

# Operating Instructions

## Deltabar PMD78B

Differential pressure measurement  
4-20mA HART





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 Warning 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

**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.](#)

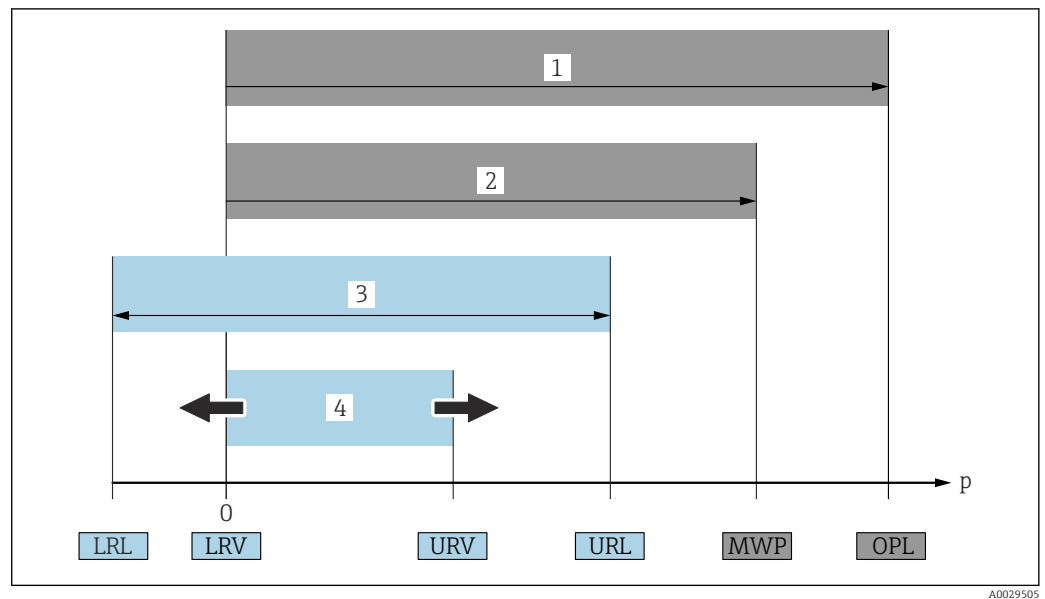
**Views:** A, B, C, ...

## 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 (over pressure limit = measuring cell overpressure limit) for the device depends on the lowest-rated element, with regard to pressure, of the selected components, i.e. the process connection must be taken into consideration in addition to the measuring cell. Observe pressure-temperature dependency. OPL (Over Pressure Limit) is a test pressure.
- 2 MWP: The MWP (maximum working pressure) for the measuring cells depends on the lowest-rated element, with regard to pressure, of the selected components, i.e. the process connection also has to be taken into consideration besides the measuring cell. Observe pressure-temperature dependency. The maximum working pressure may be applied at the device for an unlimited period of time. The maximum working pressure can be found on the nameplate.
- 3 The maximum measuring range corresponds to the span between the LRL and URL. This measuring range is equivalent to the maximum span that can be calibrated/adjusted.
- 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

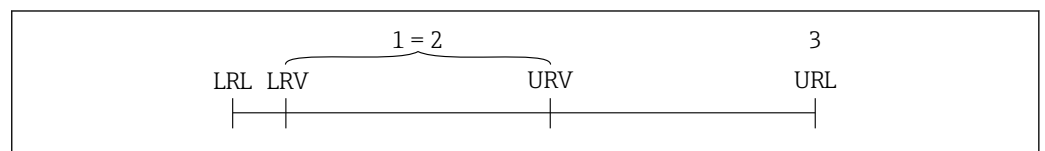
URL Upper range limit

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:

- Measuring cell: 16 bar (240 psi)
- Upper range limit (URL) = 16 bar (240 psi)
- Calibrated/adjusted span: 0 to 8 bar (0 to 120 psi)
- Lower range value (LRV) = 0 bar (0 psi)
- Upper range value (URV) = 8 bar (120 psi)

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

In this example, the TD is therefore 2:1. This measuring 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](http://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

### **HART®**

Registered trademark of the FieldComm Group, Austin, Texas USA

### **Bluetooth®**

The Bluetooth® wordmark and logos are registered trademarks of Bluetooth SIG, Inc. and any use of these trademarks by Endress+Hauser is licensed. Other trademarks and trade names are those of their respective owners.

### **Apple®**

Apple, the Apple logo, iPhone, and iPod touch are trademarks of Apple Inc., registered in the U.S. and other countries. App Store is a service mark of Apple Inc.

### **Android®**

Android, Google Play and the Google Play logo are trademarks of Google Inc.



## 2 Basic safety requirements

### 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 Deltabar is a differential pressure transmitter for measuring pressure, flow, level and differential 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.

## **2.6 Functional Safety SIL (optional)**

The Functional Safety Manual must be strictly observed for devices that are used in functional safety applications.

## **2.7 IT security**

Endress+Hauser can only provide a warranty if the device is installed and used as described in the Operating Instructions. The device is equipped with security mechanisms to protect it against any inadvertent changes to the device settings. IT security measures in line with operators' security standards and designed to provide additional protection for the device and device data transfer must be implemented by the operators themselves.

## **2.8 Device-specific IT security**

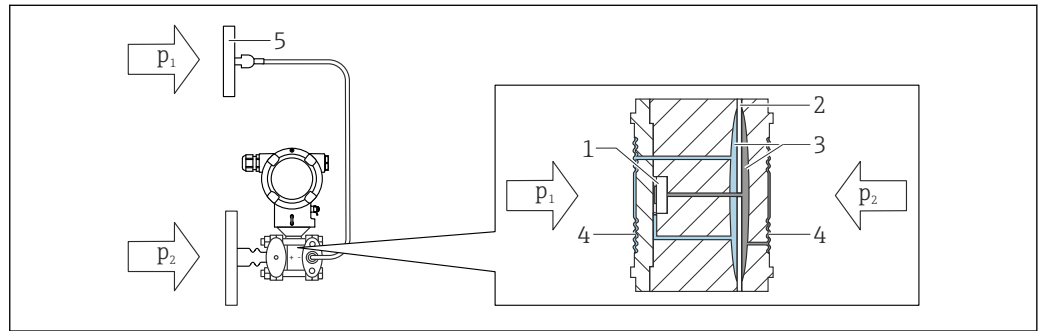
The device offers specific functions to support protective measures by the operator. These functions can be configured by the user and guarantee greater in-operation safety if used correctly. An overview of the most important functions is provided in the following section:

- Write protection via hardware write protection switch
- Access code to change user role (applies to operation via display, Bluetooth or FieldCare, DeviceCare, Asset Management Tools (e.g. AMS, PDM))

### 3 Product description

#### 3.1 Product design

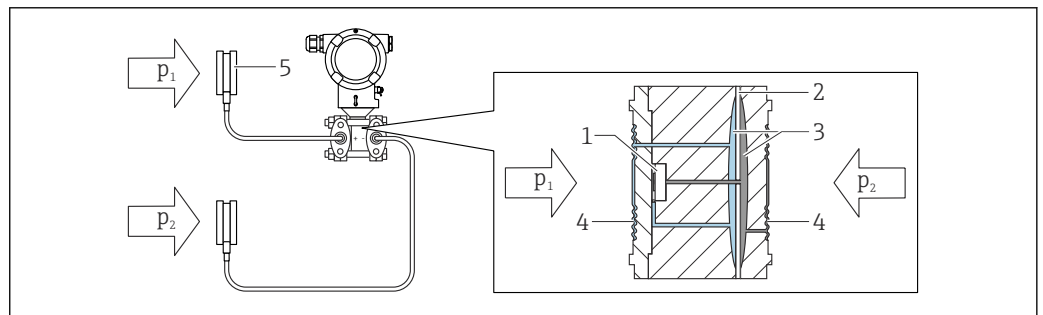
##### 3.1.1 Equipment architecture



A0043081

1 Capillary on the second side (P1) is optional

- 1 Measuring element
- 2 Middle diaphragm
- 3 Fill fluid
- 4 Internal membrane
- 5 Membrane of the diaphragm seal
- $p_1$  Pressure 1
- $p_2$  Pressure 2



A0043082

- 1 Measuring element
- 2 Middle diaphragm
- 3 Fill fluid
- 4 Internal membrane
- 5 Membrane of the diaphragm seal
- $p_1$  Pressure 1
- $p_2$  Pressure 2

The pressures applied are transferred from the membrane of the diaphragm seal to the internal membrane of the measuring cell by means of an incompressible fill fluid. This causes a deflection of the membranes on both sides. A second fill fluid transfers the pressure to a side of the measuring element where a resistance bridge is located (semiconductor technology). The change in the bridge output voltage, which depends on the differential pressure, is measured and processed further.

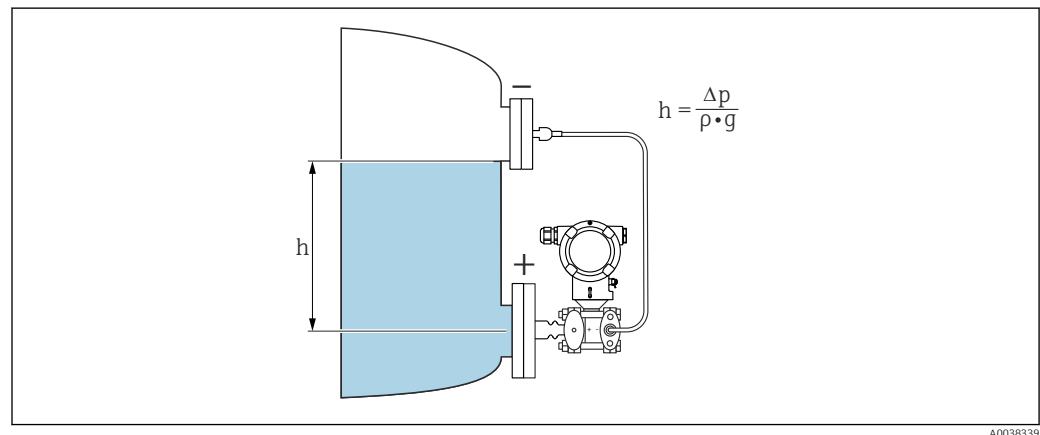
### Applications for diaphragm seals

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 (volume and mass):

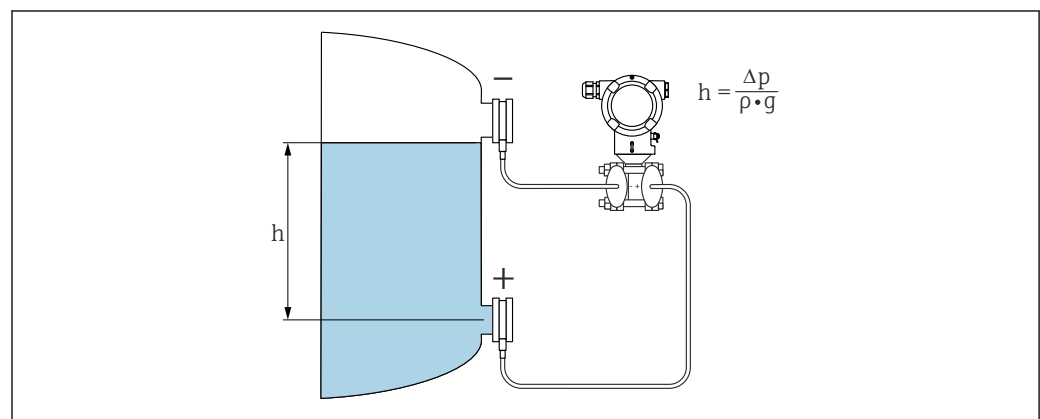
#### Diaphragm seal with temperature isolator on both sides



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$h$  Height (level)  
 $\Delta p$  Differential pressure  
 $\rho$  Density of the medium  
 $g$  Acceleration due to gravity

#### Diaphragm seal on both sides with capillary



A0038345

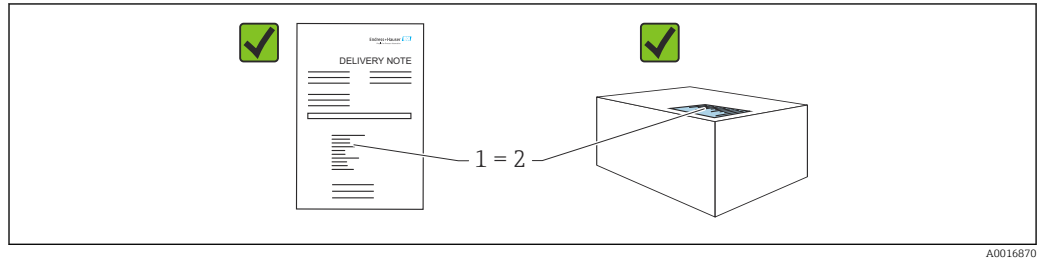
$h$  Height (level)  
 $\Delta p$  Differential pressure  
 $\rho$  Density of the medium  
 $g$  Acceleration due to gravity

**Advantages:**

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

## 4 Incoming acceptance and product identification

### 4.1 Incoming acceptance



A0016870

- 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](http://www.endress.com) → Download

### 4.2 Product identification

The following options are available for identification of the 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](http://www.endress.com/deviceviewer)): all the information about the 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 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 device to the measuring point in the original packaging.

#### WARNING

##### **Incorrect transport!**

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

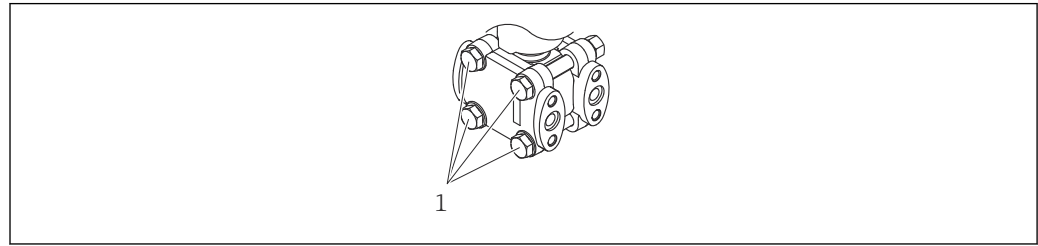
- Do not use capillaries as a carrying aid for the diaphragm seals.

## 5 Installation

### NOTICE

**The device can be damaged if handled incorrectly!**

- The removal of the screws with item number (1) is not permissible under any circumstances and will void the warranty.



A0025336

### 5.1 Installation requirements

#### 5.1.1 General instructions

- Do not clean or touch the membrane with hard and/or pointed objects.
- Do not remove the protection on the membrane until just 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

- To ensure optimal readability of the local display, align the housing and local display.
- Endress+Hauser offers a mounting bracket for installing 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 membrane
  - The flushing ring is clamped between the process connection and the flange, flange seal or pancake seal.
  - Material buildup in front of the membrane is flushed away and the pressure chamber is vented via the two lateral flushing holes.
- For measurements in media containing solids (e.g. dirty liquids), it makes sense to install separators and drain valves.
- Using a allows for easy commissioning, installation and maintenance without interrupting the process.
- When installing the device, establishing the electrical connection and during operation: prevent moisture from entering the housing.
- Point the cable and connector downwards where possible to prevent moisture from entering (e.g. rain or condensation water).



### 5.1.3 Installation instructions for devices with diaphragm seals

#### NOTICE

##### **Incorrect handling!**

Damage to the device!

- ▶ The diaphragm seal and pressure transmitter together form a sealed, calibrated system filled with fill fluid. Do not open the fill openings under any circumstances.
- ▶ Ensure strain relief to prevent the capillaries from bending (bending radius  $\geq$  100 mm (3.94 in)).
- ▶ Do not use capillaries as a carrying aid for the diaphragm seals.
- ▶ Keep within the application limits of the 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 liquid column in the capillaries must be taken into account when selecting the measuring cell. Perform zero adjustment if necessary. If a measuring cell with a small measuring range is selected, the nominal measuring cell range may be overdriven as a result of a position adjustment (position adjustment due to the zero offset caused by the installation position of the fluid column of the fill fluid).

For devices with a capillary, a suitable fastening device (mounting bracket) is recommended for installation.

During installation, ensure sufficient strain relief for the capillary to prevent it 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).

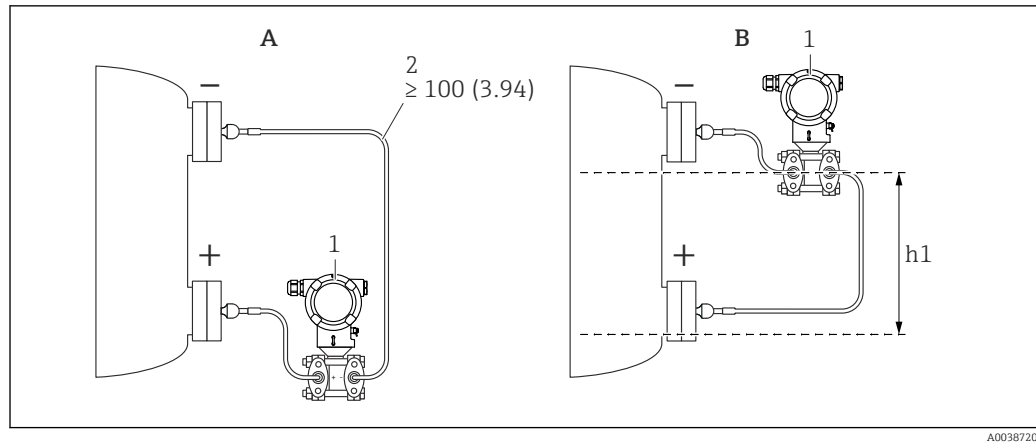
Do not mount capillaries in the vicinity of heating or cooling lines and protect them against direct sunlight.

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

##### **Vacuum applications**

In vacuum applications, mount the pressure transmitter below the diaphragm seal. This prevents additional vacuum loading of the diaphragm seal caused by the presence of fill fluid in the capillary.

If the pressure transmitter is installed above the diaphragm seal, do not exceed the maximum height difference  $h_1$ . The height difference  $h_1$  is shown in the Applicator ["Sizing Diaphragm Seal"](#).



A0038720

Unit of measurement mm (in)

A Recommended installation in a vacuum application

B Installation above the lower diaphragm seal

h1 Height difference (is shown in the Applicator "Sizing Diaphragm Seal")

1 Device

2 Bending radius  $\geq 100$  mm (3.94 in). Ensure strain relief to prevent the capillary from bending.

The maximum height difference depends on the density of the fill fluid and the lowest absolute pressure that can ever occur at the diaphragm seal (empty vessel).

### Cleaning instructions

Endress+Hauser provides flushing rings as an accessory to clean the membrane without taking the transmitter out of the process.



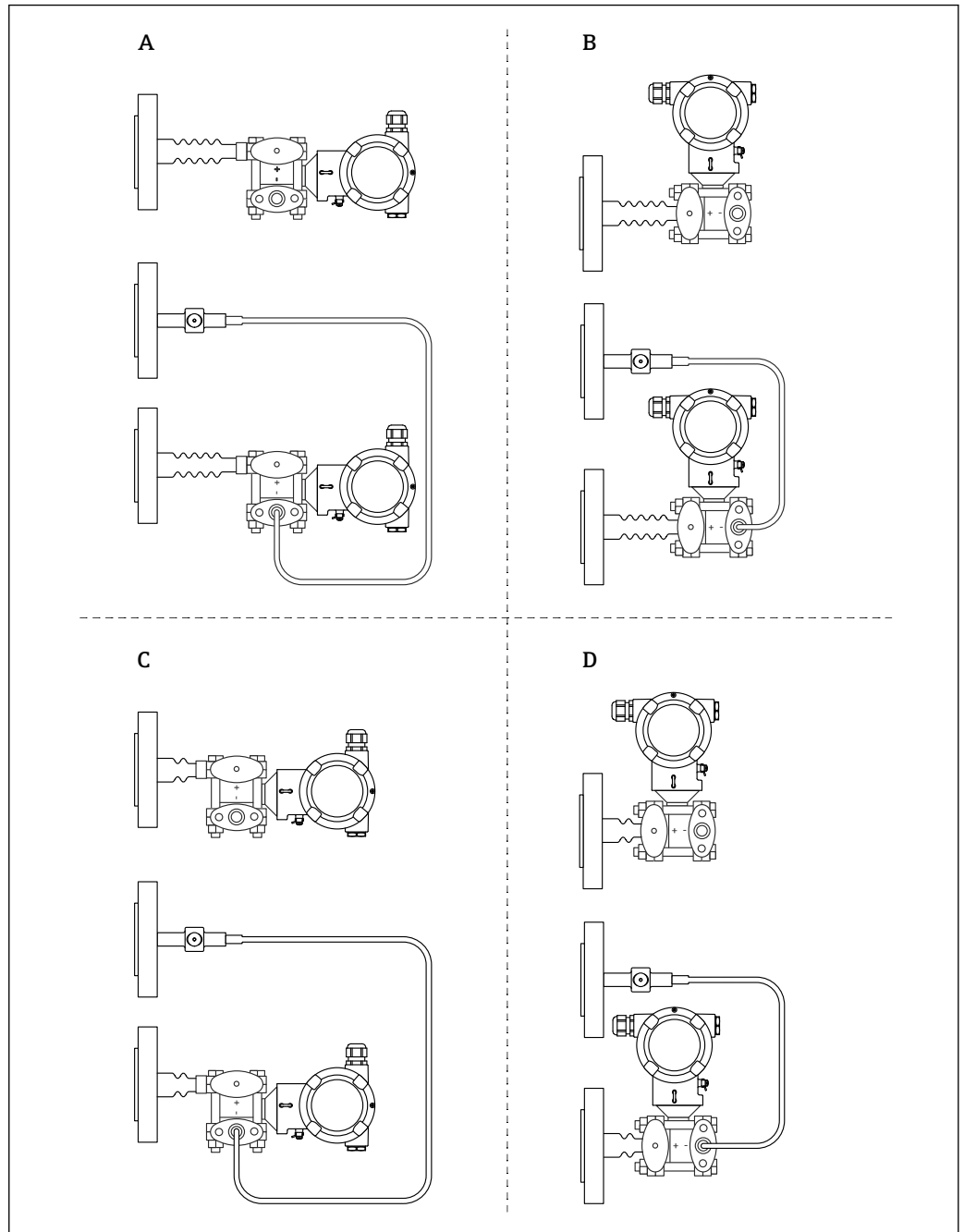
For more information, contact your Endress+Hauser sales office.

### 5.1.4 Installing pressure piping

- For recommendations for routing pressure piping, refer to DIN 19210 "Differential pressure piping for flow measurement devices" or the corresponding national or international standards
- When routing the pressure piping outdoors, ensure sufficient anti-freeze protection, e.g. by using pipe heat tracing
- Install the pressure piping with a monotonic gradient of at least 10%

### 5.1.5 Orientation

Diaphragm seal on one side or both sides with temperature isolator

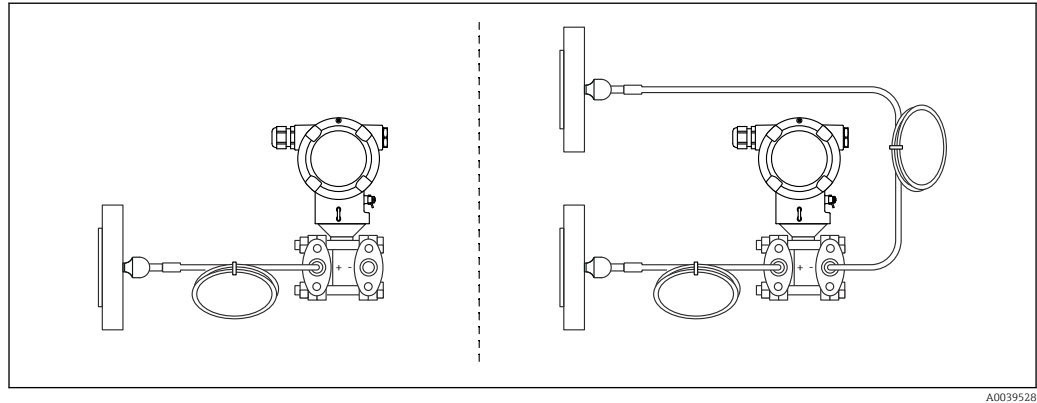


A0038658

- A Design HP side: Transmitter horizontal, temperature isolator long  
 B Design HP side: Transmitter vertical, temperature isolator long  
 C Design HP side: Transmitter horizontal, temperature isolator short  
 D Design HP side: Transmitter vertical, temperature isolator short

### Diaphragm seal on one side or both sides with capillary

In vacuum applications, mount the pressure transmitter below the lower diaphragm seal.



A0039528

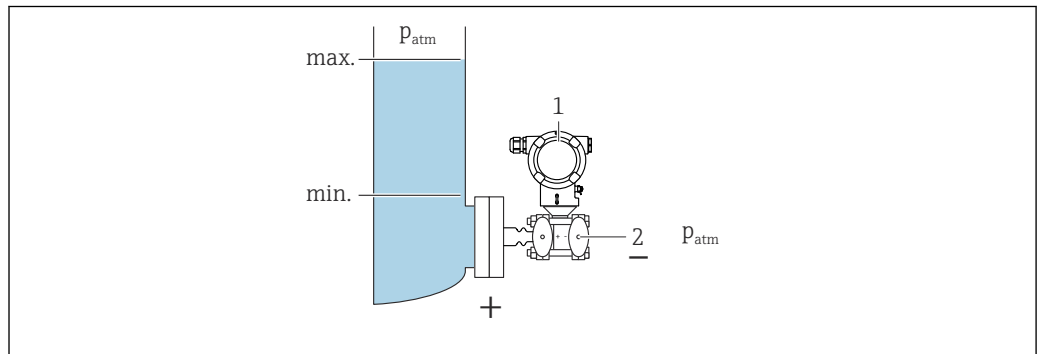


Use "[Sizing Diaphragm Seal](#)" for the installation check.

## 5.2 Installing the device

### 5.2.1 Level measurement

Level measurement in an open vessel, diaphragm seal on one side with temperature isolator

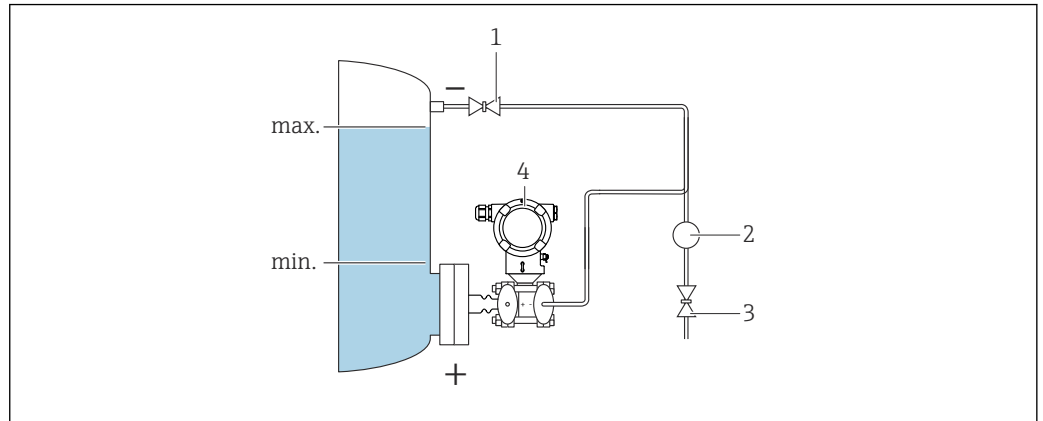


A0038702

- 1 Device
- 2 The negative side is open to atmospheric pressure

- Mount the device directly on the vessel
- The negative side is open to atmospheric pressure

### Level measurement in a closed vessel, diaphragm seal on one side with temperature isolator

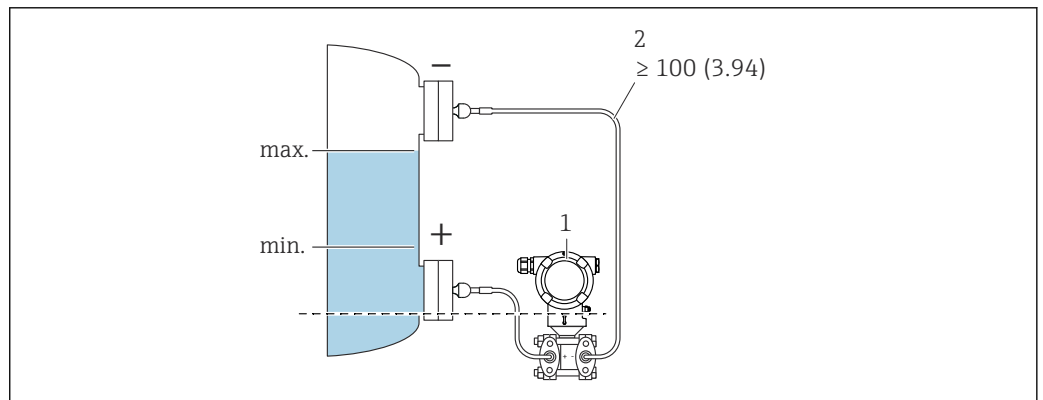


A0038703

- 1 Shut-off valve
- 2 Separator
- 3 Drain valve
- 4 Device

- Mount the device directly on the vessel
- Always connect the piping on the negative side above the maximum level

### Level measurement in a closed vessel, diaphragm seal on one side or both sides with capillary



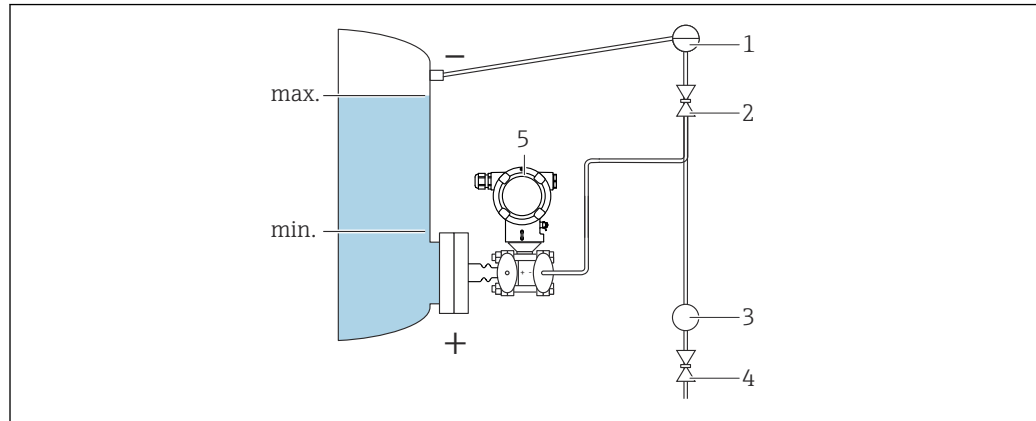
A0038705

- 1 Device
- 2 Ensure strain relief to prevent the capillary from bending (bending radius  $\geq 100$  mm (3.94 in)).

Mount the device below the lower diaphragm seal

Level measurement is only guaranteed between the upper edge of the lower diaphragm seal and the lower edge of the upper diaphragm seal.

### Level measurement in a closed vessel with superimposed vapor, diaphragm seal on one side with temperature isolator



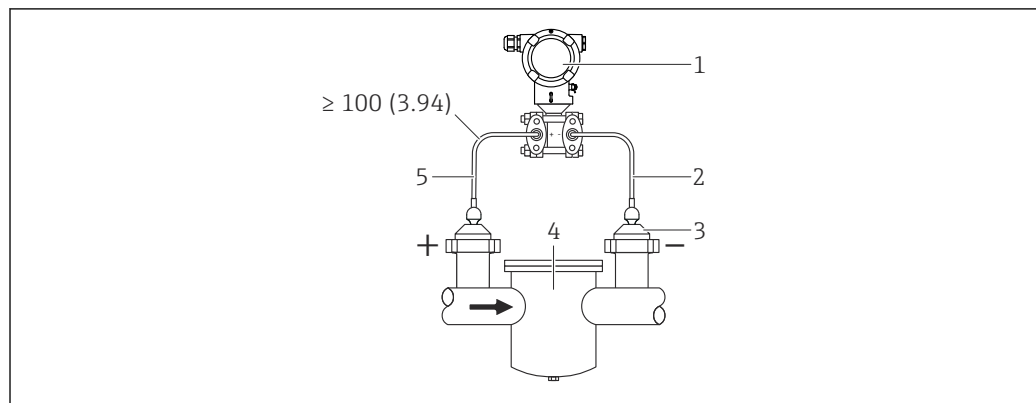
A0038707

- 1 Condensate trap
- 2 Shut-off valve
- 3 Separator
- 4 Drain valve
- 5 Device

- Mount the device directly on the vessel
- Always connect the piping on the negative side above the maximum level
- The condensate trap ensures constant pressure on the negative side
- When measuring in media with solid parts (such as dirty liquids) installing separators and drain valves is useful for capturing and removing sediment

## 5.2.2 Differential pressure measurement

### Differential pressure measurement in gases, vapors and liquids, diaphragm seal on one side or two sides with capillary



A0038710

- 1 Device
- 2 Capillary
- 3 Diaphragm seal
- 4 e.g. filter
- 5 Ensure strain relief to prevent the capillary from bending (bending radius  $\geq 100 \text{ mm}$  (3.94 in)).

- Mount diaphragm seals with capillaries on pipes at the top or side
- In vacuum applications, mount the device below the measuring point

### 5.2.3 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 devices, must be cleaned in accordance with national requirements.
- Depending on the materials used, a certain maximum temperature and a maximum pressure must not be exceeded for oxygen applications.

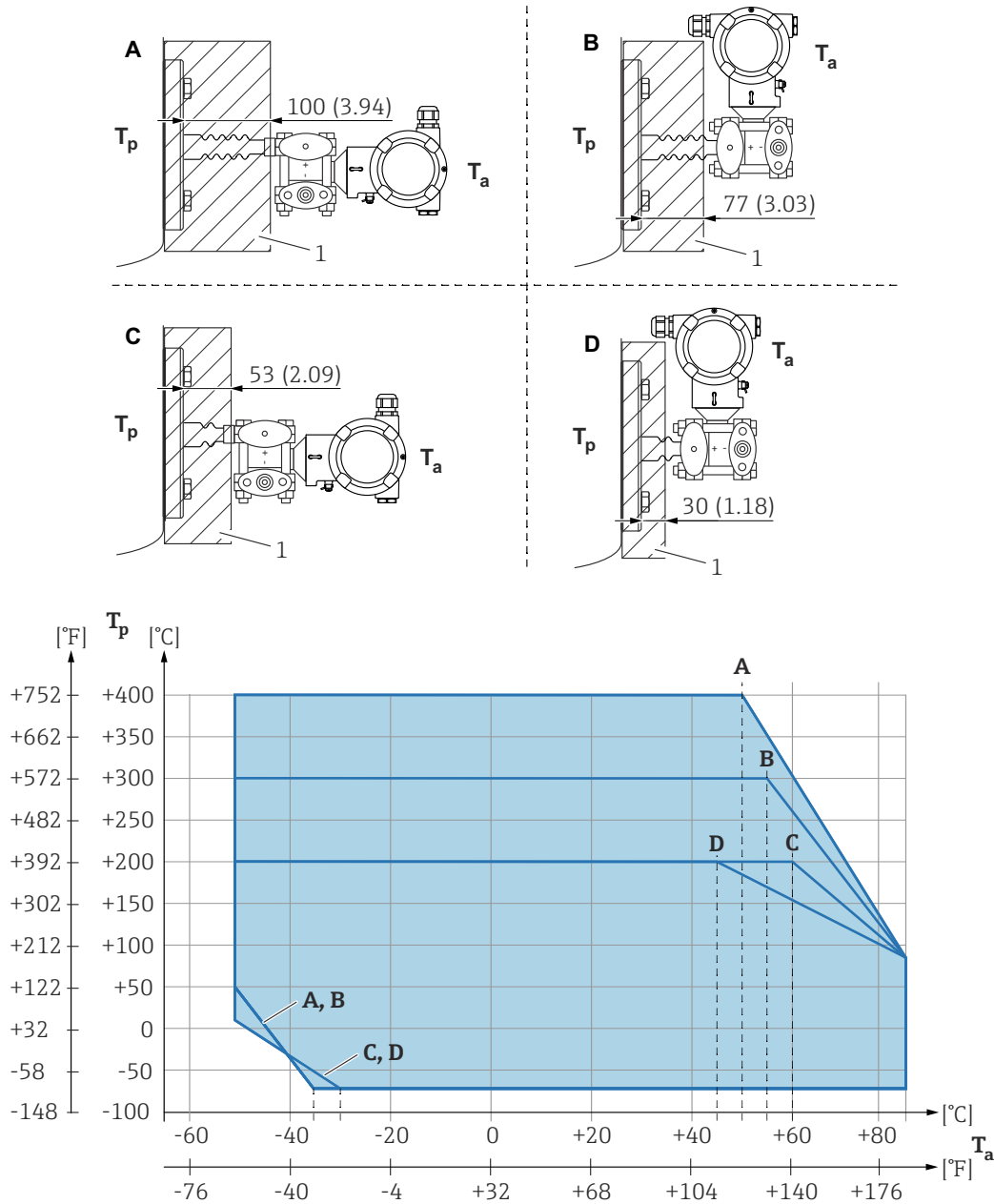
The cleaning of the device (not accessories) is provided as an optional service.

$T_{\max}$	$P_{\max}$ <sup>1)</sup>
80 °C (176 °F)	80 bar (1 200 psi)
> 80 to 120 °C (176 to 248 °F)	70 bar (1 050 psi)

1) PN of the flange

### 5.2.4 Thermal insulation when mounting with a temperature isolator

The device may only be insulated up to a certain height. The maximum permitted insulation height applies to an insulation material with a thermal conductivity  $\leq 0.04 \text{ W/(m} \times \text{K)}$  and to the maximum permitted ambient temperature and process temperature. The data were determined under the application "quiescent air".



A0039331

- 1 Insulation material
- A Transmitter horizontal, temperature isolator long
- B Transmitter vertical, temperature isolator long
- C Transmitter horizontal, temperature isolator short
- D Transmitter vertical, temperature isolator short

Without insulation, the ambient temperature decreases by 5 K.

Position	$T_a^{1)}$	$T_p^{2)}$
A	50 °C (122 °F)	400 °C (752 °F)
	85 °C (185 °F)	85 °C (185 °F) <sup>3)</sup>
	-50 °C (-58 °F)	50 °C (122 °F)
	-35 °C (-31 °F)	-70 °C (-94 °F)
B	55 °C (131 °F)	300 °C (572 °F)
	85 °C (185 °F)	85 °C (185 °F)



Position	T <sub>a</sub> <sup>1)</sup>	T <sub>p</sub> <sup>2)</sup>
C	-50 °C (-58 °F)	50 °C (122 °F)
	-35 °C (-31 °F)	-70 °C (-94 °F)
	60 °C (140 °F)	200 °C (392 °F)
	85 °C (185 °F)	85 °C (185 °F)
	-50 °C (-58 °F)	10 °C (50 °F)
	-30 °C (-22 °F)	-70 °C (-94 °F)
D	67 °C (153 °F)	200 °C (392 °F)
	85 °C (185 °F)	85 °C (185 °F)
	-50 °C (-58 °F)	10 °C (50 °F)
	-30 °C (-22 °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 fill fluid used.

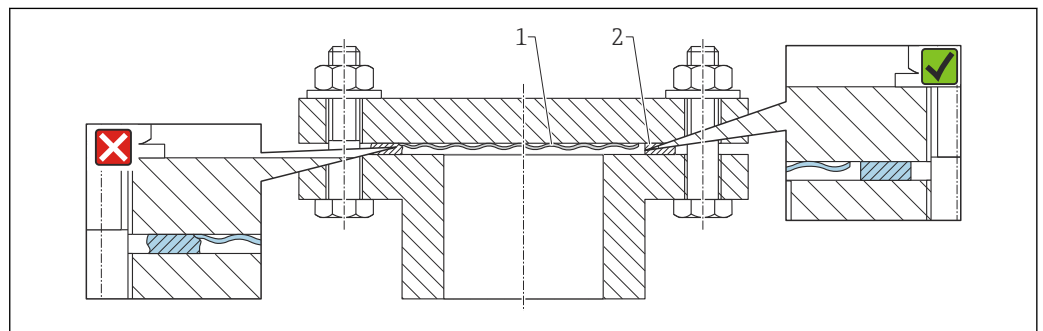
### 5.2.5 Seal for flange mounting

#### NOTICE

#### Seal pressing against the membrane!

Incorrect measurement results!

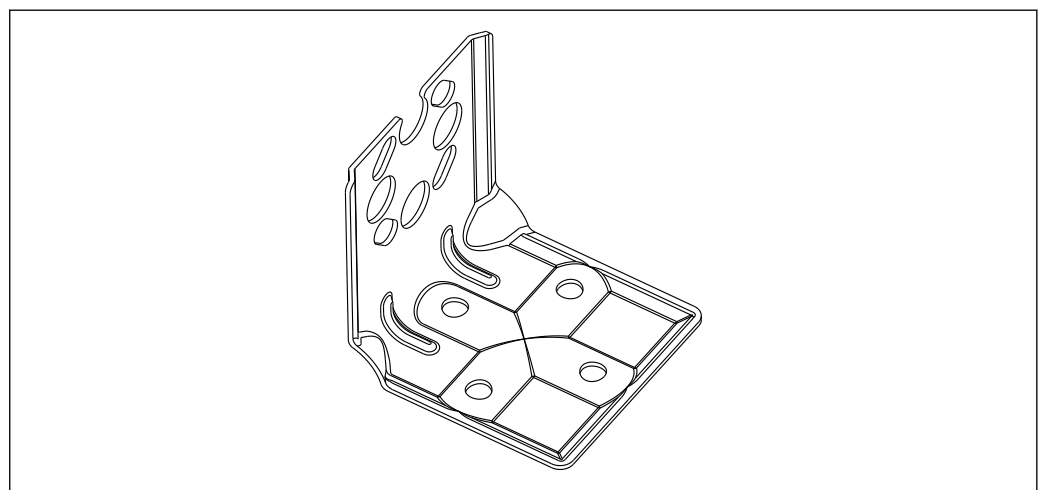
- Ensure that the seal is not touching the membrane.



A0017743

- 1 Membrane
- 2 Seal

### 5.2.6 Wall and pipe mounting



A0031326

- Bracket for wall and pipe mounting including retaining bracket for pipe mounting and two nuts
- The material of the screws used to secure the device depends on the order code.

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

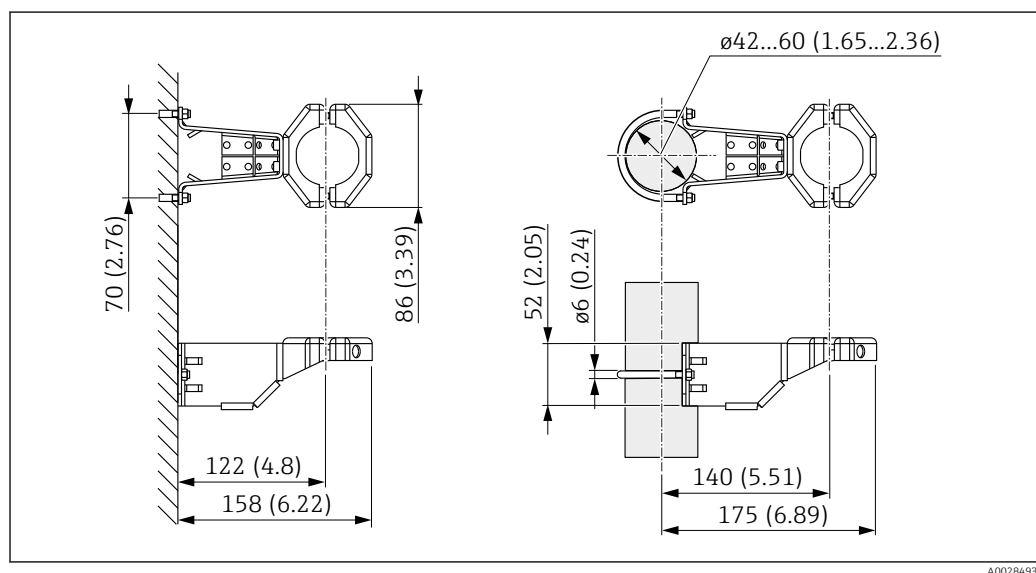
### 5.2.7 Wall and pipe mounting with a manifold (optional)

- Mount the device on a shutoff device, e.g. manifold or shutoff valve
- Use the bracket provided. This make device removal easier.

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

### 5.2.8 Mounting bracket for separate housing


The separate housing can be mounted on walls or pipes (for pipes with a diameter of 1 1/4" to 2") using the mounting bracket.



Unit of measurement mm (in)

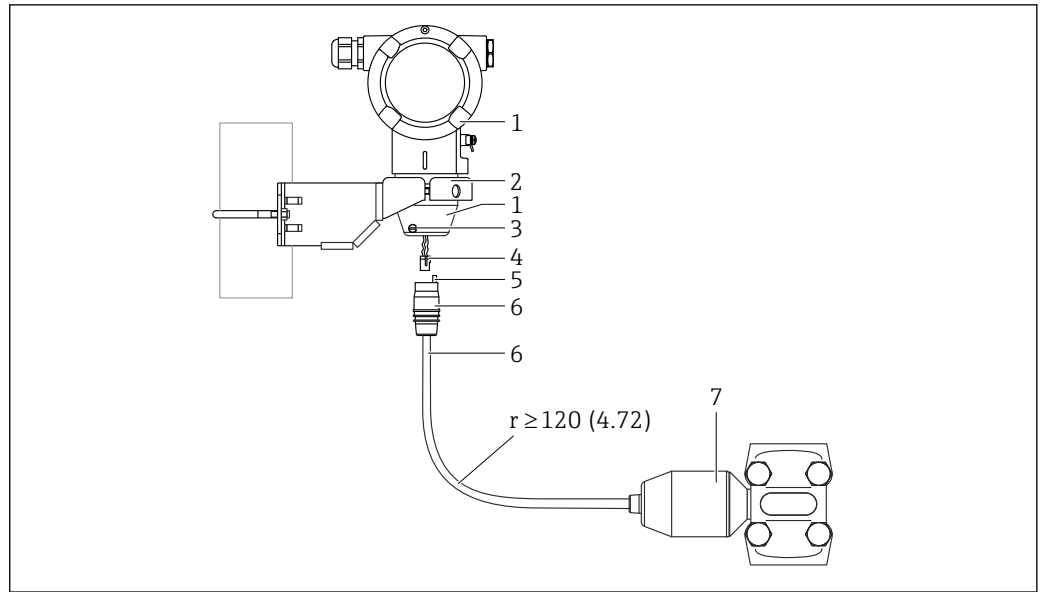
Ordering information:

Can be ordered as a separate accessory, part number 71102216

 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).

### 5.2.9 Assembling and installing the separate housing



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 1/4" to 2")
- 3 Locking screw
- 4 Plug
- 5 Pressure compensation
- 6 Cable with connection jack
- 7 In the separate housing version, the measuring cell is delivered with the process connection and cable already mounted.

#### Assembly and installation

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).

### 5.2.10 Turning the display module

#### **⚠ WARNING**

##### **Supply voltage switched on!**

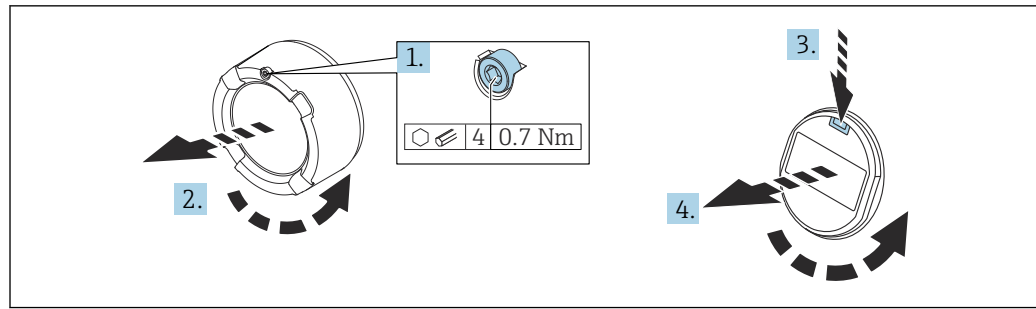
Risk of electric shock and/or explosion!

- Switch off the supply voltage before opening the device.

#### **⚠ CAUTION**

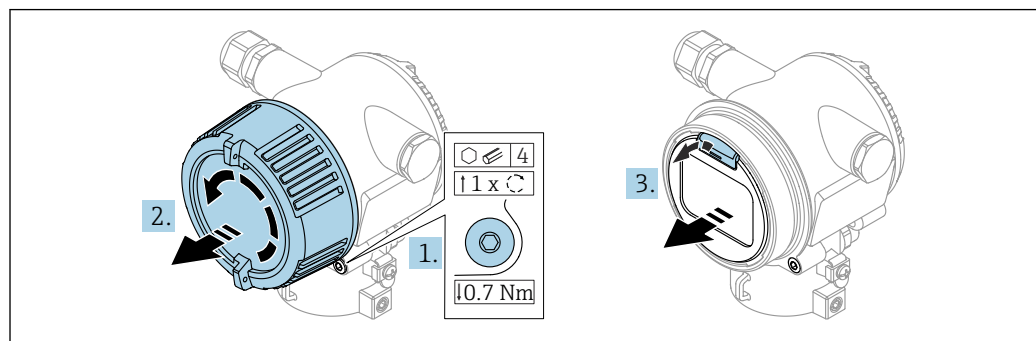
**Dual-compartment housing:** When opening the terminal compartment cover, fingers can get trapped between the cover and the pressure compensation filter.

- Open the cover slowly.



A0038224

2 Single-compartment housing and dual-compartment housing



A0058966

3 Dual-compartment housing, precision casting

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. Dual-compartment housing, precision casting: Ensure there is no tension between the cover and cover locking screw. Release any tension by turning the cover locking screw in the tightening direction.
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 provided: tighten the screw of the cover lock using the Allen key 0.7 Nm (0.52 lbf ft)  $\pm 0.2$  Nm (0.15 lbf ft).

### 5.2.11 Closing the housing covers

#### NOTICE

#### Thread and housing cover damaged from dirt and fouling!

- Remove dirt (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 threads of the electronics and connection compartment can be coated with an anti-friction coating.

The following applies for all housing materials:

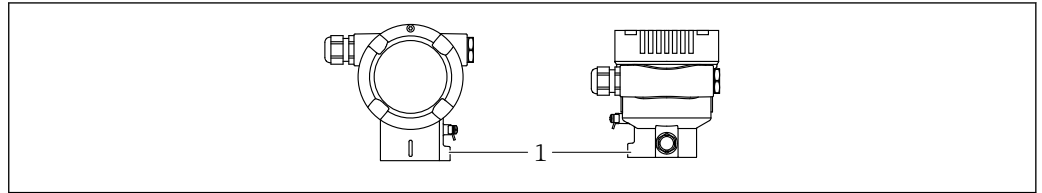
**✗ Do not lubricate the housing threads.**

### 5.2.12 Rotating the housing

The housing can be rotated up to  $360^\circ$  by loosening the set screw.

**Your benefits**

- Easy installation due to optimum alignment of housing
- Convenient access to the device's operating elements
- Optimum readability of the local display (optional)



A0043807

1 Set screw

**NOTICE****The housing cannot be unscrewed fully.**

- ▶ Loosen the external set screw by a maximum of 1.5 turns. If the screw is turned further or completely removed (beyond the screw anchor point), small parts (counter disk) may become loose and fall out.
- ▶ Tighten the securing screw (hexagon 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 Connection 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 device before the device is connected.

#### **⚠ WARNING**

##### **Ignitable sparks.**

Explosion hazard!

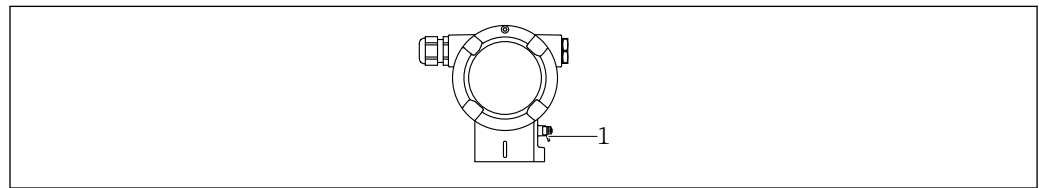
- ▶ Please refer to the separate documentation on applications in hazardous areas for the safety instructions.



For optimum electromagnetic compatibility:

- Use the shortest possible potential matching line.
- Ensure a cross-section of at least 2.5 mm<sup>2</sup> (14 AWG).

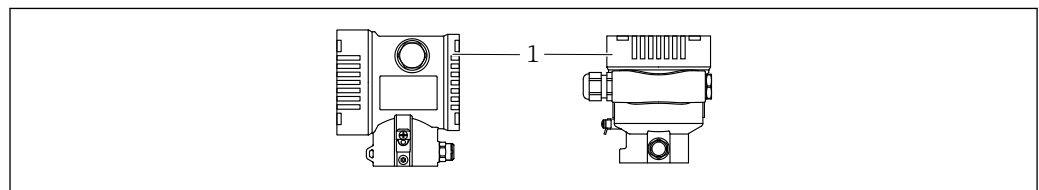
#### Dual-compartment housing



A0045412

- 1 Ground terminal for connecting the potential matching line

### 6.2 Connecting the device



A0043806

- 1 Connection compartment cover



#### **Housing thread**

The threads of the electronics and connection compartment can be coated with an anti-friction coating.

The following applies for all housing materials:

- ✗ Do not lubricate the housing threads.**

#### 6.2.1 Supply voltage

- Ex d, Ex e, non-Ex: supply voltage: 10.5 to 35 V<sub>DC</sub>
- Ex i: supply voltage: 10.5 to 30 V<sub>DC</sub>
- Nominal current: 4 to 20 mA HART

Depending on the supply voltage at the time of power-on:

- The background lighting is deactivated (supply voltage <15 V)
- The Bluetooth function (order option) is also deactivated (supply voltage <12 V).

**i** The power unit must be tested to ensure it meets safety requirements (e.g. PELV, SELV, Class 2) and must comply with the relevant protocol specifications. For 4 to 20 mA, the same requirements apply as for HART.

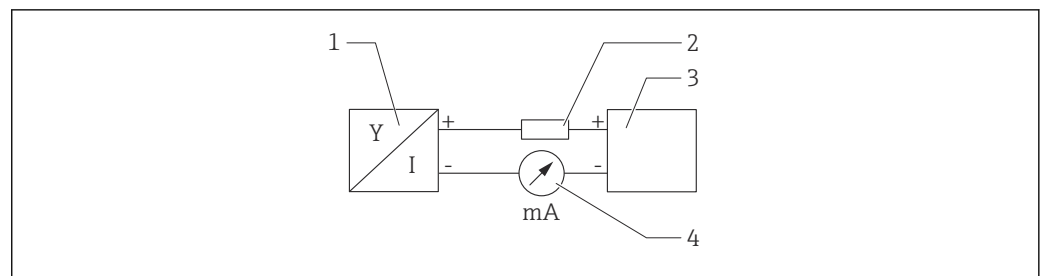
### 6.2.2 Terminals

- Supply voltage and inner ground terminal  
Clamping range: 0.5 to 2.5 mm<sup>2</sup> (20 to 14 AWG)
- External ground terminal  
Clamping range: 0.5 to 4 mm<sup>2</sup> (20 to 12 AWG)

### 6.2.3 Cable specification

- Protective ground or grounding of the cable shield: rated cross-section > 1 mm<sup>2</sup> (17 AWG)  
Rated cross-section of 0.5 mm<sup>2</sup> (20 AWG) to 2.5 mm<sup>2</sup> (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 HART



**4** Block diagram of HART connection

- 1 Device with HART communication
- 2 HART communication resistor
- 3 Power supply
- 4 multimeter

**i** The HART communication resistor of 250 Ω in the signal line is always necessary in the case of a low-impedance power supply.

**Take the voltage drop into consideration:**

Maximum 6 V for a communication resistor of 250 Ω

### 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 against transient overvoltages are applied (IEC/DIN EN 61000-4-5 Surge):

Test level on DC power ports and input/output ports is 1 000 V line to earth

**Devices with optional overvoltage protection**

- Spark-over voltage: min. 400 V<sub>DC</sub>
- Tested according to IEC/DIN EN 60079-14 sub chapter 12.3 (IEC/DIN EN 60060-1 chapter 7)
- Nominal discharge current: 10 kA

**NOTICE**

**The device may be damaged by excessively high electrical voltages.**

- ▶ Always ground the device with integrated overvoltage protection.

**Overvoltage category**

Overvoltage category II

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

Risk of electric shock and/or explosion!

- ▶ When operating the device in hazardous areas, ensure compliance with national standards and the specifications outlined in the Safety Instructions (XAs). Use the specified cable gland.
- ▶ 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 device before the power supply lines are 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.
- ▶ Protective circuits against reverse polarity, HF influences and overvoltage peaks are installed.

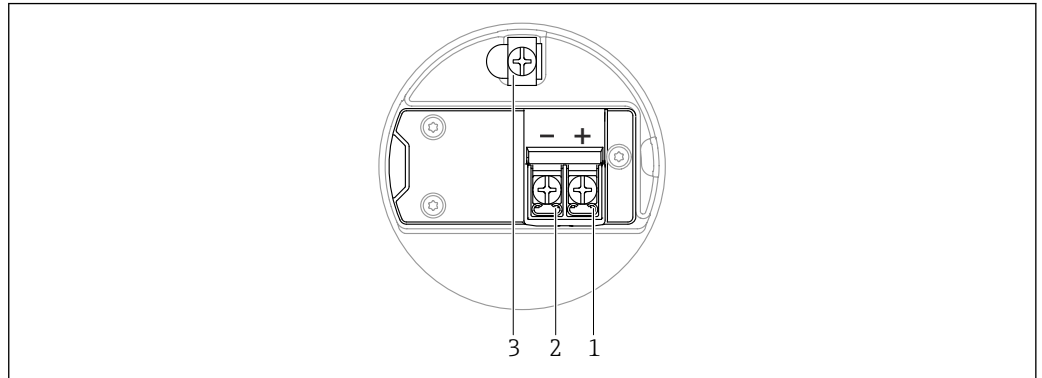
Connect the device in the following order:

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 cables.
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 provided: 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

### Dual-compartment housing




A0042803

 5 Connection terminals and ground terminal in the connection compartment

- 1 Plus terminal
- 2 Minus terminal
- 3 Internal ground terminal

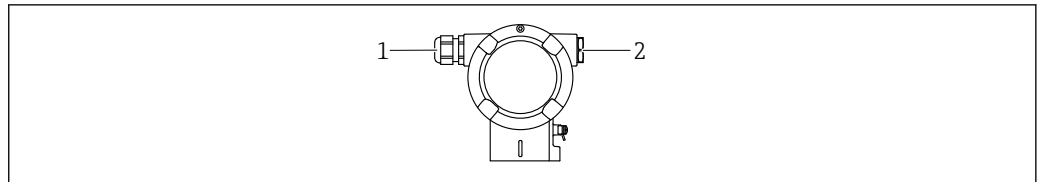
## 6.2.8 Cable entries

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

 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.


### Dual-compartment housing



A0045414

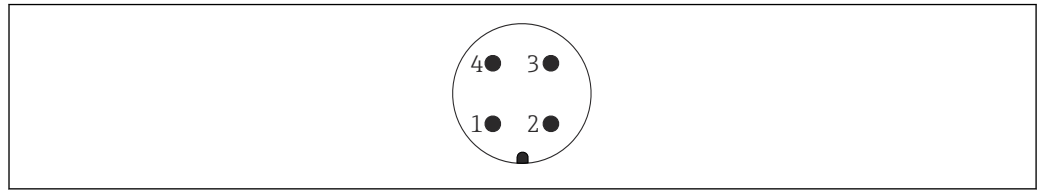
- 1 Cable entry
- 2 Blind plug

## 6.2.9 Available device plugs

 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.

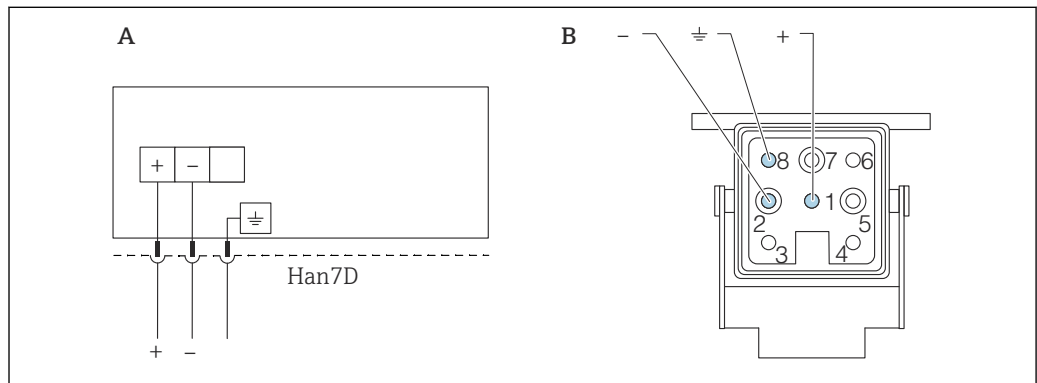
### Devices with M12 plug



A0011175

- 1 Signal +
- 2 Not used
- 3 Signal -
- 4 Earth

### Devices with a Harting plug Han7D



A0041011

- A Electrical connection for devices with Harting plug Han7D
- B View of the plug-in connection on the device
- Brown
- ≡ Green/yellow
- + Blue

## 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
- HAN7D plug, 90 degrees, IP65 NEMA Type 4X
- M12 plug

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**

**M12 plug and HAN7D plug: incorrect installation 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:

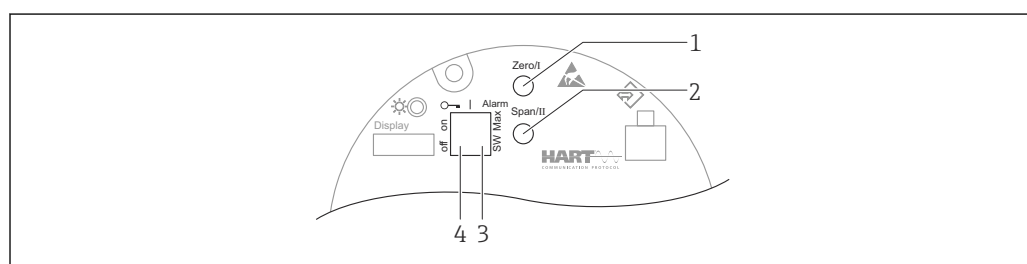
- ☐ Is the potential matching line connected?
- ☐ Is the terminal assignment correct?
- ☐ Are the cable glands and dummy plugs leak-tight?
- ☐ Are the fieldbus connectors properly secured?
- ☐ Are the covers screwed down correctly?

## 7 Operation options

### 7.1 Overview of operation options

- Operation via operating keys and DIP switches on the electronic insert
- Operation via optical operating keys on the device display (optional)
- Operation via Bluetooth® wireless technology (with optional Bluetooth device display) with SmartBlue app or FieldXpert, DeviceCare
- Operation via operating tool (Endress+Hauser FieldCare/DeviceCare or AMS, PDM, etc.)
- Operation via handheld, Fieldcare, DeviceCare, AMS and PDM

### 7.2 Operating keys and DIP switches on the electronic insert



A0039285

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

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

### 7.3 Structure and function of the operating menu

The differences between the structure of the operating menus of the local display and the Endress+Hauser FieldCare or DeviceCare operating tools can be summarized as follows:

The local display is suitable for configuring simple applications.

More elaborate applications can be configured with the Endress+Hauser FieldCare or DeviceCare tools as well as Bluetooth and the SmartBlue app and the device display.

Wizards help the user to commission the various applications. The user is guided through the individual configuration steps.

#### 7.3.1 User roles and related access authorization

The two user roles **Operator** and **Maintenance** (as-delivered state) have different write access to the parameters if a device-specific access code has been defined. This access code protects the device configuration from unauthorized access.

If an incorrect access code is entered, the user retains the **Operator** option user role.


## 7.4 Access to the operating menu via local display

### 7.4.1 Device display (optional)

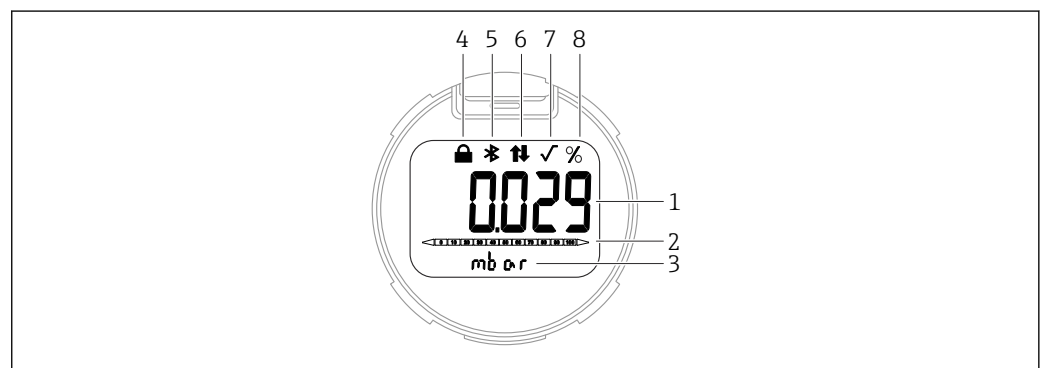
Functions:

- Display measured values and fault and notice messages
- Background lighting, which switches from green to red in the event of an error
- The device display can be removed for easier operation
- The device display fits into both housing parts (top and side) of the L-form dual-compartment housing.

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

 Depending on the supply voltage and the current consumption, background lighting is switched on or off.

Depending on the supply voltage and the current consumption, Bluetooth (optional) is switched on or off.

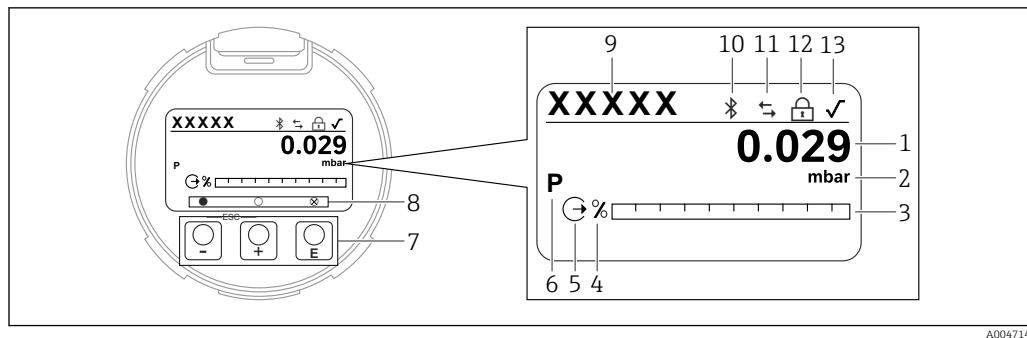


A0047143

#### 6 Segment display

- 1 Measured value (up to 5 digits)
- 2 Bar graph (refers to the specified pressure range) proportional to the current output
- 3 Unit of measured value
- 4 Locking (symbol appears when device is locked)
- 5 Bluetooth (symbol flashes if Bluetooth connection is active)
- 6 HART communication (symbol appears when HART communication is enabled)
- 7 Square root extraction (appears if the measured value is output using square root extraction)
- 8 Measured value output in %

The following graphics are examples. The display depends on the display settings.



A0047141

7 Graphic display with optical operating keys.

- 1 Measured value (up to 12 digits)
- 2 Unit of measured value
- 3 Bar graph (refers to the specified pressure range) proportional to the current output (not for PROFIBUS PA)
- 4 Bar graph unit
- 5 Symbol for current output (not for PROFIBUS PA)
- 6 Symbol for displayed measured value (e.g. p = pressure)
- 7 Optical operating keys
- 8 Symbols for key feedback. Different display symbols are possible: circle (not filled in) = key pressed briefly; circle (filled in) = key pressed for longer; circle (with X) = no operation possible due to Bluetooth connection
- 9 Device Tag
- 10 Bluetooth (symbol flashes if Bluetooth connection is active)
- 11 HART communication (symbol appears when HART communication is enabled) PROFIBUS PA communication (symbol appears when PROFIBUS PA communication is enabled)
- 12 Locking (symbol appears when device is locked)
- 13 Square root extraction (appears if the measured value is output using square root extraction)

- key
  - Navigate downwards in the selection list
  - Edit the numerical values or characters within a function
- key
  - Navigate upwards in the selection list
  - Edit the numerical values or characters within a function
- key
  - Confirm entry
  - Jump to the next item
  - Select a menu item and activate edit mode
  - Unlock/lock the display operation
  - Press and hold the key to display a short description of the selected parameter (if available)
- key and key (ESC function)
  - Exit the edit mode for a parameter without saving the changed value
  - Menu at a selection level: pressing the keys simultaneously takes the user back up a level in the menu
  - Press and hold the keys simultaneously to return to the upper level

## 7.4.2 Operation via Bluetooth® wireless technology (optional)

### Prerequisite

- Device with device display including Bluetooth
- Smartphone or tablet with Endress+Hauser SmartBlue app or PC with DeviceCare from version 1.07.05 or FieldXpert SMT70

The connection has a range of up to 25 m (82 ft). The range can vary depending on environmental conditions such as attachments, walls or ceilings.



The operating keys on the display are locked as soon as the device is connected via Bluetooth.

A flashing Bluetooth symbol indicates that a Bluetooth connection is available.



**Please note the following**

If the Bluetooth display is removed from one device and installed in another device:

- All the log-in data are only saved in the Bluetooth display and not in the device
- The password changed by the user is also saved in the Bluetooth display


### Operation via the SmartBlue app

The device can be operated and configured with the SmartBlue App.

- The SmartBlue App must be downloaded onto a mobile device for this purpose
- For information on the compatibility of the SmartBlue App with mobile devices, see **Apple App Store (iOS devices)** or **Google Play Store (Android devices)**
- Incorrect operation by unauthorized persons is prevented by means of encrypted communication and password encryption
- The Bluetooth® function can be deactivated after initial device setup



A0033202

 8 QR code for free Endress+Hauser SmartBlue App

Download and installation:

1. Scan the QR code or enter **SmartBlue** in the search field of the Apple App Store (iOS) or Google Play Store (Android).
2. Install and start the SmartBlue app.
3. For Android devices: enable location tracking (GPS) (not required for iOS devices).
4. Select a device that is ready to receive from the device list displayed.

Login:

1. Enter the user name: admin
2. Enter the initial password: serial number of the device
3. Change the password after logging in for the first time



**Notes on the password and reset code**

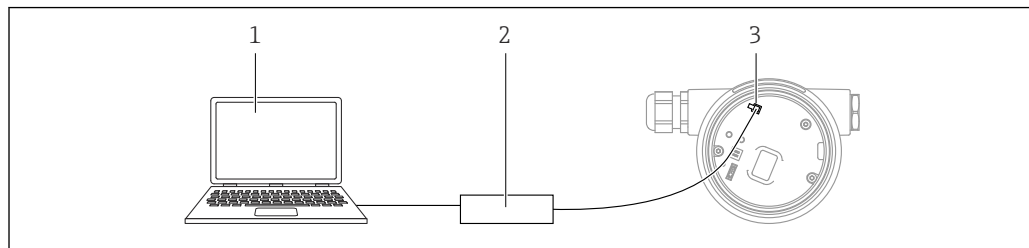
- If the user-defined password is lost, access can be restored via a reset code. The reset code is the serial number of the device in reverse. The original password is once again valid after the reset code has been entered.
- The reset code can also be changed in addition to the password.
- If the user-defined reset code is lost, the password can no longer be reset via the SmartBlue app. Contact Endress+Hauser Service in this case.

## 7.5 Access to the operating menu via the operating tool

The structure of the operating menu in the operating tools is the same as for operation via the local display. The range of functions is different however.

### 7.5.1 Connecting the operating tool

#### Service interface



A0039148

- 1 Computer with FieldCare/DeviceCare operating tool
- 2 Commubox FXA291
- 3 Service interface (CDI) of the device (= Endress+Hauser Common Data Interface)



At least 22 mA is required to update (flash) the device firmware.

### 7.5.2 DeviceCare

#### Range of functions

Tool for connecting and configuring Endress+Hauser field devices

The fastest way to configure Endress+Hauser field devices is with the dedicated "DeviceCare" tool. Together with the device type managers (DTMs), DeviceCare presents a convenient, comprehensive solution.



For details, see Innovation Brochure IN01047S.

### 7.5.3 FieldCare

#### Range of functions

FDT-based plant asset management tool from Endress+Hauser. FieldCare can configure all intelligent field devices in a system and helps you manage them. By using the status information, FieldCare is also a simple but effective way of checking their status and condition.

Access is via:

- CDI service interface
- HART communication

Typical functions:

- Configuration of transmitter parameters
- Loading and saving of device data (upload/download)
- Documenting the measuring point
- Visualizing the measured value memory (line recorder) and event logbook



For additional information about FieldCare, see Operating Instructions BA00027S and BA00059S

## 7.6 HistoROM

When replacing the electronic insert, the stored data is transferred by reconnecting the HistoROM. The device does not work without HistoROM.



The device serial number is saved in the HistoROM. The electronics serial number is saved in the electronics.

## 8 System integration

### 8.1 Overview of device description files


- Manufacturer ID: 17 (0x0011)
- Device type ID: 0x1131
- HART specification: 7.6
- DD files, information and files can be found at:
  - [www.endress.com](http://www.endress.com)
  - [www.fieldcommgroup.org](http://www.fieldcommgroup.org)

### 8.2 Measured variables via HART protocol

The following measured values are assigned to the device variables at the factory:

Device variable	Measured value
Primary variable (PV) <sup>1)</sup>	Pressure <sup>2)</sup>
Secondary variable (SV)	Sensor temperature
Tertiary variable (TV)	Electronics temperature
Quaternary variable (QV)	Sensor pressure <sup>3)</sup>

- 1) The PV is always applied to the current output.
- 2) The pressure is the calculated signal after damping and position adjustment.
- 3) The Sensor pressure is the raw signal of the measuring cell before damping and position adjustment.

 The assignment of the measured values to the device variables can be changed in the following submenu:  
Application → HART output → HART output

 In a HART Multidrop loop, only one device may use the analog current value for signal transmission. For all other devices in the **"Loop current mode" parameter**, select the **Disable** option.

#### 8.2.1 Device variables and measured values

The following codes are assigned to the device variables at the factory:

Device variable	Device variable code
Pressure	0
Scaled variable	1
Sensor temperature	2
Sensor pressure	3
Electronics temperature	4
Terminal current	5
Terminal voltage	6
Median of pressure signal	7
Noise of pressure signal	8
Percent of range	244

Device variable	Device variable code
Loop current	245
Not used	250

 The device variables can be queried by a HART® master using HART® command 9 or 33.

### 8.2.2 System units

The following table describes the supported pressure measuring units.

Index number	Description	Hart unit code
0	mbar	8
1	bar	7
2	Pa	11
3	kPa	12
4	MPa	237
5	psi	6
6	torr	13
7	atm	14
8	mmH <sub>2</sub> O	4
9	mmH <sub>2</sub> O (4°C)	239
10	mH <sub>2</sub> O	240
11	mH <sub>2</sub> O (4°C)	240
10	ftH <sub>2</sub> O	3
11	inH <sub>2</sub> O	1
12	inH <sub>2</sub> O (4°C)	238
13	mmHg	5
14	inHg	2
15	gf/cm <sup>2</sup>	9
16	kgf/cm <sup>2</sup>	10

## 9 Commissioning

### 9.1 Preparatory steps

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

#### WARNING

**The settings of the current output are relevant for safety!**

This situation can result in product overflow.

- ▶ The setting of the current output depends on the setting in the **Assign PV** parameter.
- ▶ After changing the **Assign PV** parameter, check the settings for the range (LRV and URV) and reconfigure them if necessary.

#### 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 measuring range limits.

#### 9.1.1 As-delivered state

If no customized settings were ordered:

- **Assign PV** parameter **Pressure** option
- Calibration values defined by defined measuring cell 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
- If Bluetooth is ordered, then Bluetooth is switched on

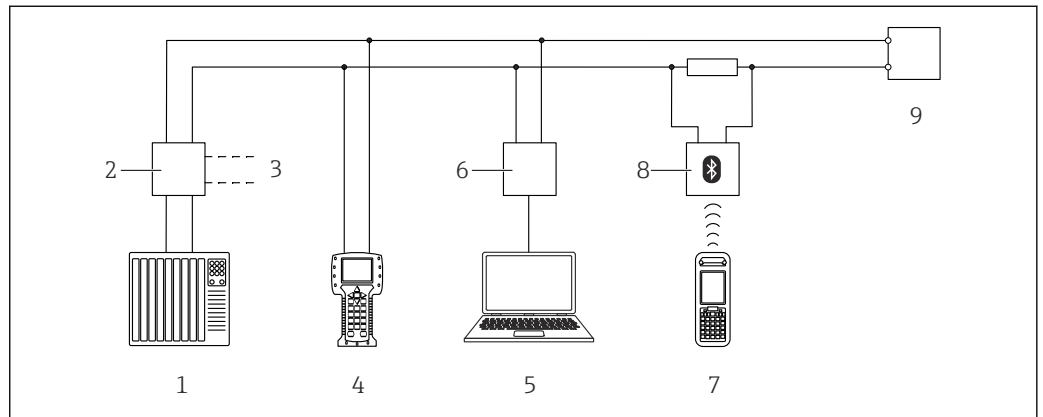
### 9.2 Function check

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)

## 9.3 Connecting via FieldCare and DeviceCare

### 9.3.1 Via HART protocol

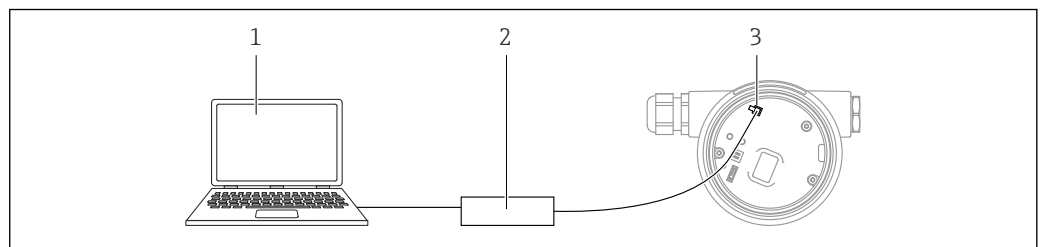


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 9 Options for remote operation via HART protocol


- 1 PLC (programmable logic controller)
- 2 Transmitter power supply unit, e.g. RN221N (with communication resistor)
- 3 Connection for Commubox FXA195 and Field Communicator 375, 475
- 4 Field Communicator 475
- 5 Computer with operating tool (e.g. FieldCare/DeviceCare, AMS Device Manager, SIMATIC PDM)
- 6 Commubox FXA195 (USB)
- 7 Field Xpert SFX350/SFX370
- 8 VIATOR Bluetooth modem with connecting cable
- 9 Device

### 9.3.2 FieldCare/DeviceCare via service interface (CDI)



A0039148

- 1 Computer with FieldCare/DeviceCare operating tool
- 2 Commubox FXA291
- 3 Service interface (CDI) of the device (= Endress+Hauser Common Data Interface)

 At least 22 mA is required to update (flash) the device firmware.

## 9.4 Configuring the device address via software


Please refer to the **HART address** parameter.





Menu path: Application → HART output → Configuration → HART address


## 9.5 Setting the operating language

### 9.5.1 Local display

#### Setting the operating language


 To set the operating language, the display first needs to be unlocked:

1. Press the  key for at least 2 s.
  - ↳ A dialog box appears.
2. Unlock the display operation.
3. In the main menu, select the **Language** parameter.
4. Press the  key.
5. Select the desired language with the  key.
6. Press the  key.

 Display operation locks automatically in the following cases:

- after 1 min on the main page if no key has been pressed
- after 10 min within the operating menu if no key has been pressed

#### Display operation - locking or unlocking

The  key must be pressed for at least 2 seconds in order to lock or unlock the optical keys. Display operation can be locked or unlocked in the dialog that appears.

Display operation locks automatically (except in the SIL wizard):

- After 1 minute on the main page if no key has been pressed
- After 10 minutes within the operating menu if no key has been pressed

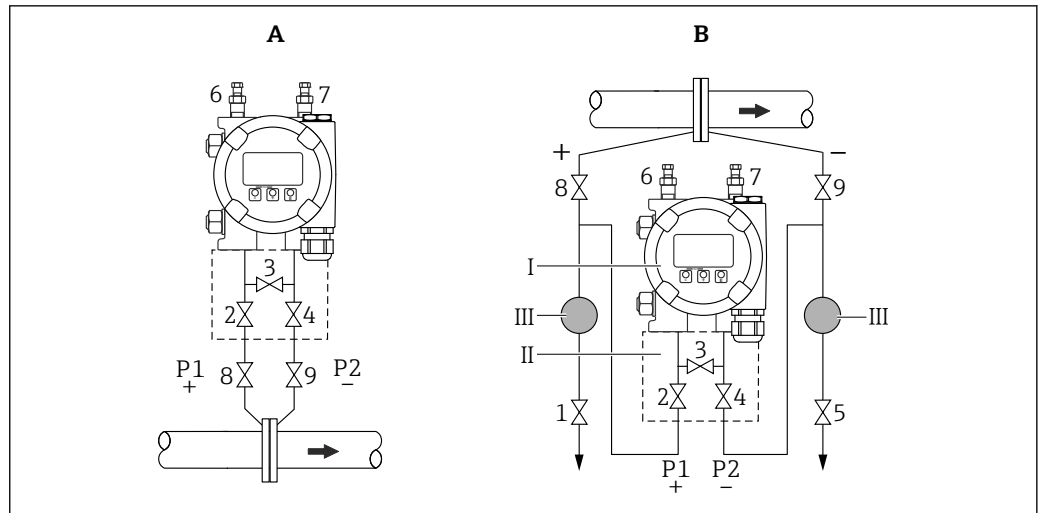
### 9.5.2 Operating tool

See the description of the relevant operating tool.

## 9.6 Configuring the device

### 9.6.1 Differential pressure measurement (e.g. flow measurement)


Before adjusting the device, the piping may need to be cleaned and filled with medium.



A0030036

- A Preferred installation for gases*  
*B Preferred installation for liquids*  
*I Device*  
*II Three-valve manifold*  
*III Separator*  
*1, 5 Drain valves*  
*2, 4 Inlet valves*  
*3 Equalization valve*  
*6, 7 Vent valves on device*  
*8, 9 Shutoff valves*

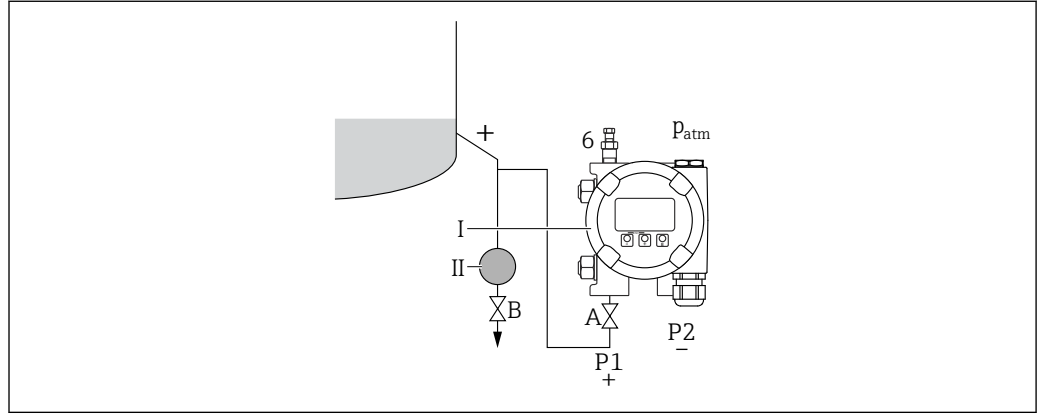
1. Close 3.
2. Fill the measuring system with medium.
  - ↳ Open A, B, 2, 4. Fluid flows in.
3. Vent device.
  - ↳ Liquids: Open 6 and 7 until the system (piping, valves and side flanges) is completely filled with medium.
  - Gases: Open 6 and 7 until the system (piping, valves and side flanges) is completely filled with gas and free from condensation.
  - Close 6 and 7.

 Check the adjustment and perform again if necessary.

## 9.6.2 Level measurement

### Open vessel

Before adjusting the device, the piping may need to be cleaned and filled with medium.



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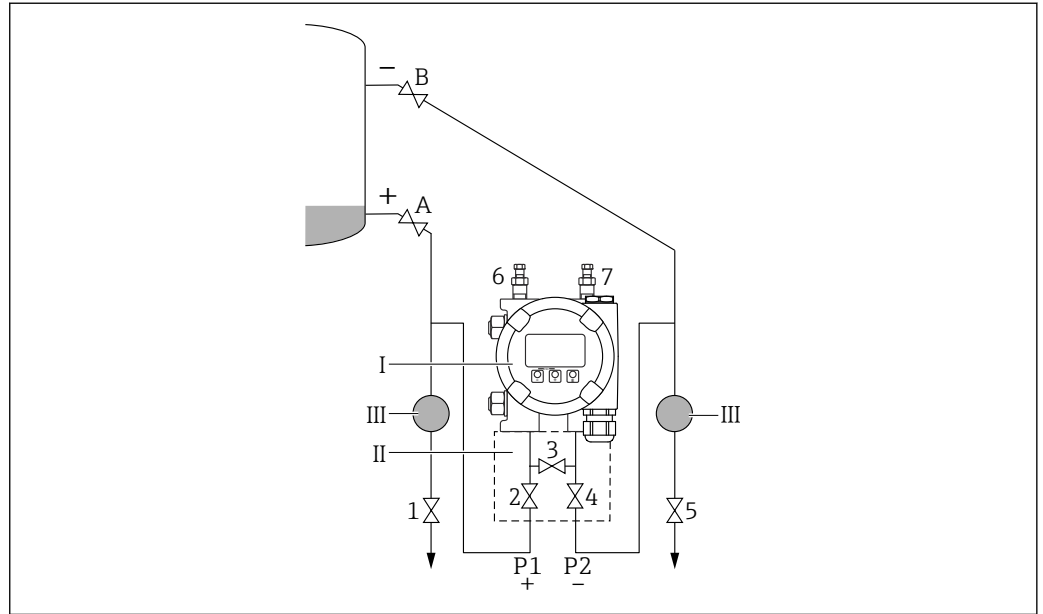
- I* Device
- II* Separator
- 6* Vent valve on device
- A* Shutoff valve
- B* Drain valve

1. Fill the vessel to above the lower tapping point.
2. Fill the measuring system with medium.
  - ↳ Open A (shutoff valve).
3. Vent device.
  - ↳ Open 6 until the system (piping, valve and side flange) is completely filled with medium.



### Closed vessel

Before adjusting the device, the piping may need to be cleaned and filled with medium.



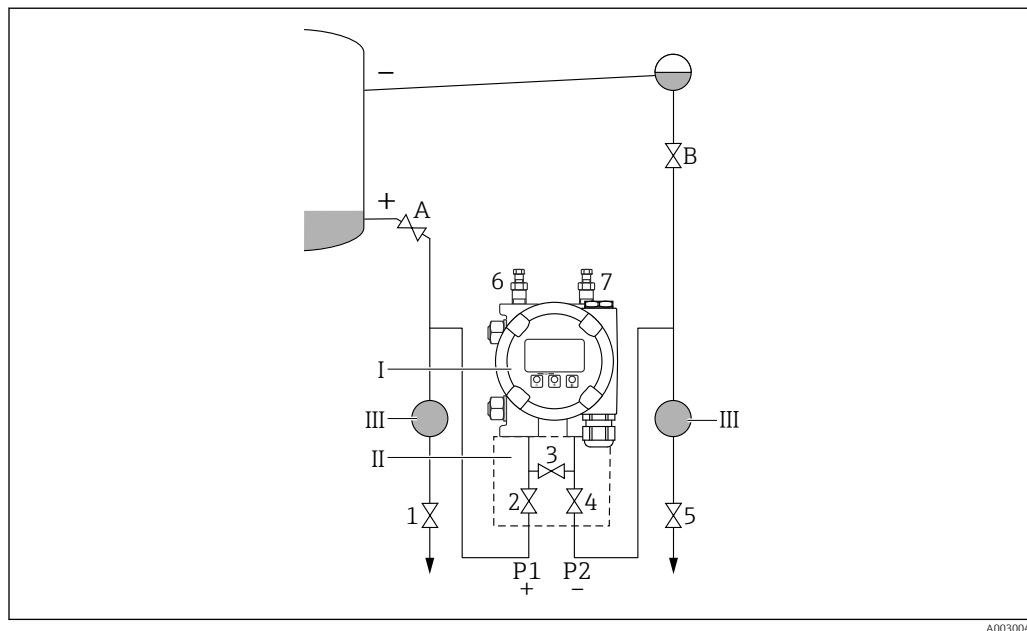
A0030039

- I* Device
- II* Three-valve manifold
- III* Separator
- 1, 5 Drain valves
- 2, 4 Inlet valves
- 3 Equalization valve
- 6, 7 Vent valves on device
- A, B Shutoff valves

1. Fill the vessel to above the lower tapping point.
2. Fill the measuring system with medium.
  - ↳ Close 3 (separate high-pressure side and low-pressure side).  
Open A and B (shutoff valves).
3. Vent high-pressure side (empty low-pressure side if necessary).
  - ↳ Open 2 and 4 (introduce fluid on high-pressure side).  
Open 6 until the system (piping, valve and side flange) is completely filled with medium.  
Open 7 until the system (piping, valve and side flange) is completely empty.

### Closed vessel with superimposed vapor

Before adjusting the device, the piping may need to be cleaned and filled with medium.



A0030040

- I Device
- II Three-valve manifold
- III Separator
- 1, 5 Drain valves
- 2, 4 Inlet valves
- 3 Equalization valve
- 6, 7 Vent valves on device
- A, B Shutoff valves

1. Fill the vessel to above the lower tapping point.
2. Fill the measuring system with medium.
  - ↳ Open A and B (shutoff valves).  
Fill the negative pressure piping to the height of the condensate trap.
3. Vent device.
  - ↳ Open 2 and 4 (introduce fluid).  
Open 6 and 7 until the system (piping, valve and side flange) is completely filled with medium.

### 9.6.3 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 the 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

#### Performing position adjustment

1. Device installed in required position and no pressure is applied.
2. Press the "Zero" and "Span" keys simultaneously for at least 3 seconds.
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. The desired pressure for the lower range value is present at the device.
2. Press "Zero" 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. The desired pressure for the upper range value is present at the device.
2. Press "Span" for at least 3 seconds.
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 for upper range value has not been accepted.  
Wet calibration is not possible if, in the **Assign PV** parameter **Scaled variable** option and in **Scaled variable transfer function** parameter **Table** option has been selected.

**Checking the settings (pressure or scaled variable)**


1. Press "Zero" key briefly (approx. 1 second) to display the lower range value.
2. Press "Span" key briefly (approx. 1 second) to display the upper range value.
3. Press "Zero" and "Span" keys briefly and at the same time (approx. 1 second) to display the calibration offset.

**Resetting the device**

- Press and hold "Zero" and "Span" simultaneously for at least 12 seconds.

### 9.6.4 Commissioning with the commissioning wizard

In FieldCare, DeviceCare <sup>1)</sup>, SmartBlue and on the display, the **Commissioning** wizard for guiding the user through the initial commissioning steps is available. Commissioning can also be carried out via the Asset Management Solution (AMS) and Process Device Manager (PDM).

1. Connect the device with FieldCare or DeviceCare.
  2. Open the device in FieldCare or DeviceCare.
    - ↳ The dashboard (homepage) of the device is displayed:
  3. In the **Guidance** menu, click the **Commissioning** wizard to open the wizard.
  4. Enter the appropriate value in each parameter or select the appropriate option. These values are written directly to the device.
  5. Click "Next" to go to the next page.
  6. Once all the pages are completed, click "End" to close the **Commissioning** wizard.
-  If the **Commissioning** wizard is canceled before all necessary parameters have been configured, the device may be in an undefined state. In such situations, it is advisable to reset the device to the factory default settings.

---

1) DeviceCare is available for download at [www.software-products.endress.com](http://www.software-products.endress.com). You must register in the Endress+Hauser software portal to download the product.

**Example: Outputting of the pressure value at the current output**

Pressure and temperature units are converted automatically. Other units are not converted.

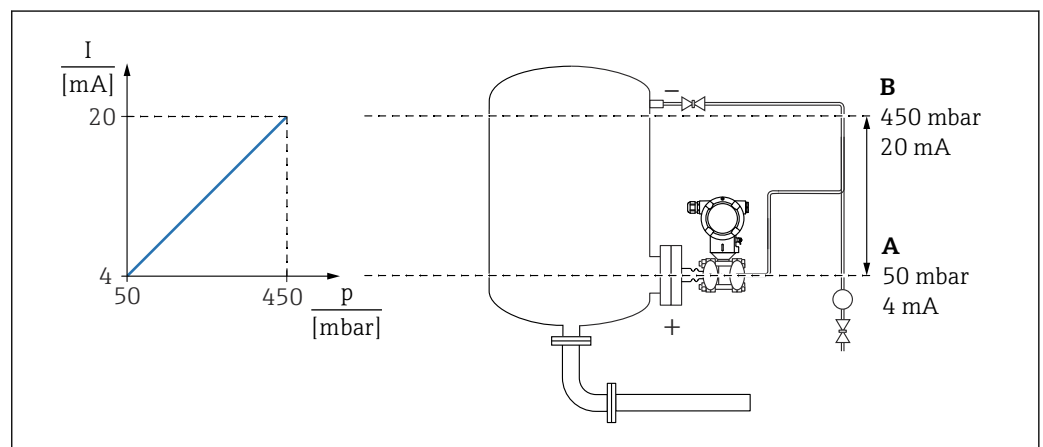
In the following example, the pressure value should be measured in a tank and output on the current output. The maximum pressure of 450 mbar (6.75 psi) corresponds to the 20 mA current. The 4 mA current corresponds to a pressure of 50 mbar (0.75 psi).

Prerequisites:

- Measured variable in direct proportion to the pressure
- Due to the orientation of the device, there may be pressure shifts in the measured value (when the vessel is empty or partly filled, the measured value is not zero)  
Perform a position adjustment if necessary

- In the **Assign PV** parameter, the **Pressure** option must be selected (factory setting).

Display: In the **Guidance** menu **Commissioning** wizard, keep pressing the  $\oplus$  key until the **Assign PV** parameter is reached. Press the  $\boxtimes$  key to confirm, select the **Pressure** option and press  $\boxtimes$  to confirm.



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A Lower range value output

B Upper range value output

Adjustment:

1. Enter the pressure value for the 4 mA current via the **Lower range value output** parameter (50 mbar (0.75 psi)).
2. Enter the pressure value for the 20 mA current via the **Upper range value output** parameter (450 mbar (6.75 psi))

Result: The measuring range is set to 4 to 20 mA.

### 9.6.5 Commissioning without the commissioning wizard

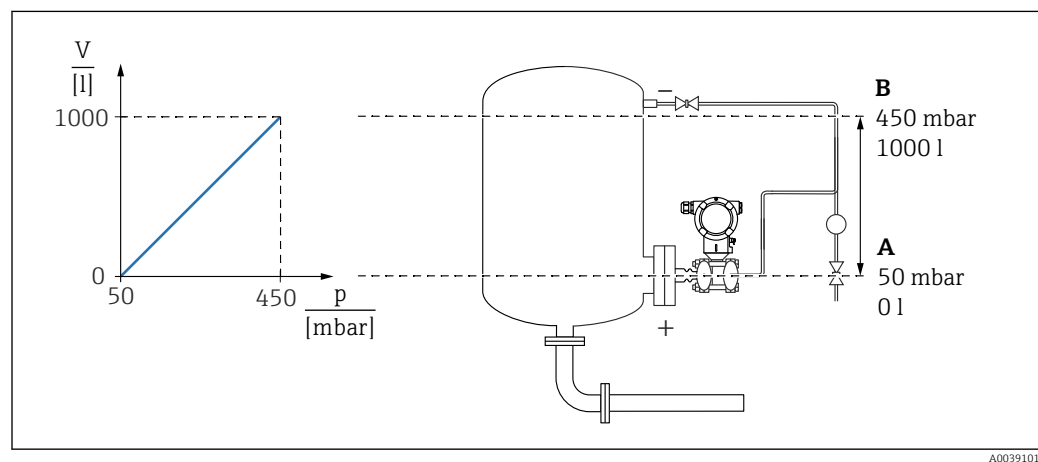
#### Example: Commissioning a volume measurement in the tank

**i** Pressure and temperature units are converted automatically. Other units are not converted.

In the following example, the volume in a tank should be measured in liters. The maximum volume of 1 000 l (264 gal) corresponds to a pressure of 450 mbar (6.75 psi). The minimum volume of 0 liters corresponds to a pressure of 50 mbar (0.75 psi).

Prerequisites:

- Measured variable in direct proportion to the pressure
- Due to the orientation of the device, there may be pressure shifts in the measured value (when the vessel is empty or partly filled, the measured value is not zero)  
Perform position adjustment if necessary



A "Pressure value 1" parameter and "Scaled variable value 1" parameter

B "Pressure value 2" parameter and "Scaled variable value 2" parameter

**i** The pressure present is displayed in the operating tool on the same settings page in the "Pressure" field.

1. Enter the pressure value for the lower calibration point via the **Pressure value 1** parameter: 50 mbar (0.75 psi)  
↳ Menu path: Application → Sensor → Scaled variable → Pressure value 1
2. Enter the volume value for the lower calibration point via the **Scaled variable value 1** parameter: 0 l (0 gal)  
↳ Menu path: Application → Sensor → Scaled variable → Scaled variable value 1
3. Enter the pressure value for the upper calibration point via the **Pressure value 2** parameter: 450 mbar (6.75 psi)  
↳ Menu path: Application → Sensor → Scaled variable → Pressure value 2
4. Enter the volume value for the upper calibration point via the **Scaled variable value 2** parameter: 1 000 l (264 gal)  
↳ Menu path: Application → Sensor → Scaled variable → Scaled variable value 2

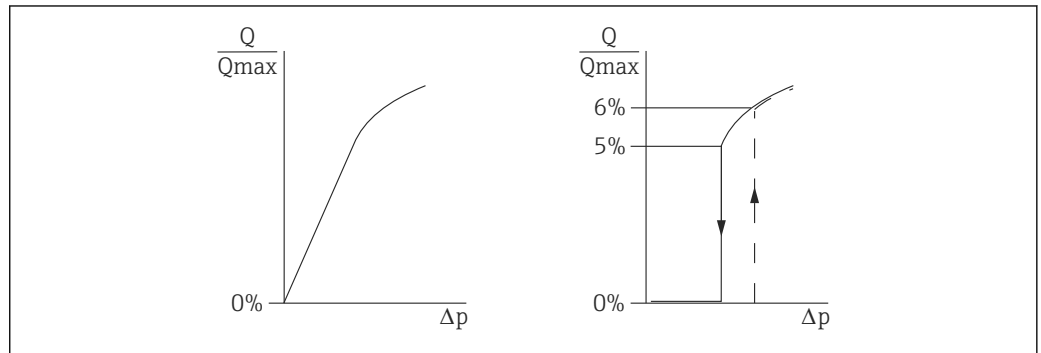
Result: The measuring range is set for 0 to 1 000 l (0 to 264 gal). Only the **Scaled variable value 1** parameter and **Scaled variable value 2** parameter are set with this setting. This setting has no effect on the current output.

#### Low flow cut off (square root extraction)

With the **Low cutoff** parameter, positive zero return can be configured in the lower measuring range.

Prerequisites:

- Measured variable with square root extraction in relation to pressure
- In the **Output current transfer function** parameter, set the **Square** option.  
Menu path: Application → Sensor → Sensor configuration → Output current transfer function
- Enter the switch-on point for the low flow cut off in the **Low cutoff** parameter (default 5 %)  
Menu path: Application → Sensor → Sensor configuration → Low cutoff



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- The hysteresis between the switch-on point and the switch-off point is always 1 % of the maximum flow value
- If 0 % is entered for the switch-on point, low flow cut off is disabled

In the **Assign PV** parameter, the **Pressure** option must be selected (factory setting).

Menu path: Application → Sensor → Scaled variable → Assign PV

Alternative menu path: Application → HART output

The set unit is also output on the fieldbus.

### 9.6.6 Linearization

In the following example, the volume in a tank with a conical outlet should be measured in  $\text{m}^3$ .

Prerequisites:

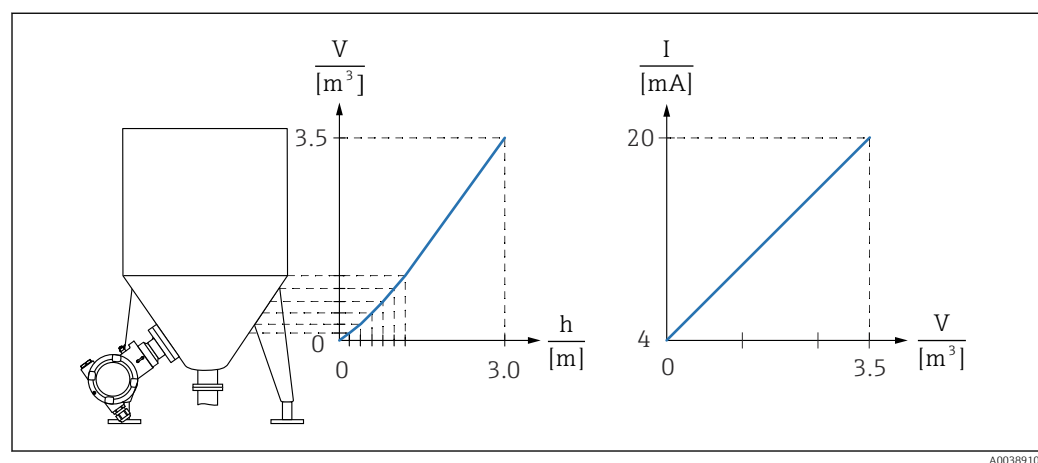
- Points for linearization table are known
- Level calibration is performed
- Linearization characteristic must continually increase or decrease

#### **⚠ WARNING**

**The settings of the current output are relevant for safety!**

This situation can result in product overflow.

- ▶ The setting of the current output depends on the setting in the **Assign PV** parameter.
- ▶ After changing the **Assign PV** parameter, check the settings for the range (LRV and URV) and reconfigure them if necessary.



1. In the **Assign PV** parameter, the **Scaled variable** option must be set.  
 ↳ Menu path: Application → HART output → HART output → Assign PV
2. Set the desired unit in the **Scaled variable unit** parameter.  
 ↳ 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.
6. Activate the table using the **Activate table** parameter.

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.



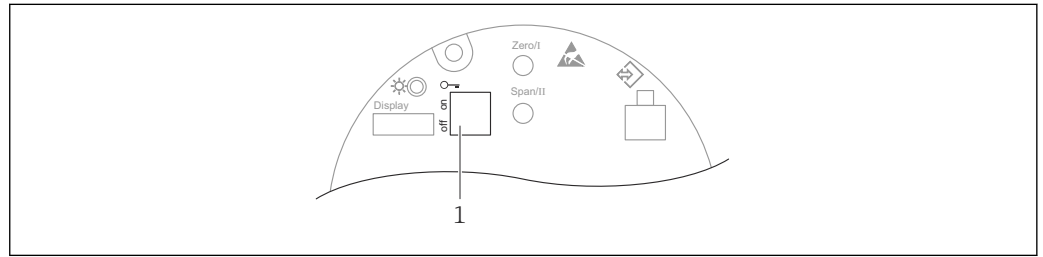
## 9.7 "Simulation" submenu

With the **Simulation** submenu, the pressure, current and diagnostic events can be simulated.

Menu path: Diagnostics → Simulation

## 9.8 Protecting settings from unauthorized access

### 9.8.1 Hardware locking or unlocking




1 DIP switch for locking and unlocking the device


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

If operation is locked via the DIP switch, you can only unlock operation again via the DIP switch.

If operation is locked via the operating menu, you can only unlock operation again via the operating menu.

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

### 9.8.2 Display operation - locking or unlocking

The  key must be pressed for at least 2 seconds in order to lock or unlock the optical keys. Display operation can be locked or unlocked in the dialog that appears.

Display operation locks automatically (except in the SIL wizard):

- After 1 minute on the main page if no key has been pressed
- After 10 minutes within the operating menu if no key has been pressed

### 9.8.3 Software locking or unlocking

 If operation is locked by means of the DIP switch, you can only unlock operation again by means of the DIP switch.

#### Locking via password in display / FieldCare / DeviceCare / SmartBlue

Access to parameter configuration of the device can be locked by assigning a password. When the device is delivered from the factory, the user role is set to **Maintenance** option. The device can be configured completely with the **Maintenance** option user role. Afterwards, access to the configuration can be locked by assigning a password. The **Maintenance** option switches to the **Operator** option as a result of this locking. The configuration can be accessed by entering the password.

The password is defined under:

**System** menu **User management** submenu

The user role is changed from the **Maintenance** option to the **Operator** option under:

System → User management

**Disabling the lock via the display / FieldCare / DeviceCare / SmartBlue**

After entering the password, you can enable parameter configuration of the device as an **Operator** option with the password. The user role then changes to **Maintenance** option.

If necessary, the password can be deleted in the **User management** submenu: System  
→ User management

## 10 Operation

### 10.1 Reading off the device locking status

Displaying active write protection:

- In the **Locking status** parameter
  - Menu path of local display: at the top operating level
  - Menu path of operating tool: System → Device management
- In the operating tool (FieldCare/DeviceCare) in the DTM header

### 10.2 Reading off measured values

All the measured values can be read off using the **Measured values** submenu.

#### Navigation

"Application" menu → Measured values

### 10.3 Adapting the device to process conditions

The following are available for this purpose:

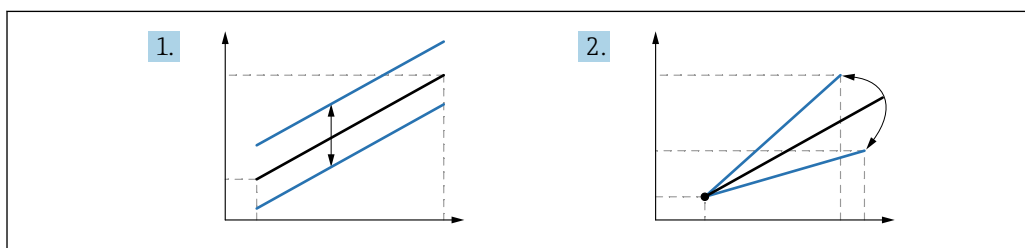
- Basic settings using the **Guidance** menu
- Advanced settings using the **Diagnostics** menu, **Application** menu and **System** menu

### 10.3.1 Sensor calibration <sup>2)</sup>.

In the course of their life cycle, pressure measuring cells **can** deviate, or drift, <sup>3)</sup> from the original pressure characteristic curve. This deviation depends on the operating conditions and can be corrected in the **Sensor calibration** submenu.

Set the value of the zero point shift before the Sensor calibration to 0.00. Application  
→ Sensor → Sensor calibration → Zero adjustment offset

1. Apply the lower pressure value (value measured with pressure reference) to the device. Enter this pressure value in the **Lower sensor trim** parameter. Application  
→ Sensor → Sensor calibration → Lower sensor trim
  - ↳ The value entered causes a parallel shift of the pressure characteristic in relation to the current Sensor calibration.
2. Apply the upper pressure value (value measured with pressure reference) to the device. Enter this pressure value in the **Upper sensor trim** parameter. Application  
→ Sensor → Sensor calibration → Upper sensor trim
  - ↳ The value entered causes a change in the slope of the current Sensor calibration.



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The accuracy of the pressure reference determines the accuracy of the device. The pressure reference must be more accurate than the device.

2) Not possible via display operation

3) Deviations caused by physical factors are also known as "Sensor drift".

## 11 Diagnostics and troubleshooting

### 11.1 General troubleshooting

#### 11.1.1 General faults

##### **Device is 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 connecting cables are not in contact with the terminals.  
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: Graphic display is set too bright or too dark  
Remedial action: Increase or decrease the contrast with the **Contrast display** parameter  
Navigation path: System → Display → Contrast 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

##### **No background lighting on the graphic display**

Possible cause: The electric current and voltage are not correct.  
Remedial action: Increase the supply voltage and restart the device.

##### **"Communication error" is indicated on the display when the device is started or the display is connected**

- Possible cause: Electromagnetic interference influence  
Remedial action: Check grounding of the device
- Possible cause: Defective cable connection or display plug  
Remedial action: Replace the display

##### **HART communication is not working**

- Possible cause: Communication resistor missing or incorrectly installed  
Remedial action: Install the communication resistor (250 Ω) correctly.
- Possible cause: Commubox is connected incorrectly  
Remedial action: Connect Commubox correctly

##### **Communication via CDI interface not working**

Possible cause: Wrong setting of the COM port on the computer  
Remedial action: Check the setting of the COM port on the computer and correct it if necessary


#### 11.1.2 Error - SmartBlue operation

Operation via SmartBlue is only possible on devices that have a display with Bluetooth (optionally available).


**Device is not visible in the live list**

- Possible cause: Supply voltage too low  
Remedial action: Increase the supply voltage.
- Possible cause: No Bluetooth connection available  
Remedial action: Enable Bluetooth in the field device via display or software tool and/or in the smartphone/tablet
- Possible cause: Bluetooth signal outside range  
Remedial action: Reduce distance between field device and smartphone/tablet  
The connection has a range of up to 25 m (82 ft)
- Possible cause: Geopositioning is not enabled on Android devices or is not permitted for the SmartBlue app.  
Remedial action: Enable/permit the geopositioning service on Android device for the SmartBlue app

**Device appears in the live list but a connection cannot be established**

- Possible cause: The device is already connected with another smartphone/tablet via Bluetooth.  
Only one point-to-point connection is permitted  
Remedial action: Disconnect the smartphone/tablet from the device
- Possible cause: Incorrect user name and password  
Remedial action: The standard user name is "admin" and the password is the device serial number indicated on the device nameplate (only if the password was not changed by the user beforehand)  
If the password has been forgotten: →  71


**Connection via SmartBlue not possible**

- Possible cause: Incorrect password entered  
Remedial action: Enter the correct password, paying attention to lower/upper case
- Possible cause: Forgotten password  
Remedy: →  71

**No communication with device via SmartBlue**

- Possible cause: Supply voltage too low  
Remedial action: Increase the supply voltage.
- Possible cause: No Bluetooth connection available  
Remedial action: Enable the Bluetooth function on the smartphone, tablet and device
- Possible cause: The device is already connected with another smartphone/tablet  
Remedial action: Disconnect the device from the other smartphone/tablet
- Ambient conditions (e.g. walls/tanks) disturbing the Bluetooth connection  
Remedial action: Establish direct line-of-sight connection
- Display does not have Bluetooth

**Device cannot be operated via SmartBlue**

- Possible cause: Incorrect password entered  
Remedial action: Enter the correct password, paying attention to lower/upper case
- Possible cause: Forgotten password  
Remedy: →  71
- Possible cause: **Operator** option has no authorization  
Remedial action: Change to the **Maintenance** option

**11.1.3 Corrective action**

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.

### 11.1.4 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 the simulation and check the current output. Replace the main electronics if the current output does not correspond to the simulated value.

### 11.1.5 Behavior of the current output in the event of a failure

The behavior of the current output in the event of failures is defined by the **Failure behavior current output** parameter.

#### Parameter overview with brief description

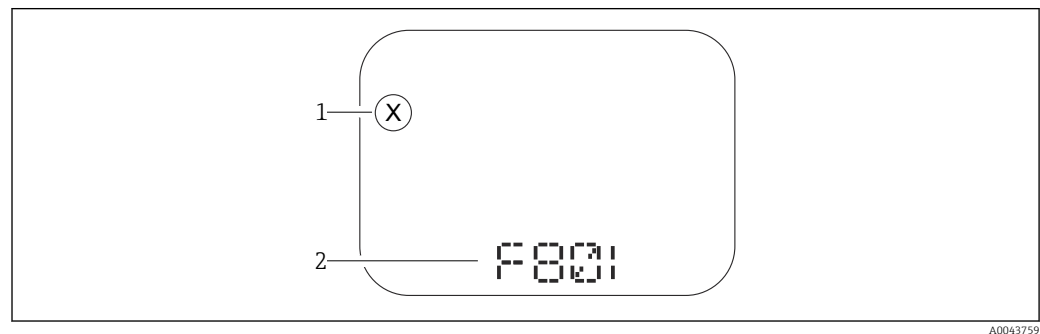
Parameter	Description	Selection / User entry
Failure behavior current output	Defines which current the output assumes in the case of an error. Min: < 3.6 mA Max: >21.5 mA  Note: The hardware DIP Switch for alarm current has priority over software setting.	<ul style="list-style-type: none"> <li>■ Min.</li> <li>■ Max.</li> </ul>
Failure current	Enter current output value in alarm condition.	21.5 to 23 mA

## 11.2 Diagnostic formation on local display

### 11.2.1 Diagnostic message

#### Measured value display and diagnostic message in the event of a failure

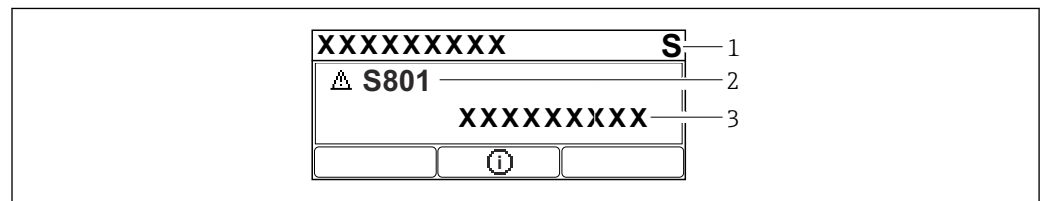
Failures detected by the device's self-monitoring system are displayed as a diagnostic message in alternation with the unit.



A0043759

- 1 Status signal  
2 Status symbol with diagnostic event

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



A0043103

- 1 Status signal  
2 Status symbol with diagnostic event  
3 Event text

#### 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 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**

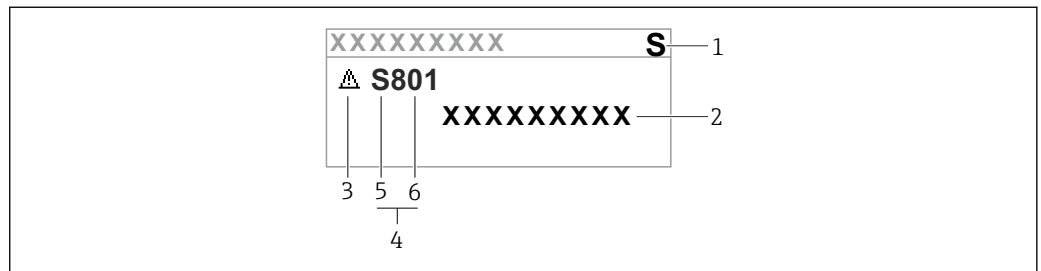
##### "Maintenance required (M)" option

Maintenance required. The measured value remains valid.



### Diagnostic event and event text

The failure can be identified by means of the diagnostic event. The event text helps you by providing information about the failure. In addition, the associated status symbol is displayed in front of the diagnostic event.



A0038013

- 1 Status signal
- 2 Event text
- 3 Status symbol
- 4 Diagnostic event
- 5 Status signal
- 6 Diagnostic number

If several diagnostic events are pending at the same time, only the diagnostic message with the highest priority is displayed.

### "Active diagnostics" parameter

☐ key

Opens the message about the remedial actions.

☐ key

Acknowledge warnings.

☐ key

Back to operating menu.

### 11.3 Diagnostic event in the operating tool

If a diagnostic event has occurred in the device, the status signal appears in the top left status area of the operating tool together with the corresponding symbol for the event level according to NAMUR NE 107:

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

Click the status signal to see the detailed status signal.

The diagnostic events and remedial measures can be printed out in the **Diagnostic list** submenu.

### 11.4 Adapting the diagnostic information

The event level can be configured:

Menu path: Diagnostics → Diagnostic settings → Configuration

### 11.5 Queued diagnostic messages

The display alternates between the queued diagnostic messages and the measured value.

Queued diagnostic messages can also be displayed in the **Active diagnostics** parameter.

Menu path: Diagnostics → Active diagnostics

### 11.6 Diagnostic list

All of the diagnostic messages currently pending can be displayed in the **Diagnostic list** submenu.

#### Navigation path

Diagnostics → Diagnostic list

### 11.6.1 List of diagnostic events

Diagnostic number	Short text	Remedy instructions	Status signal [from the factory]	Diagnostic behavior [from the factory]
<b>Diagnostic of sensor</b>				
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
<b>Diagnostic of electronic</b>				
203	HART Device Malfunction	Check device specific diagnosis.	S	Warning
204	HART Electronic Defect	Check device specific diagnosis.	F	Alarm
242	Firmware incompatible	1. Check software 2. Flash or change main electronic module	F	Alarm
252	Module incompatible	1. Check if correct electronic module 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	Replace main electronics	F	Alarm
282	Data storage inconsistent	Restart device	F	Alarm
283	Memory content inconsistent	1. Restart device 2. Contact service	F	Alarm
287	Memory content inconsistent	1. Restart device 2. Contact service	M	Warning
388	Electronics and HistoROM defective	1. Restart device 2. Replace electronics and HistoROM 3. Contact service	F	Alarm
<b>Diagnostic of configuration</b>				
410	Data transfer failed	1. Retry data transfer 2. Check connection	F	Alarm
412	Processing download	Download active, please wait	C	Warning
420	HART Device Configuration Locked	Check device locking configuration.	S	Warning
421	HART Loop Current fixed	Check Multi-drop mode or current simulation.	S	Warning
431	Trim required	Carry out trim	C	Warning
435	Linearization faulty	Check data points and min span	F	Alarm

Diagnostic number	Short text	Remedy instructions	Status signal [from the factory]	Diagnostic behavior [from the factory]
437	Configuration incompatible	1. Update firmware 2. Execute factory reset	F	Alarm
438	Dataset different	1. Check dataset file 2. Check device parameterization 3. Download new device parameterization	M	Warning
441	Current output 1 saturated	1. Check process 2. Check current output settings	S	Warning
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	S	Warning
500	Process alert pressure	1. Check process pressure 2. Check configuration of process alert	S	Warning <sup>1)</sup>
501	Process alert scaled variable	1. Check process conditions 2. Check scaled variable configuration	S	Warning <sup>1)</sup>
502	Process alert temperature	1. Check process temperature 2. Check configuration of process alert	S	Warning <sup>1)</sup>
503	Zero adjustment	1. Check measuring range 2. Check position adjustment	M	Warning
<b>Diagnostic of process</b>				
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 <sup>1)</sup>
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 <sup>1)</sup>
825	Electronics 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 <sup>1)</sup>
846	HART Non-Primary Variable Out of Limit	Check device specific diagnosis.	S	Warning
847	HART Primary Variable Out of Limit	Check device specific diagnosis.	S	Warning
848	HART Device Variable Alert	Check device specific diagnosis.	S	Warning
900	High signal noise detected	1. Check impulse line 2. Check valve position 3. Check process	M	Warning <sup>1)</sup>

Diagnostic number	Short text	Remedy instructions	Status signal [from the factory]	Diagnostic behavior [from the factory]
901	Low signal noise detected	1. Check impulse line 2. Check valve position 3. Check process	M	Warning <sup>1)</sup>
902	Min signal noise detected	1. Check impulse line 2. Check valve position 3. Check process	M	Warning <sup>1)</sup>
906	Out of range signal detected	1. Process Information. No action 2. Rebuild baseline 3. Adapt signal range thresholds	S	Warning <sup>1)</sup>

1) Diagnostic behavior can be changed.

## 11.7 Event logbook

### 11.7.1 Event history

The **Event list** submenu provides a chronological overview of the event messages that have occurred. <sup>4)</sup>.

#### 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

### 11.7.2 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

### 11.7.3 Overview of information events

Info number	Info name
I1000	----- (Device ok)
I1079	Sensor changed
I1089	Power on
I1090	Configuration reset

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

Info number	Info name
I1091	Configuration changed
I11074	Device verification active
I1110	Write protection switch changed
I11104	Loop diagnostics
I11284	DIP MIN setting to HW active
I11285	DIP SW setting active
I11341	SSD baseline created
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
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


## 11.8 Resetting the device

### 11.8.1 Resetting the device via the operating tool

Reset the device configuration - either entirely or in part - to a defined state

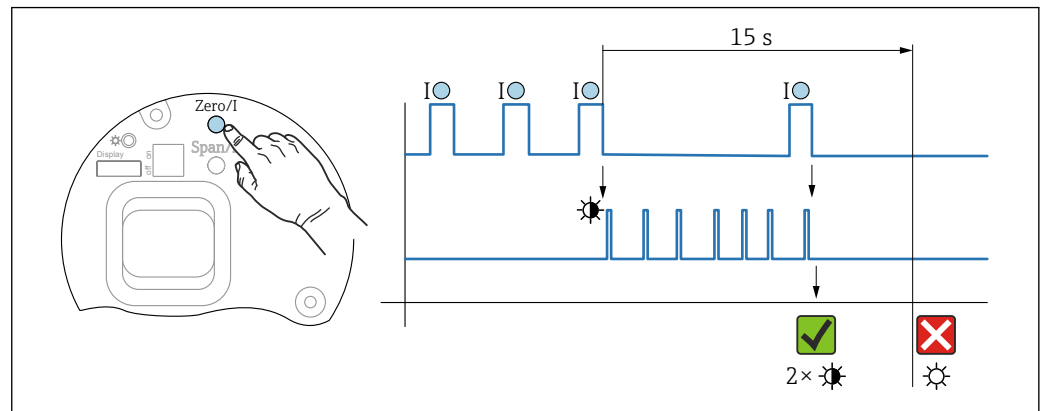
Navigation: System → Device management → Reset device

**Reset device** parameter

 For details see the "Description of device parameters" documentation.

### 11.8.2 Resetting the device via the electronic insert keys

#### Resetting Bluetooth password and user role (as of SW 1/1/2000)



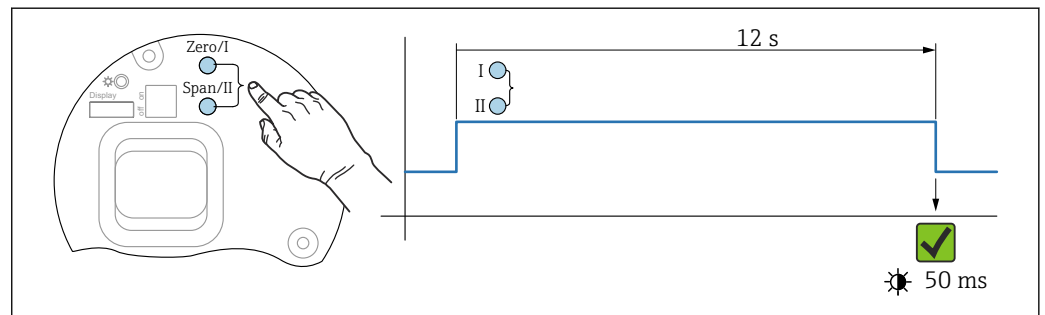
10 Sequence for resetting the password

#### Delete/reset the password

1. Press operating key I three times.  
↳ The Reset Password function is started; the LED flashes.
2. Press operating key I once within 15 s.  
↳ The password is reset, the LED flashes briefly.

If operating key I is not pressed within 15 s, the action is canceled and the LED is no longer lit.

#### Resetting the device to the factory setting



11 Operating keys on the electronic insert

#### Resetting the device to the factory setting

- ▶ Press operating key I and operating key II simultaneously for at least 12 s.  
↳ Device data are reset to the factory setting; the LED flashes briefly.


## 11.9 Device information

All the device information is contained in the **Information** submenu.

Menu path: System → Information

For details see the "Description of device parameters" document.

## 11.10 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.

### 11.10.1 Version 01.00.zz

Original software

### 11.10.2 Version 01.01.zz

- Heartbeat Technology extended functionality
- HART condensed status



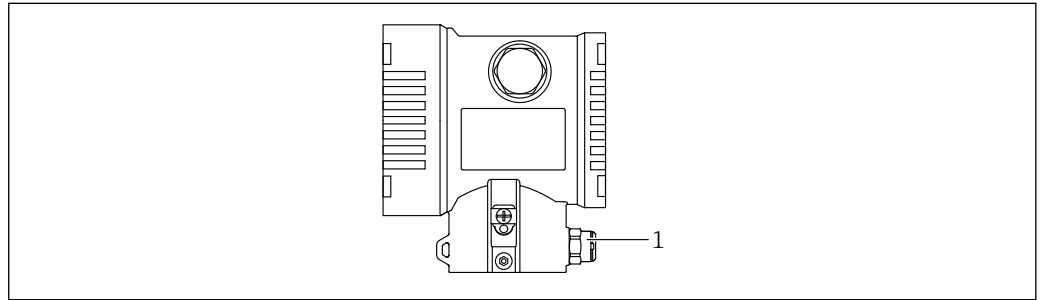
## 12 Maintenance

### 12.1 Maintenance work

This chapter describes the maintenance of physical device components.

#### 12.1.1 Pressure compensation filter

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



A0038667

1 Pressure compensation filter

#### 12.1.2 Flushing rings

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

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

#### 12.1.3 Exterior cleaning

##### Notes on cleaning

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

## 13 Repair

### 13.1 General information

#### 13.1.1 Repair concept

Under the Endress+Hauser repair concept, devices have a modular design and repairs are 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.

#### 13.1.2 Repair of Ex-certified devices

##### **WARNING**

##### **Incorrect repair can compromise electrical safety!**

Explosion Hazard!

- ▶ Repairs to Ex-certified devices must be carried out by Endress+Hauser Service or by specialist personnel according to national regulations.
- ▶ Relevant standards and national regulations on hazardous areas, safety instructions and certificates must be observed.
- ▶ Use only original Endress+Hauser spare parts.
- ▶ Please note the device designation on the nameplate. Only identical parts may be used as replacements.
- ▶ Carry out repairs according to the instructions.
- ▶ Only the Endress+Hauser service team is permitted to modify a certified device and convert it to another certified version.

### 13.2 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](http://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.

### 13.3 Replacement

##### **CAUTION**

**Data upload/download is not permitted if the device is used for safety-related applications.**

- ▶ After an entire device or an electronics module has been replaced, the parameters can be downloaded to the device again via the communication interface. For this, the data must have been uploaded to the PC beforehand using the "FieldCare/DeviceCare" software.

### 13.3.1 HistoROM

It is not necessary to perform a new device calibration after replacing the display or transmitter electronics. The parameters are saved in the HistoROM.



After replacing the transmitter electronics, remove the HistoROM and insert it into the new replacement part.

## 13.4 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 <http://www.endress.com/support/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.

## 13.5 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.

## 14 Accessories

### 14.1 Device-specific accessories

#### 14.1.1 Mechanical accessories

- Mounting bracket for housing
- Flushing rings
- Weather protective cover



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

#### 14.1.2 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.

#### 14.1.3 Weld-in accessory



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

### 14.2 Device Viewer

All the spare parts for the device, along with the order code, are listed in the *Device Viewer* (<https://www.endress.com/de/pages/supporting-tools/device-viewer>).

## 15 Technical data

### 15.1 Input

Measured variable	<b>Measured process variables</b> Differential pressure
Measuring range	Depending on the device configuration, the maximum working pressure (MWP) and the overpressure limit (OPL) can deviate from the values in the tables.

PN 160 / 16 MPa / 2400 psi

Measuring cell	Maximum measuring range		Smallest calibratable span (preset at factory) <sup>1) 2)</sup>
	lower (LRL)	upper (URL)	
[mbar (psi)]	[mbar (psi)]	[mbar (psi)]	[mbar (psi)]
100 (1.5)	-100 (-1.5)	+100 (+1.5)	5 (0.075)
500 (7.5)	-500 (-7.5)	+500 (+7.5)	5 (0.075)
3000 (45)	-3000 (-45)	+3000 (+45)	30 (0.45)
16000 (240)	-16000 (-240)	+16000 (+240)	160 (2.4)
40000 (600)	-40000 (-600)	+40000 (+600)	400 (6)

1) Turn down > 100:1 on request or can be configured at the device

2) The maximum TD is 5:1 in the case of platinum.

PN 160 / 16 MPa / 2400 psi

Measuring cell	MWP <sup>1)</sup>	OPL		Burst pressure <sup>2) 3)</sup>
		on one side	on both sides	
[mbar (psi)]	[bar (psi)]	[bar (psi)]	[bar (psi)]	[bar (psi)]
100 (1.5)	160 (2400)	160 (2400)	240 (3600)	690 (10005)
500 (7.5)	160 (2400)	160 (2400)	240 (3600)	690 (10005)
3000 (45)	160 (2400)	160 (2400)	240 (3600)	690 (10005)
16000 (240)	160 (2400)	160 (2400)	240 (3600)	690 (10005)
40000 (600)	160 (2400) <sup>4)</sup>	"+" side: 160 (2400) "-" side: 100 (1500)	240 (3600)	690 (10005)

1) MWP depends on the selected process connection.

2) Applies to the process seal materials FKM, PTFE, FFKM, EPDM and for pressure applied on both sides.

3) If the side vent valves (sv) and PTFE seal option is selected, the burst pressure is 600 bar (8 700 psi)

4) If pressure is applied on the negative side only, the MWP is 100 bar (1 500 psi).

#### Minimum static pressure

- Minimum static pressure: 50 mbar (0.75 psi)<sub>abs</sub>  
Observe the pressure and temperature application limits of the selected fill fluid
- Observe the pressure and temperature application limits of the selected fill fluid
- Vacuum applications: pay attention to the installation instructions

## 15.2 Output

Output signal	<p><b>Current output</b></p> <p>4 to 20 mA with superimposed digital communication protocol HART, 2-wire</p> <p>The current output offers a choice of three different operating modes:</p> <ul style="list-style-type: none"> <li>■ 4.0 to 20.5 mA</li> <li>■ NAMUR NE 43: 3.8 to 20.5 mA (factory setting)</li> <li>■ US mode: 3.9 to 20.8 mA</li> </ul>
Signal on alarm	<p>4 to 20 mA HART:</p> <p>Options:</p> <ul style="list-style-type: none"> <li>■ Max alarm: can be set from 21.5 to 23 mA</li> <li>■ Min. alarm: &lt; 3.6 mA (factory setting)</li> <li>■ Signal on alarm in accordance with NAMUR recommendation NE 43.</li> </ul>
Load	<p><b>4 to 20 mA HART</b></p> <div style="text-align: center;"> <math display="block">3 \rightarrow R_{L, \max} \leq \frac{U_B - 10.5 \text{ V}}{23 \text{ mA}}</math> </div> <p>1 Power supply 10.5 to 30 VDC Ex i  2 Power supply 10.5 to 35 VDC, for other types of protection and non-certified device versions  3 <math>R_{L, \max}</math> maximum load resistance  <math>U_B</math> Supply voltage</p> <p><b>i</b> Operation via handheld terminal or PC with operating program: take minimum communication resistance of 250 Ω into consideration.</p>
Damping	<p>A damping affects all outputs (output signal, display). Damping can be enabled as follows:</p> <ul style="list-style-type: none"> <li>■ Via the onsite display, Bluetooth, handheld terminal or PC with operating program, continuous from 0 to 999 seconds</li> <li>■ Factory setting: 1 s</li> </ul>
Ex connection data	<p>See the separate technical documentation (Safety Instructions (XA)) on <a href="http://www.endress.com/download">www.endress.com/download</a>.</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>

## Protocol-specific data

**HART**


- Manufacturer ID: 17 (0x11{hex})
- Device type ID: 0x1131
- Device revision: 1
- HART specification: 7
- DD revision: 1
- Device description files (DTM, DD) information and files at:
  - [www.endress.com](http://www.endress.com)
  - [www.fieldcommgroup.org](http://www.fieldcommgroup.org)
- HART load: min. 250 Ohm

*HART device variables (preset at the factory)*

The following measured values are assigned to the device variables at the factory:

Device variable	Measured value
Primary variable (PV) <sup>1)</sup>	Pressure <sup>2)</sup>
Secondary variable (SV)	Sensor temperature
Tertiary variable (TV)	Electronics temperature
Quaternary variable (QV)	Sensor pressure <sup>3)</sup>

- 1) The PV is always applied to the current output.
- 2) The pressure is the calculated signal after damping and position adjustment.
- 3) The Sensor pressure is the raw signal of the measuring cell before damping and position adjustment.

 The assignment of the measured values to the device variables can be changed in the following submenu:  
Application → HART output → HART output

 In a HART Multidrop loop, only one device may use the analog current value for signal transmission. For all other devices in the **"Loop current mode" parameter**, select the **Disable** option.

*Choice of HART device variables*

- **Pressure** option (after position correction and damping)
- Scaled variable
- Sensor temperature
- Sensor pressure
  - Sensor Pressure is the raw signal from sensor before damping and position adjustment.
- Electronics temperature
- Terminal current
  - The terminal current is the read-back current on terminal block.
- Terminal voltage 1
  - Visibility depends on order options or device settings
- **Noise of pressure signal** option and **Median of pressure signal** option
  - Visible if Heartbeat Technology ordered
- Percent of range
- Loop current
  - The loop current is the output current set by the applied pressure.

*Supported functions*

- Burst mode
- Additional transmitter status
- Device locking



**PROFIBUS PA****Manufacturer ID:**

17 (0x11)

**Ident number:**

0x1574 or 0x9700

**Profile version:**

3.02

**GSD file and version**

Information and files at:

- [www.endress.com](http://www.endress.com)


On the product page for the device: Documents/Software → Device drivers

- [www.profibus.com](http://www.profibus.com)

*Output values***Analog Input:**

- Pressure
- Scaled variable
- Sensor temperature
- Sensor pressure
- Electronics temperature
- **Median of pressure signal** option (only available if the "Heartbeat Verification + Monitoring" application package was selected).
- **Noise of pressure signal** option (only available if the "Heartbeat Verification + Monitoring" application package was selected).

**Digital Input:**

 Only available if the "Heartbeat Verification + Monitoring" application package was selected

Heartbeat Technology → SSD: Statistical Sensor Diagnostics

Heartbeat Technology → Process Window

*Input values***Analog Output:**

Analog value from PLC to be indicated on the display

*Supported functions*

- Identification & maintenance  
Simple device identification via control system and nameplate
- Automatic Ident Number Adoption  
GSD compatibility mode for generic profile 0x9700 "Transmitter with 1 Analog Input"
- Physical Layer Diagnostics  
Installation check of the PROFIBUS segment and device using terminal voltage and message monitoring
- PROFIBUS upload/download  
Reading and writing parameters is up to ten times faster with PROFIBUS upload/download
- Condensed status  
Straightforward and self-explanatory diagnostic information through categorization of occurring diagnostic messages

## Wireless HART data

- Minimum starting voltage: 10.5 V
- Start-up current: 3.6 mA
- Start-up time: <5 s
- Minimum operating voltage: 10.5 V
- Multidrop current: 4 mA

## 15.3 Environment

Ambient temperature range	<p>The following values apply up to a process temperature of +85 °C (+185 °F). The permitted ambient temperature is reduced at higher process temperatures.</p> <ul style="list-style-type: none"> <li>Without segment display or graphic display: <ul style="list-style-type: none"> <li>Standard: -40 to +85 °C (-40 to +185 °F)</li> <li>Optionally available: -50 to +85 °C (-58 to +185 °F) with restricted operating life and performance</li> <li>Optionally available: -54 to +85 °C (-65 to +185 °F); below -50 °C (-58 °F): devices can be permanently damaged</li> </ul> </li> <li>With segment display or graphic display: -40 to +85 °C (-40 to +185 °F) with limitations in optical properties such as display speed and contrast for example. Can be used without limitations up to -20 to +60 °C (-4 to +140 °F)</li> <li>Segment display: up to -50 to +85 °C (-58 to +185 °F) with restricted operating life and performance</li> <li>Devices with PVC-coated capillary armor: -25 to +80 °C (-13 to +176 °F)</li> <li>Separate housing: -20 to +60 °C (-4 to +140 °F)</li> </ul> <p>Applications with very high temperatures: use either a diaphragm seal on one side with a temperature isolator, or a diaphragm seal on one side or both sides with a capillary. Use a mounting bracket!</p> <p>If vibrations additionally occur in the application: use a device with a capillary.</p>
	<p><b>Hazardous area</b></p> <ul style="list-style-type: none"> <li>For devices for use in hazardous areas, see the Safety Instructions, Installation Drawing or Control Drawing</li> <li>Devices that have the most common explosion protection certificates (e.g. ATEX/ IEC Ex, etc.) can be used in explosive atmospheres with an ambient temperature of -54 to +85 °C (-65 to +185 °F) (optionally available). The functionality of the explosion protection Ex ia is guaranteed for ambient temperatures to -50 °C (-58 °F) (optionally available).</li> </ul> <p>At temperatures ≤ -50 °C (-58 °F), explosion protection is guaranteed by the housing in the case of flameproof enclosure (Ex d) type of protection. The functionality of the transmitter cannot be fully guaranteed. The Ex ia capability can no longer be guaranteed.</p>
Storage temperature	<ul style="list-style-type: none"> <li>Without device display: <ul style="list-style-type: none"> <li>Standard: -40 to +90 °C (-40 to +194 °F)</li> <li>Optionally available: -50 to +90 °C (-58 to +194 °F) with restricted operating life and performance</li> <li>Optionally available: -54 to +90 °C (-65 to +194 °F); below -50 °C (-58 °F): Ex d devices can be permanently damaged</li> </ul> </li> <li>With device display: -40 to +85 °C (-40 to +185 °F)</li> <li>Separate housing: -40 to +60 °C (-40 to +140 °F)</li> </ul> <p>With M12 plug, elbowed: -25 to +85 °C (-13 to +185 °F)</p> <p>Devices with PVC-coated capillary armor: -25 to +90 °C (-13 to +194 °F)</p>
Operating altitude	Up to 5 000 m (16 404 ft) above sea level.
Climate class	<p>Class 4K26 (air temperature: -20 to +50 °C (-4 to +122 °F), relative air humidity: 4 to 100 %) in accordance with IEC/EN 60721-3-4.</p> <p>Condensation is possible.</p>

## 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 mH<sub>2</sub>O 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
  - HAN7D plug, 90 degrees, IP65 NEMA Type 4X
  - M12 plug
- 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****M12 plug and HAN7D plug: incorrect installation 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 mH<sub>2</sub>O for 24 h) TYPE 4/6P

*PE cable*

- IP66 TYPE 4/6P
- IP68 (1.83 mH<sub>2</sub>O for 24 h) TYPE 4/6P

## Vibration resistance

**Aluminum dual-compartment housing**

Description	Sinusoidal vibration IEC62828-1	Shock
Device with temperature isolator	10 Hz to 60 Hz: ±0.075 mm (0.0030 in) 60 Hz to 500 Hz: 1 g	15 g

### Stainless steel dual-compartment housing and stainless steel precision-cast dual-compartment housing

Description	Sinusoidal vibration IEC62828-1	Shock
Device with temperature isolator	10 Hz to 60 Hz: $\pm 0.075$ mm (0.0030 in) 60 Hz to 500 Hz: 1 g	15 g

### Dual-compartment housing, L-form

Description	Sinusoidal vibration IEC62828-1	Shock
Device with temperature isolator <sup>1)</sup>	10 Hz to 60 Hz: $\pm 0.075$ mm (0.0030 in) 60 Hz to 500 Hz: 1 g	15 g

- 1) For applications with very high temperatures, either a measuring device with a temperature isolator or with a capillary can be used. If vibrations also occur in the application, Endress+Hauser recommends using a device with a capillary. If a device with a temperature isolator or capillary is used, it must be mounted with a mounting bracket.

### Electromagnetic compatibility (EMC)

- Electromagnetic compatibility as per IEC 61326 series and NAMUR recommendation EMC (NE21)
- With regard to the safety function (SIL), the requirements of IEC 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.

## 15.4 Process

Process temperature range

### NOTICE

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

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

### 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) <sup>3) 4) 5)</sup>
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) <sup>6) 7)</sup>

- 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 <sup>1)</sup> kg/m <sup>3</sup>
Silicone oil	970
High-temperature oil	995
Low-temperature oil	940
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, vacuum 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 devices, must be cleaned in accordance with national requirements.
- Depending on the materials used, a certain maximum temperature and a maximum pressure must not be exceeded for oxygen applications.

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

<b>T<sub>max</sub></b>	<b>P<sub>max</sub><sup>1)</sup></b>
80 °C (176 °F)	80 bar (1 200 psi)
> 80 to 120 °C (176 to 248 °F)	70 bar (1 050 psi)

1) PN of the flange

**Seals**

<b>Seal on the LP side (-)</b>	<b>Temperature</b>	<b>Pressure specifications</b>
FKM	-20 to +85 °C (-4 to +185 °F)	-
FKM Cleaned of oil and grease	-10 to +85 °C (+14 to +185 °F)	-
FKM Cleaned for oxygen service	-10 to +60 °C (+14 to +140 °F)	-
FFKM	-10 to +85 °C (+14 to +185 °F)	MWP: 160 bar (2 320 psi)
	-25 to +85 °C (-13 to +185 °F)	MWP: 100 bar (1 450 psi)
EPDM	-40 to +85 °C (-40 to +185 °F)	-
PTFE	-40 to +85 °C (-40 to +185 °F)	PN > 160 bar (2 320 psi) Minimum process temperature: -20 °C (-4 °F)
PTFE Cleaned for oxygen applications	-20 to +60 °C (-4 to +140 °F)	PN > 160 bar (2 320 psi) Minimum process temperature: -20 °C (-4 °F)

- Diaphragm seal and capillary welded: Pay attention to the temperature application limits of the fill fluid.
- Device generally OPL on one side 160 bar (2 320 psi), on both sides 240 bar (3 480 psi)  
Lower temperatures on request

Process temperature range  
(temperature at  
transmitter)

**Diaphragm seal on one side with temperature isolator**

- Dependent on design (see "Design" section)
- Dependent on diaphragm seal and fill fluid: -70 to +400 °C (-94 to +752 °F)
- Observe the temperature application limits of the fill fluid.
- Observe the maximum gauge pressure and maximum temperature
- Pay attention to the process temperature range of the seal

Design:

- Transmitter horizontal, temperature isolator long: 400 °C (752 °F)
- Transmitter vertical, temperature isolator long: 300 °C (572 °F)
- Transmitter horizontal, temperature isolator short: 200 °C (392 °F)
- Transmitter vertical, temperature isolator short: 200 °C (392 °F)

**Diaphragm seal on one side or both sides with capillary**

- Depending on diaphragm seal and fill fluid:  $-70\text{ °C}$  ( $-94\text{ °F}$ ) up to  $+400\text{ °C}$  ( $+752\text{ °F}$ )
- A4 screws of process connection, threaded separator:  $T_{\min} -60\text{ °C}$  ( $-76\text{ °F}$ )
- Observe the maximum gauge pressure and maximum temperature

**Diaphragm seal with tantalum membrane**

$-70\text{ to }+300\text{ °C}$  ( $-94\text{ to }+572\text{ °F}$ )

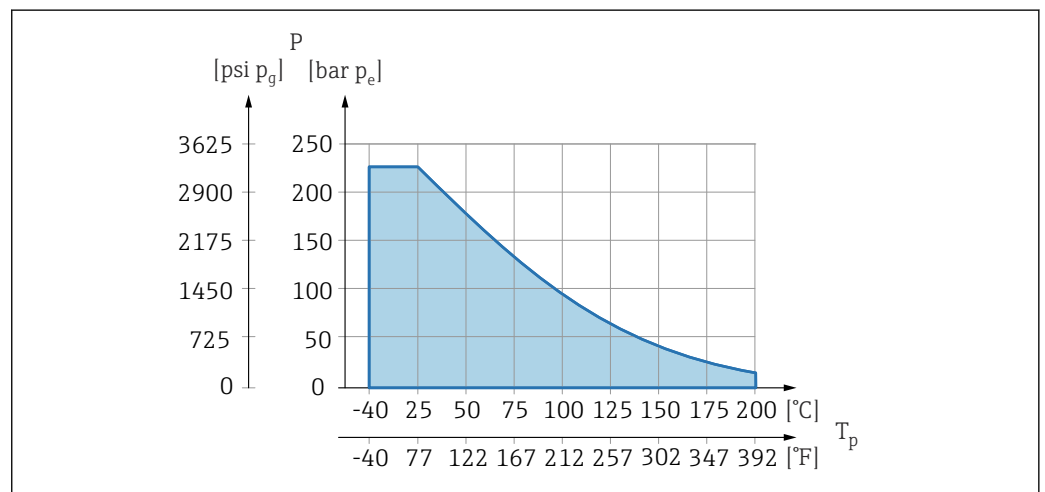
**Devices with PTFE-coated diaphragm seal membrane**

The anti-stick coating has very good anti-friction properties and protects the 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) membrane, see the following graphic:



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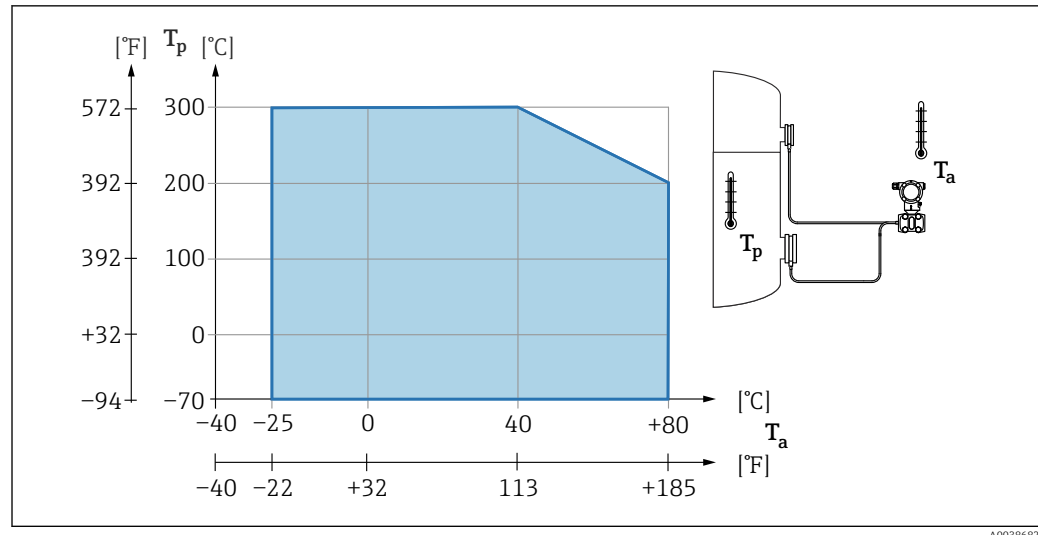
-  For vacuum applications:  $p_{\text{abs}} \leq 1\text{ bar}$  (14.5 psi) to 0.05 bar (0.725 psi) to max.  $+150\text{ °C}$  (302 °F).

If a PTFE coating has been selected, a conventional 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



## Process pressure range

### Pressure specifications

**i** The maximum pressure for the device depends on the lowest-rated element with regard to pressure.

Components are: process connection, optional mounting parts, or accessories.

### **WARNING**

#### **Incorrect design or use of the device may cause injury due to bursting parts!**

- ▶ Only operate the device within the specified limits for the components!
- ▶ MWP (maximum working pressure): The maximum working pressure is specified on the nameplate. This value refers to a reference temperature of +20 °C (+68 °F) and may be applied to the device for an unlimited 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). Maximum working pressure data that deviate from this are provided in the relevant sections of the Technical Information.
- ▶ The overpressure limit is the maximum pressure that a device may be subjected to during a test. The overpressure limit exceeds the maximum working pressure by a certain factor. 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.
- ▶ The Pressure Equipment Directive (2014/68/EU) uses the abbreviation "PT". The abbreviation "PT" corresponds to the OPL (Over Pressure Limit) of the device. OPL (Over Pressure Limit) is a test pressure.
- ▶ In the case of measuring cell range and process connection combinations where the overpressure limit (OPL) of the process connection is less than the nominal value of the measuring cell, the device is set at the factory, at the very maximum, to the OPL value of the process connection. If the entire measuring cell 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

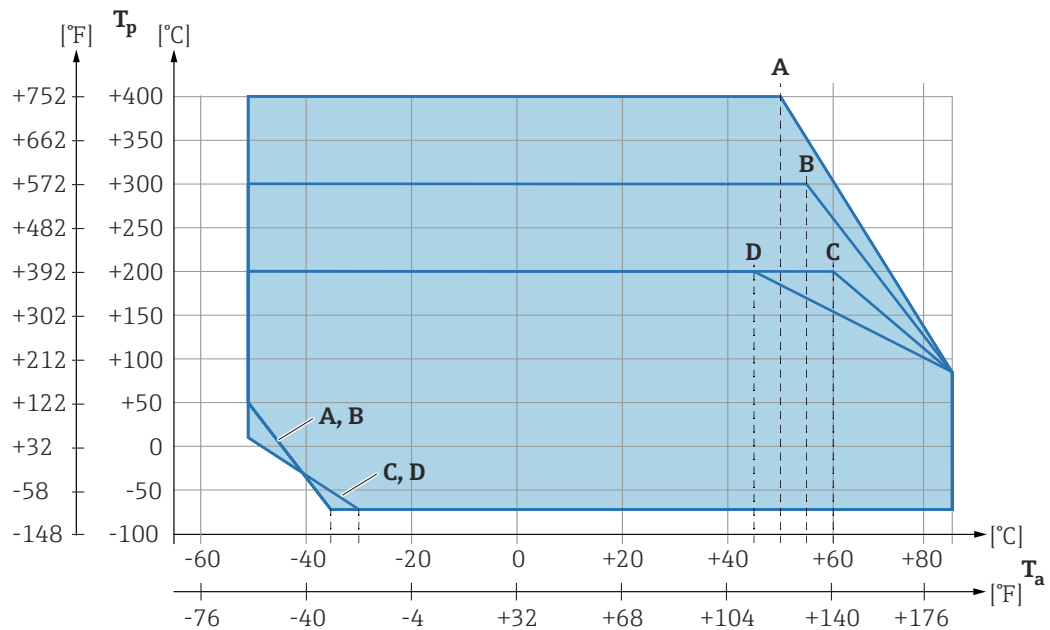
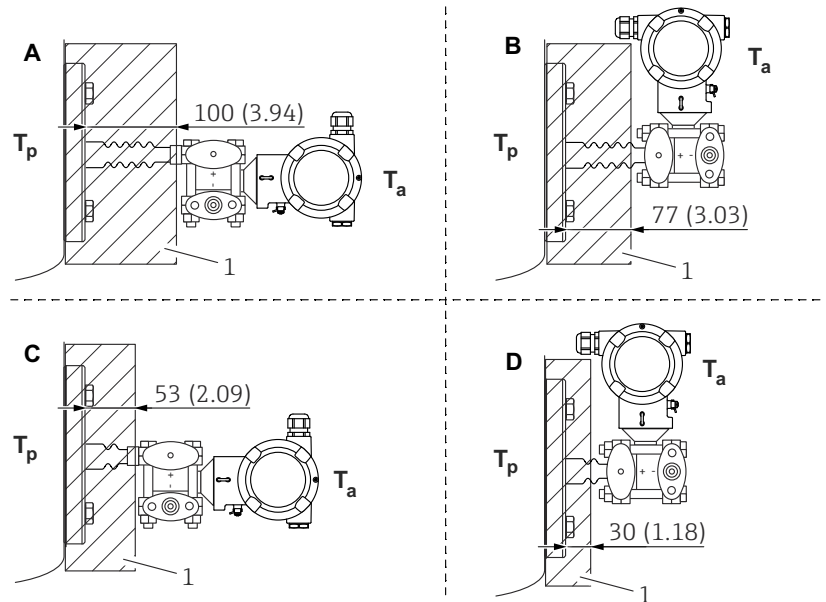
As of the specified burst pressure, the complete destruction of the pressure-bearing parts and/or a device leak must be expected. It is therefore imperative to avoid such operating conditions by carefully planning and sizing your facility.



## Thermal insulation

**Thermal insulation when mounting with a temperature isolator**

The device may only be insulated up to a certain height. The maximum permitted insulation height applies to an insulation material with a thermal conductivity  $\leq 0.04 \text{ W/(m} \times \text{K)}$  and to the maximum permitted ambient temperature and process temperature. The data were determined under the application "quiescent air".



- 1 Insulation material
- A Transmitter horizontal, temperature isolator long
- B Transmitter vertical, temperature isolator long
- C Transmitter horizontal, temperature isolator short
- D Transmitter vertical, temperature isolator short

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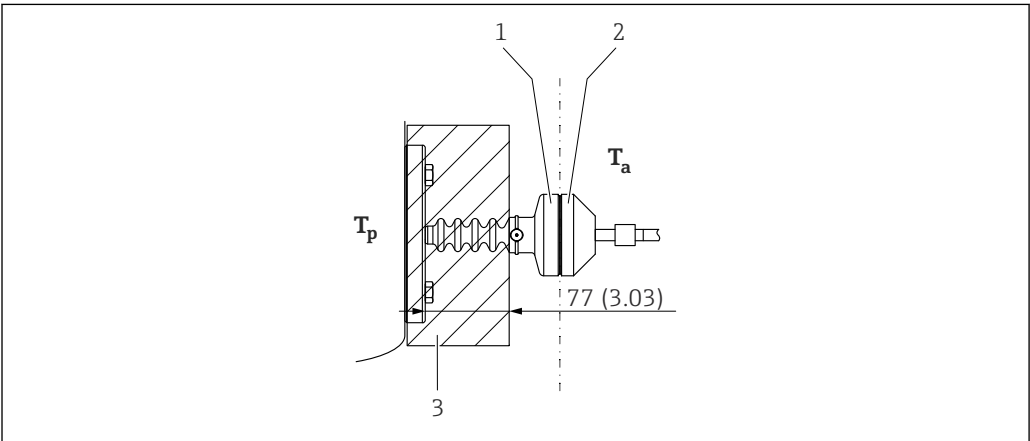
Without insulation, the ambient temperature decreases by 5 K.

Position	T <sub>a</sub> <sup>1)</sup>	T <sub>p</sub> <sup>2)</sup>
A	50 °C (122 °F)	400 °C (752 °F)
	85 °C (185 °F)	85 °C (185 °F) <sup>3)</sup>
	-50 °C (-58 °F)	50 °C (122 °F)
	-35 °C (-31 °F)	-70 °C (-94 °F)
B	55 °C (131 °F)	300 °C (572 °F)
	85 °C (185 °F)	85 °C (185 °F)
	-50 °C (-58 °F)	50 °C (122 °F)
	-35 °C (-31 °F)	-70 °C (-94 °F)
C	60 °C (140 °F)	200 °C (392 °F)
	85 °C (185 °F)	85 °C (185 °F)
	-50 °C (-58 °F)	10 °C (50 °F)
	-30 °C (-22 °F)	-70 °C (-94 °F)
D	67 °C (153 °F)	200 °C (392 °F)
	85 °C (185 °F)	85 °C (185 °F)
	-50 °C (-58 °F)	10 °C (50 °F)
	-30 °C (-22 °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 fill fluid used.

Thermal Range Expander

The device may only be insulated up to a certain height. The maximum permitted insulation height applies to an insulation material with a thermal conductivity ≤ 0.04 W/(m x K) and to the maximum permitted ambient temperature and process temperature. The data were determined under the application "quiescent air".



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- 1 Primary chamber
- 2 Secondary chamber
- 3 Insulation material

Without insulation, the ambient temperature decreases by 5 K.

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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.
Hydrogen applications	A <b>gold-coated</b> metallic membrane offers universal protection against hydrogen diffusion, both in gas applications and in applications with water-based solutions.

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## 15.5 Diaphragm seal China, order code 105

This section describes all the technical information of diaphragm seal versions with order code 105, option "8A" to "8N". All other technical information not described in this section can be found in the remaining sections of this document.

### Performance characteristics

#### Total performance

##### *Performance of the basic unit*

The calculation of the total performance for the basic unit remains unchanged.

Calculation of the diaphragm seal error: The resulting diaphragm seal error is different to the data in the Applicator, "[Sizing Diaphragm Seal](#)". The influence of the diaphragm seal error is not specified further. Specific sizing is not possible for this device version.

##### *Long-term stability*

The influence of the long-term stability for the basic unit can be determined by means of the Applicator, "[Sizing Pressure Performance](#)". The influence of the diaphragm seal system is not specified further.

##### *Total error*

The total error can be determined for the basic unit only without diaphragm seal mount.

##### *Response time*

The response time can be determined for the basic unit only without diaphragm seal mount. The influence of the diaphragm seal system is not specified further.

##### *Continuous and alternating load capacity*

The device version is designed and validated in accordance with the specifications and requirements of EN 837. Contrary to IEC 62828, a lower load resistance (temperature and pressure) must be assumed.

##### *Vibration resistance*

The device version is designed and validated in accordance with the specifications and requirements of EN 837.

#### Oxygen applications

This device version must **not** be used for oxygen applications.

### Process

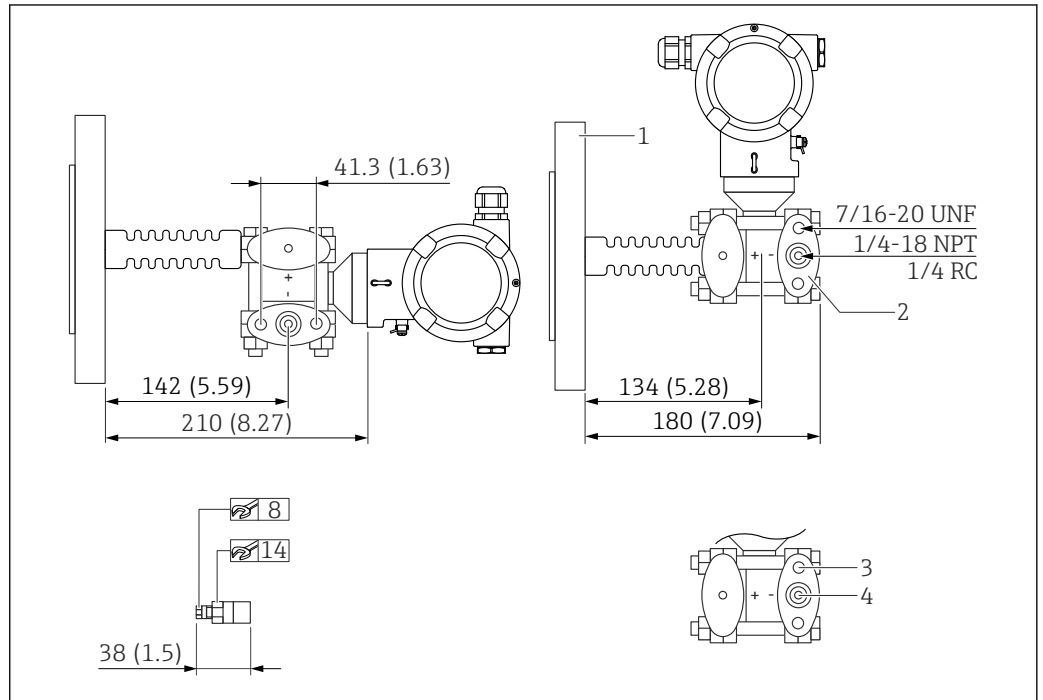
#### Process temperature range

Fill fluid	$P_{abs} = 0.05 \text{ bar (0.725 psi)}$ <sup>1)</sup>	$P_{abs} \geq 1 \text{ bar (14.5 psi)}$ <sup>2)</sup>
Silicone oil	-40 to +180 °C (-40 to +356 °F)	-40 to +250 °C (-40 to +482 °F)
High-temperature oil	-10 to +200 °C (+14 to +392 °F)	-10 to +360 °C (+14 to +680 °F)
Low-temperature oil	-98 to +60 °C (-144 to +140 °F)	-98 to +100 °C (-144 to +212 °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)

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!)

## Mechanical construction

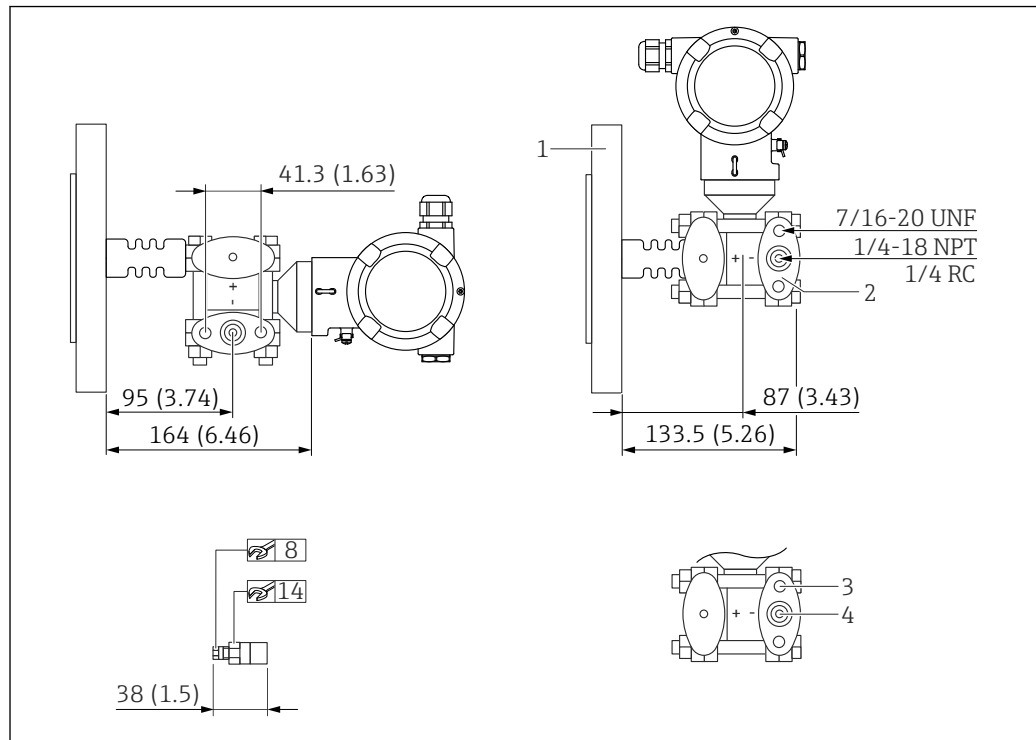
**Design, dimensions***Device with long temperature isolator*

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*Unit of measurement mm (in)*

- 1 High-pressure side
- 2 Low-pressure side
- 3 Thread depth: 15 mm (0.59 in)
- 4 Thread depth: 12 mm (0.47 in) ( $\pm 1$  mm (0.04 in))

*Device with short temperature isolator*



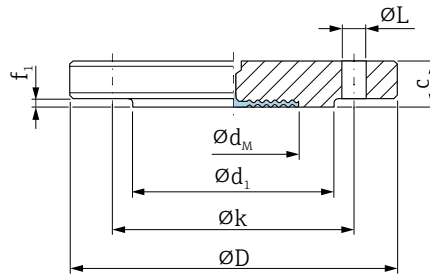
A0059262

*Unit of measurement mm (in)*

- 1 High-pressure side
- 2 Low-pressure side
- 3 Thread depth: 15 mm (0.59 in)
- 4 Thread depth: 12 mm (0.47 in) (±1 mm (0.04 in))

**Dimensions***Flange EN1092-1, Form B1 and B2, flush membrane, diaphragm seal*

Connection dimensions according to EN1092-1.



A0059092

$\varnothing D$  Diameter of flange  
 $c$  Thickness  
 $\varnothing d_1$  Raised face  
 $f_1$  Raised face  
 $\varnothing k$  Bolt circle diameter  
 $\varnothing L$  Diameter of hole  
 $\varnothing d_M$  Max. diameter of membrane

Unit mm (in)

Flange <sup>1) 2)</sup>							Boltholes			Order option <sup>3)</sup>
DN	PN	Form	$\varnothing D$	$c$	$\varnothing d_1$	$f_1$	Number	$\varnothing L$	$\varnothing k$	
			mm	mm	mm	mm		mm	mm	
DN 50	PN 10-40	B1	165	20	102	2	4	18	125	H3J
DN 50	PN 63	B2	180	26	102	2	4	22	135	FGJ
DN 50	PN 100-160	B2	195	30	102	2	4	26	145	MCJ
DN 80	PN 10-40	B1	200	24	138	2	8	18	160	H5J
DN 80	PN 100	B2	230	36	138	2	8	26	180	FPJ

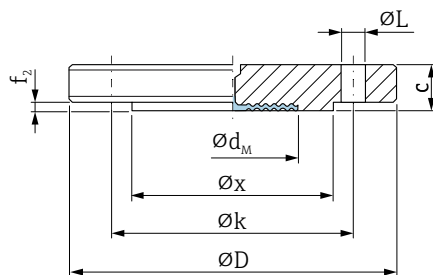
- 1) Material: AISI 316L  
 2) The flange raised face is made from the same material as the membrane.  
 3) Product Configurator order code for "Process connection"

*Maximum diameter of membrane  $\varnothing d_M$* 

DN	PN	$\varnothing d_M$ (mm)			
		316L	Alloy C276	Tantalum	Monel (Alloy 400)
DN 50	PN 10-40	60	92	92	92
DN 50	PN 63	60	92	92	92
DN 50	PN 100-160	60	92	92	92
DN 80	PN 10-40	89	127	127	127
DN 80	PN 100	89	127	127	127

*Flange EN1092-1, Form E, flush membrane, diaphragm seal*

Connection dimensions according to EN1092-1.



A0059093

$\varnothing D$  Diameter of flange  
 $c$  Thickness  
 $\varnothing x$  Raised face  
 $f2$  Raised face  
 $\varnothing k$  Bolt circle diameter  
 $\varnothing L$  Diameter of hole  
 $\varnothing d_M$  Max. diameter of membrane

Unit mm (in)

Flange <sup>1) 2)</sup>							Boltholes			Order option <sup>3)</sup>
DN	PN	Form	$\varnothing D$	$c$	$\varnothing x$	$f2$	Number	$\varnothing L$	$\varnothing k$	
			mm	mm	mm	mm		mm	mm	
DN 25	PN 10-40	E	115	18	57	4.5	4	14	85	H0J
DN 50	PN 10-40	E	165	20	87	4.5	4	18	125	H3J
DN 80	PN 10-40	E	200	24	120	4.5	8	18	160	H5J

- 1) Material: AISI 316L  
 2) The flange raised face is made from the same material as the membrane.  
 3) Product Configurator order code for "Process connection"

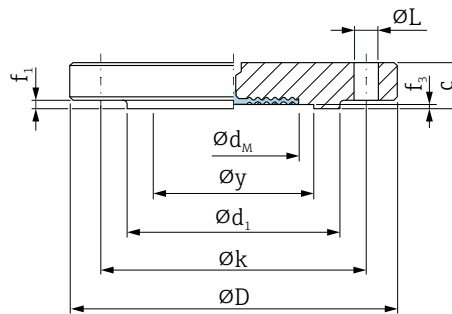
*Maximum diameter of membrane  $\varnothing d_M$*

DN	PN	$\varnothing d_M$ (mm)			
		316L	Alloy C276	Tantalum	Monel (Alloy 400)
DN 50	PN 10-40	60	92	92	92
DN 80	PN 10-40	89	127	127	127



*Flange EN1092-1, Form F, flush membrane, diaphragm seal*

Connection dimensions according to EN1092-1.



A0059094

$\varnothing D$  Diameter of flange  
 $c$  Thickness  
 $\varnothing d_1$  Raised face  
 $f_1$  Raised face  
 $f_3$  Groove height  
 $\varnothing k$  Bolt circle diameter  
 $\varnothing L$  Diameter of hole  
 $\varnothing d_M$  Max. diameter of membrane

Unit mm (in)

Flange <sup>1) 2)</sup>									Boltholes			Order option <sup>3)</sup>
DN	PN	Form	$\varnothing D$	$c$	$\varnothing d_1$	$\varnothing y$	$f_1$	$f_3$	Number	$\varnothing L$	$\varnothing k$	
			mm	mm	mm	mm	mm	mm		mm	mm	
DN 50	PN 10-40	F	165	20	102	88	3	4	4	18	125	H3J
DN 80	PN 10-40	F	200	24	138	121	3	4	8	18	160	H5J

1) Material: AISI 316L

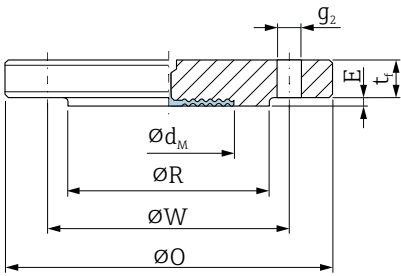
2) The flange raised face is made from the same material as the membrane.

3) Product Configurator order code for "Process connection"

*Maximum diameter of membrane  $\varnothing d_M$*

DN	PN	$\varnothing d_M$ (mm)			
		316L	Alloy C276	Tantalum	Monel (Alloy 400)
DN 50	PN 10-40	60	92	92	92
DN 80	PN 10-40	89	127	127	127

Flange ASME B16.5, Form RF and LM, flush membrane, diaphragm seal  
Connection dimensions in accordance with ASME B 16.5.



A0059098

- ØO Diameter of flange
- tf Thickness
- ØR Raised face
- E Raised face
- ØW Bolt circle diameter
- Øg<sub>2</sub> Diameter of hole
- Ød<sub>M</sub> Max. diameter of the membrane

Unit mm (in)

Flange <sup>1) 2)</sup>						Boltholes			Order option <sup>3)</sup>
NPS	Class	ØO	tf	ØR	E	Number	Øg <sub>2</sub>	ØW	
in		in	in	in	in		in	in	
2	150	6	0.71	3.63	0.08	4	3/4	4.75	ADJ
2	300	6.5	0.81	3.63	0.08	8	3/4	5	AQJ
2	400/600	6.5	1.00	3.63	0.28	8	3/4	5	A0J
2	900/1500	8.46	1.52	3.63	0.28	8	1	6.5	BFJ
2	2500	9.25	2.01	3.63	0.28	8	1 1/8	6.75	BLJ
3	150	7.5	0.88	5	0.08	4	3/4	6	AFJ
3	300	8.23	1.06	5	0.08	8	7/8	6.63	ASJ
3	400/600	8.23	1.23	5	0.28	8	7/8	6.63	A1J
3	900	9.80	1.5	5	0.28	8	1	7.5	BAJ
3	1500	10.43	1.88	5	0.28	8	1.3	8	BGJ
3	2500	12.01	2.63	5	0.28	8	1.42	9	BMJ

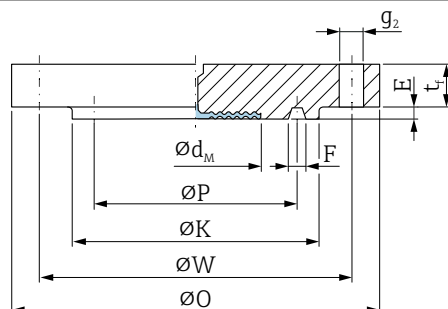
1) Material: AISI 316L  
2) The flange raised face is made from the same material as the membrane.  
3) Product Configurator order code for "Process connection"

Maximum diameter of membrane  $\varnothing d_M$

NPS	Class	$\varnothing d_M$ (in)			
		316L	Alloy C276	Tantalum	Monel (Alloy 400)
2	150	2.36	3.63	3.63	3.63
2	300	2.36	3.63	3.63	3.63
2	400/600	2.36	3.63	3.63	3.63
2	900/1500	2.36	3.63	3.63	3.63
2	2500	2.36	3.63	3.63	3.63
3	150	3.50	5.00	5.00	5.00
3	300	3.50	5.00	5.00	5.00
3	400/600	3.50	5.00	5.00	5.00
3	900	3.50	5.00	5.00	5.00
3	1500	3.50	5.00	5.00	5.00
3	2500	3.50	5.00	5.00	5.00

# Flange ASME B16.5, Form RTJ, flush membrane, diaphragm seal

Connection dimensions in accordance with ASME B 16.5.



A0059096

$\varnothing O$  Diameter of flange  
 $t_f$  Thickness  
 $\varnothing K$  Raised face  
 $E$  Raised face  
 $F$  Groove width  
 $P$  Pitch circle diameter  
 $\varnothing W$  Bolt circle diameter  
 $\varnothing g_2$  Diameter of hole  
 $\varnothing d_M$  Max. diameter of the membrane

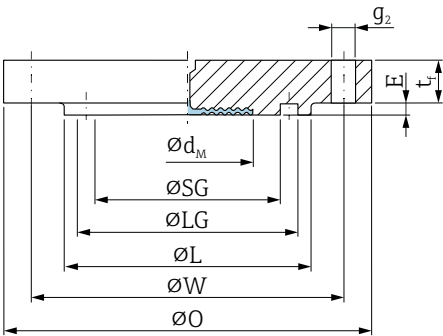
Flange <sup>1) 2)</sup>								Boltholes			Order option <sup>3)</sup>
NPS	Class	$\varnothing O$	$t_f$	P	E	F	$\varnothing K$	Number	$\varnothing g_2$	$\varnothing W$	
in		in	in	in	in	in	in		in	in	
2	150	6	0.71	82.55	6.35	8.74	102	4	3/4	4.75	ADJ
2	300	6.5	0.81	82.55	7.92	11.91	108	8	3/4	5	AQJ
2	400/600	6.5	1.00	82.55	7.92	11.91	108	8	3/4	5	AQJ
2	900/1500	8.46	1.52	95.25	7.92	11.91	124	8	1	6.5	BFJ
2	2500	9.25	2.01	101.60	7.92	11.91	133	8	1 1/8	6.75	BLJ
3	150	7.5	0.88	114.30	6.35	8.74	133	4	3/4	6	AFJ
3	300	8.23	1.06	123.82	7.92	11.91	146	8	7/8	6.63	ASJ
3	400/600	8.23	1.23	123.82	7.92	11.91	146	8	7/8	6.63	A1J
3	900	9.80	1.5	123.82	7.92	11.91	155	8	1	7.5	BAJ
3	1500	10.43	1.88	136.52	7.92	11.91	168	8	1.3	8	BGJ
3	2500	12.01	2.63	127	9.53	13.49	168	8	1.42	9	BMJ

- 1) Material: AISI 316L
- 2) The flange raised face is made from the same material as the membrane.
- 3) Product Configurator order code for "Process connection"

Maximum diameter of membrane  $\varnothing d_M$

NPS	Class	$\varnothing d_M$ (in)			
		316L	Alloy C276	Tantalum	Monel (Alloy 400)
2	150	2.36	3.63	3.63	3.63
2	300	2.36	3.63	3.63	3.63
2	400/600	2.36	3.63	3.63	3.63
2	900/1500	2.36	3.63	3.63	3.63
2	2500	2.36	3.63	3.63	3.63
3	150	3.50	5.00	5.00	5.00
3	300	3.50	5.00	5.00	5.00
3	400/600	3.50	5.00	5.00	5.00
3	900	3.50	5.00	5.00	5.00
3	1500	3.50	5.00	5.00	5.00
3	2500	3.50	5.00	5.00	5.00

Flange ASME B16.5, Form LG, flush membrane, diaphragm seal  
Connection dimensions in accordance with ASME B 16.5.



A0059097

- ØO Diameter of flange
- tf Thickness
- ØL Raised face
- f Raised face
- SG Groove internal diameter
- LG Groove internal diameter
- ØW Bolt circle diameter
- Øg<sub>2</sub> Diameter of hole
- Ød<sub>M</sub> Max. diameter of the membrane

Flange <sup>1) 2)</sup>								Boltholes			Order option <sup>3)</sup>
NPS	Class	ØO	tf	ØL	f	SG	LG	Number	Øg <sub>2</sub>	ØW	
in		in	in	in	in	mm	mm		in	in	
2	150	6	0.71	3.63	0.08	71.4	93.7	4	3/4	4.75	ADJ
2	300	6.5	0.81	3.63	0.08	71.4	93.7	8	3/4	5	AQJ
2	400/600	6.5	1.00	3.63	0.28	71.4	93.7	8	3/4	5	A0J
2	900/1500	8.46	1.52	3.63	0.28	71.4	93.7	8	1	6.5	BFJ
2	2500	9.25	2.01	3.63	0.28	71.4	93.7	8	1 1/8	6.75	BLJ
3	150	7.5	0.88	5	0.08	106.4	128.5	4	3/4	6	AFJ
3	300	8.23	1.06	5	0.08	106.4	128.5	8	7/8	6.63	ASJ
3	400/600	8.23	1.23	5	0.28	106.4	128.5	8	7/8	6.63	A1J
3	900	9.80	1.5	5	0.28	106.4	128.5	8	1	7.5	BAJ
3	1500	10.43	1.88	5	0.28	106.4	128.5	8	1.3	8	BGJ
3	2500	12.01	2.63	5	0.28	106.4	128.5	8	1.42	9	BMJ

1) Material: AISI 316L  
2) The flange raised face is made from the same material as the membrane.  
3) Product Configurator order code for "Process connection"

Maximum diameter of membrane  $\varnothing d_M$

NPS	Class	$\varnothing d_M$ (in)			
		316L	Alloy C276	Tantalum	Monel (Alloy 400)
2	150	2.36	3.63	3.63	3.63
2	300	2.36	3.63	3.63	3.63
2	400/600	2.36	3.63	3.63	3.63
2	900/1500	2.36	3.63	3.63	3.63
2	2500	2.36	3.63	3.63	3.63
3	150	3.50	5.00	5.00	5.00
3	300	3.50	5.00	5.00	5.00
3	400/600	3.50	5.00	5.00	5.00
3	900	3.50	5.00	5.00	5.00
3	1500	3.50	5.00	5.00	5.00
3	2500	3.50	5.00	5.00	5.00

**Weight***Process connections*

Weight <sup>1)</sup>	Order option <sup>2)</sup>
1.20 kg (2.65 lb)	AAJ
1.50 kg (3.31 lb)	AMJ
1.60 kg (3.53 lb)	ACJ
2.70 kg (5.95 lb)	APJ
2.50 kg (5.51 lb)	ADJ
3.40 kg (7.50 lb)	AQJ
5.10 kg (11.25 lb)	AFJ
7.00 kg (15.44 lb)	ASJ
1.70 kg (3.75 lb)	AXJ
4.30 kg (9.48 lb)	A0J
8.60 kg (18.96 lb)	A1J
13.30 kg (29.33 lb)	BAJ
3.70 kg (8.16 lb)	BDJ
10.30 kg (22.71 lb)	BFJ
21.80 kg (48.07 lb)	BGJ
15.80 kg (34.84 lb)	BLJ
39.00 kg (86.00 lb)	BMJ
1.70 kg (3.75 lb)	BJJ
1.38 kg (3.04 lb)	H0J
3.20 kg (7.06 lb)	H3J
5.54 kg (12.22 lb)	H5J

1) Total weight consisting of sensor assembly and process connection.

2) Product Configurator order code for "Process connection"



**Materials in contact with process***Membrane material*

## ■ 316L

## ■ Alloy C276

The flange raised face is made from the same material as the membrane.

## ■ 316L in the case of EN 1092-1 flanges

## ■ 316L in the case of ASME flanges

## ■ Tantalum

The flange raised face is made from the same material as the membrane.

## ■ 316L in the case of EN 1092-1 flanges

## ■ 316L in the case of ASME flanges

## ■ Monel (Alloy 400)

The flange raised face is made from the same material as the membrane.

## ■ 316L in the case of EN 1092-1 flanges

## ■ 316L in the case of ASME flanges

*Membrane coating*

## PTFE:

## ■ Coating: 50 to 65 µm (0.0019 to 0.0025 µin)

## ■ Maximum process pressure:

■ Process temperature ≤ +40 °C (+104 °F): maximum process pressure +150 bar (+2 175 psi)

■ Process temperature ≤ +150 °C (+302 °F): maximum process pressure +50 bar (+725 psi)

■ Process temperature ≤ +200 °C (+392 °F): maximum process pressure +20 bar (+290 psi)

## ■ Permitted process temperature:

■ -40 to +260 °C (-40 to +500 °F)

■ Under vacuum or negative pressure conditions at  $p_{abs} \leq 1$  bar:  
-40 to +200 °C (-40 to +392 °F)

## ■ PTFE coating serves as anti-adhesive layer and protects against abrasion

## Gold:

Coating: 25 µm (0.00098 µin)

**Materials not in contact with process***Armor for capillary*

## 316L

## ■ Capillary: ASTM 312 - 316L

## ■ Protective sleeve for capillary: ASTM A240 - 316 L

## Certificates and approvals

**Corrosion test**

Standards and test methods are available for specific versions.

Contact Endress+Hauser for a more detailed specification with the selected system configuration and order code.

**Overfill protection system**

This device version **has not** been validated as overfill protection in accordance with §63 WHG (German Water Resources Act).

**Marine approval**

This device version **does not** have marine approval.

**CRN approval**

This device version **does not** have CRN approval.

**Test reports***Test, certificate, declarations*

This device version does **not** meet the following requirements:

- AD 2000 (wetted metal parts), declaration, excluding process membrane
- NACE MR0175 / ISO 15156 (wetted metallic parts), declaration
- ASME B31.3 process piping, declaration
- ASME B31.1 power piping, declaration
- NACE MR0103/ISO 17945 (wetted metal parts), test report

The following tests **cannot** be provided for this device version:

- Helium leak test, internal procedure, test report
- Welding documentation, wetted/pressurized seams
- Inspection certificate 3.1, EN10204 (material certificate, wetted metallic parts)
- PMI test, internal procedure (wetted metallic parts), test report
- Penetrant testing ISO23277-1 (PT), wetted/pressurized metallic parts, test report
- NACE MR0103/ISO 17945 (wetted metal parts), test report
- Ambient temperature range transmitter –50 °C (–58 °F), sensor; see specification
- Ambient temperature range transmitter –60 °C (–76 °F), sensor; see specification

*Manufacturer declarations*

**No** valid manufacturer declarations are currently available for this device version.

Contact Endress+Hauser if necessary.

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