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Valid as of version
01.03.zz

Operating Instructions
Liquicap M
FMI51 PFM

Capacitive
Continuous level measurement for liquids

Endress+Hauser
People for Process Automation

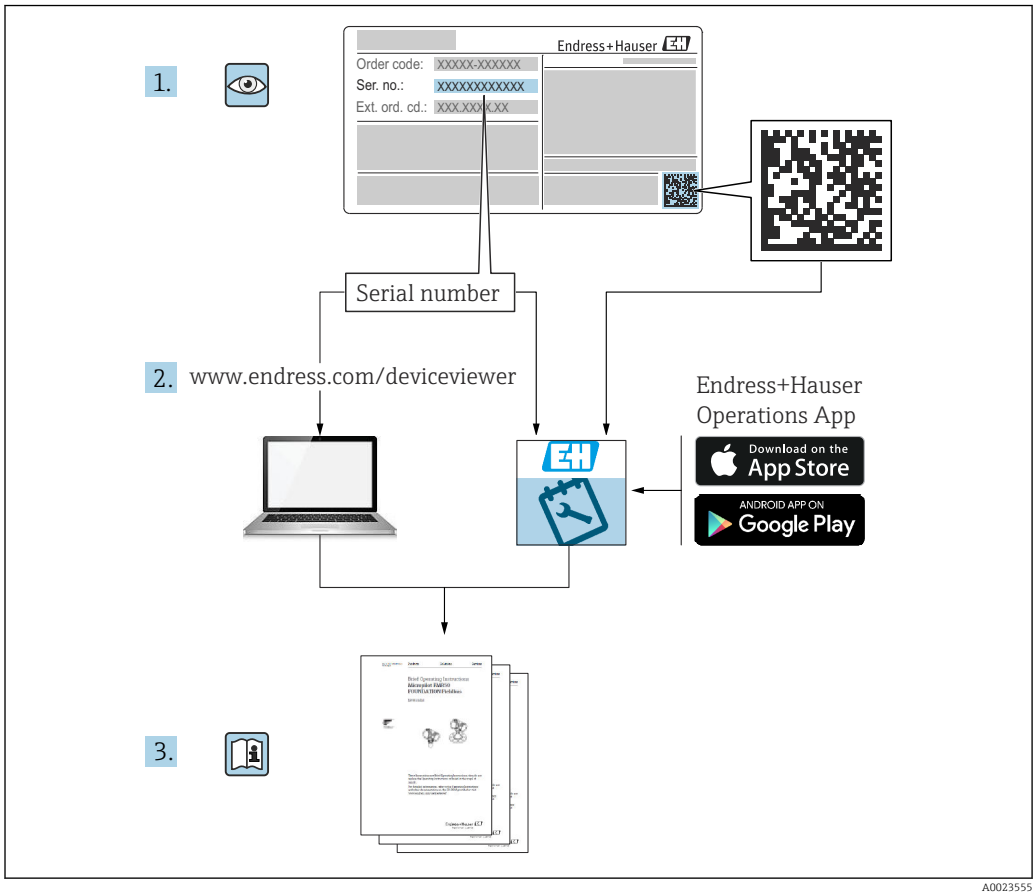

1.
Endress+Hauser
Order code: XXXXX-XXXXXX
Ser. no.: XXXXXXXXXXX
Ext. ord. cd.: XXX XXX XX XX
Serial number
2. www.endress.com/deviceviewer
Endress+Hauser
Operations App
Download on the App Store
ANDROID APP ON Google Play
3.
A0023555

Table of contents

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 Document conventions

1.2.1 Safety symbols

⚠ DANGER
This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.

⚠ WARNING
This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury.

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

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

1.2.2 Electrical symbols

Alternating current

Direct current and alternating current

Direct current

Ground connection

A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system.

Protective earth (PE)

Ground terminals that must be connected to ground prior to establishing any other connections.

The ground terminals are located on the interior and exterior of the device:
- Interior ground terminal: protective earth is connected to the mains supply.
- Exterior ground terminal: device is connected to the plant grounding system.

1.2.3 Tool symbols

Phillips head screwdriver

Flat blade screwdriver

Torx screwdriver

Allen key

Open-ended wrench

1.2.4 Symbols for certain types of information and graphics

Permitted
Procedures, processes or actions that are permitted

Preferred
Procedures, processes or actions that are preferred

Forbidden
Procedures, processes or actions that are forbidden

Tip
Indicates additional information

Reference to documentation

Reference to page

Reference to graphic

Notice or individual step to be observed

1., 2., 3.
Series of steps

Result of a step

Help in the event of a problem

Visual inspection

Operation via operating tool

Write-protected parameter

1, 2, 3, ...
Item numbers

A, B, C, ...
Views

Hazardous area
Indicates the hazardous area

Safe area (non-hazardous area)
Indicates the non-hazardous area

Safe instructions
Observe the safety instructions contained in the associated Operating Instructions

Temperature resistance of the connection cables
Specifies the minimum value of the temperature resistance of the connection cables

LED not lit

LED lit

LED flashes

1.3 Documentation

1.3.1 Technical Information

Liquicap M FMI51

TI01484F

1.3.2 Certificates

ATEX safety instructions
Liquicap M FMI51
- II 1/2 G Ex ia IIC T3...T6 Ga/Gb
  II 1/2 G Ex ia IIB T3...T6 Ga/Gb
  II 1/2 D Ex ia IIIC T90 °C Da/Db
  XA00327F
- II 1/2 Ex ia/db IIC T6...T3 Ga/Gb
  II 1/2 Ex ia/db eb IIC T6...T3 Ga/Gb
  II 1/2 D Ex ia /tb IIIC T90 °C Da/Db
  XA00328F
- Ga/Gb Ex ia IIC T3...T6
  Zone 20/21 Ex iaD 20/Ex tD A21 IP65 T 90 °C
  IECEx BVS 08.0027X
  XA00423F
- II 3 G Ex nA IIC T6 Gc
  II 3 G Ex nA nC IIC T5 Gc
  II 3C D Ex tc IIIC T100 °C Dc
  XA00346F

INMETRO safety instructions
Liquicap M FMI51
- Ex d [ia Ga] IIB T3...T6 Ga/Gb
  Ex d [ia Ga] IIC T3...T6 Ga/Gb
  Ex de [ia Ga] IIC T3...T6 Ga/Gb
  XA01171F
- Ex ia IIC T* Ga/Gb
  Ex ia IIB T* Ga/Gb
  Ex ia IIIC T90 °C Da/Db IP66
  XA01172F

NEPSI safety instructions
- Liquicap M FMI51
  Ex ia IIC/IIB T3...T6 Ga/Gb
  XA00417F
- Liquicap M FMI51
  Ex d ia IIC/IIB T3/T4/T6 Ga/Gb
  Ex d e ia IIC/IIB T3/T4/T6 Ga/Gb
  XA00418F
- Liquicap M FMI51
  Ex nA IIC T3...T6 Gc
  Ex nA nC IIC T3...T6 Gc
  XA00430F

Overfill protection DIBt (WHG)
Liquicap M FMI51
ZE00265F

Functional safety (SIL2)
Liquicap M FMI51
SD00198F

Control Drawings (CSA and FM)
- Liquicap M FMI51
  FM IS
  ZD00220F
- Liquicap M FMI51
  CSA IS
  ZD00221F
- Liquicap M FMI51
  CSA XP
  ZD00233F

1.3.3 Hygienic compatibility

Information regarding device versions that meet the requirements of 3A Sanitary Standard No. 74 and/or are certified by the EHEDG:

SD02503F

Suitable fittings and seals must be used to ensure hygiene-compliant design according to 3A and EHEDG specifications.

Comply with the maximum permitted temperature of the process seal.

The gap-free connections can be cleaned of all residue using the typical cleaning methods within this industry (CIP and SIP).

1.4 Registered trademarks

HART®
Registered trademark of the FieldComm Group, Austin, USA

TRI CLAMP®
Registered trademark of Alfa Laval Inc., Kenosha, USA

2 Basic safety instructions

2.1 Requirements for the personnel

The personnel must fulfill the following requirements to carry out the necessary tasks:
- Are trained, qualified to perform specific functions and tasks.
- Are authorized by the plant owner or operator to perform specific tasks.
- Are familiar with federal or national regulations.
- Have read and understood the instructions in the manual and supplementary documentation.
- They follow instructions and comply with conditions.

2.2 Workplace safety

For work on and with the device:
- Wear the required protective equipment according to federal or national regulations.

2.3 Operational safety

When performing configuration, testing, and maintenance work on the device, alternative supervisory measures must be taken to guarantee the operational safety and process safety.

2.3.1 Ex-area

When using the measuring system in Ex-areas, the appropriate national standards and regulations must be observed. Separate Ex-documentation, which constitutes an integral part of this documentation, is supplied with the device. The installation procedures, connection data and safety instructions it contains must be observed.

- Make sure that the technical staff has adequate training.
- The special measuring and safety-related requirements for the measuring points must be observed.

2.4 Product safety

This measuring device is designed following 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 is compliant with the EC directives listed in the device-specific EC Declaration of Conformity. Endress+Hauser confirms this by affixing the CE mark to the device.

3 Incoming acceptance and product identification

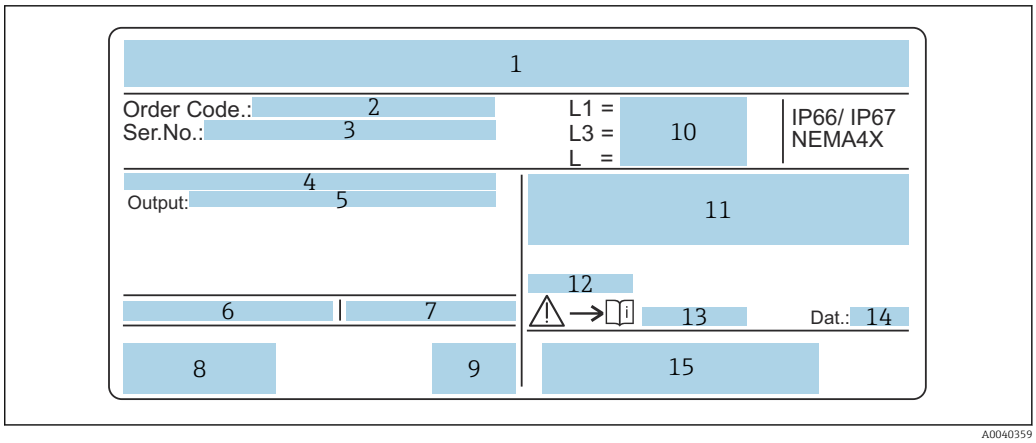
3.1 Incoming acceptance

Check whether the packaging or content is damaged. Check that the goods delivered are complete and compare the scope of delivery with the information in your order.

3.2 Product identification

The measuring device can be identified in the following ways:

- nameplate data
- extended order code with a breakdown of the device features on the delivery note
- the serial number from nameplates in *W@M Device Viewer* (www.endress.com/deviceviewer): all of the information on the measuring device is displayed along with an overview of the scope of the technical documentation provided
- the serial number on the nameplate into the *Endress+Hauser Operations App* or use the *Endress+Hauser Operations App* to scan the 2-D matrix code (QR Code) on the nameplate



1 *The nameplate*

2 *Order number*
3 *Serial number*
4 *Electronic insert*
5 *Electronic insert output value*
6 *Ambient temperature at housing*
7 *Max. permissible pressure in a tank*
8 *Safety certificates*
9 *Functional safety*
10 *Probe length values*
11 *ATEX approval*
12 *WHG approval (German Water Resources Act)*
13 *Safety information*
14 *Production date*
15 *Bar code*

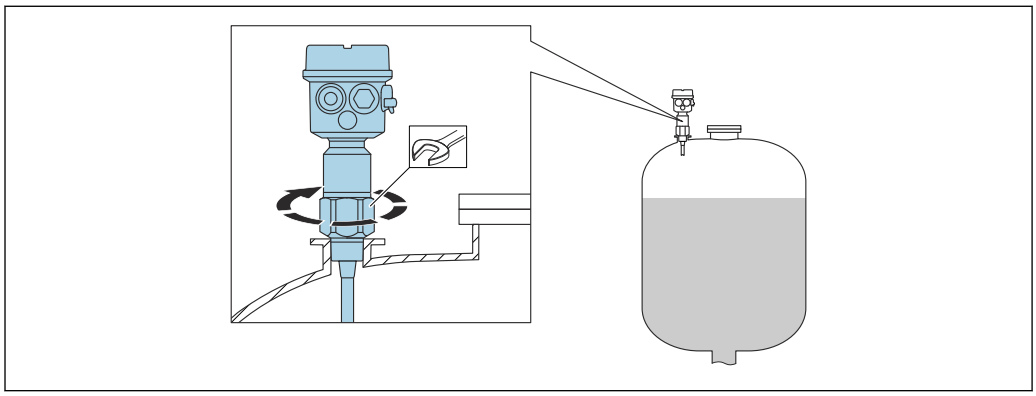
3.3 Storage and transport

For storage and transportation, pack the device to protect it against impact. The original packing offers the best protection for this. The permitted storage temperature is −50 to +85 °C (−58 to +185 °F).

4 Mounting

4.1 Quick installation guide

Probe installation



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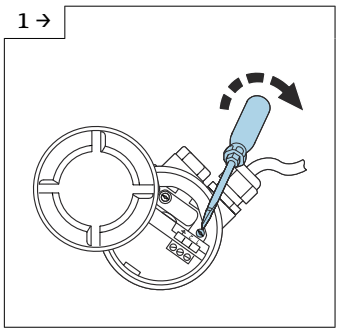
1. Screw the probe into the proper place.
2. Fasten the probe with proper torque in accordance with the thread size.

Thread size and torque value
- G½: < 80 Nm (59.0 lbf ft)
- G¾: < 100 Nm (73.7 lbf ft)
- G1: < 180 Nm (132.8 lbf ft)
- G1½: < 500 Nm (368.7 lbf ft)

Aligning the housing



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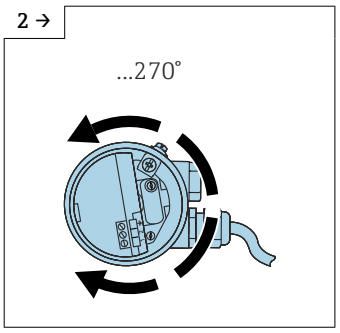
▶ Loosen the clamping screw.



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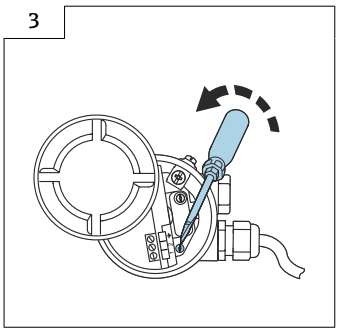
▶ Align the housing into the needed possition.



A0042109

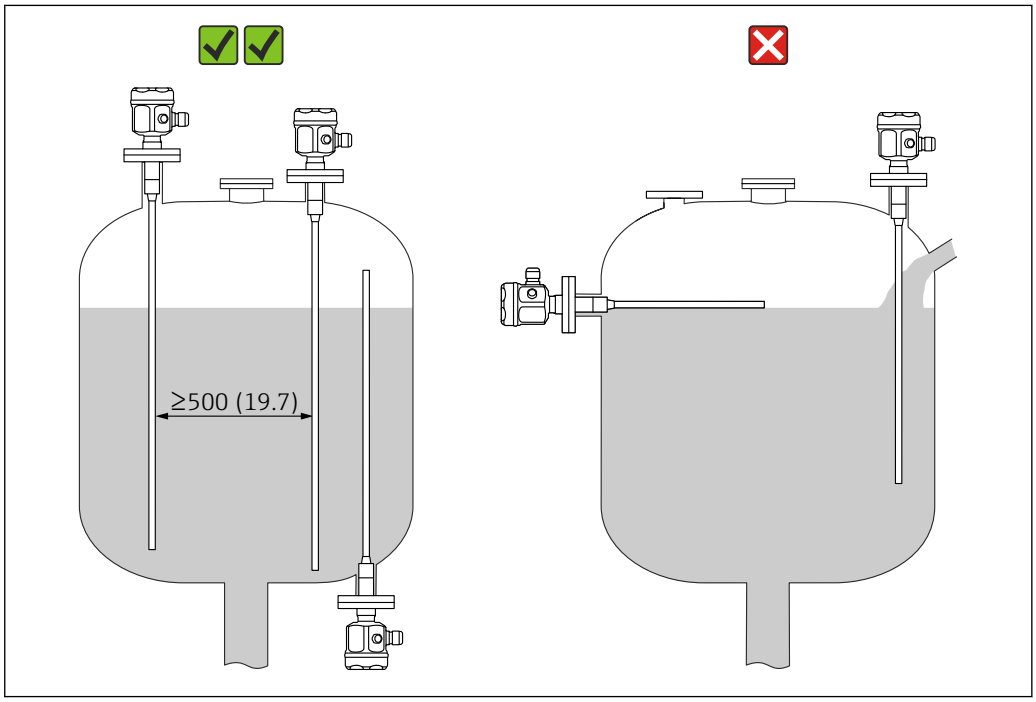
▶ Tighten the clamping screw with torque < 1 Nm (0.74 lbf ft).

4.2 Mounting requirements

4.2.1 Mounting the sensor

The Liquicap M FMI51 can be installed from the top or from the bottom.

Make sure that:
- the probe is not installed in the area of the filling curtain
- the probe is not in contact with the container wall
- the distance from the container floor is ≥10 mm (0.39 in)
- multiple probes are mounted next to each other at the minimum distance between the probes of 500 mm (19.7 in)
- the probe is at a sufficient distance from the agitator if using the probe in agitator tanks
- the rod probes with a ground tube are used in the event of severe lateral load

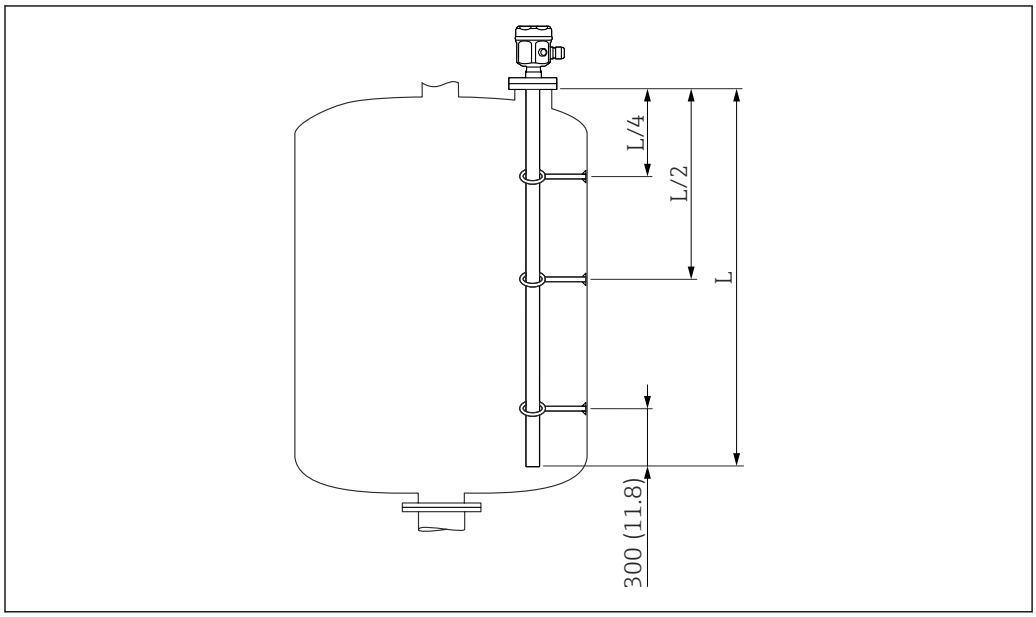


Unit of measurement mm (in)

4.2.2 Support with marine approval (GL)

Conductive or non-conductive support can be provided for fully insulated rod probes. Partially insulated rod probes may only be supported with insulation at the uninsulated end of the probe.

Rod probes with a diameter of 10 mm (0.39 in) and 16 mm (0.63 in), and a length ≥ 1 m (3.3 ft) must be supported, see → 14



Unit of measurement mm (in)

L/4 ¼ probe length
L/2 ½ probe length
L Active probe length

Example of calculating distances

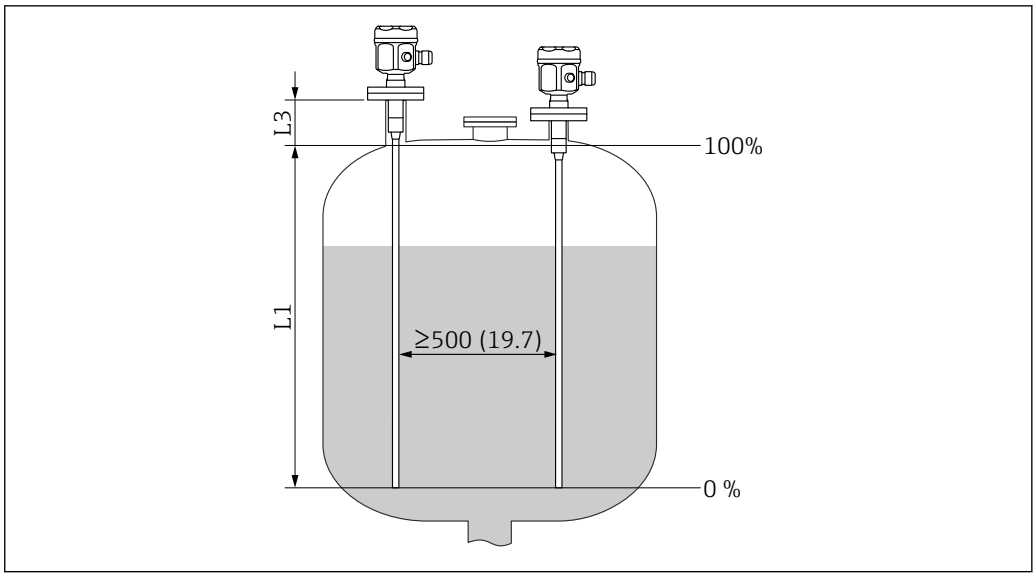
- probe length L = 2 m (6.6 ft)
- L/4 = 500 mm (19.7 in)
- L/2 = 1 m (3.3 ft)
  Measured from the end of the probe rod = 300 mm (11.8 in).

4.3 Measuring condition

Measuring range L1 is possible from the tip of the probe to the process connection.

Particularly suited for small containers.

Use a ground tube for nonconductive media.



Unit of measurement mm (in)

L1 Measuring range
L3 Inactive length

When installing in a nozzle, use inactive length (L3).

The 0 % and 100 % calibration can be inverted.

4.4 Minimum probe length for nonconductive media < 1 µS/cm

The minimum probe length can be calculated using the formula:

$$l_{min} = \frac{\Delta C_{min}}{C_s \cdot (\varepsilon_r - 1)}$$

A0040204

l_{min} *minimum probe length*
ΔC_{min} *5 pF*
C_s *probe capacitance in air*
ε_r *dielectric constant, e.g. oil = 2.0*

To check the probe capacitance in the air, see the chapter "Additional capacitance" → 37.

4.5 Installation examples

4.5.1 Rod probes

The FMI 51 rod probe can be installed:
- in conductive tanks made from metal
- in nonconductive tanks made from plastic

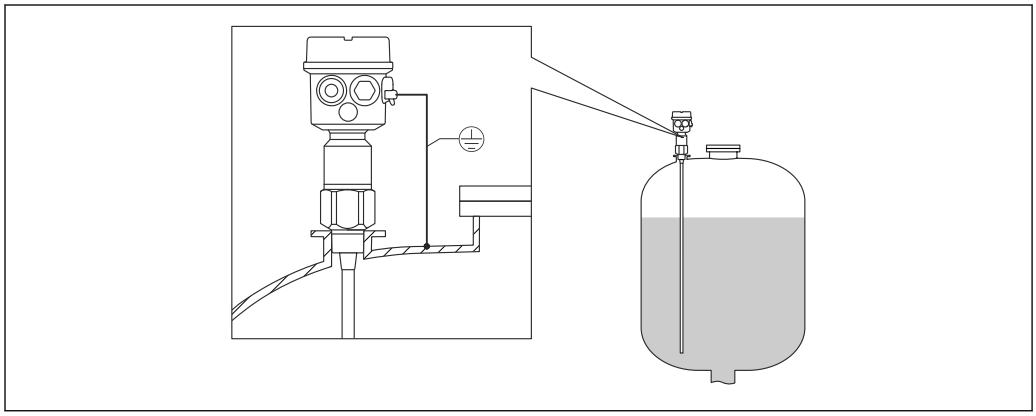
If the process connection of the probe is insulated from the metal tank using a seal material, then the ground connection on the probe housing must be connected to the tank using a short line.

If the probe is installed in a plastic tank, then a probe with ground tube must be used. The probe housing must be grounded.

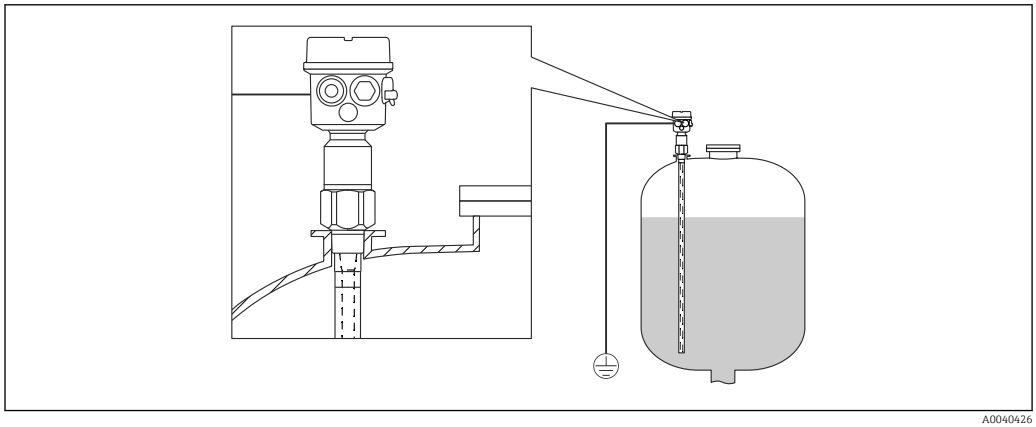
A fully insulated rod probe may be neither shortened nor extended.

Damaged insulation of the probe rod causes improper measurements.

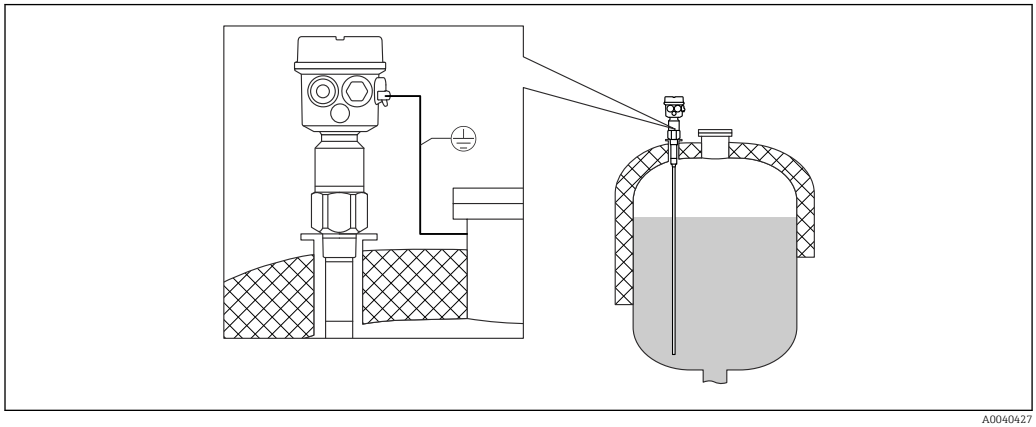
The following application examples show the vertical installation for continuous level measurement.



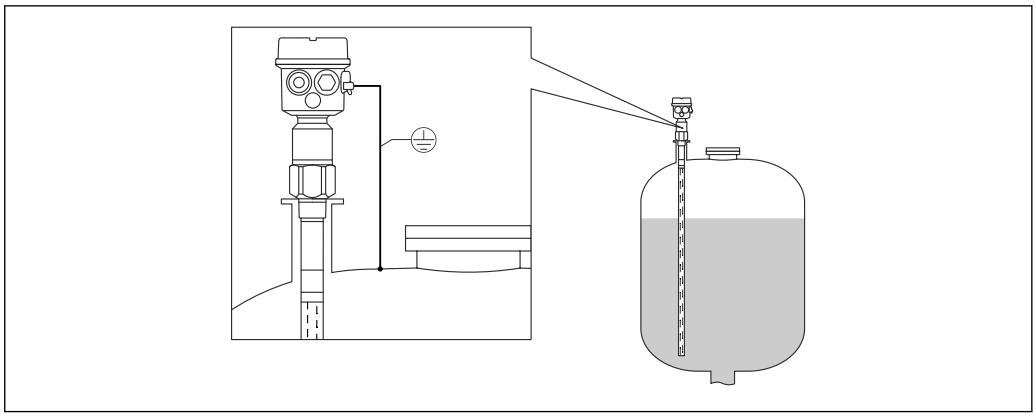
2 *A probe with the conductive tanks*



3 *A probe with ground tube for the nonconductive tanks*

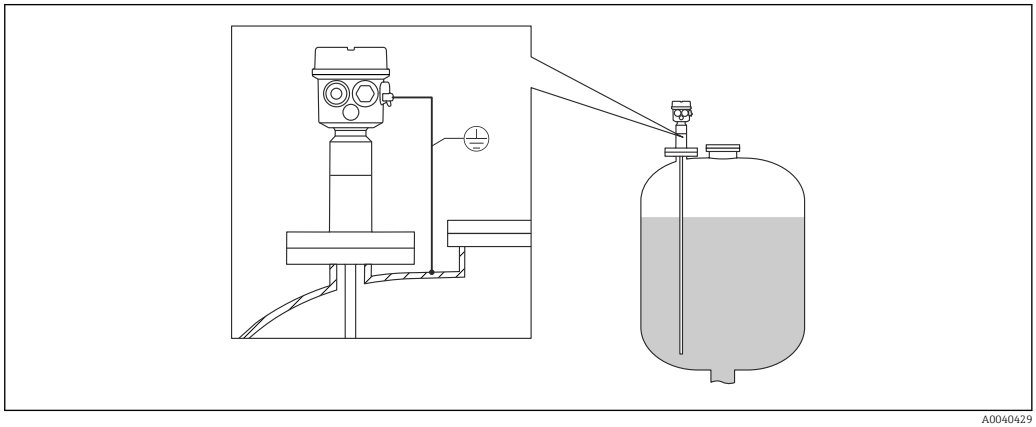


4 *A probe with inactive length for the insulated tanks*



A0040428

5 *A probe with ground tube and inactive length for mounting nozzles*



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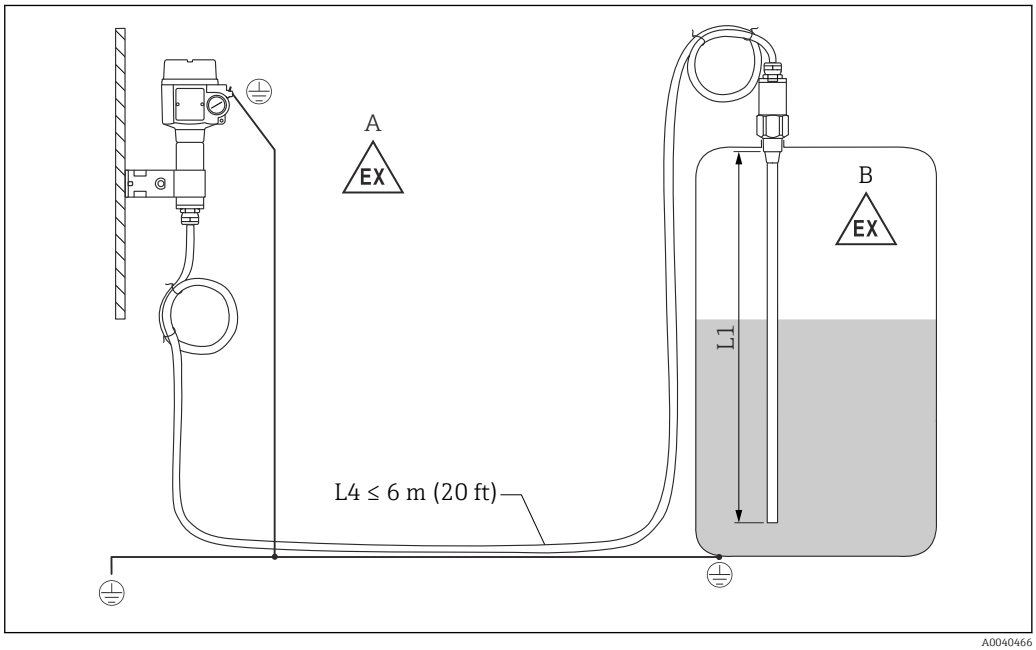
6 *A probe fully insulated with clad flange for aggressive media*

4.5.2 Probe with separate housing



A0040466

7 *Connection of the probe and separate housing*

A Explosive zone 1
B Explosive zone 0
L1 Rod length: max. 4 m (13 ft)
L4 Cable length

The maximum cable length L4 and rod length L1 cannot exceed 10 m (33 ft).

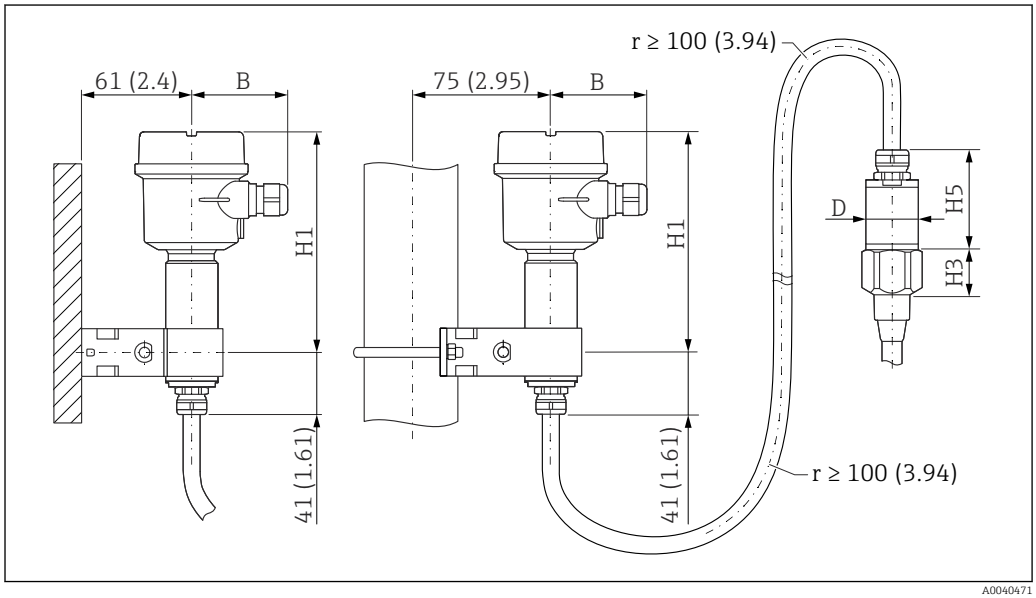
The maximum cable length between the probe and separate housing is 6 m (20 ft). The required cable length must be indicated in the ordering process of a Liquicap M with separate housing.

If the cable connection has to be shortened or led through a wall, then it must be separated from the process connection.

Extension heights: separate housing

The cable has:

- a minimum bending radius of r ≥ 100 mm (3.94 in)
- diameter Ø 10.5 mm (0.14 in)
- outer jacket made of silicone, notch resistance



8 Housing side: wall mounting, pipe mounting, and sensor side. Unit of measurement mm (in)

Values of parameters [1]:

Polyester housing (F16)
- B: 76 mm (2.99 in)
- H1: 172 mm (6.77 in)

Polyester housing (F15)
- B: 64 mm (2.52 in)
- H1: 166 mm (6.54 in)

Aluminum housing (F17)
- B: 65 mm (2.56 in)
- H1: 177 mm (6.97 in)

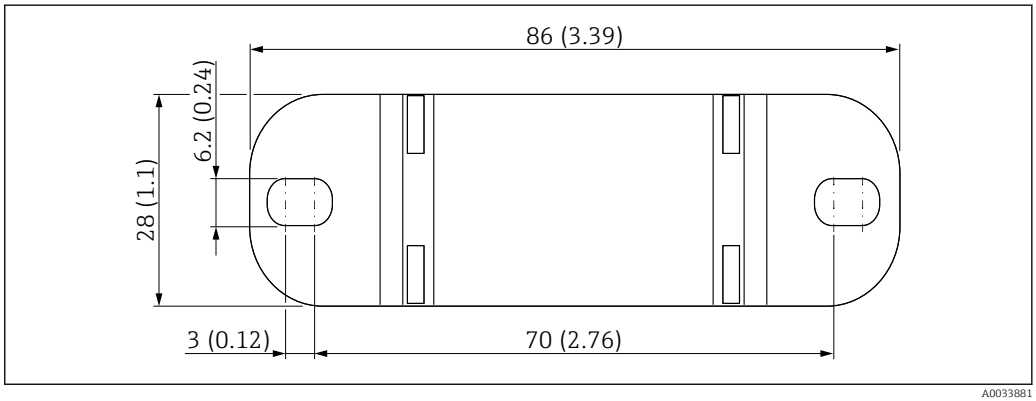
1) See parameters on the drawings.

D and H5 parameter value

- Probes Ø10 mm (0.39 in) rod:
  - D: 38 mm (1.5 in)
  - H5: 66 mm (2.6 in)
- Probes Ø16 mm (0.63 in) rod, without fully insulated inactive length and threads G¾", G1", NPT¾", NPT1", Clamp 1", Clamp 1½", Universal Ø44 mm (1.73 in), flange < DN50, ANSI 2", 10K50:
  - D: 38 mm (1.5 in)
  - H5: 66 mm (2.6 in)
- Probes Ø16 mm (0.63 in) rod, without fully insulated inactive length and threads: G1½", NPT1½", Clamp 2", DIN 11851, flange ≥ DN50, ANSI 2", 10K50:
  - D: 50 mm (1.97 in)
  - H5: 89 mm (3.5 in)
- Probes Ø22 mm (0.87 in) rod, with fully insulated inactive length:
  - D: 38 mm (1.5 in)
  - H5: 89 mm (3.5 in)

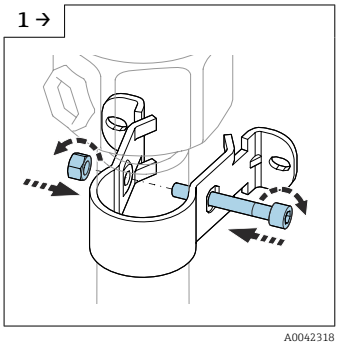
Wall bracket

- The wall bracket is a part of the scope of delivery.
- To use the wall bracket as a drill template, the wall bracket must be first screwed to the separate housing.
- The distance between the holes is reduced by screwing it to the separate housing.

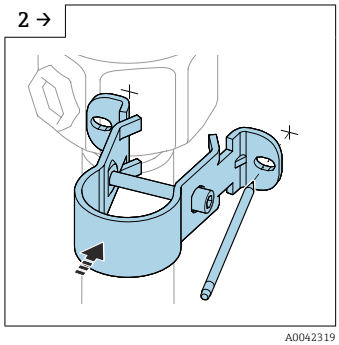


Unit of measurement mm (in)

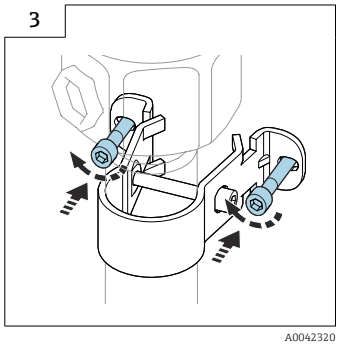
Wall mounting



▶ Screw together the wall bracket on the tube.



▶ Mark the distance between the holes on the wall before drilling.

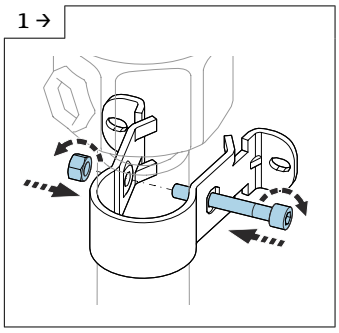


▶ Screw the separate housing on the wall.

Pipe mounting

The maximum pipe diameter is 50.8 mm (2 in).

1 →



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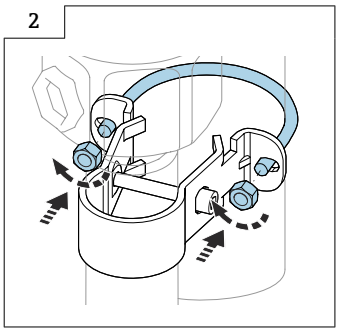
▶ Screw together the wall bracket on the tube.

2



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▶ Screw the separate housing on a pipe.

Shortening the connecting cable

NOTICE

Risk of damage to connections and cable.

▶ Make sure that neither the connecting cable nor the probe is turning with the pressing screw!

Recalibration must be performed before commissioning.

The maximum connection length between the probe and the separate housing is 6 m (20 ft).

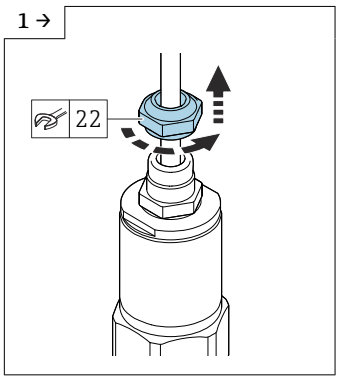
When ordering a device with separate housing, the desired length must be specified.

If the cable connection has to be shortened or led through a wall, it must be separated from the process connection.

Disconnecting the connection cable

Make sure that the connecting cable and the probe is not turning with the pressing screw.

1 →



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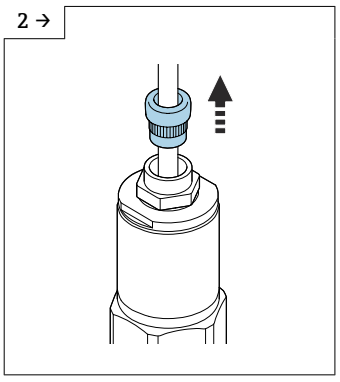
▶ Loosen the pressing screw with an open-end wrench AF22.

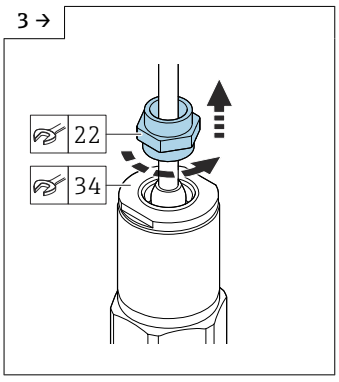
2 →



A0042112

▶ Pull the insert seal out of the cable gland.

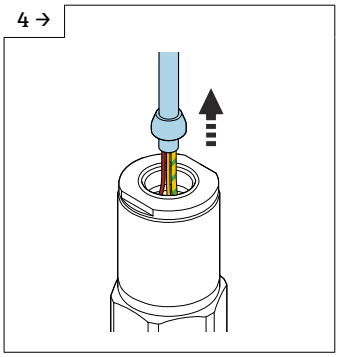
3 →



A0042113

▶ Block the adapter disk with the open-end wrench AF34 and loosen the cable gland with the open-end wrench AF22.

4 →



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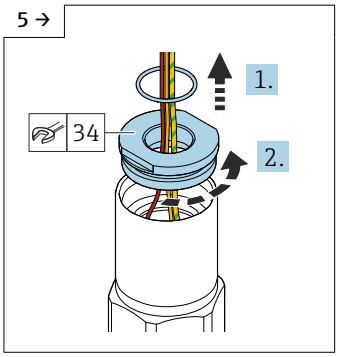
- Pull out the cable with the cone.

5 →



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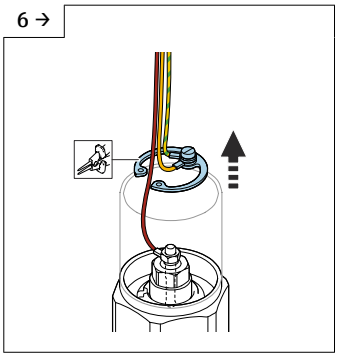
- Remove the seal and loosen the adapter disk with the open-end wrench AF34.

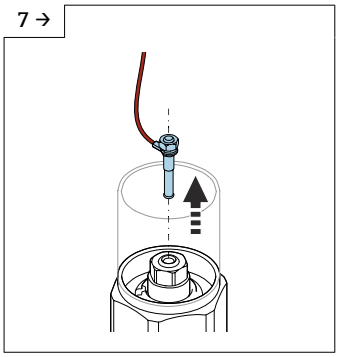
6 →



A0042116

- Remove the snap ring with a snap ring pliers.

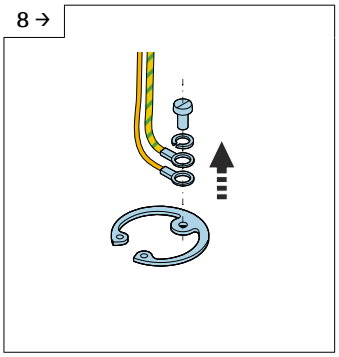
7 →



A0042117

- Remove the blade plug from the socket.

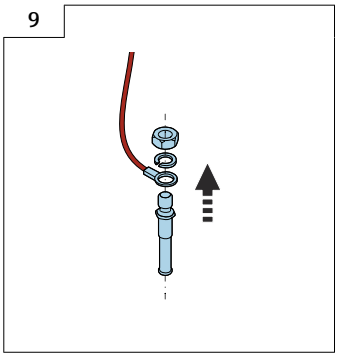
8 →



A0042118

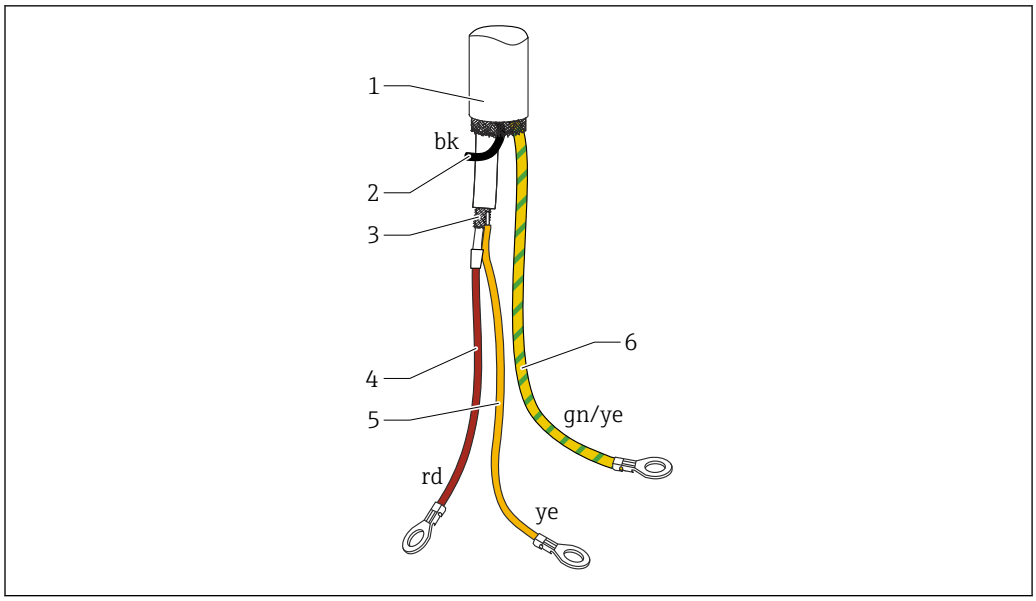
- Loosen the screw to disconnect the yellow and yellow-green cables.

9



A0042119

- Loosen the nut (M4) of the blade plug.



9 *Cable connections*

1 *External screening (not required)*
2 *Strand black (bk) (not required)*
3 *Coaxial cable with central core and screening*
4 *Solder the red (rd) strand with the central core of the coaxial cable (probe)*
5 *Solder the strand with the screening of the yellow (ye) coaxial cable (ground)*
6 *Strand yellow and green (gn/ye) with a ring terminal*

- We recommend reusing all strands with ring terminals in case of shortening the connecting cable
- To avoid the risk of short-circuiting when the strands are not to be reused, the connections of the new ring terminals must be insulated with a heat shrinking sleeve
- Use heat-shrink tubes to insulate all soldered joints

4.6 Installation instructions

NOTICE

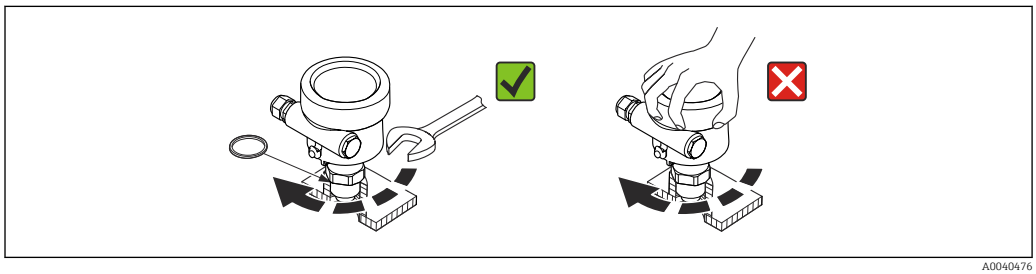
Do not damage the probe insulation during installation!

▶ Check the rod insulation.

NOTICE

Do not screw the probe using the probe housing!

▶ Use an open-end wrench to screw the probe.



4.6.1 Probe installation

Probe with thread

Cylindrical threads G½, G¾, G1, G1½

To be used with the elastomer fiber seal supplied or another chemically resistant seal. Make sure that the temperature resistance of a seal is correct.

The following applies to probes with a parallel thread and supplied seal:

Thread G½
- for pressures up to 25 bar (362.5 psi): 25 Nm (18.4 lbf ft)
- maximum torque: 80 Nm (59.0 lbf ft)

Thread G¾
- for pressures up to 25 bar (362.5 psi): 30 Nm (22.1 lbf ft)
- maximum torque: 100 Nm (73.8 lbf ft)

Thread G1
- for pressures up to 25 bar (362.5 psi): 50 Nm (36.9 lbf ft)
- maximum torque: 180 Nm (132.8 lbf ft)

Thread G1½
- for pressures up to 100 bar (1 450 psi): 300 Nm (221.3 lbf ft)
- maximum torque: 500 Nm (368.8 lbf ft)

Conical threads ½ NPT, ¾ NPT, 1 NPT, 1½ NPT

Wrap the thread with a suitable sealing material. Use conductive sealing material only.

Probe with Tri-Clamp, sanitary connection or flange

The process seal must meet the specifications of the application. Check the seal's resistance to temperature and medium.

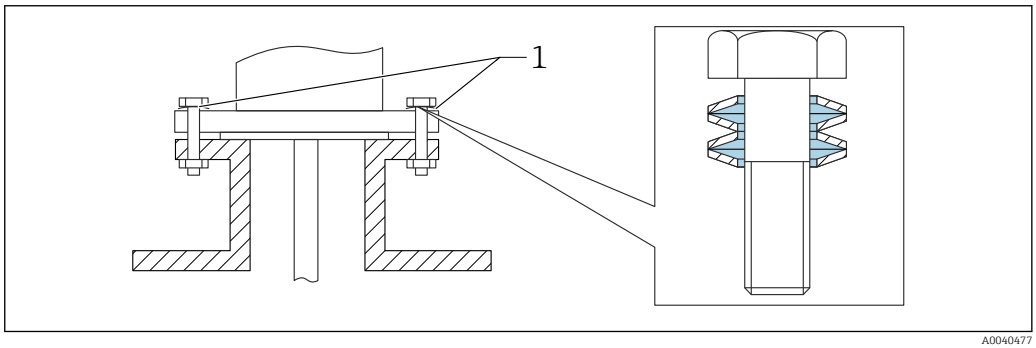
If the flange is PTFE-clad, this generally suffices as the seal up to the permitted operating pressure.

Probe with PTFE-clad flange

Use spring washers!

Depending on process pressure and process temperature, check and re-tighten the screws at regular intervals.

Recommended torque: 60 to 100 Nm (44.3 to 73.8 lbf ft).

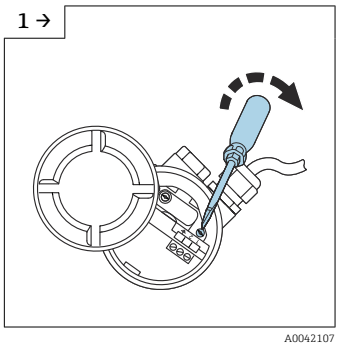


1 Spring washer

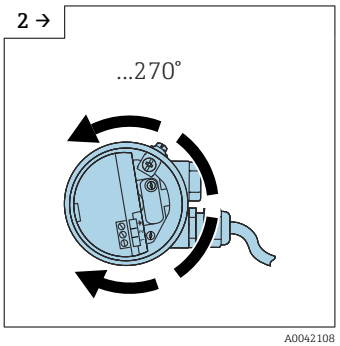
4.6.2 Aligning the housing

The housing can be rotated 270 ° to align with the cable entry. To prevent moisture penetration, route the connecting cable downwards in front of the cable gland and secure it with a cable tie. This is particularly recommended for outdoor mounting.

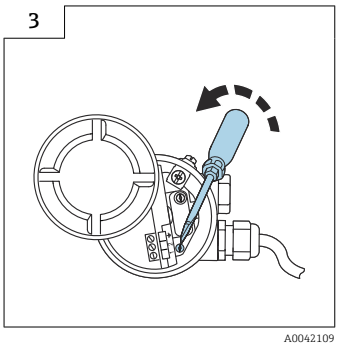
Aligning the housing



▶ Loosen the clamping screw.



▶ Align the housing into the needed position.



▶ Tighten the clamping screw with torque
< 1 Nm (0.74 lbf ft).

The clamping screw for aligning the housing type T13 is located in the electronics compartment.

4.6.3 Sealing the probe housing

Make sure that the cover is sealed. Water cannot enter into the device when performing installation, connection and configuration tasks. Always seal the housing cover and cable entries securely.

The O-ring seal on the housing cover is shipped with a coat of special lubricant applied. In this way, the cover can be sealed tight and the aluminum thread does not bite when screwing down.

Never use mineral oil-based grease as this destroys the O-ring.

4.7 Post-installation check

After installing the measuring device, carry out the following checks:

❑ Do a visual check for damages.

❑ Does the device meet the specifications at the measuring point with regard to process temperature and pressure, ambient temperature, measuring range?

❑ Has the process connection been tightened with the tightening torque?

❑ Check if the measuring points are correctly labeled.

❑ Is the device adequately protected against precipitation and direct sunlight?

5 Electrical connection

Before connecting the power supply, note the following:
- the supply voltage must match the data specified on the nameplate
- switch off the supply voltage before connecting the device
- connect the potential equalization to the ground terminal on the sensor

When using the probe in hazardous areas, the relevant national standards and the information in the safety instructions (XA) must be observed.

Use the specified cable gland only.

5.1 Connecting requirements

5.1.1 Potential equalization

DANGER

Risk of explosion!

▶ Connect the cable screen on the sensor side only if installing the probe in Ex-areas!

Connect the potential equalization to the outer ground terminal of the housing (T13, F13, F16, F17, F27). In the case of the stainless steel housing F15, the ground terminal can also be located in the housing. For further safety instructions, please refer to the separate documentation for applications in hazardous areas.

5.1.2 Electromagnetic compatibility (EMC)

Interference emission to EN 61326, Electrical Equipment Class B. Interference immunity to EN 61326, Annex A (Industrial) and NAMUR Recommendation NE 21 (EMC).

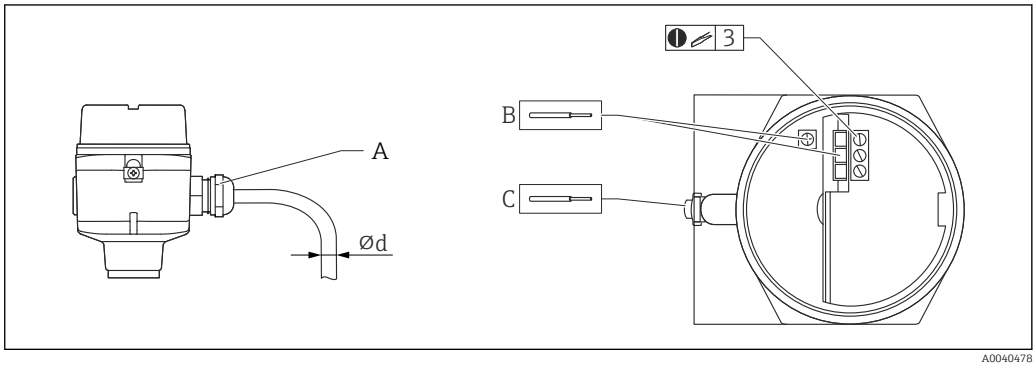
Failure current is in accordance with NAMUR NE43: FEI50H = 22 mA.

A standard commercial instrument cable can be used.

Information on connecting shielded cables is provided in Technical Information TI00241F "EMC test procedures".

5.1.3 Cable specification

Connect the electronic inserts by using commercially available instrument cables. If a potential equalization is present, and the shielded instrument cables are used, connect the shielding on both sides to optimize the shielding effect.



A0040478

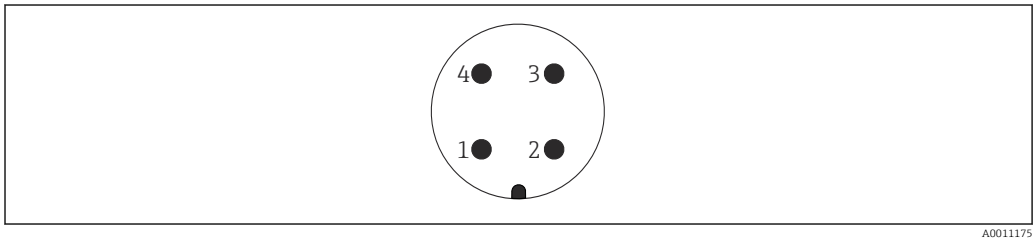
A Cable entry
B Electronic insert connections: cable size max. 2.5 mm² (14 AWG)
C The ground connection outside the housing, cable size max. 4 mm² (12 AWG)
Ød Cable diameter

Cable entries
- Nickel-plated brass: Ød = 7 to 10.5 mm (0.28 to 0.41 in)
- Synthetic material: Ød = 5 to 10 mm (0.2 to 0.38 in)
- Stainless steel: Ød = 7 to 12 mm (0.28 to 0.47 in)

5.1.4 Connector

For the version with a connector M12, the housing does not have to be opened for connecting the signal line.

PIN assignment for M12 connector



1 Positive potential
2 Not used
3 Negative potential
4 Ground

5.1.5 Supply voltage

All of the following voltage is terminal voltage directly at the device:

14.8 V_{DC} from associated supply unit

5.2 Wiring and connecting

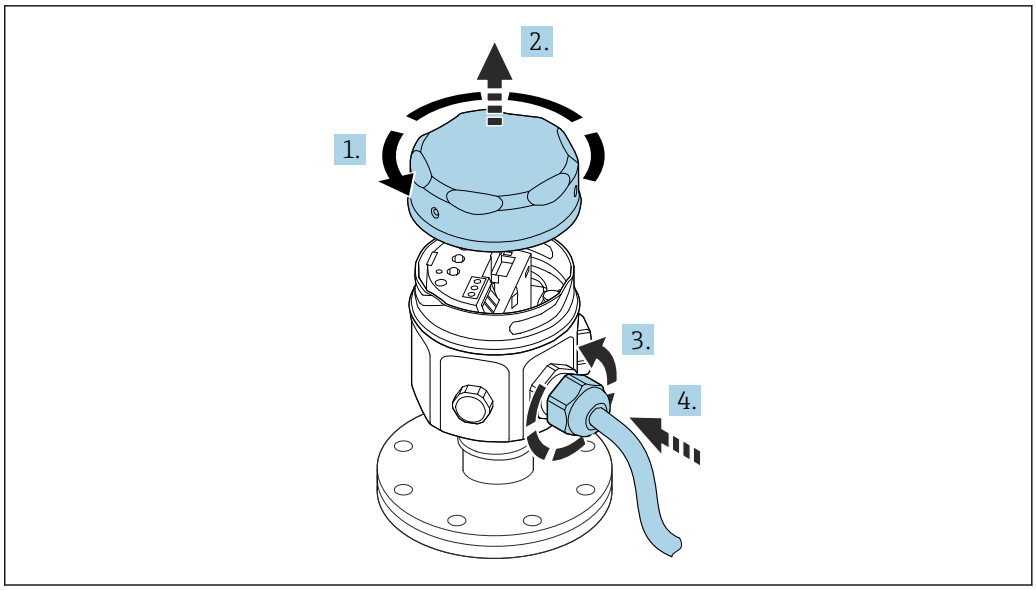
5.2.1 Connection compartment

Depending on explosion protection, the connection compartment is available in the following variants:

Standard protection, Ex ia protection
- polyester housing F16
- stainless steel housing F15
- aluminum housing F17
- aluminum housing F13 with gas-tight process seal
- stainless steel housing F27
- aluminum housing T13, with the separate connection compartment

Ex d protection, Gas-tight process seal
- aluminum housing F13 with gas-tight process seal
- stainless steel housing F27 with gas-tight process seal
- aluminum housing T13, with the separate connection compartment

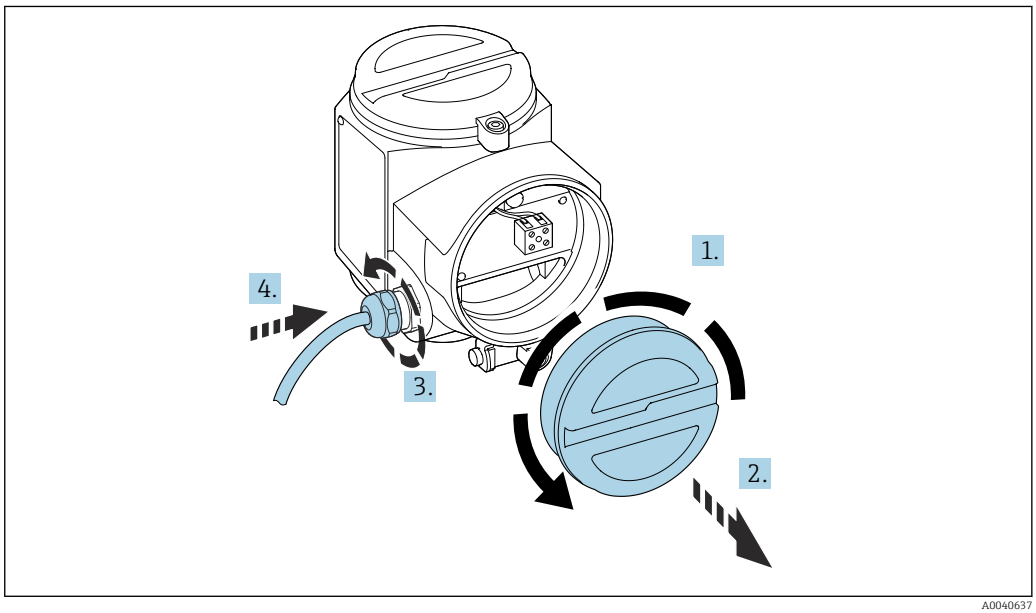
Connecting the electronic insert to the power supply:



A0040635

1. Unscrew the housing cover.
2. Remove the housing cover.
3. Release the cable gland.
4. Insert the cable.

Connecting the electronic insert to the power supply mounted in the housing T13:



A0040637

1. Unscrew the housing cover.
2. Remove the housing cover.
3. Release the cable gland.
4. Insert the cable.

5.2.2 Cable entry

Cable gland: M20x1.5 Cable entry: G ½ or NPT ½, NPT ¾

5.2.3 Supply voltage

14.8 V_{DC} from associated supply unit

5.2.4 Power consumption

Approximately 150 mW

5.2.5 Current consumption

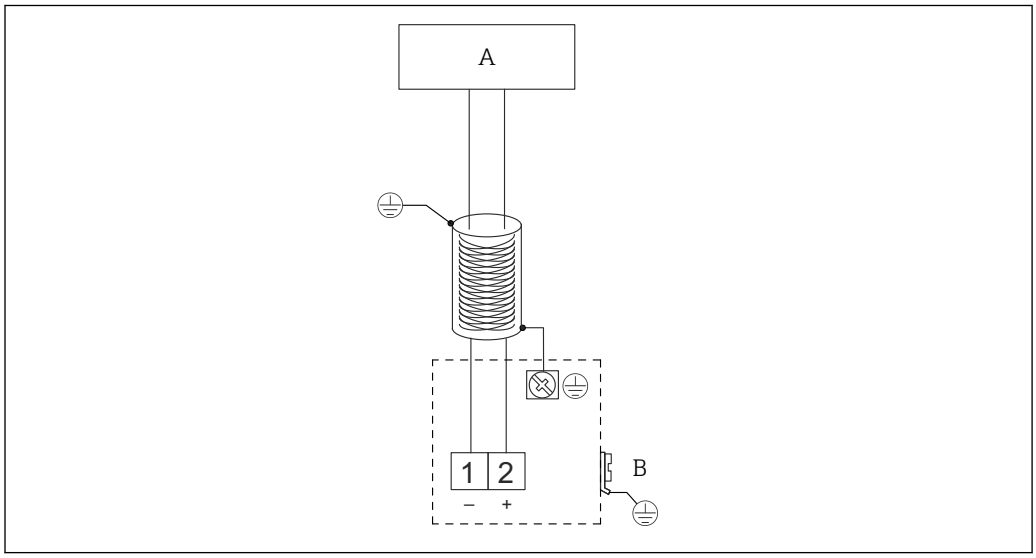
Maximum 10 mA.

5.2.6 Terminal assignment

2-wire, PFM

The twin-core, shielded connecting cable with a cable resistance of max. 25 Ω per core is connected to the screw terminals (conductor cross-section 0.5 to 2.5 mm (0.02 to 0.1 in)) in the connection compartment.

The shielding must be connected at the sensor and power supply. Protective circuits against reverse polarity, HF influences and overvoltage peaks are integrated, for more information see document "EMC test procedures" TI00241F.



A Switching unit
B Grounding terminal

5.3 Post-connection check

After wiring the measuring device, carry out the following checks:

❑ Is the terminal assignment correct?

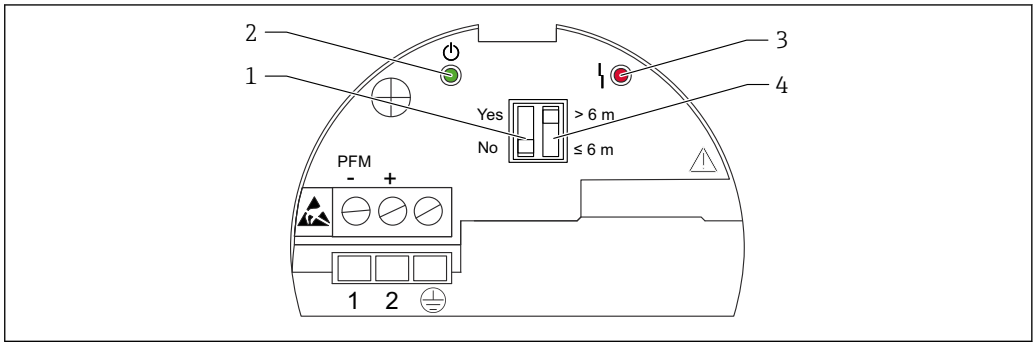
❑ Is the cable gland sealed tight?

❑ Is the housing cover fully screwed?

❑ Is the device operational and is the green LED flashing when the device is on?

6 Operation options

6.1 Display and operating elements



1 Two-position DIP switch "Build up"
2 Green LED - operational status
3 Red LED - fault
4 Two-position DIP switch "Probe length"

Elements description

- Two-position DIP switch "Build up" (1):
  - YES: setting is recommended for media that cause heavy buildup, e.g. honey
  - NO: setting is recommended for media that do not cause buildup, e.g. water
- Green LED - operational status (2):
  - indicates that the device is ready for operation when flashes every 5 s
- Red LED - fault (3)
  - flashes 5x a second - Alarm. The PFM output signalized an error current signal and sets the output of the connected switching unit to 3.6 mA or 22 mA. The switching unit outputs an alarm itself
  - flashes 1x a second - Warning. The temperature in the electronic insert is outside the permitted temperature range
- Two-position DIP switch "Probe length" (4):
  - rod probe length ≤ 4 m (13 ft), measuring range 0 to 2 000 pF

7 Commissioning

7.1 Function check

Make sure that the post-installation check and final check have been completed before you start your measuring point:

- the "Post-installation check" checklist → 24
- the "Post-connection check" checklist → 25

7.2 Transmitter

The settings on the electronic insert affect the function of the switching unit.

For further commissioning, please refer to the Operating Instructions of the transmitter power supply unit.

The device documentation of these devices is also available for download at www.endress.com-> Download -> e.g. product root: FMX570.

8 Diagnostics and troubleshooting

8.1 Diagnostic information via LEDs

The operating status of the device is indicated by the LEDs on the electronic insert.

8.1.1 Green LED is not flashing

The green LED indicates operation.

If the green LED is not flashing:
- check terminal assignment between supply unit and the electronic insert
- check supply voltage to supply unit
- check the installation state of the electronic insert

8.1.2 Red LED flashing

The red LED flashes 1x a second:

the temperature in the electronic insert is outside the permitted temperature range

The red LED flashes 5x a second:
- the PFM output frequency is 3 210 Hz
  the measuring range exceeded -> the capacitance too high at the probe
- the PFM output frequency is 3 200 Hz
  faulty probe insulation, the measuring range exceeded -> probe generates a short-circuit
- the PFM output frequency is 3 100 to 3 190 Hz
  the temperature in the electronic insert is outside the permitted temperature range

8.2 Application errors

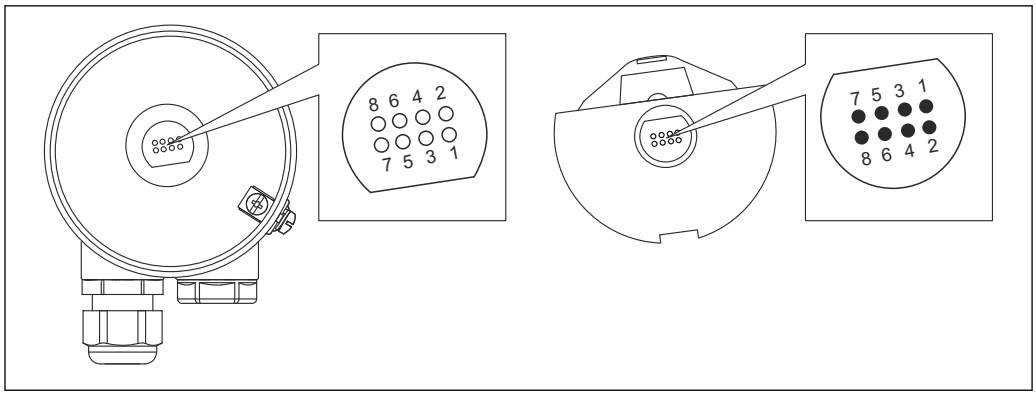
Error
- the buildup on the probe causes the measuring error
  set the DIP switch "Build up" to position "YES"
- the measuring range is to high
  set the DIP switch for the probe lenght to the setting >6 m (20 ft)

8.3 Possible measuring errors

8.3.1 Measured value is incorrect

If the measured values are incorrect, follow this procedure:

1. Verify empty and full calibration.
2. Clean the probe.
3. Verify the probe.
4. Change the installation position. Do not mount the probe in a filling curtain.
5. Check ground from process connection to the tank wall. Resistance measurement must be < 1 Ω.
6. For conductive media, check the probe insulation. Resistance measurement must be > 800 kΩ.
7. Increase the response time, if the surface is turbulent.



10 Electronic insert contacts

1 Guard
2 SDA_TXD
3 GND
4 GND EEPROM
5 GND
6 DVCC 3 V_{DC}
7 Probe
8 SCL RXD

8.4 Firmware history

Firmware V 01.00.00 / 06.2005
Updates:
original software

Hardware V 01.00
Updates:
No updates

9 Maintenance

No special maintenance work is required for the Liquicap M level transmitter.

9.1 External cleaning

Do not use a corrosive or aggressive cleaning agent to clean the housing surface and seals.

9.2 Cleaning the probe

Depending on the application, buildup of contamination or soiling can form on the probe rod. A high level of material buildup can affect the measurement result.

The regular cleaning of the probe rod is recommended if the medium tends to create a high level of buildup.

Make sure that the insulation of the probe rod is not damaged if hosing down or during mechanical cleaning.

Make sure that the probe rod insulation is resistant to cleaning agents.

9.3 Seals

The process seals of the sensor must be replaced periodically, especially when using molded aseptic seals!

The intervals between seal replacement depend on the frequency of the cleaning cycles and on the fluid and cleaning temperature.

9.4 Endress+Hauser services

Endress+Hauser offers a wide range of services.

Your Endress+Hauser Sales Center can provide detailed information on the services.

10 Repair

10.1 General notes

The Endress+Hauser repair and conversion concept provides the following:
- The measuring devices have a modular design.
- Spare parts are grouped into logical kits with the associated Installation Instructions.
- Repairs are carried out by Endress+Hauser Service or by appropriately trained customers.
- Certified devices can only be converted to other certified devices by Endress+Hauser Service or at the factory.

10.2 Spare parts

Find spare parts

Check whether it is possible to use the spare part for the measuring device.

1. Launch the Endress+Hauser Device Viewer via a web browser:
   www.endress.com/deviceviewer
2. Enter the order code or the product root in the respective field.
   ↳ Once the order code or the product root has been entered, all the suitable spare parts are listed.
   The product status is displayed.
   Available drawings of the spare parts are displayed.
3. Locate the order code of the spare part set (on the product label on the package).
   ↳ **NOTE!**
   The order code of the spare part set (on the product label on the package) can differ from the production number (on the label directly on the spare part)!
4. Check whether the order code of the spare part set appears in the list of the spare parts displayed:
   ↳ **YES:** The spare part set may be used for the measuring device.
   NO: The spare part set may not be used for the measuring device.
   If you have any questions please contact your Endress+Hauser Service organization.
5. On the **Spare parts** tab click the PDF symbol in the **MH** column.
   ↳ The Installation Instructions attached to the listed spare part are opened as a PDF file and can also be saved as a PDF file.
6. Click one of the drawings shown on the **Spare part drawings** tab.
   ↳ The corresponding exploded drawing is opened as a PDF file and can also be saved as a PDF file.

10.3 Repairing Ex-certified devices

If repairing Ex-certified devices remember that:

- Ex-certified devices may only be repaired by experienced and skilled staff or by Endress+Hauser Service
- observe all applicable standards, certificates, national Ex-area regulations and all Safety Instructions (XA)
- use only genuine spare parts from Endress+Hauser
- note the device designation on the nameplate to order the spare parts
- replace the component by the same type
- carry out the replacing in accordance with the instructions

- carry out the individual test for the device
- change the device only with a device certificated by Endress+Hauser
- report every change and repair of the device

10.4 Return

The requirements for safe device return can vary depending on the device type and national legislation.

1. Refer to the website for more information:
   http://www.endress.com/support/return-material
2. Return the device if repairs or a factory calibration are required, or if the wrong device was ordered or delivered.

10.5 Disposal

10.5.1 Removing the measuring device

1. Switch off the device.

⚠ WARNING

Danger to personnel from process conditions.

- ▶ Beware of hazardous process conditions such as pressure in the measuring device, high temperatures or aggressive fluids.

2. Carry out the mounting and connection steps from the "Mounting the measuring device" and "Connecting the measuring device" sections in reverse order. Observe the safety instructions.

10.5.2 Disposing of the measuring device

⚠ WARNING

Danger to personnel and environment from fluids that are hazardous to health.

- ▶ Ensure that the measuring device and all cavities are free of fluid residues that are hazardous to health or the environment, e.g. substances that have permeated into crevices or diffused through plastic.

Observe the following notes during disposal:

- ▶ Observe valid federal/national regulations.
- ▶ Ensure proper separation and reuse of the device components.

10.6 Replacement

After replacing a Liquicap M or the electronic insert, the calibration values must be transferred to the replacement device.

Options:

- if the probe is replaced, the calibration values in the electronic insert can be transferred to the sensor DAT (EEPROM) module via a manual download
- if the electronic insert is replaced, the calibration values of the sensor DAT (EEPROM) module can be transferred to the electronics via a manual upload

11 Accessories

11.1 Protective cover

Protective cover for F13, F17 and F27 housing
order number: 71040497

Protective cover for F16 housing
order number: 71127760

11.2 Surge arresters

11.2.1 HAW562

- For supply lines: BA00302K.
- For signal lines: BA00303K.

11.2.2 HAW569

- For signal lines in field housing: BA00304K.
- For signal or supply lines in field housing: BA00305K.

11.3 Weld-in adapter

All available weld-in adapters are described in the document TI00426F.

The documentation is available in the Download section on Endress+Hauser web site: www.endress.com

12 Technical data

12.1 Probe

12.1.1 Capacitance values of the probe

The basic capacitance of the probe is approximately 18 pF.

12.1.2 Additional capacitance

Mount the probe at a minimum distance of 50 mm (1.97 in) from a conductive container wall:
approximately 1.3 pF/100 mm (3.94 in) in the air for a rod probe

Fully insulated probe rod in water:
- approximately 38 pF/100 mm (3.94 in) for Ø 16 mm (0.63 in) rod
- approximately 45 pF/100 mm (3.94 in) for Ø 10 mm (0.39 in) rod
- approximately 50 pF/100 mm (3.94 in) for Ø 22 mm (0.87 in) rod

Rod probe with ground tube:
- approximately 6.4 pF/100 mm (3.94 in) in air
- approximately 38 pF/100 mm (3.94 in) in water for Ø 16 mm (0.63 in) probe rod
- approximately 45 pF/100 mm (3.94 in) in water for Ø 10 mm (0.39 in) probe rod

12.1.3 Probe lengths for continuous measurement in conductive liquids

The maximum length of the rod probe ≤ 4 m (13 ft) for capacitive range 0 to 2 000 pF.

12.2 Input

12.2.1 Measured variable

Continuous measurement of change in capacitance between the probe rod and container wall or ground tube, depending on the level of a liquid.

The probe covered -> high capacitance.

The probe not covered -> low capacitance.

12.2.2 Measuring range

- measuring frequency:
  500 kHz
- span ΔC
  - recommended: 25 to 4 000 pF
  - possible: 2 to 4 000 pF
- final capacitance C_E:
  max. 4 000 pF
- adjustable initial capacitance C_A:
  - < 6 m (20 ft) 0 to 2 000 pF
  - > 6 m (20 ft) 0 to 4 000 pF

12.3 Output

12.3.1 Output signal

FEI57C (PFM output)
The transmitter superimposes current pulses (PFM signal 60 to 2 800 Hz) with a pulse width of approximately 100 µs and a current strength of approximately 8 mA on the supply current.

12.3.2 Signal on alarm

Fault diagnosis can be called up via:
- Red LED on the local display
- Local display at switching unit

12.3.3 Linearization

Linearization is performed in the transmitters.

12.4 Performance characteristics

12.4.1 Reference operating conditions

Room temperature: +20 °C (+68 °F)±5 °C (±8 °F).

Span: ΔC = 25 to 4 000 pF recommended, 2 to 4 000 pF possible.

12.4.2 Maximum measured error

Non-repeatability (reproducibility) as per DIN 61298-2:
maximum ±0.1 %

Non-linearity for limit point setting (linearity) as per DIN 61298-2:
maximum ±0.25 %

12.4.3 Influence of ambient temperature

Electronic insert
< 0.06 %/10 K related to the full-scale value

Separate housing
Change in capacitance of connecting cable 0.015 pF / m per K

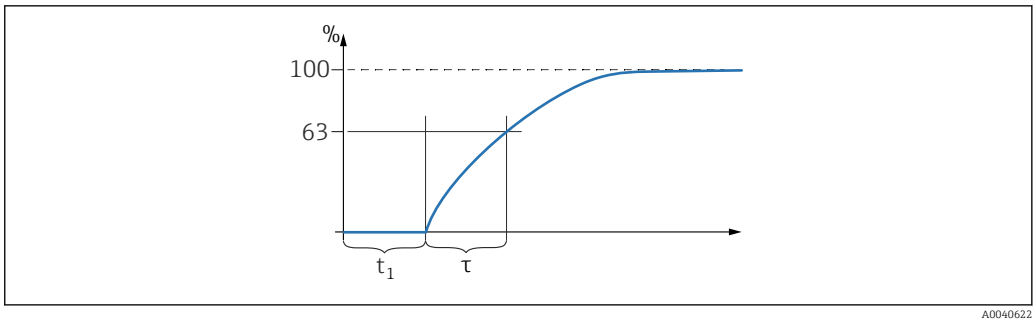
12.4.4 Switch-on behavior

1.5 s stable measured value after switch-on procedure, start-up in safe status 22 mA

12.4.5 Measured value reaction time

Observe time constant of switching unit.

t_1 = 0.3 s

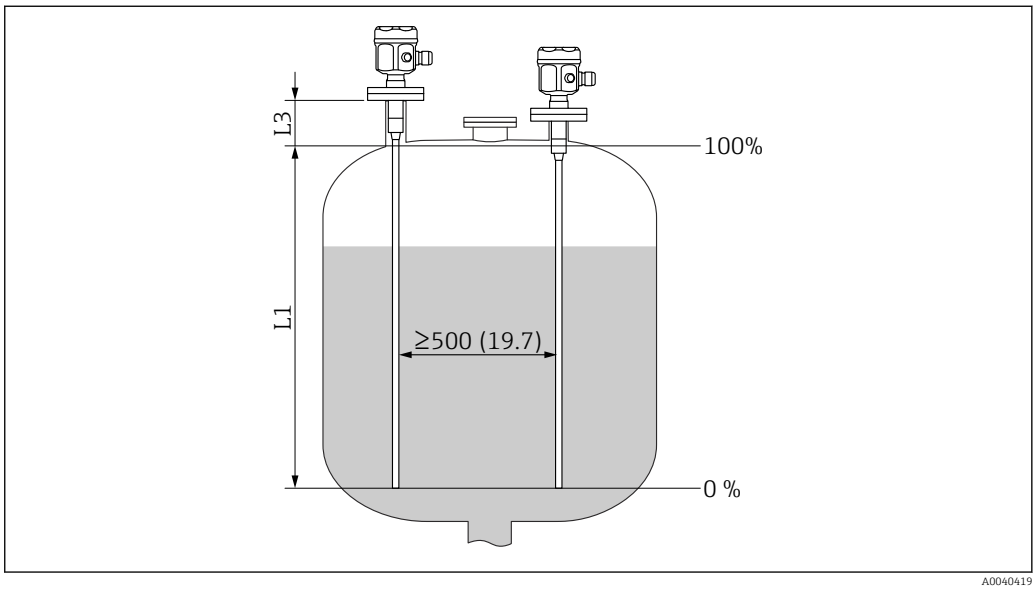


τ Time constant
t_1 Dead time

12.4.6 Accuracy of factory calibration

Empty calibration (0 %) and full calibration (100 %):
- probe length < 2 m (6.6 ft)
  ≤ 5 mm (0.2 in)
- probe length > 2 m (6.6 ft)
  approximately ≤ 2 %

Reference conditions for the factory calibration:
- medium conductivity ≥ 100 µS/cm
- minimum distance to tank wall = 250 mm (9.84 in)



Unit of measurement mm (in)

L1 Measuring range from the tip of the probe to the process connection
L3 The inactive length

In an installed state, recalibration is only necessary when:
- the 0 % or the 100 % values have to be adjusted specifically for the customer
- the liquid is not conductive
- the probe distance to the tank wall is < 250 mm (9.84 in)

12.4.7 Resolution

Zero frequency f_0 = 60 Hz
- sensitivity of the electronic insert = 0.685 Hz/pF
- entry in switching unit FMC671 under V3H5 and V3H6 or V7H5 and V7H6

12.5 Operating conditions: Environment

12.5.1 Ambient temperature range

- F16 housing: −40 to +70 °C (−40 to +158 °F)
- remaining housing: −50 to +70 °C (−58 to +158 °F)
- observe derating
- use a protective cover, when operating outdoors

12.5.2 Climate class

DIN EN 60068-2-38/IEC 68-2-38: Z/AD check

12.5.3 Vibration resistance

DIN EN 60068-2-64/IEC 68-2-64: 20 to 2 000 Hz, 0.01 g^2/Hz

12.5.4 Shock resistance

DIN EN 60068-2-27/IEC 68-2-27: 30g acceleration

12.5.5 Cleaning

Housing:

Make sure that the housing surface and seals are resistant to cleaning agents.

Probe:

Depending on the application, buildup of contamination or soiling can form on the rope. A high level of material buildup can affect the measurement result.

The regular cleaning of the rope is recommended if the medium tends to create a high level of buildup.

Make sure that the insulation of the rope is not damaged if hosing down or during mechanical cleaning.

12.5.6 Degree of protection

All protection degree regarding EN60529.

NEMA4X protection degree regarding NEMA250.

Polyester housing F16
Protection degree:
- IP66
- IP67
- NEMA 4X

Stainless steel housing F15
Protection degree:
- IP66
- IP67
- NEMA 4X

Aluminum housing F17
Protection degree:
- IP66
- IP67
- NEMA 4X

Aluminum housing F13 with gas-tight process seal
Protection degree:
- IP66
- IP68 [2)]
- NEMA 4X

Stainless steel housing F27 with gas-tight process seal
Protection degree:
- IP66
- IP67
- IP68 [2)]
- NEMA 4X

Aluminum housing T13 with gas-tight process seal and separate connection compartment (Ex d)
Protection degree:
- IP66
- IP68 [2)]
- NEMA 4X

Separate housing
Protection degree:
- IP66
- IP68 [2)]
- NEMA 4X

12.5.7 Electromagnetic compatibility (EMC)

Interference emission to EN 61326, Electrical Equipment Class B. Interference immunity to EN 61326, Annex A (Industrial) and NAMUR Recommendation NE 21 (EMC).

Failure current is in accordance with NAMUR NE43: FEI50H = 22 mA.

A standard commercial instrument cable can be used.

Information on connecting shielded cables is provided in Technical Information TI00241F "EMC test procedures".

12.6 Operating conditions: Process

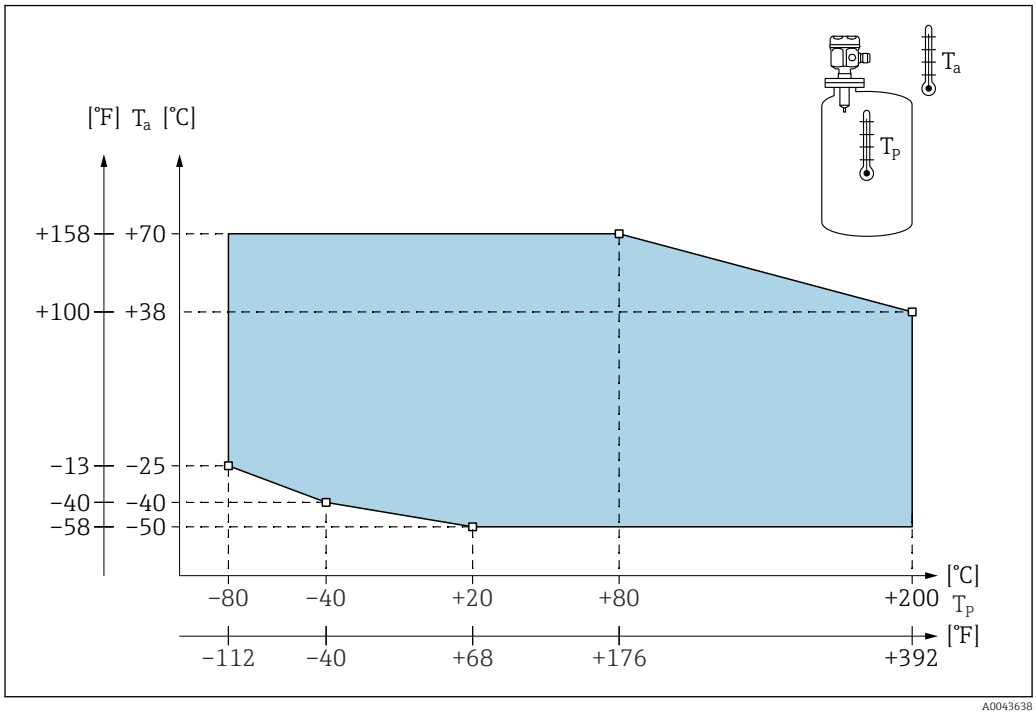
12.6.1 Process temperature range

The following diagrams apply for:
- insulation
  - PTFE
  - PFA
  - FEP
- standard applications outside hazardous areas

The temperature is restricted to T_a −40 °C (−40 °F) when the polyester housing F16 is used or if additional option B is selected: free from paint-wetting impairment substances, only FMI51.

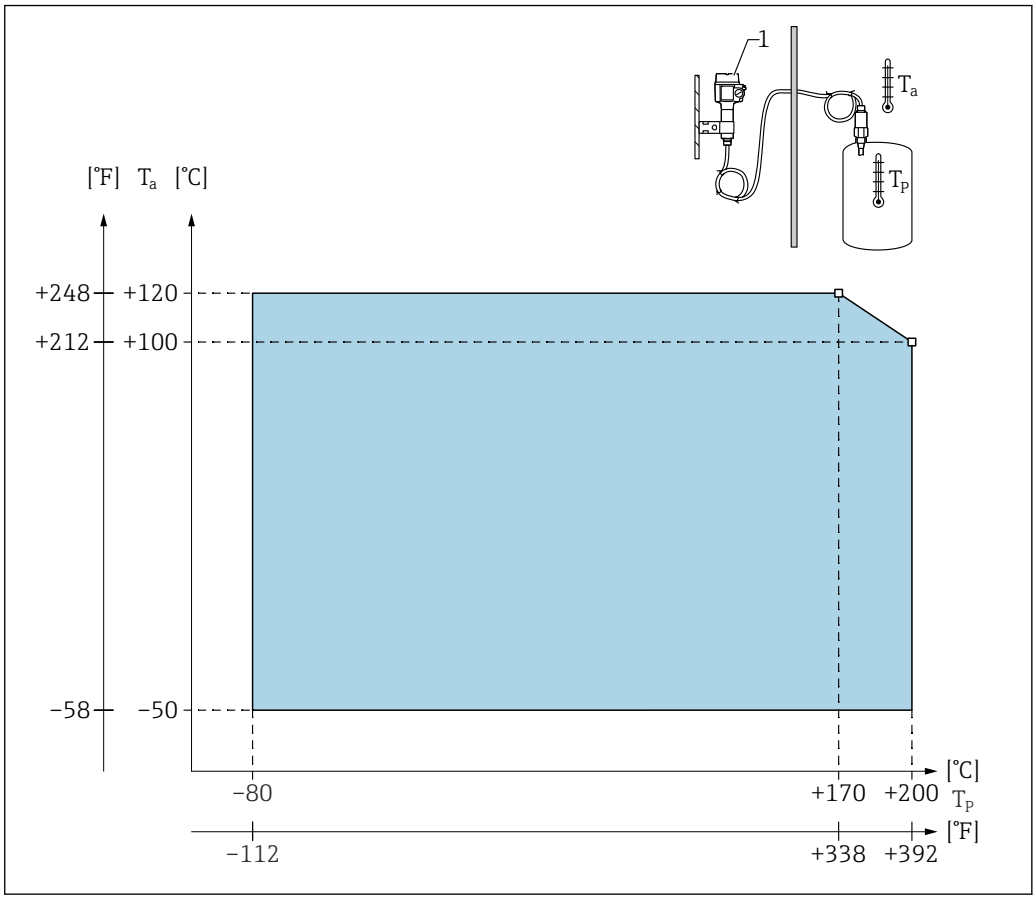
2) Only with M20 cable entry or G½ thread.

Probe with compact housing



T_a *Ambient temperature*
T_p *Process temperature*

Probe with separate housing



T_a Ambient temperature
T_p Process temperature
1 The permitted ambient temperature at the separate housing is the same as indicated for the compact housing.

Influence of process temperature

Error in case of fully insulated probes typically 0.13 %/K related to the full-scale value.

12.6.2 Process pressure limits

Probe Ø10 mm (0.39 in) including insulation

−1 to 25 bar (−14.5 to 362.5 psi)

Probe Ø16 mm (0.63 in) including insulation

- −1 to 100 bar (−14.5 to 1450 psi)
- in regards to an inactive length, the maximum permitted process pressure is 63 bar (913.5 psi)
- for CRN approval and inactive length: the maximum permitted process pressure is 32 bar (464 psi)

Probe Ø22 mm (0.87 in) including insulation

−1 to 50 bar (−14.5 to 725 psi)

Refer to the following standards for the pressure values permitted at higher temperatures:

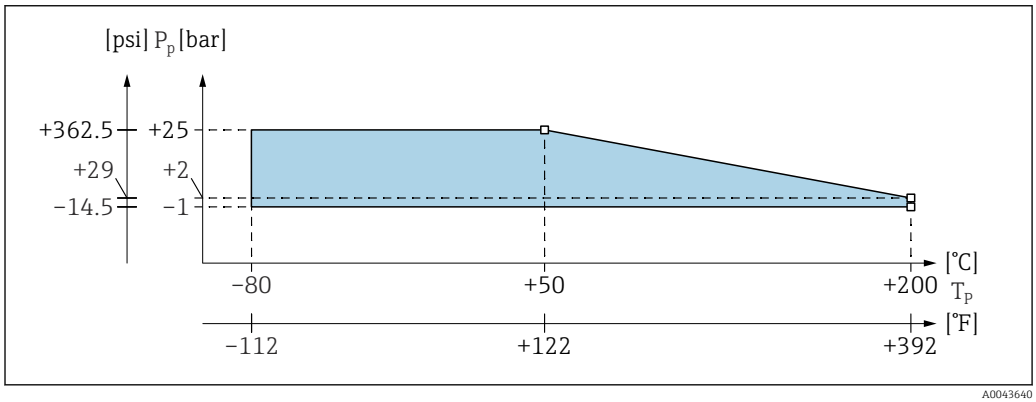
- EN 1092-1: 2005 Table, Appendix G2
  With regard to its resistance and temperature property, the material 1.4435 is identical to 1.4404 (AISI 316L) which is grouped under 13E0 in EN 1092-1 Tab. 18. The chemical composition of the two materials can be identical.
- ASME B 16.5a - 1998 Tab. 2-2.2 F316
- ASME B 16.5a - 1998 Tab. 2.3.8 N10276
- JIS B 2220

The lowest value from the derating curves of the device and the selected flange applies.

12.6.3 Pressure and temperature derating

For process connections ½", ¾", 1", flanges <DN50, <ANSI 2", <JIS 10K (ø 10 mm (0.39 in) rod) and process connections ¾", 1", flanges <DN50, <ANSI 2", <JIS 10K (ø 16 mm (0.63 in) rod)

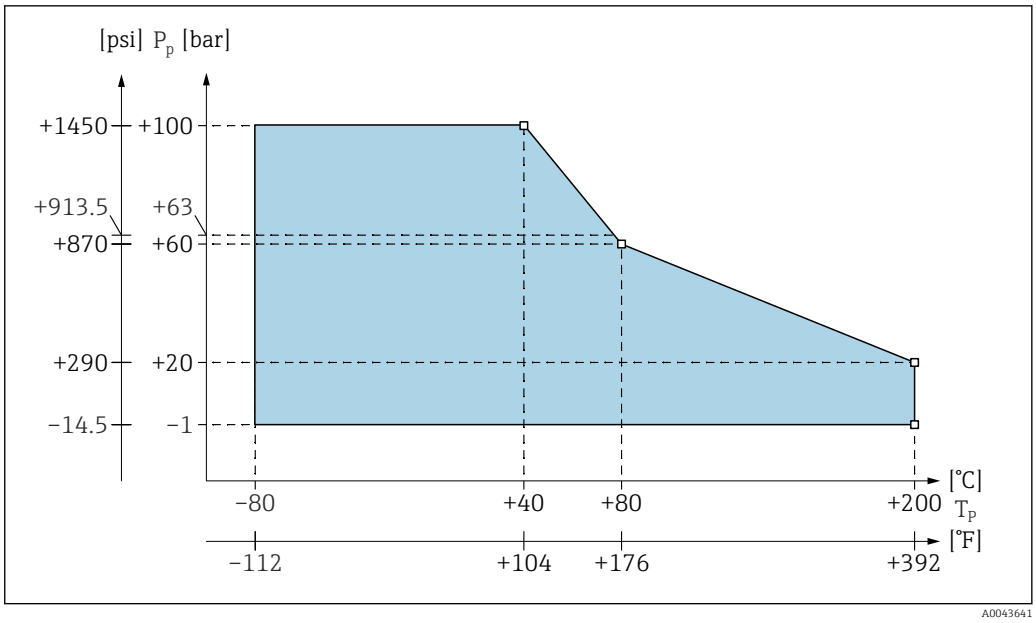
Rod insulation: PTFE, PFA



P_p *Process pressure*
T_p *Process temperature*

For process connections 1½", flanges ≥DN50, ≥ANSI 2", ≥JIS 10K (ø 16 mm (0.63 in) rod)

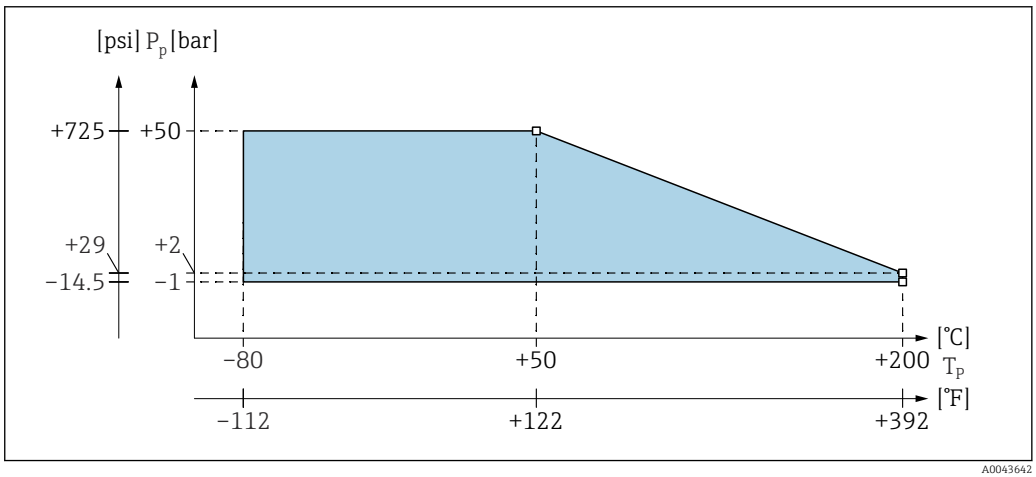
Rod insulation: PTFE, PFA



P_p Process pressure
T_p Process temperature
63 Process pressure for probes with an inactive length

With a fully insulated inactive length (ø 22 mm (0.87 in) rod)

Rod insulation: PTFE, PFA



P_p Process pressure
T_p Process temperature

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