

Operating Instructions

iTHERM

MultiSens Flex TMS01

Modular TC or RTD multipoint thermometer for direct contact with the medium for oil & gas and petrochemical applications



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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.

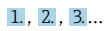


NOTICE

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.









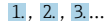



1.2.2 Electrical symbols

Symbol	Meaning
	Direct current
	Alternating current
	Direct 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: <ul style="list-style-type: none"> ■ 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		Series of steps
A, B, C, ...	Views	A-A, B-B, C-C, ...	Sections
	Hazardous area		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
	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 documentation may be available depending on the device version ordered:

Document type	Purpose and content of the document
Technical Information (TI)	Planning aid for your device The document contains all the technical data on the device and provides an overview of the accessories and other products that can be ordered for the device.
Brief Operating Instructions (KA)	Guide that takes you quickly to the 1st measured value The Brief Operating Instructions contain all the essential information from incoming acceptance and storage, to mounting, connection, operation and commissioning, through to troubleshooting, maintenance and disposal.
Operating Instructions (BA)	Your reference document These Operating Instructions contain all the information that is required in the various life cycle phases 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. The Safety Instructions are a constituent part of the Operating Instructions.  Information on the Safety Instructions (XA) that are relevant for the device is provided on the nameplate.
Supplementary device-dependent documentation (SD/FY)	Always comply strictly with the instructions in the relevant supplementary documentation. The supplementary documentation is 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 instructions

Instructions and procedures in the operating instructions may require special precautions to ensure the safety of the personnel performing the operations. Information that potentially raises safety issues is indicated by safety pictograms and symbols. Please refer to the safety messages before performing an operation preceded by pictograms and symbols. Although the information provided in this manual is believed to be accurate, be advised that the information provided is NOT a guarantee of satisfactory results. Specifically, this information is neither a warranty nor guarantee, expressed or implied, regarding performance. Please note that the manufacturer reserves the right to change and / or improve the product design and specifications without notice.

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 product is intended to measure the temperature profile inside a reactor, vessel or pipe using RTD or thermocouple technologies. The various designs of the multipoint thermometers are configurable. However, the process parameters (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 damage caused by improper or unintended use. The process-wetted materials of the measuring device 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 allowable pressure inside the reactor.
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. Specific care must be taken when the instrument's sensing elements are fixed to the plant components.
Process fluids	<p>The correct dimensions and the correct material selection can minimize the following signs of wear:</p> <ul style="list-style-type: none"> ▪ distributed and localized corrosion, ▪ erosion and abrasion, ▪ signs of corrosion caused by uncontrolled and unpredictable chemical reactions. <p>Specific process fluids analysis is necessary to properly ensure the maximum operating life of the device, through proper material selection.</p>
Fatigue	Cyclic loads during operation are not included.
Vibrations	The sensing elements can be subjected to vibrations due to high immersion lengths. These vibrations can be minimized by correctly routing the sensor element in the plant, e.g. by attaching it to internal fixtures using accessories such as clips or end tips. The tube neck has been designed to withstand vibratory loads to preserve the junction box from cyclic loading, and to avoid the unscrewing of the threaded components.
Mechanical stress	The maximum stress on the measuring device multiplied by the 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), wires, cable glands and other fittings have been selected to work within the allowed ranges in terms of the ambient temperature range.

The manufacturer is not liable for damage caused by improper or unintended use.

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

When working on and with the device:

- Wear the required personal protective equipment as per 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 measuring device is designed in accordance with good engineering practice to meet state-of-the-art safety requirements, has been tested, and 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 to the device.

3 Product description

3.1 Product design

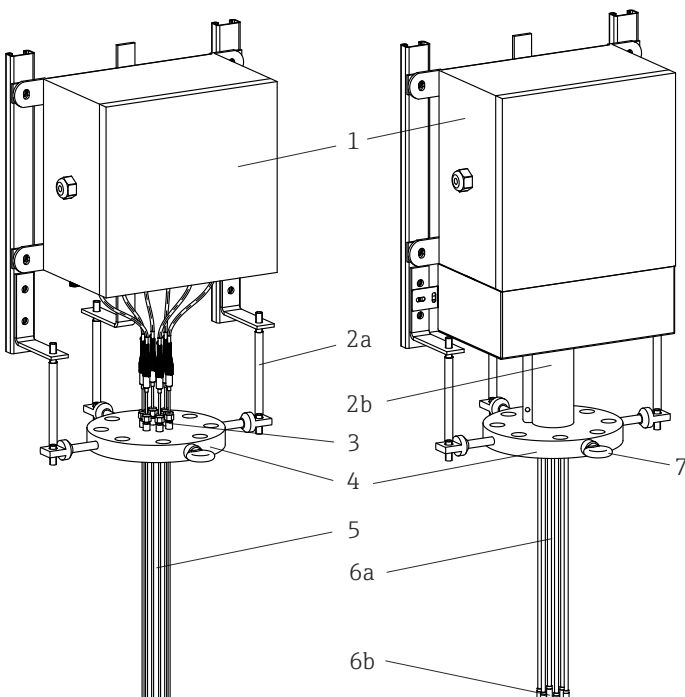
The multipoint thermometer belongs to a series of modular products for multiple temperature measurements. The design enables the individual replacement of subassemblies and components, making maintenance and spare parts management easier.

It consists of the following main sub-assemblies:

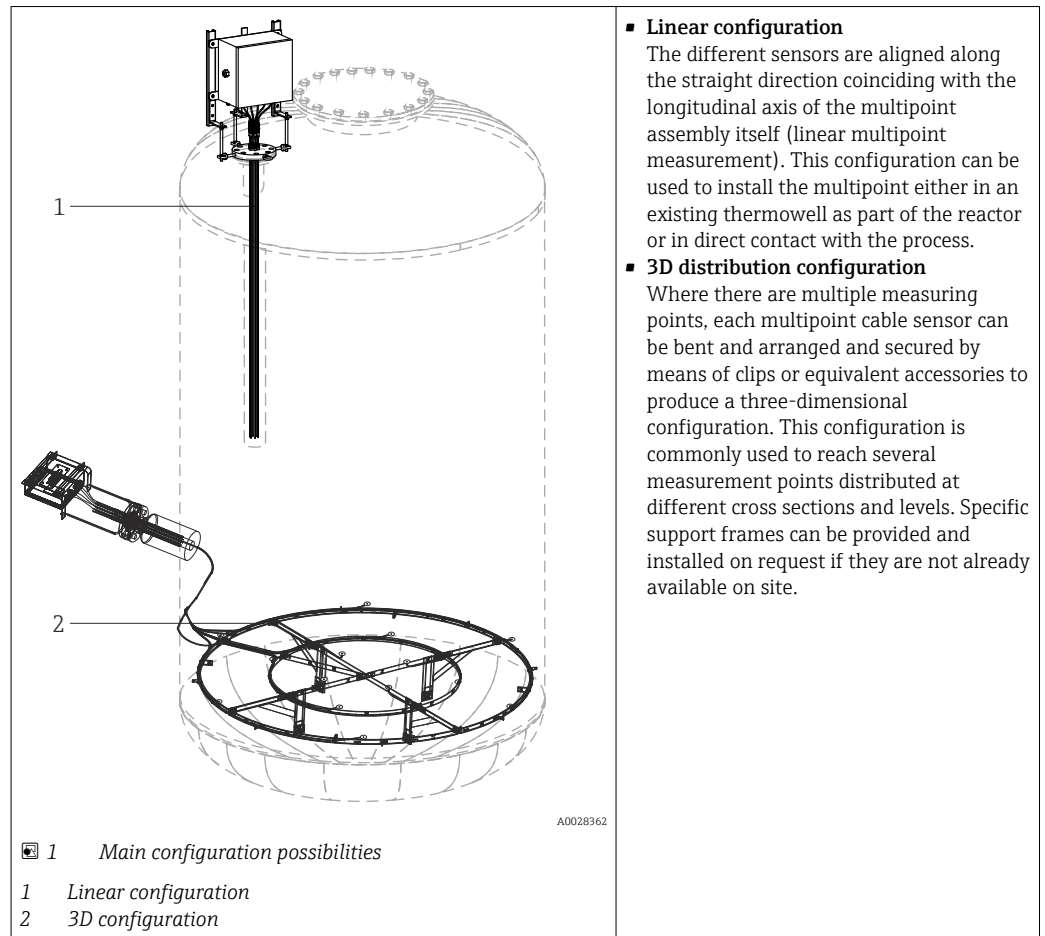
- **Single-point insert:** Consisting of a sensing element with metal sheathing (thermocouple or resistance thermometer), extension cable and bushing. If necessary, each insert can be handled as an individual spare part that can be replaced by releasing the compression fitting on the process connection. They can be ordered via specific standard product order codes (e.g. TSC310, TST310) or special codes. For the specific order code please contact the Endress+Hauser service department.
- **Multi-point insert:** Consisting of a number of independent thermocouple cables with metal sheathing in a probe, each of which is fitted with a potting seal and the relevant extension cable, resulting in a double-sealed design (Endress+Hauser ProfileSens).
- **Process connection:** An ASME or EN flange; it can be supplied with eyebolts for lifting the device.
- **Head:** It is composed of a junction box provided with its components such as cable glands, draining valves, earth screws, terminals, head transmitters, etc.
- **Neck:** It is designed to support the junction box by components such as supporting rods and plates or tube extension.
- **Additional accessories:** Components that can be ordered independently of the selected product configuration, e.g. clips, weld-on plates or blocks, sealing sleeves, spacers and labels for sensor measuring point identification.
- **Thermowells:** They are directly welded on the process connection and designed to guarantee a higher degree of mechanical protection and corrosion resistance for each sensor.

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. Externally, the extension cables are wired into the junction box, which can be directly mounted or remote.

Design		Description, available options and materials
 <p style="text-align: right; font-size: small;">A0028078</p>	1: Head	Hinged cover junction box for electrical connections. It includes components such as electrical terminals, transmitters and cable glands. <ul style="list-style-type: none"> ■ 316/316L ■ Other materials on request
	2a: Support frame	Modular frame support that is adjustable for all available junction boxes. 316/316L
	2b: Tube neck	Modular tube support that is adjustable for all available junction boxes and ensures extension cable inspection. 316/316L
	3: Compression fitting	High-performance compression fitting to ensure leak-tightness between the process and external environment. For many process fluids and various combinations of high temperatures and pressures. <ul style="list-style-type: none"> ■ 316L ■ 316H
	4: Process connection	A flange according to international standards, or customized to satisfy specific process requirements. → 40 <ul style="list-style-type: none"> ■ 304/304L ■ 316/316L ■ 316Ti ■ 321 ■ 347 ■ Other materials on request
	5: Insert	<ul style="list-style-type: none"> ■ Mineral-insulated grounded and ungrounded thermocouples or RTDs (Pt100) ■ Mineral-insulated non-grounded multipoint cable insert with thermocouples (ProfileSens) For details, refer to the Ordering information table.
	6a: Thermowells 6b: Tip closure, thermowells	The thermometer can be equipped: <ul style="list-style-type: none"> ■ either with protecting thermowells for increased mechanical strength and corrosion resistance ■ or open guiding tubes for installation in an existing thermowell <ul style="list-style-type: none"> ■ 316/316L ■ 321 ■ 347 ■ Alloy 600 ■ Other materials on request
	7: Eyebolt	Lifting device for easy handling during installation phase. 316

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 Mounting

5.1 Mounting requirements

WARNING

Failure to follow these installation guidelines could result in serious or fatal injury

- Make sure only qualified personnel perform the installation.

WARNING

Explosions could result in serious or fatal injury

- Do not remove the junction box cover in explosive atmospheres when the circuit is live.
- Before connecting any additional electric and electronic device in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non incendive field wiring practices.
- Verify that the operating atmosphere of the transmitters is consistent with the appropriate hazardous locations certifications.
- All covers and threaded components must be fully engaged to meet explosion-proof requirements.


WARNING

Process leaks could result in serious or fatal injury

- Do not release screwed parts while in operation. Install and tighten the fittings before applying pressure.

NOTICE

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

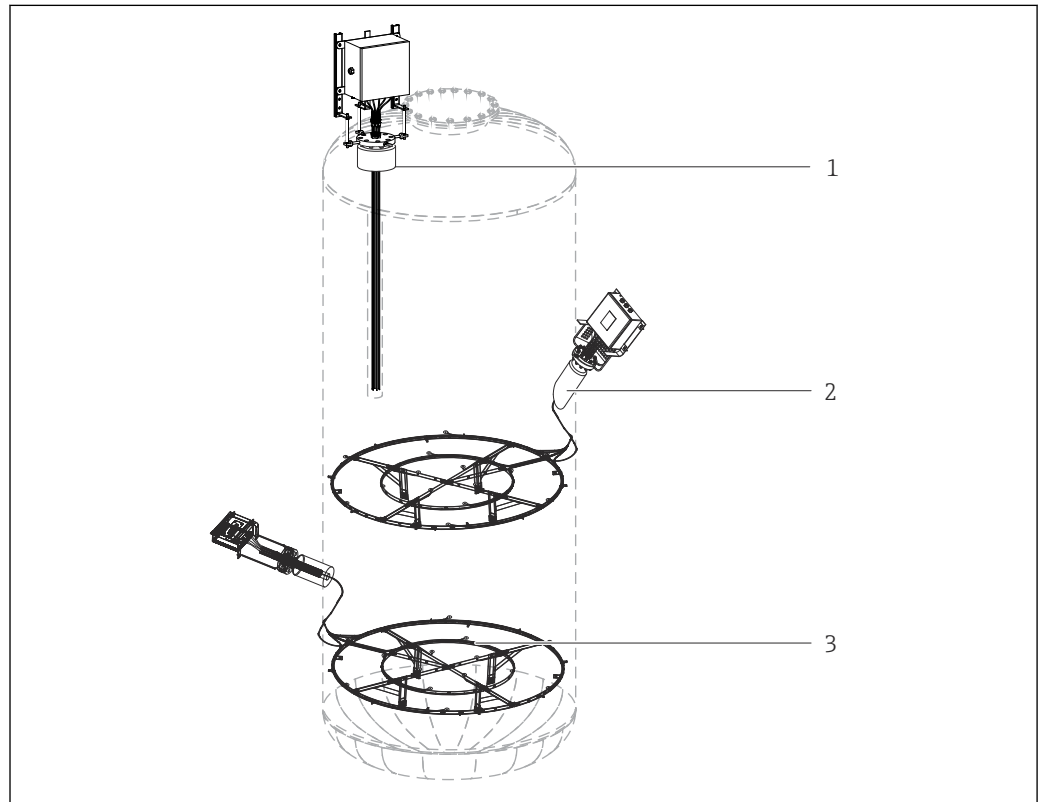
- Is it not allowed to apply additional loads or external moments to the system coming from the connection with another system not foreseen from installation plan.
- The system is not suitable for being installed in locations where vibrations are present. The deriving loads can undermine the sealing 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 →  34
- When installing in an existing thermowell, an internal inspection of the thermowell is recommended to check if any internal load is present before starting with the insertion activities of the whole device. While installing the measurement system, avoid any friction during installation, 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 is 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 Mounting location


The mounting location must meet the requirements listed in this document, e.g. ambient temperature, protection class, climate class etc. Care should be taken when checking the sizes of possible existing support frames or brackets welded on the reactor's wall (usually not included in the scope of delivery) or of any other existing frame in the installation area.

5.3 Orientation

No restrictions. The multipoint thermometer can be installed either in horizontal, oblique or in vertical configuration, related to the reactor or vessel vertical axis.



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 2 Installation examples - no restrictions to the orientation

1 Vertical installation with linear configuration

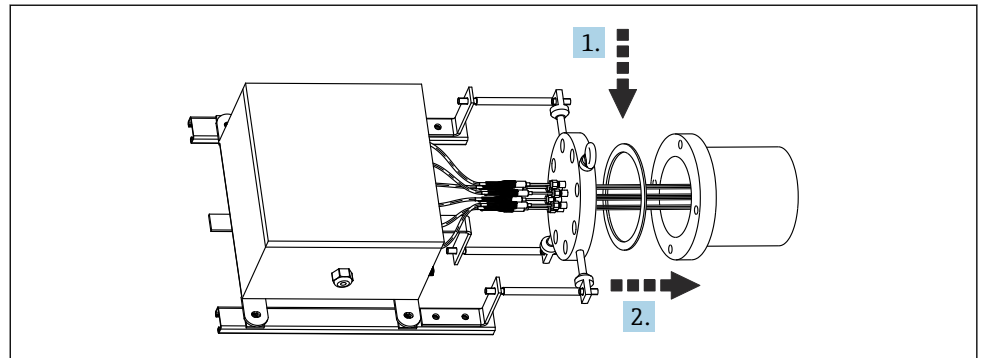
2 Oblique installation with 3D distribution configuration

3 Horizontal installation with 3D distribution configuration

5.4 Mounting the thermometer

The following instructions must be followed for proper installation of the device:

1.



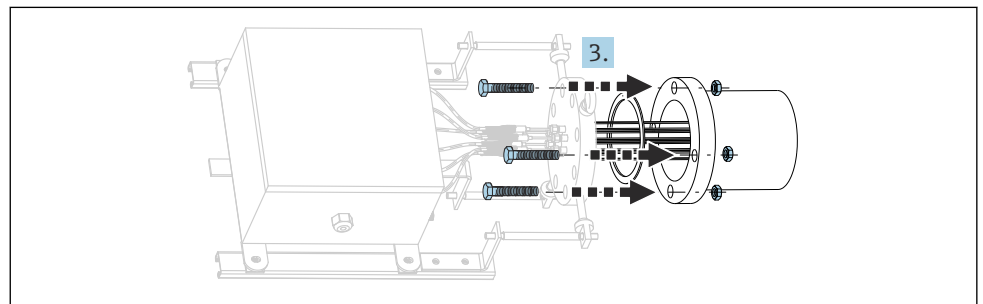
A0028369

Place the sealing ring between the flanged nozzle and the flange of the device (after first checking the cleanliness of seal seats on the flanges).

2.

Move the device towards the nozzle and insert the thermocouples or the thermocouple bundle into the nozzle. Ensure that the thermocouples in the bundle do not become entangled or deformed.

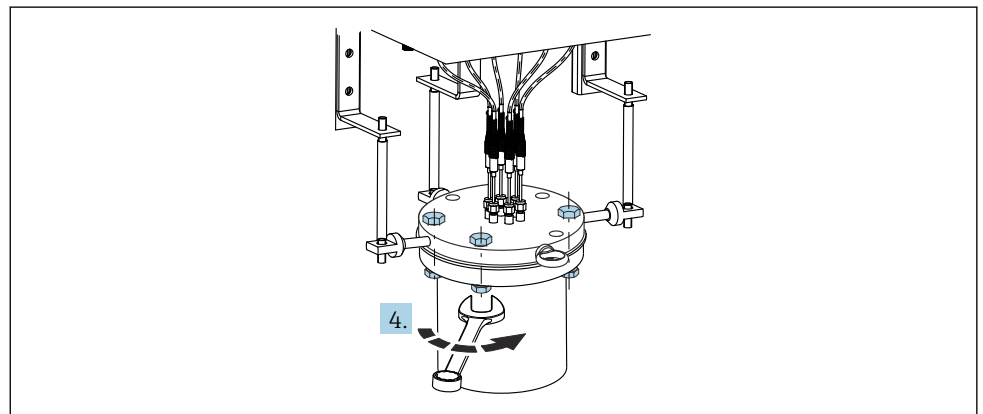
3.



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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 wrench for this but do not tighten completely yet.

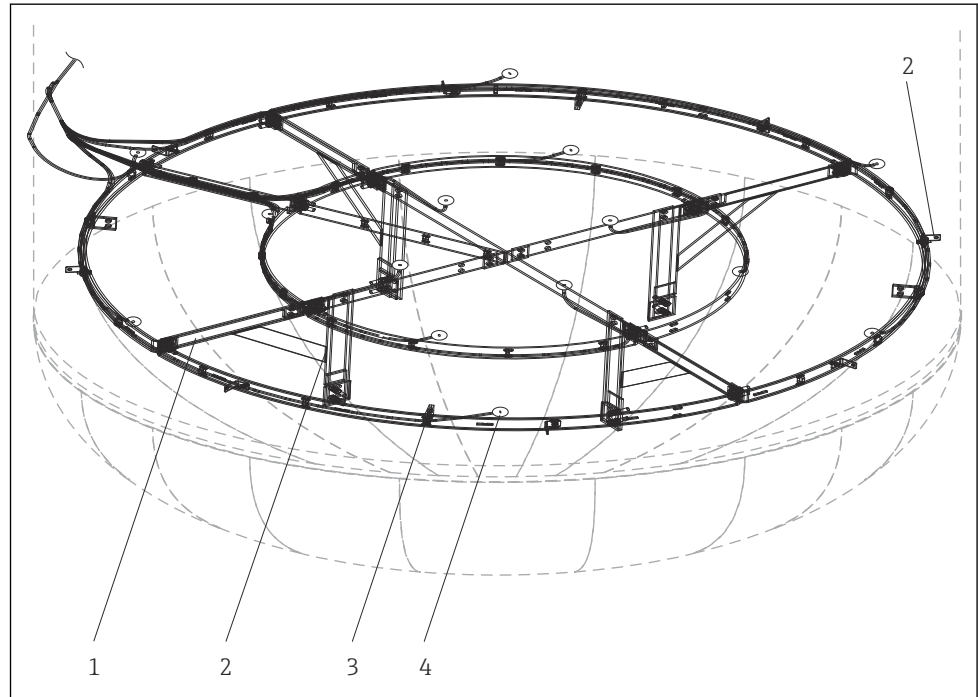
4.



A0050250

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

5.



A0029266

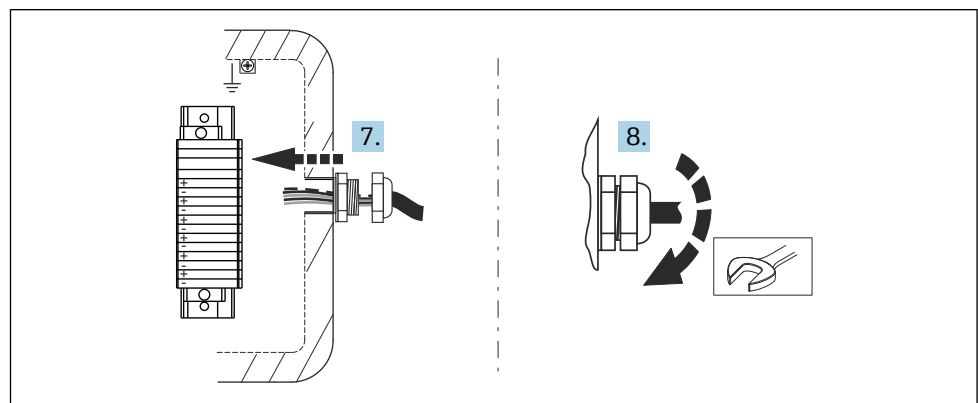
- 1 Support frame
- 2 Fixing bar
- 3 Fixing clip
- 4 Inserts or thermowell tip

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 Ω curves close to the measuring point if necessary. Remark: 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 welding it.

6.

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 the thermal contact between the tip end of the inserts or thermowells and the existing thermowell wall is guaranteed. When accessories such as spacers and/or centered rods are provided, make sure that no distortions can occur and that the original geometry is maintained.

7.



A0028375

In case of direct wiring completely introduce the extension or compensating cables through the respective cable glands in the junction box.

8. Tighten the cable glands on the junction box.
9. After opening the junction box cover, connect the compensating cables to the terminals in the junction box. Comply with the wiring instructions provided and ensure that the marking of the terminals and cables match.
10. Close the cover ensuring the right seal position to avoid any impact on the IP degree of protection.
11. In case of using the tube neck, check if all its components are still coupled properly one each other.

The mounting of the assembly is completed.


NOTICE

After mounting, perform a few simple checks on the thermometric system installed.

- ▶ Check the tightness of the threaded connections. If any part is loosened, tighten it by applying the proper torque.
- ▶ Check for correct wiring, test the electrical continuity of the thermocouples (heating of the thermocouple measuring point) and then verify the absence of short circuits.

5.5 Post-mounting checks

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)?	<input type="checkbox"/>
Do the ambient conditions match the device specification? For example: <ul style="list-style-type: none"> ■ Ambient temperature ■ Proper conditions 	<input type="checkbox"/>
Are the threaded components undeformed?	<input type="checkbox"/>
Are the seals not permanently deformed?	<input type="checkbox"/>
Installation	
Is the equipment aligned with the nozzle axis?	<input type="checkbox"/>
Are the seal seats of flanges clean?	<input type="checkbox"/>
Is the coupling between the flange and its counter flange reached?	<input type="checkbox"/>
Are the thermocouples not interlaced and undeformed?	<input type="checkbox"/>
Are the bolts completely inserted in the flange? Make sure the flange is completely attached to the nozzle.	<input type="checkbox"/>
Are the thermocouples fixed to the support structures? →  14	<input type="checkbox"/>
Are the cable glands tightened on the extension cables?	<input type="checkbox"/>
Are the extension cables connected to the junction box terminals?	<input type="checkbox"/>

6 Wiring




⚠ CAUTION

Failure to observe this may result in the destruction of parts of the electronics.

- ▶ Switch off the power supply before installing or connecting the device.
- ▶ When installing Ex-approved devices in a hazardous area please take special note of the instructions and connection schematics in the respective Ex documentation added to these Operating Instructions. The local Endress+Hauser representative is available for assistance if required.

i When wiring to a transmitter also observe the wiring instructions in the enclosed Brief Operating manuals of the relevant transmitter.

To wire 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 on →  16
5. On completion of the wiring, tighten the screw terminals. Tighten the cable glands again. In doing so, also pay particular attention to →  21. Close the housing cover again.
6. Before commissioning, ensure you follow the instructions provided in the checklist for the "Post-connection check" to avoid connection errors! →  22

6.1 Quick wiring guide

Terminal assignment

NOTICE

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

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

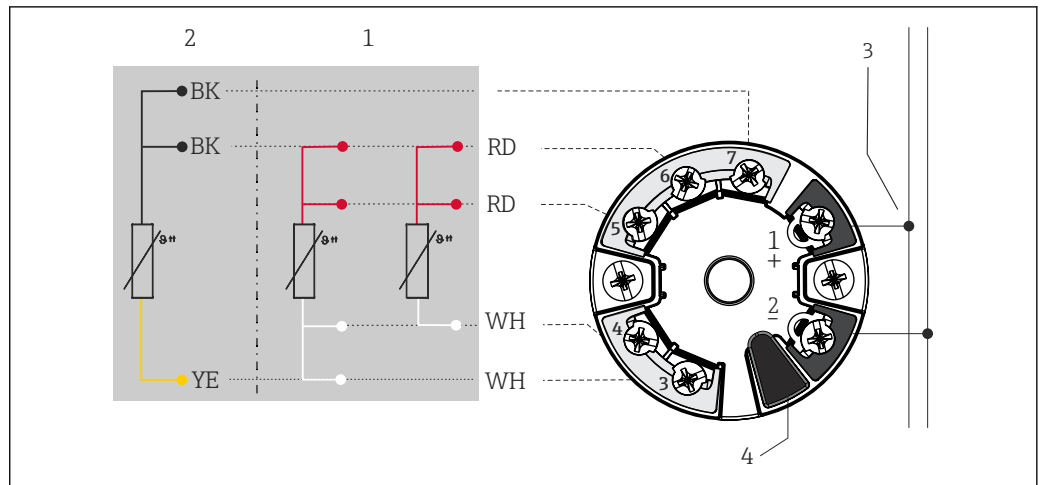
i To avoid incorrect measuring values an extension or compensation cable for direct wiring of thermocouple and RTD sensors for the signal transmission has to be used. The polarity indication on the respective terminal block and the wiring scheme has to be observed.

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

Thermocouple cable colors

According to IEC 60584	According to ASTM E230
<ul style="list-style-type: none"> ■ Type J: Black (+), white (-) ■ Type K: Green (+), white (-) ■ Type N: Pink (+), white (-) ■ Type T: Brown (+), white (-) 	<ul style="list-style-type: none"> ■ Type J: White (+), red (-) ■ Type K: Yellow (+), red (-) ■ Type N: Orange (+), red (-) ■ Type T: Blue (+), red (-)

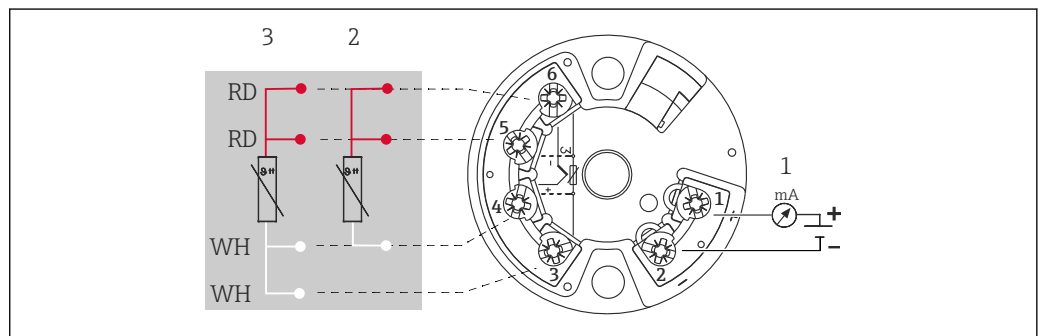
6.1.1 RTD sensor connection type



A0045466

3 Head mounted transmitter TMT8x (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

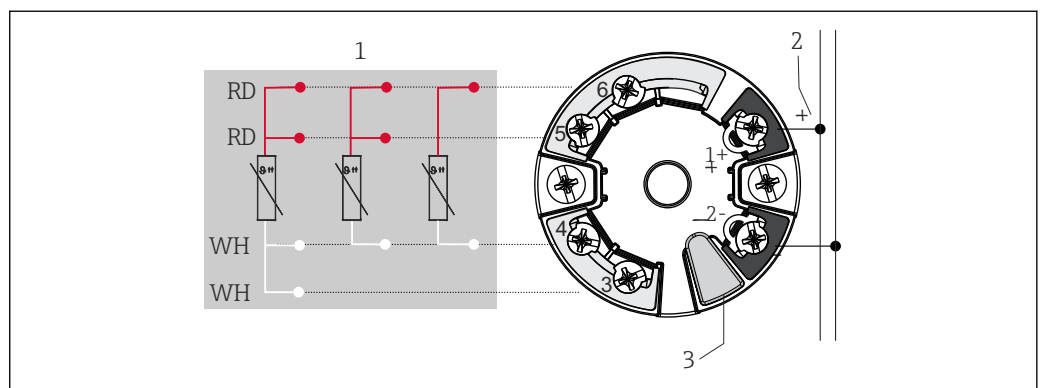


A0045600

4 Head mounted transmitter TMT18x (single sensor input)

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

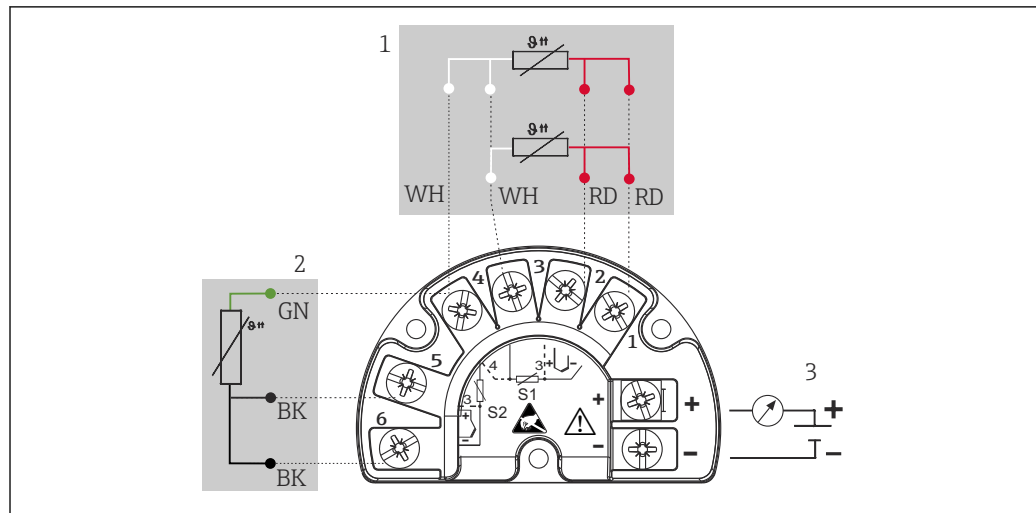
Only available with screw terminals



A0045464

5 Head mounted transmitter TMT7x or TMT31 (single sensor input)

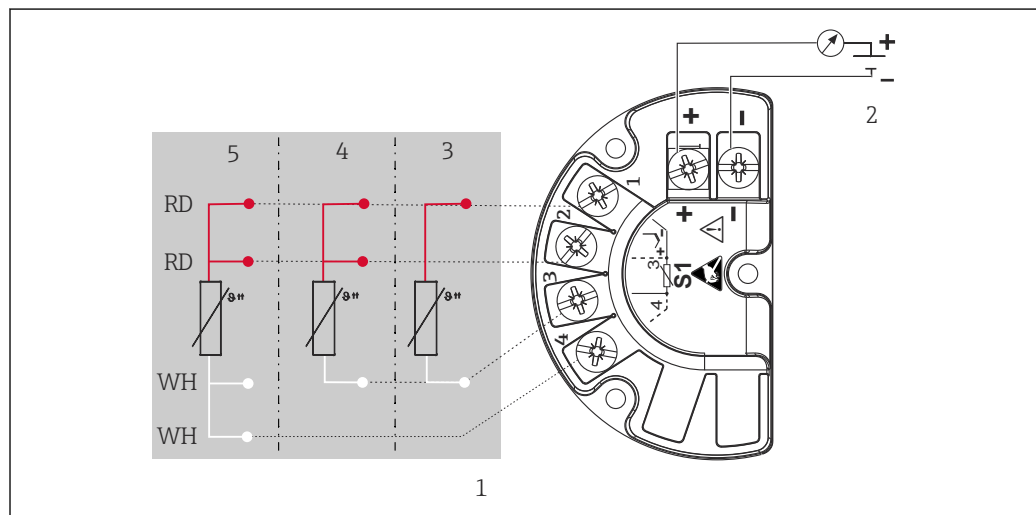
- 1 Sensor input, RTD and Ω: 4-, 3- and 2-wire
- 2 Power supply or fieldbus connection
- 3 Display connection/CDI interface

Mounted field transmitter: Fitted with screw terminals

A0045732

6 TMT162 (dual sensor 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

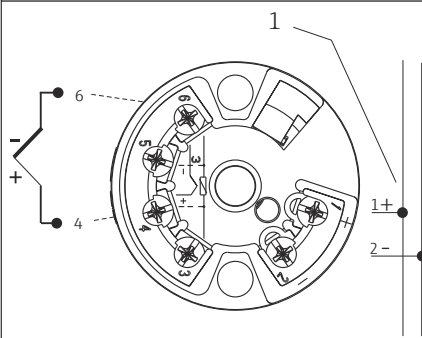
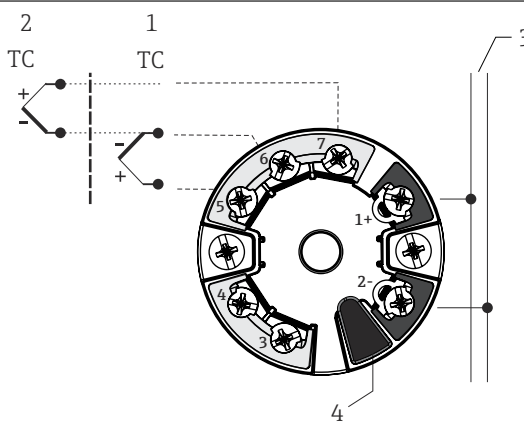
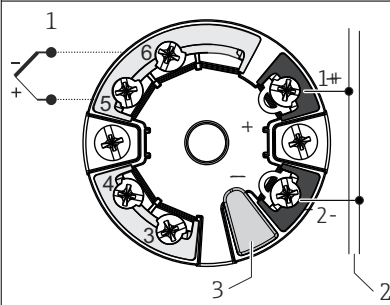
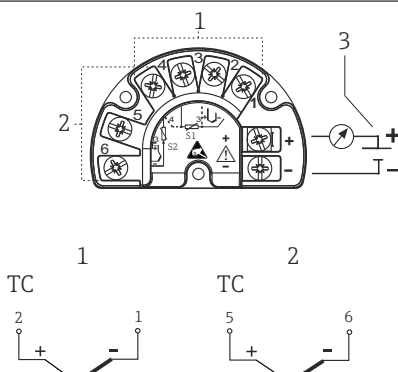


A0045733

7 TMT142B (single sensor 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

Head mounted transmitter TMT18x (single sensor input) ¹⁾	Head mounted transmitter TMT8x (dual sensor input) ²⁾
 <p>1 Power supply, head transmitter and analog output 4 to 20 mA or fieldbus communication</p> <p>A0045467</p>	 <p>1 Sensor input 1 2 Sensor input 2 3 Fieldbus communication and power supply 4 Display connection</p> <p>A0045474</p>
Head mounted transmitter TMT7x (single sensor input) ²⁾	Mounted field transmitter TMT162 or TMT142B ¹⁾
 <p>1 Sensor input TC, mV 2 Power supply, bus connection 3 Display connection/CDI interface</p> <p>A0045353</p>	 <p>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</p> <p>A0045636</p>

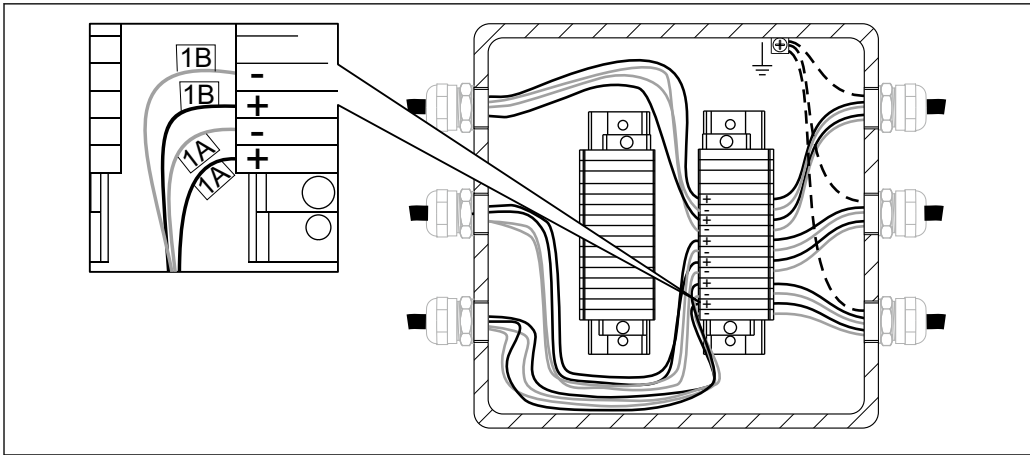
1) Fitted with screw terminals

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

6.2 Connecting the sensor cables

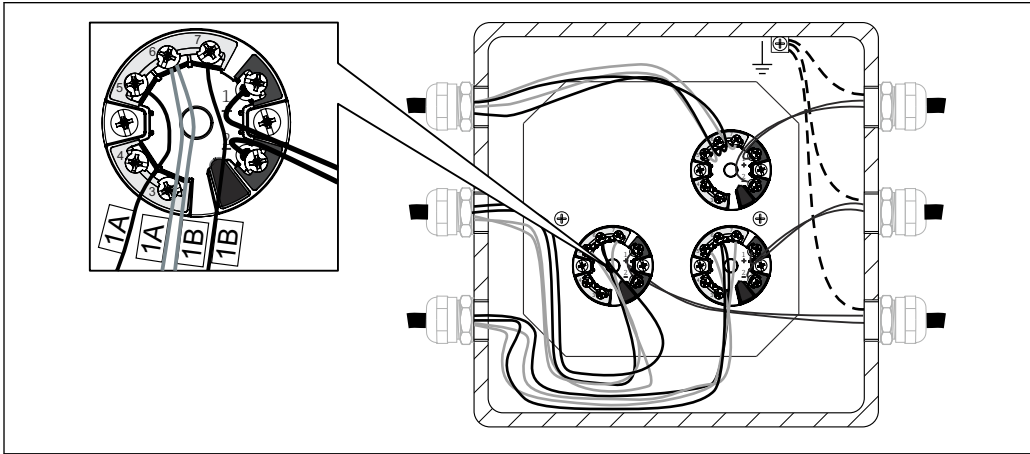
i Each sensor is marked with an individual TAG number. As default configuration, all wires are always connected to the installed transmitters or terminals and generally checked in house before final shipment.

The wiring is done in consecutive order, which means that the input channels of transmitter no. 1 are connected to the insert wires starting from insert no. 1. Transmitter no. 2 is not used until all channels of transmitter no. 1 are fully connected. The wires of each insert are marked with consecutive numbers starting from 1. If double sensors are used, the internal marking has a suffix to distinguish the two sensors, e.g. 1A and 1B for double sensors in the same insert or measuring point no. 1.



A0033288

8 Direct wiring on the mounted terminal block. Example for the internal sensor wires marking with 2 x TC sensors in insert no. 1.



A0033289

9 Mounted and wired head transmitter. Example for the internal sensor wires marking with 2 x TC

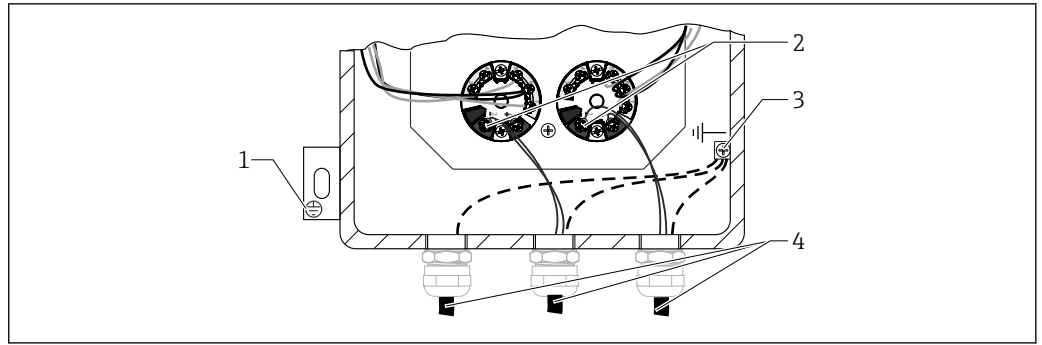
Sensor type	Transmitter type	Wiring rule
1 x RTD or TC	<ul style="list-style-type: none">Single input (one channel)Double input (two channels)	<ul style="list-style-type: none">1 Head transmitter per insert1 Head transmitter for 2 inserts
2 x RTD or TC	<ul style="list-style-type: none">Single input (one channel)Double input (two channels)	<ul style="list-style-type: none">Not available, wiring excluded1 Head transmitter per insert

6.3 Connecting the power supply and signal cables

Cable specification

- A shielded cable is recommended for fieldbus communication. Take the plant grounding concept into consideration.
- The terminals for connecting the signal cable (1+ and 2-) are protected against reverse polarity.
- Conductor cross-section:
 - Max. 2.5 mm² (14 AWG) for screw terminals
 - Max. 1.5 mm² (16 AWG) for spring terminals

Always observe the general procedure on → 16.



10 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, recommended for fieldbus connection

6.4 Shielding and grounding

i For any specific electrical shielding and grounding regarding the transmitter wiring please refer to the appropriate operating manual of the installed transmitter.

For shielding and grounding in hazardous applications, refer to the ATEX safety instructions: XA01647T

Where applicable, national installation regulations and guidelines must be observed during the 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

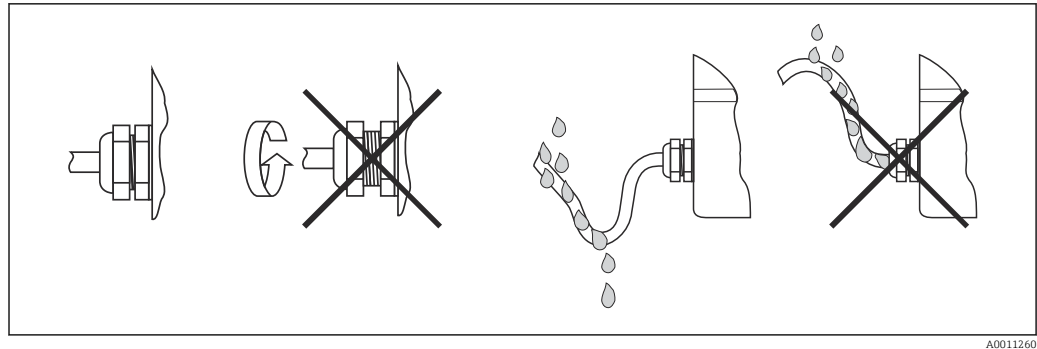
If the shielding of the cable is grounded at more than one point in systems without potential matching, power supply frequency equalizing currents can occur that damage the signal cable or have a serious effect on signal transmission.

- In such cases the shielding of the signal cable is to be grounded on only one side, i.e. it must not be connected to the ground terminal of the housing (terminal head, field housing). The shield that is not connected should be insulated!

6.5 Ensuring the degree of protection

The following points must be taken into account to ensure that the degree of protection is met: → 11, 22

- The housing seals must be clean and undamaged before they are replaced in the sealing rebate. If they are found to be too dry, they should be cleaned or even replaced.
- All housing screws and covers must be tightened.
- The cables used for connection must be of the correct specified outside diameter (e.g. M20 x 1.5, cable diameter from 0.315 to 0.47 in; 8 to 12 mm).
- Tighten the cable gland or the assembly.
- Loop the cable or conduit before placing into the entry ("Water sack"). This means that any moisture that may form cannot enter the gland. Install the device so that the cable or conduit entries are not facing upwards.
- Entries not used are to be blanked off using the blanking plates provided.



11 Connection hints to maintain IP protection

6.6 Post-connection check

Is the device undamaged (internal equipment inspection)?	<input type="checkbox"/>
Electrical connection	
Does the supply voltage match the specifications on the nameplate? This depends on the transmitter used.	<input type="checkbox"/>
Do the mounted cables have adequate strain relief?	<input type="checkbox"/>
Are the power supply and signal cables correctly connected? → 16	<input type="checkbox"/>
Are all the screw terminals well tightened and have the connections of the spring terminals been checked?	<input type="checkbox"/>
Are all cable glands installed, securely tightened and leak-tight?	<input type="checkbox"/>
Are all housing covers installed and securely tightened?	<input type="checkbox"/>
Does the marking of the terminals and cables match?	<input type="checkbox"/>
Is the electrical continuity of the thermocouple verified?	<input type="checkbox"/>

7 Commissioning

7.1 Preparations

Set-up guidelines of Standard, Extended and Advanced Commissioning for Endress+Hauser instruments in order to guarantee the function of the instrument according to:

- Endress+Hauser operating manual
- Customer set up specification, and/or
- Application conditions, when applicable under process conditions

Both the operator and the person responsible for the process should be informed that a commissioning job will be carried out, observing the following actions:

- If applicable, before disconnecting any sensor that is attached to the process, determine what chemical or fluid is being measured (observe safety data sheet).
- Be aware of the temperature and pressure conditions.
- Never open a process fitting or loosen flange bolts before you have confirmed it is safe to do so.
- Be sure not to disturb the process when disconnecting inputs/outputs or when simulating signals.
- Ensure our tools, equipment and the customer process are protected from contamination. Consider and plan necessary cleaning steps.
- When commissioning requires chemicals (e.g. as reagents for standard operation or for cleaning purposes), always follow and observe the safety regulations.

7.1.1 Reference documents


- Endress+Hauser Standard Operating Procedure for Health and Safety (see documentation code: BP01039H)
- Operating Manual of relevant tools and equipment to perform the commissioning job.
- Relevant Endress+Hauser Service Documentation (operating manual, work instructions, service info, service manual, etc.).
- Calibration certificates of the quality-related equipment if available.
- Safety Datasheet if available.
- Customer-specific documents (safety instructions, setup points, etc.).

7.1.2 Tools and equipment

Multimeter and instrument-related configuration tools as necessary from the above mentioned action list.

7.2 Post-installation check

Before commissioning the device make sure that all final checks have been carried out

- "Post-installation check" checklist
- "Post-connection check" checklist →  22

The commissioning should be performed according to our commissioning segmentation (Standard, Extended and Advanced).

7.2.1 Standard commissioning

Visual inspection of the device

1. Check the instrument(s) for damage which may have been caused during transport/shipping or mounting/wiring
2. Check that the installation is done according to the operating manual
3. Check that the wiring is done according to the operating manual and the local regulations (e.g. grounding)
4. Check the dust/water tightness of the instrument(s)
5. Check compliance with safety precautions (e.g. radiometric measurements)
6. Power up the instrument(s)
7. Check the alarm list if applicable

Ambient conditions

1. Check that the environmental conditions are appropriate for the instrument(s): Ambient temperature, humidity (ingress protection IPxx), vibrations, hazardous areas (Ex, Dust-Ex), RFI/EMC, sun protection, etc.
2. Check access to the instrument(s) for utilization and maintenance

Configuration parameters

- Configure the instrument(s) according to the Operating Manual with the parameters specified by the customer or mentioned on the design specification

Output signal value check

- Check and confirm that the local display and the output signals of the instrument(s) conform with the customer's display

7.2.2 Extended commissioning

In addition to the steps of Standard Commissioning, the following should be additionally completed:

Instrument Conformity

1. Check the received instrument(s) with the purchase order or design specification including accessories, documentation and certificates
2. Check the software version (e.g. application software such as "Batching") if provided
3. Check that the documentation has the correct issue and version

Function check

1. Test of the instrument outputs, including switching points, auxiliary inputs/outputs with the internal or an external simulator (e.g. FieldCheck)
2. Compare the measuring data/results with a reference from the customer (e.g. laboratory results for an analytical device, weighting on the scale for a batching application etc.)
3. Adjust the instrument(s) if necessary and as described in the operating manual

7.2.3 Advanced commissioning

The Advanced Commissioning provides a loop test in addition to the steps covered in the Standard and Extended Commissioning.

Loop test

1. Simulate a minimum of 3 output signals from the instrument(s) to the control room
2. Read out/note the simulated and indicated values and check for linearity

7.3 Switching on the device


Once the final checks have been successfully completed, it is time to switch on the supply voltage. Afterwards the multipoint thermometer is operational. If there are Endress+Hauser temperature transmitters in use, please refer to the enclosed Brief Operating Instructions for commissioning.

8 Diagnostics and troubleshooting

8.1 General troubleshooting


NOTICE

Repair of parts of the device

- In the event of a serious fault, a measuring device might have to be replaced. In the case of replacement see section 'Return' →  26.
- It is always important to check the connection between the cables and terminals, in order to guarantee the proper strain relief to the cables, and the tightening and the sealing of the screw terminals.

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

- Follow the checklist in section 'Post-mounting check'
- Follow the checklist in section 'Post-connection check' →  22

If transmitters are used, please refer to the documentation of the transmitter installed for diagnostic and troubleshooting procedures →  43.

9 Repair

9.1 General information

Accessibility around the device for maintenance must be guaranteed. Each component that is part of the device must – in the case of replacement – be replaced by an original Endress+Hauser spare part 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 pertaining to repair of an electrical device.

9.2 Spare parts

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

When ordering spare parts, please specify the serial number of the unit!

Spare parts of the multipoint thermometer assembly are:

- Inserts
- Cable glands
- Transmitters or electrical terminals
- Junction box and related accessories
- Ferrule sets of the compression fittings

9.3 Endress+Hauser services

Service	Description
Certifications	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 fast maintenance.
Calibration	Endress+Hauser's range of calibration services covers on-site verification tests, accredited laboratory calibrations, certificates and traceability to ensure compliance.

Service	Description
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.
Tests	<p>In order to ensure product quality and to guarantee efficiency during the entire lifetime the following tests are available:</p> <ul style="list-style-type: none"> ■ Dye penetrant test 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 ■ X-ray test 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 Pressure Equipment 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/support/return-material>
↳ Select the region.
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 offers 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 device

1. Switch off the device.
2.  **WARNING**
Danger to persons from process conditions.
 - Beware of hazardous process conditions such as pressure in the measuring device, high temperatures or aggressive fluids.

Carry out the mounting and connection steps from the chapters "Mounting the assembly" and "Wiring" in the logically reverse sequence (when applicable). Observe the safety instructions.

9.5.2 Disposing of the measuring device

Observe the following notes during disposal:

- Observe valid federal/national regulations.

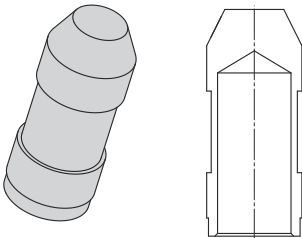
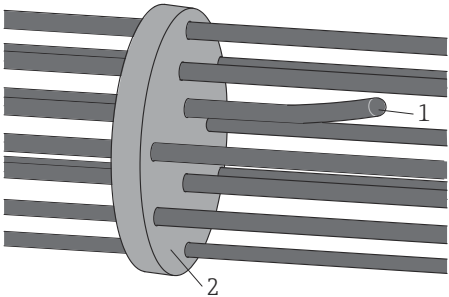
- Ensure proper separation and reuse of the device components.

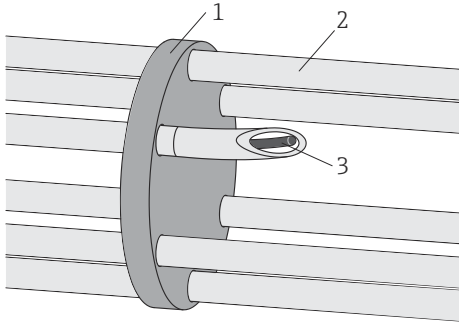
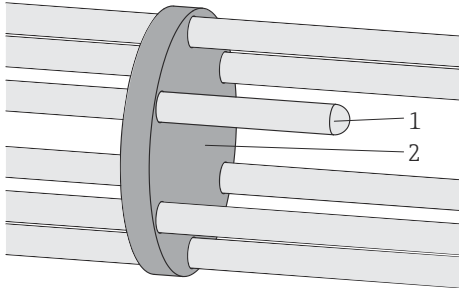
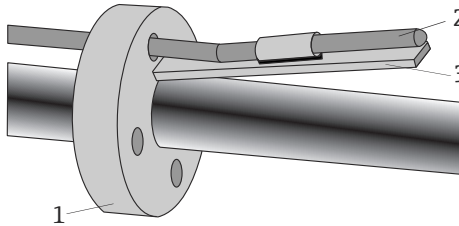
10 Accessories

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
<p>Tip end</p>  <p>A0028427</p>	<p>Terminal closure welded at the tip end of the probe in order to protect the insert (or the thermowell) from aggressive process conditions and to facilitate its fixing by means of metallic tie wraps.</p>
<p>Thermal contact system</p> <p>Insert and spacers</p>  <p>1 Insert 2 Spacer</p> <p>A0033485</p>	<ul style="list-style-type: none">■ Used on straight configurations and in case of an existing thermowell for axial centering of the insert bundle■ Prevents the twisting of the inserts■ Gives flexural stiffness to the sensor bundle

Accessories	Description
<div>Guiding tubes and spacers</div> <div><p>A0028783</p><p>1 Spacer 2 Guiding tube 3 Insert</p></div> <div><ul style="list-style-type: none">Used on straight configurations and in case of an existing thermowell for axial centering of the insert bundleGives flexural stiffness to the sensor bundleThe inserts can be replacedGuarantees thermal contact between the sensor tip and the existing thermowellModular design ¹⁾</div>	
<div>Thermowells and spacers</div> <div><p>A0028434</p><p>1 Thermowell 2 Spacer</p></div> <div><p>Used on straight configurations and inside existing thermowells</p><p>Prevents the sensor cables from twisting</p><p>Gives flexural stiffness to the sensor bundle</p><p>Enables sensor replacement</p></div>	
<div>Bimetallic strips</div> <div><p>A0028435</p><p>1 Spacer 2 Guiding tube 3 Bimetallic strips</p><p>12 Bimetallic strips with or without guiding tubes</p></div> <div><ul style="list-style-type: none">Used on straight configurations and inside existing thermowellsGuarantee thermal contact between the sensor tip and the thermowell due to bimetallic strips activated by temperature differenceNo friction during installation even with sensors already installed</div>	

1) Can be mounted in-house or on-site

10.2 Service-specific accessories

Accessories	Description
Applicator	<p>Software for selecting and sizing Endress+Hauser devices:</p> <ul style="list-style-type: none"> ■ 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 <p>Administration, documentation and access to all project-related data and parameters over the entire life cycle of a project.</p> <p>Applicator is available: Via the Internet: https://portal.endress.com/webapp/applicator</p>
Accessories	Description
Configurator	<p>Product Configurator - the tool for individual product configuration</p> <ul style="list-style-type: none"> ■ 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 <p>The Product Configurator is available on the Endress+Hauser website: www.endress.com -> Select your country -> Click "Products" -> Select the product using the filters and search field -> Open product page -> The "Configure" button to the right of the product image opens the Product Configurator.</p>
FieldCare SFE500	<p>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.</p> <p> For details, see Operating Instructions BA00027S and BA00065S</p>
DeviceCare SFE100	<p>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.</p> <p> For details, see Operating Instructions BA00027S</p>
Accessories	Description
W@M	<p>Life cycle management for your plant</p> <p>W@M offers assistance with a wide range of software applications over the entire process: from planning and procurement to the installation, commissioning and operation of the measuring devices. All the relevant information is available for every measuring device over the entire life cycle, such as the device status, device-specific documentation, spare parts etc.</p> <p>The application already contains the data of your Endress+Hauser device. Endress+Hauser also takes care of maintaining and updating the data records.</p> <p>W@M is available: Via the Internet: www.endress.com/lifecyclemanagement</p>

11 Technical data

11.1 Input

11.1.1 Measured variable

Temperature (temperature-linear transmission behavior)

11.1.2 Measuring range

RTD:

Input	Designation	Measuring range limits
RTD as per IEC 60751	Pt100	-200 to +600 °C (-328 to +1 112 °F)

Thermocouple:

Input	Designation	Measuring range limits
Thermocouples (TC) as per IEC 60584, part 1 - using an Endress+Hauser - iTEMP temperature head transmitter	Type J (Fe-CuNi)	-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	
Thermocouples (TC) - flying leads - as per IEC 60584 and ASTM E230	Type J (Fe-CuNi)	-40 to +720 °C (-40 to +1 328 °F), typical sensitivity above 0 °C ≈ 55 µV/K
	Type K (NiCr-Ni)	-40 to +1 150 °C (-40 to +2 102 °F) ¹⁾ , typical sensitivity above 0 °C ≈ 40 µV/K
	Type N (NiCrSi-NiSi)	-40 to +1 100 °C (-40 to +2 012 °F), typical sensitivity above 0 °C ≈ 40 µV/K

1) Restricted by the material of the insert outer sheath

11.2 Output

11.2.1 Output signal

Generally, the measured value can be transmitted in one of two ways:

- Directly-wired sensors - sensor measured values forwarded without a transmitter.
- Via all common protocols by selecting an appropriate Endress+Hauser iTEMP temperature transmitter. All the transmitters listed below are mounted directly in the junction box and wired with the sensory mechanism.

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

PC programmable head transmitters

They offer a high degree of flexibility, thereby supporting universal application with low inventory storage. The iTEMP transmitters can be configured quickly and easily at a PC. Endress+Hauser offers free configuration software which can be downloaded from the Endress+Hauser website. More information can be found in the Technical Information.

HART programmable head transmitters

The transmitter is a 2-wire device with one or two measuring inputs and one analog output. The device not only transfers converted signals from resistance thermometers and thermocouples, it also transfers resistance and voltage signals using HART communication. It can be installed as an intrinsically safe apparatus in Zone 1 hazardous areas and is used for instrumentation in the terminal head (flat face) as per DIN EN 50446. Quick and easy operation, visualization and maintenance using universal configuration software such as FieldCare, DeviceCare or FieldCommunicator 375/475. More information can be found in the Technical Information.

PROFIBUS PA head transmitter

Universally programmable head transmitter with PROFIBUS PA communication. Conversion of various input signals into digital output signals. High accuracy over the complete ambient temperature range. PROFIBUS PA functions and device-specific parameters are configured via fieldbus communication. For more information, see the Technical Information.

FOUNDATION fieldbus head transmitter

Universally programmable head transmitter with FOUNDATION fieldbus communication. Conversion of various input signals into digital output signals. High accuracy over the complete ambient temperature range. All transmitters are approved for use in all the main distributed control systems. The integration tests are performed in Endress+Hauser's 'System World'. For more information, see the Technical Information.

Head transmitter with PROFINET® and Ethernet-APL

The temperature 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 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.

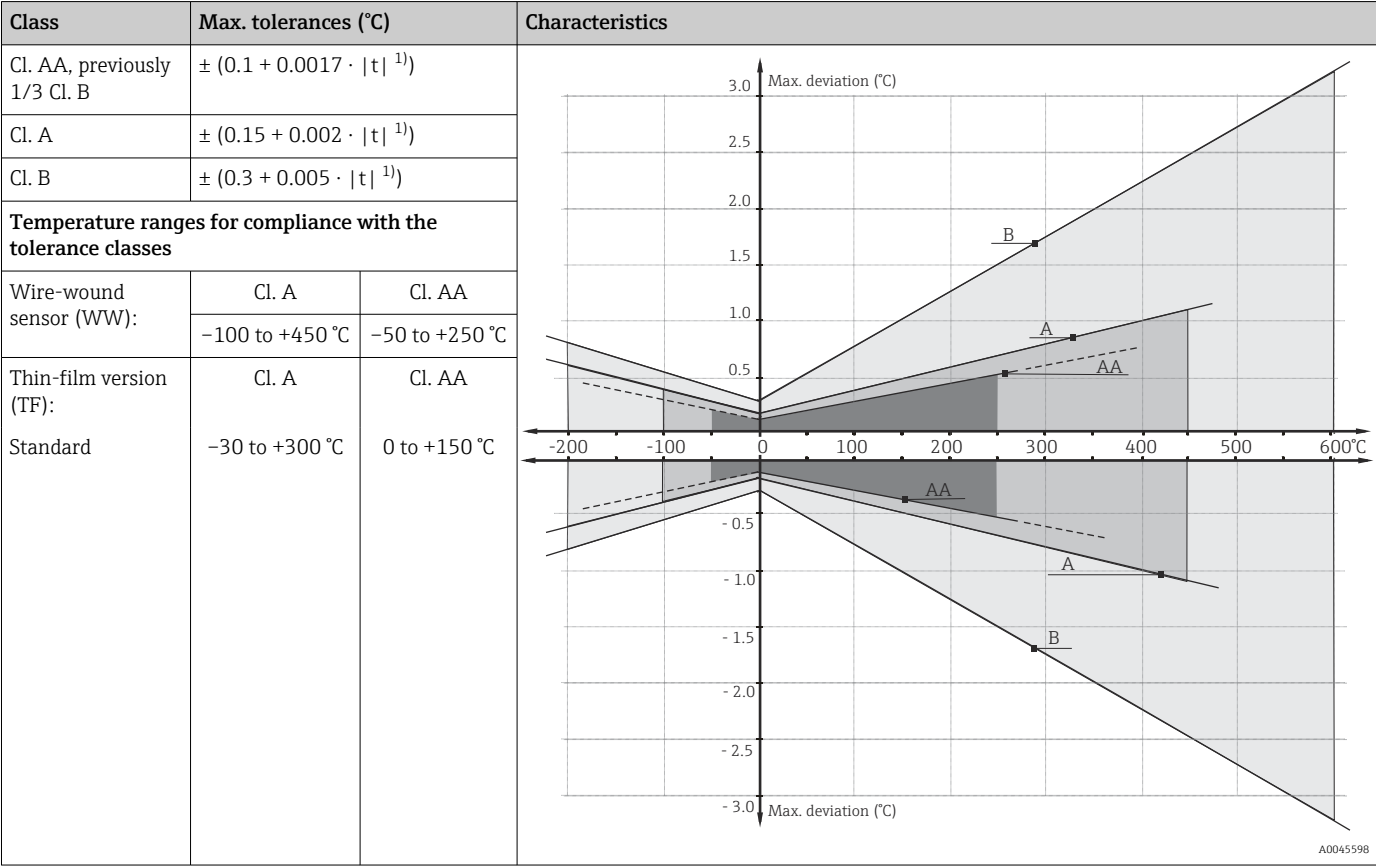
Advantages of the iTEMP transmitters:

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

11.3 Performance characteristics

11.3.1 Accuracy

RTD resistance thermometer as per IEC 60751



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

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

Permissible deviation limits of thermoelectric voltages from the standard characteristic for thermocouples as per IEC 60584 or ASTM E230/ANSI MC96.1:

Standard	Type	Standard tolerance		Special tolerance	
IEC 60584		Class	Deviation	Class	Deviation
	J (Fe-CuNi)	2	$\pm 2.5\text{ °C } (-40\text{ to } 333\text{ °C})$ $\pm 0.0075 t ^{1} (333\text{ to } 750\text{ °C})$	1	$\pm 1.5\text{ °C } (-40\text{ to } 375\text{ °C})$ $\pm 0.004 t ^{1} (375\text{ to } 750\text{ °C})$
	K (NiCr-NiAl) N (NiCrSi-NiSi)	2	$\pm 2.5\text{ °C } (-40\text{ to } 333\text{ °C})$ $\pm 0.0075 t ^{1} (333\text{ to } 1200\text{ °C})$	1	$\pm 1.5\text{ °C } (-40\text{ to } 375\text{ °C})$ $\pm 0.004 t ^{1} (375\text{ to } 1000\text{ °C})$

1) |t| = absolute temperature 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). Class 3 tolerances


cannot be satisfied. A separate material must be selected for this temperature range. This cannot be processed via the standard product.

Standard	Type	Standard tolerance	Special tolerance
ASTM E230/ANSI MC96.1		Deviation; the larger value applies in each case	
	J (Fe-CuNi)	$\pm 2.2 \text{ K or } \pm 0.0075 t ^{1)} \text{ (0 to 760 °C)}$	$\pm 1.1 \text{ K or } \pm 0.004 t ^{1)} \text{ (0 to 760 °C)}$
	K (NiCr-NiAl) N (NiCrSi-NiSi)	$\pm 2.2 \text{ K or } \pm 0.02 t ^{1)} \text{ (-200 to 0 °C)}$ $\pm 2.2 \text{ K or } \pm 0.0075 t ^{1)} \text{ (0 to 1260 °C)}$	$\pm 1.1 \text{ K or } \pm 0.004 t ^{1)} \text{ (0 to 1260 °C)}$

1) $|t|$ = absolute temperature 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 $> 0 \text{ °C}$ (32 °F). These materials are generally not suitable for temperatures $< 0 \text{ °C}$ (32 °F). The specified tolerances cannot be satisfied. A separate material must be selected for this temperature range. This cannot be processed via the standard product.

11.3.2 Reaction time

 Response time for the sensor assembly without transmitter. It refers to inserts in direct contact with process. When thermowells are selected specific evaluation should be done.

RTD

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	Reaction time	
Mineral-insulated cable, 3 mm (0.12 in)	t_{50}	2 s
	t_{90}	5 s
StrongSens RTD insert, 6 mm (1/4 in)	t_{50}	< 3.5 s
	t_{90}	< 10 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	Reaction 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 (1/4 in)	t_{50}	2 s
	t_{90}	5 s
Ungrounded thermocouple 6 mm (1/4 in)	t_{50}	2.5 s
	t_{90}	7 s

Cable sensor diameter (ProfileSens)	Reaction 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

Shock and vibration resistance

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

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.

i When calibration shall be performed once the multipoint is installed, please contact the Endress+Hauser service to get full support. Together with the Endress +Hauser service any further activity can be organized to achieve the calibration of the target sensor. In any case, it is not 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 sensing 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.

i In the case of a multipoint cable sensor, temperature-controlled calibration baths from –80 to 550 °C (–112 to 1 022 °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)). Special boreholes in the calibration furnaces are used for factory calibration of the thermometers, which ensure even distribution of the temperature from 200 to 550 °C (392 to 1 022 °F) on the corresponding section.

Two different methods are used for the inserts:

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

i Evaluation of inserts

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

11.4 Environment

11.4.1 Ambient temperature range

Junction box	Non-hazardous area	Hazardous area
Without mounted transmitter	–40 to +85 °C (–40 to +185 °F)	–40 to +60 °C (–40 to +140 °F)
With mounted head transmitter	–40 to +85 °C (–40 to +185 °F)	Depends on the respective hazardous area approval. Details see Ex documentation.

11.4.2 Storage temperature

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)

11.4.3 Humidity

Condensation according to IEC 60068-2-14:

- 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 Degree of protection

- Specification for conduit: IP68
- Specification for the junction box: IP66/67

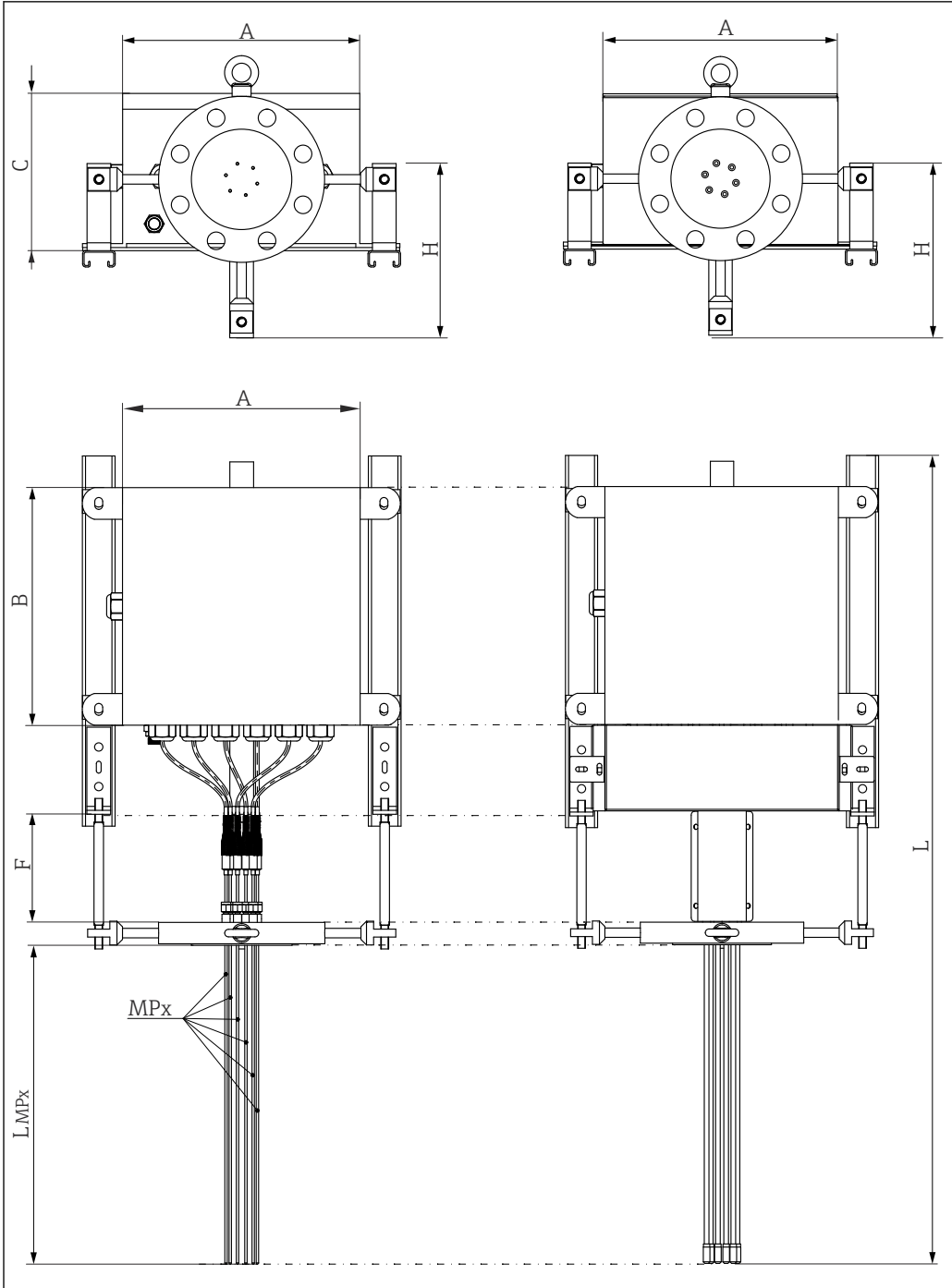
11.4.6 Electromagnetic compatibility (EMC)

Depending on the transmitter used. For detailed information see the related Technical Information, listed at the end of this document.

11.5 Mechanical construction

11.5.1 Design, dimensions

The overall multipoint assembly is composed of different sub-assemblies. Both linear and 3D configurations have the same features, dimensions and materials. Different inserts are available, based upon specific process conditions, in order to have the highest accuracy and an extended lifetime. In addition, protecting thermowells can be selected to further increase mechanical performances and corrosion resistance, and to allow insert replacement. 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 obtained by the usage of specially sealed bushings, ensuring the declared IP degree protection.



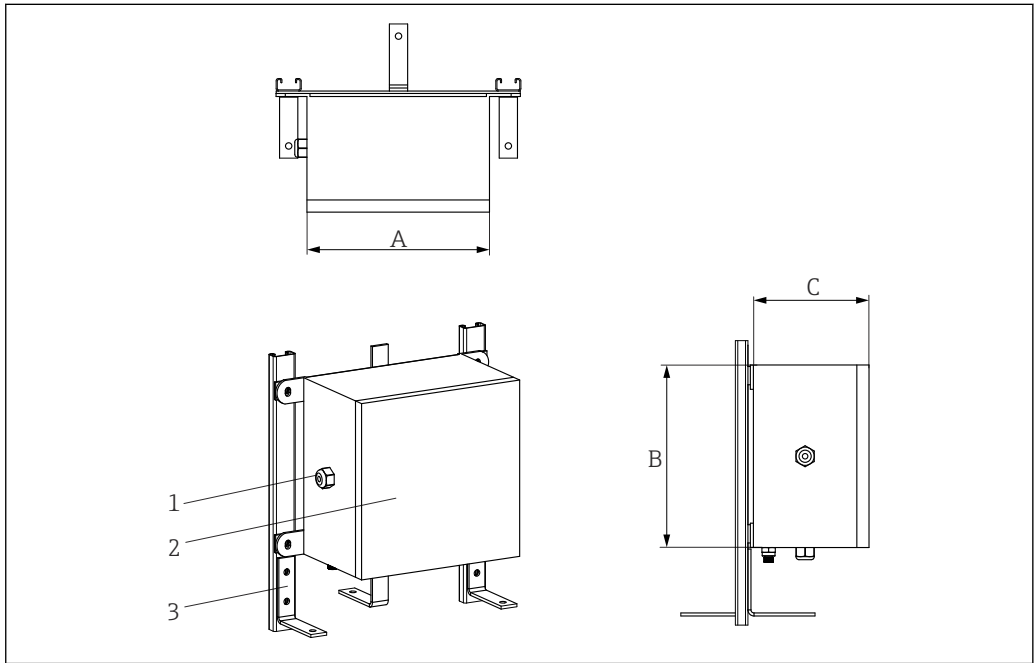
13 Design of the modular multipoint thermometer, with frame neck on the left side or with frame neck and covers on the right side. All dimensions in mm (in)

- A, B, Dimensions of the junction box, see following figure
- C
- MPx Numbers and distribution of measuring points: MP1, MP2, MP3 etc.
- L_{MPx} Different immersion length of sensing elements or thermowells
- H Dimensions of the frame of the junction box and support system
- F Tube neck length
- L Overall device length

Tube neck F in mm (in)
Standard 250 (9.84)
Specifically customized tube necks are available on request.

Immersion lengths MPx of sensing elements/thermowells:
Based on customer requirements

Junction box



A0028118

- 1 Cable gland
- 2 Junction box
- 3 Frame

The junction box is suited for chemical agents environments. Sea water corrosion resistance and extreme temperature variation stability is guaranteed. Ex e-/Ex i connections can be installed.

i The multipoint thermometer can be fitted with ground terminals and shielding connections. Please observe the system guidelines for correct connection of the cables.

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

		A	B	C
Stainless steel	Min.	170 (6.7)	170 (6.7)	130 (5.1)
	Max.	500 (19.7)	500 (19.7)	240 (9.5)
Aluminum	Min.	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	NiCr-coated brass AISI 316 / 316L
Degree of protection (IP)	IP66/67	IP66
Ambient temperature range (ATEX)	-55 to +110 °C (-67 to +230 °F)	
Approvals	ATEX, IECEx, UL, CSA, EAC approval for use in hazardous areas	

Type of specification	Junction box	Cable glands
Labeling	<ul style="list-style-type: none"> ■ ATEX II 2GD Ex e IIC T6/T5/T4 Gb Ex ia IIC T6/T5/T4 Ga Ex tb IIIC T85°C/T100°C/ T135°C Db IP66 ■ IECEx Ex e IIC T6/T5/T4 Gb/ Ex ia IIC T6/T5/T4 Ga Ex tb IIIC T85°C/T100°C/ T135°C Db IP66 ■ UL913 Class I, Zone 1, AEx e IIC; Zone 21, AEx tb IIIC IP66 ■ CSA C22.2 No.157 Class I, Zone 1 Ex e IIC; Class II, Groups E, F and G 	According to the junction box approval
Cover	Hinged	-
Maximum sealing diameter	-	6 to 12 mm (0.24 to 0.47 in)

Tube neck

The neck extension ensures the connection between the flange 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 neck extension design ensures easy access for monitoring and maintaining inserts and extension cables. It provides a very firm (rigid) connection for the junction box and vibration loads. No closed volumes are present in the neck extension. On the one hand, this prevents residual substances and potentially hazardous fluids from the environment from accumulating and damaging the appliance, while ensuring continuous ventilation on the other.

Insert and thermowells



Different insert and thermowell types are available. For other requirements not listed here, please contact the manufacturer's sales department.



In the case of a multipoint cable insert (ProfileSens), see Technical Information TI01346T

Thermocouple

Diameter in mm (in)	Type	Standard	Measuring point type	Sheath material
6 (0.24) 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 1x type T 2x type T	IEC 60584/ ASTM E230	Grounded/Ungrounded	Alloy 600/AISI 316L/Pyrosil

RTD

Diameter in mm (in)	Type	Standard	Sheath material
3 (0.12) 6 (1/4)	1x Pt100 WW 2x Pt100 WW 1x Pt100 TF 2x Pt100 TF	IEC 60751	AISI 316L

Thermowells

External diameter in mm (in)	Sheath material	Type	Thickness in mm (in)
6 (0.24)	AISI 316/316L AISI 316Ti AISI 321 AISI 347 Alloy 600	closed or open	1 (0.04) or 1.5 (0.06)
8 (0.32)	AISI 316/316L AISI 316Ti AISI 321 AISI 347 Alloy 600	closed or open	1 (0.04) or 1.5 (0.06) or 2 (0.08)
10.2 (½)	AISI 316/316L AISI 316Ti AISI 321 AISI 347 Alloy 600	closed or open	1.73 (0.068)

11.5.2 Weight

The weight can vary depending on the configuration: Dimension and content of the junction box, neck length, dimensions of process connection and the number of inserts. The approximate weight of a typically configured multipoint thermometer (number of inserts = 12, flange size = 3", medium size junction box) = 40 kg (88 lb)

11.5.3 Materials

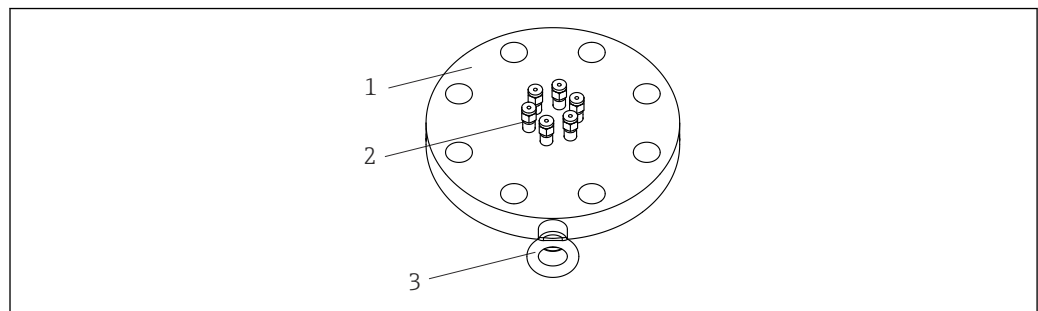
It refers to insert sheath, neck extension, junction box and all wetted parts.

The temperatures for continuous operation specified in the following table are only intended as reference values for use of the various materials in air and without any significant compressive load. The maximum operation temperatures are reduced considerably in some cases where abnormal conditions such as high mechanical load occur or in aggressive media.

Material name	Short form	Recommended max. temperature for continuous use in air	Properties
AISI 316/1.4401	X5CrNiMo 17-12-2	650 °C (1 202 °F)	<ul style="list-style-type: none"> ■ 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)	<ul style="list-style-type: none"> ■ 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

Material name	Short form	Recommended max. temperature for continuous use in air	Properties
Alloy 600/2.4816	NiCr15Fe	1 100 °C (2 012 °F)	<ul style="list-style-type: none"> ▪ A nickel/chromium alloy with very good resistance to aggressive, oxidizing and reducing atmospheres, even at high temperatures ▪ Resistance to corrosion caused by chlorine gases and chlorinated media as well as many oxidizing mineral and organic acids, sea water etc. ▪ Corrosion from ultrapure water ▪ Not to be used in sulfur-containing atmospheres
AISI 304/1.4301	X5CrNi18-10	850 °C (1 562 °F)	<ul style="list-style-type: none"> ▪ Austenitic, stainless steel ▪ Usable in water and slightly polluted waste water ▪ Resistant to organic acids, saline solutions, sulphates, alkaline solutions, etc. at relatively low temperatures only
AISI 304L/1.4307	X2CrNi18-9	850 °C (1 562 °F)	<ul style="list-style-type: none"> ▪ Good welding properties ▪ Impervious to intergranular corrosion ▪ High ductility, excellent drawing, forming, and spinning properties
AISI 316Ti/1.4571	X6CrNiMoTi17-12-2	700 °C (1 292 °F)	<ul style="list-style-type: none"> ▪ 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)	<ul style="list-style-type: none"> ▪ Austenitic, stainless steel ▪ High resistance to intergranular corrosion even after welding ▪ Good welding characteristics, suitable to all standard welding methods ▪ It is used in many sectors of the chemical industry, petrochemical, and pressurized vessels
AISI 347/1.4550	X6CrNiNb10-10	800 °C (1 472 °F)	<ul style="list-style-type: none"> ▪ Austenitic, stainless steel ▪ Good resistance to a wide variety of environments in the chemical, textile, oil refining, dairy and food industries ▪ Added niobium makes this steel impervious to intergranular corrosion ▪ Good weldability ▪ Main applications are furnace fire walls, pressure vessels, welded structures, turbine blades

11.5.4 Process connection



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14 Flange as process connection

- 1 Flange
- 2 Compression fittings
- 3 Eyebolt

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

Standard ¹⁾	Size	Design	Material
ASME	1½", 2", 3", 4", 6", 8"	150#, 300#, 400#, 600#	AISI 316, 316L, 304, 304L, 316Ti, 321, 347
EN	DN40, DN50, DN80, DN100, DN150, DN200	PN10, PN16, PN25, PN40, PN63, PN100	

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

Compression fittings

The compression fittings are welded or threaded into the flange to ensure tightness to the process connection. Dimensions correspond to the insert dimensions. Compression fittings comply with the highest standards of reliability in terms of materials and performances required.

Material	AISI 316/316H
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11.6 Certificates and approvals

11.6.1 CE Mark

The complete assembly is provided with individual components CE marked, to ensure safe use in hazardous areas and pressurized environments.

11.6.2 Hazardous area approvals

The Ex approval applies to individual components like junction box, cable glands, terminals. For further details on the available Ex versions (ATEX, UL, CSA, IECEx, NEPSI, EAC Ex), please contact your nearest Endress+Hauser sales organization. All relevant data for hazardous areas can be found in separate Ex documentation.

ATEX Ex ia inserts are available only for diameters ≥ 1.5 mm (0.6 in). For further details contact an Endress+Hauser technician.

11.6.3 Certification HART

The HART[®] temperature transmitter is registered by the FieldComm Group. The device meets the requirements of the HART[®] Communication Protocol Specifications.

11.6.4 Certification FOUNDATION Fieldbus

The FOUNDATION Fieldbus[™] temperature transmitter has successfully passed all test procedures and is certified and registered by the Fieldbus Foundation. The device thus meets all the requirements of the following specification:

- Certified according to FOUNDATION Fieldbus[™] specification
- FOUNDATION Fieldbus[™] H1
- Interoperability Test Kit (ITK), up to date revision status (device certification no. available on request): the device can also be operated with certified devices of other manufacturers
- Physical layer conformance test of the FOUNDATION Fieldbus[™]

11.6.5 Certification PROFIBUS[®] PA

The PROFIBUS[®] PA temperature transmitter is certified and registered by the PNO (PROFIBUS[®] Nutzerorganisation e. V.), PROFIBUS user organization. The device meets all the requirements of the following specifications:

- Certified according to FOUNDATION Fieldbus[™] specification
- Certified in accordance with PROFIBUS[®] PA Profile (the up to date profile version is available on request)
- The device can also be operated with certified devices of other manufacturers (interoperability)

11.6.6 Other standards and guidelines

- EN 60079: ATEX certification for hazardous areas
- IEC 60079: IECEx certification for hazardous areas
- IEC 60529: Degree of protection of housing (IP code)
- IEC 60584 and ASTM E230/ANSI MC96.1: Thermocouples

11.6.7 Material certification

The material certificate 3.1 (according to EN 10204) can be requested separately. The certificate includes a declaration related to the materials used to produce the thermometer. It guarantees the traceability of the materials through the identification number of the multipoint thermometer.

11.6.8 Test report and calibration

The "Factory calibration" is carried out according to an internal procedure in a laboratory of Endress+Hauser accredited by the European Accreditation Organization (EA) to ISO/IEC 17025. A calibration which is performed according to EA guidelines (LAT/Accredia) or (DKD/DAkKS) may be requested separately. The calibration is performed on the inserts of the multipoint.

11.6.9 Material requirements

Endress+Hauser can supply components according to AD 2000 W2 And W10 standards.

11.6.10 Welding requirements

Endress+Hauser has been audited according to DIN EN ISO 3834-2:2005.

11.6.11 Pressure equipment requirements

Endress+Hauser can supply devices according to 2014/68/EU.

11.7 Documentation

- Operating manuals iTEMP temperature transmitters:
 - TMT180, PC-programmable, single-channel, Pt100 (KA00118R)
 - HART® TMT82, two-channel, RTD, TC, Ω, mV (BA01028T)
 - PROFIBUS® PA TMT84, two-channel, RTD, TC, Ω, mV (BA00257R)
 - FOUNDATION Fieldbus™ TMT85, two-channel, RTD, TC, Ω, mV (BA00251R)
- Supplementary ATEX documentation:
ATEX/IECEx (Ex ia IIC): XA01647T
- Technical Information of inserts:
 - Resistance thermometer insert Omnigrad T TST310 (TI00085T)
 - Thermocouple insert Omnigrad T TSC310 (TI00255T)
 - Multipoint temperature cable probe iTHERM ProfileSens TS901 (TI01346T)
- Technical Information application example:
HAW562 surge arresters, (TI01012K)



www.addresses.endress.com
