

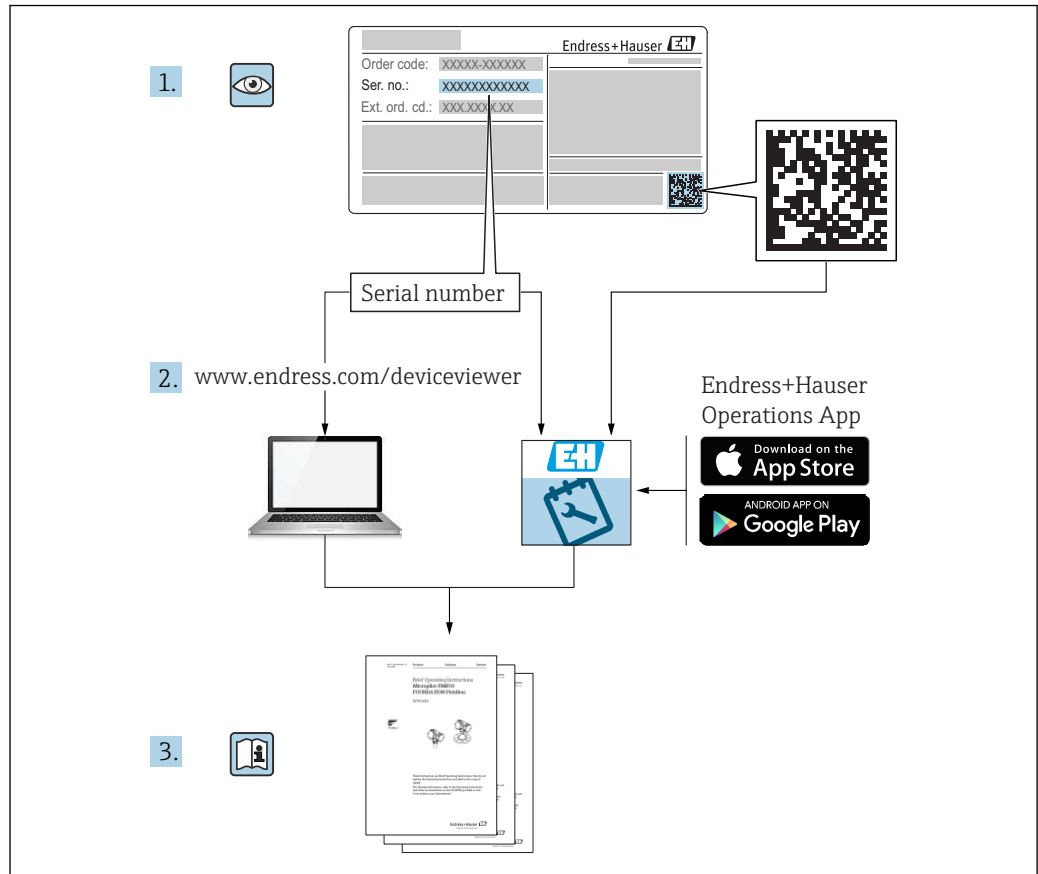
Operating Instructions

Cerabar PMP51B

Process pressure measurement
Analog

4-20 mA Analog





A0023555

- Make sure the document is stored in a safe place such that it is always available when working on or with the device
- Avoid danger to individuals or the facility: read the "Basic safety instructions" section carefully, as well as all other safety instructions in the document that are specific to working procedures

The manufacturer reserves the right to modify technical data without prior notice. The Endress+Hauser sales organization will supply you with current information and updates to these instructions.

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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 mounting, 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 dangerous situation. Failure to avoid this situation can result in serious or fatal injury.


 CAUTION

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

NOTICE

This symbol contains information on procedures and other facts which do not result in personal injury.

1.2.2 Electrical symbols

Ground connection: 

Terminal for connection to the grounding system.


1.2.3 Symbols for certain types of information


Permitted: 


Procedures, processes or actions that are permitted.

Forbidden: 

Procedures, processes or actions that are forbidden.

Additional information: 

Reference to documentation: 

Reference to page: 

Series of steps: [1](#), [2](#), [3](#)

Result of an individual step: 

1.2.4 Symbols in graphics

Item numbers: 1, 2, 3 ...

Series of steps: [1](#), [2](#), [3](#)

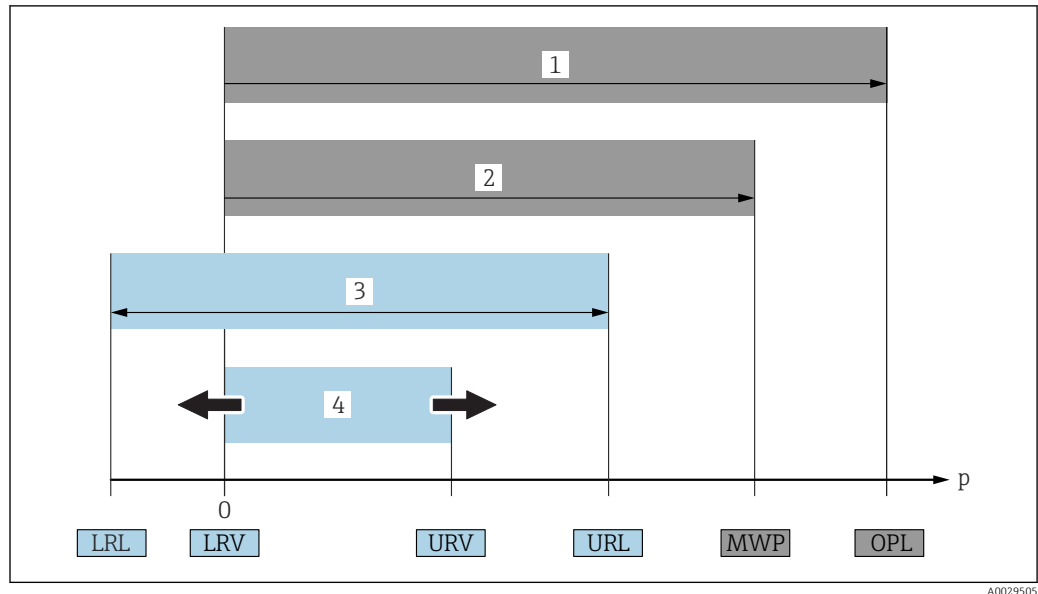
Views: A, B, C, ...

1.2.5 Symbols on the device

Safety instructions:  → 

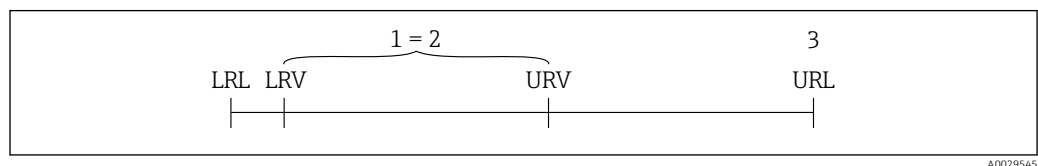
Observe the safety instructions contained in the associated Operating Instructions.

1.3 List of abbreviations



- 1 OPL: The OPL (overpressure limit = sensor overload limit) for the device depends on the lowest-rated element, with regard to pressure, of the selected components, i.e. the process connection has to be taken into consideration in addition to the measuring cell. Pay attention to the pressure/temperature dependency.
 - 2 MWP: The MWP (maximum working pressure) for the sensors depends on the lowest-rated element, with regard to pressure, of the selected components, i.e. the process connection has to be taken into consideration in addition to the measuring cell. Pay attention to the pressure/temperature dependency. The MWP may be applied at the device for an unlimited period of time. The MWP can be found on the nameplate.
 - 3 The maximum sensor measuring range corresponds to the span between the LRL and URL. This sensor measuring range is equivalent to the maximum calibratable/adjustable span.
 - 4 The calibrated/adjusted span corresponds to the span between the LRV and URV. Factory setting: 0 to URL. Other calibrated spans can be ordered as customized spans.
- p Pressure
 LRL Lower range limit
 URL Upper range limit
 LRV Lower range value
 URV Upper range value
 TD Turn down. Example - see the following section.

1.4 Turn down calculation



- 1 Calibrated/adjusted span
- 2 Zero point-based span
- 3 Upper range limit

Example:

- Sensor: 10 bar (150 psi)
- Upper range limit (URL) = 10 bar (150 psi)
- Calibrated/adjusted span: 0 to 5 bar (0 to 75 psi)
- Lower range value (LRV) = 0 bar (0 psi)
- Upper range value (URV) = 5 bar (75 psi)

$$TD = \frac{URL}{|URV - LRV|}$$

In this example, the TD is 2:1. This span is based on the zero point.

1.5 Documentation

All available documents can be downloaded using:

- the serial number of the device (see cover page for description) or
- the data matrix code of the device (see cover page for description) or
- the "Downloads" area of the website www.endress.com

1.5.1 Supplementary device-dependent documentation

Additional documents are supplied depending on the device version ordered: Always comply strictly with the instructions in the supplementary documentation. The supplementary documentation is an integral part of the device documentation.

1.6 Registered trademarks

2 Basic safety instructions

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 beginning work, the specialist staff must have read and understood the instructions in the Operating Instructions and supplementary documentation as well as in the certificates (depending on the application)
- ▶ Follow instructions and comply with conditions

The operating personnel must fulfill the following requirements:

- ▶ Being instructed and authorized according to the requirements of the task by the facility's owner-operator
- ▶ Following the instructions in these Operating Instructions

2.2 Intended use

The Cerabar is a pressure transmitter for measuring level and pressure.

2.2.1 Incorrect use

The manufacturer is not liable for damage caused by improper or non-intended use.

Verification for borderline cases:

- ▶ For special fluids and fluids for cleaning, Endress+Hauser is glad to provide assistance in verifying the corrosion resistance of fluid-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 according to federal/national regulations.
- ▶ Switch off the supply voltage before connecting the device.

2.4 Operational safety

Risk of injury!

- ▶ Operate the device only if it is in proper technical condition, free from errors and faults.
- ▶ 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, despite this, modifications are required, consult with Endress+Hauser.

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 original spare parts and accessories from Endress+Hauser only.

Hazardous area

To eliminate the risk of danger to persons or the facility when the device is used in the approval-related area (e.g. explosion protection, pressure equipment safety):

- ▶ Check the nameplate to verify if the device ordered can be put to its intended use in the approval-related area.
- ▶ Observe the specifications in the separate supplementary documentation that is an integral part of these Instructions.

2.5 Product safety

This 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.

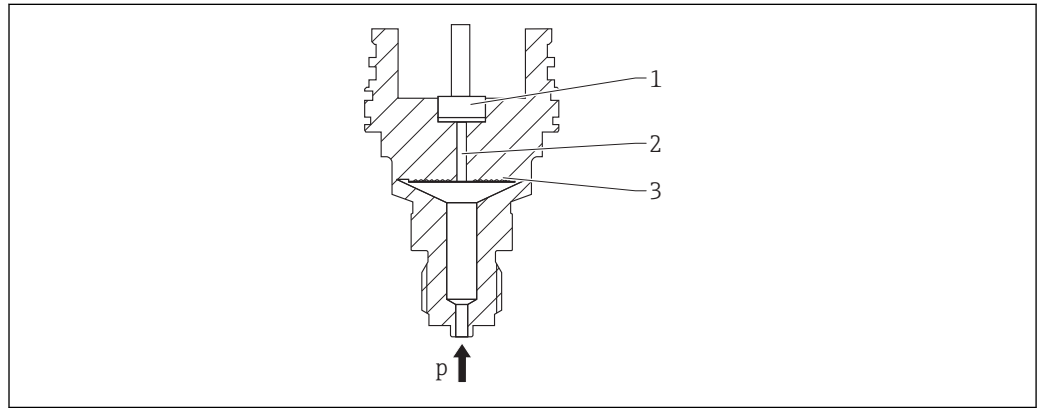
It meets general safety standards and legal requirements. It also complies with the EC directives listed in the device-specific EC Declaration of Conformity. Endress+Hauser confirms this by affixing the CE mark to the device.

3 Product description

3.1 Product design

3.1.1 Metal process membrane

Standard device (without diaphragm seal)



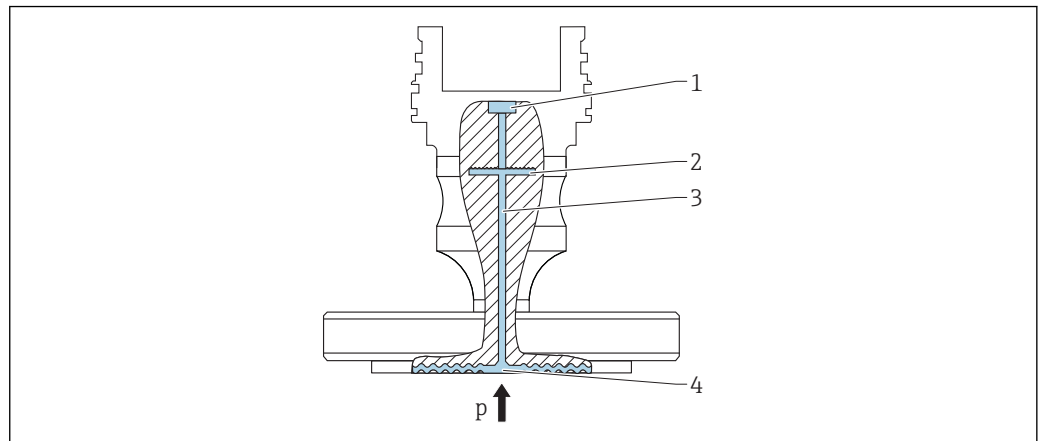
- 1 *Measuring element*
- 2 *Channel with fill fluid*
- 3 *Metal process membrane*
- p *Pressure*

The pressure deflects the metal process membrane of the sensor. A fill fluid transfers the pressure to a Wheatstone bridge (semi-conductor technology). The pressure-dependent change in the bridge output voltage is measured and evaluated.

Advantages:

- Can be used for high process pressures
- High long-term stability
- High overload resistance
- Secondary containment for enhanced integrity
- Significantly reduced thermal effect e.g. compared to diaphragm seal systems with capillaries

Device with diaphragm seal



A0043583

- 1 Measuring element
- 2 Internal process membrane
- 3 Channel with fill fluid
- 4 Metal process membrane
- p Pressure

The pressure acts on the process membrane of the diaphragm seal and is transferred from a diaphragm seal fill fluid to the internal process membrane. The internal process membrane is deflected. A fill fluid transfers the pressure to the measuring element on which a resistance bridge is located. The pressure-dependent change in the bridge output voltage is measured and evaluated.

Advantages:

- Depending on the version, can be used for process pressures up to 400 bar (6 000 psi) and for extreme process temperatures
- High long-term stability
- High overload resistance
- Standard device (without diaphragm seal): secondary containment for enhanced integrity

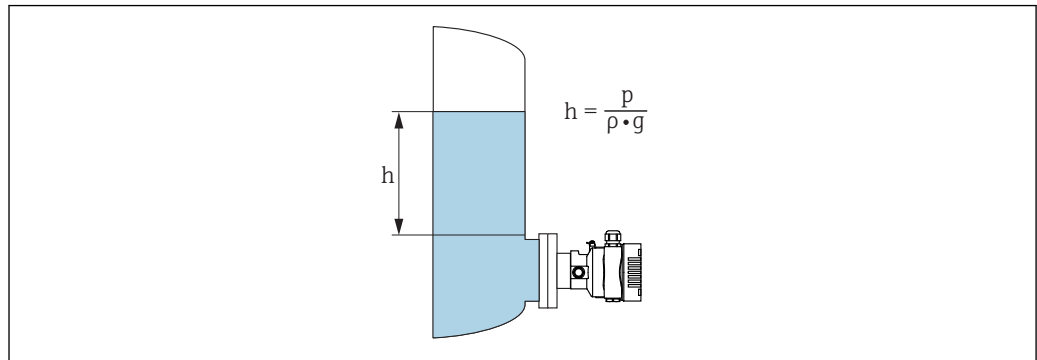
Applications for diaphragm seals

Diaphragm seal systems are used if the process and the device need to be separated. Diaphragm seal systems offer clear advantages in the following instances:

- In the case of extreme process temperatures - through the use of temperature isolators or capillaries
- In the case of strong vibrations - decouple the process from the device by using a capillary
- In the case of aggressive or corrosive media - through the use of high-durability membrane materials
- In the case of media that crystallize or contain solids - through the choice of suitable coatings
- In the case of heterogeneous and fibrous process media
- If extreme measuring point cleaning is necessary, or in the event of very damp mounting locations
- For mounting locations that are difficult to access

3.1.2 Level measurement (level, volume and mass)

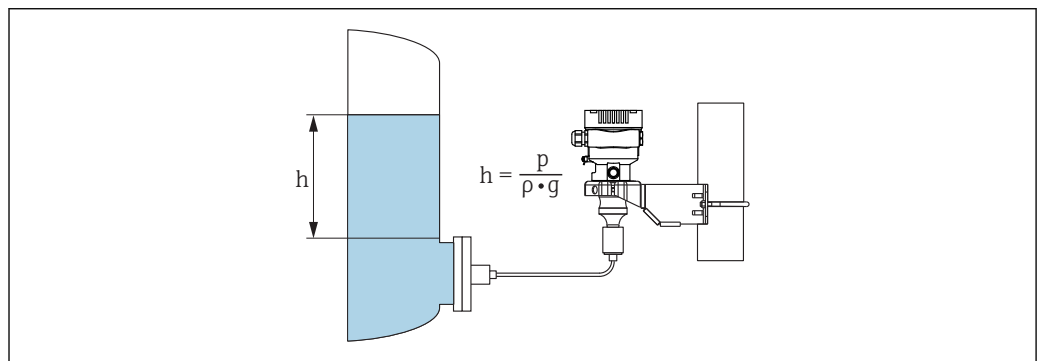
Standard device (without diaphragm seal)



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h Height (level)
p Pressure
ρ Density of the medium
g Gravitational constant

Device with diaphragm seal



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1 Sample illustration: diaphragm seal with capillary

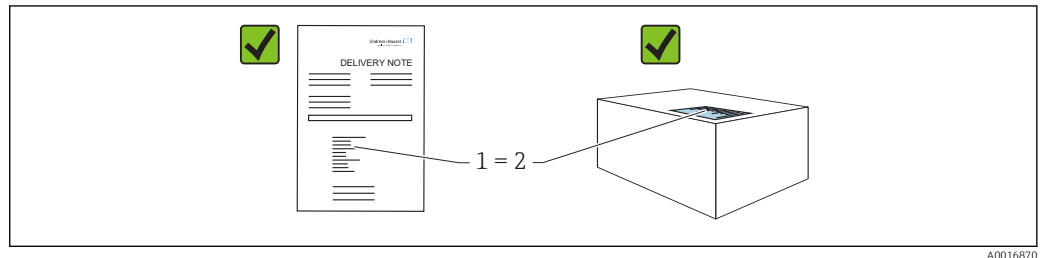
h Height (level)
p Pressure
ρ Density of the medium
g Gravitational constant

Advantages:


- Volume and mass measurements in any vessel shape with a freely programmable characteristic curve
- Has a wide range of uses, e.g.
 - For foam formation
 - In vessels with agitators or screen fittings
 - For liquid gases

4 Incoming acceptance and product identification

4.1 Incoming acceptance



- Is the order code on the delivery note (1) identical to the order code on the product sticker (2)?
- Are the goods undamaged?
- Do the data on the nameplate correspond to the order specifications and the delivery note?
- Is the documentation available?
- If required (see nameplate): are the Safety Instructions (XA) provided?

 If you can answer "no" to any of these questions, please contact Endress+Hauser.


4.1.1 Scope of delivery

The scope of delivery comprises:

- Device
- Optional accessories

Accompanying documentation:

- Brief Operating Instructions
- Final inspection report
- Additional Safety Instructions for devices with approvals (e.g. ATEX, IECEx, NEPSI, etc.)
- Optional: factory calibration form, test certificates

 The Operating Instructions are available on the Internet at:

www.endress.com → Download

4.2 Product identification

The following options are available for the identification of the measuring device:

- Nameplate specifications
- Order code with breakdown of the device features on the delivery note
- Enter the serial numbers from the nameplates in *Device Viewer* (www.endress.com/deviceviewer): all the information about the measuring device is displayed.

4.2.1 Manufacturer address

Endress+Hauser SE+Co. KG
 Hauptstraße 1
 79689 Maulburg, Germany
 Place of manufacture: See nameplate.

4.2.2 Nameplate

Different nameplates are used depending on the device version.

The nameplates contain the following information:

- Manufacturer name and device name
- Address of the certificate holder and country of manufacture
- Order code and serial number
- Technical data
- Approval-specific information

Compare the data on the nameplate with your order.

4.3 Storage and transport

4.3.1 Storage conditions

- Use the original packaging
- Store the measuring device in clean and dry conditions and protect from damage caused by shocks

Storage temperature range

See Technical Information.

4.3.2 Transporting the product to the measuring point

WARNING

Incorrect transport!

Housing and membrane may become damaged, and there is a risk of injury!

- ▶ Transport the measuring device to the measuring point in the original packaging.

WARNING

Incorrect transport!

Capillaries may become damaged, and there is a risk of injury!

- ▶ Do not use capillaries as a carrying aid for the diaphragm seals.

5 Mounting

5.1 Mounting requirements

5.1.1 General instructions

- Do not clean or touch process membrane with hard and/or pointed objects
- Do not remove process membrane protection until shortly before installation

Always firmly tighten the housing cover and the cable entries.

1. Counter-tighten the cable entries.
2. Tighten the coupling nut.

5.1.2 Installation instructions

- The standard devices (without diaphragm seals) are mounted according to the same guidelines as pressure gauges (DIN EN837-2)
- To ensure optimal readability of the local display, adjust the housing and local display
- Endress+Hauser offers a mounting bracket to mount the device on pipes or walls
- Use flushing rings for flanges, flange seals and pancake seals if buildup or clogging can be expected at the process membrane
 - The flushing ring is clamped between the process connection and the flange, flange seal or pancake seal
 - Material buildup in front of the process membrane is flushed away and the pressure chamber is vented via the two lateral flushing holes
- When measuring in media containing solids (e.g. dirty liquids), installing separators and drain valves is useful for capturing and removing sediment
- Using a valve manifold allows for easy commissioning, installation and maintenance without interrupting the process
- When mounting the device, establishing the electrical connection and during operation: prevent the penetration of moisture into the housing
- Point the cable and plug downwards as much as possible to prevent moisture from entering (e.g. rainwater or condensation)

5.1.3 Installation instructions for thread

- Device with G 1 ½" thread:
 - Place the flat seal on the sealing surface of the process connection
 - Avoid additional strain on the process membrane: do not seal the thread with hemp or similar materials
- Device with NPT thread:
 - Wrap Teflon tape around the thread to seal it
 - Tighten the device at the hexagon bolt only; do not turn it by the housing
 - When screwing in, do not overtighten the thread; tighten the NPT thread to the required depth according to the standard
- For the following process connections, a tightening torque of max. 40 Nm (29.50 lbf ft) is specified:
 - Thread ISO228 G ½" with flush membrane
 - Thread DIN13 M20 x 1.5 with flush membrane
 - NPT ¾" with flush membrane

5.1.4 Installation instructions for devices with diaphragm seals

NOTICE

Incorrect handling!

Damage to the device!

- ▶ The diaphragm seal and pressure transmitter form a closed, calibrated system which has been filled with diaphragm seal fill fluid. Never open any of the holes for fill fluid.
- ▶ Ensure strain relief to prevent the capillary from bending (bending radius \geq 100 mm (3.94 in)).
- ▶ Do not use capillaries as a carrying aid for the diaphragm seals.
- ▶ Observe the application limits of the diaphragm seal fill fluid.

General information

In the case of devices with diaphragm seals and capillaries, the zero point shift caused by the hydrostatic pressure of the filling fluid column in the capillaries must be taken into account when selecting the measuring cell. If a measuring cell with a small measuring range is selected, a position adjustment can cause the sensor to go over range (position adjustment due to zero point offset, caused by the orientation of the liquid column of the fill fluid). Perform zero point adjustment if necessary.

For devices with a capillary, use a suitable bracket (mounting bracket) for mounting.

When mounting, sufficient strain relief must be provided for the capillary to prevent the capillary from bending (capillary bending radius \geq 100 mm (3.94 in)).

Mount the capillary so that it is vibration-free (in order to avoid additional pressure fluctuations).

Do not mount capillaries in the vicinity of heating or cooling lines and protect them against direct sunlight.

More detailed installation instructions are provided in the Applicator "[Sizing Diaphragm Seal](#)".

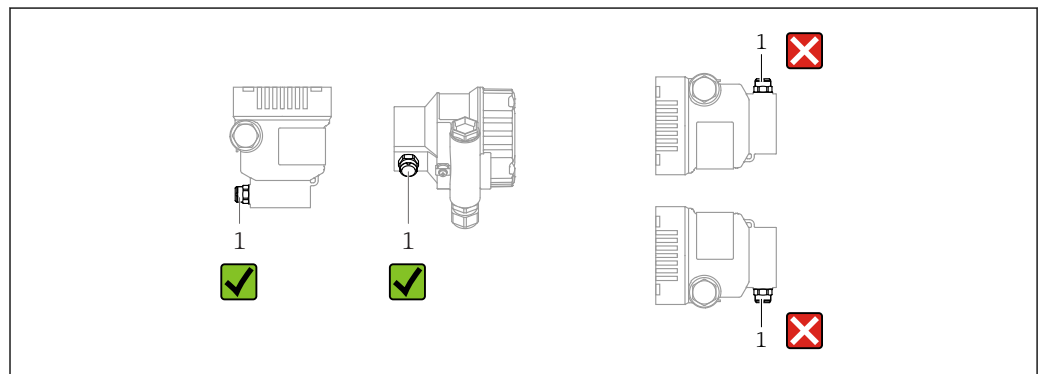
5.1.5 Orientation

NOTICE

Damage to the device!

If a heated device is cooled during a cleaning process (e.g. by cold water), a vacuum develops for a short time. As a result of this, moisture can enter the sensor via the pressure compensation element (1).

- ▶ Mount the device as follows.

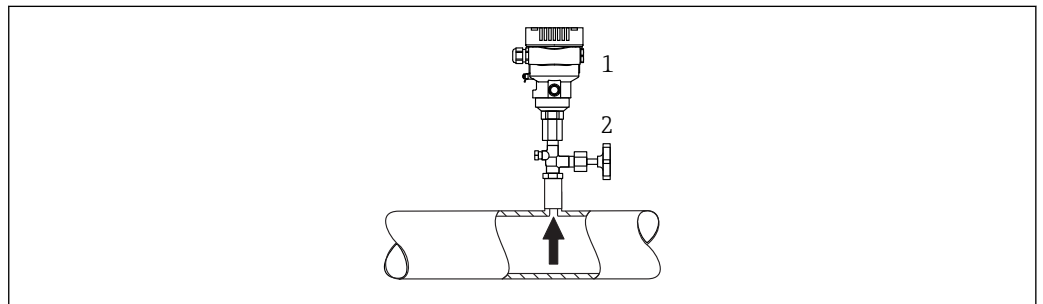


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- Keep the pressure compensation element (1) free from contamination
- A position-dependent zero point shift (when the vessel is empty the measured value does not display zero) can be corrected
- Diaphragm seals also shift the zero point, depending on the installation position
- The use of shutoff devices and/or water pocket pipes is recommended for mounting
- The orientation depends on the measuring application

5.2 Mounting the device

5.2.1 Pressure measurement in gases

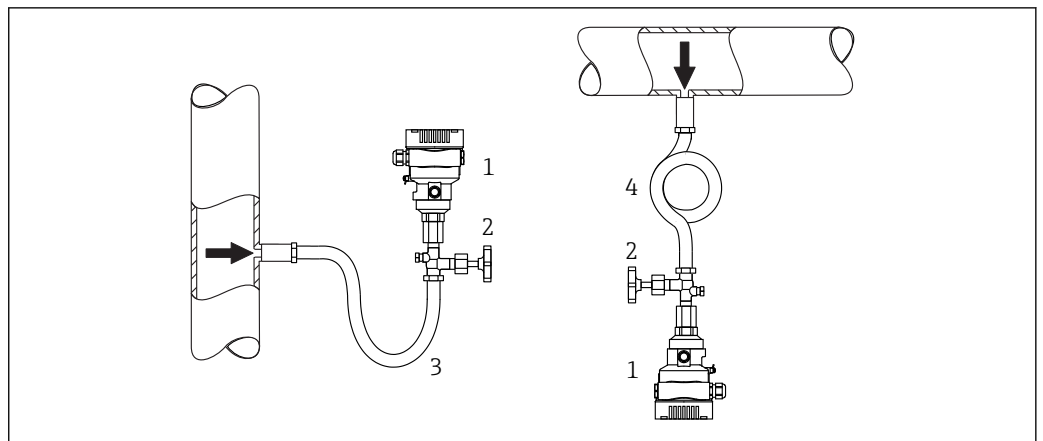


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- 1 Device
2 Shutoff device

Mount the device with the shutoff device above the tapping point so that any condensate can flow into the process.

5.2.2 Pressure measurement in vapors



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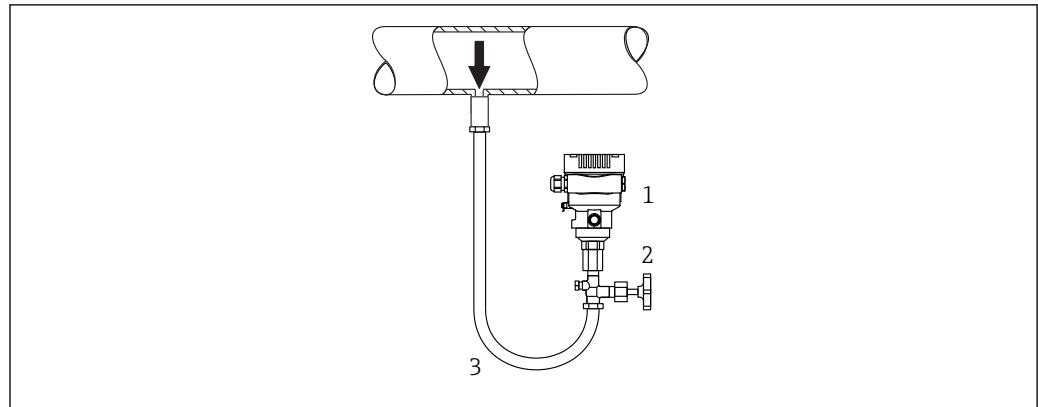
- 1 Device
2 Shutoff device
3 U-shaped water pocket pipe
4 O-shaped water pocket pipe

A water pocket pipe reduces the temperature to almost the ambient temperature. The defined water column only causes minimal (negligible) measured errors and minimal (negligible) thermal effects on the device.

Observe the maximum permitted ambient temperature of the transmitter!

- Ideally, mount the device with the O-shaped water pocket pipe below the tapping point
The device may also be mounted above the tapping point
- Fill the water pocket pipe with liquid before commissioning

5.2.3 Pressure measurement in liquids

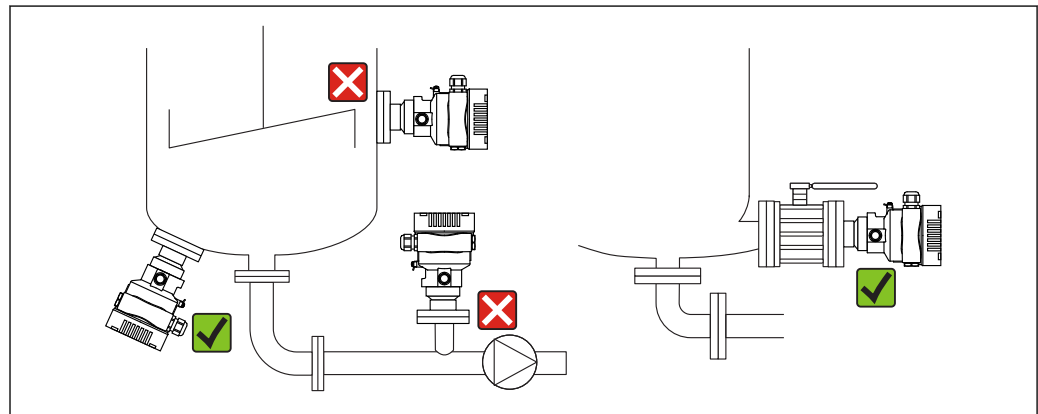


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- 1 Device
- 2 Shutoff device
- 3 Water pocket pipe

Mount the device with the shutoff device below or at the same level as the tapping point.

5.2.4 Level measurement

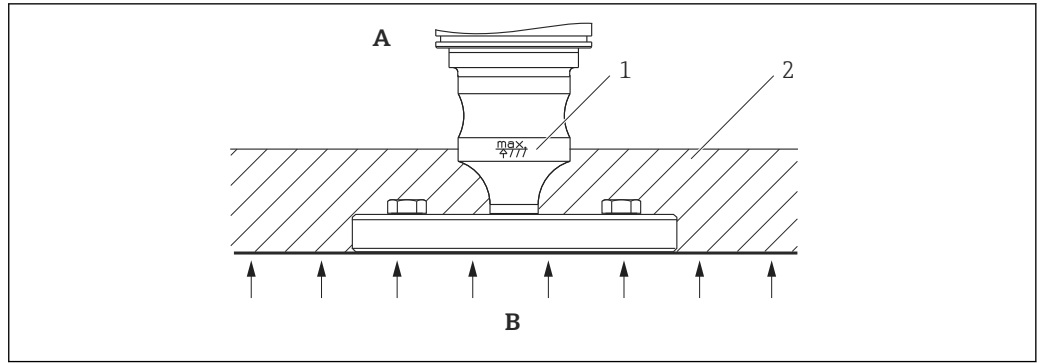


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- Always mount the device below the lowest measuring point
- Do not install the device at the following positions:
 - In the filling curtain
 - In the tank outlet
 - In the suction area of a pump
 - At a point in the tank which could be affected by pressure pulses from the agitator
- Mount the device downstream from a shutoff device: the calibration and function check can be carried out more easily

5.2.5 Thermal insulation with diaphragm seal directly mounted

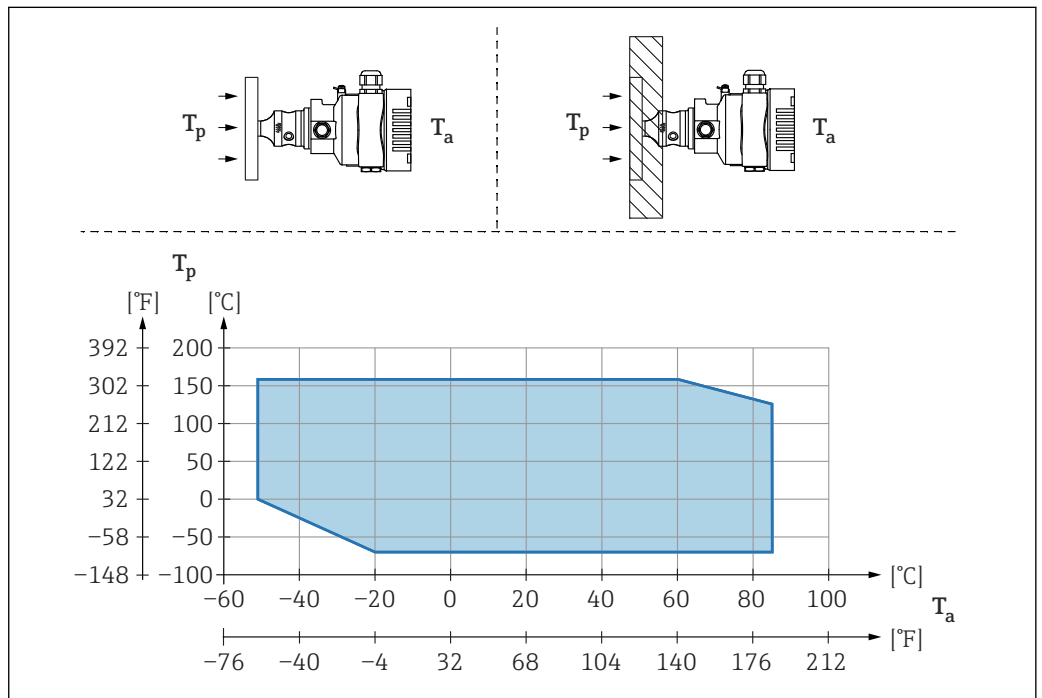
The device may only be insulated up to a certain height. The maximum permitted insulation height is indicated on the device and applies to an insulation material with a heat conductivity $\leq 0.04 \text{ W}/(\text{m} \times \text{K})$ and to the maximum permitted ambient and process temperature. The data were determined under the most critical application "quiescent air". Maximum permitted insulation height, indicated here on a device with a flange:



A0020474

- A Ambient temperature
- B Process temperature
- 1 Maximum permitted insulation height
- 2 Insulation material

5.2.6 Mounting with a "Compact" diaphragm seal type



A0040383

- T_a Ambient temperature at transmitter
- T_p Maximum process temperature

T_a	T_p
+85 °C (+185 °F)	-70 to +120 °C (-94 to +248 °F)
+60 °C (+140 °F)	-70 to +160 °C (-94 to +320 °F)
-20 °C (-4 °F)	-70 to +160 °C (-94 to +320 °F)
-50 °C (-58 °F)	0 to +160 °C (+32 to +320 °F)

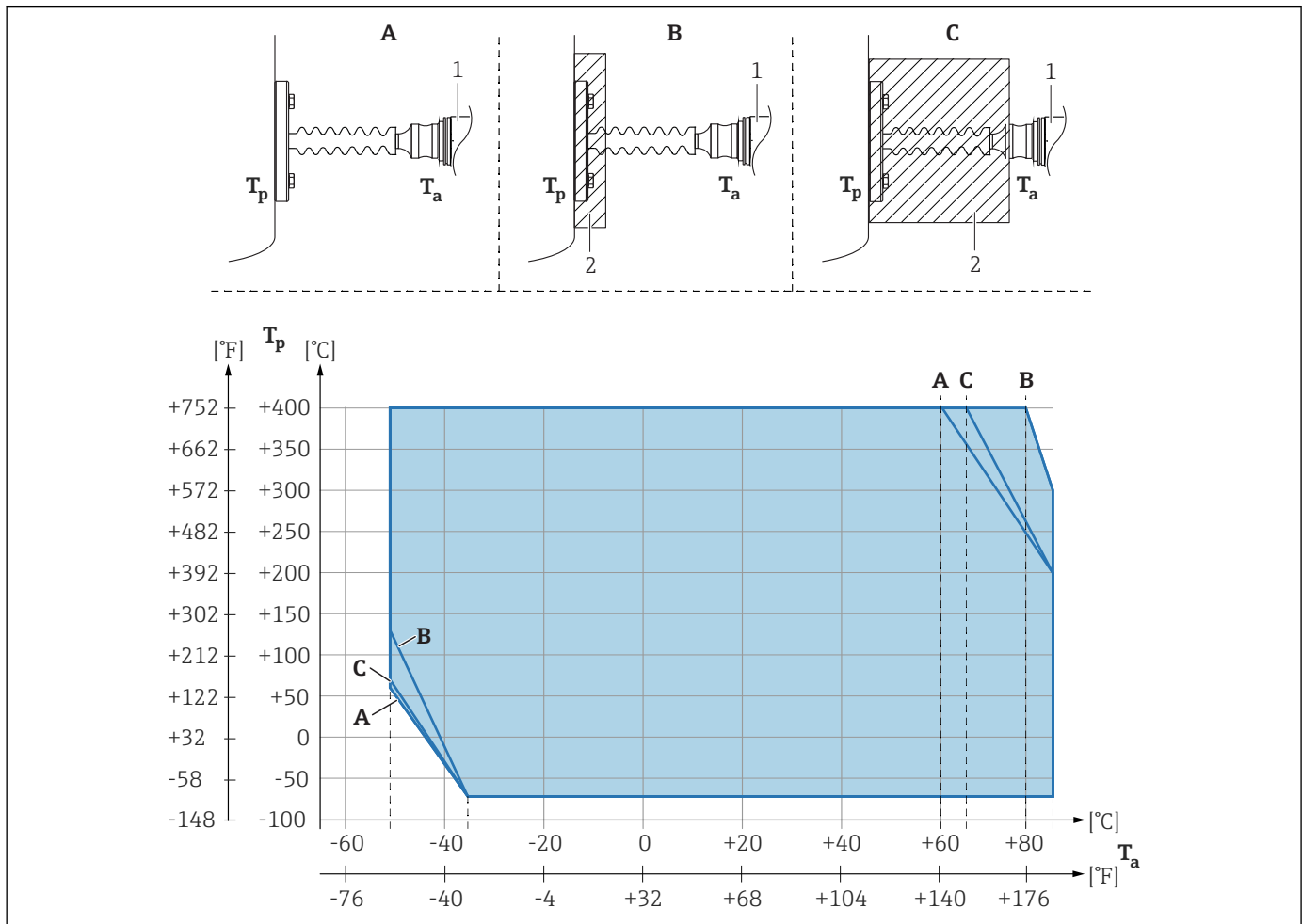
5.2.7 Thermal insulation when mounting with a "Temperature isolator" diaphragm seal type

Use of temperature isolators in the event of constant extreme medium temperatures which cause the maximum permissible electronics temperature of +85 °C (+185 °F) to be exceeded. Diaphragm seal systems with temperature isolators can be used up to a

maximum temperature of +400 °C (+752 °F) depending on the fill fluid used. For details see the Technical Information. To minimize the influence of rising heat, mount the device horizontally or with the housing pointing downwards. The additional installation height brings about a zero point shift due to the hydrostatic column in the temperature isolator. This zero point shift can be corrected on the device.

The maximum ambient temperature T_a at the transmitter depends on the maximum process temperature T_p .

The maximum process temperature depends on the diaphragm seal fill fluid used.



A0039378

- A No insulation
- B Insulation 30 mm (1.18 in)
- C Maximum insulation
- 1 Transmitter
- 2 Insulation material

Item	T_a ¹⁾	T_p ²⁾
A	60 °C (140 °F)	400 °C (752 °F) ³⁾
	85 °C (185 °F)	200 °C (392 °F)
	-50 °C (-58 °F)	60 °C (140 °F)
	-35 °C (-31 °F)	-70 °C (-94 °F)
B	80 °C (176 °F)	400 °C (752 °F) ³⁾
	85 °C (185 °F)	300 °C (572 °F)
	-50 °C (-58 °F)	130 °C (266 °F)
	-35 °C (-31 °F)	-70 °C (-94 °F)

Item	T _a ¹⁾	T _p ²⁾
C	67 °C (153 °F)	400 °C (752 °F) ³⁾
	85 °C (185 °F)	200 °C (392 °F)
	-50 °C (-58 °F)	70 °C (158 °F)
	-35 °C (-31 °F)	-70 °C (-94 °F)

- 1) Maximum ambient temperature at transmitter
- 2) Maximum process temperature
- 3) Process temperature: max. +400 °C (+752 °F), depending on the diaphragm seal fill fluid used

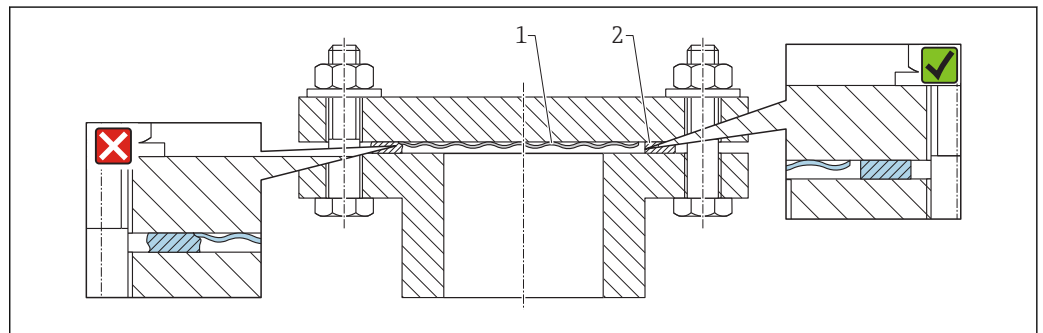
5.2.8 Seal for flange mounting

NOTICE

Seal pressing against the process isolating diaphragm!

Incorrect measurement results!

- ▶ Ensure that the seal is not touching the process isolating diaphragm.

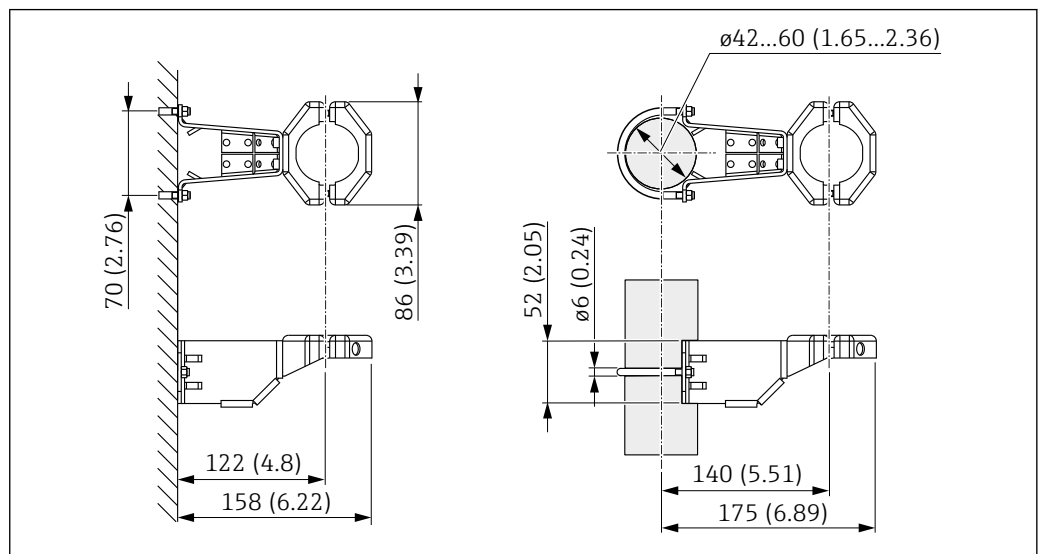


A0017743

- 1 Process isolating diaphragm
- 2 Seal

5.2.9 Mounting bracket for device or separate housing

The device or the separate housing can be mounted on walls or pipes (for pipes with a diameter of 1 ¼" to 2") using the mounting bracket.



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Unit of measurement mm (in)

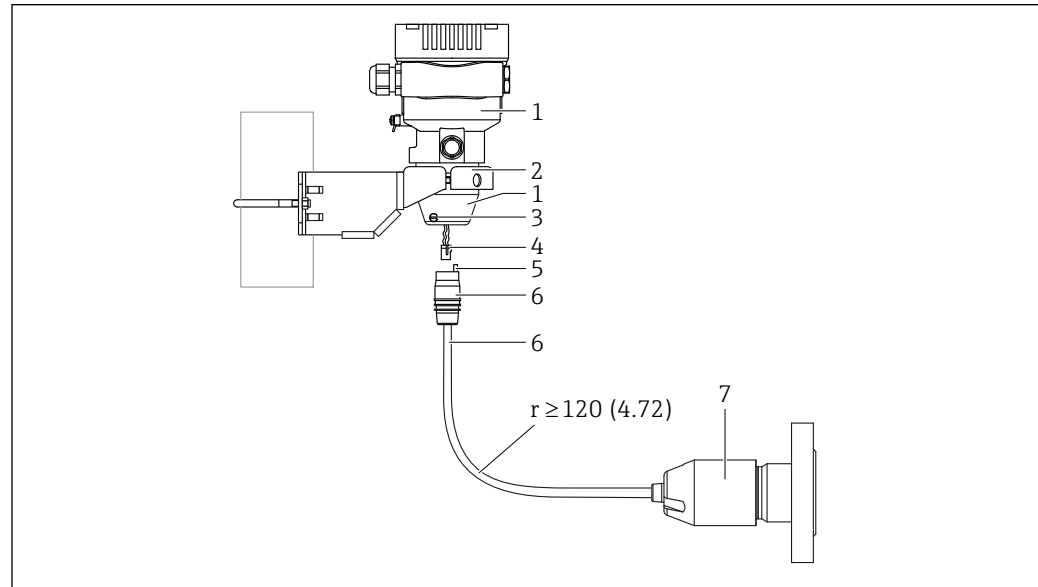
Ordering information:

- Can be ordered via the Product Configurator
- Can be ordered as a separate accessory, part number 71102216

i The mounting bracket is included in the delivery if you order the device with a separate housing.

When mounting on a pipe, tighten the nuts on the bracket uniformly with a torque of at least 5 Nm (3.69 lbf ft).

5.2.10 Assembling and mounting the separate housing



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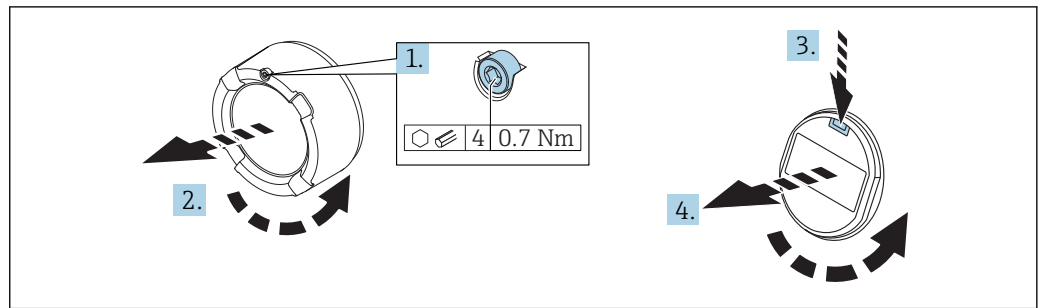
Unit of measurement mm (in)

- 1 Housing mounted with housing adapter, included
- 2 Mounting bracket provided, suitable for pipe and wall mounting (for pipe diameters from 1 ¼" up to 2")
- 3 Locking screw
- 4 Plug
- 5 Pressure compensation
- 6 Cable with connection jack
- 7 In the separate housing version, the sensor is delivered with the process connection and cable already mounted.

Assembly and mounting

1. Insert the connector (item 4) into the corresponding connection jack of the cable (item 6).
2. Insert the cable with the socket (item 6) into the housing adapter (item 1) to the end stop.
3. Tighten the locking screw (item 3).
4. Mount the housing on a wall or pipe with the mounting bracket (item 2). When mounting on a pipe, tighten the nuts on the bracket uniformly with a torque of at least 5 Nm (3.69 lbf ft). Mount the cable with a bending radius (r) \geq 120 mm (4.72 in).

5.2.11 Turning the display module



A0038224

WARNING

Supply voltage switched on!

Risk of electric shock and/or explosion!

- Switch off the supply voltage before opening the device.

1. If fitted: release the screw of the cover lock for the electronics compartment cover using the Allen key.
2. Unscrew the electronics compartment cover from the transmitter housing and check the cover seal.
3. Press the release mechanism and remove the display module.
4. Turn the display module to the desired position: maximum $4 \times 90^\circ$ in each direction. Fit the display module on the electronics compartment in the desired position until it clicks into place. Screw the electronics compartment cover back onto the transmitter housing. If fitted: tighten the screw of the cover lock using the Allen key 0.7 Nm (0.52 lbf ft) ± 0.2 Nm (0.15 lbf ft).

5.2.12 Closing the housing cover

NOTICE

Thread and housing cover damaged from dirt and fouling!

- Remove fouling (e.g. sand.) on the thread of the cover and housing.
- If you continue to encounter resistance when closing the cover, check the thread again for fouling.

i Housing thread

The thread of the electronics and connection compartment is coated with lubricant varnish.

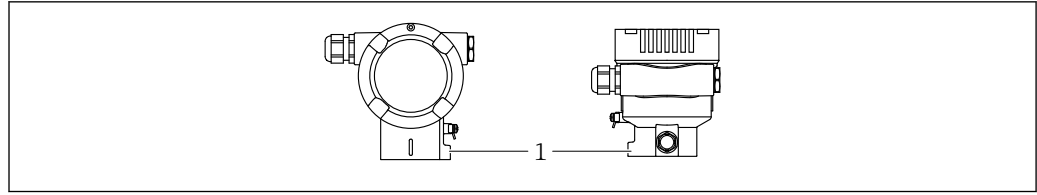
- ✗ Avoid additional lubrication.

5.2.13 Turning the housing

The housing can be rotated up to 380° by loosening the locking screw.

Your benefits

- Easy mounting due to optimum alignment of housing
- Easily accessible device operation
- Optimum readability of the onsite display (optional)



A0043807

1 Locking screw

NOTICE

The housing cannot be unscrewed fully.

- ▶ Loosen the external locking screw by a maximum of 1.5 turns. If the screw is unscrewed too much or completely (beyond the screw anchor point), small parts (counter disk) can become loose and fall out.
- ▶ Tighten the securing screw (hex socket 4 mm (0.16 in)) with maximum 3.5 Nm (2.58 lbf ft) \pm 0.3 Nm (0.22 lbf ft).

5.3 Post-mounting check

- Is the device undamaged (visual inspection)?
- Are the measuring point identification and labeling correct (visual inspection)?
- Is the device protected against precipitation and direct sunlight?
- Are the securing screws and cover lock tightened securely?
- Does the measuring device meet the measuring point specifications?

For example:

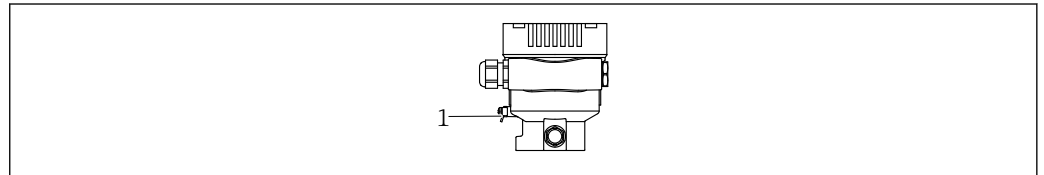
- Process temperature
- Process pressure
- Ambient temperature
- Measuring range

6 Electrical connection

6.1 Connecting requirements

6.1.1 Potential equalization

The protective ground on the device must not be connected. If necessary, the potential matching line can be connected to the outer ground terminal of the transmitter before the device is connected.



A0045411

1 Ground terminal for connecting the potential matching line

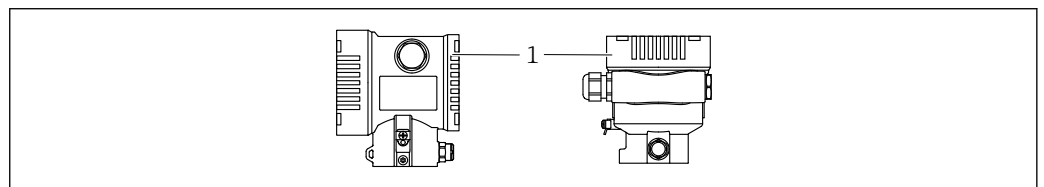
⚠ WARNING

Explosion Hazard!

► Please refer to the separate documentation on applications in hazardous areas for the safety instructions.

- i** For optimum electromagnetic compatibility:
 - Keep the potential matching line as short as possible
 - Maintain a cross-section of at least 2.5 mm² (14 AWG)

6.2 Connecting the device



A0043806

1 Connection compartment cover

i Housing thread

The thread of the electronics and connection compartment is coated with lubricant varnish.

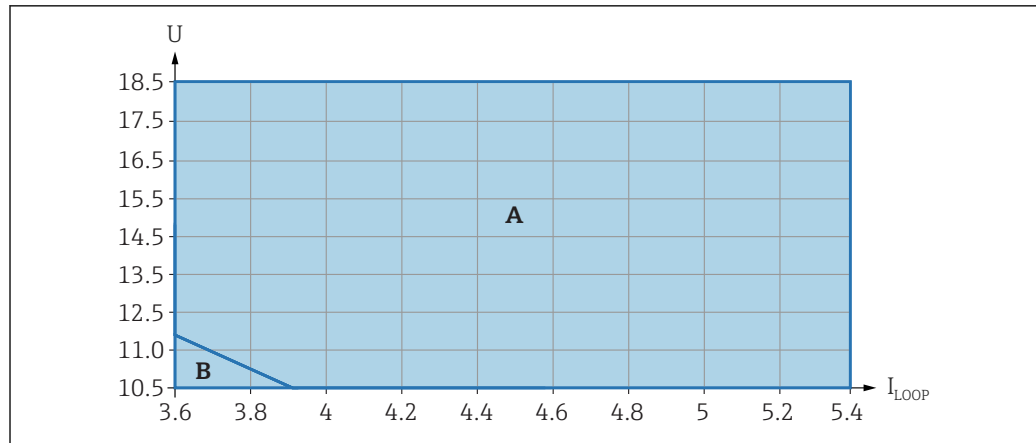
⊗ Avoid additional lubrication.

6.2.1 Supply voltage

- Ex d, Ex e, non Ex: supply voltage: 10.5 to 35 V_{DC}
- Ex i: supply voltage: 10.5 to 30 V_{DC}

i The power unit must be tested to ensure it meets safety requirements (e.g. PELV, SELV, Class 2).

Depending on the supply voltage and the current consumption, Bluetooth can optionally be switched on or off. For the dependency, see the diagram:



A0047149

- A Bluetooth can be switched on
 B Bluetooth cannot be switched on

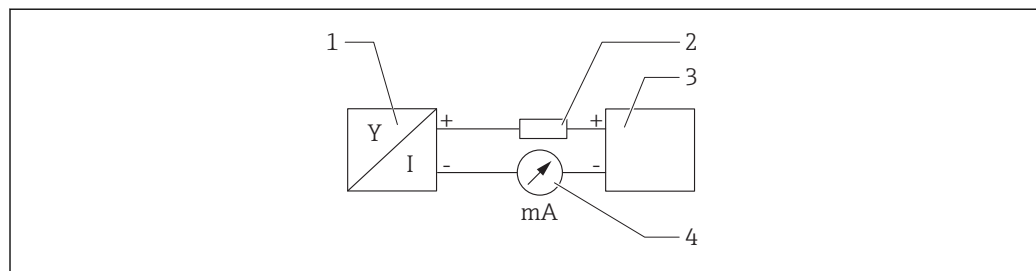
6.2.2 Terminals

- Supply voltage and internal ground terminal: 0.5 to 2.5 mm² (20 to 14 AWG)
- External ground terminal: 0.5 to 4 mm² (20 to 12 AWG)

6.2.3 Cable specification

- Protective ground or grounding of the cable shield: rated cross-section > 1 mm² (17 AWG)
 Rated cross-section of 0.5 mm² (20 AWG) to 2.5 mm² (13 AWG)
- Cable outer diameter: Ø5 to 12 mm (0.2 to 0.47 in) depends on the cable gland used (see Technical Information)

6.2.4 4-20 mA



A0028908

2 Block diagram

- 1 Device
 2 Load
 3 Power supply
 4 multimeter

6.2.5 Overvoltage protection

Devices without optional overvoltage protection

Equipment from Endress+Hauser fulfills the requirements of the product standard IEC / DIN EN 61326-1 (Table 2 Industrial Environment).

Depending on the type of port (DC power supply, input/output port) different testing levels according to IEC / DIN EN 61326-1 against transient overvoltages (Surge) are applied (IEC / DIN EN 61000-4-5 Surge):

Test level on DC power ports and input / output ports is 1000 V line to earth

Overvoltage category

Overvoltage category II

6.2.6 Wiring**⚠ WARNING****Supply voltage might be connected!**

Risk of electric shock and/or explosion!

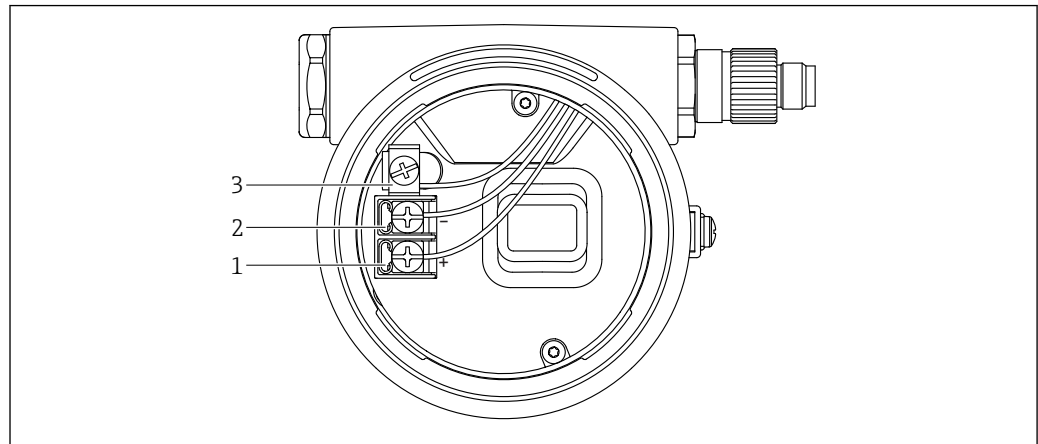
- ▶ If the device is used in hazardous areas, make sure to comply with national standards and the specifications in the Safety Instructions (XAs). The specified cable gland must be used.
- ▶ The supply voltage must match the specifications on the nameplate.
- ▶ Switch off the supply voltage before connecting the device.
- ▶ If necessary, the potential matching line can be connected to the outer ground terminal of the transmitter before the device is connected.
- ▶ A suitable circuit breaker should be provided for the device in accordance with IEC/EN 61010.
- ▶ The cables must be adequately insulated, with due consideration given to the supply voltage and the overvoltage category.
- ▶ The connecting cables must offer adequate temperature stability, with due consideration given to the ambient temperature.
- ▶ Only operate the device with the covers closed.

Connect the device in the following order:

1. Release the cover lock (if provided).
2. Unscrew the cover.
3. Guide the cables into the cable glands or cable entries.
4. Connect the cable.
5. Tighten the cable glands or cable entries so that they are leak-tight. Counter-tighten the housing entry. Use a suitable tool with width across flats AF24/25
8 Nm (5.9 lbf ft) for the M20 cable gland.
6. Screw the cover securely back onto the connection compartment.
7. If fitted: tighten the screw of the cover lock using the Allen key 0.7 Nm (0.52 lbf ft) ± 0.2 Nm (0.15 lbf ft).

6.2.7 Terminal assignment

Single compartment housing

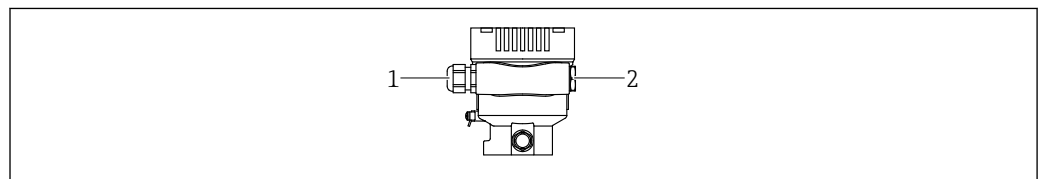


A0042594

3 Connection terminals and ground terminal in the connection compartment

- 1 Positive terminal
- 2 Negative terminal
- 3 Internal ground terminal

6.2.8 Cable entries



A0045413

- 1 Cable entry
- 2 Dummy plug

The type of cable entry depends on the device version ordered.

i Always route connecting cables downwards so that moisture cannot penetrate the connection compartment.

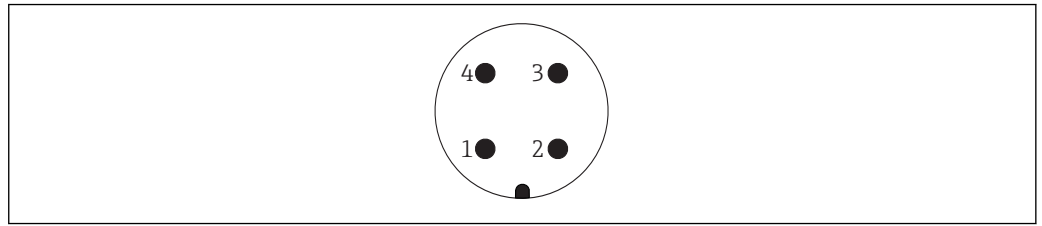
If necessary, create a drip loop or use a weather protection cover.

6.2.9 Available device plugs

i In the case of devices with a plug, it is not necessary to open the housing for connection purposes.

Use the enclosed seals to prevent the penetration of moisture into the device.

Devices with M12 plug



A0011175

- 1 Signal +
- 2 Not assigned
- 3 Signal -
- 4 Ground

6.3 Ensuring the degree of protection

6.3.1 Cable entries

- Gland M20, plastic, IP66/68 TYPE 4X/6P
- Gland M20, brass nickel plated, IP66/68 TYPE 4X/6P
- Gland M20, 316L, IP66/68 TYPE 4X/6P
- Thread M20, IP66/68 TYPE 4X/6P
- Thread G1/2, IP66/68 TYPE 4X/6P
 - If the G1/2 thread is selected, the device is delivered with an M20 thread as standard and a G1/2 adapter is included with the delivery, along with the corresponding documentation
- Thread NPT1/2, IP66/68 TYPE 4X/6P
- Dummy plug transport protection: IP22, TYPE 2
- *Cable 5 m, IP66/68 TYPE 4X/6P pressure compensation via cable
- *Valve plug ISO4400 M16, IP65 TYPE 4X
- Plug HAN7D, 90 deg. IP65 NEMA Type 4X
- Plug M12
 - When housing is closed and connecting cable is plugged in: IP66/67, NEMA Type 4X
 - When housing is open or connecting cable is not plugged in: IP20, NEMA Type 1

NOTICE

Plug M12 and plug HAN7D: incorrect mounting can invalidate the IP protection class!

- ▶ The degree of protection only applies if the connecting cable used is plugged in and screwed tight.
- ▶ The degree of protection only applies if the connecting cable used is specified according to IP67, NEMA Type 4X.
- ▶ The IP protection classes are only maintained if the dummy cap is used or the cable is connected.

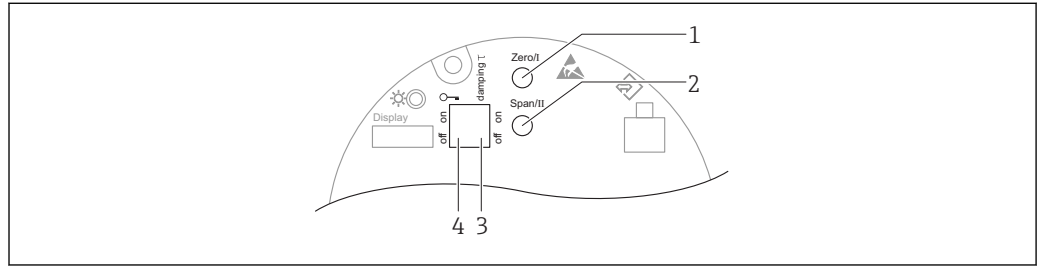
6.4 Post-connection check

After wiring the device, perform the following checks:

- Is the potential matching line connected?
- Is the terminal assignment correct?
- Are the cable glands and dummy plugs leak-tight?
- Are the fieldbus connectors properly secured?
- Are the covers screwed down correctly?

7 Operation options

7.1 Operating keys and DIP switches on the electronic insert



A0039344

- 1 Operating key for lower range value (Zero)
- 2 Operating key for upper range value (Span)
- 3 DIP switch for damping
- 4 DIP switch for locking and unlocking the device

i The setting of the DIP switches has priority over the settings made via other operation methods (e.g. FieldCare/DeviceCare).

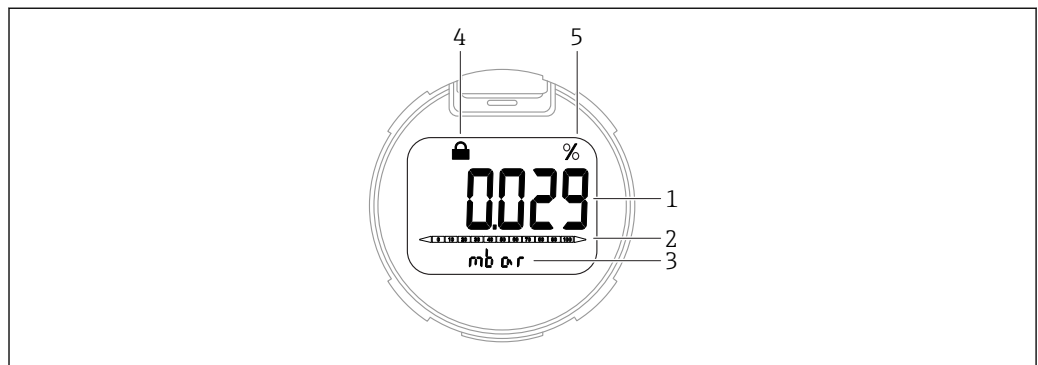
7.2 local display

7.2.1 Device display (optional)

Functions:

Display of measured values and fault and notice messages

i The device displays are available with the additional option of Bluetooth® wireless technology.



A0047140

- i** 4 Segment display
- 1 Measured value
 - 2 Bar graph proportional to the current output
 - 3 Unit of measured value
 - 4 Locked (symbol appears when the device is locked)
 - 5 Measured value output in %

8 Commissioning

8.1 Preliminaries

The measuring range and the unit in which the measured value is transmitted correspond to the data on the nameplate.

⚠ WARNING

Process pressure above or below permitted maximum/minimum!

Risk of injury if parts burst! Warnings are displayed if the pressure is too high.

- ▶ If a pressure smaller than the minimum permitted pressure or greater than the maximum permitted pressure is present at the device, a message is output.
- ▶ Only use the device within the sensor range limits!

8.1.1 As-delivered state

If no customized settings were ordered:

- Calibration values defined by defined sensor nominal value
- The alarm current is set to min. (3.6 mA), (only if no other option was selected when ordering)
- DIP switch to Off position

8.2 Function check

Perform a function check before putting the measuring point into operation:

- "Post-installation check" checklist (see the "Installation" section)
- "Post-connection check" checklist (see the "Electrical connection" section)

8.3 Device configuration

8.3.1 Commissioning with keys on the electronic insert

The following functions are possible via the keys on the electronic insert:

- Position adjustment (zero point correction)
The orientation of the device may cause a pressure shift
This pressure shift can be corrected by a position adjustment
- Setting lower range value and upper range value
The pressure applied must be within the nominal pressure limits of the sensor (see the specifications on the nameplate)
- Resetting the device

Carrying out position adjustment

1. Device installed in desired position and no pressure applied.
2. Press the "Zero" and "Span" keys simultaneously for at least 3 s.
3. When the LED lights up briefly, the pressure present has been accepted for position adjustment.

Setting the lower range value (pressure or scaled variable)

1. Desired pressure for lower range value is present at device.
2. Press the "Zero" key for at least 3 s.
3. When the LED lights up briefly, the pressure present has been accepted for the lower range value.

Setting the upper range value (pressure or scaled variable)

1. Desired pressure for upper range value is present at device.
2. Press the "Span" key for at least 3 s.
3. When the LED lights up briefly, the pressure present has been accepted for the upper range value.
4. Does the LED on the electronic insert not light up?
 - ↳ Applied pressure has not been accepted for upper range value.
Wet calibration is not possible if the **Scaled variable** option has been selected in the **Assign PV** parameter and the **Table** option has been selected in the **Scaled variable transfer function** parameter.

Checking the settings (pressure or scaled variable)

1. Press the "Zero" key briefly in order to display the lower range value.
2. Press the "Span" key briefly in order to display the upper range value.
3. Press the "Zero" and "Span" keys simultaneously in order to display the calibration offset.

Resetting the device

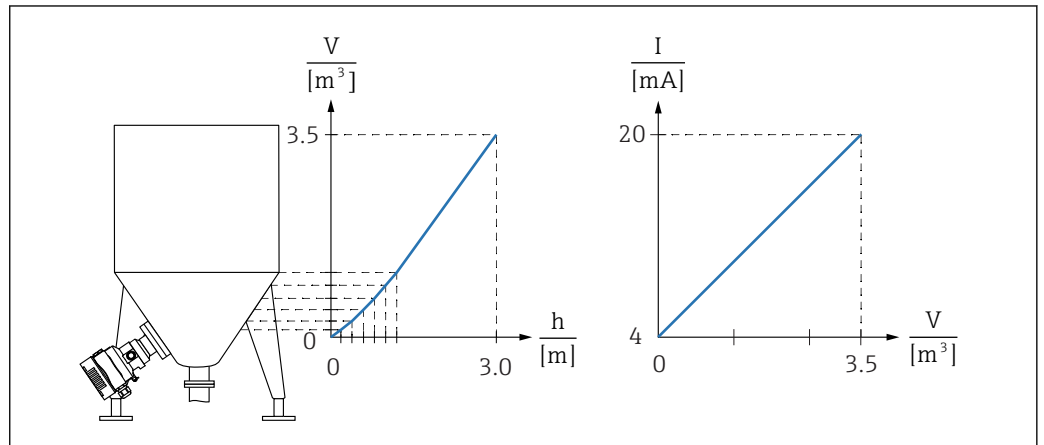
- ▶ Press and hold the "Zero" and "Span" keys simultaneously for at least 12 s.

8.3.2 Linearization

In the following example, the volume in a tank with a conical outlet should be measured in m^3 .

Prerequisites:

- Points for linearization table are known
- Level calibration is performed
- Linearization characteristic must continually increase or decrease



A0038910

1. In the **Assign PV** parameter, the **Scaled variable** option must be configured
 - ↳ Menu path: Application → HART output → HART output → Assign PV
2. In the **Scaled variable unit** parameter, set the desired unit
 - ↳ Menu path: Application → Sensor → Scaled variable → Scaled variable unit
3. The linearization table can be opened via the **Go to linearization table** parameter **Table** option.
 - ↳ Menu path: Application → Sensor → Scaled variable → Scaled variable transfer function
4. Enter the desired table values.
5. The table is activated once all the points in the table have been entered.

Result:


The measured value after linearization is displayed.

- i
 - Error message F435 "Linearization" and the alarm current appear as long as the table is being entered and until the table is activated
 - The 0% value (= 4 mA) is defined by the smallest point in the table
The 100% value (= 20 mA) is defined by the largest point in the table
 - The assignment of the volume/mass values to the current values can be changed with the **Lower range value output** parameter and **Upper range value output** parameter

8.4 Protecting settings from unauthorized access

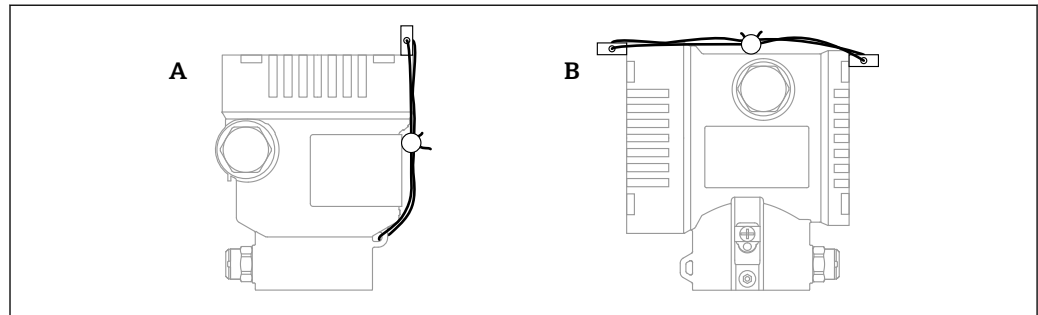
8.4.1 Hardware locking or unlocking

DIP switch 1 on the electronic insert is used to lock or unlock operation.

If operation is locked via the DIP switch, the key symbol  appears on the local display.

Sealing the device

The housing cover is designed to be sealed for use in custody transfer.



A0038742

- A Single compartment housing
- B Dual compartment housing

9 Diagnostics and troubleshooting

9.1 General troubleshooting

9.1.1 General errors

Device not responding

- Possible cause: Supply voltage does not match the specification on the nameplate
Remedial action: Apply the correct voltage
- Possible cause: The polarity of the supply voltage is wrong
Remedial action: Correct the polarity
- Possible cause: The cables do not contact the terminals properly
Remedial action: Check the electrical contact between cables and correct if necessary
- Possible cause: Load resistance too high
Remedial action: Increase the supply voltage to reach the minimum terminal voltage

No values visible on the display

- Possible cause: The plug of the display cable is not connected correctly
Remedial action: Connect the plug correctly
- Possible cause: Display is defective
Remedial action: Replace the display

9.1.2 Measures

Take the following measures if an error message is displayed:

- Check the cable/power supply
- Check the plausibility of the pressure value
- Restart the device
- Perform a reset (the device may need to be reconfigured)

If the measures do not rectify the problem, contact your Endress+Hauser office.

9.1.3 Additional tests

If no clear cause of the error can be identified or the source of the problem can be both the device and the application, the following additional tests can be performed:

1. Check the digital pressure value (display, HART, etc.).
2. Check that the device concerned is functioning correctly. Replace the device if the digital value does not correspond to the expected pressure value.
3. Switch on simulation and check the current output. Replace the main electronics if the current output does not correspond to the simulated value.

9.1.4 Response of output to errors

In the event of an error, the current output adopts the value ≤ 3.6 mA (3.6 mA factory setting).

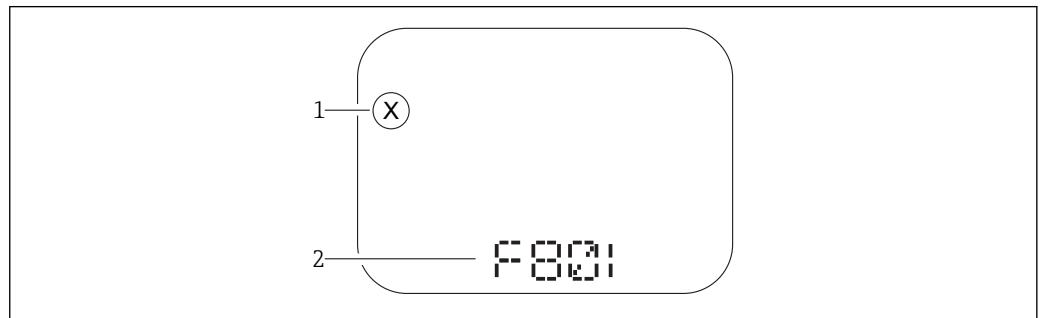
3.6 mA is the min. alarm, max. alarm can be ordered (21.5 to 23 mA).

9.2 Diagnostic information on local display

9.2.1 Diagnostic message

Measured value display and diagnostic message in alarm condition

Faults detected by the device's self-monitoring system are displayed as a diagnostic message in alternation with the unit.



- 1 Status signal
2 Status symbol with diagnostic event

Status signals

F

"Failure (F)" option

A device error has occurred. The measured value is no longer valid.

C

"Function check (C)" option

The device is in the service mode (e.g. during a simulation).

S

"Out of specification (S)" option

The device is being operated:

- Outside of its technical specifications (e.g. during startup or a cleaning)
- Outside of the configuration performed by the user (e.g. level outside configured span)

M

"Maintenance required (M)" option

Maintenance required. The measured value remains valid.

9.3 Diagnostic list

9.3.1 List of diagnostic events

Diagnostic number	Short text	Remedy instructions	Status signal [from the factory]	Diagnostic behavior [from the factory]
Diagnostic of sensor				
062	Sensor connection faulty	Check sensor connection	F	Alarm
081	Sensor initialization faulty	1. Restart device 2. Contact service	F	Alarm
100	Sensor error	1. Restart the device 2. Contact Endress+Hauser Service	F	Alarm
101	Sensor temperature	1. Check process temperature 2. Check ambient temperature	F	Alarm
102	Sensor incompatible error	1. Restart device 2. Contact service	F	Alarm
Diagnostic of electronic				
242	Firmware incompatible	1. Check software 2. Flash or change main electronic module	F	Alarm
252	Module incompatible	1. Check if correct electronic modul is plugged 2. Replace electronic module	F	Alarm
263	Incompatibility detected	Check electronic module type	M	Warning
270	Main electronics defective	Replace main electronics	F	Alarm
272	Main electronics faulty	1. Restart device 2. Contact service	F	Alarm
273	Main electronics defective	1. Transfer data or reset device 2. Contact service	F	Alarm
282	Data storage inconsistent	1. Restart device 2. Contact service	F	Alarm
283	Memory content inconsistent	1. Transfer data or reset device 2. Contact service	F	Alarm
287	Memory content inconsistent	1. Restart device 2. Contact service	M	Warning
311	Electronic failure	Maintenance required! 1. Do not perform reset 2. Contact service	M	Warning
Diagnostic of configuration				
410	Data transfer failed	1. Check connection 2. Retry data transfer	F	Alarm
412	Processing download	Download active, please wait	C	Warning
431	Trim required	Carry out trim	C	Warning
435	Linearization faulty	Check linearization table	F	Alarm
437	Configuration incompatible	1. Restart device 2. Contact service	F	Alarm
438	Dataset different	1. Check data set file 2. Check device configuration 3. Up- and download new configuration	M	Warning
441	Current output out of range	1. Check process 2. Check current output settings	S	Warning

Diagnostic number	Short text	Remedy instructions	Status signal [from the factory]	Diagnostic behavior [from the factory]
484	Failure mode simulation active	Deactivate simulation	C	Alarm
485	Process variable simulation active	Deactivate simulation	C	Warning
491	Current output simulation active	Deactivate simulation	C	Warning
495	Diagnostic event simulation active	Deactivate simulation	C	Warning
500	Process alert pressure	1. Check process pressure 2. Check configuration of process alert	S	Warning ¹⁾
501	Process alert scaled variable	1. Check process conditions 2. Check scaled variable configuration	S	Warning ¹⁾
502	Process alert temperature	1. Check process temperature 2. Check configuration of process alert	S	Warning ¹⁾
503	Zero adjustment	1. Check measuring range 2. Check position adjustment	M	Warning
Diagnostic of process				
801	Supply voltage too low	Increase supply voltage	F	Alarm
802	Supply voltage too high	Decrease supply voltage	S	Warning
805	Loop current faulty	1. Check wiring 2. Replace electronics	F	Alarm
806	Loop diagnostics	1. Check supply voltage 2. Check wiring and terminals	M	Warning ¹⁾
807	No Baseline due to insuf. volt. at 20 mA	Increase supply voltage	M	Warning
822	Sensor temperature out of range	1. Check process temperature 2. Check ambient temperature	S	Warning ¹⁾
825	Operating temperature	1. Check ambient temperature 2. Check process temperature	S	Warning
841	Operating range	1. Check the process pressure 2. Check the sensor range	S	Warning ¹⁾
900	High signal noise detected	1. Check impulse line 2. Check valve position 3. Check process	M	Warning ¹⁾
901	Low signal noise detected	1. Check impulse line 2. Check valve position 3. Check process	M	Warning ¹⁾
902	Min signal noise detected	1. Check impulse line 2. Check valve position 3. Check process	M	Warning ¹⁾
906	Out of range signal detected	1. Process Information. No action 2. Rebuild baseline 3. Adapt signal range thresholds	S	Warning ¹⁾

1) Diagnostic behavior can be changed.

9.4 Event logbook

9.4.1 Event history

The **Event list** submenu provides a chronological overview of the event messages that have occurred ¹⁾.

Navigation path

Diagnostics → Event logbook

A maximum of 100 event messages can be displayed in chronological order.

The event history includes entries for:

- Diagnostic events
- Information events

In addition to the operating time when the event occurred, each event is also assigned a symbol that indicates whether the event has occurred or is finished:

- Diagnostic event
 - ☹: Occurrence of the event
 - ☺: End of the event
- Information event
 - ☹: Occurrence of the event

9.4.2 Filtering the event logbook

Filters can be used to determine which category of event messages is displayed in the **Event list** submenu.

Navigation path

Diagnostics → Event logbook

Filter categories

- All
- Failure (F)
- Function check (C)
- Out of specification (S)
- Maintenance required (M)
- Information

9.4.3 Overview of information events

Info number	Info name
I1000	----- (Device ok)
I1079	Sensor changed
I1089	Power on
I1090	Configuration reset
I1091	Configuration changed
I11074	Device verification active
I1110	Write protection switch changed
I11104	Loop diagnostics
I1151	History reset
I1154	Reset terminal voltage min/max

1) If operating via FieldCare, the event list can be displayed with the "Event List/HistoROM" function in FieldCare.

Info number	Info name
I1155	Reset electronics temperature
I1157	Memory error event list
I1256	Display: access status changed
I1264	Safety sequence aborted
I1335	Firmware changed
I1397	Fieldbus: access status changed
I1398	CDI: access status changed
I1440	Main electronic module changed
I1444	Device verification passed
I1445	Device verification failed
I1461	Sensor verification failed
I1512	Download started
I1513	Download finished
I1514	Upload started
I1515	Upload finished
I1551	Assignment error fixed
I1552	Failed: Main electronic verification
I1554	Safety sequence started
I1555	Safety sequence confirmed
I1556	Safety mode off
I1956	Reset

9.4.4 Overview of information events

Info number	Info name
I1000	----- (Device ok)
I1079	Sensor changed
I1089	Power on
I1090	Configuration reset
I1091	Configuration changed
I11074	Device verification active
I1110	Write protection switch changed
I11104	Loop diagnostics
I1151	History reset
I1154	Reset terminal voltage min/max
I1155	Reset electronics temperature
I1157	Memory error event list
I1256	Display: access status changed
I1264	Safety sequence aborted
I1335	Firmware changed
I1397	Fieldbus: access status changed
I1398	CDI: access status changed
I1440	Main electronic module changed


Info number	Info name
I1444	Device verification passed
I1445	Device verification failed
I1461	Sensor verification failed
I1512	Download started
I1513	Download finished
I1514	Upload started
I1515	Upload finished
I1551	Assignment error fixed
I1552	Failed: Main electronic verification
I1554	Safety sequence started
I1555	Safety sequence confirmed
I1556	Safety mode off
I1956	Reset

9.5 Resetting the device

9.5.1 Resetting the device via keys on the electronic insert

Press the "Zero" and "Span" keys simultaneously for at least 12 seconds.

9.6 Firmware history

 The firmware version can explicitly be ordered via the product structure. This makes it possible to ensure the compatibility of the firmware version with an existing or planned system integration.

9.6.1 Version 01.00.zz

Original software

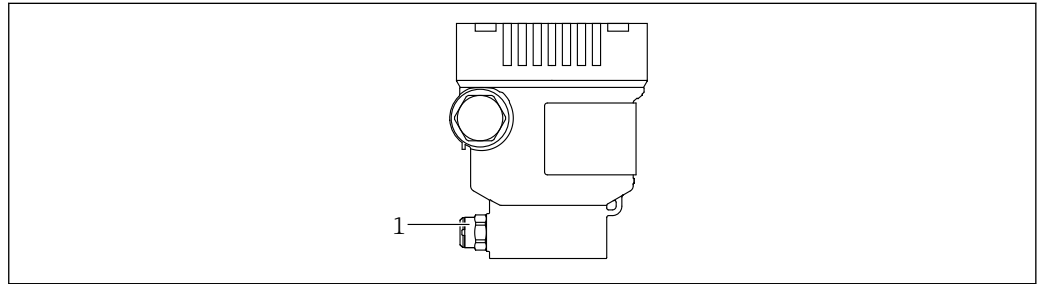
10 Maintenance

10.1 Maintenance tasks

This chapter describes the maintenance of physical device components.

10.1.1 Pressure compensation filter


Keep the pressure compensation filter (1) free from contamination.



1 Pressure compensation filter

A0043756

10.1.2 Flushing rings

 The use of flushing rings allows the process membrane to be cleaned without removing the device from the process.

For more information: contact the Endress+Hauser sales office.

10.1.3 Exterior cleaning

Notes on cleaning

- The cleaning agents used should not corrode the surfaces and the seals
- Mechanical damage to the process membrane, e.g. due to sharp objects, must be avoided
- Observe the degree of protection of the device

11 Repair

11.1 General notes

11.1.1 Repair concept

Under the Endress+Hauser repair concept, devices have a modular design and repairs can be carried out by Endress+Hauser Service or by properly trained customers.

Spare parts are grouped into logical kits with the associated replacement instructions.

For more information on service and spare parts contact Endress+Hauser Service.

11.1.2 Repairs to Ex- or SIL-certified devices

WARNING

Incorrect repair can affect electrical safety!

Explosion Hazard!

- ▶ Only specialist personnel or Endress+Hauser Service can carry out repairs to Ex certified devices.
- ▶ Observe the relevant standards and national regulations as well as Safety Instructions (XA) and certificates.
- ▶ Only use original Endress+Hauser spare parts.
- ▶ When ordering the spare part, pay attention to the device designation on the nameplate. Only replace parts with identical parts.
- ▶ Carry out repairs according to the instructions. Following a repair, the individual testing specified for the device must be performed.
- ▶ A certified device may only be converted into another certified version by Endress +Hauser Service.
- ▶ All repairs and modifications must be documented.

11.2 Spare parts

- Some replaceable device components are identified by a spare part nameplate. This contains information about the spare part.
- All the spare parts for the measuring device, along with the order code, are listed in the *Device Viewer* (www.endress.com/deviceviewer) and can be ordered. If available, users can also download the associated Installation Instructions.



Device serial number:

- Located on the device and spare part nameplate.
- Can be read out via the device software.

11.3 Return

The device must be returned in the event of a factory calibration, or if the wrong device has been ordered or delivered.

As an ISO-certified company and also due to legal regulations, Endress+Hauser is obliged to follow certain procedures when handling any returned products that have been in contact with medium. To ensure swift, safe and professional device returns, please read the return procedures and conditions on the Endress+Hauser website www.services.endress.com/return-material.

- ▶ Select country.
 - ↳ The website of the responsible sales office opens with all the relevant information relating to returns.
- 1. If the desired country is not listed:
 - Click on the "Choose your location" link.
 - ↳ An overview of Endress+Hauser sales offices and representatives opens.
- 2. Contact the Endress+Hauser sales organization responsible for your area.

11.4 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 Endress+Hauser for disposal under the applicable conditions.

12 Accessories

12.1 Device-specific accessories

12.1.1 Mechanical accessories

- Mounting bracket for housing
- Mounting bracket for block & bleed valves
- Block&Bleed valves:
 - Block&Bleed valves can be ordered as **enclosed** accessories (seal for mounting is enclosed)
 - Block&Bleed valves can be ordered as **mounted** accessories (mounted manifolds are supplied with a documented leak test)
 - Certificates (e.g. 3.1 material certificate and NACE) and tests (e.g. PMI and pressure test) that are ordered with the device apply for the transmitter and the manifold
 - During the operating life of the valves, it may be necessary to re-tighten the pack
- Water pocket pipes (PZW)
- Flushing rings
- Weather protection covers



For technical data (e.g. materials, dimensions or order numbers), see the accessory document SD01553P.

12.1.2 Plug connectors

- Plug connector M12 90 deg, IP67 5m cable, union nut, Cu Sn/Ni
- Plug connector M12, IP67 union nut, Cu Sn/Ni
- Plug connector M12, 90 deg IP67 union nut, Cu Sn/Ni



The IP protection classes are only maintained if the dummy cap is used or the cable is connected.

12.1.3 Weld-in accessory



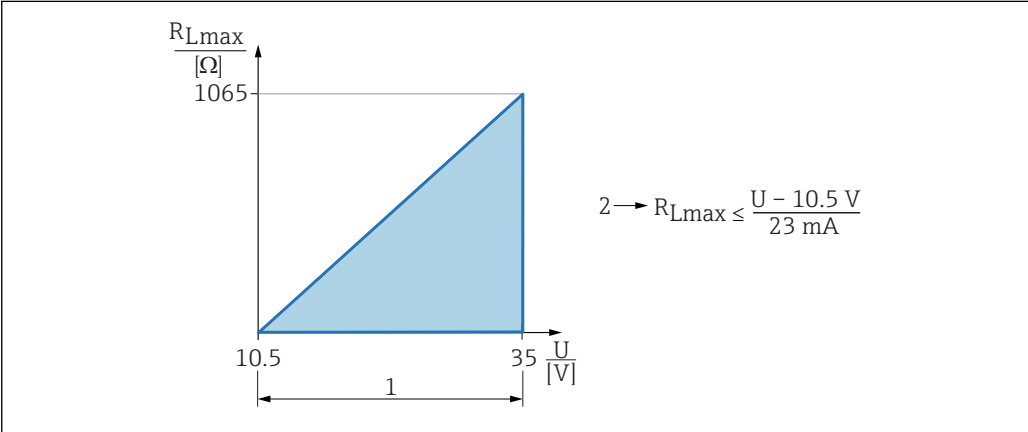
For details, refer to TI00426F/00/EN "Weld-in adapters, process adapters and flanges".

12.2 Device Viewer

All the spare parts for the device, along with the order code, are listed in the *Device Viewer* (www.endress.com/deviceviewer).

13 Technical data

13.1 Output

Output signal	<p>Current output</p> <p>4 to 20 mA analog, 2-wire</p> <p>The current output offers a choice of three different operating modes:</p> <ul style="list-style-type: none"> ■ 4.0 to 20.5 mA ■ NAMUR NE 43: 3.8 to 20.5 mA (factory setting) ■ US mode: 3.9 to 20.8 mA
Signal on alarm	<p>Signal on alarm in accordance with NAMUR recommendation NE 43.</p> <ul style="list-style-type: none"> ■ Signal over-range: > 20.5 mA ■ Signal under-range: < 3.8 mA ■ Min alarm (< 3.6 mA, factory setting)
Load	<p>4 to 20 mA analog</p> <div style="border: 1px solid black; padding: 10px; margin: 10px 0;">  </div> <p>1 Power supply 10.5 to 35 V</p> <p>2 R_{Lmax} maximum load resistance</p> <p>U Supply voltage</p>
Damping	<p>A damping affects all outputs (output signal, display). Damping can be enabled as follows:</p> <ul style="list-style-type: none"> ■ Via the DIP switch on the electronic insert ■ Factory setting: 1 s
Ex connection data	<p>See the separate technical documentation (Safety Instructions (XA)) on www.endress.com/download.</p>
Linearization	<p>The device's linearization function allows the user to convert the measured value to any units of height or volume. User-defined linearization tables of up to 32 value pairs can be entered if necessary.</p>

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13.2 Environment

Ambient temperature range

The following values apply up to a process temperature of +85 °C (+185 °F). At higher process temperatures, the permitted ambient temperature is reduced.

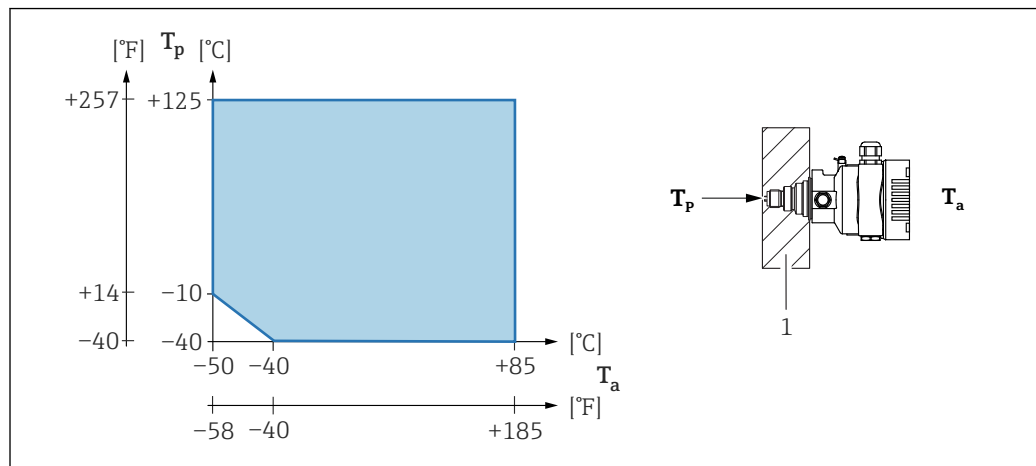
- Without LCD display:
Standard: -40 to +85 °C (-40 to +185 °F)
- With LCD display: -40 to +85 °C (-40 to +185 °F) with limitations in optical properties, such as display speed and contrast. Can be used without limitations up to -20 to +60 °C (-4 to +140 °F)
- Devices with PVC-coated capillary armor: -25 to +80 °C (-13 to +176 °F)
- Separate housing: -20 to +60 °C (-4 to +140 °F)

Applications with very high temperatures: use diaphragm seals with a temperature isolator or capillaries. Use a mounting bracket!

If vibrations additionally occur in the application: use a device with a capillary. Diaphragm seal with temperature isolator: use a mounting bracket!

Ambient temperature T_a depending on the process temperature T_p

The process connection must be fully insulated for ambient temperatures below -40 °C (-40 °F).



1 Insulation material

Hazardous area

- For devices for use in hazardous areas, see the Safety Instructions, Installation Drawing or Control Drawing
- Devices that have the most common explosion protection certificates (e.g. ATEX/ IEC Ex, etc.) can be used in explosive atmospheres up to the ambient temperature.

Storage temperature

- Without LCD display:
Standard: -40 to +90 °C (-40 to +194 °F)
- With LCD display: -40 to +85 °C (-40 to +185 °F)
- Separate housing: -40 to +60 °C (-40 to +140 °F)

With M12 plug, elbowed: -25 to +85 °C (-13 to +185 °F)

Devices with PVC-coated capillary armor: -25 to +90 °C (-13 to +194 °F)

Operating altitude

Up to 5 000 m (16 404 ft) above sea level.

Climate class	Class 4K4H (air temperature: -20 to +55 °C (-4 to +131 °F), relative humidity: 4 to 100 %) satisfied as per DIN EN 60721-3-4. Condensation is possible.
---------------	--

Atmosphere	Operation in very corrosive environment For corrosive environments (e.g. maritime environment / coastal areas), Endress+Hauser recommends the use of a PVC-coated capillary armor or a PTFE capillary armor for capillaries and the stainless steel housing. The transmitter can be additionally protected by a special coating (Technical Special Product (TSP)).
------------	---

Degree of protection	Test as per IEC 60529 and NEMA 250-2014
----------------------	---

Housing and process connection

IP66/68, TYPE 4X/6P

(IP68: (1.83 mH₂O for 24 h))

Cable entries

- Gland M20, plastic, IP66/68 TYPE 4X/6P
- Gland M20, brass nickel plated, IP66/68 TYPE 4X/6P
- Gland M20, 316L, IP66/68 TYPE 4X/6P
- Thread M20, IP66/68 TYPE 4X/6P
- Thread G1/2, IP66/68 TYPE 4X/6P
If the G1/2 thread is selected, the device is delivered with an M20 thread as standard and a G1/2 adapter is included with the delivery, along with the corresponding documentation
- Thread NPT1/2, IP66/68 TYPE 4X/6P
- Dummy plug transport protection: IP22, TYPE 2
- Plug HAN7D, 90 deg. IP65 NEMA Type 4X
- Plug M12
When housing is closed and connecting cable is plugged in: IP66/67 NEMA Type 4X
When housing is open or connecting cable is not plugged in: IP20, NEMA Type 1

NOTICE

Plug M12 and plug HAN7D: incorrect mounting can invalidate the IP protection class!

- ▶ The degree of protection only applies if the connecting cable used is plugged in and screwed tight.
- ▶ The degree of protection only applies if the connecting cable used is specified according to IP67 NEMA Type 4X.
- ▶ The IP protection classes are only maintained if the dummy cap is used or the cable is connected.

Process connection and process adapter when using the separate housing

FEP cable

- IP69 (on sensor side)
- IP66 TYPE 4/6P
- IP68 (1.83 mH₂O for 24 h) TYPE 4/6P

PE cable

- IP69 (on sensor side)
- IP66 TYPE 4/6P
- IP68 (1.83 mH₂O for 24 h) TYPE 4/6P

Vibration resistance

Single compartment housing

Mechanical construction	Sine wave oscillation IEC 61298-3:2008	Shock
Device	10 Hz to 60 Hz: ±0.35 mm (0.0138 in) 60 Hz to 1000 Hz: 5 g	30 g
Device with a "compact" or "temperature isolator" type of diaphragm seal ¹⁾	10 Hz to 60 Hz: ±0.15 mm (0.0059 in) 60 Hz to 1000 Hz: 2 g	30 g

- 1) Use either a device with a temperature isolator or with a capillary in applications with very high temperatures. If vibrations additionally occur in the application, Endress+Hauser recommends the use of a device with a capillary. If a device with a temperature isolator or capillary is used, the device must be mounted with a mounting bracket.

Electromagnetic compatibility (EMC)

- Electromagnetic compatibility as per EN 61326 series and NAMUR recommendation EMC (NE21)
- With regard to the safety function (SIL), the requirements of EN 61326-3-x are satisfied
- Maximum deviation with interference influence: < 0.5% of span with full measuring range (TD 1:1)

For more details refer to the EU Declaration of Conformity.

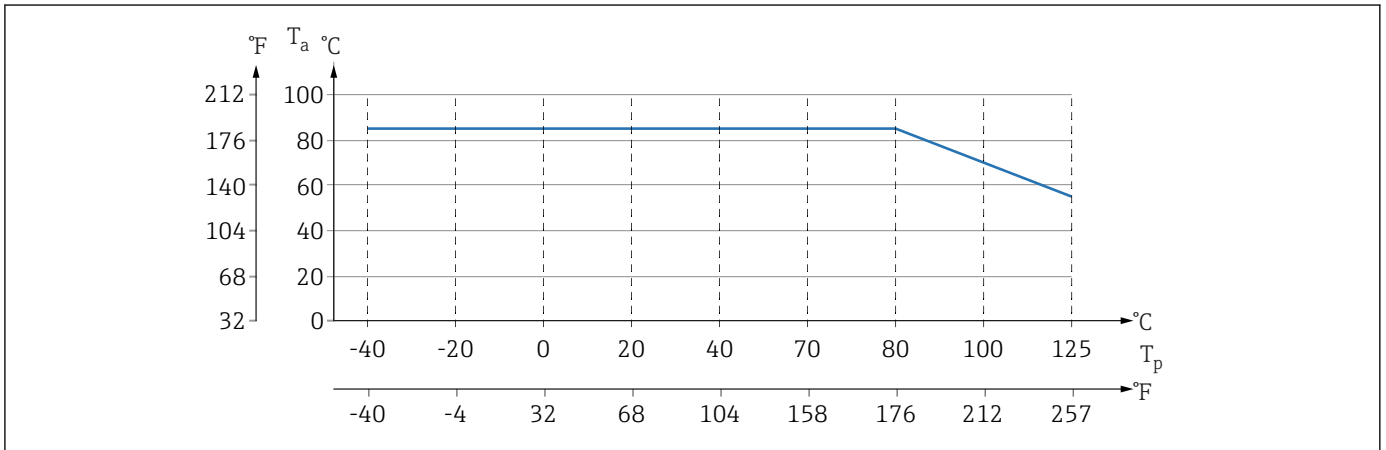
13.3 Process

Process temperature range **Standard device (without diaphragm seal)**

NOTICE

The permitted process temperature depends on the process connection, process seal, ambient temperature and the type of approval.

- All the temperature data in this document must be taken into consideration when selecting the device.



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5 Values apply for vertical mounting without insulation.

T_p Process temperature

T_a Ambient temperature

Diaphragm seal fill fluid

Fill fluid	$P_{abs} = 0.05 \text{ bar (0.725 psi)}^{1)}$	$P_{abs} \geq 1 \text{ bar (14.5 psi)}^{2)}$
Silicone oil	-40 to +180 °C (-40 to +356 °F)	-40 to +250 °C (-40 to +482 °F)
High-temperature oil	-20 to +200 °C (-4 to +392 °F)	-20 to +400 °C (-4 to +752 °F) ^{3) 4) 5)}
Low-temperature oil	-70 to +120 °C (-94 to +248 °F)	-70 to +180 °C (-94 to +356 °F)
Vegetable oil	-10 to +160 °C (+14 to +320 °F)	-10 to +220 °C (+14 to +428 °F)
Inert oil	-40 to +100 °C (-40 to +212 °F)	-40 to +175 °C (-40 to +347 °F) ^{6) 7)}

- 1) Permitted temperature range at $p_{abs} = 0.05 \text{ bar (0.725 psi)}$ (observe temperature limits of the device and the system!)
- 2) Permitted temperature range at $p_{abs} \geq 1 \text{ bar (14.5 psi)}$ (observe temperature limits of the device and the system!)
- 3) 325 °C (617 °F) at $\geq 1 \text{ bar (14.5 psi)}$ absolute pressure
- 4) 350 °C (662 °F) at $\geq 1 \text{ bar (14.5 psi)}$ absolute pressure (max. 200 hours)
- 5) 400 °C (752 °F) at $\geq 1 \text{ bar (14.5 psi)}$ absolute pressure (max. 10 hours)
- 6) 150 °C (302 °F) at $\geq 1 \text{ bar (14.5 psi)}$ absolute pressure
- 7) 175 °C (347 °F) at $\geq 1 \text{ bar (14.5 psi)}$ absolute pressure (max. 200 hours)

Fill fluid	Density ¹⁾ kg/m ³
Silicone oil	970
High-temperature oil	995
Low-temperature oil	940

Fill fluid	Density ¹⁾ kg/m ³
Vegetable oil	920
Inert oil	1900

1) Density of the diaphragm seal fill fluid at 20 °C (68 °F).

The calculation of the operating temperature range of a diaphragm seal system depends on the fill fluid, capillary length and capillary internal diameter, process temperature and oil volume of the diaphragm seal. Detailed calculations, e.g. for temperature ranges, negative pressure and temperature ranges, are done separately in the Applicator "[Sizing Diaphragm Seal](#)".



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Oxygen applications (gaseous)

Oxygen and other gases can react explosively to oils, grease and plastics. The following precautions must be taken:

- All components of the system, such as measuring devices, must be cleaned in accordance with the national requirements.
- Depending on the materials used, a certain maximum temperature and a maximum pressure must not be exceeded with oxygen applications.

The cleaning of the device (not accessories) is offered as an optional service.

- p_{max} : depending on the lowest-rated element, with regard to pressure, of the selected component: overpressure limit (OPL) of the sensor, process connection (1.5 x PN) or fill fluid (80 bar (1 200 psi))
- T_{max} : 60 °C (140 °F)

Standard device (without diaphragm seal)

- Process connections with internal process membrane: -40 to +125 °C (-40 to +257 °F) ; 150 °C (302 °F) for max. one hour)
- Process connections with flush membrane:
 - Thread (ISO228, ASME, metric DIN13) and flanges (EN, ASME, JIS): -40 to +100 °C (-40 to +212 °F)
 - Exceptions with seal supplied (M20 x 1.5, G1/2 DIN3852): -20 to +85 °C (-4 to +185 °F)

Devices with diaphragm seal

- Depends on diaphragm seal and fill fluid: -70 °C (-94 °F) up to +400 °C (+752 °F)
- Observe the maximum gauge pressure and maximum temperature

Diaphragm seal with tantalum membrane

-70 to +300 °C (-94 to +572 °F)

Devices with PTFE-coated diaphragm seal process membrane

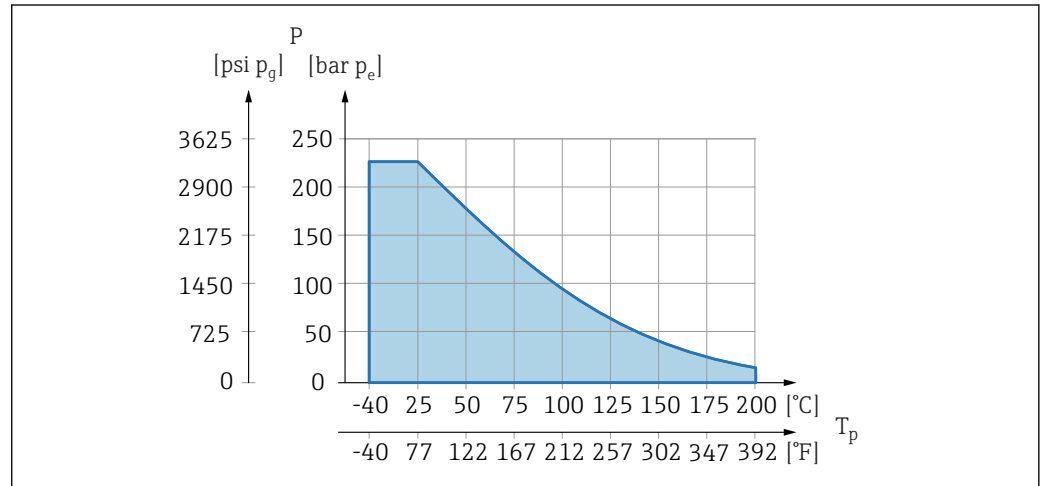
The anti-stick coating has very good anti-friction properties and protects the process membrane against abrasive media.

NOTICE

Destruction of the device due to incorrect use of PTFE coating!

- The PTFE coating used is designed to protect the unit against abrasion. It does not provide protection against corrosive media.

Area of application of the 0.25 mm (0.01 in) PTFE foil on AISI 316L (1.4404/1.4435) process membrane, see the following graphic:



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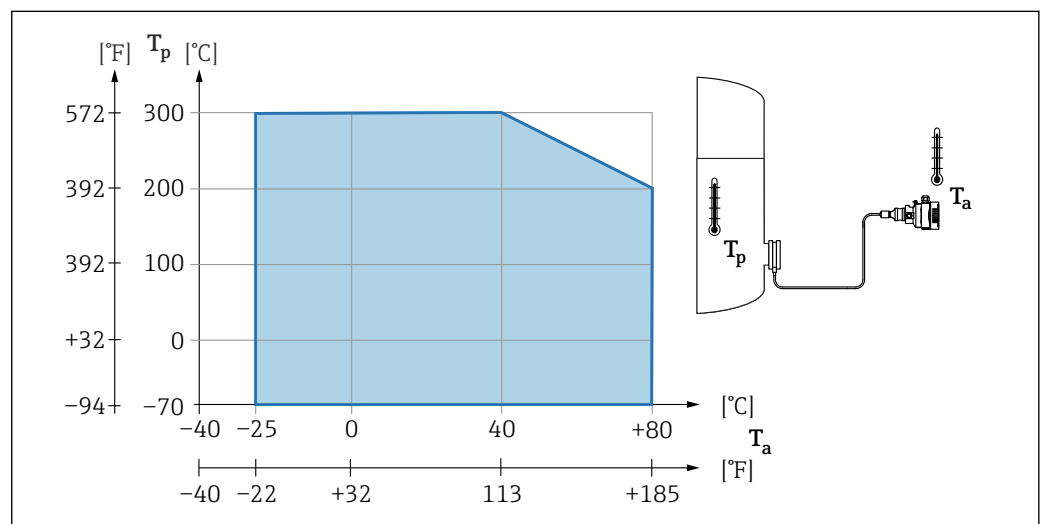
i For vacuum applications: $p_{abs} \leq 1 \text{ bar (14.5 psi)}$ to $0.05 \text{ bar (0.725 psi)}$ to max. $+150 \text{ °C (302 °F)}$.

If a PTFE coating has been selected, a conventional process membrane is always delivered.

Diaphragm seal capillary armor

Process temperature depending on the ambient temperature.

- 316L: No restrictions
- PTFE: No restrictions
- PVC: See the following diagram



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Process pressure range

Pressure specifications

⚠ WARNING

The maximum pressure for the device depends on the lowest-rated component with regard to pressure (components are: process connection, optional mounted parts or accessories).

- ▶ Only operate the device within the specified limits for the components!
- ▶ MWP (maximum working pressure): The MWP is specified on the nameplate. This value is based on a reference temperature of +20 °C (+68 °F) and may be applied to the device for an unlimited period of time. Note temperature dependence of MWP. For flanges, refer to the following standards for the permitted pressure values at higher temperatures: EN 1092-1 (with regard to their stability/temperature property, the materials 1.4435 and 1.4404 are grouped together under EN 1092-1; the chemical composition of the two materials can be identical.), ASME B 16.5a, JIS B 2220 (the latest version of the standard applies in each case). MWP data that deviate from this are provided in the relevant sections of the Technical Information.
- ▶ The overpressure limit corresponds to the overpressure limit OPL of the entire device. This value refers to a reference temperature of +20 °C (+68 °F).
- ▶ The Pressure Equipment Directive (2014/68/EU) uses the abbreviation "PS". The abbreviation "PS" corresponds to the MWP (maximum working pressure) of the device.
- ▶ In the case of sensor range and process connection combinations where the overpressure limit (OPL) of the process connection is smaller than the nominal value of the sensor, the device is set at the factory, at the very maximum, to the OPL value of the process connection. If the entire sensor range must be used, select a process connection with a higher OPL value (1.5 x PN; MWP = PN).
- ▶ Oxygen applications: do not exceed values for P_{max} and T_{max} .

Burst pressure

The following data apply for the standard device (without diaphragm seal).

Measuring range 400 mbar (6 psi) to 10 bar (150 psi)

Burst pressure: 100 bar (1 450 psi)

Measuring range 40 bar (600 psi)

Burst pressure: 250 bar (3 625 psi)

Measuring range 100 bar (1 500 psi)

Burst pressure: 1 000 bar (14 500 psi)

Measuring range 400 bar (6 000 psi)

Burst pressure: 2 000 bar (29 000 psi)

Measuring range 700 bar (10 500 psi)

Burst pressure: 2 800 bar (40 600 psi)

Ultrapure gas applications

Endress+Hauser also offers devices for special applications, such as for ultrapure gas, that are cleaned of oil and grease. No special restrictions regarding the process conditions apply to these devices.

Steam applications and saturated steam applications

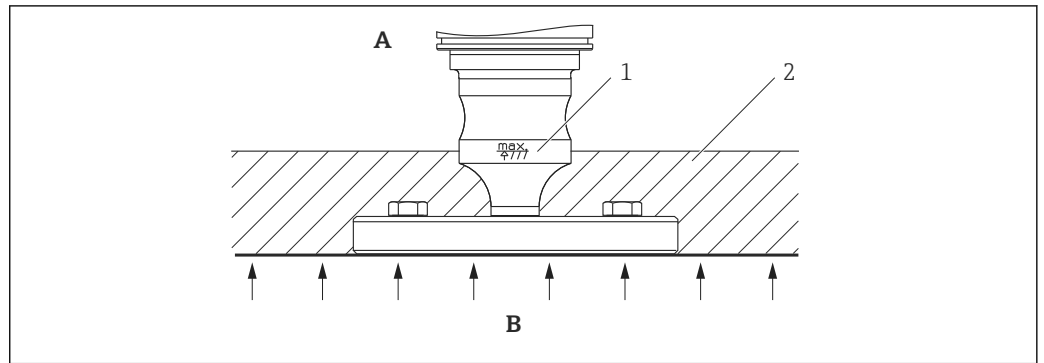
For steam and saturated steam applications: Use a device with a metal process membrane or provide a water pocket pipe for temperature decoupling when installing.

Thermal insulation

Thermal insulation with diaphragm seal directly mounted

The device may only be insulated up to a certain height. The maximum permitted insulation height is indicated on the device and applies to an insulation material with a heat conductivity $\leq 0.04 \text{ W}/(\text{m} \times \text{K})$ and to the maximum permitted ambient and process

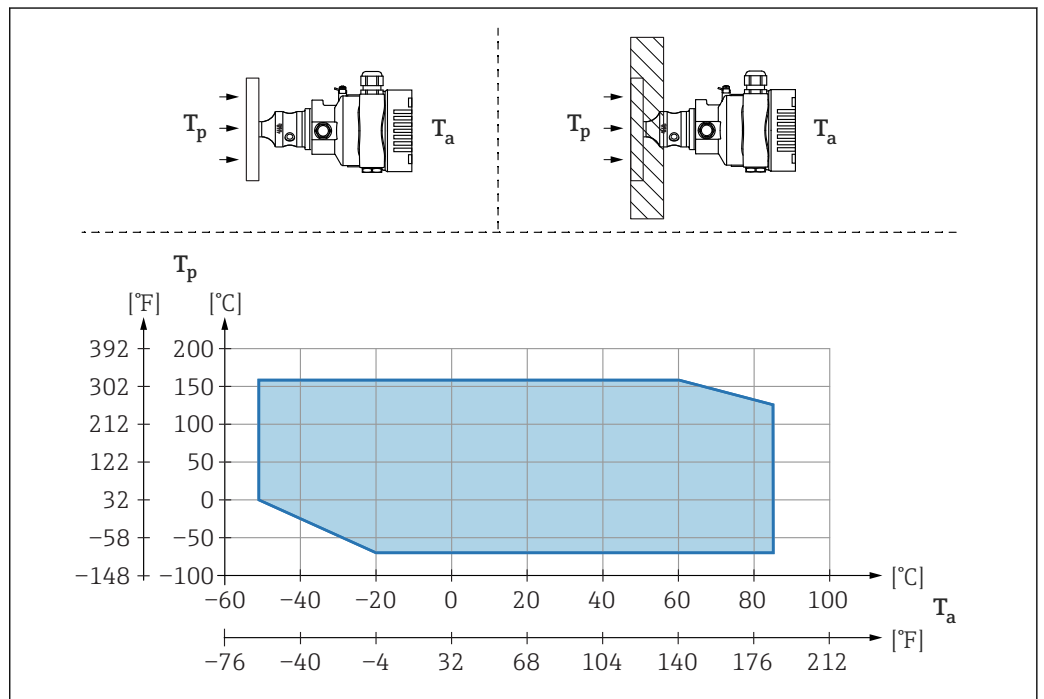
temperature. The data were determined under the most critical application "quiescent air". Maximum permitted insulation height, indicated here on a device with a flange:



A0020474

- A Ambient temperature
- B Process temperature
- 1 Maximum permitted insulation height
- 2 Insulation material

Mounting with a "Compact" diaphragm seal type



A0040383

- T_a Ambient temperature at transmitter
- T_p Maximum process temperature

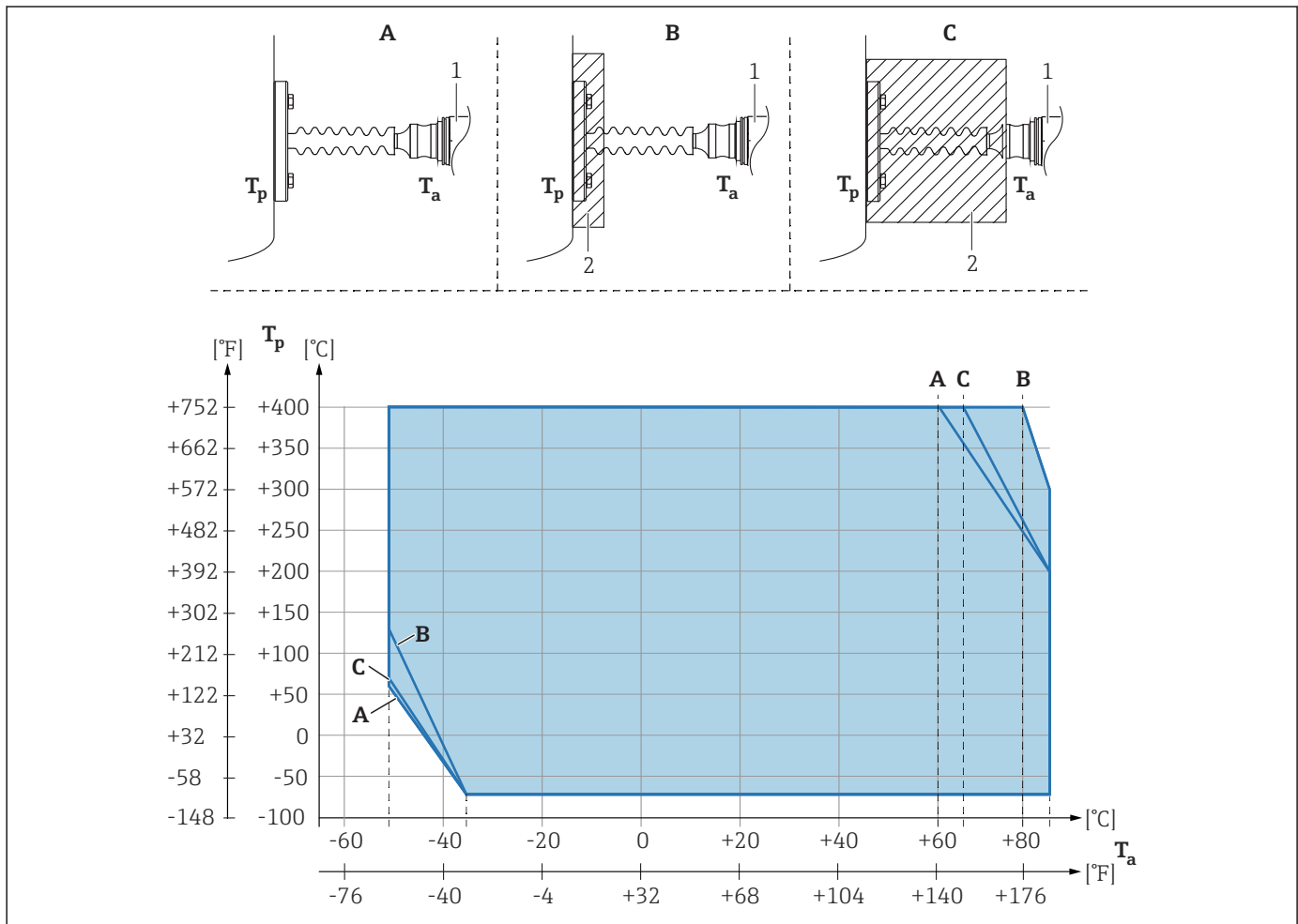
T_a	T_p
+85 °C (+185 °F)	-70 to +120 °C (-94 to +248 °F)
+60 °C (+140 °F)	-70 to +160 °C (-94 to +320 °F)
-20 °C (-4 °F)	-70 to +160 °C (-94 to +320 °F)
-50 °C (-58 °F)	0 to +160 °C (+32 to +320 °F)

Thermal insulation when mounting with a "Temperature isolator" diaphragm seal type

Use of temperature isolators in the event of constant extreme medium temperatures which cause the maximum permissible electronics temperature of +85 °C (+185 °F) to be exceeded. Diaphragm seal systems with temperature isolators can be used up to a maximum temperature of +400 °C (+752 °F) depending on the fill fluid used. For details see the Technical Information. To minimize the influence of rising heat, mount the device horizontally or with the housing pointing downwards. The additional installation height brings about a zero point shift due to the hydrostatic column in the temperature isolator. This zero point shift can be corrected on the device.

The maximum ambient temperature T_a at the transmitter depends on the maximum process temperature T_p .

The maximum process temperature depends on the diaphragm seal fill fluid used.



A0039378

- A No insulation
- B Insulation 30 mm (1.18 in)
- C Maximum insulation
- 1 Transmitter
- 2 Insulation material

Item	T_a ¹⁾	T_p ²⁾
A	60 °C (140 °F)	400 °C (752 °F) ³⁾
	85 °C (185 °F)	200 °C (392 °F)
	-50 °C (-58 °F)	60 °C (140 °F)
	-35 °C (-31 °F)	-70 °C (-94 °F)

Item	T _a ¹⁾	T _p ²⁾
B	80 °C (176 °F)	400 °C (752 °F) ³⁾
	85 °C (185 °F)	300 °C (572 °F)
	-50 °C (-58 °F)	130 °C (266 °F)
	-35 °C (-31 °F)	-70 °C (-94 °F)
C	67 °C (153 °F)	400 °C (752 °F) ³⁾
	85 °C (185 °F)	200 °C (392 °F)
	-50 °C (-58 °F)	70 °C (158 °F)
	-35 °C (-31 °F)	-70 °C (-94 °F)

- 1) Maximum ambient temperature at transmitter
- 2) Maximum process temperature
- 3) Process temperature: max. +400 °C (+752 °F), depending on the diaphragm seal fill fluid used

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