

Operating Instructions

iTHERM

MultiSens Flex TMS02

Modular direct contact TC and RTD multipoint thermometer for direct contact with the medium or with a shared or individual thermowell

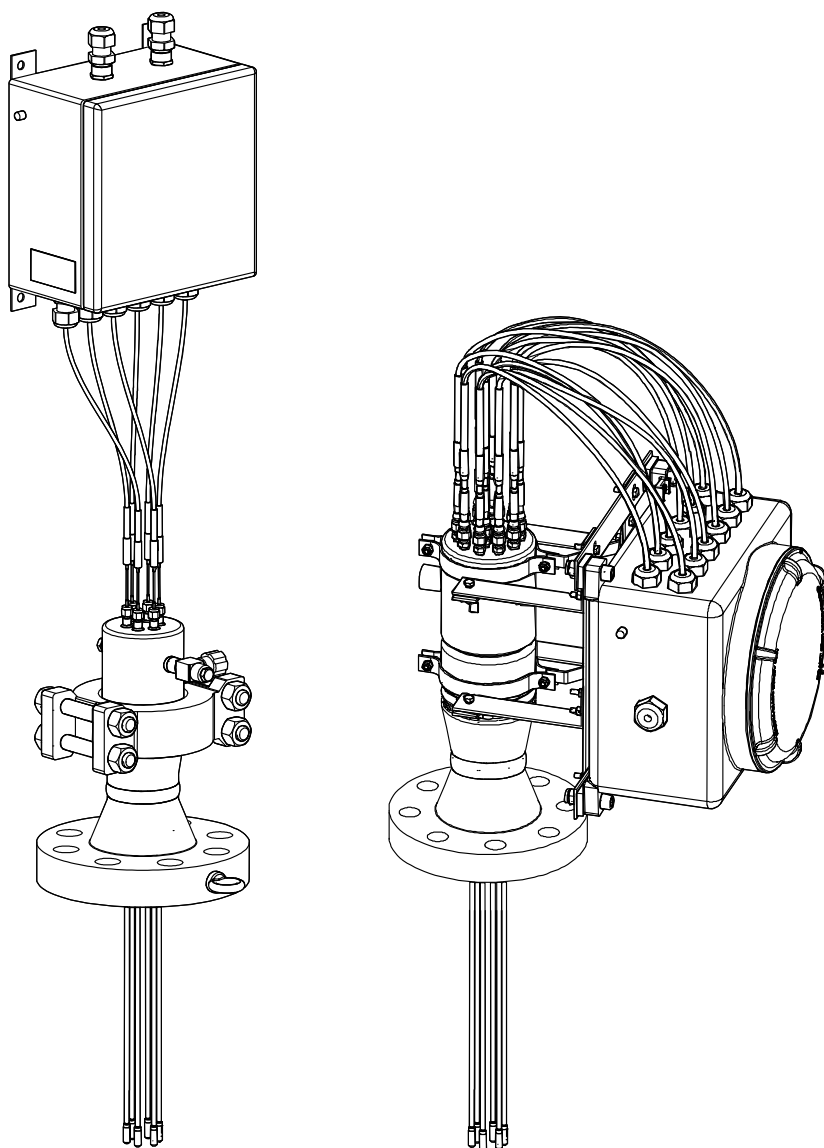


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1 About this document

1.1 Document function

These 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 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.
	Potential equalization connection (PE: Protective earth) 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: potential equalization connection is connected to the supply network. ■ Exterior ground terminal: device is connected to the plant grounding system.

1.2.3 Symbols for certain types of information

Symbol	Meaning
	Permitted Procedures, processes or actions that are permitted.
	Preferred Procedures, processes or actions that are preferred.

Symbol	Meaning
	Forbidden Procedures, processes or actions that are forbidden.
	Tip Indicates additional information.
	Reference to documentation
	Reference to page
	Reference to graphic
	Series of steps
	Result of a step
	Help in the event of a problem
	Visual inspection

1.2.4 Documentation

Document	Purpose and content of the document
iTHERM TMS02 MultiSens Flex (TI01361T/09)	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.

 The document types listed are available:
In the Download Area of the Endress+Hauser Internet site: www.endress.com → Downloads

1.2.5 Registered trademarks

- FOUNDATION™ fieldbus
Registered trademark of the Fieldbus Foundation, Austin, Texas, USA
- HART®
Registered trademark of the HART® FieldComm Group
- PROFIBUS®
Registered trademark of the PROFIBUS Nutzerorganisation 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 various designs of the multipoint thermometer are configurable. Process parameters such as temperature, pressure, density, and flow velocity must be taken into account. It is the responsibility of the operator to select the thermometer and thermowell, in particular the material used, to ensure safe operation of the temperature measuring point. The manufacturer is not liable for harm caused by improper or unintended use. The process-wetted materials of the measuring instrument must have an adequate level of resistance to the media.

The following points must be taken into account during the design stage:

Condition	Description
Internal pressure	The design of joints, threaded connections and sealing elements must correspond to the maximum working pressure inside the reactor.
Continuous operating temperature	The materials must be 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. Particular care must be taken when the sensor elements of the device are mounted on plant components.
Process fluids	Correct dimensions and appropriate material selection minimize the following types of wear: ■ Surface and localized corrosion ■ Abrasion and wear ■ Signs of corrosion caused by 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 properly routing the sensor element within the plant. This is achieved by fastening them to internal fixtures using accessories such as clips or locking sleeves. The neck extension is designed to withstand vibration loads. This protects the junction box against cyclic stresses, preventing loosening of screwed components.
Mechanical load	The maximum stresses acting on the measuring instrument, multiplied by a safety factor, must be below the permissible yielding stress of the material at any operating point of the plant.
Environmental conditions	The junction box (with and without head transmitter), cables, cable glands and other fittings have been selected for operation within the permissible ambient temperature range.

With regard to special process fluids and media used for cleaning, the manufacturer is glad to assist in clarifying the corrosion resistance of wetted materials, but does not accept any warranty or liability.

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

It consists of the following main subassemblies:

- **Insert:** Composed of individual metal sheathed sensing elements (thermocouples or RTD resistance sensors) in direct contact with the process, welded to the process flange using reinforced bushings. Alternatively, multiple individual thermowells can be welded with the process connection. This allows the replacement of inserts under operating conditions and protects the thermocouples from the ambient conditions. In this case, the inserts can be treated as individual spare parts and ordered via standard product structures (e.g. TSC310, TST310) or as special inserts. For the specific order code, please contact your Endress+Hauser specialist.
- **Process connection:** Represented by an ASME or EN flange, it may be supplied with eyebolts for lifting the device. As an alternative to the flanged process connection, a welded thermowell insert can also be provided.
- **Head:** It is composed of a junction box with the relevant components such as cable glands, draining valves, earth screws, terminals, head transmitters etc.
- **Head support frame:** Designed to support the junction box by means of components such as adjustable supporting systems.
- **Accessories:** Can be ordered independently of the selected product configuration (e.g. fastening elements, weld-on clips, reinforced sensor tips, centering stars, support frames for thermocouple mounting, pressure transmitters, manifolds, valves, purging systems and assemblies).
- **Thermowells:** They are directly welded on the process connection and are designed to guarantee a high degree of mechanical protection and corrosion resistance for each sensor.
- **Diagnostic chamber:** This subassembly consists of a closed housing that ensures the continuous monitoring of device conditions during its entire operating life and safe leakage containment of the process fluid. The chamber has connections integrated for accessories (e.g. valves, manifolds). A wide range of accessories is available to get the highest level of system information (pressure, temperature, and fluid composition).

In general, the system measures the temperature profile in the process environment using multiple sensors. These are connected to an appropriate process connection that ensures the integrity of the process.

Design without thermowells

The MultiSens Flex TMS02 without thermowell is available in a **basic** and **advanced** configuration, both with the same functions, dimensions and materials. They differ as follows:

- **"Basic" design** The extension cables are directly connected to the diagnostic chamber and the inserts are not replaceable (welded to the chamber). Leakages at the welded joints between the sensors and the process connection can be detected in the diagnostic chamber, which also contains the escaping process medium.
- **"Advanced" design** The extension cables are connected to removable stump-inserts that can be individually inspected and replaced for ease of maintenance. Compression fittings on the upper part of the diagnostic chamber ensure that the stump-inserts can be replaced. An interruption in the MI cable (provided for in the design with stump-inserts) is located inside the diagnostic chamber, so that process medium can be directed into the chamber and detected there in the event of a leakage. Leakages can come from the welded joints between the sensors and process connection or from the sensor itself. This phenomenon may occur if unexpectedly high corrosion rates compromise the insert sheath integrity.

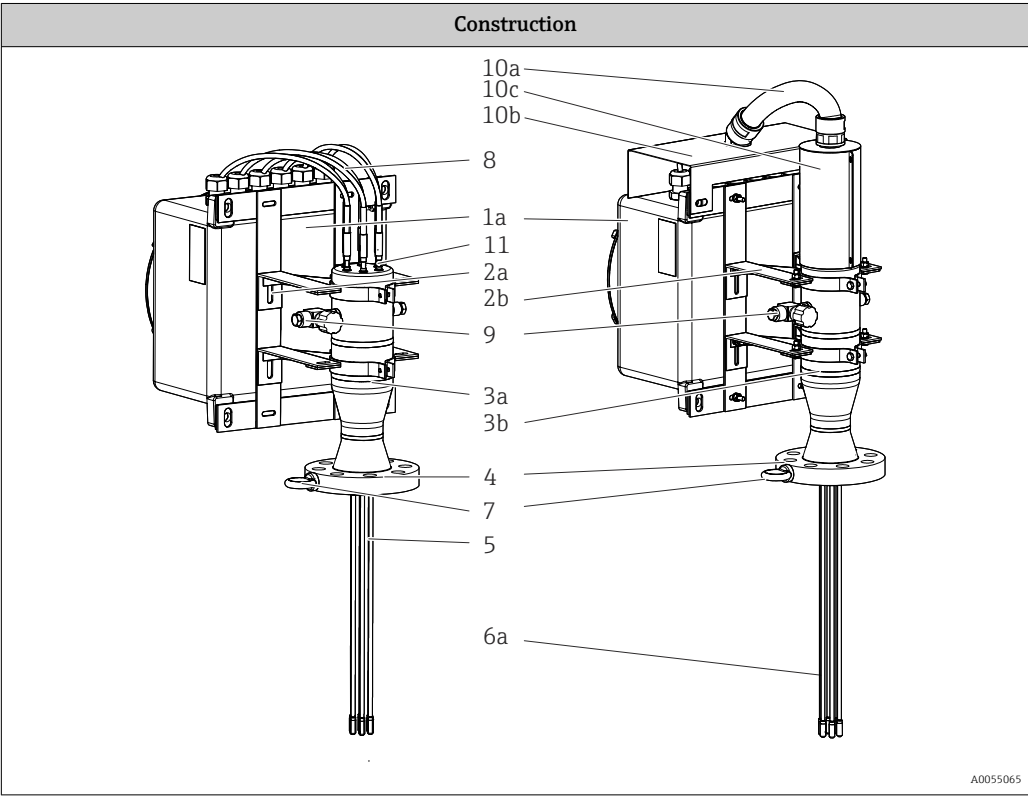
Design with thermowells

The MultiSens Flex TMS02 with thermowells is available in the **"Advanced"** configuration:

"Advanced" design The inserts can be replaced individually (including under operating conditions). Compression fittings on the upper part of the diagnostic chamber ensure that the inserts are replaceable. All thermowells end in the diagnostic chamber. In the event of a leak, the media are thus directed into the diagnostic chamber and can be detected. The leakages can come from the welded joints between the thermowells and process

connection or from the thermowell itself. This can happen if unexpectedly high corrosion rates affect the thermowell wall or permeation/permeability is not negligible.

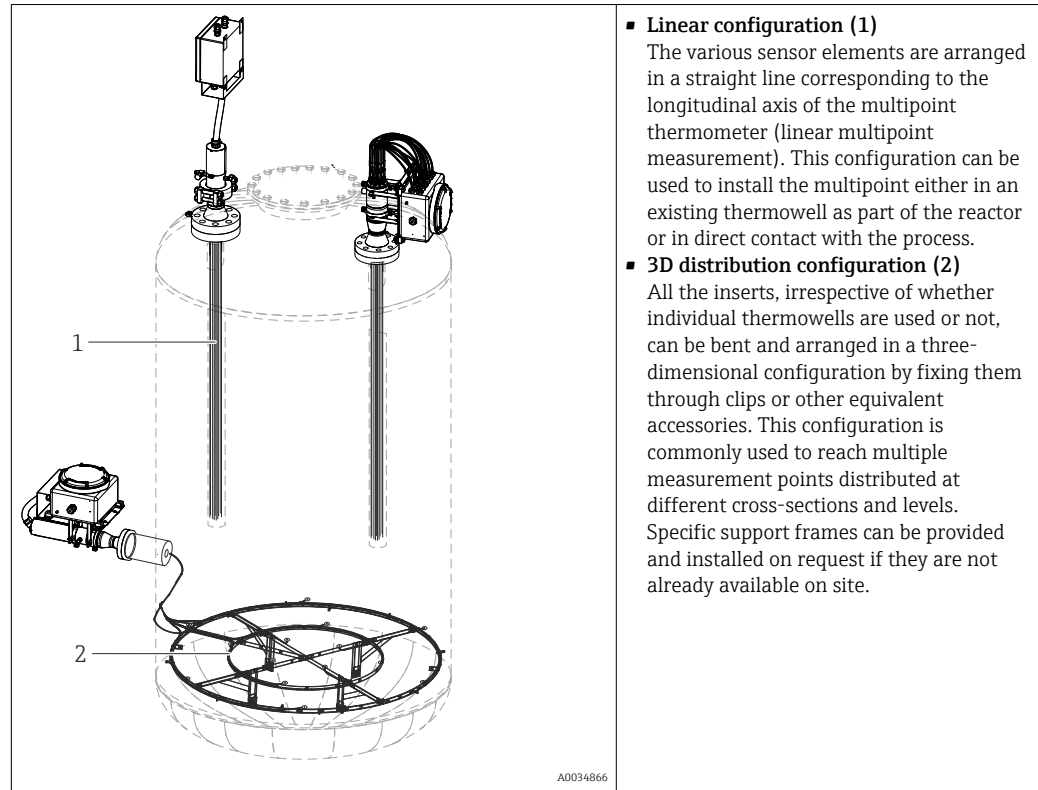
Sensor replaceability		
	Basic	Advanced
Without thermowells	Sensors are not replaceable	Only the external sensor section (connecting cables from the diagnostic chamber onwards) is replaceable.
With thermowells	Not available	Sensors are replaceable in any conditions



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 glands. ▪ 316/316L ▪ Aluminum alloys ▪ Other materials on request
2: Support frame 2a: With accessible extension cables 2b: With protected extension cables	Modular frame support that is adjustable for all available junction boxes. 316/316L
3: Diagnostic chamber 3a: Basic chamber 3b: Advanced chamber	Diagnostic chamber for leakage detection and safe containment of leaking fluids. Continuous monitoring of pressure in the diagnostic chamber. Basic configuration: For non-hazardous media Advanced configuration: For hazardous media ▪ 316/316L ▪ 321 ▪ 347

Description, available options and materials	
4: Process connection 4a: Flanged according to ASME or EN standards 4b: Welded thermowell insert engineered according to reactor design	Represented by a flange according to international standards or designed for specific process conditions → 49. Alternatively, a process connection with a clamp and quick release fastener is also possible to meet the requirements of the reactor design and process conditions. ■ 304 + 304L ■ 316 + 316L ■ 316Ti ■ 321 ■ 347 ■ Other materials on request
5: Insert	Mineral-insulated grounded and ungrounded thermocouples or resistance thermometers (Pt100). For details, refer to the 'Ordering information' table.
6a: Thermowells or open guiding tubes	The thermometer can be equipped with: ■ thermowells for higher mechanical strength and corrosion resistance, as well as for sensor replacement ■ open guide tubes for installation in an existing thermowell For details, refer to the 'Ordering information' table.
7: Eyebolt	Lifting device for easy handling during installation phase. SS 316
8: Extension cable	Cable for electrical connections between the inserts and junction box. ■ Shielded PVC ■ Shielded FEP
9: Accessories connection	Auxiliary connections for pressure detection, fluid draining, purging, overflow, sampling and analysis. ■ 316/316L ■ 321 ■ 347
10: Protection 10a: Cable conduit 10b: Cover for cable glands 10c: Extension cables cover	The cover for the extension cables consists of two half-shells, which together with the cable conduit protect the extension cables of the sensors. The two half-shells are clamped together by means of screws (clamp connection) and fastened to the upper part of the chamber. The cover for the cable conduit consists of a shaped stainless-steel plate, which is fastened to the junction box frame in order to protect the cable connections.
11: Compression fitting	Compression fittings to ensure leak-tightness between the head of the diagnostic chamber and the external environment. Suitable for many process media and various combinations of high temperatures and pressures. Not for basic design.

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



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

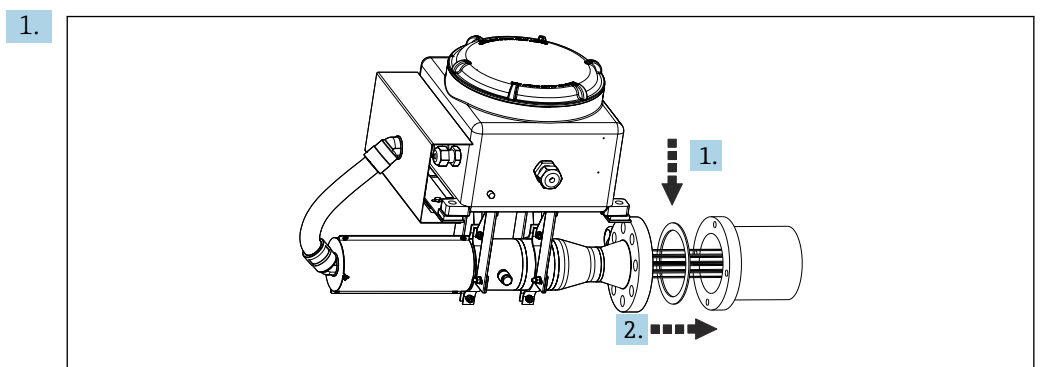
Additional loads and vibrations from other plant components can affect the operation of the sensor elements.

- ▶ Is it not allowed to apply additional loads or external moments to the system coming from the connection with another system not foreseen from installation plan.
- ▶ The system is not suitable for being installed in locations where vibrations are present. The deriving loads can undermine the sealing of the junctions and damage the operation of the sensing elements.
- ▶ It will be care of the final user to verify the installation of suitable devices in order to avoid the overcoming of the admitted limits.
- ▶ For the environment conditions please refer to the technical data → 41
- ▶ When installing in an existing thermowell, an internal inspection of the thermowell is recommended to check if any internal obstruction or deformation is present before starting with the insertion activities of the whole device. While installing the measurement system, avoid any friction, specifically avoid sparks generation. Ensure the thermal contact between the inserts and the bottom/wall of the existing thermowell. When accessories like spacers are provided, make sure that no distortions are occurred and the original geometry and position are maintained.
- ▶ When the installation is performed by direct contact with the process, ensure that any applied external loads (i.e. due to the tip fixing of the probe to any reactor internals) don't generate deformations and strains on the probe and on welds.

5.2 Installing the device

- i** The following instructions are divided into two cases: installation of a flanged device and installation of a device with welded thermowell insert. To ensure safe installation of the MultiSens, follow the instructions below.

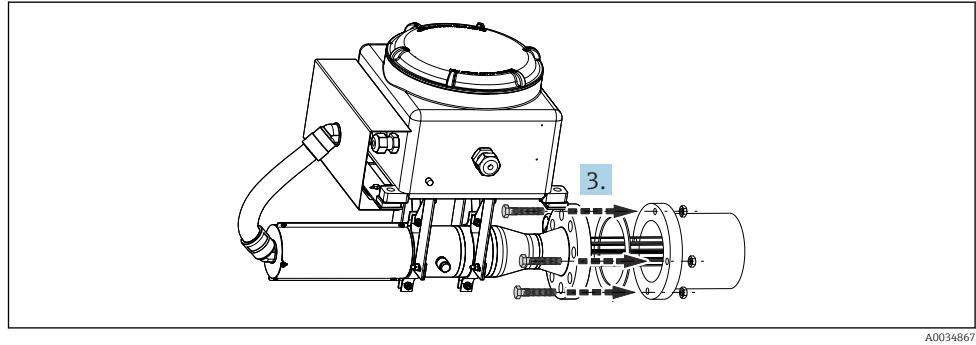
5.2.1 Installing a device with a flange



Place the sealing ring between the flanged nozzle and the device flange (first check that the sealing surfaces on the flanges are clean).

2. Bring the device close to the nozzle and insert either the thermocouple bundle (with or without guide tube system) or the thermowell bundle into the nozzle. Make sure that the bundle elements do not become entangled or deformed.

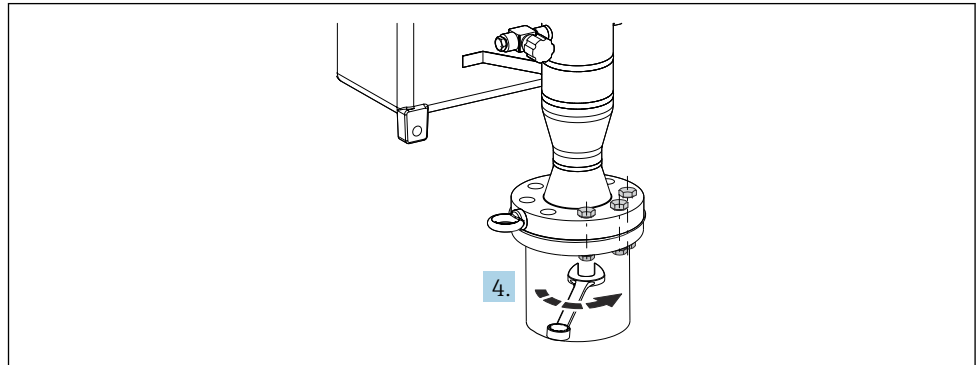
3.



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Insert the screws into the drilled holes provided on the flange and tighten them lightly with the nuts. Use a suitable screwdriver – do not tighten fully yet.

4.



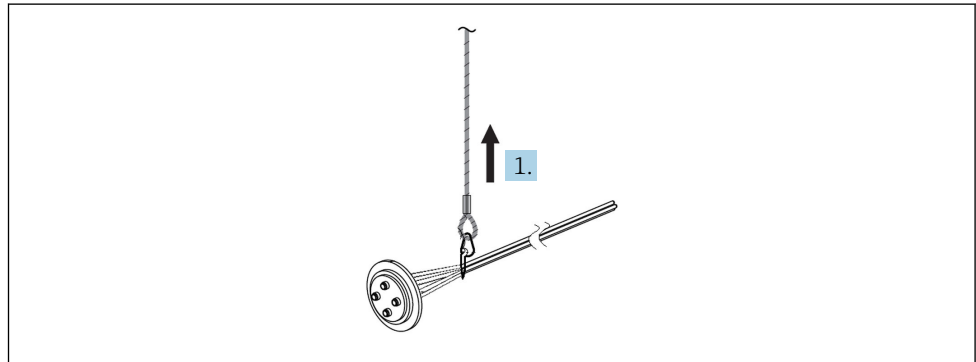
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Now screw the bolts fully into the holes on the flange and tighten them with the crossed method using an appropriate tool (i.e. controlled tightening according to the applicable standards).

5.2.2 Installing a device with a welded thermowell insert

Installation with thermowells using the supplied sealing ring

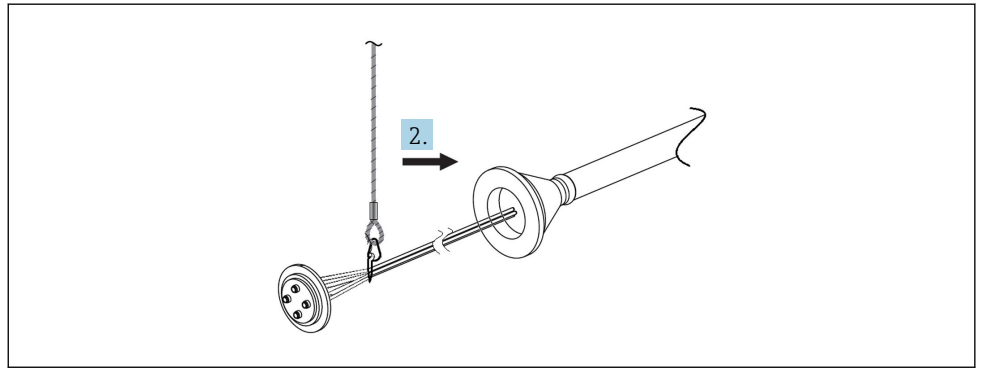
1.



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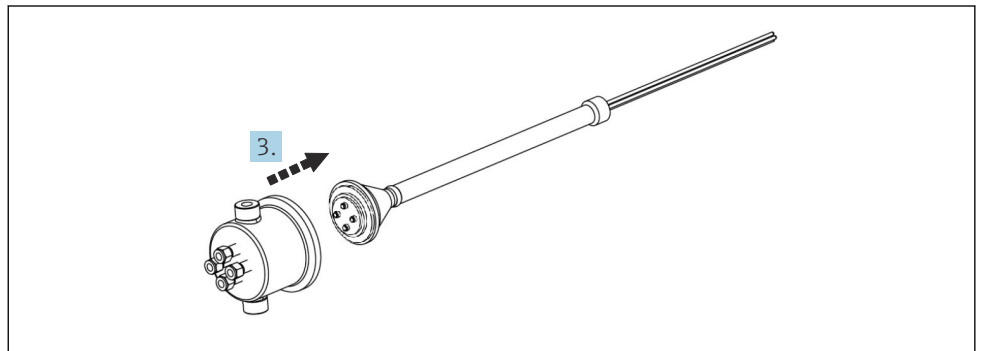
Raise the supplied sealing ring on the thermowell.

2.



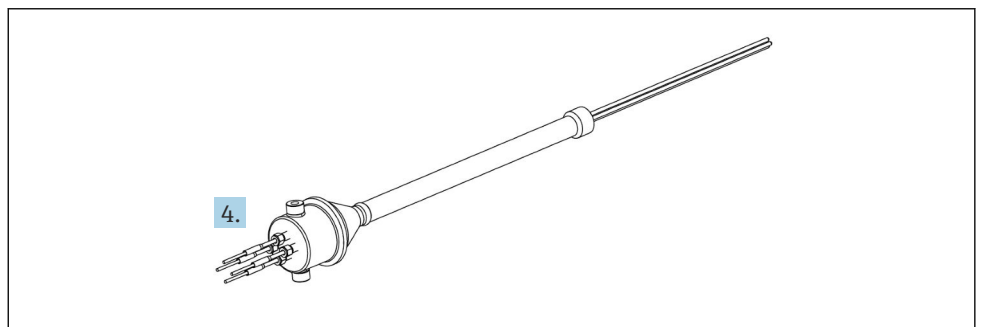
Insert the sealing ring and thermowell into the thermowell insert. Make sure they do not become entangled or deformed. If required, the thermowells can be extended with additional thermowell sections until the desired length is reached. If required, the thermowells can be extended with additional thermowell sections until the desired length is reached.

3.



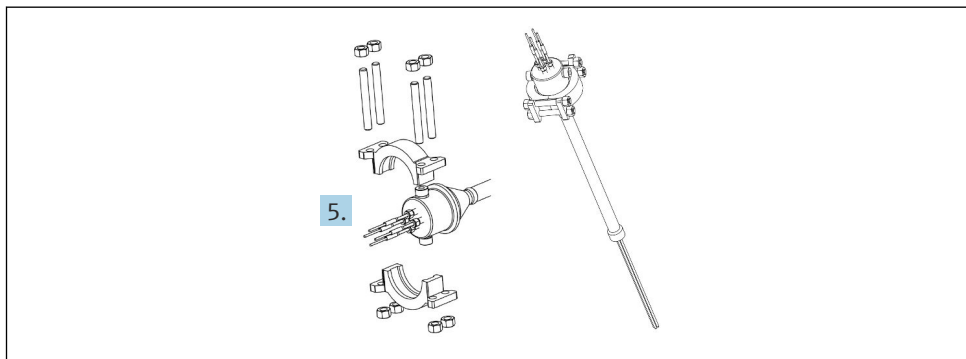
Check the sealing ring for cleanliness, then connect the diagnostic chamber and thermowell insert.

4.



Insert the thermocouples into the compression fittings. Make sure that the TAG number matches the correct position. See technical drawings for details.

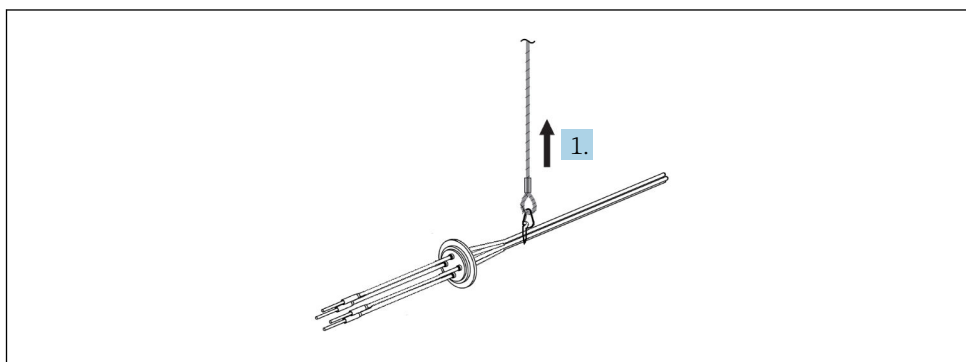
5.



Attach the clamp and tighten the compression fittings.

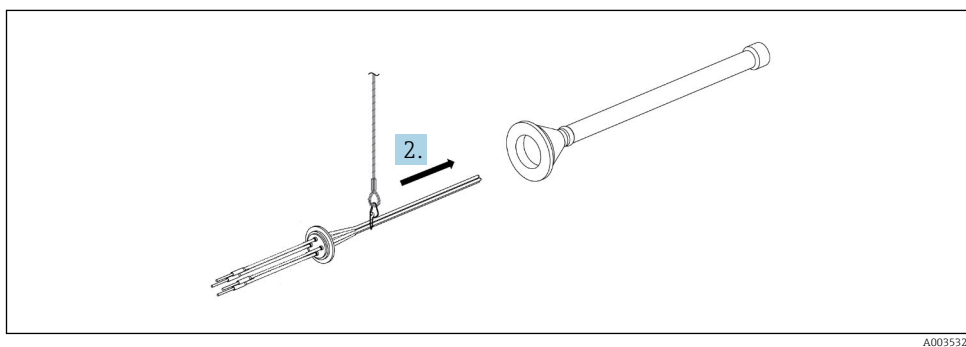
Installation with thermocouples using the supplied sealing ring

1.



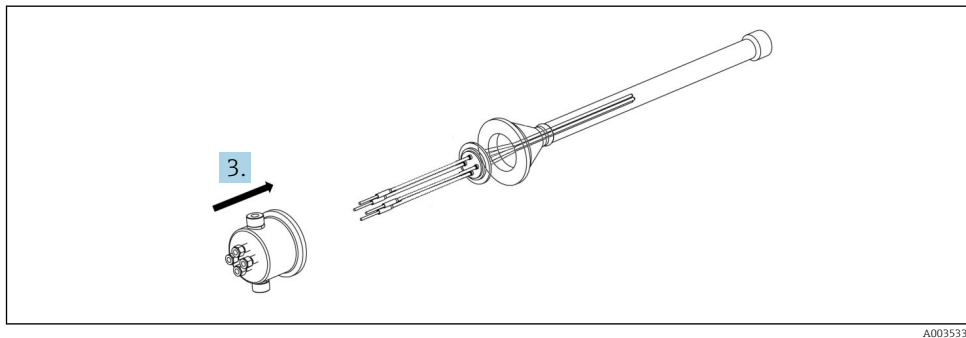
Raise the supplied sealing ring on the sensors.

2.



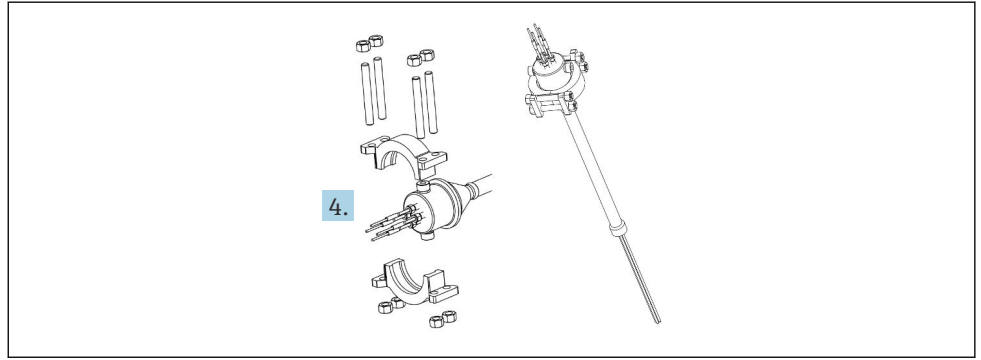
Insert the sensors into the thermowell insert. Make sure they do not become entangled or deformed.

3.



Connect the diagnostic chamber to the rest of the MultiSens system.

4.



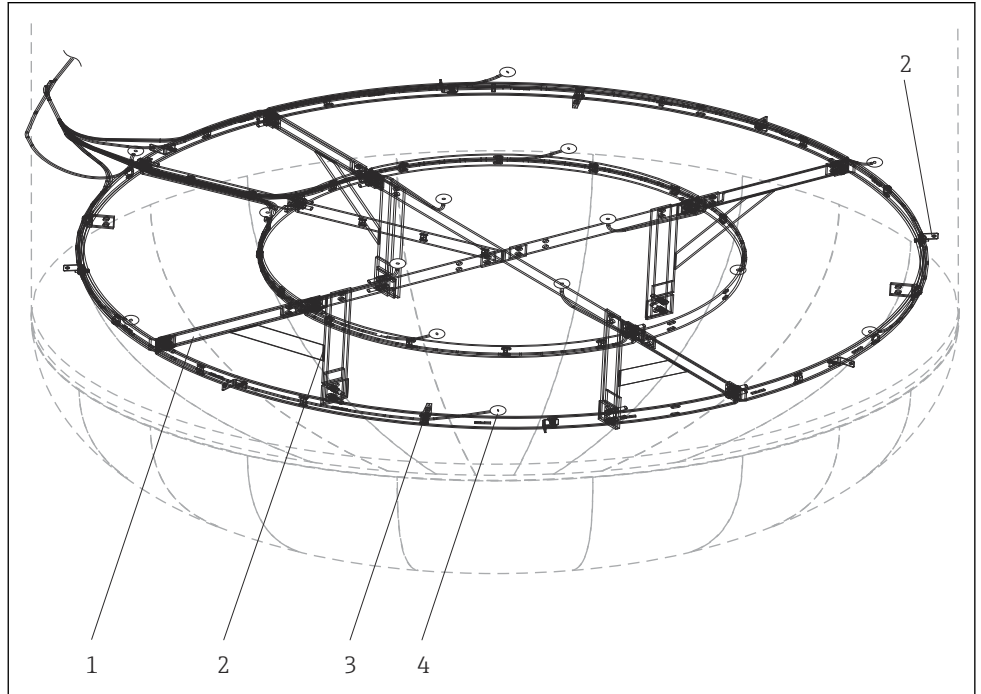
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Attach the clamp and tighten the compression fittings.

5.2.3 Completing the installation

To ensure proper installation of the device, follow the instructions below:

1.

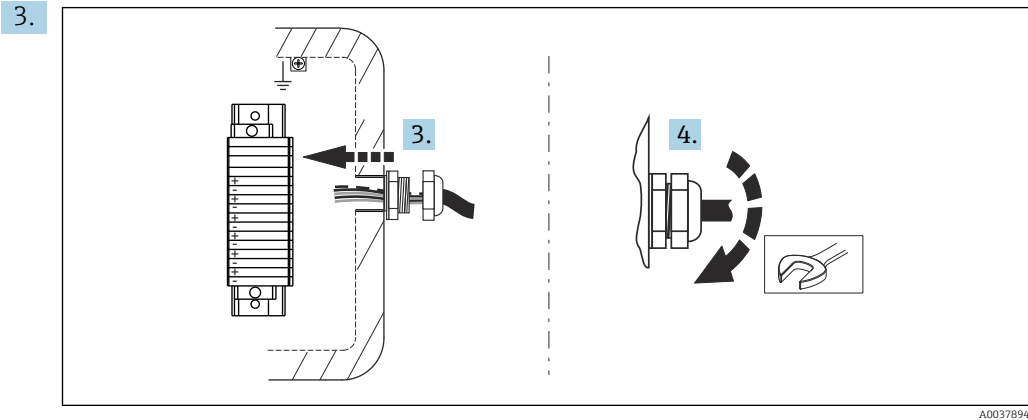


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- 1 Support frame
- 2 Fixing bar
- 3 Fixing clip
- 4 Inserts or thermowell tip

A) For 3D installation, secure all inserts or thermowells to the support structures (frame, bars, clips and all accessories provided) in accordance with the drawings. Start by fixing the sensor tip and then bend the rest over the entire length. Once the full path is defined, secure the inserts or thermowells **permanently** from the nozzle to the tip. The remaining length can be routed as U-shaped or Q curves close to the measuring point if necessary. Note: Bend each probe with a minimum radius of 5 times its external diameter and fix it to the pre-mounted structures inside the reactor by means of clips, tie wraps or by welding.

2.
- B) When installing in an existing thermowell, it is recommended to perform an internal inspection of the thermowell. To facilitate insertion, first check that there are no obstacles. When installing the measurement system, avoid any friction and spark generation in particular. Ensure that thermal contact between the tips of the inserts and the existing thermowell wall is maintained. If accessories such as centering stars and/or centered rods are provided, make sure that no deformations occurs and that the original geometry is preserved.



After opening the cover of the junction box, insert the extension or compensating cables through the appropriate cable glands into the junction box.

4.
- Tighten the cable glands on the junction box.
5.
- Connect the compensating cables to the terminals or temperature transmitters inside 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.
6.
- Close the cover. Ensure that the seal is correctly positioned, so that the ingress protection (IP) is not impaired. Place the drain valve in the correct position (to control condensation).

NOTICE

- After installation, check the thermometric system by performing a few simple tests.**
- ▶ Check the tightness of the threaded connections. If any part is loosened, tight it applying the proper torque.
 - ▶ Check for correct wiring, test the electrical continuity of the thermocouples (warming up the thermocouple measuring point) and 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 seals intact and free from permanent deformation?	☐
Installation	
Is the device aligned with the nozzle axis?	☐

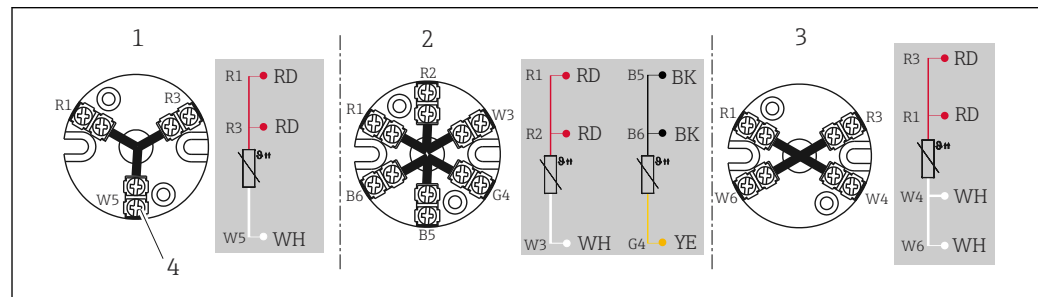
Are the seal seats of flanges clean?	☐
Are the flange and its counter flange properly bolted together?	☐
Are the thermocouples free of entanglement and deformation?	☐
Are the bolts completely inserted in the flange? Make sure the flange is completely attached to the nozzle.	☐
Are the thermocouples fixed to the support structures? →  17	☐
Are the cable glands tightened on the extension cables?	☐
Are the extension cables connected to the junction box terminals?	☐
Has thermal contact been established between the inserts and the existing thermowell?	☐
Have the extension cable protections (when ordered) been properly installed and closed?	☐

6 Power supply

- i** ■ 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.

6.1 Wiring diagrams

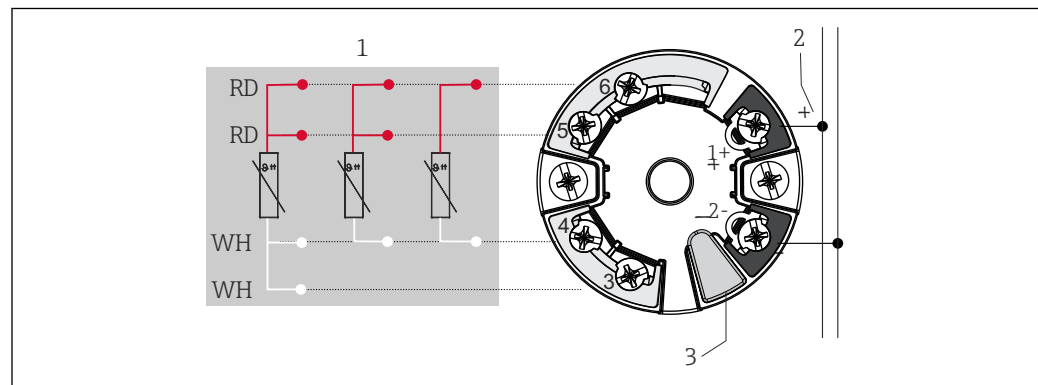
6.1.1 RTD sensor connection type



A0045453

1 Mounted terminal block

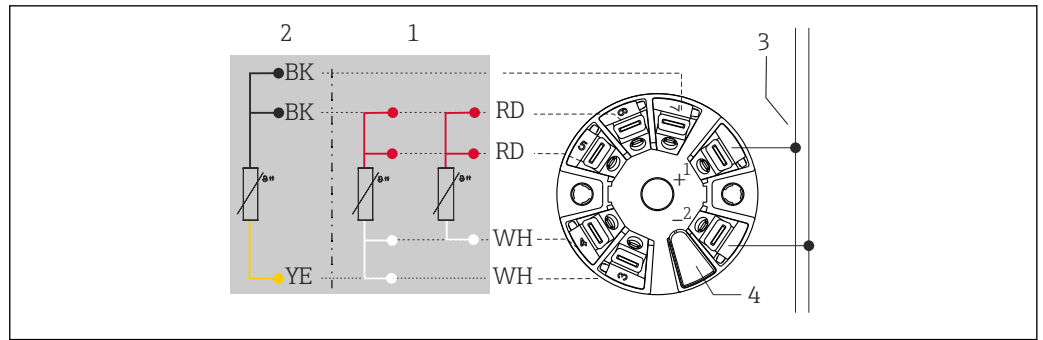
- 1 3-wire, single
- 2 2 x 3-wire, single
- 3 4-wire, single
- 4 Outside screw



A0045464

2 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

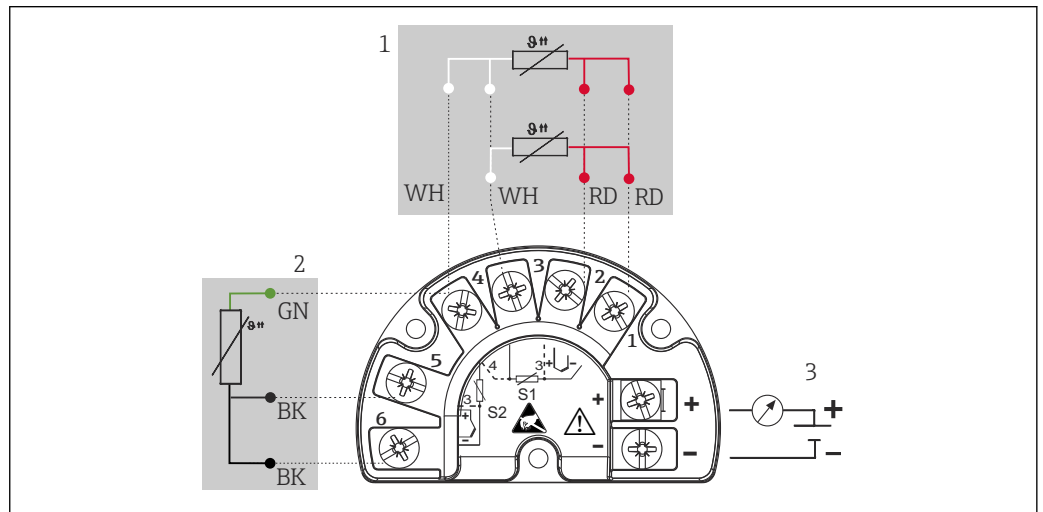


A0045466

3 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

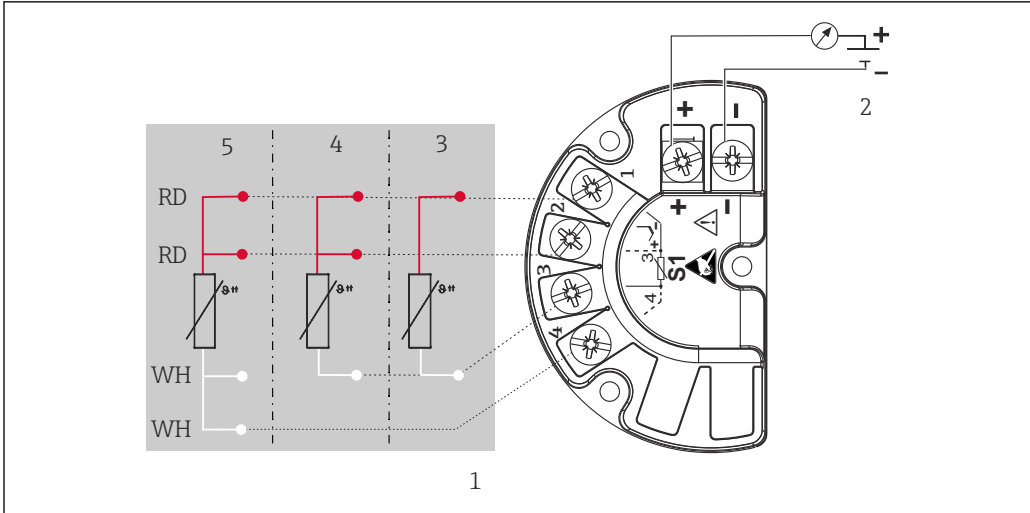
Mounted field transmitter: Fitted with screw terminals



A0045732

4 TMT162 (dual input)

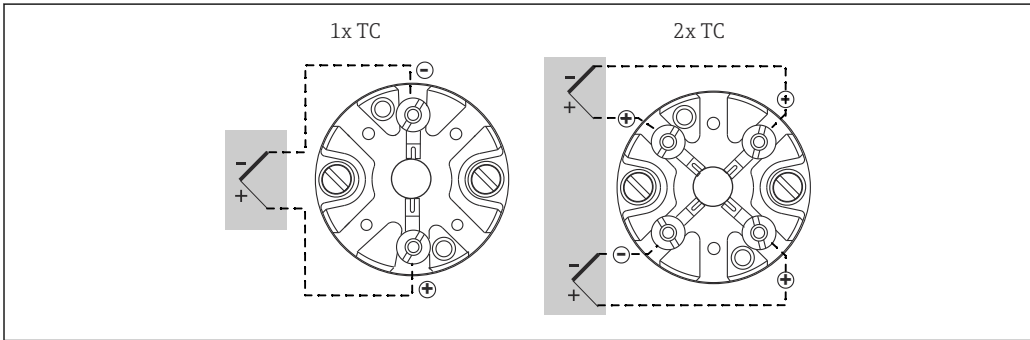
- 1 Sensor input 1, RTD: 3- and 4-wire
- 2 Sensor input 2, RTD: 3-wire
- 3 Power supply, field transmitter and analog output 4 to 20 mA or fieldbus connection



A0045733

- 5 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

6.1.2 Thermocouple (TC) sensor connection type



A0012700

- 6 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 A0045474	
Head-mounted transmitter TMT7x or TMT31 (single input) ¹⁾	Mounted field transmitter TMT162 or TMT142B
1 Sensor input TC, mV 2 Power supply, bus connection 3 Display connection/CDI interface A0045353	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 A0045636

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 (-)

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

For electronic, always start troubleshooting with the checklists available in the related operating manuals. The checklists take you directly (via various queries) to the cause of the problem and the appropriate remedial action.

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

The diagnostic chamber allows MultiSens TMS02 behavior monitoring in any working conditions (with or without fluids in the chamber). The processing of the measured data and the information from the chamber can be used to evaluate the measurement accuracy, the remaining operating life and the maintenance plan. Two different diagnostic approaches are used:

Self customer diagnosis:

1. Monitoring and recording of the pressure sequence in the diagnostic chamber since startup.
2. Compare the detected Chamber Pressure (C_p) with the partial process Hydrogen pressure (H_p).
3. In case of $C_p \leq H_p$, the physical permeation is occurring, no maintenance actions are needed.
4. In case of $C_p > H_p$, physical hydrogen permeation and leakages from the process to the chamber are occurring, maintenance have to be planned. The chamber is safely containing the fluids by being designed according to the process design conditions.

Advanced diagnosis:

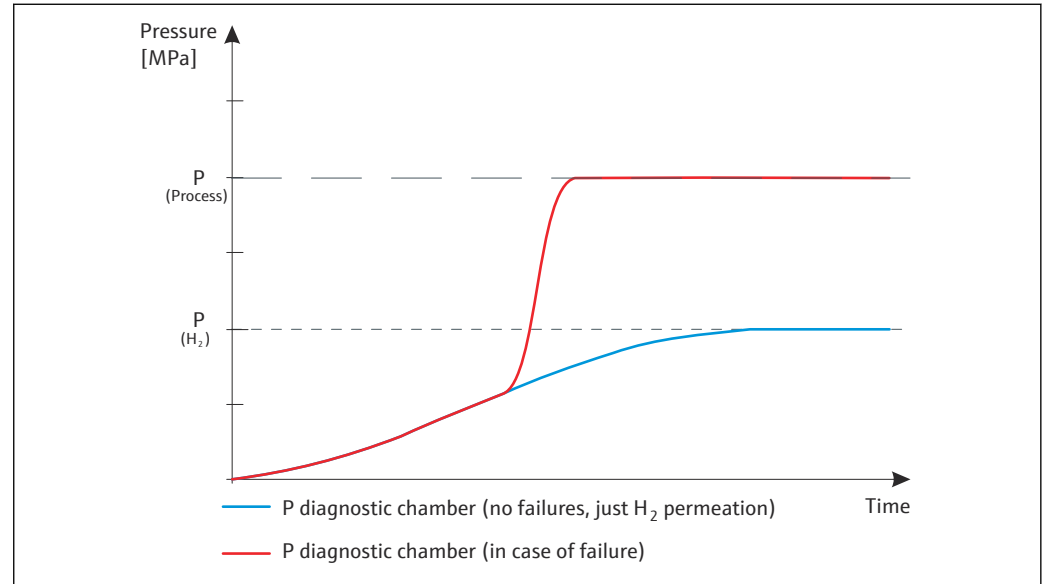
1. Monitoring and recording of the pressure sequence in the diagnostic chamber since startup.
2. Compare the detected Chamber Pressure (C_p) with the partial process Hydrogen pressure (H_p).
3. In case of $C_p \leq H_p$, the physical permeation is occurring, no maintenance actions are needed.
4. In case of $C_p > H_p$, physical hydrogen permeation and leakages from the process to the chamber are occurring, maintenance have to be planned. The chamber is safely containing the fluids by being designed according to the process design conditions. Endress+Hauser shall be informed to be able to analyze the reasons of the pressure threshold exceeding and to suggest focused actions. Close cooperation with the manufacturer is necessary to exchange process and system information. This includes the chemical composition of the fluid contained in the chamber and the temperature pattern, for example.

A pressure build-up in the diagnostic chamber may be caused by permeation or leakage during the process. Possible causes include:

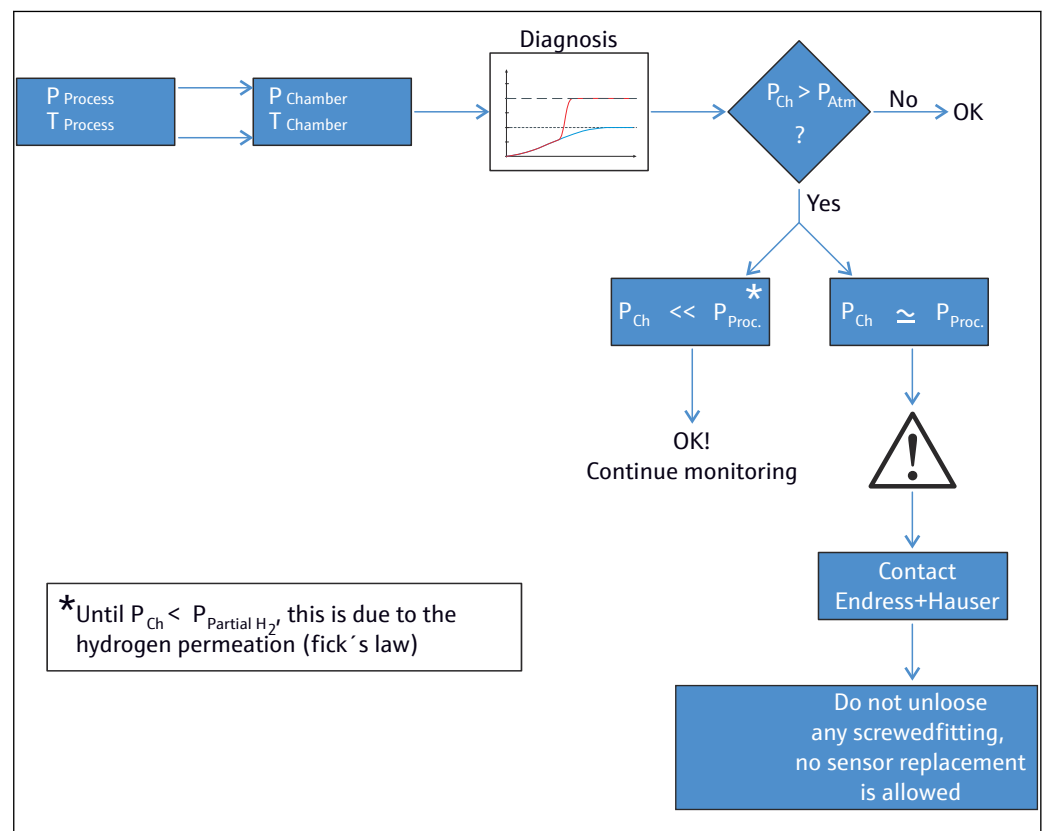
- Insert sheath
- Welding seams between inserts and chamber disk
- Thermowells

Using a E+H portable sampling system, samples of the fluids contained inside the chamber can be taken directly on site and analyzed by E+H in cooperation with the customer.

The phenomenon of permeation can be quantitatively analyzed by comparing the recorded data with the theoretical values derived from Fick's law in order to analyze the actual operating conditions of the multipoint thermometer.



A0054909



A0054910

NOTICE

Repair of parts of the device

- In the event of a serious fault, a measuring instrument might have to be replaced. In such cases, see section "Return" → 30.

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

- Follow the checklist in section "Post-installation check" →  12
- Follow the checklist in section "Post-connection check" (**Verweisziel existiert nicht, aber @y.link.required=true**)

If transmitters are used, please refer to the documentation of the transmitter installed for diagnostic and troubleshooting procedures →  50.

9 Repair

9.1 General information

It must be ensured 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 of Endress+Hauser that guarantees the same characteristics and performance. To ensure continued operational safety and reliability, repairs should only be carried out on the device if they are expressly permitted by Endress+Hauser, in compliance with federal/national regulations regarding the repair of electrical equipment.

9.2 Spare parts

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

If ordering spare parts, please specify the serial number of the device.

9.2.1 Design without protecting thermowells

Spare parts of the multipoint thermometer assembly are:

"Basic" design

- Complete junction box
- Temperature transmitter
- Electrical connection
- DIN rail
- Plate for electric terminals
- Cable gland
- Sealing sleeve for cable gland
- Adapters for cable gland
- Support frame (complete)
- Parts of support frame
- Junction box support system

"Advanced" design

- Complete junction box
- Temperature transmitter
- Electrical connection
- DIN rail
- Plate for electric terminals
- Cable gland
- Sealing sleeve for cable gland
- Adapters for cable gland
- Sensor stump + Extension cables
- Nut for compression fitting

- Support frame (complete)
- Plates for support frame
- Junction box support system

9.2.2 Design with protecting thermowells

Spare parts of the multipoint thermometer assembly are:

"Advanced" design

- Complete junction box
- Temperature transmitter
- Electrical connection
- DIN rail
- Plate for electric terminals
- Cable gland
- Sealing sleeve for cable gland
- Adapters for cable gland
- Sensor (complete)
- Nut for compression fitting
- Support frame (complete)
- Back ferrule for compression fitting
- Plates for support frame
- Junction box support system

"Advanced and modular" design

- Complete junction box
- Temperature transmitter
- Electrical connection
- DIN rail
- Plate for electric terminals
- Cable gland
- Sealing sleeve for cable gland
- Adapters for cable gland
- Sensor (complete)
- Nut for compression fitting
- Back ferrule for compression fitting
- Disk + guiding tubes bundle
- Disk + thermowell bundle

The following accessories can be selected (when replaceable) independently from the product configuration:

- Pressure transmitter
- Pressure manometer
- Assembly
- Manifolds
- Valves
- Purging systems
- Portable sampling system

9.3 Endress+Hauser services

Service	Description
Certificates	Endress+Hauser is able to fulfill requirements belonging to the design, product manufacturing, tests and commissioning according to specific approvals by handling or supplying individual certified components and by checking the integration on the whole system.
Maintenance	All Endress+Hauser systems are designed for easy maintenance thanks to a modular design that permits the replacement of old or worn parts. Standardized parts ensure quick maintenance.
Calibration	Endress+Hauser's range of calibration services covers on-site verification tests, accredited laboratory calibrations, certificates and traceability to ensure compliance.
Installation	Endress+Hauser helps you commission plants while minimizing costs. Fault free installation is decisive for the quality and longevity of the measurement system and plant running. We provide the right expertise at the right time to meet project deliverables.
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 PED Directive, EN 13445-5 and harmonized ▪ Ultrasonic testing 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.



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**

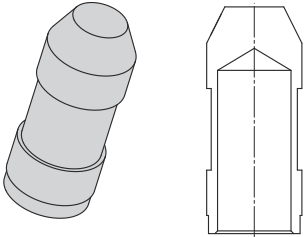
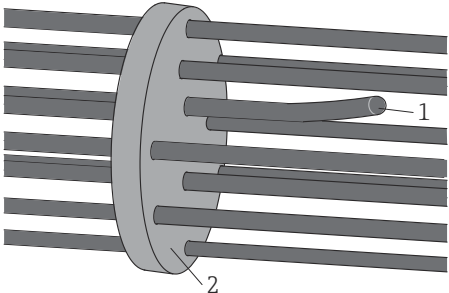
Dispose of batteries according to local regulations.

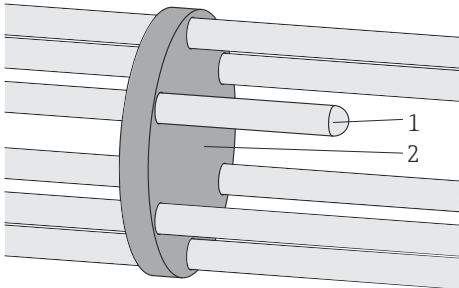
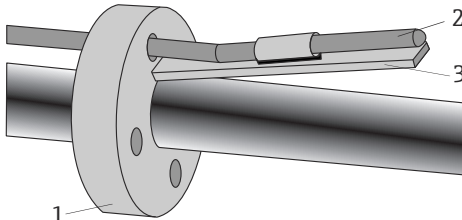
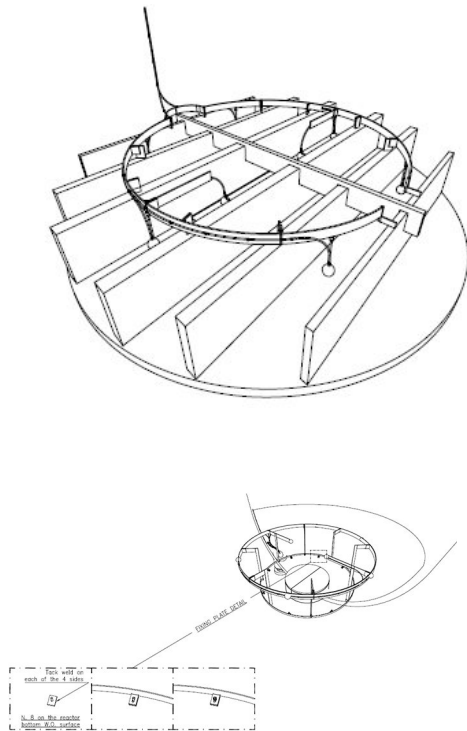
10 **Accessories**

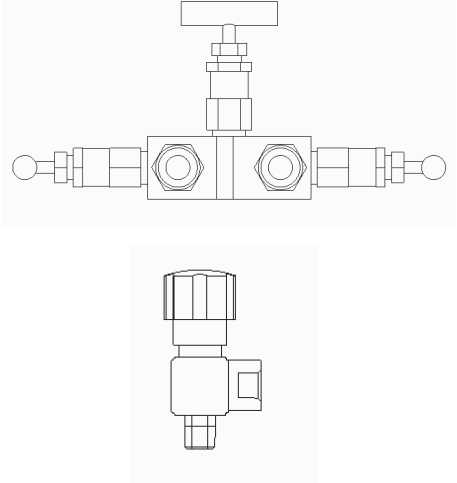
The accessories currently available for the product can be selected at www.endress.com:

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
Tip end  A0028427	Protective cap welded to the sensor tip in order to protect the insert from aggressive process conditions, simplify fastening with metallic tie wraps, and ensure proper thermal contact.
Thermal contact system	
Insert and centering stars  A0033485 1 Insert 2 Centering stars	■ Used on straight configurations and existing thermowells for axial centering of the insert bundle ■ Prevent the inserts from twisting ■ Give flexural stiffness to the sensor bundle

Accessories	Description
Thermowells and centering stars  A0028434 1 Thermowell 2 Centering stars	
Bimetallic strips  A0028435  7 Bimetallic strips with or without guiding tubes 1 Guiding tube 2 Insert 3 Bimetallic strips ■ Used on straight configurations and inside existing thermowells ■ The inserts are replaceable. ■ 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	
 A0034864 Frame	Support structure used to secure the thermocouples along the defined path

Accessories	Description
Tags	Nameplate that can be attached to identify each measuring point and the entire thermometer. Tags can be attached to the extension cables in the area between the process connection and the junction box and/or in the junction box on individual wires.
Diagnostic chamber	
Pressure transmitter	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
 A0034865	Fitting, manifolds and valves are available for mounting the pressure transmitter on the system body, and for continuous monitoring of the device under operating conditions. They are also used for venting or draining gas/liquids.
Fitting/manifolds/valves	
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 allows the connection of multiple diagnostic chambers installed in the same reactor.
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

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	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

Netilion

With the Netilion IIoT ecosystem, Endress+Hauser enables the optimization of plant performance, digitization of workflows, sharing of knowledge and improved collaboration. Drawing upon decades of experience in process automation, Endress+Hauser offers the process industry an IIoT ecosystem designed to effortlessly extract insights from data. These insights allow process optimization, leading to increased plant availability, efficiency, reliability and ultimately a more profitable plant.



www.netilion.endress.com

Applicator

Software for selecting and sizing Endress+Hauser measuring devices:

- Calculation of all the necessary data for identifying the optimum measuring device: e.g. pressure loss, accuracy or process connections.
- Graphic illustration of the calculation results

Administration, documentation and access to all project-related data and parameters over the entire life cycle of a project.

Applicator is available:

<https://portal.endress.com/webapp/applicator>

Configurator

Product Configurator - the tool for individual product configuration

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

The Configurator is 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 **Configuration**.

FieldCare SFE500	FDT-based plant asset management tool from Endress+Hauser. It can configure all smart field units in your system and helps you manage them. By using the status information, it is also a simple but effective way of checking their status and condition.  For details, see Operating Instructions BA00027S and BA00065S
DeviceCare SFE100	Configuration tool for devices via fieldbus protocols and Endress+Hauser service protocols. DeviceCare is the tool developed by Endress+Hauser for the configuration of Endress+Hauser devices. All smart devices in a plant can be configured via a point-to-point or point-to-bus connection. The user-friendly menus enable transparent and intuitive access to the field devices.  For details, see Operating Instructions BA00027S

11 Technical data

11.1 Input

11.1.1 Measured variable

Temperature (temperature-linear transmission behavior)

11.1.2 Measuring range

RTD:

Input	Description	Measuring range limits
RTD	WW	-200 to +600 °C (-328 to +1112 °F)
RTD	TF 6 mm	-50 to +400 °C (-58 to +752 °F)
RTD	TF 3 mm	-50 to +250 °C (-58 to +482 °F)
RTD	iTHERM StrongSens 6 mm	-50 to +500 °C (-58 to +932 °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)	-40 to +720 °C (-40 to +1 328 °F)
	Type K (NiCr-Ni)	-40 to +1 150 °C (-40 to +2 102 °F)
	Type N (NiCrSi-NiSi)	-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

11.2.1 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.

11.2.2 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).

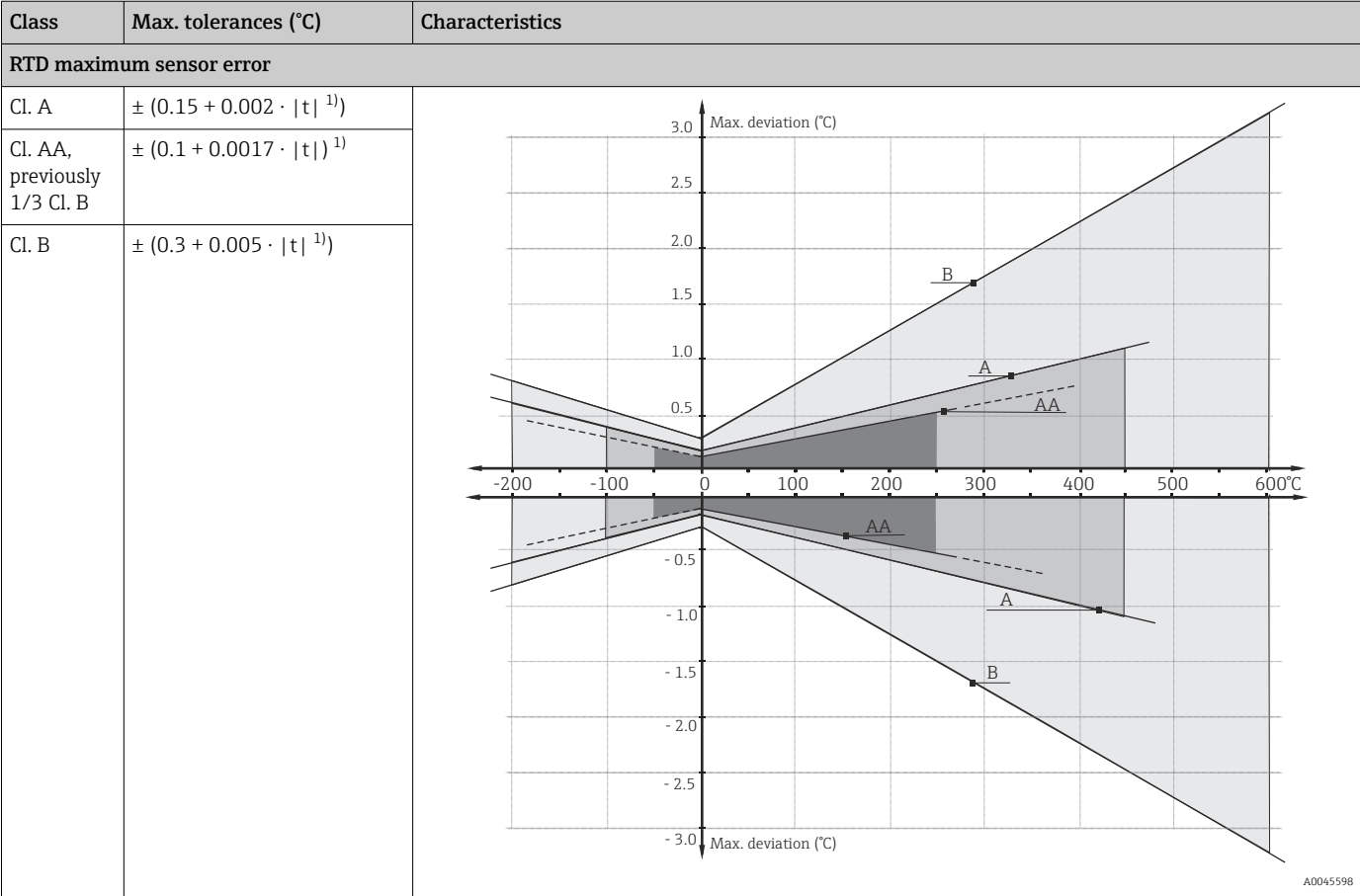
11.3 Performance characteristics

11.3.1 Reference operating conditions

This data is relevant for determining the measurement accuracy of the iTEMP transmitters used. See technical documentation of the specific iTEMP transmitter.

11.3.2 Maximum measurement error

RTD resistance thermometer according to IEC 60751



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

 To get 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) 6 mm: -50 to +400 °C (-58 to +752 °F)	-30 to +250 °C (-22 to +482 °F)	0 to +150 °C (+32 to +302 °F)
Pt100 (TF) iTHERM StrongSens	-50 to +500 °C (-58 to +932 °F)	-50 to +500 °C (-58 to +932 °F)	-30 to +300 °C (-22 to +572 °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	$\pm 2.5\text{ °C}$ (–40 to +333 °C) $\pm 0.0075\text{ t }^{1)}$ (333 to 750 °C)	1	$\pm 1.5\text{ °C}$ (–40 to +375 °C) $\pm 0.004\text{ t }^{1)}$ (375 to 750 °C)
	K (NiCr-NiAl) N (NiCrSi-NiSi)	2	$\pm 0.0075\text{ t }^{1)}$ (333 to 1 200 °C) $\pm 2.5\text{ °C}$ (–40 to +333 °C) $\pm 0.0075\text{ t }^{1)}$ (333 to 1 200 °C)	1	$\pm 1.5\text{ °C}$ (–40 to +375 °C) $\pm 0.004\text{ t }^{1)}$ (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)	$\pm 2.2\text{ K}$ or $\pm 0.0075\text{ t }^{1)}$ (0 to 760 °C)	$\pm 1.1\text{ K}$ or $\pm 0.004\text{ t }^{1)}$ (0 to 760 °C)
	K (NiCr-NiAl) N (NiCrSi-NiSi)	$\pm 2.2\text{ K}$ or $\pm 0.02\text{ t }^{1)}$ (–200 to 0 °C) $\pm 2.2\text{ K}$ or $\pm 0.0075\text{ t }^{1)}$ (0 to 1 260 °C)	$\pm 1.1\text{ K}$ or $\pm 0.004\text{ t }^{1)}$ (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.

11.3.3 Response time



Response time for the sensor assembly without transmitter. It refers to inserts in direct contact with the process. When thermowells are used, a specific assessment should be carried out.

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	
Mineral-insulated cable, 3 mm (0.12 in)	t ₅₀	2 s
	t ₉₀	5 s
StrongSens RTD insert, 6 mm (¼ in)	t ₅₀	< 5.5 s
	t ₉₀	< 16 s

Thermocouple (TC)

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

Insert diameter	Response time	
Grounded thermocouple: 3 mm (0.12 in), 2 mm (0.08 in)	t ₅₀	0.8 s
	t ₉₀	2 s
Ungrounded thermocouple: 3 mm (0.12 in), 2 mm (0.08 in)	t ₅₀	1 s
	t ₉₀	2.5 s
Grounded thermocouple 6 mm (¼ in)	t ₅₀	2 s
	t ₉₀	5 s
Ungrounded thermocouple 6 mm (¼ in)	t ₅₀	2.5 s
	t ₉₀	7 s
Grounded thermocouple 8 mm (0.31 in)	t ₅₀	2.5 s
	t ₉₀	5.5 s
Ungrounded thermocouple 8 mm (0.31 in)	t ₅₀	3 s
	t ₉₀	6 s

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

11.3.4 Shock and vibration resistance

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

11.3.5 Calibration

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

 If calibration is to be performed after the multipoint is installed, please contact the Endress+Hauser service team for support. Together with the Endress+Hauser service team, any further measures can be arranged to complete the calibration of the target sensor. Under no circumstances is it permitted to unscrew any threaded component on the process connection under operating conditions (i.e. while the process is running).

Calibration involves comparing the measured values of the measuring elements of the multipoint inserts (DUT = device under test) with those of a more precise calibration

standard using a defined and reproducible measurement method. The aim is to determine the deviation of the DUT measured values from the true value of the measured variable.

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

Two different methods are used for the inserts:

- Calibration at fixed point, e.g. at the freezing point of water at 0 °C (32 °F).
- Calibration against a precise reference thermometer.

Evaluation of inserts

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

11.4 Ambient conditions

11.4.1 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)

11.4.2 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)

11.4.3 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

11.4.4 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

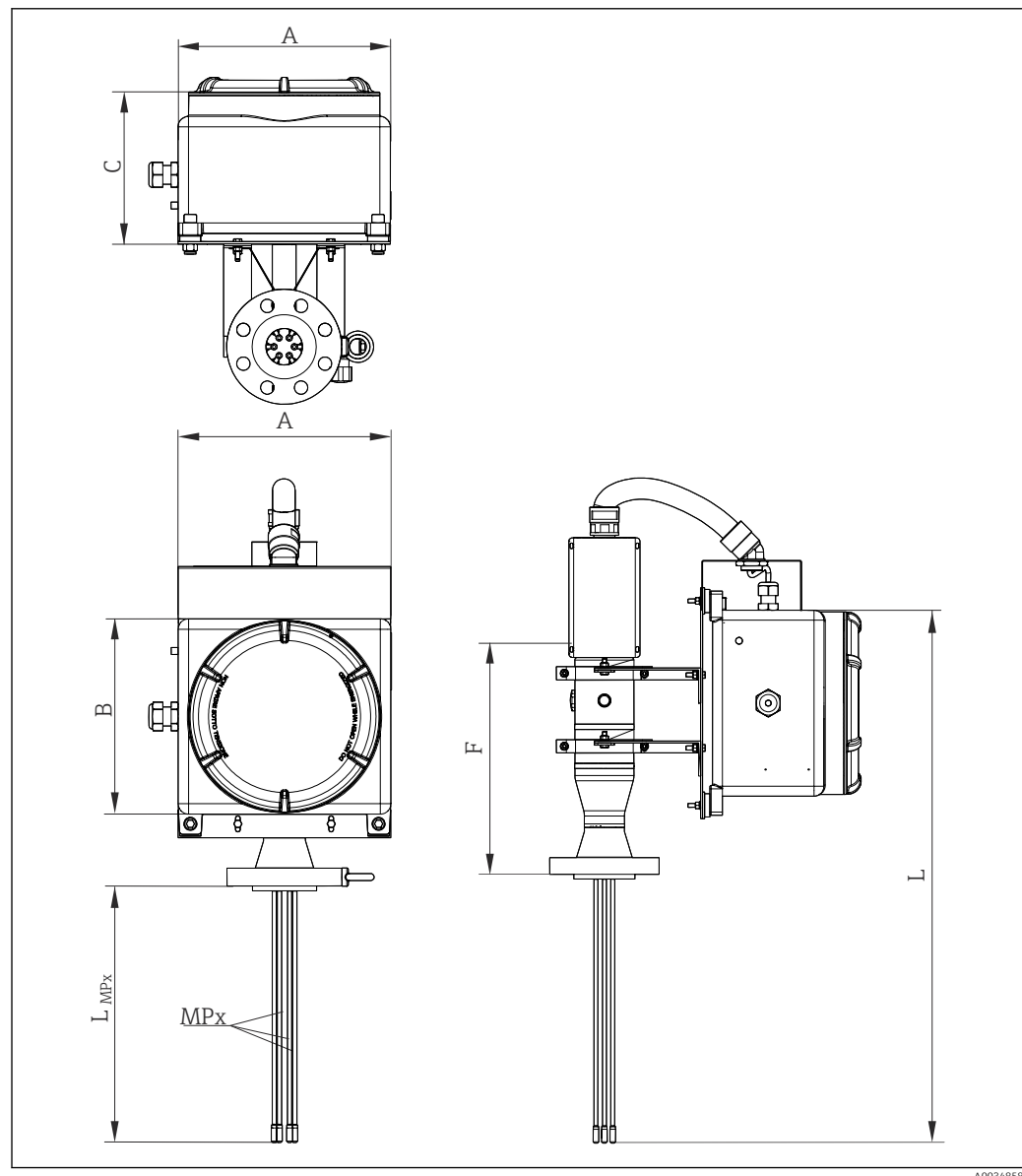
11.4.5 Electromagnetic compatibility (EMC)

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

11.5 Mechanical construction

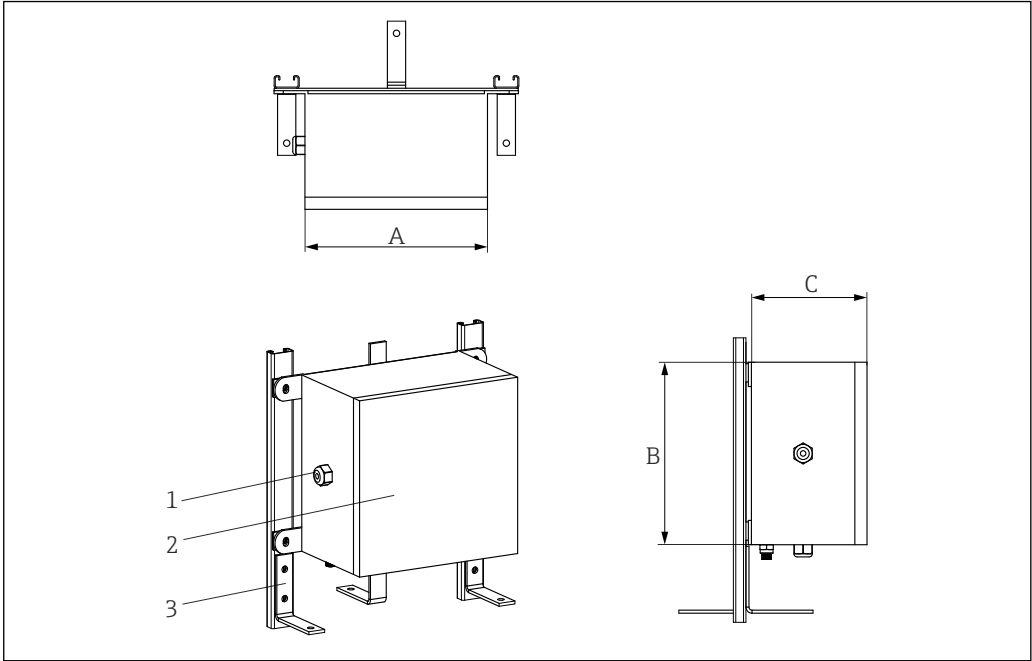
11.5.1 Design, dimensions

The multipoint thermometer is composed of four subassemblies. Both linear and 3D configurations have the same features, dimensions and materials. Different inserts are available for specific process conditions to ensure maximum accuracy and long service life. In addition, thermowells can be selected to further increase mechanical performance and corrosion resistance and to allow replacement of the insert. Associated shielded extension cables are provided with high resistance sheath materials to withstand different environmental conditions and to ensure steady and noiseless signals. The transition between the inserts and the extension cable is achieved using specially sealed bushings, thus ensuring the specified degree of protection.



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Junction box



- 1 Cable glands
- 2 Junction box
- 3 Frame

The junction box is suited to environments where chemical agents are used. Sea water corrosion resistance and extreme temperature variation stability is guaranteed. Ex-e, Ex-i terminals can be installed.

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

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

Type of specification	Junction box	Cable glands
Material	AISI 316/aluminum	NiCr-coated brass AISI 316/316L
Degree of protection (IP)	IP66/67	IP66
Ambient temperature range	-50 to +60 °C (-58 to +140 °F)	-52 to +110 °C (-61.1 to +140 °F)
Device approvals	ATEX UL, FM, CSA approval for use in hazardous area	ATEX approval for use in hazardous area
Marking	ATEX II 2GD Ex e IIC/Ex ia Ga IIC Ex tb IIIC Db T6/T5/T4 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	→ 45- According to the junction box approval

Type of specification	Junction box	Cable glands
Cover	Hinged and threaded	-
Maximum sealing diameter	-	6 to 12 mm (0.24 to 0.47 in)

Support frame

The modular frame is designed for integrated installation at various mounting angles with respect to the device base.

It ensures the connection between the diagnostic chamber and the junction box. The design was developed to facilitate different installation options and to address potential obstacles and restrictions that are present in all plants. This includes the infrastructure of the reactor, for example, (platforms, load-bearing structures, support rails, stairs, etc.) and the thermal insulation of the reactor. The frame design ensures easy access for monitoring and maintaining inserts and extension cables. It provides a fixed (rigid) connection to the junction box and is vibration-resistant. Without an enclosed housing, the frame protects the cables by means of the covers and the cable conduit of the junction box. This helps prevent the accumulation of residues and potentially hazardous fluids from the surroundings that could damage the device, while also ensuring continuous ventilation.

Insert and thermowells



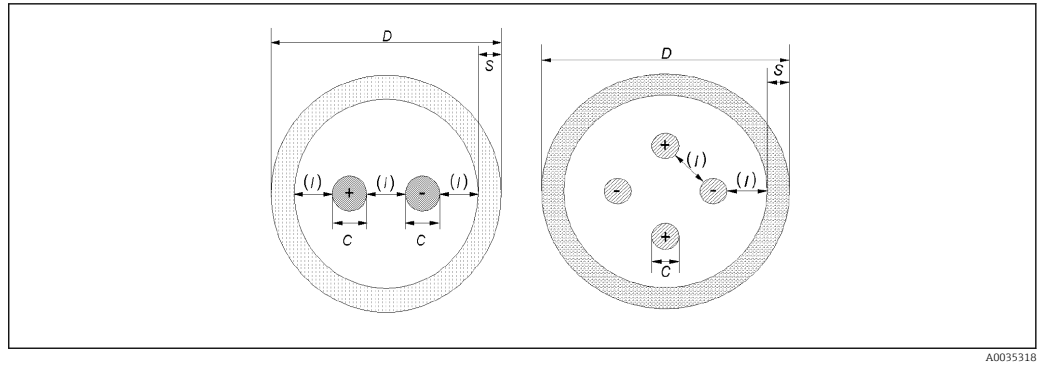
Different insert and thermowell types are available. For other requirements not described here, please contact the Endress+Hauser sales department.

Thermocouple

Diameter in mm (in)	Type	Standard	Sensor configuration	Sheath material
8 (0.31) 6 (0.23) 3 (0.12) 2 (0.08) 1.5 (0.06)	1x type K 2x type K 1x type J 2x type J 1x type N 2x type N	IEC 60584/ASTM E230	Grounded/Ungrounded	Alloy 600/AISI 316L/ Pyrosil/321/347

Conductor thickness

Sensor type	Diameter in mm (in)	Wall	Min. sheath wall thickness	Min. conductor diameter (C)
Single thermocouple	6 mm (0.23 in)	Heavy wall	0.6 mm (0.023 in)	0.90 mm = 19 AWG
Double thermocouple	6 mm (0.23 in)	Heavy wall	0.54 mm (0.021 in)	0.66 mm = 22 AWG
Single thermocouple	8 mm (0.31 in)	Heavy wall	0.8 mm (0.031 in)	1.20 mm = 17 AWG
Double thermocouple	8 mm (0.31 in)	Heavy wall	0.64 mm (0.025 in)	0.72 mm = 21 AWG
Single thermocouple	1.5 mm (0.05 in)	Standard	0.15 mm (0.005 in)	0.23 mm = 31 AWG
Double thermocouple	1.5 mm (0.05 in)	Standard	0.14 mm (0.005 in)	0.17 mm = 33 AWG
Single thermocouple	2 mm (0.07 in)	Standard	0.2 mm (0.007 in)	0.30 mm = 28 AWG
Double thermocouple	2 mm (0.07 in)	Standard	0.18 mm (0.007 in)	0.22 mm = 31 AWG
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



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RTD

Diameter in mm (in)	Type	Standard	Sheath material
3 (0.12)	1x Pt100 WW/TF	IEC 60751	AISI 316L
6 ($\frac{1}{4}$)	1xPt100 WW/TF/StrongSens or 2xPt100 WW		

Thermowells

External diameter in mm (in)	Sheath material	Type	Thickness in mm (in)
6 (0.24)	AISI 316L or AISI 321 or AISI 347 or Alloy 600	closed or open	1 (0.04) or 1.5 (0.06)
8 (0.32)	AISI 316L or AISI 321 or AISI 347 or Alloy 600	closed or open	1 (0.04) or 1.5 (0.06) or 2 (0.08)
10.24 ($\frac{1}{8}$)	AISI 316L or AISI 321 or AISI 347 or Alloy 600	closed or open	1.73 (0.06) (SCH. 40) or 2.41 (0.09) (SCH. 80)

Sealing components

The sealing components (compression fittings) are welded to the upper part of the diagnostic chamber to ensure proper sealing under all specified operating conditions and to allow maintenance or replacement of the stump-insert ("**Advanced**" solution without thermowells) or the insert ("**Advanced**" solution with thermowells).

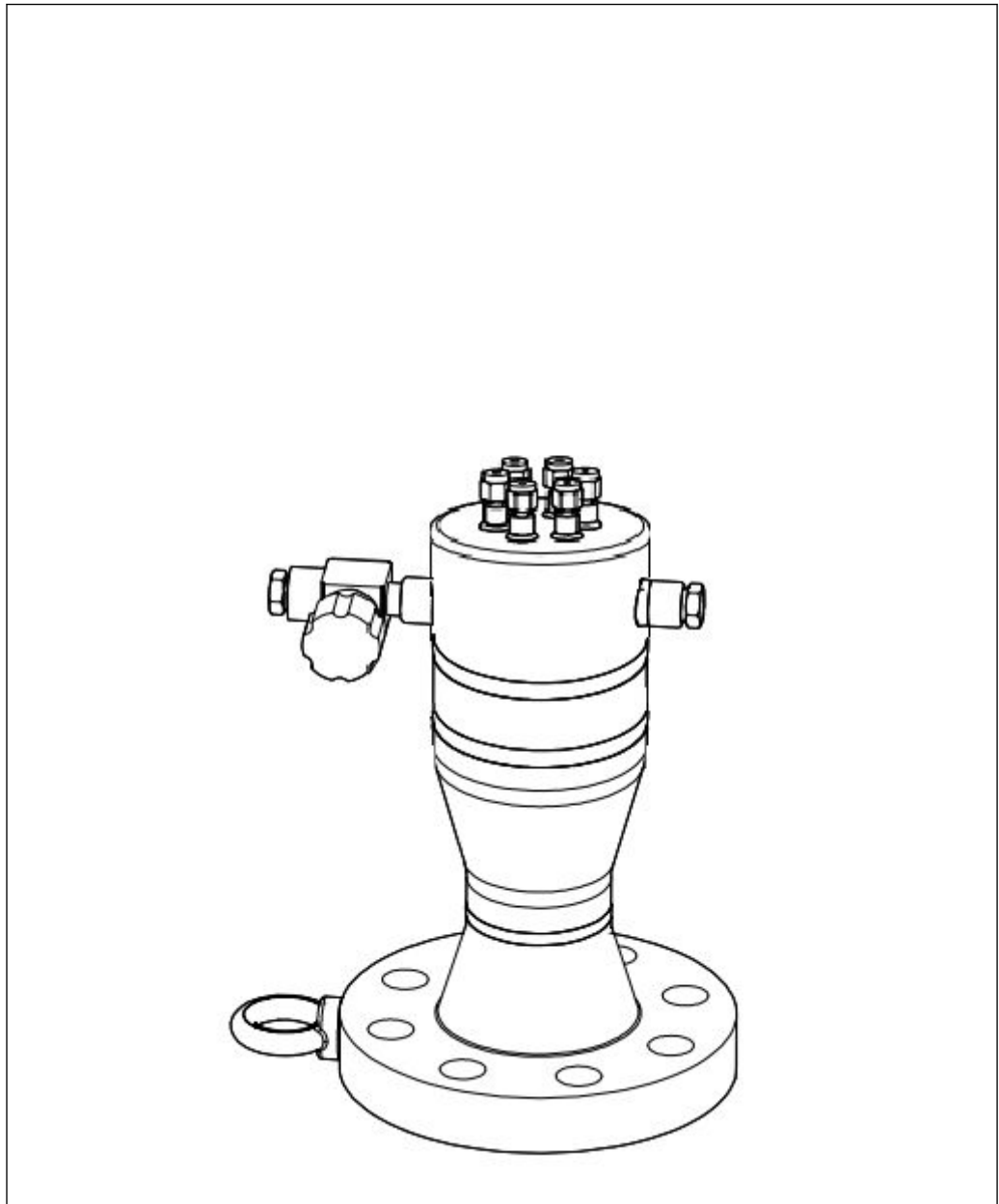
Material: AISI 316/AISI 316H

Cable glands

The installed cable glands provide the appropriate degree of reliability under the specified ambient and process conditions.

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

Diagnostic chamber



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Diagnostic function

The diagnostic chamber is a module designed to monitor the behavior of the multipoint thermometer in the event of leaks or substances escaping from the process through permeation and to safely contain them. By processing all recorded data, it enables assessment of the measurement accuracy, remaining service life, and maintenance schedule.

11.5.2 Weight

The weight may vary based on the configuration, depending on the junction box and the frame design, the diagnostic chamber and the clamp (if used), as well as the number of inserts and any accessories. The approximate weight of a typically configured multipoint thermometer (number of inserts = 12, main body = 3", medium size junction box) = 70 kg (154.3 lb).

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

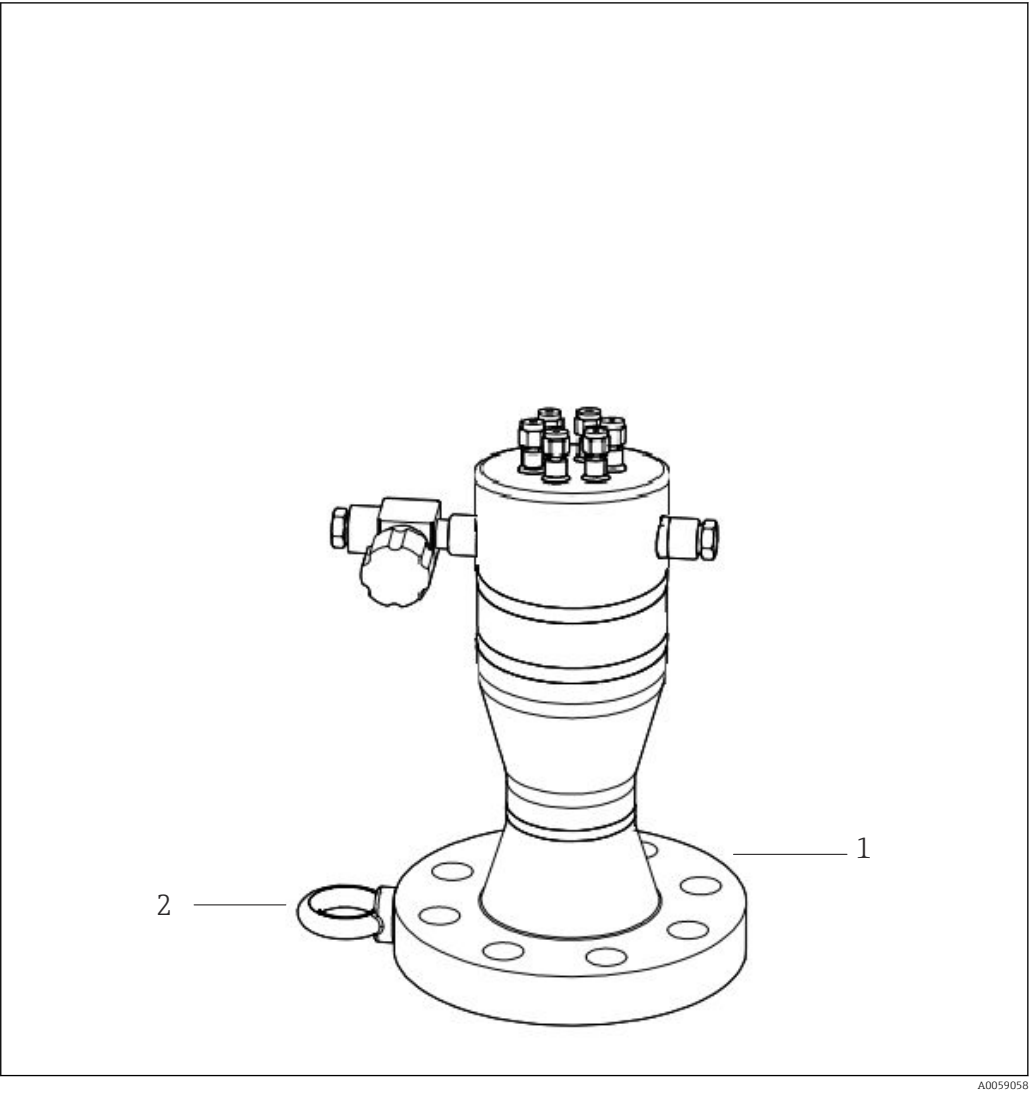
11.5.3 Materials

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

Material name	Short form	Recommended max. temperature for continuous use in air	Properties
AISI 316/1.4401	X2CrNiMo17-12-2	650 °C (1202 °F)	■ Austenitic, stainless steel ■ High corrosion resistance in general ■ Particularly high corrosion-resistance in chlorinated and acidic, non-oxidizing atmospheres by adding molybdenum (e.g. phosphoric and sulfuric acids, acetic and tartaric acids with 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 chlorinated and acidic, non-oxidizing atmospheres by adding molybdenum (e.g. phosphoric and sulfuric acids, acetic and tartaric acids with 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 to AISI316L. ■ Addition of titanium means increased resistance to intergranular corrosion even after welding ■ Broad range of uses in the chemical, petrochemical and oil industries as well as in coal chemistry ■ Can only be polished to a limited extent, titanium streaks can form

Material name	Short form	Recommended max. temperature for continuous use in air	Properties
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

11.5.4 Process connection and chamber body



8 Flange as process connection

1 Flange

2 Eyebolt

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

Standard ¹⁾	Size	Pressure rating	Material
ASME	2", 3", 4", 6", 8"	600#, 900#, 1500#, 2500#	AISI 316, 347
EN	DN15, DN80, DN100, DN125, DN150, DN200	PN40, PN63, PN100, PN 160	316/1.4401, 316L/1.4435 316Ti; 1.4571 321; 1.4541, 347; 1.4550

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

11.5.5 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 those of the insert. The compression fittings meet the highest standards of reliability in terms of materials and design.

Material	AISI 316/316H
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11.5.6 Thermowell insert (alternative process connection)

The thermowell insert process connection is designed and provided to meet plant requirements where the standard nozzle is replaced by a compact round drilled bar. This round drilled bar, named thermowell insert, is welded on the internal reactor wall by means of a specific support already provided by the reactor's manufacturer. This type of process connection allows the MultiSens system to be installed using a quick and compact clamped connection. For new plants or new reactors, the counterpart of the process connection of the MultiSens system must be butt-welded to the thermowell insert. In the case of maintenance or repair installations, no additional welding work must be performed. Simply connect the MultiSens system to the existing counterpart.

Material of the thermowell insert	AISI 321 - AISI 347 - AISI 316/L - Incoloy 825 - Inconel 625
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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.

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.



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