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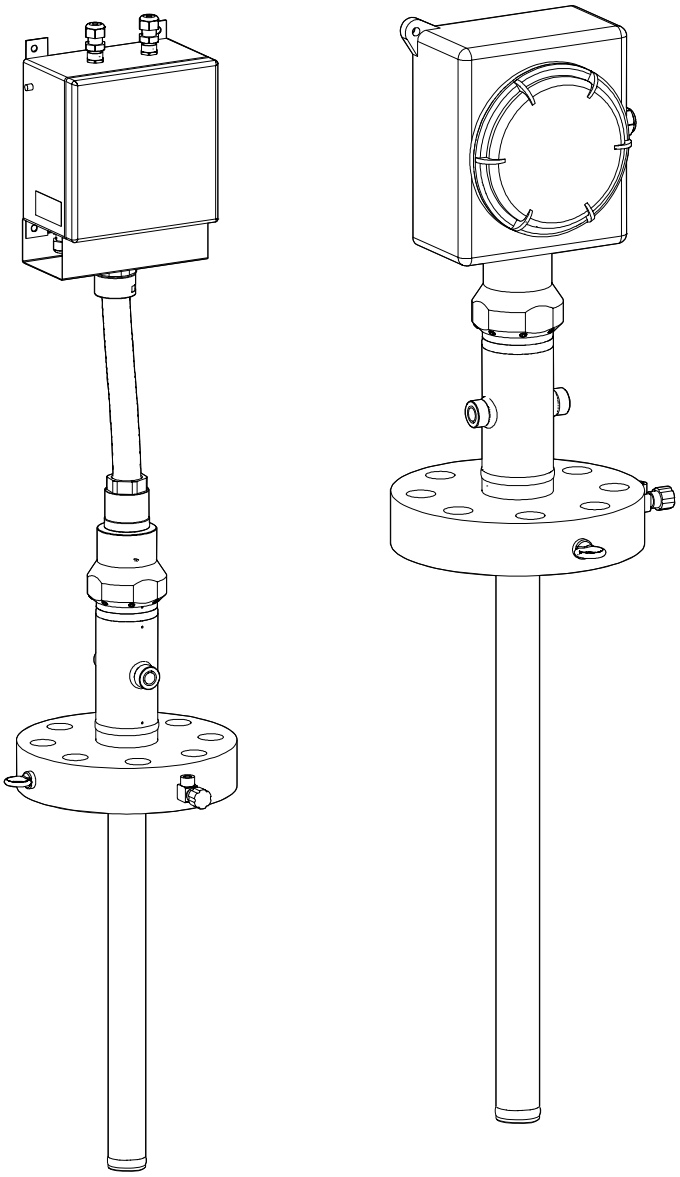
Operating Instructions
iTHERM MultiSens Linear TMS12

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



Endress+Hauser
People for Process Automation

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1 About this document

1.1 Document function

These Operating Instructions contain all the information required in the various life cycle phases of the device: from product identification, incoming acceptance and storage, to installation, connection, operation and commissioning, through to troubleshooting, maintenance and disposal.

1.2 Symbols

1.2.1 Safety symbols

⚠ DANGER
This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.

⚠ WARNING
This symbol alerts you to a potentially dangerous situation. Failure to avoid this situation can result in serious or fatal injury.

⚠ CAUTION
This symbol alerts you to a potentially dangerous situation. Failure to avoid this situation can result in minor or medium injury.

NOTICE
This symbol alerts you to a potentially harmful situation. Failure to avoid this situation can result in damage to the product or something in its vicinity.

1.2.2 Electrical symbols

Symbol	Meaning
⎓	Direct current
~	Alternating current
⎓ ~	Direct current and alternating current
⏚	**Ground connection** A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system.
⊕	**Protective earth (PE)** Ground terminals that must be connected to ground prior to establishing any other connections. The ground terminals are located on the interior and exterior of the device: ▪ Interior ground terminal: protective earth is connected to the mains supply. ▪ Exterior ground terminal: device is connected to the plant grounding system.

1.2.3 Symbols in graphics

Symbol	Meaning	Symbol	Meaning
1, 2, 3,...	Item numbers	1., 2., 3...	Series of steps
A, B, C, ...	Views	A-A, B-B, C-C, ...	Sections
EX	Hazardous area	EX	Safe area (non-hazardous area)

1.2.4 Symbols for certain types of information

Symbol	Meaning
	**Permitted** Procedures, processes or actions that are permitted.
	**Preferred** Procedures, processes or actions that are preferred.
	**Forbidden** Procedures, processes or actions that are forbidden.
	**Tip** Indicates additional information.
	Reference to documentation
	Reference to page
	Reference to graphic
	Notice or individual step to be observed
1., 2., 3...	Series of steps
	Result of a step
	Help in the event of a problem
	Visual inspection

1.2.5 Documentation

For an overview of the scope of the associated Technical Documentation, refer to the following:

- *Device Viewer* (www.endress.com/deviceviewer): Enter the serial number from the nameplate
- *Endress+Hauser Operations app*: Enter serial number from nameplate or scan matrix code on nameplate.

The following 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.

Document type	Purpose and content of the document
Safety instructions (XA)	Depending on the approval, safety instructions for electrical equipment in hazardous areas are also supplied with the device. 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.

1.2.6 Registered trademarks

FOUNDATION™ Fieldbus
Registration-pending trademark of the FieldComm Group, Austin, Texas, USA

HART®
Registered trademark of the FieldComm Group, Austin, Texas, USA

PROFIBUS®
PROFIBUS and the associated trademarks (The Association Trademark, the Technology Trademarks, the Certification Trademark and the Certified by PI Trademark) are registered trademarks of the PROFIBUS User Organization e.V. (Profibus User Organization), Karlsruhe - Germany

2 Basic safety requirements

Observe the special precautions and the instructions and procedures contained in this document to ensure the safety of operating personnel. Safety pictograms and symbols are used to identify safety-relevant information. Observe the safety instructions before carrying out any operation marked accordingly. No express or implied warranty or guarantee is given regarding performance. The manufacturer reserves the right to modify the design or specifications of the device without prior notice in order to improve it.

2.1 Requirements for the personnel

The personnel for installation, commissioning, diagnostics and maintenance must fulfill the following requirements:
- Trained, qualified specialists must have a relevant qualification for this specific function and task.
- Are authorized by the plant owner/operator.
- Are familiar with federal/national regulations.
- Before starting work, read and understand the instructions in the manual and supplementary documentation as well as the certificates (depending on the application).
- Follow instructions and comply with basic conditions.

The operating personnel must fulfill the following requirements:
- Are instructed and authorized according to the requirements of the task by the facility's owner-operator.
- Follow the instructions in this manual.

2.2 Intended use

The device is intended to measure the temperature profile inside a reactor, vessel or pipe using RTD or thermocouple technologies.

The manufacturer is not liable for harm caused by improper or non-designated use.

The device has been designed as follows:

Condition	Description
Internal pressure	The design of joints, threaded connections and sealing elements has been executed as a function of the maximum working pressure inside the reactor.
Operating temperature	The materials used were chosen according to the operating and design minimum and maximum temperatures. Thermal displacement has been taken into account to avoid intrinsic stresses and to ensure proper integration between the instrument and the plant. Take particular care when fastening the device's thermowell to the internal fixtures of the plant.
Process fluids	The choice of dimensions and, above all, material will minimize the following signs of wear: ▪ Surface and localized corrosion ▪ Abrasion and wear ▪ Corrosion phenomena due to uncontrolled and unpredictable chemical reactions Specific process fluids analysis is necessary to properly ensure the maximum operating life of the device, through proper material selection.
Fatigue	Cyclic loads during operation are not included.
Vibrations	The sensor elements may be subjected to vibrations due to high immersion lengths. These vibrations can be minimized by correctly routing the thermowell in the plant (by attaching it to internal fixtures using accessories such as clips or end sleeves. The neck extension is designed to withstand vibration loads to protect the junction box from cyclic loading. This prevents loosening of screwed components.
Mechanical stress	The maximum stress on the measuring instrument multiplied by a safety factor is guaranteed to stay below the yielding stress of the material, for every working condition of the plant.
Ambient conditions	The junction box (with and without head transmitters), cables, cable glands and other fittings have been selected to work within the permissible ambient temperature range.

2.3 Workplace safety

For work on and with the device:
- ▶ Wear the required personal protective equipment according to federal/national regulations.

2.4 Operational safety

Damage to the device!
- ▶ Operate the device in proper technical condition and fail-safe condition only.
- ▶ The operator is responsible for the interference-free operation of the device.

Modifications to the device

Unauthorized modifications to the device are not permitted and can lead to unforeseeable dangers!
- ▶ If modifications are nevertheless required, consult with the manufacturer.

Repair

To ensure continued operational safety and reliability:
- ▶ Carry out repairs on the device only if they are expressly permitted.
- ▶ Observe federal/national regulations pertaining to the repair of an electrical device.
- ▶ Use only original spare parts and accessories.

2.5 Product safety

This state-of-the-art device is designed and tested in accordance with good engineering practice to meet operational safety standards. It left the factory in a condition in which it is safe to operate.

It meets general safety standards and legal requirements. It also complies with the EU directives listed in the device-specific EU declaration of conformity. The manufacturer confirms this by affixing the CE mark.

3 Product description

3.1 Equipment architecture

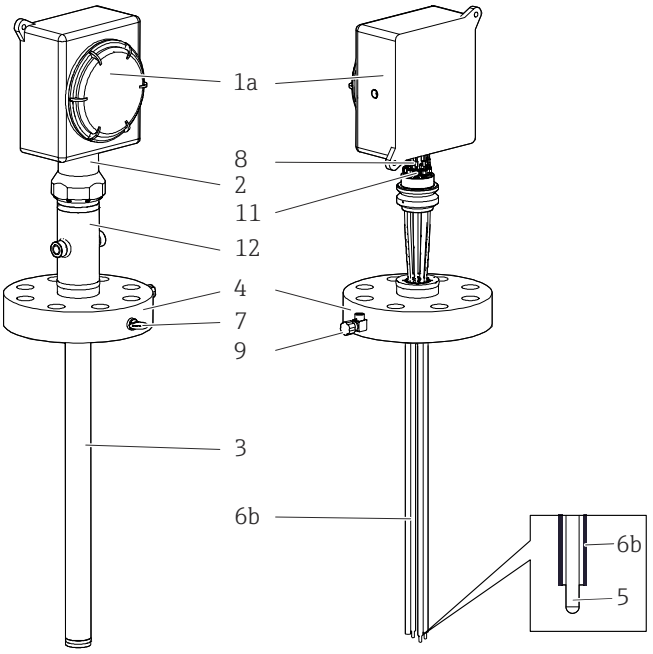
The device is one of a series of modular products for multiple temperature measurement. The design allows for the replacement of individual subassemblies and components, making maintenance and spare parts management easier.

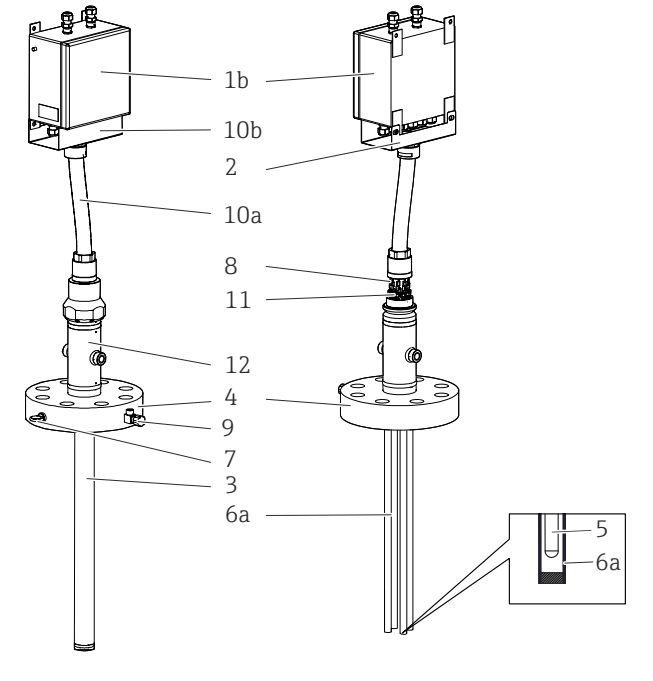
The device consists of the following subassemblies:

- **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





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.

4 Incoming acceptance and product identification

4.1 Incoming acceptance

On receipt of the delivery:

1. Check the packaging for damage.
   ↳ Report all damage immediately to the manufacturer.
   Do not install damaged components.
2. Check the scope of delivery using the delivery note.
3. Compare the data on the nameplate with the order specifications on the delivery note.
4. Check the technical documentation and all other necessary documents, e.g. certificates, to ensure they are complete.

If one of the conditions is not satisfied, contact the manufacturer.

4.2 Product identification

The device can be identified in the following ways:
- Nameplate specifications
- Enter the serial number from the nameplate into *Device Viewer* (www.endress.com/deviceviewer): all the information about the device and an overview of the Technical Documentation supplied with the device are displayed.
- Enter the serial number from the nameplate into the *Endress+Hauser Operations App* or scan the 2-D matrix code (QR code) on the nameplate with the *Endress+Hauser Operations App*: all the information about the device and the technical documentation pertaining to the device is displayed.

4.2.1 Nameplate

Do you have the correct device?

The nameplate provides you with the following information on the device:
- Manufacturer identification, device designation
- Order code
- Extended order code
- Serial number
- Tag name (TAG) (optional)

- Technical values, e.g. supply voltage, current consumption, ambient temperature, communication-specific data (optional)
- Degree of protection
- Approvals with symbols
- Reference to Safety Instructions (XA) (optional)

▶ Compare the information on the nameplate with the order.

4.2.2 Name and address of manufacturer

Name of manufacturer:	Endress+Hauser Wetzer GmbH + Co. KG
Address of manufacturer:	Obere Wank 1, D-87484 Nesselwang or www.endress.com

4.3 Storage and transport

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

4.3.1 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

Pack the device for storage and transportation in such a way that it is reliably protected against impact and external influences. The original packaging offers the best protection.

Avoid the following environmental influences during storage:
- Direct sunlight
- Proximity to hot objects
- Mechanical vibration
- Aggressive media

4.4 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**.

5 Installation

5.1 Installation requirements

⚠ WARNING

Failure to observe the installation steps can result in death or serious injury!

- ▶ Ensure that the device is installed only by appropriately qualified personnel.

⚠ WARNING

Explosions can result in death or serious injury.

- ▶ Before connecting any additional electric and electronic devices in an explosive atmosphere, make sure the devices in the loop are installed in accordance with intrinsically safe or non-sparking wiring practices.
- ▶ Verify that the operating atmosphere of the transmitters is consistent with the relevant certification for hazardous areas.
- ▶ Tighten all covers and threaded components to meet explosion protection requirements.

⚠ WARNING

Leaks in the process can result in death or serious injury.

- ▶ Install and tighten fittings before applying pressure.
- ▶ Do not loosen the threaded parts during operation.

NOTICE

Additional loads and vibrations from other plant components can affect the operation of the sensor elements.

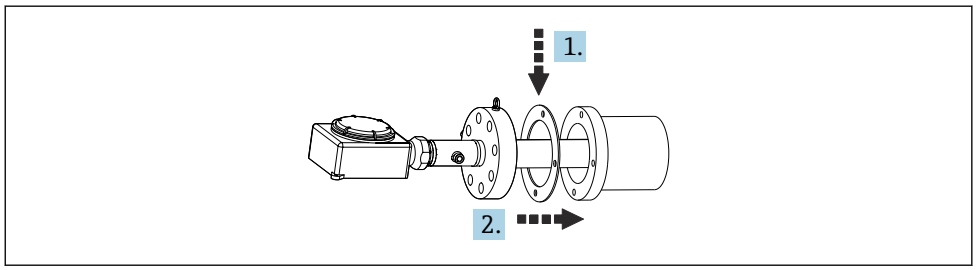
- ▶ When installing the measurement system, avoid any friction and spark generation in particular.
- ▶ Additional loads or external torques on the system caused by connection to another system and not provided for in the installation plan are not permitted.
- ▶ The device is not suitable for installations in locations where vibrations occur. Any resulting loads may impair junction seals and thus affect the operation of the sensor elements.
- ▶ For information on ambient conditions, see the Technical data.
- ▶ Only use existing internal fixtures of the vessel when external loads act on the tip of the primary thermowell. External loads include any that would deform or stress the device and, in particular, the welds.
- ▶ The end user is responsible for checking that suitable equipment has been installed. Do not exceed the permitted limit values of the device.

5.2 Installing the device

5.2.1 Installation sequence

1. Check the inside of the vessel when installing the device.
2. Check for any obstructions to simplify insertion.
3. When installing the measurement system, avoid any friction and spark generation in particular.

1.



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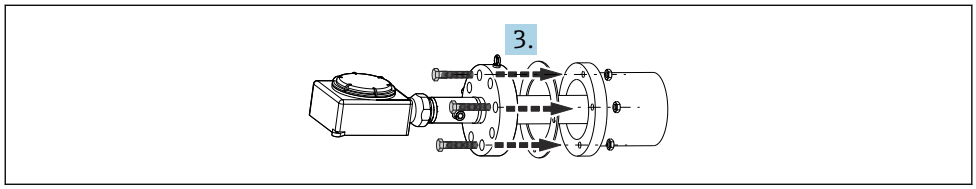
Check that the sealing surfaces on the flanges are clean. Place the sealing ring between the flanged nozzle and the device flange.

2. Move the device towards the nozzle. Insert the main thermowell into the nozzle. Ensure that no deformation occurs.

3.



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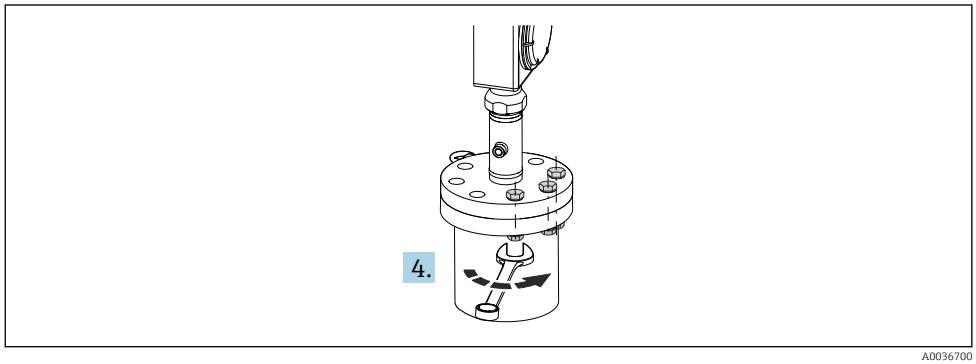
Insert the screws part way into the drilled holes provided on the flange and tighten them lightly with the nuts. Tighten slightly with the nuts. Use a suitable wrench for this but do not tighten completely yet.

4.



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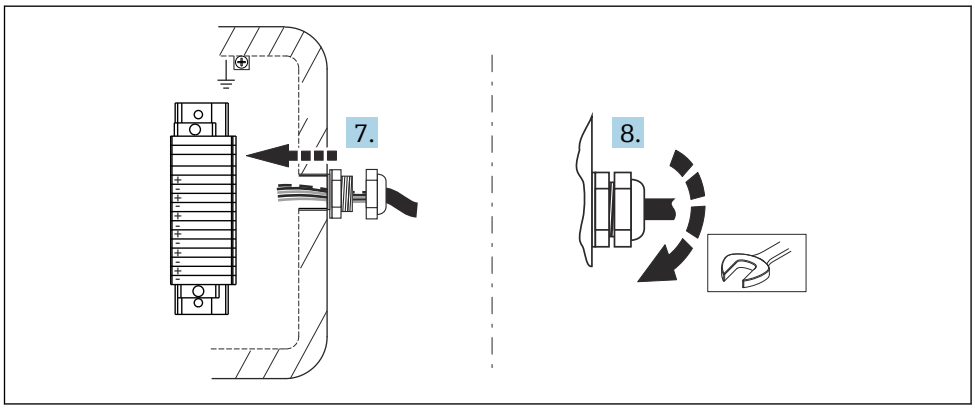
Now insert the screws fully into the drilled holes on the flange. Tighten them crosswise using a suitable tool (i.e. controlled tightening in accordance with applicable standards).

5. If necessary, adjust the alignment of the junction box. To do this, loosen the grub screws and bring the swivelling joint into the desired position. Retighten the grub screws.

6.



To wire the system, after having opened the cover of the junction box introduce the extension or compensating cables through the respective cable glands in the junction box.

7. Tighten the cable glands on the junction box.
8. Connect the cables to the connection terminals or temperature transmitters of the junction box. Follow the supplied wiring instructions. This is the only way to ensure that the correct TAG numbers of the cables are connected to the correct TAG numbers of the connection terminals.
9. Close the cover. Position the seal correctly to avoid impairing the degree of protection (IP). Place the drain valve in the correct position (to control condensation).

NOTICE

After installation, perform a few simple tests on the thermometric system installed.

- ▶ Check the tightness of the threaded connections.
- ▶ If any part is loose, tighten it applying the proper torque.
- ▶ Check that the wiring was performed correctly. Test the electrical continuity of the thermocouples (by heating the thermocouple measuring point). Ensure that no short circuits are present.

5.3 Post-installation check

Before commissioning the measuring system make sure that all final checks have been carried out:

Device condition and specifications	
Is the device undamaged (visual inspection)?	❑
Do the ambient conditions match the device specification? Example: ▪ Ambient temperature ▪ Proper conditions	❑
Are the threaded components undeformed?	❑
Are the gaskets intact and free from permanent deformation?	❑
Installation	
Is the equipment aligned with the nozzle axis?	❑
Are the gasket seats of flanges clean?	❑
Are the flange and its counter flange properly bolted together?	❑
Is the thermowell free of deformations?	❑
Are the bolts completely inserted in the flange? Make sure the flange is completely attached to the nozzle.	❑

Is the primary thermowell properly fixed to the internal infrastructures (when applicable)?	❑
Are the cable glands tightened on the extension cables?	❑
Are the extension cables connected to the junction box terminals?	❑
Are the extension cable protections (when ordered) properly assembled and closed?	❑

6 Wiring

⚠ CAUTION

Explosions can result in death or serious injury. For information on connecting the devices in hazardous areas, see the separate Ex documentation. Contact the manufacturer if you have any questions.

- ▶ Non-compliance may result in the destruction of electronics components.
- ▶ Do not install or wire the device when it is connected to the operating voltage.

For wiring with a transmitter, refer to the technical documentation of the relevant transmitter.

For wiring the device proceed as follows:

1. Open the housing cover on the junction box.
2. Open the cable glands on the sides of the junction box.
3. Feed the cables through the opening in the cable glands.
4. Connect the cables as shown; see section 1.2.
5. Once wiring is complete, tighten the screw terminals. Tighten the cable glands again. Close the housing cover.

The device is wired.

Before commissioning, refer to the checklist in the section "Post-connection check" to prevent connection errors.

6.1 Quick wiring guide

NOTICE

Destruction or malfunction of parts of the electronics through electrostatic discharge.

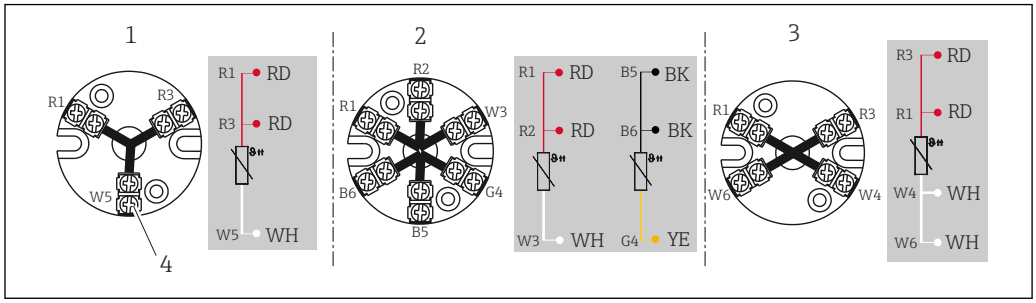
- ▶ Take appropriate measures to protect the terminals from electrostatic discharge.

When directly wiring the thermocouple and RTD sensors, use an extension or compensation cable to avoid incorrect measured values. The polarity specified on the relevant terminal block and in the wiring diagram must be observed.

The manufacturer of the device is not responsible for planning or installing the fieldbus connecting cables. Therefore the manufacturer cannot be held liable for possible damages caused by selecting materials that are not suitable for that application or due to a faulty installation.

6.1.1 Wiring diagrams

RTD sensor connection type



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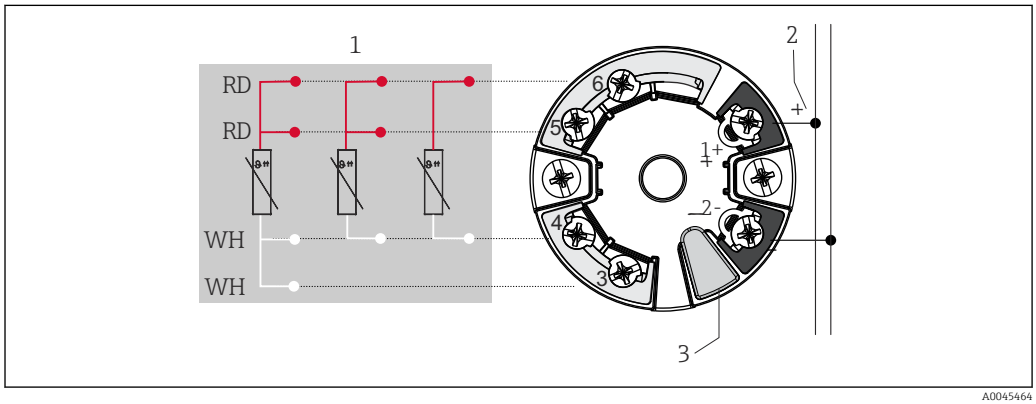
1 Mounted terminal block

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



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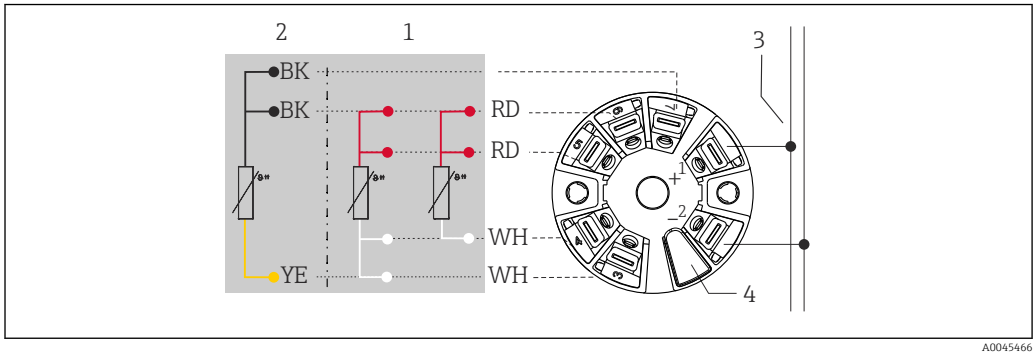
2 Head-mounted iTEMP TMT7x transmitter or iTEMP TMT31 (single sensor input)

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



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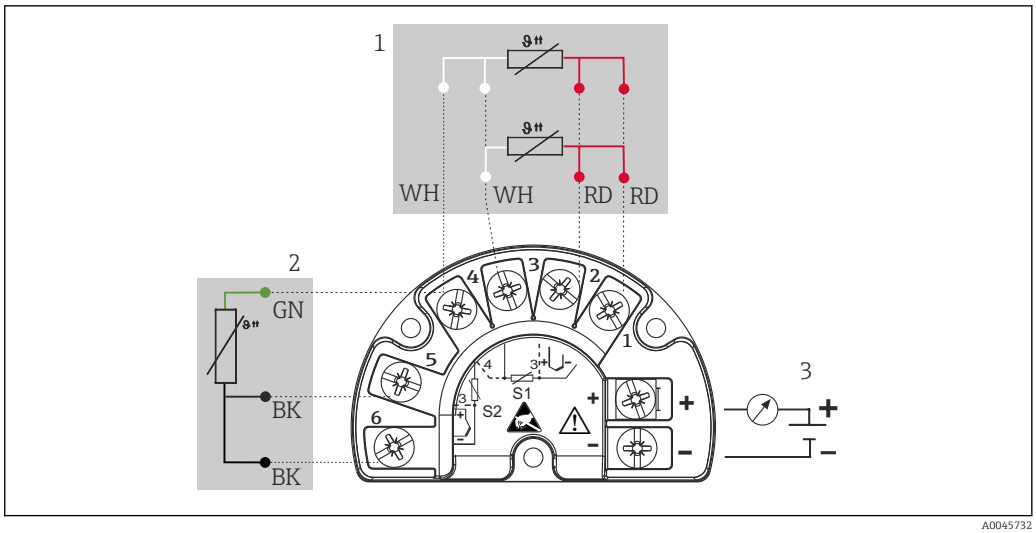
3 Head-mounted iTEMP TMT8x transmitter (dual sensor input)

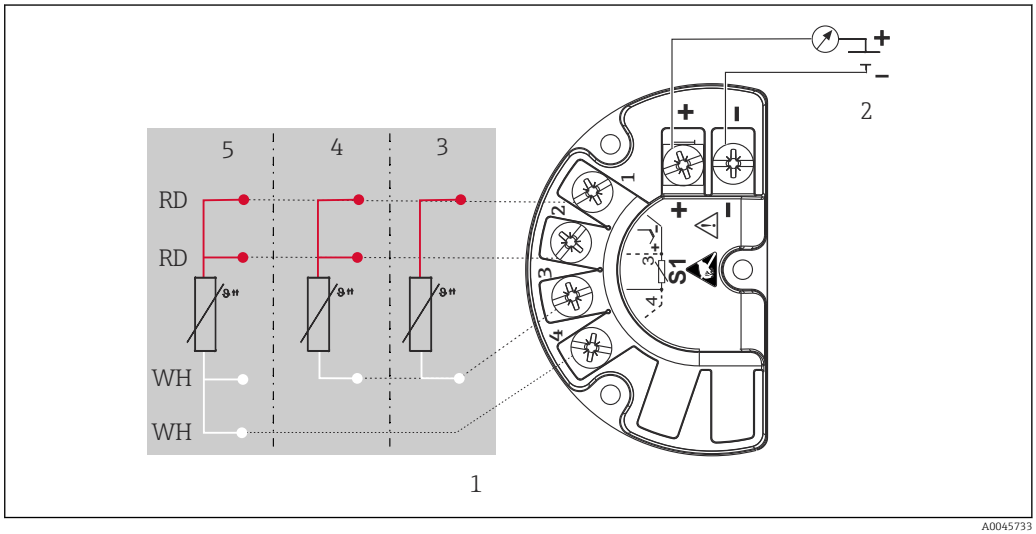
1 Sensor input 1, RTD: 4- and 3-wire
2 Sensor input 2, RTD: 3-wire
3 Power supply or fieldbus connection
4 Display connection

Mounted field transmitter: Fitted with screw terminals



4 *iTEMP TMT162 (dual input)*

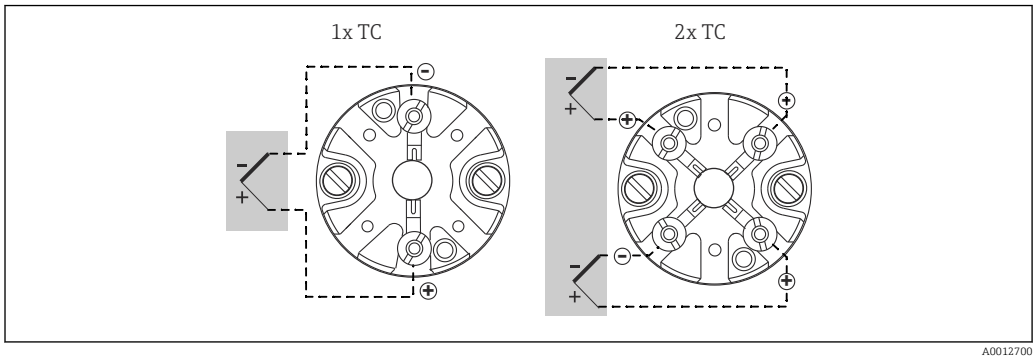
1 *Sensor input 1, RTD: 3- and 4-wire*
2 *Sensor input 2, RTD: 3-wire*
3 *Power supply, field transmitter and analog output 4 to 20 mA or fieldbus connection*



5 *iTEMP TMT142B (single input)*

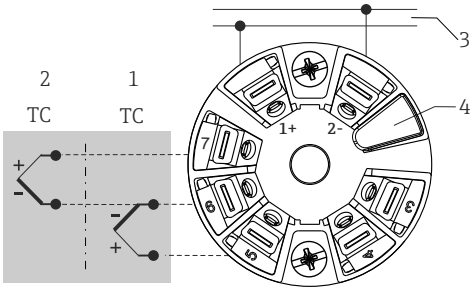
1 *Sensor input RTD*
2 *Power supply, field transmitter and analog output 4 to 20 mA, HART® signal*
3 *2-wire*
4 *3-wire*
5 *4-wire*

Thermocouple (TC) sensor connection type



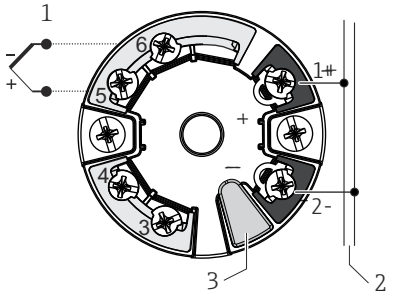
6 Mounted terminal block

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



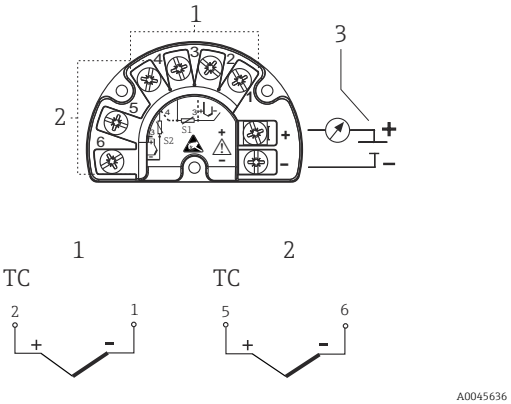
1 Sensor input 1
2 Sensor input 2
3 Fieldbus communication and power supply
4 Display connection

Head-mounted iTEMP TMT7x transmitter or iTEMP TMT31 (single sensor input) [1]



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

Mounted field transmitter iTEMP TMT162 or iTEMP TMT142B



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

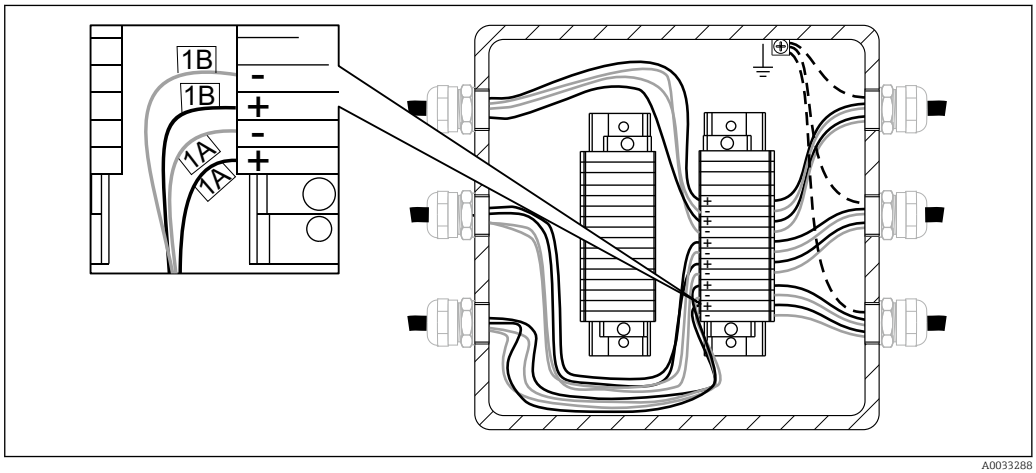
1) Fitted with spring terminals if screw terminals are not explicitly selected or a dual sensor is installed.

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 (-)

6.2 Connecting the sensor cables

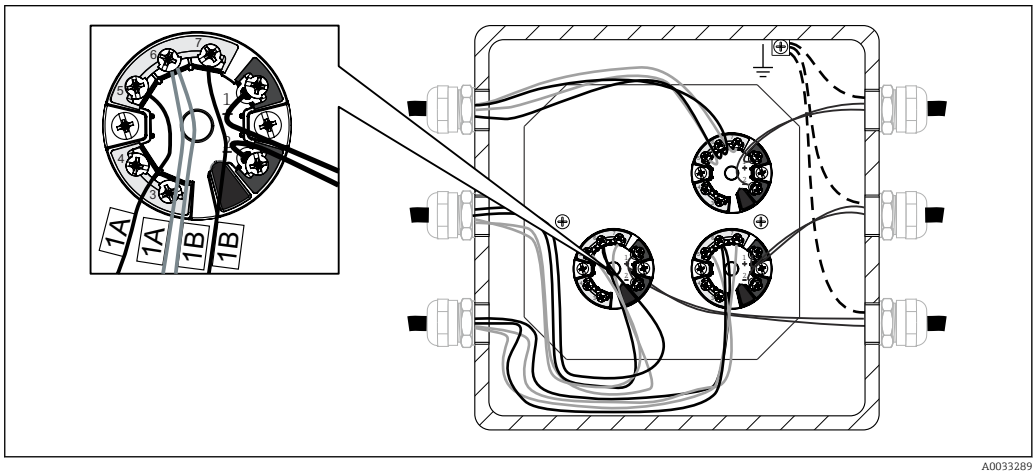
Each sensor is marked with an individual TAG number. In the standard configuration, all cables are already connected to the installed transmitters or terminals.



7 *Direct wiring on the mounted terminal block. Example of internal marking for the sensor cables with 2 x TC sensors in insert no. 1.*

The wiring is performed sequentially. The input channels of transmitter no. 1 are connected to the cables of the insert, starting with insert no. 1. Transmitter no. 2 is used only after all channels of transmitter no. 1 have been connected.

The cables of each insert are numbered consecutively, starting with 1. When two sensors are used, the internal marking is given an additional suffix to distinguish between the two sensors - for example, 1A and 1B for two sensors in the same insert or measuring point 1.



8 *Mounted and wired head transmitter. Example of the internal marking for sensor cables with two thermocouples*

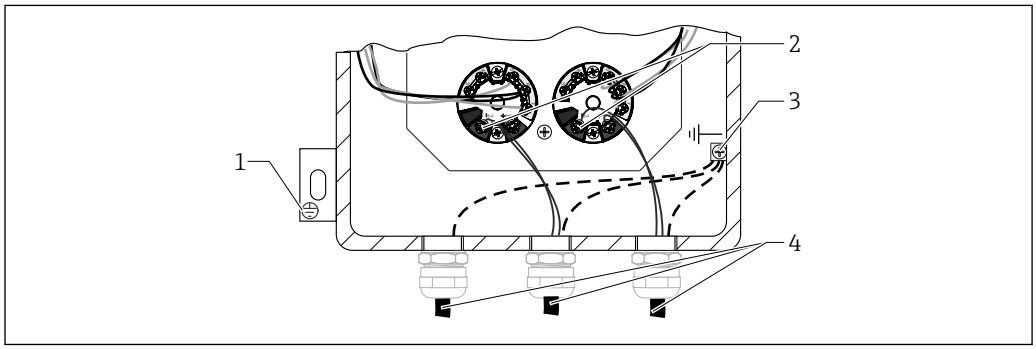
Sensor type	Transmitter type	Wiring rule
1 x RTD or TC	▪ Single input (one channel) ▪ Dual input (two channels) ▪ Multi-channel input (twelve channels)	▪ One head transmitter per insert ▪ One head transmitter for two inserts ▪ One multi-channel transmitter for eight inserts
2 x RTD or TC	▪ Single input (one channel) ▪ Dual input (two channels) ▪ Multi-channel input (twelve channels)	▪ Not available, wiring excluded ▪ One head transmitter per insert ▪ One multi-channel transmitter for four inserts

6.3 Connecting the power supply and signal cables

Take the plant grounding concept into consideration.

Cable specification

- The terminals for connecting the signal cable (1+ and 2-) are protected against reverse polarity.
- Use a shielded cable for fieldbus communication.
- Conductor cross-section:
  - Max. 2.5 mm² (14 AWG) for screw terminals
  - Max. 1.5 mm² (16 AWG) for spring terminals



9 *Connecting the signal cable and power supply to the installed transmitter*

1 *External ground terminal*
2 *Terminals for signal cable and power supply*
3 *Internal ground terminal*
4 *Shielded signal cable for fieldbus connection*

6.4 Shielding and grounding

For details on electrical shielding and grounding of transmitter wiring, refer to the technical documentation for the relevant transmitter.

Observe national installation requirements and guidelines during installation. Where there are large differences in potential between the individual grounding points, only one point of the shielding is connected directly with the reference ground. In systems without potential equalization, therefore, cable shielding of fieldbus systems should only be grounded on one side, for example at the supply unit or at safety barriers.

NOTICE

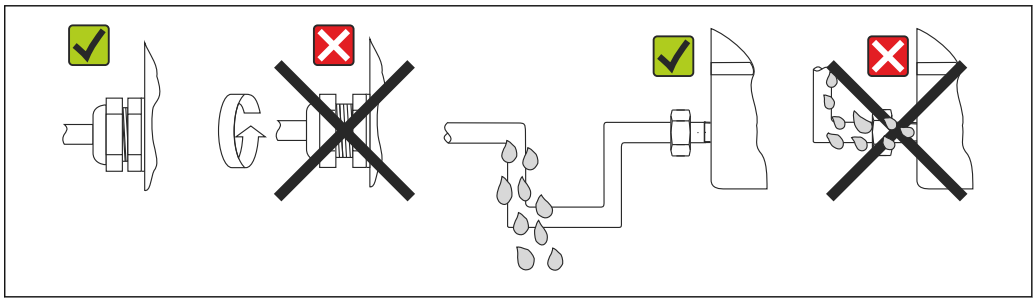
If the shielding of the cable is grounded at more than one point in systems without potential matching, power supply frequency equalizing currents can occur that damage the signal cable or have a serious effect on signal transmission.

▶ In such cases, the signal cable shield must be grounded at only one end. It must not be connected to the housing ground terminal (terminal head, field housing). Insulate the shield that is not connected.

6.5 Ensuring the degree of protection

The device meets all of the requirements in accordance with the degree of protection indicated on the nameplate. Compliance with the following points is mandatory following installation in the field or servicing in order to ensure that the housing degree of protection is maintained:

- The housing seals must be clean and undamaged when inserted into their grooves. If the seal or sealing groove is dirty, dry, clean or replace it.
- All housing screws and screw caps must be firmly tightened.
- The cables used for the connection must have the specified outer diameter (e.g. M20x1.5, cable diameter 8 to 12 mm).
- Firmly tighten the cable gland, and use it only in the specified clamping area (the cable diameter must be appropriate to the cable gland).
- The cables must loop down before they enter the cable gland ("water trap"). This means that any moisture that may form cannot enter the gland. The device must be installed so that the cable glands are not facing upwards.
- Do not twist the cables, and use only round cables.
- Replace unused cable glands with a dummy plug (included in the scope of delivery).
- Do not remove the grommet from the cable gland.
- Repeated opening/closing of the device is possible but has a negative impact on the degree of protection.



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10 Connection instructions for compliance with the degree of protection

6.6 Post-connection check

Is the device undamaged (internal equipment inspection)?	❑
Electrical connection	
Does the supply voltage match the specifications on the nameplate?	❑
Do the mounted cables have suitable strain relief?	❑
Are the power supply and signal cables correctly connected?	❑
Are all the screw terminals well tightened and have the connections of the spring terminals been checked?	❑
Are all cable glands installed, securely tightened and leak-tight?	❑
Are all housing covers installed and securely tightened?	❑
Does the marking of the terminals and cables match?	❑
Is the electrical continuity of the thermocouple verified?	❑

7 Commissioning

7.1 Preparatory steps

To ensure proper operation of the device, use the setup guides for the manufacturer's commissioning types "Standard", "Extended" and "Advanced", in accordance with:
- Operating instructions
- Customer specifications for commissioning and application conditions (including process conditions)

Take the following steps:

1. Inform the operator and personnel responsible for the process that commissioning will be carried out.
2. Determine which chemical or which medium is being measured. Observe the safety data sheet.
3. Disconnect the sensors connected to the process.
4. Observe temperature and pressure conditions.
5. Only open process fittings and loosen flange screws after ensuring that this can be done safely.
6. Be sure not to disturb the process when disconnecting input/output signal lines or when simulating signals.
7. Make sure that tools, equipment and the process are protected from contamination. Include and plan any required cleaning steps.
8. Make sure that the chemicals used do not pose any safety risks. This includes agent used for normal operation or for cleaning. Observe and comply with the relevant safety instructions.

7.1.1 Tools and equipment

For commissioning, use multimeters and device-specific configuration tools as required according to the list of measures described above.

7.2 Post-installation check

Make sure that all post-connection checks have been carried out before putting your device into operation:
- "Post-installation check" checklist
- "Post-connection check" checklist

Commissioning must be carried out according to one of the following types of commissioning: Standard, Extended or Advanced.

7.2.1 Standard commissioning

Visual inspection of device:

1. Check the device for damage.
2. Check that the device has been installed as specified in the operating instructions.
3. Check that the wiring has been carried out according to the operating instructions and the local regulations.
4. Check that the device is dustproof and waterproof.
5. Check whether the safety precautions have been observed.

6. Supply power to the device.

The visual inspection of the device is complete.

Ambient conditions:

1. Ensure that the devices are operated under suitable ambient conditions. These include ambient temperature, humidity (IPxx protection rating), vibration, explosion-hazard areas (Ex, dust-Ex), RFI/EMC, and sun protection.
2. Check that the devices are accessible for operation and maintenance purposes.

Ambient conditions have been checked.

Configuration parameters:

1. Configure the device according to the instructions in the operating instructions using the parameters specified by the customer.
2. Alternatively, configure it using the parameters specified in the design specification.

The device has been configured correctly.

Verifying the output signal value

1. Check that the local display and the output signals of the device conform with the customer's display
2. Confirm that the local display and the output signals of the device conform with the customer's display

The output value has been verified.

Standard commissioning is complete.

7.2.2 Extended commissioning

To carry out commissioning in Extended mode, perform the following steps after completing Standard commissioning:

Device conformity:

1. Compare the received device with the order or design specification, including accessories, documentation and certificates.
2. Check the software version, if available.

Device conformity has been verified.

Function test :

1. Check device outputs - including switching points, auxiliary inputs/outputs - using the internal or an external simulator.
2. Compare measurement data/results with a reference provided by the customer.
3. If necessary, adjust the device according to the description in the operating instructions.

Functional test has been completed.

Extended commissioning is complete.

7.2.3 Advanced commissioning

In addition to the steps for Standard and Extended commissioning, Advanced commissioning also includes a loop test.

Verifying the measuring circuit:

1. Simulate a minimum of 3 output signals that are transmitted from the device to the control room.
2. Read out the simulated and displayed values.
3. Record the values.
4. Check linearity.

The measuring circuit has been verified.

Advanced commissioning is complete.

7.3 Switching on the device

After completing the final check, connect the supply voltage. The multipoint thermometer is then ready for operation.

8 Diagnostics and troubleshooting

8.1 General troubleshooting

If electronic problems occur, start troubleshooting using the queries described in the operating instructions. These queries systematically guide you to the cause of the fault and the corresponding remedial actions.

For the complete temperature device, please refer to the following instruction.

NOTICE

Repair of device components

▶ Replace the device in the event of a major fault. See the section "Return".

If iTEMP transmitters from Endress+Hauser are used, refer to the technical documentation for the relevant device for troubleshooting information.

9 Maintenance

9.1 General information

Ensure that the device is easily accessible for maintenance purposes. Any component that is part of the device must, if replaced, be exchanged with an original spare part from the manufacturer that guarantees the same characteristics and performance. To ensure continued operational safety and reliability, repairs on the device may only be carried out if they have been expressly approved by the manufacturer. In addition, regional or national regulations and laws governing the repair of electrical equipment must be observed.

The following maintenance steps are applicable only for the advanced version of the device.

9.2 Spare parts

Product spare parts that are currently available can be found online at:
http://www.products.endress.com/spareparts_consumables.

When ordering spare parts, specify the serial number of the device.

Spare parts of the multipoint thermometer assembly are:

- Complete junction box
- Temperature inserts
- Temperature transmitter
- Electrical connection
- DIN rail
- Plate for electric terminals
- Cable gland
- Sealing sleeve for cable gland
- Adapters for cable gland
- Junction box support system (swiveling joint)

The additional following accessories can be selected independently from the product configuration:

- Pressure transmitter
- Pressure manometer
- Fitting
- Manifolds
- Valves

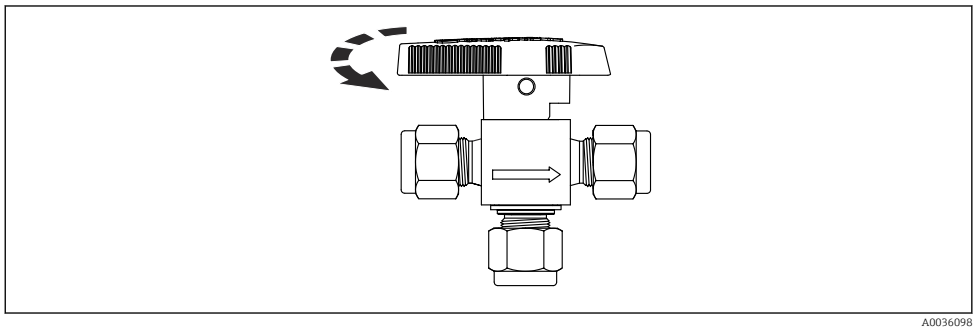
In a design with replaceable inserts, the following steps must be followed.

NOTICE

▶ Before replacing the insert, ensure that the primary thermowell and the diagnostic chamber are depressurized. To do this, check the pressure value displayed on the mounted pressure measurement device (pressure gage or pressure transmitter).

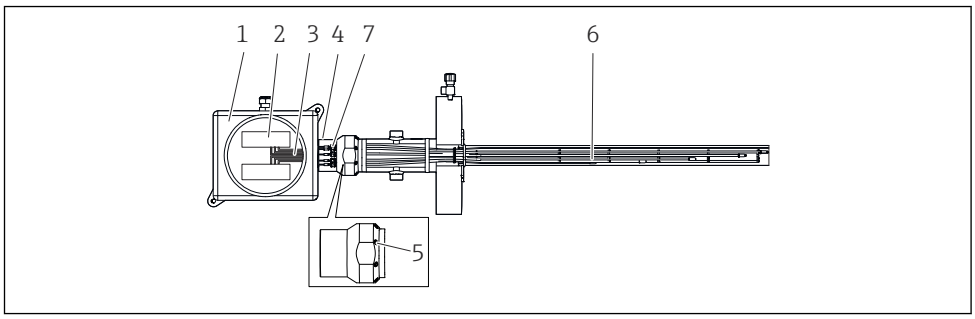
If the primary thermowell is pressurized, sensor replacement is only permitted if the diagnostic chamber is not under pressure.

If the diagnostic chamber is pressurized and a pressure gauge/transmitter is installed together with manifolds or multi-way valves, perform the safety measures listed here and then replace the inserts under operating conditions:

1. 

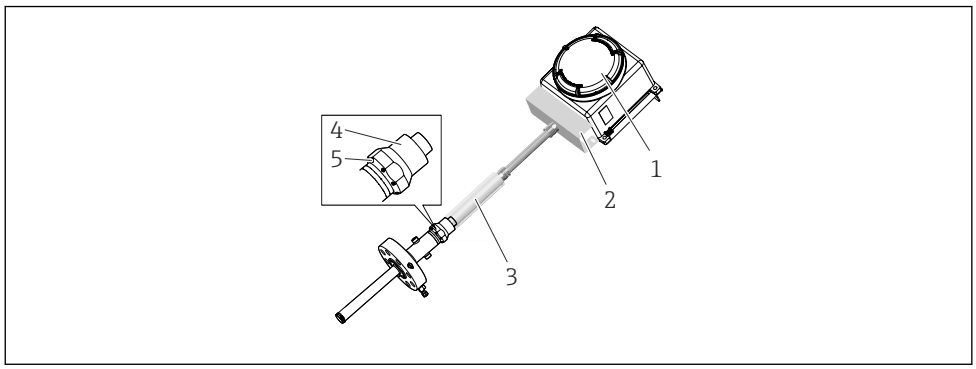
   Set the multi-way valve installed on the diagnostic chamber to the draining position. Ensure that the pressure indication remains active.
2. Safely discharge the fluids to a blowdown line or proceed according to local safety regulations.
3. Ensure that overpressure is completely released.
4. Return the multi-way valve to the original position for pressure detection.
5. Monitor the pressure indicator for a reasonable period of time, depending on the specific process conditions. Only initiate the following steps if the pressure does not increase significantly again:

Case 1: Design with directly mounted junction box

1. 

   Open the cover of the junction box (1).
2. Disconnect the sensor cables (3) of all the inserts (6) from the terminal block (2), or transmitter, inside the junction box (process side).
3. Fully unscrew the grub screws of the swiveling joint (5).
4. Remove the junction box with its joint (4) so that all sensor leads of the insert and the compression fittings are accessible.
5. Unscrew the compression fitting nuts (7).
6. Slowly and carefully pull the inserts all the way out. Ensure that the thread and sealing seats of the compression fittings are not damaged.
7. Note that the metallic ferrule of the loosened compression fitting must be replaced during each such procedure. A new set of metal ferrules is required in order to achieve the same specifications as the replaced component.
8. Guide a new insert through the compression fitting, starting with the tip. The length and specifications of the manufacturer's new insert must meet the specifications of the replaced component.
9. Tighten the nut of the compression fitting, observing the manufacturer's instructions.
10. If necessary, clean the gasket seat of the sealing groove of the swiveling joint and replace the seal if it is damaged or dry. Avoid any damage to internal connections and sealing surfaces. If scratches are detected, contact the manufacturer to replace the swiveling joint.
11. Align the junction box in its original position again using the joint. Ensure that the bundle of extension cables is fully inserted in the junction box.
12. Screw and tighten the grub screws of the swiveling joint.
13. Connect all cables of the insert, according to the wiring scheme, to the relevant terminal block or transmitter inside the junction box.
14. Close the housing cover.

Case 2: Design with remote junction box and protecting conduit

1. 

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   Open the cover of the junction box (1).
2. Disconnect the sensor cables of all the measuring inserts from the terminal blocks or transmitters inside the junction box (process side).
3. Pull the cable gland protection cover (2) out of the junction box until the cable glands are visible and accessible.
4. Loosen the sealing nuts of the cable glands on all inserts.
5. Remove the cable conduit (3) together with the sensor leads from the junction box.
6. Fully unscrew the grub screws (5) of the swiveling joint (4) and remove the cable conduit together with the swiveling joint. All extension cables are now accessible.
7. Unscrew the compression fitting nuts of the sensors which might be replaced.
8. Slowly and carefully remove the sensor. Ensure that the thread and sealing seats of the compression fittings are not damaged.
9. Note that the metallic ferrule of the loosened compression fitting must be replaced during each such procedure. A new set of metal ferrules is required in order to achieve the same specifications as the replaced component.
10. Guide all new inserts through the compression fittings, starting with the tips. The length and specifications of each new insert from the manufacturer must meet the specifications of the replaced components.
11. Tighten the nuts of the compression fittings in accordance with the manufacturer's instructions.
12. Slide the cable conduit (3) onto the new bundle of extension cables together with its swiveling joint and protection cover fitting. Return the swiveling joint to its original position.
13. Tighten the grub screws (5) of the swiveling joint (4).
14. Insert the extension cables terminals of the new sensors through their original cable glands.
15. Tighten the cable gland sealing nut.
16. Connect all cables of the insert, according to the wiring scheme, to the relevant terminal block or transmitter inside the junction box.
17. Remount the cable gland protection cover.
18. Close the housing cover.

9.3 Endress+Hauser services

Service	Description
Certificates	The manufacturer can meet the requirements relating to design, product manufacturing, testing, and commissioning of the device in accordance with specific approvals and device certifications by designing or supplying individual certified components and verifying their integration into the overall system.
Maintenance	All of the manufacturer's systems are designed for an easy maintenance due to a modular design, allowing the replacement of old or wear out parts. Standardized parts ensure fast maintenance.
Calibration	The manufacturer's range of calibration services covers on-site verification tests, accredited laboratory calibrations, certificates and traceability to ensure compliance.
Installation	The manufacturer supports commissioning of your plants while minimizing costs. Fault-free installation is crucial for the quality and service life of the measurement system and for reliable plant operation.
Testing	In order to ensure product quality and to guarantee efficiency during the entire lifetime the following tests are available: ▪ Penetrant testing according to ASME V Art. 6, UNI EN 571-1 and ASME VIII Div. 1 App 8 Standards ▪ PMI test according to ASTM E 572 ▪ HE test according to EN 13185 / EN 1779 ▪ Radiographic testing according to ASME V Art. 2, Art. 22 and ISO 17363-1 (requirements and methods) and ASME VIII Div. 1 and ISO 5817 (acceptance criteria). Thickness up to 30 mm ▪ Hydrostatic test according to the PED Directive, EN 13445-5 and harmonized ▪ Ultrasonic test available by qualified external partners according to ASME V Art. 4.

9.4 Return

The requirements for safe device return can vary depending on the device type and national legislation.

1. Refer to the web page for information: https://www.endress.com
2. If returning the device, pack the device in such a way that it is reliably protected against impact and external influences. The original packaging provides the best protection.

9.5 Disposal

If required by the Directive 2012/19/EU on waste electrical and electronic equipment (WEEE), the product is marked with the depicted symbol in order to minimize the disposal of WEEE as unsorted municipal waste. Do not dispose of products bearing this marking as unsorted municipal waste. Instead, return them to the manufacturer for disposal under the applicable conditions.

9.5.1 Removing the measuring instrument

1. Switch off the device.

⚠ WARNING

Danger to persons from process conditions!

2. Carry out the installation and connection steps from the "Installing the device" and "Connecting the device" sections in reverse order. Observe the safety instructions.

9.5.2 Disposing of the measuring device

Observe the following notes during disposal:
- ▶ Observe valid federal/national regulations.
- ▶ Ensure proper separation and reuse of the device components.

9.5.3 Battery disposal

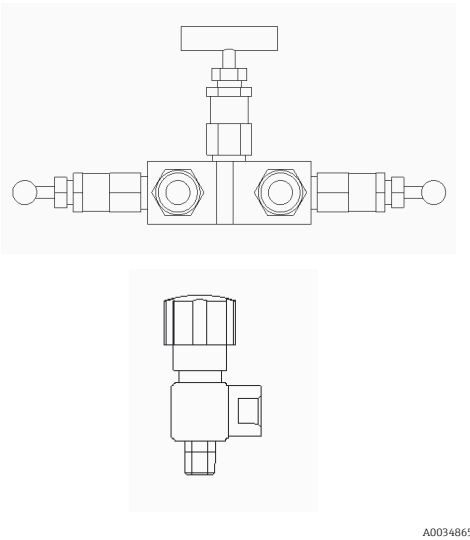
Dispose of batteries according to local regulations.

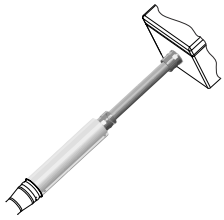
10 Accessories

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**.

10.1 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.

10.2 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

10.3 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

11 Technical data

11.1 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	

11.2 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'.

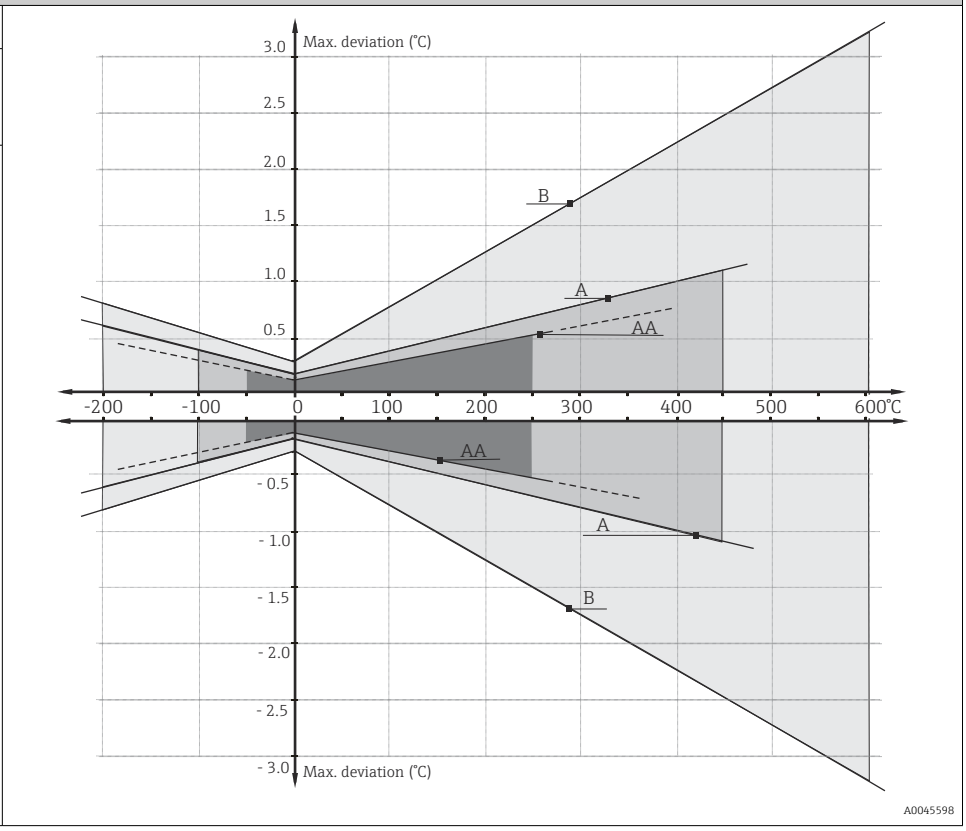
Head transmitter with PROFINET and Ethernet-APL™
The iTEMP transmitter is a 2-wire device with two measuring inputs. The device not only transfers converted signals from resistance thermometers and thermocouples, it also transfers resistance and voltage signals using the PROFINET protocol. Power is supplied 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).

11.3 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 1200 °C) ±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 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 1260 °C)	±1.1 K or ±0.004 |t| [1] (0 to 1260 °C)

1) |t| = absolute value in °C

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

Response time

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

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.

11.4 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)

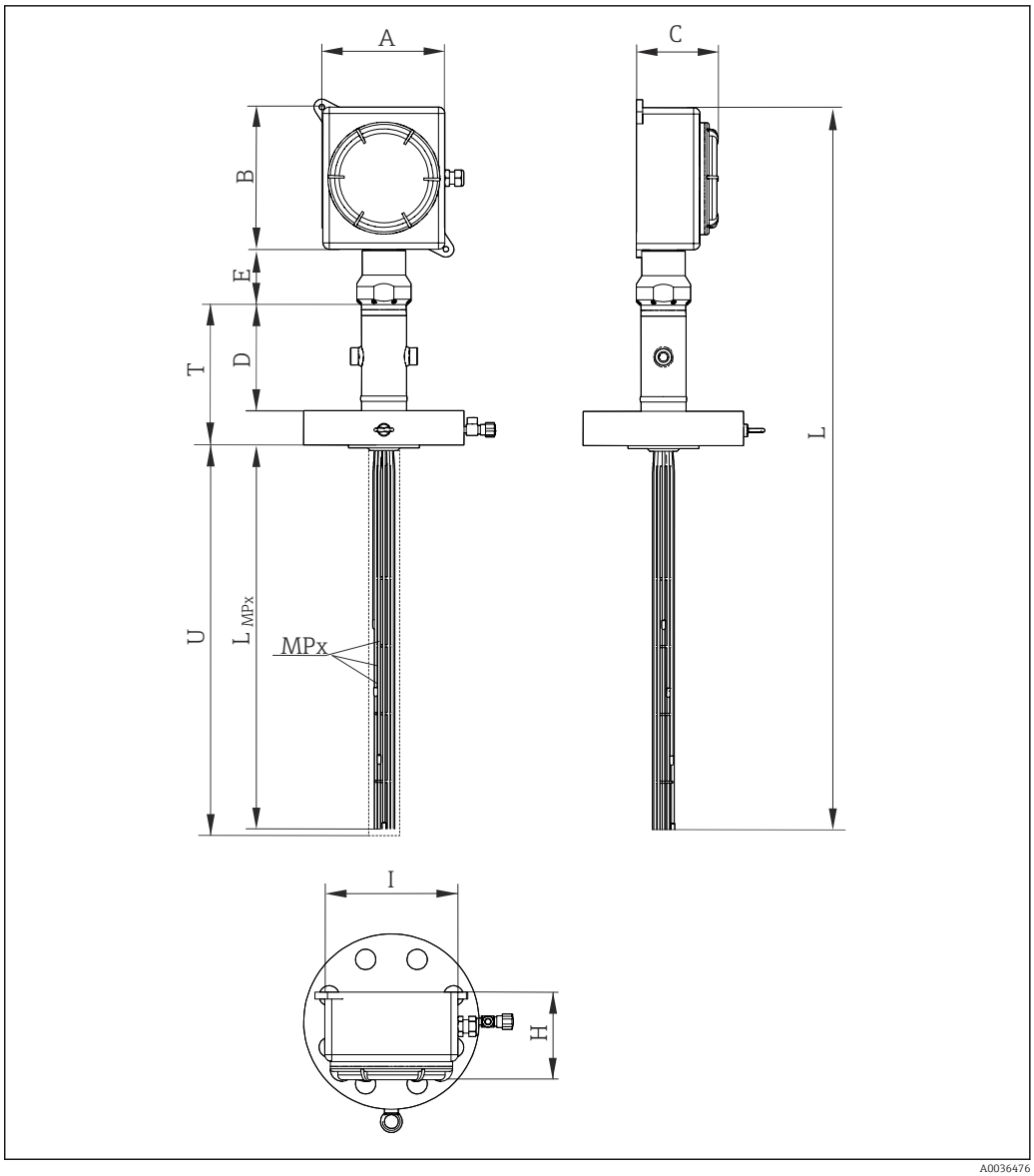
Humidity

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.

11.5 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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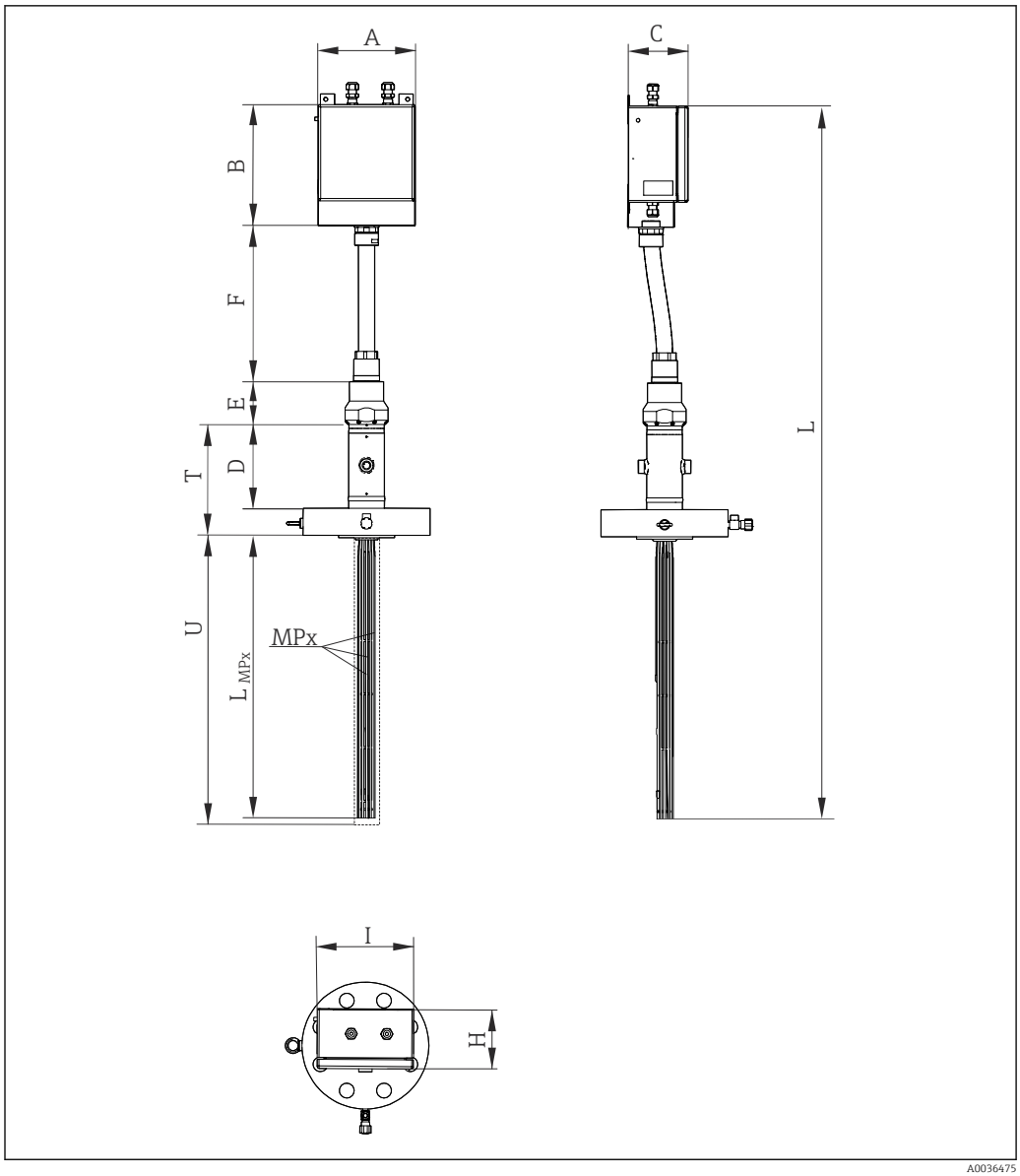
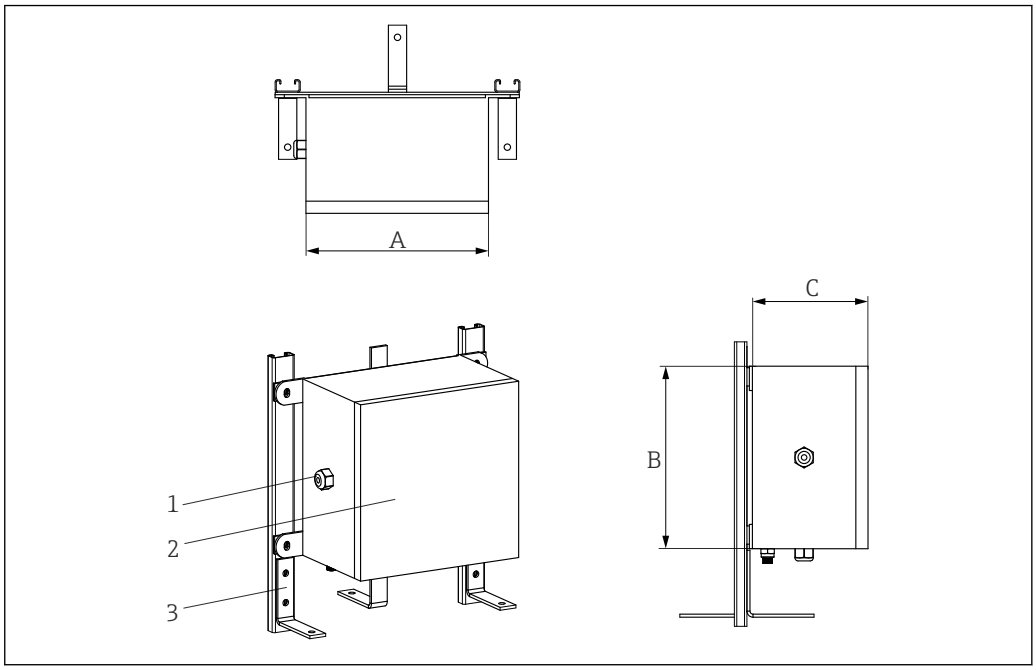


11 *Design of modular device with swiveling joint Directly mounted head in the first picture or with remote head in the second picture. All dimensions in mm (in)*

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	→ 41-
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.

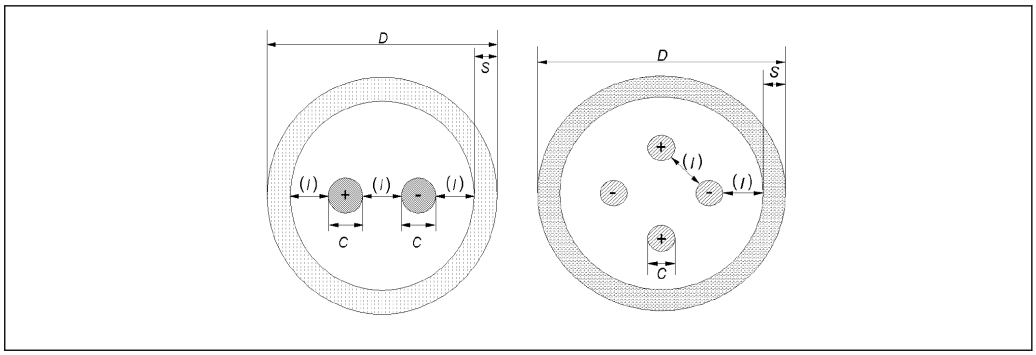
Inserts, conduits and thermowells

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



A0035318

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).

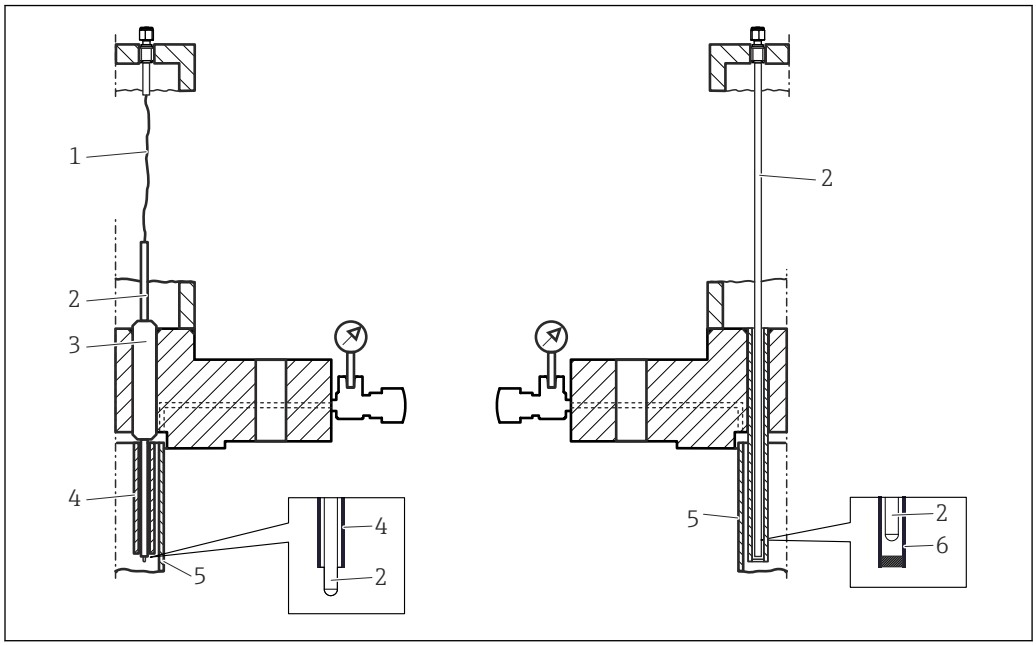
Material: AISI 316/AISI 316H

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



12 *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).

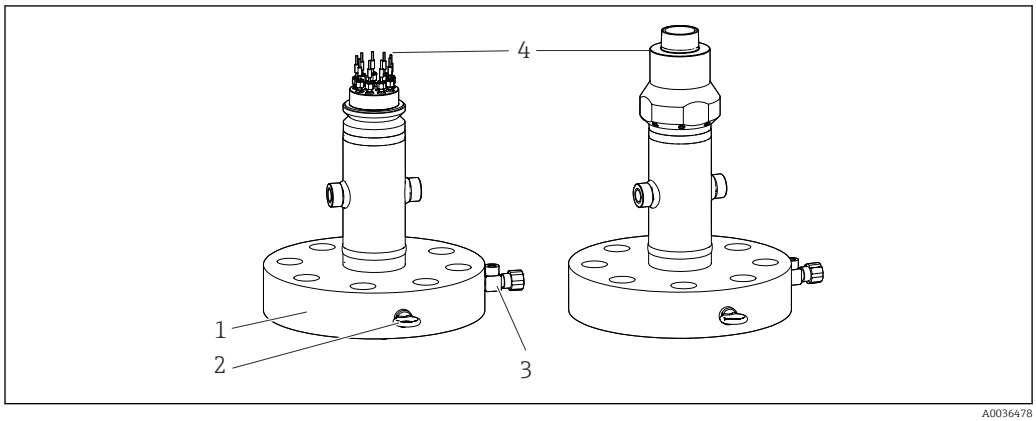
The device must only be lifted and moved using the eyebolt, which is part of the process connection.

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 (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 ▪ 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 (1 292 °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 (1 499 °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 (1 472 °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



13 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

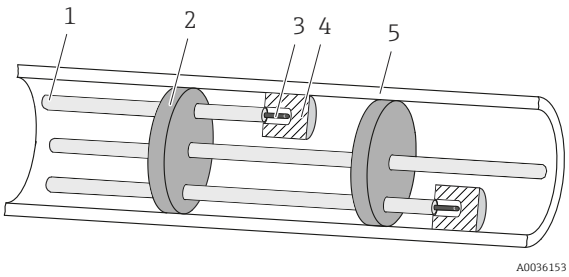
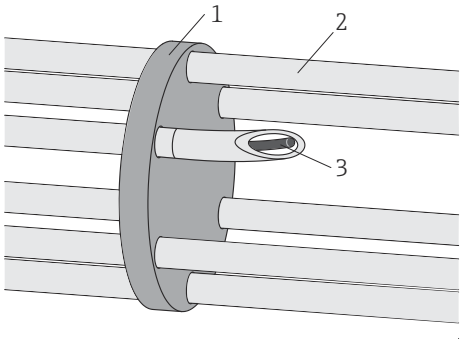
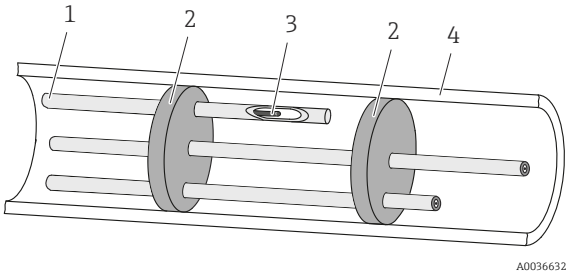
1) Flanges according to GOST standard are available on request.

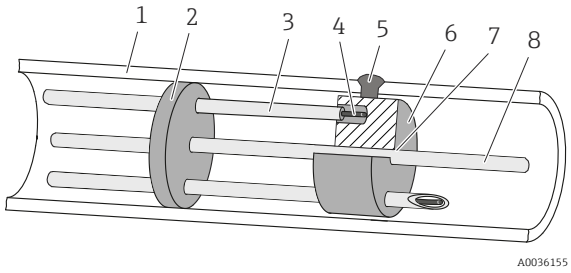
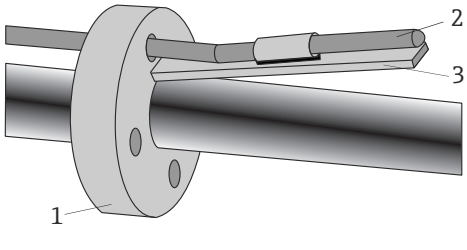
Compression fittings

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  *14 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

11.6 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**.

11.7 Documentation

For an overview of the scope of the associated Technical Documentation, refer to the following:

- *Device Viewer* (www.endress.com/deviceviewer): Enter the serial number from the nameplate
- *Endress+Hauser Operations app*: Enter serial number from nameplate or scan matrix code on nameplate.

The following 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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