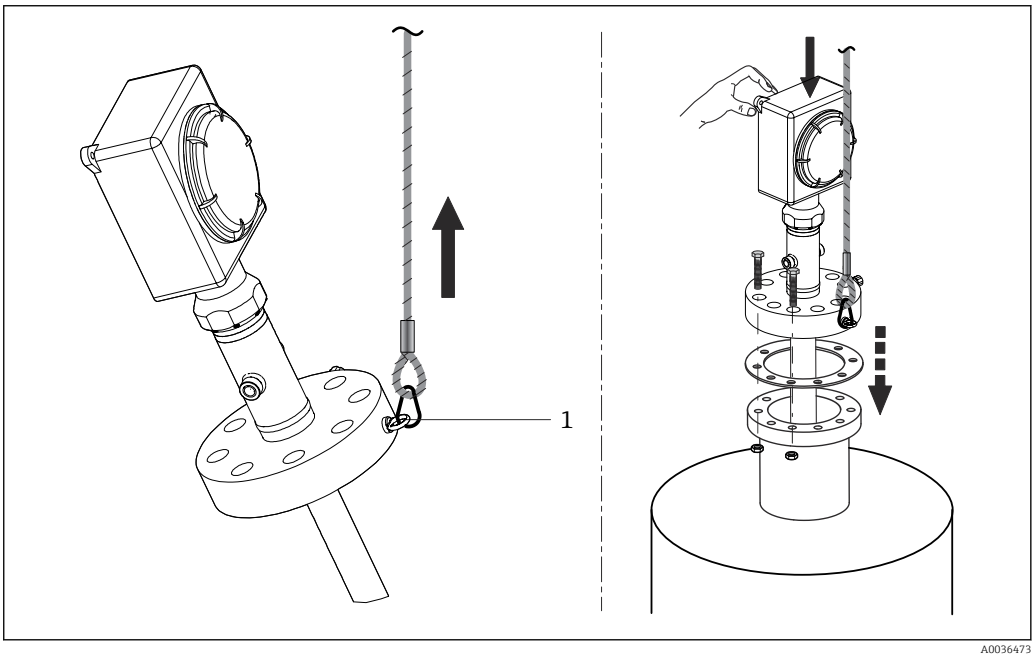
Vertical orientation (1):
The individual inserts are arranged in a straight line corresponding to the longitudinal axis of the vessel (linear multipoint measurement).
Radial orientation (2):
The individual inserts are arranged in a straight line running horizontally inside the vessel (at the level of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

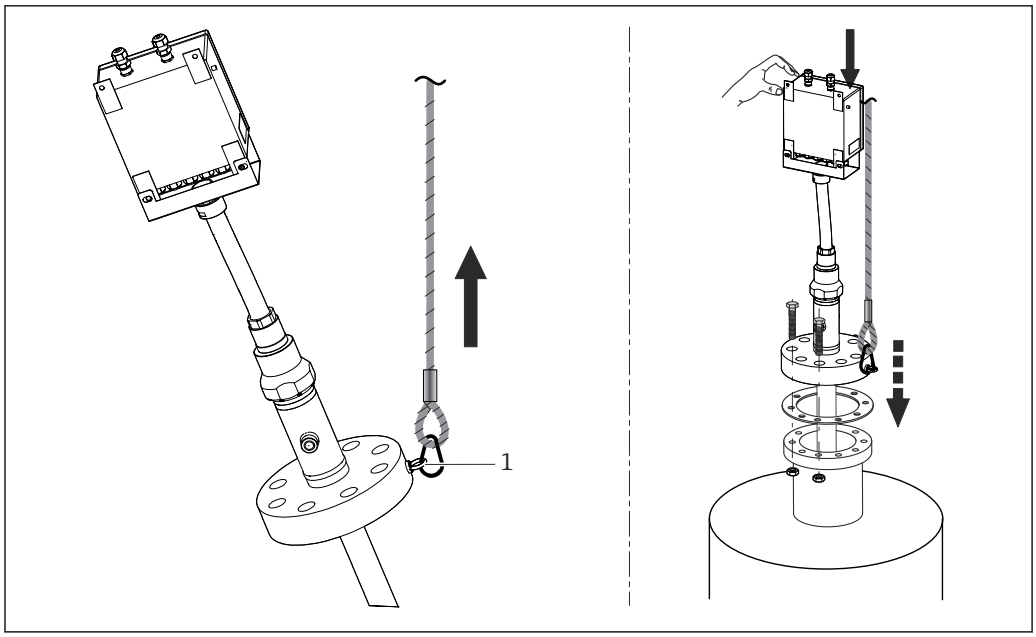
Installation instructions

The modular device is designed for installation with a flanged process connection in a vessel, reactor, tank or similar environment. All parts and components must be handled with care. When installing, lifting, or inserting the device through the existing nozzle, avoid the following:

- Incorrect alignment with the axis of the process connection
- Any load on the welded or threaded parts due to the weight of the device
- Deformation or crushing of the threaded components, bolts, nuts, cable glands and compression fittings.
- Friction between the primary thermowell and the components inside the reactor
- Mounting the primary thermowell to the reactor structure in such a way that axial movement and displacement are prevented

If the existing reactor structure cannot be used for mounting, the manufacturer can provide compact support components to enable positioning at the desired measuring points.





During installation, lift or move the entire device only using ropes that are properly attached to the flange eyebolt (1) or to the thermowell.

Ambient conditions

Ambient temperature

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 transmitter	−40 to +85 °C (−40 to +185 °F)	Depends on Ex area approval. For 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)

Depends on the head transmitter used and can be found in the Technical Documentation for the device.

Process

To select the correct product configuration, specify the process parameters, process temperature and pressure. If product-specific properties are required, additional data from the product definition must be taken into account: These include the type of process medium, phases, material concentrations, viscosity, flow conditions, turbulence and corrosion rates.

Process temperature range

Up to +816 °C (+1 501 °F) (based on standard process connection materials).

The flanges of the process connection define, through their specific pressure ratings, the maximum permissible process conditions for which the plant has been designed and under which the device may be operated.

Process pressure range

0 to 240 bar (0 to 3 481 psi)

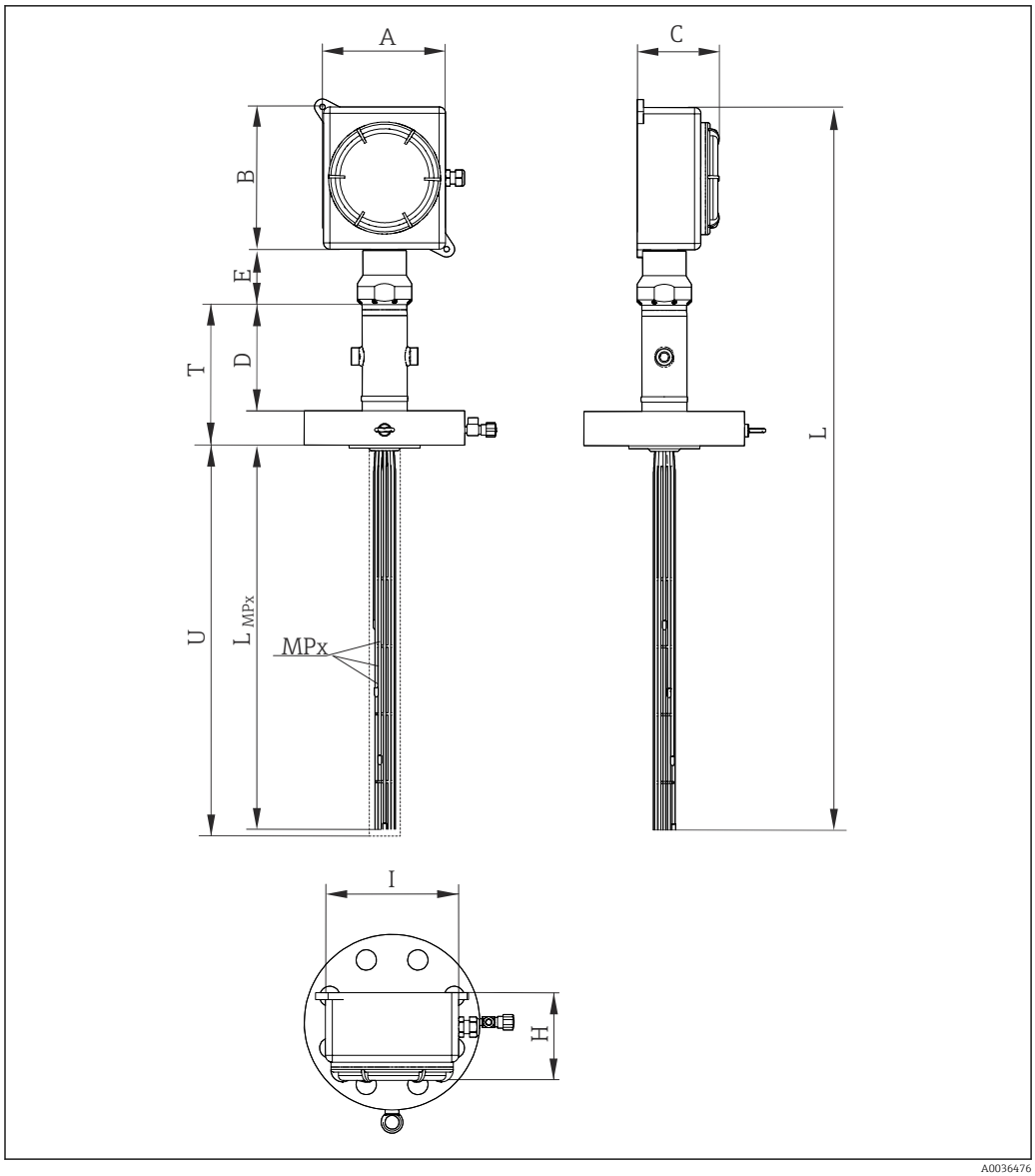
Combine the maximum required process pressure with the maximum allowable process temperature. Process connections like compression fittings, flanges with their specific pressure ratings and thermowells that have been selected according to the plant requirements, define the maximum process conditions under which the device may be operated.

Process applications:
- Atmospheric/vacuum distillation
- Catalytic cracking/hydrocracking
- Catalytic reforming
- Hydrodesulfurization
- N-based inorganics
- Ammonia
- Urea
- GTL process
- Distillation units and hydrogenation
- Hydrotreating
- Visbreaker
- Delayed coking

Mechanical construction

Design, dimensions

The device consists of various subassemblies. To ensure accuracy and service life, inserts are available for specific process conditions. The primary thermowell increases strength and corrosion resistance and allows the inserts to be replaced. Shielded extension cables with robust outer sheathing offer high durability under varying ambient conditions and ensure interference-free signal transmission. The inserts are connected to the extension cables through specially sealed feedthroughs that ensure the required degree of protection.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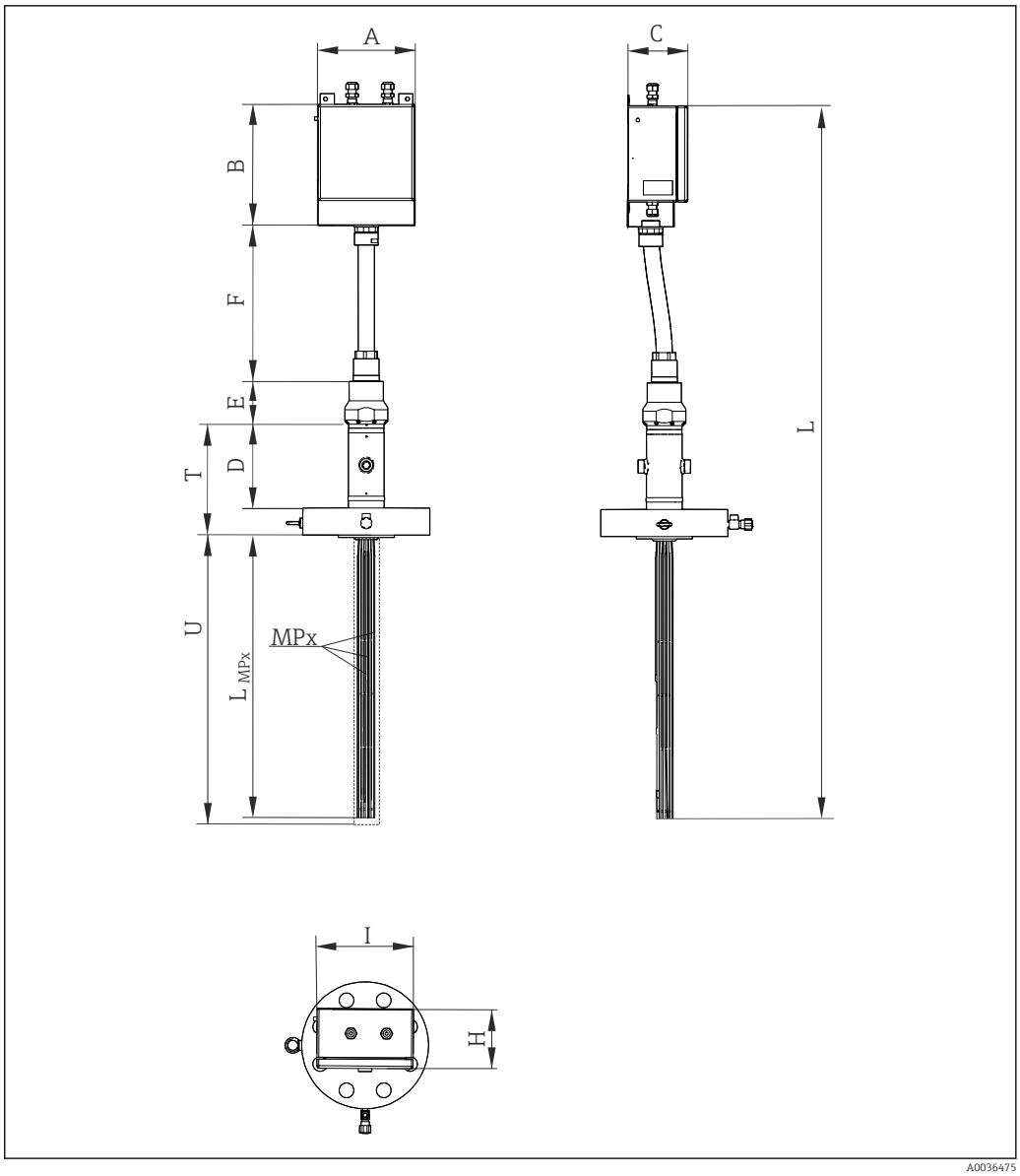
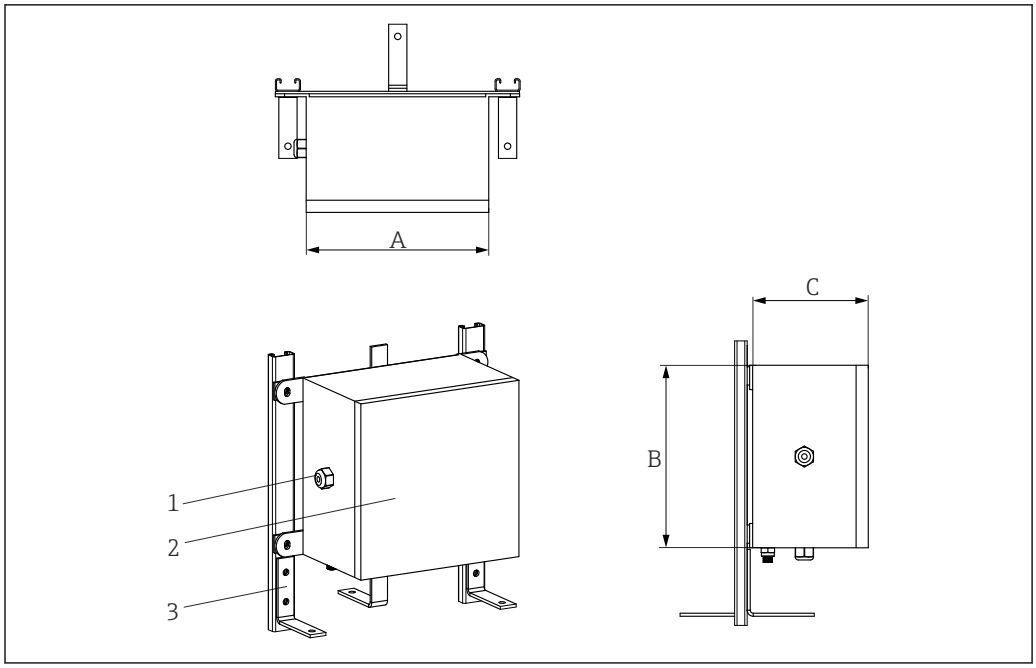


8 *Design of modular device with swiveling joint Directly mounted head in the first picture or with remote head in the second picture. All dimensions in mm (in)*

A, B, Dimensions of the junction box, see following figure
C
D Diagnostic chamber = 390 mm (15.35 in)
E Extension length
F Flexible hose length
I, H Dimensions of the junction box and support system
L_{MPx} Immersion length of inserts or thermowells
L Device length
MPx Number and distribution of measuring points: MP1, MP2, MP3 etc.
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 and 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 AISI 316/316L
Degree of protection (IP)	IP66/67	IP66
Ambient temperature	−50 to +60 °C (−58 to +140 °F)	−52 to +110 °C (−61.1 to +140 °F)

Type of specification	Junction box	Cable glands
Device approvals	ATEX, IEC, UL, CSA, FM approvals for use in hazardous area	ATEX approval for use in hazardous area
Identification	▪ ATEX II 2GD Ex e IIC/ Ex ia Ga ▪ ATEX 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	→ 🖹 22-
Cover	Hinged and threaded	-
Maximum sealing diameter	-	6 to 12 mm (0.24 to 0.47 in)

Support system

A swiveling joint is available, allowing directly mounted junction boxes to be positioned at different angles relative to the system body.

It ensures the connection between the head of the diagnostic chamber and the junction box. The system's installation concept provides easy access for monitoring and maintaining inserts and extension cables. It provides a rigid connection for the junction box and is vibration-resistant.

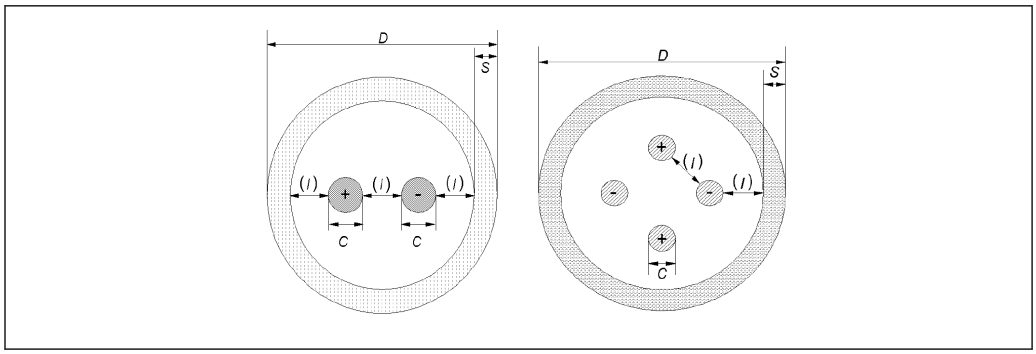
Inserts, conduits and thermowells

Thermocouple

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

Thermowells or conduits

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

Sealing components

The sealing components are welded to the diagnostic chamber to ensure proper sealing under all specified operating conditions and to allow maintenance or replacement of the stump-insert (basic solution) or the inserts (advanced solution).

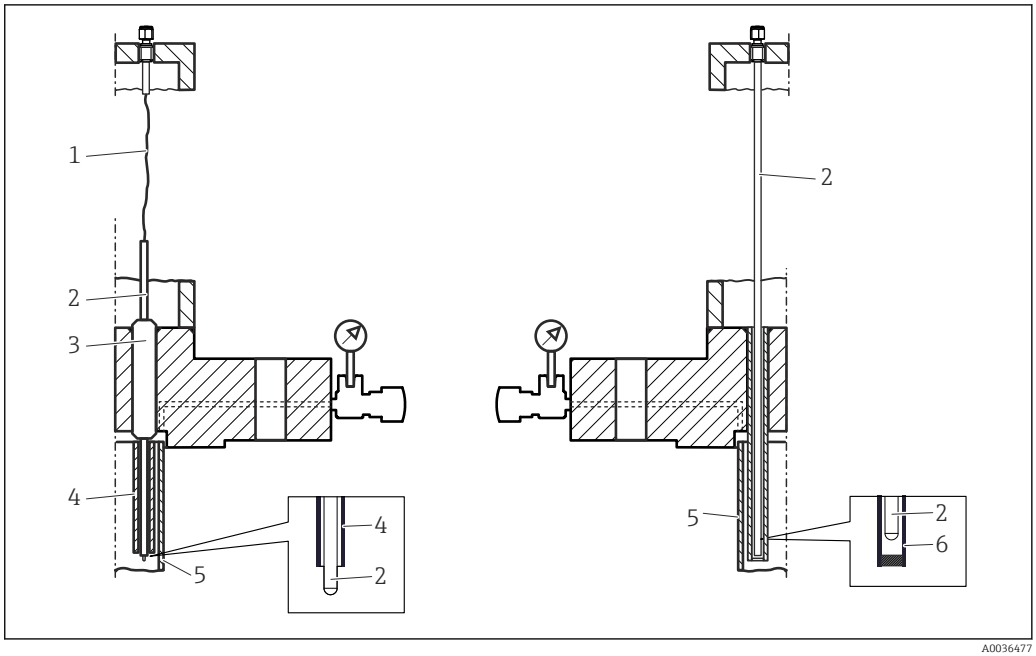
Material: AISI 316/AISI 316H

Cable glands

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

Material	Identification	IP protection class	Ambient temperature 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 (−61.6 to +230 °F)	6 to 12 mm (0.23 to 0.47 in)

Diagnostic function



9 *Left side: Basic version, right side: Advanced version*

1 *Free extension cables (interruption)*
2 *Sensor*
3 *Sleeve*
4 *Opened conduit*
5 *Primary thermowell*
6 *Thermowell*

First level of diagnostic

The reactors where the multipoint assembly is used are generally characterized by harsh conditions in terms of pressure, temperature, corrosion and dynamics of the process fluids. Thanks to the pressure port, any potential leaks or gas permeation passing through the primary thermowell can be detected and monitored. This allows maintenance to be planned in advance.

Second level of diagnostic

The diagnostic chamber is a module that monitors the behavior of the multipoint thermometer. Leaks or the permeation of gases from the process are also safely contained, if they pass the primary thermowell or one of the following elements:

- Insert sheath
- Welding seams between inserts and process connection
- Thermowells

By processing all recorded data, the second diagnostic level enables assessment of changes in measurement accuracy, remaining service life, and necessary 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) = 40 kg (88 lb).

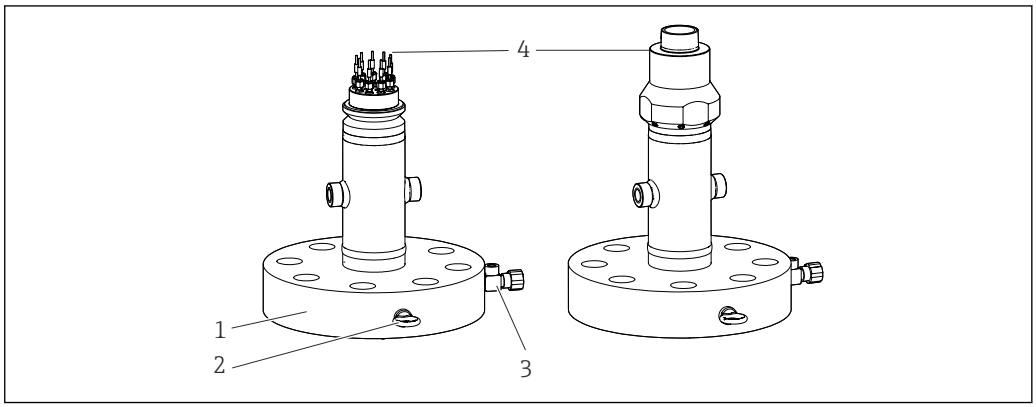
The device must only be lifted and moved using the eyebolt, which is part of the process connection.

Materials

Observe the listed material properties when selecting materials for parts in contact with the process medium:

Material name	Short form	Recommended max. temperature for continuous use in air	Properties
AISI 316/1.4401	X2CrNiMo17-12-2	650 °C (1202 °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 (1202 °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	1100 °C (2012 °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 (1562 °F)	▪ Austenitic, stainless steel ▪ Suitable for use in water and wastewater with low contamination ▪ Resistant to organic acids, saline solutions, sulphates, alkaline solutions, etc. at relatively low temperatures only
AISI 316Ti/ 1.4571	X6CrNiMoTi17-12-2	700 °C (1292 °F)	▪ Properties comparable with AISI 316L ▪ Addition of titanium means increased resistance to intergranular corrosion even after welding ▪ Broad range of uses in the chemical, petrochemical and oil industries as well as in coal chemistry ▪ Can only be polished to a limited extent, titanium streaks can form
AISI 321/1.4541	X6CrNiTi18-10	815 °C (1499 °F)	▪ Austenitic, stainless steel ▪ High resistance to intergranular corrosion even after welding ▪ Good welding characteristics, suitable for all standard welding methods ▪ It is used in many sectors of the chemical industry, petrochemical, and pressurized vessels
AISI 347/1.4550	X6CrNiNb10-10	800 °C (1472 °F)	▪ Austenitic, stainless steel ▪ High resistance in 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



10 Flange as process connection

1 Flange
2 Eyebolt
3 Pressure connection
4 Compression fitting

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

Standard [1]	Size	Pressure rating	Material
ASME	1 1/2", 2", 3"	150#, 300#, 400#, 600#, 900#	AISI 316/L, 304/L, 310, 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

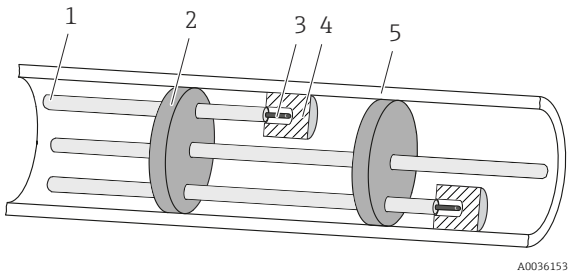
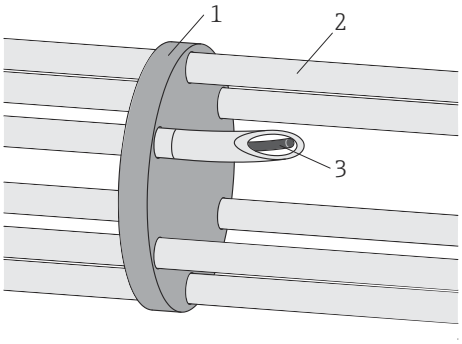
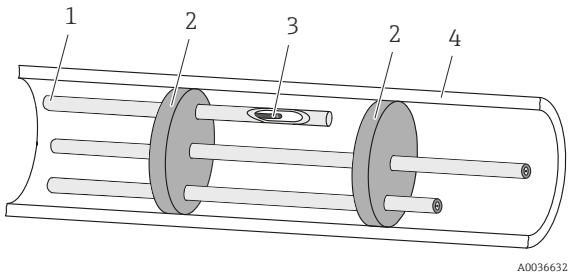
1) Flanges according to GOST standard are available on request.

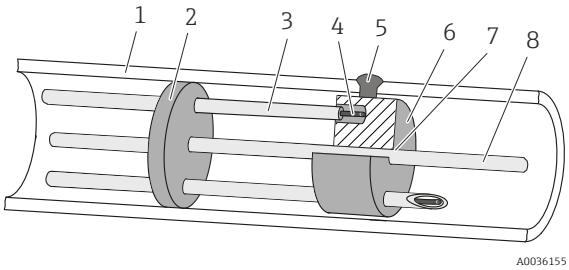
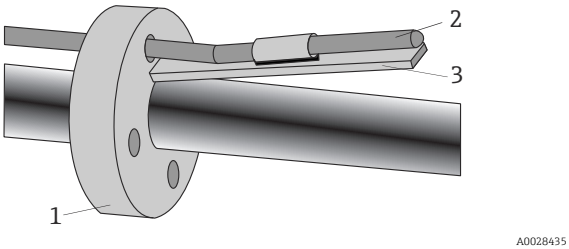
Compression fittings

The compression fittings are welded to the upper part of the diagnostic chamber to allow the inserts to be replaced. The dimensions correspond to the insert dimensions. The compression fittings meet the highest standards of reliability in terms of materials and design.

Material: AISI 316/316 H

Thermal contact components

A: Thermal contact block  A0036153 *1 Conduit* *2 Spacers* *3 Insert* *4 Thermal block* *5 Primary thermowell wall*	Pressed against the internal wall to ensure optimum heat transfer between the primary thermowell and the replaceable temperature sensor.
B: Bent conduits and spacers  A0028783 *1 Spacers* *2 Conduit* *3 Insert*	▪ Used in linear configurations and with existing thermowells for axial centering of the insert bundle ▪ Increases the flexural stiffness of the sensor bundle ▪ Enables sensor replacement. ▪ Ensures thermal contact between the sensor tip and the existing thermowell ▪ Modular design. [1)]
C: Thermowells and spacers  A0036632 *1 Thermowell* *2 Spacers* *3 Insert* *4 Primary thermowell wall*	Each sensor is protected by the thermowell with straight tip.

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

1) Can be installed either at the factory or on site

User operation

For operating details, refer to the technical documentation of the relevant transmitters or the corresponding 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**.

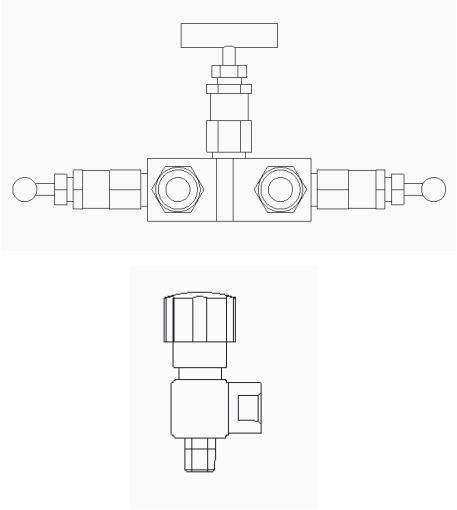
Product Configurator - the tool for individual product configuration
- Up-to-the-minute configuration data
- Depending on the device: direct input of information specific to the measuring point, such as the measuring range or operating language
- Automatic verification of exclusion criteria
- Automatic 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. Refer to the Endress+Hauser PMP sensor family
 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.
Purging system	A purging system for the depressurization of the diagnostic chamber. The system consists of: ▪ 2- and 3-way valves ▪ Pressure transmitter ▪ Two-way pressure relief valves The system enables the connection of multiple diagnostic chambers installed in the same reactor.

Accessories	Description
Portable sampling system	Portable system for field use that enables sampling of the fluid present inside the diagnostic chamber, so that it can be chemically analyzed in an external laboratory. The system consists of: ▪ Three cylinders ▪ Pressure regulator ▪ Rigid and flexible tubes ▪ Vent lines ▪ Quick connectors and valves
 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 interface. For details, see "Technical Information" TI00404F
Commubox FXA291	Connects Endress+Hauser field devices with a CDI interface (= Endress+Hauser Common Data Interface) and the USB port of a computer or laptop. For details, see "Technical Information" TI00405C
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 instruments 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 instruments 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 devices: ▪ Calculation of all the necessary data for identifying the optimum device: e.g. pressure loss, accuracy or process connections. ▪ Graphic illustration of the calculation results Administration, documentation and access to all project-related data and parameters over the entire life cycle of a project. Applicator is available: Via the Internet: https://portal.endress.com/webapp/applicator
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

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** 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 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. These are an integral part of the Operating Instructions. 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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