

## 7 Electrical connection

### NOTICE

**The measuring device does not have an internal circuit breaker.**

- ▶ For this reason, assign the measuring device a switch or power-circuit breaker so that the power supply line can be easily disconnected from the mains.
- ▶ Although the measuring device is equipped with a fuse, additional overcurrent protection (maximum 16 A) should be integrated into the system installation.

### 7.1 Electrical safety

In accordance with applicable national regulations.

### 7.2 Connection conditions

#### 7.2.1 Required tools

- Torque wrench
- For cable entries: Use corresponding tools
- Wire stripper
- When using stranded cables: Crimper for wire end ferrule

#### 7.2.2 Requirements for connecting cable

The connecting cables provided by the customer must fulfill the following requirements.

##### Permitted temperature range

- The installation guidelines that apply in the country of installation must be observed.
- The cables must be suitable for the minimum and maximum temperatures to be expected.

##### Power supply cable (incl. conductor for the inner ground terminal)

Standard installation cable is sufficient.

##### Signal cable

*Current output 0/4 to 20 mA*

Standard installation cable is sufficient.

*Current output 4 to 20 mA HART*

A shielded cable is recommended. Observe grounding concept of the plant.

*Pulse/frequency/switch output*

Standard installation cable is sufficient.

*Status input*

Standard installation cable is sufficient.

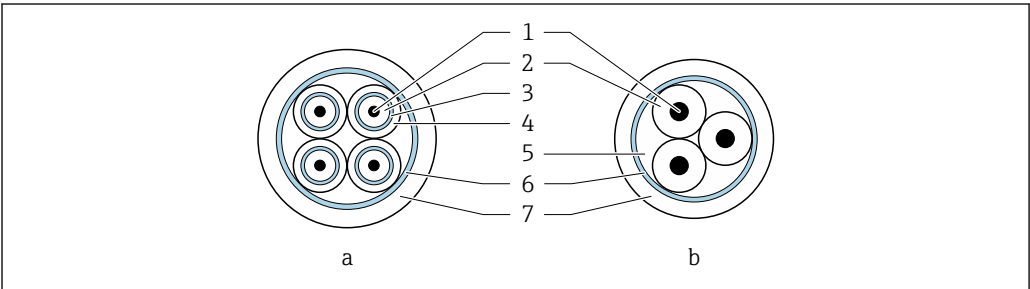
Connecting cable for remote version

Electrode cable

|                                      |                                                                                                                         |
|--------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| Standard cable                       | 3 ×0.38 mm <sup>2</sup> (20 AWG) with common, braided copper shield (ϕ ~9.5 mm (0.37 in)) and individual shielded cores |
| Cable for empty pipe detection (EPD) | 4 ×0.38 mm <sup>2</sup> (20 AWG) with common, braided copper shield (ϕ ~9.5 mm (0.37 in)) and individual shielded cores |
| Conductor resistance                 | ≤50 Ω/km (0.015 Ω/ft)                                                                                                   |
| Capacitance: core/shield             | ≤420 pF/m (128 pF/ft)                                                                                                   |
| Operating temperature                | −20 to +80 °C (−4 to +176 °F)                                                                                           |

Coil current cable

|                                         |                                                                                         |
|-----------------------------------------|-----------------------------------------------------------------------------------------|
| Standard cable                          | 3 ×0.75 mm <sup>2</sup> (18 AWG) with common, braided copper shield (ϕ ~9 mm (0.35 in)) |
| Conductor resistance                    | ≤37 Ω/km (0.011 Ω/ft)                                                                   |
| Capacitance: core/core, shield grounded | ≤120 pF/m (37 pF/ft)                                                                    |
| Operating temperature                   | −20 to +80 °C (−4 to +176 °F)                                                           |
| Test voltage for cable insulation       | ≤ AC 1433 V rms 50/60 Hz or ≥ DC 2026 V                                                 |



A0029151

6 Cable cross-section

- a Electrode cable
- b Coil current cable
- 1 Core
- 2 Core insulation
- 3 Core shield
- 4 Core jacket
- 5 Core reinforcement
- 6 Cable shield
- 7 Outer jacket

Armored connecting cable

Armored connecting cables with an additional, reinforcing metal braid should be used:

- When laying the cable directly in the ground
- Where there is a risk of damage from rodents
- Use as per IP68 degree of protection

Operation in environments with strong electrical interference

The measuring system meets the general safety requirements → 191 and EMC specifications → 175.

Grounding is by means of the ground terminal provided for the purpose inside the connection housing. The stripped and twisted lengths of cable shield to the ground terminal must be as short as possible.

#### Cable diameter

- Cable glands supplied:
  - For standard cable: M20 × 1.5 with cable  $\phi$  6 to 12 mm (0.24 to 0.47 in)
  - For reinforced cable: M20 × 1.5 with cable  $\phi$  9.5 to 16 mm (0.37 to 0.63 in)
- (Plug-in) spring terminals for wire cross-sections 0.5 to 2.5 mm<sup>2</sup> (20 to 14 AWG)

### 7.2.3 Terminal assignment

#### Transmitter

The sensor can be ordered with terminals.

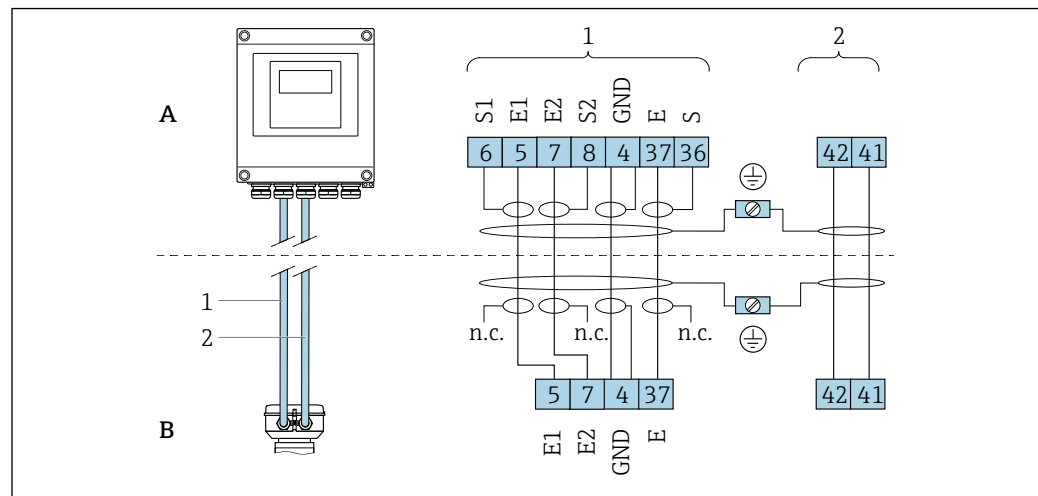
| Connection methods available |              | Possible options for order code "Electrical connection"                                                                                                                            |
|------------------------------|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Outputs                      | Power supply |                                                                                                                                                                                    |
| Terminals                    | Terminals    | <ul style="list-style-type: none"> <li>■ Option A: coupling M20x1</li> <li>■ Option B: thread M20x1</li> <li>■ Option C: thread G ½"</li> <li>■ Option D: thread NPT ½"</li> </ul> |

#### Supply voltage

| Order code "Power supply"           | Terminal numbers   | terminal voltage |             | Frequency range |
|-------------------------------------|--------------------|------------------|-------------|-----------------|
| Option L<br>(wide range power unit) | 1 (L+/L), 2 (L-/N) | DC 24 V          | ±25%        | –               |
|                                     |                    | AC 24 V          | ±25%        | 50/60 Hz, ±4 Hz |
|                                     |                    | AC 100 to 240 V  | –15 to +10% | 50/60 Hz, ±4 Hz |

*Signal transmission with current output 0 to 20 mA/4 to 20 mA HART and other outputs and inputs*

| Order code for "Output" and "Input" | Terminal numbers                                                      |        |                                                    |        |                                         |        |              |        |
|-------------------------------------|-----------------------------------------------------------------------|--------|----------------------------------------------------|--------|-----------------------------------------|--------|--------------|--------|
|                                     | Output 1                                                              |        | Output 2                                           |        | Output 3                                |        | Input        |        |
|                                     | 26 (+)                                                                | 27 (-) | 24 (+)                                             | 25 (-) | 22 (+)                                  | 23 (-) | 20 (+)       | 21 (-) |
| Option H                            | Current output<br>■ 4 to 20 mA HART (active)<br>■ 0 to 20 mA (active) |        | Pulse/frequency output (passive)                   |        | Switch output (passive)                 |        | –            |        |
| Option I                            | Current output<br>■ 4 to 20 mA HART (active)<br>■ 0 to 20 mA (active) |        | Pulse/frequency/switch output (passive)            |        | Pulse/frequency/switch output (passive) |        | Status input |        |
| Option J                            | Current output<br>■ 4 to 20 mA HART (active)<br>■ 0 to 20 mA (active) |        | Fixed assignment: Certified pulse output (passive) |        | Switch output                           |        | Status input |        |

**Remote version**

A0032059

7 Remote version terminal assignment

A Transmitter wall-mount housing

B Sensor connection housing

1 Electrode cable

2 Coil current cable

n.c. Not connected, insulated cable shields

Terminal No. and cable colors: 6/5 = brown; 7/8 = white; 4 = green; 36/37 = yellow

**7.2.4 Preparing the measuring device**

Carry out the steps in the following order:

1. Mount the sensor and transmitter.
2. Connection housing, sensor: Connect connecting cable.
3. Transmitter: Connect connecting cable.
4. Transmitter: Connect signal cable and cable for supply voltage.

**NOTICE****Insufficient sealing of the housing!**

Operational reliability of the measuring device could be compromised.

► Use suitable cable glands corresponding to the degree of protection.

1. Remove dummy plug if present.
2. If the measuring device is supplied without cable glands:  
Provide suitable cable gland for corresponding connecting cable.
3. If the measuring device is supplied with cable glands:  
Observe requirements for connecting cables → 41.

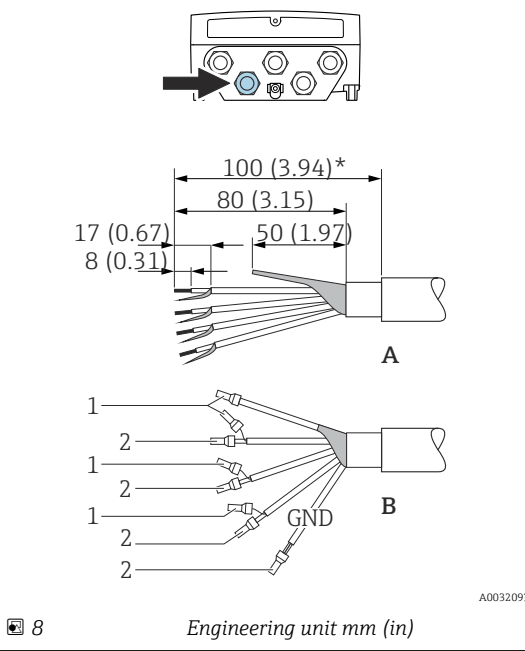
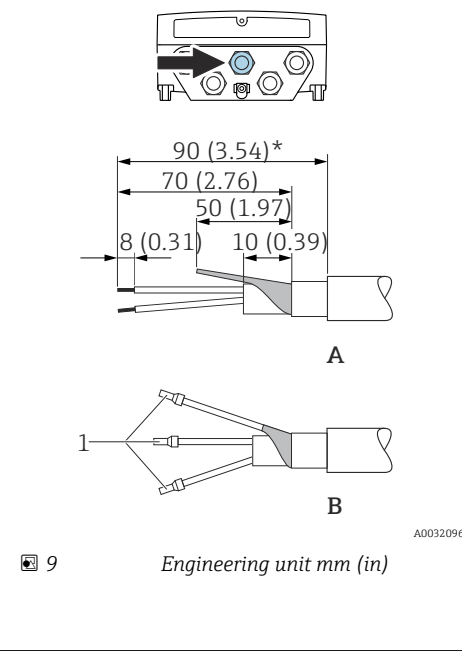
**7.2.5 Preparing the connecting cable for the remote version**

When terminating the connecting cable, pay attention to the following points:

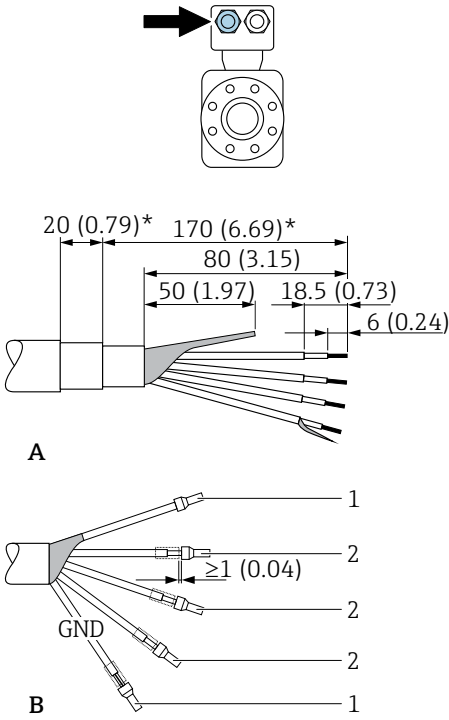
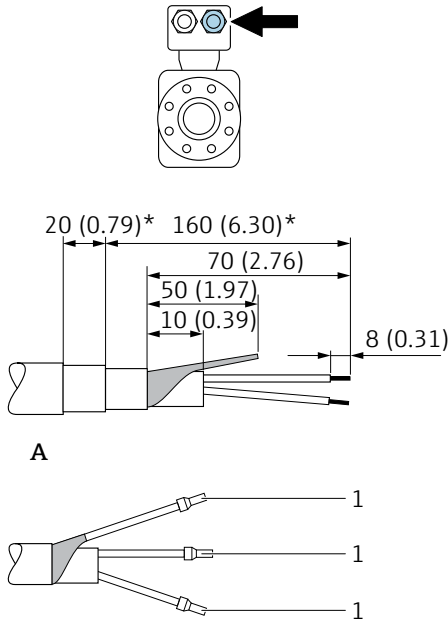
1. In the case of the electrode cable:  
Make sure that the ferrules do not touch the core shields on the sensor side.  
Minimum distance = 1 mm (exception: green "GND" cable)
2. In the case of the coil current cable:  
Insulate one core of the three-core cable at the level of the core reinforcement. You only require two cores for the connection.

3.
- For cables with fine-wire cores (stranded cables):  
Fit the cores with ferrules.

Transmitter

| Electrode cable                                                                                                                                                                                                                                                | Coil current cable                                                                                                                                    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| <div><p>8</p><p>Engineering unit mm (in)</p><p>A0032093</p></div>                                                                                                           | <div><p>9</p><p>Engineering unit mm (in)</p><p>A0032096</p></div> |
| <p>A = Termination of the cables<br/>B = Termination of the fine-wire cores with ferrules<br/>1 = Red ferrules, <math>\phi</math> 1.0 mm (0.04 in)<br/>2 = White ferrules, <math>\phi</math> 0.5 mm (0.02 in)<br/>* = Stripping only for reinforced cables</p> |                                                                                                                                                       |

## Sensor

| Electrode cable                                                                                                                                                                                                                                                    | Coil current cable                                                                                                                                         |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  <p>A</p> <p>B</p> <p>1</p> <p>2</p> <p>2</p> <p>2</p> <p>1</p> <p>GND</p> <p>≥1 (0.04)</p> <p>A0032100</p>                                                                      |  <p>A</p> <p>B</p> <p>1</p> <p>1</p> <p>1</p> <p>GND</p> <p>A0032101</p> |
| <p>A = Termination of the cables<br/> B = Termination of the fine-wire cores with ferrules<br/> 1 = Red ferrules, <math>\phi</math> 1.0 mm (0.04 in)<br/> 2 = White ferrules, <math>\phi</math> 0.5 mm (0.02 in)<br/> * = Stripping only for reinforced cables</p> |                                                                                                                                                            |

## 7.3 Connecting the measuring device

### ⚠ WARNING

#### Risk of electric shock! Components carry dangerous voltages!

- ▶ Have electrical connection work carried out by correspondingly trained specialists only.
- ▶ Observe applicable federal/national installation codes and regulations.
- ▶ Comply with local workplace safety regulations.
- ▶ Observe grounding concept of the plant.
- ▶ Never mount or wire the measuring device while it is connected to the supply voltage.
- ▶ Before the supply voltage is applied, connect the protective ground to the measuring device.

### 7.3.1 Connecting the remote version

#### ⚠ WARNING

#### Risk of damaging the electronic components!

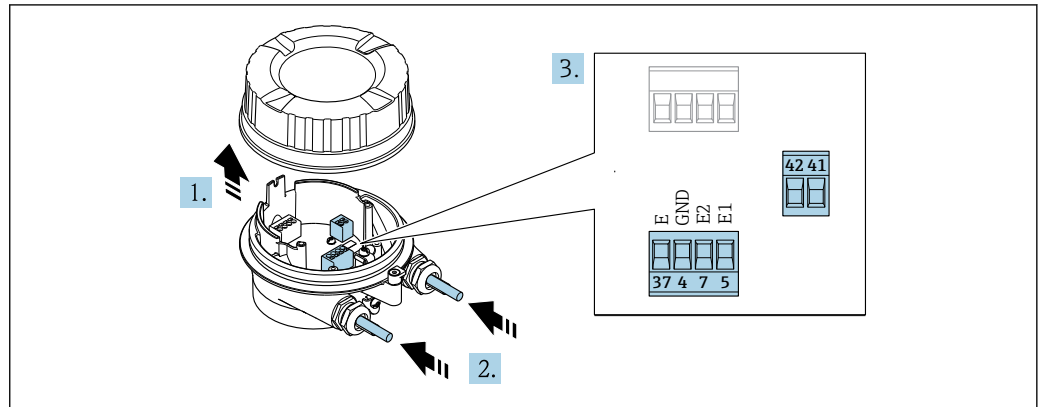
- ▶ Connect the sensor and transmitter to the same potential equalization.
- ▶ Only connect the sensor to a transmitter with the same serial number.
- ▶ Ground the connection housing of the sensor via the external screw terminal.

The following procedure (in the action sequence given) is recommended for the remote version:

1. Mount the sensor and transmitter.
2. Connect the connecting cable for the remote version.

3. Connect the transmitter.

### Connecting the connecting cable to the sensor connection housing



A0032103

 10 Sensor: connection module

1. Loosen the securing clamp of the housing cover.
2. Unscrew and lift off the housing cover.
3. **NOTICE**

#### For conduit extensions:

- Fit O-ring on cable and push it back sufficiently. When inserting the cable, the O-ring must be located outside the conduit extension.

Push the cable through the cable entry. To ensure tight sealing, do not remove the sealing ring from the cable entry.

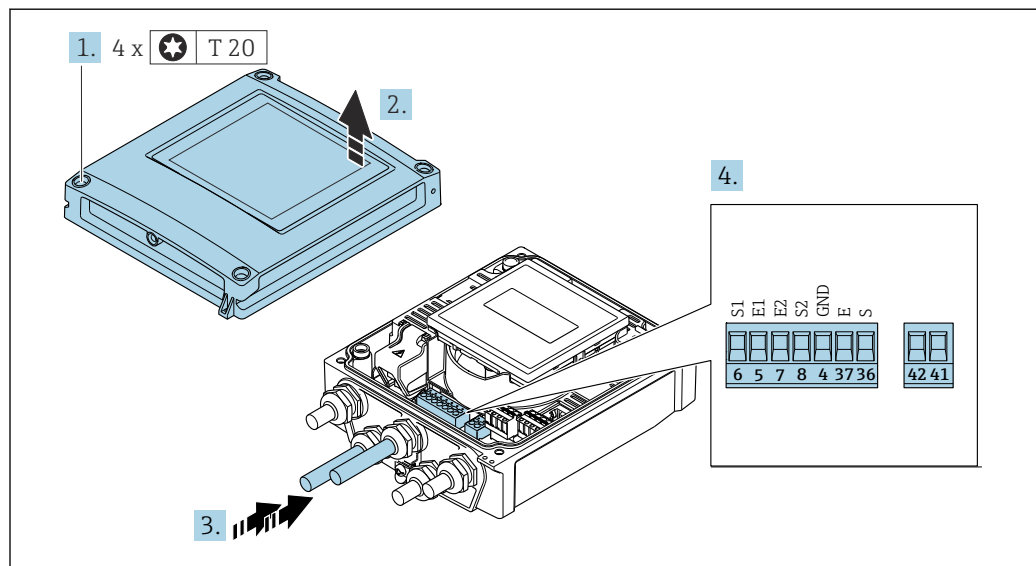
4. Strip the cable and cable ends. In the case of stranded cables, also fit ferrules  
→  44.
5. Connect the cable in accordance with the terminal assignment →  44.
6. Firmly tighten the cable glands.
7. **WARNING**

#### Housing degree of protection may be voided due to insufficient sealing of the housing.

- Screw in the screw without using any lubricant. The threads on the cover are coated with a dry lubricant.

Reverse the procedure to reassemble the sensor.

## Connecting the connecting cable to the transmitter



A0032102

11 Transmitter: main electronics module with terminals

1. Loosen the 4 fixing screws on the housing cover.
2. Open the housing cover.
3. Push the cable through the cable entry. To ensure tight sealing, do not remove the sealing ring from the cable entry.
4. Strip the cable and cable ends. In the case of stranded cables, also fit ferrules  
→ 44.
5. Connect the cable in accordance with the terminal assignment → 44.
6. Firmly tighten the cable glands.
7. **⚠ WARNING**

**Housing degree of protection may be voided due to insufficient sealing of the housing.**

- Screw in the screw without using any lubricant.

Reverse the removal procedure to reassemble the transmitter.

### 7.3.2 Connecting the transmitter

#### **⚠ WARNING**

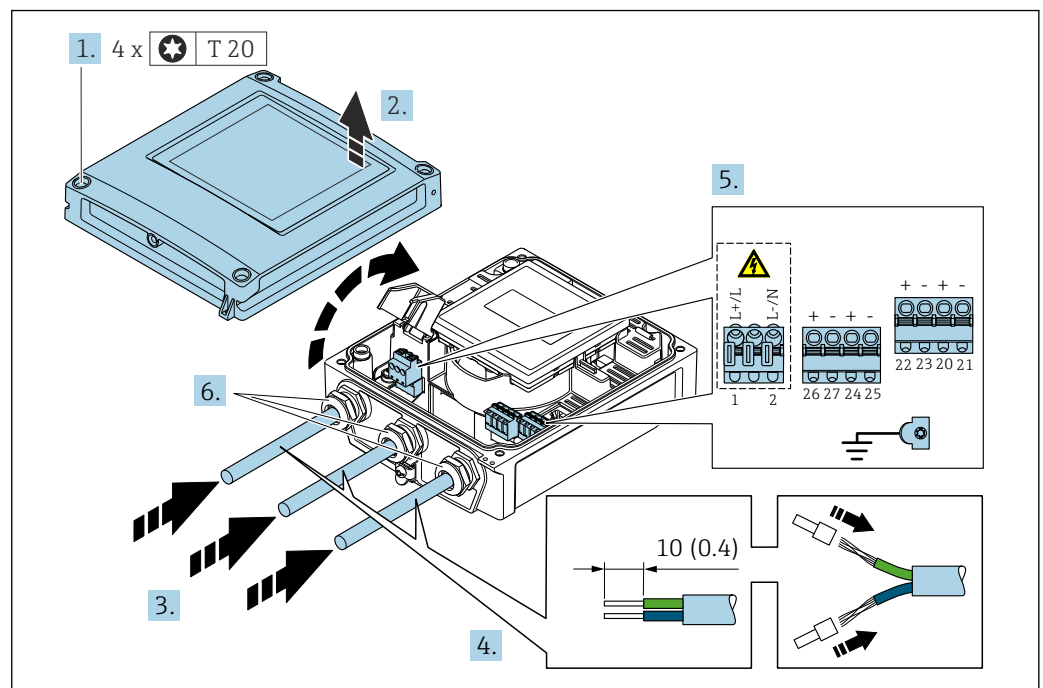
**Housing degree of protection may be voided due to insufficient sealing of the housing.**

- Screw in the screw without using any lubricant. The threads on the cover are coated with a dry lubricant.

*Tightening torques for plastic housing*

|                            |                     |
|----------------------------|---------------------|
| Housing cover fixing screw | 1 Nm (0.7 lbf ft)   |
| Cable entry                | 5 Nm (3.7 lbf ft)   |
| Ground terminal            | 2.5 Nm (1.8 lbf ft) |

**i** For HART communication: when connecting the cable shield to the ground terminal, observe the grounding concept of the facility.



12 Connecting the supply voltage and 0-20 mA/4-20 mA HART with additional outputs and inputs

1. Loosen the 4 fixing screws on the housing cover.
2. Open the housing cover.
3. Push the cable through the cable entry. To ensure tight sealing, do not remove the sealing ring from the cable entry.
4. Strip the cable and cable ends. In the case of stranded cables, also fit ferrules.
5. Connect the cables according to the terminal assignment → 43. For supply voltage: open the shock protection cover.
6. Firmly tighten the cable glands.

#### Reassembling the transmitter

1. Close the shock protection cover.
2. Close the housing cover.

**3. ⚠ WARNING**

**Housing degree of protection may be voided due to insufficient sealing of the housing.**

- ▶ Screw in the screw without using any lubricant.

Tighten the 4 fixing screws on the housing cover.

### 7.3.3 Ensuring potential equalization

#### Introduction

Correct potential equalization (equipotential bonding) is a prerequisite for stable and reliable flow measurement. Inadequate or incorrect potential equalization can result in device failure and present a safety hazard.

The following requirements must be observed to ensure correct, trouble-free measurement:

- The principle that the medium, the sensor and the transmitter must be at the same electrical potential applies.
- Take in-company grounding guidelines, materials and the grounding conditions and potential conditions of the pipe into consideration.
- Any necessary potential equalization connections must be established by ground cables with a minimum cross-section of 6 mm<sup>2</sup> (0.0093 in<sup>2</sup>).
- For remote device versions, the ground terminal in the example always refers to the sensor and not to the transmitter.

 You can order accessories like ground cables and ground disks from Endress+Hauser  
→  157

 For devices intended for use in hazardous locations, observe the instructions in the Ex documentation (XA).

#### Abbreviations used

- PE (Protective Earth): potential at the protective earth terminals of the device
- P<sub>P</sub> (Potential Pipe): potential of the pipe, measured at the flanges
- P<sub>M</sub> (Potential Medium): potential of the medium

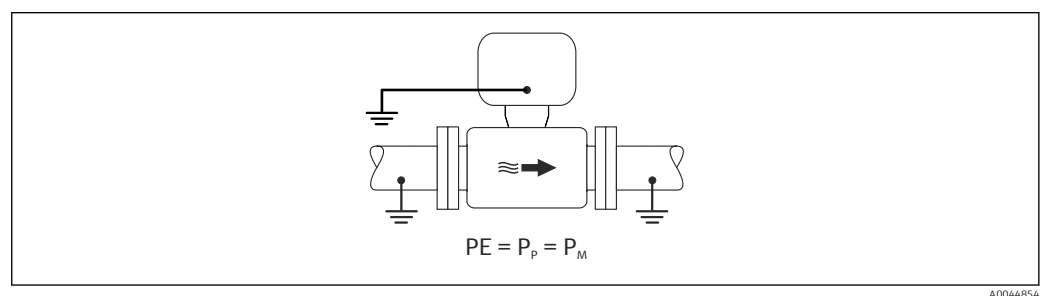
#### Connection examples for standard situations

##### *Unlined and grounded metal pipe*

- Potential equalization is via the measuring pipe.
- The medium is set to ground potential.

Starting conditions:

- Pipes are correctly grounded on both sides.
- Pipes are conductive and at the same electrical potential as the medium



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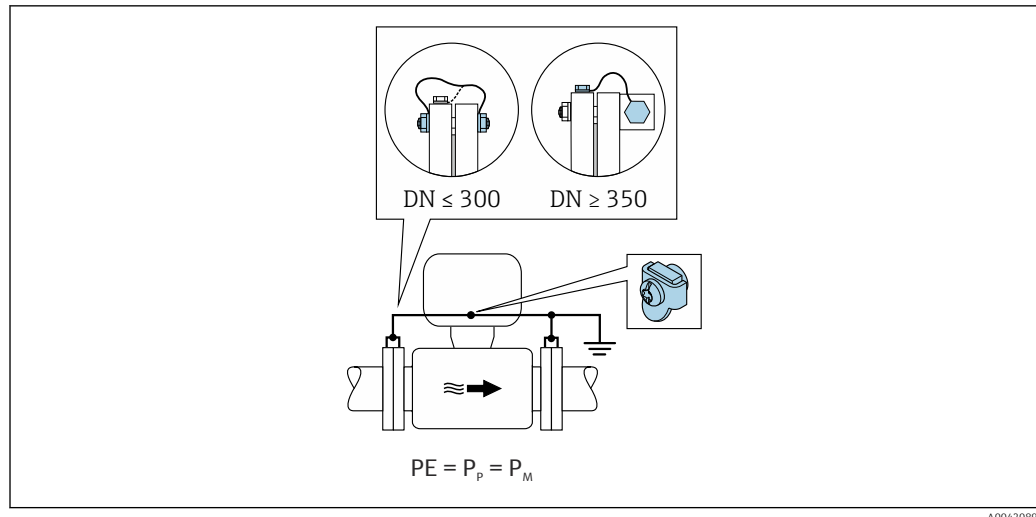
- Connect the connection housing of the transmitter or sensor to ground potential by means of the ground terminal provided for this purpose.

##### *Unlined metal pipe*

- Potential equalization is via the ground terminal and pipe flanges.
- The medium is set to ground potential.

Starting conditions:

- Pipes are not sufficiently grounded.
- Pipes are conductive and at the same electrical potential as the medium



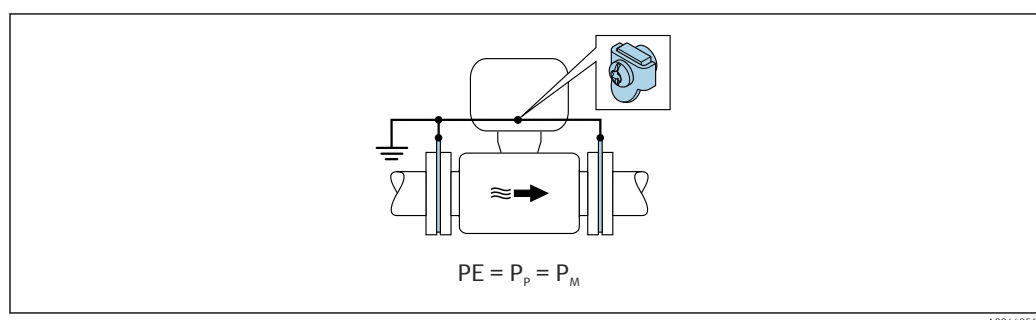
1. Connect both sensor flanges to the pipe flange via a ground cable and ground them.
  2. Connect the connection housing of the transmitter or sensor to ground potential by means of the ground terminal provided for this purpose.
- i**
- For DN  $\leq$  300 (12"): Mount the ground cable directly on the conductive flange coating of the sensor with the flange screws.
  - For DN  $\geq$  350 (14"): Mount the ground cable directly on the metal transport bracket. Observe screw tightening torques: see the Brief Operating Instructions for the sensor.

#### Plastic pipe or pipe with insulating liner

- Potential equalization is via the ground terminal and ground disks.
- The medium is set to ground potential.

#### Starting conditions:

- The pipe has an insulating effect.
- Low-impedance medium grounding close to the sensor is not guaranteed.
- Equalizing currents through the medium cannot be ruled out.



1. Connect the ground disks to the ground terminal of the connection housing of the transmitter or sensor via the ground cable.
2. Connect the connection to ground potential.

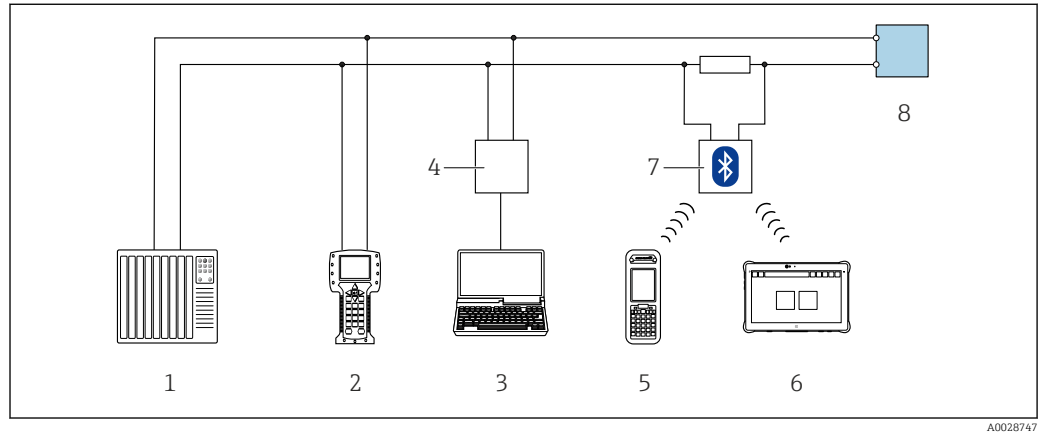
#### Connection example with the potential of the medium not equal to the protective ground

In these cases, the medium potential can differ from the potential of the device.

## 8.5.1 Connecting the operating tool

### Via HART protocol

This communication interface is available in device versions with a HART output.

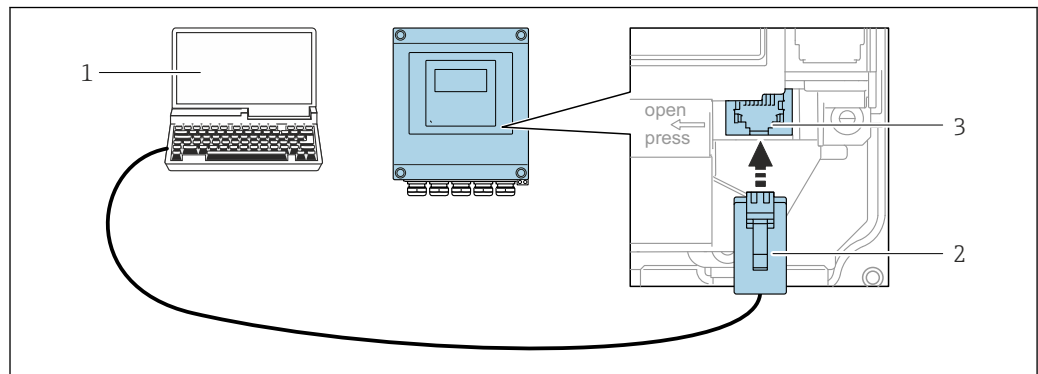


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19 Options for remote operation via HART protocol

- 1 Control system (e.g. PLC)
- 2 Field Communicator 475
- 3 Computer with operating tool (e.g. FieldCare, AMS Device Manager, SIMATIC PDM)
- 4 Commubox FXA 195 (USB)
- 5 Field Xpert SFX350 or SFX370
- 6 Field Xpert SMT70
- 7 VIATOR Bluetooth modem with connecting cable
- 8 Transmitter

### Via service interface (CDI-RJ45)



A0029163

20 Connection via service interface (CDI-RJ45)

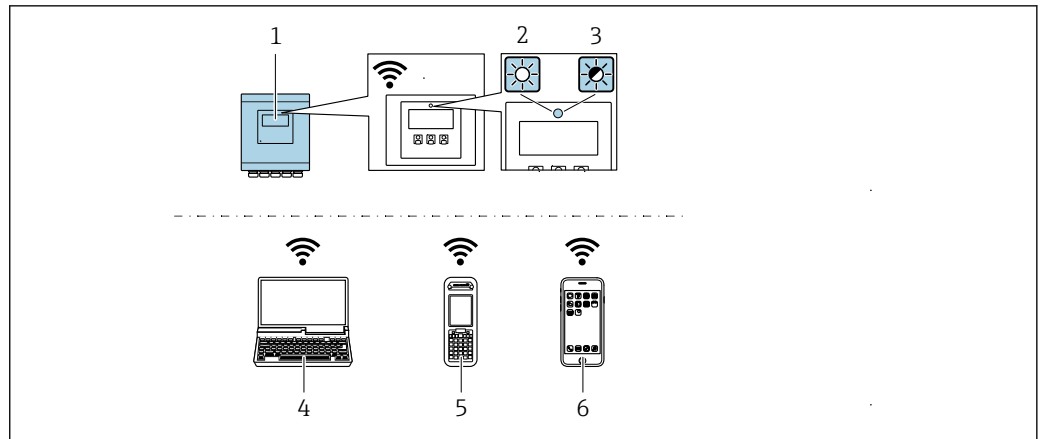
- 1 Computer with Web browser (e.g. Microsoft Internet Explorer, Microsoft Edge) for accessing the integrated device Web server or with "FieldCare", "DeviceCare" operating tool with COM DTM "CDI Communication TCP/IP"
- 2 Standard Ethernet connecting cable with RJ45 plug
- 3 Service interface (CDI-RJ45) of the measuring device with access to the integrated Web server

### Via WLAN interface

The optional WLAN interface is available on the following device version:

Order code for "Display", option BA "WLAN":

4-line, illuminated, graphic display; touch control + WLAN



A0043149

- 1 Transmitter with integrated WLAN antenna
- 2 LED lit constantly: WLAN reception is enabled on measuring device
- 3 LED flashing: WLAN connection established between operating unit and measuring device
- 4 Computer with WLAN interface and Web browser (e.g. Microsoft Internet Explorer, Microsoft Edge) for accessing the integrated device Web server or with operating tool (e.g. FieldCare, DeviceCare)
- 5 Mobile handheld terminal with WLAN interface and Web browser (e.g. Microsoft Internet Explorer, Microsoft Edge) for accessing the integrated device Web server or operating tool (e.g. FieldCare, DeviceCare)
- 6 Smart phone or tablet (e.g. Field Xpert SMT70)

|                            |                                                    |
|----------------------------|----------------------------------------------------|
| Function                   | WLAN: IEEE 802.11 b/g (2.4 GHz)                    |
| Encryption                 | WPA2-PSK AES-128 (in accordance with IEEE 802.11i) |
| Configurable WLAN channels | 1 to 11                                            |
| Degree of protection       | IP67                                               |
| Available antenna          | Internal antenna                                   |
| Range                      | Typically 10 m (32 ft)                             |

### Configuring the Internet protocol of the mobile terminal

#### NOTICE

**If the WLAN connection is lost during the configuration, settings made may be lost.**

- Make sure that the WLAN connection is not disconnected while configuring the device.

#### NOTICE

**In principle, avoid simultaneous access to the measuring device via the service interface (CDI-RJ45) and the WLAN interface from the same mobile terminal. This could cause a network conflict.**

- Only activate one service interface (CDI-RJ45 service interface or WLAN interface).
- If simultaneous communication is necessary: configure different IP address ranges, e.g. 192.168.0.1 (WLAN interface) and 192.168.1.212 (CDI-RJ45 service interface).

### Preparing the mobile terminal

- Enable WLAN reception on the mobile terminal.

### Establishing a connection from the mobile terminal to the measuring device

1. In the WLAN settings of the mobile terminal:  
Select the measuring device using the SSID (e.g. EH\_Promag\_\_A802000).
2. If necessary, select the WPA2 encryption method.

3. Enter the password: serial number of the measuring device ex-works (e.g. L100A802000).
  - ↳ LED on display module flashes: it is now possible to operate the measuring device with the Web browser, FieldCare or DeviceCare.

 The serial number can be found on the nameplate.

 To ensure the safe and swift assignment of the WLAN network to the measuring point, it is advisable to change the SSID name. It should be possible to clearly assign the SSID name to the measuring point (e.g. tag name) as it is displayed as the WLAN network.

#### Disconnecting

- ▶ After configuring the device:  
Terminate the WLAN connection between the operating unit and measuring device.

## 8.5.2 FieldCare

### Function scope

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

Access is via:

- HART protocol
- CDI-RJ45 service interface

Typical functions:

- Parameterization of transmitters
- Loading and saving device data (upload/download)
- Documentation of the measuring point
- Visualization of the measured value memory (line recorder) and event logbook

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

### Source for device description files

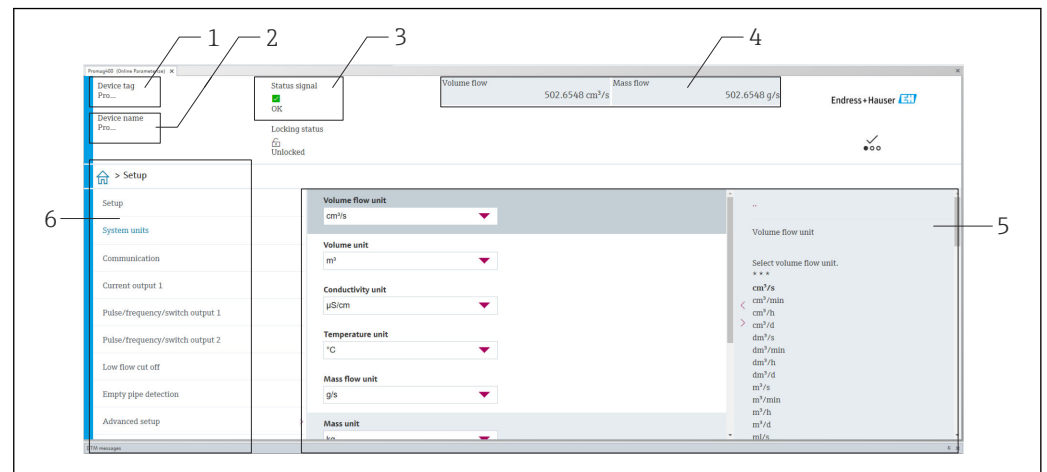
See information →  85

### Establishing a connection

1. Start FieldCare and launch the project.
2. In the network: Add a device.
  - ↳ The **Add device** window opens.
3. Select the **CDI Communication TCP/IP** option from the list and press **OK** to confirm.
4. Right-click **CDI Communication TCP/IP** and select the **Add device** option in the context menu that opens.
5. Select the desired device from the list and press **OK** to confirm.
  - ↳ The **CDI Communication TCP/IP (Configuration)** window opens.
6. Enter the device address in the **IP address** field: 192.168.1.212 and press **Enter** to confirm.
7. Establish the online connection to the device.

 For additional information, see Operating Instructions BA00027S and BA00059S

## User interface



A0008200

- 1 Device name
- 2 Tag name
- 3 Status area with status signal → 140
- 4 Display area for current measured values
- 5 Edit bar with additional functions
- 6 Navigation area with operating menu structure

### 8.5.3 DeviceCare

#### Function scope

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) it presents a convenient, comprehensive solution.



For details, see Innovation Brochure IN01047S

#### Source for device description files

See information → 85

### 8.5.4 Field Xpert SMT70, SMT77

#### Field Xpert SMT70

The Field Xpert SMT70 tablet PC for device configuration enables mobile plant asset management in hazardous and non-hazardous areas. It is suitable for commissioning and maintenance staff to manage field instruments with a digital communication interface and to record progress.

This tablet PC is designed as an all-in-one solution with a preinstalled driver library and is an easy-to-use, touch-sensitive tool which can be used to manage field instruments throughout their entire life cycle.



- Technical Information TI01342S
- Operating Instructions BA01709S
- Product page: [www.endress.com/smt70](http://www.endress.com/smt70)



Source for device description files: → 85